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Review Article

Implant Placement in Children - A Review

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Abstract

Introduction: In recent years, attempts have been made for the conduction of the best treatment plan for aesthetic and functional problems of the oral cavity which manifest at an early age. Lack or loss of permanent teeth at a young age, requires an advanced treatment plan in order to ensure a correct mastication and the best quality of life to these patients. Whether this lack or loss of teeth is associated with genetic syndromes - such as ectodermal dysplasia, cleidocranial dysostosis and cleft palate – or not, the appropriate treatment should be carefully chosen. In this article, the inclusion of implant placement in the treatment plan of these patients will be analyzed. Another use of implants in children, apart from replacing missing teeth, is helping achieve orthodontic movements.

Materials and Methods: Search for articles from PubMed, Google Scholar and Scopus scientific databases was conducted. The keywords that were used were: dental implants and early age/mini-implants and orthodontics/dental implants and cleidocranial dysplasia/dysplasia/nonsyndromal oligodontia/dental implants in children/dental implants in a young age/cleft patients implants/ectodermal dysplasia implant. In this review, systematic reviews were prefered in the selection.

Results and Discussion: The use of implants in cleidocranial dysostosis and ectodermal dysplasia contributes to a better functional and aesthetic restoration of the oral cavity, with the latter even having a beneficial effect on the psychological state of the patient [3-7]. In cleft palate patients, implants are used for gap closure not only by supporting prosthetic restorations but also for Orthodontic treatment [2]. Implant placement -as a way of treatment- of nonsyndromal oligodontia should be minimal and only prefered in severe cases [1]. Finally, the use of mini implants for orthodontic teeth movement is a technique that constantly acquires ground and is used as an alternative to traditional orthodontic techniques [12].

Conclusion: Despite the fact that implant supported restorations are contraindicated in children, there are few exceptions, where not only for psychological but also for functional reasons, such a therapy is the treatment of choice. Orthodontic implants are an alternative treatment option for some dentofacial deformities.

Keywords: Dental Implants and Early Age; Mini-Implants and Orthodontics; Dental Implants and Cleidocranial Dysplasia; Dysplasia; Nonsyndromal Oligodontia; Dental Implants in Children; Dental Implants in A Young Age; Cleft Patients Implants; Ectodermal Dysplasia Implants

Abbreviation

ED: Ectodermal Dysplasia.

Introduction

The use of dental implants and their advantages in cases of loss or congenital absence of teeth in adults are well known and scientifically proven. An increase of implant placement is observed in daily clinical practice, raising queries of whether implants could be placed in patients of primary age, too. Both people with primary or permanent dentition might lose their teeth and present oligodontia. In cases of primary dentition, there are two possible solutions. Dentists either try to maintain or create space for the eruption of the permanent tooth or choose orthodontic treatment for their patients. One of the main concerns of the dental community

is which treatment is the most suitable for cases of oligodontia in permanent dentition. The loss or absence of teeth could be related to syndromes like cleidocranial dysostosis, ectodermal dysplasia or cleft palate, though lack of teeth could be present in nonsyndromic patients too [1-3,5]. In the Orthodontic field, mini implants- as they are called - are used as a way of tooth movement. These implants differ in dimensions from the conventional ones. The aim of this review is to investigate in which cases dental implants can be used in children.

Materials and Methods

For this review, we conducted a research for articles in PubMed, Google Scholar and Scopus scientific databases. A set of predetermined keywords was used: dental implants and early age /mini-implants and orthodontics /dental implants and cleidocranial dysplasia/dysplasia/nonsyndromal oligodontia/dental implants in children /dental implants in a young age/cleft patients implants/ ectodermal dysplasia implant. During the selection process, two different researchers read the abstracts. Only articles published after 2006 were used. In addition, some articles were hand searched for possible references that could have been missed during the search. In this review, systematic reviews were prefered in the selection. Moreover, we also searched information in Laura's Mitchell book "Introduction to Orthodontics".

Results and Discussion

Oligodontia unrelated to syndromes

Oligodontia seems to be influenced by both genetic and environmental factors. It is one of the most common developmental dental anomalies with many research papers and meta – analysis regarding its prevalence in the population.

Simultaneously with the absence of teeth, anomalies in the position, the structure and the size are often developed. The form and the level of severity of Oligodontia can affect the development of the craniofacial area. This can reveal the importance of the early creation of an appropriate treatment plan which will probably include Prosthodontic and Orthodontic management. Some examples of the abnormalities that this kind of patients could present are smaller lower jaw, provision of the lower and upper incisors or shorter length of anterior and total cranial base [1].

After diagnosis of Oligodontia, which should be made by the combination of the findings from the clinical examination, pictures of the teeth, intraoral, panoramic and cephalometric x-rays, a team of Doctors should be conducted for the better management of the patients. This team would include an Orthodontist, a Prosthodontist, an Oral and Maxillofacial surgeon and a Pediatric Dentist. An appropriate treatment plan and follow-up can be structured by this team.

Usually, the first step is the decision of whether a prosthetic restoration or Orthodontic closure of the gaps will be prefered. The usage of implants is usually avoided in children, though they can be placed in situations where implants can safely and successfully replace the absent teeth, when the prosthetic restorations are not acceptable by the patient or when the removal of healthy tooth tissue is necessary in order for a prosthesis to be placed.

When it is feasible, Orthodontic therapy precedes in order to minimize the gaps and therefore the needed number of implants, while secures the configuration of the desirable profile of the patient and the preservation of the right function of the stomatognathic system [1].

Oligodontia and clefts

Cleft palate or cleft lip are the most common anomalies with a frequency of prevalence 1:700 up to 1:500 [2]. The treatment plan of clefts includes otorhinolaryngologic and orthodontic therapy after the oral and maxillofacial surgery as well as speech treatment. It is important for the masticatory and the stomatognathic system that the closure of the cleft takes place in an early age for the best development of the craniofacial system. In the first year of a cleft patient's life, goals like normal mastication, normal hearing, speech and desirable aesthetics should be achieved for the better socialization and acceptance of the person.

Dental treatment in these patients depends on the number of remaining teeth and their structure in the region of the cleft. The absence of permanent teeth of individuals with clefts can occur at a frequency of 30-50% and it is six times higher than that of non-cleft patients [2]. Orthodontic closure of the gap can be achieved or other technic such as prosthetic restoration or implant placement can be used. The orthodontic tooth movement is preferable in cases of symmetric deficiencies or sub-plastic teeth, but it is problematic for unilateral defects. The greatest disadvantage of prosthetic restorations, such as partial dentures, in addition to the loss of dental tissue is the absence of mechanical tendencies in the osteoplasty-growing alveolar ridge.

Osteoconstricted implants are gaining ground as a way to deal with these incidents. They are more preferable for upper oblique

areas. Implants have an estimated survival rate of 86.7% - 96.7% in the first 3 years, 80% - 98.6% in 5 years, and according to a survey with a follow up which lasted 16 years, 71% is the functional success of single implants to patients with clefts [2]. The authors agree that the appropriate age of placement is when the development has been completed.

Ectodermal dysplasia

Ectodermal dysplasia (ED) refers to a number of genetic syndromes which exhibit a congenital defect in two or more than two of the ectodermal structures of the body. The frequency of the condition is estimated to be about 1 in 100,000 births and there have been identified approximately 132 different syndromes associated with ED. These syndromes usually affect hair, nails, teeth, sweat glands, craniofacial features and they often present abnormalities in mesoderm-derived structures. The signs and symptoms of the oral and maxillary area include decreased growth of the upper and lower jaw, insufficient upper and lower alveolar growth, reductions in saliva excretions, and abnormalities in the number and shape of permanent and deciduous teeth [3,4].

Since many of these patients experience oligodontia or anodontia, prosthetic restoration is usually desirable. The degree of alveolar bone deficiency can make an implant-supported prosthetic restoration an appropriate definitive recovery plan for these patients. However, hereditary absence of teeth, raises the question of whether placing implants in children is a wise choice since the continuous development of the craniofacial system makes the behavior of implants doubtful.

For patients with ED, malformations in the oral cavity lead to decreased functioning during childhood. Adolescence is a critical phase for psychological and physical development. Oral and facial defects may adversely affect the physical and mental wellbeing of adolescents. Therefore, it is not surprising that ED patients request oral rehabilitation at an earlier age, resulting more than often in the long-term use of removable dentures. However, salivary gland hypoplasia in ED patients usually causes mucosal atrophy, which can make it difficult for children to use dentures because of the difficulty in removal. Considering the adaptability of children and the difficulty of using dentures, pediatric patients are often driven to fixed dentures. Seven articles assessed children aged 4 - 11 years with fixed dental implants. Among these children, 50 implants were placed to support fixed dentures with only one was lost. The result was reported to be satisfactory from the children.

It is important that the treatment plan and therefore the appropriate implant placement time are personalized. In order to ensure the best results of this personalized plan, it should be conducted after the detailed examination of all patient-related aspects. In the articles that reported the location of 142 implants in four or five-year-old children, only 2 out of 142 were lost during follow up. 52 (36.6%) of 142 implants were placed in the upper jaw while 90 (63.4%) in the lower. Most implants were placed in the anterior region. Parents reported that the location of implants and the prosthetic restoration significantly improved the nutritional intake of their children. Implant survival rates ranged from 85% to 91% in patients with ED under 18 as reported by the Guckes and others. However, Bergendal and others reported the loss of 9 out of 14 implants (64.3%) before the restoration could be loaded from five ED 5 - 12 year-old patients [3,4]. Many researchers are in favor of the use of osteoconstricted implants, because implant-supported restorations in these patients have high success rates. The disease does not seem to slow down the healing process around the implant, and osteointegration is successful.

Regarding the factors associated with implant loss, the major one seems to be the lack of spongy bone. In the advantages of early implant placement, properties like, reduction of bone loss or even stimulation of bone growth in bulky areas, better circulation, better bone treatment, and normal physical and physiological development of pediatric patients, can be listed. However, due to lack of monitoring data, the effect of implant placement on the development of ED patients, is not clear [3,4].

Cleidocranial dysostosis

Cleidocranial dysostosis is a rare birth defect that is inherited in an autosomal dominant manner and it has a great variety of clinical manifestations in maxillomandibular area. In particular, individuals who have inherited this defect present high angular palate, cleft palate, prognathism of the upper jaw because of the hypoplasia of maxilla and partial or total anodontia. More specifically, teeth show partial or even full inclusion of primary and permanent molars, supernumerary as well as twin teeth. Based on the above, it becomes obvious that people with this defect, face a multitude of problems that experts are called upon to resolve. In addition, there is a general perception that treating this dysfunction produces the best results when it happens at an early age [5-7].

The objective of dental management of cleidocranial dysostosis is to achieve the best possible functional and aesthetic result when patients are young. There is a need for a multifaceted ap-

proach to the problem. Depending on the type and severity of the abnormalities, a group of maxillofacial surgeons, orthodontists and general dentists are invited to develop a personalized treatment protocol. In this plan, dental implants are not an uncommon choice as a means of dealing with dental and occlusal problems. A typical example is the Bronx approach [2,3]. More specifically, it includes 2 - 3 surgical procedures. Initially primary teeth and supernumerary teeth are extracted under general anesthesia and the flaps, that have already been made, are sutured. Thereafter, impacted teeth are revealed and orthodontic rings are placed in order to achieve orthodontic eruption of the teeth. After the orthodontic mechanisms and remaining teeth are placed in the correct position on the arc, a Le Fort I osteotomy is made and finally, dental implants are placed. Implants are used as an effective way to support prosthesis, contributing to a better functional and aesthetic restoration of dentition [5-7].

Use of dental implants in orthodontics

Another application of implants in primary age, is mini implants in Orthodontics. Osteointergrated implants are considered by Orthodontics as an alternative method of treatment for some kinds of orthodontic abnormalities [8]. Back in time, implants' big diameter was an inhibitory factor for their use in orthodontic treatment.

The term mini implants refers to temporary support devices with smaller diameter than usual, which are placed with a simple surgical procedure in the alveolar bone and removed after the completion of orthodontic treatment [9].

Mini implants' length and diameter seem to play a very important role in their use. Their smaller diameter relative to the other implants facilitates their use as they can be placed in areas where there is proximity to the roots. Regarding the length of mini implants according to a survey by Costa., *et al.* (2005) the safest length is 4 - 6 mm [9]. Of course, considering that in each patient the thickness of the alveolar ridge varies, it would be suggested to assess each patient individually in order to decide if they are eligible for implant placement. Mini implants' behavior regarding fractures is questioned because of their small diameter. Generally, mini implants are 4 - 12 mm long and they have a diameter of 1.2 - 2 mm [9]. A number of studies suggest that the minimum depth that these implants should have on the ridge is 5 - 6 mm and even greater depth when the bone quality in the area is low. The research by Y-C.Tseng., *et al*. (2006) showed that mini implants had a greater success rate when placed in the anterior regions of the upper and lower jaw [10]. The advantages are increased restraint, functional and aesthetic improvement, resulting in young patients avoiding social and psychological problems.

It is obvious that mini implants have lots of advantages in orthodontic treatment at a young age. First of all, they increase bone support and enable orthodontic treatment with less traumatic surgical procedures. Moreover, treatment requires less time and cooperation from children than other traditional techniques. That is of utmost importance as children find it difficult to comply with dentists' instructions, such as the application of proper oral hygiene [10]. It is possible to intervene in patients with reduced bone support.

Regarding the limitations of the use of dental mini implants, they should not be applied to people with primary or mixed dentition. Therefore, they usually concern children over 12 years old. Furthermore, it is imperative to be avoided in children who present reduced healing capacity. Such cases include patients with diabetes, diseases treated by corticosteroids like Erythematous Lupus or diseases treated with bisphosphonate medications [9].

Taking into account both advantages and limitations of mini implants, their clinical applications should be mentioned. In orthodontics, implants are used as support devices on which forces are exerted and thus have the ability to control the movement of the teeth during treatment, and even replace the conventional extraoral orthodontic device. A typical example of their clinical application is Class II division 1 malocclusions. The aim of mini implants' use in these cases is to reduce the excessive overjet and to succeed distal movement of the upper molars without the use of an extraoral arc in children. Other dental transpositions in which mini-implants are used are: distal anterior teeth movement, mesial posterior teeth movement, anterior and posterior teeth intrusion [8-10].

Placement of mini implants must follow a specific procedure. There are two categories of mini implants: those that require the creation of a well before placement and those that do not (self – drilling mini-implants). The latter have been increasingly used in recent years as they reduce the duration of treatment. When it comes to placing a self- implant, the following steps should be followed: Initially, local anesthesia is done, the thickness of the soft tissue is measured and the place where the implant is to be located is found. What is to be emphasized is that often in the lower jaw

the bone is compact. Therefore, even if we use self-riding mini-implants, sometimes we should create a well in order to avoid excessive force and breakage of the implant. As far as loading of the implant is concerned, it can be done either directly or later [9-11].

Motoyoshi., *et al*. (2007) report higher success rates when loading of the implants takes place at least 3 months after implant placement [9]. Of particular value is the fact that the placement of mini-implants is a flapless procedure.

Mini orthodontic implants may exhibit certain complications [12]. Mobility of the implant when excessive force is exerted, a possibility of injury to adjacent teeth and nerves and the development of inflammation are the most common complications. This inflammation in some cases may not resolve after careful cleaning of the area and antibiotic use and the removal of the implant is the only treatment. In addition, in order to prevent injury to the adjacent tooth and especially the perforation of adjacent roots, a 2.5% prilocain and 2.5% lidocain formulation can be used as a local anesthetic which anesthetizes the soft tissues and the periosteum in the area where the implant is to be placed but does not anesthetize the periodontal membrane and pulp of adjacent teeth. Thus, the child can sense the pain in case that the clinician approaches for the placement of the implant, the adjacent area [9,10,12].

There are points that remain under investigation as the relationship between a person's development and the placement of implants in children has not been fully elucidated.

Conclusion

In cases of absence or loss of permanent teeth at an early age, the appropriate treatment plan should be conducted very carefully. Researches have clearly demonstrated the need of conduction of personalized treatment plans in these cases, considering medical and dental issues as well as psychosocial aspects of patients. Ideally a team of doctors, including both dentists and physicians should combine their knowledge and experience to plan the most suitable treatment.

Orthodontic gap closure, when the skeletal condition and profile allows it, temporary prosthetic restoration and implant placement have been examined. Usually, early tooth loss is managed preservative with Orthodontic techniques or Prosthetic placement. Implants, though they may be the best solution regarding treatment of absent teeth, their behavior could be problematic due to the continuous development of the craniofacial system. This development is usually asymmetric with phases of slow growth followed by phases of fast development. This forms an environment unsuitable for successful implant placement. Therefore, it is suggested that implant location should wait until the development is completed in exclusion of conditions like ectodermal dysplasia where implant placement can take place in an earlier age.

In addition to dental implants, Orthodontics use mini implants to help in moving teeth as atraumatically and quickly as possible. However, they may experience some complications such as fractures, implant loss, injuries to adjacent teeth, and the appearance of inflammation, often persistent, at their location place.

Conflict of Interest

There is no conflict of interest to disclose.

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