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# Failure of mini implants in orthodontics – A literature review

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## ABSTRACT

Obtaining satisfactory clinical results in orthodontic treatment requires adequate mechanical control, which includes anchorage control. Hence it is thought that temporary anchorage devices (mini implant) could provide a good solution for that problems that are encountered in conventional techniques. The aim of the review is to analyse available literature on mini implant in orthodontics and analyse factors associated with failure of implant.

**Keywords:** Mini implants, orthodontics.

## INTRODUCTION

Mini implants have become a tool to address anchorage needs in modern orthodontic practice. They have been widely utilized for anchorage reinforcement and placed within and outside of dentoalveolar region. [1] Skeletal anchorage and orthodontic mini implants especially have great attention in recent years because of their versatility, minimal surgical invasiveness, and low cost. [2] Tooth-supported anchorage resources have the consequence of producing unwanted effects on the supporting teeth. Extra oral anchorage depends on patient compliance, but patients are unwilling to accept this. Therefore, the use of a stable anchorage unit that is independent of patients cooperation and has no collateral effects on adjacent teeth came into existence in recent years through the use of mini implants. [3, 4, 5]

Clinical implication of mini implants as direct or indirect anchorage methods include

- Correction of deep bite,
- Closure of extraction spaces,
- Correction of canted occlusal plane,
- Alignment of dental midline,
- Extrusion of impacted canines,
- Distalization of either maxillary molars or mandibular teeth,
- en-masse retraction of anterior teeth,
- Molar mesialization,
- Maxillary third molar alignment,
- Intermaxillary anchorage to correct saggital discrepancies,
- correction of vertical skeletal discrepancies. [6]

The main mechanism related to efficiency of mini-implants for absolute anchorage in orthodontics is their mechanical adaptation to previously mineralized bone structures, known as inter-locking, which contributes to the success of implant [7]. Failure of implant is defined as spontaneous loss, severe clinical mobility of implant, or infected, painful, pathological changes in surrounding soft tissues. [6]

## METHODS OF REVIEW

All abstract were read, and the full texts of all relevant articles were collected and reviewed.

### The criteria of mini implant success were

1. No inflammation of the soft tissue surrounding the micro implant,
2. No clinically detectable mobility,
3. Anchorage function sustained till end of the treatment

Factors that influence the success rates of implant can be categorized into implant related factors, patient related factors, treatment related factors

Implant related factors included implant type (Indian implant or Abso Anchor), surface characteristics of implant (machined titanium [MT], sandblasted, large grit and acid-etched [SLA]), shape of implant (cylindrical or conical), insertion depth and pre drilling diameter and time of insertion and loading.

Patient related factors included sex, skeletal and dental relationship (Class I, Class II, Class III),mandibular angle (high, average and low), overbite (increased, decreased or normal),oral hygiene status (good, fair or poor), jaw involved (maxilla or mandible), side involved (right or left), and site involved (anterior to premolar area, posterior to premolar area, retro molar area or palatal area).

Treatment related factors included type of insertion (self-drilling or self-tapping), vertical position of insertion (attached or movable gingiva), time of loading, purpose of treatment, mode of loading, type of anchorage used, direction of forces applied (horizontal, vertical or both) and any inflammation present. [6]

**H Martinez et al (2001)** found that a conical shaped implant has high degree of success rate as compared to cylindrical shaped implant because of its ability to provide a tight contact between the implant and tissue as it is deeply inserted due to taper shape which has a larger diameter than the lower part. Although the conical shaped mini implant might produce good primary stability, it may need modification of thread and insertion technique to reduce higher crestal stresses, produced by its tapered or conical shape. [8, 9]

**Karim Chaddad et al in (2008)** states that the overall survival rate was 87.5% and the MT and SLA mini implants system had survival rates of 82.5% and 93.5% survival rates respectively. But ease of use significantly different between these two systems, MT was easier to use (94.1% rated simple) as compared to SLA system (93.3% rated moderate) due to its insertion technique and instrumentation design. [10]

**B Wilmes et al (2009)** both the insertion depth and predrilling diameter had a major impact on measured insertion torque. High insertion depth increases insertion torque/primary stability while larger predrilling diameter decreases insertion torque/primary stability. [2]

**P Sharma et al (2011)** found that patient related factors, there were no significant differences among the sex, jaw, side and site of placement, skeletal and dental relationship, and overbite in success rate of implant but patient with poor oral hygiene and high mandibular angle has significantly less success when compared to patient with good oral hygiene and low mandibular angle. [6]

Treatment related factors, type of micro implant insertion, time of loading, purpose of microimplant placement, mode of loading, direction of forces and type of anchorage used has no significant differences in success rate of implant. [6]

In implant related factors, there were no significant differences in the success rates of the two types of implants studied i.e Indian Implant and Absoanchor. [6]

## FACTORS THAT CONTRIBUTE TO THE FAILURE OF IMPLANTS

### Site

Bone which is fragile, flexible and deformable have little mobility to offer and may not provide ideal absolute anchorage. The cervical structures are relatively fragile, mostly compromised in terms of volume and are subjected to deflection. The bases of alveolar processes of maxilla and mandible are not flexible, for this they are more likely to receive mini implants. Mini implants placed too near the periodontal ligament causes friction between the tooth and implant resulting into inflammation and consequently peri implant bone resorption and loss of mechanical interlocking. To avoid this it must be at least 1mm away from the roots on both sides. Low bone density, thickness and alveolar bone volume affects the effective mechanical interlocking of implant. More apical mini implants are placed more resistant structures are available with denser and more voluminous cortical plates and cancellous bone .In recent extraction sites the alveolar density and cortical plates are under functional remodelling, which hinders mini implant placement in these areas. [7] The screw implants placed in maxilla showed a significantly higher success rate than in mandible. The left side had significantly higher success than right side. This might be explained by better hygiene on the left side of dental arch by right handed patients, who are most of the population. [11]

### Soft tissue location

Chaddad et al found that mini implant failure is more in non keratinised tissue than keratinised mucosa. [10] Local inflammation can be exaggerated not only by oral hygiene but also by weak non keratinised soft tissue around the neck of the screw. A recent study showed non keratinized mucosa was a risk factor for mini screw. Keratinized gingiva is thought to reduce the development of hypertrophic tissues and inflammation. In addition the screw implant in which head of the screw is covered by soft tissue, had greater success rate. The overlying soft tissue on the head of the screw implant might be a barrier against inflammation. [11, 12]

### Diameter of implant

Implant diameters ranged from 1.0mm, 1.5mm, 2.3mm, with the success rate varying from 0% to 100%.In a study by Miyawaki et al, all 1.0mm diameters screws failed but the 1.5mm and 2.3mm diameter screws showed no significant difference with the success rate of 89.9% and 85%, respectively. The results of Miyawaki et al and Park et al indicate that the screws with the diameters of 1.2mm, 1.5mm, and 2.3mm have acceptable levels of success. [11,13,14]

### Length of implant

The length of mini implant is determined by depth and quality of bone, screw angulation, transmucosal thickness, and adjacent vital structures. Short screws in regions with thick soft tissues, such as the palatal mucosa, can easily become dislodged. Longer screws are recommended in these sites. The minimal depth of placement of a mini implant is at least 5 to 6mm, but deeper placements have been recommended when bone quality is low. [13]

### Forces

The maximum force that can be withstood by a mini implant is 50N-450N. Overloading beyond 450N causes delayed mobility resulting into failure of mini implant. Excessive pressure at the commencement of the insertion of mini implant can lead to fracture of cutting tip and intense heat generation in the preinsertion drilling phase can account for local necrosis of bone, leading to failure of mini implant. [15] Liou et al found significant screw displacements after applying immediate forces of $400g^{5}$. Both light continuous and more extreme initial forces of intermittent loading have been used for orthodontic tooth movement. The duration of force application varied widely, from 3 to 37 months. Implant displacement was found in 3 studies after 9, 5.4, and 6.5 months respectively. [13]

### Density

Chances of implant failure is higher in bone with lesser density. [16] Sevimay et al stated that self drilling screws are ideal for D1 and D3 bone. Greater anchorage is achieved when mini implants are inserted into D1 and D2 bone. Placing mini implants in D4 bone is not recommended due to higher rate of failure. If the cortical bone is not

fully engaged during mini implant placement, it can slide under the mucosal tissue along the periosteum bringing about mini implant slippage. [17]

### Angle of placement

Mini screw slippage can occur in dentoalveolar regions of attached gingiva if the angle of insertion is too steep. When an angle of less than 30 degree from the occlusal plane is used and immense forces are applied there are greater chances of mini implant slippage. [17]

Insertion of mini implant at angle less than or greater than 90 degrees to the alveolar process bone might increase the mini implant failure. [18]

### Loading time

Within 16 weeks approximately 75% of mini implant failure has occurred. When loading time < 12 weeks, failure rate of mini implant was high.

Failure rate of mini implant was highest when they were loaded during first week of insertion. Failure of mini implant after loading was frequently observed until 13 weeks hence, the stability of implant requires attention until 3 months after loading. [19]

### Inflammation

Peri implantitis is an important factor in mini implant failure. Inflammation can damage the bone surrounding the neck of the screw implant. Local inflammation can be exaggerated not only by poor oral hygiene but also by weak non keratinized soft tissue around screw implant, which is a risk factor for mini implant failure. [11, 12]

### Host factor

Implants are doomed to fail in patient unmotivated to plaque control and having insufficient quality or quantity of bone to support implant fixture. Patients that smoke cigarettes have demonstrated an increase in implant failures. Similar failure rates between well control diabetics and non diabetics controls or slightly higher failure rates with Type 2 (non insulin dependent) diabetics. Inferior surgical technique (eg: inadequate irrigation of surgical site, using low torque and excessive drill speed during placement, excessive temperature elevation in bone during placement) is another possible cause of implant failure. [12]

## DISCUSSION

The overall success rate was 87.8%. Of patient related factors there were no significant differences according to sex, jaw, side, and site of placement, skeletal and dental relationship and overbite. While other study found that the chances of implant failure is more in mandible and the left side had significantly higher success than the right side. The screw heads covered by overlying soft tissue showed higher success than the exposed screw heads in the oral mucosa. The movable non keratinized alveolar mucosa is easily irritated, soft tissue inflammation around the mini screws directly associated with increased mobility. Most mini screw losses occur as a result of excessive stress at screw- bone interface. It is still not clear the maximum force load a mini screw can withstand in regard to stationary anchorage. Primary stability of implant is dependent upon appropriate cortical bone thickness. Therefore according to many authors mini implants should not be placed in less than 0.5mm to 1mm of cortical bone thickness. There are numerous factors which are responsible for implant failure like poor oral hygiene, gingivitis, thick mucosa, application of force, post extraction healing etc. Chances of implant failure is more in patient with uncontrolled diabetics, smoking, arthritis, medications (immune suppressants), periodontitis and gingivitis.

## CONCLUSION

Mini implant can be used as a temporary anchorage devices, but research in this field is still in its infancy. The success of mini implant totally depends upon bone density, implant design, force, load, patient compliance and surgical technique. Thus, proper case selection and following the recommended protocol are extremely essential to minimize failures.

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