

# Dental implants in pediatric dentistry: A Review

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## **Abstract**

*Congenital hypodontia or trauma is a frequent cause of loss of teeth in children. The absence of teeth leads to loss of function and lack of normal alveolar growth, along with unpleasant esthetics that hamper the psychosocial development of the young child. Traditionally, the management of tooth loss in the young child is done by conservative means. None of those methods of treatment are completely satisfactory and have their own drawbacks. Dental implants in a young child would be an ideal mode of treatment for the absence of teeth. One of the main deterring factors for implant placement in children is the impending growth. Growth in the maxilla and mandible does not happen uniformly in one plane. Successful implant treatment in children has been achieved by several clinicians when they incorporated a multidisciplinary approach in their treatment plan. The design and type of implant system used in pediatric patient, are responsible for successful treatment outcome. The purpose of this review is to understand the implications of implant in pediatric dentistry*

## **Introduction**

There is an large number of youngsters affected by absence or loss of teeth because of congenital hypodontia or trauma. Total anodontia is the congenital absence of all the teeth in the primary dentition and/or the permanent dentition and is a rare condition. Hypodontia or oligodontia is the absence of one or a few teeth that may manifest in several genetic and syndromic conditions, and congenitally missing teeth are commonly found in healthy individuals and will occur without the association of any developmental disorders. Apart from this trauma is a frequent cause of tooth loss in children. Loss of teeth ends up in loss of function, and lack of normal alveolar growth, in conjunction with unpleasant esthetics that hampers the psychosocial development of the young child. Traditionally, the management of single tooth loss in the young child has done by conservative means such as Maryland Bridge, resin-bonded restorations, or removable prosthesis in cases of multiple missing teeth. But these treatments are not satisfactory and have their own drawbacks<sup>1</sup>. Dental implant is a replacement treatment modality. The primary concerns of implants in young patient is danger of them becoming embedded, relocated, or displaced as the jaw grows. From a physiologic standpoint, the conservation of bone could also be the foremost important reason to be used of the implant during a growing patient. In the case of congenital partial anodontia, little alveolar bone is present and placement of implant changes the loading mechanism on bone and retards its resorption. So, these advantages must be weighed against the lack of long-term in vivo evidence-based studies supporting the use of dental implants in a child<sup>2</sup>

## **History**

Professor Per-Ingvar Branemark (1952) working within the laboratory of the vital microscopy, University of Goteberg, Sweden, accidentally discovered that the titanium bonded well with bone; a phenomenon which was later termed as osseointegration<sup>3</sup>. Branemark defined it "as a direct contact between the bone and metallic implants, without interposed soft tissues layers" (1969). In the 1970s, there were no methods available to section intact bone to metal specimens<sup>4</sup>. Therefore, the histologic evidence of osseointegration remained indirect. The

first investigator to clearly demonstrate osseointegration was Schroeder from Switzerland by using new techniques to section bone-implant specimens. They termed this union as a functional ankylosis. Adell et al. in 1981<sup>5</sup> reported a success rate of 80-100 percent after a fifteen-year study of osseointegrated implants in the treatment of edentulous jaws.

### Classification of Implants

1) Depending on the placement with the tissue

- ❖ Epiosteal implants
- ❖ Transosteal implants
- ❖ Endosteal implants

2) Depending on the material used

- ❖ Metallic Implants (titanium, titanium alloy, cobalt chromium molybdenum alloy)
- ❖ Non-Metallic Implants (Ceramics, Carbon)

3) Depending on their reaction with bone

- ❖ Bio active (hydroxyapatite)
- ❖ Bio inert implants

4) Depending on the treatment options

Mish in 1988 reported five prosthetic options of implants. Of the five, the first three are fixed prosthesis that may be partial or complete replacements, which in turn may be cemented or screw-retained. The remaining two are removable prosthesis that are classified based on the support derived.<sup>6</sup>

### Growth of the maxilla

The growth of the maxilla occurs in two ways: by apposition and by superficial remodeling<sup>7</sup>. The growth pattern of the face requires it to grow "independently under the skull", which means that the maxilla needs to move by growth, a considerable distance down and forward in relation to the skull and the cranial base. The soft tissue growth occurs by taking the maxilla forward and downward, opening space within the upper and posterior sutural connection, and therefore the new bone is added on both sides of the suture. The sutures remain the same thickness, and the various processes of the maxilla are longer, and then the bones that articulate with the maxilla also become wider. Although the maxilla grows forward and downward, its frontal surface is remodeled and the bone removed from most of the anterior surface. It is notable because the largest portion of the anterior surface of the maxilla is in resorption area, not in the apposition area. The total change in growth is the result of the translation of the maxilla forwards and downwards and simultaneous surface remodeling.<sup>8</sup> In 1993, Enlow described the jaw as a platform on wheels, moving forward, while, at the same time, its surface is being reduced on the anterior side and built later, moving in space opposite the direction of total growth. Bjork et al in 1997 and Wilcox in 2003, stated that the direction of maxillary growth is highly variable. During this period of dentition, passive growth is extremely important. After the age of seven, one-third of the estimated passive growth is completed. By enlarging itself the other two-thirds of the maxilla occurs, which must be carefully observed. As the growth direction is variable, transverse maxillary skeletal changes, vertical skeletal changes, transverse maxillary dental changes, anteroposterior maxillary dental changes can occur<sup>9</sup>. Care must be taken when choosing to position implants within the maxilla of patients in growing period. According to Andreasen (1993), the implants placed within the jaws in growth do not erupt like natural teeth. They behave like ankylosing teeth, resulting in infra-occlusion. Malmgrem et al. (1993) stated that the greater the residual growth, the greater the infra-occlusion of the crowns on the implants.

### **Growth of the mandible**

In contrast to the maxilla, both endochondral and periosteum activities are important within the growth of the mandible. Cartilaginous tissue which covering the condyle of the mandible in the temporomandibular joint is not the same as that of the epiphyseal disc or synchondrosis, as it contains hyperplasia, hypertrophy, and endochondral replacement. All other areas of the mandible are formed and grow by direct apposition to the surface and remodeling<sup>7</sup>. The length of the mandible increases almost exclusively due to posterosuperior growth of the condyle and posterior growth of the branch the increased prominence of the chin is the result of reabsorption of the labial cortex above it. According to Cieluck (1999), to allow the molars to erupt, the body of the mandible increases in length, by resorption in the anterior portion of the branch and apposition in the posterior one. The height of the branch increases from 1 to 2mm per annum. Due to the “V” shaped growth model (Enlow, 1993), there is an increase in the posterior width of the mandible, as a result, the anterior mandibular width stabilizes relatively early and only increases weakly, due to appositional growth. In childhood, the branch is located approximately where the first deciduous molar will erupt. The progressive posterior remodeling creates a space for the deciduous second molar, and then for the sequential eruption of the permanent molars. More frequently, this growth ceases before sufficient space is obtained for the eruption of third molars, which become impacted on branch<sup>10</sup>. The absence of a complicated suture as it takes place in the maxilla, is the success of implant placement in the mandible<sup>11</sup>. As transverse growth in the region of the lower incisors and canines ceases early, mandibular anterior implants have better prognosis in young patients than those placed in other areas of the mandible.

### **Multidisciplinary approach**

Successful implant treatment in children has been achieved by several clinicians once they incorporated a multidisciplinary approach in their treatment plan. The dentition present in the patient, residual space between the teeth present in the arch, amount of alveolar bone, and the timing of implant placement are the important factors to be considered when treating a child with a missing tooth, apart from growth.<sup>12</sup> Preservation of primary teeth till their root resorption, prevention of caries, or endodontic treatment to prevent any periapical pathology and subsequent bone loss is important for later implant placement. It prevents the loss of arch length and maintains the alveolar bone height. The pediatric dentist should be capable of managing the primary dentition to create a healthy oral cavity for a future implant. Montanari et al<sup>13</sup>, advocated a dental multidisciplinary team that includes a pediatric dentist, an orthodontist, a prosthodontist, and an oral and maxillofacial surgeon for a successful outcome in implant placement in children. They carried out oral rehabilitation in a child with hypohidrotic ED with an implant-supported overdenture. Conventional dentures were made for the child at the age of 2 years. At the age of 11 years and 11 months, an upper conventional denture and a lower implant-supported overdenture were made. Two tapered screw endosseous implants were placed in the anterior aspect of the mandibular jaw. After a healing period of 2 months, the implants were exposed, and two ball-attachments were connected to the implants to avoid a rigid connection. This was done to allow normal mandibular growth and to reduce interference with the patient's growth. The prosthesis was connected with implants using the two ball-attachments. After 3 years of follow-up, the mandibular implant-supported overdenture was well accepted by the patient who reported excellent masticatory and esthetic improvements. Bone augmentation procedures are required if the loss of alveolar bone occurs in conditions like trauma, congenitally missing teeth, or severely malposed teeth. Computed tomography (CT) or cone beam CT should be carried out for alveolar bone assessment.<sup>14</sup>

### **Growth Assessment**

Chronologic age isn't a real indicator of growth cessation. There is a wide range of pubertal growth spurt in boys (11–17 years) and girls (9–15 years). There is no accurate indicator as to when growth has ceased. Assessment of growth is predicated on cephalometric radiographic examination. Serial cephalometric radiographs are taken 6 months apart, and their tracings are superimposed to make sure that no growth has taken place. Although it is the most reliable method, it takes a lot of time and delays implant insertion. Another accurate way of determining skeletal age is to require a hand-wrist radiograph and compare it to a

consistent atlas. 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. As the skeletal growth of the long bones is complete, facial growth stops, or it is safe to assume that it is near completion and implants can be safely placed.<sup>1</sup>

### **Recommendation for implant placement**

Implant placement by quadrant, Maxillary anterior quadrant is an important area for consideration due to traumatic tooth loss and frequent congenital tooth absence.<sup>15</sup> Vertical and anteroposterior growth changes in this area are substantial. The vertical growth of the maxilla exceeds all other dimensions of the expansion in the quadrant; therefore premature implant placement may end up in the repetitive need to lengthen the transmucosal implant connection which leads to poor implant-to-prosthesis ratios and the potential to load magnification.<sup>16</sup> According to Krant,<sup>17</sup> the placement of implants in the anterior maxillary quadrant before the age of 15 in female patients and age of 17 in male patients should be attempted to do unique treatment planning goals and with particular emphasis on the determination of skeletal age, informed consent, and also the possibility of future implant replacement. The maxillary posterior quadrant is subject to the same general growth factors described for the maxillary anteroposterior area. An additional growth factor is transverse maxillary growth at midpalatal suture, which produces rotational growth that anteriorizes the position of the maxillary molars. Placement of osseointegrated dental implants within the maxillary posterior quadrant is best delayed until the age of 15 years in females and 17 years in males.<sup>16</sup> Mandibular anterior quadrant is the best location for the osseointegrated implant before skeletal maturation. The mandibular anterior quadrant presents fewer growth variables. The closure of the mandibular symphyseal suture occurs during the first 2 years of life. Prosthesis supported by dental implants within the anterior mandible should be of a retrievable design to permit for a mean increase of dental height of 5–6 mm, also as the anteroposterior growth. Mandibular posterior quadrant the dynamic growth and development of the posterior mandible within the transverse and anteroposterior dimensions including its rotational growth present multiple treatment concerns. Placement of osseointegrated implants in the posterior mandibular quadrant is best delayed until skeletal maturation occurs.<sup>16</sup>

### **Conclusion**

Dental implant insertion may be a possible mode of rehabilitation in children and adolescents. Published reports on the use of dental implants in young patients are as yet very limited; long-term clinical studies are necessary for sound conclusions. If the goals of treatment planning favors implant use before skeletal maturation, parents of the child needs to be informed about the benefits and possible complications of its use. Growth assessment accompanied by alveolar bone evaluation should be done at the initiation of treatment planning., the treatment can only be justified when the anticipated positive effects are greater than the drawbacks of the procedure. We have a greater responsibility of follow-up and monitoring the outcomes.

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