

Oral rehabilitation with implant supported overdentures in patients with non-reconstructed segmental mandibulectomy: A report of two cases

Rehabilitacija ust z implantatno podprto zobno protezo pri bolnikih po nerekonstruirani segmentni mandibulektomiji: dva klinična primera

Rok Zupančič,¹ Milan Kuhar²

¹ Zobozdravstvo Zupančič d.o.o., Staničeva 4, 1000 Ljubljana

² Center za stomatološko protetiko, Stomatološka klinika, Univerzitetni klinični center Ljubljana

Korespondenca/ Correspondence:

doc. dr. Milan Kuhar, dr. dent. med., Center za stomatološko protetiko, Stomatološka klinika, Univerzitetni klinični center, Hrvatski trg 6, 1000 Ljubljana
e: milan.kuhar@mf.uni-lj.si

Ključne besede:

zobna proteza, implantatno podprta, mandibulektomija, konusna prevleka, rezkana gred

Key words:

overdenture, implant supported, mandibulectomy, conical crown, milled bar

Citirajte kot/Cite as:

Zdrav Vestn 2013; 82: 695–701

Abstract

Background: Segmental mandibulectomy is most often performed as part of resection of advanced squamous cell carcinoma, which involves the mandible by extension from intraoral tissues and is usually followed by reconstruction of the mandible. However, not all mandibular defects can be surgically reconstructed, due to local or systemic factors. Oral rehabilitation with conventional removable dentures is often insufficient. In order to provide predictable support and denture retention, especially in the non-reconstructed cases of segmental mandibulectomy, dental implants are indicated.

Case report: The authors describe oral rehabilitation with implant-supported overdenture in two non-reconstructed patients with similar mandibular defect, but different etiology, as well as different denture design and different outcome in terms of success and patient satisfaction. In the first case, the defect was caused by surgical treatment of cancer, which was followed by radiotherapy and prosthodontic treatment with an implant-supported mandibular overdenture anchored with a bar. In another case, the damage was due to a suicide attempt. This was initially followed by the surgical treatment of the injury. Afterwards, the prosthodontic treatment with an implant-supported and conical-crown-anchored mandibular overdenture was performed.

Conclusions: The success of the prosthodontic oral rehabilitation of patients with segmental mandibulectomy depends on many factors. The

size of the defect and the condition of the remaining hard and soft tissues, which are affected by radiotherapy, are crucial. The etiology of the defect, the opposing jaw status, maxillomandibular relationships, the consistency of mandibular movement and the denture design play an important role as well.

Izveleček

Izhodišča: Segmentni mandibulektemiji, ki je pogost poseg pri kirurški odstranitvi napredovalega ploščatoceličnega karcinoma ustnega dna, pogosto sledi kirurška rekonstrukcija spodnje čeljusti. Zaradi lokalnih ali sistemskih dejavnikov pa vseh poškodb čeljusti ni mogoče zgolj kirurško rekonstruirati. Oskrba tovrstnih bolnikov s klasično zobno protezo praviloma ni uspešna. Predvidljivo podporo in sidranje zobne proteze, zlasti pri nerekonstruirani segmentni mandibulektemiji, je možno doseči le s pomočjo vsadkov.

Klinični primer: V prispevku je opisana zobno-protetična rehabilitacija z implantatno podprto zobno protezo pri dveh bolnikih s podobno nerekonstruirano okvaro spodnje čeljusti, vendar z različno etiologijo poškodbe, različnim načrtom zobne proteze in različnim izidom glede uspešnosti oskrbe ter zadovoljstva bolnika. V prvem primeru je poškodba spodnje čeljusti nastala po kirurškem zdravljenju raka na ustnem dnu. Temu je sledilo obsevanje in kasneje še protetična oskrba z implantatno podprto protezo, sidrano z gredjo. V drugem primeru je poškodba nastala po poskusu samomora. Sledila je kirurška

Prispelo: 5. okt. 2012,
Sprejeto: 30. apr. 2013

oskrba poškodbe in nato protetična oskrba z implantatno podprto protezo, sidrano s konusnimi prevlekami.

Zaključek: Na uspešnost protetične oskrbe ustne votline pri bolnikih s segmentno mandibulekto-

mijo vpliva več dejavnikov. Najpomembnejša sta velikost poškodbe in stanje preostalih mehkih in trdih tkiv, npr. po obsevanju. Pomembni pa so tudi vzrok poškodbe, stanje nasprotne čeljusti, medčeljustni odnosi, skladnost gibov spodnje čeljusti in nenazadnje sam načrt proteze.

Introduction

The mandible is an essential component of the stomatognathic system and it participates in many of its functions. Providing support to teeth, masticatory muscles, tongue and lower lip, it enables actions such as chewing, swallowing and speaking, playing an important role in socializing as well. Since it defines the shape of the lower third of the face its role in facial aesthetics is crucial. If the continuity of the mandible is lost, the residual segment usually deviates towards the surgical site due to unopposed action of the masticatory muscles and scar tissue contracture and many of these functions are deficient.^{1,2} The extent of functional deficiencies depends on the amount of hard and soft tissues missing.²⁻⁴

Segmental mandibulectomy is most often performed as part of the resection of advanced squamous cell carcinoma, which involves the mandible by extension from intraoral tissues. Less frequent etiologies of mandibular defects include benign tumors, trauma, infections and osteoradionecrosis.^{1,5} Techniques of surgical reconstruction of mandibular defects with alloplastic material, non-vascular or vascular autologous tissues, or a combination thereof have been described¹. However, there are evidences that alloplasts, nowadays titanium plates and mesh alone or with bone grafts, have high rates of fracture, exposure, infection, bone resorption and slow healing, while vascularized free bone flaps had fewer complications. With recent advances in microvascular surgery, vascularized free bone flaps have become a gold standard for mandibular reconstructions, and vascularized fibula graft is the method of choice for most mandibular defects.^{1,2,6} Nevertheless, since such reconstruction is often prone to early and late complication, either because of the

patient's inadequate general medical condition imposed by alcohol and tobacco abuse, or because of local factors, such as the extent of the defect and changes in the tissues induced by the postoperative radiotherapy, not all mandibular defects can be surgically reconstructed.^{1,7}

Most patients receiving radiotherapy to the head and neck region will experience some type of oral complication. Irradiation causes damage to the salivary glands, teeth, jawbone, oral mucosa, muscles and the temporomandibular joint. Quantitative and qualitative changes of the saliva and xerostomia are among the most severe and most prevalent complications that patients experience and may become a lifelong problem. Delivery of approximately 40 and more Gy to salivary glands causes permanent loss of their function. The lack of saliva causes dry mouth, difficulty mastication, swallowing and speaking, reducing sense of taste, tingling sensation, dental caries, gum disease, bad breath, discomfort when wearing dentures, increased possibility of opportunistic infections and oral health care costs⁸⁻¹⁰.

During the course of squamous cell carcinoma treatment, especially if it includes radiotherapy, many of the patients end up with extensive teeth loss, or edentulous. Their prosthetic rehabilitation with conventional complete dentures is often unpredictable due to anatomic, physiologic and psychological factors.¹¹ In order to provide sufficient support and retention, especially in the non-reconstructed cases of segmental mandibulectomy, implant-supported dentures are indicated.¹² However, even with these restorations, the chewing ability and comfort can hardly be restored to pre-treatment levels.¹²

Figure 1 (left): The panoramic radiograph of both jaws showing the bone defect of the left part of the mandible after surgical treatment of cancer and four implants inserted in the anterior right intact corpus of the mandible.
Figure 2 (right): A patient with pronounced facial asymmetry of the lower third of the face.



Owing to the effects of radiation on soft and hard tissues (hypoxia, hypocellularity, hypovascularity and reduced proliferation of several types of cells) that reduce the potential for osseointegration of implant, radiation therapy used to be considered a contraindication for placement of dental implants.^{13,14} Nevertheless, since the prosthetic rehabilitation of segmental mandibulectomy patients with conventional dentures is usually impossible, an increasing number of reports of implant-supported prosthetic rehabilitations of such cases have been noted in the literature.¹³⁻¹⁶ The placement of dental implants in combination with hyperbaric oxygen treatment can improve osseointegration. Hyperbaric oxygen therapy is the inhalation of pure oxygen at elevated pressure at typically 200–300 kPa in a chamber. Therefore, such treatment is recommended by some authors^{13,15}, a long term benefit of such a protocol, however, still lacks evidence.^{14,17}

Case report

In the following report, oral rehabilitation with implant-supported overdenture in two patients with similar non-reconstructed mandibular defect, but different aetiology,

as well as different denture design and different outcome in terms of success and patient satisfaction will be presented. Diagnostic procedures, planning and treatment of these patients require an individualized and multidisciplinary approach. The complexity of cases required that surgical insertion of dental implants be performed at the Department of Maxillofacial and Oral Surgery of the University Medical Centre Ljubljana by the surgeon using a surgical guide, which was previously constructed with respect to the prosthetic design. The prosthetic rehabilitation on implants was then performed by prosthodontists at the Department for Prosthodontics of the University Medical Centre Ljubljana.

Figure 3 (left): A milled bar with three additional attachments is screwed on implants.

Figure 4 (right): Mandibular overdenture with cast metal framework, which together with the female parts of the attachments (green coloured nylon matrices) fits precisely on the milled bar.



Case 1

A 70-year-old caucasian female was referred to our Department for Prosthodontics for prosthetic oral rehabilitation by a maxillofacial surgeon. Five years earlier, she had been diagnosed with squamous cell carcinoma on the left side of her tongue, which extended to the floor of the mouth and left mandibular corpus. At that time, the tumour was surgically removed along with the left side of the tongue and a segmental mandibulectomy, including the left half of mandibular corpus, angulus and two thirds of the left mandibular ramus (Figure 1). The patient was postoperatively irradiated to the head and neck with a full dose of 60 Gy. Due to the size of the defect and the condition of soft tissues, no surgical reconstruction was attempted. Prior to surgery, a few remaining irremediable teeth were extracted, so the patient was edentulous with no dentures for almost 5 years. Besides the problems arising from having no teeth and visible facial defect the patient also complained about dry mouth sensation.

The patient's face was asymmetrical with the chin deviating to the left and a convex profile with increased nasolabial angle due to the lack of lip support (Figure 2). The oral mucosa was mostly dry with several mucous plaques. Possible causes for the formation of plaques on the mucosa are the lack of saliva, poor oral hygiene and eating mainly soft foods rich in carbohydrates⁹. The maxillary edentulous alveolar ridge and the remaining segment of the mandibular alveolar ridge were moderately resorbed. The tongue was scarred and its mobility limited. During the mandibular movement, the remaining segment of the mandible shifted obliquely in downwards-medial and upwards-lateral direction.

Since the anatomic situation made rehabilitation with a conventional lower complete denture impossible, it was planned to place four dental implants in the remaining segment of the mandible and to carry out rehabilitation with an implant-supported mandibular overdenture and a conventional maxillary complete denture. Diagnostic teeth arrangement on articulated study casts

revealed limited interarch distance in the area posterior to second premolar, therefore implants were planed in the anterior area (Figure 1). In order to support and retain the mandibular overdenture on implants, a screw retained milled bar with a free end extension to the left side was planned. This extension should provide bilateral occlusal stability to the maxillary complete denture.

Four dental implants (diameter / length: 3,5 / 14 mm and 4,5 / 11mm; Ankylos, Dentsply Friadent, Mannheim, Germany) were placed according to the two-stage submerged protocol in combination with hyperbaric oxygen treatments, 20 prior to and 8 after the implantation. The second stage surgery was performed 6 months after the implantation, and 2 weeks later the prosthetic rehabilitation was initiated. Abutments (Balance Base, Ankylos) for a screw retained milled bar were selected. Before the milled bar was in place, the maxillomandibular relationship registration proved unreliable, partly because of the unstable mandibular record base and partly because of the inconsistent jaw movements. The maxillomandibular relationship registration was therefore repeated at a later session with the bar in place. Additional retention of the overdenture to the bar was provided by three attachments (Vario snap, Bredent GmbH & Co.KG, Senden, Germany) (Figures 3 and 4).

At denture delivery stage, the patient was extremely pleased with the result. A week later, however, she complained about dry mouth sensation. Furthermore, the patient experienced chewing and swallowing problems, regardless the absence of pain or ulceration under the dentures. Notwithstanding the attempts of adjustment, the patient mostly ate without dentures in the following few weeks. The adaptation process was slow but relatively successful, since 6 months after denture delivery the patient reported better chewing ability with the new dentures. Still, she complained that the sense of a foreign body in her mouth persists.

Case 2

A 68-year old caucasian male patient was brought to the Emergency department

Figure 5 (left): The panoramic radiograph of both jaws showing two remaining teeth in the maxilla, a lot of osteosynthetic material in both jaws and the bone defect of the left part of the mandible after surgical treatment of the suicide injury. Four implants are inserted in the right intact corpus of the mandible.

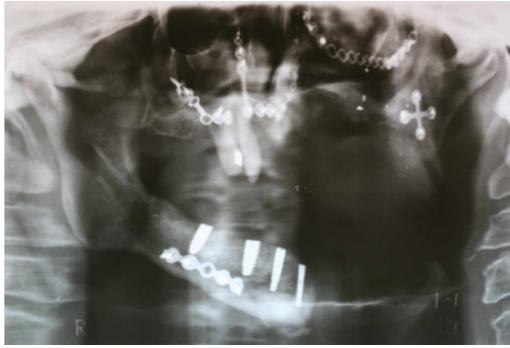
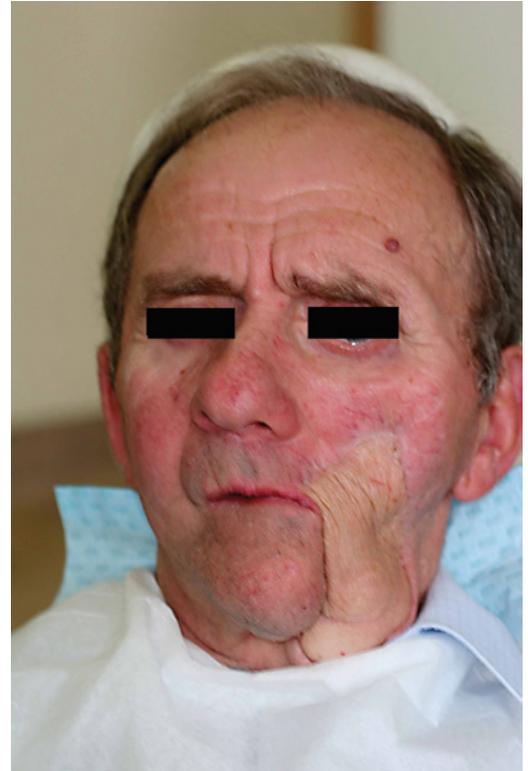


Figure 6 (right): A patient with facial asymmetry of the lower third of the face.

of the University Medical Centre Ljubljana immediately after a suicide attempt with a shotgun injury to his head. He suffered severe injuries to the left side of his face, multiple fractures of the facial skeleton, including the orbital floor, maxilla and the left side of the mandibular corpus. The crushed necrotic bone on the left side of the corpus mandible was removed. As soon as the condition was stabilized, surgical reconstruction was attempted, but 2 months later the grafts had to be removed due to infection and necrosis. In the following year, several plastic surgeries were performed to reconstruct the facial soft tissues, the reconstruction of the mandible, however, was not attempted.



The patient had a history of untreated depression and alcoholism. Prior to the injury, there had been a fixed partial denture in the maxilla and a few natural teeth in the mandible. After the injury, however, the only remaining teeth were the maxillary right canine and first premolar (Figure 5).

Also in this case the patient's face was asymmetrical, but the deviation of the chin was less pronounced. Because of the damage to facial nerves, the function of the facial muscles on the left side was impaired (Figure 6). The soft tissue transplant, covering the left cheek, was attached to the floor of

the mouth and to the remaining segment of the mandible, thus reducing the sublingual area. In the mandible, the left half of the corpus, angulus, as well as the majority of the left ramus were missing. The alveolar ridge of the right side was moderately resorbed. There were no significant defects or signs of inflammation in the partially edentulous maxilla, the upper right canine and first premolar being both vital and the probing depth not exceeding 3 mm. The probing depth measurement of the gingival sulcus or pocket depths around a tooth with periodontal probe is the best diagnostic tool to collect information regarding the health status and attachment level of periodontal tissues. Healthy gingival sulcus depth is around 3 mm with no bleeding upon probing.

Figure 7 (left): Gold conical crowns on the last two upper teeth and titanium conical abutments screwed on implants.



Figure 8 (right): Unilateral mandibular overdenture with incorporated secondary parts of double conical crowns (gold conical caps), which fit precisely on the conical implant abutments.



Greater depths can be associated with attachment loss of the tooth to the surrounding alveolar bone, which is a characteristic found in periodontitis and is called a pocket.

Having analysed the vertical and horizontal maxillomandibular relationships by a diagnostic teeth arrangement on articulated study casts, it was concluded that the vertical interarch distance was favourable, the anterior cross bite, however, could not be avoided. The following treatment plan was made: a maxillary overdenture retained by conical crowns on teeth 13 and 14 and a mandibular overdenture supported and retained by 4 implants with conical abutments (Syn-Cone, Ankylos) (Figure 7). Due to a strong fibrous insertion of the soft tissue transplant to the floor of the mouth, the mandibular overdenture could not be extended to the left side (Figure 8).

Four implants (diameter / length: 3.5 / 14 mm and 4.5 / 11, 9.5 mm; Ankylos, Dentsply Friadent) were placed according to the two-stage submerged protocol. The second-stage surgery was performed four months after the implantation. Clinical procedures in the upper and the lower jaw were performed simultaneously.

The patient has entirely accepted his new overdentures within two months and was very pleased with the result. He also responded favourably to psychiatric treatment and eventually fully recovered.

Discussion

In general, the extent of functional deficiency and the success of prosthetic rehabilitation of partial mandibulectomy patients depend on the nature of the defect³. Although both of the presented cases dealt with the similar size of the defects, there were significant differences, which affected the outcome of the prosthetic rehabilitation. The main difference between the two cases was the etiology of the defect. In the first case, the surgical therapy of the carcinoma, in particular the postoperative radiotherapy, adversely affected the condition of the soft tissues. Tender oral mucosa and the lack of saliva hindered the patient's acceptance of the dentures. The reduced mobility of the

tongue, on the other hand, caused difficulties in food placement and swallowing. Since in the second case the remaining soft tissues were healthy, the tolerance of the dentures was considerably greater.

The status of the opposing jaw, in this case the maxilla, was another important factor affecting the success of the prosthetic oral rehabilitation. In the first case, a conventional complete denture was made for the edentulous maxilla. Even though the mandibular implant overdenture was extended to the side of the defect and provided occlusal equilibrium to the maxillary complete denture, it was difficult for the patient to accept the maxillary denture due to the inadequate retention. Indeed, lack of saliva is often the main reason of impaired denture retention. In the second case, however, the two remaining teeth not only retained and supported the maxillary overdenture, they also provided significant proprioceptive control of chewing. In this particular case, therefore, the functional rehabilitation proved very successful, although extension of the mandibular denture to the side of the defect was not possible because of the insertion of the soft tissue transplant to the floor of the mouth.

In both cases the maxillomandibular relationship had a significant effect on both the prosthetic design of the overdenture on implants as well as on the success of the rehabilitation. In the first case the deviation of the remaining segment of the mandible towards the side of the defect was much greater than in the second case. In order to achieve adequate occlusion, the teeth had to be placed approximately 2 cm more vestibular than the implants. To provide rigid support in that area, the milled bar and the cast denture base were formed accordingly. Since in the second case the deviation was slighter, it was possible to fabricate overdenture on implants retained by conical crown. It should be noted that clinical and laboratory procedures for overdenture on implants retained by prefabricated conical crowns are technically less elaborate than the procedures required for milled-bar-supported overdentures on implants. Furthermore, plaque control around implants with conical crowns is

less demanding in terms of skill, whereas the implants with a milled bar in place require greater precision.

Summary

The success of the prosthetic rehabilitation of patients with segmental mandibulectomy depends on many factors. Undoubtedly, the size of the defect and the condition of the remaining hard and soft tissues, which are often affected by radiotherapy, are crucial. Nonetheless, the etiology of the defect, the status of the opposing jaw, maxilomandibular relationships, the consistency of mandibular movement and the prosthetic design play an important role as well.

Funding

This cases received no specific grant from any funding agency in the public or commercial sectors.

Acknowledgements

The authors would like to thank the surgeons of the Clinical Department for Oral and Maxillofacial Surgery at the University Medical Centre Ljubljana, for the excellent cooperation and integrated surgical treatment, which also includes insertion of implants.

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