



# DENTAL IMPLANTS IN PEDIATRIC PATIENTS – A LITERATURE REVIEW

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## Abstract:

The use of osseointegrated implants has been increasingly widespread in the adult population, but there is a certain lack in the literature on the application of this technique in children. The bone growth and development factor must be well analyzed, and the pediatric dentist must be able to suggest the use of this treatment option for oral rehabilitation, if necessary. The replacement of teeth by implants is usually restricted to patients with completed craniofacial growth. This article discusses the use of dental implants in normally growing patients, the effect of maxillary and mandibular skeletal and dental growth on the stability of those implants, bone growth and craniofacial development, the prevalence of associated psychological stress should be taken into account, in addition to the status of existing dentition and dental compliance of a pediatric patient.

**Keywords:** Children, Dental implants, Pediatric dentistry, Oligodontia, Ectodermal dysplasia, Oligodontia

**DOI Number:**10.14704/nq.2022.20.8.NQ44434

**NeuroQuantology 2022; 20(8): 4022-4029**



**Introduction:** Dental implant is defined as a prosthetic device made up of alloplastic material(s) implanted into the oral tissue under the mucosal or periosteal layer, and on or within the bone to provide retention and support for a fixed or removable prosthesis".<sup>1</sup>

Traumatic tooth loss and Congenital partial anodontia are frequently encountered in pediatric patients. In such cases, the degree of hypodontia can bring about psychological stress in the child and proper oral rehabilitation is required even before skeletal and dental maturation has occurred.<sup>2</sup>

Here, removable prosthesis is often the treatment of choice. However, it may lead to increase caries risk, residual alveolar ridge resorption, and periodontium complications.<sup>3</sup>

Dental implants for children are a new treatment modality and was discussed by many authors. There are two primary concerns:\

- i. First, if implants are present during several years of facial growth, there is a danger of them becoming embedded, relocated, or displaced as the jaw grows.
- ii. The second area of concern is the effect of prosthesis on growth changes. Design changes must be incorporated into such prosthesis to compensate for growth changes.<sup>2</sup>

Osseointegrated implants usage has been increasingly widespread in the adult population and their success depends on a surgical / prosthetic protocol followed correctly, always taking into consideration the patient's general health, adequate bone quantity, well executed surgical technique, prosthetic planning and satisfactory oral health.<sup>4</sup>

The use of implants in children and adolescents is uncommon because the dental surgeon is concerned about maxillary and mandibular "growth spurts" and patients are in the bone development stage.<sup>5</sup> In the clinical routine of the dental surgeon, one can come across situations in which osseointegrated implants could be a

great treatment option in pediatric patients.<sup>4</sup> If the implant placement protocol in adolescents is followed, properly they can be used more routinely<sup>5</sup>

Therefore, the objectives of this work are: to throw light upon the use of osseointegrated implants in pediatric patients,<sup>6</sup> adolescents and young adults to discuss its role in oral rehabilitation of children with partial or complete anodontia and also to bring out the role of dental implants in some special cases where dental implant placement might be the treatment of choice in the near future <sup>5</sup> and to facilitate the understanding of the pediatric dentist in the area of implantology so that he is able to indicate, when necessary, the use of this technique.<sup>6</sup>

**Growth consideration:** It is an important factor when planning implant placement in children and adolescents. There is no accurate indicator available to determine when growth has ceased, although a good quality method is the use of serial cephalometric radiograph taken 6 months apart with superimposed orthodontic tracings. If there are no changes occur over a period of 1 year, one may conclude that growth is complete.<sup>7</sup>

The Growth of the maxilla and mandible does not happen uniformly in one plane. It is multidirectional, occurring in sagittal, vertical, and transverse planes. It does not happen at a fixed pace, slow periods of growth are followed by phases of accelerated growth called the growth spurts. The teeth maintain their position in the arches by following this pace of growth through remodeling and drifting within the alveolar bone. Functional forces are balanced by a stable interarch occlusal relationship, which is achieved gradually within the transition from primary dentition to the permanent dentition.<sup>8</sup>

**Maxillary growth:** The growth of the maxilla occurs in two ways: by apposition (the position of the bones that articulate the maxilla to the skull) and by superficial



remodeling.<sup>4</sup>

Soft tissue growth occurs as the maxilla moves forward and downward, allowing space within the upper and posterior sutural connections to open up,

allowing new bone to grow on either side of the suture.<sup>4</sup> At puberty, sutural growth speeds up, and it is the first of the three dimensions to be completed in adolescence<sup>9</sup>

TRANSVERSE GROWTH	SAGITTAL GROWTH	VERTICAL GROWTH
<p>Early implant placement can give rise to a diastema with the adjacent teeth as transverse growth occurs, although transverse problems are not reported in implants placed in the anterior maxilla even as early as 9 years of age.<sup>10,11</sup> Moorrees <i>et al.</i> suggested that a decrease in incisor-canine circumference noted from 13 to 18 years of age was associated with a decrease in arch length.<sup>12</sup> Bishara <i>et al.</i> observed that discrepancy in arch-length increases significantly from early adolescence to mid-adulthood in both maxillary and mandibular arches.<sup>13</sup> Hence, a reduction in arch length and increased crowding during the period of maximum growth can result in an implant crown that is out of alignment with adjacent natural teeth.</p>	<p>For sagittal growth, resorption occurs at the anterior surface of maxilla that brings it downward and forward. Early placement of implants could result in a loss of labial cortical bone for the implant. Furthermore, there is a spontaneous mesial drift in the teeth in which the implants don't participate.<sup>9</sup> Hence, any implant placed in the lateral region can inhibit this drift laterally which may lead to an asymmetric arch while an implant placed in the anterior region may become more lingually positioned with time.<sup>14</sup></p>	<p>Sutural lowering allows the maxilla to grow vertically<sup>15</sup> Resorption on the nasal surface and deposition on the palatal and alveolar surfaces cause development in the orbits, as well as an increase in the size of the nasal cavity and maxillary sinuses. The face's vertical growth is the last to be completed. Vertical growth in adults is nearly complete in girls by 17–18 years, and even later in boys, and is influenced by the facial growth type (long face or short face). As a result, an implant placed too early in puberty may end up in the nasal floor after the permanent teeth have moved down.</p>

**Table 1:** Represents maxillary growth in three dimensions

**Mandibular growth:** Unlike the maxilla, the mandible's growth depends on both endochondral and periosteum activities. Because it contains hyperplasia, hypertrophy, and endochondral replacement, the cartilaginous tissue that covers the mandibular condyle in the temporomandibular joint is distinct from that of the epiphyseal disc or Synchronosis.<sup>4</sup> All other areas of the mandible are formed and grow by direct apposition to the surface and remodeling.

TRANSVERSE GROWTH	SAGITTAL GROWTH	VERTICAL GROWTH
<p>Because the symphysis closes in the first year of life,</p>	<p>The mandible, which is more closely associated with cranial</p>	<p>The mandible appears to be displaced downward and</p>



<p>transverse growth in the mandible is completed very early, and only minor change occurs after that though remodelling. Resorption minor changes occur after that thron of the bone lingually and deposition buccally occurs posteriorly, resulting in remodelling. If the implant is placed too soon, this pattern of bone growth may cause the implant to be lingually positioned<sup>16</sup></p> <p>To accommodate the permanent molars, the mandibular length is limited posterior to the primary second molars.</p>	<p>structures, grows at a different rate than the maxilla. This is more in the sagittal plane, which is in charge of transforming the child's convex facial profile into a straighter adult profile. The mandible's sagittal growth is caused by endochondral growth in the condyle, which lengthens the mandible but has no effect on its shape.<sup>16</sup></p>	<p>forward from the cranium as a result of apposition at the dentoalveolar complex and rotation of the condyle. The dentoalveolar compensatory mechanism maintains the vertical dimension. This happens when the eruption goes off without a hitch and there are no functional issues.<sup>17</sup></p>
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**Table 2:** Represents mandibular growth in three dimensions.

**Scope of Dental Implant in Pediatric Dentistry:** The popularity of implant as a treatment modality in adults is tremendous. In case of adults the amount of research done is extensive, however, the treatment planning and execution of implant placement in children and adolescents is still in its infancy.

In partially edentulous cases, long-term success of dental implants is responsible for other clinicians to broaden the use of implants to adolescents in whom teeth are missing due to injury or agenesis. Anodontia either primary or acquired occasionally creates the opportunity for the use of dental implants.<sup>15</sup>

In the absence of maxillary teeth, the maxilla remains underdeveloped both sagittally and vertically because the alveolar ridges will not develop. In contrast, the mandibular growth does not depend on the presence of teeth. Therefore, disproportionate relationship between two jaws will tend to occur in the presence of hypodontia or anodontia leading to class III

development as growth occurs throughout the normal growth period. Furthermore, physiological and psychological factors increase the pressure to start early treatment.<sup>18</sup>

According to World Health Organization –young people between the age of 10 years and 19 years are termed adolescents.<sup>9</sup> However, in adolescents the use of implants differs significantly from adults. Because a variety of changes occur in the teeth and jaws of the adolescent, special importance should be paid to the growth of the child

**Indication and Contraindication of Placing Dental Implant in Pediatric Dental Patients  
 Indication for use of Implants in adolescents**

- Pediatric patients with Ectodermal dysplasia (1988 National Institute of Health Consensus Development Conference on Dental Implants at Bethesda)<sup>19</sup>
- Children and Adolescents having



anodontia, partial anodontia, congenitally missing teeth, teeth lost as a result of trauma.<sup>7</sup>

- Implants combined with bone grafting in patients with cleft of the alveolus and palate.<sup>15</sup>

#### **Contraindication for use of Implants in adolescents**

- Prepubertal age group<sup>15</sup>
- Inadequate mesio distal space<sup>20</sup>
- Individuals with pubertal growth spurt<sup>15</sup>

**Growth Assessment:** Chronologic age is not a true indicator of growth cessation. There is a wide range of pubertal growth spurt in boys (11–17 years) and girls (9–15 years).<sup>22</sup> There is no accurate indicator as to when growth has ceased. A reliable assessment of growth is based on cephalometric radiographic examination. Serial cephalometric radiographs are taken 6 months apart, and their tracings are superimposed to ensure that no growth has taken place. Although it is the most reliable method, but it takes a lot of time and delays implant insertion.<sup>22</sup>

Another accurate way of determining skeletal age is to take a hand wrist radiograph and compare it to a standardized atlas.<sup>23</sup> Three quick indicators of growth completion are the appearance of adductor sesamoid of the thumb, capping of the epiphysis of the middle phalanx of the third finger and fusion of the epiphysis and diaphysis of the radius.<sup>24,25</sup> As the skeletal growth of the long bones is complete, facial growth too stops, or it is safe to assume that it is near completion and implants can be safely placed.<sup>22</sup>

#### **Classification Systems When Considering Implants in Growing Child<sup>26</sup>**

**Group I:** Children with one congenital missing tooth having adjacent permanent teeth

**Group II:** Children with multiple missing teeth, with permanent teeth adjacent to edentulous sites\

**Group III:** Children with ectodermal

eISSN1303-5150

dysplasia

#### **Multidisciplinary Treatment Approach:**

Several clinicians have had success with implant treatment in children after incorporating a multidisciplinary approach into their treatment plan. The child patient is seen by the pediatric dentist at a very small age and remains under his care for a long period giving sufficient time for appropriate treatment planning. Important factors to be considered when treating a child with missing tooth, apart from growth, are dentition present, residual space between the teeth present in the arch, amount of alveolar bone, and the timing of implant placement.<sup>27</sup>

**Pedodontic consideration:** Any disabilities can have an emotional impact on children, parents, and caregivers, which, when combined with caregivers' inadequate knowledge of what to do and when, can lead to misleading and incomplete information for parents and children. Therefore, pedodontist should be well versed in current knowledge and proper guidance and counselling should be given to the parents to help change the child's behaviour so that this will make it easier for the child to cope positively. In addition, emotional information should be repeated many times as psychological factors limit the message received by the recipient, for example parents and this can lead to misunderstanding and anxiety.

Children with aplasia should be identified as at risk for developing dental disease, and any symptom of caries or periodontal disease must be considered. Therefore, the International Journal of Dental Sciences should be designed for each child with aplasia, depending on the level of aplasia, the stage of mental development and the possible symptoms of dental disease. When providing dental care to children with aplasia, it is important to provide comprehensive information before intervening.

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**Orthodontic Consideration:** Orthodontists should evaluate the completion of an active growth stage, as well as body height measurements. During the initial treatment planning, the facial growth pattern should be carefully evaluated. Aplasia cases highlight potential complications during orthodontic treatment. With a decreased number of permanent teeth, the anchorage may not be as strong as usual and the forces should therefore be adjusted to the condition.

**Surgical considerations** The oral surgeon must ensure that adequate bone of sufficient quality is present at the implant sites. These patients with significant aplasia may be treated surgically using a variety of procedures, such as autotransplantation, implants, and orthognathic surgery. Autotransplantation may be utilised with a good prognosis where aplasia is mainly in one jaw and teeth from the other jaw can be used, as in individuals with asymmetrical aplasia. The position of the implants dictates the functional and aesthetically pleasing outcome of the prosthetic treatment. It is important to carefully plan the placement of the various implants in collaboration with the prosthodontist.

**Prosthodontic considerations:** When treating children and adolescents the same prosthodontic materials and methods are used as in treating adults, but therapy planning and treatment must be tailored to the young and growing patient. The prosthodontist's role in the multidisciplinary team is to be responsible for the following areas of concern:

1. Early diagnosis of final treatment
2. Appropriate abutment tooth placement
3. Considerations for aesthetic appeal
4. Prosthetic treatments on a temporary basis.

**Valle et al.**, used a multidisciplinary treatment approach to successfully treat a child with hypodontia. The paediatric dentist kept the primary second molars until the child was 17 years old, then combined them

with orthodontic treatment to create enough space for insertion of endosseous implants. External hex implants with a 4.1 mm rectangular platform were placed with immediate load after the primary teeth were extracted<sup>27</sup>

**Montanari et al.**, recommended a dental multidisciplinary team including paediatric dentist, an orthodontist, a prosthodontist, and an oral and maxillofacial surgeon. They used an implant-supported overdenture to perform oral rehabilitation in a child with hypohidrotic ED. At the age of two, the child received an upper conventional denture and a lower implant-supported overdenture. In the anterior aspect of the mandibular jaw, two tapered screw endosseous implants were placed. The mandibular implant-supported overdenture was well received by the patient, who reported excellent masticatory and aesthetic improvements after three years of follow-up.<sup>29</sup>

**Conclusion:** Dental implant insertion is a possible mode of rehabilitation in children and adolescents. Systematic treatment planning and Growth assessment accompanied with alveolar bone evaluation should be done at the initiation of treatment planning. The orthodontic treatment and surgical treatment can be initiated a year before the planned implant placement. This would utilize the time period and create a greater chance for success after the implant insertion. The technique of using implants in pediatric dentistry is basically the same procedure recommended for adult patients and the prosthetic part must be meticulously planned. The greater the physiologic harmony that can be created within the teeth, alveolar bone and growth, greater are the chances of successful implant placement in children.

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