Journal Homepage: -www.journalijar.com

INTERNATIONAL JOURNAL OF ADVANCED RESEARCH (IJAR)

Article DOI:10.21474/IJAR01/19915
DOI URL: http://dx.doi.org/10.21474/IJAR01/19915

RESEARCH ARTICLE

SCOPE OF DENTAL IMPLANTS IN PEDIATRIC DENTISTRY

Dr. Sandeep Mukherjee, Dr. Manohar Bhat, Dr. Abhishek Khairwa, Dr. Gaurav Gupta, Dr. Manib Ratnam Deka Sinha and Dr. Geetika Dixit

Manuscript Info

Manuscript History
Received: 11 September 2024
Final Accepted: 21 October 2024
Published: November 2024

Abstract

Introduction: Dental implants in pediatric patients represent a relatively new approach in dental care. However, the application of implants in children, or in individuals whose growth is not yet complete, remains a subject of debate. Since their introduction, dental implants have provided a reliable, long-lasting, and easy-to-maintain solution for replacing missing teeth in adults. They are known to help preserve the alveolar bone and offer highly aesthetic outcomes.

Methods: Before placing a dental implant, it is crucial to consider the growth and development of the patient, particularly in the context of a growing individual. The biological environment of a developing patient must be understood, as it can influence the implant's stability and success. Additionally, there are distinct differences in facial growth patterns between the maxilla and mandible, which can affect the timing and positioning of implants in these areas.

Result: The use of dental implants has been shown to be effective in children who have undergone bone removal in the maxillary and mandibular regions due to tumors, as well as in long-term bone restoration in cases of palatal clefts. Implant-based treatments have also proven beneficial for addressing dental issues related to congenital conditions, including ectodermal dysplasia, Williams-Beuren syndrome, dental agenesis, and hemifacial microsomia.

Conclusion: Although there is limited published research on the use of dental implants in young patients, long-term clinical studies are needed to draw definitive conclusions. Therefore, the potential benefits of implants should always be carefully weighed against the associated risks and complications. While the scarcity of long-term data should not deter clinicians from utilizing implant-assisted prostheses in pediatric patients, it is particularly important in cases such as children with ectodermal dysplasia (ED), where implants can be a viable and beneficial treatment option.

Introduction:-

Dental Implants: These are prosthetic devices designed to replace missing teeth. They are typically made from biocompatible alloplastic materials such as titanium or zirconia.[1]

Corresponding Author:-Dr. Sandeep Mukherjee

The absence of teeth in children and adolescents can be due to various conditions, including congenital hypodontia, trauma, and anodontia.[2]

The third molars are the teeth most commonly missing, but they typically do not require prosthetic replacement. In contrast, other teeth, such as the mandibular second premolars, maxillary lateral incisors, maxillary second premolars, and mandibular incisors, are frequently absent and may require prosthetic solutions. The prevalence of missing mandibular second premolars is approximately 2.8%, while the absence of maxillary lateral incisors occurs in about 1.6% of individuals. Missing maxillary second premolars and mandibular incisors are much rarer, with occurrence rates ranging from 0.08% to 0.23%. [2]

The loss of teeth in children can significantly impact both their appearance and function. Such absences can lead to various complications, including malocclusion, damage to the periodontal tissues, inhibited alveolar bone development, and difficulties with speech articulation.[3]

Treatment approaches for replacing missing teeth are customized based on the patient's general health, stage of cranial and dental development, the number of teeth missing, and the structure of both hard and soft tissues. For patients still growing, more conservative prosthodontic options, including removable partial dentures, fixed partial dentures, and complete dentures, are typically considered. However, each of these treatment methods has its own set of limitations.[4]

Since the advent of dental implants, they have provided a reliable, long-lasting, and easy-to-maintain solution for replacing missing teeth in adults. Implants can effectively restore dental function, preserve alveolar bone structure, and offer superior esthetics, thereby enhancing the individual's confidence and social acceptance. Nonetheless, their application in growing children remains a topic of debate.[4]

Dental Implants In Pediatric Dentistry

Dental implants have gained significant popularity as a treatment option for adults, due to extensive research and well-established procedures. However, the planning and execution of implant placement in children and adolescents are still evolving, with current methods still in the early phases of refinement.[5]

In cases of partial edentulism, the long-term success of dental implants has led many clinicians to expand their use to adolescents who are missing teeth due to trauma or congenital absence. Both primary and acquired anodontia sometimes present an opportunity for dental implant placement.[5]

When maxillary teeth are absent, the maxilla often does not develop properly in both the sagittal and vertical planes due to insufficient formation of the alveolar ridges. In contrast, the growth of the mandible is not significantly affected by the presence or absence of teeth. As a result, in cases of hypodontia or anodontia, a disproportionate relationship between the upper and lower jaws can emerge, potentially leading to a Class III malocclusion as growth continues. Furthermore, both physiological and psychological considerations strongly support the need for early intervention.[5]

The Classification System for Considering Implants in Growing Children, Proposed by Sharma and Vargervik (2006):

- **Group I**: Children with a single congenitally missing tooth, with adjacent permanent teeth present.
- **Group II**: Children with multiple missing teeth, where permanent teeth are located next to the edentulous areas.
- **Group III**: Children diagnosed with ectodermal dysplasia.

Due to space limitations and the considerable differences in treatment approaches, this discussion will concentrate solely on Group I and Group II cases. It will specifically focus on young patients with one or two missing teeth, emphasizing the management of adjacent permanent teeth, and will exclude Group III cases involving conditions like oligodontia and anodontia.[6,7]

For Group I patients, inserting an implant before growth is finished can result in the implant being positioned lower than the adjacent teeth. This misalignment can lead to aesthetic concerns and may create an unfavorable implant-to-crown ratio if the restoration is modified to compensate for the implant's submergence.[2]

For patients in Group II, removable prostheses are commonly utilized to improve tooth alignment and address edentulous spaces through orthodontic methods. In certain cases, implants may be placed before the completion of growth to provide a more functional, stable, and visually appealing outcome. Once growth is finalized, surgical methods such as segmental osteotomy or distraction osteogenesis may be required to reposition the implant for better alignment. Alternatively, aesthetic symmetry in tooth proportions and gingival contours can be enhanced by replacing the prosthesis with pink porcelain.[2]

Group III patients, often diagnosed with ectodermal dysplasia (ED), face distinct challenges regarding implant placement. Since these individuals typically lack teeth, issues related to dentoalveolar growth and implant submergence are less significant. Instead, the primary concern lies in the mandible's downward and forward growth, which can result in considerable jaw size discrepancies over time.[2]

Growth

Dental implants in children, especially before their growth is complete, are indeed a complex and debated topic. Here's a more detailed look into the considerations and controversies surrounding this treatment modality:

1. Understanding Growth and Development

- Skeletal Growth: Children's jaws and facial structures are still developing, which can affect the positioning and stability of implants. Traditional implants may interfere with natural growth patterns, potentially leading to misalignment or complications.
- Bone Maturity: Implants require sufficient bone density for stability. In growing children, the bone is less dense and may change over time, which can impact implant success.

2. Controversial Aspects

- Growth Disruption: There is concern that implants could disrupt normal jaw growth or cause asymmetries. As the child grows, the implant may not move with the growing bone, potentially leading to problems with bite and alignment.
- Long-term Effects: The long-term impact of implants on a growing child is still not fully understood. Long-term studies are needed to assess potential issues and outcomes as the child matures.[1]

The growth of the maxilla and mandible occurs in multiple directions, including sagittal, vertical, and transverse planes. This process is neither uniform nor constant, as it alternates between slow growth periods and accelerated phases known as growth spurts. During these phases, teeth adapt their positions within the dental arches through remodelling and drifting within the alveolar bone. Functional forces and the shift from primary to permanent dentition help establish a stable interarch occlusal relationship over time.[8]

Maxillary Growth

During early childhood, the transverse development of the maxilla is largely driven by the expansion of the cranial base and growth at the median suture. This sutural growth becomes more pronounced during puberty and is usually the first dimension to reach maturity during adolescence. Placing implants early can lead to a diastema between the implant and neighboring teeth due to continued transverse growth. However, transverse complications are rarely observed with implants placed in the anterior maxilla, even in patients as young as nine years old.[8]

Sagittal growth involves resorption of the anterior maxillary surface, causing it to shift downward and forward. Placing implants in this area at an early stage can result in the loss of labial cortical bone around the implant. Moreover, while teeth naturally drift mesially over time, implants remain fixed and do not accommodate this movement. As a result, implants placed in the lateral regions may impede natural mesial drift, potentially leading to an asymmetrical arch. In the anterior maxilla, continued growth and resorption may cause implants to shift lingually, resulting in misalignment over time.[8]

Vertical maxillary growth occurs through sutural lowering and involves changes such as orbital development, nasal cavity expansion, and enlargement of the maxillary sinuses. This process results from resorption on the nasal surface and deposition on the palatal and alveolar surfaces. Among the three dimensions of growth, vertical development is the last to be completed, typically reaching maturity around 17–18 years in females and later in males. The pattern of growth, whether associated with a long or short facial structure, also influences this development. Placing implants prematurely in the maxilla can result in their positioning becoming too high as growth progresses, potentially encroaching on the nasal floor after puberty while the permanent teeth continue to descend.[8]

Mandibular Growth

The mandible, being more closely connected to cranial structures, grows differently from the maxilla, especially in the sagittal plane. This growth plays a key role in transitioning a child's convex facial profile into the straighter profile seen in adults. Sagittal mandibular growth is driven by endochondral growth at the condyle, which lengthens the mandible while largely maintaining its original shape.[8]

The transverse growth of the mandible typically finishes early, usually within the first year of life, as the symphysis closes. After this, changes are minimal and mostly involve remodelling. In the posterior region, bone resorption occurs on the lingual side, while deposition happens on the buccal side, leading to further remodelling. If an implant is placed prematurely, this bone growth pattern could cause the implant to shift lingually over time. Additionally, the lengthening of the mandible is limited behind the primary second molars to allow space for the eruption of the permanent molars.[8]

Vertical growth in the mandible takes place through apposition at the dentoalveolar complex and the rotation of the condyle, which causes the mandible to move downward and forward in relation to the cranium. This vertical growth is stabilized by a compensatory process within the dentoalveolar complex, ensuring that the vertical dimension remains consistent, provided that tooth eruption occurs as expected and no functional abnormalities are present.[8]

Effect Of Growth And Implant Placement In Relation To Gender

Females typically complete most of their adolescent growth by the age of 15, while males continue to grow into their twenties. During this time, males experience significant changes, including a 20% increase in maxillary depth and a 26% increase in mandibular depth. The mandible moves forward by approximately 30%, and the relationship between the maxilla and mandible shifts by about 33%. In contrast, females undergo only minor changes between the ages of 17 and 20, but may still experience additional growth in their early twenties to early thirties, a phase referred to as post-fertilization growth acceleration.[9]

In males, the posterior facial height shows a more pronounced increase compared to the anterior facial height, with a predominantly horizontal growth pattern similar to their earlier adolescent development. In contrast, females experience a more balanced growth in both anterior and posterior facial heights, with a vertical growth pattern and a backward rotation of the mandible. This results in an increased skeletal vertical dimension. Males, however, have more vertical growth in the posterior regions of the maxilla and mandible, which flattens the angle between the anterior cranial base and the lower border of the mandible. This vertical development also contributes to a more prominent chin.[9]

In both males and females, the maxillary incisors become more upright as they reach adulthood, with the axes aligning more closely to the crowns while the roots move labially. In contrast, the mandibular incisors undergo little to no change. Females tend to have greater inclination and protrusion of their incisors, which helps maintain a consistent interincisal angle, while this angle increases in males. The maxillary incisors are typically upright by 2°–3°, with notable changes occurring between the ages of 31 and 50 years. Maxillary molars also become more upright in males, while they slightly tip in females.[9]

Although growth patterns are similar in both genders, there are significant differences in arch width. Males generally have wider arches than females, with variations ranging from 0.5 mm in the lateral incisor region to 3 mm in the molar area. This difference is primarily due to the faster rate of pubertal growth and a longer growth period in males, who continue growing until the ages of 17 to 25, compared to females whose growth typically concludes by age 15. As a result, males may be considered at higher risk for implant placement before the age of 25 due to ongoing growth during this period.[9]

Cronin et al. found that implants placed during the active growth phase may become displaced or misaligned due to continued growth, which could require their removal and replacement. However, implants placed after the age of 15 in girls and 18 in boys typically have a more favorable prognosis.[9]

Choosing A Proper Implant Insertion Age

In cases of severe anodontia or oligodontia in the mandible, implants can be placed before the pubertal growth spurt, as minimal growth changes occur in the anterior region after the age of 5–6 years due to the lack of teeth. However, for the maxilla, it is typically advised to wait until after the growth spurt before placing implants.[10]

At the 1995 consensus meeting, it was agreed that implant placement, especially in cases of partial edentulism, should ideally be delayed until craniofacial and skeletal growth is complete.[10]

Oesterle et al. noted that implants placed before growth has ceased, especially in the maxilla, tend to show unpredictable behavior and should be handled with great care. They found that implants placed during the pubertal period generally have a better success rate than those placed before puberty, although they still have a lower success rate compared to those placed after growth is complete.[10]

Determining when growth has ceased is essential for implant placement in these patients. Chronological age alone is not a reliable measure, as the timing of growth completion can vary significantly. Growth spurts typically occur around age 12 for girls and 14 for boys, but growth can continue beyond these ages and may vary by as much as 6 years. Furthermore, individuals with short or long face types may experience growth changes up to age 25. Therefore, effective management of these cases requires a collaborative approach from a dental team, including a pediatric dentist, orthodontist, surgeon, and prosthodontist.[5]

Recommendation For Implant Placement By Quadrant

The maxillary anterior quadrant is particularly important due to the common occurrence of traumatic tooth loss and congenital tooth absence. This area experiences significant vertical and anteroposterior growth changes, with vertical growth being more pronounced than other dimensions. Consequently, placing implants too early can require multiple adjustments to extend the transmucosal implant connection, which may negatively impact the implant-to-prosthesis ratio and increase the risk of load magnification.[9]

The maxillary posterior quadrant is affected by the same growth factors as the anterior area, but it also undergoes transverse growth at the midpalatal suture. This results in rotational changes that move the position of the maxillary molars anteriorly. As a result, it is recommended to delay the placement of osseointegrated dental implants in the maxillary posterior quadrant until females reach age 15 and males reach age 17 to accommodate these growth changes.[9]

The mandibular anterior quadrant is the most ideal location for placing osseointegrated implants before skeletal maturity due to its relatively stable growth characteristics. The mandibular symphyseal suture generally closes within the first two years of life, which decreases growth variability compared to other regions. For prostheses supported by implants in the anterior mandible, a retrievable design is recommended. This design allows for adjustments to accommodate an average increase in dental height of 5–6 mm and any potential anteroposterior growth.[9]

The mandibular posterior quadrant presents multiple treatment challenges due to its dynamic growth and development in both transverse and anteroposterior dimensions, along with rotational growth. These factors can complicate implant placement. For this reason, it is recommended to postpone the placement of osseointegrated implants in the posterior mandibular quadrant until skeletal maturation is fully achieved.[9]

Studies On Patients With Ectodermal Dysplasia

Smith et al. (1993) placed an implant in the mandibular anterior region of a 5-year-old patient with ectodermal dysplasia (ED). The implant was selected as the preferred treatment because it did not interfere with the developing tooth buds. However, periodic adjustments to the prosthesis were required to address challenges related to implant submergence over time.[5]

Bonvin et al. (2001) documented the clinical progression and follow-up of a child with ectodermal dysplasia (ED) who underwent early implant surgery. They explored various prosthetic restoration options, with the implants being well-tolerated. At the 4-year follow-up, the implant coverage was satisfactory, demonstrating a positive result for early intervention in this case.[5]

Alcon et al.(2006) conducted a study involving a 4-year-old patient with ectodermal dysplasia (ED) in which mandibular endosseous implants were placed. After a follow-up period of 6.3 years, it was found that the vertical growth pattern shifted to a low angle after loading, due to inadequate alveolar growth over time. To compensate for this, adjustments were made to the vertical heights of the abutments and prostheses. The study concluded that early

implant placement and fixed prostheses could be a feasible treatment option for ED patients based on the observed outcomes.[5]

Bergendal et al. (2008) conducted a survey on the use of dental implants in children with ectodermal dysplasia (ED) in Sweden, covering the period from 1985 to 2005 and focusing on patients up to age 16. They found that the implant failure rate in these children was only slightly higher than that seen in adults. The study suggested that the increased risk was more closely related to factors like small jaw size and preoperative conditions rather than the presence of ED itself.[5]

Sfeir et al.(2014) reported a case series involving three children (ages 11–12) with ectodermal dysplasia (ED), where mini-implants were used to support prosthetic restorations. The study involved placing mini-implants of varying diameters (1.8 mm–2.4 mm) and 13 mm length in the anterior regions of the mandible and maxilla. All three patients received prosthetic rehabilitation supported by these implants. The authors reported that all implants were well integrated and no abnormalities in jaw growth and development were observed during follow-up.[4]

Mello et al. (2015) reported a case involving the oral rehabilitation of a 9-year-old female patient with ectodermal dysplasia (ED). Two mini-implants, each measuring 1.6 mm in diameter and 10 mm in length, were placed. After 2 weeks, the implants were covered with a prosthetic denture. At the 6-month follow-up, the patient reported good adaptation to the prosthesis and was satisfied with the treatment outcome.[4]

The studies and case reports discussed emphasize the use of dental implants in patients with ectodermal dysplasia (ED), showing high survival rates and effectiveness, largely due to the limited options for rehabilitation resulting from insufficient jaw structure. For these patients, the primary goal should be to provide a stable and functional solution that improves their quality of life. Given the absence of a standardized protocol or widespread agreement among researchers regarding the procedures and indications for placing conventional or mini-implants in ED patients, it is essential for clinicians to carefully evaluate all potential risks and benefits. The decision on implant placement technique should be guided by a combination of clinical knowledge, professional experience, and the unique needs of each patient.[4]

Discussion:-

Dentists should not automatically rule out the use of dental implants in young patients merely to prevent infraocclusion, as studies on craniofacial growth indicate that significant changes can persist into adulthood. Consequently, the benefits of implants should be carefully balanced against the potential risks. Key advantages include reduced bone loss, improved aesthetics, enhanced function, better oral hygiene, and greater psychological well-being for the child. Implant rehabilitation can notably boost the self-esteem of children and adolescents, which is an important consideration when deciding on implant treatment.[11,12,13]

In a ten-year follow-up study, which was excluded from the review due to unspecified reasons for implant placement, 47 implants were placed in children aged 13 to 17. The study suggested that implants are a viable option for replacing missing teeth in this age group. Jivraj and Chee pointed out several important factors:

1. **Maxillary Incisor Region**: The lateral incisor area is a critical zone for implant placement due to the ongoing eruption of neighboring teeth and craniofacial changes after adolescence, which can negatively affect implants placed in this region.
2. **Distance Between Implants and Adjacent Teeth**: The proximity of an implant to adjacent teeth affects the amount of bone loss around the implant. A smaller gap between the implant and neighboring teeth is associated with increased bone loss. Therefore, it is important to ensure sufficient space for the implant before placement.

To address these issues, gaining adequate space by aligning and parallelizing adjacent teeth through non-intrusive movements before implant placement is crucial for the success of the procedure.[13,14,15,16,17]

Immediate implant placement, which involves inserting a dental implant into a fresh extraction socket right after tooth extraction, has become a widely accepted and predictable procedure. This approach is increasingly popular for replacing missing anterior teeth because it eliminates the need to wait 4-6 months for the bone to heal and regenerate before placing an implant. Studies have shown that immediate implants often experience less crestal bone loss compared to implants placed using the conventional method, where a waiting period is required for bone healing before implant placement.[18]

Williams-Beuren syndrome, dental agenesis, and hemifacial microsomia are conditions that can greatly benefit from dental implants. In these cases, implants help to resolve the functional and aesthetic challenges associated with missing or malformed teeth, providing significant improvements in both oral health and self-esteem.[19]

The 1988 National Institute of Health (NIH) Consensus Development Conference on Dental Implants, held in Bethesda, concluded that pediatric patients with functional or developmental dysfunctions could benefit from dental implants. The conference acknowledged the potential of implants to address various dental and craniofacial issues in children, especially when conventional prosthetic or restorative approaches are less effective or not feasible.[20]

The timing of implant placement in growing patients was a key focus at the Scandinavian Consensus Conference in Södertälje, Sweden. The consensus was that implant placement should generally be postponed until skeletal growth is either complete or nearly complete in typical adolescents. This approach aims to prevent complications associated with growth changes that could impact implant positioning and overall success.

For individuals with oligodontia (a condition characterized by the absence of multiple teeth) or anodontia (complete absence of teeth), early implant placement may be appropriate, particularly in the mandible. Since mandibular growth generally stabilizes earlier than maxillary growth, earlier intervention can address the patient's functional and aesthetic needs effectively.[21]

When considering implant placement for patients with ectodermal dysplasia syndrome, it's crucial to evaluate each case individually rather than relying on a one-size-fits-all chronological age.[22,23,24,25,26,27,28]

Branemark's research provided a foundation for implantology, while Cieluck's recommendations in 1999 specifically addressed the use of general anaesthesia in pediatric patients.[29,30,31,32]

Therefore, in addition to assessing the severity of hypodontia and the status of skeletal maturity, it is also crucial to consider the psychological impact on the patient before proceeding with implant placement. Addressing the psychological stress and emotional well-being of the patient, especially in younger individuals, can significantly influence the overall treatment outcome and patient satisfaction. Ensuring that the treatment aligns with the patient's emotional needs and supports their self-esteem is an essential part of comprehensive care planning.[33]

Result:-

In contemporary dental practice, implant placement is a key component of treatment planning for edentulous spaces. Implants not only enhance the patient's quality of life by improving esthetics and function but also restore normal masticatory function. As dental surgeons respond to the growing expectations of informed patients, they must balance these benefits with the challenges posed by patient growth and development.

Although implant use in adolescents is less common due to concerns about growth spurts in the maxilla and mandible, adhering to appropriate indications and timing can mitigate these issues. By following established protocols for implant placement in growing patients, dental surgeons can achieve high success rates and incorporate implants into routine practice effectively. Proper timing and consideration of the patient's growth patterns are crucial to ensure that implants function optimally and provide long-term benefits.[10]

Conclusion:-

Currently, there is insufficient evidence to conclusively support or oppose the use of dental implants in children undergoing growth. However, clinicians should not automatically dismiss implants for young patients solely to avoid complications such as infraocclusion. Studies on craniofacial development suggest that substantial changes persist into adulthood, indicating that the benefits of implants—such as improved function, reduced bone loss, enhanced aesthetics, and better oral hygiene—may outweigh potential risks.

Additionally, the psychological benefits of implants, including increased self-esteem and comfort, are particularly valuable for children and adolescents. Implant-based rehabilitation can significantly enhance a young patient's confidence and quality of life.

Although long-term clinical studies are limited, this should not discourage practitioners from considering implant-supported prostheses in pediatric cases, especially for conditions like ectodermal dysplasia (ED), where implants can provide an effective and advantageous solution.[2]

References:-

1. Nikhil marwah, textbook of pediatric dentistry (fourth edition) advancements in pediatric dentistry section – 18, dental implants in children chapter – 81, pages – 994 – 998.
2. Indrajith d.; melath anil; subair k.; arjun m. R.; prakash n.; dental implants in growing children − no longer a myth. International journal of preventive and clinical dental research 10(1): p 14-19, jan–mar 2023.
3. Rakhshan v. Congenitally missing teeth (hypodontia): a review of the literature
4. Concerning the etiology, prevalence, risk factors, patterns and treatment. Dent res
5. (isfahan) 2015; 12:1-13.
6. Iyer h, dixit ub. A review on dental implants in pediatric patients. Indian j oral health res 2021; 7:55-60
7. V krishnapriya, mayuri ganesh, divya gaur, sneha mary mathew, shilpa g., dental implants in pediatric dentistry: a review. International journal of dental and health science 2016; 3(2):405-414.
8. Jon d. Holmes, considerations in dental implant placement in the young patient: a surgeon's perspective. Seminars in orthodontics, vol 19, no 1 (march), 2013: pp 24-36.
9. Shirolkar supreet, anisha bag, khooshbu gayen, rajib sikdar, and subir sarkar, dental implants in growing children: - a multidisciplinary approach. Vol 4 issue 1, 2022: pp 30-33.
10. Agarwal n, kumar d, anand a, bahetwar sk., dental implants in children: a multidisciplinary perspective for long-term success. Natl j maxillofac surg 2016; 7:122-6.
11. M.v. Raghunadha bhatlu, satyendra t., y. Ravishankar, shameen kumar p., dental implants in growing children – a review. Andhra pradesh state dental journal / vol 9/ issue 2 /april 2016.
12. Shah ra, mitra dk, rodrigues sv, pathare pn, podar rs, vijayakar hn. Implants in adolescents. J indian soc periodontol 2013; 17:546-8.
13. Sharma p, arora a, valiathan a., age changes of jaws and soft tissue profile. The scientific world journal 20:1-7, 2014.
14. Gobbato l, paniz g, mazzocco f, wang cw., multidisciplinary management of a young female with infraoccluded dental implants: a case report. Int j esthet dent 11:162-73, 2015
15. Kamatham r, avisa p, vinnakota dn, nuvvula s., adverse effects of implants in children and adolescents: a systematic review. J clin pediatr dent. 2019;43(2):69-77.
16. Thilander b, odman j, lekholm u., orthodontic aspects of the use of oral implants in adolescents: a 10-year follow-up study. Eur j orthod 23:71531, 2001.
17. Jivraj, s., chee, w., treatment planning of implants in the aesthetic zone. Br dent j 201, 77–89 (2006)
18. Schulte j, flores am, weed m., crown-to-implant ratios of single tooth
19. Implant-supported restorations. J prosthet dent 98:1-5, 2007.
20. Schneider d, witt l, hammerle chf., influence of the crown-to-implant length ratio on the clinical performance of implants supporting single crown restorations: a cross-sectional retrospective 5-year investigation. Clin oral impl res 169-74, 2012.
21. Sheng l, silvestrin t, zhan j, wu l, zhao q, cao z, lou z, ma q., replacement of severely traumatized teeth with immediate implants and immediate loading: literature review and case reports. Dent traumatol 31:493-503, 2015.
22. Nedumgottil bm, sam s, abraham s., dental implants in children. Int j oral care res 2020; 8:57-9.
23. Ebenezer, vijay; ramalingam, balakrishnan; elumalai, m., dental implants a new treatment modality for replacement of missing teeth in adolescent patients. Indian journal of public health research & development, 2019, vol 10, issue 11, p3254.
24. Mishra sk, chowdhary n, chowdhary r., dental implants in growing children. J indian soc pedod prev dent 2013; 31:3-9.
25. Durstberger g et al. Implant-surgical and prosthetic rehabilitation of patients with multiple dental aplasia: a clinical report. Int j oral maxillofacial implants 1999; p.417-23.
26. Durstberger g et al. Handbook of facial growth. 3nd ed. Philadelphia: w b saunders company; 1993.
27. Gorlin rj et al. Oxford monographs on medical genetics. Syndromes of the head and neck. 3rd ed. Oxford: oxford university press; 1990. N.19.
28. Guckes ad et al. Using endosseous dental implants for patients with ectodermal dysplasia. Jam dent assoc 1991; 122:59-62.

29. Cagnani, a., barros, a. M. D. S., sousa, l. L. A. D., oliveira, a. M. G., zanin, l., & flório, f. M. (2014). Associação entre preferência por alimentos doces e cárie dentária. Rgo-revista gaúcha de odontologia, 62(1), 25-29.
30. Sandór kb et al. Pediatric dental implantology. J oral maxillofac surg 1995; 53(8):22. Sumiya h et al. Osseointegração e reabilitação oclusal. São paulo: santos; 1997.
31. Sennerby l et al. A biomechanical and morphometric comparison of titanium implants inserted in rabbit cortical and cancellous bone in rabbits. Int j oral maxillofac implants 1992; 7:62-71.
32. Kokich vg. Missing maxillary laterals: are implants the answer? Presented at the american association of orthodontists. 94th annual session. April 30 mav 4. Orlando, 1994.
33. Bauman, j. M., souza, j. G. S., bauman, c. D., & flório, f. M. (2018). Aspectos sociodemográficos relacionados à gravidade da maloclusão em crianças brasileiras de 12 anos. Ciência & saúde coletiva, 23, 723-732.
34. Spiekermann r. Implantology. Zurich: color atlas of dental medicine; 1995. P.91-6.
35. Stalblad p et al. Osseointegration in overdenture therapy. Swed dent j 1985; 28:169-70.
36. Apurva m., dental implants in children: a code to decipher. J dental sci 2017, 2(1): 000120.