COMPARATIVE EVALUATION OF HARD AND SOFT TISSUE CHANGES AROUND IMMEDIATELY LOADED SHORT AND LONG DENTAL IMPLANTS: AN IN VIVO STUDY

Dr. Sonu kumar[1], Dr. Rajiv Kumar Gupta[2], Dr. Narendra Kumar[3], Dr. Vikram Kapoor[4], Dr. Pallavi Sirana[5], Dr. Komal Kishlay[6]

[1]Senior Lecturer, Dept. of Prosthodontics crown and bridge and implantology, Ideas dental college and hospital Gwalior, MP.

[2]Professor, Department of Prosthodontics and Crown and Bridge, Santosh dental college and hospital, Santosh Deemed to be University, Ghaziabad UP.

[3]Former HOD. Dept. of Prosthodontics crown and bridge and implantology, Institute of dental studies and technologies, Modinagar UP.

[4]Professor, Dept. of Prosthodontics crown and bridge and implantology, Institute of dental studies and technologies, Modinagar UP.

[5]Reader, Dept. of Prosthodontics crown and bridge and implantology, Institute of dental studies and technologies, Modinagar UP.

[6]PG 3rd yr Student, Dept. of Prosthodontics crown and bridge and implantology, Buddha institute of dental science and research, Patna Bihar

DOI: 10.47750/pnr.2022.13.S06.144

Abstract

Background: Placing a dental implant in the resorbed alveolar ridge are always require complex implant surgeries. The hypothesis was that short implant could improve the implant success rate which is very conservative and efficient treatment modalities.

Purpose: The purpose of the present study was to evaluate the hard and soft tissue changes around immediately loaded short and long dental implant.

Material & Methods: A total of 15 patients were selected with 2 partially edentulous space and one short and one conventional implant was placed with immediate loading protocol. Then they were divided into two groups one immediately loaded short implant and second is immediately loaded long implants, hard and soft tissues changes were evaluated on day of implant placement and 1st month, 2nd months and 4th months.

Results: The mean score value of marginal bone loss, plaque accumulation, probing depth and sulcular bleeding were seen to be more in long implant as compared to the short implant. The difference between them was deemed to be statistically insignificant ($p<0.05$)

Conclusion: There was no significant difference recorded around immediately loaded short and conventional implant in survival rate. So, short implants could be used as an alternative for complex implant surgery in deficient ridges.

Keywords: Short implant, sinus augmentation, ultra-short implant, crown implant ratio, implant survival.

INTRODUCTION

The implants have become an important therapeutic modality mainly after the development of osseointegration by Dr Per Ingvar Branemark in year 19601. The social recognition of implants in dentistry has shown a dramatic increase in recent years, which led to a multi-million-dollar industry driven by bone augmentation, soft tissue management and aesthetic restorations. Initially, dental implant literature suggested the need for implants of length 12-20 mm to provide sufficient primary stability. Thomas Driskell invented the Bicon system of dental implants in 1968, with the introduction of the 8-mm implant2. Until 1979, the shortest conventional endosseous implants available were 10 mm in length3,4. Studies had demonstrated greater success of short implants in the mandible than in the maxilla. This was likely to be due to the poorer density and therefore, lower bone contact in the maxillary posterior bone5. However, in areas displaying severe resorption and bone height reduction, dental implant rehabilitation is limited, mainly in mandible and maxillary posterior region, where the mandibular canal and maxillary sinus, respectively, are present. Surgical protocols employing bone grafting, reconstruction, sinus lift, intra bony distraction as well as, inferior alveolar nerve transposition is an option for standard long implant rehabilitation treatments, in these areas6,7,8.

Moreover, many patients are unable or unwilling to undergo such surgical intervention due to several reasons, like high cost, need for multiple surgical procedures, poor general health, and complications related to surgeries.

This study was undertaken to evaluate the hard and soft tissue response around the immediately loaded short and long two different implant system so as to add on to available literature and increase the success rate of dental implant treatment in conventional as well as the atrophic and resorbed ridges patient with very less treatment time.

MATERIAL AND METHODS

STUDY DESIGN

The present in vivo study was conducted on 15 partially edentulous patients (males and females) on which 30 dental implants were placed between the age group of 25-50 years in the Department of Prosthodontics, Crown and Bridge, Institute of Dental Studies and Technologies, Modinagar, Ghaziabad, Uttar Pradesh India. The study protocol was approved by the research ethics review committee IERBC IDST with reference letter number IDST/IERBC/2018-21/05. All 15 patients were selected on the basis of inclusion and exclusion criteria that was designed for the study and written consent were obtained from each participant.

Inclusions criteria were follows; Age 25 to 50 years, patient motivated for fixed implant support rehabilitation, partially edentulous sites. (both male and female), healed extraction socket, stable functional occlusion, no signs and symptoms of occlusion pathology, adequate amount of bone volume and height for placement of an implant, according to the safety margins commonly adhered to implant surgery, absence of systemic disease, atrophic maxilla and mandible, ability and willingness of the patients to follow the study protocol, good overall health and oral hygiene. Exclusions criteria were follows; history of drugs and alcohol abuse, general medical status precluding surgical intervention in the jaw like cardiac disorder, Sjogren syndrome, Hepatitis B, certain immunological disease like AIDS, scleroderma, bruxism and temporomandibular disorders, chronic bone diseases, psychiatric disorders, uncontrolled diabetes, need for bone augmentation procedure, inability to adhere to planned follow up, incapacity to give informed consent. Only those patients were included in the study who were ready for the surgical placement of implants and subsequent follow up appointments.

STUDY GROUP

A total number 15 partially edentulous patients (7 males and 8 females) on which 30 dental implants (CSM implant Korea, (figure 1) for the both group A and group B were placed. The study was divided into two groups. One group consisted of 15 immediately loaded short implant (Group A) and the other consisted of 15 immediately loaded long implant (Group B). In group A implant dimension was 4mm in diameter and 8mm in length and for group B implant dimension was 4mm in diameter and 10 mm in length. Specification of this commercial implant were follows; submersed class 3 implant system with conical body design, internal hex connection (Octagon geometry), rake angle 30-degree, pitch depth 0.4 mm, pitch length 0.7 mm, surface of this implant was active resorbable blast media (RBM 1.2- 1.8 μm). One stage surgical protocol was followed for both the group and prosthetic abutment were attached, immediate loading was done with heat cure temporary crown and then after completion on osteointegration phase then it was replaced with porcelain fused to metal (PFM) crown. The hard tissue changes were evaluated with intraoral radiographs at a time interval of 0, 1, 2 and 4 months of loading. Similarly, the soft tissue changes were also evaluated at a time interval of 0, 1, 2 and 4 months by using color Vue plastic probe (Hu friedy USA) for the both Groups.

PRE-SURGICAL PROTOCOL

In diagnostic phase detailed medical history, dental history, assessment of oral health, extra oral & intra oral examination, vital signs with radiographic investigation cone beam computer tomography (CBCT), (Figure 2) for evaluation and classification of bone according to Lekholm and Zarb7 along with blood investigation complete blood count, bleeding time, Hb1AC for blood sugar was performed. Diagnostic impressions were made with irreversible hydrocolloids (Zelgan 2002, Dentsply Sirona India), casts were poured in type 2 dental stone (Kalstone, Kalabhai India), Thermoplastic sheet (Duran, Scheu Germany) was adapted on the cast with the help of vacuum former machine & stents were fabricated which guided the orientation of surgical drills at the time of surgery8. Bite registration records were made and casts were mounted on semi adjustable articulator.

SURGICAL PROTOCOL

Before starting the procedure, a prophylactic dose of 2 gm Amoxicillin (Almox, Alkame pharma India) was given to the patient 1 hour prior to surgery9. Surgical site was prepared by wiping the face with 5% Povidone iodine (Betadine, Win Medicare India) and the patient was also asked to do intraoral rinses with 0.12% chlorhexidine (Hexidine ICPA India). All surgical instruments were autoclaved. Local anesthesia Lignocaine with adrenaline (1:100000) (Lignox 2% A, Indico remedies India) was administered using disposable syringe. Once it was effective incision was given and flap was raised then osteotomy was performed using surgical drills in the progressively increasing diameter and implants were placed (Figure 3) with insertion torque between 30 Ncm to 50 Ncm depending upon the bone quality. After attachment of abutment (Figure 4), surgical site was closed by tension free suture. Postoperative instructions were given and medications (Augmentin 625 duo, GSK India) were prescribed for 5 days to the patient with mouth wash then sutures were removed after a week and oral hygiene was assessed.

LOADING PROTOCOL

Both implants (ie group A and B) were loaded with pre-fabricated heat cure crown according to non-functional immediate loading protocol10 (Figure 5). After healing and osseointegration period temporary crown are removed impression coping was attached and open tray impressions were made with polyvinyl siloxane (Aquasil, Dentsply India) impression materials (Figure 6), shade selection was done. Then after retrieving the impression laboratory analog were attached and gingival mask was applied around the analog to mimic the soft tissue architecture of oral cavity. Then crowns were fabricated in laboratory and implants were reloaded with implant crown as definitive restorations (Figure 7).

CLINICAL AND RADIOGRAPHIC EVALUATION

Following parameters for short and long implants were evaluated at the time interval of 0, 1, 2, 4 months according to Mombelli et al. Indices11 in this study to compare the soft tissues changes. Modified plaque indices (MPI) to check and compare plaque accumulation around the implant restorations, Probing depth of peri- implant soft tissues on surfaces mesiobuccally, mid buccal, distobuccal, palatal/ lingual and bleeding on probing (BOP). To check and compare the hard tissues changes around both implants cone beam computer tomography (CBCT) was used at time interval of 0, 1, 2, 4 months (Figure 8).

STATISTICAL ANALYSIS

Data compilation and presentation: The data obtained was compiled systematically, transformed from a pre-coded proforma to a computer and a master table was prepared. The total data was distributed meaningfully and presented as individual tables along with graphs. Statistical analysis: Inferential statistical analysis has been carried out in the present study. Results on continuous measurements are presented on Mean ± SD (Min-Max) and results on categorical measurements are presented in Numbers (%). Significance is assessed at 5% level of significance. Mann Whitney U Test has been used to find the significance of study parameters on ordinal scale between two groups. The statistical software namely SPSS 19.0 was used for analysis of the data and Microsoft excel have been used to generate graphs, tables, etc.

RESULTS

Comparison of modified plaque index at different intervals of time taken at the time of placement, 1 month, 2 months and 4 months after loading showed that the mean plaque index recorded for group I are 0.00, 0.7143, 0.4821, 0.2321 along with standard deviation of 0.00, 0.2749, 0.3598, and 0.2853 respectively and for group II are 0.00, 0.8833, 0.6833, 0.400 along with standard deviation of 0.00, 0.2968, 0.3467, and 0.2803 respectively (Table 1). Comparison of the sulcular bleeding index at different intervals of time taken at the time of placement, 1 month, 2 months and 4 months after loading depicted that the mean sulcular bleeding index recorded for group I were 2.7167, 0.8843, 0.6107, 0.2143 along with standard deviation of 0.2084, 0.5016, 0.4459 & 0.4026 respectively and for group II were 2.8500, 0.8773, 0.6027, 0.3167 along with standard deviation of 0.1268, 0.4955, 0.4287, and 0.2907 respectively (Table 2). Comparison of the probing depth at different intervals of time taken at the time of placement, 1 month, 2 months and 4 months after loading revealed that the mean probing depth recorded for group I were 4.3000, 4.0000, 0.6107, 0.2143 along with standard deviation of 0.2866, 0.4160, 0.6411, and 0.6160 respectively and for group II were 4.5000, 4.2667, 3.7207, 3.5167 along with standard deviation of 0.2673, 0.3336, 0.6228, and 0.6779

respectively (Table 3). Comparison of the crestal bone loss at different intervals of time taken at the time of placement, 1 month, 2 months and 4 months after loading showed that the mean crestal bone loss recorded for group I were 0.00, 0.1757, 0.3214, 0.3536 along with standard deviation of 0.00, 0.1506, 0.1565, and 0.1100 and for group II were 0.00, 0.1920, 0.3680, 0.3973 along with standard deviation of 0.00, 0.1333, 0.1738, and 0.1179 respectively (Table 4). The p value was found to be >0.05 which showed non-significant increase in the crestal bone loss, sulcular bleeding index, modified plaque index and bleeding on probing from immediately after loading to 4 months after loading.

TABLE 1. Comparison of accumulation of plaque between two groups at 0, 1, 2 and 4 months according to Modified plaque index.

Modified Plaque index		Group 1	Group 2	Mann Whitney U Test	p-value
At the time of Placement	Mean	0.00	0.00	112.500	1.000 (NS)*
	SD*	0.000	0.000		
	Median	0.00	0.00		
	Minimum	0	0		
	Maximum	0	0		
At 1 month	Mean	0.7143	0.8833	72.000	0.152 (NS)*
	SD*	0.2749	0.2968		
	Median	0.7500	1.0000		
	Minimum	0.25	0.50		
	Maximum	1.25	1.25		
At 2 months	Mean	0.4821	0.6833	65.000	0.074 (NS)*
	SD*	0.3598	0.3467		
	Median	0.5000	0.7500		
	Minimum	0.00	0.25		
	Maximum	1.50	1.50		
At 4 months	Mean	0.2321	0.4000	65.500	0.077 (NS)*
	SD*	0.2853	0.2803		
	Median	0.2500	0.2500		
	Minimum	0.00	0.00		
	Maximum	1.00	1.00		

TABLE 2 Comparison of Sulcular bleeding index score between two groups at 0, 1, 2 and 4 months.

Sulcular Bleeding Index		Group 1	Group 2	Mann Whitney U Test	p-value
At the time of Placement	Mean	2.7167	2.8500	72.000	0.087 (NS)*
	SD*	0.2084	0.1268		
	Median	2.7500	2.7500		

	Minimum	2.25	2.75		
	Maximum	3.00	3.00		
At 1 month	Mean	0.8843	0.8773	103.500	0.956 (NS)*
	SD*	0.5016	0.4955		
	Median	0.7500	0.7500		
	Minimum	0.50	0.45		
	Maximum	2.50	2.50		
At 2 months	Mean	0.6107	0.6027	100.500	0.847 (NS)*
	SD*	0.4459	0.4287		
	Median	0.5100	0.5000		
	Minimum	0.25	0.25		
	Maximum	2.00	2.00		
At 4 months	Mean	0.2143	0.3167	64.000	0.052 (NS)*
	SD*	0.4026	0.2907		
	Median	0.0000	0.2500		
	Minimum	0.00	0.00		
	Maximum	1.50	1.25		

TABLE 3 Comparison of probing depths between two groups at 0, 1, 2 and 4 months

Probing Depth		Group 1	Group 2	Mann Whitney U Test	p-value
At the time of Placement	Mean	4.3000	4.5000	70.500	0.078 (NS)*
	SD*	0.2866	0.2673		
	Median	4.2500	4.5000		
	Minimum	3.75	4.00		
	Maximum	4.75	5.00		
At 1 month	Mean	4.0000	4.2667	61.000	0.051 (NS)*
	SD*	0.4160	0.3336		
	Median	3.7500	4.2500		
	Minimum	3.50	3.75		
	Maximum	4.75	5.00		
At 2 months	Mean	3.6250	3.7207	80.000	0.269 (NS)*
	SD*	0.6411	0.6228		
	Median	3.2500	3.5000		

	Minimum	3.00	3.25		
	Maximum	5.00	5.00		
At 4 months	Mean	3.2679	3.5167	71.500	0.140 (NS)*
	SD*	0.6160	0.6779		
	Median	3.1250	3.2500		
	Minimum	2.75	2.50		
	Maximum	4.50	5.00		

TABLE 4 Comparison of crestal bone loss between two groups at 0, 1, 2 and 4 months

Crestal Bone Loss		Group 1	Group 2	Mann Whitney U Test	p-value
At the time of Placement	Mean	0.00	0.00	112.500	1.000 (NS)*
	SD*	0.000	0.000		
	Median	0.00	0.00		
	Minimum	0	0		
	Maximum	0	0		
At 1 month	Mean	0.1757	0.1920	90.000	0.506 (NS)*
	SD*	0.1050	0.1333		
	Median	0.1500	0.1500		
	Minimum	0.10	0.10		
	Maximum	0.50	0.60		
At 2 months	Mean	0.3214	0.3680	66.000	0.081 (NS)*
	SD*	0.1565	0.1738		
	Median	0.2500	0.3000		
	Minimum	0.20	0.25		
	Maximum	0.80	0.90		
At 4 months	Mean	0.3536	0.3973	79.500	0.268 (NS)*
	SD*	0.1100	0.1179		
	Median	0.3000	0.4000		
	Minimum	0.25	0.25		
	Maximum	0.60	0.65		

Figure 1

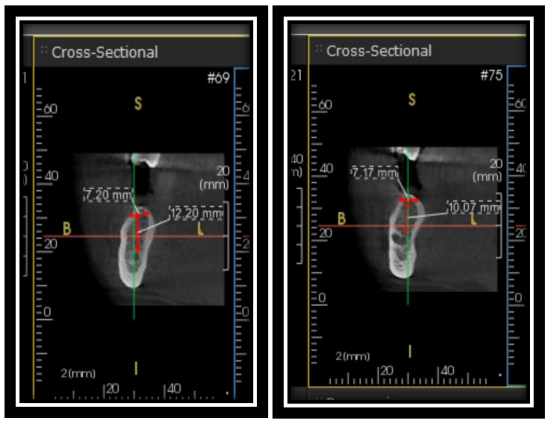

Figure 2

Figure 3

Figure 4

Figure 5

Figure 6

Figure 7

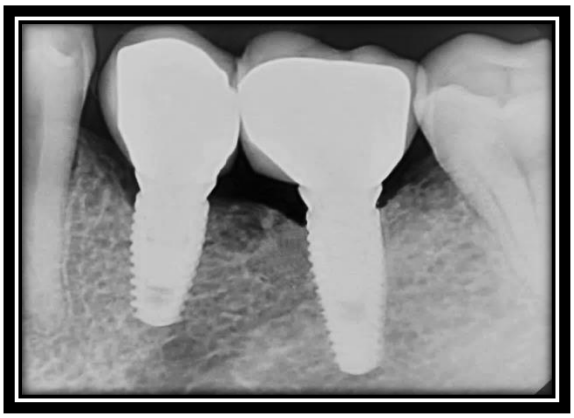

Figure 8

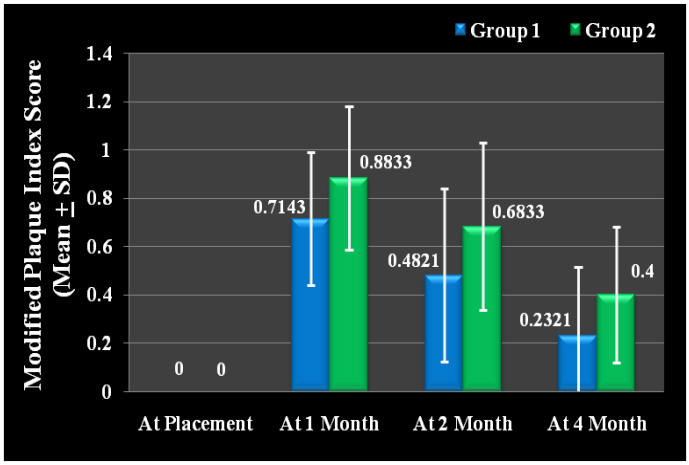

Figure 9 modified plaque index

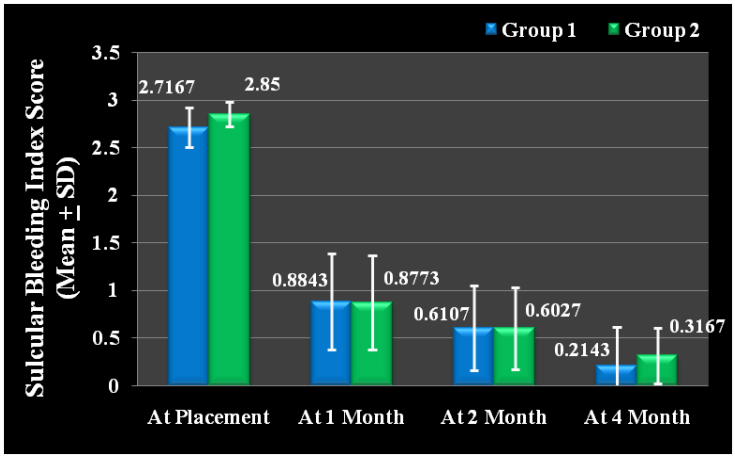

Figure 10 sulcular bleeding index

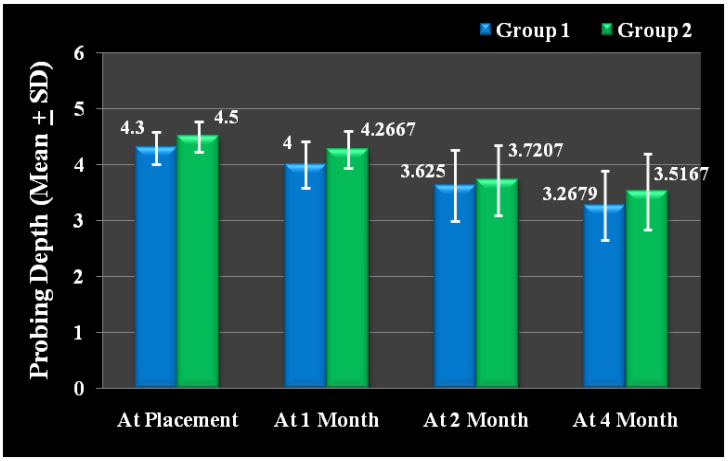

Figure 11 Probing depth

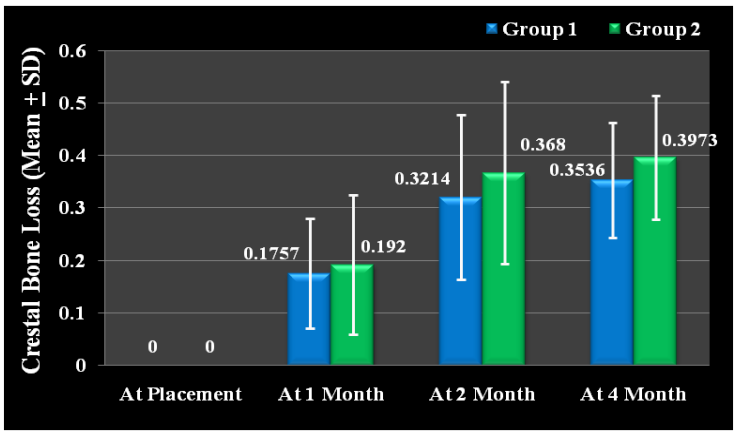

Figure 12 crestal bone loss

DISCUSSION

This vivo study was undertaken to compare the hard and soft tissue changes around immediately loaded short and long dental implants. Soft tissue and hard tissues are the foundation of implant dentistry as they have a very essential role in survival of dental implants. Maintenance of soft and hard tissues around the periphery of dental implant as well as the occlusion can increase the survival of dental implant. The mean scores for modified plaque index were found to be higher for GROUP B (Figure 9) but the difference between the two groups was not statistically significant ($p > 0.05$) as revealed by Mann-Whitney U test. The 1st evidence of plaque accumulation was recorded at 1st month which was quite higher as it was gradually decreasing the 2nd and 4th month follow up, which was due to gradual maturation of hard and soft tissues, over contouring of provisional crown or oral fluid absorption in resin crown. Roland GR. et al12 concluded that the there was no significant difference in Modified plaque indices (MPI) around immediately loaded short and conventional implant.

Probing depth and bleeding during probing were recorded, mean values for probing depth were found to be higher for GROUP B in comparison to GROUP A (Figure 11), but the difference between the two groups was not statistically significant ($p > 0.05$) as analyzed by implementing Mann-Whitney U test. Same result was recorded for sulcular bleeding index in (Figure 10). Initially the probing depth and the bleeding on probing was higher because of immature junctional epithelium around the dental implants and then gradually decreased due time. Yadav D. S et al13 evaluated the peri implant probing depth and bleeding on probing around the short implant was less as compared to conventional implant but, there was no significant difference between short and long implant.

Hard tissue evaluation was done by recording the crestal bone loss for the two groups. Maximum bone remodeling was seen during the time interval between implant placement and the time of loading (mean 0.43mm for both groups). It showed there was an increase in crestal bone loss from 1, 2 and 4 months. However, the difference in crestal bone loss between the two groups was statistically insignificant ($p > 0.05$) as analyzed from Mann-Whitney U test as seen in (Figure 12). Hence, it can be concluded that there was no difference between the short and conventional dental implant when crestal bone loss was compared. Anitua et al14 observed that there was no significant difference in the marginal bone loss and implant survival rate between immediately loaded short and long implants. There are certain studies like Atieh et al 15 concluded that that the survival rate for short implants is high then conventional one and not related to the implant surface, design, or width. Short implants may constitute a viable alternative to longer implants. From the above-mentioned observations, it can be deduced that hard and soft tissue changes around immediate loaded short and long implant are comparable to each other and the differences are statistically insignificant, and short implant can also perform equivalent to conventional one.

CONCLUSION

This study showed that short implants would be a successful treatment modality for replacement of missing teeth in resorbed ridges and areas in close approximate to anatomical structures, where standard sized implants cannot be placed, and it provides a satisfactory survival rate when compared to tedious processes of sinus lifting, ridge augmentation, etc. There were certain complications seen like debonding of temporary crown, Fracture of temporary crown, early loss of primary stability and oral hygiene maintenance etc. limitation of the present study was its smaller size, further are warranted in similar direction with larger sample size.

REFERENCES

1. Albrektsson T, Jacobsson M: Bone-metal interface in osseointegration. J Prosthet Dent 1987; 57:597.
2. Fan T, Li Y, Deng W, Wu T. and Zhang W. Short Implants Versus Longer Implants with Sinus Lifting in Atrophic Posterior Maxilla: A Meta-Analysis of RCTs. Clin Implant Dent Relat Res 2017;2;19(1):207-15.
3. Edher F. and Nguyen CT. Short dental implant a scope reviews of literature for patients with head and neck cancer. J Prosthet Dent.2017.06.201-12.
4. Rutkunas V, Bukelskiene V, Sabaliauskas V, et al. Assessment of human gingival fibroblast interaction with dental implant abutment materials. J Mater Sci: Mater Med 2015; 26:169- 9.
5. Glauser R, Ree A, Lundgren A, Gottlow J, et al. Immediate occlusal loading of Brånemark implants applied in various jawbone regions: a prospective, 1-year clinical study. Clin Implant Dent Relat Res. 2001;3(4):204-13.
6. Hinrichs JE, Kotsakis GA, Lareau, D: Soft tissue augmentation surgery for dental implants, Chapter 27. In: Kademami D, Tiwana P (eds.), Atlas of Oral and Maxfac Surg, 1st edn. Elsevier, 2015.
7. Lekholm U, Zarb GA. In: Branemark PI, Zarb GA, Albrektsson T, eds. Patient Selection and Preparation. Tissue Integrated Prostheses: Osseointegration in Clin Dent. Chicago: Quintessence Publishing Company; 1985:199-209.

8. Kathleen Manuela D'Souza, Meena Ajay Aras. Types of Implant Surgical Guides in Dentistry: A Review. J Oral Implantol.2012:38(5):643-52.
9. Romadini M et al. Antibiotic prophylaxis at dental implant placement: Which is the best protocol? A systematic review and network meta-analysis. J Clin Periodontol 2019 Mar;46(3):382-95.
10. Degidi M. and Piattelli A. Immediate functional and non-functional loading of dental implants: a 2- to 60-month follow-up study of 646 titanium implants. J Periodontol. 2003;74(2):225-41.
11. Mombelli A, Muller N, Cionca N. The epidemiology of peri-implantitis Clin. Oral Implants Res. 23(Suppl. 6), 2012, 67–76.
12. Glauser R, Zembic A, Hämmerle CH. A systematic review of marginal soft tissue at implants subjected to immediate loading or immediate restoration. Clin Oral Implants Res. 2006;17(2):82-10.
13. Yadav DS, Durrani F, Rahman F, Borang PO, et al. Comparative evaluation of hard and soft tissue parameters by using short and standard dental implants for prosthetic rehabilitation of posterior mandible: a split mouth study. J Osseointegr 2019;11(1):38-44.
14. Anitua E, Flores J, Flores C. And Alkhraisat MH. Long term outcomes of immediate loading of short: A controlled retrospective cohort study. Int J Oral Maxillofac Implants. 2016;31(6):1360-6.
15. Atieh M.A., Zadeh H., Stanford C.M. and Cooper L.F. Survival of short dental implants for treatment of posterior partial edentulism: a systematic review. Int J Oral Maxillofac Implants. 2012;27(6):1323-31.
16. Xu X., Xu Y., Liu Q., Ding H. et al Short versus standard implants for single-crown restorations in the posterior region: A systematic review and meta-analysis. J prosthet dent 2019;10(7);112-17.
17. Araki H., Nakano T., Ono S. et al. Three-dimensional finite element analysis of extra short implants focusing on implant designs and materials. Int J Implant Dent 2020;6(5)1128-36.
18. Svezia L. and Casotto F. Short Dental Implants (6 mm) Versus Standard Dental Implants (10 mm) Supporting Single Crowns in the Posterior Maxilla and/or Mandible: 2-Year Results from a Prospective Cohort Comparative Trial J Oral Maxillofac Res 2018;9(3):118-26.
19. Windael S., Vervaeke S., Wijnen L., Jacquet W. et al. Ten-year follow-up of dental implants used for immediate loading in the edentulous mandible: A prospective clinical study. Clin Implant Dent Relat Res. 2018;20(4):515-21.
20. Papaspyridakos P., De Souza A., Vazouras K. and Gholami H. Survival rates of short dental implants (≤6 mm) compared with implants longer than 6 mm in posterior jaw areas: A meta-analysis. Clin Oral Implants Res. 2018;29(16):8-20.

.