Review Article

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DENTAL IMPLANTS IN PEDIATRIC DENTISTRY: A REVIEW

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ABSTRACT:

Pediatric dental patients are most often seen visiting dentists for tooth loss due to trauma. Congenitally missing teeth are also encountered in children from time to time. Diseases such as Ectodermal dysplasia or oligodontia may lead to partial anodontia, leading to a great psychological impact in children apart from the loss of function. Removable appliance therapy is the treatment option most commonly followed in such cases, however, these appliances are seen to have their own disadvantages. Therefore, a more concrete treatment option needs to be developed in future and hence this review article throws light upon the possibility of use of dental implants in Pediatric population.

Keywords: Children, Dental implants, Pediatricdentistry ,Ectodermal Dysplasia ,Oligodontia

INTRODUCTION:

Dental implant is defined as a prosthetic device made up of alloplastic material(s) implanted into the oral tissue under the mucosal or periosteal layer, and on or within the bone to provide retention and support for a fixed or removable prosthesis".[1]

Children and adolescents are seen to manifest anodontia, congenitally missing teeth as well as teeth loss due to trauma.[2] In these cases, the degree of hypodontia can bring about psychological stress in the child and proper oral rehabilitation of the child is required before skeletal and dental maturation. Here, removable prosthesis is often the treatment of choice. However, it may lead to increase progression rate of caries, residual alveolar ridge resorption, and complications of the periodontium .[3]

Shaw reported that the dramatic changes in growth and development occurring in infancy and early childhood were not conducive to the maintenance of implants.[4] According to Dietschl and Schatz'' and Mackie and Quayle, implants in children younger than 16 to 18 years must not be placed since adjacent alveolar growth will render them infraoccluded.[5],[6]

Bergendal et al stated that implants placement must be delayed upto the point when growth is almost complete, except for rare cases of total aplasia, as in ectodermal dysplasia. [7]

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The use of implants in adolescents is uncommon because the dental surgeon is concerned about maxillary and mandibular "growth spurts". If he follows the indications and ideal timing of placement of implants, predicting their success will not be a problem for him.. If the implant placement protocol in adolescents is followed, they can be used more routinely. Therefore, the aim of this review is to throw light upon the use of dental implants in children, adolescents and young adults to discuss its role in oral rehabilitation of children with partial or complete anadontia and also to bring out the role of dental implants in some special cases where dental implant placement might be the treatment of choice in the near future.

REVIEW OF LITERATURE

A thorough review of available articles published from 1968 to 2013, obtained from the PubMed database, was done using the terms Dental implants, ectodermal dysplasia, children, oligodontia, anodontia. Articles published in languages other than English were excluded.

SCOPE OF DENTAL IMPLANTS IN PEDIATRIC DENTISTRY

Implant popularity as a treatment modality in adults is tremendous. In case of adults the amount of research being carried out is extensive, however, the treatment planning and execution of implant placement in children and adolescents is still in its infancy.

In partially edentulous cases, long-term success of dental implants has been responsible for other clinicians to broaden the use of implants to adolescents in whom teeth are missing due to trauma or agenesis.. Anodontia either primary or acquired occasionally creates the opportunity for the use of dental implants.[3]

In the absence of maxillary teeth, the maxilla will remain underdeveloped both sagittally and vertically as the alveolar ridges will not develop. In contrast, the mandibular growth is not dependent on the presence of teeth. Therefore, disproportionate relationship between two jaws will tend to occur in the presence of hypodontia or anodontia resulting in class III development as growth occurs throughout the normal growth period. Furthermore, physiological and psychological factors increase the pressure to start early treatment.[8]

According to World Health Organization –young people between the age of 10 years and 19 years are termed adolescents.[9] However, in adolescents the use of implants differs significantly from adults. Because a variety of changes occur in the dentition and jaws of the adolescent, special importance has to be given to the growth of the child.

IMPLANTS IN GROWING BONE

Placement of implants in children and adolescents has always been controversial. Few researchers advocate

their use in this group of patients and a few others strictly contraindicate their usage.

Bjork[10],[11] conducted one of the pioneering studies concerning growth patterns of the dental arches and replicating the implant insertion . For longitudinal cephalometric studies,he implanted 0.5 mm × 1.5 mm. tantalum pins in the jaws of growing children as stable landmarks. Although most pins were stable, pins affected by growth were not. The pins were also displaced by orthodontic tooth movement. Nearly all the pins placed in the resorptive areas like the anterior mandibular ramus, were lost and had to be replaced. In addition, pins placed in areas of appositional bone growth gradually became embedded.

Oesterle et al,[12] and Brahim[13] compared dental implants to ankylosed primary teeth. With lack of alveolar growth and dental eruption, an osseointegrated implant behaves much like an ankylosed primary tooth. These authors proposed that implants placed in the posterior maxilla in children may become buried to the point that the apical portion may become exposed as the nasal and antral floor remodel. Odman *et al*,[14] recommended that implants should not be placed posterior to the canines during active growth. In children with strong rotational pattern, posterior teeth undergo continued eruption, along with continued alveolar bone growth to maintain the occlusal plane, possibly causing implants to become deeply buried within the mandibular alveolar process.[15]

INDICATIONS AND CONTRAINDICATIONS OF PLACING DENTAL IMPLANTS IN PEDIATRIC DENTAL PATIENTS

Indications for use of implants in adolescents

- Pediatric patients with ectodermal dysplasia (1988 National Institute of Health Consensus Development Conference on Dental Implants at Bethesda) [2]

- Implants combined with bone grafting in patients with cleft of the alveolus and palate.[16]

- Children and adolescents having anodontia, partial anodontia, congenitally missing teeth, teeth lost as a result of trauma. [13]

Contra-indications for the use of dental implants

- Pre-pubertal age group.[16]

- Individuals with pubertal growth spurt.[16]

- Inadequate mesiodistal space.[17]

INDICATORS OF COMPLETION OF GROWTH

Completion of growth in an individual is not estimated by chronological age alone. Studying tracings of serial cephalometric radiographs taken at least 6 months apart by superimposing is

probably the most reliable method, though it requires a lot of time and irradiation and may unnecessarily delay implant insertion. Waiting for implant insertion until no growth change is seen over a period of 1 year is ideal. [18]

Skeletal growth status can be accurately appraised by comparing a conventional hand and wrist radiograph against a standardized atlas of hand and the wrist bone development. After maximum growth velocity is completed, capping of the middle phalanges of the third finger (MP3cap) usually occurs and it is an indication of deceleration in the pubertal growth spurt.On completion of pubertal growth spurt,impant placement can be considered although some risks still exist. Adult level of skeletal growth is attained when epiphysis of the radius fuses and forms a bony union with the diaphysis. This is the considered the safest time to place a solitary implant. [18]

CHOOSING A PROPER IMPLANT INSERTION AGE

The possibility exists to place implants even before the pubertal growth spurt in cases of severe anodontia or oligodontia in the mandible, since in this patient group few growth changes occur in the anterior mandibular region after the age of 5-6 years, especially because of the absence of teeth. For the maxilla, it is suggested to wait until after the growth spurt.[19]

During the consensus meeting in 1995 it was decided that implant placement in adolescents preferably should be postponed until the end of the craniofacial/skeletal growth. [19]

Oesterle *et al*.,[12] observed that implants placed before the cessation of growth especially in the maxilla are unpredictable in their behaviour and hence should be used with a great deal of caution. He suggested that implants placed during the pubertal period have a greater likelihood of success but still less than the post-pubertal or post-growth implant. Cronin *et al*.[16] observed that if implants are placed during active growth, they may be displaced or malpositioned by continued growth and may require removal and replacement. Implants placed after age 15 for girls and age 18 for boys have the most predictable prognosis. Implants placed before these ages may not be permanent and may have to be re-implanted.[16]

Op Heij et al from Catholic University of Leuven, Belgium, summarized the growth patterns of each jaw, noting their implications and giving treatment recommendations. [18] (Refer Table 1)

The key to implant placement in these patients appears to be the determination of cessation of growth. Because the age at which growth is complete varies widely, chronologic age is not a true indicator of growth cessation. The average age of growth spurts in girls is 12 years, while the average age in boys is 14 years. However, growth changes occur beyond

the time of the growth spurt and may vary by as much as 6 years. Additionally, individuals with short and long face types have shown changes up to the age of 25 years.[18] These patients require the coordinated treatment of a dental team consisting of pediatric dentist, orthodontist, surgeon and prosthodontist.[21]

In summary, psychological benefits may be associated with using implants to support an oral prosthesis in the jaws of a teenage child with many missing teeth. However clinical research has not demonstrated compelling reasons to place implants in pre teenage children to support an oral prosthesis. Carefully controlled prospective clinical studies are needed to determine the efficacy and effectiveness of the use of implants in children and young adults.[19]

Ectodermal dysplasia (ED) is a hereditary disorder that can affect several ectodermal structures. These structures may include: skin, hair, nails, teeth, nerve cells, sweat glands, parts of the eye and ear, and parts of other organs.[22]

Two distinct types of syndromes within this group are hypohydrotic (anhidrotic) and hidrotic ectodermal dysplasia.[23]

Hypohydrotic ectodermal dysplasia (Christ-Siemens-Touraine syndrome) is the most common phenotype in this group and is usually inherited as an X-linked recessive trait and includes all the signs and symptoms listed above.

Hidrotic ectodermal dysplasia is inherited in an autosomal dominant manner, with the homozygous state being lethal. Its clinical features include nail dystrophy with associated hair defects and palmoplantar dyskeratosis. No abnormality of sweat glands and teeth are seen. [22]

IMPLANT POSSIBILITY IN ECTODERMAL DYSPLASIA CASES

Children with ED usually have a normal mentality and life expectancy, and their facial appearance warrants professional concern for their emotional well-being and social progress.[24] Tanner [25] states ectodermal dysplasia with an abnormal appearance may affect normal social and psychological development in young patients. Functional needs also must be considered since the difficulty these children experience in masticating may cause nutritional problems.[24] Therefore, dental care for ED patient is paramount.

The dental literature describes many conventional prosthetic approaches to the clinical management of these patients. The lack of relevant long-term clinical studies has not prevented clinicians from using implant- assisted prostheses in children. The literature contains several anecdotal reports of the use of dental implants in children, many with anodontia or severe hypodontia, often associated with ectodermal dysplasia, or from trauma.

DISCUSSION

Osseo integration is well documented as a safe and predictable method of tooth replacement. The early clinical research was done in edentulous adults and subsequent studies have confirmed the successful application of this modality in a variety of clinical situations. Almost all of this scientific investigation, however, has been performed in adults, when the dynamics of growth and development are not an issue.

Lederman *et al* [26] conducted a study in 34 patients with a mean age of 15.1 yrs.42 implants were placed in these patients with postloading follow up after 35.5 months. Results showed 90% success rate. Majority of failures were found to be due to traumatic injuries during the healing phase after implant placement. Postloading complications were seen .Ankylosis of the dental implant was seen with failure to respond to the vertical growth of adjacent teeth and alveolus .

Johansson *et al*. [27] placed a single tooth implant in a boy who was 12.3 yrs old. He followed the case up for 4.5 yrs. It was observed that the fixtures did not move together with the adjacent teeth and the maxillary growth went on uninterrupted causing submergence of the implant at sight.

Another interesting observation was made by Escobar, Epker et al.[28] They conducted a study in edentulous children who had congenitally missing successors. They placed endosseous mandibular implants in these children. It was observed that alveolar bone growth occurred in the absence of natural teeth. The concluded that growth and preservation is dependent upon biomechanical factors rather than the presence of teeth.

Iris and Solow [29] studied the eruption of maxillary incisors and first molars in girls from 9 to 25 years by implant method. Samples comprise 14 series of lateral cephalometric films of girls obtained from the archives of the implant study by Bjork (1968). All subjects had bilateral posterior maxillary implants and one or two anterior maxillary implants. They concluded that due to continued eruption of the natural teeth, the use of osseointegrated implant with artificial teeth should not be recommended in the childhood, adolescence, and early adulthood. If placed, special provision should be made for later revision or replacement of the artificial teeth to compensate for the lack of continued eruption of such implants.

Prachar and Vaneek [30] conducted a 5 year study on the use of cylindrical or screw implants in 135 adolescent patients aged 15–19 years. 191 implants were placed. The clinical success rate was accessed by means of selected criteria, i.e., patient’s sex, the type of implant, the cause of tooth defect, and the type of prosthetic reconstruction supported by implant. Regardless of the criterion used, the rate of success was >96% over the 5 years of study.of tooth defect, and the type of prosthetic reconstruction supported by implant.

STUDIES ON PATIENTS WITH ECTODERMAL DYSPLASIA

Alcon *et al* [31] conducted a study in a 4-year-old ED patient. Mandibular endosseous implants were paced .Follow-up of 6.3 years was done. After loading, vertical growth pattern changed to low angle due to lack of alveolar growth in time. Correction by changing the vertical heights of the abutment and prosthesis was done. They concluded that early implant placement and fixed prosthesis could be a good treatment option for ED patient.

Bonvin *et al*.[32] reported the clinical course and follow-up of a child with ED treated with implant surgery very early. Different possibilities for prosthetic restoration were reviewed Tolerance was excellent. Good cover of the implant was achieved at 4 years .

Bergendal *et al*.[33] Surveyed dental implant in children with ED up to age 16 years in Sweden between 1985 and 2005. He concluded that the failure rate in children treated because of tooth agenesis was only slightly higher than that reported for adult individuals The small jaw size and preoperative conditions, rather than ED, were thought to be the main risk factors.

Smith *et al*. [34] placed an implant (mandibular anterior region) in an ED patient (5 years) He said that it was considered a treatment of choice since it did not affect tooth buds. Prosthesis remodeling due to implant submergence was required from time to time.

Guckes *et al* [35]conducted a prospective clinical trial. The effect of endosseous dental implants on the mandible of children with ED was studied in twenty-three adolescents (12–17 years) and 12 preadolescents (7–11 years). 225 implants were placed in all. Twenty-two implants failed with a success rate of 91.3% (preadolescent group 88% and adolescent group 90%) .They concluded that Osseointegrated implants in children with ED seem to be a feasible treatment.

CONCLUSION

The lack of relevant long-term clinical studies has not prevented clinicians from using implant- assisted prostheses in children. The literature contains several anecdotal reports of the use of dental implants in children, many with anodontia or severe hypodontia, often associated with ectodermal dysplasia, or from trauma. It must be noted that according to AAPD, since the age group of patients visiting Pediatric dentists extends to almost 21 years, we must recognise that for an implant prosthesis, the patients in this critical age group visit us for careful planning for an implant. Hence it is the Pedodontist's responsibility to be aware and updated and hence the objective of this dissertation is to establish the need for implant awareness in Pediatric dentists.

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TABLES:

	Transverse growth	**Saggital growth**	**Vertical growth**	**Recommendation**
Maxilla	Anterior region completed prior to adolescent growth spurt. Sutural widening greater in posterior	Closely associated with skeletal growth; when it follows the mandibular growth, loss of sutural growth via resorption results.	Maxilla displaced downward via sutural growth, remodelling and eruption; adult levels of vertical growth usually reached at age 17—18 in girls and later in boys.	Delay implant placement until skeletal growth complete.
Implications	Can lead to diastema and shifting of midline to the implant side.	Anterior resorption could result in loss of bone on labial side of implant	Leads to infraocclusal; unfavorable •Endosseous-supraosseous ratio	*In anodontic child, implant placement in the posterior could be considered under well planned conditions
Mandible	Anterior growth ceases early; limited remodeling causes least problems Posterior growth continues longer through remodeling and bone apposition	Endochondral growth at condyle and remodelling of ramus	Height increase bv condylar growth and bone apposition Facial types develop in different ways • Normal: minor rotation • Short: horizontal growth,forward rotation, deep bite. • Long: vertical growth, posterior rotation, skeletal open bite	Delay implant placement until skeletal growth complete *In a severe anodontic or oligodontic child. implants may be placed mandible. *Lack of reports with implants in posterior mandible
Implications	Premolar or molar implant could be shifted into a lingual position	No impact on implant placement • Rotation in sagittal plane must be considered	Affects anteroposterior and vertical eruption patterns • Affects relationship between implant and adjacent tooth in vertical and labiolingual direction	