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Interim Prosthodontic Management of Surgery-Induced Dental Agenesis: A Clinical Report of 8 Years of Treatment

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Abstract

The prosthodontic management of a 7-year-old girl with induced dental agenesis is described. The mandibular posterior tooth germs had been removed during surgical excision of a melanotic neuroectodermal tumor of infancy, at the age of 2 months. The ongoing prosthodontic treatment, now in its eighth year, was implemented by regular follow-up of the operation outcome and by targeted orthodontic intervention. The treatment plan included the provision of four successive interim removable partial dentures. Care was taken to preserve the oral structures, adapt to the morphological changes, and satisfy the needs of the child. Due to the unfavorable biomechanical conditions, retention and stability problems were encountered. These were resolved by engaging the mechanism of neuromuscular adaptation through optimization of the shape of the denture base. For children and adolescents with extensive dental agenesis, prosthodontic management with interim removable dentures supports function, restores esthetics, and provides a solid basis for the definitive treatment.

Agenesis is defined as the absence, failure of formation, or imperfect development of any body part.[1] Tooth agenesis is usually connected with hypodontia, the congenital absence of one or more of the normal complement of teeth,[1] originating from the arrest of the development of tooth germs. Hypodontia has been linked to inheritable genetic abnormalities and can be met either as a solitary trait[2] or as part of a syndrome,[3] such as the ectodermal dysplasia syndromes.[4]

Apart from genetic impairment, agenesis of one or more teeth may result from exogenous factors damaging the tooth germs during the first years of life. In such cases, tooth germs are present at birth and lost afterward, before they are fully developed. This type of agenesis, which could be termed "acquired hypodontia," may be induced by trauma, tumors, or oral surgery.[5]

The edentulous sites manifesting congenital tooth agenesis become longer as the number of missing teeth reaches oligodontia (more than six missing teeth).[2] They are accompanied by characteristic features concerning the shape and size of existing teeth,[6] extra- and intraoral symptoms,[7] and craniofacial growth pattern.[8-11] Such characteristics are not expected in patients where the tooth germs are originally normal, but then they are subsequently destroyed by trauma, tumor, or surgery. A solitary edentulous area surrounded by normally developed and located teeth is observed in such instances.[12]

The prosthodontic management of a child with missing teeth needs to follow a systematic protocol involving a multidisciplinary dental team and a close follow-up.[13-15] Recent publications have summarized the treatment alternatives[16,17] and have set guidelines for the management of growing individuals with missing teeth.[18] For every young person with dental agenesis, the treatment goals are to identify and satisfy the patient's needs, to protect the existing oral structures, and to optimize the growth process.[19,20] However, depending on the particular cause of tooth absence, unique clinical features may be encountered, and specific problems related to the history and underlying pathology must be addressed.[11]

The present report describes the design and course of prosthodontic treatment of a young girl with dental agenesis due to destruction of multiple teeth germs in the course of a surgical operation for the removal of a melanotic neuroectodermal tumor of infancy.

Clinical report

A 7-year-old girl was referred to the clinic of the Department of Removable Prosthodontics of the Aristotle University Dental School (Thessaloniki, Greece) by the Department of Oral and Maxillofacial Surgery, in 2001. Her medical history included an intraoral surgical operation at the age of 2 months to

Figure 1 Oral presentation of the mandibular edentulous space at the age of 7 years.

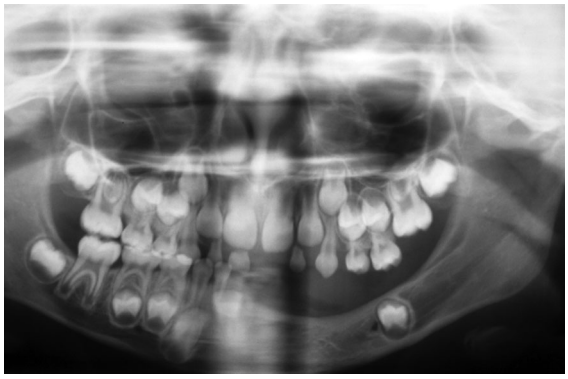

Figure 2 Panoramic radiograph of the patient at the age of 7 years.

remove a diagnosed melanotic neuroectodermal tumor of infancy (MNTI) located in the left posterior mandible. She had been under annual follow-up by the oral and maxillofacial surgery clinic.

Clinical examination revealed a long edentulous area on the left side of the mandible, probably due to the removal of tooth germs during surgery. All the teeth of the left mandibular side (K-O, 19), as well as the right mandibular primary central incisor (#P), were missing. The residual ridge was severely underdeveloped (Fig 1). Based on the clinical appearance of the edentulous area, the patient was classified as a Prosthodontic Diagnostic Index (PDI) Class IV.[21]

Radiographic examination showed the absence of all but one of the germs of the permanent teeth in the edentulous area. The rest of the primary and permanent teeth were normal. Maxillary central incisors were about to erupt (Fig 2). The face appeared normal, except for a slight collapse of the unsupported left commissure and a slight reduction of lower face height. The patient did not experience any severe functional limitation, and her main concern was esthetic rather than functional improvement.

After periodontal evaluation and oral hygiene instructions, prosthodontic treatment was planned. It included the provision of a series of interim removable partial dentures (RPDs) until the end of the growth period. The goals of the prosthodontic intervention were to improve comfort and esthetics and to prevent further deterioration of the oral structures and function. The long-term treatment protocol was organized as a time-phased plan in three phases (Table 1).

Stock metal trays were customized by cutting and bending to fit the maxillary and mandibular arches. Irreversible hydrocolloid impressions (Cavex CA3, Cavex, Haarlem, The Netherlands) were made, and diagnostic casts were constructed and mounted. An acrylic resin base with wax occlusion rim was used for the interocclusal record. The final impression was made with a border-molded custom tray and elastomeric impression material (President, Coltene, Altstatten, Switzerland). The interocclusal record was obtained at maximum intercuspation with a record base and occlusion rim, and the interim RPD was fabricated with heat-cured acrylic (Lucitone 199, Dentsply Ltd, Weybridge, UK) and individually modified acrylic teeth. Wire clasps were fitted on the teeth of the right side. After consultation with the orthodontist, it was decided to encourage an increase of the occlusal vertical dimension (OVD), by allowing the posterior permanent teeth to erupt further. An acrylic occlusal appliance (posterior bite block) was incorporated in the interim RPD by adding cold-cured acrylic dough (Jet Tooth Shade, Lang Dental, Wheeling, IL) on the denture. On the left side, the dough adhered to the occlusal surfaces of the artificial teeth, and on the right side it rested on the occlusal surfaces of the primary natural teeth in the form of a continuous onlay (Fig 3). The thickness of the onlay, approximately 1.5 mm, provided an esthetic facial appearance, sufficient interocclusal rest space, and normal speech. The acrylic onlay provided an extended area of contact for the mandibular primary teeth bilaterally and did not contact the permanent teeth. Thus, increased vertical height could be gained with the eruption of the permanent upper and lower molars. The progress of the intervention was closely supervised by the orthodontist.

The insertion of the interim RPD was accompanied by retention problems, which were attributed to the inadequate mechanical retention, restricted mucosal support, and tenderness of the ridge mucosa. To improve the retention, tissue-conditioning material (Viscogel, Dentsply Ltd) was applied on the tissue surface of the base after careful reduction of the flange borders and relief of the basal area. The lining extended on the external surface of the base and was molded by the action of the surrounding muscles. Significant improvement of denture stability and patient adaptation was achieved, and the tissue conditioner was replaced by a chairside long-term soft liner (Eversoft, Myerson, Harrow, UK). Thereafter, the patient was kept under regular follow-up, every 1 to 3 months. The denture was regularly modified to accommodate and direct the eruption of the permanent teeth. The soft liner was replaced once, 1 year later. When the denture was accidentally dropped, a midline fracture occurred and was subsequently repaired.

When the child was 10 years old, the first interim RPD was replaced to accommodate the growth of the mandible and engage the erupted mandibular permanent teeth for retention. At that time, the permanent first molars were occluding, and the incisal edges of the mandibular incisors contacted the lingual surface of the upper incisors at the cingulum, satisfying the orthodontic criterion for proper OVD. The established OVD also provided a pleasing facial appearance and comfortable function. Therefore, it was assessed that there was no need to

Table 1 Tentative/definitive treatment plan

Treatment purposes	Treatment actions
Phase I (age 7): Initiation of treatment	
Esthetic and functional improvement, optimization of OVD	• Construction of interim RPD • Incorporation of acrylic occlusal block to increase the OVD of permanent teeth.
Maintenance of oral health	• Referral to Departments of Surgery, Pediatric Dentistry, and Orthodontics • Initiation of prosthodontic follow-up program
Phase II (age 7–17): Management during childhood and adolescence	
Monitoring of growth (interdisciplinary treatment follow-up)	• Successive interim dentures to ensure space maintenance and functional loading of the edentulous crest • Provision of proper occlusal plane of interim prostheses to accommodate the erupting teeth • Orthodontic treatment to guide teeth eruption • Orthodontic follow-up to affirm normal growth of jaws • Surgical and pediatric follow-up, treatment interventions when necessary
Modifications of interim prostheses	• Frequent denture inspection, adjustments, occlusal corrections, hygienic consultation • Relining to improve fit and comfort • Addition of acrylic on worn occlusal surfaces of denture teeth to restore the occlusal plane • Frequent replacement to adapt to maxillomandibular relations, maintain occlusal contacts, keep the material in good condition, optimize fit and extension of base
Permanent treatment planning	• Discussion with patient and parents about permanent restoration options from age 16
Phase III (age 17): Permanent rehabilitation	
Treatment planning	• Verification of growth completion • Collection of diagnostic material • Design of permanent prosthesis in consultation with the multidisciplinary team • Presentation of treatment plan to patient
Permanent prosthodontic restoration	• Preprosthetic surgery • Construction of permanent prosthesis • Arrangement for follow-up

incorporate an occlusal appliance to the second interim RPD. The second interim RPD was of a similar design to the first and was constructed following a similar protocol. Special attention was given to maintaining a proper occlusal plane, to prevent overeruption of the maxillary teeth, which by that time were beginning to erupt. Self-curing acrylic resin (Jet Tooth Shade) was added to restore the worn-out acrylic occlusal surfaces of this second interim RPD, after 2 years of service.

At the age of 13, the patient started orthodontic therapy in the Department of Orthodontics, to correct the malocclusion and align the maxillary teeth. Before initiation of orthodontic treatment, a third interim RPD was constructed with the additional purpose of providing proper opposing surfaces for the maxillary teeth (Fig 4). The occlusal relationship between the RPD teeth and opposing dentition was closely monitored during the orthodontic treatment. After completion of the latter, it was decided that the existing denture should be replaced once more.

The fourth interim RPD, constructed when the patient was 15, was equipped with a cast metal frame for improved retention and stability (Fig 5). The shape of the natural teeth was not modified. The circumferential clasp arms emerged through selected spaces between the mandibular teeth and engaged existing undercuts. The denture was tissue-borne, as this type of support had served well in the previous years, while representing the most conservative approach. Minor complications, such as a localized gingival inflammation, were noticed and addressed. The patient is effectively being served by her fourth interim RPD, and the treatment team is currently collaborating on her permanent prosthodontic restoration (Fig 6, Table 1).

Discussion

MNTI is a rare tumor, affecting infants during their first year of life. It originates from the neural crest and contains large melanocyte-like epithelioid cells and smaller cells resembling neuroblasts.[22] Its usual site of manifestation is the maxilla, with the mandible accounting for about 9% of reported cases.[22,23]

MNTI is a benign tumor, and the risk of malignant transformation is low.[22,24] However, it is locally aggressive, often expanding at an alarming rate, and has a high risk of recurrence.[22,24] For these reasons, immediate surgical excision is necessary. Sacrifice of the alveolar ridge and the corresponding tooth germs is unavoidable, either because of the wide excision needed[24] or because they are infiltrated by tumor cells.[23]

The operation leaves a solitary defect spanning multiple teeth. In children, the absence of many teeth results in severe esthetic and functional limitations. The absence of teeth in the esthetic zone constitutes an appearance handicap, which may be further aggravated by the collapse of unsupported soft facial

Figure 3 Intraoral view of the first interim RPD at the age of 7 years, 6 months.

Figure 4 Intraoral view of the third interim RPD by the end of the orthodontic treatment of the maxillary arch (14 years).

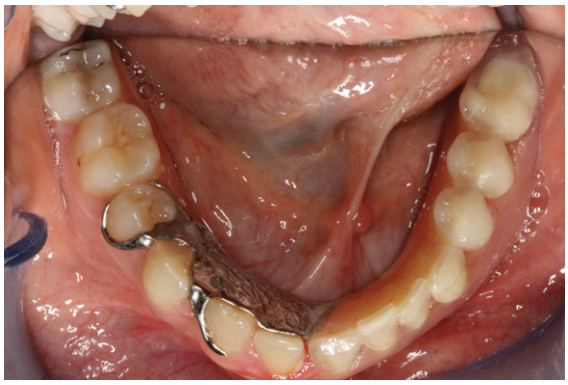

Figure 5 Intraoral occlusal view of the fourth interim RPD after 1 year of service (16 years).

tissues. The long edentulous span predisposes the patient to mastication difficulties and development of poor habits. Functional deviations as well as the uneven distribution of functional loads may have an impact on the growth and maturation of the facial hard and soft structures.[12] Finally, the eruption process and settlement of the natural dentition may be disrupted because of the absence of neighboring and opposing teeth.

Figure 6 Panoramic radiograph of the patient at the age of 16 years.

The potential complications of localized agenesis necessitate an early prosthodontic intervention. During critical growth years, close monitoring of maxillofacial growth is necessary,[25] and coordinated prosthodontic and orthodontic treatment is often needed.[16] Simple and easily modified removable appliances serve as a vehicle for the delivery of orthodontic services and direct the eruption and arrangement of the permanent teeth.[10,12,13,26] In the present report, the first interim RPD was modified to guide the settlement of the permanent dentition. While the patient was going through her mixed dentition stage, the permanent teeth were directed to occlude in the desirable OVD, assessed by both orthodontic and prosthodontic criteria. The subsequent interim RPDs prevented the natural teeth from attaining unfavorable positions and preserved the edentulous space. They also provided the young patient with much-needed functional and esthetic improvement. The restoration of function and, most importantly, esthetics is beneficial to the social and psychological maturation of a child with a handicap from the early school years through adolescence.[27-29] It should be noted that while almost 400 cases of MNTI have been published as of this writing,[24] only one report could be traced that mentions prosthodontic intervention, with an interim RPD constructed for an 8-year-old boy with a maxillary postoperational defect.[30]

Beneficial as it may be, it is a difficult task to provide a stable prosthodontic appliance in such situations.[12] The edentulous span is usually unilateral and often free-end. The ridge bulk is limited because of the operational defect and the absence of unerupted teeth. The distance between the occlusal plane and the base is excessive, resulting in unfavorable leverage during tooth contact. The crown morphology of the natural teeth does not permit proper clasping, and the need for minimal intervention precludes the use of rests. The wire clasps have a reduced retentive ability. All the former problems (encountered in the treatment of the patient presented here) contribute to a situation with compromised biomechanics and poor retention.[31] Soft liners are a valuable aid for adaptation problems,[32] as they establish an intimate, non-irritating contact of the base with the mucosa, along with optimum flange extension. Additionally, the polished surface is shaped by the action of the muscles, and the denture is retained by muscular control.[33]

Conclusion

Prosthodontic treatment of growing individuals with teeth agenesis may present unique problems associated with the

underlying cause. Early planning and close collaboration with the members of the multidisciplinary team on a long-term basis are essential. Equally important is the systematic follow-up, which allows for the timely interventions necessary to keep control of the course of treatment.

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