

Immediate dental implant placement with or without autogenous bone graft: A comparative study

ABSTRACT

Introduction: Immediate dental implants are the most accepted contemporary treatment option for the replacement of missing teeth. One pitfall of immediate implant use, however, is the inevitable residual space that remains between the implant and the socket wall, called the jumping distance, which may lead to bone resorption and formation of a bony defect, decreasing the implant stability. When this jumping distance is more than 2 mm, use of bone grafts is recommended. However, the use of grafts when the jumping distance is <2 mm is not defined in the literature.

Aim: To evaluate the peri-implant hard and soft tissue changes following immediately placed implants with a jumping distance of 2 mm with or without autogenous bone grafts.

Settings: The study was conducted between January 2016 and December 2017 in the Department of Oral and Maxillofacial Surgery.

Subjects and Methods: This was a prospective, single-center, two-arm, parallel, randomized study on patients undergoing replacement of missing anterior teeth with immediate implants. There were two groups: the study group which received bone graft and the control group which did not receive any graft. Temporary prosthesis was placed following implant placement which was replaced with definitive prosthesis 4 months later. Patients were followed up for a period of 9 months. The alveolar bone loss was evaluated radiologically using cone-beam computed tomography, and pain, suppuration, mobility, and periodontal probing depth were evaluated clinically.

Results: There were 16 participants in the study group and 17 in the control group. The alveolar bone loss was greater in the study group; however, pain, suppuration, and mobility showed no difference between the groups.

Conclusion: The immediate implants placed with or without bone grafts had similar alveolar hard and soft tissue changes when the jumping distance was <2 mm.

Keywords: autogenous bone grafts, immediate dental implant, jumping distance

INTRODUCTION

Dental implants are the most accepted contemporary treatment option for the replacement of missing teeth. Historically, implants have been placed in a delayed fashion, i.e., a few weeks or months after extraction, to allow for bone healing in the socket area. Immediate placement of implants has taken the forestage in recent times due to its numerous advantages such as preservation of alveolar bone, better implant orientation, esthetics, and psychosocial benefits provided to the patients. Besides, it overcomes the drawbacks of delayed implants such as prolonged treatment time, multiple appointments, reduction in alveolar bone dimensions, and migration of teeth into the edentulous space.^[1-5]

One pitfall of immediate implant use, however, is the inevitable residual space that remains between the implant

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body and the socket wall, due to a discrepancy in size between the implant and the socket wall. This space, which is located toward the coronal end of the implant, is called the jumping distance. Excessive jumping distance may lead to bone resorption and formation of a bony defect, decreasing the implant stability.^[6,7]

According to a study by Al-Sabbagh and Kutkut *et al.*, a jumping distance of <2 mm does not affect the implant stability. They advocate the use of bone grafts and barrier materials when this distance exceeds 2 mm. These bone grafts and barrier materials regenerate lost bone and maintain hard and soft tissue architecture. Autogenous bone grafts are osteoconductive, osteoinductive, and osteogenic. They are also biocompatible, cost-effective, and readily available. Other grafts such as demineralized freeze-dried bone allograft, freeze-dried bone allograft, and hydroxyapatites and barrier materials such as polytetrafluoroethylene and connective tissue membranes are also used to improve implant stability.^[8]

Although autografts have a wide range of applications, their use in immediate implants with a jumping distance of <2 mm is not defined in the literature; hence, the study was conducted.

This study aimed to evaluate the peri-implant hard and soft tissue changes following immediately placed implants with a jumping distance of 2 mm with or without autogenous bone grafts.

The primary objective was to assess alveolar bone loss radiologically using cone-beam computed tomography (CBCT) and the secondary objective was to assess various clinical parameters that affect implant stability such as pain, suppuration, implant mobility, and peri-implant probing depth (PPD).

The hypothesis was that the peri-implant alveolar bone and soft tissue loss in immediate implants with a jumping distance of <2 mm grafted with autogenous bone would be less than those placed without bone graft.

SUBJECTS AND METHODS

This study was a prospective, single-center, single-blinded, randomized control study conducted between January 2016 and December 2017, and it was approved by the Institutional Ethics Committee Regd No: 84/Inst/OR/2013, 668/04.05.2018.

The study population included individuals requiring the replacement of one or more nonrestorable teeth in the

esthetic zone which was indicated for extraction. The study sample included participants with good oral hygiene, adequate bone volume for implant placement (with a labial bone thickness of 2 mm or more on its labial surface and a minimum of 5 mm bone apically measured with the help of CBCT),^[9,10] and a jumping distance of <2 mm. Participants with any systemic disease or conditions that impair healing, any evidence of an infection or periodontitis, and dehiscence or lack of cortical plate after tooth extraction; physically and mentally challenged individuals; heavy smokers;^[11] and participants who were unable to attend follow-up appointments were excluded from the study. The selected participants were included in the study after obtaining informed consent from them.

The sample size of 33 was determined from the standard deviation (ρ) and the difference of mean (d) obtained from earlier studies.^[12,13] The random number sequence was obtained using a computerized software (Random Number Generator Plus application, <http://www.apache.org/licenses/LICENSE-2.0>), and the numbers were sealed in an envelope. Every even random number in the sequence was allotted to the study group which received the bone graft after implant placement, whereas every odd random number was allotted to the control group which did not receive bone graft. The evaluator was blinded to the method of intervention.

All participants in the study were administered lidocaine with adrenaline (1:200,000), and the affected tooth was carefully removed with minimal trauma to the alveolar bone [Figure 1]. The socket was then irrigated with normal saline and examined for cortical bone fracture. The appropriate implant size was determined based on radiographic assessment, socket depth, and the dimensions of the extracted root, following which the implant was inserted with a hand ratchet at 35 N/cm torque [Figures 2-4]. At this stage, the peri-implant bone defect was evaluated clinically using a periodontal probe and only those cases with a jumping distance <2 mm were selected and randomized. Size and diameter of the implants placed are mentioned in Tables 1 and 2.

Autogenous bone grafts were harvested intraorally from the mandibular symphysis. A horizontal vestibular incision was placed below the mucogingival junction and a mucoperiosteal flap was reflected, following which bone was harvested and the collected block graft was ground using a bone mill into small granules and was then placed in the peri-implant gap [Figures 5,6]. The autogenous bone graft from the chin region has been a commonly used technique for filling bone defects and has shown a high success rate.^[14,15] Although Micros and ACM drills are used for harvesting autogenous bone grafts to reduce the donor site morbidity,^[16]

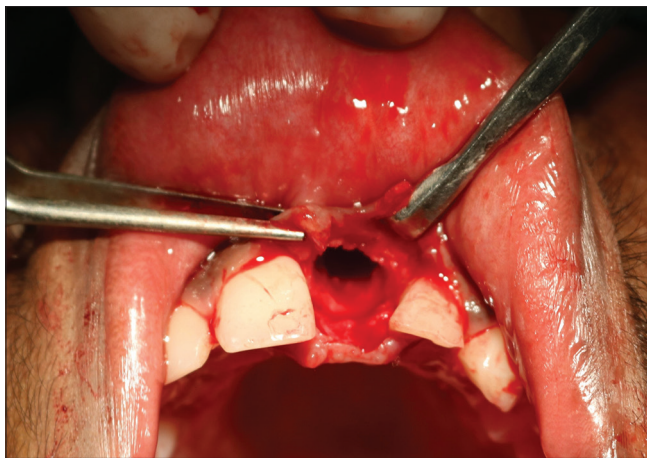


Figure 1: Extraction of the fractured tooth

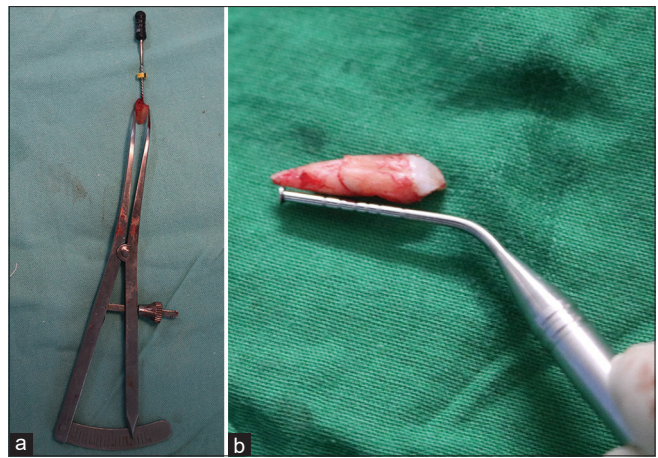


Figure 2: (a) Measurement of the tooth dimensions. (b) Measurement of the tooth dimensions

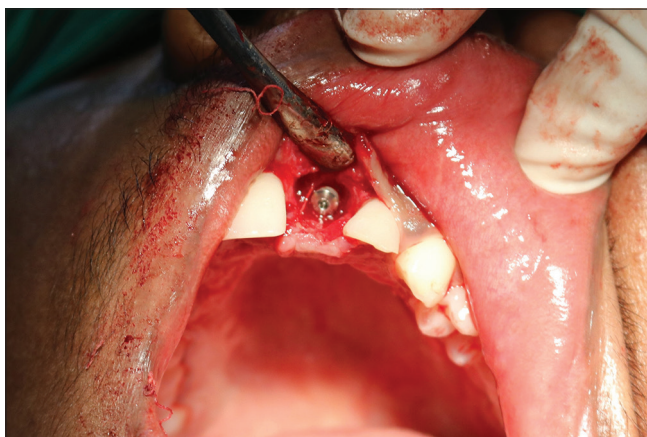


Figure 3: Placement of the implant

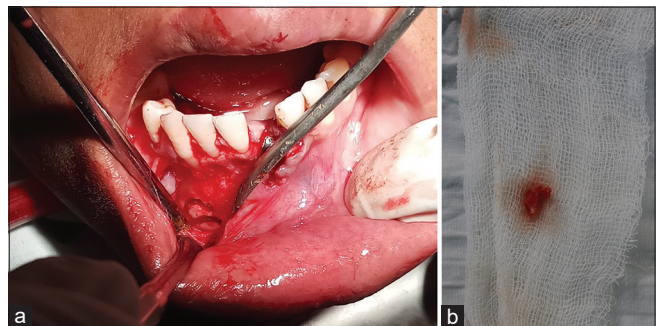


Figure 4: (a) Bone harvesting. (b) Bone harvested from symphysis

conventional method is used in this study as our institute does not have this armamentarium.

The surgical procedure for the control group was similar to that for the study group, except that bone augmentation was not done. After the placement of the implant, the implant stability quotient (ISQ) was measured using the Osstell Mentor and implants with an ISQ of more than 70 were loaded immediately with provisionalization.^[17] Metal abutment of appropriate length and angulation was selected and prepared extraorally. The prepared abutment was fixed onto the implant and relined with a light-curing acrylic resin. Postoperatively, antibiotics and analgesics were prescribed for 5 days. The patients were advised to maintain proper oral hygiene. The definitive restorations were placed 6 months after the implant placement.^[18]

The immediate implant placed during the study was evaluated using the guidelines recommended by the International Congress of Oral Implantologists given in October 2007, Pisa Consensus Conference. The International Congress of

Oral Implantologists Consensus reported the use of CBCT in implant dentistry for diagnostics, implant planning, surgical guidance, and postimplant evaluation. Hence, the alveolar bone loss was evaluated using three-dimensional CBCT. The implant mobility, pain, exudates, peri-implant probing pocket, and marginal alveolar bone loss were also measured.^[19]

All the participants in the study were advised CBCT before placement of the implant for measuring the labial bone thickness and the apical bone available, 7 days postoperatively and 6 months and 9 months after implant placements. The changes in the marginal bone level at buccal, lingual, mesial, and distal sites were evaluated radiographically from the shoulder of the implant to the alveolar crest using a dental CBCT scanner (MyRay Hyperion × 9, Italy).

The mean marginal bone loss after the placement of implants was calculated by subtracting baseline value from the values obtained at 6 months and 9 months postimplant placements. Clinically, PPD was also measured after 6 and 9 months of implant placement. Other parameters such as pain, mobility of placed implant, and exudates were also checked during the follow-up visits.

Table 1: Implants in the control group

Subjects random number	Implant diameter and length (mm)	Implant site (FDI notation)	Number of implants	Follow-up period (months)
IPS001	3.5×14	12	1	9
IPS002	3.5×16	11	1	9
IPS004	3.5×16	21	1	9
IPS007	4×13	21	1	9
IPS009	4×13	22	1	9
IPS013	3.5×11.5	12	1	9
IPS015	3.5×13	13	1	9
IPS019	3.5×13	22	1	9
IPS025	3.5×10	34	1	9
IPS026	3.5×11.5	44	1	9
IPS029	3.5×10	44	1	9
IPS029	3.5×10	45	1	9
IPS032	3.5×11.5	42	1	9
IPS035	3.5×16	41	1	9
IPS036	3.5×13	13	1	9
IPS037	3.5×16	11	1	9

FDI: Federation Dentaire Internationale

Table 2: Implants in the study group

Subjects random number	Implant diameter and length (mm)	Implant site (FDI notation)	Number of implants	Follow-up period (months)
IPS001	3.5×11.5	11	1	9
IPS005	3.5×13	31	1	9
IPS006	3.5×16	11	1	9
IPS008	3.5×13	21	1	9
IPS011	3.5×11	44	1	9
IPS012	3.5×11.5	22	1	9
IPS007	4×13	12	1	9
IPS017	3.5×13	13	1	9
IPS020	3.5×13	23	1	9
IPS021	3.5×16	11	1	9
IPS022	3×11.5	21	1	9
IPS027	3.5×16	22	1	9
IPS030	3.5×13	31	1	9
IPS031	3.5×13	32	1	9
IPS033	3.5×11.5	41	1	9
IPS034	3.5×11.5	32	1	9
IPS039	3.5×11.5	12	1	Lost to follow up

FDI: Federation Dentaire Internationale

Statistical analysis

The mean values and standard deviations were calculated for each variable and group. Differences between the groups for age, gender, periodontal probing depth, and marginal bone loss were calculated using Chi-square and independent *t*-test. Statistical computations were performed using SPSS software, version 21.0 (SPSS Inc., Chicago, IL, USA).

RESULTS

The study population, study sample, allocation of the participants, and the participants excluded from the study

and those lost to follow-up are presented according to the CONSORT guidelines. Baseline characteristics such as age and gender are mentioned in Table 3. PPDs and marginal bone level changes are mentioned in Tables 4 and 5, respectively. Clinical parameters such as pain, suppuration, and mobility showed no statistically significant difference between the groups.

DISCUSSION

The immediate implant is a new treatment modality which is gaining popularity recently. Placing the implant directly



Figure 5: Bone graft placement in the peri-implant defect

into the socket immediately after tooth extraction reduces the overall treatment time and also preserves the alveolar ridge and prevents the migration of the tooth into the edentulous space. As the implants are placed directly into the extraction socket, the socket acts as a guide in the proper orientation of the implant. These benefits made this treatment option popular, but this technique did have some limitations, one of which was the space present between the implant and the socket wall near the coronal region caused due to the mismatch in the size of the implant and the large tooth socket found immediately after tooth extraction.

Many studies have been performed to overcome this problem that utilized grafting materials to obturate this space and to increase the success of the implant. However, often, the grafted material placed acted as a foreign material, inducing inflammation and thereby producing bone loss, giving a result similar or worse than the implants placed without grafts.^[20-25]

This study was initiated with a purpose to assess the effectiveness of autogenous bone graft in immediate implant placement. This study was done to prove the hypothesis that the peri-implant alveolar bone and soft tissue loss in immediate implants with a jumping distance of <2 mm grafted with autogenous bone would be less than those placed without bone graft.

The participant baseline characteristics such as age and gender distribution did not affect the outcome of the study, as the baseline characteristics were equally distributed between the groups and showed no statistically significant findings.

In this study, the mean alveolar bone loss was greater in the control group when compared to the study group

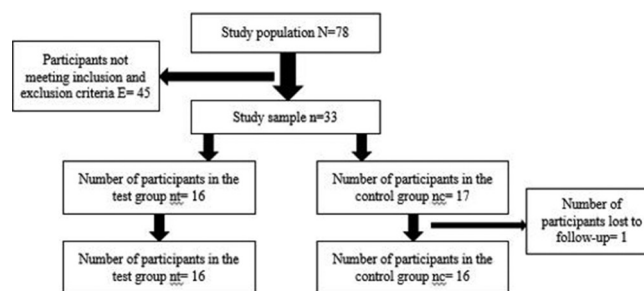


Figure 6: Process of participant selection, allocation, and randomization

at the 6th and 9th months postimplant placement. This decrease in bone loss in the study group was due to the fact that the autogenous bone graft has both osteogenic and osteoinductive properties. Al-Sulaimani *et al.* reported the bone–implant contact to be significantly higher in implant sites filled with autogenous graft compared to the sites left unfilled, which supports the results obtained from our study. A study by Tanrow *et al.* proved that use of bone grafts in some immediate dental implants improved healing of soft and hard tissues surrounding the implants. Sanz *et al.* in their study noted that there is a 60% reduction in the horizontal defect and 90% reduction in the vertical defect, suggesting that there is improved bone formation when bone grafts are placed in the defects surrounding the immediate implant. A meta-analysis by Alkudmani *et al.* and Clementini *et al.* suggested that bone grafting of the buccal gap simultaneously with immediate implant placement resulted in preserving hard and soft tissue dimensions. On the contrary, studies by Chen and Buser compared autogenous bone graft to control sites (no bone graft) and reported no significant difference in dimensional changes of the horizontal buccal defect width, the buccal plate resorption, vertical defect height, or horizontal defect depth at the 6-month follow-up. Chen and Buser studies were supported by Paolantonio *et al.*, who proved that no graft is needed for immediate dental implant placement.^[10,20,21,25-27]

This study revealed that PPD calculated at the end of the 9th month was greater in the control group when compared to the study group. On the contrary, it was seen that the PPD calculated at the end of 6 months was greater in the study group when compared to the control group. When comparing the 6th and the 9th month values, we can say that there was a net PPD reduction which was seen in the study group and there was a net gain in the PPD which was seen in the control group. The reason for the reduction in the probing pocket depth in the study group can be explained by the fact that the bone graft placed in the defect acts as a barrier, thereby reducing the growth of the gingiva into the defect and reduced the chances of the formation of the long junctional epithelium, but instead helps in the formation of new attachment which thereby reduces the

Table 3: Baseline characteristics

Characteristics	Study group	Control group	Total
Total number of patients	17	16	33
Number of males, <i>n</i> (%)	10 (58.8)	10 (62.5)	20 (60.60)
Number of female, <i>n</i> (%)	7 (41.2)	6 (37.5)	13 (39.40)
Male:female ratio	10:7	5:3	20:13
Age	25.50±8.0	26.38±7.588	25.94±7.81

Table 4: Peri-implant probing depth

Peri-implant probing depth	Mean ± SD		<i>P</i> *
	Study group	Control group	
Mesial			
6 months	2.19±0.403	2.06±0.680	0.042
9 months	1.88±0.342	2.56±0.512	0.000
Buccal			
6 months	2.25±0.447	1.81±0.750	0.003
9 months	1.75±0.447	2.44±0.512	0.000
Distal			
6 months	2.19±0.403	1.81±0.750	0.003
9 months	1.88±0.500	2.19±0.655	0.260
Lingual			
6 months	2.00±0.632	1.75±0.683	0.115
9 months	1.44±0.512	1.94±0.680	0.026

Independent *t*-test was applied. **P*<0.05 is considered statistically significant.
SD: Standard deviation

Table 5: Marginal bone level changes

Bone loss	Mean ± SD		<i>P</i> *
	Study Group	Control Group	
Mesial			
Baseline	0.575±0.2595	0.906±0.3586	0.005
6 months	0.844±0.2920	1.213±0.2920	0.004
9 months	0.931±0.3321	1.438±0.3612	0.000
Buccal			
Baseline	0.550±0.2066	0.613±0.2419	0.438
6 months	0.956±0.2555	1.113±0.2778	0.108
9 months	0.831±0.1957	1.244±0.2732	0.000
Distal			
Baseline	0.569±0.1778	0.581±0.2167	0.860
6 months	0.725±0.2145	0.913±0.2277	0.024
9 months	0.788±0.1544	0.950±0.2921	0.058
Lingual			
Baseline	0.375±0.1342	0.619±0.1905	0.000
6 months	0.581±0.1424	0.825±0.2082	0.001
9 months	0.663±0.1500	0.906±0.2175	0.001

Independent *t*-test was applied. **P*<0.05 is considered statistically significant.
SD: Standard deviation

PPD. However, in the control group, the defect has no barrier; therefore, the gingiva grows into the defect, thereby resulting in the formation of the long junctional epithelium, which is responsible for the increased PPD. This was in accordance with the study by Hassan *et al.*, where the immediate implants which received bone grafts showed decreased probing pocket depth when compared to their initial value.^[23]

Clinical conditions such as pain, mobility, and suppuration for each implant from the study and control group were assessed individually. The results of our study showed that the implant in both the group showed no signs of pain, suppuration, or mobility during the 9 months. As this study was done by taking into consideration the criteria laid by Block and Kent, the clinical conditions such as pain, suppuration, and mobility were not elicited by implants placed in the study.^[11]

The observation in the present study revealed that adequate bone healing around the implant is possible with or without the use of any graft material. However, a better bone level and less bone resorption appear to have been achieved when autogenous bone grafts are used. This study shows that immediate dental implant placement either with or without autogenous bone graft can be considered as a safe, effective, and predictable treatment option for replacing teeth.

This study has many limitations such as length of follow-up period was limited to 9 months and esthetic parameters, bone density, and donor site morbidity were not evaluated. Further studies may consider limitations mentioned above and different loading protocols.

CONCLUSION

This study was performed to assess the effect of autogenous bone graft in immediate implant with jumping distance <2 mm. It was found that the alveolar bone loss in the control group was more when compared to the bone loss in the test group. Thus, we can conclude from our study that while there is a statistical difference between the amount of bone loss between the grafted and nongrafted implant sites, this difference is nonetheless clinically insignificant. Moreover, graft harvest adds to the surgical morbidity. Thus, we do not recommend autogenous bone grafting in implants where jumping distance is <2 mm. Further studies are required with a larger sample and a longer follow-up period to cement this result.

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Conflicts of interest

There are no conflicts of interest.

REFERENCES

- Adell R, Lekholm U, Rockler B, Brånemark PI. A 15-year study of osseointegrated implants in the treatment of the edentulous jaw. *Int J Oral Surg* 1981;10:387-416.
- Altintas NY, Taskesen F, Bagis B, Baltacioglu E, Cezairli B, Senel FC. Immediate implant placement in fresh sockets versus implant placement in healed bone for full-arch fixed prostheses with conventional loading. *Int J Oral Maxillofac Surg* 2016;45:226-31.
- Rosenquist B, Grenthe B. Immediate placement of implants into extraction sockets: Implant survival. *Int J Oral Maxillofac Implants* 1996;11:205-9.
- Schwartz-Arad D, Chaushu G. Placement of implants into fresh extraction sites: 4 to 7 years retrospective evaluation of 95 immediate implants. *J Periodontol* 1997;68:1110-6.
- Chen ST, Buser D. Clinical and esthetic outcomes of implants placed in postextraction sites. *Int J Oral Maxillofac Implants* 2009;24 Suppl: 186-217.
- Botticelli D, Berglundh T, Buser D, Lindhe J. The jumping distance revisited: An experimental study in the dog. *Clin Oral Implants Res* 2003;14:35-42.
- Ghanem WA. Role of horizontal gap on the success of immediate implant. *Int J Oral Maxillofac Surg* 2015;44:e212.
- Al-Sabbagh M, Kutkut A. Immediate implant placement: Surgical techniques for prevention and management of complications. *Dent Clin North Am* 2015;59:73-95.
- Miyamoto Y, Obama T. Dental cone beam computed tomography analyses of postoperative labial bone thickness in maxillary anterior implants: Comparing immediate and delayed implant placement. *Int J Periodontics Restorative Dent* 2011;31:215-25.
- Paolantonio M, Dolci M, Scarano A, d'Archivio D, di Placido G, Tumini V, *et al.* Immediate implantation in fresh extraction sockets. A controlled clinical and histological study in man. *J Periodontol* 2001;72:1560-71.
- Block MS, Kent JN. Placement of endosseous implants into tooth extraction sites. *J Oral Maxillofac Surg* 1991;49:1269-76.
- Zhong B. How to calculate sample size in randomized controlled trial? *J Thorac Dis* 2009;1:51-4.
- Soydan SS, Cubuk S, Oguz Y, Uckan S. Are success and survival rates of early implant placement higher than immediate implant placement? *Int J Oral Maxillofac Surg* 2013;42:511-5.
- Sakkas A, Wilde F, Heufelder M, Winter K, Schramm A. Autogenous bone grafts in oral implantology-is it still a "gold standard"? A consecutive review of 279 patients with 456 clinical procedures. *Int J Implant Dent* 2017;3:23.
- Desai AJ, Thomas R, Tarun Kumar AB, Mehta DS. Current concepts and guidelines in chin graft harvesting: A literature review. *International Journal of Oral Health sciences* JanJun 2013;3:16-25.
- Aoki N, Baba J, Iwai T, Tohno I. Lateral Bone Window Approach with Micros Mini Bone Scraper for Sinus Floor Elevation. *J Maxillofac Oral Surg* 2018;17:291-5.
- Swami V, Vijayaraghavan V, Swami V. Current trends to measure implant stability. *J Indian Prosthodont Soc* 2016;16:124-30.
- Kan JY, Rungcharassaeng K, Deflorian M, Weinstein T, Wang HL, Testori T. Immediate implant placement and provisionalization of maxillary anterior single implants. *Periodontol* 2000 2018;77:197-212.
- Misch CE, Perel ML, Wang HL, Sammartino G, Galindo-Moreno P, Trisi P, *et al.* Implant success, survival, and failure: The International Congress of Oral Implantologists (ICOI) Pisa Consensus Conference. *Implant Dent* 2008;17:5-15.
- AlKudmani H, Al Jasser R, Andreana S. Is Bone Graft or Guided Bone Regeneration Needed When Placing Immediate Dental Implants? A Systematic Review. *Implant Dent* 2017;26:936-44.
- Sanz M, Lindhe J, Alcaraz J, Sanz-Sanchez I, Cecchinato D. The effect of placing a bone replacement graft in the gap at immediately placed implants: A randomized clinical trial. *Clin Oral Implants Res* 2017;28:902-10.
- Viswambaran M, Arora V, Tripathi RC, Dhiman RK. Clinical evaluation of immediate implants using different types of bone augmentation materials. *Med J Armed Forces India* 2014;70:154-62.
- Hassan KS, Kassim A, Al Ogaly AU. A comparative evaluation of immediate dental implant with autogenous versus synthetic guided bone regeneration. *Oral Surg Oral Med Oral Pathol Oral Radiol Endod* 2008;106:e8-15.
- Esposito M, Grusovin MG, Coulthard P, Worthington HV. The efficacy of various bone augmentation procedures for dental implants: A Cochrane systematic review of randomized controlled clinical trials. *Int J Oral Maxillofac Implants* 2006;21:696-710.
- Al-Sulaimani AF, Mokeem SA, Anil S. Peri-implant defect augmentation with autogenous bone: A study in beagle dogs. *J Oral Implantol* 2013;39:30-6.
- Tarnow DP, Chu SJ, Salama MA, Stappert CF, Salama H, Garber DA, *et al.* Flapless postextraction socket implant placement in the esthetic zone: Part I. The effect of bone grafting and/or provisional restoration on facial-palatal ridge dimensional change-a retrospective cohort study. *Int J Periodontics Restorative Dent* 2014;34:323-31.
- Clementini M, Tiravia L, De Risi V, Vittorini Orgeas G, Mannocci A, de Sanctis M. Dimensional changes after immediate implant placement with or without simultaneous regenerative procedures: A systematic review and meta-analysis. *J Clin Periodontol* 2015;42:666-77.