**Original Article**

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# Comparison of Success Rate between Two Different Surface Treated Miniscrews with Conventional Miniscrews during Fixed Orthodontic Treatment

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Author`s Contribution

*[1,3]Substantial contributions to the conception or design of the work; or the acquisition, [2]Final approval of the study to be published,[4,6]Active participation in active methodology, [2,3]analysis, or interpretation of data for the work, [5,6]Drafting the work or revising it critically for important intellectual content*

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**ABSTRACT**

**Objective:** To determine the success rate between two different surface treated miniscrews and conventional miniscrews during fixed orthodontic treatment.

**Methodology:** This prospective, split-mouth, comparative clinical study was conducted at Orthodontics Department of Dr. Ishrat-ul-Ebad Khan Institute of Oral Health Sciences, Dow university Hospital Karachi, from October 2024 to March 2025. Patient with fixed orthodontic therapy with requirement of absolute anchorage, patients with good oral hygiene and healthy periodontal status, aged 15 to 30 years of either gender were included. Individuals assigned to two groups, with Group A receiving sandblasted miniscrews on the right side and conventional miniscrews on the left, whereas Group B received acid-etched miniscrews on the right side and conventional miniscrews on the left side**.** The success was defined as the ability to maintain anchorage throughout orthodontic treatment without clinically detectable mobility. SPPS-26 version was used for data analysis.

**Results:** The success rate was significantly higher in Sandblasted miniscrew 80% as compared to 56.6% in conventional group (0.047). The success rate of Acid-Etched miniscrew was also found significantly higher 86.6% compared to conventional group 53.3% (p=0.010). However, the success rate was compared between Acid-Etched miniscrew and Sandblasted miniscrew, no significant difference was observed as p-value < 0.05.

**Conclusion:** Success rate of acid-etched surface miniscrews and Sandblasted miniscrews differed significantly. However, significant difference has been found in success rate between surface treated miniscrews with conventional miniscrews.

**Keywords:** Orthodontic treatment, Miniscrews, Acid-etched surface, Sandblasted.

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## Introduction

The adequate anchorage control is a fundamental prerequisite for achieving successful outcomes in fixed orthodontic treatment. According to the definition by Proffit *et al*., "anchorage is the prevention of unwanted dental disocculsion."[1] Extraoral (headgear) and intraoral (trans palatal arch, lingual arch, intermaxillary latex pulling) appliances are examples of anchorage techniques in classic orthodontic therapy.[1] Mini-screws have gained high acceptance recently among temporary anchorage devices due to the various issues associated with external appliances, including patient compliance, anchorage loss, aesthetic drawbacks, and tooth overexertion.[3] Miniscrews allow orthodontists to provide the best treatment outcome by giving them superior control over tooth movement in all three dimensions.[4] But there have also been some documented cases of failure. Failure factors include inflammation, early loosening, root injury, and orthodontic mini-implant fracture. Of them, loosening during the initial phase of treatment is thought to be clinically

significant.[5] The treatment duration is shortened by the instantaneous loading made possible by the 1.4–2.5 mm diameter and 6–12 mm length screws. Because of their absence of osseointegration, they are easy to put and remove. While self-drilling mini-screws do not require predrilling prior to insertion, self-tapping mini-screws do.[6] They can be used on a wide range of indications because of their many benefits. They are helpful in treating anterior open bite and deep bite in addition to mass molar retraction and intrusion.[7] A shorter treatment duration and a lower risk of problems are linked to the alignment of impacted canine teeth with the use of a crucial anchoring.[8]

According to a study by Marquezan M. and colleagues, the overall success rate of mini-implants varied between 79% and 98.2%.[9] In real-world clinical settings, very few prospective studies have assessed variations in stability and success rates based on the type of surface treatment. Although mini-screws are easy to use and have many benefits, there are also risks of failures like generating impairment to the neighboring teeth's roots, screw loosening or breaking, and inflammation surrounding the screw can all happen.[10] However most existing studies are either in vitro, or lacked the split-mouth design, which is considered more superior for minimizing individual-linked confounding factors including density of bone, oral hygienic status and the occlusal forces. Additionally, very limited clinical evidence directly comparing different types of surface-treated miniscrews particularly specifically sandblasted with acid-etched surface within the similar clinical framework. Hence this study was aimed to evaluate the success rate of two distinct surface-treated miniscrews versus traditional miniscrews during fixed orthodontic treatment. Subsequently by the clinical successful evaluation, the findings of this study are expected to assist clinicians in the appropriate selection of miniscrew surface characteristics that can improve stability, and will support the evidence basis decision making for the more appropriate management.

# Methodology

This prospective, split-mouth, comparative clinical study was conducted at Orthodontics Department of Dr. Ishrat-ul-Ebad Khan Institute of Oral Health Sciences (DIKIOHS) Dow university Hospital karahi. Study was conducted over six months from October 2024 to March 2025, after taking ethical approval from ethical committee of hospital (IRB-3516/DUHS/Approval/2024/209, August 9, 2024). All the patients had patient had fixed orthodontic therapy with requirement of bilateral miniscrew supported anchorage, patients with good oral hygiene and healthy periodontal status, aged 15 to 30 years of either gender were included. All the patients with craniofacial trauma or surgery history in the region of miniscrew placement, patients with active periodontal disease or poor oral hygienic status, anatomical restrictions, such as maxillary sinus pneumatization, a small interproximal alveolar bone in PA view, or a CPITN probe-deficient connected gingiva, patients with previous history of orthodontic treatment with miniscrews and those who were taking drugs which can interfere in healing like corticosteroids, bisphosphonates were excluded. After obtaining informed consent and demographic information the patients were divided randomly for surface treatment into two groups using lottery method i.e. 30 in each group. Group-A was treated with Sandblasted miniscrew on the right side of the mouth and conventional treatment on the left side, whereas, Group-B was treated with Acid-etched miniscrew on the right side of the mouth and conventional treatment on the left side. However, the patients were unaware of the type of material that was used in each location. The clinical and radiographic evaluation were done to evaluate the thickness of bone, inter-radicular space, and the thickness of soft tissues in every patient.

Patients were instructed to rinse their mouths with chlorhexidine mouthwash prior to miniscrew insertion, after which local anesthesia was administered. The insertion site for each miniscrew surface type was then selected. Miniscrews with a diameter of 1.3 mm and a length of 8 mm were placed by the principal investigator under the supervision of an experienced clinician, following a well-established clinical protocol. Postoperatively, all patients were instructed to rinse their mouths with 0.12% chlorhexidine twice daily for at least seven days. Analgesics were prescribed and taken as needed to manage postoperative pain. Additionally, patients were provided with detailed oral hygiene instructions for the miniscrew insertion site, including avoiding contact with the miniscrew using the tongue or fingers, refraining from consuming hard foods during the first two days after insertion, and avoiding tapping the miniscrew head with a toothbrush. Insertion torque and mobility were recorded to detect stability and biocompatibility at 15 days post insertion.

The effectiveness of both treatments was studied, and the success rates of the two different kinds of miniscrews were analyzed. Miniscrew success was determined by two criteria: the ability to maintain the anchorage function during orthodontic treatment and the lack of clinically observable mobility (movement more than 1 mm). All the

relevant data were collected via study proforma and analysis was done using SPSS version 26.

# Results

The overall mean age of the patients was 21.27 ± 3.07. Most of the patients were female i.e.; 57 (95%), however, no significant difference was observed in terms of demographic data in both groups (p=>0.05), as shown in table 1.

**Table I: Demographic data in both groups.**

| Demographic Data | Sandblasted miniscrew | Acid-etched miniscrew | P-value |
|---|---|---|---|
| Age (Mean ± SD) | 22.06 ± 4.04 | 21 ± 2.71 | 0.182 |
| BMI (Mean ± SD) | 21.8± 2.8 | 22.56± 3.17 | 0.79 |
| **Gender** | | | |
| Male | 0 | 3 | 0.215 |
| Female | 30 | 27 | |

The sandblasted group showed a significantly higher success rate where 24 successful miniscrews (80%) were successful, while 6 (20%) failed, compared to the conventional group where successful rate of miniscrews was (56.6%) (p-value of 0.047). Table II

**Table II: Comparison of success rate between Sandblasted miniscrews with conventional miniscrews during fixed orthodontic treatment.**

| Groups | Success Rate | | P-value |
|---|---|---|---|
| | Yes | No | |
| Sandblasted miniscrew | 24 (80%) | 06 (20%) | 0.047 |
| Conventional | 17 (56.6%) | 13 (43.3%) | |

Additionally, the Acid-Etched miniscrew also showed a significantly higher success rate 86.6% compared to the conventional group 53.3%, p-value 0.010, as shown in table III.

**Table III: Comparison of success rate between Acid-Etched miniscrew with conventional miniscrews during fixed orthodontic treatment.**

| Groups | Success Rate | | P-value |
|---|---|---|---|
| | Yes | No | |
| Acid-Etched miniscrew | 26 (86.6%) | 04 (13.3%) | 0.010 |
| Conventional | 16 (53.3%) | 14 (46.6%) | |

Furthermore, when the success rate was compared between Acid-Etched miniscrew and Sandblasted miniscrew, no significant difference was observed across the groups (p-value 0.448), as shown in table IV.

**Table IV: Comparison of success rate between Sandblasted miniscrews and Acid-Etched miniscrews during fixed orthodontic treatment.**

| Groups | Success Rate | | P-value |
|---|---|---|---|
| | Yes | No | |
| Acid-Etched miniscrew | 26 (86.6%) | 04 (13.3%) | 0.448 |
| Sandblasted miniscrew | 24 (80%) | 06 (20%) | |

# Discussion

Effective orthodontic treatment depends on accurate anchorage control, with optimal anchorage being highly advantageous as it remains stable during tooth movement.[11] Miniscrews are widely used for this purpose because they are simple to place and remove, minimize trauma to surrounding tissues, and can be inserted at various locations within the alveolar bone.[11] However, the majority of human studies reported in the literature have been retrospective in nature.

The present prospective study was conducted to evaluate the success rates of two different surface-treated miniscrews compared with conventional miniscrews during fixed orthodontic treatment. The study included 60 patients with a mean age of 21.27 ± 3.07 years, and the majority were female (57 patients, 95%). These findings are consistent with those reported by Shi et al,[12] who observed a mean patient age of 21.2 ± 2.9 years. Similarly, Velasco-Ortega et al.[13] reported a higher proportion of female participants, with 74 females and 40 males. In line with these observations, Manni et al.[4] also reported a predominance of female patients (23 out of 39); however, their study demonstrated a lower mean age of 15.55 ± 7.91 years, which may be attributed to a narrower and younger age range in their study population compared with the present study.

In this study success rate of both types of miniscrews was significantly higher compared to the conventional miniscrews. Though, when the two modified miniscrews were compared with each other, the difference was statistically insignificant, with success rates as; 86.6% for the acid-etched type and 80% for the sandblasted type. The findings of the current study were consistent with those of Park et al[8], who reported success rates of 85.7% for sandblasting and 91.8% for acid-etched surfaced mini screws in a split-mouth design in a sample of 40 patients, however, this difference did not reach statistical significance The difference was not significant since it was evident that a difference of nearly 6% in the success (or failure) rate would have required a sample that should have been even larger than the one needed to detect a difference of 15%.[8] However, the Park et al[8], observed this distinction between the two surface treatments. Furthermore, compared to the current investigation, the overall failure rate for acid-etched and sandblasted surface miniscrews was 11.2%[8], which is significantly lower in the present study 16.6%. This may be because Park and colleagues included patients with different sagittal and vertical

patterns and biomechanics, and they considered a variation of insertion sites in both jaws.

In contrast, the current study used surface-treated miniscrews in the right side and conventional treatment in the left side, so all patients received treatment on the same side. The aforementioned findings, however, are surprising in light of in vitro and in vivo assessments by Yadav et al, which serves as a reminder that clinical experience may provide a different conclusion that is mediated by the mechanisms of cellular turnover and bone relaxing. Because of the viscoelastic characteristics of bone, bone reaction participates in the early bone response (about up to 11 days).[14] In aligns to this series a recent split-mouth study involving 31 patients, the survival rates for the sandblasted and acid-etched groups were 90.3% and 83.9%, respectively, compared to the control group; however, the difference was not statistically significant.[9]

To understand the relationship between the screw's success and the interarticular space selected to anchor the fixed functional appliance in the lower arch will require more research that randomly selects the position. The authors of a retrospective study contended that miniscrews in the maxilla had much higher success rates (86.9%) than those in the mandible (76.1%).

They suggested that this discrepancy might be caused by the fact that screws are applied more frequently in the anterior part of the arches, there is more keratinized tissue there, the surgery is less taxing, and the upper jaw is more vascularized.[15] In supporting to our findings et al[5] observed that the Mini-screws treated with sandblasting and large-grit acid-etching showed a significantly better stability, even when subjected to heavy orthodontic forces during the period of healing. Additionally, these surface-treated mini-screws were safely removed without causing damage or the fracture.[5] However Cho YC et al[16] concluded that the plasma ion-implanted miniscrews showed biological performance equivalent to SLA miniscrews, specifically in terms of insertion torque, ratio of bone implant contact, mobility and bone volume fraction. Overall the excessive loading, unscrewing from interacting forces, inflammation surrounding the screw, and the application of torqueing forces[17] are some of the causes that have been suggested to contribute to miniscrew failure. Although there is a wide variety of success rates reported in the literature, the majority of studies show that surface-treated miniscrews have success rates above 80%.[18] Differences in host and geographical parameters among the investigations, as well as variances in miniscrew designs and criteria for measuring treatment effectiveness, can all be attributed for the variability in success rates.[19] However present study was limited by its single-center design**,** very limited sample size, and use of non-probability consecutive sampling, and not analyzed the complications which may affect the conclusive observation. Furthermore, the type of tooth movement was not analyzed, as miniscrews are often used for multiple simultaneous movements, making it difficult to compare success rates for the movement types of individual. Hence further studies are recommended with multicenter designs with larger and randomly selected samples to improve external strength. Likewise, evaluating specific tooth movements separately may provide more strong insights into the success rates of miniscrews under different biomechanical situations.

# Conclusion

In order to improve stability and the success of orthodontic treatment, both miniscrew surface treatments sandblasting and acid-etching were observed using clear and reliable protocols. These materials can be used to increase efficacy of miniscrews in clinical orthodontic therapy. However, further studies with larger sample size by considering the other variables that may affect the success rate must be carried out in future.

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