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Review Article

Mini Implants in Orthodontics: Unveiling Hazards and Complexities

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Abstract

The potential of clinical orthodontics has substantially increased due to mini-implants(mini-screws) anchoring. Mini-implants can provide stationary anchorages for a variety of tooth movements even in the absence of patient cooperation, and can even enable tooth movement in directions that were previously impractical using conventional orthodontic mechanics. However, there are potential dangers associated with the therapeutic usage of miniscrew anchoring. One of the worst negative effects of using miniscrew anchorage in clinical settings may be screw fracture, which can happen both during installation and removal. There are several potential contributing variables to screw failure, but the mandible and the proximity of the screw root are two major ones. Most often, soft tissue injuries are just transitory, whereas injuries to hard tissues are permanent and should be minimized.

***Keywords:** Mini-implants, TAD's, Skeletal anchorage, Mini-implant failure.*

Introduction

One of the most crucial factors in the effectiveness of clinical orthodontics is anchorage control. There are many anchorage devices available to obtain the proper anchorage. The most effective tools—extraoral anchorages like headgear or facemasks—have the drawback that their success depends on patient compliance. Elastics used between the teeth suffer from the same drawback. Although patient cooperation is not necessary for intraoral anchorages such as the transpalatal arch, lingual arch, holding arch, and others, it is impossible to guarantee absolute anchorage.

Skeletal anchoring was an idea that Creekmore and Eklund[1] introduced to the orthodontic field in the 1980s. They intruded the maxillary incisors by fixing the nasal spine with a titanium screw that had previously been used for intermaxillary fixation during orthognathic surgery. Orthodontic anchorage tools, such as miniscrews and mini-plates, were initially developed in eastern Asia in the 1990s, and they have now gained widespread acceptance[2-5]. These days, they are frequently referred to as temporary anchorage devices (TADs)[6].

Although there are many different types of TADs on the market, miniscrews composed of Ti-6V-4Al alloy have become popular among orthodontists and patients due to their biocompatibility, little discomfort, relative noninvasiveness, and lack of placement restrictions[7,8]. Contrarily, there are various dangers and difficulties associated with the therapeutic usage of miniscrew anchorage, which happen during screw insertion, under orthodontic demands, and during removal[9]. One of the most detrimental side effects of using miniscrew anchorage in clinical settings may be screw fracture, which can happen during both placement and removal[10]. The overall success rate of 4987 miniscrews in 2281 patients was 86.5%, according to a systematic review[11].

Numerous variables are being investigated and are thought to be connected to the screw failure. The majority of the time, soft tissue injuries are just transitory, however irreparable hard tissue injuries must be avoided at all costs.

Furthermore, implant-anchored orthodontics is especially concerned with pain and discomfort following implantation and root resorption brought on by tooth movement to a bone-poor location. The dangers and issues associated with miniscrew anchorage in clinical orthodontics are covered in this article.

Mini-Implant Fracture

Insertion torque is closely connected to screw fracture during placement. Miniscrews typically have an insertion torque of 3 to 10 N cm, which is significantly less than the, according to the manufacturer's instructions, breaking torque[12-13]. The doctor should think about continually derotating the miniscrew 1 or 2 turns during insertion in dense cortical bone to lessen the pressures on the miniscrew and the bone. Once the miniscrew's smooth neck has touched the periosteum, the clinician should stop insertion.

Overinsertion can cause the miniscrew neck to experience torsional stress, which can result in screw loosening and the formation of soft tissues[14].

In the mandible, where cortical bone thickness is substantially greater than in the maxilla, screw fracture is common[15]. Since screw insertion at the mid-palate also tends to require considerable insertion torque, the area 3 mm away from the midpalatal suture is ideal[16]. Even though they are left in the bone for more than a year throughout the active orthodontic treatment, miniscrews are simple to remove with a screwdriver. Suzuki and Suzuki[17] removed 280 miniscrews with a diameter of 1.5 mm and reported four fractures (1.4%). As a result of the miniscrew's focused mechanical stress at the neck via the cortical bone, most fractures occur there. A screwdriver must be turned gently and without shifting its axis to avoid fracture. In the unfortunate event that a screw fractures, an operation is attempted to remove the damaged screw. However, due to its biocompatibility, it is occasionally kept inside of the alveolar bone to prevent undue surgical invasion[18].

Mini-Implant Failure

The rates of stationary anchorage failure of miniscrews under orthodontic loading range between 11% and 30%, according to the literature[19-22]. A miniscrew that becomes loose won't regain its stability and will likely need to be taken out and replaced[23]. Bone density, peri-implant soft tissues, miniscrew design, surgical technique, and force load all affect how stable an orthodontic miniscrew will be during the course of therapy[14,24-28].

In 82 research papers, Papageorgiou et al. recently reported a meta-analysis of the success rates of orthodontic miniscrews or the risk factors for screw failure[11]. They looked at a number of variables and discovered two that were closely connected to success rates: the screw's contact with the nearby root and the location of the screw in the mandible. The proximity of the screw root was first mentioned as one of the main risk factors for screw failure by Kuroda et al.[29].

Factors Related with Mini-screw Failure[18].

Host factors

a. Systemic factors: Age, Smoking, Oral hygiene control
b. Local factors: Implant site, Keratinized tissue, Cortical bone thickness, Bone density

Technical factors

a. Screw: Diameter, Length, Taper, Shape of thread
b. Insertion: Method (self-drilling vs self-tapping), Torque, Angle, Microfracture of bone
c. Loading: Amount, Direction

As mini-implants approaches the apex, the roots get thinner and the interradicular spaces widen[15]. Therefore, it is best to implant screws as high as feasible to avoid getting close to the roots; nevertheless, aside from the clinical crown, the alveolar bone is typically covered in non-keratinized tissue. According to certain findings, screws inserted through non-keratinized mucosa had a greater failure rate[21], and they occasionally became a source of pain and suffering.

Hard Tissue Damage

Ahmed et al.'s[30] histological assessment of the cementum's capacity for reparation following intentional root contact with a miniscrew. Premolar roots were purposefully damaged with miniscrews and excised at 4, 8, or 12 weeks following the incident.

In conclusion, this study proved that cementum healing occurs after a miniscrew injury and that it is a time-dependent phenomenon. On the other hand, root damage caused by the dental pulp is irreversible, and a root canal filling should be required after a pulpectomy or tooth extraction. Miniscrews have the potential to damage periodontal tissues when they are inserted into the alveolar bone. When root damage extends into the cementum and dentin, periodontal tissues have a good mechanism for mending the damage, and clinically there won't be any major concerns[31].

Techniques for Avoiding the Root damage, Screw fracture and Failure[18].

- Minimum local anesthesia
- Placement of a screw into the wider interradicular area
- Choosing a small and short screw as possible
- Oblique insertion of miniscrew
- Placing with a self-tapping method
- Using a screwdriver with a torque limiter

Soft Tissue Damage

Around the miniscrew shaft or on the nearby buccal mucosa in touch with the miniscrew head, minor aphthous ulcerations, also known as canker sores, can appear. Described as mildly painful ulcers that infect nonkeratinized mucosa, aphthi[32]. Minor aphthous ulcerations heal on their own in 7 to 10 days without leaving any scars. With daily use of chlorhexidine (0.12%, 10 mL), placing a healing abutment, a wax pellet, or a sizable elastic separator over the miniscrew head often prevents ulcers and increases patient comfort[32]. A surgeon must be careful not to slip the screw when inserting one at an oblique angle to the surface of the bone. An excellent self-tapping technique, pre-drilling with a round bar on the cortical bone, is required to stop the soft tissue injury caused by the slippage.

Screws inserted through non-keratinized or moveable gingiva stimulate the soft tissue around them and may occasionally cause peri-implantitis. According to Chang et al.[21], miniscrew failure occasionally results from implantation into non-keratinized tissue.

Post Implantation Pain

We previously assessed the postoperative pain and discomfort after implantation of miniscrews, screws, and miniplates using a retrospective questionnaire in 75 patients[8]. Most patients receiving screws or mini-plates with mucoperiosteal flap surgery reported pain 1 day after the implantation, and 35% of them had still felt pain a week later. Additionally, most patients appealed the discomfort and swelling following the surgical procedure. On the other hand, 35% of those patients had still felt pain a week later. We suggest utilising chlorhexidine to rinse and delaying fluoride brushing for 30 minutes. Additionally, the patient can be advised to regularly lift the miniscrew attachments away from the tissue or press down the soft tissue with a plastic toothpick.

Conclusion

With the intention of educating both clinicians and patients, this article has emphasised the dangers and difficulties that could arise with miniscrew installation. Bone mass and stability of implants is directly impacted by soft tissue health. As vital as accurate installation by the orthodontist is adequate miniscrew home care by the patient. Priority should be given to simplifying the procedure as much as possible before modifying the mechanics. Miniscrews are a useful instrument that should be taken out of the orthodontist's tool belt and utilised as necessary rather than being prescribed without prudence.

Conflict of Interest

The authors declare no conflict of interest.

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