History of Medicine, 2023, 9(2): 412–415
DOI: 10.17720/2409-5834.v9.2.2023.055

Mini screw Application in Contemporary Orthodontic a Review of Literature

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Received: 11 May 2023 **Accepted:** 10 June 2023

Citation: Abdulhussein Z, Al-Maliky MA, Haleem R, Ehsan R, Shihan T, Adil Z (2023) Mini screw Application in Contemporary Orthodontic a Review of Literature. History of Medicine 9(2): 412–415. https://doi.org/10.17720/2409-5834.v9.2.2023.055

Abstract

Adequate anchoring is frequently difficult to achieve in orthodontics and dentofacial orthopaedics, particularly because many of the numerous methods established for enhancing anchorage rely on patient cooperation. The advent of skeletal anchorage with mini-screw implants, which is extensively employed in orthodontic treatments for increasing the border of tooth movement and has no patient compliance restrictions, has been a significant advancement in orthodontic therapy in recent years. The mini screw implant is only intended to be used as a temporary anchorage device. During space closure, it employs both direct and indirect anchorage. Direct anchorage is the movement of teeth utilizing orthodontic micro screw implants, whereas indirect anchorage is the stabilization of specific teeth in the dental arch and subsequent use of these stabilized anchors to move other teeth.

Keywords

Orthodontics, Mini Screw, Anchorage, Implants, Orthodontic Movement.

The advent of skeletal anchorage with mini screw implants, which is extensively utilized in orthodontic treatments for increasing the border of tooth movement and has no patient compliance restrictions, has been a significant advancement in orthodontic therapy in recent years (Chen et al., 2008b).

Mini screw implants are now well-established supplemental anchorage devices in orthodontic practice. The development of implant assisted orthodontics was motivated by the need for orthodontic treatment techniques that maximize anchoring control while minimizing patient compliance requirements. Although osseo-integrated dental implants provide dependable anchorage for malocclusion management, their applications are limited due to their considerable size.(Roberts et al., 1996)

The miniplate is more stable than the mini-screw, but the flap surgery required for insertion and removal causes swelling and discomfort. Mini-screw implants are now the most commonly used temporary anchorage

devices due to their many advantages, including their low cost and ease of surgical placement and removal. The mini-screw implant's compact and practical size allows it to be used in a variety of anatomical locations, including the interdental area (Pérez Lugo, 2018).
Mini-screw or micro-screw implants used as orthodontic anchoring, on the other hand, should be loaded early to shorten treatment duration and removed after therapy (Pérez Lugo, 2018).

1. Factors effecting the success of mini screw

The thickness of the cortical bone is a key determinant in the success of a mini-screw implant. Inadequate primary stability is frequently caused by insufficient cortical bone thickness. If primary stability is not attained at the time of implantation, the mini-screw implant may become loose throughout orthodontic therapy(Yu et al., 2014).
The deflection of mini-screw implants reduces as cortical bone thickness increases, according to numerical analyses utilizing finite element models (FEMs). Furthermore, cortical bone with a thickness of less than 1 mm is susceptible to pressures that can promote bone resorption in this region (Motoyoshi et al., 2007, Stahl et al., 2009).

Bone quality and quantity are two critical variables of primary stability that affect the long-term durability of a mini-screw implant. Stationary anchoring failure is frequently caused by poor bone density due to insufficient cortical thickness (Motoyoshi et al., 2009a, Kravitz and Kusnoto, 2007). Computed tomography (CT) measures of cortical bone thickness can be used to determine the primary implant stability of a mini-screw implant (Melsen and Verna, 2005).

2. Indications and contraindications for treatment with mini-screw implants

The most common indication for mini screw application are molar protraction followed by indirect anchorage for space closure, Intrusion of supra erupted teeth, Intrusion of anterior open bite, anterior en-masse retraction, Molar uprighting, intrusion of maxillary cant, Molar distalization, traction on impacted canine and attachment of protraction facemask(Papadopoulos et al., 2007).

While the mini screw contraindication is problematic healing, compromised immune defense, bleeding disorders, pathological bone quality, or inadequate oral hygiene Mini-screw implants may also be contraindicated in children with deciduous or early mixed dentition (Hyde et al., 2010).

3. Sites for mini screw implant placement

The area below the anterior nasal spine, the palate (either on the midpalate or the paramedian palate), the infrazygomatic crest, the maxillary tuberosities, and the alveolar process (both buccally and palatally between the roots of the teeth) are all potential sites for mini screw placement in the maxilla, within the mandible The symphysis or parasymphysis, the alveolar process (between the roots of the teeth), and the retromolar area are all potential locations for mini screw insertion (Melsen, 2005).

The inter-radicular bone of the maxilla and mandible in the molar and premolar area is the safe zone for mini-implant implantation in the posterior region. It is inserted 6mm above the cementoenamel junction in the anterior region, between the central and lateral incisors (Cornelius and Ehrenfeld, 2010). A single screw can also be put in the midline of the maxilla. Mini-screw implants can also be placed in the mandibular symphysis, retromolar, infra-zygomatic, and maxillary tuberosity areas (Bayat and Bauss, 2010).

4. Risk factors associated with failure of mini screw implants

According to a recent meta-analysis, miniscrew implants have a failure rate of 0.123 (87.7% success rate). This statistic is slightly higher than the 83.6% success rate reported in a previous uncontrolled meta-analysis. Miniscrew implants have a low and clinically acceptable failure rate when compared to other treatments, which explains their extensive usage in clinical practice (Freudenthaler et al., 2001, Papadopoulos et al., 2011).

The failure rate of miniscrew implants is unaffected by gender, insertion place, or insertion side (left vs. right). However, failure risks are higher in younger (20-year-old) patients than in older (>20-year-old) patients, most likely due to active bone metabolism and low maxillofacial bone maturation in growing

youngsters (Chuang et al., 2001, Motoyoshi et al., 2009b).

Insertion torque is related to miniscrew implant failure rates, and values greater than 10 N cm are associated with a higher failure rate than values less than 10 Ncm.(Miyawaki et al., 2003). Excess tension at the initial bone-implant interface can cause microdamage, local ischemia, and delayed healing in the neighboring bone, culminating in miniscrew implant failure.(Chen et al., 2009)

The proximity of a miniscrew implant to the next tooth root is a primary cause of failure, particularly in the mandible; root contact during insertion is another contributing factor in miniscrew implant failure (Deguchi et al., 2011). Root injuries, on the other hand, are frequently curable. The removal of the inflamed movable screws can prevent additional root resorption of the adjacent tooth (Pan et al., 2012).

Root injuries, on the other hand, are frequently curable. The removal of the inflamed movable screws can prevent additional root resorption of the adjacent tooth. In orthodontic biomechanics, finite element analysis (FEM) is important for modelling stress distribution. FEM-based numerical analyses have revealed

Attached gingiva is not usually required for miniscrew implant maintenance, however it is preferable to the oral mucosa. However, irritation of the miniscrew installation site by oral mucosa may result in undesirable conditions, such as decreased stability (Chen et al., 2008a).

5. Biomechanics considerations of mini screw implant placement

The mini screw implant is only intended to be used as a temporary anchorage device. During space closure, it employs both direct and indirect anchorage. Direct anchorage is the movement of teeth utilizing orthodontic micro screw implants, whereas indirect anchorage is the stabilization of specific teeth in the dental arch and subsequent use of these stabilized anchors to move other teeth (Miyawaki et al., 2003).

In the event of minor mesial tipping, a miniscrew assembly inserted mesially and an open coil spring with distally directed force can be used. When Miniscrew is put mesially on moderately tipped molars, an open coil spring is advised for releasing the molar, followed by an uprighting spring. It is difficult to bond the molar on the buccal surface when there is extensive tilting. A miniscrew is inserted distal to the tipped molar; the best locations are the retromolar pad area or the tuberosity area.

6. Recent advancement

Orthopaedic correction in the three dimensions of craniofacial structures has become achievable with the introduction of miniscrew implants. MARPE (miniscrew implant assisted rapid palatal expansion) is a new orthopaedic transverse maxillary expansion technique. According to studies, MARPE can produce a greater amount of orthopedic expansion than standard expansion equipment (Graf et al., 2018).

Recently, customized miniscrew implant retained appliances with CAD CAM assistance have been employed in orthodontics. For the manufacturing of appliances such as miniscrew assisted hyrax for transverse expansion, direct 3-dimensional metal printing via laser melting is used. Recent research also examines the function of biomarkers in the secondary stability of mini-implants. Changes in biomarkers including IL-1 OPG/RANKL TNF-] and circulating cell free nucleic acids. in peri-miniscrew implant crevicularfluid have been linked to secondary stability of miniscrew implants. According to studies, a higher level of biomarkers is associated with peri-implantitis, which is a probable cause of miniscrew implant (Alassy et al., 2019, Chuang et al., 2001).

7. Future directions

The introduction of orthodontic miniscrew implants broadens the range of discrepancies that may be treated with orthodontic and dentofacial orthopedic treatment. The relative usefulness and efficiency of miniscrew implants utilized for distinct clinical conditions, on the other hand, require additional investigation in prospective controlled research (Chang and Tseng, 2014).

Most of the theorized reasons in orthodontic miniscrew implant failure rates require additional evidence to support their correlations. However, CT or CBCT assessments of the dentomaxillofacial region, as well as technical advances in the miniscrew implant placement method, clearly improve the success rate of miniscrew implant placements (Costello et al., 2010).

Further clinical trials of miniscrew implants in various clinical conditions are required. Mechanical and biological aspects influence the success rate of miniscrew implants. As a result, prospective randomized trials should be conducted to evaluate biological markers and their significance in the stability of miniscrew implants. Clinical research with 3D guided splints should be promoted for the implantation of miniscrew implants. Using artificial intelligence, diagnostic and treatment planning can be automated, and discrepancies can be eliminated to enhance miniscrew implant success rates (Cogan, 2018).

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