Clinical and Radiographic Evaluation of Fresh Socket Grafting using Beta-tri-calcium Phosphate with Collagen and Platelet-Rich Fibrin for Receiving Dental Implant

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ABSTRACT

Aim*:* To compare the clinical and 3D volumetric socket bone preservation using Beta tri- calcium pohosphate plus collagen (B-TCP/Col) versus Platelet Rich Fibrin (PRF) assessed by 3D cone beam computed tomography. **Subjects and Methods:** 20 patients were treatment planned for extraction of mandibular and maxillary teeth, leaving 20 sockets for the study. Sockets were divided into 2 groups, each group consisting of 10 sockets. Sockets were grafted as follows: Group (I) sockets were grafted with B-TCP/col, Group (II) sockets were grafted with PRF. Cone beam computed tomography (CBCT) were done immediately and 3 months postoperatively, then collected data were statistically analyzed. **Results:** After 3 months, Bone height (mm) showed significant difference between the tested groups where Group A (B-TCP) produced the highest mean Bone height followed by Group B (PRF) . Bone width (mm) showed insignificant differences between the tested groups. Bone density showed insignificant differences between the tested groups. **Conclusion:** Beta tri calcium pohosphate plus collagen (B-TCP/Col) may be a adjunctive modality to accelerate bone formation in defective socket.

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INTRODUCTION

Maintenance of the natural dentition in optimal conditions of health, function and aesthetics, with the ultimate goal of enhancing the well-being of patients, remains as the main objective of periodontal therapy. In clinical scenarios involving a hopeless tooth indicated for extraction, and considering future replacement with an implant, adequate management of the extraction site may contribute to achieve predictable and satisfactory outcomes.[1]

Tooth extraction triggers a cascade of biological events, mediated by both the local inflammatory response that follows the surgical intervention and the deprivation of masticatory stimulation of the periodontium, which elicit an alteration of the homoeostasis and structural integrity of the periodontal tissues. As a consequence, a physiologic process of

disuse atrophy, characterized by an intense resorption of the alveolar bone and a partial invagination of the mucosa, takes place over the first weeks after tooth extraction.[2-5]

In an attempt to attenuate the resorptive events that follow tooth loss and to minimize the need for ancillary ridge augmentation procedures prior to delivery of implant-and/ or tooth-supported restorations, different interceptive therapies have been proposed, including partial extraction protocols, forced orthodontic extrusion and alveolar ridge preservation (ARP) performed immediately after complete tooth extraction.[6]

A wide variety of ARP treatment modalities have been described in the past 20 years, including socket preservation with bone grafting, including autografts, allografts, xenografts, and alloplasts alone or in combination with absorbable or nonabsorbable membrane .[7]

PATIENTS, SUBJECTS AND METHODS

This study was designed as a randomized controlled clinical and radiographic study carried out on a total twenty patients of both sexes (10 females and 10 males ranged in age from 19-40 years). All patients were selected from those planned for extraction of one or more hopeless tooth followed by delayed implant placement

Clinical Parametrs

To standardize the measurement of clinical parameters, acrylic stents for the extraction site were fabricated on the cast models of the dentition prepared during the treatment planning appointment using self-cure clear acrylic resin.

Mid-buccal crestal height: Measured as the distance in millimeters from a fixed reference point (FRP) on the acrylic stent to the most coronal mid-buccal crestal point on the buccal cortical plate using graduated periodontal prob.

Mid-palatal/lingual crestal height: Measured as the distance in millimeters from a fixed reference point (FRP) on the acrylic stent to the most coronal mid-palatal/lingual crestal point on the palatal/lingual cortical plate using graduated periodontal prob.

Relative socket depth: Measured as the distance in millimeters from the central hole on the acrylic stent to the most apical end of the socket/ridge using (no.20) spreader with a stopper.

Bucco-lingual width: Buccolingual width was measured corresponding with the line (line l), 2 mm apical to coronal most point on the socket/residual ridge using Ridge Mapping Caliper (GDC, Punjab, India). Local infiltration was used while measuring buccolingual dimension at 3months follow-up.

Radiographic Parameters:

- Radiographic (CBCT) parameters were recorded within 24h after the surgery and after 3 months.

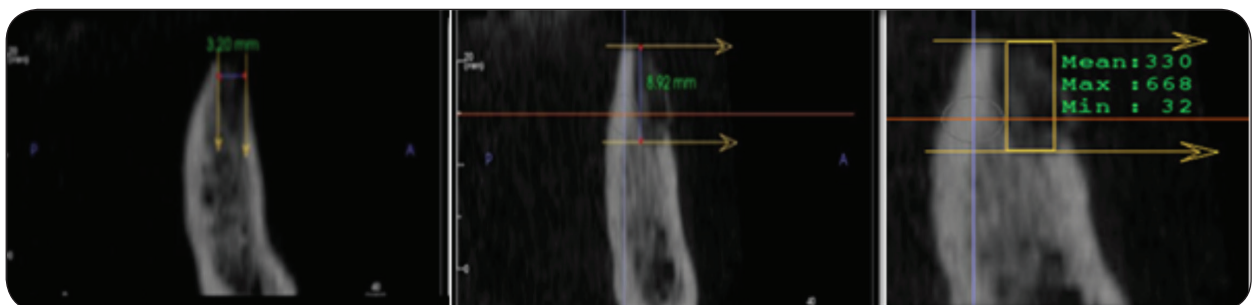- Analysis of dental CBCT scan images was done using New Tom cone beam 3D system. Fig(1)

Fig. (1)

Bone Height measurments: At the generated cross-sectional view, two tangential lines were drawn passing through the highest and lowest point of the socket, and then the distance between these two lines was measured in millimeters.

Bone width measurments: At the generated cross-sectional view, two tangential lines were drawn passing through the most buccal and most lingual/palatal points of the socket and then the distance between these two lines was measured in millimeters.

Bone density measurements: At the generated cross-sectional view, three density readings were taken for each site (Crestal, middle and apical) then the mean of the three readings was acquired.

Statistical analysis

Recorded data were analyzed using the statistical package for social sciences, version 20.0 (SPSS Inc., Chicago, Illinois, USA).

RESULTS

Clinical parametrs

- The changes in mid buccal crestal hieght, Mid-palatal/lingunl crestsal height, Relative socket depth and buccolingual width were recorded at base line and after 3 months for the two groups. The range between minimum and maximum values ,means±SD, P-values and t-values of Group I (βTCP) between baseline and after 3 months illustrated in Table(1)

- Minimum and maximum values ,means±SD, P-values and t-values of Group II (PRF) between baseline and after 3 months illustrated in

- *Using: Paired Sample t-test;* statistically significant difference between baseline and after 3 months according to Mid buccal cieslal height (mm), Mid-palatal/lingunl crests height (mm), Relative socket depth (mm) and Buccolingaal Width (mm) of Group I (βTCP).

- Statistically significant difference between baseline baseline and after 3 months according to Mid buccal cieslal height (mm), Mid-palatallingunl crests height (mm), Relative socket depth (mm) and Burcolingaal Width (mm) of Group II (PRF).

Radiographic Paramers

The changes in Bone height (mm), Bone Width (mm), Bone Density and were recorded at base line and after 3 months for the two groups.The range

Table (1): *Showing mean difference, change, t-values and P-values of Mid-buccal crestal height, Mid-palatal/lingunl crestal height, Relative socket depth and Buccolingual width in mm in Group I (βTCP/Col) and Group II between baseline and after 3 months*

			Paired t. test		Independent t. test	
Group I (βTCP/Col)	Baseline	After 3months	t-test	p-value	Base line p-value	3 months p-value
Mid-buccal crestal height	9.67±2.87	8.44±2.80	4.424	**<0.001****	0.236	0.803
Mid-palatal/lingunl crestal height	9.12±2.78	7.45±2.56	5.400	**<0.001****	0.346	0.615
Relative socket depth	21.35±3.22	9.79±3.17	8.968	**<0.001****	0.786	**0.044***
Buccolingal width	8.84±3.29	5.58±1.23	7.944	**<0.001****	**0.037***	**0.014***
Group II (PRF)						
Mid-buccal crestal height	7.68±1.96	8.84±2.04	4.766	**<0.001****		
Mid-palatal/lingunl crestal height	7.49±2.35	6.61±2.52	3.152	**0.012***		
Relative socket depth	21.91±3.08	14.14±3.09	6.294	**<0.001****		
Buccolingual width	7.41±0.88	3.45±0.88	9.682	**<0.001****		

Table (2): *Showing t-values and P-values of Bone height, Bone width and Bone denisty in Group I (βTCP/ Col)and Group II(PRF) at baseline and after 3 months.*

Group I (βTCP/Col)	Baseline	After 3months	Paired t. test		Independent t. test	
			t-test	p-value	Base line p-value	3 months p-value
Bone Height	10.53	8.50	6.054	<0.001**	0.004*	0.041*
Bone Width	6.84	5.79	2.161	0.049*	0.029*	0.114
Bone Denisty	512.50	603.90	1.047	0.309	0.018*	0.241
Group II (PRF)						
Bone Height	6.63	6.18	2.111	0.047*		
Bone Width	4.78	4.38	0.395	0.698		
Bone Denisty	295.80	593.40	4.628	<0.001**		

between minimum and maximum values ,means±SD, P-values and t-values of Group I (βTCP) between baseline and after 3 months illustrated in Table(1)

Minimum and maximum values, means±SD, P-values and t-values of Group II (PRF) between baseline and after 3 months illustrated in

Using: Paired Sample t-test; statistically significant difference between baseline and after 3 months according to Bone height (mm), Bone Width (mm), Bone Density (mm) of Group I (βTCP).

DISCUSSION

Post extraction resorption of the alveolar ridge is a progressive and irreversible process following removal of teeth. Bone loss occurs in both the alveolar height and width and is accelerated in the first six months after extraction, and has the potential to either complicate implant placement or impair the final esthetic result. Techniques to preserve natural bone and soft tissue contours are of great interest to clinicians and patients because even subtle post-extraction buccal plate resorption may have significant clinical effects, particularly in the esthetic zone.

Loss of ridge height and width results in prosthetic instability and complicated esthetic tooth replacement with implants which may require extensive reconstructive surgery later on . [8]

Alveolar ridge preservation is a procedure undertaken following an extraction, which is designed to minimize alveolar ridge resorption and maximize bone formation within the socket. However, there are clinical situations where it is not advisable to use ridge preservation at the time of extraction as in cases of acute infection. In these situations, preservation of the ridge may be delayed by six to eight weeks post-extraction.[9-10]

The rational behind ridge preservation is modulation of early stage ridge resorption, increasing bone density and facilitating future implant placement.[11]

Several solutions have been proposed for preserving extraction socket; atraumatic extraction of the tooth, immediate implant placement.[12-13] grafting materials with or without barrier membrane,[14-15] and also barrier membrane alone can used without grafting materials.[16]

Different grafting materials have been used including; autogenous bone graft harvested from on

site to another within the same individual, allograft transferred between members of the same species, xenografts from different species as bovine bone graft and alloplasts which are synthetic in origin.[17] The use of autogenous bone has always been the gold standard, but at times, autogenousbone harvesting is not feasible, where now the alternatives are allografts, xenografts or alloplastic materials [18]

The present study aimed to compare clinically and radiographically the potentiality of both beta-tricalicium phosphate covered with collagen membrane and PRF plugs in preservation of the alveolar ridge and reducing the bone dimensional changes following tooth extraction in sites planned for delayed implant placement.

The present study used Platelet-rich fibrin (PRF) plugs as a autologus grafting material for the extraction socket. PRF is the second-generation of platelet concentrate that has been used in various surgical procedures in an attempt to enhance wound healing because the high concentrations of the collected platelets allow for the slow release of growth factors at a sustained rate over a longer period, thereby optimizing wound healing .[19]

During present study was recoreded clinically rapid healing process of wound tissue and minimal postoperative pain without any signs of neither infection nor inflammation.

The classical technique for PRF preparation that invented by Dr. **Choukroun, in 2000** was followed in the current study due to its simplicity, safty from transmitted diseases and elimination of anticoagulant usage.[20]

Clinical outcomes:Vertical bone parameters including Mid-buccal crestal height, Mid-palatal/lingunl crestal height , buccu-lingual width and Relative socket depth exhibited noticeablemay also facilitate primary wound closure via fibroblast chemotactic properties, which achieves predictable treatment outcomes All the clinical parameters were recorded from an fixed reference points on the

acrylic stent fabricated on the cast as advocated by Talwar *et al* 2010 because this technique provide an accurate method for linear measurments and repreducability during different follow-up intervals.[21]

- At baseline, all the clinical parameters except relative socket depth of Group II (PRF) were higher in contrast to that of Group I (BTCP).

- At 3 months, except for mid-buccal crestal height for which an increase in Group I (PRF) was observed.

- For all the other parameters both the groups showed a reduction.

- The reduction was higher in Group II (β-TCP-COl) as compared to Group I (PRF) for all the parameters and difference between two groups was also significant ($P < 0.05$)

- In the present study showed more decrease in buccolingual width of Group lI (PRF) than Group I (β-TCP-Cl) after 3 months and GroupI-were produced the highest bone width followed by Group II.

- ***Radiographic outcomes*** :Quantity of bone formation in the form of linear measurement of Bone height exhibited noticeable preservation of the extraction socket and reduction of the degree of alveolar bone loss in both βTCP-Col and PRF groups while Bone width showed statistically significant only in (βTCP/Col) group when the ridge dimensions at 3 months compared with those at base line with favourable results to βTCP-Col group over PRF group after complete healing of the extraction socket.

- Within Group I (β-TCP-Cl), mean density values were highest in the middle third followed by coronal third and least in the apical third, whereas for Group II (PRF) mean density values were highest in the middle third followed by apical third and least in the coronal third at 3 months follow-up. In contrast to results obtained from earlier studies, where more evident density was

observed in apical part of the socket/ridge as compared to the coronal and middle third.and this is agree with[Madan R, Mohan R, Bains VK2014)[22]

- Significant reduction on mean bone height (mm) were found after 3 months (8.5±2.42 mm) compared to Immediate (10.53±2.72 mm) at p=<0.001 for Group A (B-TCP).

- Significant reduction on mean bone height (mm) were found after 3 months (6.18±2.29 mm) compared to Immediate (6.63±2.6 mm) at p=0.047 for Group B (PRF).

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التقييم الإكلينيكي والإشعاعي لاستخدام بيتا ثلاثي الكالسيوم مع الكولاجين والغشاء الليفي الغنى   الصفائح الدموية في معالجة سمحاق السنخ في التخطيط لزراعات الأسنان باستخدام الأشعة المقطعية المخروطية

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الملخص :

الهدف: مقارنة الفاعلية الاكلينيكية وباستخدام الاشعة لكلا من رقعة بيتا ثلاثي فوسفات الكالسيوم مغطي بغشاء الكولاجين مع مضغة من الصفائح الدموية الغنية بالألياف في استعاضة جَويف الفك والحد من انحساره بعد خلع الاسنان

المواد والاساليب : أجريت هذه الدراسة على عشرين مريضا من المترددين علي العيادات الخارجية بقسم طب الفم وامراض اللثه بكلية طب الفم والأسنان جامعة الازهر بالقاهرة ممن تم وضع خطة علاجية لهم بخلع واحدة او اكثر من الأسنان الميئوس منها , تتبع بعمل استعاضة لها لاحقا بغرسات الاسنان الصناعية تم تقسيمهم عشوائيا الي مجموعتين متساويتين. تم جَهيز المرضي بعمل علاج لثوي باستخدام الكواحت اليدوية وباستخدام الموجات فوق الصوتية كما تم اخذ صور فوتوغرافية للمرضي خلال فترات المتابعة تمت عملية الخلع ووضع الرقعة العظمية في كلا المجموعتين وتم اخذ القياسات الاكلينيكية بعد الخلع ووضع الرقعة العظمية وبعد 3 أشهر لتقييم كلا من:- ارتفاع منتصف القمة الشدقية وارتفاع منتصف القمة الحنكية عمق التجويف النسبي وعرض الفك (الشدقي الحنكي) كما أجريت الأشعة السينية بواسطة التصوير المقطعي مخروط الشعاع بعد الخلع ووضع الرقعة العظمية وبعد 3 أشهر لتقييم ارتفاع العظام , عرض العظم وكثافة العظام تم جمع القياسات وجدولتها وحَليلها إحصائيا.

النتائج: لقد أظهرت النتائج انخفاض الانحسار فى ارتفاع وعرض وكثافة عظام الفك عند مقارنة النتائج بعد ثلاثة اشهر مع مثيلاتها بعد الخلع مباشرة , مع تميز ملاحظ احصائيا لصالح مجموعة البيتا ثلاثي فوسفات الكالسيوم المغطي بغشاء الكولاجين اكلينيكيا في استعادة عمق التجويف النسبي والعرض الشدقي الحنكي للفك , وباستخدام الاشعة في ارتفاع العظام عند نهاية

الخلاصة: من نتائج الدراسة الحالية نستنتج ان كلا من بيتا ثلاثي فوسفات الكالسيوم المغطى بغشاء الكولاجين والصفائح الدموية الغنية بالألياف تعتبر مواد محفزة لإعادة بناء عظام الفك ومنع تأكلها بعد الخلع

الكلمات المفتاحية: استعاضه جَويف الفك، حق ناقص , بيتا ثلاثي فوسفات الكالسيوم ، صفائح غنيه بالألياف . الحفرة السنخية المعيبة. التصوير المقطعي مخروط الشعاع .تقنية ترقيع الفك.