EVALUATION OF ECTODERMAL DYSPLASIA

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This case series report outlines possible cranio-maxillofacial deformation consequences associated with ectodermal dysplasia (ED) and embryonic malformations, including dental agenesis. Also described are the oral aspects and rehabilitation. A total of 14 ED patients (7 males and 7 females, aged 5–45 years) underwent clinical examination before assessment and treatment. Lateral cephalometric radiography, Steiner’s analysis, and respiratory capacity tests were performed. Most of the patients had sparse or absent hair, a short face with an unusual facial concavity, a maxillary retrusion, and a relative mandible protrusion. Depending on age and orthopedic abnormalities, patients were treated with prosthodontic and orthodontic approaches or implant treatment. Therapists should take a comprehensive and multidisciplinary approach with these patients to improve their dental, masticatory, growth, and orthognathic conditions, as well as esthetic appearance.

Key Words: ectodermal dysplasia, denture, tooth agenesis, facial aspect (Kaohsiung J Med Sci 2006;22:171–6)

Ectodermal dysplasia (ED) describes a large and complex group of disorders defined by the abnormal development of two or more structures derived from the embryonic ectodermal layer. The most frequently reported manifestation of ED is hypohidrotic dysplasia, also termed Christ-Siemens-Touraine syndrome, or anhydrotic dysplasia [1,2].

ED patients exhibit the following clinical traits: hypotrichosis, hypohidrosis, and cranial abnormalities. Patients often have a disproportionately small face because of frontal bossing, and a depressed nasal bridge. The absence of sweat glands results in very smooth, dry skin and/or hyperkeratosis of hands and feet. Oral effects may manifest as anodontia, hypodontia, conical teeth, and lack of alveolar ridge development [1,3,4].

The earliest recorded case of ED was described in 1792 [1]. Since then, more than 170 different pathologic clinical conditions have been recognized and defined as ED. These disorders are considered relatively rare, reported to occur in 1 in 10,000 to 1 in 100,000 births [1–3,5].

The clinical manifestations of ED result in considerable social problems for affected individuals. Dental repair of the clinical manifestations of ED can have a profound impact on these patients, because the ability to look and feel like their peers is imperative to their psychological development. The literature shows that treatment not only improves patients’ functional and esthetic status, but also significantly increases their social confidence and self-esteem [1,6,7].

Herein, we review the cranio-maxillofacial deformities associated with ED and embryonic malformations, including dental agenesis, and describe the oral rehabilitation. In our series of healthy individuals, dental management was provided. Depending on their ages and abnormalities, periodontal therapies, caries management, and prosthodontic or orthodontic treatment were assessed.
Implantations and orthognathic surgery were restricted to adult patients.

**Patients and Methods**

**Patients**

This retrospective study was carried out on 14 patients (7 males and 7 females, aged 5–45 years) with a diagnosis of ED.

**Assessment**

All major characteristics of ED, such as sparse hair (trichodysplasia), smooth skin (hypohidrosis), maxillofacial defect, abnormal fingernails and toenails, skull and facial abnormalities, and the pedigree of the patients, were recorded. The characteristics noted from our patients included: abnormally sparse or no hair (11 cases, 78%), hypohidrosis from moderate to severe (12 cases, 85%), abnormal fingernails and toenails (11 cases, 78%), protuberant lips (13 cases, 92%), fever history (11 cases, 78%), asthma and difficulty breathing (6 cases, 42%), peeling skin (13 cases, 92%), loss of hearing from moderate to severe (8 cases, 57%), and parents genetically related to each other (8 cases, 57%).

Each patient had a thorough clinical examination, including skull, face, hair, teeth, nails, skin, lungs, sweat glands, and other physical features (Tables 1 and 2) (Figure 5). One patient had a tooth with malformed external root resorption (Figure 6).

**Analyses**

Steiner analysis was used to determine abnormalities; results of the maxillofacial cephalometric analyses are summarized in Table 2.

**Results and Discussion**

ED is a rare inherited multisystem disorder. Surveys of the patients’ family and medical history showed that the parents of some of our patients were related, and some symptoms of ED were seen in the parents, confirming the hereditary nature of the disease.

Diagnosis of ED is difficult. Identification of the precise type of ED requires the cooperation of the patient and consultation with specialists [8,9].

Steiner analyses revealed a facial height reduction and concavity in seven of the patients (Patients 3–6, 9, 10, 11), compared with normal values for Turkish people [10–12]. Additional results found were maxillary reduction, labial retraction, chin prominence, and naso-labial and chin reinforcement. In agreement with earlier research, we consider that length measurements may be unreliable, because they may vary according to the extent of tooth agenesis and the severity of ED [13].

In agreement with an earlier study [14], sagittal maxillary retraction and decreased vertical dento-alveolar height in the present study was related to severe hypodontia (Table 2). Maxillary retraction, mandible protrusion, and skeletal class III were found in most of our cases (6 cases; according...
Evaluation of ectodermal dysplasia

Figure 1. Patient 3. Anterior facial height significantly reduced, caused by the collapse of the distance from the anterior nasal spine to the chin. The presence of a prognathic mandible also contributes to the mild or severe facial profile concavity. Ectodermal dysplasia presents with an abnormal bulging forehead with high-implanted, brittle hair.

<p>| Table 2. Summary of the results of Steiner cephalometric analyses performed on affected patients |
|---------------------------------|-----------------|-------|-------|-------|-------|-------|-------|</p>
<table>
<thead>
<tr>
<th><strong>Cephalometric parameters and angles</strong></th>
<th>Normal value ± range</th>
<th>Patient 3</th>
<th>Patient 5</th>
<th>Patient 6</th>
<th>Patient 9</th>
<th>Patient 10</th>
<th>Patient 12</th>
</tr>
</thead>
<tbody>
<tr>
<td>SNA angle (degrees)</td>
<td>81.0 ± 3.5</td>
<td>78.5</td>
<td>72</td>
<td>73.5</td>
<td>73.5</td>
<td>77</td>
<td>76.5</td>
</tr>
<tr>
<td>Skeletal class</td>
<td>I</td>
<td>III</td>
<td>III</td>
<td>III</td>
<td>III</td>
<td>III</td>
<td>III</td>
</tr>
<tr>
<td>SNB angle (degrees)</td>
<td>78.0 ± 3.5</td>
<td>77.5</td>
<td>87</td>
<td>72</td>
<td>77.5</td>
<td>80.5</td>
<td>78.5</td>
</tr>
<tr>
<td>ANB angle (degrees)</td>
<td>3 ± 2</td>
<td>+1</td>
<td>−15</td>
<td>1.5</td>
<td>−4</td>
<td>−3.5</td>
<td>−2</td>
</tr>
<tr>
<td>SND angle (degrees)</td>
<td>74 ± 3.5</td>
<td>78</td>
<td>89</td>
<td>73</td>
<td>78</td>
<td>83</td>
<td>81.5</td>
</tr>
<tr>
<td>SN/GoGn (Sella-Nasion/Gonion-Gnasion) angle (degrees)</td>
<td>31.5 ± 5</td>
<td>28.5</td>
<td>19.5</td>
<td>31.5</td>
<td>28.5</td>
<td>19.5</td>
<td>26</td>
</tr>
<tr>
<td>NSGn angle (degrees)</td>
<td>69 ± 3.5</td>
<td>64</td>
<td>53</td>
<td>68</td>
<td>68</td>
<td>60.5</td>
<td>61.5</td>
</tr>
<tr>
<td>Upper lip/lower lip/S line (mm)</td>
<td>−0.5 ± 1.5</td>
<td>−2.5</td>
<td>−3.5</td>
<td>−3.5</td>
<td>−8</td>
<td>−6</td>
<td>−9</td>
</tr>
<tr>
<td>Lower lip/S line (mm)</td>
<td>0.0 ± 2.0</td>
<td>−4</td>
<td>−3.5</td>
<td>−3</td>
<td>−6</td>
<td>−4</td>
<td>−7</td>
</tr>
<tr>
<td>Pg-NB (mm)</td>
<td>2.0 ± 1.5</td>
<td>5</td>
<td>8</td>
<td>7.5</td>
<td>10</td>
<td>12</td>
<td>11.5</td>
</tr>
<tr>
<td>SGn:NMe (%)</td>
<td>68</td>
<td>67.9</td>
<td>71.2</td>
<td>66.6</td>
<td>68.5</td>
<td>76.4</td>
<td>70.6</td>
</tr>
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</table>

SNA angle, a measure of the anteroposterior relationship of the maxillary basal arch on the anterior cranial base; it shows the degree of maxillary prognathism. SNB angle, a measure of the anterior limit of the mandibular basal arch in relation to the anterior cranial base.

Tooth support problems and bone deformation have occurred because of the distorted resorption-apposition process [9]. As a consequence, dental agenesis could curb bone growth, as shown in the cases presently described.

In our cases, severe dental agenesis, characterized by maxillary abnormalities (specifically, maxillary hypotrophy, maxillary retrusion, and a relatively forward-upward displacement of the mandible), was shown by panoramic radiography and Steiner cephalometric analysis (Figure 5).

All of the jaws were retrusive according to the cranial base measurement of the Sella-Nasion line; however, retrusion was more prominent in the maxilla. As a result of retrusion of the maxilla and mandible, the soft tissues also showed retrusion. Skeletal class III patients usually show high angles and large gonial angles on the mandible; however, our patients showed low angles because of missing teeth.

ED patients typically have affected hair, teeth, nails, and/or skin (Figures 1–6). ED is primarily characterized by partial or complete absence of certain sweat glands (eccrine glands), causing anhydrosis or hypohidrosis (all our patients), heat intolerance, and fever; hypotrichosis (Patients 1–7, 11–14) (Figure 1), and hypodontia (all our patients) (Figures 1, 2, 5 and 6). Notably, Patient 3 had one tooth with malformed external root resorption (Figure 6); there are no similar reports in the literature.
Many individuals with ED also have characteristic facial abnormalities, including a prominent forehead, a sunken nasal bridge ("saddle nose"), unusually thick lips, and/or a reinforced chin. The skin on patients' bodies may be abnormally thin, dry, and soft with hypopigmentation (in Patients 3, 5, 6, 11) (Figure 1). However, the periorbital skin may be hyperpigmented (in Patients 1, 5, 6, 10, 11, 14) and finely wrinkled, appearing prematurely aged (Table 1). This study concurs with earlier research [1,2,4,7–9,13,15–17].

Fourteen patients in this study had hypodontia. Five patients had fewer than 10 teeth, and nine patients had more than 10 teeth (Table 1). Till and Marques [16] reported that approximately 25% of ED patients present with anodontia, whereas 75% present with oligodontia (Figure 5).

In many of our cases, affected infants and children also exhibit hypoplasia or aplasia of mucous glands within the respiratory tracts and, in some cases, decreased lung capacity and function, with the potential for increased susceptibility to certain infections and/or allergic conditions. Many
affected patients experience recurrent attacks of wheezing and breathlessness (asthma), and respiratory infections (Table 1).

Although ED can be inherited by autosomal dominant, autosomal recessive, or X-linked genetic transmission [1–3], the usual mode of inheritance is as an X-linked trait; in such cases, the disorder is fully expressed in males only. However, female heterozygotes may exhibit some of the symptoms and findings associated with the disorder. These may include absence and/or malformation of certain teeth, sparse hair, and/or reduced sweating. In autosomal recessive cases, the disorder is fully expressed in both males and females [15,18]. The ED in all of our cases was fully and equally expressed in both males and females; there was no gender differentiation.

Recent advances in molecular and biochemical methods have enabled the classification of the genes causing ED into four major functional subgroups: cell–cell communication and signaling, adhesion, transcription regulation, and development [2,3]. Despite the great number of ED cases described so far, fewer than 30 have been explained at the molecular level with identification of the causative gene. These findings provide clinicians with the opportunity to redefine ED, not simply as a result of general abnormal ectodermal development but, more precisely, as systemic pathologic conditions. However, these methods are not readily available for a routine clinical diagnosis of ED.

Our study participants were commonly young. They were usually referred to a specialist pediatrician, prosthodontist, orthodontist, pedodontist, and caries manager, as part of a multidisciplinary treatment approach. Older people with oligodontia in most cases received final prosthetic rehabilitation treatment (Patients 8–14) and felt no further need to see specialized dentists. Furthermore, in older people, it may be more difficult to determine whether a tooth is congenitally missing or has been lost, and whether the patient suffers from oligodontia or sequelae of caries or periodontitis.

In most children, all permanent teeth are visible on radiographic examinations at the age of 5 years. Because late mineralization of teeth is associated with oligodontia, it is possible that the number of missing teeth is overestimated in studies. The mean delay in tooth mineralization may increase with the number of missing teeth noted on the radiograph. However, many of our young participants were diagnosed on the basis of agenesis in the deciduous and permanent dentition.

The high prevalence of ED found in the present study was confirmed because many of the study participants had an agenesis of eight teeth or more. The signs and symptoms of dry skin, asthma, and eczema had to be extensive to be recorded. Even so, the prevalence of dry and scaly skin was high (all patients except Patient 8) (Figures 1, 3 and 4).

The linings of the nose, larynx, trachea, and lungs are moistened by various glands, some of which may be defective in ED [19]. The prevalence of asthma and difficulty in breathing (Patients 1, 3, 5, 11, 14) was also higher in our patients, although not significantly so.

In most of our ED patients (all except Patients 8 and 10), hair was sparse, dry, thin, and light colored. Odontodysplasia consisting of partial anodontia, microdontia, and enamel hypoplasia was noted in our patients. All of the patients have had dental caries.

Nails showed dysplasia, with slow growth, transverse ridges, pitting, and varying degrees of concavity (in Patients 1–3, 5, and 10–14). Hypohidrosis was clinically significant, and most patients had a history of recurrent fevers (all except Patient 10).

All patients were referred for oral management, including restoration of missing teeth, establishment of normal vertical dimensions, and provision of support for the facial soft tissues.

Conventional prosthodontic treatment (complete dentures, overdentures, or a combination of fixed and removable partial dentures) is fraught with problems because of the anatomic abnormalities of existing teeth and alveolar ridges (Figure 5). Conically shaped teeth and “knife edge” alveolar ridges result in poor retention and instability of prostheses [4,16]. There is usually a need to remake dentures in young patients as they grow, so we prefer to perform
implants only when growth has been completed (Patient 14) according to the dental and skeletal maturity, not chronologic age. Practitioners and the parents of young children must be aware of the possible consequences of dental loss and the necessity for conserving the existing dentition.

Excellent oral hygiene is also crucial to the successful treatment of these patients. Patients with ED should use topical fluoride daily for prophylaxis against the high risk of caries due to dry mouth. Our dental management provided these patients with prophylactic and esthetic support, and, consequently, avoided the social problems that are frequently associated with partial or full dentures, particularly in young people.

In conclusion, when confronted with multiple dental agenesis, the clinician should look for associated signs of ED. Practitioners must conduct a comprehensive and multidisciplinary approach to these patients for optimal esthetics and function, to allow them to develop normal dentition, mastication, growth, and orthognathic conditions, physically, emotionally, and socially, like other healthy individuals. Researchers should be providing information that will increase knowledge about ED and improve treatment and care of ED patients.

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