

Osseointegration of Two Immediately Loaded One Piece Mini Implants to Support Mandibular Overdenture

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Abstract This study was performed to investigate the validity of two one piece mini implants to support and retain mandibular overdenture. **Methods:** Seven completely edentulous patients received complete dentures. After two months, two ball type 2.8mm single piece implants were installed in the canine region and immediately loaded with their polycarbonate housing and followed up for 6 months regarding periotest values, marginal mucosal conditions, plaque accumulation and probing depth. **Results:** The results of this study showed non-noticeable changes in plaque accumulation, marginal mucosal conditions and probing depth, and significant difference in periotest values which was increased but within the accepted range (-8 to +9) for stability of the implant. **Conclusions:** Two immediately loaded one piece mini implants in the canine regions to support and retain mandibular overdenture proved to be a successful treatment.

Keywords Complete denture, Overdenture, Implant supported overdenture, Implant retained overdenture, Ball attachment

1. Introduction

Total implant supported prosthesis may be faced with economic and anatomic limitations. Overdenture concept was introduced [1] and the procedure is accepted as a definitive method of treatment [2]. The high success rate of this treatment option, allowed many authors to consider it as the quality of standard for the edentulous patient [3].

Another approach for treatment is considered, the use of minimal number of implants to improve support and or retention of the removable prosthesis [4, 5].

Wearing of complete denture for a long time generally results in alveolar bone loss [1-3]. Overdenture concept was introduced as an alternative to extraction of all teeth and fabrication of complete denture [4]. The procedure is accepted as a definitive method of treatment [5].

The concept of flapless implant surgery has been introduced and clinically applied to both delayed and immediate loading cases [6, 7]. The advantages of this technique are less surgical time and minimal trauma so postoperative pain, swelling, and discomfort related to soft tissue trauma are greatly minimized leading to accelerated postsurgical healing [8]. Moreover, the implant may be loaded after a short period from the surgery where it will save chair time, less physical and psychological trauma to

the patients, and there will be also no micro gaps between the abutment and the implant "inside the tissues" [9].

Mini dental implants (MDI) are single piece implants with a diameter ranging from 1.8mm to 3.0mm with two types of head design either ball or square type [10]. They osseointegrate well and the bone appeared to be integrated to the surface of the mini dental implant at the light microscopic level, and the bone appeared to be relatively mature and healthy [11].

Mini dental implants have the advantage of expanding the bone as they are placed, producing immediate stabilization in most situations with minimal bone removal, as well as they require only a narrow-diameter osteotomy that does not extend to the full depth of the implant, as well as they are usually loaded on the day of placement, reducing the length of the treatment period [12].

Four mini dental implants with ball heads and polycarbonate housing in the anterior region were immediately loaded to retain mandibular overdentures proved to be successful [13].

The aim of this study is to investigate the validity of two one piece mini implants to support mandibular overdenture.

2. Materials and Methods

2.1. Patients Selection

Seven completely edentulous patients were selected from the out clinic of Faculty of Dentistry, Umm Alqura University to participate in this study. They should be free

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from any systemic disease that may interfere with dental implant placement and/or osseointegration e.g. uncontrolled diabetes, hypertension, blood diseases, bone diseases....etc. All the patients should have Class I Angel's classification, adequate interarch distance [14], upper arch of moderate size while the Lower arch showing flat to moderate size ridge. Patients showing gagging reflexes, parafunctional habits and heavy smokers were excluded from the study. Only cooperative patients following instructions and having proper neuromuscular co-ordination were included in the study. The patients had an average age of 54 years.

2.2. Denture Construction

Complete dentures have been made to all cases according to the standard technique followed at the Faculty of Dentistry, Umm Alqura University. The lower denture was duplicated into transparent acrylic resin to help in implant placement.

2.3. Implant Placement

Two single piece mini implants with diameter 2.8mm and length 13 mm with a ball head (polycarbonate housing is also supplied with the implant (Mini Implants, OsteoCare Implant System Ltd. Berkshire, UK) were surgically placed in the canine regions bilaterally. The surgical template was seated over the mandibular ridge and a tissue marking probe was inserted through holes in the stent corresponding to the proposed implant sites to mark bleeding points at the sites selected for implant placement.

Flapless preparation of the implant site was done by drilling the implant osteotomies through the soft tissue then the bone guided by the surgical template to a depth equal to two third of the implant length using a single perforation profile drill of diameter 1.3mm.

The direction was kept perpendicular to the bone, and midway bucco-lingually till reaching the desired depth, putting in consideration the parallelism between the two implants. After preparation of each osteotomy site, the implant is installed until the implant was fully seated in place.

Afterward, Primary stability of each implant was checked using an adjustable torque wrench to confirm that initial primary fixation was exceeding 35N/cm. Additionally a periotest device was also used for the same purpose to confirm that the values were between -8 to +9 to submit to the immediate loading requirements (Periotest M, Medizintechnik Gulden e. K. Modautal/Germany).

2.4. Immediate Loading

After implant placement the polycarbonate housings were secured firmly over the ball abutments. The denture was adequately relined, to allow seating of the denture without any interference with the polycarbonate housings. Rubber band sheets were placed around the ball abutments to facilitate the pickup procedure and preventing the prosthesis lock in undercuts. Cold curing resin was placed in the relieved areas of the denture and the denture was seated in

the patient mouth. The resin was left to polymerize while the patient was closing in centric jaw relation with gentle pressure. The overdenture was removed, trimmed and polished with the polycarbonate housings picked up in its fitting surface and the denture was delivered to the patient. The patients were instructed to eat soft diet food for one month.

All patients were called every month for regular checkup for the overdenture, the implants and the oral hygiene.

2.5. Followup and Evaluation

All patients were evaluated clinically using plaque accumulation, marginal mucosal conditions and probing depth at 3 and 6 months. The periotest values at the time of implant placement and after 6 months.

3. Results

3.1. Plaque Accumulation (PA)

The plaque accumulation around the implant was observed as follows [14].

- 0: Absence of plaque deposits.
- 1: No plaque observed by naked eye but plaque disclosed by running periodontal probe along the gingival margin.
- 2: Visible plaque observed by naked eye with thin to moderately thick layer covering the gingival area.
- 3: Abundant plaque with heavy accumulation of soft matter, thickness of which fill crevice produced by gingival margin and tooth surface.

There was no noticeable changes in plaque accumulation throughout the study period.

3.2. Marginal Mucosal Condition (MMC)

The gingival tissues around the implants were isolated and gently dried by a piece of gauze and then each surface was individually examined and evaluated as follows [14]:

- 0: Normal gingiva; with entire absence of signs of inflammation.
- 1: Mild inflammation; with slight change in color and slight edema. No bleeding on probing.
- 2: Moderate inflammation; with redness, edema, glazing, and bleeding on probing.
- 3: Severe inflammation; marked redness, edema, ulceration, and tendency towards spontaneous bleeding.

There was no noticeable changes throughout the study period.

3.3. Probing Depth (PD)

Measured from the gingival margin to the apical end of the probe on mesiobuccal, distobuccal, midbuccal, mesiolingual, distolingual, and midlingual; using standardized William's graduated probe.

There was no noticeable changes throughout the study period.

3.4. Periotest Values (PTV)

Periotest M device (Periotest M, Medizintechnik Gulden e. K. Modautal/Germany) was used to assess implant stability at the base line and 6 months after. The entire measuring procedure requires approximately 4 seconds. Loose implants display high Periotest values, while implants with good mechanical or biological stabilities display low Periotest values.

Periotest values (PTV) of (-8 to +9) were considered the ideal values that denote successful primary stability and osseointegration. Three consecutive readings were obtained and the average of these values represented the PTV of the implant. At insertion time the mean PTV was (-2.3) with standard deviation (1.2), while after 6 months the mean PTV was (3.4) with standard deviation (1.1).

There was a statistically significant increase in the mean PTV $P (\leq 0.05)$ throughout the study period.

4. Discussion

As a biological response to the insertion of mandibular implant supported over denture, all changes in PA, MMC, PD and PTV could be explained.

All changes were within normal changes because of the careful patient selection excluding those with ridge relation discrepancies (Angle's class II and III) and those with previous history of bruxism. This helped to avoid implant overload as much as possible.

The selection of the anterior part of the mandible also allows for superior bone quantity and quality which made bone remodeling within the permissible range [6, 16, and 17]. It should be noticed that the opposing restoration was upper complete denture that exerts less load on opposite arch compared to natural dentition or fixed restorations [18].

The non-noticeable changes in PA, MMC and PD may be explained by the easiness in oral hygiene maintenance of the ball attachments due to facilitated denture insertion and removal. Moreover, the patients compliance to the given oral hygiene instructions and the ease of cleansing of the ball attachment [19] and its small size that permit accessibility for implant brushing and cleansing [20].

The single piece mini implants provide a gap free connection (bacteria proof), therefore, has optimal effect of the barrier and protection functions of the peri-implant soft tissue which allows the establishment of a tissue collar overlapping the bone implant interface [21].

Regarding the periotest results which revealed significant increase in PTV throughout the study period, the PTV still remain within the permissible range (-8 to +9) which indicates no discernible movement. The high primary stability achieved during implant insertion due to the undersized osteotomy together with the self-threading design of the implant and finally the dense bone of the anterior area of the mandible which led to adequate initial implant stability. This primary stability changed gradually to biological stability which is affected by the rate and the

quality of bone remodeling [22, 23].

5. Conclusions

Within the limitation of this study, two immediately loaded one piece mini implants in the canine regions to support and retain mandibular overdenture proved to be a successful treatment; however, longer follow-up period and radiographic evaluation will be published after the completion of one year time.

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