Coll. Antropol. **36** (2012) 1: 307–311
Case report

Prosthetic Rehabilitation of a Patient with Mandibular Resection Prosthesis Using Mini Dental Implants (MDIs) – Case Report

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A B S T R A C T

Physical disfigurement and functional impairments associated with facial trauma are a challenge to a prosthodontist, because even novel sophisticated surgical reconstructive techniques fail to provide adequate support for dental resection prosthesis. Therefore, different endosseous implants are often used as prosthesis-supporting elements. Manufacturers of dental implants have recently presented mini dental implants (MDIs) with diameter of only 1.8–2.4 mm. These implants allow very suitable prosthetic solutions within the range of their indications due to good osseointegration success rates, simple surgical technique, and immediate loading possibility. In this report, a case was presented for prosthetic rehabilitation including implantation of two Sendax type (IMTEC, Ardmore, Oklahoma, USA) MDIs in mental region, to obtain better retention and stability of the mandibular resection prosthesis and to improve function, phonation and aesthetics. The use of these implants, among aforementioned preferences, is also very cost-effective, so this implantation possibility should be taken into consideration during prosthetic treatment planning.

Key words: *prosthodontics, dental implants, mandibular prosthesis, mandibular injuries*

Introduction

Warfare facial injuries from high-velocity missiles (rifles) are often characterized with large exit wounds, severe distortion and loss of tissue and deep tissue injury from high energy cavitations within the body sometimes also demanding resection of the damaged tissue[1]. In civilian settings indications for resection of the mandible (or maxilla) are usually benign and malign tumors and trauma. Mortality rates, possible physical disfigurement, and functional impairments are usually lower when care is provided in certified trauma centers[1]. Surgical restorations of mandible resections have advanced dramatically with free-flap techniques, but it appears that even these novel surgical reconstructive techniques fail to provide adequate support for dental prostheses[2]. Therefore, it is often considered that the restoration of compromised morphologic conditions after the removal of tissue from lower mouth floor is only effective if endosseous implants are used as prosthesis-supporting elements. These cases are reported in the literature[3,4], but always the conventional implants were used. So, in the recent literature quotation on the use of mini dental implants (MDIs) as a support for resection prosthesis in compromised mandible was not found, although the use of MDIs as an obturator prosthesis support was reported[5].

It should be emphasized that the use of dental implants of smaller diameters in various forms has been present for almost 20 years. In general, these implants are 2.75–3.30 mm in diameter, and they are frequently used in cases of limited bone volume. The MDIs are even smaller, with diameters ranging from 1.8 to 2.4 mm[6].

In the beginning, the main usage of MDIs was only to serve as the helping and provisional instrument for insertion of provisional restorations during the osseointegration phase of conventional larger diameter endosseous implants[7,8] and for orthodontic purposes[9]. The assumption was that MDIs are unable to provide on-going application for implant-supported prostheses[8]. In the course of time, it was observed that these implants integrated very well clinically and were difficult to remove[7,8]. It became clear that, with minimally invasive implant inser-

Received for publication July 28, 2010

tion protocol with MDIs, they could also provide satisfactory prosthodontic rehabilitation effect[6,7].

The advantage in use of MDIs is that it is the minimally invasive, single-stage placement procedure[8]. Compared with MDIs, the insertion procedure for conventional implants (diameter 3.5 mm and wider) is aggressive surgical procedure, which requires a mucoperiosteal flap operation and full-depth bone preparation (osteotomy). Therefore, the need of recovery time during tissue regeneration, vascular function restoration, and osseointegration are present[10]. Minimally invasive technique of MDIs insertion consists of turning of the implant into the bone through a starting opening, but not a prepared bone site[8]. Therefore, there is no bone damage or bone wound during implantation. Bleeding and postoperative discomfort are reduced[7], and most importantly, healing time is shortened[10]. Such implant can be practically loaded immediately, with no need for waiting for osseointegration, and which is often very important, at low cost[7,8]. Due to their simple implant procedure these implants could also be suitable for the patients receiving partial mandibulectomy, especially because nearly one-third of such patients reject classical implant therapy primarily due to difficulties coping with additional implant surgery and time constraints[2]. Also, classical implant therapy is very expensive, so it is another reason that would often deter patients from accepting implant treatment. Aforementioned advantages and scientific findings of the MDIs provided the clinicians with the predictable and financially feasible prosthetic treatment solutions even for the patients who received partial resection of the mandible.

Case Report

A 67-year-old man presented for examination in the Clinical Department for Prosthodontics at the Dubrava University Hospital. His medical history showed that 18 years ago he was shot with the rifle during the war in Croatia. During the repair of the facial trauma he received partial resection of the mandible on the right side, and reconstruction with a free iliac bone graft. He came because he was unsatisfied with the old resection prosthesis due to low retention and mobility. The clasps on the mandibular left second and third molar had broken so the masticatory force was transferred only on the mandibular left canine that was wearing telescopic crown. During the wearing time, old mandibular resection prosthesis was not, even once, underlined[11], and so, in time, canine became excessively mobile and had to be extracted[10]. Other teeth in the mandible were missing (Figure 1). Patient had been informed about the unfavorable retention situation and possibilities of standard implant therapy and implant-supported resection prosthesis, but he could not afford it. Because therapy with MDIs is much cheaper[7], possibility of MDIs use was presented to the patient.

Dental impression with irreversible hydrocolloid (Aroma Fine DF III, GC, Tokio, Japan) was taken, and

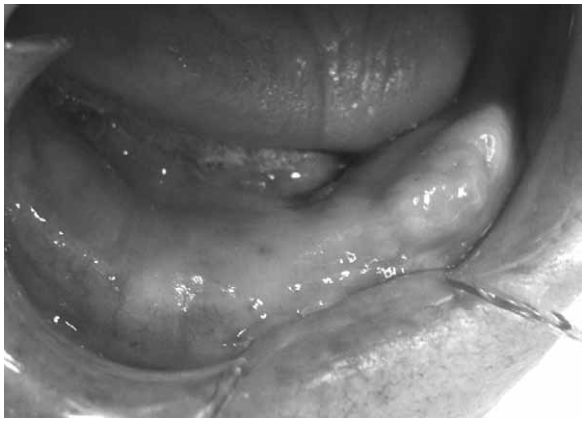

Fig. 1. Condition in patient's mouth after canine extraction.

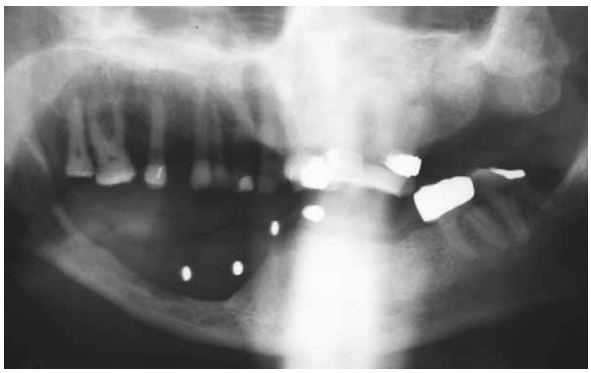

Fig. 2. Orthopantomograph with visible lead markers.

resin baseplate with lead ball bearings was produced. The orthopantomograph (with the baseplate) was taken to evaluate the possibility of mini-implant insertion and to determine their position and size (Figure 2). Because the bone graft on the resected side of the mandible was thin and with the low-density bone, it was not suitable for the implant insertion. Therefore, two telescopic crowns on the molars and two MDIs in frontal healthy part of the mandible were planned. The complete prosthetic expertise, with final financial construction was made for the patient, and because it was twice cheaper than previously suggested conventional implant-supported prosthesis, the patient decided to make mandibular resection prosthesis supported with two MDIs Sendax type (IMTEC, Ardmore, Oklahoma, USA) with ball attachments and two telescopic crowns.

Although insertion of MDIs does not require bone exposure, crestal incision was performed to observe unhealed alveolar socket of the extracted left canine. One MDI was planned to be inserted medially of the canine alveolar socket, and the other one distally of the canine alveolar socket. The mandible bone was initially drilled with the locator drill (IMTEC) on the desired spots. The bone drilling was performed using disposable surgical drill (IMTEC) of 1.1 mm diameter to the depth of ½ length of implant as recommended by the manufacturer. Parallelization of the implants was achieved with the in-

sertion of sterile, previously used, surgical drill into first drilled implant site. After drilling, the MDIs Sendax Classic Standard, O-Ball (IMTEC) dimensions 1.8 mm (diameter) x 15 mm (length) were screwed firstly using manual screwing instrument (IMTEC), and then with ratchet (torque 35 N/cm^2) (Figure 3). After insertion of MDIs, gingiva was sutured, and the sutures remained for seven days. During healing period of the gingiva, mandibular left molars were prepared (Figure 4), and the silicone corrective dental impression (Express, 3M Dental Products, St. Paul, MN) was taken to make inner telescopic crowns from CoCrMo alloy (Wironium plus, BEGO, Bremen, Germany). Acrylic resin custom tray was also made on the duplicate cast. Custom tray had the perforations on the implant sites, which were broad enough so the impression copings (IMTEC), placed on the implants, could pass through. Inner telescopic crowns were placed on the molars, and functional dental impression was taken using the condensation silicone Xantopren L (Haereus Kulzer, Hanau, Germany). Functional dental impression contained impression copings and inner telescope crowns, which were taken in the identical position as they were placed in the patient's mouth. The laboratory implant analogs (O-Ball Prosthetic Head Analog, IMTEC) were inserted into the impression copings (Figure 5), and the dental casts were poured in hard stone (Moldano, Haereus Kulzer, Dormagen, Germany). Micro metal housings (HM-2, IMTEC) were placed onto the laboratory implant analogs (Figure 6), and the metal base of the mandibular resection prosthesis containing outer (opened) telescopic crowns was produced (Figure 7). Further clinical and laboratory procedures were performed according to the routine procedure[13] for partial removable prostheses production[14]. Adequate retention and stability of resection prosthesis were obtained by MDIs and telescopic crowns. This resulted in satisfactory function and phonation, and moderate esthetics because of untreated maxillary teeth due to high prosthetic treatment costs (Figure 8).

Fig. 3. Implantation of mini dental implants.

Fig. 4. Implants after healing of the gingiva and prepared molars for telescope crowns.

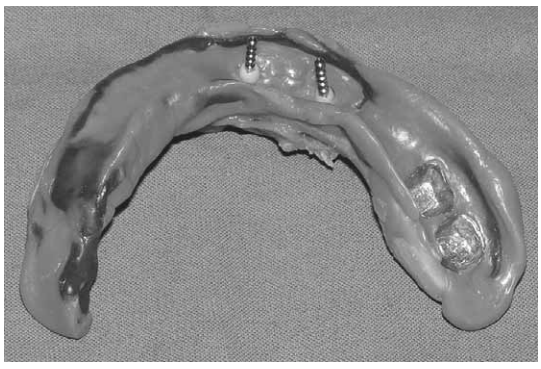

Fig. 5. Functional impression with placed laboratory implant analogs into transfer copings.

Fig. 6. Working model pored in stone with built in laboratory implant analogs and placed metal housing and telescope crowns.

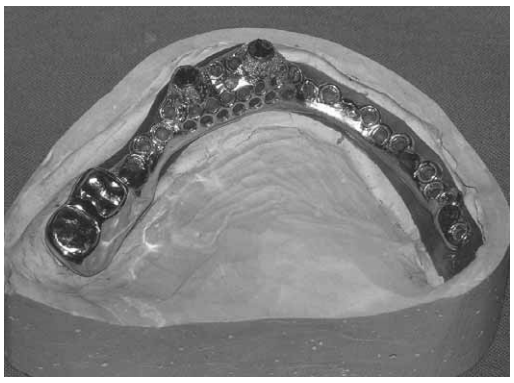

Fig. 7. Metal base of the resection prosthesis with outer (opened) telescope crowns.

Fig. 8. Resection prosthesis in patient's mouth.

Discussion

Recent advancements in facial reconstructive surgery and osseointegrated dental implants provide treatments modalities that may adequately rehabilitate patients with facial trauma and/or oral cancer so that they can return to a healthy, productive life[2]. However, conventional implants can be financially difficult for many patients, not just for this particular one, and MDIs are significantly more affordable when compared with conventional implants[7,8]. This type of implants is not just less costly, but also less complicated needing less surgically intensive treatment. Essential condition for all implants use is successful osseointegration that can be confirmed only with the long-term studies of success and survival rates of implants under load in masticatory function. Shatkin et al.[6], in their retrospective analysis over five years of 2514 MDIs (placed in 531 patients) which equally supported fixed and removable dental prostheses, found the overall implant survival rate of 94.2%. Bulard and Vance[15] in their biometric analysis of 1029-inserted MDIs used for long-term denture stabilization reported acceptable failure rate of 8.83%. Other studies of survival rates reported range from 83.9 to 97.5% depending on location and whether the MDI is used for single-tooth or multitooth-supported prosthesis[16,17]. Study of Balkin et al.[8], in which they used histological analysis, showed that the quality of MDIs osseointegration could be compared with the quality of larger diameter implants osseointegration.

Ertugrul et al.[18], in their in vitro study, revealed that implants of larger diameter are more stable under lateral forces than MDIs. This is logical because of their almost double high surface area. In clinical practice, this »disadvantage« of MDIs can be overcome by successful planning and using more implants[8]. Therefore, in this case, two MDIs were used to »substitute« one conventional implant or one missing canine that had to be extracted and thus to provide adequate retention of the resection prosthesis. Inadequate retention of a reconstructive prosthesis can cause difficulties in mastication and communication and can affect esthetics[19].

Initial stability is important for the successful osseointegration and optimal oral implant function, and it is linked with high implant success rate. It is stipulated with bone quality, implant design, and surgical technique that is used[18]. Therefore, some authors[5,20] recommend bone drilling to the depth of only 1/3 of MDI's length to achieve better initial stability. In our case, drilling to the depth of 1/2 of the MDI's length was performed (according to the manufacturer's instruction) because of dense bone structure of left healthy part of the mandible. Dense bone structure of mandible, together with selected maximal implant length contributed to the good initial stability of the implanted MDIs. Because there is no completely prepared implant site, during turning the implant itself, it should withstand remarkable torque forces and should not break. It is possible because Sendax MDIs are made of titanium 6–4 alloy which has 62.5% higher tensile strength than grade IV commercially pure titanium, the strongest of the standard commercially pure titaniums according to the American Society for Testing and Materials specification B348[21]. The higher tensile strength of such produced MDI allows auto-advance insertion without bending or fracturing[8].

The MDIs do not pretend to be substitute for conventional implants, because wider diameter implants present several advantages, such as improved prosthetic stability, reduced implant fracture, and more favorable force distribution in qualitatively and quantitatively poor bone[22]. The MDIs are suitable for use in conditions with lack of adequate bone tissue for conventional implant placement, especially in patients with narrow alveolar ridges as there is no need for relying on grafting techniques[8]. They are also very suitable for single-tooth replacement with restricted space (lower incisors)[20], but the most effective prosthodontic use of MDIs is probably for the retention and stabilization of complete dentures, especially mandibular dentures[23]. Griffitts et al.[7] evaluated patients' satisfaction with overdentures supported with MDIs (comfort, retention, chewing ability, and speaking ability), and they found that patients' satisfaction was excellent. Two MDIs used in this case, also proved to be an effective additional retention and stabilization for mandibular resection prosthesis at low cost. In this way, the problems connected with complete dentures' wear, such as lack of retention and stability, decrease in function, and difficulties in speech and soft tissue sensitivity[24,25], were solved. Therefore, this type of implant presents the opportunity to provide patients with cheaper, less complicated, and less surgically intensive treatment in a high number of cases that would be difficult to treat with the current inventory conventional, root-form implants.

Conclusion

Considering all the advantages of MDIs (success rates, surgical technique, financial advantages, possibilities of immediate loading), it can be concluded that MDIs are highly successful implant option not only for edentulous mandible, but also for the patients who have undergone mandible resection. On the basis of the remain-

ing teeth, and soft and hard tissue configuration, MDIs could be also successfully used to increase support, stability, and retention of resection prostheses and to achieve masticatory function and aesthetics. And, as mentioned, because the MDIs are cost-effective they are particularly suitable for patients who are not able to withstand the costs of more expensive conventional implants therapy.

Acknowledgements

This article originates from scientific project »Investigation of materials and clinical procedures in prosthetic dentistry« – grant No. 065-0650445-0413 supported by the Ministry of Science, Education and Sports of the Republic of Croatia.

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PROTETSKA REHABILITACIJA PACIJENTA RESEKCIJSKOM PROTEZOM MANDIBULE UZ UPORABU MINI DENTALNIH IMPLANTATA (MDI) – PRIKAZ SLUČAJA

SAŽETAK

Fizičko izobličenje i oštećenje funkcije koji su pridruženi traumama lica predstavljaju izazov za protetičara, jer čak i nove sofisticirane kirurške rekonstruktivne tehnike ne uspijevaju dati odgovarajuće ležište za resekcijsku zubnu protezu. Stoga se uporabljuju različiti endosealni implantati za retinciju takovih proteza. Proizvođači dentalnih implantata su nedavno predstavili mini dentalne implantate (MDI) promjera samo 1,8–2,4 mm. Ti implantati omogućuju vrlo prikladne protetske radove ukoliko se uporabljuju unutar granica svojih indikacija, i to zbog svoje dobre uspješnosti oseointegracije, jednostavne kirurške tehnike i mogućnosti imedijatnog opterećenja. U ovom radu prikazan je slučaj protetske rehabilitacije koja uključuje ugradnju dva mini dentalna implantata tipa Sendax (IMTEC, Ardmore, Oklahoma, SAD) u mentalnu regiju kako bi se postigla bolja retencija i stabilizacija mandibularne resekcijske proteze i time poboljšala funkcija, fonacija i estetika. Osim spomenutih prednosti, uporaba ovih implantata je i financijski vrlo povoljna, te mogućnost njihove uporabe valja svakako imati na umu tijekom planiranja protetskoga rada.