Atrophic jaw posterior rehabilitation with short and extra-short implants: two cases report

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Introduction: The remodeling and subsequent atrophy of the alveolar bone directly interferes in bone availability, creating limits to treatment with conventional implants. The rehabilitation option with short and extra-short implants has become increasingly accepted in implant dentistry. This is a predictable treatment and allows to prevent invasive surgical techniques. For these reasons, this study is justified, for elucidating such issues of clinical interest. **Methods:** by means of a literature review, are discussed the most relevant aspects in rehabilitation of patients with posterior mandibular atrophy, describing the clinical evolution of the treatments with short implants. In addition to reporting two clinical cases where patients were treated with 8-mm, 6-mm and 4-mm implants. **Results:** Clinical cases described and the support of the literature showed that the choice to treat with short and extra-short implants feature good results and clinical predictability. The great justification for the use of these implants was to avoid the need for invasive surgical techniques such as lateralization of the inferior alveolar nerve, bone grafts and osteogenic distraction. By comparing these techniques, we can observe that patients were treated with lower morbidity and cost, in addition to greater speed. **Conclusion:** We believe that the short implants can safely be used as prosthetic support in the oral rehabilitation, with success and longevity similar to regular implants. However a rigorous protocol of indication and surgical and prosthetic techniques execution must be followed to guarantee a successful treatment with predictability. **Keywords:** Dental implants. Oral surgical procedures, preprosthetic. Surgery, oral. Osseointegration.

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INTRODUCTION

Advances in the development of dental implants and implant-supported prostheses have allowed previously edentulous areas with bone height and volume in proper conditions to be restored.[1]Implant placement might be limited in cases with decreased bone height or anatomical alterations, such as pneumatization of maxillary sinus. For this reason, it represents a major challenge, especially in the posterior region. Residual bone height can limit the recommendation of implant therapy, in addition to increasing the likelihood of anatomical injuries in structures such as inferior alveolar nerve, maxillary sinus, and nasal cavity.[2] A predictable alternative aimed at compensating limited bone height is the use of surgical techniques of which purpose is to increase bone volume, namely: maxillary sinus lifting, guided bone regeneration, and a number of grafting techniques. Many patients do not accept those treatment methods, since a donor site is sometimes required, thereby increasing treatment time, costs and, above all, morbidity. In the aforementioned circumstances, short implants offer a viable, simple and predictable alternative.[3,4,5] A number of studies suggested short implants were associated with low success rates in both the maxilla and mandible.[6,7] However, those implants had not been subjected to surface treatment, which imposes limitations on clinical success, especially in the posterior region with low-quality bone. When surface-treated implants became a reality, treatment status took on a new aspect. Some authors argue that surface treatment can increase bone-to-implant contact up to 33%, which aids compensating for implant short length.[8] More recent studies suggest short implants that are properly recommended and inserted present success rates similar to those of conventional implants.[4,5,9]

Implant treatment success requires meticulous planning and surgical technique, as well as accurate prosthetic therapy.[10]

Similarly to standard implants, correct tridimensional short implant placement is a major factor for functional and esthetic treatment success. Planning or implementation failures might result in unsuccessful outcomes.[11]

Implant surface treatment is of paramount importance to ensure favorable prognosis and longevity. The following consensus has been reached among authors: the larger the bone-to-implant contact area (BIC), the more efficient dissipation of forces over the implant will be.[1,13-17]

Due to finding different opinions about implant recommendation and length, in addition to the advantages and disadvantages of implant placement in the posterior mandible, we believe the present study is appropriate.

LITERATURE REVIEW

The first implants taken as short were 7-mm in length and were developed in 1979. They were used separately or in combination with higher implants to rehabilitate partially or totally edentulous mandibles. They were created with a view to satisfying the need of addressing an increasing number of patients with atrophic maxilla.[1] However, those implants did not differ from standard ones, so as to compensate for their shorter length. This explains failure rates associated with short implants, as reported by studies published in the 1980s and 1990s.[15]

The authors of a systematic review conducted in 2012 assessed short implant success rates from 1991 to 2011, taking 28 articles into account. Results revealed a survival rate ranging from 82.45 to 98.48% from 1991 to 1995, 80 to 95.5% from 1996 to 2000, and 98 to 100% from 2001 to 2011. The study shows that treatment progress and advanc-

es in the characteristics of implants, combined with clinician's experience, aligned predictability of short implants and that of standard ones.[18]

Defining short implants is a controversial issue. A few authors consider as short implants those with length ranging from 7mm to 10mm,[19] whereas others agree on a length equal or shorter than 8mm.[20]

Because of such differences, authors have suggested implants be grouped as extrashort (≤ 6mm), short (> 6mm to < 10mm), standard (≥ 10mm to < 13mm) and high (> 13mm).[21] The suggestion was made on the basis of a literature-based research conducted in 2016, after 44 articles had been selected out of 892 studies on the length of implants of different commercial brands.

Short implants currently available are characterized not only by reduced length, but other characteristics as well. They also have a sharp cutting and compacting apex, an important adjunct to the search of stability in different bone beds; a progressive thread aimed at bone compaction, larger diameter and treatment surface, which increases BIC; and Morse taper connections, at tissue level and with platforms of smaller diameter, respecting biological space and, for this reason, providing greater stability to peri-implant tissues.[22]

ADVANTAGES

Short implants have proved an interesting alternative in cases of limited amount of bone, thus avoiding bone reconstruction surgical procedures.[2]

Treatment time is short, affordable, and with lower morbidity in comparison to clinical procedures with bone graft. The risk of mandibular nerve paresthesia remains low and the need for bone augmentation procedures in the posterior region is reduced.[23]

Short implants have success rates similar to those of standard implants. Additionally, the former can be used as support for prosthetic rehabilitation with the same predictability, provided they are properly recommended. This especially applies to the mandible where bone graft is less predictable and of greater clinical difficulty in comparison to maxillary sinus graft.[24]

CLINICAL SURGICAL CARE

Despite being widely accepted by patients and dentists as a reliable method for oral rehabilitation, a series of clinical and anatomical factors should be taken into account in implant therapy, so as to allow predictable and uneventful outcomes to be achieved. In short, implants can only be used if risks and patient's oral health is assessed. To this end, the following must be investigated: absence of acute oral pathologies and systemic disorders, smoking habits, and the presence of keratinized mucosa. Additionally, the presence of bone volume in accordance with surgical planning should be assessed.[14]

Optimal short implant placement planning must be come up on the basis of CT scans, dental casts and surgical guide. A thorough first interview is also desired. Those diagnosis and planning devices should allow bone height and thickness available for implant placement to be determined.[25]

There is no such thing as standard procedures for optimal surgery. Procedures vary according to implant shape, connection and system, as well as bone density and anatomical traits.[26] Nevertheless, we recommend two surgical steps be carried out for a lower risk of load over implants during osseointegration waiting time.

Because short implants have a smaller area available for torque/anchorage into the surgical socket, it is advisable that the rotation of drills

with a larger diameter be decreased during drilling. The procedure aims at preventing bone from heating up during instrumentation, which could potentially restrain osseointegration.[23]

In order to ensure osseointegration and satisfactory recovery not interfering in surgery success, the patient must follow post-surgical recommendations, as follows: rest, taking medication as prescribed, meticulous cleaning, provisional restoration care and fitting, and following dietary recommendations.[27]

CLINICAL PROSTHETIC CARE

Short implants usually exceed conventional prosthetic parameters, such as crown-implant ratio, thus resulting in a vertical cantilever.[28] This is acceptable, provided that direction of force and load distribution be favorable and parafunction controlled.[29] Esthetic limitations are also an issue, since short-implant-supported prostheses result in longer teeth or the use of artificial gingiva at the crown region to compensate for drawbacks.[30] Nevertheless, in the last few years, positive outcomes of treatment under the aforementioned conditions have been found, thereby making the technique feasible.[29]

Increased crown-implant ratio does not interfere in implant success if the resultant force is in axial direction. The incidence of lateral forces increases the moment arm, thus producing stress at the bone-implant interface. Those forces pose a risk of screw fracture and might lead to osseointegration loss.[14,23,28,31] The production of forces in axial direction is achieved by manufacturing smooth occlusal surfaces and carrying out proper occlusal adjustment.[32]

The occlusal table of short-implant-supported crowns must preferably be of reduced dimensions, with as much contact, shallow grooves, and short cusps as possible. Those characteristics aim at decreasing the resultant force acting on the implant system and its related components, thus enhancing biomechanics at treatment completion.[11] Smoothness around centric occlusal contact can reduce the moment arm effect, directing axial load and keeping the peri-implant bone crest unchanged, as the latter might undergo resorption, especially in view of oblique overload. This not only results from a decrease in the inclination of cusps, but it is also due to occlusal surface anatomical traits, such as large grooves and fossae, which provide benefits to implant-supported prostheses.[24]

Protected occlusion is of paramount importance for short implant success. Teeth should occlude in centric occlusion, with simultaneous and stable bilateral contact. There should be contact between centric cusps and the bottom of fossae of opposing teeth, thereby resulting in axial masticatory loading. Canine guidance should lead to disocclusion of posterior teeth both on working and balancing occlusion. During protrusion, there is contact between anterior and posterior teeth, while disoccluding the latter.[33]

CASE REPORT

Case 1

The patient was referred to the clinical service of Graduation in Implantodontics at ULBRA, Canoas, Rio Grande do Sul, Brazil due to the need of prosthetic rehabilitation of posterior mandible on both sides and little bone height available at site.

Treatment planning included Straumann™ Tissue Level RN SP 6-mm and 4-mm extrashort implants placed on #45 and #46, and 4-mm and 6-mm extrashort implants placed on #35 and #36. After six weeks of osseointegration, metal-ceramic crowns were manufactured.

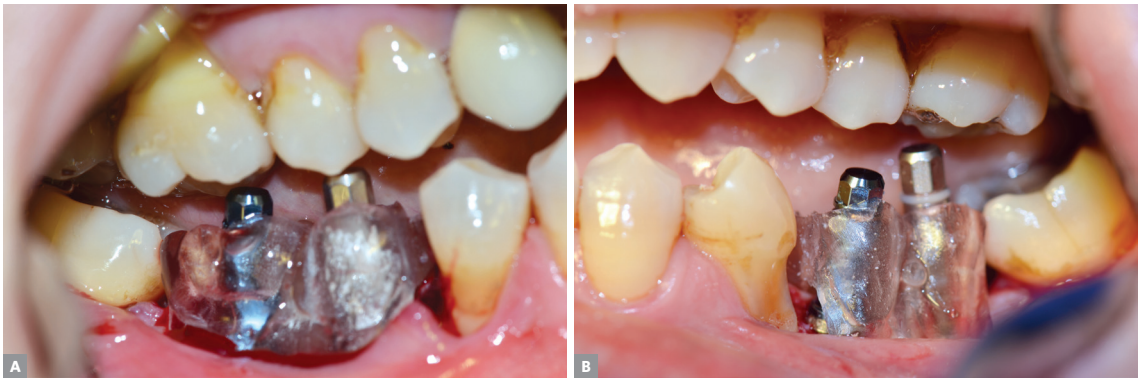

Figure 1: Straumann™ Tissue Level SLA RN 6-mm implants placed on #45 and #36, and Straumann™ Tissue Level Roxolid SlActive RN 4-mm implants. Both implant types were placed according to reverse planning and surgical guide techniques.

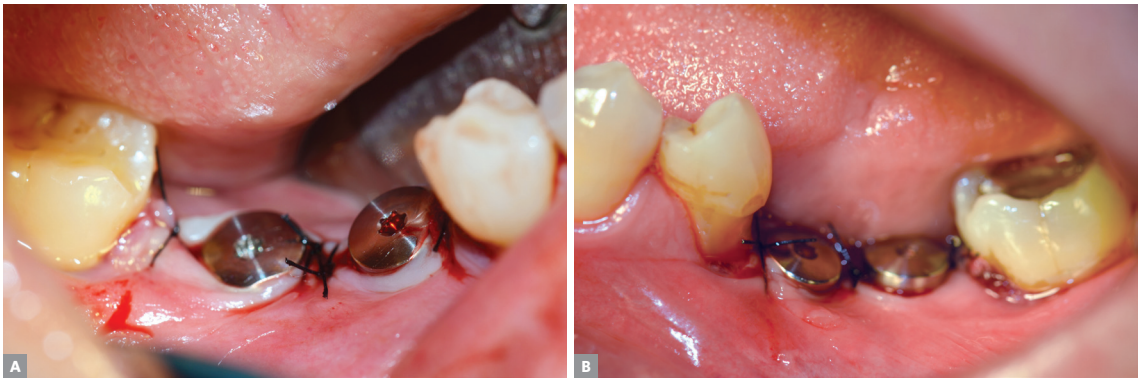

Figure 2: Healing caps placed at tissue level immediately after surgery for a 6-week osseointegration waiting time.

Figure 3: Full crowns in place, splinted in occlusion, placed on Synocta™ abutments.

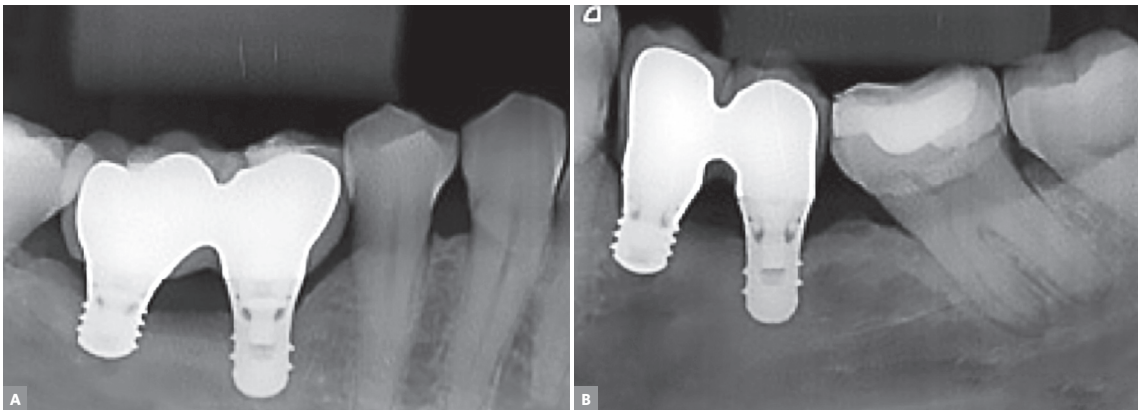

Figure 4: Control periapical radiograph one year after treatment completion. Note extrashort implants recommended due to decreased bone height associated with inferior alveolar nerve, mental foramen and proper prosthetic fitting, in addition to crown–implant ratio.

Case 2

The patient was referred to the clinical service of a private dental office after s/he had denied implant therapy or alternative treatment modalities, such as lateralization of the inferior alveolar nerve, several times. The latter was not an option of interest due to posing greater risks of causing changes to sensitivity as a result of affecting the nerve. The treatment of choice was placing three Straumann™ Tissue Level Roxolid SLActive RN SP extrashort implants 4.1mm x 4mm in length on the right side of the mandible, and two Straumann™ Tissue Level SLA RN SP implants, a short one 3.3mm x 8mm RN in length and an extrashort one 4.1mm x 6mm RN SP in length, placed for fixed-bridge restoration.

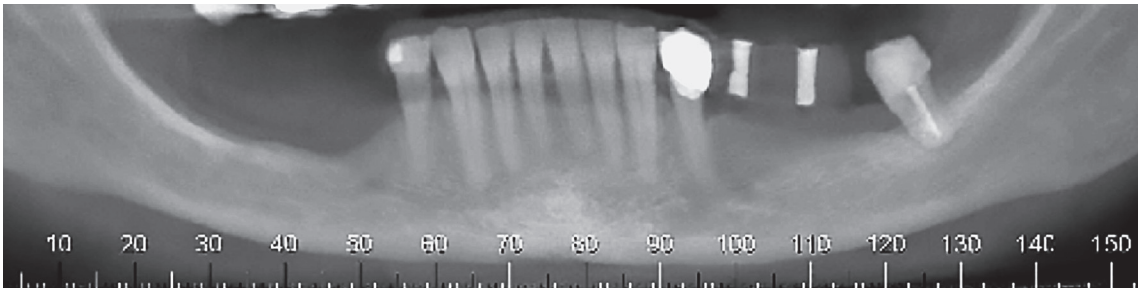

Figure 5: Preoperative CT scan revealing posterior atrophic maxilla. Computed tomography guidance only on the left side would have been previously warranted due to impossibility of implant treatment on the right side.

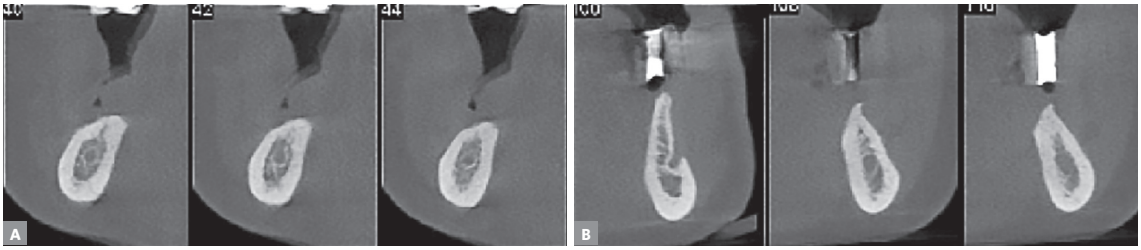

Figure 6: Tomographic slices of sites to be subjected to surgery. They reveal the amount of bone available on the right and left sides, respectively.

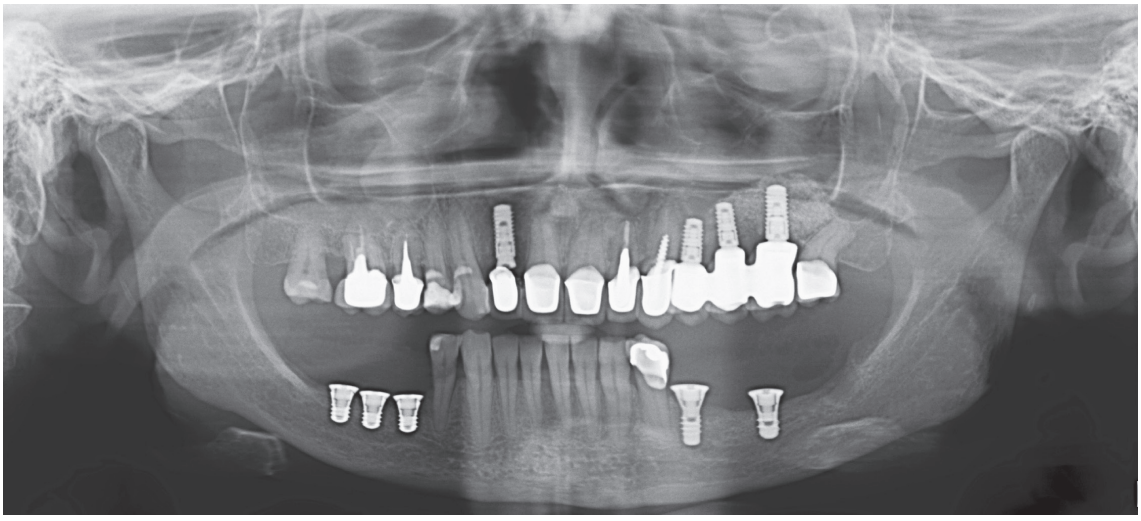

Figure 7: Panoramic radiograph six weeks after surgery revealing placement of extrashort implants on #45, #46 and #47, short implant on #35 and extrashort implant on #37.

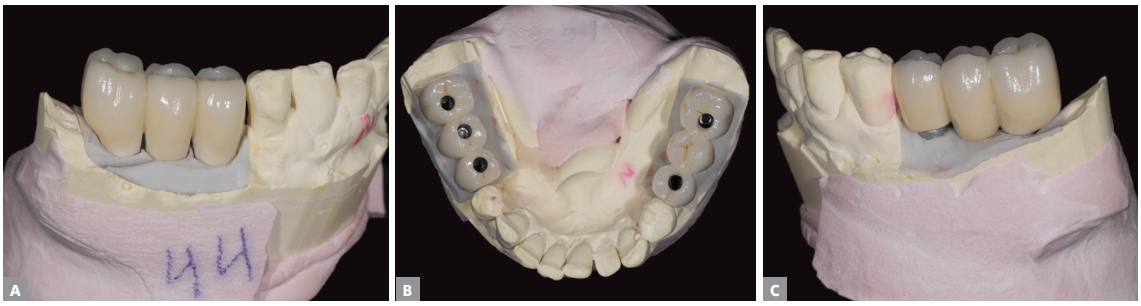

Figure 8: Characteristics of rehabilitation on articulated casts.

Figure 9: Clinical aspects of rehabilitation with extra- and short-implant-supported crowns and SynOcta™ abutments.

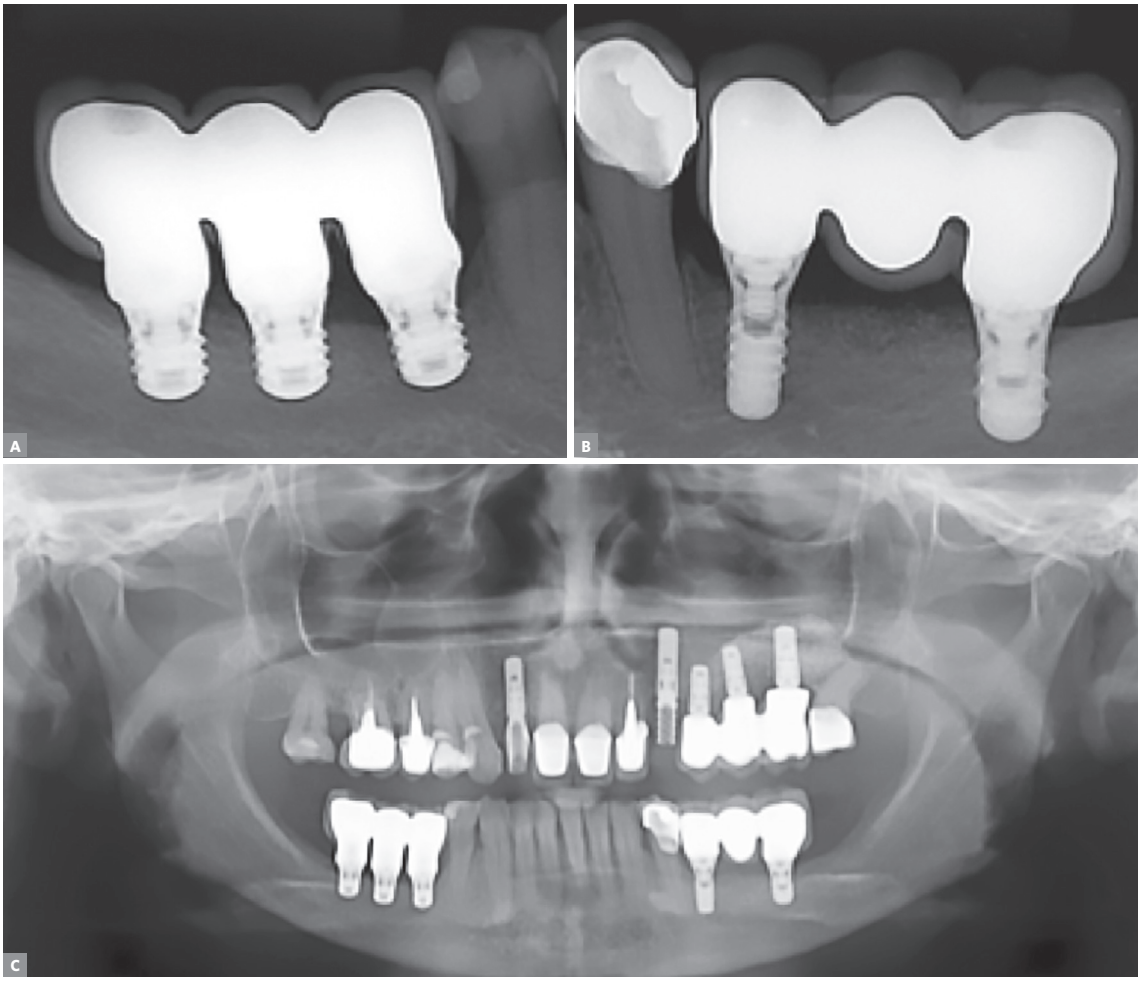

Figure 10: 1-year-follow-up periapical and panoramic radiographs revealing stability of peri-implant tissues, proper prosthetic fitting and crown-implant ratio.

DISCUSSION

Short implants were developed for sites with decreased bone height.[5,6,20] The major rationale for the use of those implants is to prevent the need for invasive surgical techniques, such as lateralization of the inferior alveolar nerve, in addition to bone grafts, and osteogenic distraction.[6,20]

Lateralization of the inferior alveolar nerve is one of the options for prosthetic rehabilitation of patients with bone defects or mild to severe alveolar resorption. Nevertheless, there is some concern over occasional sensorineural changes caused by those procedures and resulting from handling of nerve bundles. Sequelae, such as par-

esthesia, dysesthesia, and anesthesia, are types of damage that vary according to patient's anatomical complexity, surgeon's ability, and the degree of surgical difficulty.[34] A number of studies suggest the technique is advantageous due to allowing proper implant guidance, as it allows the latter to be directly viewed, in addition to providing a greater amount of bone.[35] However, as the technique shows a considerable level of complexity, it is not recommended neither for all patients nor for all dental surgeons.[36]

Alveolar osteogenic distraction is a technique aimed at gradual bone augmentation, offering the potential for new bone formation by means of natural bone repair mechanisms.[37] The advantages of the technique are as follows: there is no need for a donor site, there is presence of vital bone at osteogenic distraction site, and soft tissue gain. Nevertheless, a few authors report some complications, such as longer treatment time, high costs, risk of infection, and need for a distractor.[37] Vertical alveolar osteogenic distraction is a meticulous surgical technique with a high risk of complication. It is contraindicated when vertical residual bone height is less than 10mm.[37] Thus, for distractor use, the amount of bone required is the same as that allowing 8-mm or 10-mm implants to be placed. This would lead to predictability, shorter treatment time, less morbidity and lower costs.

Autograft is the best alternative in terms of osteogenic potential, but it also has its disadvantages, such as restricted availability, morbidity of donor site, as well as risks inherent to the process, such as partial resorption and infection.[15] Biomaterial, bone substitutes, such as homogenous, heterogeneous and synthetic material, are a few options. In spite of that, they sometimes cannot be used for atrophic alveolar ridge reconstruction due to being unpredictable while treating some types of defect, especially vertical mandibular ones.[38]

Once the aforementioned techniques are compared with those used by the cases reported in the present study, we found cases were treatment within shorter time, with facility, and less morbidity. We believe choosing short as well as extrashort implants to be placed in the posterior mandible is one of the major and most often recommended treatment modalities aimed at those cases. It is clear, as previously mentioned, that it also presents satisfactory outcomes in the maxilla; however, the posterior maxilla can be easily treated by grafting procedures with bone substitutes with great predictability and low morbidity.[39]

We recommend implant placement be carried out at two surgical steps, especially extrashort implants. Waiting time and the second surgical step are followed by prosthesis manufacturing. Implants were placed and followed-up for 12 months after full crown placement. Surface treatment is of paramount importance to treatment success due to providing greater bone-to-implant contact.[40] It is worth highlighting that despite being similar to conventional implants, short and extrashort implants are more delicate, especially during surgery, with little potential for drilling and/or placement mistakes. This is due to being shorter in length and being more prone to losing primary stability. Full crowns were joined with a view to achieving greater stability of rehabilitation. Although some authors opt for single prostheses in specific cases and, as a result, achieve satisfactory outcomes, no consensus has been reached in the scientific community.[41] Whenever implants similar in length to those used in the cases reported herein are used, splinting is recommended. Due to the aforementioned biomechanical issues, our choice was to place three extrashort implants instead of two on the right side, and fixed bridge on the left side.

FINAL CONSIDERATIONS

Short and extrashort implants are a predictable alternative with success rates similar to those of standard implants, provided they are properly recommended and carried out.

The technique is less invasive when treating atrophic sites, thereby decreasing treatment time, and resulting in less morbidity as well as post-operative complications. Additionally, costs are lower. Due to being shorter, surface treatment and, as a consequence, bone-to-implant contact seem to play a major role in osseointegration, and so does occlusion with proper load distribution and occlusal contact, all of which contribute to treatment stability in the long-term.[22,24,32,34]

Therefore, is of paramount importance that surgical and prosthetic planning be meticulously carried out. We recommend two-step surgery and splinted crowns in cases using 4-mm implants, in addition to ongoing follow-up.

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