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THERAPEUTIC POSSIBILITIES OF THE SECOND GENERATION OF PLATELET-RICH FIBRIN (A-PRF) IN THE TREATMENT OF OROANTRAL COMMUNICATIONS OAC

ТЕРАПИСКИ МОЖНОСТИ НА ВТОРАТА ГЕНЕРАЦИЈА НА ТРОМБОЦИТНО ЗБОГАТЕН ФИБРИН (A- PRF) ВО ТРЕТМАНОТ НА ОРОАНТРАЛНИТЕ КОМУНИКАЦИИ ОАК

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Abstract

OAC is a pathological communication created between the maxillary sinus and the oral cavity, which if left untreated will progress to oroantral fistula or chronic sinusitis. It usually occurs after extraction of the first maxillary molar because it is closely related to the sinus and is a common indication for extraction. PRF is an autologous product derived from the patient's blood (Choukroun's platelet-rich second-generation fibrin). The fibrin matrix is one of the major components of PRF. The fibrin matrix contains platelets (which secrete growth factors, a key factor in the mechanism of action of PRF), leukocytes, and stem cells. There are several different ways of repairing OAC, whereas different factors play a role in choosing one of them. The aim of this paper is to describe clinical cases of OAC treatment with the application of platelet-rich fibrin in the form of a plug (PRF plug) and membrane (PRF membrane). For this purpose, in two patients at the Clinic and the Department of Oral Surgery at the Faculty of Dentistry in Skopje, UKIM, PRF-plug and PRF-membrane was applied, following clinically and radiologically confirmed OAC, after tooth extraction #16 and #25. In the first case, PRF was used as a support for the surgical method, while in the second, as a conservative method for repairing the OAC. Patients noted a calm postoperative course after 24 hours, 72 hours, 7 days and 4 weeks, with no postoperative pain, presence of minimal edema, without postoperative complications. Two months postoperatively, patients underwent clinical and X-ray evaluation of the alveolar socket. Based on the results obtained from these two case studies, we can conclude that PRF-assisted repair of oro-antral communications can be a method of choice. Key words: oro-antral communication, platelet-rich fibrin, conservative treatment, surgical treatment.

Апстракт

ОАК претставува патолошка комуникација создадена помеѓу максиларниот синус и усната празнина која доколку не се лекува ќе премине во ороантрална фистула или хроничен синузит. Најчесто настанува после екстракција на првиот максиларен молар бидејќи е во најблизок сооднос со синусот и претставува честа индикација за екстракција. PRF претставува автологен производ добиен од крвта на пациентот (тромбоцитно збогатен фибрин од втора генерација на Choukroun). Фибринската матрица како една од главните компоненти содржи: тромбоцити (кои секретираат фактори на раст, клучен фактор во механизмот на дејство на PRF), леукоцити и матични клетки. Постојат повеќе различни начини за санирање на ОАК, чиј избор зависи од различни фактори. Целта на овој труд е да се опишат клинички случаи на третман на ОАК со апликација на тромбоцитно збогатен фибрин во вид на чеп (PRF plug) и мембрана (PRF membrane). За таа цел, кај двајца пациенти, на Клиниката и Катедрата за орална хирургија при Стоматолошкиот факултет во Скопје, УКИМ, беше аплициран PRF-чеп и PRF-мембрана, после клинички и рендгенолошки утврдената ОАК, по екстракција на забите #16 и #25. Во првиот случај PRF беше употребен како поддршка на хируршкиот метод, додека во вториот, како конзервативен метод за санирање на ОАК. Кај пациентите беше забележан мирен постоперативен тек по 24 часа, 72 часа, 7 дена и по 4 недели, со отсуство на постоперативна болка, присуство на минимален едем, без постоперативни компликации. Два месеца постоперативно, кај пациентите беше направена клиничка и рендгенолошка евалуација на алвеолата. Врз основа на резултатите добиени од овие два прикази на случаи, можеме да заклучиме дека PRF поддржаното санирање на ороантралните комуникации може да биде метода на избор. **Клучни зборови:** оро-антрална комуникација, тромбоцитно збогатен фибрин, конзервативен третман, хируршки третман.

Introduction

The maxillary sinus is the largest of all the bilateral paranasal cavities that begins to develop in the third month of embryonic development. It is located in the body of the maxilla and has a pyramidal shape with a base medially to the nasal cavity and apex towards the zygomatic extension. The maxillary sinus is separated from the roots of the molars by a thin layer of trabecular or spongy bone called "cancellous bone", although in some anatomical projections that bone layer is absent so that the apical tops of the roots of the molar dentition are in close correlation or projection with the floor of the sinus cavity. This condition allows the infection to spread rapidly and can enter the maxillary sinus. In such cases, the act of extracting the molar teeth may be the reason for the creation of oro-antral communication OAC with or without the presence of infection.

OAC is a communication created between the maxillary sinus and the oral cavity which, if left untreated, will turn into oroantral fistula or chronic sinusitis[1]. The close anatomical ratio of the tooth roots, especially the molars and premolars, contributes to the occurrence of this complication during their extraction.

After OAC diagnosis, clinical (positive nose-Valsalva blow test, rhinolalia-nasal speech, saline bubbles protrude through the alveolar socket) and X-ray verification, selection of the most appropriate OAC treatment is considered, considering the localization of OAC, its size, the possible presence of an infection or foreign body (corpus alienum) in the sinus.

There are two types of classic OAC treatment: conservative and surgical.

Conservative treatment is applied when the diameter of the communication is less than or equal to 2 mm; when the sinus is not infected and when there is no foreign body in it, the postoperative alveolar socket is narrow and deep. The goal of the conservative treatment is to form a stable clot in the apical part of the alveolar socket.

Surgical treatment is indicated for communication greater than 2 mm and when the post-extraction alveolar socket is shallow. Several types of incisions are used in surgical treatment (the most common is the Wassmund-Rerhman trapezoidal buccal mucoperiosteal incision).

PRF is an autologous product derived from the patient's blood (Choukroun second-generation platelet-rich fibrin). The fibrin matrix is one of the major components of PRF. The fibrin matrix contains platelets (which secrete growth factors, a key factor in the mechanism of action of PRF), leukocytes, and stem cells.

Platelets play a role in hemostasis and in the wound healing process. Activated platelets form a platelet plug, degranulate and release growth factors: cytokines (PDGF, EGF, IGF, TGF-β1, VEGF) and chemokines that attract certain cells to the injured tissue, stimulate neoangiogenesis and healing.

The clinical applications of PRF and the benefits of its use in post-extraction socket preservation, augmentative procedures for horizontal and vertical enlargement of the residual alveolar ridge, implant procedures, and periodontal regeneration have been described by many authors[2]. Gülsen et al.[3], Asaad et al.[4] analyze the effectiveness of PRF in the treatment of OAC.

The aim of this paper is to describe clinical cases of OAC treatment by applying platelet-rich fibrin in the form of PRF plug and PRF membrane.

Case reports

A-PRF protocol (advance –PRF)

Venous blood with venipuncture was collected from the medial cubital vein for the preparation of A-PRF in

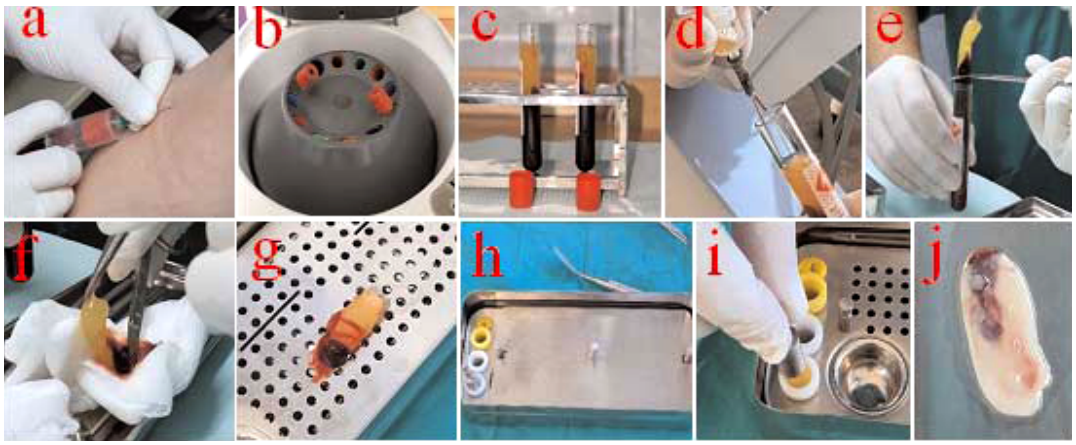

Figure 1. *a) Venepunction. b) A-PRF tubes in Centrifuge. c) A-PRF centrifuged d)PPP evacuated. e) A-PRF clot. f) erythrocyte-rich red thrombus separated g) A-PRF in PRF box. h) A-PRF covered with a metal lid. i) PRF plug. j) A- PRF membrane*

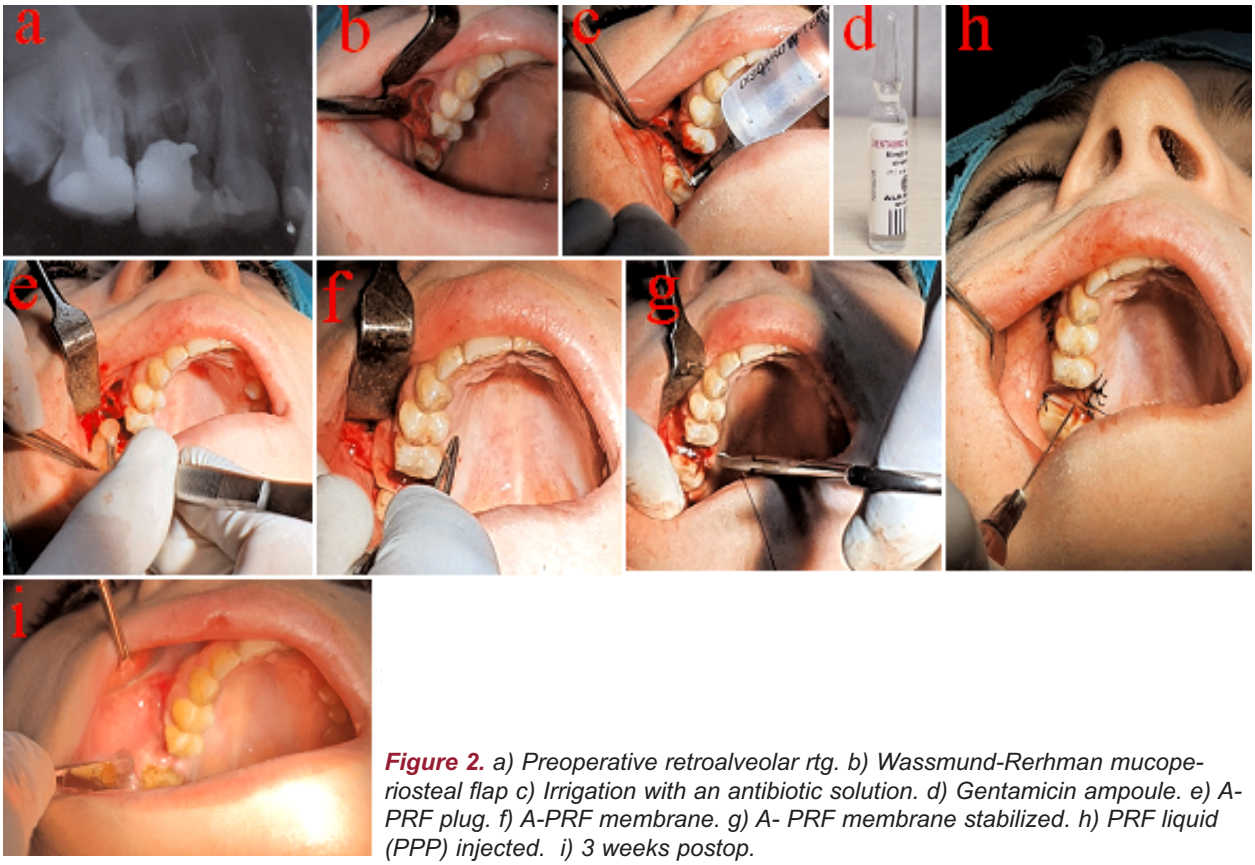

Figure 2. *a) Preoperative retroalveolar rtg. b) Wassmund-Rerhman mucoperiosteal flap c) Irrigation with an antibiotic solution. d) Gentamicin ampoule. e) A-PRF plug. f) A-PRF membrane. g) A- PRF membrane stabilized. h) PRF liquid (PPP) injected. i) 3 weeks postop.*

patients. The samples were collected in two sterile 12 ml A-PRF tubes without added anticoagulant, which were immediately centrifuged in a Duo Quattro Centrifuge at 1300 rpm for 8 min. After centrifugation, the tubes were left on a stand to stabilize for about 5 minutes. With the help of a sterile needle and syringe, the upper liquid fraction - PPP (platelet poor plasma) was evacuated from the tubes, which was injected perioperatively later after the end of the surgery to condition the soft tissues and reduce the oxidative stress. Using a sterile forceps, the middle fraction (A-PRF) of platelet-rich fibrin was removed from the tubes and placed on sterile gauze where the red erythrocyte-rich red thrombus (third layer) was carefully separated using closed sterile scissors. One PRF sample was placed on the rack in the PRF box and then covered with a metal lid that ensures the formation of a well-hydrated A-PRF membrane of equal thickness, while the other PRF sample is placed in a separate PTFE compartment from the PRF box to form a PRF plug (figure 1).

Clinical case 1

Patient aged 29 was admitted to the Clinic and the Department of Oral Surgery at the Faculty of Dentistry in Skopje, UKIM for extraction of the upper right first molar 16 (Dg. Chronic apical periodontitis 16). After the performed clinical and radiographic examinations, the patient was indicated for extraction by informing the patient about possible collision with the maxillary sinus. After the extraction and performance of the Valsalva test, the OAC from the alveolar socket of the bucodistal root was ascertained at 16 (discomfort, Valsalva +, rhinolalia). The patient was excluded from all systemic diseases that may interfere with the chosen method of repairing oroantral communication (PRF-based surgical treatment).

In the first clinical case, a Wassmund-Rerhman mucoperiosteal flap was created and additional mobility of the vestibular flap was obtained by periosteal incision. After localization and visualization of the OAC at the bucodistal part of the post-extraction alveolar socket, surgical debridement, curettage and excessive irrigation with an antibiotic solution (gentamicin ampoule) was performed. The first PRF plug was applied with bucodistal localization, and on the entire post-extraction alveolar socket, A-PRF membrane was applied and stabilized under the flap. After repositioning of the mucoperiosteal flap, 4/0 non-resorbable silk sutures were placed (horizontal matrix sutures) and the remaining liquid fraction

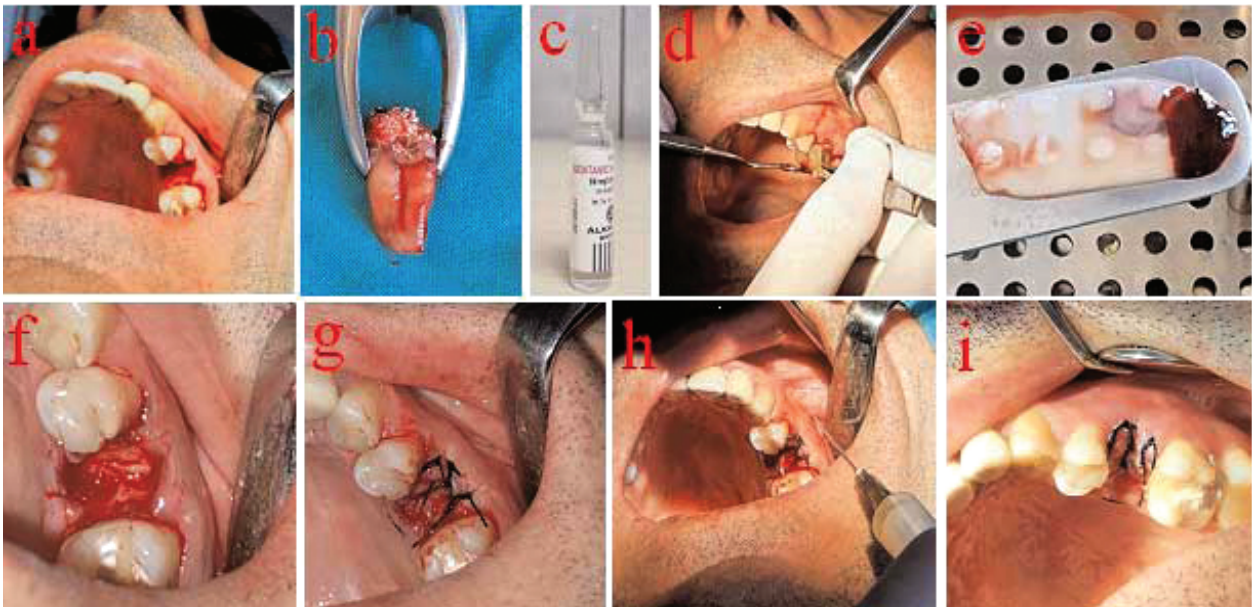

Figure 3. *a) Postextraction socket; b) Radix; c) Gentamicin ampoule d) A-PRF plug; e) A-PRF membrane; f) A-PRF membrane placed; g) A-PRF membrane stabilization with single interrupted and x- suture; h) liquid fraction – PPP injected; i) 72 hours postop*

- PPP was injected perioperatively at the vestibular aspect of the surgical field. The patient was advised to use oral antiseptics, avoid activities that may increase intranasal pressure, and antibiotic prophylaxis was administered in her postoperative care. A calm postoperative course was noted in the patient after 24 hours, 72 hours, 7 days and 4 weeks, with no postoperative pain, presence of minimal edema, without postoperative complications (surgical wound dehiscence or symptoms of maxillary sinusitis). The sutures were removed after 14 days (figure 2).

Clinical case 2

Patient aged 55 was admitted to the Clinic and the Department of Oral Surgery at the Faculty of Dentistry in Skopje, UKIM for extraction of the upper left second premolar 25. After clinical and radiographic examinations, the patient was indicated for extraction (Dg. Gangrene radix 25) with information about possible collision with the maxillary sinus. After extraction and performance of the Valsava test, the OAC from the post-extraction alveolar socket was concluded (discomfort, Valsava +, rhinolalia). The patient excluded all systemic diseases that may interfere with the chosen method of repairing oroantral communication (PRF based conservative treatment - flapless).

In the second clinical case, after tooth extraction 25 and localization / visualization of the OAC on the most apical part of the post-extraction alveolar socket, surgical debridement, curettage and abundant irrigation with antibiotic solution (gentamicin ampoule) followed. The first PRF plug is adapted to the post-extraction alveolar socket with subsequent placement and stabilization of the A-PRF membrane. A stabilizing 4/0 non-resorbable silk suture was placed and the remaining liquid fraction - PPP was injected perioperatively. The patient was advised to use oral antiseptics, avoid activities that may increase intranasal pressure, and to administer antibiotic prophylaxis in his postoperative care. A calm postoperative course was noted in the patient after 24 hours, 72 hours, 7 days and 4 weeks, in the absence of postoperative pain or discomfort. The sutures were removed after 10 days (figure 3).

Discussion

The sinus membrane covers the periosteum with a thin layer of ciliated pseudostratified respiratory epithelium, an important factor in protection and defense of the sinus cavity[5,6]. The mucociliary apparatus protects the sinus from infection, and the membrane acts as a biological barrier. In conditions of present perforation of the membrane, it is a front door for penetration and bacterial invasion.

The ciliary cells with their cilia tremble at a rate of 700-800 times per minute and allow drainage of mucous and serous secretions to the ostium, and due to its superior location, they must overcome the force of gravity.

Calyx cells produce glycoproteins that are responsible for the viscosity and elasticity of the mucosa.

The function of basal cells is unknown, but according to some authors they may serve as differentiation-capable stem cells stimulated by growth factors found in PRF.

The distance between the floor of the maxillary sinus and the apical tops of the roots of the maxillary distal teeth is approximately 1-1.25 cm[1, 6].

The most common cause of OAC is the first maxillary molar because it is closely related to the sinus and is a common indication for extraction. It is the cause of OAC in 51% of cases[7]. The roots of the second maxillary molar are also positioned quite close, which contributes to frequent injury of the mucosa of the maxillary sinus.

OAC is also much more common if a solitary tooth is extracted due to physiological atrophy of the alveolar ridge than when the dentition is intact. Other risk factors, besides anatomical, that can cause OAC include the following: pathological lesions in bone, progressive periodontitis, iatrogenic factors such as inadequate extraction force or atypical separation extractions.

In a detailed review of world literature, there are a small number of authors who analyze the effectiveness of application of second generation of platelet-rich fibrin. Gülsen et al.[3], Asaad et al.[4] analyze the effectiveness of PRF in the OAC treatment.

Surgical wound healing takes place in 4 overlapping phases: hemostasis, inflammation, proliferation and remodeling. Platelets are shown to be important cells that regulate the phase of haemostasis through formation of blood clots; capable of stimulating proliferation and activation of fibroblasts, neutrophils, macrophages, and mesenchymal stem cells, which are actively involved in wound healing (cell recruitment, proliferation, differentiation, and remodeling).

The regenerative potential of PRF can be explained by the three-dimensional structure of the fibrin matrix containing a number of growth factors and cytokines (PDGF, TGF-β1, IGF and VEGF), embedded in the fibrin matrix with a proven role in the healing process of wounds and soft and hard tissues, which gradually release over a period of more than 10 days.

PRF-releasing growth factors stimulate the proliferation and differentiation of osteoblasts, chondroblasts, endothelial cells, and fibroblasts, important in the healing processes of damaged tissues.

Furthermore, the fibrin matrix stimulates the expression of integrin avb3 which allows cells to adhere to fibrin, fibronectin, and vitronectin. This cascade of events is of particular importance for initiating the process of neoangiogenesis, and thus accelerating the healing of tissue wounds[8, 9, 10].

VEGF is a key factor in the growth of endothelial cells in neoangiogenesis that stimulates the proliferation and migration of vascular endothelial cells. VEGFR-2 is an endothelial cell receptor for VEGF.

The primary growth factor for fibroblasts in the second stage of healing is FGF-2, which acts on the recruitment, stimulation, and migration of fibroblasts that synthesize the collagen matrix.

In addition to the positive effect on soft and hard tissue healing, PRF has antihemorrhagic effects. These effects are important in reducing postoperative edema[11, 12].

Conclusion

The key to the regenerative potential of PRF lies in its angiogenic potential, control of the immune system, recruitment of circulating stem cells and stimulation of epithelialization of surgical wounds. Taking into account all these advantages of the second generation of platelet-rich fibrin PRF, such as: safety, natural autologous biomaterial, long-term release of growth factors, ease of operation and economy, we can conclude that PRF-assisted repair of oro-antral communications can be a method of choice.

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