iJRASET
International Journal For Research in Applied Science and Engineering Technology

INTERNATIONAL JOURNAL FOR RESEARCH

IN APPLIED SCIENCE & ENGINEERING TECHNOLOGY

Volume: 11 **Issue:** I **Month of publication:** January 2023

DOI: https://doi.org/10.22214/ijraset.2023.48895

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International Journal for Research in Applied Science & Engineering Technology (IJRASET)
ISSN: 2321-9653; IC Value: 45.98; SJ Impact Factor: 7.538
Volume 11 Issue I Jan 2023- Available at www.ijraset.com

A Randomised Clinical Study of the Effect of a Denture Soft Liner on Mandibular Ridge Resorption in Complete Denture Wearers After One and Two Years Of Denture Insertion

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Abstract: ***Aim: The aim of this study was to assess the effect of soft denture liners on mandibular ridge resorption in complete denture wearers after two years of use.***
Methodology: The study included 32 patients ranging in age from 35 to 65 years old. Those patients were completely edentulous with well formed ridges, Class I relation and no medical problem. Thirty two selected patients were divided into two groups, namely Experimental group and Control group. Control group (n = 16, 8 males and 8 females) received conventional maxillary and mandibular complete dentures. Whereas in Experimental group, (n = 16, 8 males and 8 females) silicone lined lower complete denture were made. Three panoramic radiographs (orthopantomogram [OPG]) were taken for each participant to assess the amount of bone resorption; immediately, one year, and two years after denture insertion. For comparing two groups at three different time intervals, analysis of variance (ANOVA) two way with post-hoc tests was used. A statistically significant p-value of less than 0.05 was considered.
Results: After denture delivery, there was significant change in bone height in all patients (p < 0.001) . The comparison of bone height between the two groups in different regions at different time intervals revealed a significant difference in bone levels at baseline to one year and baseline to two years. However, Experimental group experienced 50% less bone loss than control group over a two-year period.
Conclusion: Based on the findings of the current study, it can be inferred that use of soft liners helps in reducing residual ridge resorption significantly when compared with conventional denture material.
Keywords: Resorption, Denture Liner, Orthopantomogram, Complete Denture

I. INTRODUCTION

Because of increased life expectancy, the use of conventional complete dentures by edentulous patients is expected to increase over the next two decades[1]. The relationship of the dentures to the supporting and limiting anatomical structures is critical to the successful rehabilitation of an edentulous patient[2]. The underlying bone is critical in providing support for the dentures[3]. The health of the residual ridge is affected by a variety of local and systemic conditions, which can jeopardise bone quality and, as a result, the prognosis of prosthodontic treatment[2].

Residual ridge resorption (RRR) is a progressive, unavoidable, multifactorial, and biomechanical disease caused by a combination of anatomical, functional, metabolic, and prosthetic factors. Even the best-made dentures become loose over time as a result of RRR, necessitating a reline or remake of the prosthesis[3]. Tallgren, Atwood, and Coy discovered that the average anterior maxillary to anterior mandibular ratio (residual ridge reduction) was 1:4[4,5]. The mandibular ridge bears higher functional forces transmitted through the dentures than the maxillary ridge and hence experiences the most bone loss [6]. RRR causes a reduction in the size of the denture-bearing area, which causes issues with denture retention and stability. Fibrous tissue may occasionally replace alveolar bone, causing dentures to become displaced during function. The mucosa that covers these areas is thin, friable, and incapable of withstanding functional stress.

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Pain and ulceration in these areas may also occur as a complication[7]. As a result, these patients receive prosthesis with compromised retention and support, resulting in denture failure despite the dentist's best efforts[8]. The difficulties experienced by such patients during function can be reduced by using implants[9].

Despite being reported as highly effective, not all edentulous people can benefit from implants, due to unfavourable underlying bone, financial problems, medical and psychological constraints[10]. Treatment with resilient denture liners, on the other hand, has few limitations due to low treatment cost and non-invasive procedure[11].

The denture liner materials' resilient nature, and shock absorbency aid in impact reduction and masticatory load distribution to the ridge[12]. As per literature, the bolstering impact of soft liners limits forces to the basal bone than one without soft liners[13]. As a result, residual ridge resorption is reduced[14].

The literature on the effect of resilient liners on residual ridge resorption in complete denture wearers is currently minimal. As a result, the purpose of this study was to assess the effect of soft denture liners on mandibular ridge resorption in complete denture wearers after two years of use.

II. METHODOLOGY

Patients at Srinagar's Government Dental College were recruited for the study. The study included 32 patients ranging in age from 35 to 65 years old. The patients were evaluated for the effect of soft liner on mandibular ridge resorption after one and two years of denture insertion.

Written informed consent was obtained after participants received complete information about the procedure, including the necessity of follow-up visits and radiographs. To be eligible for the study, participants had to be edentulous in both jaws and willing to receive a new set of complete dentures, have class I jaw relation, well developed ridges with firm mucosa, and have no previous denture experience. Patients with type 2 diabetes, osteoporosis, or a history of mandibular surgery, as well as those with other than class I jaw relationship, were excluded.

Thirty two selected patients were divided into two groups, namely experimental group and control group. Control group (n = 16, 8 males and 8 females) received conventional maxillary and mandibular complete dentures. Whereas in experimental group (n = 16, 8 males and 8 females) silicone lined lower complete denture were made. Complete dentures (maxillary and mandibular) were made for all patients according to Boucher's standardised protocol. All participants were given a bilateral balanced occlusal scheme. After dewaxing, radiopaque markers were placed over the tooth surfaces of mandibular dentures at three different points (one in the central incisor region and one in the first molar regions on both sides) and glued in place. The mould was then filled with heat-cured acrylic resin. However, during packing, maxillary dentures in the experimental group were fabricated in heat cured acrylic resin, while mandibular dentures were lined with heat cured silicone based denture soft liner.

For each participant, orthopantomograms [OPG]) were taken at three time points: immediately after denture insertion, one year later, and two years later. To ensure reproducibility between subsequent films, all radiographs were taken using the same OPG machine by a trained radiographer.

For the measurements, a reference plane was drawn along the mandibular inferior border. Three perpendicular lines were made from the lower border of mandible to the radiopaque markers: one in midline and other two at molar region of two quadrants. Distances were measured using Adobe Photoshop. To reduce operator based bias and error, all measurements were performed by independent and blinded examiners. When different values were found, measurements were double-checked.

The collected data was compiled and entered into a spreadsheet (Microsoft Excel) before being exported to the SPSS data editor version 20.0. Mean & SD was used to measure quantitative variables. For comparing two groups at three different time intervals, analysis of variance (ANOVA) two way with post-hoc tests was used. A statistically significant p-value of less than 0.05 was considered.

III. RESULTS

The mean change in bone height in right posterior, anterior and left posterior region in control group from baseline to 2 years was 5.65 ± 2.75 mm , 5.76 ± 3.16 mm , and 5.9 ± 3.26 mm respectively and in experimental group, this was 2.86 ± 0.58 mm, 2.8 ± 0.54 mm and 3.01 ± 0.62 mm, respectively (Table). In both groups, the results showed a decrease in bone height at three time intervals. The comparison of bone height between the two groups in different regions at different time intervals revealed a significant difference in bone levels from baseline to one year and baseline to two years.

Comparison of mean bone loss (mm) at different regions in between Control Group (conventional) and experimental Group (silicone based liner) at a different time interval

Areas	Time Interval	Control Group (Mean±SD)	Experimental Group (Mean±SD)	P-value
Right Molar Region	Baseline-1year	2.79±1.64	1.42±0.42	<0.001
	1year-2year	2.86±1.72	1.44±0.72	<0.001
	Baseline-2year	5.65±2.75	2.86±0.58	<0.001
Incisor Region	Baseline-1year	2.82±2.25	1.39±0.61	<0.004
	1year-2year	2.94±1.71	1.41±0.42	<0.001
	Baseline-2year	5.76±3.16	2.80±0.54	<0.001
Left Molar Posterior	Baseline-1year	2.79±1.97	1.52±0.46	<0.001
	1year-2year	3.11±1.72	1.49±0.52	<0.005
	Baseline-2year	5.90±3.26	3.01±0.62	<0.001

IV. DISCUSSION

The study aimed to compare residual ridge resorption in edentulous subjects rehabilitated with complete dentures with and without soft denture liner. Subjects were selected with similar attitudes toward denture treatment (MM House classification), degree of RRR, ridge relation with no previous denture experience to standardise treatment outcomes and eliminate confounding factors[7,8]. Matched for age, gender, and general morphology within the two groups for the same reasons[7,8].

Various radiographic techniques, such as lateral cephalometric and panoramic radiographs, have been used to estimate residual ridge resorption. An orthopantomogram was used to assess mandibular alveolar bone loss in this study because an image of both jaws can be produced quickly and conveniently on a single film with relatively less radiation exposure[16,17,18]. One of the most serious issues with panoramic radiography is magnification. Larheim[19] and Svanaes stated that he variability of vertical measurements obtained from repeated panoramic radiographs is minimal when patients are positioned correctly in the panoramic apparatus. CT scans of the jaw would have been the most accurate option, but we went with the most cost-effective option[19]. A reference line was drawn along the inferior border of the mandible in the current study. Vertical lines were drawn from this line to the lower border of the radiopaque markers in three different regions.

Laboratory-processed silicone-based denture soft liner were used in the current study. The soft-liner material thickness was kept at 2 mm because a thickness of 2.5 mm resulted in a slightly higher level of stress. The above could be explained by the instability of the prosthesis over the reliner material above a certain height, which is consistent with data presented by Lima et al[20].

Bone resorption was recorded in anterior as well as in posterior region of the mandible in the current study. As per Enlow et al[21], resorption of residual ridge is faster in the premolar and molar regions of the mandible than in the anterior region due to the lower position of the reversal line in the posterior region. As a result, it is critical to document resorption in the anterior as well as posterior regions of the mandible.

The findings of this study revealed a statistically significant rate of RRR in all participants at three reference points of measurement in the mandible. Over a two-year period, participants in the experimental group experienced 50% less bone loss in all three regions than those in the control group. After one year, bone loss in the experimental group ranged from 1.42 to 1.52 mm, while it ranged from 2.79 to 2.82 mm in the control group.

Elcharkawi and ElMahdy[14] obtained similar results when comparing bone loss in the mandible after 6 months of denture delivery with and without soft liners. Babu et al[22] obtained similar results when comparing bone loss in the mandible after 6 and 12 months of denture insertion with and without soft liners. However, these studies were only conducted for a maximum of one year, whereas the current study was extended for two years. Furthermore, in the aforementioned studies, acrylic-based liners were used, which are not capable of retaining their desired properties for extended periods of time and are considered to be less durable, and thus these studies were conducted for a shorter time period. Two year time period showed mean bone loss in the range of 5.65 to 5.9 mm in control group and 2.8to 3.08 mm for experimental group.

In contrast to this study, Al-Noori and Said discovered no significant difference in bone resorption in complete denture patients with and without soft liner[23]. The reason can be different study design. In the present study only silicone based denture liner were compared. Further research with a larger sample size and comparisons with other relining materials may be conducted.

V. CONCLUSION

Silicone-based resilient lining materials have the advantage of staying soft over time. The use of the resilient reliner material reduced stress in the alveolar bone and mucosa, resulting in lower ridge resorption.

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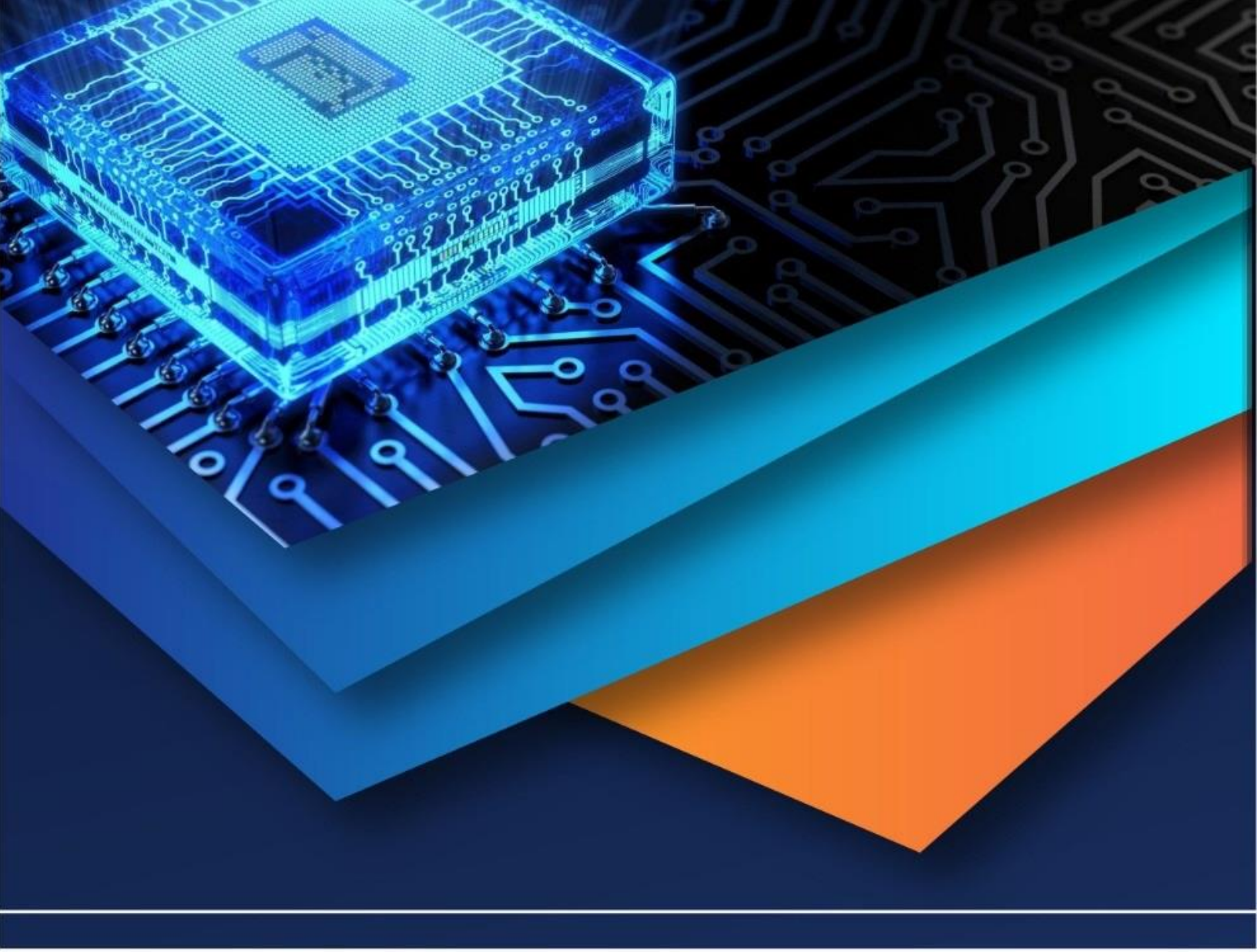

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