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Research Article

Use of Platelet-rich Fibrin in Immediate Implantation of Posterior Teeth and its effect on Soft Tissue Changes

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ABSTRACT

Background: Immediate implant placement is favored as it reduces number of surgical appointments and overall reduces treatment duration. However, at times disadvantage of this proceduce is the inadequate dimension of soft tissue surrounding the implant, which presents a challenge for immediate implantation in posterior teeth. . Due to which, patients frequently necessitate soft tissue augmentation to avoid potential complications. This study is minimally invasive technique which utilizing platelet-rich fibrin (PRF) which was employed to enhance soft tissue thickness and keratinized tissue width during immediate implantation in the posterior region of the jaw.

Methods and Materials: Total 20 bone-level implants were utilized in 20different patients for the immediate implant procedure. As soft tissue augment, 10patients were treated with platelet-rich fibrin (PRF) on immediate implants in the test group, and the rest 10 patients received connective tissue graft (CTG) on immediate implants in the control group. All implants were uncovered through surgery after 3 months and healing abutments were placed on fixtures. The width of the Keratinized tissue was measured using a periodontal probe at baseline, and after 1 month, and 3 months post implant placement, where as soft tissue thickness was measured at baseline and 3 months post implant placement.

Results: Treatment was successful for all the patients. The average keratinized tissue width in the test and control group was 3.45 and 2.65 at baseline, 4.00and 3.40 one month after surgery, and 4.20 and 3.85 three months after implant placement, respectively. Average keratinized tissue thickness in the test and control group was 2.45 and 2.05 at baseline and 3.20 and 3.25 at reentry (three months after implant placement), respectively. The average increase in keratinized tissue thickness from baseline to 3rd month was 0.75 in the test and 1.20 in the control group. The average increase in keratinized tissue width from baseline to 1st month was 0.55 in the test and 0.75 in the control group, and from baseline to 3rd month, it was 0.75 in the test and 1.20 in the control group, respectively. Data for both parameters in each group from baseline to 3rd month were statistically significant. Data for keratinized tissue thickness (p=0.077) and keratinized tissue width (p=0.089)between both the groups were not statistically significant.

Conclusion: Platelet-rich fibrin (PRF) has the potential to serve as a minimally invasive approach for augmenting soft tissue in the posterior region of the jaw during immediate implant placement.

Keywords: Platelet rich fibrin, Immediate implant, Soft tissue thickness, Keratinized gingival width, Connective tissue graft, Implantation of posterior teeth.

INTRODUCTION

Since1982, after the introduction of osteointegration in dentistry by Dr. Per Ingvar Brånemark, use of implant has become one of the main methods for treating edentulous patients[1].

The best time for implant placement in relation to tooth extraction is a topic of extensive discussion. The implant placement can be categorized into three approaches, namely immediate, delayed, or staged. The choice of which approach should be used is based on various factors, including the amount, quality, and support of existing bone, as well as the preferences of both the clinician and the patient. Immediate implant placement involves the placement of an implant at the time of extraction, while delayed implant placement is usually done after a period of 2monthswhichallowspropersofttissuehealing. Staged implant placement allows significant bone healing within the extraction site and usually requires 4 to 6 months or may be longer. Recently, immediate implant placement has emerged as available alternative approach to dental implant placement, which eliminates the need for a separate healing period prior to implant placement [2].

It is better that at the time of implant surgery the socket is filled with bone replacements to augment the soft tissue to prevent socket collapse and improve the biotype of labially placed soft tissue [4, 7 -11]. After implant placement in the immediate implantation method, a gap is established between the implant and the socket wall [3]. The jumping gap term refers to the ability of bone to bridge the horizontal distance and fill this gap. The jumping gap between the buccal bone which is already thin and the large gap increase the risk of soft and hard tissue recession [4 - 6].

Several advantages has been seen of immediate implants over the traditional approach. As overall treatment time is reduced by eliminating the need for a separate healing period before implant placement[12 -14],less surgical interventions is required, reduced cost, optimal availability of residual bone, soft tissue preservation, and all these lead to reduced healing time. There are several disadvantages of immediate implants like disruption of results due to thin biotype, there are complications which result from optimal placement and anchorage of the implant due to the post-extraction alveolar socket, also there is potential lack of keratinized gingiva to accommodate the flap, there can be possibility of additional surgery, technical sensitivity, at times there is lack of soft tissue required for implant coverage, the recession of soft tissue around the implant, and reduced facial bone after loading or during the healing period [2, 5].

Soft tissue interfaces with implants can take the form of either keratinized or non-keratinized mucosa. The keratinized mucossa is firmly anchored to the underlying periosteum by collagen fibres, while non-keratinized mucosa is characterized by the presence of elastic fibres which allow its mobility over the underlying bone. The sof ttissue around the implants is comparable to that of natural teeth, with dense connective tissue layer which separates the epithelial attachment and the marginal bone. This layer is approximately 3 to 4 mm in total height, with the epithelial attachment comprising about2 mm and the supracrestal connective tissue zone comprising about 1 mm. This layer has limited vascularity in the immediate vicinity of the implant surface .The thickness of peri-implant soft tissues can varyfrom2 mm to few millimetres.

The soft tissue which is present around the implants and teeth are similar in appearance and structural features. There is similarity in appearance of gingival sulcus, junctional epithelium, and an area of connective tissue located on the supporting bone. In the osseointegrated implant area there is no periodontal ligament and collagen fibres. In an study it has been reported that width of 4 mm around the implant. The epithelium surrounding the implant is similar to that of a natural tooth and located along the sulcular epithelium which covers the inner surface of the gingival sulcus [2]. The apical portion of gingival sulcus is covered with junctional epithelium, which is known as long junctional epithelium [15]. The morphology of the connective tissue around the implant is very similar to that of the natural teeth, with the exception of the absence of cement, periodontal ligament, and inserting fibres. The connective tissue around the implant is approximately 1-2 mm, which is longer than the periodontal connective tissue [16, 17]. Though the presence or absence of keratinized gingiva is not important for long- term implant stability, but an implant that is surrounded only by mucosa is more susceptible to problems around the implant [18].

To improve the success rate of the immediate implantation, an intervention should be performed to provide complete coverage of the socket which will increase the width of the keratinized gingiva, and will solve one of the problems of the immediate implant placement in the posterior area due to the inability to close the extracted tooth socket and decreased width of the keratinized gingival.

The most important technique employed is to place connective tissue graft (CTG) on the socket as a biological membrane. The wound is left to heal by secondary intention in the patient's mouth. This is one of the disadvantages of this method. An alternative method is that the soft tissue is augmented with platelet-rich fibrin (PRF) [19, 20].

PRF, was first introduced by Choukron (2000). It is the second generation of platelet concentrate, which contains the highest concentration of platelets, growth factors [vascular endothelial growth factor (VEGF), platelet-derived growth factor (PDGF), and transforming growth factor-β (TGF)], fibrin, fibronectin, and thrombospondin. The technique is simple as no thrombin is required. According to leukocyte content and fibrin structure, there are four categories of platelet concentrate [2], four of which are as follows:

- The Pure platelet-rich plasma (P-PRP) or leucocyte-poor PRP are prepared without leucocytes and with low-density fibrin network after activation.
- Leucocyte- and platelet-rich plasma (L-PRP) products are preparations with leucocytes and a low-density fibrin network after activation.

L-PRF is used effectively in the treatment of many lesions like extra-oral applications [treatment of diabetic foot ulcers (DFUs) pressure ulcers (PUs), acute surgical wounds, and venous leg ulcers (VLUs)].

In the treatment of periodontal bone lesions, ridge preservation, mucogingival surgery, sinus floor augmentation, implant surgery, medication-related osteonecrosis of the jaw (MRONJ) L-PRF has been seen to give promising results.

L-PRF has a strong fibrin network, which is used as soft tissue graft and as a membrane. It has been seen that over a period of 7 days L-PRF slowly releases growth factors and matrix proteins. All of these processes accelerate the wound closure and healing, and in long term prognosis it increase the stability of soft tissue coverage and the thickness of the gingiva [2, 21].

This study aims to investigate the efficacy of utilizing a less invasive platelet-rich fibrin (PRF) membrane as a substitute for soft tissue grafts in achieving full coverage of the extracted tooth socket, reducing pain and discomfort, augmenting the thickness and width of the keratinized gingival and enhancing the successrate of immediate implants.

MATERIALS AND METHODS

A randomized clinical trial was conducted to examine the effectiveness of platelet-rich fibrin (PRF) as a substitute for enhancing of tissue around dental implants on the posterior region of the jaw. Total 20 patients were randomly assigned to two groups (test and control) based on inclusion and exclusion criteria which were decided prior to the start of the study. Participants were selected from the OPD patients who reported to oral and maxillofacial surgery department in Patna Dental College and Hospital, Patna between April2022and March 2023.
Inclusion criteria for the study were, Patient of age group 18 to 50 years will be select and Patients with acquired maxillofacial defects in the maxilla and mandible which required immideate implant placement. The Exclusion Criteria were Malignancy ,Congenital maxillofacial defects , Bone disorders , Patient with psychiatric problem , Patients who were not willing for post-operative follow-up , patients having Platelet disorders and Haematological disorders and patients undergoing Chemotherapy or radiotherapy .

Study participants are randomly allocated to either the PRP group (Group 1) or the control group (Group 2) from patients that provided consent for drawing blood. Group 1 included patients agreeing to blood collection, whereas Group 2 included patients who did not agree for blood drawing.

After explaining the practical process of the research to the participants, informed patient consent was obtained. All patients in the study received the same implant system (bone-level implant). Randomization of individuals was done by the random block method.

The patients were divided into two groups:

a. The test group: PRF and mineralized boneallograftpowder500-1000µ.
b. The control group: connective tissue without PRF and mineralized bone allograft powder 5001000µ.

Preoperative Phase

Preoperative Workup: Each participant undergoes a comprehensive preoperative workup, including laboratory testing, radiographic imaging, and a detailed clinical examination.

Anesthesia: The type of anesthesia remained constant for all the patients in both the study groups. Local anesthesia was used in all the patients with no exceptions due to the complexity of the surgical procedure or patient preference.
Patients were adviced to maintain oral hygiene and patients requiring scaling were adviced for the same, after 4 weeks of maintaince then implant were placed.

Surgical Technique

The first step was atraumatic extraction of the posterior tooth under local anaesthesis.

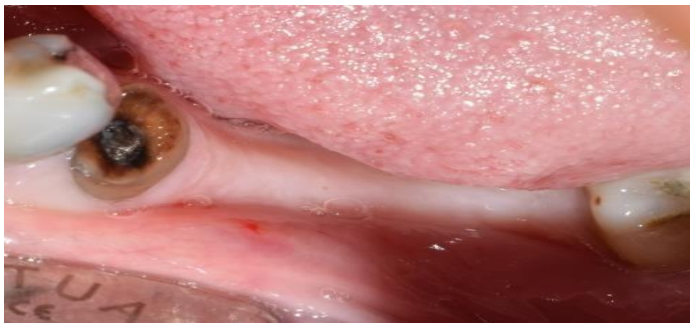

Fig.(1).Posteriortoothcandidateforimmediate implantplacement.

Periotome was used for atraumatic extraction of the tooth. As the metal blade is inserted into the periodontal ligament and circumferentially separates the majority of Sharpey's fibers from the root surface. Then using Dental forceps tooth were easy removed with minimal pressure..

During extraction, special attention was given to preserve the buccal bone. [22- 24].

Full-thickness mucoperiosteal flap with the preparation of the osteotomysite in both groups. The implant bed was prepared according to the standard protocol using the starter drill (diameter enhancer),spiral drills(internally cooled drill), and normal saline.

The diameter of the implant was 4.1 mm or 4.8 mm and the maximum length allowed was iinserted in the socket of the extracted tooth. Indeed, to maintain primary stability, it was inserted in the ½ or 2/3 of the lingual and apical sides of the extraction socket (Fig. **2**). The implant was positioned 1 mm more towards the palatal direction as compared to the protrusion of the prosthesis, with respect to the buccolingual position, also the implant platform was placed approximately 3-4 mm more apical to the mid-buccal position of the anticipated marginal mucosa of the future implant crown, and the cover screw was connected to the fixture.

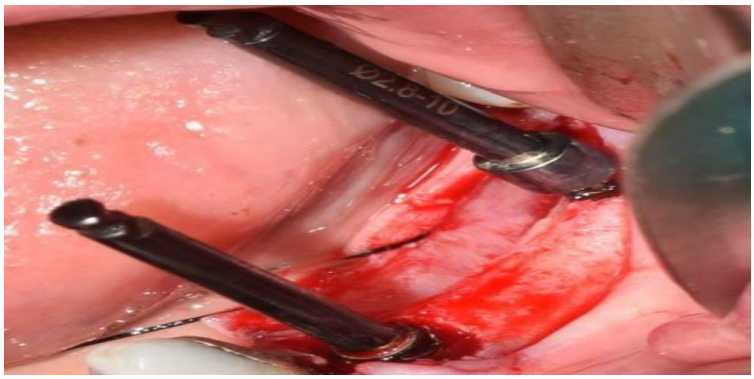

Fig. (2).Immediateimplantplacementonmandibularfirstpremolarsocket.

After the implant is placed , the jumping gap which is the distance between the implant and the bony wall of the socket in both groups were filled with allograft. Connective tissue graft was placed in control group and PRF was placed in test group after immediate implant placement. (Fig. **3**).

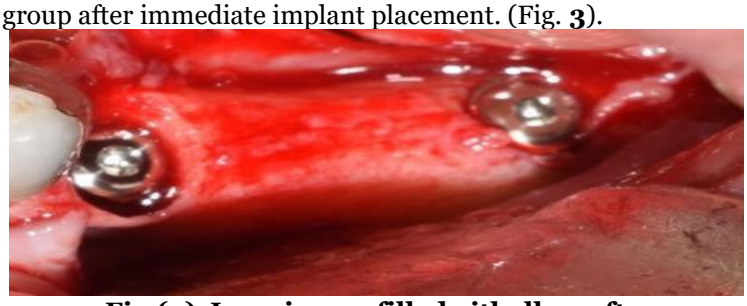

Fig.(3).Jumpinggapfilledwithallografts.

In the control group, connective tissue was harvested from the hard palate between the first premolar, first molar, and 2 mm apical to the gingival margin, maxillary tuberosity, and edentulous ridge. The thickness was approximately 1 mm. The harvested tissue was placed on the implant and under the residual keratinized mucosa of buccal and lingual regions of the surgical site and then fixed with absorbable suture.

Platelet-rich Fibrin Preparation

10 ml of blood was withdrawan from the patients immediately before the procedure and transferred in a test tube without anticoagulant. Blood samples were immediately (in less than 60 s) centrifuged at 2700 rpm for 12 min, and then the PRF clot was placed in an Xpression kit to apply gentle pressure by gravity and obtain a strong fibrin membrane. Before the wound closure and in less than 2 hours from the formation of the membranes, PRF was placed on the surface of the implant (Fig. 4A - C).

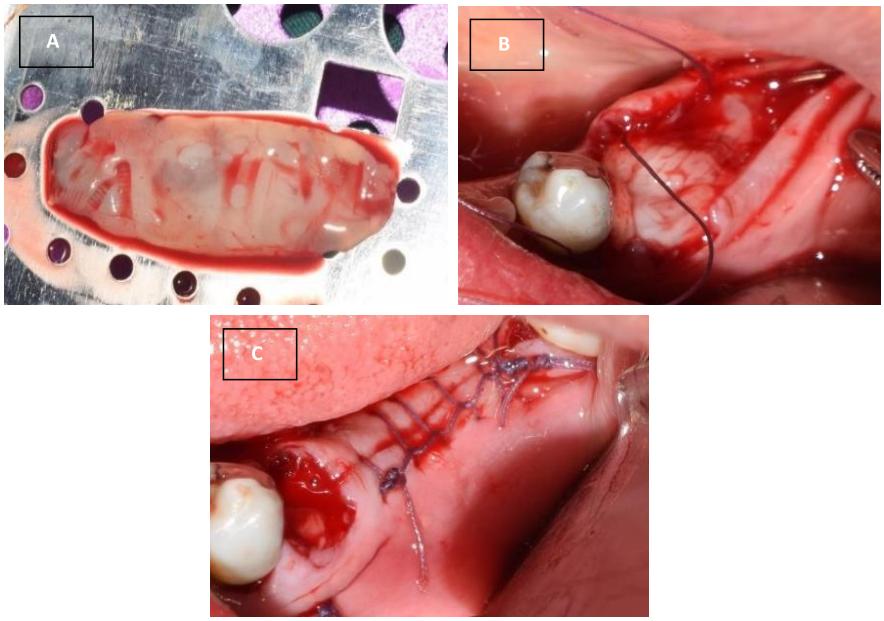

Fig. (4). (A) L-PRF membranes placed on the Xpression kit.
(B)On the site of the immediate implant L-PRF membrane placed
(C)Sutured flap and exposed L-PRF membrane on the implant.

Post surgery the patients were priscribed, medications: amoxicillin 500 mg three times a day for 5 days and ibuprofen 400 mg as an analgesic agent three times a day for two days.
Postoperative instructions were given to the patient. Chlorhexidine 0.02% mouthwash was prescribed for four weeks.
The suture removal was done on the tenth days after the surgery. The surgical site was then evaluated. The implant was exposed using the flap technique, after 3 months and healing abutment was placed on the fixture to form a suitable profile for the implant. One month, and three months after implant placement the soft tissue changes were assessed at baseline with the periodontal probe

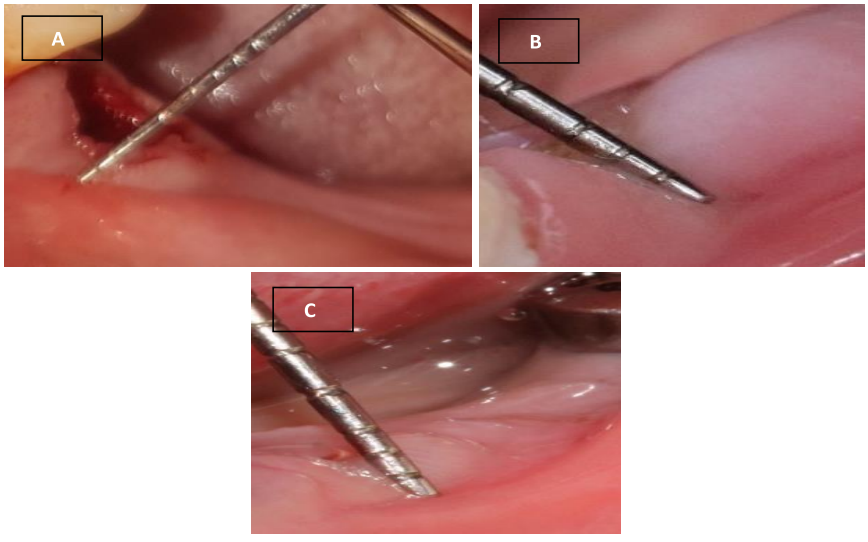

Fig. (5). (A) keratinized gingival width during surgery (baseline).
(B)Keratinized gingival width one month after the surgery.
(C)Keratinized gingival width three months after the surgery.

Parameters which were measured were as following:
• Width of Keratinized gingiva at baseline, one month post op and three months after implant surgery (Fig. 5A - C).
• Thickness of Keratinized gingiva at baseline and three months after implant surgery (Fig. 6A, B).

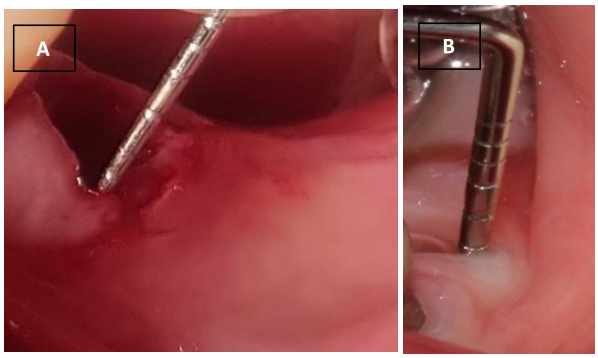

Fig. (6). (A) keratinized gingival thickness measured duringsurgery(baseline). (B) Three months after surgery thickness of Keratinizedgingival measurement.

Method of Data Collection

Statistical Methods

All the data obtained were analyzed using the SPSS, version 22. The normal distribution of data was verified using the Shapiro-Wilktest. ANOVA and Bon ferroni post-hoc test was used to check for significant differences in keratinized gingival width between times. A paired t-test was used to check significant differences in keratinized gingival thickness, and an unpaired t-test was used to check a significant difference in the keratinized gingival thickness and width, as well as their changes between the groups. The significant level was set as < 0.05.

RESULTS

A total of 20 individuals, consisting of 10 females and 10males, with a mean age of 39.25 ± 7.95 years and an age range of 18 to 50 years, were enrolled in this investigation. The PRF and CTG groups were observed to exhibit no discernible differences in age and gender (p=0.497andp=0.371,respectively).The average width of keratinized gingival at baseline, one month, and three months was not seemed statistically significant between the two groups (p=0.143,p=0.393, and p=0.579, respectively). In the PRF group, the width of the keratinized gingival demonstrated statistical significance across time (p=0.004). As compared to the baseline the Width of the keratinized gingival increased significantly after three months post operatively. The observed changes in the width of keratinized gingival were found to be statistically significant in the CTG group over time (p<0.001). at every time point whenever the keratinized gingival width was measured it had significantly increased. (Table **1**).
On an average thickness of the keratinized gingiva at baseline and after three months, there was no significant differences observed between the two groups (p=0.123andp=0.870,respectively). Table **2**
However, it is noteworthy that both the PRF and CTG groups demonstrated a statistically significant increase in gingival width three months post-treatment compared to the baseline(p=0.017 and p=0.004, respectively).
Table 1. Mean ± standard deviation seen in keratinized gingival width(mm) at baseline, 1 month post operative and 3 months post operative in PRF group and connective tissue groups.

Group	Baseline	1 Month	3 Months	p-value£
PRF	3.45±1.21[a]	4.00±1.15[a,b]	4.20±1.03[b]	0.004ϕ
CTG	2.65±0.88[a]	3.40±0.99[b]	3.85±0.94[c]	<0.001ϕ
P-value¥	0.143	0.393	0.579	-

Note:¥:unpairedt-test,£:repeatedmeasureanova,ϕ:samelettersarenotstatistically different.

Table 2. Mean ± standard deviation of keratinized gingivalthickness(mm) over timewithinprfandctg groups.

Group	Baseline	3 Months	p-value£
PRF	2.45±0.50[a]	3.20±0.59[b]	0.017ϕ
CTG	2.05±0.60[a]	3.25±0.75[b]	0.004ϕ
P-value¥	0.123	0.870	-

Note:¥:unpairedt-test,£:pairedt-test,ϕ:samelettersarenotstatistically different.

The alterations in the width and thickness of keratinized gingival was calculated at each time point ie at baseline,1 month post operatively and 3 months post operatively .The changes were finally compared between both groups receiving either platelet-rich fibrin (PRF)or connective tissue graft(CTG).No statistically significant differences was observed in the width of keratinized gingiva between the two groups, as presented in Table **3**.

Table3. Mean± standard deviation of changes in keratinized gingival width and thickness over time between prf and ctg groups.

Variables	Width			Thickness
Group	A	B	C	C
PRF	0.55±0.69	0.20±0.42	0.75±0.63	0.75±0.68
CTG	0.75±0.59	0.45±0.60	1.20±0.48	1.20±0.35
P-value¥	0.383	0.300	0.089	0.077

Note:¥:unpairedt-test,A:differencebetweenbaselineand1month,B:difference between 1 month and 3rd month, C: difference between baseline and3rd month.

DISCUSSION

The objective of the introduction of PRF which is a second-generation platelet concentrated product was to enhance the release of growth factors from platelets while eliminating anticoagulants. These anticoagulants posed potential risks of hypersensitivity reactions. The principle of PRF production is simple and requires a rapid and uncomplicated centrifugation technique that separates blood components before clot formation. This process yields a platelet-rich layer entrapped within a fibrin matrix, additionally containing leukocytes. In contrast to PRP, this matrix causes a delayed and protracted release of growth factors.[31] A fibrin clot entraps platelets and white blood cells (WBCs) and is known as leukocyte-rich PRF (L-PRF). Advanced PRF (A-PRF) is the second preparation which is linked to a greater release of growth factors.[32,33] There have been reports that injectable PRF (I-PRF) or fluid PRF had higher platelet and WBC counts than L-PRF and A-PRF. Before coagulation, which occurs after 15 to 20 minutes in a liquid form, the I-PRF can be administered into the maxillofacial regions, or scalp through injection, or combined with bone autografts.29 When fluid PRF underwent histological evaluation, it was discovered that, in contrast to PRF plugs, where the blood components were scattered randomly, leukocytes (mainly lymphocytes) and platelets were uniformly scattered throughout the studied samples. Growth factors and the 3-D fibrin produced in fluid PRF work in conjugation to offer a regulated secretion process for growth factors during the healing process.30 Fibroblast movement occurs in fluid PRF at a substantially higher rate than in PRP. There is a substantial increment in cell division when there is fluid PRF. However, the use of PRF or PRP remains a personal choice of healthcare professionals.

In our study the efficacy of PRF for soft tissue augmentation during immediate posterior tooth implantation was evaluated. Patients were divided into two groups: the test group, in which PRF was placed on the implantation socket, and the control group, in which connective tissue graft (CTG) was used.

The results of the study indicated that the use of PRF for soft tissue augmentation during immediate posterior tooth implantation was appropriate and comparable to the use of CTG. The keratinized gingival width using L-PRF was seen to be increased by 0.55mm from the base line in the first month and by 0.20 mm from the first to the third month to be precise. Overall, the keratinized gingival width increased by an average of 0.75 mm from the baseline to the third month. In the control group, the mean increase in keratinized gingival width was1.20mm.Moreover, the thickness of soft tissue increased from 2.45 to 3.20 mm (0.75mm on average) from the baseline to the time of the second stage of surgery in the test group. Whereas, increase in control group was seen to be 1.20 mm on average.

The use of platelet-rich fibrin (PRF) for the augmentation of soft tissue around implants has limited literature. Very few studies having been conducted on this toipc [20,31,32]. Also , the results of the conducted studies are not consistent with each other. Like, Temmerman *et al.* [20] used different technique, they used free gingival graft (FGG), and results showed that PRF was effective in augmenting soft tissue around implants but had lesser effect than FGG. In the following study, there results showed that both L-PRF and FGG increased gingival width, also that the increase was greater in the FGG group(1.3±0.9mm)($P < 0.05$).

In another study conducted by, Hehn *et al.* [31] they used PRF with the split-flap technique for increasing mucosal thickness and the results showed that it did not affect soft tissue augmentation around implants, which was contrary to the present study's findings. Also in few studies similar to the present one, Eren, Tunali, and Aleksic [33-35] showed that PRF had a similar effect to connective tissue graft (CTG)in augmenting soft tissue. The soft tissue around the teeth and implant was examined using the coronally advanced flap method to solve the problem of gingival recession.

On the other hand , Jankovic *et al*. [36,37], reported that PRFhad positive effect on soft tissue augmentation around teeth,but soft tissue graft had much better results than PRF.[36]. In 2010 study, PRF was compared with enamel matrix derivative (EMD) for soft tissue augmentation around teeth and the results showed no significant differences between them[37].

CONCLUSION

When the thickness of soft tissues around implants increases, it is beneficial for many reasons. Lindhe and Berglundh [16] and Linkevicius *et al*. [38] showed in there study that when soft tissue is thin, crestal bone too depletes to compensate for the required soft tissue thickness. So, thicker soft tissues around implant allows for the formation of biological width without the crestal bone recession. In our present study, the thickness of soft tissue was examined before placing the healing abutment, and there was no possibility of increasing it as a result of bone resorption to establish the biological width.
Where as in the control group of our present study, connective tissue graft was used as the gold standard technique for soft tissue augmentation, which is consistent with many other studies [39 -42]. Our study suggests that PRF can be a good alternative to connective tissue graft for soft tissue augmentation which is required around immediate implants in the posterior region of the jaw. Still a lot of studies are needed to confirm its long-term efficacy.

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