

## **PARTIAL EXTRACTION THERAPY VERSUS CONVENTIONAL IMMEDIATE IMPLANTATION AND THEIR EFFECT ON VERTICAL AND BUCCAL HORIZONTAL SUPPORTING BONE RESORPTION OF MANDIBULAR OVERDENTURE**

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### **ABSTRACT**

**The Purpose** of this study is to estimate the effect of partial extraction therapy (PET) with immediate implantation versus conventional immediate implantation in preserving vertical height and labial thickness supporting two implants retaining overdenture.

**Material and method:** Fourteen male patients of 50 - 60 years age having completely edentulous maxillary arch and bilateral standing canines in the mandibular arch indicated for extraction were selected from the outpatient clinic prosthodontics department faculty of dentistry Ain Shams University to participate in this study and allocated into 2 groups, Group I: Patients of this group were rehabilitated with implant retained mandibular overdenture with two immediately placed implants for the bilateral canines while Group II: Patients of this group were rehabilitated with implant retained mandibular overdenture with two immediately placed implants following one of the PET (socket shielding technique) for the bilateral canines. Radiographic evaluation using CBCT was done to evaluate the amount of vertical bone loss and thickness of labial plate throughout the follow-up period.

**Results :** There was a significant decrease in thickness of labial plate of bone in group I and II through out the follow up period, and on comparing the two groups there was statistical significance after one year. There was significant increase in vertical bone loss in group I and II through-out the follow up period, meanwhile on comparing the two groups regarding the vertical bone loss there was statistical significance after 6 months and after one year.( $p \leq 0.05$ ).

**Conclusion :** Within the limitation of this study, it could be concluded that partial extraction technique (socket shielding) enhances immediate implantation osseointegration and preserves supporting bone.

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## INTRODUCTION

Partial extraction therapies (PET) is a general term that includes underlying categories of surgical extraction of a root or a part of the root with the aim of preserving the natural contours of bone and soft tissue around implant-retained restorations. These include the root submergence technique<sup>[1]</sup>, the socket-shield technique<sup>[2]</sup>, the pontic-shield technique.<sup>[3]</sup>

It is known that tooth extraction triggers crestal bone resorption and loss about 24% after a five months period, changing severely the form of hard and soft tissues.<sup>(4)</sup>

Replacing missing teeth by dental implants has been a great achievement in the history of dentistry. Nowadays, placement of implants immediately after tooth extraction has become a common and acceptable clinical method. It was proven that immediate implant placement preserves bony walls and prevents collapse of alveolar bone after extraction. Other advantages of this technique include a decrease in the number of surgical procedures, treatment time and costs, an increase in patient satisfaction, placement of implant in the same position as the extracted tooth and better axial placement and esthetic results.<sup>(5-6)</sup>

It is known that physiological processes taking place immediately after tooth extraction up to the end of the 1st week include increasing the number of osteoclasts on the outside as well as on the inside of the buccal and lingual bone walls. The presence of osteoclasts on the inner surface of the socket walls indicates that the bundle bone, which is closely related with the periodontal tissue is being resorbed.<sup>(5)</sup>

Anatomically buccal bone plate of the teeth is thinner than lingual or palatal. Therefore as bundle bone is tooth-dependent tissue, it will gradually disappear after extraction. Thus, since there is more bundle bone in the crest of the buccal than

the lingual wall, hard tissue loss will become most pronounced in the buccal wall.<sup>(5)</sup>

The bundle bone is primarily vascularized by the periodontal membrane of the tooth. Therefore, this part of the alveolar bone is compromised by the extraction, to that degree that the buccal lamella is insufficiently nourished, leading to its total or partial resorption. Thus root retention may have an influence on the resorption process.<sup>(6)</sup>

The root submergence technique (RST), and submucosal root retention can virtually eliminate bone resorption. Based on this concept, the retention and stabilization of the coronal and buccal bundle bone and the retention of the periodontal membrane by retaining a coronal tooth fragment (so-called socket shield), including adequate blood supply, can be expected.<sup>(7)</sup>

The hypothesis that one surface of implant in contact with a tooth fragment may interfere with osseointegration was contradicted in a study of Hürzeler and co-workers where the implant was placed in contact with root fragment, newly formed cementum was noticed on the implant surface.<sup>(8)</sup>

Several studies have demonstrated that socket shield technique as a partial extraction therapy (PET) along with immediate implant placement (IIP) is a reliable technique and survival rate ranging between 95 % - 100% was reported.<sup>(9,10)</sup>

The objective of the current study is to estimate the effect of partial extraction therapy (PET) with immediate implantation versus conventional immediate implantation in preserving vertical height and labial thickness supporting two implants retaining overdenture.

## MATERIALS AND METHODS

### Participants

Fourteen 50 - 60 years age male patients having completely edentulous maxillary arch and bilateral

standing canines in the mandibular arch indicated for extraction were selected from the outpatient clinic of prosthodontics department faculty of dentistry Ain Shams University to participate in this study

All participants were informed with the details and steps and they signed an informed consent form that they agree for the need for extraction of these canines and implant placement. All the patients were motivated to the treatment and were informed that they will be a part in a study that needs their best co-operation.

Precise medical and dental history were taken from all patients through direct interviews and a questionnaire sheets

Clinical examination was done including extra and intra-oral examination. Patients with severe acute periodontitis, bone metabolic diseases were excluded. Full intra-oral examination for the mandibular residual alveolar ridge should exhibited adequate height and width and was covered with firm fibrous mucoperiosteum free from any signs of inflammation, ulceration or flabbiness, also the retained canines were free from acute infection, had 10 mm bone support and adequate labial plate of bone through. Adequate interarch space were ensured through tentative jaw relation record

Pre-operative Cone Beam CT (CBCT) was carried out for all patients, the teeth were considered as markers at the interforaminal region to detect the presence of any pathologic lesion and/or remaining roots in the mandibular arch, to evaluate the periodontal condition, bone support and adequate labial plate of bone of the retained canines. Also to evaluate the available bone height and width from crest of the ridge to the inferior border of the mandible in the canine area to reveal at least about 5.5 mm width and 13 mm height. (figure 1 a,b)

The retained canines should have at least 3 to 5 mm of bone beyond the apex and a bony length of 10 mm or greater for stability when placing immediate implants. The retained canine area do not include severe labial and circumferential bone defects or bony defects with two or three missing walls.

### Patients grouping

The patients were then randomly assigned using random number generator and checker into ([www.psychicscience.org/random.aspx](http://www.psychicscience.org/random.aspx)) into two equal groups.

### Group I:

Patients of this group were rehabilitated with implant retained mandibular overdenture with two immediately placed implants for the bilateral canines.

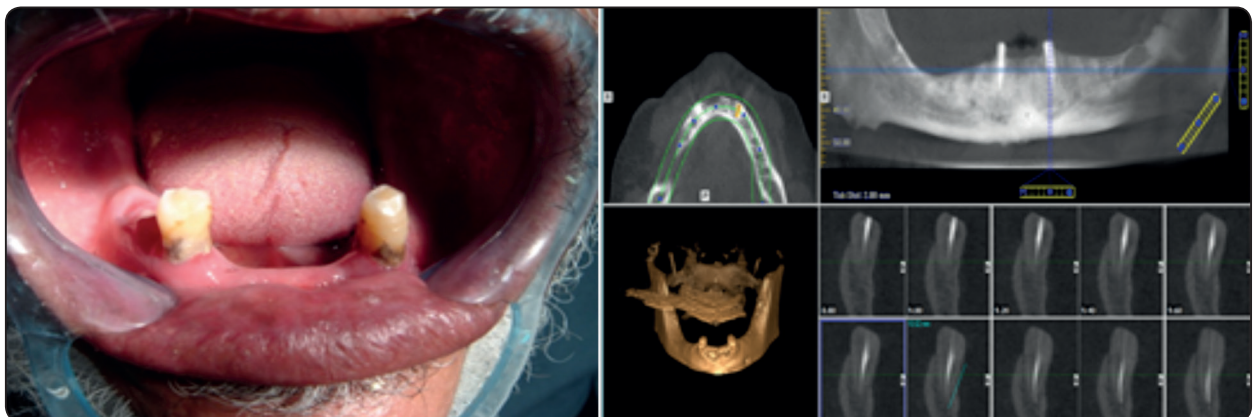


Fig. (1) (a); Two standing canines

(b) Diagnostic CBCT using the two canines as a marker

**Group II:**

Patients of this group were rehabilitated with implant retained mandibular overdenture with two immediately placed implants following one of the PET (socket shielding technique) for the bilateral canines.

**Surgical procedure****In group I:**

On the day of surgery, the patient was given profound anaesthesia (Articaine Hydrochloride) followed by ring infiltration anesthesia in the surgical region.

The retained canines were extracted with atraumatic extraction. Every attempt should be made to minimize trauma to the alveolus during the extraction. The use of a periosteal elevator is extremely critical to maintain most of the alveolar housing of the tooth to be extracted. The periosteal elevator helps in separating the periodontal ligament fibers from the tooth, thereby preventing the fracture of the alveolus. After careful inspection of the extraction socket, the walls are thoroughly curetted to remove all remnants of the periodontal ligament.

After canine extraction, the implant drill was used to make the osteotomy site for immediate implant placement, the osteotomy must be kept on the lingual aspect of the alveolus to prevent perforation of the labial plate. Once the osteotomy was prepared to the desired depth with at least 3 to 5 mm of intimate implant-to-bone contact. The ratchet wrench was used for the final stage of the implant placement with the insertion torque not less than 35N. The implants 3.5 diameter and 13 mm length (CMI implant Neobiotech, Seoul, South Korea) were stable within the osteotomy with no mobility.

The implant fixture was in contact with the socket without gap between the head or neck of the implant and surrounding socket walls, When a gap exists between the socket wall and the implant

fixture, a bone graft can be used to prevent epithelial migration into the space and aid in healing.

A wide diameter healing abutment was immediately placed, Figure of eight suture was done over the healing abutment (figure 2). One week later, patients were recalled and sutures were removed.

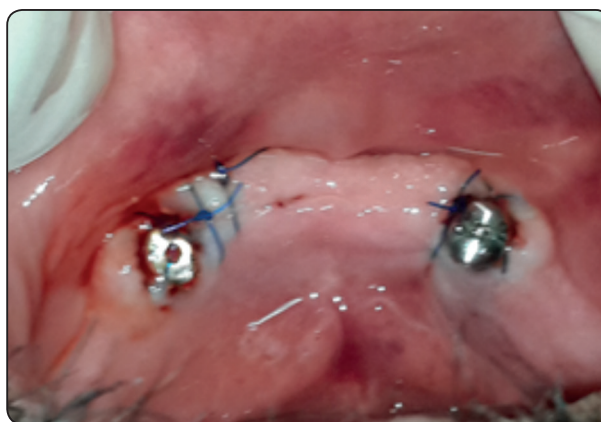


Fig (2): Healing abutment placed over the immediate implant

**In group II:**

Root canal treatment was done for the canines then the canines were reshaped to attain a dome-shaped 2mm above the free gingival margin .

On the day of surgery, the patient was given a profound anaesthesia, the root was separated vertically with tapered stone in a ratio between 1:3 labial and 2:3 lingual. Once labial and palatal root halves are adequately separated, a microperiosteal elevator is inserted into the lingual PDL space, carefully displacing the palatal root section labially into the recess created by the sectioning bur

Using the implant drill the lingual part of the root was hollowed to facilitate its removal with periosteal elevator without dislodging the labial part. (figure 3 a,b)

The height of the buccal socket shield was reduced to half the distance between the free

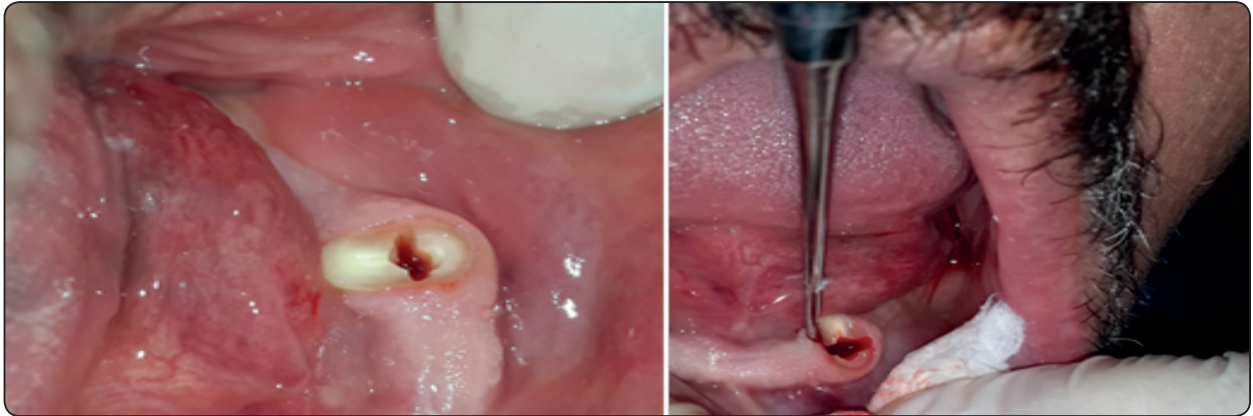


Fig. 3 (a); The root was separated vertically with tapered stone in a ratio between 1:3 labial and 2:3 lingual. Fig. 3 (B);periosteome used to dislodge the labial part of the root

gingival margin and the alveolar crest, 1mm above the labial plate level using a large round bur.

The implant drill was used to make the osteotomy site for immediate implant placement lingual to the labial shield leaving a jumping distance between the shield and the implant, the drills was held vertically through the bone at approximately 800-1000 RPM associated with constant continuous flow of copious amounts of saline solution for the full length of the implant guided by a stopper. The drilling was accomplished by using a delicate up and down pumping action, the drilling was continued for the full length of the implant which was extended 3mm more apically than the tooth for primary stability.

After the final preparation of the implant site, it was irrigated clearly with saline, then the implant sterile vial was opened and the implant Fixture driver was then used to to install the fixture in the osteotomy site (figure 4), the driver was rotated in a clockwise direction while exerting a slight downward finger till resistance was encountered during rotation.

The ratchet wrench was used for the final stage of the implant placement with the insertion torque should be not less than 35N. The implants 3.5 diameter and 13 mm length were stable within the osteotomy with no mobility.

A wide diameter healing abutment was immediately placed. Figure of eight suture was done over the healing abutment. One week later, patients were recalled and sutures were removed.



Fig. (4) Implant installed in its place

### **Prosthetic procedure**

For all patients, complete upper and lower dentures were constructed according to the conventional method :

#### ***Denture Construction:***

Primary alginate impressions were made then they were poured in dental stone to produce study casts, upon which selectively relieved acrylic resin special trays were constructed. The tray was

Border Moulded using Green-Stick compound and Zinc Oxide Eugenol material (Zinc Oxide Eugenol, Cavex, Holland BV) final impression was made and poured to obtain master casts.

Upper and lower occlusion blocks were fabricated on the master cast. Centric occluding relation was recorded following the inter-occlusal wax wafer technique and Casts were mounted on mean-value articulator. Modified cross-linked acrylic teeth (Acrylic teeth, Acrostone dental, Egypt) were modified and arranged following the lingualized concept of occlusion. The waxed up (Base plate Modeling wax, Cavex, Holland BV) dentures were then tried in the patient's mouth to ensure proper facial contour, extension, retention, stability, correct vertical dimension and harmony between centric occlusion and centric relation.

Mandibular and maxillary waxed up dentures were flaked. Wax was eliminated and processed in heat cured acrylic resin. After finishing and polishing, the dentures were delivered to the patient. Any necessary adjustments were done and post insertion instructions were given to the patient. A ball abutment attachment type with a suitable gingival collar was screwed to the implant with its driver, its torque was not more than 20 Ncm. Areas in the denture corresponding to the two inserted abutments were marked on the fitting surface of the denture. Acrylic abrasive stone was used to relieve the marked areas and create enough space to accommodate the abutment. The denture was tried in the patient's mouth to ensure complete seating. The implant positions were marked on the fitting surface of the mandibular denture by marking the heads of the O-balls by a marker A relief area was created on the fitting surface of the lower denture opposite the implant heads using an acrylic bur. The O-Ring attachments enclosed in the female metal housings were placed over the implants. The lower denture was then tested intra-orally to confirm complete seating without interfering with the original fit of the denture while in maximum intercuspation. An

elastomeric block out shim (spacer) was placed over the vertical half of the implant head (to block out undercuts) while permitting the O ball half of the abutment to protrude uncovered, this was performed to prevent any lock with the permanent hard pick up material (Hard Pick Up Material, 3MESPE, Germany).

### Method of evaluation

The focal planes of all CBCTs were adjusted to the center of the buccolingual aspect of the implant, as well as the mesiodistal (longitudinal) aspect then the thickness of the labial bone was measured to within 1/100 mm perpendicular to the implant surface at 1.5 mm (cervical width) and 5 mm (middle section width) through sagittal views then average of the 2 readings were taken.

Marginal bone height change was measured by measuring the distance from the alveolar crest to the implant apex. Values of linear measurements were recorded in the patient chart at every follow-up visit and from these data mean values of bone height change were calculated.

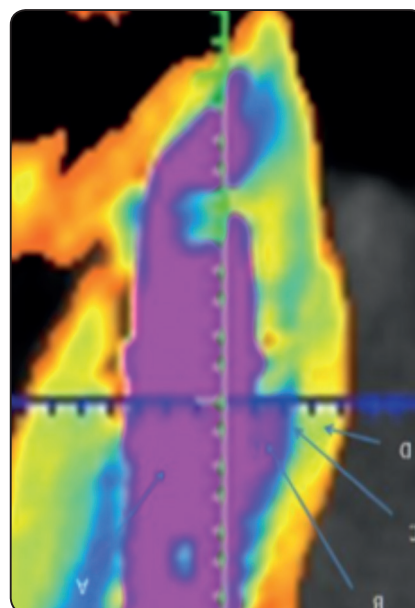


Fig. (5) Color coding of the sagittal section of implant placed lingual to the root shield (A) Implant, (B) shield, (C) labial bone, (D) Soft tissue.

**RESULTS**

The results of this study are shown in tables (1-6) .

All the data was collected and tabulated. Statistical analysis was performed by Microsoft Office 365 (Excel) and Statistical Package for Social Science (SPSS) version 25. The significant level was set at  $P \leq 0.05$ .

Independent t test was used for comparison between groups.

Anova for repeated measures was used for comparison between follow up periods within groups followed by post pairwise comparison with bonferrioni correction.

***I-Comparing between the two groups regarding the thickness of the labial plate***

TABLE (1) Comparison between groupsmean of amount of bone loss in mm and standard deviation after the surgery,after 6 months and after 12 months.

	Group	N	Mean	Std. Deviation	P value
At surgery	group I	7	0.2471	.10111	0.442
	group II	7	0.2871	.08635	
6-month	group I	7	0.2114	.09317	0.719
	group II	7	0.1943	.08059	
12-month	group I	7	0.1914	.08174	0.016*
	group II	7	0.0886	.05210	

As shown in table 1, Upon comparing the two groups regarding the thickness of the labial plate, there was statistically insignificant difference between group I and II during the first 6 months, however there was a statically significant difference ( $P=0.016$ ) between the two group after 12 months.

***a) Effect of time on group I***

TABLE (2): Comparison between mean (mm). standard deviation of bone loss in labial bone plate thickness during the first 6 months and the second 6 months in group I.

	Mean	Std. Deviation	P value
At surgery	0.2471	0.10111	0.001
6 Months	0.2114	0.09317	
12 Months	0.1914	0.08174	

While comparing the thickness of labial bone loss during the follow up periods.

Anova for repeated measures followed by post pairwise comparison with bonferrioni correction Post hock test showed significant difference between all follow up periods.

***B) Effect of time on group II***

TABLE (3): Mean (mm). standard deviation of bone loss in labial bone plate thickness during the first 6 months and the second 6 months in group I.

	Mean	Std. Deviation	P value
At surgery	0.2871	0.08635	0.001
Month 6	0.1943	0.08059	
Month 12	0.0886	0.05210	

Comparing the thickness of labial bone loss during the follow up periods in group II, Anova for repeated measures followed by post pairwise comparison with bonferrioni correction Post hock test showed significant difference between all follow up periods.

**II- Comparison between the total amounts of peri-implant vertical bone loss in the two studied groups**

TABLE (4): Mean value (mm), standard deviation (SD) and paired t test of total peri- implant bone height change in the studied groups during the follow up period.

	Group	Mean	Std. Deviation	P
Loading -6months	Group I	0.58	0.012	0.05*
	Group II	0.41	0.018	
6-12months	Group I	0.40	0.090	ns
	Group II	0.34	0.017	
Loading -12months	Group I	0.98	0.247	0.05*
	Group II	0.75	0.062	

As shown in table 4, Upon comparing the two groups regarding the vertical height of bone ,there was statistically significant difference between group I and II during the first 6 months and after one year, however there was a statically insignificant difference between the two group from 6 to 12 months.

**a) Effect of time in group I**

TABLE (5): Mean value (mm), standard deviation (SD) and paired t test of total peri- implant bone height change for group I patients during the follow up period.

	Mean	Sd.	P
Loading -6months	0.58	0.12	0.05
6month-12month	0.40	0.09	
Loading -12 months	0.98	0.24	

As shown in table 5, there was a statistical significant bone height loss during the follow up period in group I

**B) Effect of time in group II**

TABLE (6): Mean value (mm), standard deviation (SD) and paired t test of total peri- implant bone height change for group II patients during the follow up period.

	Mean	Sd.	P
Loading -6months	0.41	0.018	0.05
6 month-12 months	0.34	0.017	
Loading -12 months	0.75	0.006	

As shown in table 6, there was a statistical significant bone height loss during the follow up period in group II.

**DISCUSSION**

The process of alveolar resorption for the edentulous patient has been characterized as an inevitable and progressive process that appear quickly after tooth extraction. The width of the buccal plate of bone may be an important determinant of bone morphologic changes following extraction. During healing, the alveolar bone undergoes a remodeling process, leading to horizontal and vertical bone level change and loss. These resorption processes hinder dental rehabilitation, particularly in connection with implants. Initial implant stability is the most critical factor in implant osseointegration. Thus, an ideal site is one that has significant alveolar bone around the socket enabling the implant to fill the socket space.

Immediate implant placement in the esthetic region is stated to be the ideal treatment modality for replacing hopeless teeth.<sup>(11-13)</sup>. However, the diminished covering soft tissue and buccal plate resorption may complicate this line of treatment, especially if highly esthetic demands are involved<sup>(14)</sup>. Particularly in the esthetic zone, preservation and establishment of labial mucosa and underlying buccal bone has shown to be milestone in creating optimal results<sup>(15,16)</sup>.



Data reported in clinical studies indicate that an overall reduction in the horizontal dimensions occurred following tooth extraction and that the resorption of the buccal part of the ridge was more pronounced than the lingual part. In this way morphology of the healed alveolar ridge following tooth extraction is almost always presenting with discrepancy in bone height between the two bone plate of the alveolar ridge – lingual and buccal<sup>(2)</sup>.

However, there are several studies on immediate implant placement in the esthetic region, with long follow-up periods. They showed extreme variation in buccal bone thickness, even in cases without any buccal bone. That was in line with our results. Benic et al<sup>(17)</sup> followed 14 patients over 7 years and found a median buccal bone thickness of 0.0 mm (mean 0.4 mm).

Groenendijk et al<sup>(18)</sup> reported in a 2-year retrospective study on 16 patients a buccal bone thickness of 1.8 mm (varying from 0.9 to 2.4 mm). Another important study with remarkable follow up period (8-year prospective study) on 16 patients having immediate placement stated that median buccal bone thickness varied from 0.80 to 1.24 mm along the implant axis and never exceeded 2 mm<sup>(19)</sup>.

Even though placement of implants immediately after tooth extraction preserves bony walls and prevents collapse of alveolar bone after extraction<sup>(3-5)</sup>, a decrease in peri-implant bone height for the two studied groups was detected. This bone loss could be based on the hypothesis that marginal bone loss is the result of micro-damage accumulation occurring in bone after implant placement. It was also explained as an early manifestation of wound healing which occurs after implant placement and as a reaction to loading. Crestal bone loss could also be explained by the finding that forces applied on implants are distributed on the crestal bone rather than along the entire implant/bone interface<sup>(20)</sup>.

The result of Wilfried Engelke et al<sup>(21)</sup> concluded that a complete maintenance of the buccal plate

can be achieved in the crestal zone. This refers to the vertical height as well as the crestal width of the buccal wall. The slight increase in width may be a result of the reinforcement by the root lamella preserved in group II.

Results of this study support the opinion that immediate socket shielding insertion technique may have the potential to avoid the resorption which correspond to the desired effect of maintaining the periodontal tissue on the buccal bone plate after tooth extraction<sup>(22,23)</sup>.

## CONCLUSION

Within the limitation of this study, it could be concluded that partial extraction technique (socket shielding) enhances immediate implantation osseointegration and preserves supporting bone.

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