

Review Article

Dentofacial deformities and their management in prosthodontic practice

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Received: 10 July 2024

Accepted: 26 July 2024

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ABSTRACT

Dentofacial deformities encompass a wide range of skeletal and dental discrepancies that can significantly impact a patient's oral function, aesthetics, and overall quality of life. These deformities can arise from congenital, developmental, or acquired factors, each contributing to the complexity of diagnosis and treatment. Congenital conditions, such as cleft lip and palate and genetic syndromes, often result in significant craniofacial anomalies. Developmental disturbances, including hormonal imbalances and nutritional deficiencies, can further exacerbate these conditions. Additionally, trauma, infections, and neoplasms play a critical role in the etiology of acquired dentofacial deformities. Effective management of dentofacial deformities in prosthodontics requires a multidisciplinary approach, integrating orthodontics, oral and maxillofacial surgery, and advanced prosthodontic techniques. Diagnostic advancements, including 3D imaging and digital workflows, facilitate precise planning and customization of prosthetic solutions. Orthodontic treatment and orthognathic surgery are pivotal in correcting skeletal discrepancies and establishing a stable foundation for prosthodontic rehabilitation. Post-surgical prosthodontic interventions involve the use of high-strength ceramics, zirconia, and biocompatible implant materials to restore dental function and aesthetics. Technological advancements have revolutionized prosthodontic practice. computer-aided design and computer-aided manufacturing (CAD/CAM) technology allows for the accurate design and fabrication of prosthetic components, enhancing treatment predictability and efficiency. The development of minimally invasive techniques, such as guided implant surgery and laser applications, has reduced procedural invasiveness and improved patient outcomes. The integration of digital tools and advanced materials has significantly enhanced the precision, durability, and aesthetic quality of prosthetic restorations. Overall, the advances in prosthodontic techniques and materials have greatly improved the management of dentofacial deformities, offering patients better functional and aesthetic results. Continued innovation and research are essential to address the complex challenges associated with these deformities, ultimately enhancing patient care and outcomes in prosthodontic practice.

Keywords: CAD/CAM technology, Dentofacial deformities, High-strength ceramics vaccine, Orthognathic surgery, Prosthodontics

INTRODUCTION

Dentofacial deformities encompass a range of skeletal and dental discrepancies that result in significant aesthetic

and functional impairments. These deformities can manifest as malocclusions, facial asymmetries, and disproportional jaw relationships, often leading to compromised oral health, speech difficulties, and

psychosocial issues. The management of dentofacial deformities in prosthodontic practice involves a multidisciplinary approach, integrating orthodontics, oral and maxillofacial surgery, and restorative dentistry to achieve optimal functional and aesthetic outcomes.¹ The etiology of dentofacial deformities is multifactorial, encompassing genetic, developmental, and environmental influences. Congenital conditions such as cleft lip and palate, genetic syndromes like Treacher Collins syndrome (TCS), and developmental disorders including hemifacial microsomia are primary contributors to these deformities. Additionally, acquired factors such as trauma, infections, and neoplasms can also lead to significant dentofacial discrepancies.² The classification of dentofacial deformities is based on the anatomical location and the extent of the skeletal and dental anomalies, facilitating a systematic approach to diagnosis and treatment planning.³

Prosthodontic management of dentofacial deformities aims to restore oral function, improve facial aesthetics, and enhance the patient's quality of life. This involves a comprehensive assessment of the patient's dental, skeletal, and soft tissue structures, followed by the formulation of an individualized treatment plan. Treatment modalities may include the use of fixed or removable prostheses, dental implants, and orthodontic appliances, often in conjunction with surgical interventions such as orthognathic surgery.⁴ The integration of digital technologies, including computer-aided design and computer-aided manufacturing (CAD/CAM), has revolutionized the field of prosthodontics, enabling precise and predictable outcomes in the management of complex dentofacial deformities.¹ Advancements in prosthodontic materials and techniques have further enhanced the ability to manage dentofacial deformities effectively. Innovations such as high-strength ceramics, zirconia-based restorations, and biocompatible implant materials offer superior aesthetic and functional results. Moreover, the application of minimally invasive techniques and the development of customized prosthetic solutions tailored to the patient's unique anatomical and functional requirements have significantly improved treatment outcomes.² The management of dentofacial deformities in prosthodontic practice is a dynamic and evolving field that requires a multidisciplinary approach and the integration of advanced technologies. Continued research and innovation in prosthodontic techniques and materials are essential to address the complex challenges associated with these deformities, ultimately enhancing patient care and outcomes.

METHODS

The management of dentofacial deformities in prosthodontic practice necessitates a thorough understanding of both the functional and aesthetic aspects of these conditions. Prosthodontic treatment plays a crucial role in restoring not only the dental occlusion but also the facial harmony, significantly impacting the

patient's overall well-being. Modern prosthodontics integrates advanced diagnostic tools and treatment planning software, which allows for precise assessment and customization of prosthetic solutions. For instance, the use of 3D imaging and digital workflows facilitates accurate diagnosis and enhances the predictability of treatment outcomes.⁵ Orthognathic surgery, often in combination with orthodontic treatment, is a cornerstone in the management of severe dentofacial deformities. This surgical approach corrects jaw discrepancies, thereby improving occlusal function and facial aesthetics. Post-surgical prosthodontic rehabilitation is essential for optimizing occlusion and ensuring the stability of the surgical results. The collaboration between prosthodontists, orthodontists, and oral surgeons is pivotal in achieving comprehensive treatment goals.⁶ Additionally, the advent of new materials and techniques has revolutionized prosthodontic care. High-strength ceramics and zirconia provide durable and aesthetically pleasing restorations, while advancements in implant technology offer reliable solutions for replacing missing teeth in patients with complex deformities. These innovations have expanded the scope of prosthodontic interventions, enabling more effective and long-lasting treatments.⁵

ETIOLOGY AND CLASSIFICATION OF DENTOFACIAL DEFORMITIES

Dentofacial deformities are complex conditions resulting from a variety of etiological factors, both congenital and acquired, leading to significant functional and aesthetic impairments. Understanding the underlying causes and systematic classification of these deformities is crucial for effective diagnosis and treatment planning in prosthodontic practice. Congenital factors play a significant role in the development of dentofacial deformities. Genetic syndromes such as Treacher Collins syndrome, Pierre Robin sequence, and Crouzon syndrome are often associated with craniofacial anomalies that affect both the skeletal and dental structures. These syndromes typically involve genetic mutations that disrupt normal craniofacial development, resulting in asymmetries, malocclusions, and other deformities.⁷ Additionally, congenital conditions such as cleft lip and palate are among the most common craniofacial anomalies, with multifactorial etiologies that include genetic predisposition and environmental influences during pregnancy.

Developmental disturbances also contribute to the etiology of dentofacial deformities. Factors such as childhood illnesses, hormonal imbalances, and nutritional deficiencies can adversely affect normal craniofacial growth and development. For example, disturbances in the growth hormone axis can lead to disproportionate growth of the jawbones, resulting in conditions like mandibular prognathism or retrognathism.⁸ Early loss of primary teeth or prolonged thumb sucking can also lead to dental arch deformities and improper occlusion, further

complicating the dental and skeletal relationships. Acquired factors, including trauma, infections, and neoplasms, can lead to significant dentofacial deformities. Traumatic injuries to the face and jaws, especially during the critical periods of growth, can result in asymmetrical growth and functional impairments. Chronic infections, such as osteomyelitis, can damage the bone structure, leading to deformities and necessitating complex reconstructive procedures. Neoplasms, both benign and malignant, can disrupt normal craniofacial anatomy and require extensive surgical intervention, often followed by prosthodontic rehabilitation.⁹ The classification of dentofacial deformities is essential for a systematic approach to treatment. Deformities are typically categorized based on the anatomical location and the nature of the skeletal and dental discrepancies. Common classifications include skeletal Class I, II, and III malocclusions, which describe the anteroposterior relationships between the maxilla and mandible. Vertical discrepancies, such as open bites and deep bites, are classified based on the vertical dimension of occlusion. Transverse discrepancies, including crossbites and midline deviations, are categorized based on the lateral relationships between the dental arches.⁷ This classification framework aids in the formulation of comprehensive treatment plans that address both the functional and aesthetic aspects of dentofacial deformities. Advanced diagnostic tools, such as cephalometric analysis and 3D imaging, enhance the accuracy of these classifications, allowing for more precise and individualized treatment approaches. By understanding the etiology and classification of dentofacial deformities, prosthodontists can develop effective, multidisciplinary treatment strategies that improve patient outcomes and quality of life.

PROSTHODONTIC TREATMENT APPROACHES FOR DENTOFACIAL DEFORMITIES

Prosthodontic treatment approaches for managing dentofacial deformities involve a comprehensive, multidisciplinary strategy aimed at restoring both function and aesthetics. The complexity of these cases requires the integration of advanced prosthodontic techniques with orthodontic and surgical interventions to achieve optimal outcomes. The initial phase of prosthodontic treatment begins with a thorough diagnostic evaluation, incorporating clinical examinations, radiographic imaging, and dental impressions. Digital tools, such as 3D imaging and computer-aided design/computer-aided manufacturing (CAD/CAM) technology, have revolutionized this process by allowing precise planning and simulation of treatment outcomes.¹⁰ These technologies enable the creation of detailed virtual models of the patient's craniofacial structures, facilitating the design of custom prosthetic solutions tailored to individual anatomical and functional needs. Orthodontic treatment often precedes prosthodontic interventions in cases of dentofacial deformities. Orthodontics can correct malocclusions, align teeth, and prepare the dental arches for subsequent

prosthetic rehabilitation. This phase may involve the use of braces, clear aligners, or other orthodontic appliances to achieve proper alignment and occlusal relationships. Orthodontic treatment is crucial for creating a stable foundation upon which prosthodontic restorations can be built.¹¹ In more severe cases, orthognathic surgery is employed to correct skeletal discrepancies that cannot be addressed through orthodontics alone. This surgical intervention involves repositioning the jawbones to achieve a more balanced facial structure and improve occlusal function.

Post-surgical prosthodontic rehabilitation is essential for restoring optimal dental function and aesthetics. This phase includes the placement of fixed or removable prostheses, dental implants, and other restorative solutions to achieve a harmonious integration of the dental and facial structures.¹² The selection of prosthetic materials plays a critical role in the success of prosthodontic treatment for dentofacial deformities. High-strength ceramics, such as zirconia, offer superior durability and aesthetic qualities, making them ideal for fabricating crowns, bridges, and implant-supported restorations. Additionally, the use of biocompatible materials in dental implants ensures long-term stability and integration with the surrounding bone and soft tissues. Advances in material science have significantly enhanced the functional and aesthetic outcomes of prosthodontic treatments.¹³ The advent of minimally invasive techniques has further improved the management of dentofacial deformities in prosthodontics. Techniques such as guided implant surgery and the use of digital impression systems reduce the invasiveness of procedures, shorten recovery times, and increase the accuracy of prosthetic placements. These innovations not only improve patient comfort and satisfaction but also enhance the overall effectiveness of treatment. Prosthodontic treatment approaches for dentofacial deformities require a meticulous, multidisciplinary strategy that leverages advanced technologies and materials. By integrating orthodontic and surgical interventions with state-of-the-art prosthodontic techniques, clinicians can achieve significant improvements in both functional and aesthetic outcomes, ultimately enhancing the quality of life for patients with dentofacial deformities.

ADVANCES IN PROSTHODONTIC TECHNIQUES AND MATERIALS FOR MANAGING DENTOFACIAL DEFORMITIES

The field of prosthodontics has witnessed significant advancements in techniques and materials, substantially improving the management of dentofacial deformities. These innovations have enhanced the precision, efficiency, and outcomes of prosthodontic treatments, offering patients better functional and aesthetic results. One of the most transformative advancements in prosthodontics is the integration of digital technologies, particularly CAD/CAM systems. These technologies enable the precise design and fabrication of prosthetic

components, such as crowns, bridges, and implant abutments. The use of digital impressions and 3D imaging allows for accurate replication of the patient's oral anatomy, leading to better-fitting prostheses and reduced chair time.¹⁴ The implementation of CAD/CAM technology has revolutionized prosthodontic workflows, making the treatment process more predictable and efficient. In addition to digital advancements, significant progress has been made in the materials used for prosthodontic restorations. High-strength ceramics, such as zirconia and lithium disilicate, have become the materials of choice for many prosthodontic applications due to their excellent aesthetic properties and durability. Zirconia, in particular, offers superior strength and biocompatibility, making it ideal for both anterior and posterior restorations. The aesthetic qualities of these ceramics allow for the creation of natural-looking prostheses that blend seamlessly with the patient's existing dentition.¹⁵ Furthermore, the development of implant dentistry has provided robust solutions for managing edentulous areas and supporting prosthetic restorations in patients with dentofacial deformities. Advances in implant surface technology, such as the introduction of micro-roughened surfaces and bioactive coatings, have improved osseointegration and the long-term success of dental implants. Guided implant surgery, facilitated by digital planning and surgical guides, has enhanced the accuracy and predictability of implant placement, minimized complications and improved patient outcomes.¹⁶

Minimally invasive techniques have also become increasingly prominent in prosthodontic practice. The use of laser technology, for instance, allows for precise soft tissue management and faster healing times. Lasers can be employed for procedures such as gingival contouring, frenectomies, and soft tissue biopsies, offering a less invasive alternative to traditional surgical methods. Additionally, the application of piezoelectric surgery has improved bone cutting and manipulation during implant placement and other surgical procedures, reducing trauma to the surrounding tissues and enhancing recovery.¹⁷ The advances in prosthodontic techniques and materials have significantly improved the management of dentofacial deformities. The integration of digital technologies, the development of high-strength ceramics, the evolution of implant dentistry, and the adoption of minimally invasive techniques have all contributed to more effective, efficient, and aesthetically pleasing prosthodontic treatments. These innovations not only enhance the clinical outcomes but also improve the overall patient experience, making prosthodontic care more accessible and successful for individuals with complex dentofacial deformities.

CONCLUSION

The management of dentofacial deformities in prosthodontics has been significantly enhanced by advances in digital technologies, materials, and minimally invasive techniques. These innovations have improved

both functional and aesthetic outcomes, offering patients better quality care. Continued research and development are essential for further advancements in this dynamic field.

Funding: No funding sources

Conflict of interest: None declared

Ethical approval: Not required

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Cite this article as: Alkurdi NA, Allehyani LM, Alqahtani RS, Mullah YN, Albishi NA, Alzahrani HS, et al. deformities and their management in prosthodontic practice. *Int J Community Med Public Health* 2024;11:3266-70.