One-Piece Implant-Retained Mandibular Overdentures By Pre-Fabricated Titanium Telescopic Attachments and Frictional Varnish: A Two-Year Prospective Study

Keywords

Osseointegration
Telescopic
Overdenture
One-Piece Implant

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Received: 09.06.2016
Accepted: 05.08.2016

doi: 10.1922/EJPRD_01587Nik07

ABSTRACT

Clinical efficiency of one-piece screw-type implants with telescopic were attachments evaluated in this study. Twenty-four patients received a mandibular implant-supported overdenture and maxillary complete denture. Ninety-six one-piece implants were inserted in the inter-foraminal area. Implants were immediately loaded with an implant-retained overdenture and telescopic attachments which had frictional retention elements. There was 0.25±0.24 mm, 0.32±0.25 mm, 0.43±0.30 mm, 0.61±0.30 mm and of bone resorption after 3, 6, 12 and 24 months, respectively. The need to activate the frictional retention was the most common complication. Treatment outcomes for prefabricated telescopic retained overdentures on one-piece implants are similar to that obtained in cases of delayed loading.

INTRODUCTION

Patients with mandibular complete dentures often complain of a lack of retention and stability and decreased masticatory ability. A modern treatment for these problems is implant-supported overdentures with attachments to increase denture stability, retention, proprioception, masticatory ability and speaking. There is no significant difference in the success of overdentures supported by conventional or immediate loading protocols.[1-5] Most of the patients who need this treatment are old and physically debilitated. Three months of numerous clinical sessions are needed to provide an overdenture, which can be highly inconvenient to the patient. Although there is no significant differences between 2 and 4 implant-supported overdentures with regard to clinical and radiographic parameters, there is a tendency for those with fewer implants to require more prosthetic aftercare for their dentures.[6-8] The retention mechanism of overdentures is a controversial issue.[9] The abutment types that connect overdentures have different designs, such as bars, balls, magnets and telescopic attachments and has shown to have no significant role in the marginal bone loss,[10, 11] implant success, clinical performance, complications,[12] patient satisfaction and function. When selecting an attachment, other factors, such as oral hygiene, cost effectiveness, patient expectations, dentist experience and jaw relationships, should be considered.[2]

Telescopic attachments have shown success with high degree of longevity and comfort.[1, 13-17] They provide guidance for insertion and removal, support, and resistance to lateral movements; this leads to better oral hygiene, healthier peri-implant tissue, and easier alteration of treatment plans compared with bar attachments.[1, 2, 15, 18-20] The movement of the implants with two or four conical double crowns was more uniform than joint or parallel-sided bar attachments.[21] The telescopic part can be mounted in the denture by using an intraoral chair side or laboratory techniques. Laboratory techniques have better mechanical and polishing properties and the chair side technique is simple and less expensive and allows the patients to retain the denture.[22]

One-piece implants can be used for immediate loading, which eliminates the screw-loosening of two-piece implants in overdentures[1, 12] and decrease in the number of surgical sessions.[23, 24] The purpose of this study is to assess an immediately loaded mandibular one-piece screw implant overdenture retained with a prefabricated telescopic attachment.

MATERIAL AND METHODS:

In a prospective study, patients were selected from five private dental clinics. The study was performed in accordance with the World Medical Association Declaration of Helsinki. Dental implant treatment plan and terms and conditions were explained and handed to the patient. The treatments were performed in the dental surgeries as routine treatments and we just organized the data prior dental implant treatment.

Twenty-four patients, including 10 men and 14 women, participated in the study. The patients fulfilled the following criteria: 1) Dissatisfaction with previous denture due to bone resorption 2) a sufficient amount of bone between the mental foramina to allow placement of 4 endosseous root-form implants with a minimum length of 8 mm, 3) a medical history that did not contraindicate implant treatment, and 4) complaints concerning chewing ability, even when a new denture was made. The exclusion criteria included: 1) any systemic contraindication for oral surgery, 2) radiotherapy history in the head and neck, 3) any drug abuse or smoking, or 4) a history of autoimmune disease.

Panoramic view radiographs requested prior to treatment. In the case of unacceptable dentures, new maxillary and mandibular complete dentures were fabricated. Adjustments were made such that the patient was as comfortable as possible with the new dentures. The patients were selected and signed a written consent form after being informed about the study.

SURGICAL PROCEDURE:

Before the surgery the lingual surface of the anterior region of the denture was removed but the lingual border remained intact with the thickness of 2-3 mm, which provided a window to acquire adequate space for the abutments (*figure 1*). The modified denture was then placed in position for evaluating the clearance of the space required for the telescopic attachments (*figure 2*). After local anaesthesia a crestal incision was made. Mucoperiosteal flap was raised and then mental foramen identified. Implant osteotomy was done using serial drilling under copious irrigation. The 2 distal one-piece screw implants (OPS, Dr Nik, S&S Biomat Ltd) were placed approximately 5 mm mesial to the mental foramina. The second anterior implants were approximately 5 to 10 mm mesial to the distal implants. The recommended minimum torque for the implant placement was 30 Ncm, which was confirmed with the torque meter in the ratchet. The proper gingival height of the implant was selected after evaluating the soft tissue thickness. The surgeon had free access to the implants with two different gingival heights (2 mm or 4 mm) and two different abutment lengths (4 mm or 6 mm). After insertion of implants the parallelism of the abutments checked by direct viewing perpendicular to axial surfaces and indirect viewing from occlusal surface. If needed, in order to make the abutments parallel they were prepared and polished using carbide burs and a high-speed turbine with irrigation.

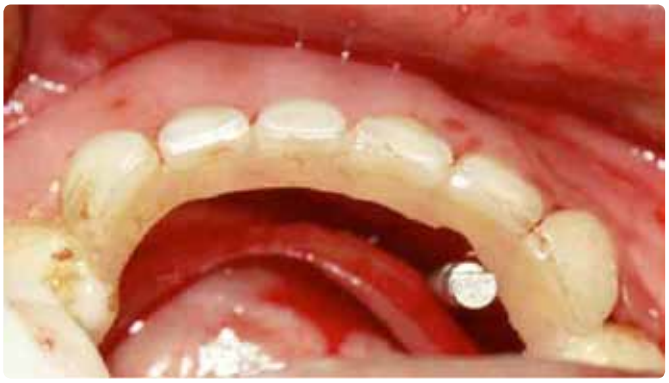

Figure 1: Lingual window in the denture will provide a guidance for proper insertion of implant.

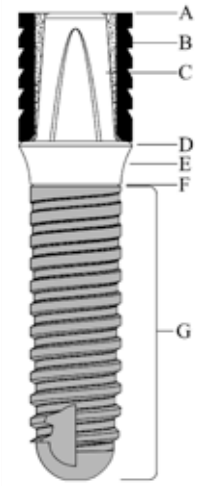

Figure 2: OPS implant. A: Telescopic attachment. B: FGP C: Abutment and Anti-rotational components.D: Prefabricated shoulder-bevelled finish line. E: Highly polished surface in direct contact with the soft tissue. F: Border between the polished and rough surfaces that was used as a reference point for the radiographic measurement of bone resorption. G: Rough titanium surface (sandblast & acid etched).

The existing denture was immediately altered for use as a telescopic-retained overdenture. A window prepared inside the anterior portion of the denture. The proper telescopic attachment selected based on the inserted implant. Red wax was applied in the space between the outer surface of the abutment and the inner surface of the telescopic attachment (*figure 3*). This prevented the attachment from wobbling while it was being mounted to the denture with acryl. Denture checked to have a passive path of insertion and removal onto the implants. Red wax was placed on the prepared window and covered the lingual window in the lingual flange of the denture to protect the acryl from displacing into the mouth while polymerizing. The cold cure resin was applied with the modified denture, which was left to set intraorally. The patient occluded their mouth until the polymerization of the acryl was finished. The denture was then removed, adjusted and polished, 1 mm highly polished surface from the finishing margin of the telescopic attachment was exposed (*figure 4*). In all the cases the retention was increased by adding resin based friction varnish (FGP-friction-fit-system, Bredent GmbH & Co) inside either the 2 or 4 matrixes. Occlusion was controlled for bilaterally balanced occlusion and the implants were immediately loaded by the overdenture. Surgical and prosthetic phase were done by the same practitioner.

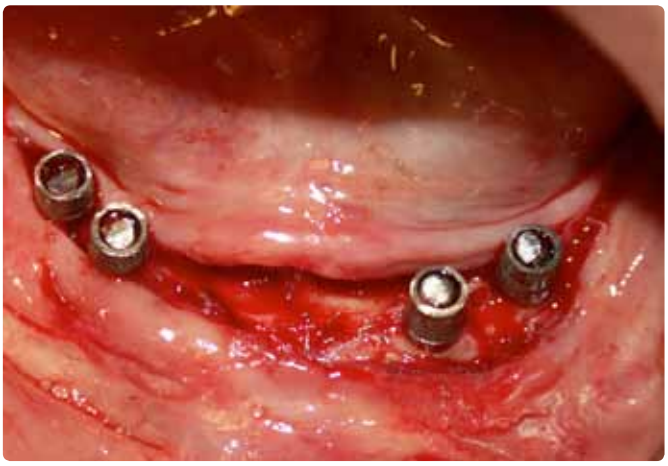

Figure 3: Prefabricated telescopic attachments are installed on the abutments (after preparation) in order to be incorporated into the denture by cold cure acrylic resin.

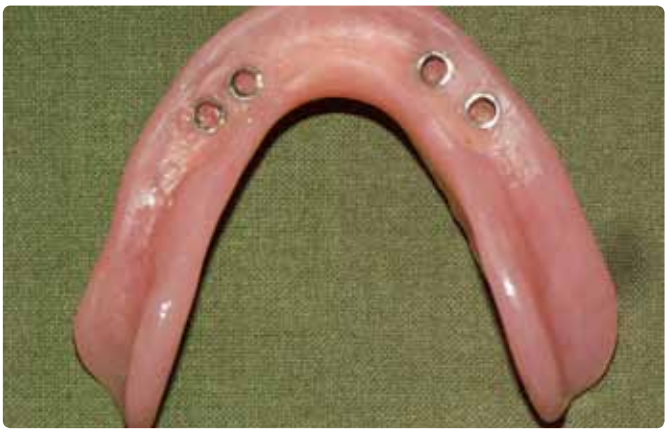

Figure 4: Attachments have been incorporated into the denture.

FOLLOW UP:

Follow-ups were scheduled at 1, 3, 6, 12 and 24 months. Increasing the retention of the telescopic attachments was based on an objective evaluation by the dentists and a patient's request for better retention. First, the previous friction varnish was removed from the matrix and refreshed with the new one. If there was a need for more retention, the friction varnish was added to additional matrixes. During follow-up sessions, the implant integration, occlusion, retention of the denture, condition of denture-bearing tissue, biological complications (soft tissue inflammation, implant mobility) and technical complications (denture problems, retention loss) were recorded.

The dentures were relined when 1) there was anteroposterior instability of the overdenture or rocking on the implants, 2) patients reported increased food accumulation under the denture base, 3) there was a wash impression with light body impression material, which had a thickness more than 1 mm, or 4) there was clinical evidence of altered occlusion. The criteria for renewing the overdenture were the same as those used for the complete denture and were based on professional judgement. The mobility of the implants was examined manually or with percussion. The outcomes were measured by independent and blinded dentists.

The distance between the first implant thread and the contact with the first bone implant was measured by panoramic radiographs obtained at 3, 6, 12 and 24 months following implant insertion. Digital radiographs or scanned radiographs were used. The contrast and zoom brightness of the radiographs were adjusted. The images were analysed using the software (Image J, 1.44p version, Wayne Rasband National Institutes of Health). The software was calibrated with the known part of the implant (implant length). Measurements were obtained for the mesial and distal surfaces, and an average was calculated for each implant at each interval.

STATISTICAL ANALYSIS:

Bone resorption was the main variable. Descriptive statistics (mean values and standard deviations) were used. The data were analysed using the software (SPSS, version 22.0, IBM, SPSS Inc). Normality of the data assessed with Kolmogorov-Smirnov (K-S) test. A one-sample t-test analysis was used to determine the significance between surgery days and follow ups to evaluate the changes in the bone. The confidence level was specified as 1 mm of bone resorption. A total of 92 samples were used. Data are given as the mean±SEM, and $p<0.05$ was considered statistically significant.

RESULTS:

All ninety-six of the dental implants were inserted with more than 30 Ncm of torque, showed successful osseointegration and could be used for prosthodontic rehabilitation (*figure 5*). There was one patient withdrawal due to residence change *(Table 1*).

Table 1. Patient and treatment characteristics

Patient and treatment characteristics	Implants/Failure
Patients (24)	96(4 Imp/Patient)/0
Mean age (range)	48-79(64.1)
Number of inserted implants	96/0
Withdrawal	1 patient
Intra oral Preparation-for paralleling & Relieving undercut	34/0
Implant length (8, 11, 13,15 mm)	4, 21, 47, 20
Implant diameter (3, 3.4, 4 mm)	18, 44, 30

With no implant loss, the survival rate in this prospective study was 100%. Normality of data was approved according to Kolmogorov-Smirnov analysis. The mean marginal bone loss after 3, 6, 12 and 24 months were 0.25±0.24 mm, 0.32±0.25 mm, 0.43±0.30 mm and 0.61±0.30 mm respectively *(Figure 6)*.

A great variety of prosthodontic or technical complications and maintenance requirements were noted during the study *(Table 2)*. The most frequent complication was the inner telescopic activation by friction varnish *(Table 3)*.

Table 2. Complications

Complications	Implants	Time
Telescopic attachment dislodgement	6	3-24 months
Telescopic attachment worn	0	
Fracture/repair of denture	2	6-24 month
Soft tissue enlargement inter abutment	0	
Denture acryl adjustments/Ulceration	6	0-24 months
Denture reline/rebase	5	6-24 months

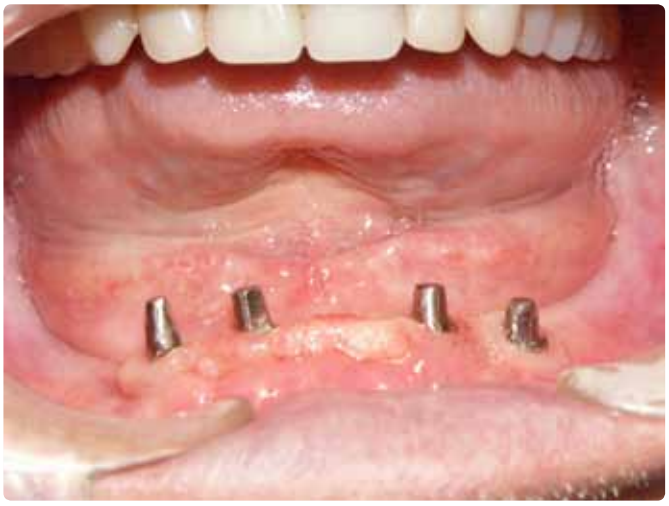

Figure 5: Soft tissue maturation near the one-piece implants is obvious.

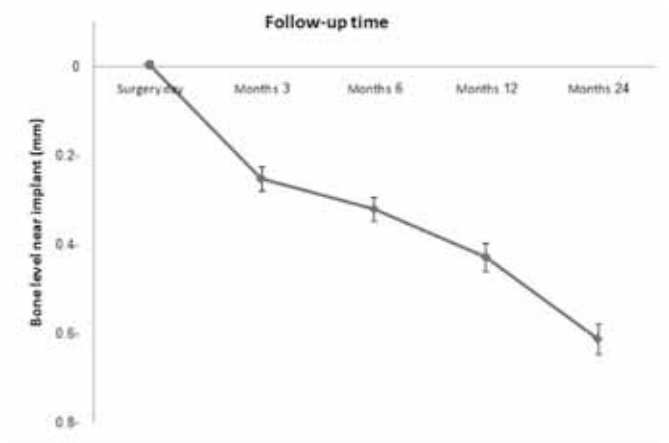

Figure 6: Marginal bone level near the implant at follow-ups. Data were compared with the accepted marginal bone resorption confidence level (1 mm in the two years). There is a significant difference between each time point and confidence level. **p<0.001 compared with the confidence level.

Table 3. Frequency of friction varnish usage. P: Patients.

	Matrix with friction varnish	Refreshed friction varnish
Day of surgery	60 (16 p. in two matrixes-7 p. in four matrixes)	0
Day of surgery – 3 months	60 (16 p. in two matrixes-7 p. in four matrixes)	0
3 months-6 months	62 (15 p. in two matrixes-8 p. in four matrixes)	8 (2 p. in two matrixes-1 p. in four matrixes)
6 months-9 months	64 (14 p. in two matrixes-9 p. in four matrixes)	2 (1 p. in two matrixes)
9 months-12 months	66 (13 p. in two matrixes-10 p. in four matrixes)	8 (2 p. in two matrixes-1 p. in four matrixes)
12 months-24 months	80 (6 p. in two matrixes-17 p. in four matrixes)	48 (6 p. in two matrixes-9 p. in four matrixes)

DISCUSSION:

The survival rate in this study was 100 %, which is comparable to the rates reported in the literature for mandibular implant-retained overdentures.[4, 7, 11, 22, 25-27] There is controversy regarding whether the splinting of implants is advantageous.[8] Although splinting of the implants is recommended to promote early loading results[5] there is no difference between splinted and unsplinted overdentures in their implant survival rates.[3, 4] Our study demonstrated that splinting is not a necessity in overdentures retained by one piece implants. The possible reasons for this survival rate maybe the predictable primary stability in the anterior mandible. The bone resorption in this study, which was 0.43±0.30 mm after one year and 0.61±0.30 mm after two years, was similar to that observed in previous studies, in fixed prosthesis 0.1-1.75 mm[11, 28] and mandibular overdentures retained by four implants.[29, 30] It is predictable to have up to 1 mm of bone resorption near the implants in the first year due to bone maturation and adaptation to occlusal forces[31] After one year, an annual bone loss of 0.2 mm is acceptable[27] Low-level bone resorption in this study could be the result of no gaps between the fixture and abutment.[32]

The tapered abutment of the implants can serve as the inner crown of the telescopic attachments. The prefabricated outer crowns are inserted inside the denture with an acrylic resin. The friction of the outer crown and conical abutment increase the retention and stability of the denture. This technique eliminates the need for impression copings and implant analogues.

The incidence of complications of overdentures retained by conventional attachments have been addressed in the literature which is higher in the first year[10, 33] and will decrease over time;[8] thus, it seems that first-year complications will be demonstrative of the overall aftercare that is needed.[8] Two to five replacements in the matrix or patrix in the first year and one reline in five years have been reported as acceptable numbers of replacements in overdentures[34] The most frequent complications of overdentures are loss of retention (fatigue-wear), fracture and adaptability of denture fitting surface.[8, 12] Decementation of the inner crown[1, 2, 35] and screw loosening[2] are the main problems that have been reported with implant supported telescopic attachments.[1] The matrix and patrix, which have been used in the overdenture design, primarily determine the amount of maintenance that is needed.[9, 12] One piece implants as the patrix of telescopic attachments, eliminate the risk of inner crown detachment and screw loosening of the abutment but their insertion needs accurate parallelism, otherwise they will need preparation in order to provide a single path of insertion for implants. However, the most frequent problem after the insertion of the overdenture in this study was the reduction in retention. The possible reason may be the preparation of the abutments in order to make a single path of insertion for all implants. This preparation enhanced the convergence angle of the abutment which may be the result of reduction in retention. Prefabricated titanium telescopic attachments have shown similar retention to precious alloys.[36] When using prefabricated titanium telescopic attachments, the treatment process is faster, and the patient can receive the final denture on the day of surgery. The direct technique with acryl was used to insert the attachments into the denture. This technique cannot be influenced by impression discrepancies or laboratory processing. Furthermore, it can facilitate chair-side attachment replacing, if necessary.[22] Although previous studies have described retention forces of these attachments that do not significantly change over the first 1.5 years,[37] we had 65 % cases with unacceptable retention. One possible reason is that the abutment preparation diminished the telescopic fitness or the wear between same titanium grade of abutment and the attachment.[38]

There are several techniques to improve the retention of telescopic attachments, such as friction varnishes and electro-forming methods. In this study we used friction varnish which has showed better retentive values compare to other techniques.[39] The retention can simply be increased by application of friction varnish as a retentive mechanism. This technique decreases the cost and treatment sessions for the patients.[24, 40]

There are no studies comparing telescopic attachments with frictional varnishes to conventional attachments like bar and ball attachments. Interference fit is the mechanism responsible for the retention of telescopic attachment. Poor retention of bar or ball attachments is related to the fatigue of the elements but the reduction in the retention of telescopic attachment is the result of decrease in the friction forces of the adjacent surfaces.[41] Correction of the retention in bar and bar attachments needs minimally two sessions and laboratory procedures of changing the components but in telescopic attachments chair side application of frictional varnishes can improve

the retention. An excessive increase in retention can simply be corrected by removing the friction varnish. The telescopic overdenture simplifies the prosthetic procedure and enables easy adjustment, modification and relining with the use of friction varnish; this results in low follow-up costs and decreases the burden of matrix maintenance. Another advantage of this method is that it does not require laboratory procedures; additionally, the patient can benefit from a high retention of the denture and reconstruction of mastication on the day of surgery. All of the cases in our study successfully regained the retention using friction varnish. The use of a single alloy, which provides sufficient rigidity to construct the overdenture without major and minor connectors, allows a peri-protective design to be used. The insertion, removal and hygienic care of the denture can be easily accomplished, even in patients with compromised manual dexterity. When combined with an easily replaced friction varnish, telescopic attachments with decreased retention provide rapid and convenient reactivation. They also provide good stability, support and retention for the overdenture.

Overall, 21 % of patients needed denture relining after two years, which is similar to the percentage found other studies (ranging from 8 % to 40 %).[9, 10] It seems that the need for relining does not depend on the attachment design.[9]

Panoramic views are less accurate compared with intra oral radiographs because of the former's imprecise methodology and magnification errors. However, due to the alveolar bone resorption, superficial insertion of the muscles in the floor of the mouth and patient discomfort, it was not practical to use intraoral radiographs parallel to the implants.

CONCLUSIONS:

Within the limits of this prospective multicentre study, one-piece screw implants demonstrated satisfactory results with prefabricated telescopic attachments after 2 years. Using the friction varnish technique to increase retention of telescopic attachments will shorten the dental sessions in geriatric patients.

ACKNOWLEDGEMENTS:

The author would like to extend his appreciation to all of the patients and their high rate of follow up in subsequent sessions. Additionally, thanks to Dr. S. M. Tonkaboni for treating the patients and Dr. A. Azami for statistical and methodological support. Using the standardized protocols, the study was independently conducted at each centre.

MANUFACTURERS' DETAILS:

- S&S Biomat Ltd, Manchester, UK
- Bredent GmbH & Co.KG, Senden, Germany
- Wayne Rasband National Institutes of Health, USA
- IBM, SPSS Inc, USA

DISCLOSURE:

Dr. Nejatian reports no conflicts of interest. Dr. Shahram Namjoy Nik is the R&D Director of S&S Biomat Ltd.

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