Comprehensive Rehabilitation for a Permanent Tooth Anodontia Patient Using an Integrated Digital Approach

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Agenesis of the permanent dentition is rare. This report describes a 20-year-old woman with 19 deciduous teeth, a single permanent mandibular premolar, and other physical traits associated with ectodermal dysplasia. The patient demonstrated esthetic parameters associated with maxillomandibular alveolar insufficiency, and her chief complaints were directed toward esthetics and the potential impact of restorative choices on function. Three typical options for restoration include overdentures, removable partial dentures, or implant-supported prostheses replacing her natural dentition. This report illustrates a fully integrated digital approach to treatment planning, the fabrication of a computer-aided design/computer-assisted manufacture surgical guide and provisional restoration, guided implant placement, and definitive restoration using monolithic zirconia implant-supported fixed dental prostheses. The lifelong management of this rehabilitation is an acknowledged challenge.


The absence of permanent dentition, termed complete anodontia, is extremely rare. While the exact prevalence of permanent tooth anodontia is unknown, the absence of more than six permanent teeth is reported to be approximately 0.14%. Anodontia seldom presents as an isolated anomaly and is usually associated with a syndrome, the most common being ectodermal dysplasia (ED). Of the over 150 reported clinically distinct ectodermal dysplasias, 120 have associated dental defects, with hypohidrotic ED being one of the more common types. Dental anomalies associated with anodontia or hypodontia include teeth that are reduced in size, malformed, and conical in shape. Additionally, alveolar bone hypoplasia with reduced occlusal vertical dimension (OVD) is observed. Patients with ED may also present with atypical hair, nails, and sweat glands.

Prosthetic treatment modalities for the ED patient include removable partial dentures, fixed partial dentures, complete dentures, and/or implant-retained prostheses. Although placement of endosseous dental implants has been successful in ED patients, this treatment is not routinely recommended in growing children. Removable prostheses, which can be modified or remade as the child grows and develops, provide a satisfactory
method for the patient to function until late adolescence is reached and implants can be placed. Upon reaching young adulthood, however, a fixed prosthesis may be more psychosocially suitable than a removable appliance.

Comprehensive rehabilitation with implants is a complex, multistep process that requires integration of surgical and restorative procedures in order to optimize the biologic, functional, and esthetic outcomes. Recent advances to the digital workflow have made it feasible to integrate all phases of a treatment plan from implant placement with immediate provisionalization to design of the definitive prosthesis. Digital planning and design allows for consistency across all stages of treatment that is more accurate and efficient than with an analog workflow. The aim of this case report is to illustrate the steps used in an integrated digital approach to plan for treatment and design and mill computer-aided design/computer-assisted manufactured surgical guides, provisional restorations, and definitive prostheses for a 20-year-old woman with permanent tooth anodontia.

Case Report

A 20-year-old female with physical traits associated with ED and a dental diagnosis of permanent tooth anodontia presented for a comprehensive evaluation with a chief complaint of esthetic and functional dissatisfaction. A physician diagnosed the patient at age 2 with ED, but this finding has not been confirmed by genetic testing. In addition to anodontia, the patient had thin, sparse hair and dysplastic fingernails. Other systemic, radiation, or pharmacologic causes of tooth agenesis were ruled out. Prior dental history included composite restorations and Smile Transitions prostheses (Glidewell Laboratories) for esthetic enhancement.

Clinical examination revealed inadequate tooth display and a decrease in the lower third of the facial height with a short upper lip (Fig 1). Maximum opening height was recorded to be 40 mm with no deviation upon opening. There was an absence of extraoral pathology in the head and neck region. The intraoral examination revealed the presence of deciduous teeth A through K, M through T (Universal system for primary teeth), and permanent tooth 34 (FDI system) (Fig 2). The maxillary and mandibular canines were conical in shape, demonstrating typical presentation in patients with ED. The lack of permanent teeth resulted in a decreased occlusal vertical dimension. There was an absence of dental caries, periodontal disease, and other intraoral pathology.

The diagnosis of permanent tooth anodontia was confirmed radiographically (Fig 3). The retained deciduous teeth displayed only modest root resorption. A large marrow space apical to tooth A was evident radiographically. No other odontogenic or osseous pathology was identified.

Treatment Planning

Diagnostic casts were mounted on a semi-adjustable articulator using an arbitrary facebow and a centric relation record taken at an OVD that restored the patient’s lower face height. A cone-beam computed tomography (CBCT) scan of the dentoalveolar region was captured.
using a Galileos imaging system (Dentsply Sirona) to complement the diagnostic information. Information gathered from the comprehensive exam, CBCT, and patient history was used to generate a treatment plan involving six maxillary and six mandibular implants supporting opposing screw-retained monolithic zirconia prostheses. The benefits, risks, and alternatives to this type of treatment were thoroughly discussed with the patient. Other proposed treatment options included: (1) tooth-supported overdentures, (2) composite restorations and removable partial dentures, and (3) no treatment. The patient’s consent to treatment was obtained, and she demonstrated an understanding that proper oral hygiene and prosthetic and implant maintenance is essential to the lifelong success of this treatment.

Treatment

A D900L scanner (3Shape) was used to scan the maxillary and mandibular casts individually and then together to record the maxillomandibular relationship. Additionally, a cast of the patient’s Smile Transitions prosthesis was scanned to transfer the desired incisor position. Both a digital wax-up of the desired tooth arrangement and the DICOM files from the patient’s CBCT were imported into 3Shape Implant Studio software. Implants were planned based on appropriate prosthetic parameters, adequate height and width of bone, avoidance of vital structures, and ideal anterior-posterior spread (Fig 4). Superimposition of the

Fig 2 Preoperative intraoral (a) facial, (b) maxillary occlusal, and (c) mandibular occlusal views. Note that teeth C, H, M, and R (Universal system for primary teeth) are malformed and conical in shape.

Fig 3 Preoperative panoramic radiograph. No permanent teeth are present except for tooth 34 (FDI system).
CBCT with the three-dimensional (3D) virtual tooth set-up allowed for the planned implant placement to be prosthetically driven (Fig 5).

In order to accurately execute the desired implant placement, the surgical plan was used to mill a pilot guide from single cross-linked clear polymethyl methacrylate (PMMA) material (Wieland Dental) using a Zenotec Select Hybrid mill (Wieland Dental). The guide was designed to be supported by the teeth not located in a planned implant location (Fig 6). Lack of interdental space did not permit the use of a fully guided surgical protocol. The last step was to use the diagnostic set-up to design and mill a double-cross-linked PMMA provisional. The Zenotec Select Hybrid mill and Temp Esthetic PMMA material (Harvest Dental) were used to create the prosthesis, which was made for initial intraoral placement and pick-up on the day of surgery.

For the maxilla, the surgical procedure consisted of extracting teeth A, C, E, F, H, J and seating the pilot guide on teeth B, D, G, and I (Fig 7). Pilot osteotomies were made through the guide at implant sites 11, 13, 16, 21, 23, and 26. The guide was removed and implant sites were prepared using standard Astra Tech Implant System EV (Dentsply Sirona) drilling sequence and manufacturer-recommended speeds. 4.2-mm–diameter Astra OsseoSpeed EV implants (Dentsply Sirona) were placed in sites 16 and 26, and 3.6-mm–diameter Astra OsseoSpeed EV implants were placed in sites 11, 13, 21, and 23. Excellent primary implant stability was achieved for all implants. Remaining
teeth B, D, G and I were then extracted. Postoperative periapical radiographs were taken to confirm proper implant placement.

Immediately after surgery, Uni Abutment EVs (Dentsply Sirona) were torqued to 35 Ncm in each implant and Temp Abutment EVs (Dentsply Sirona) were hand-tightened onto the abutments. The milled PMMA provisional was seated using a palatal strap index, and intraoral pick-up of the temporary abutments were made using Filtek Supreme Ultra flowable composite (3M). Further guidance for positioning the maxillary prostheses was provided by use of an overlay prosthesis representing the planned restorations for the mandible. The overlay prosthesis was placed on the mandibular deciduous teeth to position the maxillary prosthesis in the planned occlusal relationship at the time of temporary abutment attachment (Fig 8). The provisional restoration was finished and polished in the laboratory prior to placing it back in the patient’s mouth. Bridge Screw EVs (Dentsply Sirona) were hand-tightened to secure the prosthesis in place.

The patient was dismissed from the clinic in stable condition and returned 2 weeks later to receive mandibular treatment. Deciduous teeth K, M, N, Q, R, S, and T and permanent tooth 34 were extracted, and the pilot guide was seated on teeth O and P. Pilot osteotomies were made through the guide at implant sites 32, 34, 36, 42, 44, and 46. Astra OsseoSpeed EV implants with a 4.2-mm diameter were placed in sites 34, 36, 44, and
46, and 3.6-mm–diameter implants were placed in sites 32 and 42. Excellent primary implant stability was achieved for all implants. Lastly, teeth O and P were extracted. Postoperative periapical radiographs were taken to confirm proper implant placement. The implants were immediately loaded in the same manner as the maxilla. Occlusion was checked and adjusted so that it was mutually protected.

The patient returned 2 weeks later for a postoperative visit and was determined to be healing appropriately without complications. Final impressions would have been made at approximately 3 months postoperative per standard protocol, but the patient selected an 8-month academic travel course, delaying treatment.

Upon the patient’s return, osseointegration of all implants was manually confirmed and final impressions were made using Uni-A mutating EV Pick-Ups (Dentsply Sirona) for an open-tray impression technique. The maxillomandibular relationship was recorded using acrylic duplicates of the patient’s interim restorations. The D900L Scanner imported the master cast data into the 3Shape software. Based on the provisional restorations, a longer maxillary incisor length was requested, and the design was revised. To achieve this, the Dynamic Abutment System (PREAT) was utilized for the implant in tooth position 11; the incisal length increase resulted in the screw access channel emerging through the incisal edge.

Prototype prostheses were milled from Temp Esthetic PMMA (Fig 9). The patient wore the try-in prostheses for approximately 1 month to evaluate esthetics, phonetics, function, and passive fit of the proposed definitive restorations. Alginate impressions were made of the prosthetics, and the casts were scanned to evaluate occlusal wear patterns over this time period. Changes were made to the proposed definitive restorations based on occlusion and esthetic parameters evaluated by both the patient and the clinician. The definitive prostheses were milled using Zeno-star MO zirconia (Ivoclar Vivadent) using a Zenotec Select Hybrid mill. IPS e.max Ceram (Ivoclar Vivadent) was used to veneer only the facial surfaces of the prostheses’ anterior teeth. Titanium cylinders (PREAT) were luted to the prostheses using Multilink Hybrid Abutment cement (Ivoclar Vivadent). Lastly, an occlusal guard was designed on the definitive maxillary prosthesis using 3Shape and printed from a Form 2 3D printer (Formlabs) using clear photopolymer resin (Formlabs).

Insertion and Follow-Up Care

The screw-retained zirconia implant-supported fixed dental prostheses were inserted on Astra EV Uni Abutments using Astra EV bridge screws torqued to 15 Ncm. Esthetics, phonetics, and fit were determined to be appropriate by both the patient and clinician. A mutually protected occlusal scheme was established. Screw access holes were covered with PTFE tape and Filtek Supreme Ultra flowable composite. The occlusal guard was adjusted so that even posterior centric contacts and anterior guidance were established.

Oral hygiene instructions were given to the patient. The importance of cleaning around the implants, wearing the occlusal guard, and returning for professional maintenance were emphasized. The patient was satisfied with the esthetic and functional outcome of her rehabilitation (Fig 10). A postoperative panoramic radiograph demonstrated complete seating of the prostheses and stable bone levels (Fig 11).

The patient returned for postoperative evaluations at 1 week, 1 and 6 months, and 1 year. Assessments were positive, with minor esthetic and occlusal adjustments made at these appointments. At the 6-month visit, the patient had professional maintenance performed. Peri-implant health was determined to be excellent with absence of inflammation, plaque, and bleeding on probing. The patient will continue professional maintenance in 6-month intervals, with the prostheses being removed once a year.
Discussion

Rehabilitation of a 20-year-old female patient with permanent tooth anodontia was achieved using endosseous dental implants and implant-supported prostheses. The 12 implants integrated successfully and have been in the mouth for over 4 years with no signs of biologic or technical complications. Bone levels have remained stable during this period. Implants have been placed, loaded, and restored successfully in patients with ED, yielding survival rates between 88.5% and 97.6%. The majority of studies assessing implant survival in ED patients are in children or adolescents; it is necessary to follow these patients long-term to better understand implant performance over an extended period of time.

The patient’s full-arch implant-supported prostheses have successfully been in function for approximately 3 years with no biologic or technical complications.

Fig 10 Postoperative intraoral (a) maxillary and (b) mandibular occlusal views and extraoral (c) facial and (d) lateral views demonstrating restored OVD and enhanced esthetics from initial presentation.

Fig 11 Postoperative panoramic radiograph.
Abdulmajeed et al11 reports a cumulative prosthetic survival rate of 96.8%12–16 for complete-arch implant-supported monolithic zirconia fixed dental prostheses for up to 5 years. Prosthetic complications include porcelain chipping,12,14 fractured or loose abutments, debonded components, and fracture of the prosthesis.13 While the reported short-term performance rates of monolithic zirconia prostheses appear promising, long-term success is unknown and will require longer follow-up times to ascertain this information.

Understanding the effects of dentoalveolar changes on implant and prosthesis position over time remains an interesting subject, especially in a patient who had implants placed at a young age. It is known that late craniofacial growth can lead to spatial complications associated with implants in dentate patients, such as intruded crowns and diastemas, but it is largely unknown what will occur in edentulous patients with full-arch implant-supported prostheses. Digital dentistry poses an advantage here: As the patient ages and esthetic and functional parameters change, modifications can be made to the initial digital design, and a new prosthesis can be fabricated with relative ease.

Conclusions

An integrated digital approach using computer-aided design/computer-assisted manufacture technology allowed for streamlined planning and fabrication of surgical guides, provisional restorations, and definitive prostheses for a patient lacking permanent teeth. The patient will continue to be monitored and assessed in order to understand long-term outcomes of this type of treatment.

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References