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RESEARCH ARTICLE

MINI IMPLANTS IN PEDIATRIC DENTISTRY- A REVIEW

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ABSTRACT

An edentulous smile might look appealing in an infant but its persistence is a serious cause of concern for the parents and the child. Loss of teeth will negatively affect the child's ability to chew, and may affect his or her self esteem. The management of tooth loss in children is distinct from that of adults as the children are in growing stage and the morphology of primary tooth is different from permanent. It has always been a challenge for pedodontist to come up with the best way to replace missing teeth. Mini implants is now used in pediatric dentistry for replacing missing teeth. It becomes a promising alternative to crown anchorage, especially in oral rehabilitation of growing patient due to its simple ways to use, versatility and great biocompatibility. It provides good aesthetic and functional results which improves the child's quality of life, social integration and increases the self-esteem.

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INTRODUCTION

Myriads of children in the world are suffering from loss of teeth due to trauma or congenital hypodontia, which can leads to impaired function and lack of normal alveolar growth, along with unpleasant esthetics that affect the psychosocial development of the young child (Agarwal *et al*., 2016). It has always been a challenge to come up with the best way to replace missing teeth since ancient times (Gleiznys *et al*., 2012). The management of tooth loss in children is distinct from that of adults as the children are in growing stage and the morphology of primary tooth is different from permanent like the presence of large pulp chambers in incompletely mineralized immature teeth of children that can predisposes to loss of pulp vitality in cases of complete coverage restorations. Hence, the clinician resorts to partial coverage prosthesis such as Maryland Bridge, resin-bonded restorations or removable prosthesis. None of these methods of treatment are completely satisfactory and have their own drawbacks like partial dentures are dependent on the child's compliance, they increase the rate of decay and may cause gingival disease leading to bone resorption. Furthermore, there is the need to innovate a prosthesis from time to time to compensate for craniofacial growth (Agarwal *et al*., 2016). Mini implants have become the evolutionary change in the phase of implant placement. The most common use for mini implant is the stabilization of over denture and orthodontic treatment but now they are also used in pediatric dentistry for congenitally missing teeth and tooth loss due to trauma (Mini-Implants in Pediatric Dentistry). Since the conventional implants is a not recommended in growing patients the mini implants have came to the world of pediatric dentistry by solving the drawbacks of conventional implants in growing children. Recent literature has suggested that Mini Implants can be successfully applied in growing patients, without interfering with the normal craniofacial growth process[4]. So the aim of this paper is to give a brief account on mini implants and its importants in pediatric dentistry.

Drawbacks of conventional implants in children: The conventional implants is not recommended in growing patients since they interfere with the sagittal and transversal growth of the maxilla. Balut *et al* and Kramer *et al*. had found that the insertion of conventional implants during jaw development may lead to trauma of dental follicles, impaired tooth eruption and delayed development of orofacial structures[5]. According to Cronin, conventional implants inserted prior to completion of craniofacial growth imitate the effect of ankylosing teeth. Their use in an inappropriate age period, especially in the upper jaw, may lead to interruption of the alveolar bone development and the fall of constructions into infra-occlusion[6] and there are many more studies that have shown the conventional implants are not indicated in patients that are still growing. Mishra *et al*. explore the possibilities of successful prosthesis with conventional implants in adolescents and summarize the following main factors: implantation should be performed after completion of the skeletal growth; The exact inverse age of each child should be subjected to a cephalometric study with orthodontic monitoring;

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the minimum age for treatment is 15 years for girls and 18 years for boys; The only possible site for prosthesis before reaching the skeletal maturation is the lower frontal area, due to the lowest number of registered changes in this area (Mishra, 2013).

What is mini implants?: A mini implant is a miniature sized titanium implant that acts like the root a of tooth. Mini implants were first developed by Dr Victor I Sendax of Newyork in the early 1985. Bulard added single one piece O-ball design. They have a diameter of 1.8mm to 2.7, they are available in multiple tip, thread, body and head.Thread designs vary from thin to thick and thread spacing is also variable. Square, rectangular or o- ball heads are common[8]. Height and anatomic structures of the bone determine the length, shape, and thickness of mini-implants[9].

Comparison of Mini implants with conventional implants: Mini implants are made of one part whereas conventional implants consist of two parts(the implant and the abutment). Miniimplants have one piece titanium screw with a ball shaped head for denture stabilization or square prosthetic head for fixed applications instead of the classic abutment. Mini implants protruded over the gingival surface when they are placed into the bone where as conventional implants are placed under the gingival (Gleiznys, 2012).

Size: Mini implants are smaller in size which makes them ideal for replacing smaller teeth in areas where space is limited as well as for securing full or partial dentures where as conventional implants are more widely used when replacing larger teeth or for securing a bridge of teeth.

- Durability-Both types of implants are made from high-grade titanium alloy. Strength of an implant is due to the length of the post or screw rather than the diameter. Even though mini implants are narrower than conventional implants, the length of the post is comparable to conventional implants. Mini implants are less able to withstand substantial chewing forces when compared to conventional implants and for this reason conventional implants tend to be used when replacing molars.
- **Price:** Due to their smaller size and the straight forward nature of the surgery to place them, mini implants are more affordable than conventional implants.
- **Longevity and Success of Treatment:** A properly placed and well-maintained conventional dental implant has a very high rate of success and can last for decades or even for life. Mini implants are a much more recent innovation and fewer studies have been conducted into their success (Gleiznys *et al*., 2012)

Parts of mini implants

- Head – This part of the mini implant is exposed to the oral environment. is mainly designed to receive attachments like elastics or wires
- Neck – the connecting part between head and body It is of three different heights such as 1mm, 2mm and 3mm for accommodating different soft- tissue thickness at different implants sites.
- Body of the implant is parallel. It is either of self drilling or self tapping type. It has threads and grooves for better interlocking of the mini implant to the bone (https://mydubaidentist.com/micro-implants-temporary-anchorage-devices-tads-in-orthodontics/).

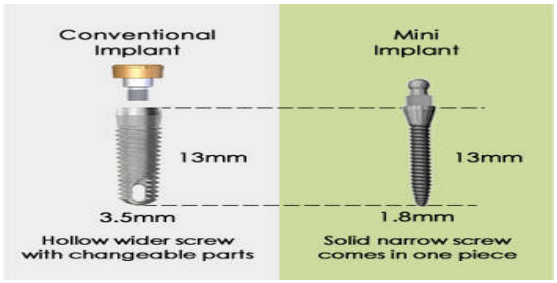

Figure 1. Comparison of mini implants and conventional implants

Figure 2. Parts of mini implant

Use

- a support for a single prosthetic rehabilitation (Vigolo, 2000; Mazor, 2004).
- a reinforcement of the dental arch against occlusal force during the healing period of main fixtures (Bulard, 2001)
- an anchor for a removable prosthesis (Sendax, 1996; Osman, 1999)
- an orthodontic anchor (Kanomi, 1997; Umehara, 2002)
- a preservation of highly advanced periodontitis affected teeth (Nagata, 2000)
- a temporary anchor for transplanted teeth (Nagata, 2002)
- Advantages
- No need for complex flap surgery. No cutting or sutures required. No need for bone grafts (Jofré, 2015; https://mydubaidentist.com/micro-implants-temporary-anchorage-devices-tads-in-orthodontics/)
- Less invasive procedure with shorter healing time. So the prosthetic tooth can be loaded within hours and the healing process is much faster. Healing time is reduced from months to days (Jofré, 2015; https://mydubaidentist.com/micro-implants-temporary-anchorage-devices-tads-in-orthodontics/).
- True innovations for children who are reluctant to have dental surgery (Mini-Implants in Pediatric Dentistry).
- Convenient: Typically the procedure can be completed in one visit and most of the patients can eat normally the same afternoon.
- Prevents facial collapse: Since the mini implant is fixed in your jawbone like a tooth root, it prevents facial collapse that can occur with bone loss.
- Less Discomfort: Less disturbance to bone and tissue means most patients need only over-the-counter pain medication, if any, for a day or so after the procedure. Mini implants do not slip, and are anchored firmly in place.

- Fewer Complications: Because mini implants have a simpler process, there are fewer negative complication
- Biocompatible (Mini-Implants in Pediatric Dentistry)
- It minimizes the cost for treatment (Mini-Implants in Pediatric Dentistry)
- Easier cleaning (Mini-Implants in Pediatric Dentistry)

Drawbacks of mini implants

- Require significant vertical bone: Mini implants still require a good amount of vertical bone as the screws are quite long. They cannot be used in areas where there is insufficient vertical bone or where there has been considerable bone loss.[20]
- More are often required: A greater number of mini implants are required for denture stabilization as the minimum needed for a lower denture is 4 whereas conventional dental implant systems may only require two. They may not be the best solution for the upper jaw where there is usually less bone density. A far greater number of mini implants are needed if they are to be used to stabilize an upper denture, typically between ten and twelve (Upendran, 2019). Whole unit must be replaced: Mini implants are a single unit, so if the implant head wears down after years of use, the entire implant must be replaced. With conventional implants the unit is in two pieces so the head or abutment can be replaced.
- Less data available on longevity:
- The potential for fracture of the implant during placement[8]
- Lack of parallelism between implants is less forgiving because of the one-piece design (Upendran, 2019)
- The reduction in resistance to occlusal loading (Upendran, 2019)

Contraindication

- Uncontrolled diabetes
- Clotting disorders
- Anticoagulant therapy like heparin , antiplatelet drugs
- Metabolic bone disease
- Chemotherapy or radiation therapy
- Chronic periodontal inflammation
- Insufficient soft tissue coverage
- Metabolic or systemic disorders associated with wound and/or bone healing
- Use of pharmaceuticals that inhibit or alter natural bone remodeling like bisphosphate
- Disorders inhibiting patient ability to maintain adequate daily oral hygiene
- Uncontrolled parafunctional habits
- Insufficient bone height (Upendran, 2019)

Selection of the insertion site

- Accessibility: area where proper access for surgical procedures
- Hard tissue conditions (quality and quantity of cortical bone): The cortical bone must be thick enough to provide sufficient stability (mechanical stabilization immediately after implantation).
- Attached gingiva should be in good condition for soft tissue sealing.
- Usability: An implant should be placed in a biomechanically favorable position to allow application of the necessary orthodontic force.
- Areas in which there is potential for irreversible injuries to important anatomic structures are high should be avoided.
- Discomfort: it should be placed in minimal discomfort area for the patient (Mini-Implants in Pediatric Dentistry).

Stability: Stability refers to the absence of mobility in the bone bed after mini implant placement. The clinical success of mini implant depends on their stability at the insertion site. Mini implant stability can be divided into Primary stability and Secondary stability. Primary stability refers to the degree of mechanical interlocking present immediately following mini implants insertion. Primary stability plays significant role in both short term and long-term clinical function of mini-implants (Simon, 2002; Gapski, 2003). Primary stability is the most important factor for the survival of mini-implants. Factors that can influence primary stability are mini implants design, insertion technique, bone quality/quantity, and bone type at the insertion site.

Secondary stability is a biological term and relates to the degree of implant/bone osseointegration, which is a term coined by Branemark as the direct structural and functional connection between living bone and the surface of a load-carrying implant (Branemark, 1983; Albrektsson, 2001). Several histological studies have shown that titanium mini implants osseointegration is less than half of that observed in conventional implants (Costa, 1998). This partial osseointegration of titanium-alloy mini implants is a distinct advantage in orthodontic applications because, while it provides effective anchorage, it can be easily removed following completion of the orthodontic treatment (Vande Vannet, 2007). Metallic screw is manufactured by turning a rod-shaped bland on lathe. The usual machining process results in smooth, polished surface that is contaminated with residue from the tool. Osseointegration of titanium surface is inhibited by both the smooth surface and the manufacturing contaminants (iron, nickel) that permeates the surface. Acid etching of titanium miniscrew removes the contaminats and increase the roughness of the screw. Acid etches titanium screw routinely achieve osseointegration. Surface roughness increases the implant stability while healing and also improves the osseointegration by inducing bone formation. The failure rate of mini implants systems that purely rely on mechanical retention during orthodontic therapy is significantly higher than that for systems utilizing both osseointegration and mechanical retention (Nanda, ?; Fouziya *et al*., 2016).

Stability curve is the relationship of primary and secondary stability can be observed in the characteristic curves. Overall stability is composed of both primary and secondary stability. Immediately after mini-implant placement, all observed stability is due to Primary stability (i.e. there is no secondary stability). Overall Primary stability decreases rapidly at first, as secondary stability takes over. The point at which the primary and secondary stability curves cross is when mini-implants are least stable, and it can be identified by the dip in the stability curve. The rate at which secondary stability increases begins to slow down after 4–5 weeks of healing.

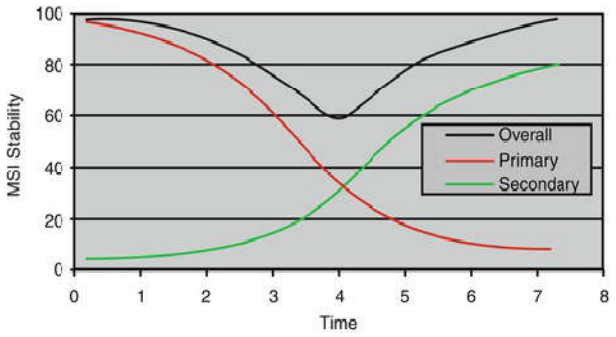

Figure 3. Stability curve

When healing has occurred and the bone has remodeled, overall mini-implants stability is primarily due to the secondary stability (Al-Ohali). They are available in two types self-tapping (ST) type and self-drilling (SD) type. The self-tapping type have a non cutting tip, require pilot hole of same length as implant, once pilot hole is drilled it can be placed without difficulty and minimal tissue damage ,they are more invasive. The screws of this system are characterized by blunt pitches and a screw apex for self-tapping only and often has a two-piece design with a surface treatment that promotes osseointegration during its use in orthodontic therapy. The complications that can occur during predrilling are thermal damage, root damage, and a drill fracture (Park, 2014; Cho *et al*., 2011). The self-drilling have cutting tip, does not required pilot hole, and required high pressure to drill through cortical bone. The disadvantages are like compression of bone, patient discomfort, resorption, loss of tactile sensitivity.

This type of screws are characterized by sharp pitches and a penetrating screw apex and do not necessarily have osseointegration- promoting surface treatment. Placement of the self-drilling mini-implant is simple and takes less time and thermal damage can be avoided. There is no risk of the drill fracture. This system also enhances primary stability by compressing bones during implantation and contact surface of bone to implant is wider The self-drilling system can enhance bone-implant contact by compressing bone and is advantageous to obtain good primary stability. When placing mini-implants in adolescent patients, thin cortical bone, or low bone density such as maxilla, self-drilling mini-implant can enhance primary stability by condensing bone. On the contrary, when placing mini-implants in patients with thick cortical bone or high density bone such as mandible, self-drilling procedure reduced stability by inducing excessive stress to outer surface of the cortical bone. In high density bone or thick cortical bone, however, the SD system is disadvantageous in obtaining good primary stability by inducing excessive pressure that can cause microfracture, adjacent cell damage, and other complications. Sowden and Schmitz reported greater bone damage when placing self-drilling mini-implants when compared with self-tapping mini-implant (Park, 2014; Cho *et al*., 2011)

Insertion Procedure

- Mini-implants should be selected according to the site
- A mild anesthetic is administered in the tissues at the site.
- Placement of mini implant is mostly flapless. However in case of narrow ridge of extensive soft tissue a minimal flap (crestal incision) is recommended to reveal the bone. This would allow exact placement of the implants at the correct angulation in the bone.
- A small hole is been drilled in the bone
- The implant is screwed at its assigned place and tightened with a winged wrench.
- The insertion of the implants will be transmucosal at occluso- gingival position (Mini-Implants in Pediatric Dentistry; Upendran, 2019).

Mini implant in children: Mini implants as a prosthetic replacement gives a psychological advantage to the child as it provides a feeling of his own teeth, the relatively small diameter allows the fixture to be placed even in the presence of transverse bone loss, the mini-implants have minimal osseointegration and, consequently, allow the volumes of soft and bone tissues to be maintained until growth is complete , their removal is non traumatic and not associated with any further deficit (Giannetti, 2010). The miniscrew stimulates the alveolar ridge and thus helps prevent ridge atrophy, and it prevents the adjacent roots from drifting into the edentulous space.[33] Sousa de Oliveira *et al*. has shown that artificial tooth-supporting orthodontic implants can be successfully used to restore missing permanent teeth in children (de Oliveira *et al*., 2017). Another study showed that mini-implants have no remarkable harm on the bone after immediate loading directly after surgery (Jofré, 2010) The simplicity of insertion of mini-implants, the lack of a recovery period and their low cost, compared with conventional implants, make them extremely suitable for temporary prosthetic treatment in children during the period of jaw bone growth (Choi, 2007). This technique is intended to temporarily satisfy the esthetic needs of the patient and can be used as a space maintainer option until the general growth of the patient is complete and the patient is monetarily ready to undergo further restorative treatment (Koka, 2006).

Conclusion

An edentulous smile might look appealing in an infant but its persistence is a serious cause of concern for the parents and the child. Mini-implant is becoming promising alternative to crown anchorage in the anterior region, especially in oral rehabilitation of growing patient due to its simple ways to use, versatility and great biocompatibility. It provides good aesthetic and functional results which improves the child's quality of life, social integration and increases the self-esteem.

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