Dental Implants in Pediatric Dentistry: A Review Article

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Abstract

Loss of teeth in children is commonly caused due to traumatic exposure or anodontia. It can lead to loss of masticatory function, altered speech, lack of self confidence and mal-alignment of teeth overtime. This hampers the esthetic and psychosocial development of children. Management of missing teeth can be done using removable prosthesis or fixed prosthesis and implants. The removable prosthesis can lead to residual ridge resorption and several periodontal problems and can cause oral hygiene maintenance issues in a child for which dental implants are considered to be an ideal mode of treatment for tooth loss. Placing an implant in a growing child can cause undue effects on maxillary and mandibular skeletal growth for which the dentist must plan a treatment taking into account the total number of missing teeth, degree of skeletal growth and related psychological stress to the child.

Keywords: *Dental Implant, Anodontia, Maxillary and mandibular skeletal growth, Child.*

Introduction

The absence of one or a few teeth manifested due to genetic condition, trauma, or any disease is known as hypodontia or oligodontia. Total anodontia is the congenital absence of all teeth in permanent or primary dentition.[1]The most commonly missing teeth are third molars and they don't require replacement. Mandibular second premolars are the second most commonly missing teeth followed by maxillary lateral incisors and maxillary second premolars.[1]The commonest cause for loss of tooth is trauma, especially the loss of anterior teeth. Its predisposing factors are incompetent lips and proclination of maxillary anterior."Avulsion Is defined as the complete and total displacement of a tooth from its socket" [1]. The most commonly avulsed teeth are maxillary central incisors.

The management of multiple tooth loss can be done by partial coverage fixed prosthesis such as resin-bonded restorations or removable prosthesis. The management of loss of a single tooth or avulsion is done as conservatively as possible in a young child. It is done by deploying treatment like replantation, attempting revascularization, apexification, and root canal treatment. The above-mentioned treatment for loss of multiple teeth has certain drawbacks. In both cases, removable and fixed dentures, the child's compliance is necessary. Maintenance of oral hygiene becomes an issue. It predisposes to several periodontal problems followed by bone resorption ultimately. Apart from that, new prosthesis needs to be fabricated from time to time, to make up for craniofacial growth.

Implants can be considered as an ideal method of treatment for tooth loss in young children, as it restores the function of missing teeth by preserving the alveolar bone and also provides excellent esthetics. However, it requires a proper understanding of growth and growth assessment by the dentist to establish a successful implant in a young patient.[2]

Growth: The maxillary and mandibular growth is multidirectional and occurs in sagittal, vertical, and transverse planes. It occurs in varying paces, periods of slow pace growth followed by accelerated growth called the growth spurts. The teeth maintain their position in the arches by following this pace of growth through

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remodeling and drifting within the alveolar bone. Functional forces are balanced by a stable inter-arch occlusal relationship achieved gradually as transition from primary to permanent dentition.[3]

Maxillary Growth: The maxillary growth occurs by displacement, growth at sutures, and surface remodeling"[2]. The displacement is of two types- primary and secondary. The primary displacement occurs by the growth of maxillary tuberosity in a posterior direction that results in the whole maxilla being carried anteriorly.[2] The secondary displacement occurs due to the growth of the cranial base that leads to displacement of the nasomaxillary complex in a downward and forward direction. The transverse growth of the maxilla is facilitated by growth at median sutures. This leads to forward and downward relocation of maxilla. Sagittal growth occurs by surface remodeling of the anterior surface of the maxilla. It brings the maxilla even more downwards and forwards.[3]

The vertical growth of the maxilla occurs by bone resorption on the lateral wall of the nose and floor of the nasal cavity followed by bone deposition on the palatal side. Also, when the teeth start erupting, there is bone deposition at the alveolar margins that increases maxillary height.[2-5]

Vertical growth is the last to complete, at around the age of 17 to 18 years in girls and even later in boys. Hence the maxillary implants tend to perforate the nasal floor even after puberty when the permanent teeth have erupted already. Mikel Westwood and Duncan James, in their study, concluded that the implants placed in the maxillary anterior region are at less risk of submersion, due to the angulation changes it undergoes. It is because of the less maxillary vertical growth and also less bone loss when the implant is placed within less time of tooth removal.[6]

Mandibular Growth:

Of the facial bones, the mandible undergoes the largest amount of growth postnatally and also exhibits the largest variability in morphology"[2]. Mandible that appears as a single bone in adults can be divided developmentally and functionally into various skeletal subunits that are namely-

Body of mandible, Alveolar process, Coronoid process, Condylar process, Angular process, Ramus, Lingual tuberosity, and the Chin[2].

- There is drifting of the ramus in the posterior direction by sequential bone resorption on the anterior part of the ramus and bone deposition on the posterior part of the ramus.
- "The displacement of the ramus results in the conversion of former ramal bone into the posterior part of the body of the mandible"[2]. By this process, there's lengthening of the body of the ramus.
- There is a flaring of the angle of the mandible as the person grows older. This occurs by sequential bone resorption on the posterior inferior aspect of the lingual side and bone deposition on the anterosuperior aspect of the lingual side of the angle of the mandible. Contrary to this, on the buccal aspect of the angle of the mandible, bone resorption occurs in the anterosuperior part and bone deposition occurs in the posteroinferior part.
- There is a posterior movement of lingual tuberosity by deposition on its posterior facing surface. It lies towards the midline of the ramus protruding in a lingual direction. "There's a large resorption field just below the lingual tuberosity. Resorption occurs producing a large depression called lingual fossa. Resorption in the fossa and deposition on the medial surface of tuberosity combined makes the lingual tuberosity more prominent.[2]
- "Alveolar process develops in response to the presence of tooth buds. As the teeth erupt, the alveolar process develops and increases in height by bone deposition at the margins"[2]. This leads to overall growth in the vertical height of the mandible.
- The growth of the chin is influenced by sexual and specific genetic factors. A fully developed chin is only seen in a man. Usually, males have a more prominent chin as compared to the females.
- The head of the condyle is covered by the Condylar cartilage to help withstand the compressive forces that occur at the joint. The mandibular growth occurs by bone deposition at the Condylar cartilage. "Also there is growth of soft tissues (muscles and connective tissues) that carry the mandible forwards, away from the cranial base. Following this, bone growth occurs at the Condyle to maintain contact with the cranial base. The Condylar growth rate increases at puberty reaching a peak between 12½ to 14 years. The growth ceases around 20 years of age[2].

- The Coronoid process grows by bone deposition on the lingual surfaces of the Coronoid processes. Also, the vertical dimension of the Coronoid process increases by the enlarging 'V' principle.

In the mandible, the amount of anterior implant exposure or submergence of a posterior implant depends on the direction and amount of rotation during growth[9]. The implants in the mandibular anterior tooth region are at a risk of getting exposed due to the infra dental resorption, at the time of formation of the chin in adolescents. The implants in the mandibular posterior tooth region are at a risk of submerging due to the appositional growth of the alveolar bone.Cronin et. al. studied mandibular growth related to the implants in children with a strong rotational growth pattern. With erupting posterior teeth, alveolar growth continued to maintain the occlusal plane. This resulted in the implant being deeply buried within the mandibular alveolar process. They suggested that successful mandibular implants are favored by a lack of complicated structure. [5-10]

Treatment approach for quadrant-wise implant placement:

Maxillary Anterior Region: It is an important area of consideration due to higher chances of traumatic tooth loss and frequent congenital tooth absence. Substantial growth is seen in vertical and anteroposterior dimensions. The vertical growth is maximum in this quadrant, as compared to all other quadrants. Hence, premature placement of implants can lead to growth cessation and requirement for lengthening transmucosal implant connection. Hence, the placement of implants should be delayed upto the age of 15 years in girls and 17 years in boys.

Maxillary Posterior Region: Maxillary posterior quadrant has similar growth factors as described for the maxillary anterior-posterior area. An additional growth factor transfers maxillary growth at midpalatal suture, which produces rotational growth that anteriorizes the position of maxillary molars. Placement of osseointegrated dental implants in the maxillary posterior quadrant is best delayed until the age of 15 years and 17 years of age in females and malesrespectively[4].

Mandibular Anterior Region: It is the best site for the placement of an osseointegrated implant before skeletal maturation. The mandibular anterior quadrant presents fewer growth variables. The closure of mandibular symphyseal suture occurs during the first two years of life. Prosthesis supported by dental implants in the anterior mandibular region should be of a retrievable designed to allow for an average increase of dental height of 5-6 mm as well as the anteroposterior growth.[4]

Mandibular Posterior Region: The dynamic growth and development of the posterior mandible in the transverse and anteroposterior dimensions coupled with its rotational growth presents multiple treatment concerns. Placement of osseointegrated implants in the posterior mandibular quadrant is best delayed until skeletal maturation.[4]

Discussion and Conclusion

Using implants in growing children has its advantages but only when it's placed at the right age, take into consideration the growth assessment of the patient. Various studies have suggested that use of implants, due to developmental changes of jaws and teeth in children, should be performed with high precision and systemic evaluation, and, if possible, be postponed up to the age of 15 years for girls and 18 years for boys and be within a long-term process. The dentist needs to take into account various factors that might lead to implant failure. Precise diagnosis, treatment planning, and extensive knowledge in the field of implants and pediatric dentistry are crucial for the dentist for the establishment of a successful implant. The evaluation of some factors, including causes of anodontia, patient's sex, range of skeletal growth, prosthesis design, the range and quality of residual bone ridge, keeping hygiene and satisfying parents' and patients' demands should be taken into consideration for the final decision making on implant positioning. In the end, the dentist decides to restore the function of the lost tooth and guard the patient's self-esteem, keeping in mind the patient's comfort and ease of maintenance of the prosthesis.

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