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CURRENT OPINION

Pediatric Implants - A Clinical Dilemma

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ABSTRACT

There are many diseases such as ectodermal dysplasia or oligodontia that lead to complete or partial anodontia in small children. Traumatic injuries commonly result in loss of one or more teeth in children . Such cases are usually rehabilitated by removable prosthesis which have to be refabricated from time to time to incorporate changes due to growth. Thus, it would be desirable to restore the dentition by means of implants in growing children. For this purpose it is important for a clinician to understand the amount and direction of the impending growth in a young child and how it is going to influence the ultimate position of the placed implant in the arch. This review paper focuses on the dilemma of when and where it could be possible to place implants for the growing child.

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INTRODUCTION

Traumatic injuries and disease conditions such as ectodermal dysplasias, congenital absence of teeth, or oligodontia can lead to edentulous conditions in children. This can be a source of immense psychological trauma to the child as well as affect the orofacial development. Generally the only form of rehabilitation of these teeth is by removable prosthesis as growth restricts the use of any fixed appliances. Considering from a child's perspective a removable prosthesis is not a very desirable option as it is dependent on the patient's compliance. Also, it is difficult to maintain, leads to increased rate of decay, gingival diseases and bone resorption associated with the prosthesis. Along with this there is the need to re-fabricate a new prosthesis from time to time to compensate for craniofacial growth. To overcome these drawbacks it would be desirable to restore the dentition of these children by means of implants rather than removable prosthesis.

The most crucial aspect to be considered in implant placement in children is the effect of growth. As they are rigid fixations, any incorrect placement can have serious consequences on the growth and development of the arches, trauma to the developing tooth buds or a deviation of the path of an erupting tooth. Therefore, it is important that clinicians understand the impact of growth and the potential risks involved in implant placement in a growing child.

MAXILLARY GROWTH

Maxillary growth occurs as a result of sutural growth as well as by its passive displacement. During the primary dentition stage, passive displacement is the major contributor to its growth as the maxilla is carried downward and forward along the cranial base. After seven years of age, two thirds of maxillary growth occurs by enlargement of the maxilla itself (1).

During early childhood, the transverse growth of the maxilla is influenced by the increasing width of the cranial base and growth at the median suture. This sutural growth accelerates at puberty and is the earliest of the three dimensions to be completed in adolescence (1).

Vertical growth of the maxilla occurs by sutural lowering of the maxilla and appo-

sition on the tooth-borne surfaces of the maxillary alveolus. There is resorption on the nasal floor and deposition on the palatal and alveolar surfaces as the alveolus increases in height (2).

MANDIBULAR GROWTH

The mandible rolls forward with apposition below the symphysis and resorption below the gonial angle (3). Thus, during growth, the face and the mandible tend to rotate with the center of rotation influenced by the direction of condylar growth. This rotation affects the direction of eruption and final position of the teeth. As the mandible increases in length it also increases in posterior width because of its 'V' shape. Mandibular anterior width stabilizes relatively early and increases only slightly by appositional growth, whereas mandibular posterior width increases with the increasing length of the mandibular body(1).

FACTORS LIMITING IMPLANT PLACEMENT IN A GROWING CHILD

Vertical Craniofacial Growth

Placement of implant is influenced by the great amount of growth in the vertical direction along with the eruption of maxillary teeth. If an implant is placed too early (before growth and eruption are complete), the implant crown will become submerged. Experimental studies in growing pigs showed that implants behave like ankylosed teeth and remain at the same location, in spite of constant remodeling of surrounding bone as the adjacent teeth erupt (4-6).

Increase in anterior facial height due to vertical growth of the craniofacial skeleton is especially rapid during the early teenage years (7). Brugnolo et al described 3 patients (11.5–13 years of age) who received implants in the anterior regions of the maxilla. After 2.5 to 4.5 years, all patients had implant crowns in infraocclusion (8). Thilander et al reported that, when implants were placed in adolescents (at ages 13.2–19.3years), most of the implant crowns were found in infraocclusion (9). Patients with an increase of anterior face height and/or posterior rotation of the mandible present a higher risk for implant infraposition when implants are placed in the anterior maxilla (10).

Growth continues in the young adults also. Ödman showed that implants placed in young patients may show implant infraposition after several years due to craniofacial growth, which may continue in the young adult patient (11, 12, 13).

Transverse Craniofacial Growth

Moorrees et al (14) suggested that a decrease of incisor-canine circumference noted from 13-18 years of age was associated with a decrease in arch length, rather than a narrowing in arch width. Similar observations were made by Dekock who quantified the average reduction to be 10% (15).

In a long term study done by Marcus et al it was observed that in a 30 year period from approximately 17 to 47 years of age, maxillary and mandibular arch width and depth decreased nearly universally as did arch length. Overall, the changes are those that would contribute to crowding in the dental arches (16).

Bishara et al (17) observed that tooth size arch length discrepancy increases significantly from early adolescence to mid adulthood in both maxillary and mandibular arches. The decrease was calculated to be 1.9 mm in males and 2.0mm in females in the maxillary arch, 2.7 and 3.5mm in the mandibular arch respectively.

Increased crowding and changes in arch form could have a significant effect on a single-tooth implant in a patient who undergoes maximum growth changes, resulting in an implant crown that is out of alignment with adjacent natural teeth (18).
There is a spontaneous mesial drift (19) in the teeth in which the implants do not participate. So any implant placed in the lateral region can inhibit this drift laterally can result in an asymmetric arch, while an implant in the anterior region cannot move with the natural teeth and become more lingually positioned with time (20).

Sagittal Growth

Resorption in the anterior part of the maxilla could result in the gradual loss of bone on the labial side of an implant. The problem increases in severity with growth. The sagittal growth of the mandible has no impact on the implant placement in children. Only the rotation of the mandible in the sagittal plane has to be considered(20).

Growth Spurt and Implant Placement

Growth occurs in spurts when there are periods of sudden acceleration of growth followed by period of latent growth (1).In a study carried out by Iseri and Solow (21), the average velocity of eruption of maxillary incisors in girls 9 to 25 years of age was 1.2 to 1.5mm per year during active growth and 0.1 to 0.2mm per year after age 17 to 18. Changes of this magnitude are difficult to compensate for if an implant is placed in a 9 to 10 year old girl. The change in boys is even more.

Experimental evidence and the behavior of ankylosed teeth suggest that an osseointegrated object remains stationary in the bone surrounding it and does not move or adapt to bone remodeling. When placed early, implants may disturb growth or have to be replaced. Implants placed during late puberty or early adulthood have the best chance for long-term usefulness (3). During the late teenage years, the amount of growth is considerably less (9). Love et al (22) and Foley and Mamandras (23) studied growth of the facial skeleton during the late teens in both sexes and reported that anterior facial height increased over the observation time, but the amount of increase was diminishing.

Differential Growth of The Sexes

There is a difference in the amount of growth between the sexes till the attainment of puberty but after age 20, the intergender difference is substantially diminished.

In their study, Fudalej et al showed a difference in growth between the sexes. Overall, growth of facial structures was greater in males. Between ages 12 and 50 years, the increase was about 120% greater in males than in females. The rate of eruption of

the maxillary central incisors in females seems to be greater than in males despite more growth of anterior facial height in males over the same time period (7).

Greater changes in clinical crown height may occur in patients provided with implant-supported crowns than in untreated control subjects, possibly more for women than men, and more for initially shorter teeth than for longer adjacent teeth (10).
In the study by Jemt T et al females showed a greater increase and incidence of anterior facial height and posterior rotation of mandible as compared to males (24). This puts them at a higher risk for infraocclusion after single implant placement.

PREDICTION OF GROWTH

Few studies are available to help the clinician determine the approximate timing of implant placement relative to the cessation of craniofacial growth (25). Because implants behave like ankylosed teeth (5, 25, 26), early implantation could lead to submergence of the implant crown and produce an esthetic and periodontal disaster (27).

There is no single method to predict when growth has completed. In fact, long term studies in adults indicate that growth never stops but continues throughout life in the same direction as during adolescence but at a much reduced rate. Even though statural growth ceases, vertical growth of the face and the resulting eruption of teeth continue past puberty (28).

Dental age is also not a good predictor. A full complement of permanent teeth does not indicate completion of facial growth (29,30). The growth of the facial skeleton continues after puberty, but the amount of growth decreases steadily and, after the second decade of life, seems to be clinically insignificant (7).

Changes from the normal pattern of growth create the greatest problem in attempting to predict growth (2). Correlation coefficients to predict the size at age 15 versus the size at age 4 are low, with prediction efficiency at 50 % or below. Hence the amount of change when applied to an individual is unpredictable (31).
The reliable methods of assessing cessation of growth are superimposing cephalometric tracings taken at least 6 months apart, and waiting until no growth changes take place for at least one year (20). Another method of evaluating is taking the hand-wrist radiograph and to observe to what degree the growth plates are closed (2).

CONCLUSION

Although implants in a young patient have advantages such as improving bone quality, good osteointegration , wound healing and a healthy status of an individual but all these factors are overridden by a principle factor i.e. growth. Thus the placement of an implant should be deferred until puberty or after the occurrence of growth spurt of the child. Patients and families should be educated about the fact that the placement of implants before the completion of growth could jeopardize the long term esthetic outcome, since the remaining changes in the growing alveolar process will not be followed by the implant.

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