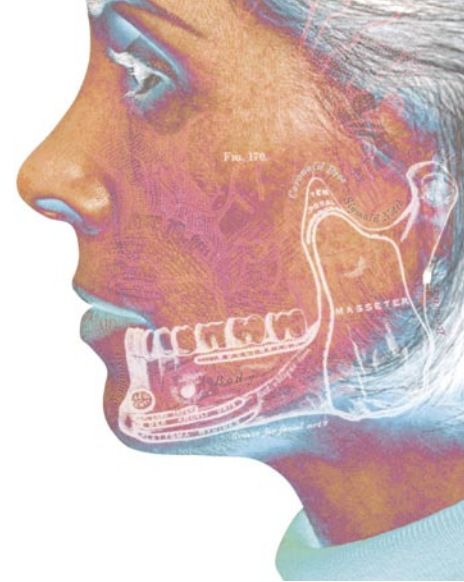


# Using Implants for the Growing Child

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## ABSTRACT

The use of implants for the growing child is not routinely recommended. The concerns about placing implants for patients in this age group are related to jaw growth. However, not all children with missing teeth need to wait for growth to be completed prior to implant placement. In this paper, the authors will discuss the indications for implant placement in the growing child. The decision for implant placement is based not only on growth, but also the number and location of the missing teeth.



In treatment planning the restoration of any edentulous space, the available options today almost always include implants. Implant-supported prostheses have had a high rate of success, as reported by Adell et al., Zarb and Symington, and as confirmed in a multicenter study by Albrektsson.<sup>1-4</sup> In edentulous patients, the 10-year survival rates of such implants were 82 percent for the maxilla and 94 percent for the mandible. Jemt et al. reported similar results for the partially edentulous patients.<sup>5</sup> In a meta-analysis of 66 papers over 10 years, Lindh et al. showed implant survival under load after six years was 93.6 percent for fixed-partial dentures and 97.5 percent for single crowns.<sup>6</sup> Implant-supported prostheses provide a number of advantages. In the partially dentate patient they eliminate the need for tooth preparation, and for the edentulous patient provide increased retention and stability for the prosthesis.



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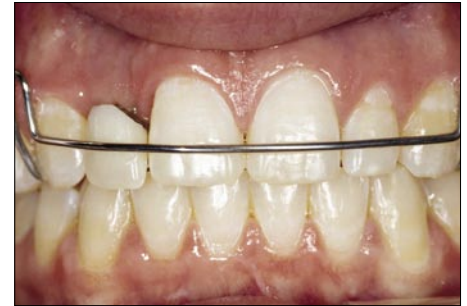
The use of implants to restore edentulous and partially edentulous patients has enabled the dentist to rehabilitate patients to a more normal masticatory function and an improved lifestyle.

There is no reason to doubt that implants will integrate when placed in the maxilla or mandible of the growing child. It is known that an integrated implant behaves like an ankylosed tooth.<sup>7</sup> The authors' concerns about placing implants in the growing child are related to jaw growth. If an implant is placed before growth is completed, will the implant still be in a position to support a restoration when growth is complete? Will the normal growth pattern of the maxilla and mandible be interfered with if an implant is placed before growth is complete? These unanswered questions have been responsible for the limited use of implants in the growing child. The purpose of this paper is to outline the indications and timing for the use of implants in the adolescent.

The basal bone of the maxilla occupies the space between the zygomatic bones laterally, the nasal structures medially, and the orbits superiorly. It forms the floor of the nose and the palate. These parts are evident in the adult edentulous patient with resorbed alveolar ridges. The maxilla in the newborn also lacks pronounced alveolar ridges. Maxillary vertical development comes with developing tooth buds and with the formation and eruption of teeth. As growth and development continue, the maxilla comes down and forward with sutural apposition and with downward and forward growth of the alveolar process with the eruption of primary and permanent teeth. The eruption path of the maxillary molars is approximately 55 degrees to the line



**Figure 1a.** Radiograph at completion of orthodontic treatment at age 15 years and 3 months.



**Figure 1b.** Same patient with a retainer maintaining space until growth is complete.

between the anterior nasal spine and the mandibular condyle.

In the absence of maxillary teeth, the alveolar ridges will not develop, and the maxilla will be underdeveloped both sagittally and vertically. In contrast, mandibular growth is not dependent on the presence of teeth. Therefore, in the presence of hypodontia or anodontia, the relationship between the two jaws will tend to be disproportionate with class III development as growth continues throughout the normal growth period.<sup>8</sup>

At the University of California, San Francisco, researchers have been conducting clinical trials using implants in children ranging in age from 6 to 18. One of the studies included an evaluation of implants placed in grafted alveolar clefts of patients with unilateral or bilateral cleft lip and palate.<sup>9</sup> A second study involved the use of implants in patients with ectodermal dysplasia.<sup>7</sup> The authors have also placed implants in children who have had maxillary or mandibular resections for tumors and subsequent reconstruction. Long-term follow up of these patients has allowed for development of a protocol for implant placement in the

growing child. The authors' objective is to discuss this protocol and provide guidelines for implant placement in the growing child.

In this paper, two studies that evaluated the effects of jaw growth on implants in the dentoalveolar region in growing pigs are cited. Odman et al. used six pigs to determine vertical dentoalveolar development in the presence of implants.<sup>10</sup> The clinical and radiographic findings demonstrated that the osseointegrated fixtures and surrounding alveolus failed to move occlusally with the adjacent dentition and bone. They concluded that implants placed in growing jaws do not change position with growth and do not improve vertical alveolar development. Thilander et al. evaluated the effect of implants on 3-D growth of the maxilla and mandible. They found that transverse growth of the mandible in the molar-premolar region of the growing pig occurred by buccal bone apposition and lingual remodeling and resorption. Therefore, they theorized that implants placed in the posterior growing mandible would be at risk for failure by progressive displacement in the alveolus. Similar bony remodeling and apposition of the

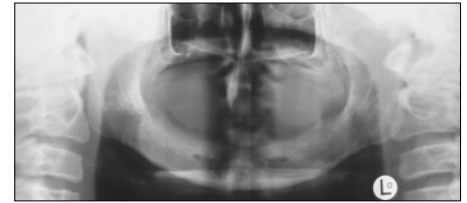


**2a.**

**Figures 2a and 2b.** Panoramic radiograph and clinical photograph of a patient with partial anodontia. Molars are present in both maxilla and mandible.



**2b.**



**Figure 3.** Panoramic radiograph of a patient with ectodermal dysplasia — only one tooth present in the anterior maxilla.

mandible anterior to the canines did not occur. Increases in maxillary width developed as a result of intermaxillary sutural growth. As in the mandible there was no evidence of buccal bone apposition or remodeling in the maxilla anterior to the canine.

Based on published data and the authors' clinical experience, they found it practical to divide the treatment of the partial or complete anodontia adolescent into three distinct groups that follow specific anatomic criteria.

■ **Group I:** Children who are congenitally missing a single tooth and have adjacent permanent teeth. (Figure 1).

■ **Group II:** Children who are missing more than a few teeth but have permanent teeth present adjacent to the edentulous sites (Figure 2). This group of patients includes those that are not included in Group I or Group III. There are many different combinations, but general guidelines will be discussed.

■ **Group III:** Children who are completely edentulous in one arch or have one or two teeth in poor positions in the arch (Figure 3).

These three groups need to be treated very differently with respect to the timing of implant placement.

## Group I

### *Children Missing a Single Permanent Tooth With Adjacent Permanent Teeth*

For patients in this group, the skeletal development is a more important consideration than chronological age. The concern here is the dentoalveolar development adjacent to the edentulous space. With growth there is downward and forward development of the alveolus in the maxilla and height increase of the alveolus in the mandible. If an implant is placed before dentoalveolar growth is complete, the implant will become submerged relative to the adjacent teeth. The implant and tooth would therefore appear apical to the adjacent teeth with a discrepancy in the free gingival margin. Not only would this be an esthetic complication, but could also result in a poor implant to crown ratio if the restoration was remade to its appropriate length. To avoid the complication of implant and dentition height discrepancies in the growing child, at UCSF, the authors recommend not placing implants until two annual cephalograms show no change in the position of the adjacent teeth

and alveolus.<sup>7</sup> Completion of dentoalveolar development/growth can be seen as early as age 16 in girls and as late as age 22 in boys (Figure 4).

## Group II

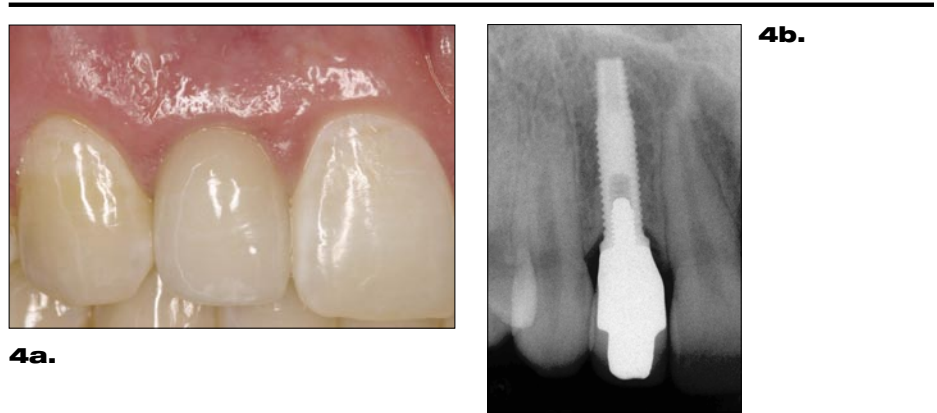
### *Children Missing More Than a Few Teeth But Have Permanent Teeth Present Adjacent to the Edentulous Sites*

Patients in this group are the most complex with regard to location and timing of implant placement. In terms of overall diagnosis they may have some form of ectodermal dysplasia or non-syndromic partial anodontia. There are many variations in the number of missing teeth and the extent and location of the edentulous spans. In planning implant placement, future dentoalveolar development and the psychological development of the patient need to be considered.

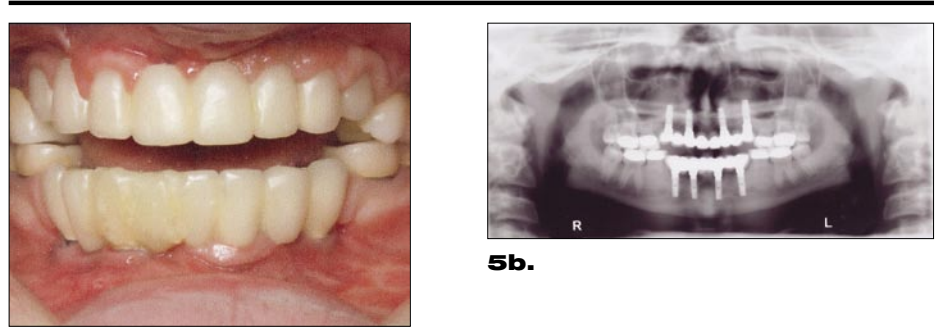
The initial objective is to orthodontically optimize the position the teeth present and to consolidate edentulous spaces. Removable prostheses are used until the entire team (including patient and family) has no objections to implant placement. The safest approach is to

wait until dentoalveolar development is complete as assessed by no change in lateral cephalograms taken one year apart. However, for some patients implants may be placed before growth is completed, in order to provide the psychological benefit of having a more functional, stable, and esthetic solution. For this group of patients, it is critical the entire team understands that when growth is completed, there will be the need for either surgical repositioning of the implant segment to a more favorable position and/or a replacement of the prosthesis.

The patient shown in **Figure 5** is a good example of what can happen when implants are placed before dentoalveolar development is complete. As posterior teeth continued to erupt, an anterior open bite developed. Once growth is complete, choices are limited. The entire anterior segment with the implants and prosthesis can be surgically repositioned with a segmental osteotomy or distraction osteogenesis. The alternative would be to remake the prosthesis utilizing pink porcelain. The pink porcelain would provide replacement for the submerged alveolus and improve the esthetic symmetry of tooth proportion and gingival position. If this child had not had implants placed before growth was completed and had a removable prosthesis, the authors believe that the treatment alternatives at this stage would be similar. The edentulous alveolus in the anterior area would be deficient and would require a large bone graft, distraction or a segmental osteotomy, followed by implant placement. If surgery was not an option and implants had to be placed, then pink porcelain or acrylic would have to be utilized for a fixed or removable implant-supported prosthesis.



**Figure 4.** A sister and brother with congenitally missing lateral incisor. Figures 4a and 4b. The sister had implant placed at age 16 years and 2 months. Figures 4c and 4d. Her brother had implant placed at age 18 years and 6 months.



**Figures 5a and 5b.** A patient with partial anodontia who had implants placed and restored before growth was complete. These photographs demonstrate submerged implants and an anterior open bite that has developed as the posterior natural teeth have continued to erupt. (Photographs courtesy of Dr. Raymond Carpenter)

### Group III

#### *The Edentulous Arch*

Patients in this group usually have a diagnosis of ectodermal dysplasia. Because teeth are not present, one does not need to be concerned about dentoalveolar growth. The only concern is the down and forward growth of the entire mandible. This can result in a jaw size discrepancy, but the implant position will not be adversely affected.<sup>9</sup>

Careful consideration must be given to the physical and psychological development of the patient when an implant placement is planned. Patients must understand the oral

hygiene requirements and must be able to perform them adequately. In the authors' experience, oral hygiene is rarely satisfactory in patients younger than 7 years old. For these reasons, the authors believe that placement of implants in patients younger than the age of 7 is not indicated.

On the basis of the studies of jaw growth, the authors avoid placement of implants posterior to the mandibular canines.<sup>10,11</sup> In the authors' study on patients with ectodermal dysplasia, implants have been successfully placed in the maxillary arch and in the mandible anterior to the mental foramen.<sup>9</sup>

The patient shown in **Figure 6** had four implants placed in the anterior

maxilla and five implants placed in the anterior mandible when he was 11 years old. A maxillary implant and tissue-supported overdenture and a mandibular fixed implant-supported prosthesis was fabricated when he was 13 years old. As seen in the serial lateral cephalograms (**Figure 7**), as the boy grew, the mandible moved forward. When growth was completed, orthognathic surgery was performed to improve the relationship of the maxilla and mandible and the prosthesis was remade (**Figure 8**). The authors believe that if he had not had the implants placed at age 11, he still would have required the orthognathic procedure. The implant position would have been the same if similar prosthesis was planned. The patient had the advantage of having the benefit of an implant-supported prosthesis during his growing years, which was significant in his social and psychological development. Having implant-supported prostheses also made the orthognathic surgery similar to a dentate patient, and the surgeon did not have the additional difficulties of working with edentulous arches.



**6a.**



**6b.**

**Figures 6a and 6b.** Completed treatment for a patient with ectodermal dysplasia — implants were placed when he was 11 years old.



**7a.**



**7b.**



**7c.**

**Figure 7.** Serial lateral cephalograms demonstrating mandibular growth. Figure 7a. Age 14 years. Figure 7b. 16 years. Figure 7c. Age 17.

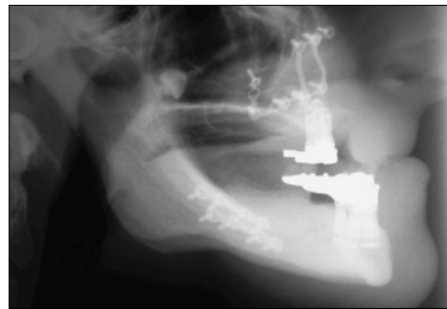
**Conclusion**

For the growing child who is missing a single tooth with adjacent natural teeth, implants should not be placed until dentoalveolar development is complete (two lateral cephalograms one year apart with no change).

For the completely edentulous growing child, implants can be planned as early as age 7. Surgery may be necessary when growth is complete to correct the jaw size discrepancy. The prosthesis may have to be remade.

For the partially edentulous growing child, the decision as to when to place implants is more complex and is dictated by the extent of the edentulous space and its proximity to natural permanent teeth. The authors' treatment approach is to first make a conventional removable prosthesis after orthodontic treatment is complete. If this provides a satisfactory result, the authors wait for growth to be completed before implant placement. If the conventional treatment is unsatisfactory, implants can be placed, but the need for surgery and/or remake of the prosthesis must be anticipated at the end of growth. ■■■■

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**8a.**



**8b.**



**8c.**



**8d.**

**Figure 8.** After orthognathic surgery at age 19 and remake of prosthesis at age 20.

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