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Original Research

A comparative evaluation of mandibular anterior ridge resorption in conventional complete dentures and four implants supported over dentures - An *in vivo* study

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***ABSTRACT*:**

Aim: The main goal and purpose of this study was to compare and evaluate the mandibular anterior residual ridge resorption in four implant-supported overdentures and conventional complete dentures. **Methods and Material:** This study involved two groups of 20 patients with different prosthetic constructions. Group (1) mandibular complete dentures (CDs) as a control (10 patients). Group (2) mandibular overdentures supported by four implants placed in the interforaminal region and the first molar region following the two-stage surgical procedure and early loading protocol as a test group (10 patients). Evaluation of anterior residual ridge resorption (RRR) was carried out at baseline, at the time of surgery, and 06 months using CBCT and mucosal thickness was assessed at baseline, three months, and six months. **Statistical analysis:** The data was statistically analysed by using the Mann-Whitney u test. **Results:** The mean change in ridge resorption from baseline to 6 months in the control group is 0.38 ± 0.01(p-value 0.006). Whereas the mean shift in ridge resorption from baseline to 6 months in the test group was 0.15 ± 0.10(p-value 0.006). The mean change in mucosal thickness from baseline to 6 months in the control group is 0.54 ±0.04(p-value 0.796). Where 0.44±0.05 (p-value 0.796). **Conclusion**: Within the limitations of the study, it was concluded that implant-supported overdentures (ISODs) are an effective treatment modality in the rehabilitation of completely edentulous mandibular arches with improved patient satisfaction, chewing ability and in terms of ridge resorption, mucosal thickness and retention when compared to conventional complete dentures (CDs).

Key-words: Conventional complete dentures (CDs), Implant-supported overdentures (ISODs), Residual ridge resorption (RRR), Cone-beam computed tomography (CBCT).

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INTRODUCTION:

The most common treatment for the edentulous patient is conventional dentures. However, such prostheses have well-documented problems such as lack of stability and retention. Continued loss of alveolar bone can occur over time, and cause previously stable dentures to become ill-fitting. It reported that more than 50% of those with complete mandibular dentures might have problems with stability and retention. They are often concerned about denture moving when eating, speaking, or laughing and report fears about the negative effect of dentures on social conditions. In some cases, people avoid social situations altogether[1].

Implant-supported overdentures (ISOD's) offer better stability, retention, and mastication. Patients report greater satisfaction with aesthetics because the denture is invisible. Implants reduce bone resorption, and the long-term success rate of implants in the lower mandible is 95%, and there are a few complications[1].

The advantage of the overdenture is the increased chewing ability and improved patient confidence. When compared with an implant-supported fixed prosthesis, the overdenture has the advantage of allowing more natural cleaning as they are removable and anchored by a fewer number of implants[2].

Factors that are affecting the planning of the overdenture treatment are:

- The number and length of the implants
- Quality and quantity of the anchoring bone
- Economic constraints[3].

In this study, mandibular anterior residual ridge resorption between the conventional complete denture and four implants supported mandibular overdenture was evaluated, and mucosal thickness was also evaluated.

SUBJECTS AND METHODS:

Methodology:
Twenty completely edentulous patients attending the Department of Prosthodontics. All the patients were grouped into two groups.
GROUP 1 (Control Group): 10 completely edentulous patients to be rehabilitated with conventional complete dentures (CDs).
GROUP 2 (Test Group): 10 completely edentulous patients to be rehabilitated with mandibular four implant-supported overdentures (MIODs) placed in the interforaminal region and first molar region.

Subject selection:

Inclusion criteria*:*
1. Patients (male or female) within the age group of 40-65 years.
2. Absence of any systemic diseases.
3. Completely edentulous maxillary and mandibular arches.
4. Edentulous period of at least three months.
5. Patients should be the first set of denture wearers.
6. Patients with resorbed mandibular ridges, where the amount of resorption occurred, was estimated on OPG by Wical and Swoope method.
7. Adequate interarch space of 16 - 22 mm.
8. Type 1 & 2 bone density
9. Adequate bone height of 15 - 20 mm anteriorly.

Bone width not less than 5 mm, both buccolingually and mesiodistally in the anterior mandible. Posteriorly bone height not less than 12-18 mm and width not less than 8 mm.

Exclusion criteria:
1. A medical and personal history that would complicate the outcome of the study, such as alcohol or drug dependency, poor health, or any other medical, physical, or psychological reason that might affect the surgical procedure, the subsequent prosthodontic treatment and required follow-up.
2. Heavy smokers.
3. Who received bone grafting in the anterior mandible
4. Patients on radiotherapy.
5. Type 3 & 4 bone density.

Two-piece titanium implant system:
ALPHA BIO implants of size, Anterior- 3.3mm diameter, 13mm length Posterior- 4.3mm diameter, and 8mm length two-piece implants were placed using implant drivers.
Informed consent was taken from all the patients those who were willingly ready for participation.

CONTROL GROUP PATIENTS
In the control group, preoperative CBCT scans were taken for all the patients for evaluation of available length and width of the bone. Initially, primary impressions of patients were brought in stock edentulous using Type I impression compound (figure 1) by muco-compressive technique into which Type II Gypsum product was poured to obtain primary casts (figure 2). Later custom trays were fabricated. An active border moulding technique was carried out in both maxillary & mandibular arches using a low fusing impression compound (Greenstick compound). Later final impressions (figure 3) by mucostatic technique were made using zinc oxide eugenol impression material. These Impressions were filled with type III Gypsum product to obtain master casts (figure 4). Self-cure acrylic denture bases were fabricated using the sprinkle-on method, and occlusal rims were prepared using modelling wax. Orientation jaw relations were performed using earpiece arbitrary type of face bow (Hanau spring bow) and transferred was to a semi-adjustable articulator (Hanau wide-Vue). Vertical jaw relations were measured using a combination of anatomic, phonetic, and swallowing methods. Bite registration was done by nick & notch method & mounting was done.

The Gothic arch tracings were done to record centric and protrusive movements of the patients (Fig 5). Inter occlusal records (i.e., Centric record-CR, Protrusive record-PR) were made using jet bite occlusal registration Material (Figure 6). These interocclusal records were used for the programming of the articulator (Figure 7). Programming of the articulator was carried out individually for all the patients using the CR and PRs obtained from them. Lateral condylar guidance was calculated using Hanau's formula L= H/8 +12.
Now the tracers were detached, and maxillary & mandibular occlusal rims were reconstructed to their previous original form. Later, teeth arrangements were carried out. To obtain balancing the functional maxillary palatal cusps of posterior teeth were set in the central groove of the mandibular teeth and the maxillary buccal cusps were kept in contact with mandibular buccal cusps. The buccal cusps and palatal cusps were in articulation and functional in the bilateral and protrusive excursions (Figure 8). The try-in of the trial dentures were done and were evaluated for occlusion, aesthetics, and phonetics. After the patient's written approval of the try-in procedure, denture processing was carried out following the conventional method and were lab remounted. Later occlusal corrections were done and were trimmed, finished & polished; followed by denture insertion (Figure 8).

Surgical and prosthodontic protocols:
All the surgical procedures were carried under strict aseptic conditions. Surgery was performed under local anaesthesia. The duplicated denture was used as a radiographic stent (fig 9). Surgical access to the mandible was gained through a mid-crestal incision over the keratinized gingiva with a No.15 B.P. blade. Full-thickness flaps were elevated using a periosteal elevator (fig 10). The osteotomy was carried out following the manufacturer's instructions (fig 11). Starting with a pilot drill of 2mm and sequential drilling under copious irrigation was carried out till the desired dimensions were achieved. Once the osteotomy site was prepared, implants of the selected size were placed using implant drivers and torque wrench (fig 12). The full-thickness flap was closed with 3 -0 silk sutures to achieve primary closure (fig 13). CBCT was taken immediately after surgery to evaluate the placement of implants radiographically and for future reference.

Post surgically, patients have advised medication. After one week, sutures were removed. The patient did not wear the previously constructed, the conventional mandibular denture for the first two weeks. Two weeks after the placement of implants, the impression surface of the denture was relieved at sites corresponding to the implant. The O-ring attachment assembly was placed over the two implants, undercuts blocked out, and auto polymerizing resin was used for direct pickup. The denture was finished, polished, and occlusion was adjusted accordingly.

POSTOPERATIVE RADIOGRAPHIC EVALUATION FOR BOTH

CONTROL AND TEST GROUP PATIENTS FOR BONE LOSS:
Postoperatively, all the patients in the control and test group were radiographically evaluated at baseline, at the time of surgery and six months by CBCT scans.
The CBCT scans were taken for each patient at baseline (fig 18), at the time of surgery (fig 19) and six months (fig 20) are evaluated for the amount of anterior mandibular RRR. The method consisted of measurements taken from the upper border of the anterior crest of the mandible to the lower border of the peak of the mandible regions.

MEASUREMENT OF MUCOSAL THICKNESS:
- Mucosal thickness is assessed using 20 No Endodontic file with a rubber stopper (fig 17). The file was inserted at the predetermined reference point to evaluate the mucosal thickness. The reference points will be taken at the midcrestal point (fig 14) and 5mm below from that point labially (fig 15) and lingually (fig 16) in the mandibular anterior region. The mucosa will be pierced at a 90-degree angle with slight pressure until hard tissue is felt. The distance from the tip of the file and rubber stopper will be recorded using an endo scale at various time intervals, i.e., at baseline, 3 months, 6 months.

CONTROL GROUP

Figure 1: Primary impression

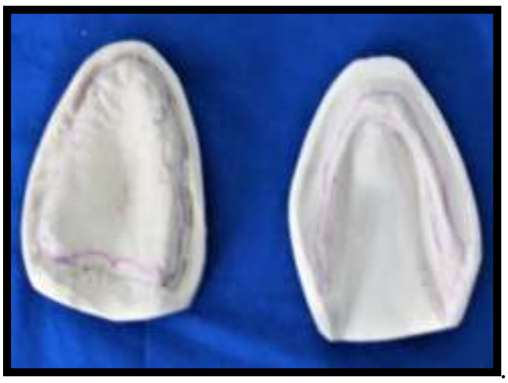


Figure 2: Primary cast

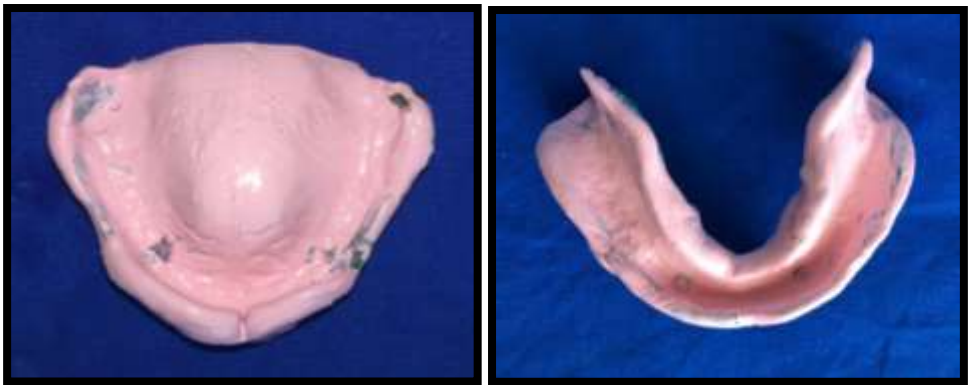


Figure 3: Secondary Impressions

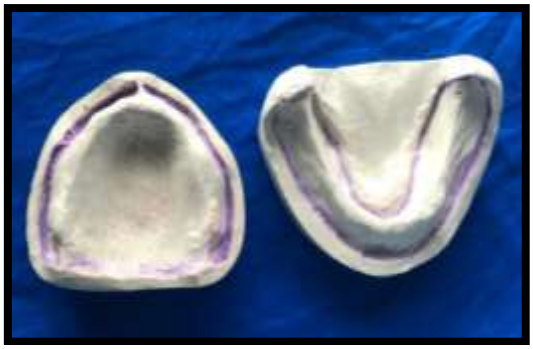


Figure 4: Secondary casts

Figure 5: Extra oral tracings

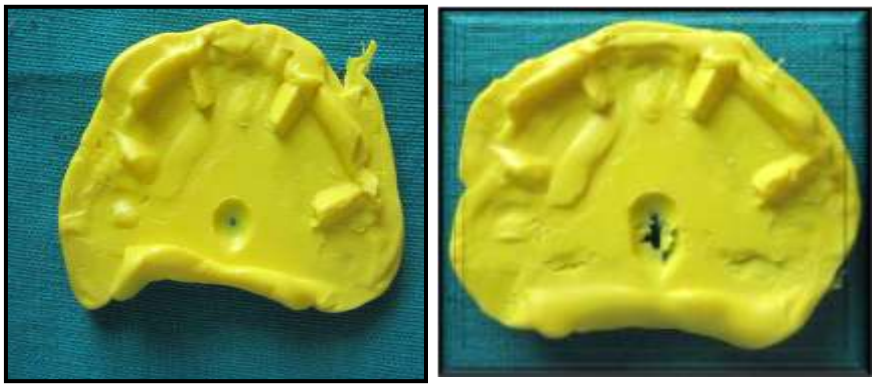


Figure 6: Inter occlusal records

Figure 7: Programming of Articulator

Figure 8: Balancing and CD insertion

Test Group

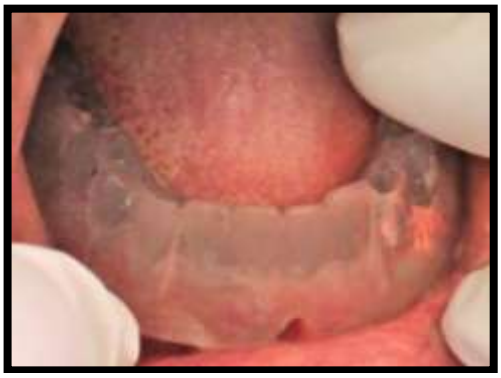


Figure 9: Surgical stent

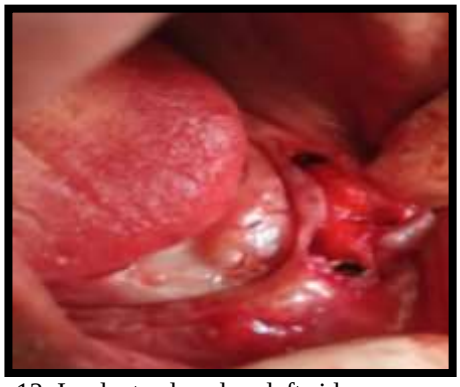


Figure 12: Implants placed on left side

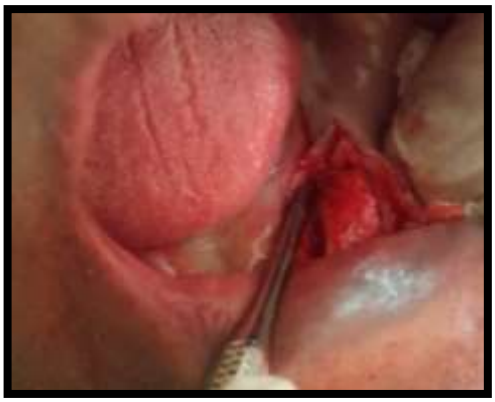


Figure 10: Incision and Flap elevation left side

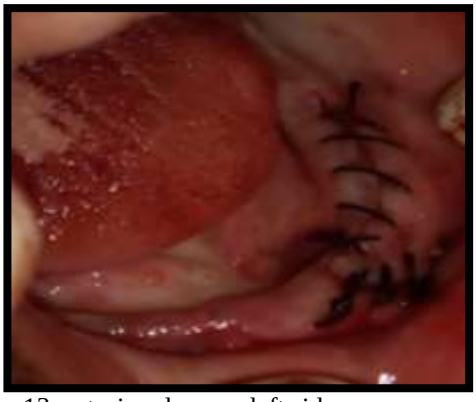


Figure 13: suturing done on left side

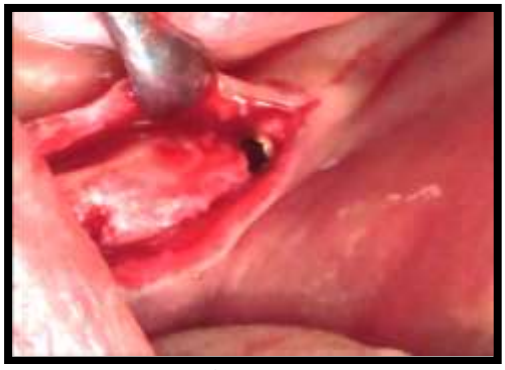


Figure 11: Osteotomy site

Evaluation of mucosal thickness

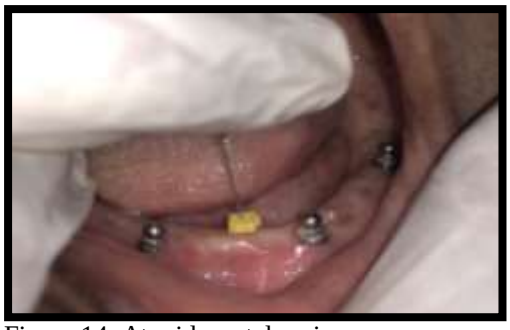


Figure 14: At mid crestal region.

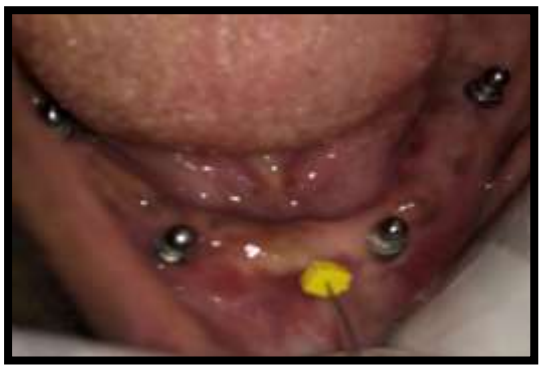


Figure 15: At labial side

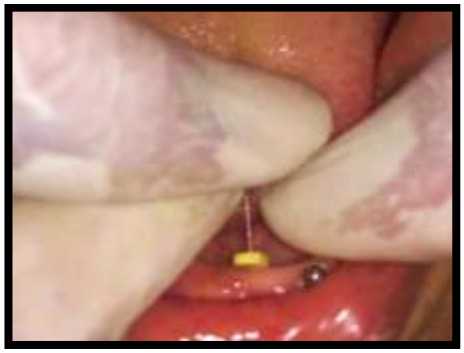


Figure 16: At lingual side

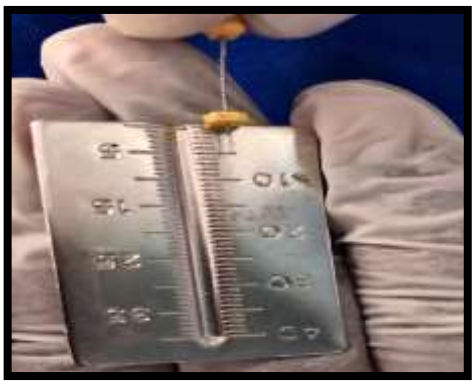


Figure 17: Thickness measurement by endo scale and 20 No endo file

Radiographic analysis

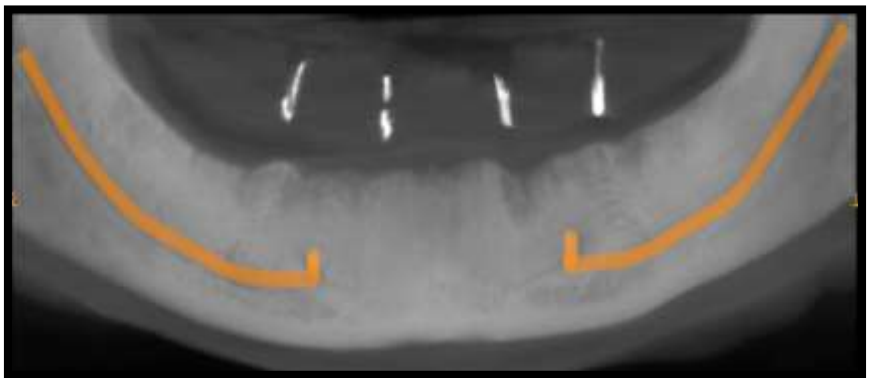


Figure 18: Preoperative CBCT image

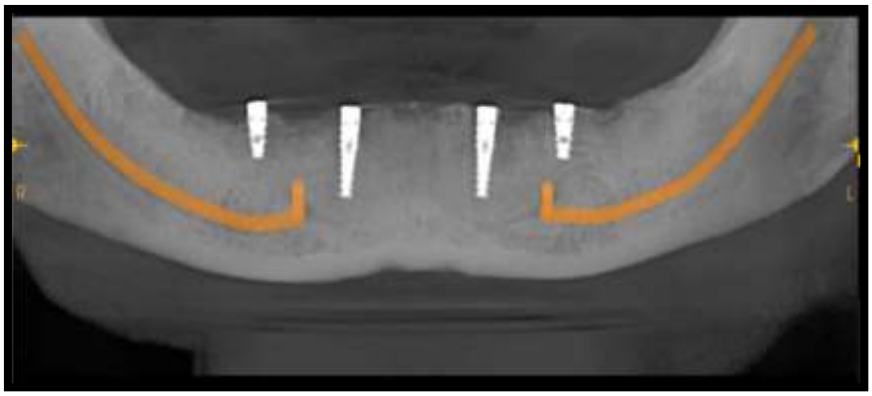


Figure 19: At the time of surgery

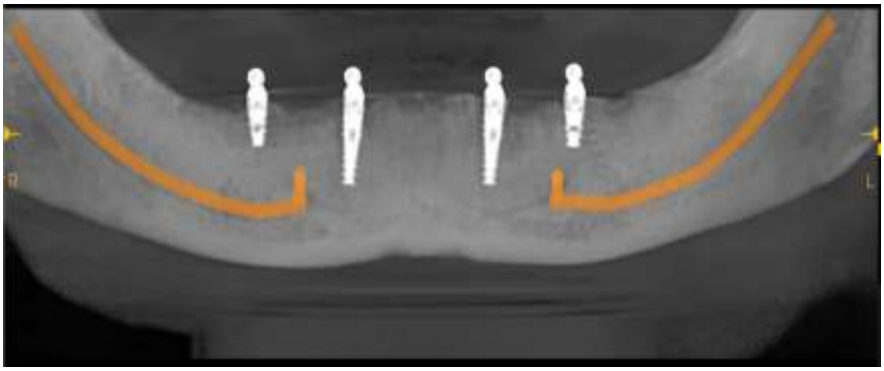


Figure 20: After 6 months

RESULTS:

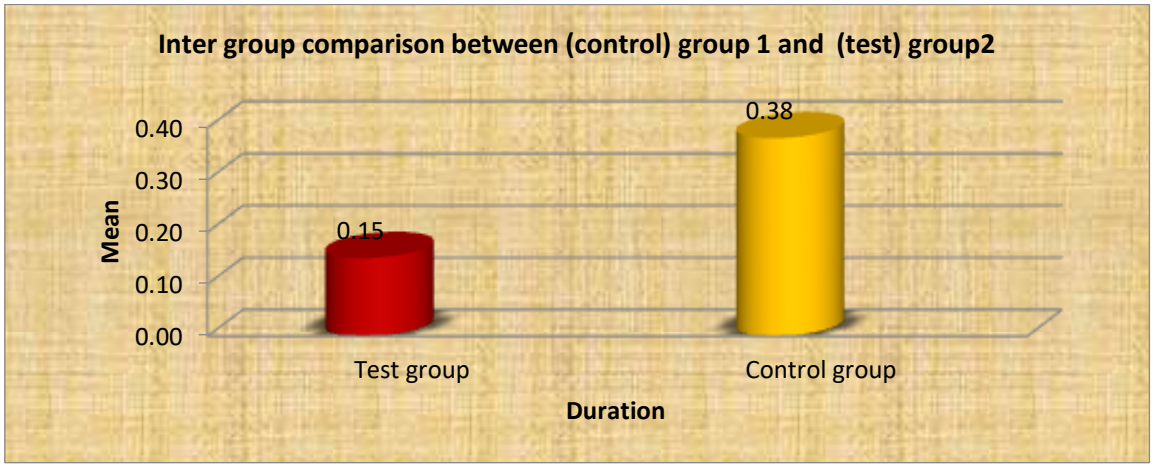
The mean change in ridge resorption from baseline to 6 months in the control group is 0.38 ± 0.01(p-value 0.006). Whereas the mean shift in ridge resorption from baseline to 6 months in the test group was 0.15 ± 0.10(p-value 0.006). The mean change in mucosal thickness from baseline to 6 months in the control group is 0.54 ±0.04(p-value 0.796). Whereas the mean change in mucosal thickness from baseline to 6 months in the test group is 0.44±0.05 (p-value 0.796).

(Control) GROUP1 Vs (test) GROUP 2

Table 1: Inter group comparison between group 2(Test group) and group 1(control group)

Region	Time interval	Group 2		Group1		P value
		Mean±SD difference	% of change	Mean±SD difference	% of change	
33	At baseline to at six months	0.15±0.10	-0.59	0.38±0.01	-1.44	0.006 S

Statistical Analysis: Mann-Whitney U test. Statistically significant if P<0.05

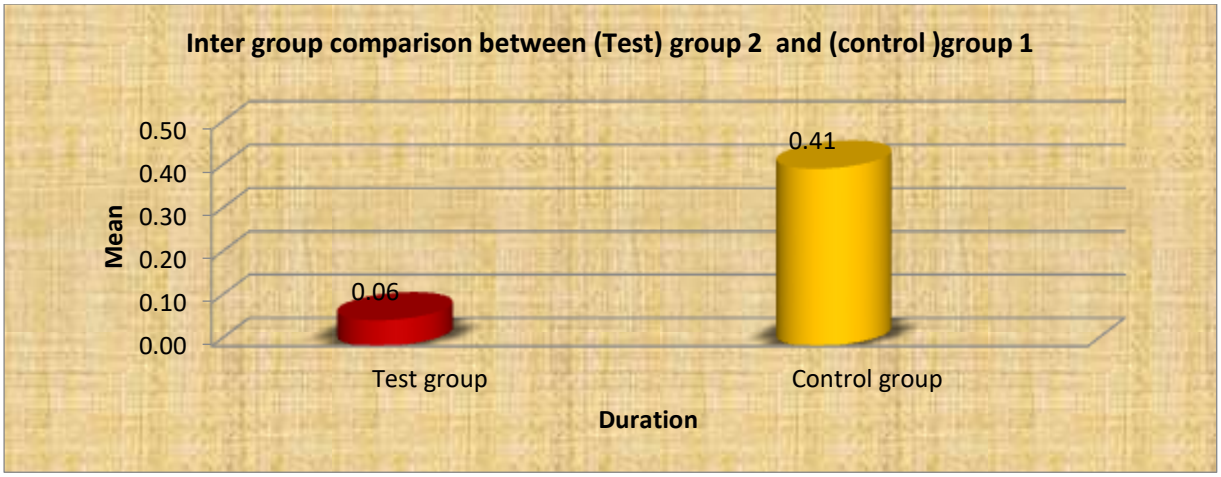


GRAPH 1: **Intergroup comparison between (control) group 1 and (test)group2 for ridge resorption**

Table 2: Inter group comparison between (Test) group 2 and (control) group 1

Region	Time interval	Test group 2		Control group1		P value
		Mean±SD difference	% of change	Mean±SD difference	% of change	
43	At baseline to at six months	0.06±0.01	-0.23	0.41±0.03	-1.54	0.000 S

Statistical Analysis: Mann-Whitney U test. Statistically significant if P<0.05



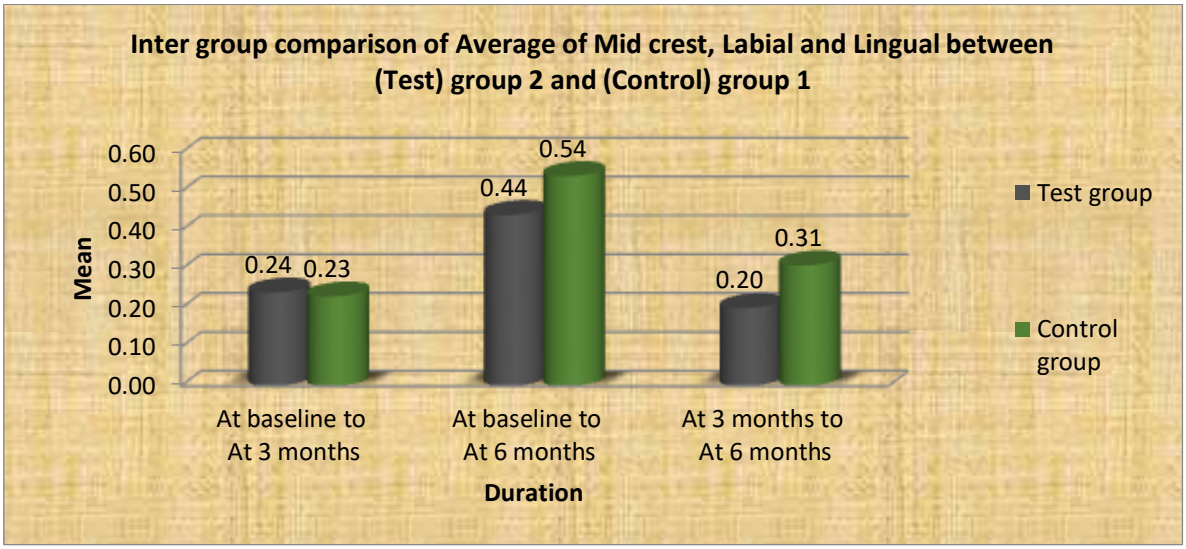
GRAPH 2: **Intergroup comparison between (Test) group 2 and (control) group 1 for ridge resorption**

EVALUATION OF MUCOSAL THICKNESS
(TEST) GROUP 2 Vs. (CONTROL) GROUP 1

Table 3: Intergroup comparison of Average of Mid crest, Labial and Lingual between (test) group 2 and (control) group 1

Duration	(Test) group 2		(Control) group 1		P value
	Mean±SD difference	% of change	Mean±SD difference	% of change	
At baseline to Three months	0.24±0.03	-8.11	0.23±0.01	-6.22	0.579 NS
At baseline to At six months	0.44±0.05	-14.86	0.54±0.04	-14.59	0.796 NS
Three months to at six months	0.20±0.02	7.35	0.31±0.05	-8.93	0.684 NS

Statistical Analysis: Mann-Whitney U test. Statistically significant if P<0.05



GRAPH 3: Intergroup comparison of Average of Mid crest, Labial and Lingual between (Test) group2 and (Control) group 1 for mucosal thickness

DISCUSSION:

Sadowsky (2001)[3] stated that bone in the anterior region, i.e., between two mental foramina, was maintained in implant-supported overdenture. The average annual bony residual ridge height physiological shrinkage was about 0.4mm in the edentulous anterior mandible. Studies had revealed better patient-based results when two implants supported mandibular overdentures have been used compared with conventional lower dentures.

Atwood et al[4] and Tallgren[5] showed an average annual alveolar ridge height reduction of

approximately 0.4 mm in the edentulous anterior mandible resulting from physiologic changes. The anterior mandibular ridge under an implant overdenture may resorb as little as 0.5 mm over five years, and long-term resorption may remain at 0.1 mm annually. Following the above study, the present study also evaluated that the mean bone loss at the mandibular anterior region at baseline, at the time of surgery, and six months in four implants supported mandibular overdenture. Mericske-Stern et al[6] reported 97% implant survival with two implants (splinted or solitary), irrespective of keratinized tissue, or duration of edentulism. In this study also ball type of attachments has been used due to above-said advantages than bar type of attachments. Roynesdal et al. used two titanium-sprayed stable screw implants in the inter foraminal region in a prospective, 24-month study. After three weeks, placement of the overdenture prosthesis to the ball attachments. The implant survival rate was 100%. So, in this present study also, an early loading protocol was followed. Baten burg et al[7] evaluated mandibular overdenture patients treated with two implants and with four implants. They found no significant differences in the peri-implant health. Following the above study, in this study, four implants supported overdenture had given. In vitro and in vivo studies by Menicucci et al[8,9] compared the stresses on the bone surrounding two implants with either a bar clip or ball attachments for overdentures. They found higher stresses on the peri-implant bone with a bar clip attachment. It has been shown that solitary ball attachments are less costly; less technique was sensitive and more comfortable to clean than bars. In this study also solitary ball attachments have been used by the advantages showed by the above studies. Gupta A, Rathee S, Agarwal J, Pachar R[10], conducted a study for the presurgical measurement of crestal bone thickness at various implant sites using CBCT images. So, in this study, also cone-beam computed tomography was used to evaluate the preoperative and postoperative bone heights.

PROSTHODONTIC PROTOCOLS

The patient was suggested not to use the conventional dentures for the first two weeks. Two weeks after the placement of implants, the impression surface of the denture was relieved at sites corresponding to the implant. Impression and transfer of the exact positions of the implants to the working cast should be accurate.

Two techniques are commonly used to incorporate the attachment into the denture base. The direct method allows the housings to be inserted intraorally. The indirect technique accomplishes laboratory processing. Common problems with indirect technique may be possible movement and damage to the attachment during packing procedures. Direct pickup technique for the incorporation of housings for ball attachments was used in this study, as described by Dominici JT et al[11]. The denture was finished, polished, and inserted.

In an in vivo study, Fontijn-Tekamp et al[12] compared a trans mandibular design of four implants and two anteriorly placed endosseous implants. They found that masticatory forces did not differ between the mainly implant-borne and mucosa-implant–borne treatments.

According to the above study, masticatory forces affecting the mucosal thickness in implant-supported overdenture and conventional complete denture has been assessed. There is no significant statistical difference observed in mucosal thickness assessment.

LIMITATIONS:

The present study was conducted on a sample size of twenty patients within the time-lapse of just six months.

- Evaluation of crestal bone loss with only one of the available systems was considered in the present study.
- The results might vary with other implant systems
- Prospective studies on a more extensive group of patients and long-term evaluation required.

CONCLUSION:

- A decreased ridge resorption in the mandibular anterior region in implant-supported overdenture wearers than conventional complete denture wearers over a while.
- So, it can be advised that implant-supported overdenture is an effective treatment modality in the rehabilitation of completely edentulous mandibular arches with improved patient satisfaction, masticatory capacity, and in terms of ridge resorption and retention.
- Whereas, mucosal thickness did not show much significant difference between both the groups.

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