

## Anatomical features and prosthetic considerations of edentulous patients with mandibular reconstruction with autograft performed more than 40 years ago

CĂTĂLINA MURARIU-MĂGUREANU<sup>1)</sup>, CRISTINA TEODORA PREOTEASA<sup>2)</sup>, LAURA IOSIF<sup>1)</sup>, MARINA IMRE<sup>1)</sup>, MARIAN CUCULESCU<sup>3)</sup>, ELENA PREOTEASA<sup>1)</sup>

<sup>1)</sup>Department of Prosthodontics, Faculty of Dental Medicine, "Carol Davila" University of Medicine and Pharmacy, Bucharest, Romania

<sup>2)</sup>Department of Ergonomics and Scientific Research Methodology, Faculty of Dental Medicine, "Carol Davila" University of Medicine and Pharmacy, Bucharest, Romania

<sup>3)</sup>Department of Preventive Dentistry, Faculty of Dental Medicine, "Carol Davila" University of Medicine and Pharmacy, Bucharest, Romania

### Abstract

In this manuscript there are presented two cases, both with mandibular reconstruction with autograft harvested from the iliac crest, performed more than 40 years ago, but with different bone defect etiology, *i.e.*, mandibular dysplasia and mandibular fracture, both having currently extensive tooth loss in the mandible, being in need for prosthetic rehabilitation. These cases confirm that reconstructive surgery of mandibular bone defects with autograft from iliac crest has a satisfactory long-term outcome, providing acceptable conditions for prosthetic rehabilitation. Bone resorption in the grafted area seems to be related to the etiology of bone defect, and influenced by preservation of dental occlusion and masticatory function. Reconstructive surgery made decades ago has sequelae that increase the difficulty of prosthetic treatment of edentulous patient, that need to be properly evaluated and included in the treatment plan, in an individualized approach, in order to obtain an acceptable functional outcome.

**Keywords:** bone defects, prosthesis, denture, overdenture, edentulism.

### Introduction

Extensive tooth loss and complete edentulism are conditions that can have a negative impact on oral health, general health, social interactions and overall on quality of life [1]. Also, rather frequently these cases present a high difficulty of prosthetic treatment, mainly in relation to tooth loss and associated severe bone alterations, and their consequences. Among the factors that aggravate these conditions even more, and increase considerable the prosthetic treatment difficulty, there is the history of reconstructed bone defects, which require special consideration during treatment planning of both conventional and implant-based prosthetic treatment.

Bone defects have various etiologies, as bone dysplasia or traumatism, sometimes requiring their anatomical reconstruction by surgery. Surgical treatments in reconstruction of the mandibular body are complex and have various techniques of approach [2]. Their success depends on various factors as defect characteristics, graft structure and size, graft source and harvesting method, the surgical technique applied, the following restoration of oral functions, being also related to some intrinsic mechanisms of bone metabolism (*e.g.*, osteoclastic activity) [3]. The autologous bone graft is still considered nowadays the "gold standard" in maxillofacial surgery [4, 5], this consisting of restoring the mandibular defect using bone from the same patient, from another topographic area (autograft from iliac crest, ribs, scapular belt).

The primary goals of reconstructive surgery are restoration of function and acceptable cosmetic result [6, 7], even so, rather frequent sequel still remains, which represents complex challenges for the prosthodontist. After surgery, many patients still have functional problems, observed during speaking and mastication (*e.g.*, a reduced masticatory area and bite force, in relation to a reduced mandibular mobility and asymmetric jaw movement), and facial asymmetry. Prosthetic treatment in these patients have an increased difficulty in relation to the interconnected alterations of the bone and soft tissue, but also of the morphological and functional ones, it being even more difficult in patients with extensive tooth loss and complete edentulism – usually aged, with associated oral and systemic comorbidities, and rather frequently unwilling to have complex prosthetic interventions [8–11]. Treatment plan must consider the appropriateness of conventional or implant based prostheses, special consideration being given to the bone area where previously there was localized the bone defect, as considering its usage for support or/and retention, and maybe the need to decrease pressure related to occlusal forces.

The cases reported in this manuscript presents the anatomical features of the mandible, and their relation to the removable prosthetic treatment, of two patients, both with mandibular reconstruction with autograft done more than 40 years ago, but with different bone defect etiology, *i.e.*, mandibular dysplasia and trauma/fracture, both having

currently extensive tooth loss in the mandible, being in need for prosthetic rehabilitation.

## ☒ Case presentations

### Case No.1

The first case is of a 62-year-old female patient, who underwent when she was 20-year-old an operation for the reconstruction of a right mandibular defect, with autologous bone graft harvested from the iliac crest, performed by Professor Stelorian Stănescu (specialist in Oral Surgery, working at the “Carol Davila” University of Medicine and Pharmacy, Bucharest, Romania), the diagnostic being mandibular dysplasia. At the time she addressed us, she had extensive tooth loss in the mandible, and by her statement priory did not have any kind of prosthetic rehabilitation.

The first patient addressed us requiring prosthetic rehabilitation of tooth loss, chief complaints being linked to compromised esthetics during speech and while smiling, and to the difficulties in performing mastication. By her statement, she did not previously have any fixed or removable prostheses. On facial examination, from the frontal view, mandibular deviation to the right side during rest position and during mouth opening was observed. By intraoral examination, partial edentulism was observed in the maxilla, with absence of maxillary left incisors and maxillary second molar, and extensive tooth loss was observed in the mandible, only mandibular left canine and mandibular second molar being present. All teeth presented severe attachment loss, it being more pronounced and accompanied by increased mobility especially for the ones on the left side. In the mandible, a reduced bone height in the lateral right mandibular edentulous area, with a vertical difference and an uneven ridge morphology was observed, which by prosthetic viewpoint meant reduced support area and blurring of the anatomical and functional borders, therefore difficulties in obtaining peripheral seal, and proper support, retention and stability of the prosthesis. Analyzing the previous data in conjunction with the panoramic radiograph, we acknowledged the increased asymmetry of the mandible, that can be described as presenting a reduced bone quantity at the right ramus, angle and body of the mandible (sites where she underwent the surgical reconstruction more than 40 years ago), compared to the left side. The vertical difference of the ridge, observed by clinical means, was identified as corresponding to the marginal area of the graft, where ligature was placed. Also, there should be mentioned that left and right body of the mandible had a rather similar radiodensity, and a slightly higher bone density in the area where the graft was ligated being observed (Figures 1 and 2).

The lower left canine and upper left teeth were extracted for periodontal reason, as presenting severe attachment loss and increased mobility, which promoted an accelerate bone loss rate. Treatment plan for prosthetic rehabilitation, considered patient’s desire to have a treatment as minimally invasive as possible, that ensures adequate masticatory function, with costs as limited as possible. Considering patient’s history and current situation, by prosthetic rehabilitation, it was desired primary restoring masticatory function, being assessed as being necessary to relieve the pressure on the grafted area that showed

severe bone loss and sequelae of surgical grafting operation. In the maxilla, a removable partial prosthesis with Bonwill clasp was made. In the mandible, an implant overdenture limited to the area corresponding to the native bone was manufactures. Two conventional implants (Implantium, UK) were placed in the native bone, and the extension of the denture base was limited in order to avoid pressure on the grafted mandibular area. The second left lower molar was preserved despite of its severe attachment loss, as presenting reduced mobility, and considered to ease the registration of intermaxillary relations, and also as promoting mastication on the left side. The patients adjusted well to both maxillary and mandibular prostheses. After three years, due to presenting increased mobility, the maxillary left canine and premolars were extracted, and a new removable acrylic partial denture was manufactured.



**Figure 1 – First case: facial aspect, intraoral aspect, and maxillary removable prosthesis.**



**Figure 2 – First case: panoramic radiograph.**

### Case No. 2

The second case is of a 59-year-old male patient, who underwent when he was 15-year-old an operation for the reconstruction of a left mandibular defect, with autologous bone graft harvested also from the iliac crest. From patient’s history, we have learned that the patient had an accident in childhood, with an associated mandibular fracture, and in addition to immobilization of mandibular fragments, reconstruction was required as presenting bone loss from the body of the mandible. At the time he



addressed us, he had complete mandibular edentulism treated by conventional dentures.

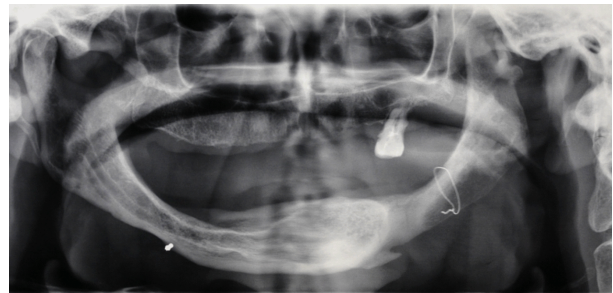
The second patient, at the time he addressed us, was presenting extensive maxillary tooth loss, only left first maxillary molar being present, and mandibular complete edentulism, being prosthetically treated by removable conventional dentures in both jaws. In the mandible, he had a conventional complete denture manufactured more than 10 years ago. Patient stated that he was content with this treatment alternative, requiring only the renewal of the mandibular complete denture. When asked regarding on performing mastication, he stated that was chewing bilaterally, not being of his habit to avoid mastication on the mandibular side with the grafted defect. On facial examination from the frontal view, facial asymmetry with mandibular deviation toward the left side was observed. Deviation to the left side, namely the grafted one, was noticed also during mouth opening, whose range was within normal limits. Intraoral examination of the mandible revealed a reduced alveolar ridge height, more pronounced on the right side – the one without ridge reconstruction, with increased asymmetry of the support area (with great disparity, probably related also to the uneven ridge resorption), with sublingual gland herniation on the right side. Analyzing the soft tissues from the periphery of prosthetic field, there was noticed that the muscles and ligaments insertion sites were high – close to ridge crest, therefore having a reduced support area, the floor of the mouth was hardened at palpation, with prominent attachment of the genioglossus muscle on apophysis geni, which relates to difficulties in establishing accurately the peripheral extension of the denture base. The fixed mucosa corresponding to the denture bearing area presented alteration of attachment to the bone support, sliding on the bone plane, altogether corresponding to a high difficulty clinical situation for obtaining adequate support, retention and stability by conventional means (Figure 3).



**Figure 3 – Second case: facial aspect, intraoral aspect of mandibular alveolar ridge, final prosthesis.**

Analyzing the panoramic radiograph (Figure 4), we observed an asymmetric mandible, with qualitative and quantitative differences between right and left mandibular body. Surprisingly, bone resorption was lower and radiodensity was higher in the mandibular left side – where he underwent the surgical reconstruction more than 40 years ago. Also, by analyzing the lower border of the left mandibular body, there were noticed some irregularities

that were probably sequelae of malpositioned or improper fixation of the bone parts or/ and bone graft.



**Figure 4 – Second case: panoramic radiograph.**

Treatment plan for prosthetic rehabilitation included keeping the existing maxillary denture and manufacturing a new conventional complete mandibular denture, by respecting the general principles and conventional phases of work. The custom impression tray, made from acrylic resin, was adapted to fit the morphological and functional limits of the prosthetic field. Impression's border molding in vestibules was performed with the ISO Functional Compound (GC Corporation) in the anterior lingual area, and Impression Compound (Kerr) in the buccal anterior and lingual posterior area.

## Discussion

The two cases presented illustrate anatomical features that can be encountered in edentulous patients with extensive tooth loss that underwent mandibular reconstruction with autograft a long time ago, in their youth, and their individualized prosthetic treatment chosen considering their present situation. Comparing them, we observed that they were similar in many regards – have similar ages (62 years and 59 years) reconstructive surgery was performed when they were young (when they were 20-year-old and 15-year-old), with the same type of bone graft (iliac crest autograft), observations being made after a similar period of time, namely 42 and 44 years, have extensive tooth loss in the mandible and present sequelae of the reconstructive surgery that needed to be addressed during prosthetic treatment planning.

Mandibular reconstruction with autograft harvested from the iliac crest is subjected to controversies regarding its resorption rate [5, 12, 13], the disparities in the scientific literature probably being linked to the high variability of clinical situations when this procedure is implemented. For the patients presented, even if records immediately after reconstructive surgery were not available, based on clinical data and patient's perception, we can say that the outcome after more than 40 years was satisfactory. Analyzing the two cases, at present time, difference regarding bone quality and quantity between the grafted mandibular side and the non-grafted side were noticed, that suggested a more severe resorption occurred in the grafted area in the first case, and in the non-grafted area in the second case. This different patterns of resorption are possibly related to the main differences that exist between them – the diagnosis made before reconstructive surgery (*i.e.*, bone dysplasia in the first case; mandibular fracture in the second), and the dental history (*i.e.*, diminished occlusal and masticatory pressure in the grafted area in the first case; respectively having normal occlusion

and masticatory function, without special consideration for the grafted area, in the second case). Bone defect etiology may explain the different pattern of resorption of the bone graft – being more pronounced for the graft placed in cases with previous pathological bone with increase osteoclastic activity, as bone dysplasia, and less pronounced for the graft placed in the normal bone, as in the patient who suffered a mandibular fracture – these findings being in accordance to some previously published case reports [14]. Lack of occlusal and masticatory forces on the grafted area also may explain the severe bone resorption observed in the grafted side of the mandible in the first patient, when considering the current theory, that states that mechanical forces dictate graft behavior, and bone remodeling depends on physical stress – the bone being deposited in sites subjected to stress, and resorbed from sites where the stress is reduced [15–18]. Therefore, maintaining normal occlusal and masticatory function may be beneficial in patients with reconstructive surgery, as may play a positive role in maintaining bone's shape and density.

In these cases, the prosthetic rehabilitation was conducted considering morphological and functional factors, but also patient's desire and expectations. From the latter, patients were rather firm in soliciting a treatment as less invasive as possible. In the first case, considering the increased resorption corresponding to the dysplastic area rebuilt by graft, a prosthetic treatment alternative that avoids putting pressure on the graft segment, and rehabilitate masticatory function, was chosen. Therefore, a mandibular implant prosthesis that was limited mainly to the left side of the jaw was manufactured. In the second case, with previous mandibular fracture, due to overall less bone resorption, lesser on the grafted side of the mandible, due to the fact that he was a previous satisfied wearer of conventional complete denture, according to his wishes, a new conventional complete denture was manufactured.

## ☒ Conclusions

These cases confirm that reconstructive surgery of mandibular bone defects with autograft from iliac crest has a satisfactory long-term outcome, providing acceptable conditions for prosthetic rehabilitation. Bone resorption in the grafted area seems to be related to the etiology of bone defect and preservation of occlusal and masticatory function. Reconstructive surgery made decades ago has sequelae that increase the difficulty of prosthetic treatment of edentulous patient, that need to be proper evaluated and included in the treatment plan, in an individualized approach in order to obtain an acceptable functional outcome.

## Conflict of interests

The authors declare that they have no conflict of interests.

## Corresponding author

Cristina Teodora Preoteasa, Lecturer, DMD, PhD, Department of Ergonomics and Scientific Research Methodology, Faculty of Dental Medicine, "Carol Davila" University of Medicine and Pharmacy; Eforiei Dental Clinic, 4–6 Eforiei Street, 50037 Bucharest, Romania; Phone +40726–275 525, e-mail: cristina\_5013@yahoo.com

## References

- [1] De Marchi RJ, Leal AF, Padilha DM, Brondani MA. Vulnerability and the psychosocial aspects of tooth loss in old age: a Southern Brazilian study. *J Cross Cult Gerontol*, 2012, 27(3): 239–258.
- [2] Damien CJ, Parsons JR. Bone graft and bone graft substitutes: a review of current technology and applications. *J Appl Biomater*, 1991, 2(3):187–208.
- [3] Nkenke E, Neukam FW. Autogenous bone harvesting and grafting in advanced jaw resorption: morbidity, resorption and implant survival. *Eur J Oral Implantol*, 2014, 7(Suppl 2):S203–S217.
- [4] Dimitriou R, Mataliotakis GI, Angoules AG, Kanakaris NK, Giannoudis PV. Complications following autologous bone graft harvesting from the iliac crest and using the RIA: a systematic review. *Injury*, 2011, 42(Suppl 2):S3–S15.
- [5] Burlibaşa C. *Chirurgie orală și maxilo-facială*. Ed. Medicală, Bucharest, 2002.
- [6] Shnayder Y, Lin D, Desai SC, Nussenbaum B, Sand JP, Wax MK. Reconstruction of the lateral mandibular defect: a review and treatment algorithm. *JAMA Facial Plast Surg*, 2015, 17(5):367–373.
- [7] Tataru AM, Wong ME, Mikos AG. *In vivo* bioreactors for mandibular reconstruction. *J Dent Res*, 2014, 93(12):1196–1202.
- [8] Preoteasa E, Meleşcanu-Imre M, Preoteasa CT, Marin M, Lerner H. Aspects of oral morphology as decision factors in mini-implant supported overdenture. *Rom J Morphol Embryol*, 2010, 51(2):309–314.
- [9] Iosif L, Preoteasa CT, Murariu-Măgureanu C, Preoteasa E. Clinical study on thermography, as modern investigation method for *Candida*-associated denture stomatitis. *Rom J Morphol Embryol*, 2016, 57(1):191–195.
- [10] Preoteasa E, Imre M, Preoteasa CT. A 3-year follow-up study of overdentures retained by mini-dental implants. *Int J Oral Maxillofac Implants*, 2014, 29(5):1170–1176.
- [11] Iosif L, Amza OE, Preoteasa E, Amza G, Preoteasa CT, Dumitrascu C. Contributions regarding the assessment of polymeric materials used in complete dentures by thermographic analysis – experimental study. *Mater Plast*, 2011, 48(1):104–109.
- [12] Misch CE. *Contemporary implant dentistry*. 3<sup>rd</sup> edition, Mosby–Elsevier, St. Louis, 2008.
- [13] Sbordone C, Toti P, Guidetti F, Califano L, Santoro A, Sbordone L. Volume changes of iliac crest autogenous bone grafts after vertical and horizontal alveolar ridge augmentation of atrophic maxillas and mandibles: a 6-year computerized tomographic follow-up. *J Oral Maxillofac Surg*, 2012, 70(11): 2559–2565.
- [14] Menon S, Venkatswamy S, Ramu V, Banu K, Ehtaih S, Kashyap VM. Craniofacial fibrous dysplasia: surgery and literature review. *Ann Maxillofac Surg*, 2013, 3(1):66–71.
- [15] Oppenheimer AJ, Tong L, Buchman SR. Craniofacial bone grafting: Wolff's law revisited. *Craniofacial Trauma Reconstr*, 2008, 1(1):49–61.
- [16] Brunski JB. *In vivo* bone response to biomechanical loading at the bone/dental-implant interface. *Adv Dent Res*, 1999, 13:99–119.
- [17] Misch CE, Qu Z, Bidez MW. Mechanical properties of trabecular bone in the human mandible: implications for dental implant treatment planning and surgical placement. *J Oral Maxillofac Surg*, 1999, 57(6):700–706; discussion 706–708.
- [18] Preoteasa E, Preoteasa CT, Iosif L, Murariu Magureanu C, Imre M. Chapter 9: Denture and overdenture complications. In: Virdi MS (ed). *Emerging trends in oral health sciences and dentistry*. InTech, Rijeka, Croatia, 2015, 193–225.