ISSN: 0975 -8542

Journal of Global Pharma Technology

Available Online at: www.jgpt.co.in

RESEARCH ARTICLE

Evaluation of Implant Stability and Marginal Bone Level for Immediately Placed Dental Implants in Fresh Extraction Sockets Augmented with Phase-pure Beta-tricalcium Phosphate

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Abstract

Objectives: The aims of this study were to evaluate dental implant stability and marginal bone level after immediate implant placement with simultaneous grafting of the gap with alloplastic material. Materials and methods: This prospective study included patients who required an extraction of hopeless teeth and subsequent immediate implant placement at a non-molar site, Full thickness mucoperiosteal flap was elevated and the buccal plates were intact in all cases. Following dental implant placement the primary stability was measured with Periotest. The gap was filled with alloplastic grafting material (Easy graft) and wound closure, then a cone beam computed tomography (CBCT) was taken. 6 months later, a second CBCT was performed and a comparison between them was made for the evaluation of marginal bone level change. Results: Twenty patients with 31 dental implants were enrolled in this study. The difference between base line and 6 months for buccal cortical plate level , palatal/lingual cortical plate level were 0.93 ± 1.15 mm , 0.57 ± 0.94 mm respectively with a highly significant difference (P=0.007) between buccal and palatal cortical plate. For primary implant stability the mean was 4.98 ± 4.26 PTV, while secondary stability was 1.36 ± 2.96 PTV with a highly significant difference (P=0.001) between primary and secondary stability. Conclusion: Good primary implant stability was achieved even in the presence of gap and the stability was adequate to attain good secondary stability after 6 months. Gaps more than 2 mm were successfully managed with rapid setting Easy graft with promising influence on stability and marginal bone level. Implant length inversely affected PTV. Bone resorptions of the cortical plate occurred more labailly/ buccally than palatally/ lingually and maximum resorption happened in the canine region.

Introduction

Dental implants are a consolidated treatment for replacing missing teeth, allowing the restoration of chewing function, speech, and aesthetics. Implants are inserted into the jawbone in order to support a dental prosthesis and remain stable due to the bone growth onto their surface. Such direct, structural and functional connection between the living bone and the implant surface, termed osseointegration [1], has surely been one of the most significant scientific breakthroughs in dentistry over the past 40 years.

Traditionally, before placing dental implants, compromised teeth are removed and the extraction sockets are left to heal for several months. However, alveolar ridge resorption after tooth extraction may considerably reduce the residual bone volume [2, 3] and compromise the favourable implant positioning required for an optimal prosthetic restoration. Such aspect is even more pronounced in the anterior maxilla, where ridge resorption is more pronounced in the buccal wall [2, 3] leading to an unfavourable buccolingual discrepancy between the implant and the prosthesis. On the other hand, a shortened treatment time between tooth removal and implant placement as well as a reduction in the amount of surgical procedures is becoming an essential requirement of patients in our daily practice. This concept was already introduced in the late 1970s [4] and has been extensively reviewed during the last decades [5, 9].

It was first thought that, to place and implant at this time point, would avoid bone remodeling [10, 11] but clinical and experimental evidence has shown that a reduction in height and width - especially of the buccal plate- will still take place [12, 13, 5].

It seems clear that a careful case selection, intact socket walls, a medium to thick biotype, lingualized positioning of the implant and adequate primary stability as well as clinicians' expertise is essential in order to achieve a stable aesthetic outcome [8, 9]. Furthermore, some authors have tried to regenerate the missing bone between the implant surface and the socket walls using various bone augmentation techniques such as autogenous bone grafts [14, 15], bone substitutes [6, 7], guided bone regeneration with resorbable [16] or non-resorbable barriers [14, 15] and various bone promoting molecules such as enamel matrix derivative [17]. The aims of the present study were (**i**) evaluation of marginal bone level after immediate implant placement and Easy graft augmentation. (**ii**) Evaluation of implant stability with the aid Periotest.

Material and Methods

Study Sample

This is a prospective clinical study organized in Dental College Teaching Hospital/ Department of oral and maxillofacial surgery / Dental Implant Unit / Baghdad University, in the period from November 2017 to November 2018. The study samples include patients with conditions indicated for immediate dental implant treatment whom seeking for dental implant treatment to replace single or multiple unrestorable maxillary and mandibular teeth by means of immediate dental implant placement.

A total of 20 patients , 8 males and 12 females aged between 25-69 years old were enrolled in this study receiving a total of (42) immediate dental implants (Nucleoss, Turkey) of which (31) implants are involved in the study of with (23) implants were 3.5 mm in diameter Ø and [8] implants were 4.1 mm in diameter Ø placed immediately in fresh extraction sockets and the gap between the sockets walls and the implants surfaces were filled with non- autogenous bone graft material (Easy graft classic , Sun star Guidor).

Eligibility Criteria

- Absence of local or systemic conditions that would absolutely jeopardize dental implant surgery.
- Patients aged ≥ 18 years.
- Patients with good oral hygiene.
- Teeth to be extracted and implant placement with augmentation procedure.

Exclusion Criteria

- Patients who had general contra-indications for dental implant surgery.
- Heavy smokers (>20 cigarette /day).
- Close proximity to vital structures such as mental foramen maxillary sinus and mandibular canal.
- Inability to achieve primary stability as a result of severe alveolar bone destruction.
- Patients with signs of acute infection and purulent exudates in the extraction zone.
- Patients with bad oral hygiene.
- Patient with no or gap ≤ than 2 mm.
- Molar teeth.

Patient's Preparation and Surgical Procedure

All patients involved in the study had good health and were eligible for dental implant surgery. Diagnostic OPG and periapical radiographs for the accused teeth were taken for patients. The patients were instructed to rinse their mouth with 0.12% chlorhexidine for one minute preoperatively.

Figure 1: Teeth No. (1.1, 1.2, 1.3, 2.1 and 2.3) that indicated for extraction and replaced with immediate dental implants due to its mobility

Surgery was done under local anesthesia. Dental extraction was carefully performed as atraumatic as in Figure 2.

Figure 2: A- extraction of the tooth No.1.1 with the use of dental forceps

Figure 3: Extracted teeth that need to be replaced with dental implants

Full thickness mucoperiosteal three sided flap (extensive or limited flap design) was reflected to expose crestal and buccal alveolar bone as in Figure 4.

Figure 4: Elevation of three sided flap and inspection of the facial bone

The facial bone carefully inspected for the presence of bone defects or gap and the extraction sockets carefully enucleated by surgical curette to remove the remnants of periodontal ligaments and granulation tissue if present then the extraction socket was extensively irrigated by normal saline solution as in Figure 5.

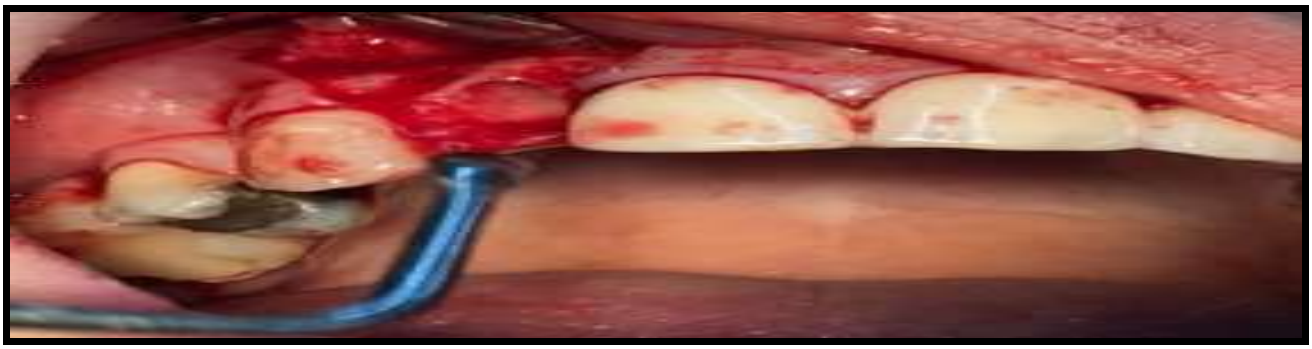

Figure 5: Enucleating the socket with the use of curette for the removal of the periodontal ligament and granulation tissue

Drilling procedure started by using the 1st drill increasing in size until reaching the requested diameter .Preparation of implant site done with 600-800 rpm speed and 35 N/Cm torque with external irrigation with normal saline solution.

Figure 7: Drilling of the implant site tooth No 2.3

The implant fixture is introduced in the socket by motorized method at a speed of 20-30 rpm with torque of 35 N/Cm and the procedure completed manually by using screw driver or ratchet. The implant fixture was placed at the same level with alveolar bone crest.

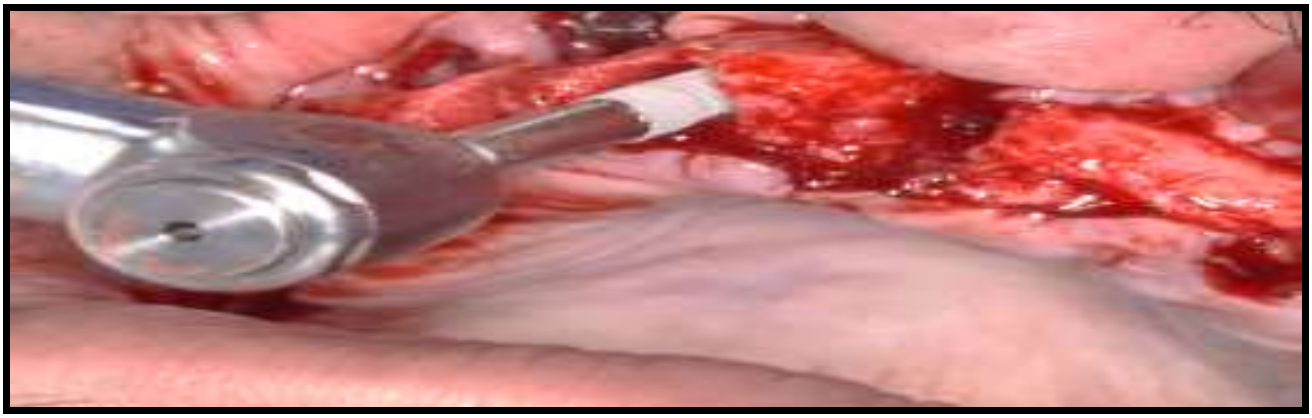

Figure 8: Installation of dental implant fixture by motorized way

This procedure was followed by measurement of the implant primary stability using Periotest. A gingival former of suitable size was inserted into the implant body and the Periotest was directed at the middle of gingival former at a distance of approximately 2 mm and held stable until the device stop and display the Periotest value. The measurement taken in a buccolingual direction .Following that the gingival former is removed and cover screw was then inserted as in Figure 8.

Figure 9: Measurement of the implant stability for tooth No.1.2 by the use of Periotest

In situation when there was an implant-bone gap, measurement was done by the use of calibrated periodontal probe placed perpendicular to the long axis of implant. If the bone-implant gap was more than 2 mm an alloplastic bone substitute introduced to fill the gaps. The gap was kept dry as much as possible before the application of Easy graft. The graft kit included a syringe containing bone substitute particles and small container of liquid (accelerator).The particles and the liquid mixed for 30 seconds and the liquid is removed from the syringe and the material was placed and compressed in the gap with condenser as in Figure 10.

Figure 9: A-Following implant installation, B- Bone substitute application

The setting time of the material depend on the presence of blood required 5-7 minutes. After setting of the material, wound closure is performed by simple interrupted suture using 3/0 non-resorbable black silk suture (Dynek, Australia)

Post-operative Care

Immediately after surgery the patients instructed to apply cold pack over the operation site extra orally 15 minute / hour for the first 8 hours, the patients also instructed to eat soft diet, avoid warm diet, mouth rinsing and eating over the site of the surgery at the day of the surgical procedure. Post-operative medication included Amoxicillin capsule 500 mg and Metronidazole 500 mg 3 times daily, the treatment continued for 5 days.in case of patients allergic to penicillin, Azithromycin tablet 500 mg once daily for 3 days, Paracetamol 500 mg with caffeine 65 mg tablet was prescribed as analgesic on need.

Radio Graphical Assessment

In the same day after surgery a CBCT (Carestream CS 8100 3D Health Inc., France) was taken for confirmation of the position of the implant, the relation of the implant to the crestal bone level in 3 planes as a baseline measurement. 6 months later another CBCT was done to examine the amount of crestal bone resorption that occurred.

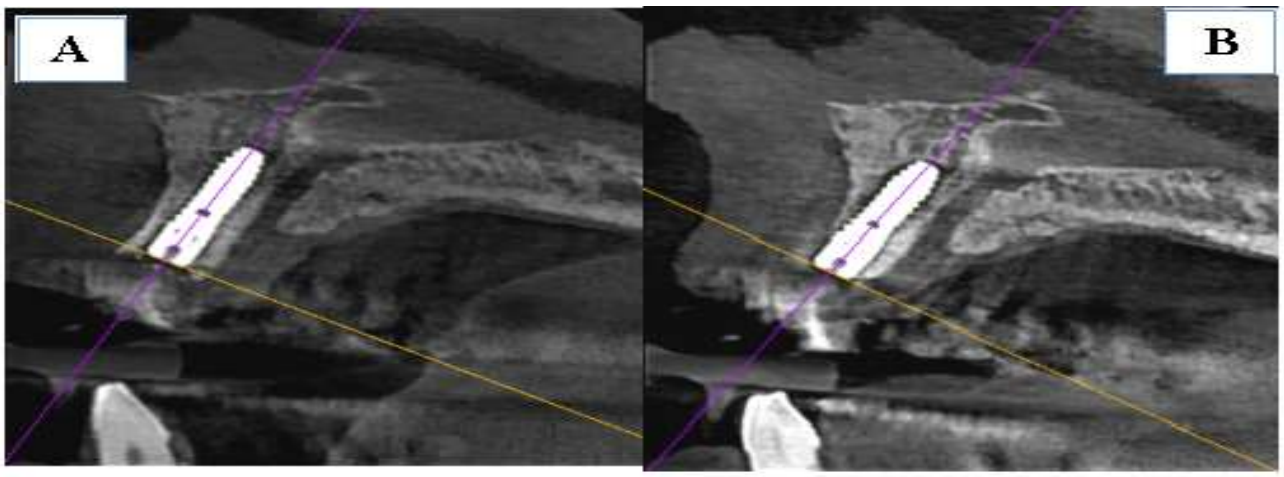

Figure 11: A-The relation between the implant and the crest of alveolar bone immediately after implant placement, B-The relation after 6 months for assessment of crestal bone resorption

Stability Measurement

Secondary implant stability was measured 6 months following dental implant placement, after osseointegration by the use of Periotest M and the final PTV was registered.

Follow-up Visits

Suture removal was scheduled 2 weeks after surgery.

Results

Twenty patients with a mean age of 48.95 years received 31 immediately placed dental implant in fresh extraction sockets.

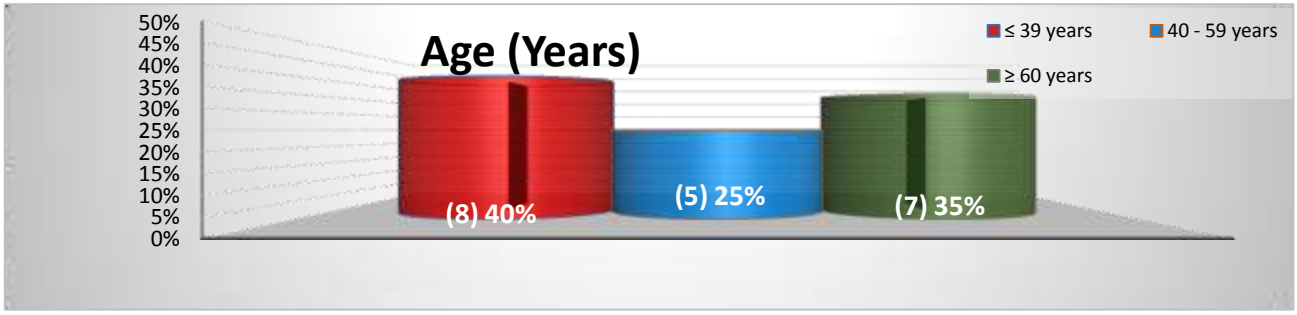

Figure 12: Distribution of study patients by age

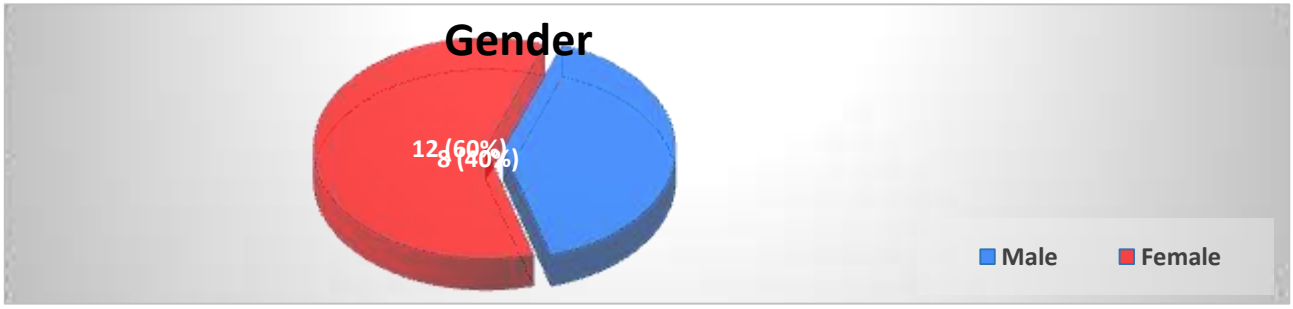

Figure 13: Distribution of study patients by gender

Table 1: Comparison between primary and secondary implant stability (mean)

Type of stability	Implant stability score (Periotest value) Mean ± Std. Dev	P-Value
Primary	4.98 ± 4.26	**0.001**
Secondary	1.36 ± 2.96	

Table 2: Comparison of crestal bone resorption between buccal and palatal bones (mean)

Cortical plate	Crestal bone resorption Mean ± SD
Buccal plate	0.93 ± 1.15
Palatal plate	0.57 ± 0.94

Table 3: Comparison of crestal bone resorption between buccal and palatal cortical plates according to tooth site (mean)

Tooth site	Crestal bone resorption		P- Value
	Buccal Mean ± SD	Palatal Mean ± SD	
1	0.48 ± 0.34	0.21 ± 0.19	**0.021**
2	0.66 ± 0.4	0.63 ± 0.26	**0.868**
3	2.81 ± 1.49	1.71 ± 1.73	**0.079**
4	0.36 ± 0.2	0.18 ± 0.2	**0.367**
5	0.38 ± 0.35	0.2 ± 0.21	**0.053**

Discussion

Primary implant stability is one of the most critical factors in determining long-term implant success, as it is the prerequisite to gain adequate osseointegration [18]. In this study the mean of PTV of the primary stability was (4.98 ± 4.26), while the mean of PTV of secondary stability was (1.36 ± 2.96).

In the case of successful implants, PTVs lies within the range of -5 to +5 [19]. This improved secondary stability may be attributed to the good primary stability which has a great effect on osseointegration by reducing micro motion and decreasing the risk of fibrous encapsulation and failure of implant since the study involved delayed implant loading protocol.

As a result the increase in the secondary stability (mean of PTV was 1.36 ± 2.96) observed with a high significant difference between primary and secondary stability, this may be the result of bone formation around the implant and osseointegration lead to an increase in the bone implant contact which coincide with Drago, [20] (PTV decreased when surface area contact increase).

The statistical analysis of this study demonstrated a high significant difference between primary and secondary stability in relation with dental implants dimensions (3514, 3512) due to the inverse correlation between the PTV and the length of the implant and supported by Drago [20] (the longer the implant the greater the surface area the lower PTV).

In the current study the mean of crestal bone resorption demonstrated a highly significant difference between buccal and palatal cortical plate bone resorption in which the mean of buccal cortical resorption (0.93 ± 1.15 mm) was higher than that of palatal cortical plate (0.57 ± 0.94 mm) this may be contributed to many factors such as trauma accompanied with extraction or disruption of the blood supply from periosteum. Dohiem [21] stated that the blood supply from periodontal ligaments seems to be one of the main etiological factors in the dimensional stability of the hard and soft tissues so any disruption to it this will lead to bone resorption. Also the higher resorption of buccal cortical plate may be due to thin buccal cortical plate in which thickness less than 2mm will result in increase in the buccal cortical plate resorption which coincide with Spray et al [22].And Park [23].

While the maximum resorption occured in the tooth site No.3 (canine) in which it represent the highest mean of resorption (circular resorption). The increase in the resorption of the canine area may be related to the wide bucco-palatal dimension of the tooth leaving thin buccal cortical plate and thin periosteom this will jeopardize the buccal plate fate and increase the risk of resorption, in which according to Spray et al [22]. Park [23] thickness of cortical plate less than 2mm will undergone accelerated bone resorption.

Conclusion

In summary, the results of this prospective study have shown that good primary stability can be achieved even in the presence of buccal gap and this stability was adequate to attain good secondary stability. Bone resorption occurred more buccally/labially than lingually/palatally and maximum resorption occurred in the canine area.

References

1. Brånemark PI, Breine U, Adell R, Hansson BO, Lindström J, Ohlsson Å (1969) Intra-osseous anchorage of dental prostheses: I. Experimental studies. Scandinavian journal of plastic and reconstructive surgery, 1: 3(2):81-100.
2. Van der Weijden F, Dell'Acqua F, Slot DE (2009) Alveolar bone dimensional changes of post-extraction sockets in humans: a systematic review. Journal of clinical period ontology, 36(12): 1048-58.
3. Tan WL, Wong TLT, Wong MCM, Lang NP (2012) A systematic review of post-extractional alveolar hard and soft tissue dimensional changes in humans. Clinical Oral Implants. Research, 23(5): 1-21.
4. Schulte W, Heimke G (1976) The T€ubinger immediate implant. Quintessenz, 27: 17-23.
5. Ferrus J, Cecchinato D, Pjetursson EB, Lang NP, Sanz M, Lindhe J (2010) Factors influencing ridge alterations following immediate implant placement into extraction sockets. Clinical oral implants research, 21(1):22-9.
6. Cosyn J, Eghbali A, De Bruyn H, Collys K, Cleymaet R, De Rouck T (2011) Immediate single-tooth implants in the anterior maxilla: 3-year results of a case series on hard and soft tissue response and aesthetics. Journal of Clinical Periodontology, 38(8):746-53.
7. Benic GI, Mokti M, Chen CJ, Weber HP, Hämmerle CH, Gallucci GO (2012) Dimensions of buccal bone and mucosa at immediately placed implants after 7 years: a clinical and cone beam computed tomography study. Clinical Oral Implants Research, 23(5):560-6.
8. Lang NP, Pun L, Lau KY, Li KY, Wong MC (2012) A systematic review on survival and success rates of implants placed immediately into fresh extraction

sockets after at least 1 year. Clinical Oral Implants Research, 23: 39-66.

9. Chen ST, Buser D (2014) Esthetic outcomes following immediate and early implant placement in the anterior maxilla-a systematic review. Int. J. Oral. Maxillofac Implants, 1 (29):186-215.
10. Werbitt MJ, Goldberg PV (1992) The Immediate Implant Bone Preservation and Bone Regeneration. International Journal of Periodontics & Restorative Dentistry, 1(12):3.
11. Watzek G, Haider R, Mensdorff-Pouilly N, Haas R (1995) Immediate and delayed implantation for complete restoration of the jaw following extraction of all residual teeth: a retrospective study comparing different types of serial immediate implantation. International Journal of Oral & Maxillofacial Implants, 1 (10): 5.
12. Araújo MG, Sukekava F, Wennström JL, Lindhe J (2005) Ridge alterations following implant placement in fresh extraction sockets: an experimental study in the dog. Journal of clinical period ontology, 32(6):645-52.
13. Araujo MG, Wennström JL, Lindhe J (2006) Modeling of the buccal and lingual bone walls of fresh extraction sites following implant installation. Clinical oral implants research, 17(6):606-14.
14. Becker W, Becker BE, Polizzi G, Bergstrom C (1994) Autogenous Bone Grafting of Bone Defects Adjacent to Implants Placed Into Immediate Extraction Sockets in Patients: A Prospective Study. International Journal of Oral & Maxillofacial Implants, 1 (9): 4.
15. Becker W, Dahlin C, Becker BE, Lekholm U, Van Steenberghe D, Higuchi K, Kultje C (1994) The use of e-PTFE barrier membranes for bone promotion around titanium implants placed into extraction sockets: a prospective multicenter study. International Journal of Oral & Maxillofacial Implants, 1 (9): 1.
16. Koh RU, Oh TJ, Rudek I, Neiva GF, Misch CE, Rothman ED, Wang HL (2011) Hard and soft tissue changes after crestal and subcrestal immediate implant placement. Journal of period ontology, 82(8): 1112-20.
17. Cangini F, Cornelini R (2005) A comparison between enamel matrix derivative and a bioabsorbable membrane to enhance healing around transmucosal immediate post-extraction implants. Journal of period ontology, 76(10):1785-92.
18. Lioubavina-Hack N, Lang NP, Karring T (2006) Significance of primary stability for osseointegration of dental implants. Clinical Oral Implants Research, 17(3):244-50.
19. Meredith N, Friberg B, Sennerby L, Aparicio C (1998) Relationship between contact time measurements and PTV values when using the Periotest to measure implant stability. Int. J. Prosthodont, 11: 269-75.
20. Drago CJ (2000) A prospective study to assess osseointegration of dental endosseous implants with the Periotest instrument. International Journal of Oral & Maxillofacial Implants, 15.
21. Dohiem M (2018) Immediate implant placement in canine region using root membrane technique with follow up 2 years case report. Future Dental Journal, 1: 4(1):43-6.
22. Spray JR, Black CG, Morris HF, Ochi S (2000) The influence of bone thickness on facial marginal bone response: stage 1 placement through stage 2 uncovering. Annals of Period ontology, 1: 5(1):119-28.
23. Park N (2017) Implant Cervical Collars: Preserving Crestal Bone. Inclusive, 7: 91-2.

