

Two Years Retrospective Evaluation of Overdenture Retained by Symphyseal Single Implant Using Two Types of Attachments

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Abstract:

Background: This study was aimed to evaluate complete mandibular overdentures retained by a symphyseal single implant using ball and magnet attachments in both clinical and radiographic evaluation.

Materials and Methods: Ten dental press fit titanium implants were installed in the lower jaws of completely edentulous patients according to two-stage surgical protocol. For each patient, one implant was installed in the symphyseal midline region, and left submerged and unloaded for 4 months. The patients were then divided into two equal groups. The first group received mandibular overdentures retained by ball and socket attachment. The second group received mandibular overdentures retained by magnet attachment. Both groups were supplied with conventional maxillary complete dentures. All patients were evaluated immediately after denture insertion, 6 months, and 12 months and after 24 months of overdenture insertion.

Results: The study showed insignificant difference regarding the clinical condition and the marginal bone height changes in both groups during the follow-up period.

Conclusion: Single implant retained overdenture with ball and socket or magnetic attachments was easy in construction, required less home care to maintain gingival health and give satisfactory clinical results.

Key Words: Attachment, dental implant, overdenture

Introduction

Some of the completely edentulous patients have difficulty to wear conventional complete mandibular denture owing to

poor support and retention precipitated by advanced bone resorption, xerostomia, loss of attached keratinized tissue and neuromuscular degeneration. Several methods of treatment for this category of patients have been reported. Some of these methods are the implant-supported mandibular overdenture retained by bar-clip attachments, ball attachments, as well as mandibular overdenture retained by magnets.^{1,2}

Endosseous dental implant has greatly improved the condition of the edentulous mandible, for which implant success rates greater than 95% have been reported.³

Mandibular two implant-supported overdenture can be considered as the first choice standard of care for treatment of edentulous patients.⁴ Furthermore, two implants either splinted or none splinted placed in the interforaminal region have been considered the minimum number of implants required for anchorage of an implant/mucosa supported overdenture.⁵

There is usually sufficient bone to place implants in anterior area of the mandible i.e. (favorable local bone quality and quantity).⁶ However in some cases, due to severe mandibular atrophy and financial causes especially poor geriatric patients the placement of 2 interforaminal implants is impossible.^{7,8}

Few investigators recommend the use of a single implant for anchorage of mandibular overdenture.⁹⁻¹³ In this present study, we carried out a clinical investigation using within-subject comparison in order to evaluate the treatment outcomes of single implant-retained over-denture (with ball and socket and magnet attachments) with regards to patient satisfaction clinical and radiographic evaluation.

Materials and Methods

Ten dental press fit titanium Dyna Dental Implant (Dyna Dental Engineering, Bergen p zoom, The Netherlands) with 3.6 mm diameter and 13 mm length were installed in the lower jaws of completely edentulous patients. For each patient, one implant was installed in the symphyseal midline region. All subjects were selected free from any local or systemic diseases that contraindicate dental implant therapy or may affect the prognosis of implants.

After osseointegration period of four months, the implants were exposed and connected to the healing abutments. The patients were divided into two groups.

Five patients for each group. Patients of the first Group A received mandibular complete overdenture with ball attachments. Patients of the second Group B received mandibular complete overdenture with magnetic attachments (Figures 1 and 2). The caps of the ball and socket and magnets were attached to the dentures at the time of delivery by the chairside technique (Figures 3 and 4). Patients of both groups were supplied with conventional maxillary complete dentures.

All cases were evaluated immediately after denture insertion, 6 months, and 12 months and after 24 months of overdenture insertion.

Clinical evaluation

Patients satisfaction and complaints

In these recall, patients' satisfaction/complaints were assessed and compared with the dissatisfied baseline data. To quantify the level of satisfaction/complaints, a scale ranging from 1 to 5 (very good/good/satisfactory/sufficient/not satisfactory and no/mild/moderate/severe/very severe complaints) was used to evaluate the subjective data.¹²

Gingival index (GI)

At first the gingiva around each implant was smoothly dried with sterilized gauze and air; then all surfaces Mesial, Distal, Buccal, and Lingual (M, D, B, L) were scored individually according to Loe and Silness index (1963).¹⁴ The mean GI score of the four surfaces was considered the mean of the four surfaces (M, D, B, L) collectively.

Radiographic evaluation

The marginal bone level for each implant was evaluated at the time of overdenture insertion, 6 months, 12 months and 24 months after final placement of the overdenture. Digital Panoramic radiographs were taken for each patient by using the same machine for the assessment of crestal bone level. The marginal bone level was assessed at mesial and distal side of the fixture on the radiographs. The bone height was measured to the nearest 0.01 mm using Planmeca Romexis Viewer Software. For each implant, the bone height was detected in the same manner. The difference in the bone height between the follow-up periods were calculated and tabulated for analysis.



Figure 1: Patient with ball attachment.



Figure 3: Denture with socket.



Figure 2: Patient with magnet attachment.



Figure 4: Denture with magnet.

Statistical analysis

Statistical analysis was carried out using SAS program (SAS, 1988).¹⁵ Student's *t*-test (Procedure TTEST of SAS) was run to test the effect of group (ball versus magnet) within each time on all measurements. Paired *t*-test (Procedure Means of SAS) was used to test the significance between each two time intervals within each group on all measurements.

Results

Results of clinical evaluation

During the whole follow-up period, all patients were satisfied regarding denture stability, retention, and esthetics. No mobility was occurred in any direction for all tested implants. All abutments showed high sharp sound on percussion. The mean values and standard deviations of the measured patients' satisfaction score were summarized in Table 1. It appeared that there was a significant improvement in patients satisfaction score, and when comparing both groups, there was an insignificant difference between both groups during the follow-up period.

The mean values and standard deviations of patients' complaints are summarized in Table 2. It appeared that there was a significant improvement in patients complaints score. When comparing both groups, there was an insignificant difference between both groups during the follow-up period.

The mean values and standard deviations of the measured GI.

Scores are summarized in Table 3. It appeared that there was a minimal gingival inflammation in both groups. Statistical analysis of changes in mean values of GI showed insignificant difference between both groups at different periods.

Results of radiographic evaluation

The results of bone height are summarized in Table 4. Both groups showed slight marginal bone loss, and when comparing

both groups, there were insignificant differences during the whole follow-up periods.

Discussion

Single implant-supported overdentures may be appropriate for the treatment of edentulism in geriatric patient groups because of diminished functional demands and the realization that implant/patient life expectancy is limited.⁹

In this study, the implant diameter and length was fixed in all cases (3.6 mm width and 13 mm length) which are the most common dimensions used in the anterior mandible. Different implant dimensions lead to different surface area contacting supporting bone that may influence the distribution of stresses per unit-area.¹⁶

In this study, the use of push-in implant has many advantages; the surgical procedures are easy, minimizing operating time and postoperative complications. The serrated design of the implant was chosen because of its initial resistance to shear stress which is pre-request for successful osseointegration.¹⁷

Magnet attachments used in conjunction with osseointegrated implants are more functional and less stressful to the implant system than any other attachment because the retention element is free to slide or rotate on the keeper element in the function. These properties permit a degree of lateral and rocking movement of the denture such as that occurs when the soft tissue supporting the denture is displaced in function without exerting significant translatory or rotational forces on the supporting roots or implants. In this sense, the system can be said to provide a form of stress breaking so that the implants are not overloaded.¹⁸

The ball and socket attachments were used to reduce and distribute the load transmitted from the implant to the alveolar bone.¹⁹ They allow multidirectional movements of

Table 1: Descriptive statistics and test of significant for the effect of group and time on satisfaction scores.

| Satisfied score | Time | 0 time | | | 6 months | | | 12 months | | | 24 months | | |
|------------------|--------------|--------|-------|----|----------|-------|----|-----------|-------|----|-----------|-------|----|
| | Group | Mean | SD | DT | Mean | SD | DT | Mean | SD | DT | Mean | SD | DT |
| With the denture | Group A Ball | 3.667 | 0.577 | a | 1.667 | 0.577 | b | 1.333 | 0.577 | b | 2.000 | 0.000 | b |
| | Group Magnet | 3.667 | 0.577 | a | 2.333 | 0.577 | ab | 2.000 | 1.000 | b | 2.667 | 0.577 | ab |
| | P | NS | | | NS | | | NS | | | NS | | |

SD: Standard deviation, P: Probability level for the effect of group, NS: Insignificant ($P>0.05$), DT: Duncan's Multiple Range test for the effect of time. Means with the same letter within each row are not significantly different at $P=0.05$

Table 2: Descriptive statistics and test of significant for the effect of group and time on function complains scores.

| Function complains | Time | 0 time | | | 6 months | | | 12 months | | | 24 months | | |
|-----------------------|--------------|--------|-------|----|----------|-------|----|-----------|-------|----|-----------|-------|----|
| | Group | Mean | SD | DT | Mean | SD | DT | Mean | SD | DT | Mean | SD | DT |
| With complete denture | Group Ball | 3.667 | 0.577 | a | 1.667 | 0.577 | b | 1.333 | 0.577 | b | 1.333 | 0.577 | b |
| | Group Magnet | 3.667 | 0.577 | a | 1.667 | 0.577 | b | 1.667 | 0.577 | b | 2.000 | 0.000 | b |
| | P | NS | | | NS | | | NS | | | NS | | |

SD: Standard deviation, P: Probability level for the effect of group, NS: Insignificant ($P>0.05$), DT: Duncan's Multiple Range Test for the effect of time. Means with the same letter within each row are not significantly different at $P=0.05$

Table 3: Descriptive statistics and test of significant for the effect of time and group on changes in gingival index.

| Time | Group A | | | Group B | | | P2 |
|---------|---------|-------|----|---------|-------|----|----|
| | Mean | SD | P1 | Mean | SD | P1 | |
| 0-6 M | 0.333 | 0.577 | NS | 0.000 | 1.000 | NS | NS |
| 0-12 M | 1.000 | 0.000 | ** | 1.000 | 1.000 | NS | NS |
| 0-24 M | 1.333 | 0.577 | * | 1.333 | 1.155 | NS | NS |
| 6-12 M | 0.667 | 0.577 | NS | 1.000 | 0.000 | ** | NS |
| 6-24 M | 1.000 | 0.000 | ** | 1.333 | 0.577 | * | NS |
| 12-24 M | 0.333 | 0.577 | NS | 0.333 | 0.577 | NS | NS |

SD: Standard deviation, P1: Probability level for the effect of time, P2: Probability level for the effect of group, NS: Insignificant ($P>0.05$). *Significant at $P\leq 0.05$. **Significant at $P\leq 0.01$

Table 4: Descriptive statistics and test of significant for the effect of time and group on changes in bone height.

| Time | Group A | | | Group B | | | P2 |
|---------|---------|-------|-----|---------|-------|----|----|
| | Mean | SD | P1 | Mean | SD | P1 | |
| 0-6 M | -0.650 | 0.132 | * | -0.750 | 0.391 | NS | NS |
| 0-12 M | -1.017 | 0.115 | ** | -0.983 | 0.333 | * | NS |
| 0-24 M | -1.283 | 0.029 | *** | -1.217 | 0.176 | ** | NS |
| 6-12 M | -0.367 | 0.144 | * | -0.233 | 0.104 | NS | NS |
| 6-24 M | -0.633 | 0.104 | ** | -0.467 | 0.252 | NS | NS |
| 12-24 M | -0.267 | 0.104 | * | -0.233 | 0.236 | NS | NS |

SD: Standard deviation, P1: Probability level for the effect of time, P2: Probability level for the effect of group, NS: Insignificant ($P>0.05$), *Significant at $P\leq 0.05$, **Significant at $P\leq 0.01$, ***Significant at $P\leq 0.001$

the prosthesis, so acting as a shock absorber decreasing load on the abutment.²⁰

The therapeutic approach used in this study improved the prosthesis stability and subsequently eliminated migratory pain for the patient suffering from this symptoms and this result was matched with the result of other investigators.^{9-11,21,22}

All tested implants were integrated at the second stage surgery to yield a success rate of 100%. This percentage remained stable during the follow-up period. This result was confirmed during the follow-up period and matched by other investigators.²¹

The values obtained with regard to the patients' subjective satisfaction\complaints about the retention and fit of their dentures, functions such as speech and eating, and improved general facial esthetics were satisfactory and may not differ from those of prosthetic anchorage that employ a greater number of implants, particularly in geriatric patients who meet the anatomic and prosthetic requirement for this type of treatment, restoration can be a relatively inexpensive, a surgically and prosthetically simple way of retaining a complete denture.^{13,22,23}

The gingival tissues surrounding all studied implants showed signs of very slight inflammation. Only grade one of GI was detected in some cases especially in Group A. These healthy gingival conditions might be due to proper oral hygiene and the absence of cement in the implant system that might be responsible for gingival health.²⁴

Advanced age, reduced dexterity of elderly patients and environmental conditions of overdentures do not represent higher risk for the development of peri-implant lesions.²⁵ This has been confirmed by the results of this study in which the peri-implant mucosal parameters were compatible with healthy tissues throughout the follow-up periods.

An *in vitro* model study demonstrated that the single implant-supported overdenture increased retention and stability as compared with the conventional complete overdenture; furthermore, the biomechanical effects were comparable to those observed in a mandibular two-implant retained overdenture.²⁶ In comparison with two-implant overdenture, the single implant presented other advantages such as lower component costs and shorter treatment time while maintaining comparable patient satisfaction.²²

The radiographic examinations revealed that most of the marginal bone resorption took place during the first 6 months of prosthetic loading. The results of the bone height in this study showed insignificant difference between both tested groups. Approximately, half the total bone loss in the immediate 6 months after loading occurred within the first month of the second surgical stage. The mean values of bone resorption in this study fully comply with the success criteria²⁷ being lower than 1.5 mm of yearly resorption after abundant connection.

The use of a single implant is justified because of the fact that in geriatric patients, implant service time is probably limited and in case of failure, the costs and the repetition of the procedure may not be prohibitive for the patient. As far as the location of the single-tooth implant is concerned, the symphysis has many advantages. One advantage of the median position is that the symphysis constitutes an excellent host site for an implant in terms of bone quantity and quality. This region is also easily accessible, demanding minimal time, and surgical trauma (e.g., only local anesthesia is necessary); with the result that few postoperative complications are seen. Although, there was some concern regarding the potential risk of mandibular fracture because of the anatomical structure.²³ There was little difference found between the risk anticipated in overdentures retained by one implant and those retained by two implants.^{28,29}

Conclusions

- Implant-retained mandibular overdenture using a single implant is a relatively simple treatment protocol that reduces the component, surgical and laboratory procedure that a greater number of edentulous patients could benefit from this treatment.
- The use of a single implant at the symphyseal area (midline) is adequate to retain mandibular complete overdentures and can be considered a satisfactory treatment modality.
- Single implant retained overdenture with ball and socket or magnetic attachments was easy in construction, required

less home care to maintain gingival health, and give satisfactory clinical results.

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