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TO COMPARE AND EVALUATE MARGINAL BONE LOSS AROUND SHORT AND LONG IMPLANTS PLACED IN POSTERIOR MAXILLA VIA CONVENTIONAL DRILLS AND OSTEOTOMES.

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Abstract

PURPOSE- *To calculate the marginal bone loss occuring around short and long implants placed using bone condensing osteotomes as well as using conventional drilling and to understand the viability of osteotome technique and short implants.*

MATERIALS AND METHODS- *An in-vivo study was undertaken to evaluate the crestal bone loss on mesial and distal aspect of short and long implants placed via osteotomes and conventional drills (group A,B,C,D 5 implants per group) using standardized intra-oral periapical radiographs at baseline,3 months and 3 months post loading Statistical Analysis Used: Student's unpaired t-test.*

RESULTS- *Long implant via drills and osteotomes were group A and B and their results were statistically significant different ($p < 0.004$), short implant via drills and osteotomes were group C and D where better bone level was observed for short implant via osteotomes, when compared long implant via osteotome (group B) and short implant via osteotome The results show that bone level measurement at 3 months post loading were higher at mesial (0.52mm) and distal (1.06mm) positions for long implants compared to short implants placed via osteotome. The results were statistically significant ($p<0.05$).*

CONCLUSION- *Considering the limitations of implant placement in the posterior maxilla, osteotome and short implants are a non-invasive and predictable procedure for allowing implant placement and bypassing the invasive surgical, bone augmentation and graft procedures.*

Keywords- Atrophic maxilla, osteotomes, short implants, marginal bone loss, bone condensation

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Introduction

Endosteal dental implants are devices placed into the alveolar and/or basal bone of the maxilla or mandible that transect a cortical plate. They can be used to support and retain fixed dental prostheses, removable dental prostheses or maxillofacial prostheses.[1] Quality of life in adults can be highly affected by tooth loss as a consequence of compromised oral function, loss of social status and diminished self-esteem.[2] Prevention of atrophy after tooth extraction by socket or ridge preservation or reconstruction of the alveolar crest in cases of atrophy by augmentation with autologous bone or bone substitute materials of different origins have become reliable treatment options to establish a sufficient implantation bed. However, extensive augmentation procedures as therapy of choice for all patients should be viewed critically. Due to compromised general health, anamnestic data, or individual demands of the patient, minimally invasive methods to restore oral function should be considered.[3] Conventionally surgeons aim for placement of the longest possible implant in any given site as long as the bone was available its placement does not hinder the final prosthetic result in terms of esthetics. This was especially crucial in the past, when implants presented a machined surface and the most common way to increase implant-to-bone contact was to increase the surface area available by placing a wider or longer implant. The longer and wider implants were clearly associated with higher success rates at that time when placed in similar intraoral sites. However, the posterior maxilla presents a uniquely challenging site for implant placement due to several complicating factors. Some of the factors that lead to difficulties in implant placement and success in the maxillary molar region are:

- Difficult and challenging access
- Limited visibility
- Commonly reduced interarch space
- Post extraction resorption that leads to extensive tissue loss over time, as well as sinus pneumatization
- Poor (type IV) bone quality (thin layer of cortical bone surrounding a core of low-density trabecular bone) associated with the least favorable success rate.[4]

Different surgical techniques enabling the reconstruction of maxillaries with reduced bone height have been described in the literature. These procedures allowed the implant rehabilitation in situations that implant placement would be contraindicated in the past. Several surgical techniques have been advocated for vertical bone augmentation of severely resorbed ridge, such as guided bone regeneration combined with bone graft, the interposition of bone block grafts (inlay technique), sinus elevation, and distraction osteogenesis. The inferior alveolar nerve lateralization and transposition are the examples of uncommon procedures in the mandible. In this scenario, the placement of short implants appears as an alternative treatment to avoid advanced surgical procedures and their corresponding morbidity.[5] The posterior maxilla is one of the most challenging anatomic locations for the implant placement that requires adjunctive surgical procedures. This special study covers leading researches and reviews on this topic that we believe would contribute to clinicians.[6] In the last ten years, the use of short implants has increased significantly, especially in partially edentulous maxillae but information regarding extra-short implants (<7 mm) remains limited[7]. Studies have explored the short-term and long term survival rates of short implants<6 mm). Unfortunately, the evidence supporting the use of short implants (<6 mm) in the posterior maxilla is weak, and no guideline statement is currently recommended[8]. Implants <10 mm with traditional machined surfaces showed inferior success rates compared with longer implants in the past. So due to the

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sinus pneumatization placement of long implants requires a sinus lift via a lateral window osteotomy (LWO) but it does have some disadvantages, including a higher cost, increased morbidity, risk of serious infection, and delayed healing time.[9] As a less invasive alternative, osteotome.[9] techniques can obtain a localized elevation of the sinus floor through a 3-mm– to 6-mm–diameter crestal osteotomy, which minimizes the degree of flap elevation and thus eliminates the need for preparation of a larger bony window in the lateral aspect of the alveolus When there is adequate subantral bone for the primary stabilization of implants, osteotome-mediated sinus floor elevation (OMSFE) procedures procure 2 mm to 7 mm of localized sinus floor elevation, usually permitting the simultaneous placement of implants of 10 mm or lesser in length.[10] The Osteotome technique was first detailed in multiple publications by Summers where use of blunt instruments called Osteotome were used for elevation of the sinus, bone augmentation occurs followed by dental implant placement simultaneously or four to six months later as a two-stage technique.[11] This made it possible to insert the Osteotome within the maxillary bone and compress the latter – there by affording increased bone density for the preparation of beds of the same diameter as the required implant. The placement of implants in narrow maxillary crests in a single surgical step, involving the use of expansion osteotomes,has become a routine, predictable and easy technique.[12] So to highlight the technical and biological complications associated with both short implants, and compare the marginal bone loss occurring around them when placed via surgical Osteotome and conventional drills the present study is being conducted.

Aims and Objectives

Aim:

1. To calculate marginal bone loss around long and short implants placed via osteotomes and conventional drills in posterior maxilla based on radiological examination.

Objectives:

To compare marginal bone loss/gain between long implants placed via conventional drills and long implants placed via osteotomes at baseline, 3 months and 3 months post loading. (A and B GROUPS)

To compare marginal bone loss/gain between short implants placed via conventional drills and short implant placed via osteotomes at baseline, 3 months and 3 months post loading. (C and D GROUPS)

To compare bone loss/gain and between long implants placed via osteotomes and short implants placed via osteotomes at baseline, 3 months and 3 months post loading.(B and D GROUPS)

Materials and Method

The present study was carried out in Department of Prosthodontics, Vyas Dental College and Hospital, Jodhpur from Nov 2019 to Dec 2021. This in vivo study was performed after approval was received from Institutional review of Vyas Dental College & Hospital (11/2019).

A total of 24 implants were placed in patients reporting to the out-patient Department of Prosthodontics and Crown and Bridge and Implantology, Vyas Dental College and Hospital, Jodhpur based on the inclusion and the exclusion criteria.

Inclusion Criteria

1. Maxillary Posterior healed (post 3 months of extraction) edentulous arch.

2. Co-operative patient, willing for surgery and proper follow up.

3. Sufficient buccolingual width (>8mm)

4. Presence of occluding mandibular teeth

5. Residual alveolar bone height at least 5mm

6. Sufficient mesiodistal width (7 to 9mm)

Exclusion Criteria

1. Un-coprative patients and age <18

2. General contraindications for implant surgery

3. Poor oral hygiene

4. Smoking, or any kind of substance abuse

3. Pregnancy

4. Immunocompromised state or systemic conditions

5. Bruxism

6. Radiotherapy of head and neck region for malignancy

7. Patients with acute infection in the area intended for implant placement (sinusitis)

Study was divided into following groups based on the length and technique of placement

Group A- 5 Long (>8 mm) implant placement by conventional drilling.

Group B- 5 Long (>8 mm) implant placement by osteotome.

Group C- 5 Short (8 or <8mm) implant placement by conventional drilling.

Group D- 5 Short (8 or<8 mm) implant placement by osteotomes.

Detailed medical and dental history of each patient was taken. After an explanation of the proposed study criteria, including alternate treatment, potential risks and benefits, the participants were asked to sign an informed consent

After evaluating bone height from the crest to the sinus floor, if that was greater than >5mm long(>8mm) implant was planned for groups A and B, placement was via drills for 5 subjects of group A and via osteotomes for 5 subjects of group B. If the residual bone height was less equal to 5 mm short implants (8mm) were planned for Groups C and D, placement was via drills for 5 subjects of group C and via osteotomes for 5 subjects of group D. The implants used were ADIN Touareg^{TM-S} Spiral dental implant along with all the surgical armamentarium. Required for placing implant. (Fig 1)

Protocol for implants placed via conventional drilling (Groups A and C)

On the day of surgery the patient was prepared and was given a posterior superior nerve block (PSA), greater palatine nerve block and infiltration around the teeth and appropriately anesthetized. Intrasucular and vertical incisions were made with a 15c blade and a full thickness flap was raised. Osteotomy preparation began with the 2mm pilot drill followed by the successive drills and since the bone quality in the posterior maxilla was suspected to be D3 the last drill was kept size lesser than the desired implant width. After the osteotomy was prepared long ADIN implant (Fig 2) was inserted (Fig 3) achieving a primary stability of 35Ncm. Cover screw was placed followed by sutures and a baseline x-ray was obtained.

Protocol for implants placed via osteotome technique (Groups B and D)

On the day of surgery the patient were prepared and was given a posterior superior nerve block (PSA), greater palatine nerve block and infiltration around the teeth and appropriately anesthetized. Intrasucular and vertical incisions were made with a 15c blade and underlying alveolar bone was

exposed by raising a full thickness flap. Osteotomy preparation began with the 2mm pilot drill at 600rpm under saline cooling till a depth of 13mm was done and an IOPA with the pilot drill was taken which showed that the prepared depth was very close to the sinus floor and the bone quality was too soft to widen the osteotomy further so we began to condense the bone using osteotomes and so the implant length was changed to 11.5mm along with the sinus floor lift of 1mm was done using the CONCAVE osteotome [JULL-DENT DENTAL IMPLANT INSTRUMENTS & DENTAL IMPLANT,

Fig 1- Armamentarium Used In The Study

Fig 2-Implant Dimensions

Fig 3- Implant Placement

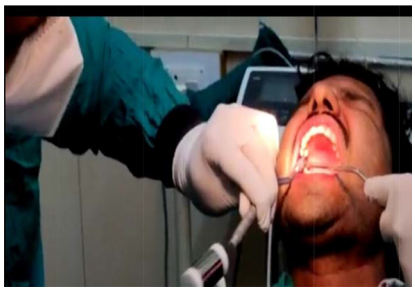

Fig 4- Malleting With Osteotome

Fig 5-Concave Osteotome And Mallet

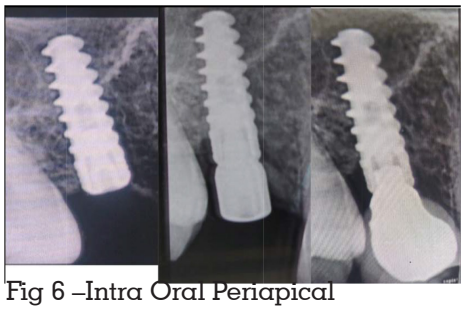

Fig 6 –Intra Oral Periapical Radiographs At Baseline, 3 Months And 3 Months Post Loading

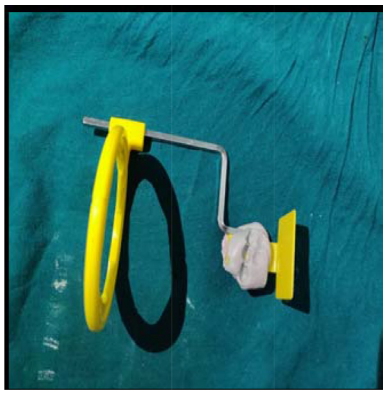

Fig 7 – Rvg Sensor Holder(Rinn Xcp Dentsply) With Putty Bite

Fig 8 – Rvg Sensor Position Standardised With Holder

Fig 9 – Accuacy Evaluation On Digitised Iopa Radiograph

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TABLE 1- GROUP A

Subject	BASELINE		3 MONTHS		3 POST LOADING	
	MESIAL	DISTAL	MESIAL	DISTAL	MESIAL	DISTAL
1	1.2mm	1mm	2mm	2.8mm	1mm	1mm
2	2mm	2.5mm	2mm	2.8mm	1.5mm	1mm
3-Implant 1 Implant 2	1mm 1mm	1mm 2mm	1.5mm 1mm	2.8mm 2mm	1mm 0.6mm	1.5mm 0.8mm
4- Implant 1 Implant 2	1.4mm 1mm	1mm 1.2mm	1.8mm 2mm	2.2mm 2mm	1mm 1mm	1mm 1.5mm
5	1mm	2mm	2mm	2.5mm	1.5mm	0.5mm

TABLE 2- GROUP B

Subject	BASELINE		3 MONTHS		3 POST LOADING	
	MESIAL	DISTAL	MESIAL	DISTAL	MESIAL	DISTAL
1	0mm	0mm	2.1mm	1mm	1mm	1.5mm
2	2mm	2mm	2mm	2mm	0.8mm	2.5mm
3	2mm	1.5mm	2mm	1.5mm	1mm	2mm
4-Implant 1 Implant 2	2mm 2.8mm	0.5mm 1.5mm	1.5mm 1mm	1mm 1.5mm	1mm 0.8mm	1.5mm 1.8mm
5	1mm	1mm	1.2mm	1mm	1mm	1.5mm

TABLE 3-GROUP C

Subject	BASELINE		3 MONTHS		3 POST LOADING	
	MESIAL	DISTAL	MESIAL	DISTAL	MESIAL	DISTAL
1	0mm	0mm	2mm	2.5mm	0.2mm	2.2mm
2	1mm	0.8mm	1mm	1.2mm	0.8mm	1mm
3	0.6mm	0.8mm	1mm	1mm	0.5mm	1mm
4	1.8mm	2mm	2.8mm	2.5mm	1mm	2.2mm
5	0.5mm	1mm	1mm	1mm	0.5mm	0.5mm

TABLE 4-GROUP D

Subject	BASELINE		3 MONTHS		3 POST LOADING	
	MESIAL	DISTAL	MESIAL	DISTAL	MESIAL	DISTAL
1	0.5mm	0.5mm	`1.5mm	1mm	0.5mm	1mm
2	0.5mm	0.8mm	1mm	1mm	002mm	0.5mm
3	1mm	0.4mm	1mm	1mm	0.2mm	0.2mm
4	1mm	1.2mm	1mm	1.5mm	0.8mm	0.5mm
5	1mm	2mm	1.5mm	2.2mm	0.5mm	1.5mm

MUMBAI]. Post the 2mm pilot drill the compacting and bone expansion began using the 2.5 mm osteotome (FIG 4 and FIG 5) till the depth of 11.5 using the stopper, followed by 3mm, and since the quality was too soft the last width kept was 3.5mm 1 mm less than the desired implant width where the osteotomes were inserted and rotated simultaneously and were kept inside for 30 to 60 seconds to allow the bone to expand before inserting the bigger diameter after going 1mm deep with each osteotome xray was taken to check the sinus floor and as we reached the sinus floor osteotomes were tapped gently with the mallet and if osteotome faced resistance further widening was done. The valsalva maneuver was performed was performed on multiple occasions to detect any communication an no oroantral communication was noted. Condensing and bone expansion was achieved till depth of 11.5 and width 4.2, followed by which the implant was inserted with a primary stability of 35ncm, cover screws were placed and flaps were sutured.

Post Operative Instructions

After the surgery all the subjects of each group were asked to used ice pack to avoid any edema or swelling and were asked to refrain from blowing vigorously through the nose, sucking through straws to avoid increase or decrease in maxillary air pressure. To prevent secondary infection of the sinus and surgery site 500mg amoxicillin, Metrogyl 400mg Betadine rinse and 0.2% chlorhexidine mouthwash was prescribed. Post 10 days the patient was called for suture removal.

Graph 1: Comparison of bone level measurements between long implants placed via conventional drills and via osteotome.

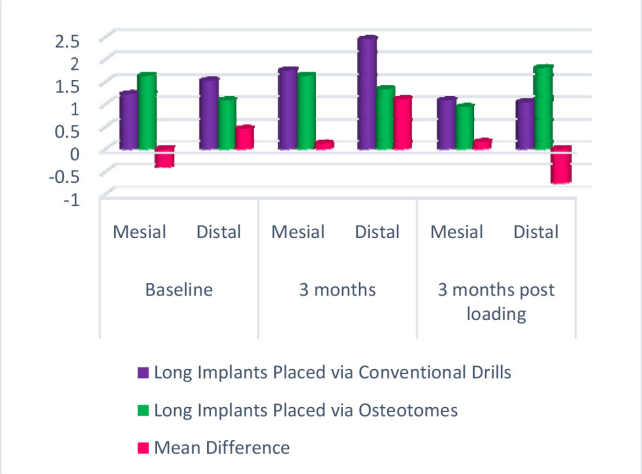

Table 5: SHOWS COMPARISON OF BONE LEVEL MEASUREMENTS BETWEEN LONG IMPLANTS PLACED VIA CONVENTIONAL DRILLS AND VIA OSTEOTOME.

Time Period	Positions	Mean Difference	T	df	Range	p value
Baseline	**Mesial**	-0.40	-0.95	6.23	-1.43 - 0.62	0.377
	Distal	0.44	1.18	11	-0.383- 1.27	0.262
3 months	**Mesial**	0.12	0.52	11	-0.39 - 0.64	0.609
	Distal	1.10	5.11	11	0.63 - 1.58	**0.001**
3 months post loading	**Mesial**	0.15	1.11	11	-0.14 - 0.45	0.288
	Distal	-0.75	-3.59	11	-1.22 - -0.29	**0.004**

Independent t-Test, P <0.05 Significant

Radiographic Protocol and Accuracy Evaluation

RVG was taken immediately(baseline) after the implant placement, at 3 months and 3 months post loading (Fig 6) to assess and measure the bone level. X-rays were taken using long cone paralleling technique (70kv, 10 mA, 0.2 seconds) and x-ray was digitized using a specialized software (SOPRO IMAGING SYSTEM version 2.0.272.0, size 4.27 MB) to avoid error each IOPA was standardized using RVG SESNSOR HOLDER [RINN XCP FILM HOLDER] (Fig 7, Fig 8) on which patient putty bite was taken so that at each follow up the sensor can be placed in the same position and errors can be avoided.

The marginal bone loss will be determined by measuring the distance from the implant abutment interface to the first visible bone implant contact (FBIC). Both mesial and distal sites were measured separately and average values will be calculated. (Fig 9) For more accuracy three readings were taken and their average value were calculated. All the calculations were performed by single clinician. If the measured value is more than the previous value there will be bone loss, if the measured value if less than the previous value there will be a bone gain.

Results

Software- SPSS version 20

Statistical tests: The Normality tests Kolmogorov-Smirnov and Shapiro-Wilks tests show that the data is normally distributed. We conducted parametric tests. Independent- t test was done to compare the two groups, keeping value of significance $p<0.05$.

Graph 2: Comparison of bone level measurements between short implants placed via conventional drills and via osteotome.

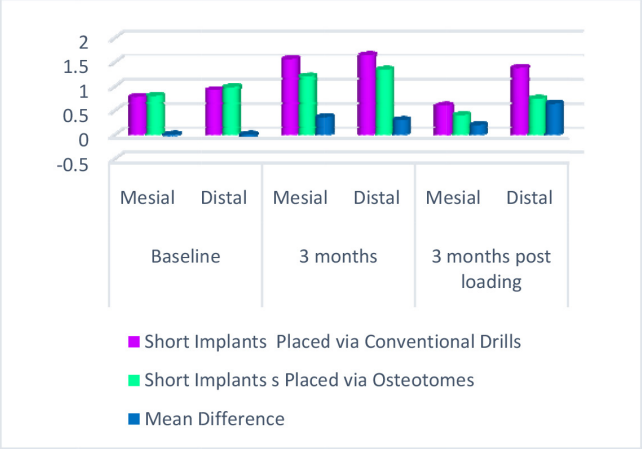

Table 6: Comparison of bone level measurements between short implants placed via conventional drills and via osteotome.

Time Period	Positions	Mean Difference	t	df	Range	p value
Baseline	**Mesial**	-0.02	-0.062	8	-0.76 - 0.72	0.952
	Distal	-0.06	-0.139	8	-1.05 - 0.93	0.893
3 months	**Mesial**	0.36	0.0934	4.88	-0.63 - 1.35	0.394
	Distal	0.30	0.707	8	-0.67 - 1.27	0.500
3 months post loading	**Mesial**	0.19	1.016	8	-0.24 - 0.64	0.339
	Distal	0.64	1.539	8	-0.31 - 1.59	0.162

Independent t-Test, P <0.05 Significant

Independent- t test: was used to compare the difference between the mean of two independent samples

Comparison was done between groups A and B, Groups C and D, Groups B and D

The readings for the groups A,B,C,D are summarised below in the tables

Inference: The results show that bone level measurement at 3 months was higher at distal position for long implants placed via conventional drill compared to osteotome. The results were statistically significant ($p<0.001$).

At 3 months post loading, bone level measurement was higher at mesial (0.15mm) position for long implants placed via conventional drill compared to osteotome. The results were not statistically significant ($p=0.288$). The bone level measurement at 3 months post loading was higher at distal (0.75mm) position for long implants placed via osteotome compared to conventional drill. The results were statistically significant different ($p < 0.004$).

Inference: The results show that bone level measurement at 3 months was higher at mesial and distal positions for short implants placed via conventional drill compared to osteotome. But the results were not statistically significant ($p>0.05$).

At 3 months post loading, bone level measurement were higher at mesial (0.19mm) and distal (0.64mm) positions for short implants placed via conventional drill compared to osteotome. But the results were

Graph 3: Comparison of bone level measurements between long and short implants placed via osteotome.

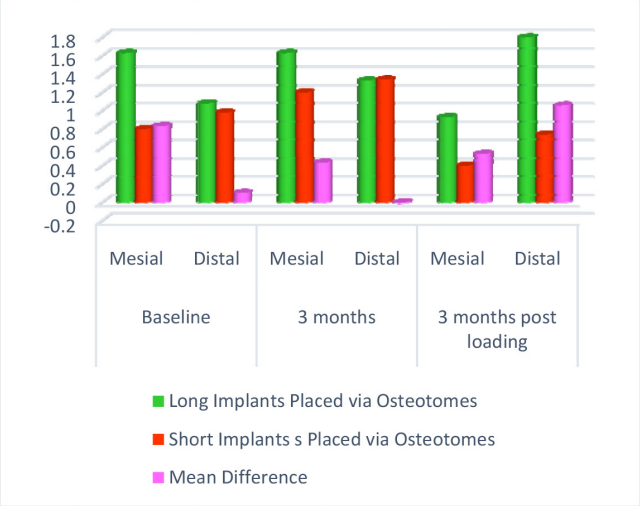

Table 7: Comparison of bone level measurements between long and short implants placed via osteotome.

Time Period	Positions	Mean Difference	t	Df	Range	p value
Baseline	**Mesial**	0.83	1.822	9	-0.20 - 1.86	0.102
	Distal	0.10	0.244	9	-0.85 - 1.06	0.813
3 months	**Mesial**	0.43	1.819	9	-0.10 - 0.97	0.102
	Distal	0.00	-0.024	9	-0.64 - 0.63	0.982
3 months post loading	**Mesial**	0.52	3.744	4.78	0.16 - 0.89	**0.015**
	Distal	1.06	3.859	9	0.43 - 1.68	**0.004**

Independent t-Test, P <0.05 Significant

not statistically significant different ($p > 0.05$).

Inference: The results show that bone level measurement at 3 months post loading were higher at mesial (0.52mm) and distal (1.06mm) positions for long implants compared to short implants placed via osteotome. The results were statistically significant ($p<0.05$).

At baseline and 3 months, bone level measurement was higher at mesial and distal positions for long implants compared to short implants placed via osteotome. But the results were not statistically significant different ($p > 0.05$).

Discussion

The posterior maxilla is one of the most challenging anatomic locations for the implant placement. The main reason for that is the pneumatization of sinus subsequent to the tooth loss. Vertical augmentation of the posterior maxilla has commonly been achieved by maxillary sinus augmentation. The main drawbacks of these augmentation procedures include morbidities such as post-operative infection, mucosal tissue breakdown, pain, bleeding, and neurosensory deficit. The alternative approach for the treatment of sites with vertical ridge deficiency has included short implants. Since the literature on short implants has some deficiencies, a thorough understanding about short implants becomes an important prerequisite before placing them.[12,13,14,15,16] There are numerous classifications proposed for short implants[17] but For the purpose of this case study 6th European Consensus Conference of European association of Dental Implantologists in 2011 approved the classification given by Olate which states implant as short if their length is <8mm, medium if between 9 to 13mm and long implant if > 13mm[18].

Graph 4: Mean values of bone level measurements of all Study groups at Baseline, 3 months and 3 months post loading.

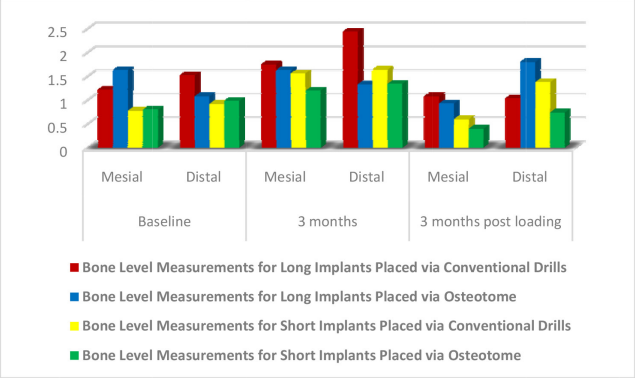

Table 8: Mean values of bone level measurements of all Study groups at Baseline, 3Months and 3 months post loading.

Groups	Positions	Long Implants Placed via Conventional Drills	Long Implants Placed via Osteotome	Short Implants Placed via Conventional Drills	Short Implants Placed via Osteotome
Baseline	**Mesial**	1.22	1.63	0.78	0.8
	Distal	1.52	1.08	0.92	0.98
3 months	**Mesial**	1.75	1.63	1.56	1.2
	Distal	2.44	1.33	1.64	1.34
3 months post loading	**Mesial**	1.08	0.93	0.6	0.4
	Distal	1.04	1.8	1.38	0.74

ADVANTAGES OF SHORT IMPLANTS- Lower cost, Less presurgical time and Costs for surgery, can Avoid Complications that result from advanced grafting procedures, Increases patient's acceptability, Less surgeries involved, Fewer complications, Quicker rehabilitation time[19]. Moreover when coming to the biomechanical considerations for short and long implants both it has been reported that long implants are associated with more of biological complications, where as short implants report more of technical or prosthetic complications.[20,21] Also less amount of marginal bone loss has been reposted around short implants due to "stress shielding" effect occuring around short implants.

Surgical considerations for short implants –Two stage surgery with delayed loading, eliminating the countersink drill, soft drilling protocol.

Prosthetic considerations for short implants- internal hex connection, platform switching, narrow occlusal table, flattening cuspal inclines,eliminating cantilevers, splinting implants[22].

Technical and biological consideration for short and long implants

Short implants were associated with significantly lower biological complication rates compared with long implants placed after maxillary sinus augmentation. Short implants were associated with higher rates of prosthetic complications compared with long implants[23]. Eight out of eleven studies observed technical complications after 5 years in function, in particular screw loosening, decementation.

The reason why we opted for osteotome technique was because the poor bone quality and the sinus pneumatization posed as obstruction for rehabilitating the maxilla every time with a standard length implant and drilling on top of it lead to loosing the poor quality bone, so osteotomes came to the rescue which are bone condensing instruments. Osteotomes are optimally used by pressing the instrument into the bone and malleting, ie, tapping the osteotome into place with a surgical mallet only when there is slight resistance. Firmer resistance may indicate the need for wide-ning the cortex with a drill. Generally, most resistance is caused by a cortical opening that is too small for the osteo-tome to easily pass through.[25,24]

Once the desired depth has been reached, and before moving on to the next instrument, it is advisable to wait 30-40 seconds for bone microfractures to form and dilate and compact the adjacent bone. So bone preservation, good tactile sense to the operator, facilitating short implant placement, avoiding complex grafting/ augmentation procedures as well as economic are some of the advantages of osteotomes for posterior atrophic maxilla. And as anticipated osteotomes proved a very good technique to restore the posterior maxilla with short implants in a quick and precised way needless to say keeping the occlusion and other biomechanical factors in mind.[26,27]

Conclusion

When compared groups A (Long Implants placed via drills) and B (long placed via osteotome) at 3 months post loading, bone level measurement was higher at mesial (0.15mm) position for long implants placed via conventional drill compared to osteotome. The results were not statistically significant ($p=0.288$). The bone level measurement at 3 months post loading was higher at distal (0.75mm) position for long implants placed via osteotome compared to conventional drill. The results were statistically significant different ($p < 0.004$). So, osteotome technique proves beneficial for placing long implants

When compared groups C (short implants placed via drills) and D (short implants placed via osteotomes). At 3 months post loading, bone level measurement were higher at mesial (0.19mm) and

distal (0.64mm) positions for short implants placed via conventional drill compared to osteotome. But the results were not statistically significant different ($p > 0.05$).

When compared groups B (long implants via osteotomes) and D (short implants via osteotomes) The results show that bone level measurement at 3 months post loading were higher at mesial (0.52mm) and distal (1.06mm) positions for long implants compared to short implants placed via osteotome. The results were statistically significant ($p<0.05$).

Within the limitations of the study it can be concluded that there was initial bone loss seen at baseline and 3 months around both short and long implants when placed via osteotome technique which was statistically significant however 3 months post loading the difference was compensated around implants placed via osteotome and the difference was not that statistically significant. So the gain for long implants via osteotome was statistically significant making osteotome technique an advantage for placing long implant but the low bone level for short implants via osteotome was less statistically significant making osteotomes and short implants a beneficial and mannagable protocol for highly atrophied maxillary ridges.

LIMITATIONS OF THIS STUDY- The limitations of the study are small sample size, less follow up period so Suggestions for further research include the demand for more longitudinal studies with larger samples and longer follow-up times on short and long implants. Osteotome technique not to be used in type 1 and type 2 bone quality and also in patients suffering with Benign Paroxysmal Positional Vertigo [BPPV].

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