Use of mini dental implants in ectodermal dysplasia children: follow-up of three cases

Introduction

Ectodermal dysplasia (ED) is a hereditary condition affecting one in a hundred thousand live births. ED is a hereditary genodermatosis characterised by a congenital defect of two ectodermal structures or more [Singer et al., 2012]. The most common form of ED is X-linked anhidrotic ectodermal dysplasia (AED), also known as the Christ-Siemens-Touraine Syndrome, involving a mutation in the AED gene [Kere et al., 1996; Freire-Maia et al., 2001].

The impact on primary and permanent teeth is reflected by dental malformations and anomalies of number and shape [Artopoulou et al., 2009]. The literature describes a multitude of treatments which enable a prosthetic, functional, aesthetic and psychosocial rehabilitation of young patients with ED [Artopoulou et al., 2009; Singer et al., 2012]. Expert opinion concerning the traditional removable prosthesis is unanimous [Artopoulou et al., 2009; Heuberer et al., 2012; Mishra et al., 2013]. In fact, the oral rehabilitation of patients with partial or total prosthesis supported by the mucous membranes or the teeth (overdenture) is the most common and least expensive treatment modality [Heuberer et al., 2012; Yap and Klineberg, 2009]. However, a general discontent is observed among children wearing prosthesis resulting in a lack of compliance with the use of the appliance [Heuberer et al., 2012]. In addition, a rise of carious lesions, periodontal complications and an increased rate of alveolar resorption have been observed. Still, the removable prosthesis remains an important step preceding the placement of dental implants [Artopoulou et al., 2009; Mishra et al., 2013]. The recent introduction of implants that support prostheses is better tolerated, and hence, more adapted [Güler et al., 2005; Artopoulou et al., 2009; Yap and Klineberg 2009; Bulut et al., 2010; Singer et al., 2012; Amichia et al., 2010; Heuberer et al., 2012; Mishra et al., 2013].

The ideal time and location of implant placement in young patients has fuelled significant research [Mishra et al., 2013] mainly due to the influence of craniofacial growth on the implant’s behaviour [Singer et al., 2012]. Despite this, the literature still does not offer a consensus regarding the ideal time for implant placement. However, the majority of the authors agree that the anterior part of the mandible is the ideal site of implant placement since the transverse growth is stable starting the age of six [Singer et al., 2012]. The use of mini-implants for the prosthetic rehabilitation of growing children has been described by Güler [2005] and recently by Giannetti [2010]. In this paper, we present three cases of oral rehabilitation with mini-implants in patients with ectodermal dysplasia between the ages of 11 and 12.

Case reports

First case
A 6-year-old boy, suffering from AED, on clinical...
examination presented with only tooth 11 with a conical peg-like crown on clinical examination (Fig. 1). The radiographic exam showed three tooth germs in a nearly horizontal position with a conical crown in the anterior region of the maxilla which resembled teeth 12, 21 and 23. In the mandible, only the germs of teeth 37 and 47 are present (Fig. 2). At this point, a coronoplasty of tooth 11 using a celluloid cap and a removable prosthesis were performed to meet the aesthetic and functional requirements (Fig. 3).

At the age of eight, the upper prosthesis becomes unstable, and clinical examination shows the beginning of eruption of 21 in an oblique position (Fig. 4). A treatment plan is established with initial surgical release of the three teeth with apical repositioning flap and by release of the prosthesis next to the surgical site.

Six months later, the three teeth straighten their axes of eruption, and then a coronoplasty using celluloid caps is performed (Fig. 5).

At the age of 11, after discussion with the child and his parents, it was decided to insert two mini-implants (MDI, 3M ESPE, N.C. Ardmore USA) (Collared Standard Ball) 1.8 x 13 mm in the right side and 2.1 mm x 13 mm in the left side of the anterior region of the mandible. A new prosthesis using two housings on the implants (MDI, 3M ESPE, N.C. Ardmore, USA. Metal Housing MH3) was fabricated, which solved the problem of instability of the previous prosthesis (Fig. 6, 7, 8, 9).
Second case

A 10-year-old boy, suffering from a mild form of ectodermal dysplasia (ED), presented with agenesis of all permanent teeth except teeth 34, 37 and 47. We used a removable partial denture in the maxilla and a lingual arch to support two artificial teeth (replacing the missing lateral incisors) in the mandible, in order to meet the aesthetic and functional needs (Fig. 10, 11).

At the age of 12, two mini-implants 13 mm in length (MDI, 3M ESPE, N.C. Ardmore, USA) (Collared Standard Ball) were inserted in the mandible to replace the lateral incisors: a 1.8 x 13 mm in the site of tooth 42, and a 2.4 x 13 mm in the site of tooth 32 (Fig. 12).

At the age of 14, four mini-implants were inserted in the alveolar bone to replace the upper four incisors (MDI, 3M ESPE, N.C. Ardmore, USA) (Collared Square Head, 2.4 x 13 mm) (Fig. 13).

At the age of 16, four years after the insertion of the lower implants, and two years after the insertion of the upper implants, the aesthetic and functional results were very satisfactory. At this stage, ceramic
crowns for a better aesthetic appearance were used to replace the upper composite restorations. In the mandible, ceramic restorations were postponed pending the status of teeth 31 and 41, which showed a slight mobility (Fig. 14).

**Third case**

An 8-year-old boy suffering from a mild form of ED had agenesis of all permanent teeth except 14, 12 and 21. Its temporary dentition was complete, and teeth 51, 52, 61, 62, 71, and 81 had been lost after normal root resorption. We replaced the missing 11 and 22 using a fixed appliance followed by a coronoplasty of 12 and 21 (Fig. 15). At the age of 12, the upper prosthesis was replaced with two mini-implants (MDI, 3M ESPE, N.C. Ardmore USA) (Collared Square

**FIG. 14 A**
Clinical aspect of the prosthetic restorations.

**FIG. 14 B, 14 C** After 2 years ceramic caps top the implants. The root of 63 shows advanced resorption.

**FIG. 14 D** After 4 years X-ray shows the integration of the mini-implants.

**FIG. 15** The maxillary prosthetic restoration 4 years later. The panoramic X-ray at the age of 12 shows only 3 permanent teeth (14, 12, and 21). The axial sections of the upper and lower cone beam CT shows thickness of 3 to 4 mm and 2 to 3 mm at the level of the alveolar process.

**FIG. 16 A, B** X-ray after insertion of the mini-implants. C Retroalveolar maxilla X-ray 2 years after. D Retroalveolar X-ray of the mandibular anterior region after 1 more year, showing the metal-ceramic restoration on the two mini-implants. E At the age of 14 tooth 14 is erupting.
Head, 2.4 x 13 mm) (Fig. 16 a, 16 c). At the age of 13, two mini-implants were inserted to replace the two mandibular central incisors (MDI, 3M ESPE, N.C. Ardmore USA) (Collared Square Head, 1.8 x 13 mm) (Fig. 16 b): after one year, the composite restorations of 31 and 41 were replaced by metal-ceramic crowns (Fig. 16 d, 16 e).

Discussion

It is now accepted that the use of implants before completion of the orofacial growth is only recommended in cases of severe hypodontia and particularly in the case of anhidrotic ectodermal dysplasia syndrome (AED) [Alcan et al., 2006; Koch G et al., 1996; Percinoto et al., 2001; Bulut et al., 2010]. For some authors, it is even recommended that implant treatment is complete before the age of puberty to ensure aesthetics, as well as optimal functional and psychosocial development [Giray et al., 2003; Nunn et al., 2003]. These children generally have low oral health-related quality of life [Jokovic et al., 2002], and have been shown to suffer from psychosocial depression especially around the age of nine, as they begin to realize that their condition is quite different from that of other children [Högberget et al., 1986].

Regarding the site of implantation, most authors agree that the use of implants in the anterior mandibular site is an accepted therapeutic approach that does not interfere with the mandibular growth [Bergendal et al., 1991; Bergendal, 2001; Kargul et al., 2001; Kiray et al., 2003; Kramer et al., 2007]. A slight change in the angle of the mandibular implant may occur during rotational mandibular growth [Becktor et al., 2001], but this can easily be corrected by adjusting the prosthetic restoration [Smith et al., 1993]. In the maxilla the use of implants in the almost complete anodontic cases does not usually carry the disadvantage of infraocclusion which is seen in young normal children [Kramer et al., 2007; Sennerby et al., 1993; Guckes et al., 1997]. However, in case of infraocclusion, a new prosthesis solves the problem. In addition, it is recommended to avoid any fixed implant restoration crossing the midpalatal suture to prevent any transversal growth disturbance [Cronin and Oesterle, 1998]. Moreover, for Sweeney et al. (2005), the lack of development of the alveolar ridge may be the cause of implant failure in children with AED, but this problem is solved by the use of mini-implants with diameters ranging between 1.8 and 2.4 mm.

All therapies were discussed in advance with the parents and especially the children, because their approval and cooperation are essential for the success of the treatment [Kearns et al., 1999].

We should note that in the literature we found only one article on the use of mini-implants in children with ectodermal dysplasia [Güler et al., 2005], and only one article on the use of mini-implants in healthy children [Giannetti et al., 2010].

Among the advantages of using mini-implants in children with AED, we noted the following points.

- The diameters of mini-implants adapt perfectly to the reduced thickness of the bone crest [Choi, 2007].
- The protocol requires only a single, small surgical procedure, and insertion will be complete by the self-cutting and self-advancement of the implant [Gibney, 2001; Campello and Camara, 2002; Lerner, 2009].
- There is no need for a submerged healing period; additionally, the prosthetic restoration can be performed immediately [Choi, 2007].
- The relatively small cost compared to the prices of conventional implants makes them more accessible to a larger number of patients [English and Bohle, 2003; Christensen, 2006].

The first case closely followed the recommendations made in the literature about the use of implants in children [Bergendal et al., 1991; Bergendal, 2001; Kargul et al., 2001; Giray et al., 2003; Kramer et al., 2007]. However, by analysing the axial slices obtained with the cone beam CT, it is clear that it would have been impossible to use conventional implants without bone augmentation surgery [Davarpanah et al., 2000]. This justified the use of mini-implants (MDI, 3M ESPE, N.C. Ardmore, USA) (Collared Standard Ball, 1.8 x 13 mm).

On the other hand, the slight divergence of the axes of mini-implants is recommended to enable immediate prosthetic loading and better resistance to axial tensile forces [Shatkin et al., 2007].

Two years later, the two implants were still well integrated and retained the denture in complete function. The next step in this case was a combination of bringing closer the maxillary central incisors, and a new prosthetic rehabilitation of the maxilla.

On the other hand, in the second and third cases, we used implants of two different diameters (MDI, 3M ESPE, N.C. Ardmore, USA) (Collared Standard Ball, 1.8 and 2.4 x 10 mm) according to the thickness of the bone crest. In the maxilla, a different profile of mini-implants (macro designed, with deeper and more spaced coils) were used, as indicated in these cases (MDI, 3M ESPE, N.C. Ardmore, USA) (Collared Square Head, 2.4 x 13 mm; Collared Standard Ball, 1.8 and 2.4 x 10 mm). The prosthetic restoration can initially be performed using composite caps, allowing a one-year transitional period of adaptation to the new occlusion. Then, metal-ceramic prosthesis may be applied. In these two clinical cases, it is important to note that the existing temporary dentition, which, in fact, becomes permanent due to multiple agenesis, may be gradually lost as the child grows older (Fig. 12 c, 12 d and Fig. 16 c), or if retained may undergo rapid wear, leading to a...
collapse of the occlusion. Therefore, the use of mini-implants at this age stabilises the occlusal height until replacement of the lost teeth.

In general, after one to four years of follow-up, we noted no tendency to infraocclusion: it could be because growth of the alveolar bone is seriously impaired in these special cases [Yenisey et al., 2004]; retained temporary teeth, though they do not undergo physiological exfoliation, usually show relatively rapid wear of edges and occlusal surfaces and therefore tend to be lost.

Conclusion

The use of implants in children with ectodermal dysplasia is an approach that should be part of the armamentarium of a paediatric dentist. Its role is undeniable in enhancing aesthetics, function and psychosocial development. The contribution of the mini-implant adds more by avoiding complex bone augmentation procedures, and a reduction in the number of surgeries required for conventional implants. A longer follow-up is necessary in these cases to adjust occlusion as growth changes occur.

References