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Review Article

Immediate Loading of Mini Dental Implants for Stabilization of Mandibular Complete Dentures: Rationale and Clinical Considerations

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Abstract

Implant retained mandibular overdentures are a successful treatment option for the edentulous patients with long-term predictable outcomes, using conventional loading protocols. In recent year modified loading protocols such as immediate loading have been introduced. These loading protocols showed good clinical results with favorable peri-implant tissue response after implant insertion. However, a limitation of this immediate loading treatment protocols is the diameter of the implants. In cases where the residual bone width is limited, patients still need to undergo a bone augmentation procedure before the implants can be inserted. An alternative treatment is to use implants with reduced diameter- the so called Mini Dental Implants (MDIs). The MDI is a one-piece implant that does not require a separate abutment. This simplifies the restorative phase resulting in a reduced cost for the patient. Although long term data and success rates for MDIs are not available, recent studies on immediately loaded implants with a diameter of 1,8 mm, 2,1 mm and 2,4 mm that used to support mandibular over dentures showed high success rates. The literature review shows that the MDIs have the potential being a viable alternative to the current treatment. The aim of this article is to describe the rationale of utilizing MDIs to retain mandibular implant over dentures, and to describe in detail the surgical and prosthetic protocols associated with this treatment modality.

ABBREVIATIONS

MDIs: Mini Dental Implants

INTRODUCTION

Implant-retained overdentures are an established treatment option to improve oral health-related quality of life in edentulous patients [1,2-4]. Up till about 1995 it was suggested that an osseointegration phase of 3 to 6 months for dental implants was required to achieve predictable treatment outcomes. Publications in the experimental and clinical literature showed however that successful osseointegration of implants exposed to early or immediate loading can be achieved [5,6].

Immediate loading of dental implants is defined as being earlier than one week subsequent to implant placement [7]. The immediate loading of implants with overdentures was first reported by Ledermann where 4 implants supported an overdenture [8].

The proposed advantages for such loading protocols are a reduction in the number of surgical and prosthodontic procedures, associated clinical time, healing periods, treatment costs and an improvement of the patient's quality of life. Immediate or early loading of two implants in the edentulous mandible to support an overdenture has been investigated in the literature [9,10-14]. However, a limitation of immediate loading treatment protocols has been the diameter of the implants. In cases where the residual bone width is limited, patients still need to undergo a bone augmentation procedure before standard sized implants can be inserted. An implant of nearly 4 mm in diameter requires at least 6 mm of bone in a facial-lingual dimension for placement without grafting additional bone to augment the site [15].

An alternative to standard or narrow diameter implants in the edentulous mandible is the use of Mini Dental Implants (MDIs). The MDI is a one-piece implant that does not require a separate abutment. This simplifies the restorative phase resulting in reduced costs for the patient. Although initially MDIs were used for temporary prosthetic stabilization during the healing phase of

standard implants their reproducible success has expanded their use [16-18]. Subsequently, they have been used for long term fixed and removable prosthetics [19]. Griffitts et al., placed 116 MDIs in the anterior zone of the mandible. The reported success rate for the implants was 97.4% whereas a great improvement was mentioned by the patients with regard to retention of the prosthesis, chewing ability, and comfort in a comparison of questionnaires completed pre-operatively and at five months post-operative. In a cost benefit analysis the authors concluded that the cost of four MDIs was equivalent to one conventional implant [20]. Shatkin et al., have placed 2514 MDIs over a period of 5 years with an overall survival of 94.2% [21]. The literature review showed that the 'Mini Dental Implant' has the potential of substituting the current standard care for the edentulous mandible (2 implant overdenture) and can be a viable alternative to the current treatment. In case of narrow ridges the alternative to mini implants is an augmentation of the ridge in order to provide adequate bone width for placement of conventional implants [22]. This treatment modality therefore might be a solution particularly suited for medically compromised patient. That means patients who would otherwise be excluded as a result of health problems that preclude extensive surgical procedures can benefit from implant treatment resulting in an improvement in the quality of their lives. Clinical and radiographic outcomes of immediately loaded MDIs used for long term stabilization of over dentures as an alternative to standard sized implant overdentures have been already published in the literature clinical and radiograpich outcomes of Ahn et al., showed that 26 of 27 MDIs were stable after 21 weeks of follow up [23]. In a prospective recent study by Elsyad et al., it was shown that the peri-implant tissue responses of immediately loaded MDIs supporting mandibular overdentures were favourable after 3 years. The cumulative survival rate was 96.4% and the success rates of MDIs were 92.9% [24].

Although the mini dental implant has a reduced surface area compared with a conventional dental implant, histology in miniature swine has indicated that MDIs are capable of achieving significant osseointegration after three months. The histomorphometric evaluation showed bone integration in all implant samples at three months (average BIC of 82%) [25].

The narrow diameter of the MDI allows a simplified insertion technique involving placement without raising a flap. To summarize, the benefits of providing an implant over denture on mini implants include the fact that the treatment is cheaper and it is simpler (the prosthetic part requires less appointments and of shorter time).

INSERTION PROTOCOL-SURGICAL CONSIDERATIONS

3M ESPE Mini Dental Implants are especially indicated for the stabilization of complete mandibular dentures. Atrohpy of the jaw that necessitates denture stabilization makes however implant placement difficult. It is possible to place some mini-diameter implants (≈ 1.8 mm) in bone that is as narrow as 3 mm in a facial-lingual dimension. It is necessary to have adequate crestal-apical bone for a 10-mm–length implant, preferably 12 mm or more [24].

MDI's rely on mechanical anchoring through cortical bone contact and compression. Osseo-integration occurs over time, but it means that is not crucial for function (Figures 1,2).

Preoperative planning

Case planning includes a maximum of diagnostic information. A panoramic x-ray is the minimum requirement, a Cone Beam CT scan is recommended for 3D planning especially in cases with very narrow ridges.

Raising a flap or flapless

If there is sufficient width of the ridge a flapless transgingival technique for the pilot drill is possible. When however a narrow ridge of extensive soft tissue is present a minimal flap (crestal incision) is recommended to reveal the bone. This would allow exact placement of the implants at the correct angulation in the bone (Figures 3,4).

Surgical protocol

3M™ ESPE™ MDI Mini Dental Implant System utilizes a self-tapping threaded screw design and employs minimally invasive surgical intervention. Implant placement involves the following procedure:

The left and right Mental Foramen are marked with intra-oral skin marker. The ridge is marked 7 mm anterior of the mental foramen to indicate the most distal implant size. This safety zone includes a potentially present 3-5 mm anterior loop and a 2 mm security margin.

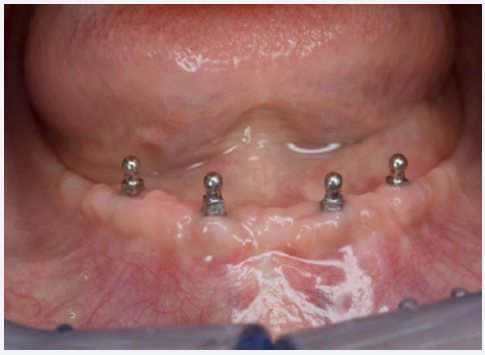

Figure 1 Intraoral view of fully seated MDIs.

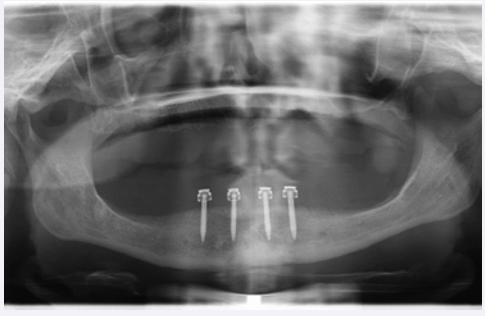

Figure 2 Radiographic view of MDIs.

Figure 3 Flapless placement of MDIs.

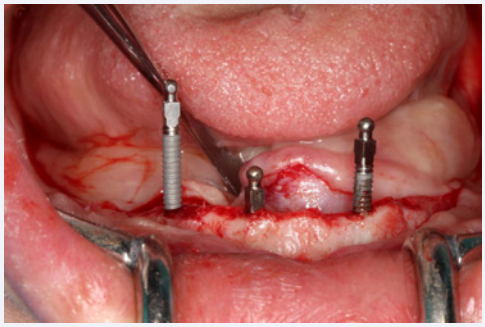

Figure 4 Placement of MDIs after raising a flap.

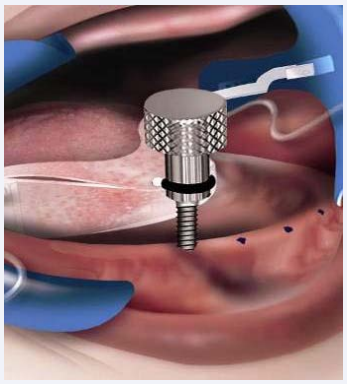

Figure 5 Implant insertion Using Finger Driver.

When in doubt regarding the position of the mental nerve, the mental foramen should be exposed prior to implant placement to ascertain its position. The remaining sites are marked with at least 5 mm between each one. After administration of local anesthesia, the pilot hole is prepared with the correspondent pilot drill. If during the implant insertion the torque exceeds a certain value (45 Ncm), the implant should be unscrewed and the drill hole should be deepened to 2/3 of the implant length. The MDI is screwed directly in the pilot hole until there is sufficient friction (Figures 5,6). Using a torque wrench with adapter the MDI implant is manually screwed into the final position. Care should be taken to avoid lateral forces, which can cause fracture even with torque levels in a safe range. It is also important to allow enough time between turns for bone displacement (7 seconds per ¼ turn and wait 5 to 10 seconds) (Figure 7).

The torque should not exceed 45 Ncm during implant placement. If the torque wrench breaks away at 35 Ncm the implant has enough stability for immediate loading. If the implant can be fully seated without the wrench breaking away at 35Ncm, bone quality is not sufficient and a better location should be chosen for implant placement

Prosthetic protocol

Direct prosthetic protocols for new denture: The anterior, roughen tissue born surface of the denture is relieved to accommodate implants and metal housings, creating individual holes or a trough and adhesive is applied.

The blockout shims are trimmed to appropriate length and one shim on each implant is placed to block out undercuts. The metal housings are placed on each implant and are checked for passive fit over shims. The denture is placed in patient's mouth and is checked for passive fit over implants and housings. A thin layer of adhesive is applied to the tissue-contact surface of the denture. SECURE Hard Pick-Up acrylic material is extruded directly onto Metal Housings and into the troughed denture. The Denture is placed in patient's mouth in normal occlusion for 6 – 8 minutes while acrylic sets. Finally the denture is trimmed and polished.

Indirect prosthetic protocols for new denture: The O-Ball Impression Copings are snapped directly onto each O-Ball MDI Implant. Soft tissue may prevent full engagement of the coping on implants seated too deeply into soft tissue. In such a case, it is recommended to take an impression of the O-Ball head of the implant without impression copings applied. Standard crown and bridge impression techniques are used to pick up the impression

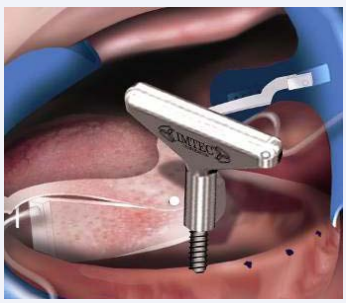

Figure 6 Advancement of the implant using the Winged Thumb Wrench.

Figure 7 Final Seating of the implant with Torque Wrench.

copings, recording each implant's position easily and accurately.

Once the impression has fully set, the tray is carefully removed from the patient's mouth and it is confirmed that all impression copings have been captured accurately in the impression.

The appropriate MDI Lab Analog is inserted by reviewing the type of MDI O-Ball Implant used in the case. The square neck of MDI Analog is aligned with the square opening at the base of the Impression Coping. The analog is pressed into the coping until a snap fit is observed. Standard stone model fabrication techniques are used to form the model. Once the stone has set completely, the impression is carefully removed from the model (Figures 8,9).

DISCUSSION

MDIs are manufactured as one piece to include an abutment designed for support and/or retention of a provisional or definitive prosthesis [26]. Although there are several MDI systems in today's market, we have referred to the 3M™ ESPE™ MDI system since it is a one piece implant with a relatively good documentation. It was introduced originally as the IMTEC Sendax MDI™ system and since then several studies have shown that it can be used successfully in completely edentulous patients who face problems with the retention of their conventional mandibular dentures. MDIs are combined in most cases with an increased number of implants (usually four) in order to compensate for the reduced diameter and surface area and may be a feasible treatment alternative. A recent retrospective study of up to seven years, showed a high survival rate of the MDIs used to support mandibular over dentures (94.9%) when the maxilla was provided with complete dentures [27]. The survival rates of MDIs reported in the literature are comparable to those of immediately loaded standard sized implants for which current clinical research shows that they can be reliably used to support mandibular overdenture prostheses [7].

Figure 8 Lab analogues placed into the pickup copings.

Figure 9 Master cast with Analogs.

Clinical and radiographic peri-implant tissue response of immediately loaded MDIs supporting mandibular over dentures were also favourable after 3 years of function [24]. The vertical marginal bone loss reported in the aforementioned study was -1.26 ± 0.64 mm 36 months after loading, and it was comparable to that experienced with standard sized implants. The authors attributed this decreased crestal bone loss to a combination of factors such as the flapless placement, the self tapping characteristics of the MDIs which may aid to increase bone density \ surrounding the implants and the resiliency of the O-ring housing which acts as a shock absorber.

Beyond clinical findings however patients' perception on how implant treatment contributes to their quality of life and overall satisfaction is also relevant. Based on the data of a five year prospective study patients' satisfaction with MDI-retained mandibular overdentures increased significantly with time [28].

As any other type of oral rehabilitation the provision of implant-retained overdentures, requires a regular and ongoing maintenance program to ensure long term clinical success. Relining of a mandibular implant overdenture might occur more often in cases of immediate loading of the MDIs because secondary healing of the soft tissue around the implants may require relining of the prostheses [29]. Other prosthodontic complications may include wear/replacement the O-ring attachments, detachment of the metal housing and fracture of the mandibular over denture and maxillary denture relining procedures.This treatment modility therefore, may require a considerable amount of prosthetic maintenance and repair over time [28]. In general however, it is difficult to make definitive conclusions since, even when studies report on prosthodontic complications, there is a lack of predetermined criteria related to a successful prosthodontic outcome. In any case it is important to emphasize that the success of any implant over denture begins with a well-made, well-fitting denture with proper extensions and occlusion.

Mini Dental Implants have the potential to be an adequate cost-effective alternative for denture stabilization in the edentulous mandible, especially in situations in which standardized implants could not be used without additional grafting procedures. There is however a lack or well-controlled randomized clinical trials with sufficient sample size comparing MDIs with conventional diameter implants used to support mandibular over dentures

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