Indian J.Sci.Res. 6(2) : 193-197, 2015 Review Article ISSN : 0976-2876 (Print)
ISSN : 2250-0138 (Online)

IMPLANTS IN PAEDODONTICS: A PUZZLED CORNER

NAVDHA CHAUDHARY[a], BABITA AHLAWAT[bd1], ASHOK KUMAR[c], VIJAYLAXMY[d] AND PAWAN GOEL[e]

[a]Department of Pedodontics and Preventive Dentistry, Eklavya Dental College, Kotputli, Jaipur, Rajasthan, India
[bd]Department of Dentistry, SHKM GMC, Nalhar, Mewat, Haryana, India
[c]Department of ENT, SHKM GMC, Nalhar, Mewat, Haryana, India
[e]Department of Community Medicine, SHKM GMC, Nalhar, Mewat, Haryana, India

ABSTRACT

Implant placement in adults is a promising treatment option but its use in children is still a dilemma. The dental as well as the skeletal changes occurring in both the jaws from childhood till adolescence makes the use of implants in children an issue of major concern. Considering the growth changes in maxilla and mandible, this review is an insight of possible outcomes of implant placement in a growing child.

KEYWORDS : Dental implants, Maxillary growth, Mandibular growth, Ectodermal dysplasia

A dentist may come across certain conditions of paediatric patients where oral rehabilitation is of utmost importance even before the completion of growth. The most commonly encountered problems amongst many are tooth loss as a result of trauma and congenital complete or partial anodontia such as seen in patients with ectodermal dysplasia or in patients of cleft lip and palate. There are two primary concerns for implant placement in a growing patient, firstly the danger of displacement, relocation or submergence of implants with the growing jaws and secondly, effect of implant prosthesis on the normal jaw growth.Determination of growth is important while placement of implants in children and adolescents, but no reliable indicator is available to determine whether the growth has ceased or not. Kokich said that stabilization of shoe and garment size, arrest of growth in height, shaving in males, and absence of change in serial cephalometric radiographs taken 1 year apart can be used as a measure of growth arrest. (Fudalejet al, 2007) The behavior of an osseointegrated implant in a growing child is well represented by an ankylosed primary tooth. Although the etiology of ankylosed primary teeth is poorly understood, it appears that even amicroscopic lack of periodontal ligament in one or more areas of the primary tooth can produce ankylosis. (Rubin et al., 1984)Ankylosis arrests both dental eruption andalveolar bone formation in the affected area. An osseointegrated implant would behave much like an ankylosed primary tooth with the lack of alveolar growthand dental eruption. This example of aberrant growth provides a clue to propertreatment planning and use of implants.

Growing Arches and Implant Placement

The dynamic relation of the anteroposterior and rotational growth of the mandible to the transverse arch width and dental height changes must be understood before placing endosseous implants in actively growing patients. Research models demonstrate that osseointegrated implants lack the compensatory growth mechanism of the natural dentition. Remodeling associated with skeletal growth in the region of the implant placement site could cause the implant to either become unsupported by bone or submerged within it.

In a growing child, replacing a permanent tooth lost from trauma with an implant poses a challenging dilemma because the implant's lack of eruption potential can lead to discrepancies in the occlusal plane, esthetic problems and possible disruption of the normal development of the jaw. (Kramer et al, 2007)

Effect of Maxillary Skeletal Growth Patterns on Fate of Implant (Oesterle et al., 1993)

Anterioposterior Growth

- Midface grows in downward and forward direction relative to the anterior cranial base.
- Passive displacement (1/3rdgrowth), Enlargement (2/3rd growth).
- Primary dentition period), passive growth - major factor in maxillary growth.

[1]**Corresponding author**

- Less important as the anterior sutures of the cranial base close.
- Much of the anterior surface of the maxilla is resorptive whereas new bone is added on the posterior and superior anterior cranial suturalattachments .

Implications on Implant Placement

- Anterior maxillary implants placed in a growing child risk losing bony support through resorption of the labial cortex.

Transverse Growth

- Mid palatal suture of maxilla enables mid face to synchronize its lateral growth.
- Growth of the median suture accelerates at puberty - most significant factor in transverse growth of maxilla.
- Greater in posterior region as compared to anterior region.
- This results in mutual transverse rotation of two halves of maxilla.

Implications on Implant Placement

- Implants placed either side of an active midpalatal suture will separate with growth.
- If implant structure crosses midpalatal suture, it may limit or even restrict transverse growth.

Vertical Growth

- Alveolus increases in height by apposition on its occlusalaspect, it is simultaneously decreased by resorption at nasal floor.

Implications on Implant Placement

- Any posteriorly positioned implants placed in a young child may become significantly submerged and even be translated into the maxillary antrum as a result of growth.

Effect of Maxillary Dental Growth Patterns on Fate of Implant (Oesterle et al., 1993)

Anterioposterior Growth

- Arch circumference decreases a small amount during growth whereas arch length also decreases slightly with emergence of first permanent molar.(Moyers et al, 1976 and Moorrees et al, 1969)
- As the maxillary incisors erupt arch length increases a small amount but then decreases as the primary molars are lost, hence the net result is that the arch length is shorter at 18 years of age than at 4 years.
- Teeth move within the arch relative to each other, there is a change in the position of the entire maxillary dentition also, a significant mesial shift is seen relative to the body of the maxilla.
- Arch dimensions continue to change even after the eruption of the permanent dentition.

Implication on implant placement

- The implant and theassociated dentition are unable to move mesially with the changes in growth, this causes disturbance in alignment and occlusion as well.
- Care must be taken to avoid placing the maxillary implant before the eruption of the permanent teeth.

Transverse Growth

- Once erupted many permanent teeth do not maintain a fixed position.
- Dental width changes very little with the primary dentition while a significant change in arch width occurs with the eruption of the permanent teeth.
- Females growth nearly completed by 15 years.
- Males continue to grow until 17-19 years.

Implications on Implant Placement

- Placement in adolescent males must be delayed longer than in adolescent females to allow the substantial completion of growth.

Vertical Growth

- Increase in alveolar height continues with eruption of permanent incisors, however there is with remodeling of bone during eruption of permanent teeth combined with downward and forward growth of nasal spine.
- Changes in the height of the palate partially reflect the increase in alveolar height.

Implications on implant placement

- An implant would become embedded in bone with changes in the vertical height.

Effect of Mandibular Skeletal Growth Patterns on Fate of Implants (Cronin et al., 1994)

Anterioposterior Growth

- Mandible lengthen exclusively by posterosuperior growth of condyle as well as by posterior growth of ramus.
- Increasing prominence of chin during adolescence seen primarily in males, is not much as a result as of appositional growth at chin as it is of resorption.

- To accommodate the eruption of the molars, the body of the mandible increases in length by resorption on the anterior aspect of the ramus and by deposition on the posterior aspect, concurrently the ramal height increases 1 2 mm per year. (Rilo et al, 1979)
- The posterior width of mandible increases by virtue of its V configuration following Enlow's V principle, symphyseal suture ceases to be a growth area prior to eruption of primary teeth as it fuses by one year of age.
- As a result mandibular anterior width stabilizes relatively early and only increases slightly by appositional growth.
- The mandible tends to grow downward and forward and the chin becomes more prominent with time as a result of resorption of the labial cortex above the chin point.
- The mandible grows in length as the ramus is extensively remodeled.

Implications on Implant Placement

- Successful implants in the mandible are also favored by the lack of a complicating suture. Because the symphyseal suture begins to close within months of birth, there is no danger of implant surgery traumatizing a growth site and little possibility that a prosthesis placed across the midline could limit transverse growth.
- Mandibular midline implants, therefore, have a better prognosis in a young patient than those placed in other areas of the mandible.

Rotational Growth

- Mandible exhibits a rotational pattern as it grows in relation to maxilla.
- This result in forward rotation of the mandible with the centre of rotation either being in the centre of the condyle, at the incisal edges of the mandibular anterior teeth or in the region of the mandibular pre molars.
- When the condyle grows vertically the vertical growth in the ramus exceeds that of the symphyseal area.
- The net effect of this rotational pattern of growth is to upright the ramus, flatten the mandibular plane and decrease the gonial angle which is greater in infants and obtuse and about 175 degree and then decreases progressively as muscle finds insertion.

Implications on Implant Placement

- Implants or the ankylosed teeth would be carried inferior with the rotation of the mandible making them more prone for submergence within the alveolar process.

Effect of Mandibular Dental Growth Patterns On Fate of Implant (Cronin et al., 1994)

Arch Length Growth

- As permanent incisor erupt there is generally little or no change in mandibular arch length.
- Additional arch length changes occur as mandible grows, amount of change varying with direction of growth.

Implications on Implant Placement

- The mandible has a V configuration, posterior teeth naturally erupt at ever-increasing widths.
- The distance between teeth can increase to coordinate with increase in maxillary width, but this occurs by alveolar remodeling and is usually not dramatic.
- For this reason, an implant is not likely to be esthetically or functionally malpositioned because of increase in arch length.

Transverse Growth

- Intercanine width increases as permanent central incisors erupt and replace their antecedents and wedge primary canines laterally and distally into primate space.

Implications on Implant Placement

- The symphyseal suture closes within months of birth.
- There is little possibility that prosthesis across the midline could limit transverse growth.
- Mandibular midline implants, thus, have a better prognosis in a young patient than those placed in other areas of the mandible.

Vertical Growth

- The dental height of the incisor and the molar increases in a similar pattern throughout growth.
- The permanent incisor re establish the dental height of the exfoliated primary teeth by the age of 9 years, while at the same time the first permanent molars reach the level of the primary molars.

Implications on Implant Placement

- Prosthesis design must allow for the average increase in dental height of 5 to 6 mm.
- The burying of an implant because of occlusal alveolar bone apposition is possible in both the posterior and anterior segments.

Recommendations of Implant Placement in Growing Patients

Whenever possible, implant placement should be delayed until age 15 for girls and age 18 for boys. Implants placed after these ages have the most predictable prognosis. The parents and patient must be fully informed that implants placed before these ages may not be "permanent" and may have to be reimplanted. If implants are deemed necessary in a child, care must be taken during implant placement and subsequent prosthesis design. Although the primary area of concern is the midpalatal suture of the maxilla, the growing patient who has received an implant in either arch must still be monitored closely to assure that the implant remains functional and does not disturb growth. (Cronin et al, 1994)

Maxilla

Delay implant placement until skeletal growth is complete. In anodontic child, implant placement in the posterior could be considered under well planned conditions. Rigid transpalatal prostheses in the prepubertal or early pubertal patient should be avoided to allow unrestricted transverse maxillary growth. Implants placed during the pubertal period have a greater likelihood of success, but still less than the postpubertal or postgrowth implant.(Oesterle et al., 1993)

Mandible

One serious concern that limits the utilization of mandibular osseointegrated implants in growing children is the vertical eruption (and in some cases, angular change) of dental units. The burying of an implant because of occlusal alveolar bone apposition is possible in both the posterior and anterior segments. This condition could be exacerbated in both areas by an unfavorable rotational growth pattern. (Cronin et al, 1994)

DISCUSSION

One of the most common reasons for placing implants in growing patients physiologically is to preserve the bone, other reasons being esthetic considerations and psychological factors. The benefits of implants in growing patients are important to be measured against the concerns regarding their premature placement.Guckes et al, 1991in their study found that bone volume in children may not be sufficient for the placement of implants in ideal positions for prosthesis support. In the totally anodontic patients, the vertical and anterioposterior changes in alveolar development may not be as important as in the partially anodontic patient in whom considerable dental changes can be expected with growth.Cronin et al and smith et al(Cronin et al, 1994) documented the placement of endosseous implants in the anterior mandibular region as early as 5 years of age with positive treatment results. Prachar and Vaneek(Prachar et al, 2003) present the results of a 5 year study on the use of cylindrical or screw implants in adolescents of age 15-19 years. Regardless of the criterion used, the rate of success was always higher than 96% over the 5 years of study, whereas Shaw reported that the dramatic growth changes occurring in infancy and early childhood were not conducive to the maintenance of implants. Prosthesis remodeling as stated by Smith et al 1993 and Kearns et al, 1999 is an undesirable condition due to the repetitive need to lengthen the transmucosal implant-to prosthesis ratios and the potential load magnification. According to Dietschi and Schatz,1997 and Mackie and Quayle, 1993, implant placement in children younger than 16 18 years must be avoided.

Bergendal et al., 1996 stated that implants must be placed when growth is almost complete, except for rare cases of total aplasia as in ectodermal dysplasia. Elsewhere, it has been recommended that treatment with implants must be delayed until the age of thirteen years, since an implant placed at the age of 7 or 8 may not be in favorable position at the age of 16 years. At the consensus conference on oral implants in young patients, it was agreed that implants should not be placed until growth and skeletal development is completed or nearly completed.

CONCLUSION

The key to implant placement in paediatric patients is the determination of growth cessation and regular monitoring with time. A reliable evaluation of growth based on cephalometric radiographic examination should be done. Interim prosthesis should be the treatment of choice in actively growing patients followed by implants when growth has reached a stable phase.

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