

Multidisciplinary approaches in oral rehabilitation of patients with severe bone loss: integration of maxillofacial surgery, implantology and orthodontics for functional and aesthetic optimization – a narrative review

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ABSTRACT

Background: Severe bone loss in the maxillofacial region poses a significant challenge in oral rehabilitation, often resulting in functional impairment, aesthetic concerns, and reduced quality of life. Traditional removable dentures exacerbate bone resorption, necessitating a multidisciplinary approach integrating maxillofacial surgery, implantology, and orthodontics. This narrative review explores the evidence-based strategies for optimizing functional and aesthetic outcomes in such cases. **Methods:** A systematic literature search was conducted using PubMed, Scopus, and Google Scholar, focusing on studies published between 2014 and 2024. Keywords included 'oral rehabilitation with severe bone loss,' 'maxillofacial surgery and implants,' 'orthodontics in implantology,' and 'functional outcomes of implant-supported rehabilitation.' Studies were included if they addressed the integration of maxillofacial surgery, implantology, and orthodontics in treating severe bone loss, emphasizing clinical efficacy and patient outcomes. **Results:** Multidisciplinary interventions significantly improve oral rehabilitation outcomes. Maxillofacial surgery facilitates bone grafting and reconstruction, enhancing implant stability. Implantology provides fixed prosthetic solutions that restore function and aesthetics, reducing the adverse effects of edentulism. Orthodontic approaches optimize occlusal alignment and prosthetic fit, further improving treatment predictability. Advances in digital imaging and minimally invasive techniques enhance precision and long-term success. These combined approaches foster better treatment outcomes and patient satisfaction, demonstrating the importance of integrated care in oral healthcare. **Conclusion:** Oral rehabilitation of patients with severe bone loss requires a comprehensive, multidisciplinary strategy. The collaboration of maxillofacial surgeons, implantologists, and orthodontists ensures optimal functional and aesthetic outcomes. Future advancements in digital planning, biomaterials, and minimally invasive techniques will further refine treatment protocols, enhancing patient care and quality of life.

Keywords: Digital planning, orthognathic surgery, implantology, severe malocclusions, functional outcomes, aesthetic outcomes, virtual surgical planning, 3D imaging.

INTRODUCTION

The long-lasting failing dentition is a frequent and insidious day-to-day clinical challenge. Common features include heavily restored teeth, incongruous prostheses, residual roots, periapical lesions, abundant deposits of dental calculus, and periodontal disease. Alveolar bone loss occurs strictly together with periodontitis progression through an inflammatory host response to microbial threats (Maiorana et al., 2020). Comprehensive horizontal bone resorption can be noticed at radiographic examinations when combined with vertical bony defects that lead to the loss of alveolar process. Bone remodeling intensifies when patients use conventional removable dentures and leads to substantial reduction of mandibular ridge dimensions and subsequent mandibular forward-upward rotation (Shaghaghian et al., 2015). The protruding action of the chin becomes restricted when the ridge height shortens, thus leading to problems with prosthesis attachment. The impaired fit and insufficient stability create uncomfortable conditions for patients when they chew and speak.

Multiple variables result in diminished oral health-related quality of life that patients with removable dentures experience (Shaghaghian et al., 2015). Implant-retained prosthesis provides better quality of life than conventional dentures based on research that shows improvements in physical pain and disability as well as psychological discomfort and disability and functional limitations (Sánchez-Siles et al., 2018). Edentulism causes major functional damage as well as poor psychological and aesthetic problems for affected patients. Edentulism causes three main limitations that include restricted food choices, communication difficulty, weakened facial muscle stability, and reduced height. The combined negative effects make edentulism qualify as a physical handicap according to World Health Organization standards (Maiorana et al., 2020). A thorough analysis demonstrates the significance of conserving tainted teeth in their initial condition followed by dental implant protocols for hopeless tooth replacement. It is essential to perform thorough evaluations with multidisciplinary assessment because this method enables practitioners to determine customized treatment strategies that fulfill patient

expectations for extended periods (Giannobile & Lang, 2016). This narrative review explores the role of a multidisciplinary approach—combining maxillofacial surgery, implantology, and orthodontics—in the oral rehabilitation of patients with severe bone loss. The goal is to highlight evidence-based strategies that enhance treatment outcomes and improve patient quality of life.

METHODS

The review followed systematic methods to research and examine multidisciplinary oral rehabilitation methods for severe bone loss patients through maxillofacial surgery combined with implantology and orthodontics. A study evaluates the joint use of dental professions to create optimal surgical and aesthetic results in subjects who have major bone disappearance while seeking advanced treatment practices based on research evidence.

Search Strategy

The search included major academic databases PubMed and Scopus and Google Scholar merged with search terms 'oral rehabilitation with severe bone loss' 'maxillofacial surgery and implants' 'orthodontics in implantology' 'functional outcomes of implant-supported rehabilitation' and 'aesthetic optimization in bone loss rehabilitation.' Studies published in English between 2014 and 2024 served as the basis for the review because they represented the modern developments and techniques in this progressing field.

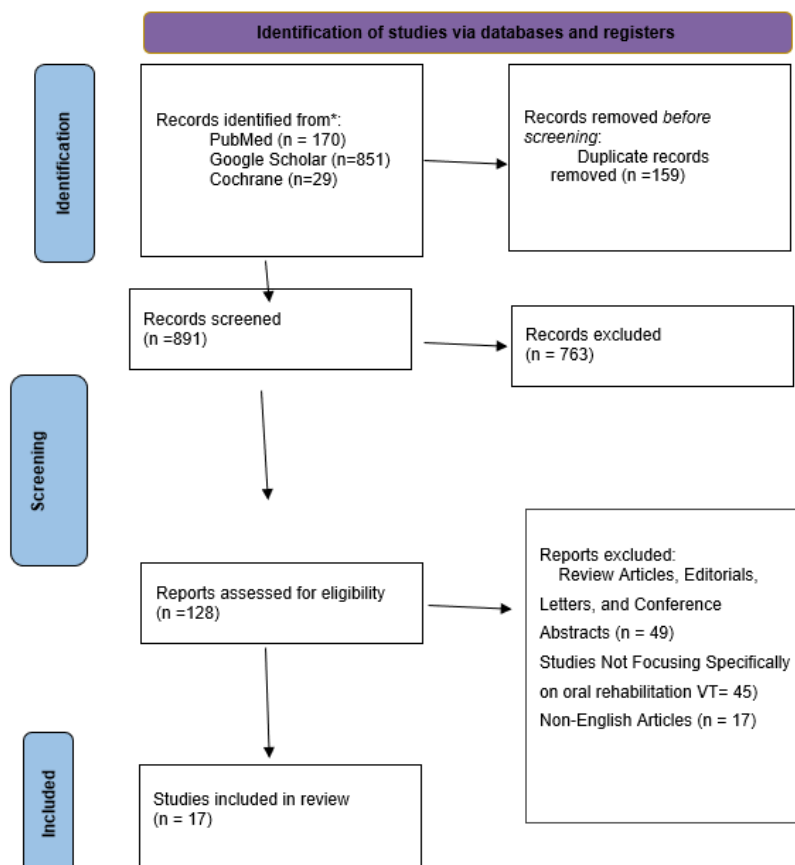
Inclusion and Exclusion Criteria

The eligible studies analyzed maxillofacial surgery together with implantology and orthodontics, which addressed bone loss rehabilitation in patients. Human studies, which assessed functional and aesthetic outcomes from the combination of treatment modalities, made up the focus of eligible research. The review process excluded studies unless they presented solid clinical effectiveness data and used digital planning techniques appropriate for preserving research quality.

Data Categorization and Analysis

The studies were categorized into three primary focus areas: maxillofacial surgery, implantology, and orthodontics, with a focus on each discipline's contribution to functional and aesthetic outcomes. The research evaluated clinical success together with implant survivability rates and patient satisfaction levels as well as long-term stability results. This review promotes multidisciplinary techniques which lead practitioners to adopt evidence-based strategies that deliver superior functional results with better aesthetics for severe bone loss patients to enhance their quality of life.

Figure 1. Prisma Flow Diagram



RESULTS AND DISCUSSION

The importance of a multidisciplinary approach involving maxillofacial surgery, implantology, and orthodontics in the oral rehabilitation of patients with severe bone loss is crucial for improving treatment outcomes and patient quality of life. The integration of these disciplines ensures comprehensive care that addresses complex dental and aesthetic challenges.

Multidisciplinary Approaches in the Rehabilitation of Severe Maxillofacial Defects

Maxillofacial defects extending over extensive areas present functional and cosmetic complications due to both birth defects and surgical tumor removals as well as traumatic injuries (Uğurlu et al., 2007). The absence of teeth causes alveolar bone resorption together with remodeling until it results in an atrophic residual ridge (De Freitas et al., 2006). Treatment plans based on prosthetic rehabilitation methods help restore both structural and functional, and presentable qualities in cases of severe soft tissue plus hard tissue defects (Bahar Tuna et al., 2012). Medical experts need to use multiple treatment methods for managing patients who suffer severe maxillofacial trauma and acquired maxillary defects (Wiens, 1990)(Sykes et al., 2002)(Uğurlu et al., 2007)(Wiens, 1992). Medical intervention can establish normal operation together with typical facial appearance in these patients. These cases differ from congenital maxillary defect patients based on the rapid physiological changes that result from surgical or traumatic maxilla resections (Sykes et al., 2002). When trauma Gökçen-Röhlig et al., 2009) causes substantial injuries to the maxillofacial area, fabricating overdentures becomes the recommended option because hard and soft tissue damage, along with lip support, can be managed through acrylic resin usage (Gökçen-Röhlig et al., 2009). The utilization of hard acrylic resin materials leads to distress for healing mouth tissues because of their effect on sensitive oral mucosa. The need for bone grafting exists when treating bone loss in the maxilla and mandible, aside from implant planning. The reconstruction of extensive soft tissue with hard tissue damage demands an implant-retained or retentive prosthetic to generate satisfactory facial support together with oral functionality restoration (Cakan et al., 2006). The treatment provides professionals with a valuable way to strengthen their prosthetic work through increased stability and retention in addition to the preservation of natural tissues (McAndrew, 2002). The patient refused implant-retained fixed prostheses because he did not want the vertical bone augmentation given the multiple needed surgical procedures for implant treatment. A tissue ceramic functioned with a zirconia-based crown prosthesis serves as the alternative therapeutic approach in this situation.

High-strength full-ceramic system represents the preferred option for frequent restorations in the front as well as back regions of the mouth. The chemical and physical properties of Zirconia feature corrosion-resistant behavior and low thermal conductivity along with high flexural strength (900–1200 MPa) and Vickers hardness of 1200 and its bidirectional completeness with optimized esthetics (Papaspriidakos & Lal, 2008). The attachment of bacteria to this material surface remains minimal (Papaspriidakos & Lal, 2008). The clinical use of zirconia frameworks in fixed partial denture construction for anterior and posterior teeth exists because this material performs better in flexural strength than aluminum oxide. Multiple studies examining zirconia in vitro environments have proved its superior strength compared to aluminum oxide and other ceramic materials (Bahar Tuna et al., 2012). The literature contains limited data concerning zirconia framework systems with zirconium oxide (zirconia) 3 and 4 posterior units that have undergone clinical examination for long periods (Papaspriidakos & Lal, 2008). Research on implant supported fixed dentures has been published by Papaspriidakos and Lal in recent times (Maiorana et al., 2020). Special treatment procedures for patients with wide maxillofacial defects require extra planning combined with adjusted philosophies which help establish conditions to restore both functional and esthetic functions. The treatment plan focuses on developing both soft tissue shape and position alongside maintaining tooth and bone conditions (Morton et al., 2000). Tissue-compatible porcelain serves as a method to remedy soft tissue deficiencies by creating both market-like esthetic appearances and strong lip functionality in the maxillary front area. Modified prosthetic rehabilitation improves both the appearance of the final restoration and offers support for dental rehabilitative procedures and tooth replacement and construction of hard and soft tissues.

Role of Surgery in Oral Rehabilitation

Oral rehabilitation surgery has experienced fundamental changes through recent advancements throughout maxillofacial surgery and implantology combined with orthodontics in pursuit of superior functional as well as aesthetic results (Yu, 2013). OGS emerged as a dental specialty subspecialty twenty years ago, then grew to become a multidisciplinary discipline, which provides fundamental rehabilitation for patients who have experienced major bone deterioration (Ureel et al., 2024). The review points out how combined surgical methods together with technological improvements and minimally invasive approaches lead to better results during oral rehabilitation procedures. The main advancement in oral rehabilitation concerns functional surgery approaches. The medical community now prefers modern surgical techniques that preserve vital anatomical structures over traditional methods since these procedures lead to fewer postoperative complications including facial asymmetry and limited mobility. Oral cancer patients under selective lymph node dissection benefit from the preservation of essential structures like sternocleidomastoid muscle and internal jugular vein which improves functional

results and quality of life (Wijbenga et al., 2016). Modern salivary gland surgery now includes endoscopic stone extraction and submandibular gland transfer for minimization of surgical trauma and prevention of radiation-induced xerostomia (Vermaire et al., 2022).

Tumor resection in maxilla and mandible benefits greatly from reparative surgical techniques which help restore functional abilities. Fibula composite flaps along with dental implants built into vascularized constructs result in enhanced speech and mastication functions and better facial appearance compared to typical prosthetic rehabilitation approaches (Illand et al., 2023). The reconstructive techniques achieve better functional outcomes, alongside aesthetic outcomes for patients when compared to standard reconstructive practices. Modern OMS relies on minimally invasive surgery as its main practice since patients receive reduced physical and psychological trauma during treatments. Arthroscopy for temporomandibular joint disorders and sialendoscopy for salivary gland disease illustrate the recent tendency of adopting minimally invasive yet efficient surgical interventions that continue to gain popularity (Ritschl et al., 2024). The procedures deliver enhanced recovery times through decreased surgical morbidity, which lends them important value to oral rehabilitation efforts.

The advancing technology, especially related to computer-aided surgery, provides unprecedented precision while enhancing safety during oral rehabilitation procedures. Modern surgical techniques based on computer-assisted navigation systems and robotic systems measure up implant placement accuracy along with bone grafting capabilities and maxillofacial reconstructive operations (Khatib et al., 2020). The technologies started in neurosurgery and orthopedics have proven effective for OMS and improve both surgical outcome predictions and decrease complications. Modern dental facilities are increasingly adopting transoral robotic surgery because this robotic approach demonstrates potential benefits for treating complex oral rehabilitation procedures (Brown et al., 2016). Integration of surgical breakthroughs combined with teamwork between different medical specialties has revolutionized oral rehabilitation procedures. New surgical approaches in OMS continue to evolve through functional designs, which use minimally invasive techniques and assist with technology because they establish OMS as a vital discipline for functional and aesthetic restoration (Probst et al., 2023). Oral rehabilitation will experience improvement through an expanding collection of surgical treatments as new methods and technologies continue to develop.

Implants in Complex Oral Rehabilitation

With its steady and durable solution for tooth replacement in complicated circumstances, implants have completely transformed the area of oral rehabilitation (NATHALI et al., 2024). Modern dental restorations depend on implants to supply patients with structural support needed for both functional and cosmetic restoration after tooth loss or major dental damage. Dental implant procedures typically implement modern digital design systems and joint treatments in complicated restoration environments to achieve both precise and dependable outcomes (Landi et al., 2016). This technique enables the patient to feel confident about both their dental health and themselves while extending rehabilitation duration through better outcomes which improve life quality. Implants play a critical role for patients with demanding oral rehabilitation needs because they allow them to regain functional capabilities and preserve their facial attractiveness according to Lanza et al and Maiorana et al. Medical professionals experience difficulties placing dental implants within patients who both smoke and actively suffer from periodontitis. The detailed treatment plan for periodontal diseases alongside stability assurance needs follows the description (Lanza et al., 2017). Restoration of both functional and aesthetic needs depended on effective implant integration following directed bone regeneration (Maiorana et al., 2020). Batisse et al outlines that alternative methods should be considered when implant procedures cannot achieve optimal results. The combination between adhesive dentistry and removable prosthesis might work as an adequate solution because they highlight the disadvantages of implant treatment for adult patients with extensive microdontia (Batisse et al., 2022). The article written by Lancione et al. explains that virtual surgical planning in three dimensions made osseointegrated implants more prevalent within dental reconstruction techniques (Lancione et al., 2021). The innovative approach makes implant placement possible during the main surgical procedure for patients with complex maxillary or mandibular conditions, which proves highly beneficial. The multidisciplinary team achieves efficient and successful rehabilitation through its correct positioning of implants during the planning and execution phases. According to János et al, a full-mouth rehabilitation should use implants when patients present with gummy grins and absent posterior teeth (János et al., 2023). Implants placed in the proximal areas of upper and lower arches served both esthetic purposes and chewing function. The treatment success depended on implants, an essential component of complete oral rehabilitation, because zirconia ceramic served as the material to integrate implants successfully into the entire treatment plan. The introduction of dental implants represents an essential treatment approach for patients with previous periodontitis experience (Doulkeridou et al., 2020). The patient in a full treatment plan received implant placement as part of periodontal therapy when confronting one of the detailed situations. Physicians must collaborate through periodontology, prosthodontics, and implantology processes to deliver best practices to patients with poor oral health as demonstrated through implant success in hard-to-treat situations. Qiu et al remarked on the application of implant-supported fixed bridges through digital workflow for rehabilitation purposes that solved functional and cosmetic issues (Qiu et al., 2024). The

permanent solution implants presented for tooth replacement in this case allowed digital technology to work more effectively while enhancing treatment quality along with speed. Al-Sunbul et al emphasizes that implant placement stands as vital within total treatment designs which regard complete oral health assessments (Al-Sunbul et al., 2024).

Orthodontic Interventions in Rehabilitation

Especially in situations involving structural alignment and occlusal problems, orthodontic therapies are essential to the rehabilitation of difficult dental cases. Orthodontic treatments help address crowding and enamel issues and positional defects before managing restorative work including prostheses placement and restoration work (Thomas et al., 2021). The entire rehabilitation plan benefits functionally from orthodontic treatments, which produce both an attractive teeth appearance and functional enhancement. A reliable outcome combined with visual appeal requires orthodontic treatment that works together with other specialties, which proves its essential role in total rehabilitation planning. Maiorana et al (2020) mention that orthodontic treatment becomes essential to prepare the mouth cavity for elaborate rehabilitation procedures (Maiorana et al., 2020). Orthodontic treatment became essential because it needed to create room for implant placement by straightening all remaining teeth. Functional along with aesthetically acceptable results from prosthetic procedures required the inclusion of orthodontic intervention to the multidisciplinary treatment plan. Patients achieved successful clinical outcomes through the active coordination between orthodontic specialists and all other dental professionals involved. The patient undergoing treatment displayed widespread microdontia according to Batisse et al, while traditional orthodontic interventions were not the primary focus (Batisse et al., 2022). A successful result required collaboration between detachable prosthesis and adhesive dentistry to create the solution. The treatment plan needs modifications specifically tailored to individual patient needs because orthodontic solutions are sometimes restricted according to this data. Doukeridou et al. (2022) demonstrated how orthodontics operates within multidisciplinary care for a periodontitis patient. Orthodontic treatment proved its effectiveness after periodontal health improvement through various non-surgical and surgical therapies. The orthodontic intervention successfully joined comprehensive patient care plans with other dental specialties because it resolved both functional and aesthetic concerns. Agarwal et al indicates that orthodontic forced eruption through teeth works as a treatment for subgingival maxillary central incisor fractures to restore prosthetics. Later restorative procedures become possible because teeth extrusion through braces enables direct treatment access to the fracture border (Agarwal et al., 2020). The restorative procedure benefits from better cosmetic outcomes while preventing future complications through this technique implementation. Thus, in complicated instances of oral rehabilitation, orthodontic procedures are essential to attaining both functional and cosmetic success.

Discussion

Maxillofacial surgery combined with implantology and orthodontics during oral rehabilitation leads to better clinical and aesthetic outcomes for patients with major bone loss conditions. A combined specialist approach in medicine results in enhanced prosthetic attachment and better chewing function while restoring facial proportions, which produce improved life quality results for patients (Figueiredo et al., 2025; Jánosí et al., 2023). The use of implant-supported prostheses leads to enhanced bite strength and decreased masticatory pain for patients with severe bone loss according to research (Qiu et al., 2024) Digital planning and guided implant placement enables surgeons to achieve higher accuracy during procedures which lowers complication rates while preserving long-term implant stability (Qiu et al., 2024; Wijbenga et al., 2016).

Aesthetic results have been enhanced substantially through the multidisciplinary approach because orthodontic adjustments alongside implant placement and surgical augmentation produce a natural appearance of the restoration. Through soft-tissue grafting procedures such as connective tissue grafts and platelet-rich fibrin, the surgical team achieves better peri-implant soft tissue appearance and cuts down on gingival recession (Agarwal et al., 2020)(Thoma et al., 2018). The advanced aesthetic characteristics of zirconia-based prosthetics improve integration because of their exceptional biocompatibility and translucency properties, which make them the preferred material for front teeth replacements (Bahar Tuna et al., 2012). Autogenous bone grafts and alloplastic substitutes have proven essential in surgical ridge reconstruction and implant-preparation procedures according to surgical standards (Jánosí et al., 2023; Lancione et al., 2021). Patients receiving implants benefit from two crucial techniques providing predictable integration when building up exposed bone landmarks like vertical and horizontal. Recent innovations in CAD/CAM technology currently allow manufacturers to create precise custom prosthetic frameworks which lead to increased patient satisfaction by reducing the need for adjustments (Probst et al., 2023).

The success of treatment depends on orthodontic intervention through improved positioning of implants and dental relations including situations where patients have malocclusion or insufficient interarch space (Landi et al., 2016). The alignment of teeth before implant placement improves both implant placement accuracy and adjacent teeth integration as well as biomechanical stress prevention (Lanza et al., 2017; Maiorana et al., 2019). Extra Clinical orthodontic procedures help maintain tooth alveolar bone height through extrusion methods, which creates fewer requirements for extensive graft procedures before implant placement (Doukeridou et al., 2020). Several restrictions limit the findings obtained in current

research studies. Retrospective study designs and small sample sizes featured in multiple studies affect the general applicability of their findings. The outcome assessment becomes limited because patient selection variations and treatment procedures differences create difficulties in comparison analysis (Jánosi et al., 2023). The implementation of digital planning tools meets challenges through expensive technology requirements and specific training needs. Studies must carry out extensive randomized controlled trials across multiple treatment facilities to establish the enduring effectiveness of complete patient care treatments. Research in bone tissue regeneration and peri-implant soft tissue health benefits from active exploration of innovative biomaterial development (Jánosi et al., 2023), (Ureel et al., 2024), (Bahar Tuna et al., 2012). Research involving patient-reported satisfaction and psychological well-being measures will strengthen the understanding of clinical outcomes beyond simple biomedical markers (Jánosi et al., 2023). The application of artificial intelligence and machine learning technology holds great potential to change treatment planning through predictive analytics, which generates custom-made rehabilitation strategies.

CONCLUSIONS

The integration of maxillofacial surgery, implantology, and orthodontics is essential for the effective oral rehabilitation of patients with severe bone loss. A multidisciplinary approach leads to improved functional and aesthetic results, which restores both speeches, along with eating capabilities, and facial attractiveness. Better patient quality of life results from the combination of advanced surgical approaches that use minimally invasive procedures with implant-supported prosthetics. The development of zirconia-based materials extends treatment lifetime while adding more compatibility to patient bodies. The achievement of long-lasting outcomes depends on how complex dental and skeletal issues are treated with an extensive treatment strategy. Future research must develop better digital planning instruments and individualized treatment approaches to improve the results of patient rehabilitation.

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