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DIFFERENT TREATMENT MODALITIES IN FREE END SADDLE CASES

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ABSTRACT

Objectives: The raised purpose of this study was to introduce a hybrid partial denture design that combines metal framework with low stiffness polyacetal resin clasp and denture base and to clinically examine its effect on bone height of distal aspect of the ridge and crestal bone height surrounding the principal abutment in comparison to traditional metal framework I-bar partial denture in unilateral distal extension cases.

Methods: Twenty male partially edentulous patients having Kennedy class II in lower arch and intact maxillary arch were selected and divided into two groups. Group I received traditional metal framework I-bar partial denture. Group II received metal framework major connector with low stiffness polyacetal resin clasp and denture base. Bone height changes in distal aspect of the ridge and crestal bone height changes surrounding the principal abutment were measured using a special soft wear of Digora system at insertion, six, twelve and eighteen months after insertion and results were statistically analyzed (Student-t-test, $p \leq 0.05$).

Results: The two groups showed bone resorption in distal aspect of the ridge however, statistically significant difference between the two groups was found in favor of hybrid partial denture design. Mesial and distal crestal bone height reduction occurred with statistically non-significant difference between the two groups.

Conclusion: The hybrid partial denture with low stiffness polyacetal resin clasp and denture base is a good alternative with patients suffering from compromised bony conditions or when esthetics is of primary concern.

KEY WORDS: Unilateral distal extension base, low stiffness polyacetal resin.

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INTRODUCTION

The design of distal extension removable partial dentures that will preserve the abutment teeth, hard and soft tissues of the edentulous ridge has taxed the ingenuity of dentists for years especially in patients with compromised bony conditions. [1-4] These dentures drive their support from the relatively stable supporting abutment tooth or teeth and the resilient soft tissues overlying the residual edentulous ridge. These two tissues exhibit different degrees of displaceability. The resiliency of the mucoperiostium is twenty five times greater than that of periodontal membrane of the abutment teeth, thus the distribution of the load would not be equal as the compressibility coefficiants are different. [5,6]

The forces, which produce torque on the abutment teeth and residual alveolar ridge should be controlled and minimized in the design of distal extension removable partial dentures. Physiologic adaptation of the denture base to the tissues as well as maximum coverage within the physiologic tolerance of the lining border structures aid in load reduction.[6] However, the problem with the conventional denture is that on its tissue surface, the denture is rigid leading to uneven distribution of load. This drawback even worsens in the case of flabby, atrophic and unemployed ridges with excessive bone resorption. Various methods and materials have been used to give a cushioning effect to the tissues. Parker [7], and El Charkawi et. al. [8] applied resilient liner sandwiched between the two hard denture resin bases to act as a shock absorber and distribute the occlusal load, thus decreasing the transmitted force to the alveolar ridge.

Recently flexible resin has been used in the fabrication of partial dentures. The flexibility of the resin achieves the effect of a stress-breaker without attachments. The gingiva is gently stimulated under mastication, and unnatural stresses on the remaining teeth are substantially reduced. In addition the flexible resin offers comfort, esthetics, function, bio-compatibility and unique physical properties. It can be built quite thin yielding more sensation, it is nearly unbreakable, lightweight, resilient, colored pink like the gums and can form not only the denture base, but the clasps as well. Since the clasps are built to curl around the necks of the teeth, they are practically indistinguishable from the gums that normally surround the teeth. [9-12] However, the main disadvantage of all-flexible acrylic partial denture is lack of support which limits its use as long term prosthesis. [13-15]

A good alternative to the all-flexible partial denture is the hybrid design that combines a metal framework with low stiffness polyacetal resin clasp and denture base. It has the advantage of being tooth supported with enhanced support and stability of the metal rest, in addition to the advantages of the flexible resin. The flexibility of the resin allows the design to take full advantage of available undercuts, especially recessed areas of supporting alveolar contours. The resin passes over high points and protuberances easily, relaxing into the natural undercut to provide retention without pressure at the contact point.[16] Further more the flexibility of resin clasps allows its placement in deeper undercuts on abutments which makes it suitable for use when esthetics or periodontal health is of primary concern. [17,18] Under mastication, the flexibility of the material absorbs a portion of the shock of movement, and the gentle movement of the base creates a slight massaging effect over the residual alveolar ridge. This produces a stimulation that has been shown to retard the deterioration of natural tissue and bone. Also, because the dimensions of residual alveolar ridge are not stable due to bone resorption, mucosal changes and tissue irritation, an ideal denture should be flexible and continuously adapt itself to the mucosa, yet it has to be rigid to support the teeth during actual use. These properties are difficult to be combined in one material, but can be done by using a combination of materials and techniques. [15]

The raised purpose of this study was to introduce a hybrid partial denture design that combines a metal framework with low stiffness polyacetal resin clasp and denture base and to clinically examine its effect on bone height of distal aspect of the ridge and crestal bone height surrounding the principal abutment in comparison to traditional metal framework I-bar partial denture in unilateral distal extension cases.

MATERIALS AND METHODS

Twenty male partially edentulous patients were selected from the prosthodontic clinic of Faculty of Dentistry, Misr University for Science and Technology with age ranging from 30-45 years. The patients had intact maxillary arch and mandibular unilateral distal extension ridge (Kennedy's class II) with missing lower second and first molar and second premolar. The edentulous ridge was in normal morphological shape and had a firm mucosa. The remaining natural teeth had sufficient bony support and were free from periodontal diseases as determined by radiographic examination. As a routine work in this study, before starting prosthetic treatment, the following was performed:

- For all patients, periodontal therapy was accomplished. This included proper scaling (sub-and supra gingival root planning and pocket eradication).
- The patients were instructed to follow proper oral hygiene instructions, including tooth bushing, inter-dental stimulation and antiseptic mouth wash.
- Carious teeth were restored with a suitable filling material.

The selected patients were randomly classified into two equal groups according to the planned partial denture design:

Group I: In this group ten patients received traditional cobalt- chromium metal framework I-bar partial denture. (Fig. 1a,b)

Group II: In this group ten patients received a hybrid partial denture design that combines a cobalt-chromium metal framework with low stiffness polyacetal resin(Valplast; Valplast Intl Corp, Long Island City, NY, USA) clasp and denture base. (Fig. 2a,b)

Fig.(1a) Metallic framework of traditional I-bar partial denture

Fig. (1b) Traditional I-bar partial denture

Fig. (2a) Metallic framework of hybrid partial denture

Fig. (2b) Hybrid partial denture

Procedures for both groups

Alginate impressions (Alginmax, Major Prodotti. Dentari S. P. A. Moncalieri. Italy) for both arches were made in properly adjusted stock trays and poured in an improved stone to produce the study casts. Preliminary surveying of the lower study cast was carried out, to establish a suitable path of insertion and removal, and the needed mouth preparation. Mesial occlusal rest seat and distal guiding plane were prepared on the first premolar in the distally extended side. In the intact side, mesial occlusal rest seat was prepared on the first premolar, distal occlusal rest seat was prepared on the first molar and mesial occlusal rest seat was prepared on the second molar. An alginate impression was made in especially constructed lower resin tray with the borders functionally traced, boxed and poured in an improved stone to obtain the master cast. After necessary modification of the master cast, duplication of the modified master cast by agar agar hydrocolloid duplicating material was done to produce the refractory cast.

Ready made wax pattern was used to design the partial denture framework. In the two groups the design factors were as follows: lingual bar major connector used to connect the two bilateral parts of the removal partial denture. Minor connectors joined to the major connector at right angles. Mesial occlusal rest and lingual C-clasps for reciprocation on the first premolar in the distally extended side. In the intact side, mesial occlusal rest on the first premolar for indirect retention. Double Acher clasp on the first and second molars having mesial occlusal rest on the second molar and distal occlusal rest on the first molar with lingual C-clasps for reciprocation and buccal C-clasps for retention. For group I with traditional metal framework I-bar partial denture, combination type denture base was designed with I shaped retentive arm emerging from the saddle to engage the buccal undercut on the first premolar.

The framework was casted in cobalt-chromium alloy, tried in the patient's mouth and adjusted. On the metal framework, an acrylic tray was constructed, the borders were shortened and functionally traced with green stick compound material (Perfectin, S. A. I. C., HUBAC, BUENESAIRES, Argentina). The acrylic tray was loaded with zinc oxide eugenol paste (Cavex impression paste, Cavex Holland by P.O. Box 852, 2003 RW) and supported by positioning two fingers on the primary occlusal rests and the third one on the indirect retainer to record the residual ridge in its functional form. The edentulous area was sawed and discarded, the framework with the zinc oxide eugenol was reseated on the cast, poured in an improved stone and a corrected master cast was developed. Dentures were constructed according to conventional methods, following guidelines explained by Rodney et al. [19] Upper and lower jaw relation was recorded. Cross- linked acrylic teeth (Vita, Bad Sackingen-Germany) were set up and tried in the patient's mouth. The denture base was processed in heat cured poly methyl metha acrylate (Acrostone, Acrostone Dental Factory, Cairo, Egypt) for group I (Fig. 3) and low stiffness polyacetal resin with gum colored buccal retentive clasp emerging from the saddle for group II (Fig.4). Laboratory remounting was carried out for occlusal perfection, followed by finishing and polishing of the denture. At the time of denture insertion, all subjects were instructed for proper oral and dental hygiene and asked to return back for inspection according to the planned schedule.

Evaluation procedures:

After performing the needed post insertion adjustments, the evaluation procedures were accomplished at time of insertion of the removable partial denture, at six , twelve and eighteen months after insertion to examine bone height changes in the distal aspect of the ridge and crestal bone height changes surrounding the principal abutments.

For each patient self cure acrylic template (Peka Tray, Bayer Dental Leverkusen, Germany) was constructed covering the natural teeth and the distal aspect of the ridge with a round stainless steel wire (Dentaurim,Germany)0.7mm in diameter embedded in its fitting surface, extending horizontally from the principal abutment to the end of second molar level. A notch was done in the embedded wire at 10mm from the distal surface of the principal abutment. Following the methods described by Plotnick et al.[20] of long cone paralleling technique, periapical radiographs (Kodak Ektaspeed Plus, poly-soft periapical dental films size format 2, DF.) were taken to the principal abutment and the distal aspect of the ridge during the follow up period by using x-ray machine (France Trophy Radiologie, type 6510,) with exposure time 0.5 sec.. All films were processed by an automatic processor (M 35X- OMAT Processor. Kodak. France) for standardization. Periapical radiographs of each patient were digitized using a full page scanner (Artec image seamier 24000 dpi. Taiwan). After digitization of images, they were stored and processed by a computer (IBM compatible computer) to be projected onto a monitor. A special soft wear of Digora system (DIGORA, Orion Corporation, Soredex medical system, Helsinki, Finland.) was used for assessing mesial and distal crestal bone height surrounding

Fig. (3) Traditional I-bar partial denture

Fig. (4) Hybrid partial denture

the principal abutment and bone height of the distal aspect of the ridge.

Using the Digora soft wear the following measurements were obtained: (Fig.5)

- The distance from the alveolar crest to the apex of the each principal abutment tooth root on its mesial and distal surfaces.
- The distance from a fixed point selected by the Digora program on the x-ray film at the notch in the embedded wire to the distal aspect of the ridge.

All measurements were recorded, the collected data was tabulated and statistically analyzed.

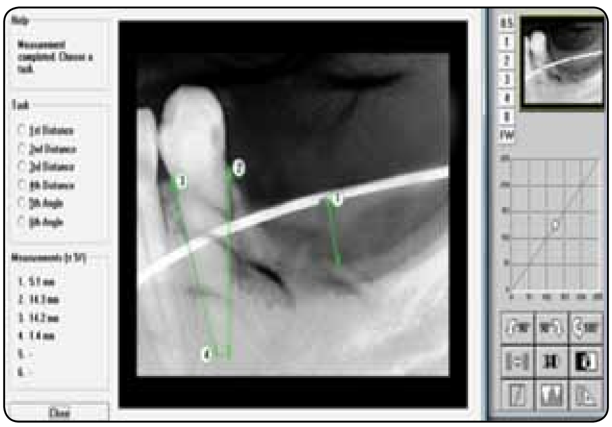

Fig. (5) Bone height measurements

RESULTS

Effect of different partial denture designs on bone height of distal aspect of the ridge:

Table I shows increase in bone height loss of distal aspect of the ridge throughout the study period in both groups.

Statistical analysis of mean percent change in bone height of distal aspect of the ridge for hybrid versus traditional partial denture designs showed statistically significant difference between the two groups at different intervals of follow-up period where hybrid partial denture design showed less bone height reduction except at (0-6m) where the difference was non-significant as shown in table II.

Effect of different partial denture designs on crestal bone height surrounding the mesial surface of the principal abutment:

Table III shows decrease in crestal bone height surrounding the mesial surface of the principal abutment throughout the study period in both groups.

Statistical analysis of the mean percent change in bone height loss of crestal bone surrounding the mesial surface of the principal abutment for

TABLE (I) Mean and standard deviation of bone height changes of distal aspect of the ridge for hybrid and traditional partial denture designs at different intervals of follow-up period.

	Hybrid Design		Traditional Design	
	Mean (mm)	Standard deviation	Mean (mm)	Standard deviation
Denture insertion	4.840	0.6132	4.870	0.8407
6 Months	4.950	0.8263	4.950	0.8449
12 months	4.980	0.5846	5.120	0.8311
18 months	5.125	0.5731	5.310	0.8465

TABLE (II) Comparison of bone height changes of distal aspect of the ridge for hybrid and traditional partial denture designs at different intervals of follow-up period.

	Hybrid Design		Traditional Design		Comparison of mean % changes of Hybrid versus Traditional	
	Mean difference (mm)	Mean % change	Mean difference (mm)	Mean % change	Unpaired t-test	P-value
0-6m	0.11	2.272727	0.08	1.652893	0.06177	0.9511 ns
6-12m	0.03	0.606061	0.17	3.434343	3.5	0.0065 *
12-18m	0.145	0.606061	0.19	3.710937	2.1	0.05*
0-18m	0.285	5.88843	0.44	9.0349	4.013	0.0008*

**Significant (P<0.05)*   *ns= non-significant(P>0.05)*

TABLE (III) Mean and standard deviation of crestal bone height surrounding the mesial surface of the principal abutment for hybrid and traditional partial denture designs at different intervals of follow-up period.

	Hybrid Design		Traditional Design	
	Mean (mm)	Standard deviation	Mean (mm)	Standard deviation
Denture insertion	12.95	1.235	13.29	1.369
6 Months	12.89	1.249	13.21	1.362
12 months	12.81	1.225	13.13	1.347
18 months	12.71	1.234	13.05	1.356

the hybrid versus the traditional group showed non-significant differences at different intervals of follow-up period as shown in table IV.

Effect of different partial denture designs on crestal bone height surrounding the distal surface of the principal abutment:

Table V shows decrease in crestal bone height surrounding the distal surface of the principal abutment throughout the study period in both groups.

Statistical analysis of the mean percent change in bone height loss of crestal bone surrounding the distal surface of the principal abutment for the hybrid versus the traditional group showed non-significant differences at different intervals of follow-up period as shown in table VI.

TABLE (IV) Comparison of crestal bone height changes surrounding the mesial surface of the principal abutment for hybrid and traditional partial denture designs at different intervals of follow-up period.

	Hybrid Design		Traditional Design		Comparison of mean % changes of Hybrid versus Traditional	
	Mean difference (mm)	Mean % change	Mean difference (mm)	Mean % change	Unpaired t-test	P-value
0-6m	-0.06	-0.46332	-0.08	-0.60196	0.8199	0.4174Ns
6-12m	-0.08	-0.62064	-0.08	-0.62064	0.7936	0.4324Ns
12-18m	-0.1	-0.78064	-0.08	-0.60929	0.8294	0.4120Ns
0-18m	-0.24	-1.85328	-0.24	-1.80587	0.852	0.3996Ns

**Significant (P<0.05) ns= non-significant(P>0.05)*

TABLE (V) Mean and standard deviation of crestal bone height surrounding the distal surface of the principal abutment for hybrid and traditional partial denture designs at different intervals of follow-up period.

	Hybrid Design		Traditional Design	
	Mean (mm)	Standard deviation	Mean (mm)	Standard deviation
Denture insertion	10.70	1.889	11.54	1.677
6 Months	10.62	1.856	11.46	1.673
12 months	10.50	1.841	11.32	1.663
18 months	10.35	1.854	11.20	1.671

TABLE (VI) Comparison of crestal bone height changes surrounding the distal surface of the principal abutment for hybrid and traditional partial denture designs at different intervals of follow-up period.

	Hybrid Design		Traditional Design		Comparison of mean % changes of Hybrid versus Traditional	
	Mean difference (mm)	Mean % change	Mean difference (mm)	Mean % change	Unpaired t-test	P-value
0-6m	-0.08	-0.74766	-0.08	-0.69324	0.8331	0.451626Ns
6-12m	-0.12	-1.12994	-0.14	-1.22164	0.8614	0.4376Ns
12-18m	-0.15	-1.42857	-0.12	-1.06007	1.537	0.1326Ns
0-18m	-0.35	-3.27103	-0.34	-2.94627	1.153	0.3132Ns

**Significant (P<0.05) ns= non-significant(P>0.05)*

DISCUSSION

The progressive loss of bone height in distal aspect of the ridge throughout the investigation period might be attributed to the denture movement during function which drives its support from the relatively stable supporting abutment tooth and resilient soft tissues overlying the residual edentulous ridge, both exhibiting different degrees of displaceability. The resorption in distal aspect of the ridge was less with hybrid partial denture design, which can be explained by the fact that under mastication the flexibility of polyacetal resin used in the denture base of hybrid design absorbs a portion of shock of the movement, and the gentle movement of the base creates a slight massaging effect over the residual alveolar ridge. This produces a stimulation that has been shown to retard the deterioration of natural tissue and bone. Also, because the dimensions of residual alveolar ridge are not stable due to bone resorption, mucosal changes and tissue irritation, the flexible resin base continuously adapts itself to the mucosa helping in load reduction. [6]

The progressive decrease in crestal bone height surrounding the principal abutment throughout the investigation period might be attributed to the torque exerted on the free end abutment teeth resulting from denture movement during function. Carr et al. [21] clarified that any movement of distal extension base is inevitably a rotational movement which if is in a tissue-ward direction may result in undesirable torque on the abutment tooth. The insignificant difference in crestal bone reduction on mesial and distal surface of the principal abutment may be explained by the fact that polyacetal resin clasp and I-bar both being flexible allow movement away from the undercut and release from the abutment tooth when occlusal forces are applied to the denture base, however they give good resistance to occlusal displacement by engaging the undercut when lifting force is applied.

CONCLUSIONS

The hybrid partial denture design which combined metal framework with low stiffness polyacetal resin clasp and denture base is a good alternative with patients suffering from compromised bony conditions or when esthetics is of primary concern.

REFERENCES

1. Becker CM, Kaiser DA, Goldfogel M.H. Evaluation of removable partial denture design. J Prosthodont 1994: 3:158-166.

2. Giffin K.M. Solving the distal extension removable partial denture base movement dilemma a clinical report. J Prosthet Dent 1996: 76:347-349.

3. Kapur KK, Deupree R, Dent RJ, Hasse A L. A randomized clinical trial of two basic removable partial denture designs. Part I.: Comparisons of five-year success rates and periodontal health. J Prosthet Dent 1994: 72:268-282.

4. Wright PS, Hellyer PH. Gingival recession related to removable partial dentures in older patients. J Prosthet Dent 1995:74: 602-607.

5. Ogata K, Shimigu K. Longitudenal study of forces transmitted from denture base to retainers of free end saddle dentures with Akers clasps. J. Oral Rehabil 1991:18: 471.

6. Monteith BD. Management of loading force on mandibular distal extension prosthesis. Part I.: Evaluation of concepts for design I. J Prosthet Dent 1984: 52: 673-681.

7. Parker HM. Impact reduction in complete and partial dentures. A pilot study. J Prosthet. Dent 1996:16: 227-45.

8. El Charkawi HG, Goodkind RJ, Delong R, Douglas WH. The effect of resilient layer distal extension partial denture on the movement of abutment teeth: A new methodology. J Prosthet Dent1988: 60: 622-627.

9. Fitton JS, Davies EH, Howlett JA, Pearson GI. The physical properties of a polyacetal denture resin. Clin Mater 1994:17:125-129.

10. Phoenix RD, Mansueto MA, Ackerman NA, Jones RE. Evaluation of mechanical and thermal properties of commonly used denture base resin. J Prosthodont 2004:13:17-7.

11. Chu CH, Chow TW. Esthetic design of removable partial dentures. Gen Dent 2003:51:322-324.

12. Savion Y, Sharon-Buller A, Kalisker Y, Kalisker N, Sela M.{The use of Dental D (polyacetal resin) as an alternative for chrome-cobalt removable partial denture: case report.} Refuat Hapeh Vahashinayim 2001:18:30-31,108.

13. McCarthey JW, Fiks S. The all acrylic resin mandibular removable partial denture design consideration. J Prosthet Dent 1997:77: 638.

14. Davenport JC, Basker RM, Heath JR, Ralf J.P. A color atlas of removable partial dentures. Wolf Med. Pub. Ltd.,1989.

15. Dammani B, Shingote B, Athavale S, Kakade D. Liquid supported denture. A gentle option. J. Indian Prosthodontic Society 2007:7: 117.

16. Lowe LG. Flexible denture flanges for patients exhibiting undercut tuberosities and reduced width of the buccal vestibule: a clinical report. J Prosthet Dent 2004:92:128-131.

17. Arda T, Arikan A. An in vitro comparison of retentive force and deformation of acetal resin and cobalt-chromium clasps. J Prosthet Dent 2005:94:267-274.

18. Jiao T, Chang T, Caputo AA. Load transfer characteristics of unilateral distal extension removable partial dentures with polyacetal resin supporting components. Aust Dent J 2009:54:31-37.

19. Rodney D, David R, Cberles F. Stewart,s clinical removable partial prosthodontics 3rd edition Quintessence Publishing Co., Inc Chicago, Berlin, Tokyo, London,2003:367-449.

20. Plotnick IJ, Beresin VE, Simkins AB. A technique for standardized serial dental radiographs. J Periodontol 1971:42:297-299.

21. Carr AB, Mc Giveney GP, Brown DT. McCracken's Removable Partial Prosthodontics, 11th edition Mosby Co., St. Louis, Missouri, 2005:25-33.