

Total rehabilitation with implant-supported and implant-retained prostheses in atrophic maxillae: Aesthetic and functional resolution for totally edentulous patients

Reabilitação total com próteses implantossuportadas em maxilas atróficas: Resolução estética e funcional para pacientes totalmente desdentados.

Rehabilitación total con prótesis implantosoportadas en maxilares atróficos: Resolución estética y funcional para pacientes desdentados totales

Received: 10/30/2022 | Revised: 11/18/2022 | Accepted: 11/24/2022 | Published: 12/01/2022

André Massoni Fernandes

ORCID: <https://orcid.org/0000-0002-7657-9886>
University Center of Northern Sao Paulo, Brazil
E-mail: andrediafarma@hotmail.com

Pedro Aryel Carvalho Dias

ORCID: <https://orcid.org/0000-0002-9536-5090>
University Center of Northern Sao Paulo, Brazil
E-mail: pedroaryel2000@gmail.com

Isis Almela End Hoshino

ORCID: <https://orcid.org/0000-0001-8570-0425>
Araçatuba School of Dentistry, Brazil
E-mail: isis.hoshino@unesp.br

Rodolfo Bruniera Anchieta

ORCID: <https://orcid.org/0000-0002-7920-7885>
Araçatuba School of Dentistry, Brazil
E-mail: rodolfoanchieta2@hotmail.com

Abstract

Introduction: Implant-supported prostheses are an excellent treatment option for totally edentulous patients, however, some conditions, such as extremely atrophic jaws, may limit their application. Aims: to demonstrate and discuss, through a series of clinical cases, the functional aesthetic resolution of totally edentulous patients with atrophic maxillae, using three different implant-prosthesis approach. *Methods and Material:* This article describes a clinical case series of patients has between 65 and 75 years old, who lost all upper teeth and had severely atrophic jaws. Due to the bone situation of the maxilla, an osteotome was planned for sinus floor elevation and followed by an allogeneic bone graft. After 18 months of bone integration, osseointegrated implants were installed and different prostheses were made for each case. *Conclusions:* It is possible to conclude that with the use of advanced surgical and prosthetic planning it is possible to recover the aesthetics and function of a serious and complex clinical case.

Keywords: Atrophic maxillae; Fixed implant denture; Oral implants; Platelet-rich fibrin; Platelet-rich plasma.

Resumo

Introdução: As próteses implanto-suportadas é uma excelente opção de tratamento para pacientes desdentados totais, entretanto, algumas condições como maxilas extremamente atróficas, pode limitar a sua aplicação. Objetivos: demonstrar e discutir, através de uma série de casos clínicos, a resolução estética funcional de pacientes totalmente desdentados com maxilas atróficas, utilizando três diferentes abordagens implante-prótese. *Métodos e Material:* Este artigo descreve uma série de casos clínicos de pacientes com idade entre 65 e 75 anos, que perderam todos os dentes superiores e apresentavam mandíbulas severamente atróficas. Devido à situação óssea da maxila, foi planejado um osteótomo para elevação do assoalho do seio e seguido de um enxerto ósseo alogênico em ambos casos. Após 18 meses de integração óssea, implantes osseointegrados foram instalados e próteses diferentes foram confeccionadas para cada caso. *Conclusões:* É possível concluir que com o uso de planejamento cirúrgico e protético avançado é possível recuperar a estética e função de um caso clínico grave e complexo.

Palavras-chave: Maxilas atróficas; Prótese fixa sobre implantes; Implantes orais; Fibrina rica em plaquetas; Plasma rico em plaquetas.

Resumen

Introducción: Las prótesis implantosoportadas son una excelente opción de tratamiento para pacientes totalmente edéntulos, sin embargo, algunas condiciones como maxilares extremadamente atróficos pueden limitar su aplicación. Objetivos: demostrar y discutir, a través de una serie de casos clínicos, la resolución estética funcional de pacientes

totalmente edéntulos con maxilar atrófico, utilizando tres abordajes implantoprótesis diferentes. *Material y Métodos:* Este artículo describe una serie de casos clínicos de pacientes con edades comprendidas entre los 65 y 75 años, que habían perdido todos los dientes superiores y tenían mandíbulas severamente atróficas. Debido a la situación ósea del maxilar, se planeó un osteótomo para la elevación del piso del seno y seguido de un injerto óseo alogénico en ambos casos. Después de 18 meses de integración ósea, se colocaron implantes osteointegrados y se realizaron diferentes prótesis para cada caso. *Conclusiones:* Es posible concluir que con el uso de la planificación quirúrgica y protésica avanzada es posible recuperar la estética y función de un caso clínico grave y complejo.

Palabras clave: Maxilares atróficos; Prótesis fija sobre implantes; Implantes orales; Fibrina rica en plaquetas; Plasma rico en plaquetas.

1. Introduction

Complete edentulous represents a common problem in the health of the population. The lack of teeth is related to masticatory incapacity, unfavorable aesthetics caused by the loss of facial muscle support, including other problems such as alteration of the vertical dimension. In addition to decrease the masticatory capacity which may cause deficits in the patient's nutritional replacement and psychological problems (Sharma et al. 2017).

Currently, there is still a wide variety of opinions about the best treatment option for the rehabilitation of totally edentulous patients. The biological and individual characteristics of each patient have priority in choosing the best treatment option, as well as their financial possibilities (Kern et al. 2016).

Implant-supported and implant-retained complete dentures undoubtedly represent a good treatment option currently available for complete edentulous patients (Chausu & Schwartz-Arad, 1999). However, for some situations such as extremely atrophic maxilla, this kind of treatment is often a challenge due to anatomical factors. Deficient bone height and thickness in the anterior region of the maxilla, and inadequate residual bone height due to maxillary expansion and/or resorption of alveolar bone with low bone density and quality are common in posterior regions of the maxilla, this generates inadequate dimensions of the ridge for the three-dimensional implant placement (Cucchi et al. 2017).

Though there are currently many bone regeneration techniques available for the recovery of atrophic maxillae, including the possibility to only use synthetic bone grafts, minimizing postoperative recovery and comorbid. One of the techniques that can be used with synthetic bone grafts is the elevation of the maxillary sinus floor, allowing bone gain in height. Still, despite being less invasive than autologous block grafts in the anterior region of the maxilla, with this maxillary sinus elevation technique, bone gain occurs only in the posterior region of the maxilla, leading to the creation of an anterior cantilever in the case of using implant-retained and implant-supported prostheses (Lamas et al. 2020; Jensen-Louwerse et al. 2021; Kim et al. 2014).

Among the prosthetic options for the rehabilitation of complete edentulous patients with implant-supported prostheses, two basic types stand out: implant-supported and implant-retained prostheses. Regarding the implant-supported prostheses, the conventional protocol prosthesis or fixed prosthesis stands out for being fixed on the implants, returning the masticatory force similar to natural dentition, and excellent aesthetics. This type of prosthesis can be made of various materials, including metal-acrylic resin, metal-ceramic, or entirely in ceramic, as zirconia (Bagegni et al. 2019).

Another treatment option is called an overdenture prosthesis, that is an implant-retained prostheses, and could be attached on implants by four types of retention attachments, namely: Ball, pin, bar-clip, magnet type, and telescopic attachments (Alqutaibi et al. 2017; Chandan et al. 2017). Each system has a retainer, where one component is fixed to the lower surface of the prosthesis and the other is connected to the implant (Sutariya et al. 2021). The main feature of this type of prosthesis is that it is easy to clean, in addition to the possibility of recovering the lip support (Dudley et al. 2015).

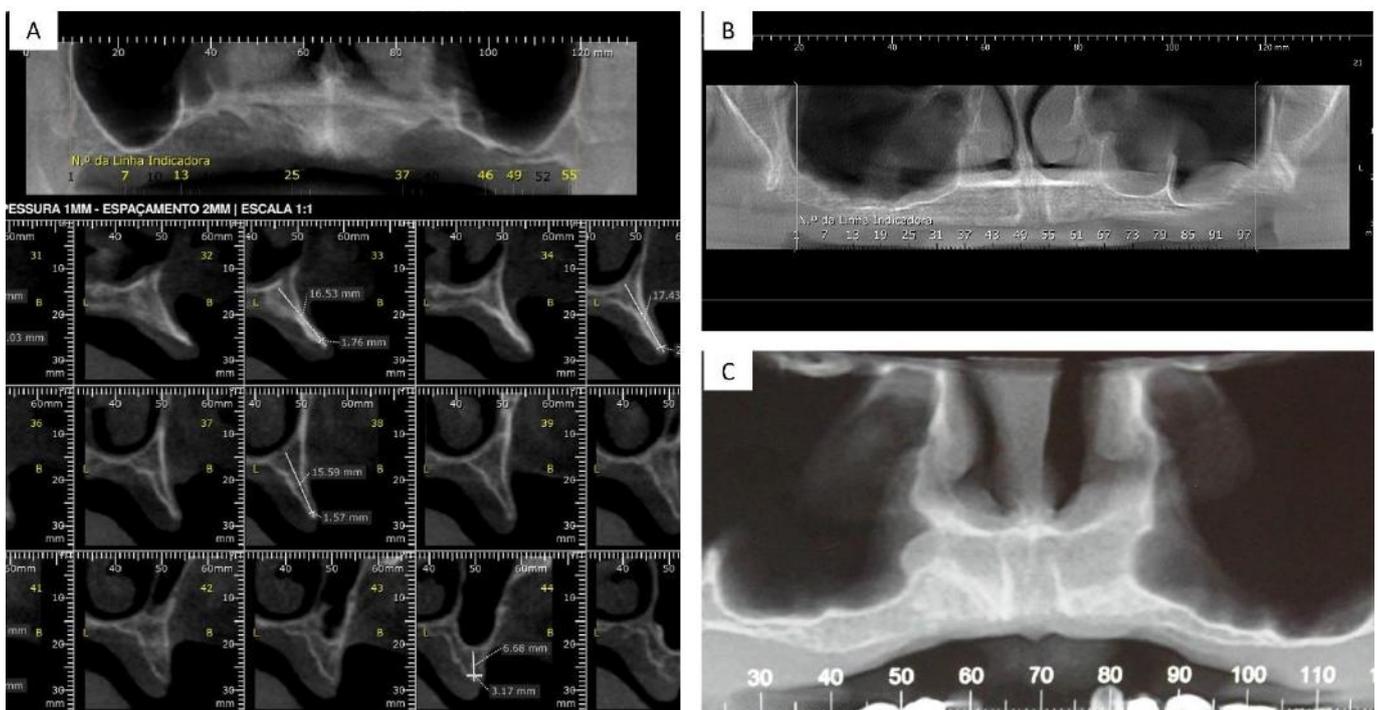
Thus, the objective of this article is to demonstrate and discuss, through a series of clinical cases, the functional aesthetic resolution of totally edentulous patients with atrophic maxillae, using three different implant-prosthesis approach.

2. Clinical Cases

In all clinical cases that will be described below, the same clinical protocol was followed. Initially, after signing the informed consent form, anamnesis and physical examination were performed. Complementary blood tests, cardiological evaluation, and imaging tests such as panoramic radiographs and computerized tomography were requested. The patients has between 65 and 75 years old.

In all cases, the presence of atrophic maxilla with an absence of horizontal bone in the anterior region was observed, and pneumatization of the maxillary sinuses in the bilateral posterior region (Figure 1 A-C). To avoid more complex and traumatic surgeries, the autologous block graft in the anterior region was discarded.

Figure 1 - Computed Tomography (CT) of Atrophic Maxilla, showing the thickness per segment of residual basal bone. **A.** CT referring to case 1; **B.** CT referring to case 2; **C.** CT referring to case 3.



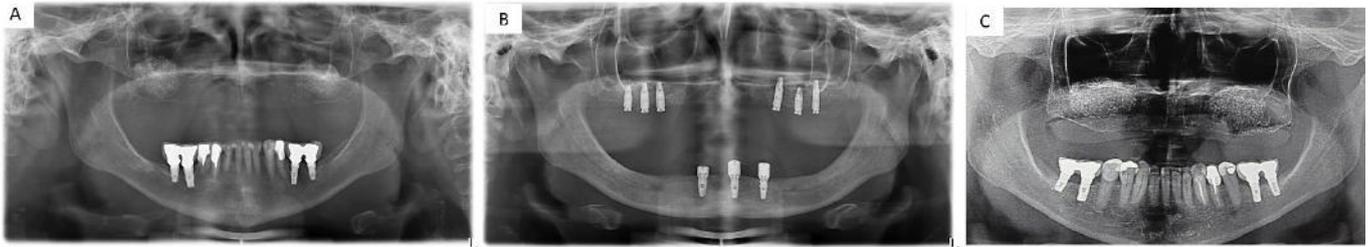
Source: Authors.

The clinical protocol used for all cases was the maxillary sinus lift surgery, using the window technique, and using osteotomy with diamond burs in low rotation. A xenograft (Bio-oss, Geistlich, Switzerland) associated with platelet-rich plasma (PRP) was used. After the graft was positioned in the surgical pocket associated with PRP, a collagen membrane (Lumina Coat, Criteria, Brazil) was placed and fibrin-rich plasma (FRP) was placed on top as protection. The suture was performed with polyglactin thread.

Control radiographs of 12 months were performed in all cases (Figure 2 A-C), and after 18 months of graft healing, dental implant placement surgeries were performed (Figure 3 A-C). Only one case the implant placement occurs at the same time of sinus lift surgery (Figure 2 B). The manufacture of implant prostheses followed the principles of reverse planning, following the sequence: 1st) Planning impression with a closed tray transfer and silicone; 2nd) Working impression with individual tray and polyether material using open transfers; 3rd) Adjustment of the orientation plane (dimensional of occlusion, lip support, buccal corridor, orientation lines, assembly in a semi-adjustable articulator, and choice of teeth, etc.); 4th) Test of the teeth on the wax plane; 5th) Test of the metallic bar; 6th) New teeth test and choice of artificial gingiva color; 7th)

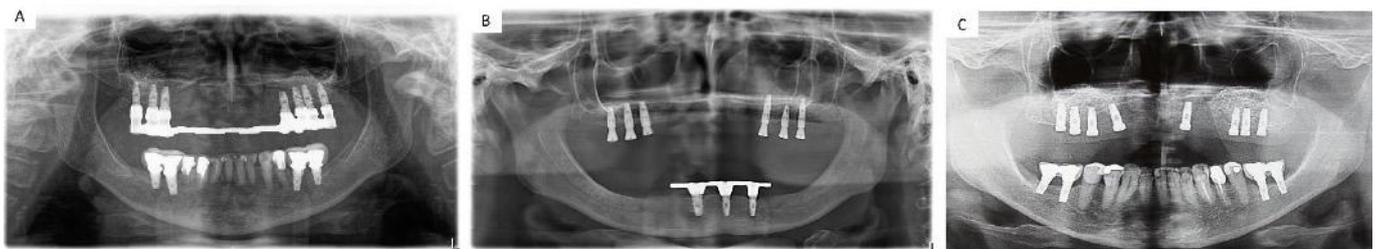
Prosthesis test, adjustments, and orientation; 8th) control.

Figure 2 - Panoramic radiograph for evaluation and analysis of the bone graft in the bilateral region of the maxillary sinus after 12 months of graft. **A.** Panoramic radiograph at case 1; **B.** Panoramic radiograph at case 2; **C.** Panoramic radiograph at case 3.



Source: Authors.

Figure 3 - Panoramic radiograph to evaluate implant placement. **A.** Installation of 7 external hexagon connection implants of 4.1x 11.5 mm after 18 months of bone grafting; **B.** Installation of 6 morse taper implants of 3.8 x 13mm concomitantly with bone graft; **C.** Installation 8 4.1x 11.5mm external hexagon connection implants after 18 months of bone grafting.

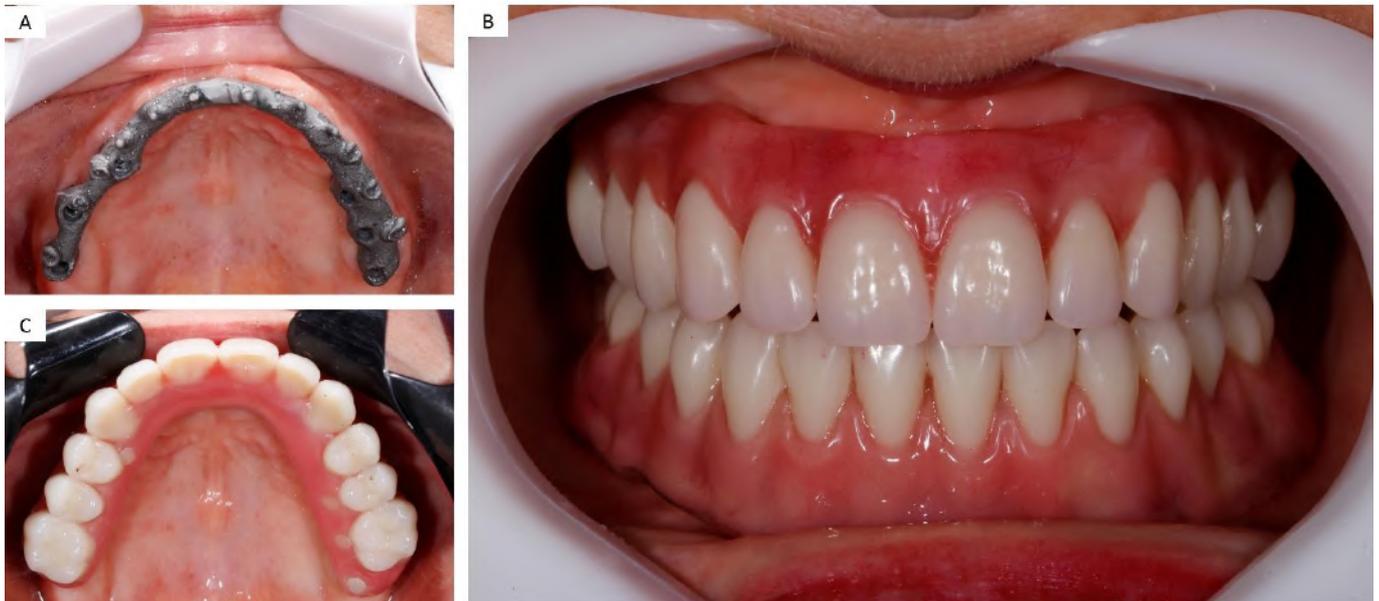


Source: Authors.

Case 1 - Overdenture Type Prosthesis

In this case, seven external hexagon connection implants of 4.1x 11.5 mm (diameter x length) were performed (SIN implants, Tryon, Brazil), but osseointegration was observed in only 5 of them. After the second stage surgery of the implants for healing placement, the procedures for making the prosthesis began. The choice for overdenture prosthesis without a palate was made due to the need for good lip support, and the patient's preference for removable prostheses due to facility for cleaning. In this case, 3 clip-bar retention systems were used, two fixed on the posterior region (one on each side) and another to the anterior region of the bar (Figure 4 A-B). At the end of the treatment, there was excellent lip support, and aesthetics, and the patient was completely satisfied. (Figure 4 C).

Figure 4 - Sequence of the prosthetic step at case 1. **A.** Installation of 3 clip-bar retention systems were used; **B.** Prosthesis. **C.** Final appearance of overdenture type prosthesis.



Source: Authors.

Case 2- Acrylic resin implant-supported prosthesis

After verifying the osseointegration of the six 3.8 x 13mm morse taper implants (SIN implants, SW Strong, Brazil), the implants were reopened and healing devices were installed. The choice for the resin protocol was due to several factors: 1st) The patient's desire to have fixed teeth; 2nd) The Presence of 6 osseointegrated implants, ensuring good support on the anterior lever arm; 3rd) The presence in the lower jaw of an acrylic implant prosthesis, making the occlusion between the two prostheses compatible and thus causing less wear on the artificial teeth; 4th) Adequate lip support with this type of prosthesis; 5th) Cost-effectiveness and ease of repair of the prosthesis in relation to ceramic prostheses (Figure 5 A-C).

Figure 5 A and B - Sequence of the prosthetic step at case 2. **C.** Final appearance of acrylic resin implant-supported prosthesis.



Source: Authors.

Case 3 – Metal-ceramic dentogingival implant-supported prosthesis

After check the osseointegration of the eight 4.1x 11.5mm external hexagon connection implants (SIN implants, SW Strong, Brazil), the implants were reopened and the healing devices were installed. The choice for the metal-ceramic

dentogingival fixed protocol type was due to several factors: 1st) The patient's desire to have fixed teeth; 2nd) Presence of 7 implants, ensuring good support on the anterior lever arm; 3rd) Presence of prosthesis on metal-ceramic implants in the lower region, making the materials compatible, and less wear of the prosthesis; 4th) Need for moderate lip support, which can be achieved with this type of prosthesis. Regarding metal-ceramic prostheses, the excellent esthetics compared to resin prostheses, as well as less wear and staining, stand out. However, repairs caused by chipping or fracture of porcelain are more difficult to repair than acrylic resin prostheses (Figure 6 A-C).

Figure 6 A and B - Sequence of the prosthetic step at case 3. **C**. Final appearance of metal-ceramic dentogingival implant-



supported prosthesis.

Source: Authors.

3. Discussion

Edentulism is one of the most common problems that affect the health of the elderly population. Tooth loss results in reduced bone mass responsible for complete denture support, retention, and stability. Decreased retention and stability of the denture are considered one of the main causes of reduced quality of life-related to oral health in the elderly (Aal MA et al. 2021).

Implant-retained prostheses as overdenture type are an excellent method for the complete prosthetic treatment of the mandible and maxilla, presenting relatively lower costs and uncomplicated clinical management with a significant improvement in the retention and stabilization of the prosthesis, which is mainly retained by implants. through attachments (Idzior-Haufa et al. 2021; Keshk et al. 2017).

According to the study by Idzior-Haufa et al, O'Ring-type attachments cause less displacement of the overdenture, however, they generate higher stresses on the implants compared to overdentures retained by bar-clip (Idzior-Haufa et al. 2021).

The costs for making an overdenture remain slightly below average when compared to an implant-supported fixed complete denture, however, the maintenance of an overdenture can occur on average after 12 months of prosthesis installation, and the main problems related to it are the loss of retention due to wear of the retention systems of the prosthesis (Wakam et al. 2022).

According to studies by Payne et al for mandibular and maxillary overdentures, there is insufficient evidence to

determine the relative effectiveness of different retention systems on prosthetic success, prosthetic maintenance, patient satisfaction, preference, or costs. It is not possible to determine which retention system should be preferred for mandibular overdentures, and there is not enough data in the literature to define the best indications (Payne et al. 2018).

Krishna et al, concluded in their study that overdentures are not the gold standard for completely edentulous mouths, however, the implant-retained overdenture provides the patient with good retention and stability for the denture, in addition to psychological well-being similar to fixed dentures (Krishna et al. 2022).

To choose a fixed implant-supported or removable implant-retained prosthesis (overdenture), several factors must be associated with this choice, such as: bone quantity and quality, implant distribution and location, maxillo-mandibular relationship, nature of the occlusion, opposite, costs and time for making and maintaining the prosthesis. According to Selim et al, in their study, it can be concluded that implant-supported fixed prostheses obtained higher rates in terms of stability, chewing ability, speaking ability, and esthetics. However, it is worth remembering that in some situations the lack of a buccal flange in fixed prostheses can cause a deficiency in lip support. In addition, in terms of ease of cleaning, removable implant-retained prostheses were more effective and practical (Selim et al. 2016).

Many combinations of materials such as metal-plastic prostheses (acrylic) and metal-ceramic prostheses have been used to manufacture fixed complete dentures on implants. However, complications such as chipped teeth, surface wear, and difficulty in the color selection are one of the disadvantages of metallic-acrylic alloys. About metal-ceramic prostheses, complications such as fracture of the ceramic, chipping of the ceramic, lack of passive adjustment, and consequently, its difficulty in repair and costs are very common (Carames et al. 2015).

Nedir et al, in their study, had more complications with implant-retained removable prostheses compared to implant-supported fixed (Nedir et al. 2006).

According to Alfarsi et al, protocol-type prostheses made of acrylic have a relatively lower manufacturing cost, in addition to being lighter and easier to repair. Metal-ceramic or all-ceramic fixed complete dentures, on the other hand, present better aesthetics, good mechanical characteristics, and easier cleaning. However, it should be noted that in cases of patients with poor oral hygiene, the acrylic protocol prosthesis remains unfavorable (Alfarsi et al. 2020).

Rösing et al, found in their study that patients must receive individualized care and support to maintain peri-implant health. Not to mention risk management such as biofilm control, smoking and diabetes are essential to prevent peri-implantitis and peri-implant mucositis (Rösing et al. 2019). It is essential to ask the patient to return for maintenance of their implant-supported prosthesis, and the correct guidance on the forms of hygiene and care by the professional to the patient, thus having longevity and success of osseointegrated implants (Mok et al. 2007).

4. Conclusion

Both types of prostheses were possible to be performed when positioning the implants only in the posterior region of the maxilla. Of the various treatment modalities available for the rehabilitation of edentulous patients, fixed implant-supported prostheses are proven to be one of the best treatment options in terms of chewing comfort and stability. On the other hand, implant-retained prostheses as overdentures type are easy to clean because they are removable, had low cost, but require greater maintenance. Thus, it is up to the dentist to evaluate each case and thus propose the best treatment within the physiological, and financial conditions of each patient.

References

Aal, M. A., Naguib, A., Salah, A., Foda, K., Sheta, N., & Nabi, N. A. (2021). Masticatory Ability for a Single Implant Mandibular Overdenture Retained by Two Different Attachments: A Randomized Controlled Trial. *Int J Dent.*; 2021: 1632848.

- Alfarsi, M. A., & Shaik, S. (2020). Implant-supported fixed hybrid acrylic complete dentures opposing fully restored mandibular metal ceramic restorations. *BMJ case rep*; 13: e233913.
- Alqutaibi, A. Y., & Kaddah, A. F. (2016). Attachments used with implant supported overdenture. *Int Dent Med J Adv Res*; 2: 1-5.
- Bagegni, A., Abou-Ayash, S., Rücker, G., Algarny, A., & Att, W. (2019). The influence of prosthetic material on implant and prosthetic survival of implant-supported fixed complete dentures: a systematic review and meta-analysis. *J Prosthodont Res*; 63: 251-265.
- Carames, J., Suinaga, L. T., Yu, Y. C. P., Pérez, A., & Kang, M. (2015). Clinical Advantages and Limitations of Monolithic Zirconia Restorations Full Arch Implant Supported Reconstruction: case series. *Int J Dent*; 2015: 392496.
- Chandan, K. (2017). Implant supported overdenture attachments – A review. *IOSR J Dent Med Sci (IOSR-JDMS)*. 16: 87-91.
- Chaushu, G., & Schwartz-Arad, D. (1999). Full-arch restoration of the jaw with fixed ceramo-metal prosthesis: late implant placement. *J Periodontol*; 70: 90-94.
- Cucchi, A., Vignudelli, E., Franco, S., & Corinaldesi, G. (2017). Minimally Invasive Approach Based on Pterygoid and Short Implants for Rehabilitation of an Extremely Atrophic Maxilla: Case Report. *Implant Dent*; 26: 639-644.
- Dudley J (2015). Implants for the ageing population. *Aust Dent J*; 60: 28-43.
- Idzior-Haufa, M., Pilarska, A., Hedzelek, W., Boniecki, P., Pilarski, K., & Dorocka-Bobkowska, B. (2021). A Comparison of Biomechanical Properties of Implant-Retained Overdenture Based on Precision Attachment Type. *Materials (Basel)*; 14: 2598.
- Jensen-Louwerse, C., Sikma, H., Cune, M. S., Guljé, F. L., & Meijer, H. J. A. (2021). Single implant-supported two-unit cantilever fixed partial dentures in the posterior region: a retrospective case series with a mean follow-up of 6.5 years. *Int J Implant Dent*; 7: 78.
- Keshk, A. M., Alqutaibi, A. Y., Algabri, R. S., Swedan, M. S., & Kaddah, A. (2017). Prosthodontic maintenance and peri-implant tissue conditions for telescopic attachment-retained mandibular implant overdenture: Systematic review and meta-analysis of randomized clinical trials. *Eur J Dent*; 11: 559-568.
- Kern, J. S., Kern, T., Wolfart, S., & Heussen, N. (2016). A systematic review and meta-analysis of removable and fixed implant-supported prostheses in edentulous jaws: post-loading implant loss. *Clin Oral Implants Res*; 27: 174-195.
- Kim, Y. K., Lee, J., Yun, J. Y., Yun, P. Y., & Um, I. W. (2014). Comparison of autogenous tooth bone graft and synthetic bone graft materials used for bone resorption around implants after crestal approach sinus lifting: a retrospective study. *J Periodontal Implant Sci*; 44: 216-221.
- Krishna, S., Kumar, R., & Sailasri, K. (2022). Implant-Supported Overdenture Using Ball Attachments in Maxilla and Mandible: A Case Report. *Cureus*; 14: e23264.
- Lamas, J. M. A., Sánchez, M. G., González, L. C., García, A. S., Sánchez, J. A. (2020). Vertical Bone Gain after Sinus Lift Procedures with Beta-Tricalcium Phosphate and Simultaneous Implant Placement-A Cross-Sectional Study. *Medicina (Kaunas)*; 56: 609.
- Mok, J., Emami, E., Kobayashi, T., & Feine, J. S. (2007). An Oral Hygiene Brochure for Your Implant Overdenture Patients. *J Can Dent Assoc*; 73: 713.
- Nedir, R., Bischof, M., Szmukler-Moncler, S., Belser, U. C., Samson, J. (2006). Prosthetic complications with dental implants: from an up-to-8-year experience in private practice. *Int J Oral Maxillofac Implants*; 21: 919-928.
- Payne, A. G., Alsabeeha, N. H., Atieh, M. A., Esposito, M., Ma, S., El-Wegoud, M. A. (2018). Interventions for replacing missing teeth: attachment systems for implant overdentures in edentulous jaws. *Cochrane Database Syst Rev*; 10: CD008001.
- Rösing, C. K., Fiorini, T., Haas, A. N., Muniz, F. W. M. G., Oppermann, R. V., & Susin, C. (2019). The impact of maintenance on peri-implant health. *Braz Oral Res*; 33: e074.
- Sharma, A. J., Nagrath, R., & Lahori, M. A comparative evaluation of chewing efficiency, masticatory bite force, and patient satisfaction between conventional denture and implant-supported mandibular overdenture: An in vivo study. *J Indian Prosthodont Soc*. 2017; 17: 361–372.
- Selim, K., Ali, S., & Reda, A. (2016). Implant Supported Fixed Restorations versus Implant Supported Removable Overdentures: A Systematic Review. *Open Access Maced J Med Sci*; 4: 726-732.
- Sutariya, P. V., Shah, H. M., Patel, S. D., Upadhyay, H. H., Pathan, M. R., Shah, R. P. (2021). Mandibular implant-supported overdenture: A systematic review and meta-analysis for optimum selection of attachment system. *J Indian Prosthodont Soc*; 21:319-327.
- Wakam, R., Benoit, A., Mawussi, K. B., & Gorin, C. (2022). Evaluation of Retention, Wear, and Maintenance of Attachment Systems for Single- or Two-Implant-Retained Mandibular Overdentures: A Systematic Review. *Materials (Basel)*; 15: 1933.