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Patching up the bone – A Case Report of Autologous Fibrin Matrix in Combination with Autogenous Bone Graft for Bone and Soft Tissue Regeneration

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ABSTRACT

Platelet Rich Fibrin (PRF) is a natural autologous fibrin matrix and is an effective biomaterial product. The application of PRF in oral surgery is not limited to tissue regeneration, but it has been utilized in several minor and major oral surgical procedures. Numerous studies have proven that either alone or in combination with bone graft, PRF acts as bone and soft tissue regeneration and it is able to stimulate physiological wound healing. This case report will introduce the utilization of PRF combined with autogenous bone graft in restoring four walls dental socket defect due to post-surgical extraction complication and plan for implant placement in the future. It acts in the form of a resorbable membrane and stem cell connector to the

bone. After 3 months post-surgery review, there was no signs of infection or tissue rejection and the harvested bone was still viable. The PRF is comparable to commercially available membrane in the market, where clinical results can be predicted and possibility of reduction in post-surgical complications is achieved. This is due to 1) its compatibility with bone graft materials notably autogenous type, 2) induced neovascularisation and 3) reduction in inflammatory reaction. Our team is confident that the result of PRF at the edentulous region for rehabilitation purposes is beneficial and cost-effective to our patients. (205 words)

Keywords: Platelet Rich Fibrin (PRF), dental socket defect, soft tissue regeneration, hard tissue regeneration, alveolar defect

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Introduction

The most important component in restoring missing teeth is the quality of its remaining soft and hard tissue. Resorption or defective alveolar bone and insufficient gingival tissue, that may result from traumatic extraction, dental trauma, periodontal disease, infection and disuse atrophies (congenital or acquired) might delay the process [1,2]. These factors must be taken into consideration if implant placement is opted as a treatment of choice, since implant surgery requires an area of 2mm of healthy bone around the surgical site[3]. To restore the volume and quality of bone that had been loss, autogenous bone grafting and tissue augmentation are commonly used today as a gold standard, due to its exceptional osteogenic, osteoconductive and osteoinductive properties.

The use of PRF was first reported in 2001 by Choukroun et al[4] as second generation natural fibrin-based biomaterial enriched by platelet and growth factors. Several studies have reported on the utilisation of PRF in dental surgery, while by Dohan et al[5] specifically reported its utilisation in oral surgery in 2006. Tajima et al[6] elaborated that PRF was harvested from an anticoagulant free blood, which was then prepared by centrifugation to extract serum, PRF clot and red blood cells. A study by Cortese et al[7] found that the ability of PRF to accelerate wound healing as well as bone and tissue regeneration has made it an ideal autologous grafting material. PRF is capable to act alone or in combination with bone graft to promote bone growth and maturation.

Case Report

A 46 year-old man with known allergies to sulphur and metronidazole presented at the Oral & Maxillofacial Surgery (OMFS) Clinic, Universiti Teknologi MARA (UiTM) to have his missing teeth replaced with implants. Patient claimed that he had previously undergone a surgical extraction of impacted lower right first premolar (44) at a private dental practice. He also had an extraction of 45, due to its mobility that was associated with severe bone resorption around the area.

Examination and Investigations

Upon intra-oral examination, four-wall defects with severe alveolar bone resorption was noted from lateral aspect of lower right canine (43) to mesial aspect of lower right first molar (46). Further imaging with an orthopantomogram (OPG) revealed retained root of 44, located at the apical of mesial root of 46, and is in close proximity to the right inferior alveolar nerve (IAN) canal (Figure 1). Severe vertical and horizontal bone loss was also noted at the edentulous area.

Figure 1- Initial OPG radiograph showing severe bone resorption on lower right premolar area with retained root of 44.

Treatment Plan

After considering all treat options, we agreed for removal of retained root of 44, followed by augmentation of autologous bone harvested prior to implant placement. Autologous bone augmentation will be harvested from the patients' iliac crest. The procedure was done under general anaesthesia.

Step 1 – Surgical removal of retained root of 44

Before the surgical procedure was started, 10 millilitre of blood was withdrawn from the patient into a plain tube (BD Plymouth®) without an anticoagulant. The blood was immediately centrifuged at 1300 revolutions per minutes (rpm) for 8 minutes. Local infiltration was administered at the surgical area with 1 cartridge 2% Lignocaine with 1:100000 epinephrine (Duopharma (M) Sdn Bhd). Alveolar bone removal was performed at the site of the retained root of 44 with extra precaution to avoid injury to the right inferior alveolar nerve. Retained root of 44 was elevated successfully using elevators. The socket was irrigated with normal saline 0.9% and inspected (Figure 2).

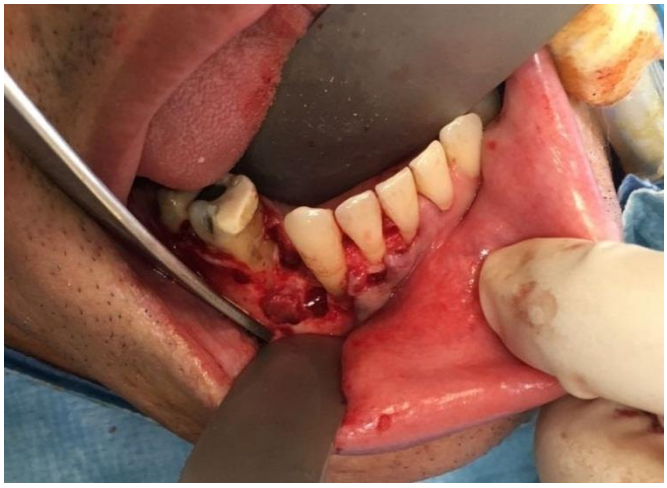

Figure 2- Retained root of 44 extracted, with severe alveolar resorption noted at the surgical area.

Step 2 – Harvesting autologous left iliac crest bone graft

The marked area at anterior superior iliac spine was cleaned with povidone iodine and local infiltration with 1 cartridge 2% Lignocaine with 1:100000 epinephrine was administered. Cortical cancellous bone block 2.0 x 1.0 centimetres was harvested from the left iliac crest. Closure of donor surgical site was performed layer by layer up to skin with Vicryl® 4.0 (Johnson & Johnson International) and Ethilon® 4.0 (Ethicon LLC).

Step 3 – Autologous bone augmentation with bone block and PRF

The cortical cancellous bone block harvested from iliac crest was trimmed and placed at the defective area. The autogenous bone block was secured with DePuy Synthes 5 holes titanium plate and five screws (Figure 3). PRF was then placed on the bone graft as an autologous membrane covering the whole surface of the bone graft (Figure 4). Finally, mucoperiosteal flap was repositioned and secured with watertight sutures using Vicryl® 3.0 (Johnson & Johnson International).

Figure 3- Harvested autogenous bone block trimmed and placed into the socket and secured with fixation plate.

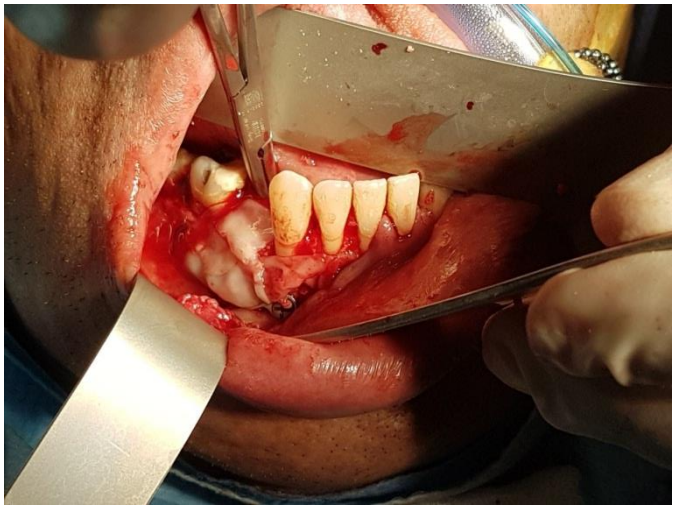

Figure 4- PRF acts as a resorbable membrane placed over the bone graft.

Review

Post-operative OPG was taken during follow-up (Figure 5), revealing intact fixation plate, with no abnormal radiolucency or radiopacity noted around the surgical area. The bone graft was viable with minimal resorption at surgical site. Patient denied having any signs of pain, numbness, swelling or discharge.

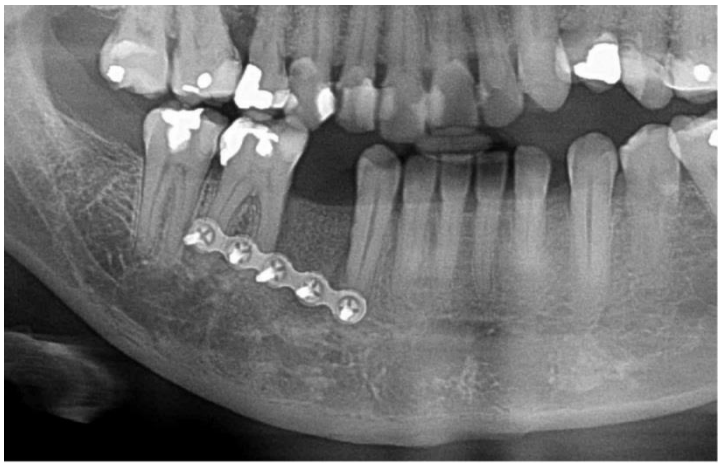

Figure 5- Orthopantomogram at three months follow up.

Discussion

In the field of oral & maxillofacial surgery, PRF has been widely used due to its benefit in both haemostasis and dental tissue grafting. Documented by Borie et al[8], the minimal immunological reactions induced following its use and its ability to be utilised with bone graft makes PRF a great preference in dental surgery. Its single-step handling via a simple process using autologous blood with minimal manipulation, as well as its cost-effectiveness, added to the advantages of PRF procurement. Furthermore, the natural fibrin with growth factors element in PRF can help in ensuring its prolonged activity, while stimulating tissue regeneration efficaciously.

Cortese et al[9] reported the different protocols in the centrifugation process that will produce different forms of PRF, with each form having its distinct functions. The PRF can be used either solely or in combination with a bone graft. When used as a membrane, PRF acts as a fibrin to protect and stabilise graft materials. In addition, PRF may also serve as biological connector between different graft materials, either autograft or allograft bone, as studied by Choukroun et al[10,11].

Theoretically, Dohan et al[12,13] had reported the beneficial effects of PRF, which is its ability to release growth factors such as platelet-derived growth factors and to transform growth factor-beta with great potential for bone regeneration and healing biomaterial. On the other hand, Dohan et al[14] found that PRF also decreases the frequency of intraoperative and postoperative bleeding, facilitates soft tissue healing, supports in the initial stability of the grafted tissue at the recipient sites, encourages development of rapid vascularization of the healing tissue and induces regeneration with bone graft combination.

Besides tissue regeneration, Whitman et al[15] also utilised PRF in reconstructive maxillofacial surgery, ablative surgery in the maxillofacial region, mandibular reconstruction, surgical repair of alveolar clefts, and oro-antral and oro-nasal fistulas closure with encouraging results.

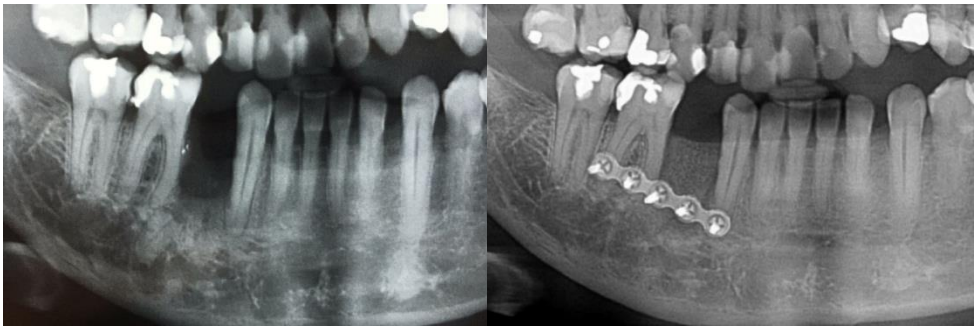

Figure 6 – Comparison pre and post orthopantomogram radiograph.

Conclusion

In our case report, the combination of autogenous bone graft with PRF decreased the risk of post-surgical complications, resulting in adequate healing with minimal bone resorption. Our team predicts that satisfactory clinical results can be predicted based on the observation of significant bone and tissue healing in this patient. Further studies, with more case series is required to document the success of the usage of PRF in oral and maxillofacial fields.

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