

Occlusal Rehabilitation in a Patient with Oligodontia and Microdontia using Implants and Full-Ceramic Restorations: A Clinical Report.

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Oligodontia is the agenesis of six or more permanent teeth, excluding the third molars. Multidisciplinary dental treatments should be performed sequentially due to the restoration requirements for good oral function, aesthetics and self-confidence of patients. In this study, we report a case using dental implants and full-ceramic prostheses to restore the absent and malformed teeth in a patient with agenesis of 18 permanent teeth and with some primary teeth retained. The dental sequential treatments began when she was 16 years old, and she wore removable partial dentures for 4 years with unsatisfying restoration outcome. When she became an adult, dental implants and full-ceramic prostheses were used to restore the absent and malformed teeth. Finally, the patient was very satisfied with the functional and aesthetic outcomes of the prosthetic treatment.

Key words: occlusal rehabilitation, oligodontia, dental implant, minimally invasive restoration, PAX9 mutations

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Oligodontia is one type of tooth agenesis, which is defined as the absence of six or more permanent teeth, excluding the third molars. The prevalence of oligodontia is estimated at 0.1 to 0.2% in the general population¹. Although tooth agenesis is a multifactorial disease that is regulated by both genetic and environmental factors, the genetic influence is considered a key role in the pathogenic process.

Oral manifestations of patients with tooth agenesis may include malformed teeth or microdontia², alveolar bone hypoplasia and retained primary teeth³. The

unusual appearance, characteristic of oligodontia, can greatly affect the patient self-confidence and social activities. Therefore, tooth agenesis patients should initiate dental treatment in childhood due to functional, aesthetical and psychological requirements^{4,5}. To achieve the better final prosthetic outcome possible, tooth agenesis patients require a multidisciplinary sequential treatment^{1,6,7}, which should involve in particular, orthodontics and restorative dentistry⁸.

The prosthodontic methods for tooth agenesis patients include removable dentures, fixed partial dentures, implant-supported prostheses, and a combination of the above. Removable dentures are commonly used to treat juvenile oligodontia patients⁹ because they are still growing. Removable dentures are economical, conservative and reversible; however, it is hard to achieve the level of aesthetical results and masticatory function that is often asked from patients. Therefore, fixed dentures and implant-supported prostheses are better choices for adult tooth agenesis patients.

Case report

The patient first presented at the Department of Prosthodontics, Peking University School and Hospital of Stomatology, when she was 16 years old, with a chief

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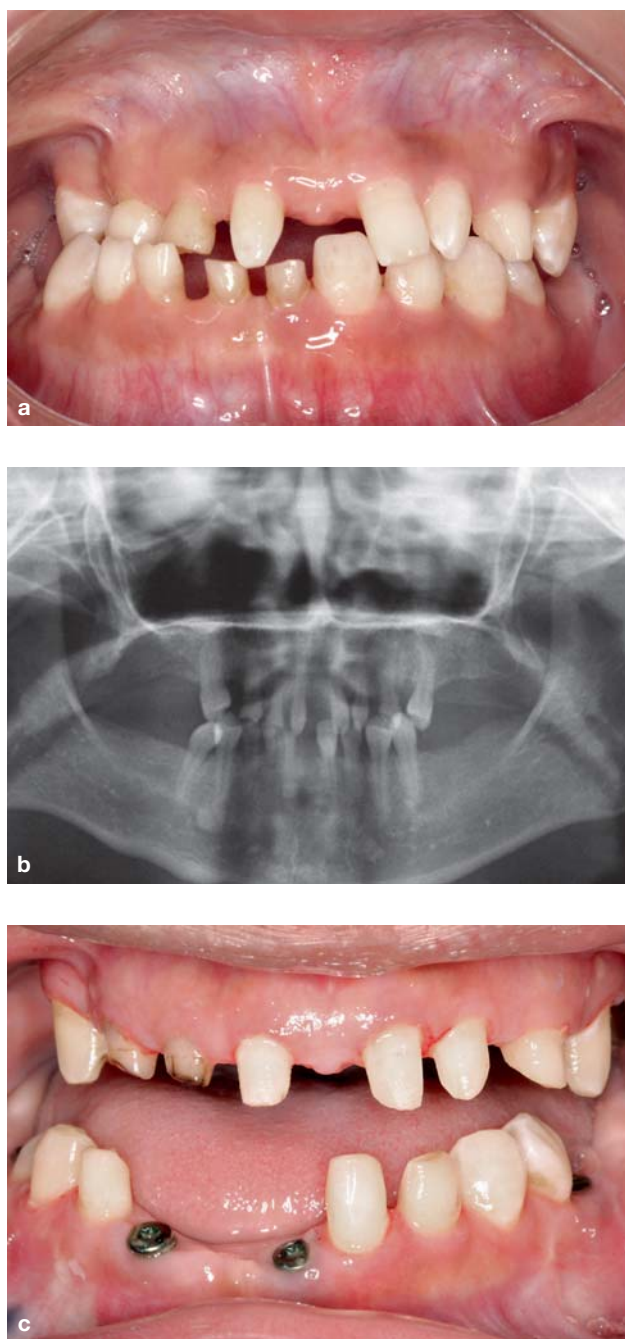


Fig 1 (a) Pretreatment intraoral view. (b) Pretreatment panoramic radiograph. (c) Intraoral view of minimally invasive preparations.

complaint of oligodontia and an unaesthetic smile. She denied a history of tooth extraction. No other apparent ectodermal abnormalities such as nail, hair, skin, or sweat gland hypoplasia, were observed. Her facial appearance was influenced by oligodontia and malocclusion (Fig 1a). The patient had an agenesis of 18 permanent teeth, and some retained primary teeth (Fig 1b).

The erupted permanent teeth were malformed in crown size and shape, and presented as microdontia or conical teeth. A unilateral posterior reverse articulation and a mild mandibular deformity were found in the right side. Her parents were unaffected. Genetic analysis revealed that the patient harboured a *de novo* *PAX9* mutation¹⁰. All the treatment options were discussed with her and her parents. Finally, based on age, costs and conservative considerations, she refused to receive an orthodontic treatment and preferred the removable prostheses.

Four years later, the patient was recalled with fractured overdentures and multiple caries. She was no longer satisfied with the aesthetics and function of her removable partial dentures, and was eager to get a better aesthetical and functional outcome using implants and full-ceramic restorations. Therefore, a comprehensive multidisciplinary treatment plan was proposed, which comprised the following steps: 1) performing an orthognathic and orthodontic therapy to get a better tooth arrangement; 2) inserting implants to replace the missing permanent teeth and to achieve a better occlusal function; 3) using full-ceramic crowns to improve the shape of the malformed permanent teeth and retained primary teeth, and consequently, establish a stable occlusion. However, the orthognathic and orthodontic treatment plan was refused again by the patient due to economic and time-consuming concerns.

By evaluating the patient's old dentures and dental situations¹¹, we found that her oral restorative space was insufficient, and the vertical dimension of her face had decreased due to the agenesis of all molars. To improve the aesthetical effects of her anterior teeth and obtain enough space for the restorations, a crown-lengthening surgery and the increase of vertical dimension were proposed. One of the requirements for the vertical dimension increase for this patient was the acquisition of enough space for the restoration of worn or short dentition¹². No abnormalities were found in the physical and radiographic examinations of the patient's TMJs; therefore, the elevation of her vertical dimension was doable.

The patient's loose teeth, including the mandibular left primary central incisor and right primary lateral incisor, were extracted. Three months later, cone-beam computed tomography (CBCT) scans were performed to evaluate her residual alveolar bones. The Osseospeed implants (Astra Tech, Mölndal, Sweden) were used to replace the maxillary right and left first molars, and the Roxolid implants (Straumann, Basel, Switzerland) were used for the mandibular teeth. The maxillary sinus floor elevation and guided bone regeneration (GBR) were performed using bone substitutes (Bio-Oss, Geistlich



Fig 2 (a) Anterior view of the final wax-up that was fabricated using a customised incisal guide table. (b) Occlusal view of the final wax-up (maxilla). (c) Occlusal view of the final wax-up (mandible). (d) Intraoral view at the end of the prosthodontic treatment.

Biomaterials, Wolhusen, Switzerland) as well as barrier membranes (Bio-Guide, Geistlich Biomaterials), with the implants being placed simultaneously. Six months after the implantation, small gingival incisions were performed to remove the closure caps and screw on the healing abutments to the implants. One month after the stage-two surgery, the patient's old dentures and a Gothic arch tracer were used as reference to obtain the maxillomandibular relationship record. An intraoral assessment was conducted to determine the aesthetic parameters, including the exposure length of maxillary incisors under the upper lip, incisal edge position and the smile line. A face bow was used to transfer the relationship of her maxillary arch and temporomandibular joint (TMJ); subsequently, the casts were mounted on a semi-adjustable articulator. The occlusion was designed to be re-established at the centric relation position.

To visualise the final restorative effect, a diagnostic wax-up was performed before the preparation. Diagnostic mock-ups were made using bis-acryl resin (Protemp 4, 3M ESPE, Seefeld, Germany), which were

also used as guides to simplify the preparation procedure and to obtain a minimally invasive preparation. After the preparation (Fig 1c), provisional restorations were fabricated and cemented on the tooth abutments using provisional cements (RelyX Temp NE, 3M ESPE). The patient was asked to wear provisional restorations for 4 months, and was recalled after 24 hours, 1 month, and 3 months for examinations and occlusal adjustment. During the observation period, no muscle or TMJ dysfunction were found, and she was satisfied with the restorations in terms of shape, function and phonetics.

Later on, definitive impressions were taken using a polyether impression material (Impregum Penta Soft, 3M ESPE). The patient's maxilla/mandible relation was decided using the provisional restorations as reference and transferred to a semi-adjustable articulator via cross-mounting. The restorations were completed in the laboratory (Fig 2a-c) and tried-in to evaluate the colour, occlusion and phonetics clinically (Fig 2d). Finally, her posterior implant-supported crowns were screw-

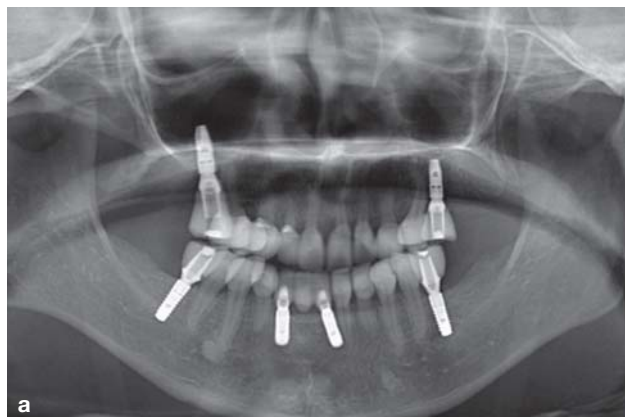


Fig 3 (a) Two years posttreatment, panoramic radiograph showing that the alveolar bone was stable in the peri-implant areas. (b) The patient was satisfied with her 'smile' after the treatment.

retained, and full-ceramic crowns of residual teeth and mandibular anterior implant-supported full-ceramic fixed partial denture (IPS e.max, Ivoclar Vivadent, Schaan, Liechtenstein) were cemented using resin cements (RelyX U200, 3M ESPE).

The patient was very satisfied with the restoration outcomes. She was instructed to perform adequate oral hygiene and was recalled every 6 months over a 2-year follow-up period (Fig 3). So far, she has done well with good oral hygiene, and the hard and soft tissues remained stable.

Discussion

The clinical diagnosis of oligodontia was based on the number of missing permanent teeth congenitally. The genetic analysis revealed that the patient carried a *PAX9* mutation¹⁰. For patients with oligodontia, the precise mutation site can be used for genetic counselling and prenatal diagnosis to prevent the familial inheritance. The genotype-phenotype correlation analysis of *PAX9*-mutant patients has shown that the molars are commonly absent and the residual teeth are malformed or microdontia is present, which severely reduce the masticatory efficiency and affect the patient appearance¹³⁻¹⁵. Therefore, once a clinical diagnosis is confirmed, the dental treatment should be initiated as soon as possible to improve the patient oral function, aesthetics and psychological wellbeing, and to help the growth of jaw bones by masticatory stimulation.

Removable dentures are the most commonly used restoration for juvenile patients with oligodontia, because their craniofacial development has not yet completed. Removable dentures are easy to adjust and may be renewed following the patient's development.

However, excessive abrasion on the occlusive surface of artificial teeth and deformation of the casting clasp in removable dentures are often observed after a long-term of usage, which may lead to lower masticatory efficiency and poor retention. When patients become adults, implant-supported restorations are recommended due to their higher masticatory efficiency and better retention compared with removable dentures.

In our study, to achieve acceptable aesthetics and functional results, the treatment plan included a combination of implant-supported prostheses and full-ceramic prostheses. Dental implants were used to preserve the alveolar bone and support the prostheses to confer higher masticatory efficiency. Because our female patient was a little short in stature, had smaller muscle strength and occlusal force without any oral parafunction, the monolithic lithium disilicate (IPS e.max) single crown and posterior three-unit fixed partial denture could support her masticatory force, and provide the nice aesthetic and adhesive properties. However, because the patient refused the orthognathic and orthodontic treatments, her mandibular lateral deformity and unilateral reverse articulation of right posterior teeth were not completely corrected after our prosthodontic treatment.

Conclusion

We report here the sequential treatment procedures of a non-syndromic oligodontia patient. Along with the progress of genetic techniques, the precise genetic diagnosis of oligodontia helps doctors to understand the pathogenesis of this genetic disease and further helps them to manage and treat it properly. The appropriate treatment should be selected for the oligodontia patient at different ages to improve the oral function such as mastication,

pronunciation, aesthetic appearance and to help the normal psychological development accordingly.

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Conflicts of interest

The authors declare no conflicts of interest related to this study.

Author contribution

Drs Yan Jun GE and I-Ting Yeh contributed to the data acquisition, analysis, interpretation and drafted the manuscript; Dr Sing-Wai WONG contributed to the data acquisition and interpretation; Professor Hailan FENG and Dr Dong HAN contributed to the conception, design and critically revised the manuscript. All authors gave their final approval and agree to be accountable for all aspects of the work.

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