# Prosthetic Aspects and Patient Satisfaction with Resilient Liner and Clip Attachments for Bar- and Implant-Retained Mandibular Overdentures: A 3-Year Randomized Clinical Study

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***Purpose:*** This report aimed to compare prosthetic aspects and patient satisfaction during a 3-year randomized clinical trial of bar- and implant-retained mandibular overdentures attached with either resilient liners or clips. ***Materials and Methods:*** Thirty edentulous male patients (mean age: 62.5 years) received two implants in the anterior mandible after being allocated into two equal groups (according to attachment type received) using balanced randomization. After 3 months, implants were connected with resilient bars. New maxillary complete dentures were then constructed, and mandibular overdentures were retained to the bars with either clips (group I) or silicone resilient liners (group II). Subjects indicated satisfaction with their prostheses using a questionnaire and visual analog scale. Patient satisfaction and prosthetic complications were recorded for both attachments at 6 months and 1 and 3 years after overdenture insertion. ***Results:*** Comfort and stability with the maxillary denture and ease of hygiene procedures were rated higher in group II, while ease of handling the dentures was rated higher in group I. No significant differences in other parameters of patient satisfaction between groups were noted after 3 years. The mean number of prosthetic adjustments and repairs in group I (11.9) was significantly higher ($P = .00$) compared to that in group II (4.8). The most common complication in group I was clip wear, while separation of the resilient liner from the denture base was the most common problem in group II. Hyperplasia under the bar and flabby ridge in the maxilla occurred significantly more often in group I compared to group II. ***Conclusions:*** Resilient liner–retained mandibular overdentures had comparable patient satisfaction, less prosthetic maintenance and costs, and less soft tissue complications when compared to clip-retained ones after 3 years. *Int J Prosthodont 2012;25:148–156.*

Problems related to lack of stability and retention of conventional complete dentures can be solved by endosseous implants to which an overdenture can be attached.[1] A two-implant overdenture has become increasingly popular within the past 20 years and is considered to be the standard of care in cases of mandibular edentulism.[2] Such overdentures can receive their retention from attachments that may (bar/clips) or may not splint the implants (ball type, magnetic, and telescopic attachments).[1,3,4] The most common method for retaining two-implant overdentures is a combination of metal/plastic clips attached to a bar.[5,6] There is some evidence that stresses and loads are distributed more uniformly if the implants are connected by a bar.[7]

The ultimate choice of attachment type should be based on clinical performance of the attachments regarding the functional loads on the implants and surrounding tissues, patient's satisfaction with treatment, technical problems, maintenance service, and attachment costs.[8,9] Evaluation of such performance should come from clinical trials comparing restorative options in a single study population, preferably with a long observation period.[8]

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**Table 1** Characteristics of the Study Sample at Baseline According to Balancing Criteria

| | Group I (clip attachment) | Group II (resilient liner attachment) |
|---|---|---|
| Mean age (y) | 62.1 | 63.0 |
| Mean symphysial bone height (mm) | 20.0 | 18.6 |
| Mean period of mandibular edentulism (y) | 14.2 | 15.0 |
| Mean no. of mandibular dentures | 1.9 | 1.9 |

Several studies reported the use of resilient liners as a matrix over bar[10–12] and ball[13] attachments for implant overdentures. When used as a method of retention for implant-retained overdentures, these liners obturate the spaces around the bar, absorb energy, distribute masticatory forces to the implants and edentulous ridge, and provide greater latitude of movement and comfort to the patient.[10,11] In a short-term randomized clinical trial,[12] the author concluded that resilient liner attachments to the bar of an implant-retained mandibular overdenture have more favorable clinical and radiographic peri-implant tissue responses than clip attachments.

The aim of this randomized controlled trial was to evaluate differences in prosthetic outcomes and patient satisfaction between clip and resilient liner attachments for bar- and implant-retained mandibular overdentures over a 3-year period. The null hypothesis was that there would be no differences in patient satisfaction and prosthodontic maintenance between both attachments.

## Materials and Methods

Thirty edentulous male patients with a mean age of 62 years complaining of insufficient retention of their mandibular dentures were selected from the outpatient clinic of the Department of Removable Prosthodontics, Mansoura University, Eldakahlia, Egypt, from August 2004 to May 2005. Exclusion criteria were insufficient bone volume in the interforaminal region of the mandible to harbor two implants with a minimum length of 12 mm, mucosal lesions, and insufficient interarch space. Patients with diabetes, osteoporosis, smoking habits, and administrative or physical considerations that would seriously affect the surgical procedure were also excluded. All patients were enrolled in this study following their acceptance of the faculty committee's duly approved and explained research protocol and signing an informed consent form. They were stratified according to the criteria presented in Table 1 and assigned equally to receive either clip (group I) or resilient liner attachments (group II) using balanced randomization.[14]

For all patients, two implants (Zimmer) were inserted in the canine region of the mandible using a standardized submerged surgical approach. After 3 months, implants were connected with a resilient bar (OT Bar Multiuse, RHEIN 83) leaving a 2-mm clearance space between the bar and ridge. A new maxillary complete denture and an implant-retained mandibular overdenture were then constructed. In group I, retentive clips (Yellow, medium retention, RHEIN 83) were picked up intraorally with autopolymerized acrylic resin (Fig 1). In group II, overdentures over the bar were relined with an autopolymerized addition silicone resilient liner (Softliner, Promedica) using the closed mouth relining technique (Fig 2). The surgical and prosthodontic procedures are described elsewhere.[12] All prosthetic procedures were performed by the same prosthodontist who was not blinded to the type of attachment used. Patients were scheduled for follow-up visits 3, 6, 12, 24, and 36 months after overdenture insertion. The dentures were adjusted and repaired as needed.

### *Patient Satisfaction*

Patient satisfaction with overdentures was investigated through two questionnaires,[1,9] which were given to the patients in Arabic. The first questionnaire included three series. The first series consisted of five questions (A to E) in which patients gave their answers on an ordered scale with numbers ranging from 1 (very bad) to 9 (excellent). The second series (another five questions, F to J) had to be answered with a "yes/no" response. Finally, two questions (K and L) focused on a more descriptive answer (Table 2). The second questionnaire was based on a visual analog scale (VAS) in which patients gave their answers as a mark on a scale from 0 to 100 mm (low/worst to high/best) (Table 3).

**Fig 1** Clip-retained mandibular implant overdenture.

**Fig 2** Resilient liner–retained mandibular implant overdenture.

**Table 2** Questionnaire 1 for Overdentures

| Question | Content |
|---|---|
| **Part 1: Scale from 1 (very bad) to 9 (excellent)** | |
| A | How do you find your prosthesis in general? |
| B | How well does your prosthesis remain in place? |
| C | How well can you eat with your prosthesis? |
| D | How well can you talk with your prosthesis? |
| E | How do you find the appearance of your prosthesis? |
| **Part 2: Yes/no** | |
| F | Do you avoid contact with other people because of fear of loosing your prosthesis? |
| G | Does your prosthesis bother your mind? |
| H | Does food impaction regularly occur under your prosthesis? |
| I | Were your expectations about your prosthesis realized? |
| J | Would you repeat the same treatment? |
| **Part 3: Descriptive response** | |
| K | How many times do you take out your prosthesis because of discomfort? |
| L | If you were to repeat the treatment, would you choose: *(1)* the same solution or *(2)* a fixed prosthesis? |

**Table 3** Questionnaire 2 for Overdentures (100-mm VAS)

| Question | Content |
|---|---|
| 1 | Describe the extent of comfort with your maxillary denture. |
| 2 | Describe the extent of comfort with your mandibular overdenture. |
| 3 | How would you rate the fit (stability/retention) of your maxillary denture? |
| 4 | How would you rate the fit (stability/retention) of your mandibular overdenture? |
| 5 | Do you have difficulties speaking with your prosthesis? |
| 6 | How often does your prosthesis affect your socializing? |
| 7 | Are there activities you avoid because of the possibility of being embarrassed by your prosthesis? |
| 8 | How would you rate the ease of handling of your dentures (insertion/removal)? |
| 9 | How difficult is it for you to bite off soft foods? |
| 10 | How difficult is it for you to bite off hard foods? |
| 11 | How difficult is it for you to chew soft foods? |
| 12 | How difficult is it for you to chew hard foods? |
| 13 | How satisfied are you with the healing since your implant surgery? |
| 14 | Do you think your implant-supported prosthesis is actually part of you? |
| 15 | How would you rate the ease of hygiene procedures? |

### *Prosthetic Evaluation*

The following prosthetic complications were recorded according to the method described by Naert et al[1] and Krennmair et al[15]: mechanical complications of the implants, attachments, mandibular overdenture, and maxillary complete dentures and soft tissue complications of denture-bearing areas (mucositis, soreness, ulcer decubitus, hyperplasia, and flabby ridge) in the maxilla and mandible, expressed as number of sites. Evaluations of patient satisfaction and prosthetic aspects for both groups were performed at 6 months (T1) and 1 (T2) and 3 years (T3) after overdenture insertion.

**Table 4** Mean Scores of Questionnaire 1 Part 1 for Overdentures

| | | T1 (n = 14) | | T2 (n = 12) | | T3 (n = 10) | |
|---|---|---|---|---|---|---|---|
| Question | Content | Group I | Group II | Group I | Group II | Group I | Group II |
| A | How do you find your prosthesis in general? | 7.57 | 7.50 | 7.91 | 7.83 | 8.60 | 8.10 |
| B | How well does your prosthesis remain in place? | 8.71 | 7.42 | 8.66 | 8.00 | 8.70 | 8.30 |
| | | *P* = .001* | | *P* = .010* | | | |
| C | How well can you eat with your prosthesis? | 8.14 | 7.07 | 8.50 | 7.41 | 8.70 | 8.00 |
| | | *P* = .017* | | *P* = .005* | | | |
| D | How well can you talk with your prosthesis? | 8.00 | 7.35 | 8.25 | 8.00 | 8.80 | 8.40 |
| E | How do you find the appearance of your prosthesis? | 7.92 | 6.85 | 8.08 | 7.66 | 8.30 | 8.10 |
| | | *P* = .010* | | *P* = .045* | | | |

*Statistically significant difference between groups (two-tailed Mann-Whitney test, $P < .05$).

**Table 5** No. of Patients Giving a Positive Response to Questionnaire 1 Part 2

| | | T1 (n = 14) | | T2 (n = 12) | | T3 (n = 10) | |
|---|---|---|---|---|---|---|---|
| Question | Content | Group I | Group II | Group I | Group II | Group I | Group II |
| F | Do you avoid contact with other people because of fear of loosing your prosthesis? | 3 | 4 | 0 | 4 | 2 | 5 |
| | | | | *P* = .029* | | | |
| G | Does your prosthesis bother your mind? | 7 | 3 | 5 | 0 | 1 | 0 |
| | | | | *P* = .014* | | | |
| H | Does food impaction regularly occur under your prosthesis? | 6 | 9 | 4 | 6 | 3 | 5 |
| I | Were your expectations about your prosthesis realized? | 13 | 11 | 11 | 11 | 9 | 10 |
| J | Would you repeat the same treatment? | 12 | 9 | 11 | 8 | 10 | 9 |

*Statistically significant difference between groups (two-tailed Mann-Whitney test, $P < .05$).

### *Statistical Analysis*

The SPSS statistical package version 17 (IBM) was used for statistical analysis. The Friedman test was used to test for significance between observation times since the data were not distributed normally. If there was a significant difference between observation times, the Wilcoxon signed-rank test was used for pairwise testing within groups. The Mann-Whitney *U* test was applied for testing differences between attachment groups. *P* values were significant if < .05 at a confidence interval of 95%.

## Results

### *Patient Dropout*

At year 3, 5 patients had dropped out from each group. At T1, a patient in group I with a single implant that had failed during the osseointegration period was excluded, and another patient in group II moved out of the area. After 1 year (T2), 2 patients in group I could not attend the follow-up because of severe illness. One patient moved out of the area, and another patient died after 9 months in group II. At year 3, 2 patients (1 in each group) could not attend the evaluation process regularly for severe medical reasons. Groups were compared before treatment for the variables mentioned in Table 1 using an independent samples *t* test, with no significant differences detected.

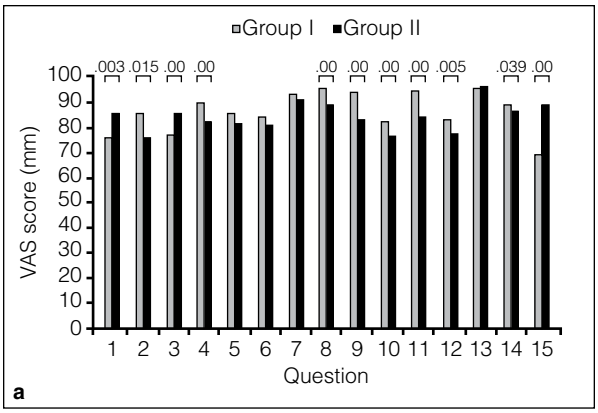
### *Patient Satisfaction*

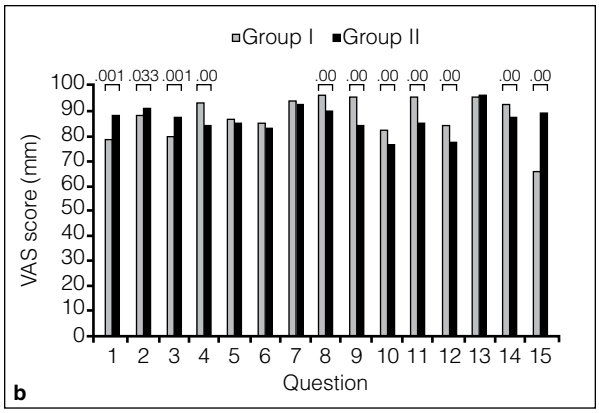
Answers to the first questionnaire for the overdentures at T1, T2, and T3 did not differ significantly between groups for general satisfaction and phonetics (Table 4). Food impaction occurred regularly in both groups, although all patients' expectations with their prostheses were realized and all of them would repeat the same treatment again (Table 5). The number of patients who removed their overdentures one to three times per day because of discomfort did not differ significantly between groups (Table 6). Prosthesis stability, chewing comfort, esthetics, removal of the overdenture (more

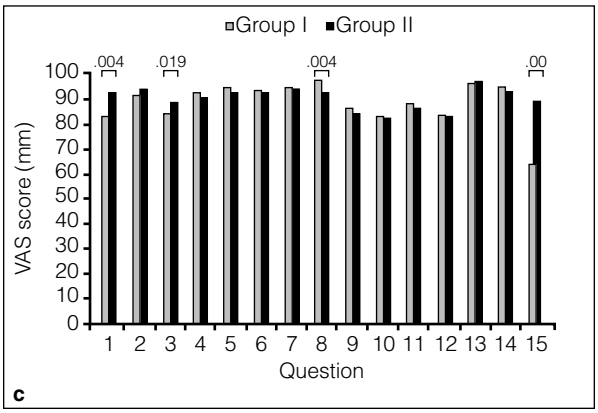
**Table 6** Distribution of Patient Answers to Questionnaire 1 Part 3

| | | T1 (n = 14) | | T2 (n = 12) | | T3 (n = 10) | |
|---|---|---|---|---|---|---|---|
| Question | Content | Group I | Group II | Group I | Group II | Group I | Group II |
| K | How many times do you take out your prosthesis because of discomfort? | | | | | | |
| | 1–3 times/day | 11 | 13 | 11 | 12 | 10 | 10 |
| | > 3 times/day | 3 | 1 | 1 | 0 | 0 | 0 |
| | | $P$ = .035* | | $P$ = .033* | | | |
| L | If you were to repeat the treatment, would you choose: *(1)* the same solution or *(2)* a fixed prosthesis? | | | | | | |
| | Same | 12 | 6 | 12 | 5 | 9 | 4 |
| | Fixed | 2 | 8 | 0 | 7 | 1 | 6 |
| | | | | $P$ = .014* | | | |

*Statistically significant difference between groups (two-sided Mann-Whitney test, $P < .05$).




**Figs 3a to 3c** Patient satisfaction **(a)** 6 months (T1), **(b)** 1 year (T2), and **(c)** 3 years (T3) after overdenture insertion based on a VAS (questionnaire 2). Lines joining the bars indicate $P$ values (Mann-Whitney test).

than three times per day) because of discomfort, and "bothering the mind by the prosthesis" were rated significantly higher in group I compared to group II after 1 year, while "fear of loosening of the overdenture" and choice of fixed prosthesis were higher in group II compared to group I. After 3 years (T3), no significant difference between groups was noted (Mann-Whitney test). General comfort, eating ability, and phonetics increased significantly after 3 years in both groups (Friedman test, $P < .05$). Food impaction under the denture in group II and bothering the mind by the prosthesis in group I decreased significantly with time ($P$ = .039 and .04, respectively). Other answers to questionnaire 1 showed no significant differences between groups after 3 years.

Answers to the second questionnaire at T1, T2, and T3 are presented in Figs 3a, 3b, and 3c, respectively. No significant differences were detected for patient

**Table 7** No. of Prosthetic Complications and Maintenance in Mandibular Overdentures and Maxillary Complete Dentures

| | T1 (n = 14) | | T2 (n = 12) | | T3 (n = 10) | |
|---|---|---|---|---|---|---|
| | Group I | Group II | Group I | Group II | Group I | Group II |
| **Implant component** | | | | | | |
| Implant fracture | 0 | 0 | 0 | 0 | 0 | 0 |
| Occlusal screw (bar) loosening | 10 | 6 | 11 | 5 | 10 | 5 |
| | | | *P* = .011* | | *P* = .012* | |
| Abutment loosening | 9 | 4 | 5 | 4 | 3 | 5 |
| Abutment fracture | 0 | 0 | 0 | 0 | 0 | 0 |
| Bar fracture | 0 | 0 | 0 | 0 | 1 | 0 |
| **Condition of attachments** | | | | | | |
| Wear of clip | 12 | – | 9 | – | 33 | – |
| Fracture of clip | 2 | – | 1 | – | 3 | – |
| Replacement of clip | 14 | – | 10 | – | 36 | – |
| Resilient liner tear | – | 0 | – | 2 | – | 4 |
| Separation of resilient liner from the denture base/ resilient liner replacement | – | 2 | – | 2 | – | 8 |
| **Mandibular overdenture** | | | | | | |
| Prosthesis teeth fracture | 2 | 3 | 2 | 4 | 3 | 6 |
| Prosthesis teeth worn | 3 | 1 | 5 | 2 | 9 | 3 |
| | | | | | *P* = .005* | |
| Occlusal adjustments | 6 | 4 | 2 | 0 | 0 | 0 |
| Overdenture fracture/repair | 0 | 0 | 0 | 1 | 1 | 4 |
| Denture margin modification | 8 | 4 | 6 | 2 | 3 | 0 |
| Overdenture relining | 0 | 1 | 3 | 5 | 2 | 8 |
| | | | | | *P* = .025* | |
| New overdenture made (if adjustments or repair were not possible) | 0 | 1 | 1 | 1 | 1 | 2 |
| **Maxillary complete denture** | | | | | | |
| Denture fracture | 0 | 0 | 1 | 0 | 3 | 0 |
| Denture teeth fracture | 0 | 0 | 1 | 0 | 2 | 0 |
| Denture reline | 3 | 0 | 7 | 2 | 8 | 3 |
| | | | | | *P* = .039* | |
| Denture renewed | 0 | 0 | 0 | 0 | 1 | 0 |
| **Mean no. of complications** | 4.5 | 1.6 | 5.3 | 2.5 | 11.9 | 4.8 |
| **Mean cost of maintenance** | $32.5 | $19 | $58 | $27 | $130 | $96 |

*Statistically significant difference between groups (two-sided Mann-Whitney test, $P < .05$).

satisfaction between groups at all observation times with regard to speech, socializing, performing activities without embarrassment, and healing. Comfort with the mandibular overdenture was greater in group II while stability of the mandibular overdenture was greater in group I after 1 year; however, these differences disappeared after 3 years. Ease of handling the prosthesis, ease of biting or chewing hard/soft food, and the prosthesis being part of the patient rated significantly higher in group I compared to group II after 1 year. However, comfort and stability with the maxillary denture and ease of hygiene procedures were significantly greater in group II compared to group I at all observation times. Answers to questionnaire 2 revealed a significant increase in patient satisfaction over time in both groups (Friedman test, $P < .05$), except for ease of oral hygiene, which was significantly decreased in group I.

**Table 8** No. of Sites with Mucosa Complications in the Mandible and Maxilla

| | T1 (n = 14) | | T2 (n = 12) | | T3 (n = 10) | |
|---|---|---|---|---|---|---|
| | Group I | Group II | Group I | Group II | Group I | Group II |
| **Mandibular overdenture** | | | | | | |
| Mucositis | 5 | 0 | 4 | 0 | 4 | 2 |
| | | *P* = .015* | | *P* = .032* | | |
| Soreness | 5 | 1 | 2 | 0 | 0 | 0 |
| | | *P* = .049* | | | | |
| Decubitis ulcer | 2 | 3 | 0 | 0 | 0 | 0 |
| Hyperplasia under the bar | 1 | 0 | 4 | 0 | 4 | 0 |
| | | | | *P* = .039* | | *P* = .029* |
| Flabby ridge | 0 | 0 | 0 | 0 | 0 | 0 |
| **Maxillary complete denture** | | | | | | |
| Mucositis | 1 | 0 | 3 | 1 | 5 | 2 |
| Soreness | 4 | 1 | 2 | 0 | 0 | 0 |
| Decubitis ulcer | 1 | 0 | 2 | 0 | 2 | 0 |
| Hyperplasia | 0 | 0 | 0 | 0 | 1 | 0 |
| Flabby ridge | 0 | 0 | 2 | 0 | 7 | 2 |
| | | | | | | *P* = .028* |

*Statistically significant difference between groups (two-sided Mann-Whitney test, $P < .05$).

### *Prosthetic Outcome*

Table 7 presents the incidence of prosthetic complications and maintenance and the mean cost of maintenance at different observation times for each group. After 3 years of follow-up, the mean number of adjustments and repairs in group I (11.9) was significantly higher compared to that in group II (4.8, $P = .00$). The most common complications for group I were clip wear (n = 33) and clip replacement (n = 36), while the most common complication for group II was separation of the resilient liner from the denture base (n = 8). Occlusal screw/bar loosening, wear of prosthesis teeth, and maxillary denture relining occurred significantly more in group I compared to group II, while overdenture relining incidence was higher in group II compared to group I after 3 years. In group I, the incidence of maxillary denture relining and worn teeth increased with time ($P = .014$ and .009, respectively), while abutment loosening, occlusal adjustments, and denture margin modifications decreased with time ($P = .009$, .009, and .022, respectively). Group II demonstrated much lower cost of maintenance than group I at all observation times.

The number of sites with soft tissue complications in the mandible and maxilla are presented in Table 8. Mucositis, soreness, and hyperplasia under the bar in the mandible and flabby ridge in the maxilla occurred significantly more often in group I compared to group II. n group I, soreness under the overdenture decreased ($P = .022$) and flabby ridge sites increased ($P = .004$) over time.

## Discussion

Five patients in each group were not available the entire follow-up, which is not surprising considering the rather aged study population. Patient satisfaction after 3 years with bar clips was similar to that obtained by Naert et al[16]; however, retention and speech were rated higher and food impaction was rated lower in this study. This might be because clips were replaced only on patients' requests in the study of Naert and associates, while in this study, clips were renewed once wear or fracture was observed in the recall visits. Therefore, it is recommended for long-term maintenance that the decision of clip replacement be made by the clinician because allowing the patient to determine the need for replacement would affect the frequency of recall appointments because of the cost factor. In both studies, the dramatic improvement in retention and stability of overdentures when compared to previous conventional dentures made the majority of patients choose to

repeat the same treatment. Since this study was the first to evaluate patient satisfaction with overdentures retained by resilient liners over implants, it was not possible to compare the results directly with the results of other studies.

Prosthesis stability, chewing ability, removal of the overdenture because of discomfort, and the prosthesis bothering the mind were rated significantly higher with clips when compared to resilient liners after 1 year of overdenture insertion. These findings may be because clips, which more firmly grip the bar than the resilient liner, caused an increase in prosthesis stability and retention, which in turn produced comfort during chewing[9,17] but might bother the patient's mind and cause him to remove the prosthesis for tissue rest. This explanation is in line with the results of a crossover trial[18] in which the authors reported that a mandibular overdenture with the bar-clip attachment provided a stable fit and strong occlusal force during chewing. Esthetics was affected with the resilient liner more than clips since 2 to 3 mm of space over the bar was required for the resilient liners to retain their viscoelastic properties.[10] This space makes the mandibular teeth more visible and causes slight bulging of the lower lip.

The resilient liners absorb and distribute masticatory forces to the implants and edentulous ridge, thus providing greater latitude of movement, which in turn increases patient comfort.[10,11] The shock-absorbing ability of resilient liners when both dentures occlude together may be also responsible for increased comfort and stability of the maxillary denture, while the increased retention and stability of clip-retained mandibular overdentures may evoke discomfort and instability of these dentures.[1,19,20] However, the reduced stability and retention of resilient liner attachments makes the patients fear loosening of the denture and prefer fixed prostheses. After 3 years, the difference in patient satisfaction between attachments disappeared, which may reflect the good neuromuscular control developed over time in both groups. Such neuromuscular control is also responsible for increased patient satisfaction over time.

The clip-retained overdentures were handled more easily than resilient liner–retained ones, which makes them less hard to seat.[4] This finding may be attributed to the definite path of insertion and removal of the prosthesis created by the clips, while soft liner resiliency and tear may affect this path. The resilient liner matrix completely obturates the space around the bar[10] and continuously cleans the bar and abutments during denture insertion and removal, thus preventing plaque accumulation regardless of the oral hygiene practices of the patients.[12] Conversely, the unobturated free spaces within the denture base around the bar and abutments with clip attachments provide a sheltered area for plaque to accumulate, which jeopardizes oral hygiene procedures.[18,21]

The increased number of prosthetic complications in both groups during the last 2 years contrasts with the results of several studies[9,15,22] in which the majority of complications were concentrated during the first year. The increased retention with clips causes a higher force, which evokes abutment and occlusal screw loosening,[9] whereas the resilient liners absorb these forces,[10,11] resulting in decreased incidence of screw loosening. The incidence of clip replacement in this study was higher than that reported in other studies.[1,6,16] One reason could be attributed to the material from which the clips were constructed. The plastic clips in this study were associated with more wear and fractures, while metal clips need more activation than replacement.

The incidence of clip-retained overdenture relining was comparable to that observed by Gotfredsen and Holm.[20] The increased relining incidence of resilient liner–retained overdentures compared to clip-retained ones may be because these liners enhance ridge loading and resorption. The increased retention and stability of clip-retained overdentures was associated with increased chewing ability and more tooth wear than resilient liner–retained overdenture teeth.

The most common complication for the maxilla was relining of the maxillary dentures, which occurred more frequently with the clip than with the resilient liner attachment. This finding agrees with previous studies[15,20] and may reflect the high forces exerted by clip-retained mandibular overdentures on the maxilla.[1] Such forces induce maxillary bone loss, a flabby ridge, and instability of the maxillary dentures; therefore, the combination syndrome may develop.[23]

Mucositis and soreness were associated more frequently with clips. This observation supports the findings of other studies[1,16] and may be attributed to enhanced overdenture rotation around the bar with increased posterior ridge loading. In contrast, excellent settling of the resilient liner–retained overdentures on the supporting tissues decreased soft tissue complications. In the clip-retained group, gingival hyperplasia occurred more frequently because of the dead space beneath the bar, which prevents good access for cleaning and may cause a soft tissue inflammatory response.[1,16,24,25] In contrast, the soft liner matrix completely obturates the space around the bar[10] and prevents gingival hyperplasia. However, bacterial colonization of these liners was not evaluated in this study and still needs further investigation.

Overall, the null hypothesis was not fulfilled. The author recommends further investigation of the influence of resilient liner and clip attachments on oral function, such as muscle activity during chewing and masticatory efficiency.

## Conclusions

Based on the data of this 3-year trial, the following conclusions can be drawn with caution, since only male subjects were included and the dropout quotient was quite high:

- Comfort and stability with maxillary dentures and ease of hygiene procedures were significantly higher with resilient liners, while ease of handling the dentures was higher with clips after 3 years of observation. No difference in other parameters of patient satisfaction between attachments was observed.
- The resilient liner showed a lesser need for prosthodontic maintenance and repairs with much less cost than clip attachments. The most common complication for clips was wear/replacement, whereas the most common problem for resilient liners was separation from the denture base.
- The clip attachments showed significantly higher soft tissue complications (mucositis, hyperplasia under the bar, and maxillary flabby ridge) than resilient liner attachments.

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