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Review Article

Dental Implants in Children - A Review

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Abstract

An edentulous smile might look appealing in an infant but it can be a matter of concern to the parents. With the progression of time, the loss of teeth will negatively affect the child's ability to chew and may also produce an impact on the self-esteem. Traditionally, the management of tooth loss in the child is done by conservative means by using a removable prosthesis, Maryland bridge or resin-bonded-restorations, although none of these methods are completely satisfactory and have their own drawbacks. The use of dental implants has been increased with leaps and bounds ever-since the concept of osseointegration has been identified and accepted. Dental implants in children is the most preferred treatment option by the parents as it provides a good esthetic and functional results thus improving the child's quality of life, social integration and self-esteem. This review article is an attempt to highlight the use of dental implants in normal growing children and the influence of dental and skeletal growth on the stability of those implants.

Keywords: Children Dental Implant; Dental and Skeletal Growth; Hypodontia; Anodontia

Introduction

The use of dental implants to replace the missing teeth has been increased since leaps and bounds ever since the concept of osseointegration has been identified and accepted. Patients with dental implant retained prosthesis have shown to have enhanced chewing comfort, stability of the prosthesis, speech quality and esthetics along with reduced resorption of the alveolar ridge. Thus, dental implants are now being recognized as the best possible mode for replacing the missing teeth [1]. Although edentulism is usually associated with ageing patient; congenital partial anodontia, hypodontia and traumatic tooth loss are the most frequent causes of loss of teeth in children leading to lack of normal alveolar growth, loss of function along with unpleasant esthetics further affecting the psychosocial development and self-esteem of the young child [2].

Traditionally, the management of tooth loss in the young child is done by conservative means such as resin-bonded restorations, Maryland Bridge or removable prosthesis but none of those methods of treatment are completely satisfactory and have their own limitations [3]. With the increase in quality of life and more number

of highly qualified and well educated parents, these days there is more and more awareness of use of dental implants as one of the most predictable means to replace the missing teeth and parents wish to implement the same even in their children with missing teeth [4]. Although dental implants in a young patient have advantages such as improving bone quality, good osseointegration, wound healing and a healthy status of an individual, all these factors are overridden by a principal factor i.e., growth. Thus the need of the hour is to educate the parents and families about the fact that placement of dental implants before completion of the growth could jeopardize the long-term esthetic outcome of their child and thus it is better to defer the implant placement until puberty or after the occurrence of the growth spurt of the child [4,5]. This article is an attempt to discuss the use of dental implants in children and the influence of maxillary and mandibular skeletal and dental growth on the stability of those implants.

History

The concepts of osseointegration as described by Professor Per-Ingvar Branemark and functional ankylosis by Schroeder in the era of 1965 - 1975 is probably one of the most important landmark events to have happened for the field of Dentistry [6,7]. The property of titanium metal to integrate within the human bone and maintain this integration under occlusal loads in the site prepared with aseptic and atraumatic surgical technique to receive the same has revolutionarized the dental care [6].

Dental Implant is analogous to tooth root and used in dentistry to support the restorations that resemble the teeth or group of teeth. Virtually all implants placed in 21st century appeared similar to an actual tooth root and thus possess a root form and are placed within the bone. Prior to the advent of root form endossous implants, most of the implants were either blade endosseous implants in the shape of the metal piece placed inside the bone resembling a flat blade, or subperiosteal implants in which framework was constructed to lie upon and was attached within the screws to the exposed bone of the jaws [3,6]. Thus dental implants can be used to support number of dental prosthesis including crowns, implant-supported-bridges or dentures which work on the concept of osseointegration which is a direct structural and functional connection between ordered, living bone and the surface of a load-carrying-implant [6,7].

Growth

Growth according to Todd is defined as increase in size. The growth of maxilla and mandible occur in a multidirectional approach in sagittal, vertical and transverse planes showing periods of slow and accelerated growth called growth spurts [8]. Functional forces are balanced by a stable inter-arch occlusal relationship, which can be achieved gradually as transition from primary to permanent dentition occurs [8,9].

Growth changes seen in maxilla [9-11]

Maxillary growth occurs as a result of sutural growth and its displacement. This implies that the maxilla has to move a substantial distance downwards and forwards in relation to skull and cranial base [4]. The transverse growth, which occurs in early childhood, is influenced by the increased width of cranial base and growth at the median suture. This growth accelerates at puberty and completes by adolescence. The total change in growth is the result of the translation of the maxilla forwards and downwards and simultaneous surface remodeling.

Vertical growth of the maxilla takes place by sutural lowering of the maxilla along with apposition on the tooth-borne surfaces of the maxillary alveolus. The growth direction in maxillary arch is variable wherein transverse maxillary skeletal changes, vertical skeletal changes, transverse maxillary dental changes, antero posterior maxillary dental changes can occur. Hence care must be taken while selecting implants in growing patients for maxillary implants. According to Andreason (1993) [11], implants placed within the jaws act like ankylosed teeth, which may result in infra-occlusion Maxillary implants also have the likelihood of perforating the nasal floor due to remodelling changes.

Growth changes seen in mandible [9-11]

Mandible is closely associated with the cranial structures and has a differential growth pattern. This leads to making the facial profile straight from convex during adolescence. The sagittal growth in mandible is more of endochondral growth formation which causes increase in the length of the bone.

Growth in the vertical dimension takes place by the opposition at the dentoalveolar complex and rotation of the condyle that displaces the mandible downward and forward away from the cranium. According to Enlow's V shaped hypothesis, the mandible

undergoes remodeling which results in increased width in the posterior aspect. The anterior part width stabilizes early and also is comparatively weak due to appositional growth.

As there are no complicated sutures present as that in maxilla, the prognosis of placement of implants in young children is good with better prognosis seen in the anterior mandible region [4].

Also as the growth in mandible is by apposition, there are chances of submergence of implants and infradental resoption during chin formation in adolescents. But there is no risk for symphysis development.

Indicators of completion of growth [3-5]

Growth in an individual cannot be estimated by their chronological age. On a generalized note, females mature early and at a faster rate than males.[3] There are different methods available for the estimation of age, but there is no such accurate indicator to determine the cessation of growth [3,4].

Assessment of growth can be predicted using

- **Superimposing tracing of serial cephalometric radiographs:** This is considered to be the most reliable method but is very tedious and time consuming and may also delay the placement of implants.
- **Hand wrist radiograph:** It helps in providing a general view on the growth and development in an adolescent patient. The capping stage marks the pubertal onset and peak thus helps in treatment planning. Based on the stage of growth, the time of placement of implant may be determined. The best and safest time for the placement of a single implant is when the epiphysis of the radius is fused and forms a bony union with the diaphysis. Once the skeletal growth of long bones is completed, the facial growth is stopped. This is also considered as the stage of safe implant placement.

Recommendations for the placement of implants by region [3-5,11].

Anterior maxilla

Placement of implant in this region is dangerous due to the inconsistency of growth [3]. This region is important for consideration because of frequent traumatic tooth loss, congenital absence along with increased vertical growth changes [3,4]. Premature implant placement may cause repetitive need to lengthen the transgingival or transmucosal part of implant leading to a poor implant to prosthesis ratio [4].

It is advised to delay implant placement until the completion of skeletal growth.

The ideal ages for the placement of implants in anterior maxillary region is below 15 years in females and 17 years in males [4]. Hence this gives the importance of determination of skeletal maturity before the progression of implant placement.

Maxillary posterior region

The growth factors associated are similar to the anterior maxillary region. The additional growth factor is transverse maxillary growth at the midpalatine suture, which causes rotational growth that anteriorizes the position of maxillary molars [3].

Early inserted implants may get submerged occlusally and get exposed apically due to resorption of bone in the maxillary sinus and floor of the mouth [5].

Ideal ages for the placement of implants in posterior maxillary region is until 15 years for females and 17 years in males [11].

Mandibular anterior region

This region supposedly has tremendous potential for an implant supported prosthesis which is due to the presentation of very few growth variables. Dental implants to be used must simulate the growth of mandible in terms of height as well as anteroposteriorly. But the use of implants with dentition is not recommended at an early age as there are chances of significant compensatory changes in dentition during the growth phase [11].

Mandibular posterior region

The growth patterns of mandibular posterior region in transverse and anteroposterior dimensions associated with rotational growth produces multiple treatment concerns [3]. it is recommended to delay the placement of implant in this region until the skeletal growth is completed. If not then it may cause progressive infra occlusion of implant and also cause damage to the adjacent dentition which inhibits the placement of implant at this region later [11].

Discussion

Dental implant placement in a young patient improves bone quality, good osseointegration, wound healing and an overall health of an individual. However, there is no exact age at which an implant has to be placed but a general principle of maturity rates have given a conclusion that implant placement would be successful if delayed until 15 years for girls and 18 years for boys [4] wherein mandibular anterior region is considered as the best region for implant placement. Moreover, in children affected from hypodontia, anodontia and ectodermal dysplasia, the extensive lack of both deciduous and permanent dentition results in atrophy and a reduced growth rate of the affected alveolar process. Such pediatric patients can benefit remarkably from an implant-supported oral rehabilitation.

However, the primary concern of implants in young patient is danger of them becoming embedded, relocated or displaced as the jaw grows. Bjork (1977) [12]. reported that the implanted pins in the jaws of children in the path of erupting teeth were displaced, those placed in the resorptive areas were lost and pins placed in the areas of appositional bone growth became embedded. Cronin., *et al.* (1994) [13]. observed the growth of mandible as related to implants in children with a strong rotational growth pattern and concluded that posterior teeth continued to erupt along with continued alveolar growth to maintain the occlusal plane, possibly causing implants to become deeply buried within the mandibular alveolar process as related to implants in children with a strong rotational growth pattern. Moreover, Ledermann., *et al.* (1993) [14] in their 7-year follow up study observed that failure of dental implants to respond to the vertical growth of adjacent teeth and alveolus was due to ankylosis. However, Guckes., *et al*. (1997) [15]. in his 5-year follow up examination observed that dental implants located in the mandible and maxilla did not move despite the growth, although prosthesis was remodeled to accommodate eruption of maxillary teeth and facial growth. Kearns., *et al.* (1999) [16] also suggested that prosthesis remodeling was necessary in some patients secondary to implant submergence. Similarly, Oesterle (1993) [17] observed that an osseointegrated implant would behave much like an ankylosed primary tooth, with the same lack of alveolar growth and dental eruption and thus it would appear to submerge into the alveolus. However, Cronin., *et al.* (1994) [13] observed that implants placed during the active growth period may be displaced or malpositioned by continued growth and may require removal and replacement and implants placed after the age of 15 years for girls and 18 for boys showed a good prognosis.

Bhatlu., *et al*. (2016) [11] suggested to take extreme caution in placing implants in children because of growth changes in jaw and the dentition; and whenever possible, implant placement must be delayed until the age of 15 years for girls and 18 years for boys. They also recommended to wait for the completion of dental and skeletal growth, except for severe cases of ectodermal dysplasia.

Ponnudurai., *et al*. (2020) [3] observed that 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. In such cases, the prosthetic changes must also be incorporated to compensate for growth changes.

Study by Muhamad (2021) [4] suggested that patients and families should be educated about the fact that placement of implants before the completion of growth could jeopardize the long-term esthetic outcome and thus the placement of an implant should be deferred until puberty or after the occurrence of growth spurt of the child.

Summary and Conclusion

Within the limitations of this review article, it can be suggested that the use of implant due to developmental changes of jaws and teeth in children should be performed with high precision and systematic evaluation and if possible be postponed upto the age of 15 years for girls and 18 years for boys [11]. Moreover, evaluation of factors like causes of anodontia, patient's gender, skeletal growth, prosthesis design, the range and quality of residual bone ridge, oral hygiene maintenance, parent-patient-satisfaction should be taken into consideration for final decision-making and implant positioning [4,5].

It can thus be concluded that although implants in young patients have advantages like improving bone quality, good osseointegration, wound healing and improved health status, the overall factors are overridden by a principle factor i.e. growth [4]. Thus, the need of the hour is to defer the implant placement until puberty or after the occurrence of growth spurt of the child. Patients and families should be educated about the fact that placement of implants before the completion of growth could jeopardize the long-term esthetic outcome, since the remaining changes in the grow-

ing alveolar process will not be followed by the implant. Placing the dental implants after the completion of growth would guard the patient's self-esteem and socialization in the interim growing phase by providing fixed prosthesis which could be used with least complications but maximum comfort.