

Digital Aesthetic Rehabilitation of Bilateral Peg-Shaped Maxillary Premolars: A Rare Dental Anomaly in a Pediatric Patient

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ABSTRACT

Peg-shaped teeth are an uncommon developmental anomaly that may negatively affect dental aesthetics, occlusal harmony, and psychosocial health in pediatric patients. While maxillary lateral incisors are most often involved, the occurrence of bilateral peg-shaped maxillary premolars is extremely rare, with limited published evidence available to inform optimal clinical management strategies.

We report a case of a 14-year-old female patient with bilateral microdontia of the maxillary premolars. Following conservative tooth preparation, customized zirconia crowns were fabricated using intraoral scanning and CAD/CAM technology, providing precise marginal and occlusal fit, efficient treatment, and durable, aesthetic restorations. This case highlights the effectiveness of digital workflows and zirconia crowns in managing rare permanent tooth anomalies, underscoring the importance of early diagnosis, multidisciplinary planning, patient counseling, and long-term follow-up to monitor growth-related changes and restoration longevity.

Keywords: Pediatric Microdontia, Bilateral Peg-shaped Premolars, CAD/CAM, Zirconia Crowns

INTRODUCTION

Anomalies of the maxillary lateral incisors, involving variations in shape, size, or even complete absence, are among the most frequently encountered developmental disturbances in the anterior dentition. Their prevalence has been reported to range between 1.6% and 4.9%, with a higher occurrence in females. Peg-shaped maxillary lateral incisors represent the most common morphological alteration, while

hypodontia affects approximately 1.7% of individuals in relation to upper lateral incisors, and about 0.25% exhibit agenesis of the lower lateral incisors. However, while maxillary second premolars may occasionally present with unusual root canal anatomy, the occurrence of microdontia in maxillary second premolars are exceedingly rare and sparsely documented in the literature [1,2].

Microdontia represents an uncommon developmental dental anomaly characterized by a reduction in tooth size relative to normal standards, with a higher prevalence in the permanent dentition and infrequent occurrence in the primary dentition. It may manifest as true or pseudo forms and can be further categorized as localized, affecting one or a few teeth, or generalized, involving the entire dentition. Etiology is considered multifactorial, with genetic predisposition and disturbances in growth and development playing pivotal roles in its manifestation. These anomalies may adversely impact aesthetics, function, occlusion, and the psychosocial well-being of children, highlighting the need for early diagnosis and timely intervention in pediatric dentistry to achieve both functional restoration and aesthetic harmony [3,4].

Recent innovations in digital dentistry have streamlined restorative care for pediatric patients. Intraoral scanning provides a precise, minimally invasive, and child-friendly alternative to conventional impressions, while zirconia restorations offer superior aesthetics, strength, and biocompatibility [5]. Together, these advances facilitate predictable, durable, and aesthetically pleasing outcomes in young patients.

This case report highlights the management of peg-shaped maxillary premolars in a pediatric patient using digital intraoral scanning and customized zirconia crowns, emphasizing the role of contemporary digital workflows in enhancing treatment outcomes and patient comfort.

CASE PRESENTATION

A 14-year-old female patient reported to the Department of Pediatric and Preventive Dentistry, University College of Medical Sciences, Guru Teg Bahadur Hospital with concern regarding the presence of unusually small-sized upper teeth on both sides. The patient's medical history was unremarkable, with no relevant family history. Clinical examination revealed microdontia with

respect to teeth 15 and 25 (Figure 1). Additionally, a deep mesio-occlusal carious lesion was present with respect to the right maxillary first molar which was tender on percussion with normal adjacent soft tissues. The patient desired a treatment option that was not only aesthetically pleasing but also cost-effective and time-efficient. Considering these expectations, along with the results of the aesthetic and functional analysis, full coverage restoration with customized zirconia crowns was planned with respect to teeth 15 and 25. Zirconia crowns were chosen for their superior strength, biocompatibility, and natural tooth-like translucency, making them ideal for long-term functional stability while providing excellent aesthetics. Furthermore, the digital workflow with intraoral scanning minimized chairside adjustments and streamlined fabrication, offering the patient a fast and reliable rehabilitation outcome.



Figure 1: Preoperative maxillary occlusal view illustrating bilateral peg-shaped morphology (microdontia) of teeth 15 and 25.

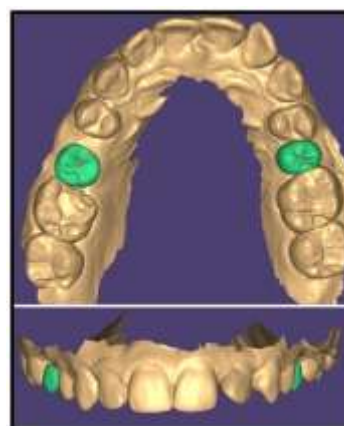


Figure 2: Computer-aided design (CAD) of the crown illustrating optimized shape, contour, and anatomical characteristics prior to fabrication.



Figure 3: Postoperative maxillary occlusal view illustrating definitive zirconia crown placement on bilateral peg-shaped maxillary second premolars (teeth 15 and 25) and restoration of tooth 16.

Management: Parental informed consent and the child's verbal assent were secured prior to initiating treatment. Management of microdontia in teeth 15 and 25 was planned with zirconia crowns fabricated through intraoral scanning. Tooth preparation involved 1–1.5 mm circumferential axial reduction, careful rounding of line angles, and optimal taper to ensure proper retention, while occlusal clearance was confirmed using articulating paper. Digital impressions obtained with intraoral scanning were transferred to CAD software for precise crown design, tailored in shape, contour, and occlusion (Figure 2). High-strength zirconia crowns were subsequently milled and assessed during try-in for accuracy of fit, aesthetics, and functional balance. Following minor refinements, crowns were cemented using resin-modified glass ionomer cement (Figure 3). Postoperative evaluation revealed harmonious occlusion, pleasing aesthetics, and patient satisfaction, with oral hygiene guidance provided. Furthermore, the right maxillary first molar was managed by performing root canal therapy with all the four canals (MB1, MB2, DB, P) obturated.

DISCUSSION

Tooth development progresses through initiation, proliferation, histodifferentiation, morphodifferentiation, and apposition. Disturbances at these stages may lead to anomalies in number, size, or morphology. While mechanisms remain unclear, evidence highlights genetic mutations,

environmental influences, and epigenetic factors as key contributors, reflecting the multifactorial etiology of dental developmental variations. Studies indicate that over 300 genes are involved in orchestrating tooth development. Among these, AXIN2, MSX1, and PAX9 have been specifically associated with hypodontia. Environmental factors contributing to this condition include maternal rubella infection, maxillofacial trauma, and exposure to agents such as thalidomide or chemotherapeutic drugs [16,7].

In the present case, the patient was non-syndromic, with no observable anomalies and an unremarkable past medical history. Microdontia is characterized by teeth that are smaller than the normal size. It may involve both the primary and permanent dentitions, although it is more frequently seen in permanent teeth. The condition shows a higher prevalence in females than in males. Among the commonly affected teeth, maxillary lateral incisors are most often involved, typically presenting as “peg-shaped” or “conical” teeth. Microdontia has been linked to several syndromes, including Rieger anomaly, orofaciogigital syndrome, oculo-mandibulo-facial syndrome, and pituitary dwarfism, and it may also be observed in children with a history of chemoradiotherapy. While syndromic associations are well-documented, isolated non-syndromic cases of microdontia are relatively uncommon [18].

In pediatric patients, peg-shaped teeth, being a rare developmental anomaly, not only affect dental aesthetics but also impact occlusal function and psychosocial health. Although peg-shaped lateral incisors are commonly reported, bilateral peg-shaped maxillary premolars are exceptionally rare, with limited literature advocating mostly conservative interventions [12,9].

The integration of zirconia crowns with intraoral scanning and CAD/CAM technology provides superior strength, aesthetics, biocompatibility, and precise fit, minimizing plaque, microleakage, and wear. Although widely used in primary teeth, their

application for permanent premolar microdontia is scarcely reported, highlighting the clinical significance of this case [10]. Meticulous tooth preparation with adequate reduction, smooth line angles, and proper taper optimized retention while preserving structure. Intraoral scanning enabled precise margin and occlusal capture, reducing chair time and patient discomfort. Digital workflows enhance fit and accuracy in pediatric restorations, though long-term outcomes of zirconia for permanent premolars with microdontia remain limited.

Limitations include cost and accessibility of CAD/CAM zirconia crowns, the influence of pediatric growth and eruption on long-term fit, potential behavioral challenges during multiple visits, and limited follow-up in single-case reports, leaving survival rates and complications largely unestablished. In comparison, composite resin restorations provide a conservative and cost-effective solution for peg-shaped teeth with reasonable medium-term outcomes, yet they are prone to discoloration, wear, marginal breakdown, and require frequent maintenance [9,10].

In pediatric patients presenting with permanent tooth microdontia, including premolars, zirconia crowns fabricated through digital workflows offer a durable, aesthetic, and functional restorative solution. Successful outcomes rely on early diagnosis and coordinated multidisciplinary planning, incorporating restorative and, if necessary, orthodontic input. Comprehensive counselling of patients and caregivers regarding treatment costs, hygiene practices, ongoing maintenance, and potential adjustments associated with growth is critical to ensure long-term satisfaction and clinical success.

Future studies should involve larger cohorts and long-term follow-ups to assess zirconia crown survival in pediatric microdontia, compare digital versus conventional workflows and restorative materials, and evaluate how growth-related occlusal and

jaw changes influence early permanent tooth restorations.

CONCLUSION

Bilateral peg-shaped maxillary premolars represent an exceptionally rare developmental anomaly that can compromise aesthetics and function in pediatric patients. This case demonstrates that CAD/CAM-fabricated zirconia crowns, guided by a digital workflow, provide a predictable, minimally invasive, and aesthetically pleasing treatment option. Early diagnosis, individualized treatment planning, and periodic follow-up are essential for achieving long-term clinical success and patient satisfaction.

Declaration by Authors

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