

Anatomical and surgical considerations for fixed implant-supported prostheses in edentulous elderly patients

Abstract

Total edentulism can lead to changes in the anatomy of jaws over the years in elderly subjects. Therefore, the dental surgeon must comprehend the anatomical variations and surgical peculiarities of elderly total edentulous subjects requiring oral rehabilitation with fixed implant-supported prostheses. This article aims to discuss the different approaches and anatomical considerations to perform a precise dental implant placement for full-arch fixed implant-supported prostheses.

Keywords: dental implants, implantology, anatomy

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Abbreviations: 3D-CT, three-dimensional computerized tomography; CAD/CAM, computer-aided design/ computer-aided manufacturing;

Introduction

As the global population ages, the demand for oral rehabilitation in elderly subjects has risen.¹ Additionally, edentulism is a global public health challenge until nowadays.² Dental implants have emerged as a viable and effective solution for restoring oral function and aesthetics with fixed implant-supported prostheses.¹ However, successful implant surgery in elderly edentulous patients necessitates a thorough understanding of the anatomical alterations that occur with age in an edentulous jaw. Therefore, this article aims to list the main anatomical

and surgical considerations in the oral rehabilitation of elderly fully edentulous with fixed implant-supported prostheses.

One of the primary challenges in oral rehabilitation of elderly total edentulous patients is the progressive resorption of alveolar bone.³ The alveolar processes undergo a continuous remodeling process after tooth loss, resulting in decreased bone volume and altered bone density.⁴ This is a significant consideration for dental implant placement, as satisfactory bone support is crucial for primary implant stability and long-term success.⁵ Therefore, over the years different strategies of oral rehabilitation were established to overcome the challenges of anatomical alterations in edentulous elderly patients. A schematic representation of the main approaches for dental implant placement for full-arch fixed implant-supported prostheses along this study is presented in the Figure 1.

Dental implant placement for full-arch fixed implant-supported prostheses

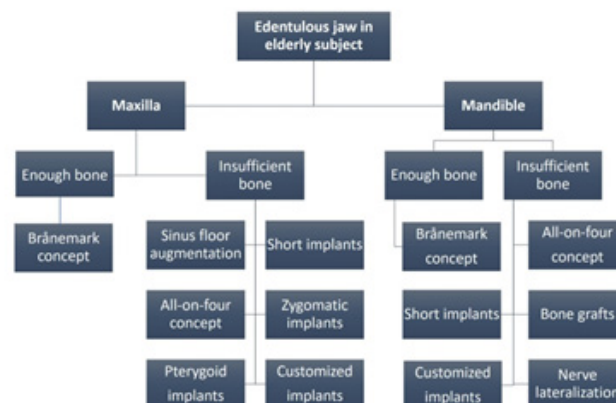


Figure 1 Dental implant placement for full-arch fixed implant-supported prostheses.

Tooth loss can lead to sinus pneumatization in the maxilla, consequently causing the maxillary sinus expansion.⁶ The sinus pneumatization may compromise the available bone for implant placement mainly in the posterior maxilla.⁶ Understanding the extent of sinus pneumatization is essential for determining the need for sinus floor augmentation procedures or the use of short implants.⁷ The sinus floor augmentation can be performed with autologous bone or exogenous bone substitutes.⁷ For cases undergoing sinus floor augmentation or with enough bone in the maxilla, the most implemented technique is the Brånemark surgical-prosthetic protocol.⁸ In these cases, it is used six dental implants in the maxilla to support the fixed implant-supported prostheses.⁹

Another currently used technique is the All-on-four protocol, where four dental implants are distributed in the anterior maxilla.¹⁰ Thus, four dental implants are placed in the remaining bone with more density in the anterior maxilla. Two anterior dental implants are placed axially and palatably next to the incisive foramen and apically close to the cortical bone in the floor of the nasal cavity.¹⁰ Additionally, two distal dental implants are placed in both the canine pillars. These distal implants are commonly inclined to increase the distance between the anterior implants.¹⁰ Consequently, reducing the cantilever length of the prosthesis allows to use of a prosthesis with up to twelve teeth and reduces the risk of prosthesis fracture.¹⁰ The main highlight of the All-on-four concept is the avoidance of sinus floor augmentation and the high chances of immediate loading.¹⁰

Pterygoid implants are alternative dental implants used in the most posterior region of the maxilla.¹² These implants are inserted adjacent to the maxillary tuberosity in the pterygoid process of the sphenoid.¹² The pterygoid process is considered an anatomical masticatory pillar; thus, this area is reinforced to resist the masticatory functions.¹² The implant placement in the pterygoid area facilitates the immediate loading in the maxilla.¹² The technique also avoids sinus floor augmentation, as well as it permits a posterior implant to distribute the implants following the Roy polygonal concept.¹³ An important concept established in the implantology is the Roy polygonal, this principle is used to divide the masticatory forces directed in the prosthesis.¹³ An anatomical observation during the pterygoid implant is the injury risk in the maxillary artery, greater palatine artery, and posterior superior alveolar nerve.¹⁴

Zygomatic implants are different from conventional dental implants since they are longer and inserted in the zygomatic bone.¹⁵ This advanced approach is beneficial for individuals with significant bone loss in the maxilla, which does not permit the placement of traditional implants mainly in the posterior maxilla.¹⁵ The zygomatic implant is placed in the dense zygomatic area, allowing immediate loading.¹⁵ However, it is essential to note that the placement of zygomatic implants requires high training from the dental surgeon.¹⁶ These implants are placed near the orbital floor and zygomatic nerve, and then an acute previous evaluation is performed using 3D-CT planning.¹⁶

In the mandible, the alveolar ridge often experiences atrophy, leading to a loss of vertical and horizontal dimensions.¹⁷ Edentulism can complicate implant placement, as insufficient bone volume may necessitate bone augmentation procedures such as ridge preservation after tooth extraction or bone grafting to create a stable bone foundation for implants.¹⁷ The Brånemark protocol using six implants can be implemented in cases with enough bone in the mandible.¹⁸ However, the bone loss can approximate the alveolar process to the inferior alveolar nerve, challenging the implant placement in the posterior mandible.¹⁰ In cases where it is not possible the insert implants in the

posterior mandible, the All-on-Four concept is appropriate.¹⁰ Thus, four implants are distributed in the anterior mandible between the mental foramen.¹⁸ Alternative surgical approaches, such as: inferior alveolar nerve lateralization, short dental implant and vertical bone grafts are also useful techniques in cases of insufficient posterior mandible bone.

Apart from bone alterations, the soft tissues in the oral cavity also change in elderly edentulous patients. The loss of teeth can result in a reduction of the attached gingiva, impacting the future health of the peri-implant tissues.¹⁹ Comprehensive assessments of soft tissue quality and quantity are crucial in planning successful implant-supported prostheses.¹⁹ Also, one of the most important reasons for long-term implant success is the healthy peri-implant tissues.¹⁹ Thus, a periodic dental consult for cleaning the prosthesis is crucial to prevent peri-implantitis, the main complication related to dental implants.²⁰ Likewise, adequate oral hygiene of the fixed implant-supported prostheses by the patient is essential to inhibit firstly peri-implant microsites and secondly peri-implantitis.

Elderly patients often present with systemic health issues that may affect their candidacy for dental implant surgery. Close collaboration between dental professionals and medical clinicians is essential to assess the patient's overall health, ensuring that any systemic conditions are appropriately managed before implant surgery.²¹ Untreated systemic alterations such as diabetes mellitus and hypertension are considered risk factors for osseointegration.^{22,23} Therefore, multi-professional care is fundamental for an integrated treatment in elderly patients requiring dental implants. Ultimately, the future research pretends to join innovations in the digital implantology sources, such as: oral scanning, CAD/CAM technology, surgical guides and mainly customized sub-periosteal implants.²⁴ It is important to note that customized subperiosteal implants for rehabilitation of atrophic jaws are a single-stage procedure with immediate loading. Besides to be performed in a lesser time, this technique allows the implant customization according to the unique anatomy of each patient.²⁵

Conclusion

Full-arch implant rehabilitation in elderly edentulous patients requires a meticulous understanding of the anatomical alterations that occur with age. Successful outcomes hinge on careful assessment, treatment planning, and a multidisciplinary approach to address both local and systemic factors. By recognizing and addressing these anatomical considerations with different surgical approaches, dental professionals can enhance the quality of life for elderly individuals seeking oral rehabilitation with fixed implant-supported prostheses.

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Conflicts of interest

The authors declare any conflict of interest.

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