MedRead Journal of Dental Science

Research Article

Effect of Modified Spacer Design on Residual Ridge Resorption Rate in Low Bmd Male Patients: A Long Term Prospective Study

Praveen Rai[1*], Ashutosh Gupta[3], Arvind Tripathi[2], Ritika Sharma[4], Vijay Yadav[1]

[1]*Senior Lecturer, Department of Prosthodontics, Saraswati Dental College, Lucknow, India*

[2]*Professor and Head, Department of Prosthodontics, Saraswati Dental College, Lucknow, India*

[3]*Reader, Department of Prosthodontics, Saraswati Dental College, Lucknow, India*

[4]*Lecturer, Department of Prosthodontics, Saraswati Dental College, Lucknow, India*

***Corresponding author:** Praveen Rai, Senior Lecturer, Department of Prosthodontics, Saraswati Dental College, Lucknow*

***Received:** April 04, 2020*

***Accepted:** June 02, 2020*

***Published**: June 11, 2020*

Abstract

Purpose: The purpose of this study was to modify denture fabrication technique according to residual ridge quality, in an attempt to retard residual ridge resorption (RRR).

Methods: Forty eight (48) edentulous patients were selected. All subjects taken up for the study were subjected to pre treatment bone mineral density assessment and panoramic radiograph. Based on this assessment the patients were divided into two groups - 1and 2. In each group the patients were randomly divided equally into two subgroups. For one subgroup, dentures were fabricated using the Standard Spacer Design (SSD). For the other subgroup, Modified Spacer Design (MSD) was used. Postoperative radiograph was done after 28 months of denture use.

Results: In all the study groups i.e 1and 2 mean reduction in bone height and width was higher in SSD subgroup as compared to the MSD subgroup.

Conclusion: The results of the study clearly indicate that dentures made with conventional standard impression procedure cumulate the restorative process and enhance residual alveolar ridge resorption.

Keywords: Alveolar Bone Resorption; Osteoporosis; Bone Mineral Density; Selective Pressure Technique

Introduction

Most individuals seeking prosthodontic rehabilitation, especially those requiring complete dentures are aged above 50 years [1-3]. There is conclusive evidence of decline in Bone Mineral Density (BMD) with ageing [4]. Altered hormonal status, gender, vitamin metabolism, systemic disorders, pathological and congenital conditions play an important role in determining the quality of alveolar ridge [5].

Complete dentures transfer functional loads directly onto the residual alveolar bone causing resorption [6]. Complete denture patients often suffer from osteopenia or osteoporosis, which can accelerate RRR [7]. One method to reduce RRR is selective pressure technique advocated by Carl O Boucher [8]. This technique involves a combination of principles of both pressure and minimal pressure technique, thereby loading the areas which can withstand functional forces and relieving those which cannot.

The present study was planned to compare the effect of modified and standard spacer design on residual ridge resorption in low BMD male patients.

Materials and Method

This prospective study was confined to 48 male patients who fulfilled the inclusion criteria. The inclusion and exclusion criteria of the subjects were established by means of history, clinical examination and consultation with the physician.

Inclusion criteria:

- Only male subjects were taken up for the study to exclude the possible variation due to menopausal factors in female subjects.
- Mean age group 60 ± 10 years

Exclusion criteria:

- Subjects with a history of /or undergoing treatment for endocrine, metabolic or skeletal disorders, smoking or alcohol intake [9].
- All patients included in the study had been edentulous for more than 1 year. This criterion was used to preclude the

Citation: Praveen Rai, Tripathi A, Gupta A, Sharma R and Yadav V. Effect of Modified Spacer Design on Residual Ridge Resorption Rate in Low Bmd Male Patients: A Long Term Prospective Study. MedRead J Dent Sci. 2020; 1(1): 1002.

effect of time dependent RRR.

All the subjects were informed and the study was approved by the institutional human ethical committee.

Study Design

All subjects taken up for the study were subjected to pre treatment bone mineral density assessment (DEXA scan) and panoramic radiograph. Based on this assessment the patients were divided into two groups - 1 and 2.

- Group1 (Normal) : comprised of edentulous subjects with BMD values greater than -1 T score termed as having normal bone mineral density (n=18)
- Group 2 (Osteoporotic) : edentulous subjects having BMD values less than -2.5 T score (n = 14) [10].

In each group the patients were randomly divided equally into two subgroups. For one subgroup, dentures were fabricated using the standard spacer design (SSD). For the other subgroup , modified spacer design (MSD) was used. Postoperative panoramic radiographh was done after 28 months of denture use.

Standard spacer design (bouchewwr's technique)[11]

The primary impressions of maxillary and mandibular residual ridges were made with impression compound. The casts were prepared in type II gypsum. A 1mm thick baseplate wax (DPI, India) was applied on the case except over the posterior palatal seal area. Custom tray was fabricated for the functional border molding of the denture bearing area. After border molding was completed, the spacer was removed and the final impression was taken with light body vinyl polysiloxane (Coltene Whaledent, Switzerland). The final casts were prepared in type III gypsum.

Modified spacer design [12]

The primary impressions of maxillary and mandibular residual ridges were made with impression compound (Pinnacle, DPI, India). The casts were prepared in type II gypsum. A thin sheet of wax (0.4mm) was adapted in all areas except for the posterior palatal seal area. A 1.5mm modelling wax (DPI, India) was adapted on the top of the already adapted wax sheet. Remove the modelling wax in the region of crest of the alveolar ridge and horizontal plates of the palate, as these are the stress bearing area. Custom tray was fabricated for the functional border molding of the denture bearing area. After border molding was completed, the spacer was removed and the final impression was taken with light body vinyl polysiloxane (Coltene Whaledent, Switzerland). The final casts were prepared in type III gypsum.

High resolution panoramic radiographs of maxilla were made. Alveolar bone height was assessed pre and post restoration at 5 different locations i.e molar and canine region bilaterally and incisor region using technique describe by Ural et al [21]. The values were compiled, and evaluated for the 2 subgroups in each group and compared post rehabilitation.

The data thus obtained, was analyzed using Statistical Package for Social Sciences (SPSS) version 15.0. Independent t test is done for comparison of SSD and MSD in normal and osteoportic group separately.

Results

Values of bone measurements at five different locations (A, B, C, D, E) on maxillary panoramic radiograph for normal and osteoporotic bone are given in Table 1 and 2).

Table 1: Bone measurements for normal patients.

		Impression procedure	N	Mean	Std. Deviation	t	df	P VALUE
A	preoperative Bone measurement (in mm)	MSD	3	10.6	1.389244	0.728	4	0.507
		SSD	3	9.766667	1.415392			
	Post operative Bone measurement (in mm)	MSD	3	10.46667	1.28582	0.938	4	0.402
		SSD	3	9.4	1.493319			
	DIFFERENCE IN BONE HEIGHT	MSD	3	0.133333	0.152753	-1.565	4	0.193
		SSD	3	0.366667	0.208167			
B	preoperative Bone measurement (in mm)	MSD	3	13.2	1.345362	0.221	4	0.836
		SSD	3	12.93333	1.604161			
	Post operative Bone measurement (in mm)	MSD	3	12.96667	1.361372	0.265	4	0.804
		SSD	3	12.63333	1.703917			
	DIFFERENCE IN BONE HEIGHT	MSD	3	0.233333	0.057735	-1	4	0.374
		SSD	3	0.3	0.1			
C	preoperative Bone measurement (in mm)	MSD	3	12.8	1.276715	0.599	4	0.582
		SSD	3	12.1	1.571623			
	Post operative Bone measurement (in mm)	MSD	3	12.6	1.276715	0.728	4	0.507
		SSD	3	11.73333	1.619671			
	DIFFERENCE IN BONE HEIGHT	MSD	3	0.2	0	-2.5	2	0.13
		SSD	3	0.366667	0.11547			
D	preoperative Bone measurement (in mm)	MSD	3	18.33333	4.854208	0.726	4	0.508
		SSD	3	14.1	8.860587			
	Post operative Bone measurement (in mm)	MSD	3	18.1	4.950758	0.743	4	0.499
		SSD	3	13.76667	8.809275			
	DIFFERENCE IN BONE HEIGHT	MSD	3	0.233333	0.152753	-1.061	4	0.349
		SSD	3	0.333333	0.057735			
E	preoperative Bone measurement (in mm)	MSD	3	13.33333	4.104063	0.726	4	0.508
		SSD	3	10.2	6.2522			
	Post operative Bone measurement (in mm)	MSD	3	13.03333	4.202777	0.75	4	0.495
		SSD	3	9.766667	6.262853			
	DIFFERENCE IN BONE HEIGHT	MSD	3	0.3	0.1	-2	4	0.116
		SSD	3	0.433333	0.057735			

Table 2: Bone measurements for osteoporotic patients.

		Impression procedure	N	Mean	Std. Deviation	t	df	P VALUE
A	preoperative Bone measurement (in mm)	SSD	3	4.266667	0.665833	1.544	4	0.197
		MSD	3	3.566667	0.416333			
	Post operative Bone measurement (in mm)	SSD	3	3.266667	0.378594	0	4	1
		MSD	3	3.266667	0.493288			
	DIFFERENCE IN BONE HEIGHT	SSD	3	1	0.3	3.834	4	<0.05
		MSD	3	0.3	0.1			
B	preoperative Bone measurement (in mm)	SSD	3	11.16667	0.288675	-0.448	4	0.677
		MSD	3	11.4	0.8544			
	Post operative Bone measurement (in mm)	SSD	3	10.53333	0.416333	-0.17	4	0.873
		MSD	3	10.63333	0.929157			
	DIFFERENCE IN BONE HEIGHT	SSD	3	0.633333	0.568624	-0.315	4	0.768
		MSD	3	0.766667	0.46188			
C	preoperative Bone measurement (in mm)	SSD	3	9.633333	2.753785	-1.61	2.128	0.241
		MSD	3	12.23333	0.493288			
	Post operative Bone measurement (in mm)	SSD	3	8.966667	2.540341	-1.751	2.101	0.216
		MSD	3	11.56667	0.404145			
	DIFFERENCE IN BONE HEIGHT	SSD	3	0.666667	0.321455	0	4	1
		MSD	3	0.666667	0.152753			
D	preoperative Bone measurement (in mm)	SSD	3	3.266667	0.650641	0	4	1
		MSD	3	3.266667	0.776745			
	Post operative Bone measurement (in mm)	SSD	3	2.7	0.360555	-0.463	4	0.667
		MSD	3	2.9	0.655744			
	DIFFERENCE IN BONE HEIGHT	SSD	3	0.566667	0.305505	1.014	4	<0.05
		MSD	3	0.366667	0.152753			
E	preoperative Bone measurement (in mm)	SSD	3	4.133333	0.351189	-1.233	4	0.285
		MSD	3	5.1	1.311488			
	Post operative Bone measurement (in mm)	SSD	3	3.1	0.87178	-1.598	4	0.185
		MSD	3	4.666667	1.457166			
	DIFFERENCE IN BONE HEIGHT	SSD	3	1.033333	0.602771	1.591	4	<0.05
		MSD	3	0.433333	0.251661			

For normal patients (Figure 1) at all locations (A,B,C,D,E), comparison of the difference in bone height between the two groups showed that difference in bone height was higher in SSD group as compared to MSD group. This difference is statistically insignificant showing very small changes following modified spacer use in normal BMD patients.

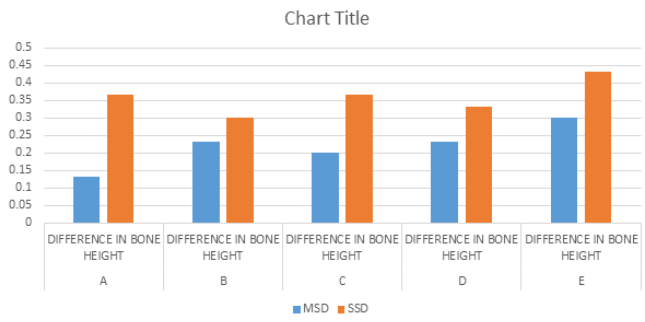

Figure 1: Difference in bone height for normal patients.

For osteoporotic patients (Figure 2), comparison of the difference in bone height between the two groups showed that difference in bone height was higher in SSD group at location A, D and E. At location B, difference in bone height is higher in MSD group with a t value of -0.315 and is statistically non significant with a p value of 0.768. No change in difference in bone height was observed at location C.

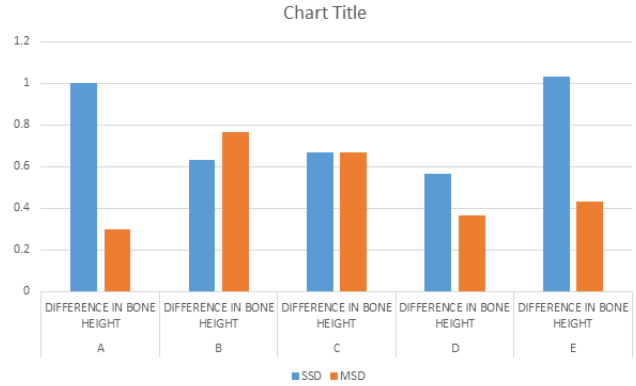

Figure 2: Difference in bone height for osteoporotic patients.

Discussion

Oral and facial musculature during functional jaw movements such as mastication, swallowing, produce forces on the occlusal surface of artificial teeth, which is transmitted via the denture base to the underlying residual ridge [13-15]. Complete dentures which are primarily 'tissue-borne' transmit the stress through the mucosa directly to the residual ridge, making it the primary stress bearing area. The inherent capacity of the bone to bear these transmitted stresses depends on the quality of the bone, which is different in different part of the jaws hence 5 different locations were chosen namely the molar and canine region bilaterally and the incisor region in maxillary alveolar ridges. Alveolar bone height was calculated with the help of panoramic CT scans at these locations before and after 28 months of denture use fabricated with standard spacer design and modified spacer design in normal and osteoporotic bone.

There has been a considerable disagreement regarding the placement of pressures, relief, and post dams in maxillary impressions [16]. The crest of the upper ridge is considered as a stress bearing area as it is covered with fibrous connective tissue, which is closely attached to the bone. The median suture where the two maxillary bones join together is covered with mucous membrane and very little submucosal tissue. Hence, they should be relieved of pressure. All these considerations are required in a selective pressure technique [8]. However due to movement of denture under function, entire denture bearing area is

under tensile and shear stress despite of selective loading. To overcome this effect a combination of minimal pressure and selective pressure technque was applied in present study. A full spacer would record tissue with minimal displacement and partial spacer over full spacer would provide selective pressure.

The results of the study clearly indicate that dentures made with standard spacer design cumulate the resorptive process and increases the residual alveolar ridge resorption in osteoporotic bone. However, no significant changes in difference in bone height at different locations was observed in normal bone indicating that the new spacer design is helpful in osteoporotic bone.

As seen in literature [17-19], it has been repeatedly said that the pressure exerted by the denture should be in accordance with the underlying tissues for the maximum preservation of tissues, leading to the development of various methods to selectively minimize pressure on tissues. A study by chopra et al. [20] showed that selectively loading of the maxillary denture base area significantly reduces the pressure generated at that area. In almost all these studies, emphasis was on recording the pressure generated either with different spacer design or with different impression material used for taking impression but none study provides data on residual ridge resorption rate.

The major limitation of the present study was resorption rate at different location was not compared statistically that might had provided useful data on stress generated at different parts of oral cavity during denture function.

Conclusion

Within the limits of present study, complete dentures made with modified spacer design reduces residual alveolar ridge resorption in osteoporotic bone although further study on this topic is warranted.

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