Short Communication

The Influence of Interimplant Distance and Attachment Type on the Retention Characteristics of Mandibular Overdentures on 2 Implants: 6-Month Fatigue Retention Values

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This in vitro study evaluated the 6-month fatigue retention provided by 5 paired overdenture attachments placed at 3 different interimplant distances (19, 23, and 29 mm). Mean fatigue retention was calculated for each attachment type and compared with the retention produced by the other attachments tested and the initial retention values published earlier. Interimplant distance was found to play a significant role only in the retention of the Hader bar with red and yellow clips. A significant reduction in retention values was observed for 4 of 5 attachment types. *Int J Prosthodont 2008;21:152–154.*

Results from both clinical and laboratory studies suggest that a bar coupled with 2 metal clips provides better long-term retention to an implant overdenture than either a bar with 2 plastic clips or a pair of nonsplinted attachments, but no guidelines exist regarding how far apart the attachments should be placed for optimum retention. This in vitro study aimed to examine the effect of interimplant distance (ID) on the fatigue retention of mandibular overdentures on 2 implants.

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Materials and Methods

The type, sample size, and specifications of the attachment pairs used in this in vitro study are shown in Table 1. All pairs were tested at IDs of 19, 23, and 29 mm. Detailed data on the identification of the 3 IDs, the preparation of the attachments tested, and the measurement of their initial retention were previously published.[1]

Following initial retention measurements, the attachments were kept in a water bath (distilled water, 37ºC). The attachments were removed every 15 days and carefully subjected to 45 manual pulls. These 45 pulls represent the number of times the overdenture would be removed by the patient over a period of 15 days if removed following each meal for oral hygiene purposes. Upon completion of the pulls, the attachments were stored in the water bath for another 15 days before they were removed again and subjected to a new cycle of fatigue pulls. This procedure was repeated 12 times to simulate a 6-month period of use. The total number of fatigue cycles was 540 pulls. Next, the attachments were measured for fatigue retention in the same manner as for initial retention (50 mm/min crosshead speed, 10 pulls for mean fatigue peak tensile load, load cell 0 to 50 N).[1]

Mean fatigue retention values were compared using a 1-way analysis of variance Bonferroni test. Statistical significance was set at .05. Statistically significant differences between initial and fatigue values were assessed using a nonparametric Kruskal-Wallis test. All measurements were performed by the same operator.

Table 1 Attachment Types Used in the Study[1]

Manufacturer	Attachment	Type	Material of male component	Material of female component
Metalor	1 MP bar/2 clips	Hader bar	Type III gold alloy (3 star)	Plastic (white)
Metalor	1 MP bar/2 clips	Hader bar	Type III gold alloy (3 star)	Plastic (yellow)
Metalor	1 MP bar/2 clips	Hader bar	Type III gold alloy (3 star)	Plastic (red)
Astra Tech	2 ball abutments (cuff length: 3.00 mm)	Ball/socket	Titanium	Gold
Aichi Steel	2 Magfit IP-AD	Magnet/keeper	AUM20 stainless steel (keeper)	NdFeB (magnet)

NdFeB = neodymium-iron-boron.

Table 2 Fatigue Retention Values of Each Attachment Type at 3 Interimplant Distances

	Interimplant distance			Statistical significance
Attachment	19 mm	23 mm	29 mm	per ID ($P < .05$)
Bar/red clips	12.6 N (SD: 0.65)	15.58 N (SD: 1.32)	20.73 N (SD: 0.38)	29 > 19 ($P = .0024$)
Bar/yellow clips	9.26 N (SD: 0.52)	12.16 N (SD: 1.08)	11.92 N (SD: 0.12)	23 > 19 ($P = .002$) 29 > 19 ($P = .003$)
Bar/white clips	5.54 N (SD: 0.17)	7.35 N (SD: 0.60)	5.95 N (SD: 0.75)	NS
Ball/sockets	23.37 N (SD: 1.75)	21.91 N (SD: 1.56)	20.19 N (SD: 2.16)	NS
Magnets	1.21 N (SD: 0.15)	1.07 N (SD: 0.14)	1.26 N (SD: 0.13)	NS
Statistical significance per attachment type ($P < .05$)	BS > BR ($P = .000$) BS > BY ($P = .000$) BS > BW ($P = .000$) BS > MK ($P = .000$) BR > BW ($P = .003$) BR > MK ($P = .000$) BY > MK ($P = .001$)	BS > BY ($P = .017$) BS > BW ($P = .001$) BS > MK ($P = .000$) BR > BW ($P = .049$) BR > MK ($P = .001$) BY > MK ($P = .005$)	BS > BY ($P = .003$) BS > BW ($P = .000$) BS > MK ($P = .000$) BR > BY ($P = .002$) BR > BW ($P = .000$) BR > MK ($P = .000$) BY > BW ($P = .026$) BY > MK ($P = .000$)	

ID = interimplant distance; BS = ball/socket; BR = bar/red clips; BY = bar/yellow clips; BW = bar/white clips; MK = magnet/keeper.

Results

Table 2 presents the fatigue retention values of each attachment type at all 3 IDs. Only the red and yellow plastic clips were affected by ID. A highly statistically significant decrease between initial and fatigue retention was observed for all attachment types except magnets. Table 3 presents the mean reduction in retention as calculated by the following formula:

$$MR (\%) = (R_I - R_F) / R_I$$

where MR is the mean reduction in retention of each attachment type, R_I is the initial retention, and R_F is the fatigue retention.

Table 3 Mean Reduction in Retention Per Attachment Per Interimplant Distance Following 6 Months of Simulated Use

	Interimplant distance		
Attachment	19 mm	23 mm	29 mm
White clips	61%	60%	60%
Yellow clips	54%	41.5%	42%
Red clips	54%	50%	26%
Ball/sockets	32%	40%	50%
Magnets	1.7%	5.3%	2.3%

Discussion

ID was found to significantly affect the fatigue retention of only the Hader/red clips and Hader/yellow clips (Table 2). Two red plastic clips positioned 13 mm apart (29 mm ID) on a Hader bar produced statistically higher retention compared to when they were placed closer together. A pair of yellow clips seems to produce statistically higher retention when placed at an intermediate distance of 7 mm (23 mm ID). For the rest of the attachments tested in this study, fatigue retention remained unaffected by ID.

Comparisons within each ID revealed that ball/sockets and bar/red clips were the most retentive attach-

Fig 1 Corrosion developing inside the magnet case *(left)* and wear of white clips after fatigue use *(right)*.

ments at 23 and 29 mm, respectively. The ball/sockets were also the dominant attachment at 19 mm, making these the attachment of choice for all IDs (Table 2). Magnets exhibited the lowest retention after the white clips. To the authors' knowledge, this is the first study indicating that intermediate use of soft (white) plastic clips for Hader-type bars can lead to retention levels similar to that of magnets. Degradation of the contact surface of the clip is responsible for this phenomenon (Fig 1).

The significant decrease from initial retention values[1] identified for all friction-based attachments is in disagreement with earlier reports,[2,3] possibly because of manufacturing variations. The small decrease in retention for the magnets is in accordance with the mean life expectancy of 19.25 months for neodymium-iron-boron (NdFeB) magnets.[4] Initiation of corrosive phenomena inside the case containing the magnet was observed macroscopically (Fig 1).[5]

Finally, this study examined the fatigue of overdenture attachments created by the repeated removal of the prosthesis. However, in the actual clinical situation, attachment fatigue is also created by cycling loading resulting from the function of the overdenture prosthesis, and this factor was not examined in the present study. Further, the clinical merits of the study are inevitably limited by the duration of the experimental period. These are obvious limitations of this laboratory study.

Conclusions

Following simulated use, red and yellow plastic clips for Hader bars perform statistically worse when placed closer rather than farther apart. Degradation of the retention after a 6-month simulated clinical use was observed for all attachments except magnets. Ball/sockets are the attachment of choice at all interimplant distances.

References

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