Ectodermal dysplasia (ED) is a rare, hereditary, congenital disease characterized by abnormal development of certain tissues and structures of ectodermal origin. Disturbances in tissues derived from other embryologic layers are not uncommon. The ectodermal germ layer gives rise to different organs and structures, including the nose, eyes, hair, nails, sweat glands, and enamel. The prevalence of hypohidrotic ED in the general population has been estimated between 1:10,000 and 1:100,000 male live births. Individuals with this disease generally exhibit a triad of symptoms: hypodontia, hypotrichosis, and hypohidrosis.

Dental abnormalities can range from anodontia to hypodontia, which is the more common form. Both deciduous and permanent dentitions seem to be affected, and conical or peg-shaped teeth predominate. In the absence of teeth, the alveolar process is poorly developed, decreasing the occlusal vertical dimension (OVD) and giving the child’s face an aged appearance, similar to that of a patient with edentulism. The growth and development of the child, however, is normal.

Dental treatment should start early in the life of the patient. Function, psychology, and esthetics are primary reasons behind such an early approach. Facial appearance can create an inadequate self-image, leading to social withdrawal and difficulty integrating into society; the dental appearance of these young patients, therefore, is of the utmost importance. Treatment timing and sequence should be determined in conjunction with the patient’s parents and may include fixed, removable, or implant-supported fixed partial dentures.

Removable prosthodontics is the most frequently used treatment for ED. When teeth are present for support, overdentures have been successful. In addition to being straightforward and inexpensive, removable prosthodontics are a reversible and conservative treatment that will leave the teeth of the young patient intact and preserve the alveolar bone. Mini-implants can be considered as a viable reversible treatment option for a growing child with ED. Subsequently, the adult patient can be provided with more definitive treatment, including implant-supported prostheses, without damaging their few remaining teeth. Overdentures help...
to achieve better function, esthetics, and phonetics, along with improved self-image. Limitations of this option with very young patients include the patient’s failure to comply with oral hygiene, which requires several recall visits (3 to 4 months), daily application of stannous fluoride to minimize dental caries, and periodic replacement of the overdenture because of the child’s normal growth.

Removable complete overdenture prostheses (RCOPs) have been used successfully for patients with ED who present with hypodontia, especially young patients who have not yet stopped growing. Monolithic, multichromatic computer-aided design and computer-aided manufacturing (CAD-CAM) has been developed to fabricate removal complete dental prostheses (RCDPs). Compared with conventionally processed dentures, CAD-CAM RCDPs show several advantages, including a reduction of residual monomer, improved physical properties of the acrylic resin base, reduction in polymerization shrinkage, and reduced adhesion of Candida albicans organisms to the denture base. In addition, CAD-CAM RCDPs can be provided over fewer patient visits, the digital files permit easier remakes, and denture base adaptation and retention are improved.

This clinical report describes the treatment of an adolescent patient with ectodermal dysplasia, using monolithic, multichromatic CAD-CAM RCOPs.

CLINICAL REPORT

A 14-year-old white boy presented with his parents to the graduate prosthodontic clinic at Indiana University School of Dentistry complaining of an unpleasant smile and the inability to masticate properly. His parents stated that he is socially shy and aware of his condition, especially when his classmates are around him. Their wish was to replace the missing teeth to improve their son’s esthetics and mastication. His medical history included a diagnosis of ED; and he had no history of allergic reactions to medications, local anesthetics, or food. His dental history disclosed that he visited his dentist regularly and had not exfoliated his primary teeth.

He exhibited a reduced lower face height and saddle nose. He presented with a dolichocephalic face type and a concave lateral profile. In addition, he had a low smile line, with less than 75% of the maxillary central incisor showing at maximum smile. Intraoral screening was negative for cancer, generalized microdontia, hypodontia, and diastemas. The patient presented with mixed dentition with primary teeth (maxillary right second molar, maxillary first molars, maxillary canines, maxillary lateral and central incisors, mandibular lateral incisors, and mandibular canines) in addition to some erupted permanent teeth (maxillary first molars, maxillary left second premolar, mandibular first molars, and mandibular first and second premolars). The rest of the teeth were clinically missing. A unilateral segmental reverse articulation of the left side was noted, with slight dental wear of the primary teeth on the same side. Moreover, he presented with signs of generalized slight gingival inflammation with bleeding on probing and no sign of clinical attachment loss. The patient showed acceptable oral hygiene and no dental caries was detected (Fig. 1).

The panoramic radiograph showed congenitally missing permanent teeth (maxillary third molars,
maxillary second molars, maxillary first and second premolars, maxillary canines, maxillary incisors, mandibular second and third molars, mandibular canines, and mandibular incisors). Complete mouth radiographs showed no dental caries (Fig. 2). His condition was diagnosed by using American College of Prosthodontists class IV partial edentulism, a low smile line, an abnormal posterior cusp-to-fossa relationship with unilateral segmental reverse articulation of the left side, and localized mild attrition with wear of left maxillary central incisor, maxillary lateral incisor, and maxillary canine. Moreover, his diagnosis included generalized, slight plaque-induced gingivitis. The patient's teeth were mildly microdontic, and some of the primary and permanent teeth were congenitally missing. Furthermore, the patient showed signs of reduced OVD.

Due to his incomplete growth, the treatment of choice was to fabricate monolithic, multichromatic CAD-CAM acrylic resin RCOPs by using the AvaDent system (Global Dental Science LLC) to retain the remaining primary and permanent teeth and to restore esthetics, phonetics, and function. After the risks, benefits, and alternatives were discussed with the parents, the treatment plan was agreed. The parents were warned that their son might refuse to wear the RCOPs, which could add to the complexity of the treatment and affect the outcome.

Maxillary and mandibular preliminary impressions were made with alginate impression material (Jeltrate; Dentsply Sirona). Maxillary and mandibular custom trays were fabricated with light-activated acrylic resin materials (Triad; Dentsply Sirona). Tray adhesive material (AvaDent Tray Adhesive; Global Dental Science LLC) was applied to the borders of the custom trays. Maxillary and mandibular border molds were made of medium body polyvinyl siloxane (PVS) border molding materials (AvaDent Border Molding Material; Global Dental Science LLC). The definitive impressions were made of medium- and light-body PVS impression materials (AvaDent Impression Material; Global Dental Science LLC). Stabilizing occlusal records were made of light-activated acrylic resin material (Triad; Dentsply Sirona) and type III baseplate wax (TruWax; Dentsply Sirona) to re-established the OVD. A PVS occlusal relation registration material (AvaDent Registration Material; Global
Dental Science LLC) was used to record the centric relation at the re-established OVD. An index was made using PVS putty impression material (EXAFLEX Putty; GC America, Inc) to identify the smile line, anterior occlusal plane, and maxillary anterior tooth width and height (Fig. 3).

Definitive casts were scanned with a laboratory scanner (Dental Wings iSeries; Dental Wings Inc) and articulated digitally with the help of the centric relation record. The putty index was also scanned and digitally superimposed on the maxillary digital casts. Maxillary and mandibular RCOPs were digitally designed, and a prototype was milled from tooth-colored monolithic poly(methyl methacrylate) (PMMA) material (Functional BTI; Global Dental Science LLC) (Fig. 4). The RCOPs prototype was used to verify the OVD, function, occlusion, phonetics, and esthetics. The parents had some comments regarding the length of the maxillary anterior teeth, and their suggested length was marked on the RCOPs prototype (Fig. 5). The RCOPs prototype was scanned again to record the occlusal modification and modify the length of the maxillary teeth according to the marks. The RCOPs were then milled from monolithic, multichromatic cross-linked PMMA material (AvaDent XCL-1; Global Dental Science LLC) (Fig. 6). During the delivery visit, the existing teeth were not modified because a relief of 0.5 mm was added over the existing teeth in the design of the prostheses. Minor adjustments
were made to the intaglio surface after applying pressure-indicating paste (PIP; Mizzy). Both of the RCOPs were then placed in the patient’s mouth, and the occlusion was adjusted (Figs. 7, 8).

Oral hygiene instructions were given, and the patient was instructed to remove the prostheses at night and clean his teeth and both the maxillary and mandibular RCOPs with a nonabrasive paste and soft-bristle brush. Daily applications of a nonaqueous solution of topical 0.4% stannous fluoride gel (Colgate Gel-Kam; Colgate-Palmolive Co) were prescribed, and the patient was scheduled for a 3-month follow-up for more adjustment to compensate for his skeletal and dental growth. At the 2-year recall appointment, new maxillary and mandibular RCOPs will be made. When the patient attains final skeletal growth, a definitive treatment can be implemented.

DISCUSSION

A tentative diagnosis of ED was based on the following clinical signs and symptoms: sparse hair, eyebrows, and eyelashes; dry skin with periorbital hyperkeratosis; dysmorphic facial features; impaired function of the exocrine glands; and a family history of ED. Early dental treatment of ED is important for a young patient’s quality of life. Function, psychology, and esthetics can be improved dramatically by using such an approach. Moreover, the skeletal growth of young patients should be considered and can dictate treatment. Long-term provisional treatment can prepare such patients for definitive treatment options, including implant-supported prostheses after cessation of skeletal growth without jeopardizing function and esthetics.

Osseointegrated implants have been widely used with high success rates in the management of patients with ED. In addition, implant-supported restorations seem to positively affect the quality of life of young patients. Dental implants also play an important role in the preservation of the alveolar bone, which is already scarce because of lack of teeth. However, several reports have raised concerns regarding the placement of endosteal implants in young patients with growing jaws. Croinin et al described mandibular jaw growth and the consequences of placing an implant in such a growing jaw.

Although different treatment approaches have been described to treat patients with ED, a removable dental prosthesis is considered a viable alternative, especially for young individuals. RCOPs have been successfully implemented as one form of treatment for patients with ED who present with hypodontia and microdontia. It is a reversible treatment that retains the remaining teeth to preserve the alveolar bone. However, the inability of very young patients to comply with oral hygiene requires several recall visits and a daily application of stannous fluoride to minimize dental caries and a periodic adjustment and replacement of the overdenture because of the child’s normal growth.

Digital designing and milling of the RCDP provided significant benefits. Although fabricating conventional RCDPs can be technique-sensitive, especially during the delivery visit, these complications can be minimized with monolithic, multichromatic CAD-CAM RCDPs. They require fewer patient visits and less chairside time, which benefitted a patient of his age and reduced his chances of missing classes. Using monolithic cross-linked PMMA material (AvaDent XCL-1; Global Dental Science LLC) will reduce the incidence of acrylic tooth debonding, especially considering the minimum availability of restorative space and the physical activities of young individuals. The cost of CAD-CAM RCDPs, which is higher than that of conventional RCDPs, is one of the limitations of this technique.

In this clinical scenario, the centric relation record was obtained during the jaw relations visit. The patient
exhibited good neuromuscular control, making the centric relation record more predictable. At the clinical evaluation visit, the RCOPs prototype was used to verify the centric relation, and the option of trying the prototype at home for few days was given. However, the patient felt comfortable with the overall result and was excited to move forward with the definitive prostheses.

Clinical challenges may exist with very young patients with ED, such as a 4- to 6-year-old child. The child should try the prototype for a few days so that the clinician can evaluate the patient's cooperation and other prosthetic parameters such as centric relation and OVD. The prototype should then be examined for wear facets and any slide from centric relation that might exist should be removed.

**SUMMARY**

This clinical report is presented to demonstrate that monolithic, multichromatic CAD-CAM acrylic resin (RCOPs) can be used to treat adolescent patients with ED. Good oral hygiene is a key factor in the overall success of the treatment. This patient tolerated his new OVD well and followed every instruction, which should predict an acceptable long-term outcome and prognosis. Although special care and more experience are needed to treat these types of patients with CAD-CAM RCOPs, this report shows that a promising outcome can be achieved.

**REFERENCES**


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