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Oral rehabilitation with an implant-supported mesostructure on a microvascularized mandibular graft: A 12-year follow-up study

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CASE STUDY

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ABSTRACT

Due to the increased survival of the population, treatment of oral cavity tumour patients is increasingly common. In this context, oral rehabilitation construction methods have been developed to contribute to improving the patient's quality of life. Developments in the areas of oral implantology and rehabilitation, along with microvascularized grafts, have increased the possibility of rehabilitating patients undergoing hemimandibulectomy with more effective and lasting treatment. This article aims to demonstrate an aesthetic and functional oral rehabilitation method, both in terms of the oral cavity and the lower face, in a young patient submitted to a left lateral hemimandibulectomy, using a mesostructure fixed onto implants.

Key Words
Hemimandibulectomy, mandibular tumours, mandibular graft, dental implants, prosthetic mesostructure, oral rehabilitation

Implications for Practice:

1. What is known about this subject?
Ameloblastoma is defined as an odontogenic epithelial tumour and represents approximately 11 per cent of all odontogenic tumours.

2. What new information is offered in this case study?
Due to exacerbated dentofacial discrepancies, after reconstructive surgery, a mesostructure was developed with a first element fitted to the implants and a second attached by friction.

3. What are the implications for research, policy, or practice?
In patients undergoing hemimandibulectomy, the projection of a mesostructure onto dental implants provides better lingual, labial and facial support.

Background

Oral cavity tumours, particularly mandibular tumours, are treated by removal of the lesion and adjacent tissue. In the case of invasive tumours, in addition to the lesion, sectioning of a part of the jaw is necessary. Reconstruction with a microvascularized bone flap from the fibula is a recommended treatment for these patients. This treatment makes it possible, at a later stage, to perform oral rehabilitation with implants, due to the flap's vascularization.[1,2]

Total or partial segmental resection of the jaw implies a fundamental loss of the stomatognathic apparatus, including aesthetics and functionality. Tumours that are located in the mandibular segment cause changes to the oral cavity, face and skin. A negative component of this type of tumour is patient disfigurement, which translates into a social limitation. This situation is exacerbated due to the gap between the residual jaw and the autotransplanted bone.[3-10]

The possibility of rehabilitation with dental implants, together with a well-designed prosthesis, results in better performance of the jaw in terms of eccentric movements and provides better occlusal, articular and masticatory capacity. The mesostructure, a prosthesis designed in 2 parts, provides better lingual, labial and facial support to patients who have undergone hemimandibulectomy.[11]

Dental implants currently offer successful rehabilitation, and there are sufficient studies to guarantee the oral rehabilitation of hemimandibulectomy patients. Reconstructive surgery should be performed first and foremost to ensure the patient's physical integrity; in addition, where possible, the best possible positioning of the bone graft should be ensured to allow placement of osseointegrated implants to facilitate patient rehabilitation.[12-17]

Case details

The case was a female patient, 18 years old, with ameloblastoma, an odontogenic tumour of epithelial origin that, due to its frequency, requires special care. This tumour type is the most common oral cavity neoplasm affecting the jaw and is responsible for 11 per cent of all odontogenic tumours.

The treatment proposed and implemented for this patient with this tumour was to perform partial excision of the jaw surrounding the tumour. A hemimandibulectomy was surgically performed, with a transfer of a vascularized bone flap from the fibula performed concomitantly (Figure 1).

With the patient's consent, a fixed prosthesis was inserted onto the osseointegrated implants in the oral rehabilitation service of the Instituto Universitário de Ciências da Saúde (IUCS) master's programme. In this context, the following 3 situations requiring correction were detected: the horizontal offset of the residual bone and fibular transplant, the vertical discrepancy of transplant bone height with the remaining teeth and intrusion of the patient's face on the left side. To overcome these 3 defects, an implant-supported mesostructure-type fixed prosthesis consisting of 2 independent elements was proposed.

Three implants (Brånemark System™, Nobel Biocare, Goteborg, Sweden), 13mm long and 4.0mm in diameter, were inserted 3 years after reconstructive surgery following standard protocol. The 3 osseointegrated implants were inserted into the transplanted fibular bone, corresponding to teeth 3.4, 3.5 and 3.6 of the removed jaw half (Figure 2). A linear incision corresponding to the bone collar was made, with 2 discharges. The implants were inserted with a surgical micromotor (Implantmed, W & H, Austria) in continuous physiological solution (Eurospital, Italy) irrigation. The osseointegration period for the 3 implants was 8 months, which passed without complications.[18-19]

At the beginning of the prosthetic phase, impressions were made directly from the implants, with splinted impression coping with a photopolymerizable product (Conlight, DentaMed, Friedberg, Germany). The final impression was made using the double mixing technique with silicone putty (President Putty, Coltene, Switzerland) and light silicone (President, Microsystem Lightbody, Coltene, Switzerland). The colour was selected using a Vita machine (VITA Easyshade, VITA Germany) and was compared to the Vita ceramics colour scale (VITA Zahnfabrik, Bad Sackigen, Germany) based on adjacent teeth.

The dental prosthesis laboratory obtained the gypsum model that allowed the laboratory stages to be implemented and a more in-depth study of the case to be performed. Due to the dentofacial discrepancies existing after reconstructive surgery, a mesostructure for the patient's oral rehabilitation was created.

The metallic mesostructure (Gialloy CB/N, Ludwigshafen, Germany) consisted of 2 elements: the first was fitted to the implant head, and the second attached to the first element by friction. The purpose of the first metallic structure was to retain the fixed prosthesis, and it was connected to the osseointegrated implants. The second metallic structure was cemented onto the first structure and included the artificial teeth and the pink ceramic that replaced the patient's gums, reconstructing the defect caused by displacement of the bone graft (Figure 3).

A composite test (Signum, Heraeus Kulzer, Germany) was performed to verify prosthetic adaptation of the mesostructure and to observe the positioning of the artificial teeth. During this clinical stage, we verified whether the height discrepancy caused by the transplanted bone graft had been corrected. This clinical action allowed us to verify whether invagination of the jugal mucosa, caused by the flap surgery, was corrected by placement of the mesostructure. Ceramic finishing was then performed (Heraceram, Heraeus Kulzer, Germany). Having completed the mesostructure, the first structure was fitted to the implants and screwed in with a torque of 30 Ncn (Figure 4). The second structure was then cemented with a resin (Multilink, Automix, Ivoclar, Vivadent USA) (Figure 5).

The patient was followed up 5 years later, and the fitting and functioning of the oral rehabilitation had remained unchanged. Thus, the desired patterns of this rehabilitation, in terms of height compensation, face intrusion compensation and bone offset compensation were still intact after 5 years (Figure 6).

At the 12-year follow-up appointment, the mesostructure maintained its function and remained unchanged; clinically, there was a slight gingival recession near the abutments, but no exposure of the implants; radiographically, we could verify that there were bone losses of 2mm next to the first implant and 3mm next to the more posterior implants, but these losses were within internationally accepted parameters described in the article by Geraets et al., where an initial marginal bone loss during the first year of 1.0-1.5mm and losses of <0.2mm in subsequent years are deemed acceptable (Figure 7).[20]

Discussion

The recommendations in the literature, described in the article by Effiom et al., suggest that in the case of ameloblastomas, the option of radical surgery confers a disease-free survival rate and absence of secondary recurrence of at least 10 years.[2]

In such cases, oral rehabilitation usually involves a multidisciplinary team, including orthodontic, oral surgery, periodontology and prosthodontic elements. In their recent article, Hu et al., performed a retrospective analysis of the data of 6 patients who underwent jaw resection in childhood, without immediate bone restoration, and who underwent a secondary mandibular reconstruction procedure in adulthood, for which the importance of a multidisciplinary intervention was noted.[6]

The approach to be taken depends on the success of the graft and the remaining bone availability. Normally, oral rehabilitations with osseointegrated implants guarantee the patient greater stability, comfort and function than removable prostheses. Reconstructive hemimandibulectomy patients experience changes at the occlusal level. There is a marked vertical discrepancy between the grafted and ungrafted areas. This pathology in the vertical and occlusal dimensions is due to the gap produced in the transition between the residual jaw bone and the transplanted bone graft.[8]

Vascularised fibula graft was first described by Taylor in 1975. After demonstrating that osteotomies can be performed in vascularised fibula grafts without compromising the viabilityof the bone segment, vascularised free fibula flap became the state of art reconstruction method after mandible ablation. The free fibula flap provides the greatest bone length, is suitable to accept dental implants and allows incorporation of a skin island for mouth floor or lip reconstruction. In this case a skin paddle was planned and centred over the pre-planned intraoral mucosal deficit. A meshed split skin graft was used to cover the donor area defect. Many techniques are described in the literature to cover huge tissue defects, Inchingolo et al., described a reconstruction of the cartilaginous nasal septum using two vestibular labial mucosa flaps to reconstruct the mucosa, and cartilage from the ear conch for the cartilaginous septum.[21,22]

The main limitation of using the fibula flap is the insufficient bone for the reconstruction of both the skeletal base (inferior border of mandible) and the alveolar ridge. This lack of bone stock is especially evident in the ablation of dentate mandibles resulting in a vertical discrepancy between reconstructed and unaffected sides. Surgically, other methods could have been used to increase the vertical height of the fibula including distraction osteogenesis and non-vascularized onlay bone graft, which both require additional surgery. The “double barrel” avoids the requirement of an additional surgery, and avoids the morbidity of a new donor site. Double-barreling the fibula increases its height whilst leaving the upper strut architecturally unchanged for accepting osseointegrated dental implants.[23]

In this clinical case no other bone grafts, bone substitutes or bioactive factors were applied. Often described in the literature, they attempt to facilitate and enhance the healing process when suboptimal conditions exist. Depending on their properties, preparation and application, bone grafts augment natural healing via osteoinductive, osteoconductive and/or osteogenic mechanisms.[24-26]

Marrelli et al., in a retrospective observational study of 127 tapered dental implants placed in the immediate post-extraction sites of maxillary bone of 59 patients, used a Platelet-Rich Fibrin membrane to increase the peri-implant tissues maintenance around dental implants. They concluded that these bioactive factors contribute for a long-term maintenance of crestal bone and the rapid healing of soft tissue dimension with maintenance of peri-implant papilla.[27]

Prosthetically, the gap between the residual bone and the graft means that, most of the time, the supported implant rehabilitation has very large abutments to compensate for the vertical discrepancy. Thus, the success of rehabilitations with very high abutments is compromised due to implant instability. Hemimandibulectomy patients usually have this difficulty, which is associated with facial intrusion.[21]

This limitation makes it difficult to use other solutions in terms of rehabilitation. Overdentures, screwed structures, conus solutions are very difficult to perform due to the discrepancy between the implant and the occlusal plane. Bar-clip and stud attachments can provide a good prosthetic solution in terms of retention, hygiene and aesthetics. Silva et al., in their study concluded that even with different implant angulation and saliva pH values, the attachments could perform good overall retention.[28,29]

In the clinical case presented, the patient’s oral rehabilitation was performed with a mesostructure. In this manner, we were able to correct the patient's occlusal discrepancy without using exaggeratedly high abutments. The 2 structures made it possible to correct large changes to the vertical dimension, by compensation of the structure screwed to the osseointegrated implants. Furthermore, in this type of rehabilitation, implants may have incorrect inclination due to the anatomical characteristics of the grafts, which may cause the prosthesis to have an inadequate insertion axis and could potentially lead to implant failure. Mesostructures are prostheses that, due to their characteristic 2 metallic structures, make it possible to modify the implant's inclination. The prosthetic screws sometimes exit lingually; as the first structure is screwed and the second structure is cemented onto the first, this type of correction can be performed to provide aesthetic improvement.

Quality of life, aesthetic results and functionality are dramatically improved with this type of oral rehabilitation.

Conclusion

Oral rehabilitation with a mesostructure-type prosthesis fixed onto implants, as described in this article, allows functionality and comfort to be restored to hemimandibulectomy patients.

Major practical contribution of the present clinical case was in the sense of evidencing a good prosthesis solution in more adverse situations.

In future investigations, it will be important to perform surgical techniques that allow to reduce prosthetic constraints, as in the technique of the “double barrel” Fibula.

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PEER REVIEW

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CONFLICTS OF INTEREST

The authors declare that they have no competing interests.

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PATIENT CONSENT

The authors, *Mendes JM, Silva AS, Aroso C, Salazar F*, declare that:

1. They have obtained written, informed consent for the publication of the details relating to the patient(s) in this report.
2. All possible steps have been taken to safeguard the identity of the patient(s).
3. This submission is compliant with the requirements of local research ethics committees.

Figure 1: Orthopantomography of hemimandibulectomy with vascularized fibular bone flap

Figure 2: Orthopantomography with insertion of dental implants

Figure 3: Constituent elements of the mesostructure

Figure 4: A. Fixing of the first structure to the implants; B. Radiographic confirmation

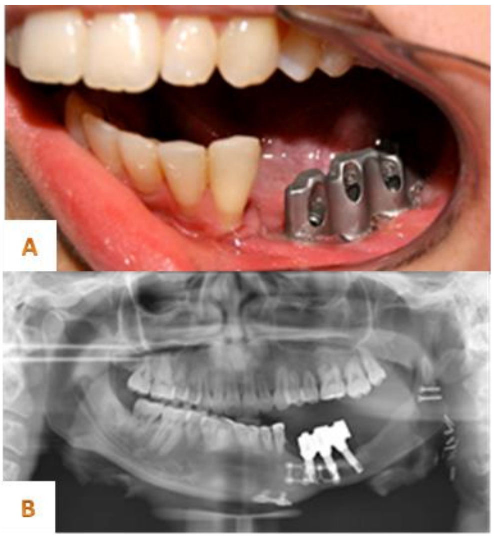

Figure 5: A. Placement of the rehabilitation in the mouth; B: Facial photo with completed work

Figure 6: Five-year follow-up; A. Radiographic confirmation; B. Intra-Oral; C. Facial

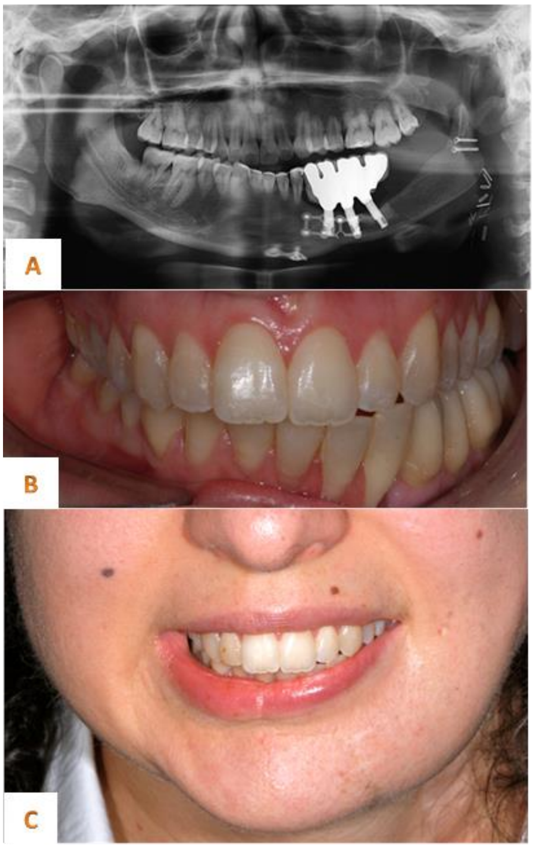

Figure 7: Twelve-year follow-up; A. Teleradiography; B. Orthopantomography; C. Intra-oral; D. Facial