

To Evaluate Success And Failure Rate Of Temporary Anchorage Devices (TADS) In Various Attachments Sites In Maxilla

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Abstract:-

Introduction:-The concept of anchorage is very important in orthodontic treatment outcome and best anchorage is provided by miniscrews. This study focuses on the evaluation of success and failure rate of mini screws used for absolute anchorage. The method of placement and technique is also stated and bone density level, position of roots, anatomic landmarks such as maxillary sinus is also explained. The histologic pattern of gingiva is an important consideration in placing miniscrews, when placed in attached gingiva.

Material & Method:-The span of study is 24 months with sample size of 195 mini screws placed between age group of 20-45 years in different sites of maxilla such as in the Attached and Unattached Gingiva on the Buccal and Anterior region of maxillary alveolar process, median and Paramedian region of palate with recall period of 1- 3 month, 3- 6 month and more than 6 months was followed.

Result:-The overall success rate of mini-screw rate in Attached and Unattached gingiva was highest 90% and 70% between 1st Premolar and 2nd Premolar region region with failure rate of 0 % after 1 year follow up. Whereas in palatal region the paramedian region showed good success rate of mini screw of 80% in between first and second premolar region which is better than midpalatal region.

Conclusion:-Thus this study overall concludes that miniscrews are an efficient way of providing anchorage with good success rate when placed in attached gingiva.

Keywords:- miniscrews, failure rate, attached gingiva

Introduction:-

The best efficacy of treatment is observed when there is no movement of the anchorage unit (zero anchorage loss) as a consequence of the reaction forces applied to move teeth this is known as Absolute or infinite anchorage. Such an anchorage can only be obtained by two method, using ankylosed teeth or using implants, both rely on bone for their anchorage¹.

The Moyer's Symposium in 2004 agreed that the term mini-implant should be applied to palatal implants, miniscrews and microscrews. Creekmore in 1997, described the use of absolute anchorage for treatment of deep overbite using a vitallium bone-screw inserted in the anterior nasal spine². Osseointegrated implants are largely used for skeletal anchorage purposes as they remain stable under orthodontic loading³ but they were expensive, required invasive procedure. Whereas miniscrews are self-tapping devices that do not require osseointegration and are only mechanically retained⁴. As they were self tapping devices which created a thread as it advances into the bone which avoids use of drilling methods for insertion. Immediate loading and easy removal of miniscrews was possible. The thicker the cortical plate the better the survival rate of miniscrews. A mini-implant which was made specifically for orthodontic use was described in 1997 by

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Kanomi⁵. Miniscrew can provide two different types of anchorage: direct and indirect. Direct anchorage describes situations where the teeth desired to be move are pitted directly against mini implants. Indirect Anchorage refers to stabilization of certain teeth in the dental arch & the subsequent use of these stabilized anchors to move other teeth in the dental arch⁶. The mini implants are associated with number of issues such as when placing intra-radicular implants there is root damage. In a study by Papadopoulos⁷ in 2007 stated that the soft tissue impingement, ulceration, and inflammation to be common occurrences, but noted that they are often minor and reversible. Another study by Cope⁸ suggested that soft tissue complications can be limited by proper orientation of auxiliary devices connected to implants, and by rigorous oral hygiene. According to the data by Park⁹ in 2006, Wiechmann¹⁰ in 2007 and Miyawaka¹¹ in 2003 all found implants to be more successful in the maxilla as compared to the mandible, as maxilla has greater amount of keratinized tissue, less demanding surgical procedures, and greater vascularization as compared to lower jaw.

Based on three retrospective cohort studies by Moon CH¹² in 2008 and 2010, Baek SH¹³ investigated miniscrew failures, they concluded on average, the first 2 months after insertion are crucial, with 58% of all failures occurring in this period and with 20% of the overall failures taking place between months 2 and 3. At this point change in treatment plan may be difficult or even impossible. Considering the above findings, an attempt has been made in this study to evaluate the success and failure rate of miniscrews, when placed in various sites of Maxillary arch.

Aim & Objectives:-

Evaluation of the success and failure rate of mini implant temporary anchorage devices in Attached and Unattached gingiva of various site in maxillary arch.

1. Bone Quality:

The stability of mini-screw implants depends on the quality and quantity of the cortical bone. According to the Misch¹⁴ the maxillary alveolar bone is mostly composed of porous bone, corresponding to D3 or D4, whereas the mandible has dense bone classified as D2 and D3. The anterior area tends to have denser bone than posterior area^{15 16} The maxillary buccal cortical bone between the second premolar and first molar is thickest.

Factors Contributing to failure rate & success rate of Implants :-

During placement of a mini screw, the roots of the teeth, nerves and blood vessels, the bone and sinuses in the vicinity of the intended site of placement are all vulnerable to perforation. In the maxilla, the commonly used sites for mini-screw placement are the buccal/palatal alveolar area, the mid-palatal region, and the maxillary tuberosity. The anatomic structures that need to be considered during placement of mini screws are:

i) Tooth Roots

When planning to insert a mini screw between tooth roots, a panoramic radiograph/ IOPA should be used to select the site of placement to check inter-radicular space at the chosen site. These space is maximum between the maxillary second premolar and first molar.



1.

Fig 1: Selection of an Implantation site in the Maxilla.

The safe zone is indicated in blue, while the danger zone are indicated in red.

Greater Palatine Neurovascular Bundle-The two greater palatine foramina are typically located medial to the upper third molars.

ii) Nasal Cavity

The nasal crest is triangular in shape with a width of 5.4 mm at its base and a height of 5.6 mm in the average adult, which is sufficient for mini-screw placement¹⁷ Mini-screw placement in the mid-palatal suture area should be avoided whereas in growing children mid palatal suture mini screw should be avoided because ossification of the suture is incomplete. The para-median area of the palate is a more favorable site in such cases.

iii) Maxillary Sinus

It is pyramidal in shape^{18 19} Perforation of the membrane can occur easily during insertion of an orthodontic mini-screw implant into zygomatic crest²⁰ Zygomatic crest thickness at the level of the first molar's mesio-buccal root is the suitable site for the insertion of orthodontic mini-screw. Zygomatic crest gets gradually thinner in an apical direction and the risk of sinus perforation increases²¹

Placement Specifications:- A mini-screw should be placed 14-16mm above the occlusal plane with the angulation of 55-70° which allows for considerations of individual anatomical variation in sinus pneumatization and the length and inclination of the tooth roots²²

Material And Methods: -

A 24 months descriptive study was conducted, from a period of September 2016 to August 2018. The total sample in the study consisted of 195 mini screw subject between the age group of 20 to 45 years placed in the Attached and Unattached Gingiva on the Buccal and Anterior region, Median and Paramedian region of palate. Recall period of 1- 3 month , 3- 6 month and more than 6months was followed.

All These Patients Were Subjected to The Following Inclusion And Exclusion Criteria.

Inclusion Criteria :

1. Patient with presence of all permanent teeth.
2. Patient with healthy gingival/periodontal condition.
3. Patient with absence of systemic diseases.
4. Patient with absence of cleft lip and palate.
5. Patient with absence of psychological disorder.
6. Patient non-allergic to local anesthetic agent.
7. Patients non-allergic to titanium metal.

Exclusion Criteria :

1. Patients with Congenital deformity of Oro-Facial structures or having pharyngeal pathology.
2. Patients on long term medication.

3. Chronic ulcers in oral cavity.
4. Chronic Periodontitis/Gingivitis.
5. Allergic to titanium metal.

Informed written consent was taken from the patients regarding to the treatment procedure. A subject was excluded from the investigation if a lack of compliance during the study was detected.

Methodology:-

Collection of sample was done based on following procedure: -

1) PRE- PLACEMENT:

All the essential diagnostic records i.e. Intra-Oral Peri-apical Radiograph (IOPA), OPG, Lateral Cephalometrics in some cases CBCT to asses bone level, bone health. Antibiotics were given as prophylactic measure.

c) Placement Procedure:



Fig 2: The mini screw was mounted on a hand driver and secured on the cortical bone surface, before driving through the bone. Stop driving when the head of the screw lies at the level of the surface of the gingiva. Detach the driver from the mini screw by pulling the driver exactly in line with the axis of the screw.



Fig 3

To prevent fracture of mini-screw, bracket holder was used for final rotation of implant

2) MINISCREW PLACEMENT:

Before insertion, the placement site was determined by placing the probe parallel to the long axis of the teeth and keeping in mind the position of the tip of the mini screw.

A) Sterilization of Miniscrew, Instruments, Implant Driver was carried out.

B) Preparation of insertion site:

-The patient was instructed to rinse with a chlorhexidine solution, cleaning the operative area with Betadine Solution was done.

- Local Anesthesia- 2% lidocaine with epinephrine 1:50 000 given. Usually injection of a quarter of a single 1.8 ml ampule was sufficient for alveolar minis crew placement.

- A pinpoint marking was made at the planned insertion site with a periodontal probe.

I) Palatal Mini-Screw:**Fig 4**

Here the favorable position of the first molar's palatal root and the buccal angulation of the second premolar provide excellent access for direct insertion of a mini screw.

a) Median Area:**Fig 5**

The mini screw should be inserted perpendicular to the roof of the oral cavity. In deep palates, the mini screw may have to be inserted slightly from posterior to anterior direction in the sagittal plane.

**Fig 6****1) Between Central & Lateral Incisor**

60–80° angulation, wide inter-radicular space present.

The average distance between the maxillary incisor roots is 2.28mm at a level 5-7mm apical to alveolar crest.

OBSERVATIONS AND RESULTS**table 1**

Sr.No	Site of placement of implant	Total Implants	Success Rate(%)	Failure in 1-3 months(%)	Failure after 3 - 6months (%)	Failure after 6 months - 1year(%)
	Buccal(B)					
A)	Attached Gingiva					
i)	Between 1 st Premolar and 2 nd Premolar	10	9	1	0	0
ii)	Between 2 nd Premolar and 1 st molar	40	33	5	2	0
iii)	Between 1 st Molar and 2 nd Molar	10	6	3	1	0
B)	Un-Attached Gingiva					
i)	Between 1 st Premolar and 2 nd Premolar	10	7	3	0	0
ii)	Between 2 nd Premolar and 1 st molar	40	25	8	7	0
iii)	Between 1 st Molar and 2 nd Molar	10	5	3	2	0
	Palatal(P)					
A)	Median area					
i)	Between 1 st Premolar and 2 nd Premolar	5	4	1	0	0
ii)	Between 2 nd Premolar and 1 st molar	5	3	2	1	0
iii)	Between 1 st Molar and 2 nd Molar	5	2	3	0	0
B)	Paramedian area					
i)	Between 1 st Premolar and 2 nd Premolar	10	7	2	1	0
ii)	Between 2 nd Premolar and 1 st molar	10	6	4	0	0
iii)	Between 1 st Molar and 2 nd Molar	10	3	4	3	0
	Anterior(A)					
i)	Between central incisors	10	9	1	0	0
ii)	Between central and Lateral incisors	10	8	1	1	0
iii)	Between lateral incisor and canine	10	8	2	0	0

Table No. 1 The summary of the Mini-screw placed in Maxillary Arch

Table No.2: Comparison between Success and failure rates of (Mini- Screws) placed in Maxillary Arch at Attached and Unattached Gingiva- Buccal (B) at various sites of placement of implant.

	Attached Gingiva- Buccal (B)		Unattached Gingiva- Buccal (B)	
	Success Rate (%)	Failure rate (%)	Success Rate (%)	Failure rate (%)
Between 1 st Premolar and 2 nd Premolar	9(90%)	1(10%)	7(70%)	3(30%)
Between 2 nd Premolar and 1 st molar	33(82.50%)	7(17.5%)	25(62.5%)	15(37.5%)
Between 1 st Molar and 2 nd Molar	6(60%)	4(40%)	5(50%)	5(50%)
Over all	48(80%)	12(20%)	37(61.67%)	23(38.33%)

Table 2

The success rate is significantly higher in Attached Gingiva – Buccal (B) as compared than in Unattached Gingiva – Buccal (B) at various sites of placement of implant ($p < 0.01$).

Table No.3: Comparison between Success and failure rates of (Mini- Screws) placed in Maxillary Arch at Median area and Paramedian area Palatal (P) at various sites of placement of implant

By applying Z test of difference- significant correlation between 1st Molar and 2nd Molar sites of placement of implant at Median area and Paramedian area Palatal (P) ($p > 0.05$).

	Median area Palatal (P)		Paramedian area Palatal (P)	
	Success Rate (%)	Failure rate (%)	Success Rate (%)	Failure rate (%)
Between 1 st Premolar and 2 nd Premolar	4(80%)	1(20%)	7(70%)	3(30%)
Between 2 nd Premolar and 1 st molar	3(60%)	2(40%)	6(60%)	4(40%)
Between 1 st Molar and 2 nd Molar	2(40%)	3(60%)	3(30%)	7(70%)
Over all	9(60%)	6(40%)	16(53.33%)	14(46.67%)

Statistical analysis:-

- 1) Comparisons were done by applying Z test of difference between two proportions at 5% (p, 0.05) and 1% (p, 0.01) level of significance.
- 2) Statistical analysis software namely SYSTAT version 12 (By Cranes software, Bangalore) was used to analyze the data.

DISCUSSION:-

In orthodontics, anchorage has attracted considerable interest and remained major problem. Several types of extraoral anchors have been used like headgears but major problem in this was patient compliance, several intraoral anchors like the conventional osseointegrated implant, miniplate have been used earlier but major disadvantage with these was invasive surgical preparation. Mini-implants have the advantages of low cost, no surgical placement and high versatility²³. The advantage of mini-screws over others devices are they are of smaller size and they also allow primary stability to immediate loading, or early loading within 4 weeks of placement as they do not osseointegrate. The mini-screws are mainly used in the various areas, among these maxillary arch is considered to be common site for implant placement as it has greater amount of keratinized tissue. Mini-screws have a high risk of failure when placed in unattached gingiva, the risk of failure and fracture during placement increases as the mini-screws diameter decreases. Unscrewing moments must be avoided during force application, and mini-screws inserted between roots might need to be

repositioned during treatment to complete tooth movements. Cortical bone thickness and trabecular bone density are important factors to be considered when determining a mini-screw placement site.

Papadopoulos and Antoszewska J(2009)²⁴ the overall success rates of MIs that remained stable during a mean treatment time of 19.2 +- 2.3 months was 93.43%. The overall Sex, age, jaw, soft tissue management, and placement side did not show any difference in the success rate²⁵. **Park**⁹ concurred the overall success rate in his study was 91.6%. The clinical variables of screw-implant factors (type, diameter, and length), occlusogingival positioning) and management factors (angle of placement, onset and method of force application, ligature wire extension, exposure of screw head, and oral hygiene) did not show any statistical differences in success rates. Mobility of mini screw, jaw (maxilla or mandible), side of placement (right or left) and inflammation showed significant reduction in success rates. **Park, Miyawaki** all found implants to be more successful in the maxilla as compared to the mandible.

According to this study, the success rate of TADs in Maxillary arch at Attached and Unattached Gingiva was 80% and 61.67% which was higher than the 37 % reported by Kim and 78.6% by Moon and 81.1% - 88.6% by Kuorda et al. Therefore, if the miniscrews withstands more than a 6-month period of force application, it can be considered successful and stable.

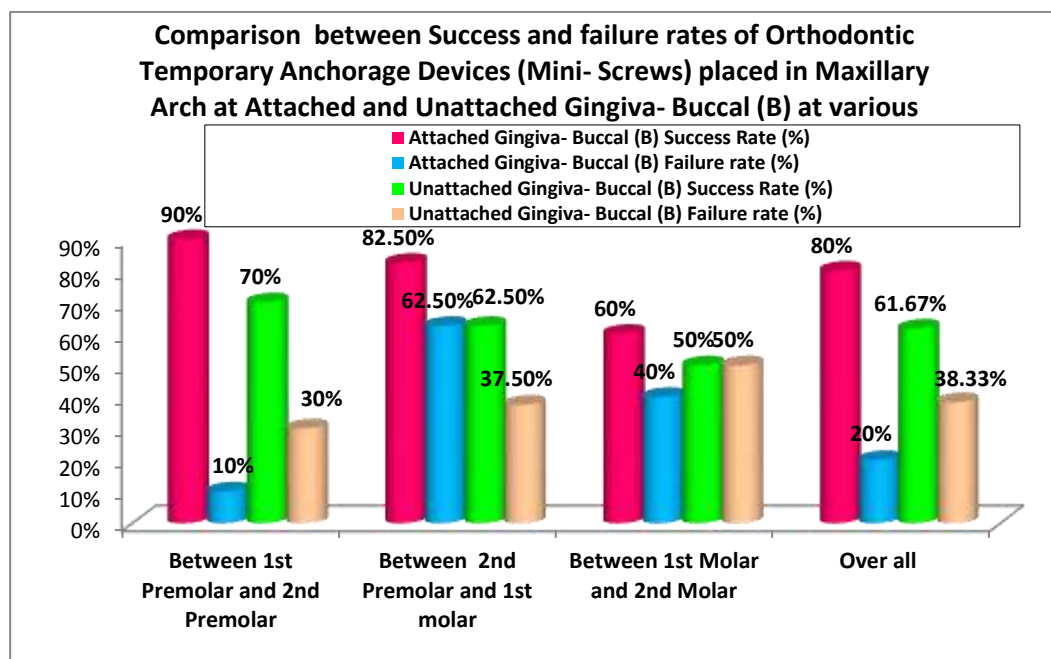


Table 4

I) BUCCAL MINI-SCREWS:**a) Mini-screws in the attached gingiva:**

Cheng et al. (2004)²⁶, Wiechmann et al. (2007)¹⁰ reported the overall success of miniscrews placement in Attached Gingiva was 77.2%. And also the angulation of mini-screw placement can be changed to oblique direction instead of perpendicular direction, which can reduce or eliminate the risk of root injury.

In this study the success rate was 80% and the failure rate was 20%.

B) Mini-screws in the Un-attached gingiva:

Warrer et al. (1995)²⁷ claimed that the absence of mucosal keratinization implies a higher susceptibility to destruction of peri-implant tissues induced by plaque.

In this study the success rate was 61.67% failure rate was 38.33%.

The success rate of mini-screws in this study was 70% in between 1st Premolar and 2nd Premolar region, followed by 60% in 2nd Premolar and 1st Molar region and 30% between 1st Molar and 2nd Molar region. The area between the first and second premolars

provides more favorable accessibility as well as slightly superior bone quality.

II) PALATAL MINI-SCREWS**a) Median region:**

Most of the studies reported by Song Yi lin²⁸ stated that 90.09% success rate in the mid palatal area. Reasons for high success rate in mid- palatal region might be due to the abundance of compact bone and thin gingival tissue in the area. The anterior palate offer greater acceptance compared to other locations at palate. Additionally, hard bone renders a high risk of implant fracture during the insertion procedure. Fracture of a micro-implant would be less if diameter is greater than 1.5 mm and shape is tapered/conical. In this study in palatal region the overall success rate is 60% and failure rate is 40%.

b) Para-median region:

Kim and colleagues²⁹ recorded a success rate of 88.2%. In this study in para median region the overall success rate is 53.33 and the failure rate is 46.67%.

III) ANTERIOR MINI-SCREWS:

Tseng et al³⁰ who found that success rates were the highest in the anterior tooth bearing region of the maxilla. **Chen et al**³¹ also observed the success rate was best in maxillary anterior dento-alveolus followed by maxillary posterior dento alveolus³²

The success rate of mini-screws in this study between central incisors was 90% at, followed by 60% between central and lateral incisor and 30% between lateral incisor and canine. The area between two central incisors have good cortical bone and attached gingiva, therefore the success rate is high in this region.

In this study the overall success rate in anterior region was 83.33% and failure rate was 16.66%.

Conclusion:-

1) The overall success and failure rate was 83.8% and 16.67%. Dislodgement of the mini-screw occurred most frequently in the first 1–2 months, and more than 90% of the failures occurred within the first 4 months.

2) The success rate of mini-screw rate in Attached and Unattached gingiva was highest 90% and 70% between 1st Premolar and 2nd Premolar region, followed by 82.50% and 62.5% at 2nd Premolar and 1st Molar region and 60% and 61.67% 1st Molar and 2nd Molar region.

3) The success rate of mini-screw(TADs) at Median and Para-median area was 80% and 70% at between 1st Premolar and 2nd Premolar region, followed by 60% at 2nd Premolar and 1st Molar region and 40% and 30% between 1st Molar and 2nd Molar region.

4) The success rate of mini- screws in this study between central incisors was 90% at, followed by 60% between central and lateral incisor and 30% between lateral incisor and

canine. The success rate of mini-screws was greater between central incisors.

Further studies are required to validate the results.

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