Primljen / Received on: 26.11.2023.
Revidiran / Revised on: 24.12.2023.
Prihvaćen / Accepted on: 16. 1. 2024.

PRIKAZ SLUČAJA
CASE REPORT
doi: 10.5937/asn2490957G

UPOTREBA FIBRINA OBOGAĆENOG TROMBOCITIMA TOKOM PROTOKOLA AUTOTRANSPLATACIJE ZUBA

USE OF PLATELET-ENRICHED FIBRIN IN THE PROTOCOL FOR AUTOTRANSPLANTATION OF TEETH

Jordan Gjurčeski[1], Daniela Veleska-Stevkovska[2]

[1]PRIVATNA STOMATOLOŠKA PRAKSA "LEGE ARTIS-DR JORDAN GJURČESKI", SKOPLJE, SEVERNA MAKEDONIJA
[2]UNIVERZITET SVETI ĆIRILO I METODIJE, STOMATOLOŠKI FAKULTET, KATEDRA ZA ORALNU HIRURGIJU, SKOPLJE, SEVERNA MAKEDONIJA

[1]PRIVATE HEALTH ORGANIZATION "LEGE ARTIS—DR. JORDAN GJURCHESKI", SKOPJE
[2]SS. CYRIL AND METHODIUS UNIVERSITY, FACULTY OF DENTISTRY, DEPARTMENT OF ORAL SURGERY, SKOPJE, NORTH MACEDONIA

Sažetak

Uvod: *Autotransplantacija (ATT) se definiše kao hirurška transpozicija zuba sa njegovog prvobitnog mesta u alveolarnom grebenu u novo mesto. Donor zub može biti iznikao ili neiznikli zub, vitalan ili avitaln, sa završenim ili nedovršenim rastom korena. Donor mesto može biti sveža alveola načinjena posle ektrakcije zuba, sa ili bez infekcije, sa prisutna sva 4 manje od 4 koštana zida. Autotransplantacija u novu alveolu se može biti odložena (nakon par nedelja nakon ekstrakcije) ili rana – u novoformiranu alveolu.. Fibrin bogat trombocitima A-PRF definiše se kao autogeni fibrinski ugrušak obogaćen trombocitima i leukocitima, a može se koristiti kao biomaterijal u obliku čepa ili presovane membrane.*
Cilj*: Studija je imala za cilj da proceni uticaj primene A-PRF na zarastanje i razvoj mekih tkiva, kostiju i korena kod autotransplantiranih zuba kod istog pacijenta, merenjem kliničkih i radioloških parametara.*
Prikaz slučaja: *Koristeći metod split mouth, obavljene su dve procedure kod istog pacijenta. U prvom slučaju AT je izveden na klasičan način, a u drugom slučaju A-PRF je uključen u hirurški protokol.*
Zaključak*: Postoji pozitivna tendencija uticaja fibrina bogatog trombocitima na kliničke i radiološke parametre autotransplantiranih zuba. Za konkretnije zaključke o ovoj temi potreban je opsežan period praćenja i više kliničkih slučajeva.*

Ključne reči: *autotransplantacija, fibrin bogat trombocitima, proces zarastanja*

Corresponding author*:*
Jordan Gjurčeski, DDM, PhD student
Ordinacija Lege Artis-dr Jordan Gjurčeski
Skoplje,, Severna Makedonija
E-mail: legeartis.dr.jordan@gmail.com

Abstract

Introduction: *Autotransplantation (ATT) is defined as the surgical transposition of a tooth from its original place in the alveolar ridge, to a new place in the ridge. The donor tooth can be erupted or impacted, vital or non-vital, with completed or uncompleted root formation. The recipient bed can be a fresh extraction socket, with or without infection, it can have all 4 bony walls, or less than 4, ATT can be finished later (after a couple of weeks following extraction) or in a newly formed socket (prepared bed). Platelet-rich fibrin is defined as an autogenous fibrin clot enriched with platelets and leukocytes, and it can be used as a biomaterial in the form of a plug or pressed membrane.*
Aim: *The study aimed to evaluate the influence of using A-PRF on the soft tissue, bone and root healing and development in autotransplanted teeth in the same patient, via measuring of clinical and radiological parameters.*
Case report: *According to the split mouth design, two procedures were performed on the same patient. In the first case, AT was performed in a classical manner, and in the second case, an A-PRF was included in the surgical protocol.*
Conclusion: *There is a positive tendency for the influence of platelet-rich fibrin on the clinical and radiological parameters of the autotransplanted teeth. Extensive follow-up period and more clinical cases are needed for more specific conclusions about this topic.*

Key words: *autotransplantation, platelet rich fibrin, healing process*

Introduction

Autotransplantation

Autotransplantation represents the surgical relocation (transplantation) of a tooth from its original place in the alveolar ridge, to another in the alveolar ridge. The procedure is performed by intentional avulsion (removal with minimal trauma) of the donor tooth, and moving it into an already existing or newly created alveolus (place–recipient). The donor tooth can be erupted or impacted, vital or non-vital, with completed or unfinished root growth. The recipient site can be a fresh extraction alveolus with or without infection present. The recipient place can have all 4 walls intact or one of them missing. Autotransplantation can be delayed (after several weeks of extraction) or transplanted into a newly formed alveolus (prepared bearing)[1,2].

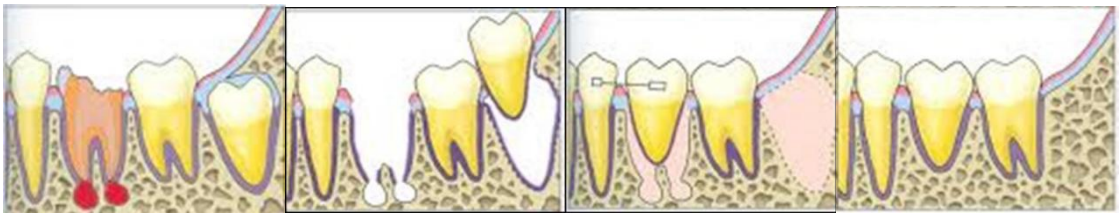

Figure 1. Autotransplantation procedure[3]

According to Bauss et al.[4], ATT is an accepted and predictable procedure for replacing an irreparable tooth. Contrary to implants, the transplant adapts to the eruption of the surrounding teeth and the developmental changes in the oral region, but it can also be orthodontically moved. It is therefore considered an ideal treatment for tooth replacement in young patients. Periodontal ligament (PDL) of autoransplanted tooth gives regenerative potential to a graft itself, stimulating the regeneration of the soft tissue attachment (epithelial and connective tissue), and leading to the restoration of a normal alveolar ridge and the preservation of the gingival architecture.

According to Tričković-Janjić O. et al.[5], preserving teeth in the dentition by replantation, even temporarily, during the child's intensive orofacial development is of great importance for maintaining the local integrity of bone structures and the proper continuation of orofacial development.

Several authors[1,2,4] give preference to other indications for ATT, emphasizing that it is a therapeutic option in cases of tooth loss due to trauma, caries, periodontopathy, and endodontic problems, but also in cases of impaction or agenesis. They emphasize that, unlike implants, transplanted teeth keep their periodontium alive, thus providing the above-mentioned advantages in terms of bone and soft tissue preservation, as well as the possibility of orthodontic or physiological movement. One of the biggest advantages of this procedure is that it can be performed in young patients who are still growing, in whom, on the other hand, the incidence of tooth loss due to trauma is relatively high.

Autotransplantation of teeth was performed many years ago but with varying degrees of success. Even in the time of the pharaohs, attempts were made to transplant teeth from the slaves to the pharaohs, but due to lack of histocompatibility, it ended in failure. This procedure can be very successful if performed carefully while respecting biological principles and using appropriate clinical techniques[6,7](Figure 1.).

Subsequently, the foundations of the modern dental AT were laid by M. L. Hale, who in 1954 documented the first AT of teeth[7], and Slagsvold and Bjercke in 1960 at the University of Oslo established the first surgical protocol for this procedure[8]. The predictability and success of this treatment have risen to a much higher level than before, which was proven by numerous long-term studies on the subject. Predictive factors for graft survival are directly related to preserving cell viability of the periodontal ligament of the donor tooth. Improper handling of the tooth during the intervention and its extraoral time can damage the ligament structure, which leads to postoperative complications of various kinds. Therefore, this procedure requires very gentle, atraumatic tooth extraction and careful handling during the procedure[9].

Several authors deal with this issue. In their paper, Yong Yoon et al.[10] state that despite the widespread use of dental implants and the

experience gained, however, ATT of teeth can be a very difficult procedure to perform. A number of factors affect the success rate, including the developmental stage of the donor tooth root, the anatomy of the tooth, surgical trauma, the time the tooth spends outside the alveolar cup, the shape and size of the recipient alveolus, the condition of the recipient alveolus (the diagnosis of the tooth being extracted) and the blood supply of the bearing. The outcome of ATT also depends on careful patient/case selection, delicate surgical technique, and understanding of the biological principles of work.

The survival and prognosis of autotransplanted teeth is similar to that of dental implants. However, it must be emphasized that certain complications can undermine the clinical outcome of these teeth. These include complications such as root resorption which can be inflammatory resorption or replacement resorption which will lead to ankylosis, pulp necrosis, impaired periodontal healing, etc.[1,2,4].

Various numerical data can be found in the literature about the percentage of survival/success/complications, but still, in the service of this paper, we decided to single out the data of a meta-study that has summarized the data of 32 other studies, considering that it shows the most objective picture. Author Evelyn C. et al.[1] found in their meta-analysis that the survival rate of these teeth, shown after 1, 5 and 10 years, was 97.4, 97.8 and 96.3 % respectively. They also show the one-year success rate of the intervention, which is 96.6%, but also the rate of complications such as ankylosis (2.0%), root resorption (2.9%) and pulp necrosis (3.3%).

Andreasen J.O. et al.[7] in their study of patients aged 7–35 years with a total of 370 autotransplanted teeth, examined root resorption in these teeth. According to their results, root resorption was observed in 52 of the examined teeth. They found that root resorption was significantly associated with the degree of root development of the donor tooth, as well as with the degree of eruption of the donor tooth. According to them, trauma to the periodontal ligament is a key factor in the development of root resorption later.

Platelet-rich fibrin (with special reference to A-PRF)

By definition, platelet-rich fibrin (PRF) is an autogenous fibrin plug enriched with platelets and leukocytes that can be used as a biomaterial in the form of a plug or pressed membrane. It belongs to the second generation of platelet concentrates obtained by simple physical procedures on autologous blood taken from the patient, as products are obtained that are proven to accelerate the healing of soft and hard tissues during water tissue and bone regeneration. The method was developed by J. Choukroun et al. in 2001[11](Figure 2.).

Figure 2. An A-PRF plug obtained from the patient's peripheral blood

The essence of the second generation is in the protocol for obtaining PRF that is created and directed to cause the accumulation of platelets and released cytokines in the fibrin plug[12]. As a result, a concentrate of multiple wound healing promoters is obtained in the wound, which is usually diluted in the initially collected blood. The slow polymerization of fibrin during the processing and obtaining of PRF leads to the incorporation of platelet-derived cytokines inside the fibrin network. This indicates that PRF, unlike other platelet concentrates (first generation), will gradually release the trapped cytokines during fibrin remodeling, which in turn explains the positive impact on the speed of tissue healing that we can clinically register.

In their study, Stojanovic S. et al.[13], conclude that isolated characterization of the respective growth factors' effects is practically impossible due to their actions being pleiotropic and mutually overlapping. Studies of physiological processes in which growth factors have a regulatory role indicate that these molecules rarely act in biological isolation.

The mechanism of action of PRF is through its structure and its composition. It represents a network of densely distributed fibrin fibers with a trimolecular and tetramolecular structure in which a large number of platelets and leukocytes are incorporated. Degranulation of platelets enables plasmin proteins, pro- and anti-inflammatory cytokines (IL-1, IL-6, IL-4, IL-8) and growth factors (TGF, VEGF, PDGF, IGF) to be released from their dense α-granules[14].

Because of such properties of PRF, it can be applied in many medical branches as an autologous biomaterial in oral and maxillofacial surgery, ear, nose and throat surgery, plastic surgery, orthopedics, etc. In oral and maxillofacial surgery it can be used alone or in combination with graft materials in: periodontal surgery, sinus floor elevation[15,16], ridge augmentation, jaw reconstruction[17], regeneration after cyst enucleation[15], guided bone regeneration[17], alveolar preservation[18], Medicine Related Osteonecrosis of Jaw—MRONJ[19], autotransplantation [20] etc.

Aim

This study aimed to evaluate the influence of the use of A-PRF on the soft tissue, bone and root healing and development in autotransplanted teeth in the same patient, via measuring clinical and radiological parameters.

Materials and Methods

Two separate cases of autotransplanted teeth, performed on the same patient at a different time interval, are shown and analyzed (split mouth study)(Figure 3).

In the first case, the ATT was performed in a classical way. The protocol of ATT includes preoperative measures (taking antibiotics one week before intervention if there is an existing infection in the surrounding tissue and measures for excellent oral hygiene and daily rinsing with antiseptic oral solution), and perioperative actions in the following order: atraumatic extraction of the damaged tooth, preparation of the extraction alveolus entailed vigorous curettage of all pathological tissues from the inside, breaking of the interdental septum if necessary, and osteotomy, if necessary, extracting the donor tooth as atraumatic as possible and fitting the tooth in the recipient alveolus in infraocclusion. Then, sutures are placed on the soft tissue, but also through the occlusal surface of the tooth, with the aim of its initial stabilization for 7–14 days. After that, an elastic splint must be placed (an elastic wire that is glued with a composite material to the vestibular surface of the tooth and two other adjacent teeth) to immobilize the transplant. The splint remains for 2–3 weeks and then is removed to prevent ankyloses.

In the second case, the procedure was performed with the application of A-PRF according to the protocol. Both interventions were performed by the same doctor and at the same place—Private Health Organization “University Dental Clinical Center Prof. Dr. Bojo Andreski", Skopje.

The entire procedure was explained to the patient and she signed a consent before the beginning. The patient’s case history parameters of importance for monitoring were recorded, pre and postoperatively.

A female patient aged 20 years, non-smoker, without any systemic diseases (ASA 1), came to the office (Private Health Organization “University Dental Clinical Center Prof. Dr. Bojo Andreski", Skopje) complaining about successive episodes of acute and chronic inflammatory reactions in the lower right quadrant of the alveolar ridge. No visible changes were observed on extraoral inspection, while during intraoral inspection extensive carious defects as well as fractures of the crowns of the first and second molars in the lower right molar region were noticed. There

was mild but firm edema with little sensitivity to pressure on that side. Both teeth reacted painfully on horizontal and vertical percussion**.** The interradicular zone showed spontaneous separation of the roots, in both cases. The presence of incomplete endodontic treatment, extensive carious lesions in the coronal and root part of the tooth, and extensive periapical lightening around the roots of both teeth were noticed in the orthopantomogram. The orthopantomogram also showed the presence of 4 unerupted wisdom teeth with incomplete root growth(Figure 3).

The following measurements were performed on the patient:

1. Clinical measurements for periodontal healing (1 and 3 months)

-depth of periodontal pocket/sulcus

-index of gingival inflammation according to Silness and Loe[21]

-wound healing index according to Morelli[22]

-luxation index according to Grace and Smales[23]

2. X-ray measurements (after 3 months)

-presence/absence of lamina dura and periodontal space

-root growth in mm

-presence/absence of periapical radiolucency.

Figure 3. Preoperative OTP image of the patient

Figure 4. Postoperative OTP image immidiately after autotransplantation of tooth 48

Figure 5. Postoperative OTP image after autotransplantation of tooth 38 (6 month after the autotransplantaton of tooth 48)

Figure 6. Postoperative OTP image several months after autotransplantation of tooth 38

Figure 7. Preopertive evaluation

Figure 8**.** Intraoral condition 1 month after the first transplantation

Figure 9. Intraoral condition 1 month after the second transplantation

Case 1.

Extraction tooth: 47(Figure 3 and 7**)**
Donor tooth: 48

One week before the intervention, the patient was prescribed antibiotic therapy which included Amoxicillin + Clavulanic Acid (875 + 125) to be taken twice at a dosage of one tablet a day orally, and Cetylpyridinium chloride 0.05% was recommended for rinsing the mouth twice a day.

The procedures were performed according to the principles of asepsis and antisepsis. The patient rinsed mouth with Cetylpyridinium chloride 0.05% for 2 minutes, just before the intervention. Block anesthesia with 4% Articaine HCL (Artinibsa) with 1:100000 epinephrine was applied for the branches of N.mandibularis. Dens 47 was extracted using elevators and root forceps, taking care about atraumatic extraction. Vigorous curettage of all pathological tissues from the inside of alveolus was performed, and to achieve better fitting of the donor tooth, we broke the interradicular septum. There was no need for additional adjustment and osteotomy of the alveolus.

A triangular incision was made using scalpel blade #15, and a mucoperiosteal flap was raised. Very careful osteotomy was made around the crown, and the impacted tooth was carefully extracted using elevators. The extracted tooth was immediately placed in the prepared socket without pressure and was positioned in infraocclusion before being sutured with silk, non-absorbable suture (#3/0). There was no need for occlusal adjustment in this case (Figure 10).

The extra-alveolar time of the tooth is extremely important and is related to the prognosis of the tooth. In this case, extra-alveolar time was short (15 sec). After that, an elastic splint was placed. An elastic wire was glued with a composite material (enamel was etched with 38% orthophosphoric acid, bonded with Te-econom bond, and glued with Te-econom flow composite) to the vestibular surface of the tooth and two other adjacent teeth. The splint remained for 3 weeks and then removed to prevent ankylosis. The sutures were removed after 10 days. In this case, the donor tooth had incomplete root growth and its vitality was checked after 1, 3, and 6 months. The patient was prescribed antibiotic therapy for one week postoperatively, as well as vitamin supplementation (1000 mg of Vitamin C and 2000 IU of Vitamin D) for 6 months(Figure 4, Figure 10). Additionally, the patient was advised to maintain exceptional oral hygiene and attend scheduled check-ups (Figure 8).

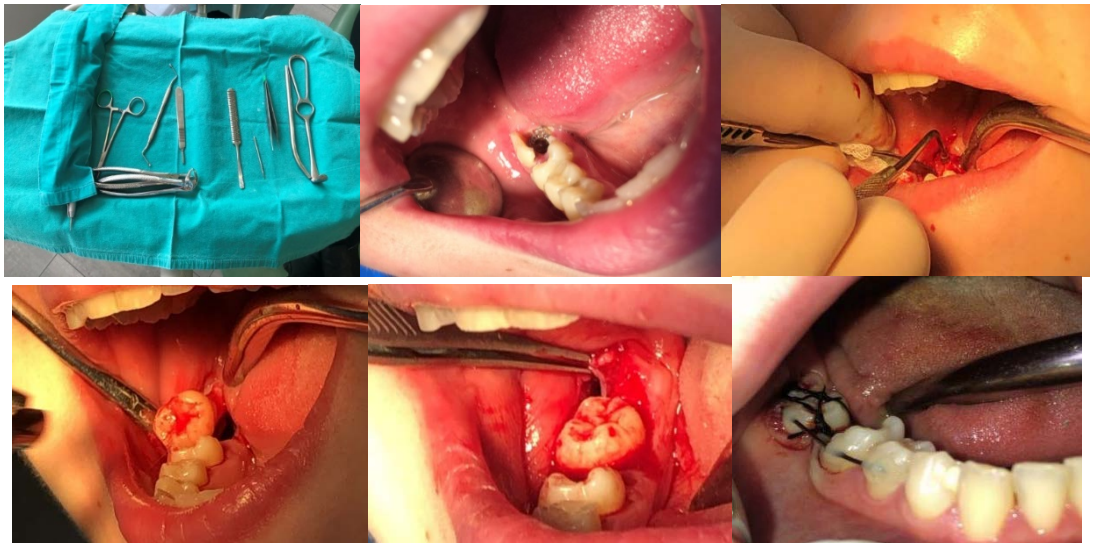

Figure 10. Surgical protocol for ATT

Case 2.

Extraction tooth: 46
Donor tooth 38(Figure 3***.)***

One week before the intervention, the patient was prescribed antibiotic therapy which included Amoxicillin + Clavulanic Acid (875 + 125) to be taken at a dosage of one tablet twice a day. Additionally, Cetylpyridinium chloride 0.05% was recommended for rinsing the mouth twice a day.

The second ATT in the patient was performed assisted by A-PRF. As the donor tooth was on the opposite side, bilateral block anesthesias were required. The first step was on the right side–preparation of the socket, and the second step was surgical extraction of the donor tooth.

In this case, A-PRF was used according to the protocol of J. Choukroun[15]. Before the start of the surgical intervention, venous blood was collected from the cubital vein using the Vacutainer method[24] in two specially designed A-PRF tubes of 10 ml each, which were placed in a BIOBASE LC-H4K centrifuge, BIOBASE, Jinjan, Shandong, China, side by side, at 1200 rpm for 8 minutes. The fibrin plug was placed in a PRF box and pressed, in order to obtain a suitable membrane, and the PRF exudate obtained during pressing was collected in a sterile container (Figure 11).

After the donor tooth was extracted, it was set to stay immersed in the collected PRF exudate for 3 minutes (it can stay as long as needed while other preparations are made).

The socket was lined with a PRF membrane and the tooth was pushed into socked, in order for the membrane to act as a physical shock absorber to protect against excessive pressure, but also as a biological substrate for assisted healing(Figure 12***).***

The rest of the procedures were identical to the first case. The surgical protocol for autotranslplantation is shown in Figure 10,11,12).

Figure 11. The obtained PRF plugs placed in a PRF box for pressing

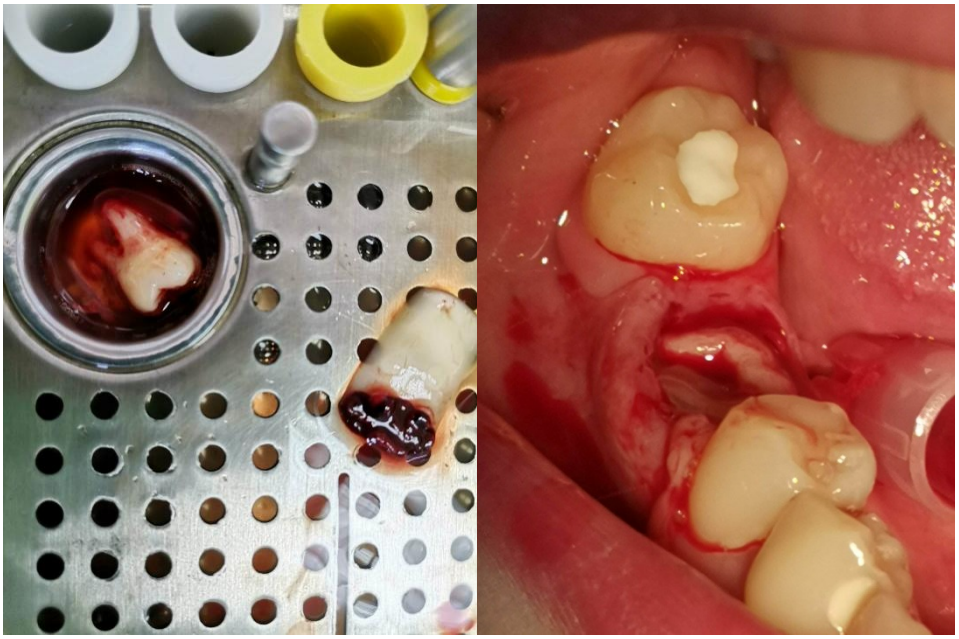

Figure 12. Use of PRF in the ATT protocol

Results

According to the performed measurements, the following results were obtained.

The depth of the periodontal pocket/sulcus in both cases in the first month postoperatively was above normal and amounted to 4 mm. After the third month, the depth of the sulcus space in the first case was 2 mm, while in the second case, it was 1 mm (Table 1).

Gingival inflammation according to the Sillnes and Loe index[21] numerically shows the state of inflammation of the tissue, where the number 0 means the absence of any signs of inflammation (redness, bleeding), while the number 3 means the presence of pronounced redness and spontaneous bleeding. In the first case, in the first month around the transplant, the presence of pronounced redness and bleeding was observed (index 3), while after the third month, the inflammation was significantly reduced, but still present (index 1). In case 2, in the first month there was also pronounced soft tissue inflammation, but with less bleeding, while after the third month, there was no inflammation at all (Table 2).

According to the wound healing index according to Morelli[22], in both cases the wounds healed successfully, there was no presence of pus and mobility and loss of the graft but there were still signs of inflammation,

which in the second case completely disappeared after 3 months (Table 3).

The luxation index, in both cases, showed significant luxation after the first month, much more pronounced in the second case (more than 2 mm), while after the third month, in both cases, the luxation was reduced to a normal, physiological luxation (Table 4).

The radiological characteristics after the first month in all cases and for all parameters remained unchanged immediately after transplantation, while after the third month, a change was observed in all of them with the formation of bone tissue, shaping of the lamina dura, reduction of periapical lightening, and most importantly, root growth of several mm (Table 5, 6 and 7).

Table 1. Depth of periodontal pocket

Depth of periodontal pocket/sulcus		
	Case 1	Case 2
After 1st month	4 mm	4 mm
After 3rd month	2 mm	1 mm

Table 2. Gingival inflammation according to the Silness and Loe Index[21]

Gingival inflammation according to the Silness and Loe Index		
	Case 1	Case 2
After 1st month	3	2
After 3rd month	1	0

Table 3. Wound healing index according to Morelli et al.[22]

Wound healing index according to Morelli et al.		
	Case 1	Case 2
After 1st month	2	2
After 3rd month	1	0

Table 4. Luxation according to the Grace and Smales Index[23]

Luxation according to the Grace and Smales Index		
	Case 1	Case 2
After 1st month	2	3
After 3rd month	1	1

Table 5. Presence of lamina dura

Presence of lamina dura		
	Case 1	Case 2
After 1st month	no	no
After 3rd month	yes	yes

Table 6. Presence of periapical radiolucency

Presence of periapical radiolucency		
	Case 1	Case 2
After 1st month	yes	yes
After 3rd month	no	no

Table 7. Root growth

Root growth		
	Case 1	Case 2
After 1st month	0 mm	0 mm
After 3rd month	2 mm	2 mm

Discussion

According to the literature, several criteria are cited as key factors in performing successful ATT. The recipient bed must be free of any infections and with a sufficient amount of bone that will provide good support and stabilization for the transplanted tooth. As for the donor tooth, the ideal candidate is the tooth with incomplete root growth, because they have the potential to form the root and preserve the vitality of the pulp. Some other prognostic factors that may influence the success rate are atraumatic tooth extraction, limited root injury and PDL, minimal root manipulation, and reduced extraoral time. All the above factors are associated with reducing the risk of PDL damage, which would lead to the most common complications of the autotransplanted tooth, such as internal/external root resorption and ankylosis[25].

Stojanović et al.[26] in their study on avulsed and replanted teeth emphasized the meaning of the extraalveolar time and the splinting method. They stated that the success of therapy and periodontal healing depended on the duration and conditions of extraoral tooth preservation, the degree of damage to the periodontal ligament, and the condition of the pulp. The age of the patient, concomitant injuries and the manner and duration of splinting are essential to the degree and manner of survival of avulsed teeth in the jaws. The splint is placed for a period of 7–10 days and physiological and mechanical cleaning should be simple. Rigid splinting should be avoided.

If we follow the criteria for ideal case for ATT, there should be no infection and inflammation in the persisting alveolus and surrounding bone. In both our cases, in the recipient bed, there was the presence of chronic inflammation. Before we decided to perform the procedure, we searched the literature for ATT in chronic infection site, but also for immediate dental implants in the presence of chronic bone infection, looking for justification for our procedure.

Tsukiboshi M. et al.[27] state that in the case of an immediate ATT, the hopeless tooth in the recipient site is extracted first. When the recipient tooth has a periapical lesion, the granulation tissue should be thoroughly removed, but care should be taken not to curettage the periodontal ligament of the extraction socket if unnecessary.

Bell C. et al.[28] state that in sockets with 3–4 intact walls, minimal periodontal resorption and good primary stability, immediate implantation is a safe procedure, despite the present chronic infection. A report by Siegenthaler and Lindeboom suggest that the complication rates with implants placed in the infected sites compared to those of non-infected sites are almost the same[29]. Novaes Jr. and Novaes[30] in their study stated success by few pre and postoperative measures including antibiotic administration, meticulous cleaning, and alveolar debridement. Hegde R. et al.[31] concluded that immediate implant placement and loading represent a viable treatment option for infected sites when combined with an antibiotic regime and complete elimination of microbiota from the infection socket.

According to the literature, we also strongly believe that the use of PRF products in infection/inflammation site has its anti-inflammatory properties. As Tanan K. G. et al.[32] state, in addition to growth factors, several pro- and anti-inflammatory cytokines

can also be produced by leukocytes in PRF membranes. It has been shown that the release of cytokines continues in the three-dimensional architecture of PRF, starting from the early inflammatory period up to 21 days. Due to these properties, PRF can regulate inflammatory processes and increase angiogenesis. In addition, the release of these substances can accelerate tissue healing and reduce the rate of postoperative complications.

The criteria for successful ATT are similarly described and divided in a large number of papers, but as the most appropriate we will take the division of Andreasen et al.[33]. Regarding the clinical examination, the division is made according to the following criteria: 1) physiological mobility; 2) no pain on percussion; 3) probing depth < 3mm; 4) no signs of inflammation; and 5) normal chewing function. The radiological criteria are: 1) normal spatium periodontale; 2) no progressive resorption of the root; and 3) presence of lamina dura. ATT is considered unsuccessful when there is a prolonged inflammation of the recipient cavity or when the transplanted tooth appears clinically unhealthy with persistent grade 3 mobility, ankylosis, or progressive root or bone resorption.

Keranmu et al.[34] in their study of 52 patients with ATT, where classic manner and PRF were compared on 26 patients, showed that initial stability of the graft in the PRF group is better immediately after the intervention, which is contrary to this case. Periapical lesions in 23 of 26 subjects with PRF healed completely with new alveolar bone within 3 months, whereas in the control group, only 9 cases showed complete lesion healing after three months. In the PRF group, all patients showed satisfactory mastication, no abnormal mobility, periodontal pockets, and root resorption or ankylosis. In the control group, deep periodontal pockets were observed in some of the subjects.

Jorge González et al.[35] in their study on 10 cases made a comparison of classical and PRF manner and showed that 10 patients had a functional and asymptomatic transplanted tooth with physiological mobility even after 1 year. All 10 had a positive vitality test and all transplants showed positive root growth (on average 2.01mm per year). The probing depth was not greater than 4 mm during the first year.

The use of A-PRF is thought to be a promoter of wound healing and angiogenesis processes. Usage in ATT cases enhances the natural revascularization process of the transplanted tooth. Also, keeping the donor tooth in a PRF exudate while outside the alveolus may have an effect on preserving the vitality of cells from both the pulp and the PDL, thus improving the clinical outcome[15].

PRF stimulates angiogenesis through migration, division and phenotypic changes of endothelial cells. It also stimulates cell mitosis and induces osteogenesis without an inflammatory reaction. These effects work through a slow process that lasts at least a week[36] and up to 4 weeks[37].

PRF can induce strong and prolonged differentiation and stimulation of osteoblasts together with fibroblasts within 14 days[38].

After 12 months of follow-up, Bakhtiar et al. showed radiological evidence of prolonged root development and closure of the apex in 4 teeth with incomplete growth and necrotic pulp[39].

These "miraculous" powers of PRF are described and explained by various authors throughout the literature. Alkofahi et al.[40] stated that this is due to the fact that PRF contains a dense network of fibrin and an abundance of growth factors such as platelet-derived growth factor and vascular endothelial growth factor. An important factor is transforming growth factor b1 (TGFb1) which is simultaneously secreted by Hertwig's coat and positively affects the differentiation of dental papilla cells to transform into odontoblasts, providing a suitable environment for PDL cell proliferation and extracellular matrix synthesis. Finally, the authors conclude that the benefit of using PRF in ATT of teeth with incomplete root growth is great in the early and late stages of the regenerative process.

The results obtained in this study show certain trends that leave an impression on the researcher who sees and follows those cases. The tendency for improved early soft tissue healing of the wound after ATT can be seen. This can be seen through the reduction of the depth of the sulcus, the reduction of the degree of inflammation of the soft tissue, and the rapid healing of the wound without early complications.

There was postoperative edema in both cases, but we have to mention that the edema was on the donor site, not on the recipient site, and it was due to surgical trauma of the tissue around the impacted teeth. There was no significant and unusual postoperative pain after the second day of surgery in both cases.

The degree of luxation of the teeth in the first month, which is higher in the tooth with the use of PRF, can be explained by the early persistence of the membrane in the alveolus, which acts as a soft tissue barrier until it is

resorbed. However, later, the degree of luxation equalizes with the tooth without PRF.

The data in this study indicate no difference in the healing of hard tissues, which means that in both cases the same goes successfully. However, the short period of follow-up in our study does not allow us to make a more detailed judgment and comparison with the literature.

Conclusion

The obtained results show a positive tendency for the influence of platelet-rich fibrin on the clinical and radiological parameters of the autotransplanted teeth. Extensive follow-up period and more clinical cases are needed for more specific conclusions about this topic. The positive results of this study encourage us to continue our research on this topic.

Conflicts of Interest

The authors declare that they have no conflict of interest.

Financial Support: None

LITERATURA/REFERENCES

1. Evelyn C. M. Rohof & Wouter Kerdijk & Johan Jansma & Christos Livas & Yijin; Autotransplantation of teeth with incomplete root formation:a systematic review and meta-analysis; Ren1Clinical Oral Investigations(2018) 22:1613-1624
2. https://doi.org/10.1007/s00784-018-2408;
2. Rohof ECM, Kerdijk W, Jansma J, Livas C, Ren Y. Autotransplantation of teeth with incomplete root formation: a systematic review and meta-analysis. Clin Oral Investig. 2018 May;22(4):1613-1624.
3. http://www.myhealth.gov.my/en/tooth-transplantation/
4. Bauss O, Zonios I, Engelke W. Effect of additional surgical procedures on root development of transplanted immature third molars. Int J Oral Maxillofac Surg 2008;37:730–5;
5. Tričković Janjić O, Ranković Janjić M , Stojković B, Igić M, Stojanović S. Dry method of transport and delayed replantation of avulsed tooth – therapy and outcome. Acta Stomatologica Naissi 2021;37(83): 2175 – 2185
6. Jae Hyun Park, Kiyoshi Tai , Daisuke Hayashi; Tooth Autotransplantation as a Treatment Option: A Review; J Clin Pediatr Dent 2011;35(2): 129–136.
7. Andreasen JO, Paulsen HU, Yu Z, et al. A long-term study of 370 autotransplanted premolars. Part III. Periodontal healing subsequent to transplantation. Eur J Orthod 1990;12:25–37.
8. Slagsvold O, Bjercke B. Autotransplantation of premolars with partly formed roots: a radiographic study of root growth. Am J Orthod 1974;66:355–66.
9. Lucas-Taulé E, Llaquet M, Muñoz-Peñalver J, Somoza J, Satorres-Nieto M, Hernández-Alfaro F. Fully Guided Tooth Autotransplantation Using a Multidrilling Axis Surgical Stent: Proof of Concept. J Endod. 2020 Oct;46(10):1515-1521. ;
10. Yong Yoon, Yong-Gun Kim, Jo-Young Suh, and Jae-Mok Lee; The prognosis of autotransplanted tooth on molar region: 5 years follow up cases; Oral Biology Research, 2017; September 30, 41(3):147-15.
11. Kumar RV, Shubhashini N. Platelet rich fibrin: a new paradigm in periodontal regeneration. Cell Tissue Bank. 2013 Sep;14(3):453-63. .
12. Naik B, Karunakar P, Jayadev M, Marshal VR. Role of Platelet rich fibrin in wound healing: A critical review. J Conserv Dent. 2013 Jul;16(4):284-93.
13. Stojanović S, Tijanić M,Jovanović G, Spasić M,Denčić T.Uloga faktora rasta u zarastanju ekstrakcione rane. Acta Stomatologica Naissi 2015;31(72):1524-1537.
14. David M D , Joseph Choukroun, Antoine Diss, Steve L Dohan, Anthony J J Dohan, Jaafar Mouhyi, Bruno Gogly; Platelet-rich fibrin (PRF): a second generation platelet concentrate. Part II: platelet-related biologic features; Oral Surg Oral Med Oral Pathol Oral Radiol Endod. 2006 Mar;101(3):e45-50.
15. Choukroun J, Diss A, Simonpieri A, Girard MO, Schoeffler C, Dohan SL, Dohan AJ, Mouhyi J, Dohan DM. Platelet-rich fibrin (PRF): a second-generation platelet concentrate. Part IV: clinical effects on tissue healing. Oral Surg Oral Med Oral Pathol Oral Radiol Endod. 2006 Mar;101(3):e56-60.
16. Inchingolo F, Tatullo M, Marrelli M, Inchingolo AM, Scacco S, Inchingolo AD, Dipalma G, Vermesan D, Abbinante A, Cagiano R. Trial with Platelet-Rich Fibrin and Bio-Oss used as grafting materials in the treatment of the severe maxillar bone atrophy: clinical and radiological evaluations. Eur Rev Med Pharmacol Sci. 2010 Dec;14(12):1075-84.
17. Corso, Marco & Toffler, Michael & Ehrenfest, D.M. Use of an autologous leukocyte and platelet-rich fibrin (L-PRF) membrane in post-avulsion sites: An overview of Choukroun's PRF.2010; 1:27-35.
18. Zhao, Jiing-Huei & Tsai, Chung-Hung & Chang, Yu-Chao. . Clinical and histologic evaluation of extraction socket healing filled with platelet rich fibrin. Journal of Dental Sciences - Journal of Dental Sciences 2011;6:116-122.
19. Canellas JVDS, Ritto FG, Figueredo CMDS, Fischer RG, de Oliveira GP, Thole AA, Medeiros PJD. Histomorphometric evaluation of different grafting materials used for alveolar ridge preservation: a systematic review and network meta-analysis. Int J Oral Maxillofac Surg. 2020 Jun;49(6):797-810.
20. Robindro Singh W, Aheibam K, Nameirakpam A. Post-Odontoma autotransplantation of an impacted tooth: A case report. J Oral Biol Craniofac Res. 2015 May-Aug;5(2):120-3.
21. Dholam KP, Gurav S, Dugad J, Banavli S. Correlation of oral health of children with acute leukemia during the induction phase. Indian J Med Paediatr Oncol. 2014 Jan;35(1):36-9.
22. Morelli T, Neiva R, Nevins ML, McGuire MK, Scheyer ET, Oh TJ, Braun TM, Nör JE, Bates D, Giannobile WV. Angiogenic biomarkers and healing of living cellular constructs. J Dent Res. 2011 Apr;90(4):456-62.
23. Shalakha M et al.; Indices to Assess Tooth Mobility-A Review; International Journal of Dental Science and Innovative Research (IJDSIR) IJDSIR : Dental Publication Service Available Online at: www.ijdsir.com 2019;2(2): 630 - 635
24. Thomson JM, Easton AC, Faragher EB. The use of Vacutainer tubes for collection and storage of blood for coagulation testing. Clin Lab Haematol. 1983;5(4):413-21.
25. Rey Lescure M, Valente NA, Chatelain S, Cinquini C, Barone A. Autotransplantation of Two Immature Third Molars with the Use of L-PRF. Case Rep Dent. 2021 Jan 2:6672711.
26. Stojanović S, Tijanić M, Burić K, Burić N, Spasić M, Todorović K, Stojković B, Petrović M, Mitić D. Avulsion of permanent teeth in children and adults - therapeutic options for longer survival. Acta Stomatologica Naissi 2021;37(83): 2213 – 2223.
27. Tsukiboshi M, Tsukiboshi C, Levin L. A step-by step guide for autotransplantation of teeth. Dental Traumatology. 2023; 39(Suppl. 1): 70–80.
28. Bell C, et al. The immediate placement of dental implants into extraction sites with periapical lesions: a retrospective chart review. J Oral Maxillofac Surg. 2011;69:1623–1627.
29. Crespi R, Cappare P, Gherlone E. Fresh-socket implants in periapical infected sites in humans. J Periodontol. 2010;81(3):378–383.
30. Novaes AB, Jr, Novaes AB, et al. Immediate implants placed into infected sites: a histomorphometric study in dogs. Int J Oral Maxillofac Implants. 1998;13:422–427.
31. Hegde R, Krishna Prasad D, Shetty DV, Shetty M. Immediate Placement and Restoration of Implant in Periapical Infected Site in the Maxillary Esthetic Zone: A Case Report. J Indian Prosthodont Soc. 2014 Dec;14(Suppl 1):299-302.

32. Tanan Karaca G, Duygu G, Er N, Ozgun E. Comparative Investigation of Anti-Inflammatory Effect of Platelet-Rich Fibrin after Mandibular Wisdom Tooth Surgery: A Randomized Controlled Study. Journal of Clinical Medicine. 2023; 12(13):4250. https://doi.org/10.3390/jcm12134250
33. Andreasen JO. Effect of extra-alveolar period and storage media upon periodontal and pulpal healing after replantation of mature permanent incisors in monkeys. Int J Oral Surg. 1981;10(1):43–53.
34. Keranmu D, Ainiwaer A, Nuermuhanmode N, Ling W. Application of concentrated growth factor to autotransplantation with inflammation in recipient area. BMC Oral Health. 2021 Oct 30;21(1):556
35. Gonzalez-Ocasio J, Stevens M. Autotransplantation of Third Molars With Platelet-Rich Plasma for Immediate Replacement of Extracted Non-Restorable Teeth: A Case Series. J Oral Maxillofac Surg. 2017 Sep;75(9):1833.e1-1833
36. Mazor Z., Horowitz R. A., Del Corso M., Prasad H. S., Rohrer M. D., Dohan Ehrenfest D. M. Sinus floor augmentation with simultaneous implant placement using Choukroun's platelet-rich fibrin as the sole grafting material: a radiologic and histologic study at 6 months. Journal of Periodontology. 2009;80(12):2056–2064;
37. Mengji A, Shastri M., Anjum R. The clinical application of platelet-rich fibrin (PRF) and allograft in treatment of bony defect—a case report. IOSR Journal of Dental and Medical Sciences. 2015;14.
38. Dohan Ehrenfest D. M., Diss A., Odin G., Doglioli P., Hippolyte M. P., Charrier J. B. In vitro effects of Choukroun's PRF (platelet-rich fibrin) on human gingival fibroblasts, dermal prekeratinocytes, preadipocytes, and maxillofacial osteoblasts in primary cultures. Oral Surgery, Oral Medicine, Oral Pathology, Oral Radiology, and Endodontics. 2009;108(3):341–352.
39. Bakhtiar H., Esmaeili S., Fakhr Tabatabayi S., Ellini M. R., Nekoofar M. H., Dummer P. M. H. Second-generation platelet concentrate (platelet-rich fibrin) as a scaffold in regenerative endodontics: a case series. Journal of Endodontia. 2017;43(3):401–408.
40. Alkofahi H, Maghaireh A, Fnaish M, Jarrah M, Bataineh M. Application of Platelet-Rich Fibrin as Regeneration Assistant in Immediate Auotransplantation of Third Molar with Unformed Roots: Case Report and Review of Literature. Case Rep Dent. 2020 Jan 21;2020:8170646.