



MALAYSIAN DENTAL JOURNAL

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Malaysian Dental Journal
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 Bukit Damansara, 50490 Kuala Lumpur
 Tel: 603-20951532, 20947606, Fax: 603-20944670
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Cover page: A case of oligodontia receiving orthodontic treatment to improve function and aesthetics. Picture courtesy of Dr. Wey Mang Chek.



Aim And Scope

The Malaysian Dental Journal covers all aspects of work in Dentistry and supporting aspects of Medicine. Interaction with other disciplines is encouraged. The contents of the journal will include invited editorials, original scientific articles, case reports, technical innovations. A section on back to the basics which will contain articles covering basic sciences, book reviews, product review from time to time, letter to the editors and calendar of events. The mission is to promote and elevate the quality of patient care and to promote the advancement of practice, education and scientific research in Malaysia.

Publication

The Malaysian Dental Journal is an official publication of the Malaysian Dental Association and is published half yearly (KDN PP4069/12/98)

Subscription

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EDITORIAL: PUBLICATIONS AND KEY PERFORMANCE INDEX

Welcome to this issue of Malaysian Dental Journal.

As the official publication for Malaysian Dental Association, the Malaysian Dental Journal is slowly gaining popularity in this region. The electronic versions of the current and previous issues of MDJ have been made available at the secured e-journal section of the MDA website. We have received contribution of articles from authors in neighbouring countries i.e. Indonesia, India, Mongolia and Singapore. With more dental schools mushrooming in this country, contributions from local authors have been encouraging. There are ten dental schools in Malaysia at present i.e. six in public university and four in private university/college. Dental officers from the government sector have also been actively contributing as government has encouraged the dental officers to get involved in research, scientific paper presentation and publication.

Key performance index has been introduced to improve the efficiency and productivity of an organisation. Various layers in an organisation ranging from the top management to the supporting staff have to lay down measurable indices to bring the performance of the organisation to a greater height. Amongst the indices relevant to dentistry were improvement in patient charter, organisation and participation in community projects, creativity and innovations in teaching and learning activities, scientific paper presentations and publications.

With increasing emphasis on evidence-based practice to provide the best to the patients, scientific research, scientific presentations and publications have become an important triad to improve the provision of healthcare. This is especially so for academic institutions that train and produce the next generation of healthcare workers, much emphasis has been placed for staff, postgraduate students and also undergraduate students to conduct research and publish the scientific findings. The MDJ is currently a peer-reviewed, indexed journal and provide a good avenue for disseminating knowledge in the dental literature. It is hope that the academic institutions and government sector will encourage staffs to continue contributing articles to MDJ. It is also hope that academic staffs and specialists are willing to impart their expertise and spare their precious time in the manuscript reviewing process.

As the renewal of annual practicing certificate will be tied with CPD points in the near future, MDJ has provided another source for obtaining the CPD points. After reading through the articles in the journal, there is a short section of quizzes pertaining to the articles, upon answering the quiz, CPD points can be obtained from the MDA secretariat.

Thank you kindly for your warm support.

Associate Professor Dr. Seow Liang Lin

Editor

Malaysian Dental Journal



Are Cox-2 Inhibitors A Solution To Problems Associated With Current Oral Analgesics? A Revisit With A Perspective Of Local Need.

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ABSTRACT

The primary obligation and ultimate responsibility of a dental surgeon is not only to restore aesthetic and function, but also to relieve pain which originates from dental pathology or surgical procedures performed. Post operative dental pain is mainly of inflammatory origin. Common traditional oral analgesics, namely salicylates, paracetamol and non-steroidal anti-inflammatory drugs have been the drugs of choice, but are increasingly being superseded by newer designer analgesics, the cyclooxygenase-2 (COX-2) inhibitors. This article reviews the advantages and disadvantages of prescribing common traditional oral analgesics as well as exploring the potential use of COX-2 inhibitors as an alternative to these analgesics for the control of post operative pain in dentistry.

Key words

pain, analgesic, NSAIDs, COX-2 inhibitor

INTRODUCTION

Pain can originate from dental pathology or as an outcome of trauma or surgical procedures performed on patients. Postoperative dental pain is mainly of inflammatory origin and is caused mainly by increased prostaglandin (PG) synthesis.^{1,2} Pain studies showed that majority of patients suffered their highest pain level on the day of operation, especially within the first 3 to 5 hours postoperation.^{3,4} This happens irrespective of their age, operating time, who the operators are, types of impaction and presence or absence of pericoronitis during the previous 3 weeks.³ It was suggested that pain was however, influenced by the gender of the patients.^{3,5}

Analgesics most commonly prescribed in dentistry for acute minor oral surgical pain relief include salicylates, the nonsteroidal anti-inflammatory drugs (NSAIDs), paracetamol and various opioid-containing analgesic combinations. As these oral analgesics have been used for a long time and have well proven track records, the authors wish to group them as "common traditional oral analgesics". Paracetamol and the NSAIDs such as mefenamic acid and ibuprofen, are examples of analgesics commonly prescribed for minor oral surgical procedures in Malaysia.⁶ These NSAIDs (salicylates included) and presumably paracetamol act by inhibiting enzyme cyclooxygenase responsible for the formation of PGs that promote pain and inflammation.⁷

Although NSAIDs are effective analgesics for mild to moderate pain, they are associated with potentially serious side effects, including gastrointestinal (GI) haemorrhage and ulceration and alteration of platelet function.⁸ These happen because NSAIDs inhibit both the constitutive (COX-1) and inducible (COX-2) isoforms of cyclooxygenase (COX).

The induction of COX-2 after inflammatory stimuli has led to the hypothesis that COX-2 inhibition primarily accounts for the therapeutic properties of NSAIDs. COX-2 inhibitors now constitute a new group of NSAIDs which, at recommended doses, block the production of PG by COX-2, but not COX-1. Two COX-2 inhibitors are currently available in Malaysia – celecoxib (Celebrex®, Pfizer), which is taken twice daily, and etoricoxib (Arcoxia®, MSD Merck), which is taken once daily. Celecoxib and etoricoxib show significantly lower incidences of gastrotoxicity than non-selective NSAIDs but at the same time show potent analgesic property.^{9,10-13} Moreover, in comparison with conventional NSAIDs, celecoxib and etoricoxib generally have a longer duration of action; 12 hours and 22 hours respectively.

This article reviews the advantages and disadvantages of prescribing common traditional oral analgesics as well as exploring the potential use of COX-2 inhibitors as an alternative to these analgesics for the control of post operative pain in dentistry.

Role of NSAIDs in post operative dental pain

Non-steroidal anti-inflammatory drugs (NSAIDs) are the most commonly prescribed analgesic agents for oral surgical outpatients. It has been more than 30 years since Sir John Vane first reported that the pharmacological actions of aspirin-like drugs could be explained by their ability to inhibit enzyme cyclooxygenase (COX).¹⁴

In specific, aspirin and related NSAIDs work at the site of tissue damage, the spinal cord and/or higher brain centres to prevent PG formation by inhibiting cyclooxygenase, or COX activity.⁷ In 1990, the enzyme COX was demonstrated to exist in 2 distinct isoforms, constitutive (COX-1) and inducible (COX-2) isoforms.¹⁵ With partial exception of paracetamol, which has minimal anti-inflammatory effects, NSAIDs exert a combination of analgesic, anti-pyretic, and anti-inflammatory effects by their actions on both COX-1 and COX-2.⁷

Nearly all NSAIDs marketed today inhibit both COX-1 and COX-2, and most have selectivity for COX-1.¹⁶ However, not all NSAIDs are equal. Some are better analgesics, while others are more effective anti-inflammatories. They also vary greatly in the degree of side effects produced.^{17,18} Because of the clear differences with respect to the relative inhibition of these enzymes by different NSAIDs, the Relative IC₅₀ (concentration required to produce 50% inhibition of COX activity) values for COX-1 and COX-2 are calculated. This COX-2/COX-1 ratio indicates the relative inhibition of these enzymes. A high ratio is most desirable because it implies that the compound is a relatively specific COX-2 inhibitor. Epidemiologic studies demonstrate that this ratio correlates closely with the safety profile of NSAIDs.¹⁶ The COX-2/COX-1 selectivity ratios of some commonly used traditional NSAIDs are shown in Table 1.^{18,19} The reasons for different COX specificities are not entirely clear but one theory is that nuclear COX-2 may be more susceptible to drugs that can cross plasma membranes and endoplasmic reticulum efficiently.

Table 1: COX-2/COX-1 ratios of traditional NSAIDs

NSAIDs	COX-2/COX-1 ratio*
Meloxicam	4.00
Aspirin	3.12
Ibuprofen	1.78
Indomethacin	1.78
Naproxen	0.88
Ketorolac	0.68

* A ratio of >1 indicates a greater inhibition of COX-2 than COX-1

As the prototypical NSAID, aspirin remains the gold standard against which other orally active analgesics are compared. It is relatively selective for COX-1 and it therefore has a tendency to cause gastric bleeding and ulceration, especially when used in high doses and for

a long duration of time. Aspirin works by acetylating the enzyme COX. Typical doses of 325mg and 650mg encompass most of aspirin's analgesic dose response curve in the average adult.⁷

Ibuprofen was the first NSAID that demonstrate analgesic superiority to aspirin.⁷ A 400 mg dose of ibuprofen has been shown to have a greater peak analgesic effect and a longer duration than 600 mg of aspirin or 1 gm paracetamol, or 60 mg of codeine. It has at least comparable efficacy to traditional opioid analgesic combinations.^{20,21} However, the half-life of ibuprofen is short, at only two hours.

Naproxen sodium, an NSAID structurally related to ibuprofen, has a half-life of about 13 hours. This allows for less frequent dosing as compared to ibuprofen. A 220 mg dose of naproxen sodium is equivalent to 200 mg of ibuprofen in analgesic onset and peak effect but has a longer duration of action.²² The same holds true if the dosage is doubled for both analgesics.²³

Diclofenac, ketoprofen, flurbiprofen, meclofenamate, and diflunisal are additional NSAIDs with analgesic activity in the dental setting similar to that of ibuprofen or naproxen. Fenoprofen is also approved for the management of acute pain, but its slow absorption retards the onset of analgesia. Ketorolac, an NSAID commonly used for parenteral administration, is restricted in its oral dosage form to patients who have already received the drug by injection. Lastly, etodolac is a well-tolerated NSAID but has not been proven to be superior to aspirin for relieving pain of dental origin.⁷

The major limitations of NSAIDs are their gastrointestinal (GI) adverse effects (perforation, ulceration and bleeding), impairment of haemostatic function, and renal failure (with long-term therapy). It has been reported that 15 to 20% of patients taking NSAIDs develop peptic ulcer and almost 3% of this group experience gastrointestinal haemorrhage or ulcer perforation at some point of time.^{24,25} In addition, they are not recommended during pregnancy and lactation.²⁶

Mefenamic acid, the most popular oral analgesics for dental pain in Malaysia

Mefenamic acid is a member of the fenamate group of NSAIDs first discovered in 1962. In one of the first clinical trials conducted, Cass and Frederik²⁷ found that 250mg of mefenamic acid was superior to 600 mg of aspirin and approximately equivalent to 50 rag of codeine (base) or a combination of 227.5 mg of aspirin, 162.5 mg of acetophenetidin, 32.5 rag of caffeine, and 25 mg of codeine (base). They also found a great increase in efficacy when the dose was doubled, resulting in the current recommended dosage of 500 mg for moderate pain.

Mefenamic acid is used for the relief of mild-to-moderate pain in doses up to 500 mg three times daily for the treatment of rheumatoid arthritis. It is also used to relieve pain arising from soft tissue injuries, dysmenorrhoea, menorrhagia and other painful musculoskeletal conditions.²⁸⁻³⁰ In Malaysia, it is widely used for the control of postextraction and postsurgical dental pain.⁶ It can also be used as a rescue analgesic, as shown in a study

on the effect of perioperative auricular electroacupuncture after third molar tooth extraction.³¹ In humans, mefenamic acid is metabolised by both phase I enzymes and the phase II enzyme family UDP-glucuronosyltransferase. Three glucuronides had been identified and isolated from human urine after oral administration of mefenamic acid.³²

The efficacy of mefenamic acid in the control of postsurgical pain has last been studied against aspirin and placebo more than a quarter century ago. Then, the researchers found that mefenamic acid was well tolerated and was clearly superior to placebo and equalled or exceeded the ability of aspirin to control postsurgical pain in the parameters measured.³³

The use of mefenamic acid as a pre-emptive drug has been studied in obstetric and gynaecological medicine, but no similar literatures could be found for dentistry. Nagele *et al.*³⁴ assessed its efficacy as premedication before hysteroscopy in a double-blind, placebo controlled trial. They showed that 500 mg mefenamic acid given one hour before hysteroscopy significantly reduce pain after hysteroscopy, though it had no significant benefit in the discomfort experienced during this procedure. They suggested that a larger dose or a longer interval between premedication and hysteroscopy may possibly be associated with greater benefits.

Over the years, mefenamic acid gradually becomes unpopular in the western world because of concerns on its adverse effects, especially among the elderly. The following side effects are implicated:

- Gastro-intestinal bleeding and ulceration^{35,36}
- Severe intestinal damage³⁷
- Hepatotoxicity³⁵
- Nephrotoxicity including acute renal failure and tubulointerstitial nephritis^{35,38,39}
- Fixed drug eruption⁴⁰
- Induction of pseudoporphyria⁴¹
- Mefenamic acid-induced bullous pemphigoid⁴²
- Frank colitis in patients with no known predisposing factors⁴³

In fact, an authoritative pharmacological text had stated there were no reasons for continuing to prescribe mefenamic acid as there is now a wide range of safer and more effective analgesics.⁴⁴ In the western world, the use of mefenamic acid has been superseded by newer and better NSAIDs like ibuprofen, naproxen sodium and diclofenac.

The incidence of adverse effects to mefenamic acid among Malaysian is unknown. Perhaps it is time that such a study is done to determine whether mefenamic acid does cause as much complications as reported in western literatures. By doing so, we can also ascertain whether to continue or discontinue its prescription to our patients.

Paracetamol, the reliable work-horse.

Paracetamol is a common over-the-counter analgesic that is routinely used as mild analgesic and antipyretic.⁴⁵ It is effective in relieving mild to moderate pain.⁴⁶ Its analgesic and anti-pyretic properties are found to be comparable to that of aspirin. Skjelbred *et al.*⁴⁷ reported no observable difference when comparing the analgesic effect

of paracetamol and aspirin, but their “patient preference scores” showed a tendency to favour paracetamol. An early placebo controlled trial showed a significant analgesic effect of paracetamol over the first three postoperative days.⁴⁸ The study by Seymour and Rawlins⁴⁹ confirmed this finding, though they suggested that the magnitude of the analgesic effect demonstrated was insufficient for the immediate postoperative period in most patients. Several other studies had compared the efficacy of paracetamol against codeine, naproxen sodium and ibuprofen.⁵⁰⁻⁵³

Analgesia achieved with paracetamol in the average adult becomes readily measurable at a dose of 300 mg and plateaus at 1 gm.⁷ Efficacy aside, the advantage of using paracetamol is that it does not elicit gastrointestinal irritation or prolong bleeding that is typical of long term NSAIDs usage. It can be safely prescribed to pregnant patients and those who developed hypersensitivity to NSAIDs.^{26,54} The disadvantage is that hepatotoxicity will occur if there is overdosage.⁷

Though it is a well-accepted analgesic agent, its mechanism of action has never been properly understood. Its association with inhibition of prostaglandin synthetase was first suggested more than thirty years ago.⁵⁵ More recently, its mechanism of action has been associated with the discovery of so-called COX-3, COX-1b or COX-1v of a splice variant of COX-1 mRNA, retaining intron 1.¹⁴ Clinically achievable concentrations of paracetamol have been noted to be able to inhibit this so-called COX-3, COX-1b or COX-1v.⁵⁶

Paracetamol exerts weaker inhibition of peripheral PG synthesis than NSAIDs.^{57,58} Limited data available suggests that paracetamol may enhance analgesia when added to an NSAID, compared to NSAIDs alone.⁵⁹ It is one of the drugs of choice for use as rescue medicine in pain study.^{31,60} It has been suggested to be the viable alternative to NSAIDs because of the low incidence of adverse effects. It is also suggested to be the preferred choice in high-risk patients.⁵⁹ Clinically, it is routinely prescribed as the analgesic of choice to supplement NSAIDs when these are expected to be ineffective to control patient’s pain.⁶¹ However, the use of paracetamol as supplementary analgesic or rescue analgesic is not common among Malaysian patients.⁶ In fact, it is the second most routinely prescribed main analgesic, after mefenamic acid, for pain control following third molar surgery in this group of patients.

Paracetamol, like ibuprofen, has a short half-life of around 2-3 hours. As a result, frequent dosing is necessary. The recommended regimen is 500 – 1000 mg every 4 to 6 hours.⁶² So, in order to improve patient convenience and compliance, especially for the benefit of patient at night-time, a sustained release (SR) product containing 665 mg paracetamol (Panadol Extend®; GlaxoSmithKline, United Kingdom) which is designed to provide analgesia for up to 8 hours after dosing has been introduced. The tablet has a bi-layer design containing immediate release (IR) paracetamol with a second layer of SR paracetamol. Nevertheless, a study by Coulthard *et al.*⁶³ failed to show added advantage of SR paracetamol except for a longer duration of activity. The onset of analgesia and peak

analgesic effect of SR paracetamol was equivalent to that of IR paracetamol.

In summary, paracetamol and the non-selective NSAIDs described above inhibit both COX-1 and COX-2, but have proven to be highly effective and safe in the short-term management of acute pain, such as dental pain.¹⁴ Their role in the management of post operative dental pain, either alone or in combination, will remain until "better" analgesics with lesser side effects are developed. Of course, in this quest, a new class of NSAIDs, a class of COX-2 selective inhibitors (also termed CSIs or Coxibs) has been developed with the aim of reducing the GI adverse effects of traditional NSAIDs while maintaining their effective anti-inflammatory and analgesic properties.

Cyclooxygenase-2 (COX-2) Inhibitors, the new kids on the block

As has been highlighted, COX-2 is a largely inducible isoform whose synthesis is activated in damaged or stimulated tissues that leads to the formation of pro-inflammatory PG. Hence, COX-2 plays a major role in inflammation and pain.⁶⁴ Since its identification, two

generations of highly selective inhibitors of this isoform had been developed and approved for marketing by the US Food and Drug Administration (FDA). These COX-2 inhibitors, namely celecoxib, rofecoxib, valdecoxib, lumiracoxib, parecoxib and etoricoxib were developed with the aim to significantly reduce the serious gastrointestinal adverse effects associated with the long term use of high-dose NSAIDs that inhibit COX-2 as well as COX-1.¹⁴ The COX-2/COX-1 selectivity ratios of COX-2 inhibitors currently in the market are shown in Table 2.

Table 2: COX-2/COX-1 ratios of COX-2 inhibitors

COX-2 Inhibitors	COX-2/COX-1 ratio*
Lumiracoxib	700
Etoricoxib	344
Rofecoxib [†]	35
Valdecoxib	30
Parecoxib	30
Celecoxib	7

* A ratio of >1 indicates a greater inhibition of COX-2 than COX-1

Note: Rofecoxib[†] was voluntarily withdrawn from the market in 2004.

Table 3: Studies on the efficacy of COX-2 inhibitors for acute dental pain

Year	Researchers	Drugs	Results
1999	Malstrom et al. ⁶⁵	Rofecoxib, 50mg Celecoxib, 200 mg Ibuprofen, 400 mg Placebo	1. Celecoxib inferior to rofecoxib with regard to onset and analgesic effect
2002	Daniels et al. ⁶⁶	Valdecoxib, 20mg Valdecoxib, 40mg Oxycodone, 10mg + paracetamol, 1g Placebo	1. 1. Valdecoxib 20mg & 40 mg and oxycodone/paracetamol were equivalent with regard to time to onset 2. 2. Valdecoxib 40 mg and oxycodone/paracetamol were equivalent with regard to peak analgesic effect (Valdecoxib 20 mg less efficacious) 3. 2. Both Valdecoxib dosages exhibited longer duration of action compared to oxycodone/paracetamol
2002	Doyle et al. ⁶⁷	Ibuprofen liquigels, 400mg at baseline, 4 hours & 8 hours. Celecoxib, 200 mg at baseline, placebo at 4 hours & 8 hours. Placebo at baseline, 4 hours & 8 hours.	Ibuprofen superior to celecoxib with regard to onset, duration of action and analgesic effect
2002	Khan et al. ⁶⁸	Celecoxib, 200 mg Ibuprofen, 600 mg Placebo All: 1st dose 1 hour pre-operative, followed by 2nd dose 8 hours post-operative	Ibuprofen superior to celecoxib with regard to analgesic effect

2002	Malstrom et al. ⁶⁹	Rofecoxib, 50mg Celecoxib, 200 mg Celecoxib, 400 mg Ibuprofen, 400 mg Placebo	<ol style="list-style-type: none"> 1. Time to onset of analgesic effect and peak analgesic effect were similar for rofecoxib 50 mg and celecoxib 400 mg. 2. Celecoxib 200mg inferior to rofecoxib with regard to onset and analgesic effect 3. Celecoxib 400mg is superior to celecoxib 200 mg with regard to analgesic effect
2002	Fricke et al. ⁷⁰	Rofecoxib, 50 mg; followed by placebo if requested at 4 hours Valdecoxib, 40 mg followed by second dose if requested at 4 hours Placebo; followed by placebo if requested at 4 hours	<ol style="list-style-type: none"> 1. Valdecoxib superior to rofecoxib with regard to onset and analgesic effect 2. Valdecoxib exhibited longer duration of action.
2004	Christensen et al. ⁷¹	Valdecoxib, 40 mg Rofecoxib, 50 mg Placebo	<ol style="list-style-type: none"> 1. Valdecoxib superior to rofecoxib with regard to onset and analgesic effect at first 90 minutes 2. After that, analgesic effect similar between valdecoxib and rofecoxib
2004	Zelenakas et al. ⁷²	Lumiracoxib, 50 mg Lumiracoxib, 100 mg Ibuprofen, 400 mg Placebo	<ol style="list-style-type: none"> 1. Lumiracoxib and ibuprofen were equivalent with regard to onset and analgesic effect 2. Lumiracoxib exhibited longer duration of action
2004	Kellstein et al. ⁷³	Lumiracoxib, 400 mg Rofecoxib, 50 mg Celecoxib, 200 mg Placebo	<ol style="list-style-type: none"> 1. Lumiracoxib and rofecoxib superior to celecoxib with regard to onset and analgesic effect 2. Lumiracoxib superior to rofecoxib with regard to onset
2004	Chang et al. ⁷⁴	Etoricoxib, 120 mg Oxycodone, 10mg + paracetamol, 650 mg Placebo	<ol style="list-style-type: none"> 1. Oxycodone/paracetamol superior to etoricoxib with regards to onset 2. Etoricoxib exhibited longer duration of action than oxycodone/paracetamol 3. Etoricoxib superior to oxycodone/paracetamol with regard to analgesic effect
2004	Malstrom et al. ⁷⁵	Etoricoxib, 120mg Naproxen sodium, 550 mg Paracetamol, 600mg + codeine 60 mg Placebo	<ol style="list-style-type: none"> 1. Etoricoxib and naproxen sodium were equivalent with regard to analgesic effect and are superior to paracetamol/codeine 2. Etoricoxib, naproxen sodium and paracetamol/codeine were equivalent with regard to onset 3. Etoricoxib and naproxen sodium exhibited longer duration of action than paracetamol/codeine
2004	Malstrom et al. ⁷⁶	Etoricoxib, 60mg Etoricoxib, 120mg Etoricoxib, 180mg Etoricoxib, 240 mg Ibuprofen, 400 mg Placebo	<ol style="list-style-type: none"> 1. Etoricoxib 120 & 180 mg superior to etoricoxib 60 mg and ibuprofen with regard to analgesic effect 2. Etoricoxib 120, 180 & 240 mg and ibuprofen were equivalent with regard to onset 3. Etoricoxib exhibited longer duration of action than ibuprofen 4. Etoricoxib 120 mg determined to be the minimum dose that had maximal efficacy.

2005	Malstrom et al. ⁷⁷	Etoricoxib, 120mg Paracetamol 600mg + codeine 60 mg Oxycodone, 10 mg + Paracetamol 650 mg Placebo	1. Etoricoxib superior to paracetamol/codeine and oxycodone/paracetamol with regard to analgesic effect 2. Paracetamol/codeine and oxycodone/paracetamol superior to etoricoxib with regard to onset 3. Etoricoxib exhibited longer duration of action than paracetamol/codeine and oxycodone/paracetamol
2005	Chalini and Raman ⁷⁸	Etoricoxib, 60 mg, twice daily Aceclofenac, 100mg, twice daily	Etoricoxib and aceclofenac were equivalent with regard to analgesic effect

Note: Unless stated, these were single-dose studies.

All these COX-2 inhibitors are taken orally, except for parecoxib, which is the only COX-2 inhibitor available for intravenous or intramuscular injection. Parecoxib is a prodrug of valdecoxib. Table 3 summarises the chronological outcomes of some of the current studies on the efficacy of oral COX-2 inhibitors for the treatment of acute dental pain. Studies purely on Rofecoxib are not included since this analgesic is no longer of clinical relevance.

The following discussion will concentrate solely on celecoxib and etoricoxib as they are the COX-2 inhibitors currently available in Malaysia. As can be seen in Table 3, a single dose of celecoxib (200 mg) provided analgesic efficacy similar to that of aspirin (650 mg), but inferior to those of ibuprofen (400 mg) and naproxen (550 mg), as measured by time to onset of pain relief and peak pain relief. As a matter of fact, even at doses up to 400 mg, celecoxib was still inferior to naproxen (550 mg).^{65,67,68} Similarly, etoricoxib has been shown to have a comparable clinical efficacy with traditional NSAIDs (Table 3). Etoricoxib was equivalent to aceclofenac and naproxen sodium^{75,78} but superior to ibuprofen, paracetamol/codeine and oxycodone/paracetamol with regards to analgesic effect.^{74,75-77} In addition, etoricoxib exhibited longer duration of action than all these drugs.

It has to be noted that all the drugs listed in the studies in Table 3 were given postoperatively. Studies on the pre-emptive use of COX-2 inhibitors in other specialties, for example the use of etoricoxib as a pre-emptive medication in orthopaedic surgery,⁷⁹ general surgery⁸⁰ and obstetric and gynaecological surgery⁸¹ all showed potential role of a COX-2 inhibitor as a pre-emptive medication. Etoricoxib, for example was found to significantly decrease postoperative pain score,^{79,81} reduce time to discharge⁷⁹ and reduce the need for post operative opioids.⁷⁹⁻⁸¹ Such a potential application for use to control postoperative dental pain should be considered seriously.

DISCUSSION

Are COX-2 inhibitors the oral analgesics of the future?

The introduction of these selective COX-2 inhibitors has allowed specific targeting of inflammatory

PG production while at the same time minimising adverse effects such as gastrointestinal irritation, ulceration and bleeding problems. There is reasonable evidence showing that these new drugs are preferable in patients who are at an increased risk of developing serious upper-GI complications, in patients who take aspirin for cardiovascular comorbid conditions, and in those allergic to aspirin. Etoricoxib for example, has been recommended as an alternative drug for patients who are hypersensitive to NSAIDs.^{82,83} Studies have confirmed that there is a lack of cross-reactivity between etoricoxib and aspirin in aspirin-exacerbated respiratory disease (AERD),⁸⁴ thus making it a safe alternative for a patient who is allergic to aspirin and/or its associated drugs. Furthermore, COX-2 inhibitors may be given more safely than NSAIDs in perioperative settings because of their lack of impairment of the blood-clotting. However, they are not recommended for patients who are pregnant or lactating.⁸⁵

The high costs of COX-2 inhibitors, however, limit their routine use during the short period of postoperative dental pain, which in most cases last between 2 to 4 days. This is because of the lack of increased risk to developing serious GI complications with the short-term use of cost-saving NSAIDs.⁸⁶ Not to be forgotten, more recent well designed randomised controlled clinical trials have demonstrated that the apparent gastrointestinal advantage of selective COX-2 inhibitors appears to be outweighed by their potential for cardiovascular toxicity.^{14,87}

Lastly, it has to be noted that adverse reaction to a COX-2 inhibitor had been reported; among which were anaphylactoid reaction,⁸⁸ fixed drug eruption and generalized erythema.⁸⁹ In specific, allergic reactions have been reported to celecoxib and valdecoxib as they have a sulfonamide structure and are therefore, contraindicated for patients with known sulfa allergy.^{90,91} Nevertheless, the number of patients developing adverse reactions is still very low. For example, Weberschock *et al.*⁹² in a recent systematic structured review found only 10 out of 328 patients taking etoricoxib who developed adverse reactions, all of which had been allergic/urticarial in nature. Nevertheless, these newer designer oral analgesics must be used with caution.

Based on current evidences, the authors are of the opinion that COX-2 inhibitors certainly have important roles to play in the control of pain in dentistry, given the

nature of their pharmacological design and long duration of action. These are:

1. Potentially better patient compliance due to less frequent dosing.
2. Potential use in pain control in conjunction with certain religious reason e.g. the Muslim fasting month. Due to its long-acting effect, a patient can still perform his/her religious obligation without interference.
3. An alternative analgesic for patients with severe GI problem.
4. An alternative to patients with allergy to aspirin and/or other NSAIDs.
5. A potential pre-emptive premedication for patients undergoing dental surgeries under general anaesthesia without interfering with pre-operative fasting.

CONCLUSION

In conclusion, the common traditional analgesics, namely, paracetamol and NSAIDs (aspirin included) still play a major role in the management of post operative dental pain. As they are only given over a short duration, the risk of developing severe or long-term adverse reactions is minimised. They are well-researched, of reasonable cost and have proven to be as effective as the newer COX-2 inhibitors in term of post operative dental pain efficacy and onset. The COX-2 inhibitors, while a novel idea, is still plaque with the worry of possible long term adverse effect previously undetected in clinical trials, as well as its higher cost. Perhaps they are best used in conjunction with the indications summarised above.

Disclaimer

This review is intended to give a broad overview of some of the common analgesics available in Malaysia based on the authors' experience and past reports. The lists are not exhaustive and readers are advised to scrutinise the manufacturers' latest recommendations for indications and contraindications prior to prescribing the analgesic(s) of concern, especially to patients with a medical condition.

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Oral Granular Cell Tumour: A Clinicopathological Study Of 7 Cases And A Brief Review Of The Literature

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ABSTRACT

Oral granular cell tumour is a fairly rare lesion with a predilection for the tongue. Seven cases (6 females, 1 male) of oral granular cell tumour were seen during the 40 year period (1967-2006) in Stomatology Unit, Institute for Medical Research (IMR) in which 5 cases were located at the tongue. All the cases presented as a single swelling and excisional biopsies were carried out in all cases.

Key words

oral granular cell tumour

INTRODUCTION

Oral granular cell tumour is an uncommon lesion with a predilection for the tongue. The aim of this article is to report seven oral granular cell tumour cases seen during the 40 year period from 1967 to 2006 of Stomatology Unit, Institute for Medical Research (IMR) and briefly discussed the clinicopathologic features.

MATERIALS AND METHODS

The records from the Stomatology Unit, IMR were searched for granular cell tumour cases from 1967 to 2006. Congenital epulis cases, another known granular cell lesion were excluded. Only 7 cases of granular cell tumour were retrieved. The request forms and histological features were reviewed. Immunostaining for desmin, muscle specific actin and S100 protein using standard procedure were carried out for all the cases selected.

RESULTS

The patients' characteristics are summarized in Table 1. There were 6 females and 1 male, with a mean age of 29.4 years (range 11-62 years). The patients comprised of 3 Malays, 3 Indians and 1 Chinese. Five cases were located

at the tongue, 1 in the buccal mucosa and 1 at the buccal sulcus. Most of the cases (n=5) presented as a painless growth with durations ranging from 3 weeks to 2 years. The growths measured 0.5 to 1.5 cm in diameter. In all the cases, excisional biopsy was performed. Histologically all the cases showed sheets of polygonal cells with granular eosinophilic cytoplasm and small vesicular nuclei which extended from the subepithelial zone to the muscular layer. The cells appeared cytologically benign. Pseudoepitheliomatous hyperplasia of the epithelium was observed in 3 cases.

Immunohistochemistry staining was only carried out in 6 cases since in one case, there was not enough tissue left in the wax block. Immunostaining with S100 protein showed 5 cases positive for the antibody. In one case, the immunostaining result was inconclusive. All cases demonstrated negativity for desmin and also muscle specific actin.

Table 1: Clinicopathological features of 7 cases of oral granular cell tumour

NO	RACE	SEX	AGE	SITE	SIGN & SYMPTOM
1	Malay	F	34	dorsum of tongue	painless swelling
2	Indian	M	25	right lateral border of tongue	painful swelling
3	Malay	F	11	right buccal mucosa	painless swelling
4	Indian	F	62	left lateral border of tongue	painless swelling
5	Malay	F	22	buccal sulcus adjacent to 14 and 15	painful swelling
6	Indian	F	33	anterior dorsum tongue	painless swelling
7	Chinese	F	19	mid dorsum tongue	painless swelling

DISCUSSION

Granular cell tumour is a rare soft tissue lesion with a predilection for the oral cavity although it has been reported to occur in other parts of the body such as oesophagus¹, thyroid² and colon³. Intra-orally, the most common site is the tongue⁴⁻⁸. However, oral granular cell tumour occurring in the parotid gland⁹, palate¹⁰, lower lip¹¹ and floor of mouth¹² has been reported. The most common site in this study was the tongue (n=5, 71.4%) of which 3 cases were located at the dorsal part and 2 on the lateral border.

In this case series, the granular cell tumour was more prevalent among the females (n=6, 85.7%). This finding concurs with other studies^{4, 6-8}. Oral granular cell tumours have been reported in all age groups ranging from 3 years⁷ to 75 years¹¹, however it frequently occurs in the third and fourth decades of life^{4, 6, 8}. The average age in this study was 29.4 years and only one case presented in a child.

Clinically it usually presents as a small, firm, rounded painless swelling with normal mucosal colour which generally gives an impression of a fibrous polyp. Thus, oral granular cell tumours are usually excised immediately by the surgeons. In our study, the clinical diagnosis given by the surgeons included fibroma, lipoma, neurofibroma, neurilemoma and papilloma. Granular cell tumour is a fairly slow growing benign lesion. In a series of 8 cases, Eguia et al⁴ reported the duration of the lesion in the oral cavity ranging from 3 months to 2 years. Oral granular cell tumour usually happens singly although multiple lesions occurring in the oral cavity have been reported^{11, 13}.

Microscopically, the cells of granular cell tumour are rounded, polygonal with nuclei ranging from small and dark to large with vesicular nuclei. The cytoplasm contains fine to coarsely eosinophilic granules. The cells are arranged in ribbons or nests divided by slender fibrous connective tissue septa or in large sheets with no particular cellular arrangement¹⁴. Other histological features include pseudoepitheliomatous hyperplasia of the epithelium. This feature may give a false impression of a squamous cell carcinoma if a biopsy was taken superficially and thus will affect the mode of treatment to the patient. In this study, only 3 cases were observed to have pseudoepitheliomatous hyperplasia. In a study done by Eguia et al⁴, 87.5% of the cases were noted to have pseudoepitheliomatous

hyperplasia in the overlying epithelium. The cause of pseudoepitheliomatous hyperplasia is unknown. Granular cell tumours with pseudoepitheliomatous hyperplasia exhibited increase in Ki-67 staining in the basal cells of the overlying epithelium and it may represent an induction phenomenon mediated by unidentified molecules produced by the granular cells⁸.

Although Abrikossoff first described granular cell tumour (granular cell myoblastoma) 80 years ago and considered it as a muscle tumour¹⁴, it is currently believed to be of neural origin. Immunohistochemistry demonstrates the cells are positive to S100 protein^{6, 8, 15-19} and neuron specific enolase^{16, 17}, but do not react with chromogranin¹⁶, desmin²⁰, actin²⁰ and myoglobin²⁰. In our study, five cases were positive for S100 protein. This finding concurs with other studies^{6, 8, 15-19}.

A number of tumours have a granular appearance when seen microscopically. The differential diagnosis includes alveolar soft part sarcoma and rhabdomyoma. Alveolar soft part sarcoma is characterized by the pseudoalveolar arrangement of large, oval to polyhedral cell usually with distinct cell boundaries²¹. Rhabdomyoma is composed of eosinophilic polygonal cells containing granular cytoplasm with presence of cross striation¹⁴. Another lesion which contains granular cells is the congenital epulis that happens in a newborn¹⁴. It is a benign lesion occurring usually on the maxillary alveolar ridge of the newborns. Although histologically congenital epulis and granular cell tumour have similar features, congenital epulis does not exhibit immunoreactivity for S100 protein^{18, 22}.

Generally, the treatment for oral granular cell tumour is straightforward by simple excision. The prognosis is good and recurrence is rare. Eleven cases of oral granular cell tumours were treated by excisional resection using laser with no evidence of recurrence⁵. Granular cell tumours can undergo malignant transformation. Lesions are classified as malignant granular cell tumours if three or more criteria are met: necrosis, spindling, vesicular nuclei with large nucleoli, increased mitotic activity, high nuclear to cytoplasmic ratio and pleomorphism²³. In a review done by Aksoy et al²⁴, out of 52 reported cases of metastatic granular cell tumour, 4 cases originated from oral region.

CONCLUSION

Although oral granular cell tumour is quite an uncommon lesion in the oral cavity, clinicians should consider it in their clinical differential diagnosis of a single lump when seen clinically especially if the lesion is located on the tongue.

ACKNOWLEDGEMENT

The authors thank the Director General of Health Malaysia and also to Director of Institute for Medical Research, Kuala Lumpur for their kind permission to publish this paper.

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Ability of Whitening Toothpastes in Removing Stains from Composite Resins

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ABSTRACT

Objectives: The objectives of the study were to assess: i) the staining susceptibility of composite resins, ii) the ability of whitening toothpastes in removing stains from composite resins. **Materials and Methods:** Thirty specimens from each composite resins: Filtek Z350 (3M ESPE), Filtek Z250 (3M ESPE) and Beautifil (Shofu Inc.) were fabricated. After polishing, specimens were immersed in coffee for 3 days. Specimens were then brushed twice a day for 2 weeks using Colgate Total (Colgate-Palmolive, control group), Colgate Advanced Whitening (Colgate-Palmolive, test group) and Darlie All Shiny White (Hawley & Hazel Chemical Co., test group). Colour changes (ΔE^*) were measured using Spectrophotometer at baseline, after coffee immersion and after brushing. Results were statistically analyzed using one way ANOVA and Tukey's test. **Results:** There was significant difference in terms of colour changes for Filtek Z350, Filtek Z250 and Beautifil after coffee immersion ($P < 0.05$). There was no significant difference in the ability to remove stains amongst the toothpastes investigated ($P > 0.05$). **Conclusions:** Filtek Z350 was able to resist staining by coffee better than Filtek Z250 and Beautifil. The whitening toothpastes did not offer added advantage in terms of ability to remove stains compared to ordinary toothpaste.

INTRODUCTION

Increasing demand for aesthetic restorations has driven composite resins to be used widely for both anterior and posterior teeth. Amongst the advantages offered by this tooth-coloured restorative materials were strength, excellent aesthetics, ability to bond to tooth structure and enable minimal invasive tooth preparation. Newer generation of materials such as packable and nanofilled composites have been introduced to meet the challenges in the dental market¹. In addition, pre-reacted glass ionomer cement technology has been utilized to add the advantages of glass ionomer cement to composite resins.

Discolouration of composite resin restorations still poses a problem especially for heavy smoker, coffee and tea drinker². Composite resins are susceptible to discolouration by accumulating stains from food dyes and dietary colourant³. Rough and irregular surface is one of the contributory factors for external staining and discolouration and it is closely related to the type of composite resin material⁴. The structure and the characteristics of the filler particles in the composite resins have direct impact on surface smoothness and thus increase the susceptibility to extrinsic staining⁵. Once staining has occurred, brushing with toothpastes and bleaching procedures may remove

the stains partially or totally⁶. It has been demonstrated that tooth brushing can abrade the surface of composite resins with a three-body wear process⁷.

In the last ten years, dentifrices have become more specialized and can be classified as therapeutic or cosmetic⁸. With regards to cosmetic function, dentifrices have become a useful solution to remove extrinsic stains, therefore whitened the teeth and also the surface of restorations⁹. The dentifrices can act in two different ways i.e. mechanically by the action of abrasives such as silica or chemically by the effect of whitening agents like peroxides and sodium bicarbonate. The effectiveness of whitening toothpastes has been widely investigated^{8,9}. It would be of interest to evaluate the effect of the whitening toothpastes on tooth coloured restorative materials. The present study, therefore, was conducted to:

1. to assess the susceptibility of various types of composite resins to staining.
2. to evaluate the ability of whitening toothpastes in removing stains from composite resins.

MATERIALS AND METHODS

Three different types of resin based composites were investigated in this study: (i) Filtek Z350, a nanofilled composite resin (3M ESPE, USA); (ii) Filtek Z250, a microhybrid composite resin (3M ESPE, USA); (iii) Beautifil, a composite resin incorporated with pre-reacted glass ionomer particles, also known as Giomer (Shofu Inc, Japan) (Table 1). A total of 90 composite disc specimens (Shade: A3; dimension: 10mm diameter x 2 mm depth) were fabricated, i.e. 30 specimens for Filtek Z350, Filtek Z250 and for Beautifil respectively. A cylindrical mould was constructed using polytetrafluoroethylene (PTFE) for the fabrication of disc specimens (Figure 1). The discs were light-polymerized against a Mylar strip using a visible light activation unit (Dentsply/Caulk, USA) according to the manufacturers' recommended curing time. A glass slide was used to press out the access material prior to curing. After curing, all specimens were kept in distilled water for 24 hours at 37°C in the incubator (Memmert GmbH + Co. KG). They were then polished with aluminium oxide discs - Sof-Lex Contouring and Polishing Disc System (3M ESPE, USA) according to the manufacturer's instructions. After the specimens had been polished, they were subjected to colour measurement by using a Reflection Spectrophotometer (Dataflash®100) (Figure 2). The colour changes for the specimens were evaluated at 3 stages i.e. prior to coffee immersion (baseline), after coffee immersion and after brushing. Measuring conditions, techniques and calibration of the spectrophotometer were standardized for every measuring sessions. Each specimen was measured 3 times and the average value was taken. Values were recorded in the Commission Internationale de l'Eclairage(CIE) CIELAB colour system relative to CIE standard illuminant A (incandescent light) against a white background on the Reflection Spectrophotometer. Colour coordinates for lightness, namely, white/black(L*), red/green(a*), and yellow/blue(b*) were measured. Reflectance values versus wavelength were obtained for each specimen from 400nm to 700nm. The colour changes between baseline, after coffee immersion and after brushing were analyzed on a ΔL^* , Δa^* , and Δb^* distribution map. Total colour differences are expressed by the following formula:

$$\Delta E^*=[(\Delta L^*)^2+(\Delta a^*)^2+(\Delta b^*)^2]^{1/2}$$

Figure 1: Polytetrafluoroethylene (PTFE) mould



Figure 2: Reflection Spectrophotometer



Figure 3: Brushing of specimens

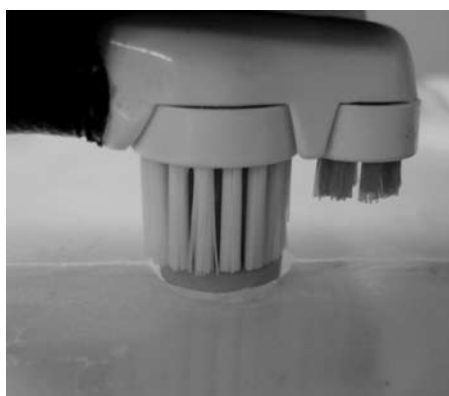
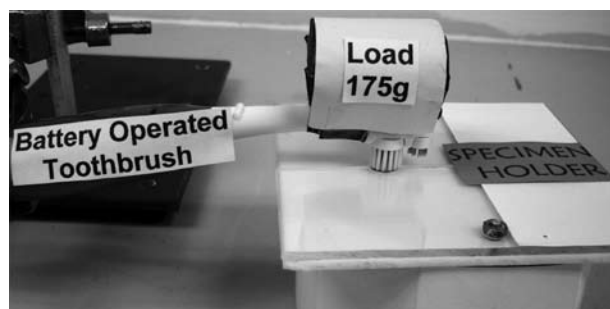


Figure 4: Toothbrush abrasion apparatus



Coffee solution (Nescafe® Classic, Nestlé® Products Sdn. Bhd.) was selected as the soaking medium to evaluate the staining susceptibility of the composite resins in this study as coffee is a potential colourant commonly consumed in local diet. 15 grams of coffee powder were dissolved into 500ml of hot water to made the coffee solution. After the baseline pre-immersion colour measurement was taken, all specimens were immersed in the coffee solution for 3 days at 37°C in the incubator. The post-immersion colour measurements were recorded using the Reflection Spectrophotometer.

After the post-immersion colour measurement was recorded, the stained specimens were mounted in a specimen holder on a stable base. The whitening toothpastes employed in this study were (1) Colgate Advanced Whitening and (2) Darlie All Shiny White. Colgate Total, a conventional toothpaste was used as control (Table 2). Dentifrice slurry was prepared by mixing the respective toothpaste with distilled water at a ratio of 1:1 by weight. Slurry was mixed at room temperature for 10 minutes in stirrer set (Torrey Pines Scientific, Inc., CA, USA). 10ml of the dentifrice slurry was added on the surface of each specimen disc using a pipette at 30 seconds interval to maintain a constant supply. Colgate Motion Battery-Powered toothbrush (Colgate-Palmolive) with soft nylon bristles was selected as the toothbrush abrasion apparatus (Figures 3 & 4). The filaments in each tuft of the brush were carefully aligned perpendicular to the surface of the specimen, and touched the surface of the specimen evenly without bending. During each placement of specimens in the specimen holder, a caliper was used to ensure constant

height is maintained between the head of the bristles and the specimen. Each specimen was subjected to 2 minutes of brushing with a rotation-oscillation rate of 16,000 cycles per minute generated by the battery-powered toothbrush at room temperature. A brushing load of 175g was chosen to simulate observed brushing practice¹⁰. The bristle head was changed after brushing every ten specimens. The batteries for the toothbrush were changed at every one hour. The specimens were brushed twice daily for a consecutive period of 14 days. After each brushing, the specimens were rinsed with distilled water for 1 minute. After completing the 2 weeks brushing procedure, the specimens were blotted dry and subjected to colour change measurement using Reflection Spectrophotometer.

Statistical analysis was carried out using SPSS for Windows (Version 11.5). The data for colour changes (ΔE^*) were analyzed using One-way Anova and Tukey's multicomparison tests.

Table 1: Composite Resins used in this study

Materials	Type	Polymer	Fillers	Filler Size	Filler content (% by volume)
Filtek Z350	Nanofilled	Bis-GMA, Bis-EMA, UDMA, TEGDMA	Zirconia silica	5-20nm	59.5%
Filtek Z250	Microhybrid	Bis-GMA, Bis-EMA, UDMA	Zirconia silica	0.01-3.5 μ m	60%
Beautifil	Giomer (Composite resin with pre-reacted glass ionomer fibers)	Bis-GMA, TEGDMA	S-PRG based on Fluoroboroaluminosilicate glass	0.01-5.0 μ m	66.3%

Table 2: Compositions of the toothpastes

Toothpastes	Compositions
Colgate Total (Control)	Sodium Fluoride 0.22% (0.10% w/w Fluoride ion), Triclosan 0.30%, Water, Sorbitol, Hydrated Silica, PVM/MA Copolymer, Sodium Lauryl Sulphate, Flavor, Titanium Dioxide, Carrageenan, Sodium Hydroxide, Sodium Saccharin.
Colgate Advanced Whitening	Sodium Fluoride 0.22% w/w, Water, Hydrated Silica, Sorbitol, Glycerin, Sodium Lauryl Sulphate, Flavor, Carrageenan, Tetrasodium Pyrophosphate, Titanium Dioxide, Sodium Saccharin, Sodium Hydroxide.
Darlie All Shiny White	Sodium Fluoride, Water, Silicon Dioxide, Sorbitol, Glycerin, Sodium Lauryl Sulphate, Flavor, Carrageenan, Tetrasodium Pyrophosphate, Sodium Saccharin, Titanium Dioxide, Blue Poly 50 (FD&C Blue #1 & Polyethylene).

RESULTS

The mean colour changes for all the composite resins (Filtek Z350, Filtek Z250 and Beautifil) after immersion in coffee for 3 days were shown in Figure 5. The values of colour changes were recorded in National Bureau of Standard (N.B.S.) units. Filtek Z350 exhibited the least colour change followed by Filtek Z250 and Beautifil. Beautifil exhibited the greatest colour change (Figure 5). The mean colour change for Filtek Z350 was 10.49 N.B.S. units while the corresponding data for Filtek Z250 and Beautifil was 11.35 N.B.S. units and 11.80 N.B.S. units respectively. Statistically there was a significant difference in terms of colour changes for Filtek Z350, Filtek Z250 and Beautifil after immersion in coffee. Based on a study carried out by Ruyter et.al.¹¹, colour change (ΔE^*) of more than (\geq) 3.3 N.B.S. units was considered visually perceptible as well as clinically unacceptable. The alpha rating according to United States Public Health Service (USPHS) clinical evaluation system corresponds to ΔE^* values range between 2.2 N.B.S. units to 4.4 N.B.S. units. Therefore, in accordance with the above information, using the criterion for perceptible colour change of $\Delta E^* \geq 3.3$ N.B.S. units, all specimens tested had perceptible colour changes after immersed in coffee for 3 days.

The mean colour changes for Filtek Z350, Filtek Z250 and Beautifil after brushing with Colgate Total, Colgate Advanced Whitening and Darlie All Shiny White were depicted in Figure 6. Filtek Z350 specimens showed 4.23 N.B.S. units, 4.38 N.B.S. units and 4.80 N.B.S. units of mean colour change respectively after brushing with Colgate Total, Colgate Advanced Whitening and Darlie All Shiny White while Filtek Z250 demonstrated mean colour change of 4.40 N.B.S. units, 4.76 N.B.S. units and 5.27 N.B.S. units respectively. Beautifil showed mean colour change of 5.89 N.B.S. units, 6.08 N.B.S. units and 6.67 N.B.S. units after brushing with Colgate Total, Colgate Advanced Whitening and Darlie All Shiny White. The trend for the colour changes for Filtek Z350, Filtek Z250 and Beautifil specimens brushed with Colgate Total, Colgate Advanced Whitening and Darlie All Shiny White was fairly similar. Darlie All Shiny White group exhibited greatest colour change, however, statistical analysis revealed that the mean colour changes of the three types of composite resins after brushing with all three toothpastes (Colgate Total as control, Colgate Advanced Whitening and Darlie All Shiny White as test group) were not significantly different from each other ($p > 0.05$).

Figure 5: Colour changes of Filtek Z350, Filtek Z250 and Beautifil after immersion in coffee solution for three days.

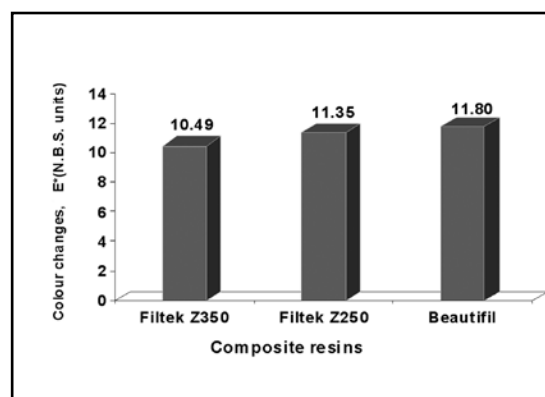
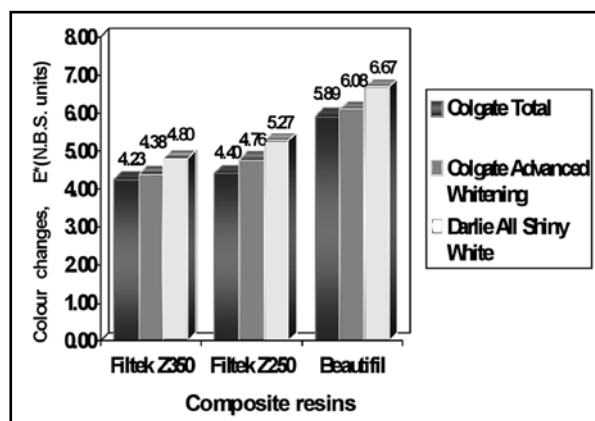


Figure 6: Colour changes of Filtek Z350, Filtek Z250 and Beautifil after brushing with Colgate Total, Colgate Advanced Whitening and Darlie All Shiny White



DISCUSSION

Three commercially available composite resins were selected in this study i.e. a nanofilled composite resin (Filtek Z350, 3M ESPE, USA), a microhybrid composite resin (Filtek Z250, 3M ESPE, USA) and composite resin incorporated with pre-reacted glass ionomer particles, also known as Giomer (Beautifil, Shofu Inc, Japan). New composites integrating nanofiller technology have been introduced into clinical practice to achieve better polishability and wear resistance; however, there is limited information on their susceptibility to external stains. Giomer has been introduced in the last decade and claimed to have the advantages of fluoride releasing and recharging, good wear resistance, excellent radiopacity and excellent aesthetics. With the introduction of these new materials, it is warrant to evaluate their staining susceptibility to ensure long term clinical success as unsightly discolouration of tooth-coloured restorations has become one of the main reasons for replacement of these restorations.

It is important to select a valid colour-measuring instrument to assess the colour changes of the test

specimens. Instrumental colorimetry warrants quantitative evaluation and comparison of colour changes of materials and eliminates the subjective interpretation of visual colour comparisons¹². Reflection Spectrophotometer was utilized in the present study as it has the ability to measure the reflectance of light within the entire visible spectrum and the measurements can be cross-referenced to existing shade guide, so there is immediate clinical relevance to the numeric data generated.

Tobacco use and certain dietary habits (coffee, tea, carbonated drinks consumption) may contribute to external discolouration of composite resins^{3, 13}. Discolouration and marginal degradation were two main reasons why restorations were replaced¹⁴. Coffee is a commonly consumed beverage worldwide including in Malaysia. Coffee solution has been investigated in various studies and found to have the ability to stain composite resins^{4, 13, 15, 16, 17}. Um and Ruyter¹⁷ suggested that coffee may stain by adsorption and adsorption of its colourants onto/into the organic phase of composite resins.

It has been stated in the literature that 24 hours storage time of the specimens in soaking medium simulated consumption of the respective solutions over 1 month^{15, 17}. In the present study, 3 days were chosen as the period of immersion for the specimens to simulate the effect of coffee consumption in a long term period (approximately 3 months). The results are expected to be accentuated by the continuous immersion. The actual staining effect in the oral cavity would need a longer period of time because of daily oral hygiene procedures, dilution by saliva and the variation in individual dietary habits. However, the results can provide an indication of the staining susceptibility of the various types of composite resins investigated.

In the present study, great care was taken to minimize variation in the brushing of the specimens, a standardized load of 175g was mounted on the electric toothbrush to impart a constant load. This load was the approximate force used in routine daily brushing¹⁰. The distance between the bristle head and specimen was also measured with a caliper during each placement of specimen in the specimen holder to ensure similar loading for each specimen. The dentifrice slurry was prepared based on study done by Teixeira et al.¹⁸ by mixing each type of dentifrice with distilled water at a ratio of 1:1 by weight and thus producing three types of dentifrice slurry for brushing. This is to simulate effect of dilution by saliva. Pfarrer and White¹⁹ prepared the slurry mixing the dentifrice with distilled water at a ratio of 1:3 by weight. However, it was found that the dentifrice slurry prepared by the ratio of 1:3 was too diluted and watery during the pilot study. Thus, the ratio of 1:1 by weight was employed in the main study.

After immersion in coffee, Beautifil showed the most severe colour changes and Filtek Z350 the least amongst the three materials tested. The structure of composite resins and the characteristics of the particles have direct impact on the surface smoothness and the susceptibility to extrinsic staining^{5, 20, 21}. Average particle size of the primary fillers in Filtek Z350 was in the nanometer range (5-20nm), whereas

those of Filtek Z250 and Beautifil were in the micrometer range (0.01-3.5 μ m and 0.01-5.0 μ m respectively). Owing to the smaller filler particle size of Filtek Z350, the surface produced after polishing was smooth, therefore the potential to retain stains was reduced. Similar findings were found in the study carried out by Sumita et al.²². They had developed nanocomposites from nanofillers and measured the nanocomposite's properties in vitro in comparison with hybrids, microhybrids and microfill. In addition, the findings in the present study are supported by Lu et al.⁴ who found that surface roughness (Ra) had a positive linear relationship with the colour changes of composite resins tested, the smaller Ra i.e. the smoother the surface, the less discolouration (the more resistance to stain) of the material. Therefore, Filtek Z350, a nanofilled composite was less susceptible to staining than Filtek Z250, a microhybrid composite where the filler particles are considerably larger than nano-sized particles.

The resin matrix also played an important role in susceptibility to staining via surface adsorption and absorption mechanism. Both Filtek Z350 and Filtek Z250 used urethane dimethacrylate (UDMA) in its resin matrix system which has better colour stability compared to Giomer which used TEGDMA (with poorer colour stability) in its resin matrix system¹⁵. The urethane dimethacrylate matrix has lower viscosity, lower water sorption and greater toughness. Giomer contains more organic matrix than composites, thus increase their susceptibility to water absorption and the hydrogel layer of the glass filler rendered its hydrophilic properties which cause surface disintegration in the aqueous environment^{23, 24, 25, 26}. This would explain why Beautiful was the least stain resistant.

Abundance of toothpastes/dentifrices containing different formulations has been introduced in the market, with some trying to improve the efficiency of cleaning and promoting tooth-whitening¹⁹. The whitening dentifrices can act in two different ways: physically remove superficial stain by the action of the abrasives or act chemically by the effect of peroxides²⁷. The present study found that there was no difference between the regular toothpaste (Colgate Total) and the whitening toothpastes (Colgate Advanced Whitening and Darlie All Shiny White) in terms of the ability to remove stains from discoloured composite resin materials. Although it is not totally clear how abrasiveness of a toothpaste can specifically affect the discoloured tooth surface, it would be expected that the abrasiveness act by reducing or eliminating extrinsic stains²⁷. Based on the formulation of the whitening toothpastes investigated in the present study, it would appear that the dentifrices remove stains primarily based on abrasive action. Our findings correlate with the results achieved by Amaral et al.²⁷, which explained that the incorporation of abrasives in specific dentifrices might help physically in removing stains but since all the toothpastes in our study contain abrasives, some degree of stain removal may be expected even with the regular toothpaste i.e Colgate Total. However, Yankell et al.²⁸ and Sharma et al.²⁹ reported that whitening dentifrices exhibited superior stain removal

property compared to standard dentifrices. The dentifrices used by Yankell et al.²⁸ and Sharma et al.²⁹ may contain ingredients with chemical action. The importance of chemical action has also been demonstrated by Koertge et al., who performed a longitudinal clinical study on baking soda based dentifrices and found that they are significantly more effective in removing extrinsic stain than standard silica-based dentifrices (abrasive type) although it is less abrasive compared to the silica-based dentifrices.

Koertge et al.⁸ had stated that the whitening effect or stain removal effect of a dentifrice may not solely related to its abrasiveness. In the present study, Colgate Total, Colgate Advanced Whitening and Darlie All Shiny White demonstrated no significant difference in the ability to remove stains from three types of composite resins i.e. Filtek Z350 (nanofilled), Filtek Z250 (microhybrid) and Beautifil (Giomer). Both Colgate Total and Colgate Advanced Whitening were manufactured by the same manufacturer. It is important to take note of the increase in surface roughness of composite resins when brushed with whitening dentifrices with high abrasivity. The increase in surface roughness after long term toothbrushing may lead to easier absorption and adsorption of external stains³⁰. Eventually, this may negate the purpose of the whitening dentifrice and formed a vicious cycle of stains formation.

CONCLUSION

Within the limitations of the present study, it can be concluded that coffee solution has the ability to stain composite resins on prolonged and heavy consumption leading to discolouration that can be perceived clinically. The clinicians should warn patients with large composite restorations to reduce intake of coffee or rinse immediately after consumption to avoid unsightly discolouration of the restorations. Filtek Z350 was more stain resistant than Filtek Z250 and Beautifil. The whitening toothpastes (Colgate Advanced Whitening and Darlie All Shiny White) do not offer added advantage to remove stains compared to ordinary toothpaste (Colgate Total). Lastly, we advocate further study to evaluate the effect of whitening toothpaste on surface roughness of composites resins and also the effect of vicious cycle of brushing and consumption of coffee on long term colour stability of composite resins.

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Latest recommendations for dental radiography in general dental practice.

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INTRODUCTION

Radiology is important in the diagnostic assessment, treatment and monitoring progress of patients having dental and maxillofacial diseases. The central question in dental radiology is whether there is any risk with regard to low doses of radiation and what are the necessary protection needed to prevent any hazardous outcome with X-raying. With the emergence of the new millennium, major changes are happening in the field of science and technology. More efficient equipments are being discovered and more researches are being conducted to elicit better understanding of the radiation process and its effect on the human health. This article will review the latest guidelines for proper radiographic practice from the USA and Europe. It will address topics like the risks from dental radiography, selection criteria, protection for patients and staff, improvement to X-ray equipments, room dimensions and lead lining requirements. We have limited our research to intraoral, panoramic and cephalometric radiographs because these are the radiographs or images that are commonly taken in the general practice setting.

OBJECTIVES

1. To make the general dental practitioner aware of the latest trend and guidelines with regard to dental radiography, particularly standards from United States of America and Europe.
2. To dispel any myths and misinformation about radiographic protection.
3. To analyze the reason and rationale for the proposed guidelines with supportive research articles.
4. To educate the general practitioner of the need to make changes to laws pertaining to dental radiation.

METHODS

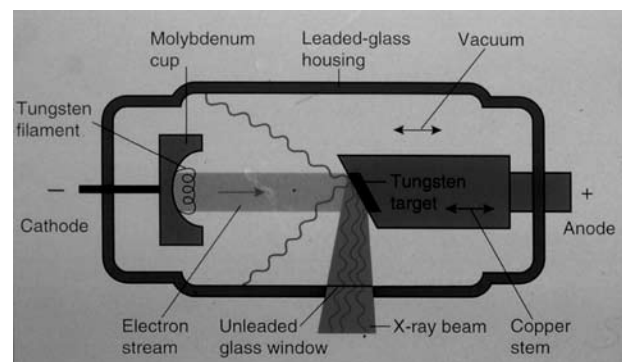
Literature research activities were undertaken at the library of University of Malaya. Pubmed was searched

using the term “dental radiographs” in combination with other relevant key words including “guidelines”, “risks”, “protection”, “thyroid” and “pregnancy”. Relevant researches to justify the guidelines were also perused.

Risk from dental radiation doses.

What happens after the press of the button and you hear the familiar beep? X-rays are produced by electrons bombarding a target material (usually tungsten) and are subsequently brought suddenly to rest. This happens inside a small evacuated glass envelope called the X-ray tube (Figure 1).

Figure 1 : The anode enlarged showing the target and production of X-ray. Adapted from Dental Radiography. Principles and techniques 3rd Edition. Iannucci JM and Howrton LJ.



This X-ray will pass through the patient and hit the X-ray film or digital receptor. The X-ray will affect film emulsion to produce the visual image (radiograph) or with the digital receptor, the data is transferred to the computer to produce an image. When the X-ray passes through human tissue, it can produce biological damaging effects. These effects can be classified into two main categories:-

- a) Deterministic effects
- b) Stochastic effects

Deterministic effects are the damaging effects to the body of the person exposed that will definitely result from a specific high dose of radiation. Example includes skin reddening, cataract formation, decrease in white blood cell count and vomiting. In all cases a threshold dose exists, below which there will be no effect. Typical minimum dose for any deterministic effects is 1Sv¹. In dental radiography, typical effective dose does not cause this deterministic effect.

The risk of stochastic effect is higher on rapidly dividing tissues. There is no threshold dose for the stochastic effect to take place. Every exposure to ionizing radiation carries with it the possibility of inducing stochastic effect which is not related to the quality or quantity of the X-ray. The lower the dose, the lower the probability of cell damage. Examples of stochastic effects are leukemia, certain tumors and mutations from any sudden change to a gene or chromosome and hereditary defects.

A broad estimate of the magnitude of the risk of developing a fatal radiation induced cancer, from various X-ray examinations, was tabled by Whaites in 2006¹. This was a collection of information from National Radiographic Protection Board² and the European Guidelines on Radiographic Protection³ (Table 1).

Table 1: Estimated risk of cancer with the type of dental X-ray¹.

Type of examination	Estimated risk of fatal cancer
2 dental intraoral	1 in 2000000
Panaromic	1 in 2000000
Skull (PA)	1 in 670000
Lateral Ceph	1 in 2000000
Chest (PA)	1 in 1000000
CT scan Head	1 in 10000
CT scan Chest	1 in 2500

As can be extrapolated from the above figures, the risk from common dental X-rays are almost negligible. Moreover everyone is exposed to some form of ionizing radiation from the environment in which we live. The highest source is from the natural background radiation i.e. the cosmic rays and gamma radiation from the rocks and soil in the earth's crust. There is also radiation from certain foods. Radon and its decay products are also found in granite stones. Below is a table of the dosage from natural radiation.

Table 2: Average dose of radiation from natural sources¹.

Radiation source	Average annual dose
Cosmic rays	300 μ Sv
Gamma radiation	400 μ Sv
Foodstuff	370 μ Sv
Radon	700 μ Sv

An average individual dose from background radiation is estimated at approximately 1.8mSv per year in UK, while in USA it's estimated approximately 3.6mSv¹. For other countries the average is about 2.4 mSv per year³.

To understand this perspective better, below are the typical doses to patients for a range of standard exposures.

Table 3: Average dose of radiation from dental X-rays³

X-ray technique	Effective Dose
Intraoral radiograph (Periapical /Bitewing)	1 μ Sv – 8.3 μ Sv ⁴
Anterior occlusal	8 μ Sv ⁵
Panoramic	3.85 μ Sv- 30 μ Sv ⁵
Lateral cephalometric	2 μ Sv – 3 μ Sv ⁶
Cross sectional (single slice)	1 μ Sv – 189 μ Sv ⁵
CT scan mandible	364 μ Sv – 1202 μ Sv ⁵
CT scan maxilla	100 μ Sv – 3324 μ Sv ⁵
Cone Beam CT	36.9 μ Sv – 50.3 μ Sv ⁷

The figures for CT scan and cross sectional views are given because of its increased use by the general dental practitioners for implant work.

With the above figures in mind, a panoramic radiograph is associated with effective dose which is equivalent to the same as 1-5days of additional background radiation⁵. Two bite wings would be equivalent to about 1 day additional background radiation⁴. For comparative purpose a chest X-ray (20 μ Sv) would be equivalent to 3 days of background radiation³. It definitely shows that the radiation doses from dental radiography are indeed very small. However, every effort must be undertaken to reduce radiation to practical limits as any dose carries a risk of inducing malignancy.

Patient Entrance Dose

Patient Entrance Dose (PED) is defined as the absorbed dose measured at the end of the director cone for a typical intraoral radiograph without backscatter from the patient. PED is proportional to the tube current, length of exposure, the square of the peak voltage and the distance between X-ray source and patient. The use of higher peak kilovoltages increases beam penetration and this may allow the use of a lower tube current, thus reducing the

dose. Increasing the focus to skin distance (FSD) reduces the dose greatly, for example if the FSD is doubled, the PED will be reduced by a factor of four⁸. The mean PED for 45kV to 55kV sets using E speed film is 4.1 mGy (4.1 μ Sv) and for machine with 60kV to 70kV sets using E speed film is 1.8 mGy (1.8 μ Sv)⁹. When compared to the chest X-ray, the average PED is only 0.24mGy (0.24 μ Sv)⁹. This is due to the focus to skin distance in intraoral radiographs which is around 200mm and the same distance in chest X-ray is 1500mm. The implication of this fact is although the effective dose is less in intraoral radiography, the patient entrance dose (or skin exposed dose) is substantially higher. Therefore every effort must be taken to minimize this exposure for the patient.

Hormesis

Definition of hormesis – the induction of beneficial effects by low doses of an otherwise harmful physical (eg:⁹ ionizing radiation) or chemical agent.

The overwhelming majority of the current available epidemiological data on populations exposed to ionizing radiation support the assumption that there is a linear non-threshold dose-response relationship. However epidemiological data fail to demonstrate detrimental effects of ionizing radiation absorbed doses smaller than 100-200mSv. Risk estimates for these levels are therefore based on extrapolations from higher doses. Sasaki et al¹⁰ stated that, for mammalian cells, the optimum dose for a radio-adaptive response is below 100mSv. Adaptive response to radiation is an effect that has been convincingly demonstrated in cultured cells. There is however still doubt over how this influences the risk of multicellular organism and also over the duration of the radio-adaptive effect. If a hormetic effect of radiation exists, it seems to be rather weak and inconsistent. Overall there is currently insufficient evidence for radiation hormesis to warrant any far reaching change in the present radiation policy associated with risks of ionizing radiation¹¹.

Patient selection

Currently there are no clear guidelines to justify when radiographs are necessary in Malaysia. Radiographs are requested based on the training that the particular dentist has undergone and individual preference. In 2002, Nambiar and Lim¹² conducted a survey of the practice of dental radiography in Malaysia and found that the general dental practitioners in Malaysia are not very dependent on dental radiographs because the majority took less than 20 intraoral films per month. Therefore we looked into guidelines from the American Dental Association¹³ and The Faculty of General Dental Practitioners Royal College of Surgeons London¹⁴ for guidance. It is essential that selection of appropriate radiograph is based on the individual patient's history and clinical examination. The 'routine' use of radiographs on patients based on a generalized or screening approach is not acceptable¹⁵. It is also not acceptable to take radiographs for medical records, training purpose like those practised in dental schools or for research purpose

which does not directly benefit the patient¹⁶.

Listed below are some of the conditions that might require dental radiographs.

1. Dental Caries Diagnosis

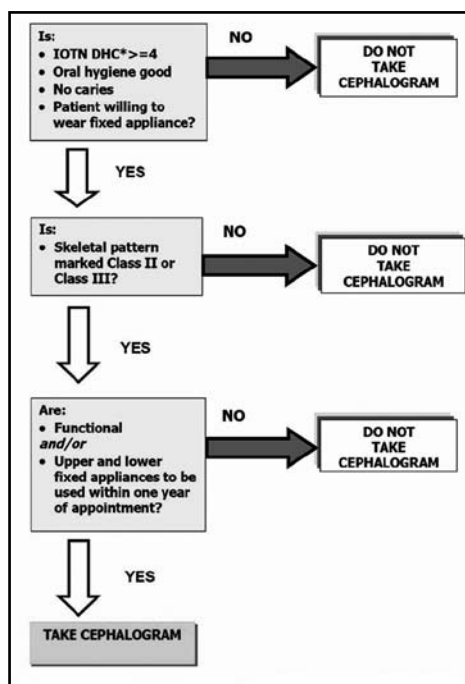
The posterior bitewing radiographs are essential adjunct to clinical examination¹⁴. However before this radiograph is requested, the initial clinical examination must include an assessment of caries risk (as high, medium or low). If the risk of carious lesion is high, for example there are multiple carious lesions, extracted tooth, poor oral hygiene then bitewing radiographs can be requested every six months. If there is moderate risk, radiographs can be requested every year and if the risk is low, the patient would need bitewings every 2 years only. The rationale for this time frame is early enamel lesion progresses at a relatively slow rate taking at least two years to progress into dentine¹⁷. Furthermore, intervals between subsequent bitewing radiographs must be reassessed for each new period as individuals can move in and out of carious risk categories.

2. Orthodontics

Radiographs are needed following clinical examination in a proportion of orthodontic patients. A clinical examination is necessary to ensure that the radiographs requested will be appropriate for the patient's specific orthodontic problem. Cephalometric lateral skull radiographs are not necessary if the patient is not indicated for fixed appliance or functional appliance. These radiographs are also not necessary if there is an obvious Class I skeletal pattern¹⁸. The value of hand wrist radiographs in clinical orthodontics has been questioned as these views lack the reliability to predict growth spurts. Similarly radiographs for TMJ cannot be justified and films taken for this reason have no impact on the treatment planning¹⁹.

Below is the guideline for taking cephalometric radiographs from British Orthodontic Society¹⁸.

Figure 2: Flowchart to show when the cephalometric radiograph is necessary¹⁸.



3. Periodontology

The diagnosis of periodontal disease depends on a clinical examination. This maybe supplemented by radiographs if they provide additional information which could potentially change patient management and prognosis. There is insufficient evidence to propose robust guidelines on choice of radiography for periodontal diagnosis and treatment (i.e full mouth periapical radiographs) when a panoramic radiograph will be sufficient. Only when the clinician contemplates for accurate bone level measurement, the intraoral radiographs employing the paralleling technique must be taken. However existing radiographs e.g. bitewings taken for caries diagnosis should be used in the first few instances²⁰.

4. Endodontics

Radiographs are essential for many aspects of endodontic treatment²¹. Electronic apex locators are useful in reducing the number of exposures during working length estimation. Preferably all intraoral radiographs are taken with a positioning device to prevent unnecessary radiation exposure to the fingers of the patient or the operator. This also ensures consistent quality of the image²².

5. Prosthetic

In the absence of any clinical signs or symptom, there is no justification for any radiographic examination in an edentulous patient²³. The obvious exception is if implant treatment is planned.

6. Oral surgery

In case of third molars, a panoramic radiograph will provide information about the distance of the tooth to the lower border of mandible, course and relationship of the mandibular canal²⁴. In other situations e.g. apicectomy or root removal, intraoral radiography will be sufficient. There is no convincing evidence to support the need for routine radiographs prior normal tooth extraction²⁵. Having said that, if there is any history of previous difficult extraction, a clinical support of unusual anatomy or surgical extraction of the tooth or if it's close to an anatomical structure, it is prudent to take preoperative radiographs. Radiographs are essential in implantology for pre-operative planning and post- operative assessment.

7. Pregnant patients

Dental radiographs may be prescribed for pregnant patients because the dose is very low and the beam is not directed towards the developing fetus. There is also no need to use a lead protection apron^{2,3,16,26}. However the use of lead apron continues to be advised on the grounds that it reassures the patient. A study by Hujuel et al²⁷ is frequently quoted to show the effects of dental radiographs to the developing fetus. They reported that dental radiography is associated with low birth weight. This study was severely criticized by the dental community because of its inadequacies. Brent²⁸ exposed the deficiency of that study. He also mentioned that epidemiologic and animal studies that involved radiation to the thyroid, pituitary and head did not cause fetal growth retardation as a result of these exposures.

8. Patients undergoing Radiation Therapy

No special consideration applies to dental radiographs for patient undergoing radiation therapy to head and neck. These patients are at high risk of developing dental disease and the radiation exposure from dental radiographs is negligible when compared to the exposure they already are receiving in the treatment¹³.

9. Children

The indication to take radiographs is similar to adults but the younger the individual, the higher is the vulnerability to radiation because of the large number of cell divisions occurring in small children. Children also have a higher proportion of the bone marrow located in the skull than adults. Smith et al.²⁹ have shown in that the calculation of risk estimates, about one induction of malignancy per 1000000 exposures to 5 year olds can be expected. Leaded apron with thyroid collar should be provided for the child and any accompanying person in the same room as the patient during the exposure³⁰.

The exposure time for children under 10 years of age can be reduced to half the exposure time required for adults; and for children between 10 to 15 years of age, the exposure time can be reduced by one third³¹. The amount of radiation is very much reduced if the current guidelines

on the X-ray equipment are adhered. The guidelines are presented below.

X-ray equipment

a) Kilovoltage

Developments in the design of dental X-ray equipment have improved both from the perspective of radiation hygiene and image quality. The operating potential of dental X-ray machine affects the radiation dose and backscatter radiation. Lower voltages produce higher contrast images and higher entrance skin doses. Higher voltages produce lower contrast images that enable better separation of objects with different densities¹³. A kilovoltage of 60-70 Kvp is considered reasonable compromise in intraoral radiography²⁶. Constant potential X-ray generation (direct current) is a modern alternative to traditional pulsating kilovoltage for both intra and extraoral dental X-rays. Such a method of x-ray generation gives fewer low energy X-rays and hence gives reduction to skin dosage for patients³².

b) Filtration

Filtration of the X-ray beam removes the lower energized photons. Therefore it reduces the skin doses to the patients. Filtration using aluminum is an essential component in the new X-ray machines. Regulations require the total filtration in the path of dental X-ray beam to be equal to the equivalent of 1.5mm of aluminium for 70kVp and 2.5mm of aluminium for all voltage above 70kVp³³.

c) Collimation

Collimation limits the amount of radiation, to which the patient is exposed. Most recent dental intraoral X-ray machines are manufactured with long open ended positioning indicating device (PID) or spacer cone with a diameter of at least 60mm. The X-ray tube head with a short plastic pointed closed spacer cone is unacceptable nowadays because the scatter from the pointer cone produces a large diameter beam (more than 60 mm) and the focus to skin distance is shorter than 100mm. This will greatly increase the radiation to the patient³⁴. The use of long source to skin distances of 400 mm rather than short distances of 200 mm decreases exposure by 10 to 25 percent. Therefore it is appropriate that the tube length to be in between 200 mm to 400 mm¹⁶. Cederberg et al³⁵ have calculated the effective dose and the estimated risk from the use of short and long, round and rectangular open ended PIDs. They concluded that long and short rectangular open ended PIDs collimation resulted in the lowest effective dose with values 3.5 to 5 times less than long and short round open ended PIDs. The use of rectangular collimation has been recommended both in UK^{2,36} and USA¹³. The use of rectangular collimation however definitely requires the use of film holding device for beam alignment to prevent cone cuts. Rectangular collimation can be achieved by attaching a special rectangular collimating plate adapter to the end of the round PID or using a film holder that

incorporates a metal shield to block radiation beyond the edges of the film².

For panoramic radiography, the operator has no way of collimating the X-rays. However newer machines offer field size trimming to reduce the area exposed. Some machines come with child imaging mode that reduces the exposed size further by 27 -45%³⁷.

For cephalometric radiography, the dosage can be reduced by the use of wedge collimation to remove part of the skull from the diagnostic area³⁷. However the manufactures of the machines still have not incorporated this into their machine. Soft tissue profile using wedge filters is common on lateral cephalometric radiographs. Some amount of dose reduction can be achieved if the filter is placed between the patient and the X-ray source rather than between the patient and the film³².

d) Films and Intensifying screens

Another method to reduce the radiation dose to the patient is by using faster film speed. Film speed for intraoral are available in D Speed, E speed and F speed with D speed being the slowest and F speed the fastest. The use of E speed compared to D speed film can result in up to 50 % percent decrease in exposure to the patient. Therefore it is recommended film speed lower than E speed should not be used for dental radiography^{2,38}. Radiation can also be reduced for extraoral films by using a "rare-earth" intensifying screen. Previous generations of intensifying screens were composed of phosphors such as calcium tungsten. Rare earth screens with film speed of 400 (image speed system) or greater can reduce patient radiation exposure by 50% compared to calcium tungstate intensifying screens².

e) Digital Receptors

There are two distinct types of sensors, corded sensors which capture and digitize the image directly and non- corded or wireless sensors which capture the image indirectly and then digitize it with a scanner. The corded sensors have a computer chip receptor embedded in them. Currently corded sensors use either of two types of chips: Charged Couple Device (CCD) chips or Complementary Metal-Oxide semiconductor (CMOS) chips with Active Pixel Sensors (APC)³⁹. CMOS-APS is the latest development in direct digital sensor technology. Externally, CMOS sensor appear identical to CCD detectors but they use an active pixel technology and are less expensive to manufacture⁴⁰. The APS technology reduces by a factor of 100 the system power required to process the image compared to CCD⁴⁰. In addition the APS system eliminates the need for charge transfer and may improve the reliability and lifespan of the sensor⁴¹. However CMOS-APS sensors have more fixed pattern noise and a smaller active area for image acquisition⁴². In the CCD and CMOS system, a chip is used as a sensor for the radiation image. A cable connects the sensor to the computer and the image is displayed on a computer monitor after exposure of the sensor. In Storage Plate (SP) system, a phosphor plate is exposed and a latent image is stored in the phosphor plate.

The information contained in the plate is released by exposure to a laser scanner which displays the image on a computer. Both systems require much less radiation compared to the conventional film based system. Digora digital images exposed with 10% of the dose required for E dental films still gave a satisfactory image quality for estimation of endodontic working length estimation³². Other studies Pauzaras et al⁴⁰ and Huysman et al⁴³ have confirmed at least 50% reduction in exposure time using digital radiography compared with E speed films. Although the diagnostic quality of digital images is comparable to that of conventional film, there are some concerns about digital images. These include poorer resolution, small receptors, the thickness and rigidity of receptors, infection control and proprietary formats for image viewing may limit electronic transfer and accessibility of the digital image.

f) Radiographic Technique

The retaking of radiographs are less likely to result when good radiographic techniques are applied. It is a well known fact that paralleling technique, when accurately applied, produces better image quality than the bisecting angle technique. Furthermore, the use of long position indicating device (PID) produces less divergent X-ray beam, thereby creating a smaller diameter of radiation exposure on the patient. Both these techniques require that the open end of the PID to be positioned as close to the patient's face as possible. When using a film holder with an external aiming ring, the dentist should slide the ring in as close to the patient's skin as possible to allow the PID to be positioned correctly. By placing the end of the PID only 1 inch away, the amount of radiation can differ by as much as 25%, often prompting the exposure setting to be increased to produce radiographs of appropriate density (Figure 3)⁴⁹. Paying careful attention to placing the PID correctly, the dentist should examine the resultant radiographs and reevaluate the current exposure setting to see if the time can be further decreased.

Figure 3: This incorrect positioning of the aiming ring places the PID too far away from the patient's skin. Placing the PID closer to the patient's skin would decrease the amount of radiation required to produce an image of appropriate quality.

Figure adapted from Thomson M E. Radiation Safety Update. www.contemporaryoralhygieneonline.com/issues/articels/2006-03_03.asp. Accessed 28.02.08



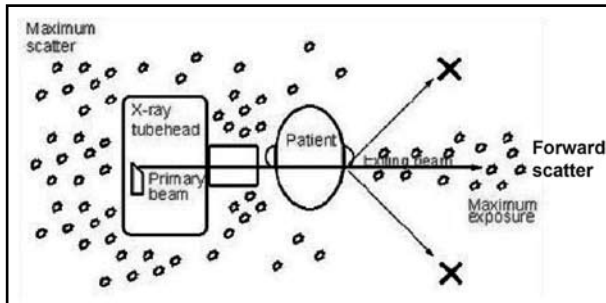
Room dimensions

X-ray travels in a straight line unless they interact with matter which change their direction of travel. The main beam is known as the primary beam. When this beam interacts with the patients' head, radiation is scattered in all direction. For dental radiography, the radiation dose in the primary beam is typically a few micro Sieverts at the end of the cone. If measured from 1 meter of the primary beam, the amount of radiation is 1000 times less than the dosage at the end of the cone^{44,45,46}.

When the patient is seated upright, maximum exposure occurs as the primary beam exits the opposite side of the patient's head and also straight back towards the X-ray tubehead. The area of minimum exposure is at 45° to the beam as it exits the patient (Figure 4). For both intraoral, panoramic and cephalometry radiographs, standing at a distance of greater than 2 meters should ensure the annual dose is kept below 1mSV provided the weekly workload is less than 100 intraorals per week or 50 pan/cep radiographs per week^{2,3}. Therefore lead lining of the X-ray room might not be necessary if the workload is as stipulated above and the operator can stand more than 2 meters away from the source of the X-ray. However for very high radiographic workload or very cramped location, extra protection can be provided after seeking advice from the Radiographic Protection Supervisor. Calculation of barrier thickness requires specific knowledge of equipment specifications. These includes information on X-ray generating waveform, kVp range, mA range, timer range, inherent and added filtration, measured average tube head leakage at a specific distance from head, dimensions and lead equivalence of shielding incorporated into image receptor holders that may act as a primary barrier. When a protection area is provided it should incorporate protection of not less than the equivalent of 0.5mm lead². Current guidelines from Ministry of Health Malaysia⁴⁷ stipulate the required internal dimensions of the room for intraoral dental X-ray is 2 metres length by 3 metres width and 3 metres height. For dental panoramic machine the dimensions are 2.5 metres length by 3.5 metres width and 3 metres height. Furthermore the doors and walls must be lined with 1 mm of lead equivalent⁴⁸. For panoramic radiography the walls must be lined with 1.5mm lead equivalent. The equivalent of 1 mm lead is 9 cm of concrete, 20cm of gypsum, 6 cm of steel or 8cm of glass plate¹⁶.

Figure 4: The X mark the regions where minimum scatter radiation occurs, 45° to the beam as it exits the patient. Maximum exposure occurs as the beam exits the patient and also straight back towards the X-ray tubehead.

Figure adapted from Thomson M E. Radiation Safety Update. www.contemporaryoralhygieneonline.com/issues/articles/2006-03_03.asp. Accessed 28.02.08



Protective Leaded Aprons

Leaded apron for patients were recommended when dental X-ray equipment was much less sophisticated. This was when poorly collimated, unfiltered dental X-ray doses used were in the range of 50mGy (equivalent to 50mSv)⁵⁰. Currently gonadal doses from panoramic or full mouth intraoral examination do not exceed 5 μ Gy (equivalent to 5 μ Sv)³. In another study by Saini et al⁵¹, they found the average registered dose in the gonadal region around 0.8mrad (8 μ Sv) for 20 consequent intraoral exposures and 0.21mrad (2.1 μ Sv) for panoramic exposures⁵¹.

Moreover, lead aprons do not provide protection from scattered radiation internally within the body. In cases of panoramic radiography, they may physically interfere with the procedure and degrade the final image³⁶. However leaded apron is necessary for any adult who provides assistance by supporting the patient and will be in the same room as the patient during the procedure.

Thyroid Collar

Thyroid collar is recommended for children and pregnant patients^{16,27} because the thyroid gland is particularly radiosensitive and occasionally is in the way of the primary beam. Interestingly studies have shown that rectangular collimation for intraoral radiography offers similar level of thyroid protection to leaded shielding, in addition to its dose reducing effects^{32,36}. Thyroid shielding is inappropriate for panoramic radiography as it may interfere with the primary beam. In cephalometric radiography, lead thyroid protection is necessary if the beam collimation does not exclude the thyroid gland⁵². Guidelines from the Ministry of Health Malaysia⁴⁷ state that thyroid collars to be used where the thyroid may be in the primary beam. This may be in vertex occlusal view which is very rarely taken nowadays.

Staff protection

National Council for Radiographic Protection¹⁶ in US has specified the mean dose received by dental workers as 0.2mSv per year. In UK, National Radiographical Protection Board² estimates the mean dose of 0.1mSv per year. International Council on Radiographic Protection has set the effective dose to be no more than 100 mSv in any consequent 5 years with a maximum of 50mSv in any year⁴⁸. These figures are way above the mean dose in a typical dental practice. Therefore staff monitoring by personal dosimeter is not required unless the risk assessment indicates that individual doses are likely to exceed 1mSv per year (workload above 100 intraoral or 50 panoramic per week).

Medical examination for dental practitioners

According to the Atomic Licensing Act 1984⁵³ the dental practitioner who operates the X-ray machine is required to undergo a complete medical examination before using the radiography machine. This examination which includes a chest radiograph, needs to be repeated every 3 years until the dentist retires or if there is any abnormalities detected⁵⁴. We could not find any evidence to support this practice. As mentioned before, the radiation dosage from dental X-ray is very low and the medical practitioner would not be able to detect any abnormality during this examination. Therefore this additional irradiation on the dental surgeon is indeed unnecessary.

CONCLUSION

Exposure to any form of ionizing radiation can be dangerous to health and this includes dental radiography. Fortunately the relative risks associated with dentistry are very low. If the recommended guidelines are followed, our exposure to radiation can be minimized and traditional protection like the lead lined rooms and lead aprons can be abandoned. This is however dependent on the policy makers at the Ministry of Health.

Summary of the new recommendations that are proposed:

- Rectangular collimation.
- F speed film / Digital Systems
- Rare earth intensifying screen for extraoral films with film speed of more than 400 (Image speed system).
- 'DC' constant potential X-ray machines.
- Long open ended cone (at least more than 200 mm skin to source distance)
- 60 to 70 Kvp for intraoral radiographs.
- Use of paralleling technique with film holder for intraoral radiographs.

Disclaimer: Practitioners are advised to follow the current regulations set by the Ministry of Health regarding the use of dental radiography machines until if there are any changes. The above report is merely for updating knowledge regarding radiation reduction and protection procedures for both the patient, staff/dental surgery assistants and the dental surgeon without compromising the diagnostic quality of radiographs.

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Posterior Teeth Mesialization With Mini-implants In An Oligodontia Patient

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SUMMARY

A case report of a 16 year old male oligodontia patient who presented with a Class I malocclusion on a skeletal I base. He had multiple missing teeth of upper lateral incisors and all premolars except for lower right first premolar. Treatment involved fixed appliance with the aid of mini-implants to mesialize posterior teeth in order to reduce the number of prosthodontic replacement of the remaining missing teeth planned for the future. The application of the mini-implants in the sequence of treatment is presented.

Key words

orthodontic mini-implant, mesialize posterior teeth, oligodontia

INTRODUCTION

Definition

Hypodontia is a developmental absence of only a few teeth, while oligodontia denotes congenital absence of many teeth¹. It is the most common craniofacial malformation². If six or more permanent teeth are missing, the term oligodontia is used³.

Prevalence and Etiology

Hypodontia involving four or more congenitally missing permanent teeth excluding third molars is relatively less common than that involving less number of teeth and reported to have a prevalence of 0.08 – 0.5%^{4,5,6,7}, and this has been found to be usually associated with some general systemic condition. The prevalence of hypodontia in the permanent dentition among a Chinese population has been reported to be 6.9%, frequently involving the lower incisor, representing 60% of all missing teeth, followed by maxillary second premolars at 10% and maxillary lateral incisors at 8%⁸. The etiology is broad and includes environmental factors such as infection⁹,

trauma, drugs, chemotherapy or radiotherapy at young age¹⁰, genetic factors^{11,12} and associated with conditions such as ectodermal dysplasia, cleft lip and palate, Down's syndrome and hemifacial microsomia¹³.

Features and Presenting Problems

Malocclusions related to absence of teeth are common, such as rotations, tilting, drifting and spaces. Microdontia is a frequent association, significantly in hypodontia involving six or more congenitally missing teeth^{14,15}. Other dental anomalies are transposition of permanent teeth¹⁶, impaction of permanent teeth^{17,18}, taurodontism¹⁹ and ankylosis²⁰. A significant retroclination of incisors and an increased interincisal angle were also observed with increasing severity of hypodontia²¹. Some studies have reported flat or concave facial profile, obtuse naso-labial angle, retrognathic maxilla, reduced anterior face height and mandibular plane angle in severe hypodontia with absence of six or more teeth^{4,22,23}.

Conventional Treatment Options

1. Space Closure

Space closure enhanced by correct timing of extraction of the retained deciduous teeth to facilitate bodily movement of the still developing permanent teeth has been advocated as one measure^{24,25}. Mesialization of posterior teeth forwards to close the edentulous space, either with conventional orthodontics, reverse headgear or with the help of mini-implants, such as the micro/miniscrew, onplant and mini-plates.

2. Orthodontic Space Redistribution for Prosthetic Replacement

In some hypodontia cases, orthodontic space redistribution is needed to facilitate prosthetic replacement. Orthodontic uprighting of mesially tilted molar is not uncommon to make it a more favourable abutment for prosthesis²⁶. Restoration of edentulous spaces can then be carried out with prosthesis such as dental implants and dentures.

3. Autotransplantation

Factors ensuring successful transplantation of teeth are the need for open apex to allow revascularization of the pulp and sufficient root length to allow continue development of the root²⁷, status of root development^{28,29,30} and atraumatic surgical procedure³¹.

4. Restorative treatment

Composite build up or veneers can address tooth-size discrepancy commonly associated with hypodontia³².

The following case report describes the use of orthodontic mini-implants to mesialize posterior teeth in order to reduce the number of prosthodontic replacement in the treatment of a patient with oligodontia where he had missing upper laterals and all premolars except for lower right first premolar.

DIAGNOSIS

A 15 year 7 month Chinese boy sought treatment for the gaps in his upper front teeth (Fig 1). He had convex lateral profile with a retrusive mandible (Fig 2). Permanent teeth that were not present in the mouth were #18, #15, #14, #12, #22, #24, #25, #28, #34, #35, #38, #45 and #48. Those present were as follows:

7	6	3	1	1	3	6	7			
7	6	4	3	2	1	1	2	3	6	7



Fig 1 Pre-treatment intra-oral views



Fig 2 Pre- and post- treatment lateral profiles

Teeth present includes #55, #64, #65, #75 and #85 and some were restored (Fig 3). The missing teeth had resulted in generalized spacing in both arches. Overjet was 3.5mm (Fig 4), overbite 2.5mm, left molars in Class I and right in 1/2 unit Class II relationship (Fig 5). Mandibular midline was shifted 3 mm left. Upper canines were unusually conical shaped, short and narrow (Fig 6). Upper central incisors were short, squarish and straight-sided. Dental panoramic tomogram showed presence of unerupted #28 and #38, bringing to a total of 11 missing teeth (Fig 7). Cephalometric analysis suggested a retrognathic maxilla and mandible (Table 1). The ANB angle suggested a skeletal Class I relationship. Anterior face height was proportionate and the upper incisors were retroclined



Fig 3 Pre-treatment orthopantomogram

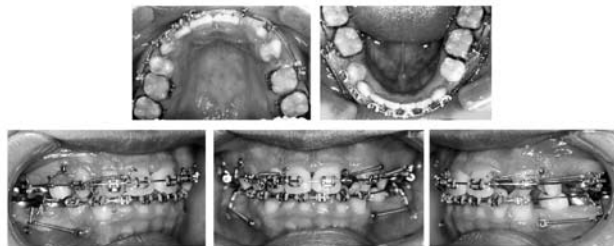
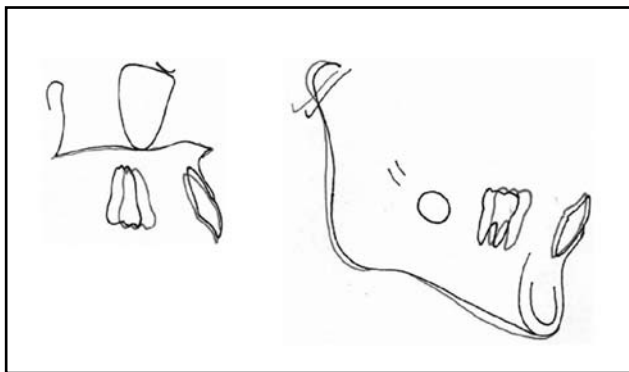


Fig 4 Treatment progress records taken on Jan 2005



Fig 5 Post-treatment intra-oral views



Pre-treatment _____

Post-treatment _____

Fig 6 Maxillary and mandibular superimposition of pre- and post-treatment cephalometric radiographs registered on the anterior border of zygomatic process superimposition and Björk's stable mandibular structures respectively

VARIABLE	PRETREATMENT	POSTTREATMENT	NORMAL
SNA	74.2°	76.4°	82° ± 3.5
SNB	71.1°	74.2°	79° ± 3.0
ANB	3.1°	2.3°	3.0° ± 2.0
Wits appraisal	0.0 mm	-2.7 mm	-4.5 mm ± 3.0
Upper incisor to maxillary plane angle	111°	110.7°	118° ± 6
Lower incisor to mandibular plane angle	95°	95.2°	97° ± 7
Interincisal angle	129.6°	128.9°	115° ± 8
Maxillary mandibular planes angle	24.4°	25.4°	26° ± 5
Upper anterior face height	64.8 mm	64.9 mm	54.0 mm
Lower anterior face height	78.4 mm	81.0 mm	64.0 mm
Face height ratio	55%	56%	55%
Lower incisor to APo line	5.4 mm	4.4 mm	5.5 mm ± 2.5
Lower lip to Ricketts E Plane	1.9 mm	0.7 mm	4.0 mm ± 2.5

Source of normal values for Chinese: Cooke (1987) Cooke (1986)

Table 1: Pre- and post- treatment cephalometric analysis

PROBLEM LIST

1. Oligodontia with missing upper laterals, all premolars except lower right first premolar and right third molars.
2. Spacing of upper and lower arches.
3. Lower midline shifted left.
4. Upper centrals and lower incisors were short and straight-sided, and upper canines were short, conical and narrow.

TREATMENT AIMS/OBJECTIVES

1. Redistribute permanent teeth
2. Utilise and eliminate residual spaces
3. Reduce the number of prosthodontic replacement for missing teeth
4. Resize deciduous teeth in preparation for future prosthodontic replacement
5. Maintain bone volume and space for prosthodontic replacement by delaying removal of remaining deciduous teeth till appropriate maturity age
6. Correct midline discrepancy
7. Improve dental aesthetics especially of anterior teeth
8. Retention with intermediate term replacement of missing teeth

RATIONALE FOR TREATMENT

Autotransplantation was discarded after consultation with oral surgeons because of the immature root formation of the third molars. As the patient's incisors were upright, there were too few teeth remaining and his unfavourable profile, mini-implant was used for added anchorage to mesialize all first and second molars by one premolar space. This allowed for the number of prosthetic replacements to be reduced from nine to five involving upper lateral incisors, upper first premolars and lower left premolar. Retention was planned with a retainer incorporating

passive anterior bite plane in order to maintain vertical space required for future prosthodontic replacements. Removal of the remaining deciduous teeth was to be postponed until patient is ready for more permanent prosthodontic replacements. Resizing of deciduous teeth was planned together with the prosthodontists in order to maintain optimum space for a normal-sized permanent replacement in future. Hygienist referral was done for maintenance of oral hygiene, prosthodontist for temporary composite build-up of upper canines during treatment, assessment of space required interocclusally and mesio-distally for prosthodontic replacement of missing teeth and periodontist for possibility of crown lengthening procedure on short clinical crowns.

TREATMENT PROGRESS

Treatment started at 15 year 9 month and ended 18 years of age. Orthodontic treatment started with referral to the oral surgeon for removal of #85, placement of fixed appliances with initial levelling and alignment wires.

Prior to placement of AbsoAnchor® mini-implants, all repositioning of permanent teeth are done on 017" x 025" SS. Gradual stripping of deciduous teeth to resize to permanent replacement and to allow mesialization of posterior teeth was carried out (Fig 8). 1.4mm x 8mm and 1.5mm x 6mm mini-implants were first placed by the orthodontist in the first and fourth quadrants respectively, distal to permanent canines. Location was determined with the help of periapical radiographs and with consideration of amount of movement required. Mesialization of #13 and #46 was done immediately using the mini-implant with aid of extended steel hooks on 019" x 025" SS with the aid of extended steel hooks on molar bands (Fig 9). After placement of mini-implants on the second and third quadrants, mesialization of posterior teeth was commenced on the related quadrants, in conjunction with gradual stripping of deciduous teeth (Fig 10).

COMPLICATIONS ENCOUNTERED DURING TREATMENT

Overall, the patient was compliant with oral hygiene and tolerant with all aspects of treatment. Anchorage control after placement of the mini-screws was better and treatment progressed much faster and more predictably. However, two out of the four mini-implants loosened and dislodged midway of treatment and had to be replaced. During movement of upper right canine mesially, frequent dislodgement of the bracket on lower right first premolar occurred due to the biting of the upper canine, and it was decided to rebracket it after the upper canine has been mesialized.

TREATMENT RESULTS

Post-treatment record shows that lateral profile has been maintained with no overt flattening (Fig 11). Extra-oral appearance is pleasing and the smile greatly improved

with redistribution of teeth and acrylic teeth replacement of upper lateral incisors. Class I molar relationship was achieved (Fig 12). Post-treatment overjet and overbite are within normal limits. Overbite stability is good as long as patient wear upper removable retainer. Dental midlines coincide with facial midline. Composite build-up of upper canines and central incisors has been placed as intermediate plan prior to definitive prosthodontic treatment.

Lateral cephalogram analysis showed slight retroclination of upper and small retraction of lower incisors and lips (Table 2). Individual superimposition on maxilla (Fig 13) and mandible (Fig 14) showed molar mesialization. Panoramic radiographs reveal adequate root parallelism except for #44, with some blunting of lower right first molar root tips (Fig 15). Bodily mesialization of first permanent had been successfully carried out. Roots adjacent to planned future implants have been positioned with sufficient bone space vertically and mesio-distally. The position of the developing #28 and #38 needs to be reviewed. Although interincisal angle was reduced from pre-treatment value, post-treatment angle is still more than the norms, therefore long-term retention of overbite involving a removable retainer with anterior bite plate was planned.

DISCUSSION

The pattern of oligodontia presented by this case report conforms to the findings in a study conducted on the pattern of severe hypodontia affecting at least 5 teeth excluding the third molars where it was reported to be affecting mainly maxillary lateral incisors (16%), followed by mandibular second premolar (11%), mandibular central incisor and maxillary second premolar (10% each)³³.

Different methods of mesialization

Mesialization of posterior teeth by means of conventional orthodontics to close spaces often tax the anchorage from remaining teeth and unwanted tooth movement can still happen, therefore in hypodontia patients with an already retrusive profile as in this patient, conventional orthodontic space closure would be detrimental to the facial profile^{34,35}. Therefore various other types of posterior teeth mesialization have been advocated, such as extra-oral traction with chin cup³⁵ and gradual self-mesialization via hemisection³⁴. Reverse headgear was also one of the ways recommended to provide anchorage for moving upper posterior teeth forward to close the edentulous space or to advance the hypoplastic maxilla in hypodontia patients^{36,37}, however this method requires a higher level of patient's co-operation.

The introduction of "absolute" anchorage system helps reduce anchorage control problem and thus have been documented for this purpose^{35,38,39,40}. Sliding jigs were applied on the buccal for distalization of the lower posterior teeth⁴¹. Costa et al.⁴² placed screws in the mandible for mesial movement of the molars. Loading protocols for screws involve immediate loading or a waiting period of 2 weeks to apply forces⁴³ and only a short waiting period was required before loading^{44,45}. This advantage reduces the

treatment period and, thus, increases patient acceptability.

Success rate

Bernhart et al.⁴⁶ placed 21 mini-implants on the paramedian region of the palate for protraction of posterior teeth, among various other purposes and presented an 86% success rate after 11.6 months of use.

CONCLUSIONS

As a conclusion, mesialization of posterior teeth with mini-implants is a worthwhile treatment option especially in a severe hypodontia patient in order to reduce cost of prosthodontic replacement without overt flattening of patient's profile.

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The Reliability Of Bitemark Evidence: Analysis And Recommendations In The Context Of Malaysian Criminal Justice System

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ABSTRACT

Forensic odontological examination of a disputed bitemark can furnish the police and the prosecutor with useful evidence to either implicate or exonerate a person in relation to a crime, on the basis that each person's bitemark is as distinctive as his or her dentition. The aims of this article are (a) to evaluate the extent of which bitemark evidence is reliable as a proof of identification of a biter for the purposes of criminal investigation and prosecution in Malaysia and (b) to make the necessary recommendations (if any) for the purpose of improving the reliability of such evidence. Where a questioned bitemark is not sufficiently detailed, any findings made from its examination shall be highly unreliable and prejudicial. On the other hand, where a bitemark is sufficiently detailed, then any findings made from its examination may be reliable, provided that the forensic odontologists and other practitioners in the criminal justice system are professionally trained to handle the said bitemark. Therefore, police officers must be given a basic training in the field of forensic odontology so that they will be able to appreciate the evidential value of bitemark and contribute to the development of bitemark cases in Malaysia. The relevant authorities governing the dental practice in Malaysia should standardize the methodology and terminology used in bitemark examination and in the reporting of its findings so that confusion and inconsistency among the forensic odontologists are kept absolutely low. Finally, forensic odontologists must be given specialized training in bitemark examination so that the probative value of their findings can be improved.

INTRODUCTION

The American Board of Forensic Odontology (ABFO) defines a bitemark as (i) a representative pattern left in an object or tissue by the dental structures of an animal or human and (ii) a physical alteration in a medium caused by the contact of teeth.¹ MacDonald propounded that any mark produced by teeth, in combination with other oral parts like the lips and tongue, also falls within the definition of a bitemark.² However, in this article, the word "bitemark" shall be understood as a representative pattern produced by the anterior teeth of a human biter on the surface of any bitten substance, and the meaning of the word "bitemarks" shall be construed accordingly.

At the scene of a crime, bitemarks are usually found on the body of physically-abused or sexually-assaulted victims, on any unfinished food like cheese, apple or discarded chewing gums, or on any other inanimate objects like pencil or duct tapes.^{3,4} In some cases, bitemarks can also be inflicted by a victim on the assailant's body in self-defence. Moreover, some bitemarks may be self-inflicted, especially in those cases where there are false allegations

of rape or abuse, while others may be inflicted as a result of mutual consent between the parties.⁵

The forensic value of bitemarks is that they can be used either to implicate or to exonerate a person, in relation to a crime.⁶ This is possible based on the postulates that dental characteristics of the anterior teeth are distinctive among the individuals and this asserted distinctiveness can be transferred and recorded in the form of a bitemark⁷ (Figs. 1 and 2). In short, a bitemark is the mirror-image of the dentition of a biter and it follows that where a disputed bitemark matches (or does not match) with the dental features of a person, then that person, within the reasonable medical/dental certainty, is (or is not) the biter. For this reason, it is often stated that a person may lie through his teeth but the teeth themselves do not lie.⁷

Be that as it may, the reliability of bitemark evidence as a proof of identification of a biter (where the identity of the said biter is both relevant and in contention) has to be established in the court of law before such evidence can be relied upon. Justice Paul (as his Lordship then was) stated that trial judges must warn themselves as to the dangers of convicting accused persons based on any evidence, where

the reliability of that evidence is disputed.⁸ The duty on the trial judges to warn as such was first propounded in the English case of Regina v Turnbull (the facts of this case are irrelevant), where Lord Widgery in that case held that any failure on the part of a trial judge to do so is likely to result in a conviction (if any) being quashed.⁹

The aims of this article are (a) to evaluate the extent of which bitemark evidence is reliable as a proof of identification of a biter for the purposes of criminal investigation and prosecution in Malaysia and (b) to make the necessary recommendations (if any) for the purpose of improving the reliability of such evidence.

It is important to note that this method of identification is still in the stage of infancy in Malaysia (and many other countries, for the matter).⁴ Therefore, in this article, reference shall be made to selected decisions of the courts in foreign jurisdictions and also to journal articles published in overseas.

Figure 1: A photograph (horizontally flipped) showing, inter alia, that the distal margin of the right maxillary central incisor has a labial rotation. This characteristic, in combination with other dental characteristics, creates distinctiveness in the dentition of this volunteer.

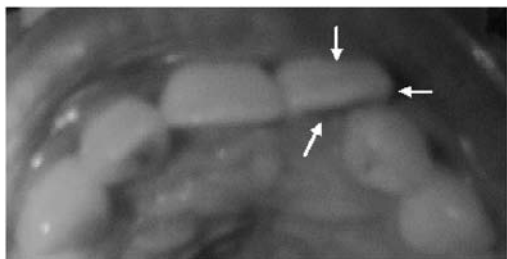
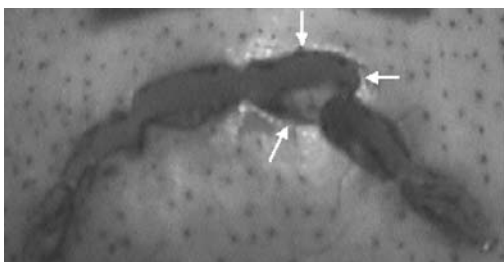


Figure 2: A photograph showing a partial bitemark on a fruit substance which exhibits the distinctive characteristics of the dentition of the volunteer, mentioned in Figure 1.



CASE STUDIES

CASE 1: Theodore Bundy

On 15 January 1978, two university students, Lisa Levy, and her roommate, Martha Bowman, became the latest victims of a notorious serial-killer in Florida, United States (US).^{10,11} Levy was raped and struck on the head with a blunt object while Bowman was strangled with a pair of pantyhose. The police found few print smudges and sperm samples but they later turned out to be inconclusive.

There was also an odd bitemark on Levy's left buttock and the investigating officer took its photograph for further analysis (Fig. 3). The suspect, Theodore Bundy, who had been seen fleeing the crime-scene area under suspicious circumstances by an eye-witness, was later arrested by the police. His dentition was examined by a forensic odontologist, Dr. Richard Souviron, who then traced Bundy's dental impression onto a transparent sheet and laid it over the real-size photograph of the bitemark. At the trial, Dr. Souviron testified that the indentation of the bitemark was unique and showed how it matches with Bundy's dental impression (Fig. 4). At the end of the trial, the jury found Bundy guilty as charged and accordingly, the trial judge sentenced him to death. This was the first case in Florida's legal history that relied heavily on bitemark evidence.^{10,11}

Figure 3: A photograph showing an odd bitemark on the rape and murder victim's left buttock. © Dr. Michael Bowers, <http://forensic.to/webhome/bitemarks1>. (Used by permission)

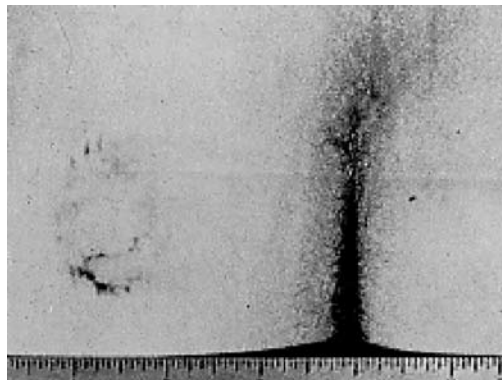
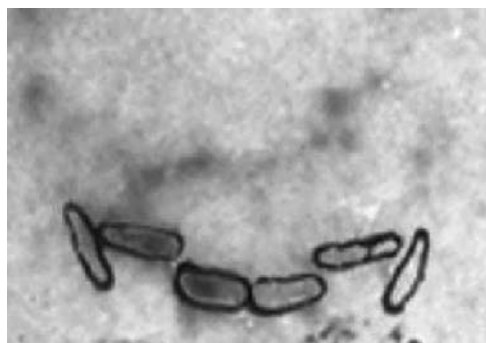


Figure 4: A photograph showing how the unique indentation of the bitemark on the victim's buttock matched with the accused's dental impression. © Dr. Michael Bowers, <http://forensic.to/webhome/bitemarks1>. (Used by permission)



CASE 2: Ray Krone

On 29 December 1991, a cocktail waitress, Kim Ancona, was found dead in the men's restroom at a lounge in Phoenix, US.¹²⁻¹⁴ A post-mortem examination of the body revealed that she had been stabbed 11 times and her left breast had been bitten through the tank-top that she was wearing at that time. There were neither fingerprints nor semen found on her. The police immediately arrested Ray Krone, a former US Air Force mailman, based on the facts that he had been a regular customer at the lounge where Ancona was working and had known her personally. From the day of his arrest, however, Krone maintained his innocence. The only proof against him was the evidence of a forensic odontologist, Dr. Raymond Rawson, who testified that the bitemark on the victim's breast matched with Krone's dentition (Fig. 5). The jury was convinced with the testimony of Dr. Rawson and found Krone guilty of first degree murder. The trial court sentenced him to death but due to some other legal reasons, the conviction was regarded as unsafe and a re-trial was ordered. Two years after waiting on the death row, Krone was again found guilty at the re-trial but the sentence was reduced to life imprisonment. Eight years later, a permission to conduct a DNA (deoxyribonucleic acid) test on the saliva deposited on Ancona's tank-top was granted. Shockingly, the test revealed that Krone was not the attacker. After spending a total of 10 years in jail, Krone was finally acquitted. Maricopa County Attorney, Rick Romley, made a public apology to Krone and the US government pledged to compensate him for his losses.¹²⁻¹⁴

Figure 5: A photograph showing how the forensic odontologist in this case found a positive match between the disputed bitemark and the dental features of the accused. © Dr. Michael Bowers, <http://forensic.to/webhome/bitemarks1>. (Used by permission)

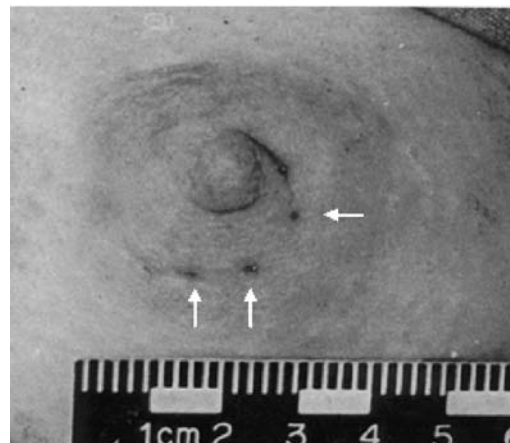


CASE 3: Fredrik Torgersen

In 1957, a 16-year old girl was sexually harassed and murdered in Norway.¹⁵⁻¹⁷ During the postmortem examination, an injury consistent with a partial human bitemark was discovered below her left nipple (Fig. 6). The police arrested Fredrik Torgersen near the crime scene area, based on his previous criminal records which include a conviction for the offence of attempted rape. Forensic odontologist, Dr. Ferdinand Strøm, then compared the bitemark with Torgersen's dentition and concluded that it is highly likely that Torgersen had produced the bitemark.

Being unhappy with that conclusion, Torgersen demanded that the bitemark and his dentition should be re-examined by another expert and Professor Dr. Jens Wærhaug was then called for such purpose. Without consulting Dr. Strøm or referring to his findings, Professor Dr. Wærhaug reached to a similar conclusion. Torgersen was subsequently charged at the Norwegian Crown Court in 1958, where at the end of the trial, he was found guilty and sentenced to prison. Norwegian Supreme Court dismissed his appeal but shortly before Torgersen's release from the prison in 1974, his application to re-open the case was allowed. The court then appointed another forensic odontologist, Professor Dr. Gisle Bang to shed some light on the matter under enquiry. He re-evaluated all the evidence and used modern comparison methods like the scanning electron microscopy and a stereometric plotting technique. Expectedly, his conclusion supported the earlier findings. However in 1998, Torgersen's private dentist reported that Torgersen could not have produced the bitemark and as a result, a further appeal to re-open the case was made. A year later, it was granted and two experts, Professor Dr. Gordon MacDonald and Dr. David Whittaker, were consulted. After evaluating all the evidence available, they concurred with the findings made by the three forensic odontologists earlier. Despite five leading experts' opinions against him, Torgersen still maintained that he is innocent.¹⁵⁻¹⁷ In 2001, Dr. Michael Bowers independently examined the evidence of this case and astonishingly, he found that Torgersen did not produce the disputed bitemark. He made the following submission: I exclude Mr. Torgersen as the creator of this bitemark. My opinion is that there is considerable forensic evidence that creates reasonable doubt that Mr. Torgersen created the bitemark on the deceased's body. The physical evidence I have seen does not convince me that the State's argument of a positive identification is correct. In fact, I conclude that the State's argument is an excellent example of a false positive identification.¹⁸

Figure 6: A photograph showing a partial bitemark below the left nipple of a murdered victim. © Dr. Michael Bowers, <http://forensic.to/webhome/bitemarks2/Image2.gif>. (Used by permission)



DISCUSSION

On one hand, bitemark evidence has brought about the conviction of the notorious serial killer, Theodore Bundy, but on the other hand, the same has condemned Ray Krone to prison for 10 years for the crime that he did not do. Also, Fredrik Torgersen's guilt is still doubtful despite the fact that he has served his sentence. So, is bitemark evidence reliable? In order to find the answer, the following points have to be evaluated first, namely, (i) the tenability of the postulates underpinning bitemark analysis and (ii) the efficiency of forensic odontologists in properly carrying out the said analysis.

The Postulates of Bitemark Analysis

As noted earlier, the use of bitemark evidence in implicating or exonerating a person in criminal cases, rests upon the postulates that the dental characteristics of the anterior teeth are distinctive among the individuals and this asserted distinctiveness can be transferred and recorded in the form of a bitemark.⁷

Sweet stated that the premise that human dentition is unique to each individual is widely accepted.¹⁹ In fact, 91% of the participating forensic odontologists in an online survey believed that human dentition is unique, 1% believed that it is not and remaining 8% were unsure.²⁰ Giannelli explained that there are 160 dental surfaces (32 teeth x 5 anatomic surfaces) in the dentition of an average adult human-being, which may contain identifying characteristics.²¹ He further explained that restorations may also offer numerous points of individuality, in addition to the number of teeth, prostheses, decay, malposition, malrotation, peculiar shapes, root canal therapy, bone patterns, bite relationship and oral pathology.²¹

On the practical basis, a significant number of dead bodies have been positively identified by means of teeth.⁴ Although the non-availability of the ante-mortem dental records for the purpose of comparing with the post-mortem dental findings can be a hindrance to the positive identification of a dead body, by and large, this method has been successful where others have either failed or not conveniently available.⁴ The International Criminal Police Organization (INTERPOL) stated that dental evidence is a particularly important and effective method of identification and can often be so accurate that it will positively identify an individual by itself.²²

Rawson et al, in 1984, examined 397 bitemarks produced on wax and applied a statistical probability theory to the results.²³ In confirming that human dentitions are unique among individuals, they claimed that the probability of finding two sets of dentition with all six front teeth of the same jaw in the same position is 1.4×10^{13} .²³ The authors further stated that a match at five teeth on a bitemark would be sufficient evidence to positively identify an individual as the biter to the exclusion of all others.²³ Pretty argued that although this study determined that a human dentition is unique, the conclusion is often wrongly extended to incorporate the uniqueness of

bitemarks.²⁴ Such extension begs the question because it assumes something crucial that is a matter of contention.

Logically, before a bitemark can be said to exhibit all the unique characteristics of a biter's dentition, there are conditions that need to be fulfilled. Firstly, the substance on which a bitemark is produced must be capable of registering and retaining the bitemark in its original size and shape. Secondly, distortions, which can alter the original size and shape of a bitemark, must never occur, either during or after the biting process.^{24,25} Unless these two conditions are fulfilled, a bitemark produced by a person cannot be regarded as distinctive as the dentition of that person.

Nature of the Substance

A number of studies were conducted to show how the accuracy of forensic odontologists varies when bitemarks were produced on different substances. Firstly, Whittaker conducted a study in 1975 where two examiners were asked to compare directly the dental casts of the volunteers with the bitemarks they had produced on the wax and pig-skin.²⁶ The examiners were 98.8% accurate when they examined the bitemarks produced on the wax but only 63.7% accurate when they examined those produced on the pig-skin.²⁶ Secondly, the American Board of Forensic Odontology conducted a workshop in 1999 where its members were asked to match four bitemarks produced on pig skin to seven dental models. The accuracy of the members in correctly matching them was only 36.5%.²⁷

Finally, in 2005, a bitemark study was conducted in India where 100 volunteers were randomly chosen and divided equally into four groups.²⁸ The volunteers were required to produce a bitemark on the substance provided to them, according to their groups. The bitemark samples were collected and then compared with their dental casts. The results showed that, inter alia, the accuracy of the forensic odontologists was only 60% when they examined the bitemarks inflicted on the skin whereas their accuracy was incredibly 100% when they examined those on the clay-wax.²⁸

All the above studies confirmed that the accuracy of the forensic odontologists deteriorates whenever they are asked to examine bitemarks produced on the skin substance. The skin, unlike the clay-wax, is a poor substance on which bitemarks can be accurately registered.²⁹

Pretty commented as follows:

Wax is an excellent material for bite registrations; indeed it is used clinically for this very purpose. However, it is very dissimilar to skin, which can be regarded as a poor registration material. This is endorsed by the results from pig skin study which resulted in a dramatic drop in accuracy.²⁵

It should be highlighted that even the recorded lower rate of accuracy scored by the forensic odontologists when examining the bitemarks produced on the skin substance is, in actuality, an overstatement since bitemarks produced for experimental purposes normally are of good quality and examined immediately after they have been inflicted, compared to those found in real cases.

Occurrence of Distortions

There are two kinds of distortion, namely, (i) that occurs during the biting process (primary distortion) and (ii) that occurs after that (secondary distortion).³⁰

Due to the fact that bitemarks in criminal cases mostly are the by-products of violent acts, especially when they are inflicted on human skin, primary distortion may occur. The skin is highly variable in terms of anatomical location, underlying musculature, fat, curvature and looseness or adherence to underlying tissues³¹ and further it is also highly visco-elastic, which allows stretching to occur during the biting process.³⁰ Primary distortions may also occur for other reasons, like the area bitten, the way the biting was done, the force used and the health of the victim. For that reason, it is possible that a same biter may leave marks of differing appearance on the same victim.³⁰

Secondary distortions may occur naturally, for example, due to the self-healing process in a living person and postmortem changes in a dead one, or unnaturally, when a victim seeks medical treatment.³⁰ In 1974, Bioengineering Unit of the University of Strathclyde conducted a research to examine the features of a biting process that are likely to impact upon the appearance of bitemarks on human skin. The authors concluded that the changes in bitemark appearance are likely to be greater as the injury grows older.²⁹ Whittaker found in his study that the accuracy of the forensic odontologists had dropped to a mere 16% when they compared the dental casts of the putative biters with the photographs of the bitemarks on the pig skin, which were taken after a 24-hour period.²⁶ Secondary distortions also occur due to the changes in the position of a body while examining a bitemark³² (thus a round bitemark may become oval) and wrong camera angulations or lighting while taking the photographs.³³

Conclusion

Even if it is assumed that each man has a distinctive dentition, it cannot be so assumed that it will produce an equally distinctive bitemark, especially when it is made on skin. The reason is that skin, unlike clay-wax, is not a substance which is capable of registering and retaining bitemark in its original size and shape. Moreover, distortions to a bitemark may occur during or after the biting process. Since there are many other factors that can shape the characteristics of a bitemark and not just the dentition of a biter, a bitemark produced on human skin may not be as distinctive as the dentition of the biter. Wilkinson and Gerugthy have put it rather crudely as follows:

There is no documented scientific data to support the hypothesis that a latent bitemark, like a latent fingerprint, is a true and accurate reflection of this uniqueness. To the contrary, what little scientific evidence that does exist clearly supports the conclusion that crime-related bite marks are grossly distorted, inaccurate and therefore unreliable as a method of identification.³⁴

The Efficiency of Forensic Odontologists

Detailed, step-by-step procedures that are involved in a

bitemark examination fall outside the limited scope of this article. It is sufficient to mention that ordinarily, the said examination involves three stages, namely, (i) registration of a disputed bitemark and a putative biter's dentition, (ii) comparison of the bitemark and the dentition, and (iii) evaluation of the points of similarity or dissimilarity between them.¹⁹ The contentious issue is that although the experts based their conclusions on objective data, their opinions are essentially subjective ones.^{35,36}

Giannelli wrote that there is no accepted minimum (or maximum) number of points of similarity required for a positive identification and the experts who have testified in bitemark cases in US have used as low as eight points to as high as 52 points.^{21,37-39} Like firearms identification, bitemark identification is based on the examiner's experience and expertise.²¹ In Malaysia, the relevancy of scientific evidence (which is a condition precedent to the admissibility of that evidence in the court of law) is based on the expertise of the testifying witness in that science.⁴⁰ It is this factor that often results in disagreements among bitemark experts. For example, in the case of *People v Smith*, four experts for the prosecution testified that the mark on a murder victim's body is a bitemark and it had been produced by the accused person, whereas three experts for the defence testified that it is not at all a bitemark!⁴¹ The conflict of opinions as such can easily give rise to doubts and may be sufficient to show that bitemark evidence is unreliable.⁴²

PROBLEMS AND RECOMMENDATIONS

Sensibly, nothing can be done to improve the nature of the skin or to control the amount of distortions that may occur during a biting process. Hence, if a questioned bitemark is not sufficiently detailed, then any findings made from its examination shall be highly unreliable and prejudicial. On the other hand, where a bitemark is sufficiently detailed, then any findings made from its examination may be reliable, provided that the forensic odontologists and other practitioners in the criminal justice system are professionally trained. In this section, selected problems faced by them shall be discussed, followed by the proposed recommendations.

Problems

Firstly, the investigating officers seldom give sufficient importance to bitemarks when collecting evidence. In one local case, a 22-year old Indonesian student succumbed to her injuries few days after she had been raped and pushed from the balcony of her apartment by a serial rapist.⁴³ During the postmortem examination at the University of Malaya Medical Centre, an oval-shaped injury pattern was discovered on her left breast. In his examination report, Professor Dr. Phrabhakaran Nambiar made the following comments:

The almost oval-shaped contusion on the upper outer quadrant of the left breast was consistent with an adult human bite. However, as the site of injury was turning

greenish-yellow in colour, it implied that there was a time lapsed between the infliction of injury and the examination. The delay in carrying out examination has contributed to the inability of arriving at a firm decision. An early examination, to a great extent would have overcome some of these problems, so that a definite conclusion could have arrived at.⁴³

Secondly, in Malaysia, there is no standardization of the methodology employed in a bitemark examination or of the terminology used in the reporting of bitemark evidence. Ultimately, which methodology or terminology is used, it depends on the experience of the forensic odontologist who carries out the examination, the policy of the institution in which he is employed, the needs of the case under enquiry and the availability of the equipments and materials.

Thirdly, no proper training in the field of forensic odontology is provided to dental students or practitioners in this country. Although there is no law in Malaysia which specifies the minimum qualification or experience required on the part of dental practitioners before they can conduct bitemark examinations or give evidence in court, the need for such training is paramount. The reason is that any lacking or insufficiency of such qualification or experience on their part may nevertheless affect the weight or probative value of their conclusion.⁴⁴ It should be borne in mind that evidence with low probative value may not be sufficient to discharge the prosecution's legal burden, which may result in the acquittal of a culpable person. This is because the law compulsorily requires the trial court to record an order to that effect if it finds that the prosecution has not proved beyond reasonable doubt all the ingredients of the offence with which such person is charged, including his identity.^{45,46} Ignorance of this point will only lead to disappointment, not to mention lost of time, energy and money.

Recommendations

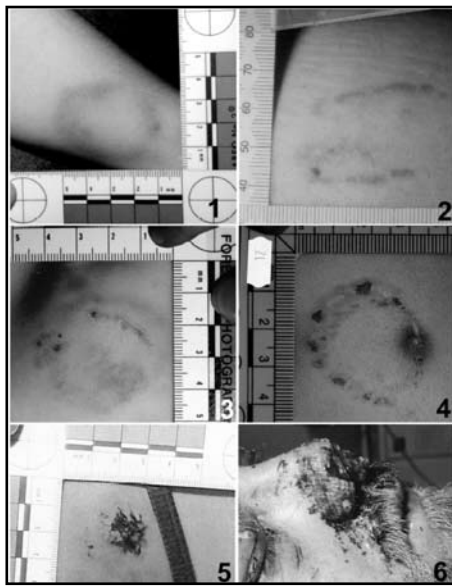
Firstly, all police officers from the criminal investigation department must be given a basic training in forensic odontology so that they can at least understand the nature and evidential value of a pattern which is consistent with a human bitemark and cause it to be examined by a forensic odontologist, as soon as possible. Pretty has created an index which shows the relationship between each level of bitemark severity and its corresponding evidential value (Figs. 7 and 8). According to this index, the evidential value of a bitemark first increases with the severity of its injury and then decreases.⁴⁷ Hence, bitemarks falling into levels 3 and 4 are said to carry high evidential value and may be reliable but those falling into other levels are not. As noted in the local case above, the failure on the part of the police in recognizing the nature and evidential value of a bitemark has rendered it forensically useless.⁴³ Comparatively, the bitemark evidence, which was successfully used in convicting Theodore Bundy, was available at the prosecution's disposal only because the investigating officer in that case had wisely taken the

photograph of the disputed bitemark at the crime-scene, with a ruler placed near it.^{10,11}

Figure 7: A table showing the relationship between each level of bitemark severity and its corresponding forensic significance. © Dr. Iain Pretty, http://www.forensicdentistryonline.org/bitemark_index.pdf. (Used by permission)

Level	Severity	Significance
1	Very mild bruising, no individual tooth marks present, diffuse arches visible, may be caused by something other than teeth	Low
2	Obvious bruising with individual, discrete areas associated with teeth, skin remains intact	Moderate
3	Very obvious bruising with small lacerations associated with teeth on the most severe aspects of the injury, likely to be assessed as definite bitemark	High
4	Numerous areas of laceration, with some bruising, some areas of the wound may be incised. Unlikely to be confused with any other injury mechanism	High
5	Partial avulsion of tissue, some lacerations present indicating teeth as the probable cause of the injury	Moderate
6	Complete avulsion of tissue, possibly some scalloping of the injury margins suggested that teeth may have been responsible for the injury. May not be an obvious bite injury	Low

Figure 8: Photographs showing the severity of each level of bitemark. © Dr. Iain Pretty, http://www.forensicdentistryonline.org/bitemark_index.pdf. (Used by permission)



Another reason the police should cause bitemarks to be so examined, regardless of the availability of other evidence, is that such examination will promote the development of bitemark cases in Malaysia. Hitherto, there is no Malaysian case-law which reports that bitemark evidence was presented in court, let alone it was relied on as a basis of the finding of guilt or acquittal. The more bitemarks are examined, the more will be known about their reliability in proving the identity of a biter.

This is important so that in cases where only a bitemark is available, then the police, the prosecution, the defence counsels, the trial judge and even the public will be able to appreciate its evidential value. Interestingly, DNA analysis was practically unheard some 20 years ago but, because of the determination shown by the police and the forensic scientists in finding new ways to fight crimes and criminals, today it is an established investigative tool.⁴⁸

Secondly, the forensic odontologists must be careful when making any decision since once they write something in a report or say something under oath, they own that forever; good, bad or indifferent.⁴⁹ For that reason, in Malaysia, the methodology employed in a bitemark examination and the terminology used in the reporting of bitemark evidence should be standardized so that no matter where the bitemark is examined and by whom, the conclusion will be the same and the words contained therein will carry the same meaning. In US, the duty to ensure such uniformity is carried out by the ABFO, which regularly conducts workshops and issues guidelines and standards pertaining to the general practice of forensic odontology to ensure that one member's opinion is as good as the opinion of any other member.¹

However, given the fact that there are only a

handful of forensic odontologists in Malaysia, the prospect for the establishment of the Malaysian Board of Forensic Odontology may not be feasible, even in the near future.

The duty to ensure such professional uniformity should instead be placed on the shoulder of Malaysian Dental Association, Malaysian Dental Council, Ministry of Health or other relevant authorities regulating the practice of dentistry in Malaysia, in collaboration with the criminal justice agencies like the Royal Malaysia Police, Attorney General's Chamber, Malaysian Bar Council and Chemistry Department.

Thirdly, selected dental officers at the governmental hospitals in Malaysia should be given a formal training in the field of forensic odontology so that they are familiar with the roles and responsibilities of a forensic odontologist. A forensic odontologist is required, inter alia, to apply dental knowledge in identifying, weighing, collecting, preserving, examining, interpreting and reporting bitemark evidence.

More importantly (and without derogating from the generality of the foregoing), forensic odontologists must be trained to reach their conclusions independent of any other evidence. In short, they should not tailor-make their findings to corroborate other evidence or to support or oppose the police's case against a particular individual.¹⁷ Bang advised that forensic odontologists should start all investigations with an open mind and when they find evidence in disfavour of one person, they should not run away from the responsibility but express exactly their opinion.¹⁷ Similarly, Bowers contended that knowing a suspect was caught crawling through the window does not add any weight to otherwise non-probative bitemark evidence.⁵⁰ Put it eloquently, forensic scientists should not navigate scientific waters with an eye fixed solely on conclusions but must navigate with a critical eye focused firmly on the methods dictated by logic.⁴⁹

Furthermore, forensic odontologists must also be trained to give only scientific reasons to support their conclusions. Nordby explained that reasoned opinions developed from scientifically acceptable methods will avoid subjective, unsupported and untested hunches and guesses.⁴⁹ Likewise, Bowers contended that such opinions will boost the reliability of bitemark evidence and commented further as follows:

The interpretation of a bitemark case must be determined by methods that are reproducible and obvious. The "I can see it, you can't?" school of expertise will not lead us into the 21st century. Instead, it will spell the doom of this particular aspect of crime investigation. An opinion is worth nothing unless the supportive data is clearly describable and can be demonstrated in court.⁵⁰

For that reason, the law provides that where the opinion of an expert witness is relevant in a court proceeding, the grounds on which his opinion is based are equally relevant in that proceeding.⁵¹ The purpose is to give an opportunity to such witness to justify his or her opinion and in the event no such justification is given, that opinion shall be rejected by the court. In the case of *Sim Ah Song v Rex* (the facts of this case are irrelevant), Chief Justice Brown held as follows:

A bare expression of the expert's opinion has no evidential value at all. Unless he gives an explanation which supplies understanding of the subject which the court lacks, the court is in no better position than it was before.⁵²

A proper training will definitely produce far more competent dental practitioners who can contribute effectively in the field of forensic odontology.

Having discussed thus far, there is an important point that needs consideration. In any forensic investigations, it is not infrequent that the practitioners in the criminal justice system fail to appreciate the fact that the biological sciences (including dental science) cannot, in the present state of knowledge, be expected to deliver the exactitude of the mathematical sciences.⁵³ Furthermore, Pretty argued that it is healthy within any discipline that some contentious issues exist, since without an inquisitorial approach no science would advance.⁵⁴ Therefore, although the trainings should be aimed to improve the efficiency of the forensic odontologists in Malaysia and create a uniformity among them, bitemark evidence should not be rejected as unreliable on the sole ground that there are still disagreements among the experts.

CONCLUSION

The reliability of bitemark evidence depends on two factors, namely, (i) whether a disputed bitemark is sufficiently detailed and (ii) whether forensic odontologists and other practitioners in the criminal justice system are professionally trained to handle the said bitemark. Due to the hostile nature of the environment in which bitemarks are produced on human skin, such bitemarks may not be sufficiently detailed and any findings made from its examination shall be highly unreliable and prejudicial. However, if the disputed bitemarks are sufficiently detailed, then professionally trained forensic team can make all the difference between justice and injustice.

Therefore, selected police officers must be given a basic training in the field of forensic odontology so that they will be able to appreciate the evidential value of bitemark and contribute to the development of bitemark cases in Malaysia. The relevant authorities governing the dental practice in Malaysia should standardize the methodology and terminology used in bitemark examination and in the reporting of its findings so that confusion and inconsistency among the forensic odontologists are kept absolutely low. Finally, forensic odontologists must be given specialized training in bitemark examination so that the probative value of their findings can be improved.

ACKNOWLEDGMENT

The authors thank Professor Dr. Kasinathan Nadesan (John Hunter Hospital, New South Wales); Dr. Iain Pretty (University of Manchester); Dr. Michael Bowers (Diplomate of the American Board of Forensic Odontology); Dr. Hjh. Noraini Nun Nahar Hj. Yunus (Paediatric Institute, Kuala

Lumpur Hospital); Dr. Jal Zabdi Mohd. Yusoff (Faculty of Law, University of Malaya); Ms. Gunamalar Joorindanjn (Advocate & Solicitor, Messrs Gunamalar Law Chambers) and Dato' Amiruddin Idris for their contributions during the preparation and writing of this article.

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Students Perception And Satisfactory Level In Preclinical Fixed Prosthodontic Teaching: Post And Core

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ABSTRACT

Introduction: Preclinical teaching using simulation is very beneficial in training dental graduates. The use of laboratory simulation for its undergraduate training during the preclinical years has been used in dental education. **Purpose:** The aim of this study was to evaluate student's perception, self evaluation and satisfactory level in preparing duralay burn-out post and core in preclinical fixed prosthodontics sessions. **Materials and Methods:** The participants comprised of 104 fourth year dental undergraduates in the Faculty of Dentistry Universiti Kebangsaan Malaysia. The students had undergone preclinical session for endodontics during the 3rd year and had already completed root canal treatment on single rooted tooth. The same tooth was used for preclinical post and core preparation. The gutta percha was partially removed and the root canal was prepared. They then proceeded with the preparation of duralay build-up/pattern based on the lecture, video demonstration and manual given. Once completed and satisfied with their work, students were asked to answer the questionnaires in the simulation manual. **Results:** Student response rate was 88.46% (92/104). Majority of the students were satisfied with their canal preparation, with about 5mm gutta percha left apically, appropriately shaped canal with sufficient retention and resistance form. They also thought that the surface of the duralay was good with no voids. With regards to the coronal preparation, majority of them incorporated ferrule effect and prepared preliminary crown preparation. More than half of the students claimed the level of difficulty of this procedure was moderate. Furthermore, majority of them said that the lecture and the preclinical manual were sufficient and helpful. The help from the supervisors was also benefit in preparing duralay burnout post and core. **Conclusions:** From this study, majority of fourth year dental students could perform appropriate canal preparation as well as duralay pattern post and core. Only one student did not feel competent and confident in doing canal preparation and duralay pattern post and core. Our teaching methods and aids were proven to help them in preparing these tasks.

Key words

preclinical fixed prosthodontics, post and core, duralay build-up, satisfaction level, perception

INTRODUCTION

Preclinical fixed prosthodontics is part of fixed prosthodontic curriculum designed to expand on the student's skills in clinical fixed prosthodontics. The purpose of this course is to introduce the students to the basic principles and techniques of fixed prosthodontics. Fixed prosthodontic educators must continually evaluate the curriculum to ensure that the principles of evidence based teaching are being met.

Prosthodontic curriculum and laboratory surveys are useful tools in assessing prosthodontic education. ¹ Previous surveys have shown that the preclinical technical experience of students varies greatly from school to school.

^{2,5} Schools stress different phases of preclinical experience, and there is a great variety in the types of restorations fabricated by the students. ² The clinical experience is likewise diverse. ³⁻⁵ Some schools require the students to complete all laboratory procedures, some consider the laboratory procedures optional for extra credit, and some offer technical support for all laboratory procedures. ³

At the Faculty of Dentistry Universiti Kebangsaan Malaysia, the preclinical fixed prosthodontic training started at the beginning of the fourth year. It is focused on procedures that are discipline-based and the students have the opportunity to work closely with the supervisors or lecturers in every step in the required exercise. Therefore, students would gain more clinical experience during the

training session. During this period of training, it is hoped that students would develop high self-confidence and competence as well as a high level of satisfaction before they treat patients in the real clinical setting. It was the aim of this study to evaluate student's perception, self evaluation and satisfactory level in preparing duralay burn-out post in preclinical fixed prosthodontics sessions after lectures and video demonstrations.

MATERIALS AND METHODS

1. Participants

The participants comprised of 104 dental students in their fourth year of undergraduate study. All students had experience in dental simulation session in their third year for preclinical operative procedures. These sessions were conducted in Simulation Laboratory Faculty of Dentistry, Universiti Kebangsaan Malaysia (UKM).

Before the sessions started, participants were given a preclinical manual consists of diagrams and pictures of all the procedures that they have to perform, evaluation criteria and multiple choice questionnaires on their performance. The training period consists of two, one-hour lectures per week, each of which is followed by three to six hours of preclinical laboratory practice time per week. This laboratory time specifically focuses on the concepts taught in the classroom. In addition, a live video demonstration on how to prepare duralay burn-out post was shown before the students started any procedures in simulation laboratory. The students were asked to participate in this study, and written consent from them was obtained.

At the end of this seven-week period, and after completing and passing all the tasks, the students entered the clinic and performed fixed prosthodontics treatment.

2. Procedures

4th year students had undergone preclinical session for endodontics during the 3rd year and already completed root canal treatment on single rooted tooth. The same tooth was used for preclinical post and core preparation.

Gates Gliddens (DENTSPLY Maillefer, Oklahoma, USA) and Parapost drills (ParaPost®XPTM, Coltene/Whaledent Inc., New Jersey, USA) were used to remove and shape the canals to an appropriate size and depth. The minimum length of the post is equal to the length of the clinical crown. The recommended length is two-thirds the length of the root in bone while maintaining 5 mm of gutta-percha at the apex. A second periapical radiograph (KODAK INSIGHT Carestream Health Inc., New York, USA) was taken to confirm adequacy of canal enlargement and the length of gutta percha (DENTSPLY Maillefer, France) apically. Then, they can proceed with preparation of duralay build-up/pattern.

First, they need to lubricate the remaining tooth structure with Vaseline (Chesebrough Ponds USA Co., Connecticut, USA) provided, then the mixed duralay

(Reliance Dental Mfg. Co, Illinois, USA) was added to the burn-out post (ParaPost®XPTM, Coltene/Whaledent Inc. New Jersey, USA). The completed duralay post and core were allowed to polymerize. Using diamond bur (Komet, NTI-Kahla GmbH, Kahla, Germany) water and suction, the duralay core was prepared to the shape of an ideal crown preparation in the same manner as a conventional preparation.

Once completed and satisfied with their work, students were asked to answer the questionnaires in the preclinical manual. At the end of the preclinical, the students hand in their mounted tooth, radiographs, completed post and core pattern as well as their preclinical manual.

3. Data Collection

Data collection took place on the second week after the preclinical sessions ended. The data were processed and analyzed by means of the Statistical Package for the Social Sciences (SPSS version 12.0).

RESULTS

From 104 fourth year dental undergraduate UKM students, only 92 students completed the questionnaire.

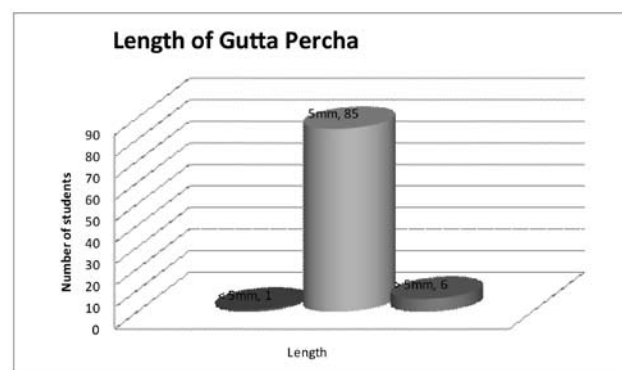
A. CANAL PREPARATION

Question A1: How much of gutta percha did you leave apically?

- Less than 5mm
- About 5mm
- More than 5mm

85 students (92.4%) left the gutta percha around 5mm apically; 6 students (6.5%) admitted to leave the gutta percha more than 5mm while only 1 student (1.1%) left less than 5mm of gutta percha apically. Refer to Figure 1.

Figure 1: Length of gutta percha left apically

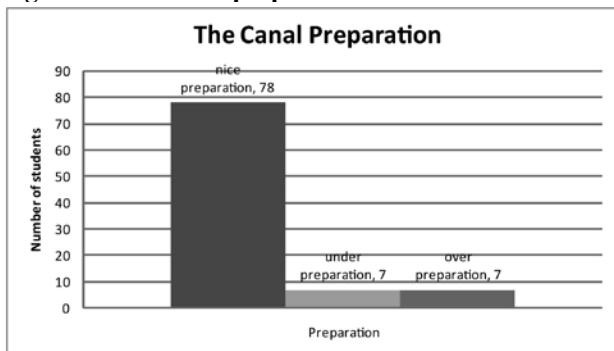


Question A2: The canal preparation is,

- Over preparation
- Under preparation
- Nicely shaped

78 students (84.8%) claimed the canal was nicely prepared; 7 students (7.6%) declared the canal was under preparation; and another 7 students (7.6%) said the canal was over preparation. Refer to Figure 2.

Figure 2: The canal preparation



Question A3: What is your crown/root ratio?

- a. 1:1
- b. 1:2
- c. 1:3
- d. 2:1

48 students (52.2%) stated the crown/root ratio was 1:2; 27 of the students claimed the crown/root ratio was 1:1; and the remaining, 17 students (18.5%) confirmed that the crown/root ratio was 1:3. Refer to Table 1.

Table 1: Crown / Root ratio

Crown Root Ratio	1:1	1:2	1:3	Total
Number of Student	27	48	17	92

B. RESISTANCE AND RETENTION

Question B1: What do you think of your preparation, in terms of resistance and retention?

- a. Insufficient resistance and retention
- b. Sufficient resistance and retention

With regards to resistance and retention form of the canal preparation (Figure 3), 84 students (91%) claimed that resistance and retention of the canal was sufficient. Only 8 students (9%) thought that it was insufficient.

Figure 3: Retention and resistance form



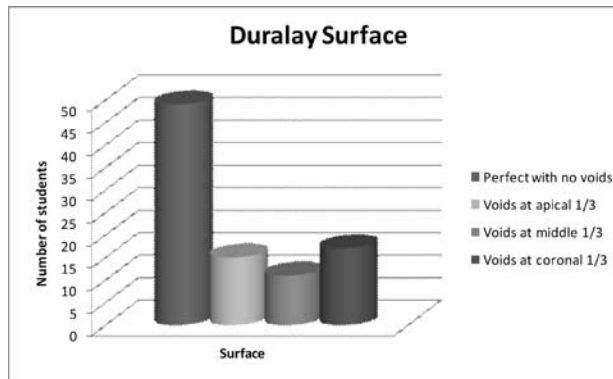
C. DURALAY CORE/CORONAL PREPARATION

Question C1: What do you think of the duralay surface?

- a. Voids at apical 1/3
- b. Voids at middle 1/3
- c. Voids at coronal 1/3
- d. Perfect with no voids

49 students (53.3%) stated their duralay post and core's surface were perfect with no voids at all; 17 students (18.5%) claimed the voids were only at coronal third; 15 students (16.3%) found voids at apical third; and the remaining 12% of the students (11) found voids at middle third of the post and core's surface. Refer to Figure 4.

Figure 4: Condition of duralay surface



Question C2: What is your duralay post diameter?

- a. Smaller than 1/3 the width of the root
- b. About 1/3 the width of the root
- c. Wider than 1/3 the width of the root

Question C3: How long is your duralay post length?

- Less than 1/3 of the root length
- About 1/3 of the root length
- More than 1/3 of the root length

Majority of the students, 75 (81.5%) thought the width of their duralay post was about one-third the width of the root; 14 students (15.2%) claimed it was smaller; and only 3 students (3.3%) said it was wider than one-third of the width of the root.

As for the post length, 45 students (48.9%) prepared the canal within one-third of the root length. 43 students (46.7%) prepared longer than one-third of the root length and 4 students (4.3%) prepared less than one-third of the root length. Refer to Table 2.

Table 2: Duralay post width and length

Post	Number of students
	Post width
< 1/3 of root width	14
1/3 of root width	75
> 1/3 of root width	3
	Post length
< 1/3 of root length	4
1/3 of root length	45
> 1/3 of root length	43

Question C4: How did you carry out your coronal preparation?

- With ferrule preparation
- Without ferrule preparation

Question C5: Did you do preliminary crown preparation during the making of duralay pattern?

- Yes
- No
- Not sure

The students were taught about the importance of ferrule effect and were asked to incorporate the effect on their core preparation. However, 16 students (17.4%) thought that they failed to do so. To finish off the preparation, students were taught to prepare preliminary crown preparation. 36 students did so while 42 students were not sure whether they had done the crown preparation. The rest of them did

not do any kind of crown preparation. Refer to Table 3.

Table 3: Ferrule preparation and preliminary crown preparation

Response	Number of students
	Ferrule Preparation
Yes	76
No	16
	Preliminary Crown Preparation
Yes	36
No	14
Not sure	42

D. STUDENT'S SATISFACTION**Question D1: How satisfied are you with your canal preparation?**

- Very satisfied
- Slightly satisfied
- Not satisfied at all
- I do not care

Question D2: How satisfied are you with your duralay build up?

- Very satisfied
- Slightly satisfied
- Not satisfied at all
- I do not care

68 students (73.9%) were slightly satisfied with their canal preparation; 21 of them (22.8%) were very satisfied and only 3 students (3.3%) were not satisfied with their preparation. 61 out of 92 students (66.3%) were slightly satisfied with their duralay build up; 26 of them (28.3%) were very satisfied and only 5 students were not satisfied with their preparation. Refer to Table 4.

Table 4: Student's satisfaction

Satisfaction level	Not satisfied	Slightly satisfied	Very satisfied	Total (students)
Canal preparation	3	68	21	92
Duralay build up	5	61	26	92

E. LEVEL OF DIFFICULTY**Question E1: Rate the level of difficulty of this treatment as a whole**

- Very easy
- Easy
- Moderate
- Difficult
- Very difficult

Only 1 student claimed that post and core fabrication with the mean of duralay burn-out was very easy. 2 students (2.2%) said it was easy while 72 students (78.3%) pointed out that the level of difficulty was moderate for this task. On the other hand, 17 students (18.5%) claimed that overall procedure was difficult and none said it was very difficult. Refer to Table 5.

Table 5: Level of difficulty

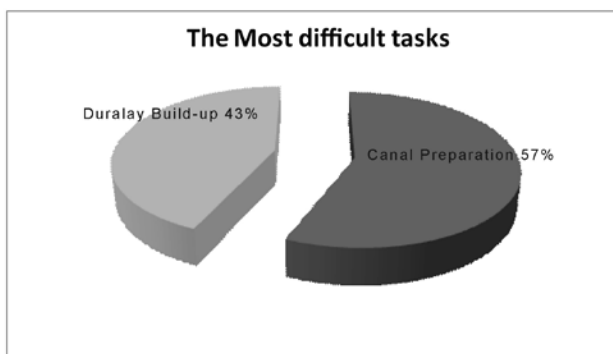
Level of Difficulty	Students
Very Easy	1
Easy	2
Moderate	72
Difficult	17
Very Difficult	0
Total	92

Question E2: Which stage of the treatment is the most difficult to you?

- a. Canal preparation
- b. Duralay build up

52 students (57%) claimed that canal preparation stage was the more difficult than duralay build up stage. Refer to Figure 5.

Figure 5: The most difficult tasks



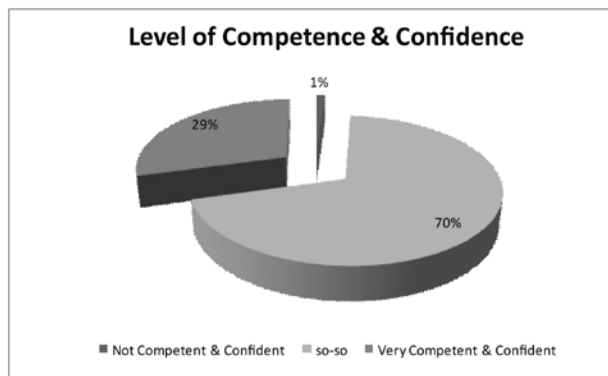
F. LEVEL OF COMPETENCE AND CONFIDENCE

Question F1: Do you think you are competent to do this treatment on patient?

- a. Yes
- b. No

When questioned about their level of competency and confidence to treat patient with post and core, 27 of them (29%) said that they were very competent and confident in doing so; 64 students claimed to be in so-so group and only 1 student had no confidence and competence doing this treatment procedure. Refer to Figure 6.

Figure 6: Student competence and confidence



G. TEACHING

Question G1: Overall, do you think that the lectures provide the adequate knowledge for this topic?

- a. Yes
- b. No

Question G2: Overall, do you think that the demonstrations provided adequate?

- a. Yes
- b. No

Question G3: Overall, do you think that the pre-clinical manual provides the adequate knowledge?

- a. Yes
- b. No

Question G4: Do you think that the lecturer/tutor assists you adequately

- a. Yes
- b. No

70 students (76.1%) thought that the lectures given were very good, while 22 of them (23.9%) said that the lectures were not thorough. Out of 92 students, 39 (42.4%) claimed that the video demonstration helped them. On the other hand, 53 students (57.6%) said that the demonstration did not assist them at all. With regards to the preclinical manual given to them before the session started, 73 students (79.3%) commented that the manual was good and the remaining of the students claimed that the manual could be improved. 74 students (80.4%) said lecturer or tutor assisted them but 18 students (19.6%) stated that the lecturer or tutor did not help them during preclinical session. Refer to Table 6.

Table 6: Teaching

Response	Lectures	Demonstration	Manual	Assistance
yes	70	39	73	74
No	22	53	19	18
Total	92	92	92	92

DISCUSSION

The results show that prosthodontic education and simulation experiences received vary between participants. It is interesting to state that most of the participants perceived and evaluated their canal preparation as good to almost perfect leaving 5 mm gutta percha apically with acceptable crown/root ratio. At the end of post and core preclinical session, the participants excellently produced an ideal duralay post and core with appropriate post width and length, relatively smooth surface and superior resistance and retention. 82% of them prepared ferrule even though at the beginning they had difficulty in understanding its rationale and technique. Simultaneously, the positive perception leads to better self evaluation as well as satisfaction and competence level.

The participants rated their level of satisfaction for canal preparation and duralay build-up as very satisfied or slightly satisfied. There is always a possibility that they could perform better if they were given a second chance. Weighing between canal preparation and core build-up, most participants claimed that canal preparation is more difficult to prepare compared to core build-up. This is probably because they could not access directly into the canal and also fear of perforation. With duralay build-up, only direct access is needed and there is always a chance to rebuild and redo it.

In this study, students' perceptions of confidence and competence were measured to assess the effect of the preclinical teaching. The participants had experience in the simulation clinic for other disciplines such as operative but not for fixed prosthodontics, and it was anticipated that their confidence would be low at the beginning of the preclinical course. Perhaps a more accurate evaluation would have been obtained by measuring the students' perceptions after completion of the preclinical session.

As anticipated, prosthodontic educators in this faculty spent significantly more time interacting with students during their preclinical fixed prosthodontics. The total number of lecture hours for preclinical fixed prosthodontics is 36 hours while 42 hours were spare for preclinical laboratory. Petropoulos et al stated that fixed prosthodontics lecture hours (42) scored the highest lectures hours followed by complete denture (28) and removable partial denture (21) among US dental schools.^{4,5} In UKM, lectures are available online, Fixed Prosthodontics e-Learning (FPeL), therefore the students can spend more hours reviewing the lectures after traditional classroom

lecture. Murphy in 2004 reported that dental students prefer visual learning at a higher percentage than the sample population measured in the VARK (an acronym for Visual, Aural, Read/Write, and Kinesthetic) website.⁶ The distribution of dental student scores shows a preference for instructors who use strong visual presentations and facilitate note-taking during lectures.⁶ Rashedi also reported that most US dental schools having live demonstrations of laboratory procedures as well as prerecorded video demonstrations for these procedures.⁴ Unfortunately, only prerecorded live demonstration of clinical procedures for post and core was available for the students. Students' involvement is not needed in every laboratory step, since most laboratory work is being delegated. This result was consistence with also Weintraub et al in 1997.⁷ This is the sole reason why we do not conduct any laboratory demonstration. Dental educators should be aware of these differences in order to explore opportunities for making the educational experience more productive and enjoyable. However, our teaching methods and aids did remarkably help the participants in performing these tasks.

CONCLUSIONS

It can be concluded from this study that almost all fourth year dental students can perform good canal preparation as well as duralay pattern post and core. Unfortunately, one student did not feel competent and confident enough in performing canal preparation and duralay pattern post and core. However, the teaching methods were proven to help the students in preparing these tasks. The survey results can only be interpreted with respect to the questions that were used. There are limitations to this study and bias in the questionnaires due to the nature and formulation of the questions.

ACKNOWLEDGEMENT

The authors thank Simulation Laboratory staff who generously devoted their time and effort to ensure Preclinical Fixed Prosthodontics run smoothly. Special thanks to Mrs. Siti Zubaidah Anuar* for proofreading this report.

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Inhibitory Effect of Mixed Paste of Ca(OH)_2 And BaSO_4 against Bacteria In Infected Root Canal.

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ABSTRACT

The aim of this study was to evaluate the inhibitory effect of mixed paste of Ca(OH)_2 and BaSO_4 in various ratios against bacteria isolated from infected root canal. The isolated bacteria sample was taken from the lower first molar diagnosed with necrotic pulp. The sample of bacteria was selected by gram staining and further cultured in the brain heart infusion solution. Bacteria suspension in blood gel was given 5 holes with diameter of 5 mm to accommodate Ca(OH)_2 and BaSO_4 mixture with the ratio of 6: 1, 7:1, 8:1, 9:1 and 10:1 to observe the inhibitory zone with intervals of 24 hours, 48 hours, 72 hours, and 10 days. The addition of BaSO_4 to Ca(OH)_2 decreased the inhibitory effect against bacteria growth. Two-way analysis of variants test between the inhibitory diameter with the ratio of Ca(OH)_2 and BaSO_4 and time of incubation showed significant difference ($p < 0.05$). There was a significant difference between ratio of 6:1 to the rest of other ratios in the inhibition of bacterial growth. There was also a significant difference between the incubation periods- 10 days incubation period was different from other incubation periods. Calcium hydroxide was more effective in eliminating aerobic bacteria compared to the anaerobic. Within the limitations of the present study, it is concluded that addition of barium sulfate affected the efficacy of antibacterial effect and the time period of contact between calcium hydroxide with the micro-organisms also has an effect on the bacterial growth.

Key words

bacteria inhibition, mixture of Ca(OH)_2 and BaSO_4 , aerobe and anaerobe bacteria, infected root canal

INTRODUCTION

Microorganisms are the main cause of endodontic infection. Many attempts for endodontic success are devoted to eliminate as many as possible microorganisms that exist in the root canal. In addition to the appropriate preparation of the root canals, medicament of root canals is required to achieve the objective.

The medicaments for root canals include chlorophenol campher menthol, formocresol and cresatine. These medicaments have adverse impacts due to their antigenic and cytotoxic nature and short effectiveness. Apart from these medicament, calcium hydroxide Ca(OH)_2 have been proven its efficacy clinically and possessed beneficial characteristics to be used as ideal medicament for root canal. If the use of Ca(OH)_2 for maintaining pulp capping and pulpotomy is considered as a biological wound dressing, Ca(OH)_2 also serves as biological root healing at apex and periapical tissue. Besides triggering lipopolysaccharide degradation, Ca(OH)_2 with pH of 11.5 plays the role as

powerful alkaline substance and is recommended by some researchers to be used as medicament for root canal and contains anti bacterial properties against most bacteria species found in endodontic infection.

The efficacy of Ca(OH)_2 as medicament for root canal will be maximum if injected during the process and make sure it fills the root canal space thoroughly. Radiograph may be taken to confirm that the entire root canal has been filled with the medicament. Pure calcium hydroxide is not visible under any radiograph, and to make this material radio-opaque, it must be added with a contrastive material, namely BaSO_4 .

The aim of this experiment was to find out the optimal ratio between Ca(OH)_2 and BaSO_4 in minimizing/inhibiting the growth of various bacteria that trigger infection in the root canal.

Safavi & Nakayama (2000)¹ have shown that pH of Ca(OH)_2 is 11.5 and to increase its pH, saline or anesthesia solution may be added and mixed with Ca(OH)_2 powder. Hydroxyl ions penetrate the dentinal tubule when smear

layer is cleaned using ethyl diamine tetra acid (EDTA) solution. The high pH of calcium hydroxide is effective to eliminate bacteria, as most bacteria cannot not withstand pH ≥ 9.5, and only a few bacteria can live in a condition with pH=11 or higher. Consequently, Ca(OH)₂ may also be used as the “dressing” for root canal by killing the bacteria.¹ The most resistant bacterial within root canal and dentinal tubule are *Enterococcus faecalis*.

As some of the bacteria may survive in an environment with pH of 11.5, Stock (1995)² argued that if the root canal contains much exudates, thick Ca(OH)₂ may be applied for 1-2 weeks and repeated until the root canal is completely dry. On the other hand, Rivera and William(1994)³ have mentioned that a redundant filling may trigger minor but acute inflammation and the excessive Ca(OH)₂ will be quickly reabsorbed due to the activity of macrophage cells.

Nerwich (1993)⁴ suggested that calcium hydroxide has bactericidal and disinfectant characteristics. High concentration of hydroxyl ion may eliminate microorganisms in the root canal that was not reachable during the biomechanical preparation. Hydroxyl ion may denature protein and hydrolyze fat in lipopolysaccharide of microorganisms. Consequently, the bacteria cell walls will be damaged and the bacteria are killed. Lipopolysaccharide are found on the surface of negative gram bacteria and own biological effect which may trigger periapical diseases.

Cohen and Burns (2002)⁵ showed that Ca(OH)₂ was able to denaturalize protein and hydrolyze necrotic tissue, in both aerobe or anaerobe conditions. Safavi and Nichols (1993)⁶ suggested that the hydroxyl ion bound to lipopolysaccharide (LPS) will damage the ester bond of hydroxide acid fat as characterized with the loss of hydroxide fat. The use of Ca(OH)₂ in endodontics will lead to the detoxification of lipopolysaccharide residue within the root canal, and it was said that such might prevent bone resorption. Aside from that, Ca(OH)₂ is not a good heat conductor, it is easily manipulated and fairly stable and does not cause any tooth colouration. Cohen and Burns (2002)⁵ also pointed out that the application of Ca(OH)₂ may alleviate dentinal sensitiveness from the external and internal stimulations as Ca(OH)₂ and CO₂ from the air will form CaCO₃ to protect against the pain. It was said that the application of Ca(OH)₂ causes only minor irritation to the tissue.

Calcium hidroxide may inhibit macrophage phagocytes and it therefore reduces the inflammation reaction in the periapical area. Calcium hydroxide paste will disperse into calcium ion and hydroxide ion. Calcium ion will mix with O₂ (air) and form calcium carbonate. The formation process of calcium carbonate (CaCO₃) in the root canal will be overly sluggish and clinically the amount will be insignificant⁷.

MATERIALS AND METHODS

The tooth with necrotic pulp tissue was isolated using cotton roll and saliva injector. The pulp roof was

opened with sterile round drill. The extirpation of the pulp tissue was conducted using sterile extirpation syringe and then directly put into the seedling tube containing Thioglycolate. In this study, the sample was taken from the first right lower molar diagnose with necrotic pulp. The sample was taken from mesiobuccal, mesiolingual and distal roots. The incubation was carried out at the temperature of 37°C for 24 hours.

After 24-hour, all bacteria were Gram stained to differentiate the types of bacteria. The bacteria were planted into the blood medium and incubated at the temperature of 37°C for 24 hours. The growing bacteria were further identified. These types of acquired bacteria were made as the sample with the exception of hypha fungi and fungi because it had to employ a special media such as Sabourand dextrose gel.

Then each sample was planted in BHI (Brain Heart Infusion) solution and left in room temperature for 6-8 hours. The bacteria sample planted to BHI was called “suspension”. After 6-8 hours the bacteria suspension was poured into the blood bel, spread evenly until homogenous, with the ratio of one bacteria suspension = one blood gel and in each blood gel was given 5 holes with the diameter of 5 mm to accommodate the Ca(OH)₂ and BaSO₄ solution of various ratio. When inhibitory zone occurs, it will be visible around such holes. The ratio of Ca(OH)₂ and BaSO₄ in 6: 1, 7:1, 8:1, 9:1 and 10:1 were investigated. The inhibitory zone was observed at intervals of 24 hours, 48 hours, 72 hours, and 10 days.

RESULTS

The bacterias that have been isolated from the necrotic pulpal tissue were as shown below in Table 1.

Table 1. Types of bacteria found in necrotic pulp

Location	Types of bacteria Found	
Distal Root	Gram + Bacillus	++
	Gram - Coccobacil	++
	Gram + Staphylococcus anaerobe	+
Mesiobuccal Root	Gram + Bacillus	+++
	Gram - Coccobacil	++
	Gram + Staphylococcus	+
	Fungi	+
Mesiolingual Root	Gram + Bacillus anaerobe	++
	Fungi	+

Notes:

- + = 100 bacteria per specimen with 100 x magnification
- ++ = 101-250 bacteria per specimen with 100 x magnification
- +++ = 251-400 bacteria per specimen with 100 x magnification

Table 2 showed that the inhibitory zone of all types of bacteria observed become larger with increased observation period of 24 hours, 48 hours, 72 hours and 10 days. In general, higher ratio of calcium hydroxide to BaSO₄ has larger inhibitory effect to all types of bacteria.

Based on the diameter inhibitory zone measurement, it was shown that the largest inhibitory effect was in the ratio of Ca(OH)₂ : BaSO₄ = 10:1 and the incubation time was 10 days as shown in Table 3. However, based on the result of multiple comparison test with HSD Tukey test, it was shown that such result was not statistically significant different at the ratio of Ca(OH)₂ : BaSO₄ at 7:1, 8:1 and 9:1 within the 10-day incubation.

The result of statistical test with two-way analysis of variants between the diameter of blocking and ratio of the average magnitude of inhibitory zone during the 4 periods in all types of anaerobe bacteria observed and in various ratios of Ca(OH)₂ : BaSO₄ during incubation, indicated a significant difference ($p < 0.05$). Accordingly, a multiple posterior comparative test was administered using the honestly significant difference (HSD) from Tukey.

Prior to the test using HSD Tukey, a one-way variant analysis was administered among the treatment groups to obtain the critical value that will be used as the multiplier. Based on one-way anova, the multiplier of 5.07 was obtained with average quadrante (Msc) of 2.68. With such value, HSD value as the differential figure of 2.369 was acquired from among the average groups.

There is a statistical significant difference between the ratio of 6:1 and 7:1, 6:1 and 8:1, 6:1 and 9:1, 6:1 and 10:1. The addition of BaSO₄ to Ca(OH)₂ affected its inhibitory effect against bacteria that trigger endodontic infection (Table 3). There was also a significant difference between incubation period of 72 hours and 10 days with all various ratios of Ca(OH)₂ : BaSO₄. There was no significant difference between incubation period of 24 hours, 48 hours and 72 hours all various ratios of Ca(OH)₂ : BaSO₄ except 9: 1 and 10:1 at 48 and 72 hours.

Table 2 The average and standard deviation of the observation results of root canal bacteria inhibitory zone based on the ratio of Ca(OH)₂ : BaSO₄ and the seedling time.

Ratio of Ca(OH) ₂ : BaSO ₄	Seedling time	Average ± standard deviation (mm)
6:1	24 hours	1.208 ± 0.334
	48 hours	1.625 ± 0.606
	72 hours	2.625 ± 0.882
	10 days	4.083 ± 2.275
7:1	24 hours	1.500 ± 0.603
	48 hours	1.917 ± 0.900
	72 hours	3.000 ± 1.243
	10 days	4.417 ± 2.592
8:1	24 hours	1.833 ± 0.651
	48 hours	2.208 ± 1.076
	72 hours	3.125 ± 1.316
	10 days	4.625 ± 2.595
9:1	24 hours	2.000 ± 0.707
	48 hours	2.458 ± 1.322
	72 hours	3.500 ± 1.784
	10 days	4.917 ± 2.721
10:1	24 hours	2.042 ± 0.689
	48 hours	2.542 ± 1.322
	72 hours	3.625 ± 1.785
	10 days	5.292 ± 3.056

Table 3 The average diameter of inhibitory zone during the 4 observed intervals and various ratios of Ca(OH)₂ and BaSO₄

Ratio of Ca(OH) ₂ : BaSO ₄	Inhibitory zone (mm)			
	24 hours	48 Hours	72 Hours	10 days
6:1	1.208	1.625	2.625	4.083
7:1	1.500	1.917	2.958	4.375
8:1	1.792	2.208	3.083	4.583
9:1	1.917	2.458	3.458	4.875
10:1	2.083	2.583	3.583	5.292

Tables 4 and 5 showed that in general the inhibitory zones were smaller in anaerobic bacteria compared to the aerobic bacteria. This meant that Ca(OH)₂ was more effective in eliminating aerobic bacteria compared to anaerobes.

Table 4 The average diameter of inhibitory zone for anaerobic bacteria during the 4 observed intervals and various ratios of Ca(OH)₂ and BaSO₄

Ratio of Ca(OH) ₂ : BaSO ₄	Inhibitory zone (mm)			
	24 hours	48 Hours	72 Hours	10 days
6:1	1.214	1.429	2.429	2.429
7:1	1.286	1.643	2.5	2.5
8:1	1.571	1.786	1.571	2.714
9:1	1.571	1.857	2.714	2.786
10:1	2.643	2.143	2.857	3

Table 5 The average diameter of inhibitory zone for aerobic bacteria during the 4 observed intervals and various ratios of Ca(OH)₂ and BaSO₄

Ratio of Ca(OH) ₂ : BaSO ₄	Inhibitory zone (mm)			
	24 hours	48 Hours	72 Hours	10 days
6:1	2.1	1.9	2.9	6.4
7:1	1.7	2.3	3.6	7
8:1	2.1	2.8	3.8	7.3
9:1	2.4	3.3	4.5	7.8
10:1	2.5	3.2	4.9	8.5

DISCUSSION

This study has isolated 6 types of bacteria that trigger endodontic infection. The bacteria were taken from the tooth pulp sample diagnosed with pulpal necrosis. The result six types of bacteria were:

- A. Aerobic:
1. Bacillus Gram (+)
 2. Staphylococcus Gram (+)
 3. Coccobacil Gram (-)
- B. Anaerobic:
1. Coccobacil Gram (-)
 2. Staphylococcus Gram (+)
 3. Bacillus Gram (+)

The various ratios of Ca(OH)₂ and BaSO₄ paste exhibited inhibitory effect to all types of isolated bacteria. According to the study of Safavi and Nakayama (2000)¹, the most resistant bacteria found in the root canal that will survive within the dentine tubule with pH = 11.5 are *Enterococcus faecalis*.

Based on the study conducted by Siqueira and Uzeda (1998)⁸, calcium hydroxide does not prove to be effective against *Enterococcus faecalis*. To increase the effectiveness of calcium hydroxide against *Enterococcus faecalis*, this material must be combined with camphorated parachlorophenol (CMCP) and glycerin⁸. Such mixture will produce calcium paramonochlorophenol and hydroxyl ion as bactericide agent. However, there were also suggestions that the addition of camphorated parachlorophenol will increase irritation. The effective use of Ca(OH)₂ as medicament during the endodontic care is excellent, addition of other materials such as BaSO₄ may effect its effectiveness. It is suggested to use pure Ca(OH)₂ or with the addition of other materials in least amount. However, to ensure that the filling material looks radio-opaque, it may be added with barium sulfate with the ratio of 6-8:1.⁹

In the present study, addition of more BaSO₄ influenced the effectiveness of the inhibitory effect of Ca(OH)₂ against bacterial growth. The ratio of 7:1 or more proved to have no difference in terms of the antibacterial efficacy.

The main factor that leads to the failure of endodontic care is the bacteria that remain in the periapical region and within the root canal. Such bacteria entered the periapical area through the lateral canal or additional canal, due to low oxygen pressure, existence of debris and necrotic tissue that serve as nutrition for the bacteria, particularly in the teeth of which their pulp was necrose. As a result, the bacteria form colonization, multiply themselves and cause infection to the root canal system including the periapical tissue¹⁰.

The types of bacteria found in the roots are mainly gram + bacillus and gram negative Coccobacillus. The findings of this study concurred to that conducted by Silva and colleagues (2002)¹¹ whereby in the necrotic root canal or/and chronic periapical condition, anaerobic bacteria were abundant, especially negative gram bacteria. It is also said that not only negative gram bacteria has different virulence but it produces toxic in the periapical tissue and contains endotoxin in the cell walls.

Endotoxin comprises lipopolysaccharide (LPS) which is released when the bacteria are dead and this resulted in inflammation reactions and bone re-absorption in the apical areas, and according to Silva and colleagues (2002)¹¹, calcium hydroxide may neutralize the toxins of endotoxin bacteria and inhibit lipopolysaccharides(LPS). In the present study, the Ca(OH)₂ and BaSO₄ paste was able to provide inhibitory effect against the growth of bacteria that trigger endodontic infection. The inhibitory zone increased in line with the length of the contact with such paste (24 hours, 48 hours, 72 hours, 10 days). Calcium hydroxide cannot diffuse through dentine tubule in a short period of time¹². Calcium hydroxide can eliminate bacteria via a direct contact but it takes at least a week to increase the dentinal pH to 9.4. According to the study by Suzuki and colleagues (1999)¹³, calcium hydroxide will become more effective when its pH is higher. High pH level of calcium hydroxide stimulates the formation of calcification tissue. Apart from that, calcium hydroxide may reduce the toxicity and stimulate the mechanism of local cure¹⁴.

According to Ingle (2002)¹⁵, calcium hydroxide may inhibit the bacteria growth in the root canal, although it works slowly and must be in direct contact with the tissue. Calcium hydroxide is also recommended for root canal that is unlikely or difficult to dry (weeping canals). Its use as inter-canal cure between visits gives a favorable result. However prolonged period of contact may be needed to impart maximum efficacy to eliminate the bacteria as shown in this study. The contact time has significant effect on the inhibition of bacterial growth.

CONCLUSION

Within the limitations of the present study, it is concluded that:

- (1) The Ca(OH)₂ and BaSO₄ mixture paste showed the inhibitory effect to the growth of bacteria in infected canal. The addition of BaSO₄ affected the effectiveness of Ca(OH)₂ at ratio of 6:1, higher ratio of Ca(OH)₂ : BaSO₄ at 7:1, 8:1, 9:1 and 10:1 appear to have similar efficacy.
- (2) Calcium hydroxide was more effective in eliminating aerobic bacterias compared to anaerobics.
- (3) The time frame of contact for Ca(OH)₂ is also important, as Ca(OH)₂ needs sufficient time to diffuse in order to impart its efficacy.

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Mothers' Knowledge Of Fluoride Toothpaste Usage By Their Preschool - Children

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ABSTRACT

Background Mothers play an important role in preventing fluorosis due to inadvertent swallowing of fluoridated toothpaste and enhancing the effectiveness of toothbrushing amongst preschool children through proper supervision. **Aim** To investigate the knowledge of mothers with regards to the benefits and risks of fluoride toothpaste usage among preschool children and to assess the level of parental supervision during toothbrushing. **In additional**, we wish to investigate the toothpaste purchasing behaviour of mothers in relation to brand, price, flavour, fluoride content and the influence of advertisement. **Methodology** Cross-sectional study of a representative random sample of 373 mothers of 5-6 year old preschool children through self-administered questionnaires. **Result** The response rate was 90.3% (337). The majority (61.7%) of the mothers reported that the amount of toothpaste their children used was half-length. Most mothers (70.6%) claimed they usually apply toothpaste for their child. About one-half (50.4%) reported the children applied the toothpaste themselves. Only 41.2% of the respondents supervised their children every time during toothbrushing. The mean age at which the child started brushing and using toothpaste was about 34 months (S.D. 14.9) and 37 months (S.D.14.8) respectively. Almost all (95.8%) reported that their children rinsed their mouth after toothbrushing. The mothers' choice of toothpaste for their child was influence by brand (91.4%), flavour (91.4%) and fluoride content (84.6%) with price being the least of the factors. The majority of the respondents (82.7%) had average to good overall knowledge scores. There was significant association ($P=0.034$) between the level of education of the mothers and their level of knowledge on fluoride toothpaste usage. **Conclusion** Future oral health messages for preschool children and mothers in Perlis should target areas found lacking in terms of knowledge and practices with regards to fluoride toothpaste usage. This includes regular supervision of preschool children during toothbrushing by parents and using only a small amount of toothpaste for young children.

INTRODUCTION

Early childhood caries is common world wide¹. In Malaysia, findings from the last nationwide survey found that caries prevalence in 5-year-olds was 87.1%² and 80.6% in 6-year-olds³. Only 19.4% of 6-year-olds were caries-free. This far lower than the target set in the National Oral Health Goals for 2010 was to have at least 30% caries-free.

To achieve this goal, the Oral Health Division (OHD) implemented nationwide community water fluoridation since 1972 which benefits about 64.8% of the population in Malaysia⁴.

Another strategy for caries prevention adopted by the OHD is to encourage the use of fluoridated toothpaste. Widespread use of fluoridated toothpastes is an important factor for the fall in caries prevalence in Western countries

^{5,6}. In Malaysia, almost of the toothpastes sold locally contain fluoride⁷. Although effective for caries prevention, fluoride overdose during the growth period in children can lead to developmental defects of enamel.

In Malaysia, a study among 16 year-old schoolchildren found 74.7% prevalence of fluorosis in fluoridated areas compared to only 14.2% in non-fluoridated areas⁹. More than 40% of these children started to use toothpaste between the ages of 2-4 years. More than one-half (54.9%) of children used a full brush length of toothpaste but only 5% used a pea-sized toothpaste. There was increasing public concern over the effects of fluoride on teeth and general health which were expressed in local newspapers. However the effects were minimal and insignificant. The impacts were mainly psychological due to mild fluorosis. Only 3.6% of those with fluorosis said it affected their decision to go out with friends. Thus the

perceived social impact was mild and did not affect their lives considerably ¹⁰.

Fluoride ingestion by young children occurs because they may inadvertently swallow some toothpaste during toothbrushing ¹¹. Among the factors that increased the risks for fluorosis are using fluoride toothpaste before the age of 6 years ¹², no adult supervision while brushing and children who used more than 0.5g (0.5mgF) of toothpaste per brushing ¹³.

Thus to reduce the risk of fluorosis, O'Mullane ¹⁴ recommended that toothbrushing with fluoride toothpaste should start no sooner than 2 to 2.5 years old to prevent fluorosis of maxillary central incisors. Konig ¹⁵ recommended that parents brush their children's teeth with a pea-sized toothpaste once a day, starting when the first deciduous teeth erupt. However, it was shown that the weight of a pea-sized toothpaste can vary across cultures. For example in Malaysia, Amdah ¹⁶ measured a pea-sized toothpaste to be equivalent to about 0.35g. A pea-size in Shanghai China was 0.25g ¹⁷, whereas in the West, Loveren et al ¹³ reported that a small pea was about 0.50g.

On the other hand, Rock ¹⁸ reported that even a pea-sized quantity of toothpaste may be too much because children may swallow up to half of the toothpaste dispensed. He recommended that young children use only a smear of low fluoride toothpaste under parental supervision. Thus what is most important is parental supervision during toothbrushing to ensure safety and effectiveness.

The parents, especially mothers are influential figures in determining children's behaviour. Mothers decide the kind of toothbrush, the amount of toothpaste used and the pattern of brushing their children adopt. Furthermore, the earlier the influence, the more likely it will determine the attitude and behaviour of their children which may be difficult to change later in life. With this in view, the oral health programme for antenatal mothers was set up in the early 1970s whereby antenatal mothers attending Maternal and Child Health Clinics for their check-ups are given dental health education. They will then be referred to the dental clinic for an oral examination. To date the impact of the oral health messages given in this antenatal programme especially with regard to the usage of fluoridated toothpaste in tooth brushing practices has never been assessed.

As such, the aim of this study was to investigate the knowledge, attitude and behaviour of the parents in relation to usage of fluoridated toothpaste during toothbrushing by their preschool children in the state of Perlis. The objectives were 1) to assess the level of supervision of preschool children by their parents during toothbrushing, 2) to investigate the knowledge of mothers of preschool children with regards to the benefits and risks of fluoride toothpaste usage among preschool children and 3) to investigate the toothpaste purchasing behaviour of mothers in relation to brand preference, pricing, flavouring, fluoride content and the influence of advertisement.

MATERIALS AND METHODS

This is a cross-sectional study on the mothers or guardians of preschool children in the state of Perlis using a stratified random sample representative of all preschool children in the state. The total population of preschool children was 7018 from 241 preschools. Based on a 95% confidence level, an estimated prevalence of about 40% of preschoolers who applied pea-sized amount of toothpaste ¹⁶, the minimum sample size required was calculated to be about 292 (Epi Info 3). To compensate for non-response the total sample size was inflated to 373. The population was first stratified by schools. A total of 14 preschools were then randomly selected from which all the mothers of 5 and 6 year-old preschool children who were enrolled were included in the sample.

Prior to data collection permission was obtained from the relevant departments to conduct the survey at the preschools. Data collection period was from 10 January 2005 to early March 2005. The questionnaires were adapted from a previous study ¹⁶. The data collected included demographic profiles, knowledge, attitude and daily practice with regards to fluoride toothpaste usage. The contents of the questionnaires were validated by two lecturers from the Department of Community Dentistry, Faculty of Dentistry, University Malaya.

Pretest of the questionnaire for the mothers was conducted among ten personnel who have preschool children at the Kangar Dental Clinic. This was done to check for clarity of the questionnaire and to evaluate the respondents' understanding. Appropriate modifications were made to the questionnaire forms after taking into consideration some ambiguities and their suggestions.

The self-administered questionnaires for the mothers were sent by hand via the selected preschool children. Each parent was given a week to complete the questionnaire, at the end of which the questionnaires were collected back through the teachers.

The returned questionnaires were checked for completeness. Incomplete questionnaires were either sent back to the relevant parent through their preschool children to be completed or contacted through phone for clarification. The data were then analysed using the Statistical Package for Social Sciences (SPSS) version 11.0 programme. Analysis was limited to mainly descriptive statistics.

RESULTS

Of the 373 self-administered questionnaires sent to the mothers/guardians via their preschool children from the selected preschools, 337(90.3%) were completed and returned to the survey team. Table 1 refers to the sociodemographic characteristics of the mothers/guardians of the preschool children involved in the survey. The mean age of the mothers/guardians was 36.6 years (SD=7) with the majority (64.4%) being 35 years and above. Their age ranged from 22 to 61 years old. The majority of the

respondents (83.8%) had secondary education and higher. Only 5% did not have formal education. Most of the respondents reported earning RM1000 and less (61.7%). About 50% of them had two or more children below the age of 6 years whilst about half of them had only one child of this age.

Table1. Sociodemographic characteristics of mothers/guardians

Sociodemographic characteristics of parents		n	%
Mothers' age	20-24	9	2.7
	25-29	42	12.5
	30-34	69	20.5
	35 yrs and above	217	64.4
	Total	337	100.0
Educational level	none	17	5.0
	primary	40	11.9
	secondary up to form 5	199	59.1
	secondary to form 6 or college	43	12.8
	university	38	11.3
	Total	337	100
Monthly household income	less than RM500	120	35.6
	RM501-RM1000	88	26.1
	RM1001-RM2000	58	17.2
	RM2001 and above	71	21.1
	Total	337	100
No. of children 6yrs and below	1	169	50.1
	2	101	30.0
	3	50	14.8
	4	13	3.9
	5	4	1.2
	Total	337	100

All the respondents claimed that their children practiced toothbrushing (Table 2). The majority (87.2%) reported that their children practiced daily tooth brushing and of these, the majority (54.1%) brushed their teeth twice daily. Almost all (97.6%) the respondents claimed their children used the correct sized (child/junior) toothbrush (Table 2). The majority (77.7%) of the mothers reported that their children used fluoridated toothpaste (Table 2). About 13% were not aware if the toothpaste used by their children were fluoridated or not. The majority (61.7%) reported that the amount of toothpaste their children used during tooth brushing was half length (Table 2). Those who claimed their children used a pea size amount of toothpaste comprised 19%. About 15% reported that their children used full length toothpaste during toothbrushing.

The majority of the mothers (70.6%) claimed that they personally applied toothpaste for their child (Table 3). About half (50.4%) of them said that the children applied the toothpaste themselves (Table 3). Only 41.2% of the

respondents said they supervised their children every time during tooth brushing whilst 54% reported that supervision was done only sometimes (Table 3). Only about 5% of the mothers admitted they never supervised their children during tooth brushing.

According to the mothers, the mean age at which their child started brushing was about 34 months (SD=14.9) whereas the mean age at which the child started using toothpaste was about 37 months (SD=14.8) (Table 4). Almost all the respondents (95.8%) reported that their children rinsed their mouth after toothbrushing (Table 5). The majority (81.6%) claimed their children spit during toothbrushing whereas 18.1% reported both spitting and swallowing habits among their children (Table 4). Only one child was reported to have the habit of swallowing toothpaste during tooth brushing.

Table 6 shows the overall knowledge of the respondents with regards to fluoride toothpaste usage. Each correct answer was given a score of 2, each incorrect

Table 2. Toothbrushing and toothpaste used

Item	Responses	Frequency	Percent
Frequency of toothbrushing by child	once a day	112	33.2
	2x/day	159	47.2
	3x or more a day	23	6.8
	sometimes but not daily	43	12.8
	Never	0	0
	Total	337	100
Size of toothbrush used by child	adult	8	2.4
	child/junior	329	97.6
	Total	337	100
Whether toothpaste used fluoridated	Yes	262	77.7
	No	31	9.2
	don't know	44	13.1
	Total	337	100
Amount of toothpaste used during tooth brushing	full length	52	15.4
	half length	208	61.7
	pea size	64	19.0
	smear	13	3.9
	Total	337	100

Table 3. Mothers' claim of supervision of child during toothbrushing and who usually dispense toothpaste for child

Item		N	%
Mother's claim as to who usually dispense .	Mother herself	238	70.6
	Father	62	18.4
	Child	170	50.4
	Siblings	48	14.2
	Others**	16	4.7
Mothers' claim of supervision of child during tooth brushing	every time during brushing	139	41.2
	sometimes	182	54.0
	never supervise	16	4.7
	Total	337	100

*More than one response is allowed for this question.

** Maid (7), Grandmother (6), auntie (3)

Table 4. Age at which child starts tooth brushing and using toothpaste

Age child starts tooth brushing in months		Age child starts using toothpaste in months	
N	336	336	
	1	1	
Mean	34.09	37.08	
Mode	48	48	
Std. Deviation	14.913	14.798	
Minimum	6	9	
Maximum	72	72	

Table 5. Mothers' claim of rinsing, swallowing habit of children during tooth brushing

Question		N	%
Does your child rinse mouth after brushing?	yes	323	95.8
	No	5	1.5
	don't know	9	2.7
Total		337	100
Does child spit or swallow toothpaste spit during toothbrushing?	275	81.6	
	swallow	1	.3
	spit and swallow	61	18.1
Total		337	100

Table 6. Knowledge of mothers/guardians on specific issues with regards fluoride toothpaste usage

No Question	Correct		Incorrect		Don't Know		Total %
	n	%	n	%	n	%	
1 Fluoridated toothpaste is good for oral health	284	84.3	12	3.6	41	12.2	100
2 Fluoridate toothpaste if swallowed in large amount by child <6yrs does not	102	30.3	136	40.4	99	29.4	100
3 In my opinion, all children <6yrs must be supervised by adult during tooth brushing with fluoridated toothpaste	282	83.7	24	7.1	31	9.2	100
4 toothpaste with high fluoride content is better for child than toothpaste with low fluoride content	146	43.3	86	25.5	105	31.2	100
5 Fluoridated toothpaste for adult can be used by child	167	49.6	125	37.1	45	13.3	100

Table 7. Overall knowledge of mothers'/guardians with regards fluoride toothpaste usage

Level of knowledge	n	%
low	58	17.2
average	138	40.9
good	141	41.8
Total	337	100

answer was scored 0 and every “don’t know” answer was given a score of 1. A composite score was then computed by summing up the score for each respondent. The knowledge scores were then categorized as poor (0-4), average (5-7) and good (8-10). The majority of the respondents (82.7%) had average to good overall knowledge score. Only 17.2% had low overall knowledge score. There was a significant association (χ^2 test, $p = 0.034$) between the level of education of the mothers and their level of knowledge on fluoride toothpaste usage. The proportion of those with good knowledge was higher among those educated compared to the uneducated (Table 7).

The knowledge of the mothers/guardians on specific issues with regards to fluoride toothpaste usage is shown in Table 8. The majority of the respondents (84.3%) were aware that fluoridated toothpaste is beneficial to oral health. Most of them also knew that children below 6 years old must be supervised by an adult during tooth brushing. However, 40.4% of them erroneously thought that fluoride toothpaste if swallowed in large amounts by children below 6 years does not adversely affect their health whereas 29.4% had no knowledge about this risk. About

30% of the mothers did not know whether toothpaste with high fluoride content is better for their children compared to those with low fluoride content. About 50% of the respondents thought that fluoridated toothpaste for adults can be used for children.

On the whole, the majority of the mothers (70.3 % to 91.4%) cited brand, flavour, fluoride content and TV advertisement as influencing their decision in purchasing a particular toothpaste (Table 9). On the other hand, only about 34% agreed that price was the determining factor for their choice of toothpaste. Brand (91.4%) and flavour (91.4%) seems to be the most important factors influencing the mothers’ choice of particular toothpaste followed by fluoride content (84.6%). Only about a third (34.1%) of mothers/guardians cited price as influencing the choice of toothpaste for their child. There appears to be a significant association between household income and the choice of toothpaste based on pricing (χ^2 test, $p = 0.001$). A higher proportion of those who belonged to the higher income group compared to the lower income group were not influenced by pricing when choosing toothpaste for their children (Table 10).

Table 8. Level of education and overall knowledge pertaining fluoride toothpaste usage

Level of education	Overall Level of Knowledge						Total		χ^2 Statistics* (df)	P-value
	poor		average		good		n	%		
	n	%	n	%	n	%				
No schooling	4	23.5	11	64.7	2	11.8	17	100	6.75(2)	0.034
primary and higher	54	16.9	127	39.7	139	43.4	320	100		
Total	58	17.2	138	40.9	141	41.8	337	100		

Table 9. Reasons for mothers’ choice of particular toothpaste for child

No	Reasons for mothers’ choice of a particular toothpaste for child	Agree		Disagree		Total	
		n	%	n	%	n	%
1	It is a trusted brand	308	91.4	29	8.6	337	100
2	It is the cheapest	115	34.1	222	65.9	337	100
3	My child likes the flavour	308	91.4	29	8.6	337	100
4	It is fluoridated	285	84.6	52	15.4	337	100
5	It is advertised in television	237	70.3	100	29.7	337	100

Table 10. Household income and choice of toothpaste based on the cheapest price

Household income	Choice of toothpaste is because it is the cheapest				Total		χ^2 Statistics* (df)	P-value
	agree		disagree		n	%		
	n	%	n	%				
Lower income (<RM 1000)	85	40.9	123	59.1	208	100	10.98(1)	0.001
Higher income (RM1000 & above)	30	23.3	99	76.7	129	100		
Total	115	34.1	222	65.9	337	100		

*Chi-Square Test

DISCUSSION

The majority of the mothers involved in this survey were educated, with about 84% having undergone secondary education and above. However, about 62% of the respondents reported that they had lower income (<RM1000). This data must be interpreted with caution as respondents are usually reluctant to reveal their actual earnings. About half the mothers had one child below the age of six whilst the rest had two or more children below six years under their care.

About 87% of the respondents reported that their children practiced daily toothbrushing, 47.2% twice daily and 6.8% thrice daily. This is in contrast to the findings in a study by Amdah (2000) 16 on 100 preschool children in the Kuala Langat, Selangor where all children were reported to practise daily tooth brushing; 59% once or twice daily and 41% thrice daily. Therefore the dental nurses in giving dental health education talks to the preschool children need to emphasize the importance of daily toothbrushing practices amongst these children. Similarly this message has also to be brought across to the antenatal and post natal mothers attending public health clinics.

Selecting the correct toothbrush size for their preschool children appears not to be a problem among the mothers as almost all (97.6%) of them reported that their children used child- sized toothbrush. However, when it comes to selection of toothpaste a lower proportion (77.7%) of the mothers chose fluoridated toothpaste. Dental health education for the mothers at the antenatal and postnatal public health clinics needs to include the benefits of using fluoridated toothpaste for young children.

Fluoride ingestion from toothpaste by young children is influenced by parental supervision and who usually dispenses toothpaste for them. To reduce the risk of fluorosis, it has been recommended that parents must supervise the amount of toothpaste used during brushing up to the age of six years²¹. Less than three-quarters of the mothers claimed they usually applied toothpaste for their children for toothbrushing. About half of them reported the

children usually applied the toothpaste themselves. One can therefore see that the two key persons who usually applied toothpaste for the children were the mothers and /or the children themselves.

Nowadays, it is a norm for mothers to join the workforce and leave the care of their children either to the babysitters or relatives. Most of the time the children are therefore left to dispense toothpaste for themselves during toothbrushing. This may result in the children applying more than the pea sized amount of toothpaste. Furthermore, only less than half of the mothers' reported supervising their children regularly during toothbrushing whilst more than half supervised either sometimes or never at all.

Mascarenhas¹² showed that the use of fluoride toothpaste before the age of six years is a risk indicator for fluorosis. In the present study it was found that the mean age at which the preschool children started brushing with toothpaste was about three years. Since the majority of the respondents (77.7%) claimed that their children used fluoridated toothpaste, this posed as a risk factor for fluorosis among these children. Moreover the majority of the mothers (77.1%) also said their children used toothpaste of half- or full-length of toothbrush which is more than the recommended amount of toothpaste for young children.

This is despite the efforts of the dental nurses from the public oral health services who visit the kindergartens twice yearly to deliver dental health education talks and to conduct toothbrush drills for the children. They may have been influenced by commercial television advertisements on toothpastes which usually show full length application of toothpaste on the toothbrush. On the other hand, estimating the size of a small pea may not be as simple as it may appear. The average weight of a pea-sized toothpaste as dispensed by ten lecturers in Malaysia was 0.35g¹⁶, a pea size according to Zhou et al¹⁷ from Shanghai, China was 0.25g whereas to Loveren et al¹³ in the West it was 0.5g. It can be clearly seen that there is difficulty in estimating the size of a small pea which varies across individuals and communities. It may therefore be

pertinent to adopt the recommendation by Rock¹⁸ that the brush be merely smeared with toothpaste as the commonly recommended pea-sized quantity as perceived by different individuals and communities may be too much.

The amount of fluoride ingested from toothpaste was significantly reduced by rinsing and/or spitting habits during tooth brushing¹³. Though the majority of the preschool children were reported to rinse and spit during toothbrushing, inadvertent ingestion of toothpaste can still occur due to the swallowing reflexes of young children being not fully developed.

Knowledge on fluoride toothpaste usage does not seem to be a problem as the majority of them (83.7%) achieved average to good knowledge score. However, mothers seemed to be less knowledgeable with regards to certain specific issues, i.e. the danger of accidentally swallowing fluoride toothpaste in large amounts and the use of the correct formulation of fluoridated toothpaste for children. About 40% of the mothers did not agree and about 30% did not know that accidentally swallowing fluoridated toothpaste in large amounts can adversely affect dental health. Many (37.1%) erroneously thought that fluoridated toothpaste for adults can be used for children whilst some 13% were ignorant over this issue. Hence, future oral health messages to the mothers by dental personnel should incorporate and emphasise these specific shortcomings. Mothers will also need to be empowered to make informed choices especially with regards the purchase of fluoridated toothpaste. More than a quarter of them thought toothpaste with higher fluoride content is better for children and about a third were ignorant as to whether toothpaste with higher fluoride content is better for children or vice versa. Several recommendations were put forth by a group of experts from four European countries who gathered at Basel, one of which was to increase the fluoride content in toothpaste for toddlers from 250ppm to 500ppm¹⁵. Dental personnel need to empower the mothers with this knowledge to help them make appropriate choices when purchasing toothpaste for young children under their care. It noteworthy that the Ministry of Health has also taken a good proactive step to reduce the recommended level for public water fluoridation from a range of 0.5-0.7ppm to a range of 0.4-0.6ppm in order to reduce the risk of fluorosis whilst maintaining the beneficial effects of cariostasis.

Brand and flavour seemed to be the two main factors influencing the toothpaste purchasing behaviour of the mothers of the preschool children involved in this survey. The majority of the mothers tend to purchase flavoured toothpaste which appeals to their children. Levy²² reported that in some cases, the use of dentifrice flavoured for children could put preschool children at increased risk for dental fluorosis. However, in other cases, the special flavours could enhance children's acceptance of having their teeth brushed regularly thereby reaping the preventive benefits of fluoride dentifrice. The majority of the mothers (84.3%) involved in this survey were aware that fluoridated toothpaste is good for oral health. This is reflected in the appropriate toothpaste purchasing behaviour

of 84.6% of the respondents who cited fluoride content as influencing their decision in the purchase of toothpaste. The toothpaste purchasing behaviour of more than two thirds of the mothers seemed to be influenced by television advertisements. It is widely known that media has a far reaching influence on the public. This may in part explain the preference of mothers for certain brands of toothpaste. Interestingly, only about a-third of the respondents cited that their purchasing behaviour is influenced by price. This is in contrast to the findings of a survey by Mat¹⁶ where almost all the mothers (96%) cited that price was the determining factor in their purchase of toothpaste for their children. However, there is a significant difference in purchasing behaviour with regards to pricing between the higher income and the lower income group. This may be because those in the higher income group tend to look for quality or preference of their children when purchasing toothpaste as the price is not an issue with this group.

CONCLUSION AND RECOMMENDATIONS

More than 80% of the respondents had average to good overall knowledge score. Mothers seemed to be less knowledgeable with regards to certain specific issues, i.e. the danger of accidentally swallowing fluoride toothpaste in large amounts and the use of the correct formulation of fluoridated toothpaste for children. There was a significant association between the level of education of the mothers and their level of knowledge on fluoride toothpaste usage. About half of them reported the children usually applied the toothpaste themselves. Only less than half of the mothers' reported supervising their children regularly during toothbrushing whilst the rest supervised either sometimes or never at all. The majority of the mothers said their children used toothpaste of half- or full-length of toothbrush which is more than the recommended amount of toothpaste for young children. Brand and flavour seemed to be the two main factors influencing the toothpaste purchasing behaviour of the mothers of the preschool children involved in this survey

Future oral health messages for the preschool children and mothers in Perlis will have to target areas found lacking in terms of knowledge and practices in relation to fluoride toothpaste usage. Oral health messages for mothers or guardians should emphasise on the importance of parental supervision during toothbrushing and application of pea-size or smear amount of toothpaste during brushing, especially if they cannot afford to buy special lower fluoride toothpaste for children due to economic limitations. Mothers should be equipped with appropriate knowledge with regards to fluoride toothpaste usage and empowered to make informed and appropriate choices when purchasing toothpaste for their children.

ACKNOWLEDGEMENTS

We acknowledge the assistance of Dr Dahari Dol Patah, Dr Shafinaz bt Mad Arsyad, Mdm Noayu bt Adin, Mdm Manirah bt Hashim and all personnel of Perlis Oral Health Services Department involved in this research project.

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Management of Full Mouth Prosthodontic Rehabilitation Utilizing a Combination of Porcelain Fused to Metal and High Strength Zirconium-oxide Crowns

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ABSTRACT

Full mouth fixed prosthodontic rehabilitation of a compromised occlusion is always a clinical challenge. Precise diagnosis, prudent choice of prosthodontic materials, and meticulous treatment execution are essential for successful treatment outcome over a long period of time. The prosthodontic treatment of a partially edentulous oral cavity with loss of vertical dimension of occlusion is presented. Innovative prosthodontic materials were used in this report.

INTRODUCTION

Prudent clinical judgement, careful consideration of risks and benefits of various treatment options are essential for the treatment planning and long-term success of prosthodontic treatment.¹ It is known that loss of vertical dimension of occlusion may pose significant clinical difficulties in prosthodontic treatment.^{2,3} The re-establishment and maintenance of a new vertical dimension of occlusion is seldom taught in the undergraduate dental curriculum.

Vertical dimension of occlusion is defined as the vertical measurement of the face between two selected points superior and inferior to the oral cavity when the occluding members are in contact.⁴ Various methods have been proposed for the assessment and re-establishment of treatment vertical dimension.³ The vertical measurement of physiological rest position should have a higher value than the vertical dimension of occlusion; the difference is referred to as the interocclusal rest space⁴, which is essential for normal patient function.

It is known that as teeth are worn out the alveolar bone may undergo an adaptive process which may compensate for the loss of tooth structure.⁵ Therefore, the vertical dimension of occlusion should be carefully assessed before the initiation of restorative procedures. In general, alteration of vertical dimension of occlusion should be approached with great care^{5, 6} and excessive changes of vertical dimension of occlusion should be avoided.⁶

One of the challenges in full mouth fixed prosthodontic rehabilitation is in obtaining an accurate impression of multiple abutment teeth. Dental impressions sent to commercial laboratories for conventional fixed prostheses have commonly been found to be deficient in several respects.⁷ One of the major deficiencies is that the margins of tooth preparations are inadequately registered in the definitive impression. Since the master blueprint for crown restorations is the definitive impression,⁸ it is crucial that a good impression technique be employed to obtain an accurate impression that will allow fabrication of precisely-fitting indirect restorations, which may in turn determine the restorations' longevity.⁹

Traditional porcelain-fused-to-metal anterior crown restorations require the placement of labial crown margins within the gingival sulcus in order to mask the hue and value transition between the root surface and the porcelain-fused-to-metal restoration. However, intracrevicular placement of crown margins are related to adverse periodontal tissue response.¹⁰⁻¹² From a periodontal point of view, preparation margins are best kept away from the gingival margin.¹²

The dentition, the masticatory muscles and the temporomandibular joints form a class 3 lever system. In a class 3 lever system, functional load is inversely proportional to the length of the lever arm. Anterior teeth are under less functional load compared with posterior teeth. Porcelain-fused-to-metal restorations are commonly used in the posterior teeth because of its well-documented long term clinical track record in anterior and posterior

teeth.^{13-18, 19, 20} Newer zirconium-oxide based materials are usually prescribed in the anterior region due to its demonstrated promising physical properties^{21, 22} and reasonable clinical longevity.²³ In-vitro studies also show that the wear of metal occlusal surface against porcelain occlusal material is not unacceptable when there is no bruxing activities.²⁴

This article describes the prosthodontic management of a mutilated dentition using different types of conventional and implant supported fixed restorations.

CLINICAL REPORT

A 45-years-old female from overseas presented with multiple missing teeth and dental discoloration. This patient has an extremely busy work schedule and only occasionally visits our country for her dental and medical treatment needs. The patient desired to restore function and aesthetics. She presented clinically with moderate dental attrition, defective restorations, loss of posterior support, loss of occlusal vertical dimension, and compromised aesthetics (Figure 1). The pre-treatment radiograph showed inadequate endodontic obturation, missing mandibular posterior teeth, over-eruption of maxillary posterior teeth and dental attrition of the incisors. In spite of the overall condition, the natural teeth were free of active dental caries. The mandibular posterior bone sites were diagnosed as type 2B24 (Figure 2). A diagnostic dental wax up on the mounted maxillary and mandibular casts in a semi-adjustable articulator (Hanau Wide-vue; Teledyne Waterpik, Fort Collins, Colo) was performed. The proportions of the anterior teeth were corrected to the estimated 0.618 width-to-height ratio of central incisors using Golden proportion²⁶⁻²⁹ as a guideline. The results indicated that 3mm increase in vertical dimension of occlusion was needed at the incisal pin level in order to restore proper incisal anatomy.

The overall treatment plan included placement of endosseous implants in the mandibular posterior area, re-establishment of vertical dimension of occlusion, re-treatment of the endodontically involved teeth, placement of fixed restorations in the maxilla and mandible. Since most of the teeth in the maxillary arch required full coverage restorations, fixed dental prostheses were prescribed for the replacement of the missing maxillary right first premolar and left first molar. Upon completion of endodontic treatments, the posterior teeth were restored with post and core foundations prior to full coverage restoration preparation.⁷ endosseous implants (Nobelreplace, Nobel Biocare, Yorba Linda, CA) were placed by a periodontist in the posterior mandible with the presence of a prosthodontist. No surgical stent was used in this patient. All implants were placed with 45Ncm insertion torque.

In order to establish anterior guidance³⁰, restoration of the anterior teeth should be completed before the restoration of the posterior implants. The anterior teeth were prepared in the usual manner for complete coverage crown restorations (Figures 3). The left maxillary and mandibular

second molars were also prepared to receive provisional restorations for additional vertical dimension support. Margins of the tooth preparations were kept supra-gingival and no gingival displacement procedures on the prepared teeth were necessary. High-viscosity vinyl polysiloxane material (Aquasil Ultra Heavy; Dentsply DeTrey GmbH, Konstanz, Germany) was carefully injected onto all tooth preparations, ensuring that all teeth surfaces including the margins were recorded. A stock tray loaded with putty material (Aquasil Putty; Dentsply DeTrey GmbH, Konstanz, Germany) was seated over the entire dental arch to make the definitive impression. A centric relation record was made with a vinyl polysiloxane material (Regisil PB; Dentsply). The maxillary and mandibular definitive casts were mounted arbitrarily in the center of the articulator using average settings.^{31, 32} Provisional crown restorations (Luxatemp Automix, Xenith/DMG, Englewood, NJ) were placed on the prepared incisors, and on the left maxillary and mandibular second molars at the established vertical dimension of occlusion.

Figure 1. Pre-treatment intra-oral frontal view presenting with attrition, loss of posterior support, reduced occlusal vertical dimension and compromised aesthetics.



Figure 2. Pre-treatment orthopantomogram radiograph showing inadequate endodontic obturations, dental attrition and inadequately restored teeth.

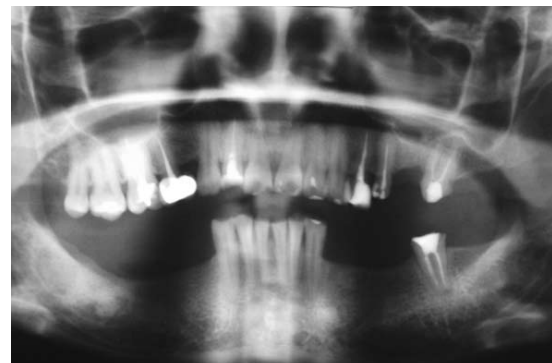


Figure 3. Completed tooth preparations for full coverage restorations at the approximated treatment occlusal vertical dimension. Note the equi-gingival preparation margins.



The development of the planned definitive complete coverage, indirect restorations were carried out as usual on the definitive casts. All maxillary and mandibular anterior teeth were restored with cubic zirconium base full-ceramic crowns (Cercon, Degudent GmbH, Hanau, DE). (Fig. 4) The completed anterior restorations were cemented in self-adhesive resin luting agent (Rely-X Unicem, ESPE, St. Paul, MN).

Figure 4. Completed anterior full ceramic crown restorations. Additional occlusal support was gained by provisional restorations on the left maxillary and mandibular second molars.



The patient was re-evaluated after 2 months of usage of the definitively restored incisors and provisionally restored left maxillary and mandibular second molars at the newly established vertical dimension of occlusion. The patient reported no discomfort and she was well-adapted to the new restorations. No abnormal clinical signs were noted.

Maxillary posterior teeth were then prepared for restoration with complete coverage porcelain-fused-to-metal crowns with metal occlusal surfaces (Figures 5). Mandibular posterior tooth and endosseous implants were restored with complete coverage porcelain-fused-to-metal crowns with porcelain occlusal surfaces (Figures 6). Definitive maxillary and mandibular

impressions were made using the technique described earlier. The development of the definitive posterior restorations were carried out in the usual manner on the definitive casts. Splinted cemented-type porcelain-fused-to-metal restorations with porcelain occlusal surfaces were prescribed for the implant supported mandibular posterior teeth.

After the mandibular implant abutments were torqued to 32 Ncm, the abutment screw holes were sealed with gutta-percha (Mynol; Block Drug Corp, Jersey City, NJ). All maxillary and mandibular posterior restorations were cemented with resin-modified glass ionomer luting agent (Rely-X Unicem, ESPE, St. Paul, MN). Anterior guided occlusal schemes were verified intra-orally before and after prosthesis cementation.

Figure 5. Occlusal view (mirror image) of completed definitive maxillary restorations. Note the metal occlusal surfaces on the posterior teeth.



Figure 6. Occlusal view (mirror image) of completed definitive mandibular restorations with porcelain occlusal surfaces.



Figure 7. Post-operative radiograph showing the combination of prosthodontic treatment modalities. The radio-opaque nature of the full ceramic restorations allow radiographic assessment of restoration fit.



DISCUSSION

The re-establishment of a new vertical dimension of occlusion is a crucial element of this report. It was necessary to make impressions which registered all tooth preparations in the anterior segment at once.

As the patient desired a high level of aesthetics, full ceramic restorations were chosen for all anterior restorations. Since the minimum core thickness for this full ceramic system is 0.4 mm, this enabled conservation of tooth structure while achieving reasonable aesthetics simultaneously.

By prescribing full ceramic restorations, intra-sulcular placement of crown margins on the labial surface becomes less important from an esthetic point of view. In this report, the anterior teeth were essentially caries free, teeth preparation margins were made at the supra-gingival level and gingival retraction procedures were eliminated. As gingival retraction cord placement was not required, there was less physical trauma to the gingival tissues and less clinical time was needed. This is particularly beneficial for thin gingival biotypes.

Full mouth rehabilitation using fixed prostheses usually require a longer term provisional restoration in order to facilitate predictable treatment outcome. In this patient, due to her busy travel schedule, long term provisional restoration for the purpose of verifying her adaptability and multiple visits for professional clinical adjustment of provisional restorations established at the new vertical dimension of occlusion was not feasible. The anterior teeth were restored based on the diagnostic wax up without long term provisional restoration before definitive cementation of the definitive crown restorations. This treatment sequence left almost no room for clinical errors in the execution of the planned treatment. Intra-oral verification of the new occlusal scheme and detailed in-situ clinical adjustment of the restorations on the day of prostheses insertion were essential for proper treatment execution. In this unique treatment approach, the patient should be informed of the potential financial and time implications if there is any need for re-fabrication of the

definitive restorations.

In order to maximize the aesthetic outcome³³, porcelain occlusal surfaces were prescribed in the mandibular teeth. In the maxillary posterior teeth, metal occlusal surfaces were prescribed for its ease of fabrication and superior structural strength.

CONCLUSION

The functional management of a complex prosthodontic rehabilitation is a clinical challenge. Various restorative materials were used in this report. A combination of high strength full ceramic restorations and porcelain fused to metal restorations with metal and porcelain occlusal surfaces enhances the overall aesthetic outcome as well as functional predictability over a long period of time.

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What Expert Says ... Periodontal Abscess

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PERIODONTAL ABSCESS

Abscess of the periodontium is a localized purulent inflammation of the periodontal tissues¹. It has been classified into three categories which are gingival abscess, periodontal abscess and pericoronal abscess².³ A periodontal abscess can be defined as a localized purulent infection affecting the tissues surrounding a periodontal pocket that can lead to the destruction of supporting structures⁴ including tortuous periodontal pockets, furcation involvement, and intrabony defects⁵. The lesion may be acute or chronic abscess. A localized acute abscess may progress to a chronic abscess if the pus drains through a fistula into the outer gingival surface or into the periodontal pocket⁶.

PATHOGENESIS AND MICROBIOLOGY

The basic pathogenic mechanisms of the periodontal abscess do not differ from other abscesses in the body. The formation of the periodontal abscess is initiated by the multiplication and invasion of periodontal tissues by selected species of periodontal bacteria. It has been reported, the increased bacterial activity could be the result of an imbalance in bacterial hemostasis, destruction of the epithelium barrier, and/or by random events⁷.

The microbiota of periodontal abscess has been characterized by the presence of periodontal pathogens present in chronic and aggressive periodontitis. Jaramillo et al 2005 reported in his study that *Fusobacterium spp.*, *P. intermedia/nigrescens* and *P. gingivalis* were found to be the most prevalent microorganisms associated with periodontal abscess. These were also similar findings in previous reports^{8,9,10}. Jaramillo et al. 2005 also concluded that the presence of Gram-negative enteric rods may be of clinical importance. However, the isolated microorganisms can differ among patients, sites, and even at the same site^{4,11}. Therefore rationale use of antibiotic adjunctive therapy in abscess treatment must be taken into more serious consideration. These findings also emphasized the suggestions that use of antibiotics must be based on susceptibility testing, instead of a unique protocol of adjunctive antimicrobial regime.

ETIOLOGY

Different etiologies have been proposed, some of them related to the exacerbation of a non-treated pre-existing cases of chronic periodontitis, precipitated by changes in the subgingival microflora and/or decrease host resistance^{5,12}, antibiotic use in untreated periodontitis^{4,13} and can also be associated with periodontal trauma¹⁴, occlusion of pocket orifices, furcation involvement, and diabetes⁵.

Closure or occlusion of the periodontal pocket by local factors such as impaction of food or foreign bodies^{15,16}, is believed to reduce the clearance of bacteria and accumulation of host cells^{17,18}. This may lead to spreading of infection from the pocket into supporting tissues and is then localized forming periodontal abscess.

Smith RG & Davies RM²⁰ stated in their study that the incidence of acute periodontal abscesses, clinical and/or radiologic evidence of furcation involvement was noted in majority periodontal abscess in molars. This is in agreement with another study that most periodontal abscess occurred in molars (37 of 40 cases, 92.5%)²¹.

In some cases, multiple periodontal abscesses cannot be explained by local factors alone. Unnecessary systemic antibiotic administration to patient with untreated advanced periodontal disease may trigger abscess formation^{13,8}. This may be due to superinfection with opportunistic organisms resulting in development of periodontal abscesses.

Patients with diabetes mellitus are more prone to acute periodontal abscess due to systemic alterations that causes low host resistance such as impaired cellular immunity, decreased leukocyte chemotaxis / phagocytosis and bacterial activity. Diabetes mellitus causes vascular changes and altered collagen metabolism that may increase susceptibility to abscess formation²² in the oral cavity.

Other factors that may trigger periodontal abscess formation include trauma to the tooth such as perforation to the lateral wall of the root in endodontic therapy and anatomic dental anomalies such as enamel pearls in molar furcations and invaginated roots⁵. These situations may contribute to the initiation of periodontal disease. Enamel pearls for example are ectopic deposits of enamel that can be located at furcation. The presence of enamel in these locations prevents connective tissue attachment, thus predisposed the involved areas to periodontal breakdown with presence of dental plaque in susceptible individuals.

CLINICAL FEATURES

A periodontal abscess may be acute in its presentation, or chronic in nature. However chronic lesions may become acute abscesses if the orifice of the sinus tract becomes occluded²³. The following could be used as a guide on the sign and symptoms related to periodontal abscess²⁴ :

- edema and redness at the affected site.
- increased mobility of the affected tooth.
- increased probing depth.
- bleeding or purulent exudate on probing.
- bone loss determined radiographically

An acute periodontal abscess can be seen clinically as a void elevation of the gingiva along the lateral aspects of the root. The gingiva usually is edematous and red with a smooth shiny surface. In most cases, pus may be expressed when tissue is palpated. Patient may experience pain, swelling with “pressure in the gums”, increased tooth mobility and tenderness on mastication⁵. Other signs and symptoms are deepening periodontal pocket depths, tooth elevation in socket, exudation, elevated temperature and presence of regional lymphadenopathy.

A chronic periodontal abscess can present as no pain or dull pain, with localized inflammatory lesion, intermittent exudation and slight tooth elevation. Clinically, there is presence of fistulous tract often associated with a deep pocket and usually without systemic involvement.

TREATMENT

Once a periodontal abscess has been diagnosed, emergency treatment needs to be provided primarily to resolve the infection. Generally, treatment options for periodontal abscess, whether acute or chronic phase are:

1. drainage of suppuration through pocket retraction or incision
2. scaling and root debridement
3. periodontal surgery
4. systemic antibiotics as an adjunct to mechanical debridement
5. tooth removal

The acute abscess is treated to alleviate symptoms, control the spread of infection, and establish drainage. Patient’s medical history, dental history, and systemic condition are reviewed and evaluated to assist in the diagnosis and to determine the need for systemic antibiotics.

Drainage through periodontal pocket is the first line treatment in managing acute periodontal abscess. Local anesthesia is given to provide some comfort to patient and may not ensure total pain control, depending on the severity and spread of the infection. The pocket wall is then gently retracted with a periodontal probe or curette in an attempt to promote drainage through the pocket orifice. Gentle pressure and abundant irrigation with water or antimicrobials may assist to express exudates and clear the pocket. This can be easily done with use of ultrasonic irrigation. Deep (subgingival) scaling and root

planning may be undertaken if the lesion is small and access is uncomplicated. If the lesion is large and/or deep and drainage cannot be established, root debridement by non-surgical or surgical access should be delayed until major clinical signs have subsided²⁵. In these patients, use of systemic antibiotics such as tetracycline, penicillin, metronidazole, amoxicillin/clavulanic and azythromycin, is recommended^{26,27} for a reasonable duration.

Suppuration drainage can also be achieved through external incision if there is no communication with the oral cavity thorough the periodontal pockets or sinuses. A vertical cut is made through the most fluctuant centre of a gingival abscess. The tissue lateral to the incision can be separated with a curette or periosteal elevator. Fluctuant matter is expressed and the wound edges approximated under light digital pressure with moist gauze pad. In abscesses presenting with severe swelling and inflammation, aggressive mechanical instrumentation should be delayed in favor of antibiotic therapy so as to avoid damage to healthy contiguous periodontal tissues.

It is worth noting that when an inadequate treatment is carried out (e.g., antibiotic therapy without abscess drainage associated with supragingival scaling), the exacerbation of the abscess will be prolonged and clinical signs may persist^{24,28}. Thus this emphasizes the indication of antibiotic therapy to be restricted only for patients with systemic signs including lymphadenopathy, fever, malaise²⁹, medically compromised, or when a diffuse infection is observed^{30,7}.

In addition, post treatment instruction includes frequent rinsing with warm salt water (saline) and periodic application of chlorhexidine for short duration between 1 - 2 weeks can offer an alternative to antibiotics. Analgesic can be prescribed for patient’s comfort. This often results in satisfactory healing and the lesion can be treated as a chronic abscess²⁹.

A chronic periodontal abscess can simply be treated with scaling and root planning, or surgical therapy. Surgical intervention is usually considered when deep vertical or furcation defects are encountered and are beyond the therapeutic capabilities of non-surgical instrumentation²⁹. This invasive treatment approach following reassessment after initial therapy is important to restore function, and aesthetics and to enable patient to maintain health of periodontium. Nevertheless, definitive periodontal treatment should be in accordance to treatment needs of the patient as indicated in the CPITN Index³¹ and optimal oral hygiene care is an essential pre-requisite.

CONCLUSION

A periodontal abscess is a localized purulent infection affecting the tissues surrounding a periodontal pocket that can lead to the destruction of supporting structures. Generally, first line management for periodontal abscess whether acute or chronic phase are control of infection and drainage through pocket retraction or incision, scaling and root debridement with or without systemic antibiotics, depending on the needs. Tooth removal is indicated when prognosis of the tooth is poor. Antibiotic prescription alone without local debridement is not recommended.

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Acute abscess on buccal gingival margin of adjacent to 47



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ABSTRACTS OF SCIENTIFIC PAPERS PRESENTED AT THE 65TH MDA/AGM SCIENTIFIC CONVENTION AND TRADE EXHIBITION, 20th - 22th JUNE 2008

MEDIATION – THE MDA EXPERIENCE

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Objectives: To review the cases that was mediated by MDA complaints bureau from 2004 until 2007.

Methods: This is a retrospective analysis of the complaints from the files of MDA.

Results: There was 41 cases from that time period. Most of the cases involves oral surgical procedures (10) and endodontics (9). 69% of the cases where from clinics in the Klang Valey. 69% of the cases was successfully mediated, 10% unresolved and the 21% are in various stages of mediation.

Conclusion: The complaints that are mediated by MDA is steadily increasing but we manage to settle most of the cases.

Keywords: dental negligence, mediation, risks

REHABILITATION OF THE PERIODONTAL PATIENT

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Periodontal diseases often result in the loss of teeth and/or supporting tissues. Migration of teeth with derangement of occlusion result in compromised function and aesthetics. The author will illustrate, by means of clinical examples, the complex interdisciplinary treatment modalities used to rehabilitate patients with advanced periodontitis. Dental implants, aesthetic dentistry, orthodontics, endodontics and periodontics are used in a planned and staged manner to achieve the best possible outcome.

Keywords: Periodontitis, ortho-perio interface, dental implants

THE EFFECT OF DENTURE LABELLING ON THE FLEXURAL STRENGTH OF RESIN ACRYLIC DENTURE

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Objective: The aim of the study was to compare the flexural strength of conventional resin acrylic denture with flexural strength of labelled resin acrylic denture fabricated using two different techniques; heat cured and cold cured.

Materials and Methods: Forty-five resin acrylic blocks were fabricated with fixed dimensions 64 mm x 10 mm x 2.5 mm. There were equally divided into three groups; conventional (no labelling included), and heat and cold cured labelled resin acrylic. The flexural strength of each block was measured using INSTRON 8874 Universal Testing Machine (INSTRON Inc, USA). One-way ANOVA and Tukey Post-Hock Test, and one sample t-test (test value=55N) were used for statistical analyses. The significance level was set at 5%.

Results: The flexural strength can be arranged in descending order of cold-cured>conventional>heat-cured techniques. All multiple comparisons were significant, $p<0.05$. The peak load for conventional and cold-cured labelled resin acrylic was significantly better than minimum peak load 55N (both $p<0.001$) while heat-cured peak load was equal to minimum peak load.

Conclusion: Both techniques are acceptable for application with cold-cured labelling technique is more recommended since its flexural strength is even better than conventional resin acrylic.

Keywords: denture labelling, flexural strength, resin acrylic denture

A STUDY OF SATISFACTION WITH SCHOOL DENTAL SERVICES AMONG 12-YEARS-OLD SCHOOL CHILDREN IN JOHOR

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Objectives: To evaluate the students' perception on Johor School Dental Services and to make recommendations for corrective actions or continual improvements, if necessary.

Methods: This is a cross-sectional study of satisfaction survey among 2170 12-years-old school children in Johor. The Dental Satisfaction Questionnaire developed by Johor Dental Services was used to assess the satisfaction level. The questionnaire, consisting of fifteen items, including 5 important domains; tangibles, reliability, responsiveness, assurance and empathy, was distributed to the selected schoolchildren after receiving dental checkup/treatment in their school.

Results: The response rate was 84.9%. Majority of the 12-years-old school children (96.9%) were satisfied with the quality of care they received. Only small percentage (3%) was dissatisfied with the dental care. The following items explained most of the variance of satisfaction with school dental care: "Pegawai Pergigian/ Jururawat pergigian sentiasa prihatin dengan pesakit" (Dental officer/dental nurses always care about the patients), "Pegawai Pergigian/Jururawat Pergigian dan kakitangan pergigian lain sentiasa bersedia memberi bantuan bagi semua masalah pergigian murid" (Dental officer/dental nurses and other dental staff are ever willing to help solve all students' dental problems), "Kakitangan pergigian menjalankan tugas mereka dengan bersungguh-sungguh dan berdedikasi" (Dental staff are hardworking and dedicated). Dissatisfactions, meanwhile, were associated with the following items: "Jika saya perlu dirujuk kepada pegawai lain, tempoh temujanji yang diberi adalah memadai" (If I should be referred to other dental officer, the appointment period given is reasonable), and "Maklumat-maklumat mengenai kesihatan pergigian mudah didapati" (Oral health information is easily available).

Conclusion: Overall, most of the 12 years-old school children were satisfied with the quality of dental care they received. The high percentage of satisfaction, well above the state set target (85%), is a good achievement to be proud of. This only serves to motivate us for even better services to be rendered in the future.

Keywords: satisfaction, dental satisfaction questionnaire, quality of dental care

THE ALL-ON-FOUR CONCEPT FOR DENTAL IMPLANT PLACEMENT IN THE EDENTULOUS JAW

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Objectives: To highlight some the clinical aspect of the All-on-Four technique applied in few of the cases done in our setting, while discussing the advantages and disadvantages this technique.

Methods: Review of literature and clinical cases of implant placement using the All-on-Four technique.

Results: The All-on-Four clinical solutions for implants placement in the edentulous jaw was developed by Dr. Paulo Málo from Portugal. The technique uses only four implants in the edentulous jaw by tilting posterior implants to increase inter-implant distances and increasing implant anchorage in bone.

Conclusion: With this technique, it is possible to provide optimal prosthesis support and allow immediate function even in cases with minimal bone volume.

Keywords: All-on-Four technique, dental implant, edentulous

SURFACE ROUGHNESS AND STAINING SUSCEPTIBILITY OF COMPOSITE RESINS

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Objectives: The objectives of the study were to evaluate (i) the surface roughness of composite resins polished with various polishing systems; (ii) susceptibility of composite resins to staining after immersion in various dietary dyes and (iii) the correlation between surface roughness and susceptibility to staining.

Methods: One hundred and eighty specimens of two composite resins were fabricated: Filtek Z350 (3M Co., USA; ninety specimens) and Solare (GC Dental Products Corp, Japan; ninety specimens). The specimens were polished with Sof-Lex™ Discs (3M Co., USA) and Enhance™ Polishing System (Dentsply International Inc., USA) with curing against Mylar strip as control. The surface roughness (Ra) was measured with Atomic Force Microscope (AFM). Subsequently, ten discs from each polishing system and control group were immersed in coffee, curry and thick soya sauce and colour changes (ΔE^*ab) were measured using a spectrophotometer. Results were statistically analyzed using one way ANOVA and Tukey test.

Results: There was a significant difference in the surface roughness between Mylar and the other 2 polishing systems for both composite resins ($p < 0.05$). Findings also showed that there was no significant difference between Sof-Lex and Enhance for Filtek Z350 but there was a significant difference for Solare ($p < 0.05$). There was no significant difference in colour changes between the control group and the test groups when immersed in coffee and thick soya sauce ($p > 0.05$). However there was a significant difference when the test groups were immersed in curry ($p < 0.05$).

Conclusions: Both polishing systems provide equally good surface finishing for Solare and Filtek Z350. Curry produces significant discolouration on composite resins.

Clinical significance: It is advisable for patients with large anterior composite restorations to brush or rinse their mouth after consuming curry.

Keywords: composite resins, surface roughness, staining susceptibility

THE SEVERITY OF GINGIVAL ENLARGEMENT INDUCED BY CYCLOSPORIN-A AND NIFEDIPINE AN EXPERIMENTAL STUDY IN RABBIT

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Objectives: The present study was undertaken to estimate the severity of gingival enlargement induced by Cyclosporin – A and Nifedipine separately and in combination.

Material & Methods: Thirty adult rabbits were used in this study. , divided equally into 3 main experimental groups. The first group received 10mg/kg/day Nifedipine, The second received 10mg/kg/day CsA, the third received combination of 10mg/kg/day Nifedipine and CsA by gastric feeding from day 1 till day 70. Alginate impressions were taken for the anterior segments of the maxilla and mandible for each animal on the days 0, 30, 70, and 110. Gingival enlargement was assessed on stone study models according to Seymour's method.

Results: revealed a highly significant difference in the mean values of the gingival enlargement scores in the experimental group that received combination of CsA and Nifedipine, compared to that received either CsA or Nifedipine, and in the group that receive CsA compared to that received Nifedipine on day 70 of the experiment.

Conclusion: the effect of CsA in causing gingival enlargement was significantly more than the effect of Nifedipine, While the effect of the combination of the two drugs caused significantly more gingival enlargement than the effect of one of the drugs alone, Drug withdrawal shows partial regression of gingival enlargement on day 110 in the experimental groups.

Keywords: Cyclosporin – A, Nifedipine, gingival enlargement, rabbit

COMPLETE DENTURE DELIVERED BY UNIVERSITI KEBANGSAAN MALAYSIA'S (UKM) DENTAL STUDENTS – A RETROSPECTIVE STUDY.

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Abstract: This study is aim to evaluate quality of complete dentures delivered by UKM dental students from 2001 to 2005.

Objectives: The objectives of this study are to identify complications, failures and success related to complete dentures made by UKM dental students and to assess patient's satisfactory level who received complete dentures made by UKM dental students.

Materials and Methods: Methods used in this study are including references by using electronic databases for articles and studies, systematic folder searching from 40 000 patient's folder, pilot study through cases managed in 2006/2007, clinical examination, patient's satisfaction and data analysis by using SPSS version 12.0.

Result: Result shows that overall quality of complete dentures delivered by UKM dental students is good. As for the patient's satisfactorily level, most of the subjects satisfied with their denture.

Conclusion: Majority of complete dentures delivered by UKM dental students is in a good quality and most of the patient satisfied with their denture.

Keywords: complete denture, edentulous, psychology, satisfaction level

REVIEW OF OUTCOMES OF THE ORAL CANCER IN THE KLANG VALLEY REGION.

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Objectives: To highlight the outcomes of oral cancer patients in Klang Valley from 2000 to May 2008.

Methods: This is a retrospective analysis of 178 patients' record that was diagnosed to have oral cancer in Klang Valley. We analyzed the age group, gender, ethnic and type of cancer, the stage of the patients when they were referred, the type of treatment involved, the years and the outcomes after the treatment.

Results: Oral cancer commonly diagnosed in the ethnic of India (66%) with the female group (102). The mean age group is 60.02. 95% of the patient was diagnosed to have squamous cell carcinoma and the site of oral cancer that commonly involved was buccal mucosa (33%), followed by tongue (32%). 84% of the patient were diagnosed at stage IV while the most common modality of treatment are surgery (20%), followed by surgery, chemotherapy and radiotherapy (18%) and also palliative radiotherapy and chemotherapy (18%). About 41% of the patients survive within the first 5 years after the treatment.

Conclusions: Majority of patients had their tumours diagnosed at the advanced stage with the mortality increases in relation to the stage at which diagnosis is made.

Keywords: oral cancer, squamous cell carcinoma, surgery

OVERCOMING PROBLEMS ASSOCIATED WITH TRANSPORT DISC DISTRACTION OSTEOGENESIS IN MANDIBULAR RECONSTRUCTION

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Transport disc distraction osteogenesis (TDDO) is an alternative method to reconstruct mandible following tumor ablation. This is method of mandibular reconstruction was successfully done for the first time in Malaysia. This paper presents a few cases of reconstruction of the mandible using TDDO. Resected segment of the mandible were successfully reconstructed using distraction osteogenesis without the need for complicated bone grafts. Also discussed in this paper are some of the steps taken to overcome the problems encountered during distraction osteogenesis and what could be done to prevent such problems from recurring. Advantages and disadvantages of these procedures over other methods of mandibular reconstruction have been highlighted.

Keywords: transport disc distraction osteogenesis, mandibular reconstruction, resection

SPORTS RELATED MAXILLOFACIAL FRACTURES: A PRELIMINARY STUDY

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Objectives: To assess the spectrum of maxillofacial fractures sustained during sports in Ministry of Health Hospitals Malaysia.

Methods: From June 1st 2002 to May 31st 2003 detailed records of facial trauma patients in 23 major Ministry of Health Hospitals were recorded prospectively on a modified proforma by Meaders and Sullivan . The study collected data regarding age group, gender, the aetiology of the fracture, the treatment employed and the complications following treatment. Patients were followed up for a period of 3 months.

Results: A total of 1862 cases of maxillofacial fractures were recorded and of these only 18 cases were sports related. The highest incidence of sports related facial fracture was in the age group 10-19 years (11 cases). All the cases recorded were in male patients and no female. The bone most commonly fractures is the mandible (7cases), followed by dento-alveolar fracture of the maxillary bone (4 cases). Closed reduction was the most common mode of treatment (7 cases) followed by conservative method (6 cases). All patients recovered uneventful.

Conclusions: This study provides an initial data base for facial fractures related to sports in the Malaysia population. Sports injuries are likely to be more common in the future as a result of an increase in leisure time. Protective measures need to be considered in the high contact sports.

Keywords: Maxillofacial trauma, sports, injury.

EFFECT OF TWO POLISHING SYSTEMS ON THE SURFACE ROUGHNESS OF COMPOSITES

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Objectives: To determine the surface roughness of 3 types of dental composites when polished with 2 types of polishing systems.

Methods: 60 specimens of 10 mm in diameter and 2 mm thick were made for each composites, Filtek™Z350 (3M ESPE, St Paul Minn USA), Grandio (Voco,Germany) and Glacier (ISD, Australia). The specimens were divided into three groups: group 1-Mylar matrix (control), group 2-Sof-Lex™ System (3M ESPE, St Paul, U.S.A) and group 3-Astrobrush (Ivoclar Vivadent, Liechtenstein).The specimens were polished according to the manufacturers' instructions and the mean surface roughness (Ra) were determined using a profilometer (SurfTest SV400, Mitotoyo,

Japan) and Universal Scanning Probe Microscope, USPM (Ambious Technology). The data were subjected to analysis of variance (ANOVA) and Dunnett T3 post hoc test.

Results: Two way ANOVA showed significant interaction between polishing agents and composites ($p < .05$). Dunnett T3, showed that the surface roughness of composites produced by polishing agents was significantly different with Mylar producing the smoothest surface followed by Sof-Lex™ and Astrobrush. When the types of composites were compared, Dunnett T3 showed that no significant difference was observed between Grandio and Filtek, but significantly smoother compared to Glacier ($p < .05$). One way ANOVA was carried out to test significant levels between polishing agents for each individual composites. For Glacier, significant difference were detected, Mylar exhibiting the smoothest surface (0.10 ± 0.02) followed by Sof-Lex™ (0.29 ± 0.05) and Astrobrush (1.04 ± 0.32). Similar trend was observed for Filtek. As for Grandio, Mylar produced the smoothest surface (0.07 ± 0.02); however there was no significant difference was detected between Astrobrush (0.30 ± 0.05) and Sof-Lex™ (0.28 ± 0.03).

Conclusions: Mylar produced the smoothest surface for all composites tested. Both Sof-Lex™ and Astrobrush produce equally smooth surface for Grandio, however Sof-Lex™ produce smoother surface compared to Astrobrush for Filtek.

Keywords: fluoride readings, temperature, storage time

THE EFFECT OF TEMPERATURE AND STORAGE TIME ON FLUORIDE LEVEL READINGS OF WATER SAMPLES USING HACH'S COLORIMETER IN JOHOR BAHRU AND KOTA TINGGI DISTRICTS

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Objectives: To study the association between storage time on fluoride level reading of water sample and to study the association between temperature on fluoride level reading of water sample.

Methods: This is a cross sectional study of fluoride level readings of water samples collected from 10 water fluoridation plants and 10 reticulation points in Johor Bahru and Kota Tinggi districts from March 2006 to September 2006.

Results: There is no significant association between storage time of water samples and fluoride level readings using a Hach's colorimeter. However, there is a significant association between temperature and fluoride level readings of water samples. Fluoride level reading is negatively correlated with temperature of water sample ($p < 0.01$). Regression analysis between both temperature and storage time of water samples shows a significant negative relationship between temperature of water samples and fluoride level reading ($p < 0.01$) and no significant relationship between storage time and fluoride level reading.

Conclusion: Findings from this study demonstrate that temperature of water samples affect the fluoride level reading during analysis using a Hach's colorimeter. There is a need to standardise temperature of water samples when analysing for fluoride level using a Hach's colorimeter. Otherwise, a standard fluoride level analyser controlling for temperature is necessary to demonstrate true readings of fluoride level in water samples.

Keywords: fluoride readings, temperature, storage time

ORAL CANDIDA AND DISEASE CONTROL IN NON-INSULIN DEPENDENT DIABETIC MELLITUS PATIENTS

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Objective: This study was designed to assess the relationship of oral Candida colonization, carriage and infection to the glycaemic control in Non-Insulin Dependent Diabetes Mellitus (NIDDM) patients. Determination of the relationship of candidal carriage in smokers and denture wearers to the glycaemic control among NIDDM patients was also carried out.

Materials & Methods: NIDDM patients were recruited randomly from Diabetic Clinic in USM. A total of one hundred and two (102) NIDDM patients, on treatment and follow up were included in this study. All patients underwent oral examination after being interviewed. Relevant information was taken from the medical records for each of the patients. Oral rinse technique was performed for isolation of fungi species. Data were registered and analyzed by using SPSS version 11.0.

Results: It was found that the candidal carriage and Candida colonization was significantly higher in poor-glycaemic control compared with well-controlled group. *Candida albicans* species was found to be the most common fungi recovered from diabetic patients (73.4%), followed by *Candida stellatoidea* species (10.8%). Only two (2) diabetic patients were found to have oral candidal lesions. A significant relationship was found between denture wearing and glycaemic control, whereas non-significant relationship was observed between smoking habits and glycaemic control.

Conclusion: From this study, it was concluded that the status of glycaemic control play a role in candidal carriage and colonization among NIDDM patients.

Keywords: Diabetes mellitus, Candidal species , glycaemic control .

DENTURE TEETH SET-UP MOULD

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Objective: It takes about 90 minutes to complete an upper and lower complete denture teeth set-up. This restricts the number of denture appointment in the government dental clinics. Denture Set-up Mould fabrication was taken up to overcome this problem.

Method: The moulds are of different sizes according to the teeth and jaw size. The teeth are set according to the principles of teeth setting. The mould is reusable and can be disinfected.

Results: A six-month study before and after use of denture set-up mould showed that by using the mould, time for teeth setting was reduced to 30 minutes. Denture appointments could be increased from 7 to 12 patients per day. The waiting time for new denture patients was reduced from 5-6 months to less than 2 months. The number of dentures fabricated by each technician monthly increased from 20 to 36 units. This led to increase in revenue from issue of dentures by 77%. However, some limitations observed were the mould could not be used in situations where the vertical dimension is reduced and there is no provision for edge-to-edge or cross bite conditions.

Conclusion: With the reduction in working time for every case of complete denture teeth set-up, the customer satisfaction level is dramatically improved. Despite certain limitations, denture set-up mould benefits all its stake holders including the dental service providers, its customers as well as the government.

Keywords: Complete denture, teeth set-up, denture mould

REFERRAL TREND OF PATIENTS REFERRED TO UNIT PAKAR PERIODONTIK, KLINIK PERGIGIAN PERINGGIT, POLIKLINIK KOMUNITI PERINGGIT, MELAKA.

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Objectives: To assess the pattern of distribution of cases referred for periodontal treatment at Unit Pakar Periodontik, Melaka, in terms of profile of cases, sources of referrals and appropriateness of cases referred for treatment.

Methods: This is a retrospective analysis involving patients which were randomly referred for treatment at Unit Pakar Periodontik, KP Peringgit, Melaka in 2005. We analysed the number, gender, age group, ethnicity, sources of referrals, relevant medical history and nature of patients' complaints.

Results: Total number of patients referred was 150 with an average of 15 new cases per month. 68 (45.3%) male and 82 (54.7%) were female; the age range was 10-79 years old. Malays were the most referred 81(58.7%) compared to Chinese 49(32.7%), Indians 17(11.3%) and other ethnic groups 2(1.3%). The age range of 40-49years old was the most referred, 38. Referral from dental clinics; most cases were referred from KP Peringgit (38.0%) followed by KP Melaka Tengah(22.7%) and Bahagian Bedah Mulut, Hospital Melaka, (16.7%). Referral according to district / area of residence; Melaka Tengah (85.7%), Alor Gajah (5.3%), Jasin (6.7%) and (3.3%) was referred from outside Melaka. It was found that 17.3% of patients had Diabetes Mellitus while 16% had hypertension. Most common complaint was mobile teeth (23.3%) followed by swollen gums(15.3%) and bleeding gums (13.3%).

Conclusions: Most cases referred for periodontal treatment are Malaysians residing in Melaka, mostly referred by the government dental clinics from Melaka Tengah District. Most complaints of cases referred were indicative of periodontal problems.

Keywords: Referral trends, patients, Unit Pakar Periodontik

ORAL TONGUE CANCER – THE HKL EXPERIENCE

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Objective: Tongue cancer is associated with significant morbidity and poor mortality rate. This is a preliminary study to analyze a case series of patients with tongue cancer managed in the Department of Oral Surgery, Hospital Kuala Lumpur.

Methods: A retrospective review was conducted in a group of 34 patients presented with tongue cancer in the Department of Oral Surgery, Hospital Kuala Lumpur from January 2001 to December 2006. Demographic data, stage of disease presentation, treatment modality and survival at one year were described.

Results: Most patients (n=15, 47.1%) were already at Stage IV of disease when they first presented at our clinic. The most common treatment modality was surgery alone (11 patients, 32.4%), followed by surgery with post-operative radiotherapy (5 patients, 14.7%), surgery with post-operative chemotherapy (3 patients, 8.8%), and surgery with post-operative radio and chemotherapy (3 patients, 8.8%). 4 patients were found not fit for surgery and were placed under supportive therapy. 8 patients either refused or defaulted treatment, and subsequently were lost to follow-up. At one year after initial diagnosis, patient's status was evaluated as: Dead of disease (21%), Dead due to other reasons (19%), Alive without evidence of disease (32%). One patient was reported with cancer recurrence at the tongue. **Conclusion:** Majority of patients presented at late stage of disease when functional impairment and mortality rates are high. This study highlights the need to advocate early detection and intervention of tongue cancer.

Keywords: Tongue cancer, Survival, Treatment modality



CONTINUING PROFESSIONAL DEVELOPMENT QUIZ (CPD POINTS= 2)

Dear Colleagues,

In this issue of the *MDJ*, we continue with column of Continuing Professional Development Quiz whereby you will get two (2) CPD points by just trying out the quizzes. This is a self-administered test and is designed to help colleagues accumulate CPD points. Your feedback is greatly appreciated. These quiz questions were kindly provided by Dr. Kathiravan Purmal, Dr. Wey Mang Chek, Mr. Shamsher Singh, Prof Prabhakaran Nambiar, Dr, Natasya Ahmad Tarib, Dr Ajura Abdul Jalil and Assoc. Prof. Seow Liang Lin.

Thank you.

Assoc. Prof. Seow Liang Lin,
Editor, Malaysian Dental Journal.

- The risk of stochastic effect of radiation is higher on:
 - Tooth structure
 - Dividing cells
 - Salivary gland
 - Thyroid gland
- The least amount of radiation is produced by using:
 - Short rectangular cone
 - Long round cone
 - Long rectangular cone
 - Short pointed cone
- All the following legal statements are true, EXCEPT
 - It is a requirement of law that all dental practitioners in Malaysia must possess a postgraduate qualification, specializing in forensic odontology, before they are allowed to give bitemark evidence in court as expert witnesses.
 - The probative value of a forensic odontologist's opinion is proportional to his qualifications and experience.
 - Trial judges must warn themselves as to the dangers of convicting accused persons based on any unreliable evidence.
 - The prosecution has a duty to prove beyond reasonable doubt all the ingredients of the offence with which a person is charged, including his identity.
- Which one of the following statements is TRUE?
 - Secondary distortion occurs during the physical altercation between a victim and the assailant, when the latter bites the former.
 - Ray Krone was wrongly acquitted by the court in the United States due to the error on the part of the prosecution's expert witness.
 - In United States, the duty to ensure the standardization in the field of forensic odontology is carried out by the American Board of Forensic Odontology (ABFO).
 - Bitemark evidence should be rejected at face value since, in the present state of knowledge, it cannot be expected to deliver the exactitude of the mathematical sciences.
- What is the most common site of oral granular cell tumour?
 - palate
 - tongue
 - lower lip
 - floor of mouth
- Currently, granular cell tumour is believed to be of _____ origin.
 - muscle
 - vascular
 - neural
 - epithelium
- The following are side effects of mefenamic acid, except
 - gastro-intestinal bleeding
 - hepatotoxicity
 - acute renal failure
 - trigger asthmatic attack

8. The advantages of COX-2 inhibitors as analgesics include:
- longer duration of action
 - less gastrointestinal side effects
 - potent analgesic property
 - economical
- i & ii
 - i & iii
 - i, ii & iii
 - all of the above
9. A study in Malaysia has shown that prevalence of fluorosis amongst 16 year-old school children is approximately _____ in areas with fluoridated water supply
- 45%
 - 55%
 - 65%
 - 75%
10. Below are the major factors the mothers of pre-school children in Perlis would take into consideration when purchasing toothpaste except:
- price
 - brand
 - flavour
 - fluoride content
11. Colour changes of _____ is clinically perceptible
- 1.3 NBS units
 - 2.3 NBS units
 - 3.3 NBS units
 - 4.3 NBS units
12. In the study evaluating staining susceptibility of composite resins, which is the correct sequence from the least to the most susceptible to staining:
- Z350, Beautifil, Z250
 - Beautifil, Z250, Z350
 - Z250, Z350, Beautifil
 - Z350, Z250, Beautifil
13. Preclinical teaching has the following advantages except
- Building up student's competent in the treatment's procedure
 - Building up student's confidence in the treatment's procedure
 - Familiarized student with clinical procedure
 - Wasting clinical time for students to learn
14. Following are effective methods of teaching preclinical skills except
- close monitoring of student's progress
 - self directed learning
 - live demonstration of the practical procedures
 - lectures and tutorials
15. Which of the following statements is correct?
- The vertical measurement of physiological rest position should have a lower value than the vertical dimension of occlusion.
 - Long-term provisional restorations are necessary in full mouth rehabilitation cases, to verify patients' adaptability to the new vertical dimension of occlusion.
 - Excessive changes of vertical dimension of occlusion should not be avoided since they are usually well tolerated.
 - Vertical dimension of occlusion is defined as the vertical measurement of the face between two selected points superior and inferior to the nose when the occluding members are in contact.
16. Which of the following statements is correct?
- The dentition, the masticatory muscles and the temporomandibular joints form a class 3 lever system.
 - When prescribing full ceramic restorations, intra-sulcular placement of crown margins on the labial surface becomes more important from an esthetic point of view.
 - Metal occlusal surfaces can be prescribed for crowns on mandibular teeth to maximize the esthetic outcome in a full mouth rehabilitation case.
 - In order to establish anterior guidance, restoration of the posterior teeth should be completed before the restoration of anterior teeth.
17. The term hypodontia refers to
- Total absence of teeth
 - Congenital absence of many teeth
 - Missing six or more permanent teeth
 - A developmental absence of only a few teeth
18. Common features related to hypodontia are
- Macrodonia
 - Malocclusions related to absence of teeth
 - Bimaxillary protrusion
 - Transposition of deciduous teeth

17. D	18. B	19. A	20. C
13. D	14. B	15. C	16. A
9. D	10. A	11. C	12. D
5. B	6. C	7. D	8. C
1. B	2. C	3. A	4. C

ANSWERS:



Aim And Scope

The Malaysian Dental Journal covers all aspects of work in Dentistry and supporting aspects of Medicine. Interaction with other disciplines is encouraged. The contents of the journal will include invited editorials, original scientific articles, case reports, technical innovations. A section on back to the basics which will contain articles covering basic sciences, book reviews, product review from time to time, letter to the editors and calendar of events. The mission is to promote and elevate the quality of patient care and to promote the advancement of practice, education and scientific research in Malaysia.

Publication

The Malaysian Dental Journal is an official publication of the Malaysian Dental Association and is published half yearly (KDN PP4069/12/98)

Instructions to contributors

Original articles, editorial, correspondence and suggestion for review articles should be sent to:

Editor,
Malaysian Dental Journal
Malaysian Dental Association
54-2, Medan Setia 2, Plaza Damansara
50490 Kuala Lumpur, Malaysia

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