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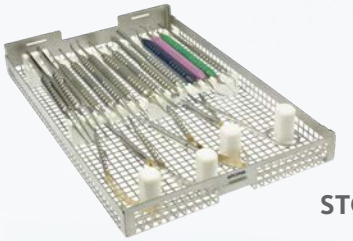

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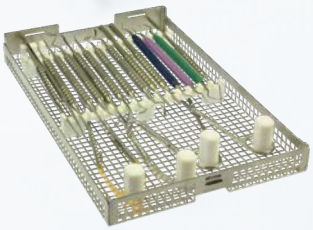

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Editor's Notes

Welcome

I am delighted to present the Editor's Report for the last quarter of 2023. It is with great pleasure that I provide you with an overview of the notable developments and achievements over the past six months.

During this quarter, we received an increased number of high-quality manuscript submissions in the disciplines of periodontology, prosthodontics, and implant dentistry. The Editorial Board has implemented a peer review process for submitted manuscripts to ensure high level of publication. I would like to extend my heartfelt appreciation to our esteemed reviewers for their commitment to establish the journal's high-quality standards.

To further enhance the journal's expertise and reach, we have expanded our editorial board by inviting distinguished scholars and researchers across Australia and New Zealand to join the editorial board. Their contributions are invaluable in shaping the journal's direction and maintaining its academic excellence.

For this journal issue, we have published three articles. The first article by *Dr Alexander Khominsky and Dr Luan Ngo* (University of Melbourne) is titled '*Clinical application of platelet-rich plasma and fibrin in periodontal and peri-implant regeneration, a narrative review*.' This review provides important clinical information regarding the use of autologous platelet concentrates (APCs) techniques in periodontal and implant related regeneration procedures.

The second article by *Dr Su Sheng Quach* (University of Queensland) is a narrative review about periodontal defects associated with impacted third molars and effectiveness of different treatment strategies to prevent and/or mitigate the periodontal defects following impacted lower third molar extraction.

The last article by *Dr Aya Alali* (University of Melbourne) discusses the maintenance of peri-implant health in full arch fixed implant retained prostheses. Full arch fixed implant-supported prostheses are commonly used for the rehabilitation of edentulous jaws. The health and stability of dental implants over time are often challenged by biological complications associated with biofilm. Hence this review will provide a certain insight into peri-implant health management in full arch implant supported fixed prostheses.

On behalf of the editorial board, I'd like to thank all the contributors to the journal and hope to see continuous support from the societies.

Regards,

A/Prof Ryan Lee
Editor-in-chief

President's Notes

I am pleased to present the President's Report for the last quarter of 2023. It has been a period of significant achievements, challenges, and opportunities for our society. The last quarter was busy with all the planning for the upcoming biennial ASP/AOS/APS conference in 2024. We are now only one year away from the conference. It has been truly an amazing and life-time experience to organise a combined conference with all these prestigious societies in Australia. The industry responses are very enthusiastic, and we have successfully invited many world leading academics and clinicians as speakers. I believe this will be an incredible opportunity to meet them all in person in the Gold Coast, 2024. I'd like to thank both the organising committee and scientific committee for their efforts to plan this great conference.

I have an announcement that our long-time serving secretary, Kayla Ashkar, has stepped down from her role as of 31st of July, 2023. I'd like to take a moment to express our heartfelt gratitude for her exceptional service and dedication as our society's secretary all these years. Although it is very sad her going, I'd like to congratulate her on her new role in ANZAP and wish her the best for a new chapter in her career.

Following Kayla's departure, we have appointed a new secretary, Bella Cherkasskaya. Bella was highly recommended for her extensive experience and knowledge with various professional societies, including AOS. We welcome Bella to our society and I am looking forward to working with her in coming years.

In closing, I would like to congratulate all the authors who have published in this issue of the journal and hope everyone enjoys the reading.

Sincerely,

A/Prof Ryan Lee
ASP Federal President

As we approach the last quarter of 2023 we are now one year out from the biennial combined conference between the AOS, APS and ASP. It will be the first time that our 3 prestigious societies have combined at this level to host a shared conference. This conference, which will take place from the 18th-21st of September 2023 in the Gold Coast will be one of the biggest Periodontics and implant conferences of the year in Australia. So please save the day and don't miss this incredible opportunity which will be themed "**Staying between the flags 2.0**" a link to the last AOS conference that was held in the Gold Coast in 2009. The scientific committee is in the process of confirming some high calibre speakers, so stay tuned for more. I'd like to thank both the organising and scientific committees for their efforts in putting this conference together.

Congratulations go to all the authors that have been published in the current journal and a big thank you also goes to the editors and administrators for their tireless efforts in making this publication possible.

Wishing you and your families all the best for the upcoming Christmas and holiday period.

Dr Angelos Sourial

AOS Federal President

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The Australian Journal of Periodontology
and Implant Dentistry

Clinical Application of Platelet-Rich Plasma and Fibrin in Periodontal and Peri-Implant Regeneration: A Narrative Review

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1. Introduction

Regeneration in dentistry has been marked by mid-term success with xenograft and allograft products, and although these have excellent osteoconductive properties, there has been increasing research to improve the osteogenesis of graft materials through growth factors. Although xenogeneic and allogenic stimulatory products such as exogenous growth factors and proteins are being developed, there is interest in the efficacy of minimally invasive autologous products that can achieve improved healing outcomes.

Platelets are a key modulator of cell migration, proliferation, differentiation and angiogenesis, and aid in regeneration (1). Autologous platelet concentrates (APCs) are produced by centrifugation of venous blood at different speeds and the use or non-use of thrombin and an anticoagulant. This enables creation of the main generations of APCs: platelet-rich plasma (PRP), platelet-rich fibrin (PRF) and concentrated growth factor (CGF). Given its relative availability, biocompatibility and cost-effectiveness, the efficacy of platelet concentrates in wound healing and regeneration has been of research and clinical interest (1). Platelets include growth factors (GFs) such as: basic fibroblast growth factor (bFGF), vascular endothelial growth factor (VEGF), insulin-like growth factor-1 (IGF-1), transforming growth factor β-1 (TGF-β1) and platelet-derived growth factor-BB (PDGF-BB). PRF and CGF produce significantly more GFs during the centrifugation process as compared to PRP. The levels of bFGF in CGF and PRF are significantly higher than in PRP. However, the levels of the other growth factors mentioned above do not differ significantly among the different APCs (2). These GFs are able to stimulate different stem cells within wounds.

Different kinds of stem cells in the oral cavity can differentiate to different lineages of cells, in particular with stimulation of growth factors (3). Gingival mesenchymal stem cells (MSC) have shown advantages as a source of MSC even compared to the gold standard, bone marrow (4). Periodontal ligament stem cells (PDLSCs) can differentiate into adipocytes, collagen-forming cells and cementoblast-like cells. After transplantation, these cells have shown an ability to generate a cementum/PDL-like structure and

Abstract:

Autologous platelet concentrates and their products provide a biocompatible and cost-effective source of growth factors and scaffold material. The current review provides clinical information regarding the use of autologous platelet concentrates techniques in periodontal and implant related regeneration procedures. In the treatment of periodontal intrabony defects and furcation defects, platelet rich plasma has shown inconsistent clinical results when compared to open flap debridement alone or as an adjunct to bovine derived xenograft (BDX) or demineralised freeze-dried bone allograft (DFDBA). Intrabony defects are often indicated for a regenerative protocol, and although there has been some evidence that platelet rich fibrin provides an additive effect to BDX or collagen membrane (CM) or DFDBA in intrabony and furcation defects, this has been inconsistently reported and the evidence seems to be limited. In recession defects, PRF seems to provide limited benefit, however does demonstrate superior outcomes when used in the donor site to minimise postoperative pain and discomfort for patients compared with traditional closure techniques. Smokers have shown to particularly benefit from PRF and its ability to improve soft tissue closure with less pain and fewer complications in socket graft approaches. In augmentation procedures, the use of PRF alone is insufficient to minimise significant risks of crestal loss, however as an adjunct to BDX/CM demonstrates improved early success of bone volume gain and maturation. In comparison to access flaps alone in peri-implantitis surgery, PRF does provide a significant improvement in treatment outcomes, but once again when compared with traditional regenerative protocols (BDX/CM) outcomes are not demonstrating significant clinical benefit. The benefits of APCs seems to be limited to certain clinical scenarios in periodontal and implant regeneration, however

enable the repair of the periodontal tissue. Hence, these cells have the potential to repair tissues destroyed by periodontal diseases (5). Bone healing is assisted by MSCs and osteoblast progenitor and differentiated cells, as well as stimulation of bone morphogenetic proteins (BMPs) (6).

The current review has discussd the main APCs: PRP, PRF and CGF. PRP, which was first described by Whitman and colleagues, is prepared by the centrifugation of autologous whole blood together with thrombin and calcium chloride, to form a 'platelet gel' (7). The second generation of APCs, PRF, was developed by Choukroun and described first by Dohan and colleagues (8). The preparation of PRF does not require the addition of any exogenous material (8). The newest APC, CGF, was first defined by Sacco and colleagues (9). CGF is produced in a manner similar to that used to produce PRF but involves different centrifugation speeds (9). This narrative review seeks to address the increasing usage of APCs in dental practice, with attention given to periodontal and peri-implant regeneration.

2. Wound Healing

APCs aim to improve and accelerate wound healing, which consists of four integrated phases: haemostasis, inflammation, proliferation and tissue remodelling or resolution (10). Wounds that exhibit impaired healing, may enter a state of pathologic inflammation with adverse outcomes and further management requirements. A study reviewing Medicare (an Australian government universal healthcare scheme) expenditures in 2017 demonstrated that 15% of Medicare beneficiaries (8.2 million) had at least one type of wound/infection (not pneumonia) and surgical infections were the most prevalent (4.0%), followed by diabetic infections (3.4%), with a mid-range estimated cost of surgical wound care to be US $13.1 billion (11).

Inflammation and proliferation includes several processes: biochemical activation, cellular activation and cellular response. There is a conversion of the mechanical injury into biochemical signals. The clotting cascade enables fibrin to facilitate homeostasis, and it activates thrombin. Thrombin, calcium chloride and adenosine diphosphate (ADP) trigger the activation of platelets, leading to the release of alpha granules from platelets, with the subsequent secretion of a large variety of growth and differentiation factors.

The complement cascade also includes the release of substances that are important for wound repair. During this process, bradykinin is produced, which causes vasodilatation

Abstract: *(continued)*

it's use needs to be evaluated based on a risk-benefit assessment for each individual patient.

The authors declare that they have no competing interests

Keywords: platelet-rich, PRP, PRF, regeneration, periodontal, peri-implant, augmentation, grafting

and the activation of plasminogen to produce plasmin, which degrades the fibrin. The fibrin degradation causes monocyte migration and vasodilatation, leading to a cellular response where GFs are released from platelets. These GFs signal the local epithelial and mesenchymal cells to migrate, divide and enhance the synthesis of the collagen matrix. The platelet count in PRP is 338% of the platelet count of the whole blood and GF concentrations are on average 3-5 times higher as well, enhancing the healing and regenerative capability (12).

3. APC

Over the last two decades, there has been an increasing generate of techniques to develop different types of APCs to supersede their predecessors in terms of application, or to create niche application and strengths. This development alone has been a revolutionary step in biological manufacturing science.

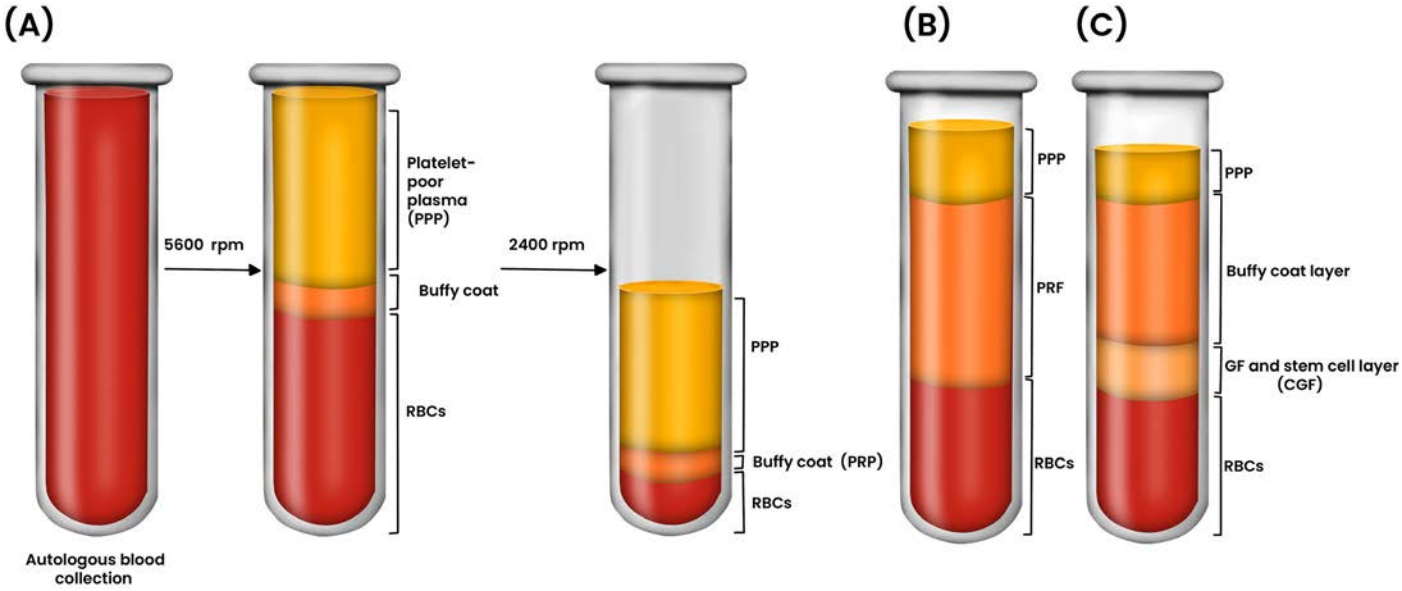
3.1 Platelet Rich Plasma (PRP)

During the first generation preparation of PRP, xenogeneic thrombin and anticoagulant were added, however this led to a risk of an immunologic and infectious response, making its contemporary use limited (7).

3.2 PRP Technique

In the pre-operative period, 10 mL blood is collected in a sterile centrifuge tube, containing citrate–phosphate–dextrose solution (as anticoagulant). First, it is centrifugated (Medtronic Electromedic, Elmd-500 Autotransfusion system, Parker, CO, USA) at 5600 rpm. The result of this stage is the separation into two layers: first layer - platelet-poor plasma (PPP); second layer - red blood cells (RBCs) and buffy coat,

Figure 1. (a) PRP (platelet-rich plasma): after the first centrifugation period, there is a separation of two layers: on top - platelet-poor plasma (PPP), on bottom - red blood cells (RBCs) and buffy coat. The products of the second centrifugation period are: top - PPP; bottom - buffy coat (PRP) and residual RBCs. (b) PRF (platelet-rich fibrin): The layers after centrifugation period are: RBCs, fibrin clot layer (PRF) and PPP. (c) CGF (concentrated growth factor): after the centrifugation period, four layers are obtained: 1. RBC layer; 2. GF and stem cell layer (CGF); 3. Buffy coat layer; 4. serum layer (PPP). Adapted Mijiritsky et al. (2021)



which contains platelets and white blood cells (WBCs) (Figure 1a) (13). Only the layer of RBCs and buffy coat then continues to the second stage of separation. The second centrifugation period is processed at 2400 rpm in order to separate the buffy coat into PRP and residual RBCs. When the surgeon needs to use the PRP, thrombin is dissolved in 10 mL 10% calcium chloride in a sterile cup. Then, 7 mL PRP and 2 mL air are aspirated into a 10 mL syringe, and a 1 mL mixture of thrombin and calcium chloride is aspirated. Within 30 s, the thrombin polymerises the fibrin into an insoluble gel, platelet degranulation and the release of GFs and cytokines. It should be noted that there is a variable difference in platelet quantity amongst patients: platelet and WBC count is higher in younger people and higher in females compared to males, indicating the inherent variation of PRF between individuals and also possibly at different time points.

3.3 Platelet-Rich Fibrin (PRF)

In 2006, Choukroun and colleagues reported on a new alternative to PRP: platelet-rich fibrin (PRF) (8) . The application of PRF is different from PRP and does not require use of any anticoagulant or thrombin, only centrifuged autologous blood. Fibrin is an insoluble molecule that is the activated form of fibrinogen, a soluble molecule by thrombin, factor XIII, calcium ions and fibronectin. Fibrin is part of the last stage in the coagulation cascade. This molecule is found in platelet alpha granules and in plasma. Fibrin becomes a biological adhesive that enables the stabilization of the initial platelet cluster during coagulation. The regeneration capacity of PRF is due to its angiogenesis potential, which can be explained by the 3D fibrin matrix that can carry cytokines and GFs such as VEGF, IGF, TGF-β1 and PDGF (13).

Several adaptations of PRF have been created since the original PRF, which is also known as leukocyte PRF. These include injectable PRF (I-PRF), advanced PRF (A-PRF) and titanium PRF (T-PRF). L-PRF's impediment includes rapid degradation properties (<2 weeks). A novel titanium prepared PRF (T-PRF) was developed in 2014 (14). The T-PRF method is based on the hypothesis that titanium may be more effective in activating platelets than the silica activators used with glass tubes in L-PRF and may increase substantivity to a month in situ (15). Albumin-PRF is created by tempering PPP layer to create a denatured albumin gel which is then mixed with the PRF layer (16). A-PRF was

developed using a lower centrifugate rate, creating a more porous structure, in which more platelets and leukocytes are imbedded. Miron and colleagues published a modification to PRF: an injectable liquid formulation of PRF (I-PRF). As compared to PRP, after 10 days, I-PRF released higher levels of GFs such as IGF-1, EGF, PDGF-AA/AB. Furthermore, I-PRF induced the higher fibroblast migration, while PRP induced higher levels of cell proliferation (17). Fujioka-Kobayashi and colleagues noted that modification to centrifugation speed and time influences GF release. As centrifugation speed decreases, GF and leukocyte release from the PRF clot is increased (18).

3.4 PRF Technique

As described by Choukroun and colleagues, intravenous blood is collected in 10 mL tubes with no anti-coagulant addition; it is then centrifugated at 3000 rpm for 10 min. At the end of the procedure, three layers are obtained: 1. RBC layer; 2. Fibrin clot layer (PRF); 3. Serum layer (PPP) (Figure 1b). The coagulation process starts immediately when the blood comes into contact with the glass tube (8).

3.5 Concentrated Growth Factor (CGF)

In 2006, Sacco reported on another platelet concentrate - CGF (9). CGF is produced in a manner that is similar to that used to produce PRF, but it involves a different centrifuge speed. CGF contains GFs such as VEGF, PDGF, IGF-I and TGF-β1. Compared to PRF, CGF contains a denser and richer GF–fibrin matrix. Furthermore, CGF has a 3D fibrin network in which growth factors are closely bound to one another. This provides the slow release of growth factors, which helps with wound healing (21).

3.6 CGF Technique

As described by Bozkurt and colleagues, intravenous blood is collected in two 10 mL glass-coated plastic tubes with no anticoagulant addition. The tubes are immediately centrifuged (Medifuge, Silfradent, S. Sofia, Italy) in the following manner: 30 s acceleration, 2 min 2700 rpm, 4 min 2400 rpm, 4 min 2700 rpm, 3 min 3000 rpm and 36 s deceleration (Table 1). At the end of the procedure, four layers are obtained from bottom to top: RBC layer, GF and stem cell layer (CGF), buffy coat layer, and serum layer (PPP) (Figure 1c). The CGF layer can then be separated and squeezed in a special box at a thickness of 1 mm (22).

4. Periodontal Regeneration

Periodontitis, a chronic inflammatory disease associated with clinical attachment level (CAL) loss and bone loss of the surrounding structures that support the tooth within the jaw, is present in a moderate to severe form in approximately 64% of adults aged 65 and over (23). Nonsurgical and conservative management of periodontitis is a mainstay of treatment and highly effective (24). Residual non responsive areas of chronic infection and intrabony defects (IBD) are at risk of progression (25) and have been recommended for surgical intervention (25, 26). As a result, improving outcomes and predictability of regenerative procedures is acutely relevant to periodontal practice.

Table 1. Types of PRFs

	Centrifugal speed (rpm)	Centrifugal time (mins)	Tube type	State
Platelet rich fibrin (L-PRF) (19)	2700	12	Glass	Solid
Concentrated Growth Factor (CGF) (9)	2700 2400 2700 3000	2 4 4 3	Glass	Solid
Titanium platelet-rich fibrin (T-PRF) (14)	2700	12	Titanium	Solid
Advanced platelet-rich fibrin (A-PRF) (20)	1300	14	Glass	Solid
Albumin platelet-rich fibrin (Alb-PRF) (16)	1300	8	Glass	Solid
Injectable platelet-rich fibrin (I-PRF) (16)	700	3	Plastic	Liquid

PRF = platelet-rich fibrin

4.1 PRP

4.1.1 Intrabony Defects

Some studies found that over a period of 6 months, the addition of PRP to a bovine-derived xenograft (BDX) improved the clinical periodontal response. Hanna and colleagues demonstrated improved clinical results in terms of pocket depth (PD) reduction and CAL gain, in comparison to the use of a graft alone (27). The combination of PRP with BDX and a collagen membrane (CM) is more effective in IBD as compared to BDX/CM alone (28). The impact of a CM was further investigated, and a comparison between a PRP/BDX group and PRP/BDX/CM demonstrated no significant differences, highlighting that perhaps in the presence of PRP the additive effect of a CM is limited (29). Similarly, Piemontese and colleagues (30) has shown that the addition of PRP to demineralized freeze-dried bone allografts (DFDBA) increases the effectiveness in pocket depth reduction and CAL gain. Moreover, the addition of PRP to bone autografts and allografts has been shown to induce dense matured bone with organized trabeculae (31) and the use of PRP increases bone deposition (12).

Compared with the above studies, others have shown no significant benefits. Two 12 month studies had failed to show the benefit of PRP to improve clinical results, whether as an adjunct to BDX and a non-resorbable membrane or with BDX alone (32, 33). PRP has shown not to provide clinical benefit with beta tricalcium phosphate (β-TCP) in the treatment of IBD (34). In addition to the inconsistent clinical benefit, there are also a few limitations to the use of PRP. Compared with PRF, PRP requires a greater volume of blood drawn, higher costs and requires additional thrombin, which has shown to inhibit cell migration during bone repair (35). Traditionally, the source of thrombin was exogenous (i.e., bovine), thus there is a risk of transmissible infectious diseases and, bovine specific thrombin increases the risk of the production of antibodies to factors V and XI, which increases the risk of coagulopathies (36).

4.1.2 Furcations

In Grade 2 mandibular furcations open flap debridement (OFD) with PRP demonstrated PD reduction of 2.3 mm vs. 0.8 mm in OFD alone, and CAL gain of 2 mm vs 0.1 mm (37). Lekovic and colleagues treated Grade 2 mandibular furcations with a PRP/BDX/CM in a split mouth approach comparing with an OFD, demonstrating significantly superior results in PD reduction, CAL gain, vertical and horizontal defect fill (38). A canine study with manually created defects were evaluated the histological difference between the test group treated with PRP/Bioglass/CM versus a positive control Bioglass/CM. Both groups demonstrated regeneration of periodontal structures, however the PRP group demonstrated more cementum coronally, less connective tissue, higher density bone with greater mineralisation and less marrow spaces demonstrating the increase capacity for regeneration with PRP (39).

4.2 PRF

Since 2009, the use of the PRP technique has diminished since the use of PRF does not require exogenous sources of thrombin and the risk that carries. In an *in vitro* study (40), rat osteoblasts showed that cells treated with exudates of PRF reached peak mineralization in 14 days significantly more than those treated with PRP, demonstrating superiority in expression of alkaline phosphatase and induction of mineralization in response to markedly released TGF-β1 and PDGF-AB. Porcine studies have demonstrated with PRF centrifuge, PRF fibrin improves the periodontal osseous defect healing by up-regulating phosphorylated extracellular signal-regulated protein kinase expression and suppressing the osteoclastogenesis by promoting secretion of osteoprotegerin (OPG) in osteoblasts cultures and influencing periodontal ligament fibroblasts (41, 42). Moreover, PRF enhances cell attachment, proliferation, and collagen-related protein expression of human osteoblasts (43). The act of PRF as a membrane has been investigated, and it's stability varies from 7 to 11 days as the network of fibrin disintegrates with release of incorporated growth factors (44). This is partially explained by the mechanical properties of PRF, which have demonstrated a significant lower Young's modulus of elasticity of PRF membranes (0.35 GPa) compared with bovine CM (2.74 GPa). After 1 week, the PRF membrane has degraded by 36% of its initial weight compared with 3% in the bovine collagen membrane group (45). This limits its use as a membrane for regenerative purposes, as periodontal and bone regeneration warrants a period of at least 4-6 weeks for epithelial exclusion (46).

4.2.1 Intrabony defects

PRF has demonstrated superior results compared with open-flap debridement (OFD) alone procedures in IBD (47). Three-wall defects demonstrated a PD reduction of 4.55 mm in the PRF group versus 3.21 mm in the OFD, with a particularly significant difference in mean bone infill (as interpreted radiographically) of 48.26% compared with 1.80% (48).

Statistically, these results persisted, whilst with limited clinical benefit, in 2-3 wall defects where PD reduction improved from 1.6 mm in the control to 1.9 mm in the test group (49). A rationale for this may be due to PRF providing significantly higher gingival crevicular fluid concentrations of angiogenic biomarkers and lower receptor activator of nuclear factor kappa-B ligand (RANKL)/OPG ratio (50, 51).

Lekovic and colleagues (52) tested the use of PRF alone or as an adjunct to BDX in IBD and the clinical parameters significantly improved further in the combination group. The PRF alone group had a 3.24-3.35 mm PD reduction and 2.12-2.24 mm CAL gain, in comparison to the combination results of 4.29-4.47 mm PD reduction and 3.71-3.82 mm CAL gain. The combination of OFD/PRF/hydroxyapatite (HA) improved the outcome in IBD in comparison to PRF alone (53). When PRF was combined with DFDBA in IBD, there was significant PD reduction and CAL gained compared to DFDBA alone (54). A similar outcome was found when PRF was combined with a CM compared to a CM alone (55, 56).

In contrast other studies have shown the addition of PRF did not improve PD reduction and CAL gain, such as when added to enamel matrix derivatives, BDX or Bioactive Glass Putty (57-59). More novel approaches have also assessed the benefit of PRF and the added benefit of soluble forms of metformin, statins or bisphosphonates that are applied intra-surgically demonstrating early evidence of an added statistical benefit (60-62).

T-PRF compressed membranes have recently been utilised to treat endo-perio lesions in anterior teeth with a randomised controlled trial comparing T-PRF to a negative control of OFD alone, and positive control of DFDBA/CM. T-PRF demonstrated significantly improved outcomes compared to the OFD group. PD reduction and CAL gain was similar between the T-PRF and DFDBA/CM groups, while the DFDBA/CM demonstrated an increased reduction in radiographic bone infill (63). T-PRF and L-PRF were compared in the treatment of IBD at the Oxford Dental College, and although demonstrated better results compared with OFD alone, did not demonstrated significant differences between the two groups (64).

4.2.2 Furcations

Seventy-two Grade 2 mandibular molar defects were treated with OFD alone, PRF or PRF and 1% alendronate (65). Mean PD reduction was respectively, 2.41 mm, 3.69 mm and 4.4 mm, with CAL gain of 2.3 mm, 3.39 mm and 4.12 mm. Bone defect fill was similar for the PRF and PRF and 1% alendronate group with 49.43% and 56%, versus 10.25% in the OFD group. When PRF was combined with DFDBA in mandibular molar furcations, there was significant horizontal attachment gain to DFDBA alone (4.57 mm versus 1.50 mm), otherwise vertical changes were similar (66). Thus, despite evidence of improved outcomes, there appears to be inconsistent results with the use of PRF techniques in IBD, and although there is a benefit compared with OFD alone it's results alone are inferior to traditional regeneration techniques. As an adjunct to traditional techniques it appears to have some benefit. Further investigation of APCs with longer substantivity such as T-PRF may be of further interest for studies.

4.3 CGF

4.3.1 IBD

Regarding CGF, there are limited studies available in relation to periodontal regeneration. When combined with a BDX, CGF might be a superior scaffolding material (67). CGF presents number of advantages. The use of CGF involves a simple and inexpensive procedure (68). As above with respect to PRF, the use of CGF requires no exogenous additions, such as thrombin or calcium chloride. Therefore, the probability of cross-contamination is low. Similar to PRF, the use of CGF is associated with the steady release of growth factors over 7–10 days. There are also some limitations to the use of CGF, for example, the platelet count in CGF is influenced by the blood pH and this can affect cell proliferation capabilities (68).

As a more novel APC, clinical studies are limited in investigating CGF. A randomised controlled trial investigated treatment of IBD of 1 wall defects with 4 treatment groups: OFD, OFD + CGF, OFD + BDX, and OFD/CGF/BDX. Groups OFD/BDX and OFD/CGF/BDX demonstrated significantly better outcomes than OFD and OFD/CGF, and CGF did not seem to have an additive effect to the OFD/BDX group (67). This was in contrast to Qiao and colleagues (2016), who demonstrated a significant additive benefit of CGF to bovine porous bone mineral in periodontal regeneration of 2-3 wall IBD, suggesting that the increase bone walls, adjacent cells and graft stability may influence CGF's additive benefit (69). Given the limited clinical studies present, it's difficult to draw any conclusions at this stage.

5. Soft tissue regeneration

In regards to soft tissue regeneration and treatment of recession defects, the use of PRF has been investigated in a systematic review (70). In RT1 (71) recession defects, PRF as adjunct to a coronally advanced flap (CAF) procedure did not

differ significantly from the use of CAF alone. When CAF/PRF was compared with CAF combined with a connective tissue graft (CTG), there was a statistically significantly greater recession root coverage favouring CAF/CTG, with a minor mean difference of −3.97%. In contrast, Keceli and colleagues investigated the adjunctive use of PRF in combination with CAF/CTG flap compared with CAG/CTG alone, and demonstrated an improvement in change of recession coverage by a mean of 0.45mm, indicating a lack of predictability in outcome (72). RT1 gingival recessions with abrasion defects were treated either T-PRF (63 teeth) or CTG (51 teeth) using a modified tunnel technique. After 12 months, the mean root coverages were 93.29% and 93.22% in the T-PRF and CTG groups respectively. CTG resulted in greater gingival thickness than T-PRF at 6 and 12 months post-surgery compared to baseline. However, the mean amounts of keratinised tissue width (KTW) increased by 1.97mm and 0.75mm in the T-PRF and CTG groups, respectively (73). Thus, at this stage, PRF's ability to provide a predictable improvement in soft tissue outcomes seems limited.

CTGs require a donor site, which can be often a source of pain and discomfort for patients. Several studies have described PRF's benefit in the donor site with improved patient centred outcomes including pain management from the harvested donor site in comparison to suturing alone in subepithelial harvesting (74) and in comparison to collagen sponges and suturing in free gingival harvests (75). In clinical practice, this may be a useful technique to improve patient centred outcomes.

6. Regeneration in relation to Implant Reconstruction

Implants are an expanding area of reconstructive dentistry with excellent survival rates (76). Over half of implant placements may require additional bone graft procedures to allow adequate bony housing for a prosthetically restorable implant to be placed, which leads to pressure on the scientific community to explore different modalities for bone augmentation and regeneration (77).

6.1 Alveolar Ridge Preservation (ARP)

A variety of PRF additions to bone grafting substitutes has been explored, with A-PFR/FDBA suggesting the greatest reduction in socket dimensions. L-PRF application in extraction sockets demonstrates consistent results of reducing reduction in horizontal width dimension and less post operative pain, however no difference in vertical loss compared to extraction without socket grafting was noted (78, 79). PRF seems to have no additive benefit to DFDBA in socket grafting procedures (80), in contrast a four arm randomised clinical trial comparing socket grafting with no graft (negative control), A-PRF alone, A-PRF/freeze-dried bone allograft (FDBA), and FDBA alone demonstrated a similar result between A-PRF and FDBA, with A-PRF/FDBA demonstrating the best results in height and width reduction. The treatment group using A-PRF demonstrated the highest percentage of vital bone (46%) of all groups and was significantly greater than the FDBA group (81).

Al-Maawi and colleagues assessed the impact of PRF in ARP in a systematic review (82). Two-thirds of the studies in a systematic reviewed showed that PRF significantly reduced the postoperative pain, especially in the first 1-3 days after tooth extraction. Soft tissue healing was significantly improved in the group of PRF compared to the spontaneous wound healing after 1 week (75% of the evaluated studies). Although socket fill was higher and dimensional bone loss was significantly lower in the PRF group compared to the spontaneous wound healing after 8-15 weeks, these results did not persist at 6 months, indicating that perhaps the benefits of PRF alone may be limited in duration.

Soft tissue healing is particularly important and can compromise surgical areas in those with a suppressed immune system. A study investigated the benefits of PRF in extraction socket healing as part of a socket grafting approach in patients who were smokers. A four arm clinical trial investigated the groups: A-PRF, A-PRF/FDBA, FDBA/CM and a positive control, collagen plug group. Both A-PRF and A-PRF/FDBA demonstrated significantly faster rates of soft tissue closure when compared to the other groups, and in addition patients experienced less pain and fewer complications, highlighting that perhaps it's benefit may be short term and beneficial in those with higher risks of early soft tissue healing (83). Although studies have demonstrated improved outcomes with the adjunct use of PRF, these results have been inconsistent. It seems that perhaps PRF's supplementary use may be better indicated to those patient at risk of early soft tissue complications.

6.2 Simultaneous Ridge Augmentation

Animal models have explored the use of PRF in peri-implant defects. Eight New Zealand white rabbits were used for this study. Two peri-implant defects sized 3.0 × 5.0 mm were prepared after drilling to host a dental implant in the tibia, one was left to heal with no intervention and the other was

the experimental group with PRF. In the histomorphometric analysis, mean new bone formation was 29.30% in the experimental group and 11.06% in the control group. Mean bone-to-implant contact was 39.43% in the experimental group and 17.11% in the control group, demonstrating the benefit in speeding up early growth and maturation of bone (84).

The sinus floor is known for its unique osteogenic properties (85) and a study compared bone formation in the elevated maxillary sinus between PRF and blood clot alone as the sole sinus-filling material with the implant as a tent pole. The study was a randomized controlled trial with a split-mouth design involving seven patients. An implant was placed on one side only and blood was allowed to fill the elevated sinus cavity; on the other side, PRF plugs were inserted. The sinus window was covered by non-resorbable titanium-reinforced membrane. The results showed that there was no statistically significant difference between the two groups, but the PRF group showed increased bone gain in the mesial, buccal, and palatal regions, and increased average height and bucco-palatal width at the height of the old and new sinus floor. A greater increase in distal bone height was seen in the control group. It was concluded that PRF may be more effective as a sole sinus-filling material in the elevated sinus cavity with an implant as a tent pole (86).

Isik and colleagues investigated whether the addition of a liquid PRF in combination with xenograft would improve outcomes for implants placed with simultaneous ridge augmentation in the posterior mandible (87). Implant placement with dehiscence of the buccal bone had perforations of the adjacent cortical plate, and either a positive control of BDX/CM or I-PRF/BDX/CM in a submerged protocol. At 6 months postoperatively, the mean values of augmentation thickness were 1.63 mm, 2.59 mm, and 3.11 mm for the test group and 1.34 mm, 2.49 mm, and 2.97 mm for the control group at 2 mm, 4 mm, and 6 mm below to the implant shoulder. The mean marginal bone loss was found to be less than 1 mm for both study groups during the 2 years of follow-up after prosthetic loading and implant survival rate was 100% for both study groups (87). Another prospective study has demonstrated that combining PRF membranes with particulate BDX can be effective and safe in treating horizontal bone defects in the anterior maxilla together with implant placement as part of a full arch rehabilitation with immediate temporary prosthesis loading (88). Although statistical significance was reached in the prior studies, clinically the improvement may be considered marginal.

An immediate placement protocol in maxillary premolar sites were divided into two groups, the first receiving xenograft as the jump gap filling material, and the second group receiving PRF. After 6 months, the PRF group demonstrated greater crestal bone loss (1.85mm) compared with the xenograft (0.77mm) as well greater bucco-palatal horizontal bone loss (1.63mm) versus the xenograft group (0.59mm). Implant stability quotient (ISQ) levels were also significantly lower in the PRF group (89). Thus, although PRF seems to be better than no external grafting, it is not a replacement of traditional grafting procedures, however may act as an adjunct to improve the early success of bone volume gain and maturation.

6.3 Staged Augmentation Procedures

Rehabilitation of an edentulous posterior maxilla with dental implants is challenging, and sinus floor augmentation is often considered. A split-mouth randomized clinical trial evaluated 10 patients who required bilateral sinus floor augmentation. It assessed the effect of sinus floor augmentation via a lateral window approach with PRF compared with freeze-dried bone allograft (FDBA) on the stability of dental implants. L-PRF plugs and membranes were used in one quadrant while FDBA and collagen membranes were used in the other quadrant. No volumetric or histological assessments were made, however the mean ISQ significantly increased greater in the PRF group over a 6 month period (90). The more novel T-PRF was also evaluated in sinus lifting procedures and after 6 months demonstrated significantly greater bone height (>69%), bone volume (>53%) and bone density (>85%), even though ISQ values were similar (91).

Twelve patients requiring two-stage bilateral maxillary sinus augmentation were randomly grafted with BDX/PRF (test) or BDX alone (control) in a split-mouth design. Implants were placed in the augmented sites after 4 months in the test group and 8 months in the control group with bone biopsies collected. Histological evaluation demonstrated increased percentage of newly formed bone for the test group (44.58%) compared to the control group (30.02%). The amount of residual graft in the control group was significantly higher (13.75%) than in the test group (3.59%). ISQ immediately after implant placement was significantly higher in the control group (ISQ 75.13) compared to the test group (ISQ 60.9). The ISQ values at loading did not differ between the groups. Implant survival rate was 100% for both groups (92). Although the indication for positive benefits and earlier loading ability, research in PRF's benefits in sinus augmentation seems to be inconclusive as some

research has demonstrated no added benefits from its use (93) while others support the accelerated bone healing with the addition of PRF to BDX (94, 95).

A two year follow up study on a small number of implants placed in edentulous ridges with staged block grafting. The control group covered the autogenous block grafted with BDX and a CM, whereas the test group covered the area with three PRF membranes. Six months after, implants were placed and restored. There was no difference in implant survival, however the mean marginal bone level of the control was statistically less by 0.43 mm compared with the test group (96). These studies suggest PRF's use in staged augmentation procedures may be limited.

6.4 Peri-Implantitis

With the increasing replacement of missing and compromised teeth with dental implants, there is an increasing prevalence of peri-implantitis in the population. A recent long-term clinical cohort study evaluating 4247 patients and 10871 dental implants, showed that at 15 years, 14% of patients experienced an implant failure and 6% of implants failed (76). Peri-implantitis prevalence ranges between 10-26% of implants at 10 years (97).

Studies are sparse on the impact of APC in the treatment of peri-implant defects. To evaluate a baseline benefit of PRF, an earlier study compared its effects versus OFD alone. Nineteen patients with peri-implant bone loss were randomly allocated to two groups: a PRF group who received fibrin scaffold and the control group of access flap. At 6 months after surgery, the PRF group demonstrated higher mean PD reductions (2.82 versus 2.05 mm), more gains in CAL (3.31 versus 1.84 mm) and increased amount of keratinized mucosa compared with the control group (98). A 12-month study evaluated the treatment of peri-implantitis defects with BDX covered with either CGF or a CM. PD, CAL and vertical defect depth values were statistically significant in favour of the CM group at 12 months (99). As studies are limited, studies are limited to suggest significant benefit compared to traditional regenerative protocols.

7. Tooth regeneration

A novel area of research with is the entire regrowth of a tooth and it's supporting apparatus. PRF has been demonstrated to stimulate osteogenic differentiation of human dental pulp cells by upregulating OPG and alkaline phosphatase expression (100). Tooth and periodontium regeneration has been demonstrated with a combination of PRF and fibrin glue to enrich the microenvironment with growth factors (101). Unerupted molar tooth buds were harvested from swine and cultured in vitro for 3 weeks to obtain dental bud cells (DBCs). DBCs were suspended in fibrin glue and then enclosed with PRF, and the DBC-fibrin glue-PRF composite was autografted back into the original alveolar sockets. Radiographic and histological examinations were used to identify the regenerated tooth structure 36 weeks after implantation. One pig developed a complete tooth with crown, root, pulp, enamel, dentin, odontoblast, cementum, blood vessels, and periodontal ligaments in indiscriminate shape. Although we are perhaps years away from whole tooth-periodontium regeneration, this area of research may become a future evolution of clinical practice.

Conclusion

The review has provided clinical information regarding the use of autologous platelet concentrates techniques in periodontal and implant related regeneration procedures. In the treatment of periodontal intrabony defects and furcation defects, PRP has shown inconsistent clinical results when compared to OFD alone or as an adjunct to BDX or DFDBA. Histologically, it does seem to demonstrate superior results with greater mineralisation, bone maturation and cementum regeneration. PRF has demonstrated clinical improvement when compared to OFD alone in 3 wall defects, however this benefit is not present when defects are 2-3 wall and may indicate that substantivity and matrix stability may be a limiting factor. Intrabony defects are often indicated for a regenerative protocol, and although there has been some evidence that PRF provides an additive effect to BDX or CM or DFDBA in IBD and furcations, this has been inconsistently reported and the evidence seems to be limited. CGF has very few clinical trials to report on and evaluate. In recession defects, PRF seems to provide limited benefit, however does demonstrate superior outcomes when used in the donor site to minimise postoperative pain and discomfort for patients compared with traditional closure techniques.

In extraction sockets, PRF seems to provide relatively consistent outcomes of improved patient postoperative pain and early tissue closure, with better 2-3 month ridge dimensions compared to extraction alone. However these benefits are limited and do not last beyond 6 months, and when compared with traditional xenografts and allografts provide an inferior result. Smokers have shown to particularly benefit from PRF and its ability to improve soft tissue closure with less pain and fewer complications

in socket graft approaches. This may indicate that those who are at risk of early soft tissue complications may benefit from the adjunctive use of PRF. In augmentation procedures, the use of PRF alone is insufficient to minimise significant risks of crestal loss, however as an adjunct to BDX/CM demonstrates improved early success of bone volume gain and maturation. In sinus augmentations, evidence seems to be inconclusive, however it may provide a role in minor sinus elevation procedures (instead of a blood clot), and where protection of the sinus membrane may be warranted as a protective membrane. In comparison to access flaps alone in peri-implantitis surgery, PRF does provide a significant improvement in treatment outcomes, but once again when compared with traditional regenerative protocols (BDX/CM) outcomes are not demonstrating significant clinical benefit.

The benefits of APCs seems to be limited to certain clinical scenarios in periodontal and implant regeneration, however it's use needs to be evaluated based on a risk-benefit assessment for each individual patient. Logistically and clinically, this may seem more practical when coupled with general anaesthetic based procedures where venepuncture is already required. Venepuncture does have its own complication rates, with 12.3% experiencing minor bruising and 3.4% experiencing more severe complications, predominantly syncope however also rare occurrences of nerve injury (102). The future of healthcare is moving towards individualised treatment solutions. In this sense APCs provides a relatively convenient source of autologous growth factors and biological material that may have ongoing iterations and improved applications.

List of Abbreviations

Advanced PRF (A-PRF)
Adenosine phosphate (ADP)
Autologous platelet concentrates (APCs)
Bovine-derived xenograft (BDX)
Basic fibroblast growth factor (bFGF)
Bone morphogenetic proteins (BMPs)
Beta tricalcium phosphate (β-TCP)
Clinical attachment level (CAL)
Coronally advanced flap (CAF)
Concentrated growth factor (CGF)
Collagen membrane (CM)
Connective tissue graft (CTG)
Dental bud cells (DBCs)
Freeze-dried bone allograft (FDBA)
Growth factors (GFs)
Intrabony defects (IBD)
Insulin-like growth factor-1 (IGF-1)
Injectable PRF (I-PRF)
Keratinised tissue width (KTW)
Leukocyte PRF (L-PRF)
Mesenchymal stem cells (MSC)
Open flap debridement (OFD)
Osteoprotegerin (OPG)
Pocket depth (PD)
Platelet-derived growth factor-BB (PDGF-BB)
Periodontal ligament stem cells (PDLSCs)
Platelet-rich plasma (PRP)
Platelet-rich fibrin (PRF)
Red blood cells (RBCs)
Transforming growth factor β-1 (TGF-β1)
Titanium PRF (T-PRF)
Vascular endothelial growth factor (VEGF)

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Periodontal Defects Associated with Impacted Third Molars and the Effectiveness of Different Treatment Modalities: A Narrative Review

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Abstract:

Impacted third molars are often associated with periodontal defects affecting the distal aspect of the second molar (D2M). These periodontal defects have been reported to persist after extraction, which may affect the long term periodontal prognosis of the second molar. Management of such defects is difficult and although a number of different interventions have been investigated, there is still little consensus on the optimal treatment strategy. The aim of this review is to examine the factors associated with the presence of periodontal defects D2M and the evidence supporting different interventions in the treatment of such defects.

1. Introduction

Third molar impaction is a common occurrence, with a reported worldwide prevalence of 24%.(1) The odds of third molar impaction in the mandible are higher than in the maxilla(1) and has been suggested to result from inadequate space in the retromolar area.(2) Although controversy exists regarding the timing and necessity of third molar removal,(3) a systematic review by Vandeplas et al. (2020)(4) has shown that retained third molars rarely remain healthy, with periodontal disease often affecting both the third molar and adjacent second molar.

Impacted third molars have been shown to be associated with periodontal defects on the D2M. These defects in some cases persist even after extraction(5) and a number of local and patient factors have been shown to be risk factors.(6) The persistence of such defects results in an increased risk of disease progression and tooth loss.(7)

The present review examines the current understanding of the aetiology and risk factors for poor periodontal healing on the D2M after third molar extraction and summarises the treatment modalities which have been investigated to reduce the prevalence of persistent periodontal defects.

2. Aetiology and the third molar as a predisposing factor

An impacted third molar is thought to contribute to the formation of periodontitis by acting as a predisposing factor, allowing the accumulation of plaque and likely contributing to the ecological niche required for disease initiation and progression.(8, 9) Further, in the case of partially erupted third molars the gingival seal D2M may also be compromised. Periodontal disease affecting the D2M has been shown to have an increased prevalence when associated with mandibular third molars compared to maxillary third molars,(10) as well as with third molars with a mesio-angular and horizontal impaction, in relatively deep positions.(11, 12) Disease prevalence has also been shown to be correlated with the patient's age, likely being a surrogate

marker of time for disease progression.(10) This is consistent with a longitudinal study conducted at The University of Kentucky and The University of North Carolina by Blakey et al. (2009),(13) which showed increased disease prevalence and progression over time when third molars were retained. In this study a probing pocket depth (PPD) ≥4mm on the D2M at baseline was significantly more likely to increase in depth by 2mm after 2 years.

3. Extraction: risk factor or treatment modality?

Treatment of periodontal pathology in this clinical context is complicated by the bony architecture of the extraction socket and the poor soft tissue quality characteristic of the third molar region.(10) Third molar retention and conservative management has been shown to provide minimal benefit,(14) often leading clinicians to extract the associated third molar.

Healing after extraction initially involves the formation of a blood clot. This is sequentially replaced by a provisional connective tissue matrix, woven bone and finally lamellar bone and bone marrow.(15) Clinically, healing is represented by the closure of the socket entrance with firm epithelialized soft tissue and radiographic bone fill of the socket. Complete radiographic bone fill may take between 3 to 6 months, after which some remodelling occurs over the subsequent 6 months.(16)

Studies have investigated the effect of extraction on pre-existing defects. These studies have mainly examined mandibular defects, consistent with the increased prevalence associated with these teeth.(10, 17) The majority of such studies have shown improvement in the periodontal condition, supporting extraction as a treatment option.(13, 17-22) In a longitudinal study described by Blakey et al. (2009)(13) more patients had no PPD ≥5mm at follow-up after surgery (49%) when compared to baseline (39%). Montero et al. (2011)(18) showed that after extraction in a cohort with a PPD of 5mm D2M at baseline there was an improvement of approximately 0.6mm every 3 months for 12 months. Improvement in radiographic bone levels after extraction were also reported in a split mouth study, when compared to no extraction.(23)

It has been shown however that in some cases defects associated with the D2M persist even after extraction. Kugelberg et al. (1990)(5) found in a retrospective study that PPD ≥7mm and intrabony defects ≥4mm associated with the D2M were present even 4 years after third molar removal, with a prevalence of 25.0% in subjects ≤25 years of age and 51.9% in individuals ≥26 years old.

Iatrogenic trauma during third molar removal has also been suggested to be a risk factor for the development of periodontal defects associated with the D2M.(24) A review by Dodson et al. (2007)(25) examining third molar removal as a risk factor found that there was a 'predictable, finite, measurable risk of bone loss' after surgery and concluded that caution is required when extracting third molars in older patients without defects. However, the review did not critically appraise the included publications and consequently the results should be interpreted carefully.(26)

Dicus et al. (2010)(27) evaluated data from two studies where details of the surgery, including bone removal and perceived difficulty were recorded. Subjects were significantly more likely to have an improved D2M periodontal status after surgery than a deteriorated status ($p < .01$). Data estimating the extensiveness of surgery did not show significant association with postsurgical D2M periodontal outcomes. Although limited by sample size, this study suggests that iatrogenic damage is an uncommon occurrence. Further well designed studies are required to understand the true risk associated with surgical trauma.

Extraction has generally been shown to be associated with clinical improvements as recently shown in a meta-analysis(28). However, resolution does not occur in all cases and there appears to be certain risk factors which predispose towards incomplete healing in certain individuals.

4. Factors influencing healing following extraction

Associations with incomplete resolution of defects have been reported and fall into three categories, namely local factors, surgical factors and patient factors.

The presence of pre-existing lesions as a local risk factor has been supported in a number of studies(27, 29) and was reported as the variable with the highest correlation to the presence of postoperative intrabony defects in a study by Kugelberg et al. (1991)(30). Pang et al. (2022)(28) in a recent systematic review investigated factors which may influence the periodontal healing of the D2M after lower third molar surgery. This review examined randomised controlled trials (RCTs) and prospective studies with at least 6 months of follow-up and found that a higher PPD at baseline was considered predictive of higher PPD at follow-up. Other local factors with a reported association include the depth

of impaction,(18, 31) mesio-angular impaction,(27, 29) eruption,(32-34) and the contact area between the third molar and D2M.(30).

Some studies have indicated a possible association between persisting defects and aspects of the third molar extraction surgery, including flap design,(35, 36) suturing technique,(37, 38) design and extent of the osteotomy and tooth division techniques.(39, 40) However systematic reviews have indicated that the current evidence is limited. (41, 42)

Patient factors such as age and inadequate plaque control have also been examined.(29, 30) Kugelberg et al. (1990,1991)(5, 20) showed that an older age at the time of extraction was highly correlated with the prevalence of persisting defects. Similarly, in a prospective study Kugelberg(20) reported greater reduction in the number of deep intrabony defects persisting post-extraction in the ≤20 year-old group vs the ≥30 year-old group. Pang et al. (2022) (28) however in their systematic review found that although there seemed to be a positive linear relationship between age and final PPD this association was not statistically significant ($p = 0.082$). Kugelberg et al. (1991)(30) also found that oral hygiene was of minor importance when examining different factors contributing to the prevalence of defects.

5. Clinical implications

As discussed, there is evidence that pockets (≥7mm) and intrabony defects (≥4mm) may persist even 4 years after third molar removal.(5) However, there are a limited number of studies examining the long term consequence of these periodontal defects.

In periodontitis, deep pockets are not always consistent with disease and may be considered healthy with a reduced periodontium. They have been shown to remain stable over long periods, particularly if careful supportive periodontal therapy is provided.(43, 44) Consequently a deep PPD must be considered together with the presence or absence of bleeding on probing.(45)

Nevertheless, there does appear to be an increased risk of disease progression and tooth loss in such sites. A retrospective cohort study by Matuliene et al. (2008) (7) investigated the influence of residual pocketing and bleeding on probing after active periodontal therapy, on the progression of periodontitis and tooth loss. The study found that a PPD of 7mm represented a risk factor for tooth loss with odds ratios of 37.9 and 64.2 at site and tooth levels respectively. This indicates there may be an increased risk of tooth loss in residual defects associated with impacted third molars.

6. Treatment modalities

A number of different interventions have been examined to treat residual defects associated with the D2M, either as adjuncts during extraction or as monotherapies, with results showing varying degrees of therapeutic benefit. These include debridement, coronectomy and a variety of regenerative approaches, however the evidence to support any treatment modality is currently limited.

6.1 Debridement at the time of extraction

Debridement of the D2M at the time of extraction has been investigated as an adjunctive therapeutic but studies have produced inconsistent results.(46-48) Leung et al. (2005)(47) examined in a RCT of 30 patients the benefit of root debridement at the time of extraction over socket debridement alone, in a high risk group of patients, but found no significant difference between the two treatment groups.

A systematic review by Ramirez et al. (2012)(49) noted that there may be a reduction in PPD on the D2M from root debridement and plaque control programs however due to limited reporting of the interventions provided and heterogeneity in methods between studies concluded that no recommendations could be made. A more recent systematic review has also reported a lack of strong evidence.(28)

6.2 Coronectomy

Data from a number of studies have suggested a potential benefit to the periodontal condition on the D2M when coronectomy is performed.(50, 51) It has been hypothesised that coronal migration of the root and the associated periodontal complex may result in regeneration.(51) These studies however are limited by a lack of a control group and consequently it is difficult to conclude that there is benefit beyond extraction.

6.3 Regenerative periodontal therapy

Regenerative periodontal therapy aims to re-establish lost supporting periodontal tissues to restore form and function. Periodontal regeneration has been shown to be achievable with various materials (e.g. membranes, bone grafts and substitutes, biological factors) and techniques.(52, 53) These

improvements have demonstrated long term stability, with treated teeth retained after 10-15 years of follow-up.(54-57)

Regeneration with different techniques and materials have been investigated in defects in the D2M, including guided tissue regeneration,(58-63) the use of allografts,(64) autologous bone,(65) alloplasts,(66, 67) and xenografts,(68) in osseous grafting and in combination techniques.

Following Melcher's concepts of compartmentalisation,(69) guided tissue regeneration (GTR) techniques utilise barrier membranes to facilitate the migration of bone cells and PDL cells to defects by preventing soft tissue cells from infiltrating into the defect.(70, 71) Earlier studies utilising GTR during extraction of third molars reported that the technique was technically challenging, resulted in membrane collapse and minimal benefits.(32, 61) These studies are limited however by an absence of a pre-existing defects at baseline. When treating high risk patients (bony defects >6mm) statistically significant benefits in terms of clinical attachment levels (CAL) and radiographic bone gain have been demonstrated, which appear to be achievable with both expanded polytetrafluoroethylene and collagen membranes.(59)

Osseous grafting of autogenous bone has shown improvement in crestal alveolar bone levels (ABL) measured radiographically but no significant changes in terms of PPD at 6 months.(65) Autogenous dentine grafts have been examined by Sánchez-Labrador et al. (2020)(72) and showed significantly better outcomes in terms of PPD and radiographic healing, however such an approach is limited by the extensive time required for graft preparation.

A small number of studies have examined the use of deproteinised bovine bone material (DBBM) alone or with the use of a membrane and have shown significant reductions in PPD, gain in CAL(73, 74) as well as crestal ABL(74) compared to control. The combination of DBBM and a collagen membrane also appears to be superior to DBBM alone.(73)

A systematic review by Toledano-Serrabona et al. (2021) (68) concluded that xenograft and collagen membrane favoured greater PPD reduction and CAL gain compared to spontaneous healing. The review however only included three studies and recommended further well-conducted investigations with larger sample sizes and longer follow-up.

Currently significant heterogeneity limits the ability to draw any robust conclusions and recommendations regarding the use of regeneration and the optimal protocol.(28, 41) A systematic review by Camps-Font et al. (75) examining the efficacy and safety of different modalities of regeneration did not find one protocol superior to any other and concluded that there was a need for more well-designed randomised controlled trials.

7. Conclusion

The presence of mesially and horizontally impacted lower third molars represents a risk factor for periodontal disease which may compromise the adjacent second molar. Both local and patient factors have been shown to be associated with residual defects after extraction. Although a variety of interventions have been investigated to reduce the prevalence of persisting periodontal defects, currently there is insufficient evidence to support their use.

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Maintenance of Peri-Implant Health in Full Arch Fixed Implant Retained Prostheses

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Introduction

Dental implants have increased in popularity as a treatment modality for the replacement of absent or lost teeth (1). The number of edentulous patients utilizing dental implants is growing (2). Full arch fixed implant-supported prostheses are commonly used for the rehabilitation of edentulous jaws. However, the health and stability of dental implants over time are frequently challenged by biological complications associated with a bacterial biofilm (3). Adequate biofilm removal has a great impact on the long-term success of dental implants (4). Regular maintenance and management of known risk factors are the core of implant-disease management (5). Clinical practice guidelines regarding recall visits could vary depending on the prosthetic design, the health status of the implant(s) and the retrievability of the prosthetic components. The purpose of this essay is to discuss the available literature on the maintenance of Implant-supported fixed Complete Dental Prostheses (IFCDP) and their removal for maintenance of peri-implant health.

Peri implant health

Implant health is generally recognized by the lack of signs of inflammation at the peri-implant mucosa including swelling, erythema, bleeding on probing and suppuration (6). In the presence of any the mentioned signs, peri-implant diseases may develop. Peri-implant mucositis can be defined as the inflammation of the peri-implant mucosa without a continuous marginal bone loss (7), and peri-implantitis, currently defined as being a pathological condition that occurs in peri-implant tissues and is characterized by progressive loss of supporting bone and inflammation in the peri-implant mucosa (3). If left untreated, soft tissue damage and bone loss can lead to implant failure (8). Plaque is known as the primary aetiological factor in the pathogenesis of peri-implant diseases (6). The inflammatory process is associated with bacterial colonization, which can start within an hour of implant insertion, studies have shown that a mature complex biofilm can be found within fourteen days of implant placement (9).

Abstract:

Background: Professional peri-implant care of full arch fixed implant supported prostheses is important for the maintenance peri-implant health.

Aim: To discuss the removal of the prosthesis as part of regular maintenance of full arch implant supported prosthesis.

Materials and methods: Articles regarding peri-implant health, peri-implant diseases, implant maintenance, full arch implant supported prosthesis were retrieved based on three search engines; PubMed, Google Scholar and Cochrane library.

Results: The literature shows heterogenicity in the professional maintenance protocols content, frequency, and removal of the prosthetic component for clinical evaluation of the per-implant mucosal status. The literature also lacks a systematic protocol that clinicians can follow for full arch fixed implant supported prostheses maintenance.

Conclusion: There is a need for a consensus on the recommendations for patient-specific maintenance regimen for those who wear full arch fixed implant supported prosthesis.

Keywords: Full arch fixed implant supported prosthesis, Maintenance, Peri-implant diseases, Periimplant health

The development of biofilm on implants was shown to be a cause of peri-implant mucositis (10). Histologically, peri-implant mucositis samples from humans exhibited an inflammatory lesion that was larger in size and contained a higher number of leukocytes compared to the same samples at the time of implant placement (11). In the analysis of peri-implantitis lesions with advanced bone loss, more extensive inflammatory infiltrates were evident in the connective tissue underneath an ulcerated epithelium.

Poor oral hygiene and inadequate professional care are strongly associated with an increased risk of periimplant diseases. Other systemic and local factors include the history of periodontitis, smoking, diabetes, and implant malposition. In 2006, Ferriera and colleagues investigated the prevalence and risk factors of peri-implant diseases in 212 subjects. The prevalence of peri-implant mucositis and peri-implantitis were 64.6% and 8.9%, respectively. The findings demonstrated a dose-dependent association between plaque scores and peri-implant disease, with participants exhibiting a worse peri-implant condition having higher plaque scores. Very poor plaque score (median ≥2 full mouth plaque score Silness & Loe 1964) were found to have an odd ratio of 14 of developing peri-implantitis (12). In a human experimental model, Salvi et al. demonstrated that at 3 weeks following reinstitution of oral hygiene, some peri-implant mucositis sites exhibited clinical signs of inflammation, suggesting that it may take longer for the inflammation to be resolved around implants than teeth (13). Therefore, implant maintenance has been considered the main defence line against the progression of peri-implant diseases (14).

Maintenance of peri-implant health

The imperativeness of regular maintenance is key for prevention and control of peri-implant diseases (5). Studies have reinforced the need for establishing a regular supportive care program (SPC) following initial installation of the implant (15), (16). Similarly, studies that have examined treatment outcomes following diagnoses and management of peri-implantitis have further reinforced the need for strict and personalised SPC. This has been demonstrated in long-term follow-up studies, where those who participated in implant maintenance protocols showed higher survival rates and lower peri-implant complications than those who did not. A systematic review in 2015, assessed the impact of mechanical and/or chemical plaque control in the management of peri-implant mucositis. Although it is a reversible pathology, complete resolution of peri-implant mucositis by means of patient-administered measures was not reported in any study, highlighting the importance of professional intervention (17). Prosthetic treatment provided by general dentists had a significant association with peri-implantitis compared to specialists (18). Subsequently, in a consensus report based on four systematic reviews, it was recommended that the implant position and the structure of the supra-structure should allow sufficient access to regular diagnosis by probing and personal and professional oral hygiene measures (19). This was also reinforced in the recent report from the World Workshop in 2017 that implant position and design of the supra-structure can affect access for homecare and professional plaque removal, and subsequently affect the health of peri-implant tissues (3).

Up to date, there is no optimal maintenance protocol for implant supported prostheses. There is a great heterogeneity in the literature of how frequently the implant maintenance should occur, and the suitable recall interval of each patient (20). Ideally, implant supportive therapy should consider disease characteristics at the peri-implant site, prosthetic shape and materials, the relationship of the prosthetic part to the mucosal surface around the implant, as well as the loading time of the prosthesis.

Lack of adhesion to SPC has been shown to be demonstrably associated with increased incidence of bone loss and implant loss, especially in patients who are periodontally compromised (21). Periodontally compromised patients (PCP) who were non-adherent to SPC had increased fullmouth bleeding scores and a significantly increased percentage of sites with peri-implantitis, with the severe PCP and non-adherent to SPC patients had a mean 88.9% of implants with PPD ≥6mm, compared to 34.7% of implants in severe PCP who were adherent to SPC (22).

Similarly, in moderate PCP and non-adherent to SPC patients had a mean 58.1% of implants with PPD ≥6mm, compared to 15.6% of implants in moderate PCP who were adherent to SPC. In periodontally healthy patents, there was no significant difference in % of implants with PPD≥6mm between adherent versus non-adherent patients (22). Therefore, prior to implant placement, clinicians should inform patients about the significance of both self- and professional implant care, providing specific instructions on how to accomplish this. Moreover, a 5 years follow up study was conducted on 149 dental implants in 22 partially edentulous and 5 fully edentulous patients. Among these 149 implants, 71 had peri-implantitis surgically treated and 78 did not. The baseline clinical assessment was performed 6 months after surgery of the 71 treated implants; 43

presented healthy peri-implant condition, while 28 had residual PPD either of 4–5mm or ≥6mm associated with BOP. All recall visits involved removal of the prosthesis to allow for implant examination and mucosal debridement. The analysis demonstrated low plaque and bleeding scores, as well as stability of 43 healthy implants. The authors concluded that peri-implant conditions showed stability in patients with optimal OH and show up for recalls every 6 months (23). Patients should be made aware that compliance to recall sessions may be the best methods to avoid biological complications and their subsequent complex management.

Full arch fixed implant supported prostheses and their maintenance

Full arch dental implant-supported prostheses can be either removable (overdentures) or fixed (IFCDPs) (24). IFCDPs can be retained by cement, screws, or a combination of both (25). IFCDPs are unretrievable by the patient and can only be removed by the restoring clinician using designated instruments at the office. One of the earliest reports on the use of IFCDPs was published in 1982. The study followed 12 patients with edentulous mandibles who received 4-6 implants (All on X) between the two mental foraminal region, according to Branemark's protocol. The protocol also stated that the base of the prosthesis should 4-5 mm higher than the ridge mucosa, to facilitate cleaning. The patients were given oral hygiene instructions and were called 12 months after the prosthetic insertion to review the plaque control performance (26).

Biofilm accumulation can be a serious problem in full arch prostheses. The oral environment can act as a reservoir for the indigenous flora, even when no teeth are present in the mouth, including periodontal pathogens, to colonise the peri-implant pockets (27). Studies showed gram-positive facultative cocci (80%) were predominantly cultivated prior to implant placement in fully edentulous patients (28). Therefore, even those who were fully edentulous before implant therapy, would still be at risk of biological complications, as the oral cavity is never sterile. Those patients need to perform meticulous plaque control, and comply with a long-term maintenance protocol, to maintain the aesthetics, health and function of the implants and the prostheses. However, this may be hard to implement in real circumstances. Patients who have being without teeth for a long time prior to implant placement may not adhere to self-hygienic oral care practices. Furthermore, motivation to maintain adequate plaque control and manual dexterity tends to decline as one age (29), (30).

Long term follow ups on the biological complications in IFCDPs are scarce. A retrospective analysis of 5-year observation of rough dental implants was conducted to examine 457 implants in 71 IFCDPs (24). There were two groups in the study, one with metal ceramic restorations and the other with metal resin. In terms of their retention method, half of the devices were cemented and the other were screw retained. The rate of biological complications of both minor and major complications at the end of observation period was found to be surprisingly high (88%, 274 implants from 63 IFCDPs). Interestingly, of the 6 implants that failed, poor oral hygiene was a common risk factor. The estimated peri-implantitis rate for 10 years, based on the 5-year analysis, was about 20%. The linear regression analysis showed that high plaque scores related significantly to bone loss. The design of the prosthesis influenced the feasibility of self-performed plaque control, for example, metal-resin are bulky compared to metal-ceramic, which may limit the access for cleaning. Moreover, selection of restoration material, whether ceramic or resin, did not have any significant effect on the complication rate (24). However, none of the prostheses were removed and so no record was taken of the pocket depths or bleeding on probing around any of the implants. The results were based on the reported occurrence of mucosal recession, hyperplasia and radiographic bone loss. As mentioned in the criteria for peri-implant health monitoring, probing depths of all surfaces (buccal, palatal/lingual, Mesial, distal) should ideally be recorded at each recall visit. It is known that accessibility for the periodontal probe can be hindered sometimes by the proximity of the restorative contour to the mucosa. To overcome this challenge, at least one surface per implant should be selected where pocket depth can be measured (4).

The frequency of SPC of implant supported prostheses as well as the self-performed hygiene regimes in 18 studies were analysed. The recall intervals were once every 3 months in the first year for most of the studies. After the first year, recalls can become less frequent, mainly when the patient presents with good hygiene and low risk for disease. The morphology of the gingival side of the pontic should be designed in a way that makes the restoration less plaque retentive, by providing a more convex than concave surface (31). Another clinical trial, compared composite resin, CAD CAM Titanium or acrylic resin full arch fixed implant supported prostheses. Prostheses were removed and plaque scores were tested on multiple visits, Titanium had the lowest plaque scores

and mucosal inflammation compared to the other groups. Despite the small sample size (average of 10 patients per group), the study provides an understanding of how the material used in prosthetic design affects the outcome (32).

Full arch fixed prostheses studies involve more focus on the professional care than implant supported overdentures or removable partial prostheses. There are some recommendations in the literature as to what should be included in a maintenance visit. Those are mainly a detailed revision of the oral hygiene protocol, assessment of the clinical peri-implant condition, which necessitates the removal of the prosthesis, as well as assessment of clinical parameters such as probing depths, bleeding on probing, mobility, followed by cleaning both the prosthesis and the implant/implants which may include laboratory procedures to polish the intaglio surfaces (33).

Immediately loaded full arch prosthesis were also investigated. Patients were instructed to use spongy interdental floss while soft tissues are healing, this switch to interdental brushes 4 weeks after the surgery. The follow-up intervals happened every 6 months for the first two years, then once a year for another two years. Probing depths around the implants remained stable after 4 years. The plaque levels were higher at the first follow-up visit six months after surgery, which suggests that the first recall should occur sooner. However, the study lacked a control group, and there was no o mention if the prosthetic part was removed (34).

There seems to be controversy in the literature about clear guidelines of recall intervals for IFCDPs. A study that used Branemark's protocol back in 1990, recommended that recall visits should occur at least once a year (35). A systematic review on the recall and maintenance protocols of implant borne restorations investigated 20 randomized clinical trials and observational studies. demonstrated that studies of different , adapted variant protocols, as some were 3 months, or every 6 months, once a year, without clear justification (36). No study has yet been conducted that would compare the two distinct recall protocols in a single cohort and thus makes it difficult to favour one protocol over another.

Another area of debate is whether removal of the restoration is needed at every recall visit. Some studies claimed that removal of the prosthesis come with many disadvantages, such as dependency on the dentist for the removal and insertion of the prosthesis, in other words, a dental hygienist would not be able to perform this professional care during the maintenance visit. Also, more chair side time is required and potential damage to the prosthetic components upon unscrewing and screwing (37). A split mouth clinical trial of the same group (38), IFCDPs were removed then cleaned with either manual carbon fibre curettes for one half of the mouth, or either glycine air polishing or sodium bicarbonate air polishing for the other half. Plaque levels were significantly reduced using the powered instruments, with higher patients acceptance to the glycine air polishing . Nevertheless, the results of this study are only based on one recall, while the impact of a particular protocol on peri-implant health requires consistent results on multiple recalls.

The American college of prosthodontics (ACP) in their position paper in 2016, recommended that prosthesis removal should only take place when there signs of peri-implantitis are evident or for prosthetic repair purposes (39). This is due to the possible alterations to the mechanical and physical properties of abutment screws caused by repeated tightening and loosening. Studies on this matter showed that changes in the original torque of the implant to abutment connection, as well, elongation in the screws, reduction in the stability of the interface may result from inappropriate screw tightening at recall visits (40).

Conclusion

Regular professional maintenance is key for prevention and control of peri-implant diseases (5). Peri-implant disease management is majorly focused on the disruption of the pathological biofilm. Poor oral hygiene and a lack of maintenance therapy are strong risk factors for peri-implantitis (12). For optimal clinical outcomes, these risk factors must be thoroughly discussed when planning implant therapy. The diagnostic parameters of periimplant disease should be evaluated regularly, including a combination of clinical signs of inflammation, peri-implant mucosal probing depths, bleeding on probing and radiographic bone levels, that need to be brought together to early detect, and monitor peri-implant diseases (1). The design of the prosthesis should ultimately allow for proper access to probing and biofilm debridement. Patients and their treating clinicians must collaborate on a strict, long-term maintenance schedule to follow-up properly and manage any issues as early as possible due to the complex nature of full-arch, implant-supported fixed prostheses (3). In addition, the patient should adhere to the home-care plaque control instructions for effective treatment outcomes (29). There are deficiencies in the current literature regarding guidelines for recall and

maintenance of IFCDPs. The available studies unambiguously demonstrated that dental professionals must provide lifelong maintenance for implant-borne fixed prostheses.

However, there is lack of agreement on the timing, frequency, and value of prosthesis removal, as part of the maintenance visit. There is a need for a consensus in the future, on specific guidelines regarding recommended methods and frequency of maintenance of IFCDPs, to assist clinicians balance risk with benefits for individual case management, instead of using a "one-recipe-for-all" approach.

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ASP NSW Branch Committee Details and Meetings

President: Dr Sal Shahidi

Secretary/Treasurer: Dr Jeremy Vo

State Branch Councillor: Dr Robert Fell

Secretariat: Mrs Helen Mooney

Email: helen.mooney4@gmail.com

Meeting name: ASP (NSW) Full Day Seminar

Meeting date & time: MONDAY, 30 October 2023

Meeting location: Swissotel, 68 Market Street, Sydney (above Myer Department Store)

Speakers: Dr Isabella Rocchietta

Topics: Vertical Ridge Augmentation by means of GBR

Cost & other details: Members $150, Non Members $550, Non Member Hygienists & Post Grads $350

ASP QLD Branch Committee Details and Meetings

President: Dr Marina Kamel

Vice President: Dr Tatiana Tkatchenko

Secretary: Dr Gabrielle Bou-Samra

Treasurer: Ms Aneta Zielinski

Federal Councillor: A/Prof Ryan Lee

Email: aspqld@gmail.com

Meeting name: ASP (QLD) Clinical Day

Meeting date & time: Full day event: Thursday 2nd Nov 8.30 am - 5.30pm

Meeting location: The Inchcolm by Ovolo

Speakers: Dr Isabella Rocchietta

Topics: Horizontal and Vertical Bone Augmentation

Cost & other details: Free for ASP-Q membership, $350 for non-members

ASP SA Branch Committee Details and Meetings

President: Dr Geoff Harvey

Secretary:

Treasurer:

State Branch Councillor:

Support: Leo Lander, Danny Ho, A/Prof Sushil Kaur

Email: aspsa2@gmail.com

Meeting name: ASP SA dinner meeting #4, including AGM

Meeting date & time: Wednesday 18 October 2023, 6pm for 6:30pm start

Meeting location: Lenzerheide Restaurant, 146 Belair Rd, Hawthorn SA 5062

Speakers: Dr Danny Ho

Topics: Mucogingival problems: Diagnosis and Management

Cost & other details: $125 for guest attendance, no additional charge for ASP SA members. RSVP via EventBrite invitation

ASP VIC Branch Committee Details and Meetings

President: Dr Larissa Ong

Vice President: Dr Alice Huynh

Secretary/Treasurer: Dr Eugene Sheftel

Branch Councillor: Dr Sarah Chin

Email: aspvic@gmail.com

Meeting name: ASP (VIC) November 2023 Dinner-Lecture meeting

Meeting date & time: Wednesday 15th November 2023 6.00pm registration for a 6.30pm start

Meeting location: Woodward Centre - 10th Floor, Melbourne Law, University of Melbourne, 185 Pelham Street, Carlton Vic 3053

Speakers: A/Prof. Tino Mercado

Topics: Enamel Matrix Derivative, a 25-year Journey: Lecture on the Biology, Development and Clinical Indications

Cost & other details: Members: Free Guests: $180 Includes drinks and a 3-course meal

ASP WA Branch Committee Details and Meetings

President: Dr Nish Bhargava

Secretary: Ms Jennine Bywaters

Treasurer: Dr Samy Francis

Federal Councillor: Dr Fritz Heitz

Email: aspwaperth@gmail.com

Meeting name: ASP(WA) End of Year Dinner Lecture

Meeting date & time: Friday, 17 November 2023, 6pm

Meeting location: The Stables, Hay Street, Perth

Speakers: Prof Lisa Heitz-Mayfield

Topics: EFP clinical guidelines for prevention and treatment of peri-implantitis: What does it all mean?

Cost & other details: TBC

AOS NSW Committee Details and Meetings

President: Dr Eugene Foo
Secretary: Dr Cecilia So
Treasurer: Dr Bruce Munroe
Federal Councillor: A/Prof George Pal
Admin/Secretariat: Heather Archer
Email: infonsw@aos.org.au

Meeting name: AOS (NSW) Dinner Meeting & AGM

Meeting date & time: Tuesday, 17th October 2023 6pm

Meeting location: The View Sydney, 17 Blue Street North Sydney

Speakers: Dr Tony Rotondo

Topics: Management Of Two Tooth Spaces In The Aesthetic Zone

Cost & other details: Members: Free
Guests: $143.00
Register via email - infonsw@aos.org.au

AOS QLD Committee Details and Meetings

President: Dr Peter LC Chen
Secretary: Dr Marina Kamel
Treasurer: Dr Jonathan Ng
General Committee: Dr Daniel Hu
Email: aosqld@gmail.com

Meeting name: GBR and Socket Graft hands on course

Meeting date & time: 6th of October

Meeting location: The Point Brisbane Hotel 21 Lambert St, Kangaroo Point Queensland 4169

Speakers: AOS Queensland Committee Members

Topics: GBR and Socket Graft

Cost & other details: Non AOS Qld branch Members: $1000 AOS Qld branch Member $500 - More information available at - https://forms.gle/bw7325Nup4En6mmu7/

AOS SA Committee Details and Meetings

President: Dr Ramon Baba
Secretary: Mr Hab Awwad
Treasurer: Dr Chris Hodge
Federal Councillor: Dr Ramon Baba
Admin/Secretariat: Ms Francine Poole
Email: infoaos.sa@gmail.com

Meeting name: AOS (SA) full day lecture and workshop (hosted by W9)

Meeting date & time: Friday, 3 November 2023

Meeting location: Pullman Hotel, Adelaide

Speakers: Dr Peter Fairbarn

Topics: New Ideas in Dental Bone Regeneration

Cost & other details: Registrations via w9 event page - see AOS SA eventbrite page for details

AOS Victoria Committee Details and Meetings

President: Dr Angelos Sourial

Secretary: Dr Gaurika Sud

Treasurer: Dr Betty Lisa Matthews

Federal Councillor: Dr Gabriel Rodriguez-Ortiz

Committee Members: Mr Jason Savage, Mr Paul Fagliarone, Brandon Krapf, Dr Larissa Ong, Dr Philip Ho

Admin/Secretariat: Ms Bella Cherkasskaya

Email: infovic@aos.org.au aosvic@gmail.com

Meeting name: Dinner meeting and online broadcasting

Meeting date & time: 12 October 2023

Meeting location: Royal South Yarra Lawn Tennis Club 310 Williams Road North, Toorak 3142

Speakers: Dr. Mahmoud Shalash BDS, MSc, PhD (Egypt)

Topics: 3D planning /immediate guided surgery and Temporisation

Cost & other details: Members- free, Students - $55, Online members (dinner) - $110, Non-members - $190

Meeting name: Online

Meeting date & time: TBA

Meeting location: Zoom

Speakers: Dr Gabriel Rodrigues Ortiz - Periodontist Melbourne.

Topics: How to integrate the implants to your dental practice. Where to start and what to do if you want to do implants?

Cost & other details: Members- free, Students - $0, Online members - $0, Non-members - $50

Meeting name: Online

Meeting date & time: Nov-23

Meeting location: Online

Speakers: Jessy Green –

Topics: How to talk to the patient about implants

Cost & other details: Members- free, Students - $0, Online members - $0, Non-members - $50

Meeting name:

Meeting date & time: May-24

Meeting location: TBA

Speakers: Dr Stephen Chan and Dr Anthony Dickenson.

Topics: Troubleshooting compromised implant cases. Surgical issues, Restorative issues

Cost & other details: Members- free, Students - $55, Online members (dinner) - $110, Non-members - $190

AOS WA Committee Details and Meetings

President: Dr Tony Strangio
Secretary: Dr Andrew Ziepe
Treasurer: Dr Richard Williams
Federal Councillor: Dr Roy Sarmidi
Admin/Secretariat: Dr Andrew Ziepe
Email: aoswa2018@gmail.com

Meeting Name: For all meetings from October onwards please see our website for update
Meeting date & time:
Meeting location:
Speakers:
Topics:
Cost & other details:

Find out online...

Meeting details are also available online:

Australian Society of Periodontology
https://www.asp.asn.au/
Or check with your state branch Secretary/Secretariat for further details.

Australasian Osseointegration Society
https://www.aos.org.au/
Or check with your state branch Secretary/Secretariat for further details.

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