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# Stability of orthodontic anchoring devices: a narrative review

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## ABSTRACT

**Background and objectives.** Temporary anchoring devices (TADs) are essential for controlling unwanted reactive movements in teeth because orthodontic treatments require effective anchorage to control tooth movement. The goal of this systematic review is to collect information on the advantages, disadvantages, and applications of TADs in orthodontic treatment by addressing the variables affecting their stability and efficacy.

**Materials and methods.** Our review is a non-Cochrane review, following the PICO format for selection criteria, analyzed studies published between 2011 and 2021. The review focused on systematic reviews, meta-analyses, RCTs, case control, and cohort studies in English, extracted from PubMed and Google Scholar databases. A total of 123 papers were assessed, with 39 included for review.

**Results.** The review found that TAD stability is highly influenced by micro-implant design, operator experience, placement technique, bone morphology and histology, and patient variables (such as age and sex). Notably, the quality and amount of bone, the length and diameter of the implant, and the surgical method all played a significant role in achieving primary stability. Although loosening and discomfort are possible side effects, TADs have been demonstrated to provide reliable and effective anchoring during orthodontic treatment.

**Conclusions.** Greater treatment efficacy and patient comfort are made possible by the significant advancement in orthodontic anchoring that TADs represent. The performance of TADs is largely dependent on variables like operator experience, micro-screw size, and bone quality. The mandibular site presented a higher risk of loosening, although patient factors such as age and sex did not significantly affect the loosening rate. This review emphasizes how important it is to take these factors into account in order to maximize TAD stability and, consequently, therapeutic results.

**Keywords:** TADS, orthodontic anchorage, skeletal-anchorage, mini-implants failure-rate, mini-implants success-rate; mini-implant stability

**Abbreviations**
PICO – Patient, Intervention, Comparison, Outcome
RCT – random control study
TAD – temporary anchorage device

## INTRODUCTION

During orthodontic treatment, the teeth are subjected to pressures and moments, and these active forces always produce reciprocal forces that are equal in size but directed in the opposite direction. Redirecting these reciprocal pressures is necessary to reduce unwanted tooth movement and maximize the efficacy of treatment. The ability to withstand

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these undesirable reactive tooth movements is known as orthodontic anchoring, and it can be provided by other teeth, the palate, the head and neck, or bone implants [1].

In the fields of orthodontics and dentofacial orthopedics, maintaining adequate anchoring can be challenging, particularly since many of the various methods for improving it depend on patient compliance [2].

A temporary anchoring device (TAD) is a device that is temporarily secured to bone with the purpose of increasing orthodontic anchorage. It may be used to reinforce the teeth of the reactive unit or prevent the necessity for the reactive unit altogether. The TAD is subsequently removed once it has served its purpose. The implants can be inserted transosteally, subperiosteally, or endosteally, and they can be mechanically (cortically supported) or biochemically bound to the bone (osseointegrated). Implants that have been osseointegrated can be employed as a very secure form of anchoring. Implants do not have a periodontal membrane and fuse with bone. Consequently, when a force is exerted on them, they remain locked in place, and in some circumstances, they can serve as an ideal means of anchorage.

Recently, there have been advancements in the development of small orthodontic screws that can be used in the retromolar area to reposition teeth in a distal or anterior direction. 4mm implants can be inserted into the greatest thickness of the nasal crest, namely at the anterior mid-line of the palate. A trans-palatal bar may be also used as a connection from the mini-screws to the teeth [3].

Dental implants can be utilized for orthodontic anchoring, although they are not classified as temporary anchorage devices because they are not extracted after orthodontic therapy. Significantly, using dental implants and temporary anchorage devices (TADs) in orthodontic treatment enables unlimited anchorage, which is defined as no movement (zero loss of anchorage) due to the reaction forces exerted on the implants [4].

The development of skeletal anchoring with miniscrew implants and miniplates, which is extensively utilized in orthodontic treatments for increasing the border of tooth movement and has no patient compliance restrictions, has been a major advancement in orthodontic therapy in recent years. Miniscrew implants are now a well-known supplemental anchoring device that is commonly utilized in orthodontics [2]. TADs are currently employed to generate different types of tooth movement [5]. But they have disadvantages also. One disadvantage of TADs is their failure rate, which ranges from 5% to 20% in orthodontic literature [5]. 1 to 3 out of every 10 placed TAD become mobile and cannot serve as intended [6-9]. The primary difficulty is unpredictability, as well as recognizing the components that lead to such failure. As a result, any treatment method, including TAD, must account for the likelihood of failure.

The characteristics have been categorized into three groups: implant-dependent (including format, diameter, length, and shape), operator-dependent (including location, orientation of insertion, method of insertion, soft tissue thickness, manner of loading, and the magnitude of force used), and patient-dependent (including age, sex, and oral hygiene) [5].

Several research has been published to date on the application, function, and efficiency of different anchoring methods. However, because there are so many different study designs, sample sizes, and research techniques, it can be difficult for a practitioner to comprehend the findings and evidence offered in these studies [10]. Considering this, and in light of the growing relevance of evidence-based medicine, a comprehensive evaluation of current knowledge appears to be appropriate. By giving a full description of the available data, systematic reviews strive to find, analyze, and synthesize information from scientific clinical research in order to give helpful solutions to scientific problems [10].

## AIM

The following study aimed to compare numerous characteristics and parameters in order to assess the overall success of anchoring and orthodontic therapy.

## MATERIALS AND METHODS

The current narrative review was classified as a non-Cochrane review by the National Institute for Health Research PROSPERO International Prospective Register of Systematic Reviews.

Selection criteria structured in the PICO format are presented in Table 1. Inclusion and exclusion criteria can be found in Table 2.

**TABLE 1.** Selection Criteria-PICO

| Population/ Sample characteristics | Patients undergoing orthodontic treatment |
|---|---|
| Intervention | Orthodontic treatment |
| Comparison | N.A |
| Outcome | Different factors and parameters |

Research question: Do different factors and parameters affect the success rates of an orthodontic intervention?

The criteria for inclusion and exclusion are as follows:

**TABLE 2.** Inclusion and exclusion criteria

| Inclusion criteria | | Exclusion criteria | |
|---|---|---|---|
| 1. | Systematic reviews and meta-analyses, RTCs, case control and cohort studies written in English are also eligible | 1. | Research at the bottom of the hierarchy, such as case reports and expert opinions |
| 2. | Publications published between 2011 and 2021 | 2. | Studies produced and published in languages other than English |

The search covered publications published between 2011 and 2021, spanning a ten-year period. Pubmed and Google Scholar were the electronic medical databases used for this review.

The search was carried out by employing keywords as well as geographical synonyms for the terms “TAD's,” “orthodontic anchorage,” and “temporary anchorage devices.”

A Pubmed search yielded 2946 articles, whereas the Google Scholar search yielded 16,600 results. The search engines of the medical databases were filtered both by relevancy and best match. Their selection was manual, based on their proximity to the chosen topic, and they were further separated based on whether they covered information regarding the relevance of elements in the progress of orthodontic treatment utilizing temporary anchoring devices.

## RESULTS

According to a Pubmed search based on the PICO format presented in the Materials and Methods section, 2946 publications were, however a Google Scholar search yielded 16,600 results. Relevance and best match are the two criteria used to classify medical database search engines. These individuals were chosen manually based on how closely they related to the chosen topic and if they gave information on the significance of various parts of orthodontic treatment employing temporary anchoring devices during the advancement of the treatment. For the final evaluation, a total of 123 papers were further assessed, with 39 of those articles being included in this literature review (Table 3).

### 1. Factors associated with temporary anchorage devices stability

#### Design of a micro-implant

Micro-implants are screw-shaped, measuring 1.0-2.0 mm in diameter and 6-12 mm in length. The small dimensions are crucial because they enable the insertion of TADs in restricted interradicular zones, leading to an appropriate orthodontic force vector.

It is important to note that the stability of TADs is mostly determined by their initial stability. Therefore, using bigger diameters, rather than smaller ones, will

**TABLE 3.** Studies included in the review

| Author | | Journal of Publication | Year of Publication |
|---|---|---|---|
| 1. | Antoszewska et al. [9] | Am J Orthod Dentofacial Orthop | 2009 |
| 2. | Miyawaki et al. [11] | Am J Orthod Dentofacial Orthop | 2003 |
| 3. | Motoyoshi et al. [12] | Journal of Oral Sci | 2011 |
| 4. | Wilmes et al. [13] | J Orofac Orthop | 2006 |
| 5. | Chen et al. [14] | J Oral Maxillofac Surg | 2006 |
| 6. | Sarul et al. [15] | Angle Orthod | 2015 |
| 7. | Crismani et al. [16] | Am J Orthod Dentofacial Orthop | 2010 |
| 8. | Dalessandri et al. [17] | Eur J Orthod | 2014 |
| 9. | Migliorati et al. [18] | Eur J Orthod | 2013 |
| 10. | Chaddad et al. [19] | Angle Orthod | 2008 |
| 11. | Moon et al. [20] | J Orthod Dentofacial Orthop | 2010 |
| 12. | Cheng SJ et al. [21] | Int J Oral Maxillofac Implants | 2004 |
| 13. | Chen YJ et al. [22] | Clin Oral Implan Res | 2007 |
| 14. | Lee et al. [23] | Am J Orthod Dentofacial Orthop | 2010 |
| 15. | Lim et al. [24] | Am J Orthod Dentofacial Orthop | 2009 |
| 16. | Meredith et al. [25] | Int J Prosthodont | 1998 |
| 17. | Chen YJ et al. [2] | Clin Oral Implan Res | 2008 |
| 18. | Çehreli et al. [26] | Am J Orthod Dentofacial Orthop | 2012 |
| 19. | Migliorati et al. [18] | Eur J Orthod | 2012 |
| 20. | Wilmes et al. [13] | Int J Oral Maxillofac Surg | 2011 |
| 21. | Cha et al. [27] | Am J Orthod Dentofacial Orthop | 2010 |
| 22. | McManus et al. [28] | Am J Orthod Dentofacial Orthop | 2011 |
| 23. | Motoyoshi et al. [29] | Int J Oral Maxillofac Implants | 2007 |
| 24. | Marquezan et al. [30] | Angle Orthod | 2014 |
| 25. | Motoyoshi et al. [31] | Clin Oral Implan Res | 2006 |
| 26. | Meursinge Reynders et al. [32] | Am J Orthod Dentofacial Orthop | 2012 |
| 27. | Park et al. [5] | Am J Orthod Dentofacial Orthop | 2008 |
| 28. | Viwattanatipa et al. [33] | Am J Orthod Dentofacial Orthop | 2009 |
| 29. | Zitzmann et al. [34] | J Clin Periodontol | 2004 |
| 30. | Ericsson et al. [35] | Clin Oral Implan Res | 1992 |
| 31. | Kuroda et al. [36] | Am J Orthod Dentofacial Orthop | 2007 |
| 32. | Bayat et al. [37] | J Orofac Orthop | 2010 |
| 33. | Lim et al. [7] | Eur J Orthod | 2011 |
| 34. | Chen et al. [38] | Am J Orthod Dentofacial Orthop | 2008 |
| 35. | Türköz et al. [39] | Eur J Orthod | 2011 |
| 36. | Melsen et al. [40] | Eur J Orthod | 2000 |
| 37. | Büchter et al. [41] | Clin Orthod Res. | 2005 |
| 38. | Motoyoshi et al. [42] | Int J Oral Maxillofac Surg | 2007 |
| 39. | Jung et al. [43] | Clin Oral Implan Res | 2012 |

increase the stiffness of the micro-screws. There is evidence in the literature that supports this notion.

Miyawaki et al. [11] and Motoyoshi et al. [12] have found that screws with a diameter of 1.0 mm or smaller should be avoided due to their much higher failure rate compared to screws with larger cross-sectional areas. The research conducted by Wilmes et al. [13] supports this result, as the scientists found that 1.1 mm screws had lower stability compared to 1.6 mm screws. Chen et al. [14] and Sarul et al. [15] discovered that screws with minimum lengths of 1.2 8 mm and 1.3 8 mm, correspondingly, provide enough initial stability.

Two other meta-analyses conducted by Crismani et al. [16] and Dalessandri et al. [17] have confirmed and supported these results. They have determined that screws with minimum lengths of 1.2 8 mm and 1.3 8 mm, correspondingly, provide enough primary stability.

Consequently, it is advisable to employ micro-screws of at least this size for most therapeutic applications, reserving the smaller Temporary Anchorage Device (TAD) for specific and carefully selected situations.

Migliorati et al. conducted a study to examine the influence of micro-screw thread form on stability in the design of temporary anchorage devices (TADs) [18]. The researchers evaluated a geometric TAD connection to analyze the mechanical properties of miniscrews, quantified as the ratio between the average thread depth and the pitch (D/P).

These findings indicate that a larger surface area is linked to enhanced endurance of micro-implants.

Chadad et al. demonstrated that etching and sandblasting the surface of orthodontic micro-screws did not improve its stability, highlighting the continued significance of screw size [19].

The factors related to the design of the micro-implant that influence its stability are shown in Table 4.

## 2. Patient's characteristics

### Sex and age

Table 5 summarizes the influence of patient variables on the durability of micro-implants.

The majority of the studies found no significant differences between men and women in terms of micro-implant stability [20-24], which was completely corroborated by two separate meta-analyses [16,17], demonstrating that sex has no effect on micro-implant loosening.

In terms of age, Chen et al. [22] found considerably higher micro-screw instability in patients aged

**TABLE 4.** Factors related to the design of the micro-implant that influence its stability

| Micro Implant Design | Influence on the stability of the micro-implant | Authors |
|---|---|---|
| Diameter | Diameter at least 1-2mm improves the stability of micro-implants | Miyawaki S. et al. [11], Motoyoshi M. [12], Wilmes B. et al. [13] |
| Length | Length of at least 8mm promotes the stability of micro-implants | Chen CH. et al [14], Sarul M. et al. [15] |
| Thread shape factor | Higher values of thread shape factor increase the stability of micro-implants | Crismani AG. et al. [16], Dalessandri D. et al. [17] |
| Surface preparation | Etching and sandblasting does not enhance the stability of micro implants | Migliorati M. et al. [18], Cheddad K. et al. [19] |

**TABLE 5.** Factors correlated with stability of micro-implants related to the patient

| Factor | Influence on the stability of micro-implants | Authors |
|---|---|---|
| Sex | Sex has no influence on the stability of micro-implants | Moon CH. et al. [20], Chang SJ. et al. [21], Chen YJ. et al. [22]. |
| Age | Age has no or very little impact on the stability of micro-implants | Lee SJ. et al. [23], Lim HJ. et al. [24], Meredith N. [25] |
| Location | Micro implants are more stable in the maxilla compared to the mandible | Çehreli S. et al. [26], Migliorati M. et al. [18], Wilmes B. et al., [44], |
| Bone quality and quantity | Thicker cortical plate and higher bone density promotes stability of the micro-implants | McManus MM. et al. [28], Motoyoshi M. et al [29], Marquezan M. et al [30] |
| Placement torque | Values ranging from 5 to 10. N correlate with higher stability of the micro-implants | Motoyoshi M. et al. [31], Reynders RAM. et al [32], |
| Nicotine addiction | Smoking of 10 or more cigarettes per day impairs the stability of the micro-implants | Viwattanatipa N. et al. [33], Zitzmann NU. et al. [34], Ericsson I. et al. [35] |

20 to 30, in contrast to Lee et al. [23], who found the best success rates in this age group.

Apart from these two data, most studies [9,11,20,21] found no correlation between patient age and micro-implant stability; two meta-analyses [16,17] corroborate these findings.

Furthermore, while Dalessandri et al. [17] report a greater failure rate in patients under the age of 20, the difference is modest and negligible.

**Bone Anatomy and Histology**

Orthodontic mini-screws implanted in the mandible experience a significantly higher rate of failure compared to those inserted in the maxilla [20]. According to Cheng et al., the thick cortical plate in the mandible causes a rapid rise in temperature during pre-drilling, potentially leading to bone overheating [21].

Another potential danger linked to the heightened thickness of the cerebral cortex is the possibility of bone ischemia caused by the elevated pressure exerted by the mini-screw [25]. Elevated temperature and pressure contribute to the necrosis and degeneration of the bone that provides support to the micro-implant, resulting in the loss of its initial stability and necessitating replacement.

On the other hand, multiple studies have found no disparities in the stability of micro-implants in either the upper jaw or lower jaw. Chen et al. [2] found that the quality of the bone is more important than its position for micro-screw fixation. This is consistent with the findings of Miyawaki et al. [11], who also concluded that cortical thickness is more influential than location.

However, the results of the meta-analyses clearly demonstrate that orthodontic micro-implants placed in the mandible have a greater likelihood of failure [16,17].

As a result, when the TAD in the mandible loosens, another anchoring reinforce approach should be considered early in the treatment planning phase.

The importance of both the quality and quantity of bone in achieving primary stability, which is crucial for the survival of orthodontic mini-screws, is evident. Tightening torque and pull-out force are two crucial factors that affect the screw's capacity to remain securely fixed in the bone. Empirical investigations have demonstrated a direct correlation between these two variables and the thickness and density of the cortical plate, as well as the density of the cancellous bone [18,26,27,44], a finding that is corroborated by study conducted on cadavers [28].

Motoyoshi et al. found that a minimum thickness of 1 mm is required for satisfactory primary stability [29].

The meta-analysis conducted by Marquezan et al. [30] found a good correlation between cortical bone thickness and micro-implant stability. However, the authors stressed the importance of further high-quality clinical research to further support their final conclusion. Motoyoshi et al. determined that the optimal torque values for placement range from 5 to 10 N/cm [31].

As per the authors, a smaller value suggests inadequate mechanical bonding of the micro-screw, while a greater value shows excessive pressure exerted by the implant on the bone, perhaps leading to ischemic osteonecrosis. Meursinge Reynders et al. conducted a meta-analysis and found that there is no optimal rate of torque for inserting mini-implants. However, this could be attributed to the low number of research publications that fit the requirements and were taken into account in the study [32].

**Susceptibility to inflammation**

The detrimental effects of the inflammatory process on the surrounding tissues of the micro-implants have also been extensively discussed in several studies [2,5,7,11,21,33,34]. Research findings indicate that a deep-seated inflammatory process leads to bone degradation, resulting in the eventual loss of stability of the micro-implant [34,35].

Dalessandri et al. found that peri-micro-implantitis significantly raises the likelihood of micro-screw failure by approximately 9 times. This complication is strongly influenced by peri-micro-implantitis, making it one of the most significant factors contributing to the problem [17].

The phenomena can arise either due to infection caused by oral microflora or due to close proximity or tight contact with the adjacent root [36].

Therefore, it is crucial to employ a completely sterile and precise technique for placing micro-implants, and to thoroughly clean the tissues surrounding the micro-screw, in order to minimize failures caused by inflammation.

According to Kuroda et al., placing the micro-implant in free mucosa enhances the likelihood of inflammation. Therefore, it is recommended to position it in connected gingiva whenever feasible [45].

**Nicotine addiction**

According to Bayat and Baus [37], individuals who smoke more than 10 cigarettes per day are at a much higher risk of experiencing micro-implant failure compared to nonsmokers or those who smoke less cigarettes.

Consequently, a medical questionnaire should assist in examining the frequency and intensity of nicotine use, as well as the quantity of cigarettes consumed. If the nicotine use is significant or excessive, it should be considered when evaluating the potential durability of micro-screws utilized in a specific individual.

### 3. Management of TAD

**Placement procedure**

There have been several suggested clinical placement guidelines. Mini-screws are usually inserted under topical or local anesthesia.

They can be drilled or screwed into the bone cortical with or without prior pilot hole preparation, using a hand screwdriver or a contra-angled driver.

The procedure takes between 5 and 15 minutes, depending on the operator experience and the patient cooperation.

Table 6 illustrates the impact of orthodontic mini-screw maintenance on its stability. Multiple surgical protocols for micro-implant insertion have been documented in scientific literature, with the main differentiation being between pre-drilling (self-tapping) and drill-free (self-drilling) techniques [5,7]. The use of the drill-free technology in experiments conducted on dogs demonstrated enhanced stability of the micro-implants. Subsequent histological analysis revealed a higher degree of proximity between the screw and the adjacent bone [38]. A comparative analysis of clinical studies found that the success rates of 1.4 mm micro-implants inserted using the self-tapping method, with either a 0.9- or 1.1-mm pilot bur and without pre-drilling, were identical [39]. There were statistically significant differences in success rates: the highest success rate was observed for micro-screws put using the free-drilling technique, while the lowest success rate was observed for TADs placed using pre-drilling with a 1.1 mm bur. The findings of the cited research indicate that the stability of micro-implant insertion is improved when pre-drilling is not performed. However, it is important to exercise caution when interpreting these findings due to the limited number of micro-screws that were examined. By avoiding the drilling procedure, it seems that there is an increase in the contact and stability between the bone and screw due to the thin cortical and thick cancellous bone in the maxilla. When the jaw has thick cortical bone, there is a high danger of applying too much pressure on the bone during micro-implantation without pre-drilling. This can lead to reduced blood supply and tissue death, known as ischemia and necrosis. Therefore, pre-drilling is necessary in the mandible. Miyawaki et al. [11] and Kuroda et al. [45] assessed surgical techniques involving the use of mucoperiosteal flap elevation. They found that micro-implants inserted without the need for flap elevation had a higher rate of survival. In addition, patients who underwent the less invasive, flapless technique reported significantly lower levels of postoperative discomfort and edema [45]. Consequently, making a small (2-3 mm) vertical cut in the mucosa before inserting a temporary anchorage device (TAD) is the most effective way to manage soft tissues. This incision exposes the bone surface and prevents soft tissues from wrapping around a pilot drill. Antoszewska et al. confirmed the effectiveness of this approach by achieving success rates of over 93 percent [9].

**Loading protocol**

Unlike prosthetic implants, which necessitate an extended healing period and osteointegration, orthodontic micro-implants can be loaded much earlier due to their primary stability fixation, rather than relying on secondary stability. While there is some osteointegration in the case of TAD, it does not have a substantial impact on their stability [40]. The literature states that the loading time after surgery can range from immediate to 3 months. However, most writers agree that immediate loading is feasible and reasonable as long as a moderate force is applied [38-42].

The meta-analysis conducted by Crismani et al demonstrated that the stability of micro-implants

**TABLE 6.** Influence of micro-implant management on their stability

| Micro-implant management | Influence on the stability of the micro-implant | Author |
|---|---|---|
| Self-drilling vs tapping | In the maxilla: smaller or no pilot drilling promotes stability<br>In the mandible: pilot drilling with burs | Antoszewska J. et al. [9],<br>Miyawaki S. et al. [11],<br>Crismani AG. et al. [16],<br>Dalessandri D. et al. [17] |
| Flap preparation | Flapless surgery ensures higher stability of the micro-implants | Viwattanatipa N. et al. [33],<br>Zitzmann NU. et al. [34],<br>Ericsson I. et al. [35],<br>Kuroda S. et al. [36],<br>Kuroda S. et al. [45],<br>Bayat E. et al. [37] |
| Loading protocol | Allowed immediate loading with forces up to 200g | Lim HJ. et al. [7],<br>Chen Y. et al. [38],<br>Türköz C. et al. [39],<br>Melsen B. et al. [40],<br>Büchter A. et al. [41],<br>Motoyoshi M. et al. [42],<br>Jung BA. et al. [43]. |

was attained within a few days after applying a force of up to 200 g [16]. Dalessandri et al's meta-analysis provides additional evidence for the feasibility of early loading, as it demonstrates that there is no significant difference in stability between micro-implants loaded within 4 weeks after implantation and those loaded beyond 4 weeks [17]. However, it is reasonable to postpone loading for a period of 2 weeks after the insertion of micro-implants in order to ensure undisturbed healing of the mucosa around the TAD heads. This is crucial for avoiding inflammation, which is a major cause of orthodontic mini-screw failures.

**Operator's experience**

According to Lim et al., the proficiency of the operator has a significant impact on the stability of orthodontic mini-screws [7]. According to the authors, clinicians who had inserted a minimum of 20 micro-screws had a 3.6-fold greater probability of achieving primary stability compared to operators who had performed less procedures.

Jung et al. showed that the clinician's proficiency also affects the positioning of the TAD on the palate [43].

In addition, Cho et al. found that increasing the number of micro-implantations decreases the likelihood of causing damage to a nearby root [46]. The stability of micro-implants implanted by both a maxillofacial surgeon and an orthodontist showed no significant differences, indicating that orthodontists are fully capable of doing successful micro-implantations once they have gained the necessary expertise [2].

## DISCUSSION

Temporary anchoring devices (TADS) are a relatively new addition to the dental arsenal that can be used instead of traditional extra-oral orthodontic devices. According to a review of the literature, using TADS is an orthodontic method that is dependable, safe, and has a high rate of success.

Temporary anchorage devices have a lot of promise since they can satisfy several fundamental needs for both the orthodontist and the patient. In reality, these technologies allow for absolute anchorage-independent and systematic patient compliance, as well as the ability to provide rapid, cosmetic, and cost-effective therapy. The most significant risks (damage to nerves, root canal, maxillary sinus, and nasal cavity) are mentioned as probable complications in the literature and are still preventable with proper pre-operative examination. The most frequent problems, such as device loosening and local irritation, are mild annoyances that the doctor may readily handle.

The introduction of TADS at the beginning of the twenty-first century dramatically improved orthodontic treatment efficacy while also enhancing patient comfort. However, like with any other anchorage-boosting approach, using TADS has various drawbacks, the most serious of which is a loss of stability.

Based on available data, the efficacy rates of micro-implants range from 75 to 94 percent. This means that around 1 to 3 out of every 10 installed TADS (Temporary Anchorage Devices) become loose and are unable to function as intended [6–9].

Consequently, the failure of a micro-screw requires a further insertion, which increases the expense, duration, and discomfort of the treatment.

The premature dislodgement of orthodontic micro-implants has been a significant problem since they were first introduced in clinical practice. This has led to the need for research on the factors that contribute to the instability of temporary anchorage devices (TADS).

The use of temporary intraoral skeletal anchoring devices has become increasingly common in modern orthodontics. Therefore, it is crucial to understand the factors that affect the stability of these micro-implants in order to fully utilize their potential.

The latest research indicates that the survival of micro-implants is dependent on factors such as bone quality and quantity, the use of micro-screws with dimensions of at least 1.2 diameter and 8 mm length, and inflammation prevention. However, factors like age and sex do not have an impact on micro-screw loosening, which is more common in the mandible.

Enhancing the learning curve is essential for optimizing the success rates of microscrews, since improved surgical proficiency enhances the stability of placed micro-implants.

Due to the varied nature of the studies analyzed and the diversity of the data, it is important to interpret the findings of this analysis with caution. The definition of success was not consistent across the papers examined in this investigation, making it inappropriate to provide an exact figure for implant stability and success, as well as the factors that may affect these figures.

In addition, only a limited number of studies investigated whether treatment objectives could have been achieved without the use of Temporary Anchorage Devices (TADs) by utilizing other methods for orthodontic anchorage.

Nevertheless, certain overarching inferences can be derived from the examination of the data:

1. TADs were selected among many anchoring options in the studies analyzed. They were largely chosen due to their compliance-free nature and their tendency to be less bulky compared to other anchorage devices.
2. The utilization scope achievement rates of TADs surpassed 80% in all investigations.

3. Transosseous dental implants (TADs) shown greater efficacy when placed in the maxillary alveolar bone compared to the mandibular alveolar bone.

It is crucial to maintain proper oral hygiene around the implant site since it helps decrease soft tissue irritation, which is associated with higher chances of TAD failure.

Regarding the safety of mini-implants, although there are various possible places for insertion, the most common position is in the keratinized gingivae of the inter-radicular gap between the upper second and first premolars. During the insertion of TADs, there is a constant risk of root injury, which requires a careful and precise therapeutic approach.

Clinical and histological tests have shown that when the implant touches the tooth during implantation or when the tooth moves afterwards, the root regions start undergoing resorptive processes. Nevertheless, studies have indicated that eliminating contact would promptly lead to the formation of cementum and complete healing of the root canal [47,48].

The patient's cooperation is typically essential for the success of any orthodontic treatment.

The level of patients' cooperation is impacted by the intensity of their pain and suffering. Oliver and Knapman found that patients' apprehension of pain was a significant barrier to receiving orthodontic treatment. Additionally, 39 percent of patients identified discomfort as the most unpleasant aspect of the treatment [49].

Patients demonstrate a high level of tolerance towards temporary anchoring devices, however there is a scarcity of scientific study on this matter in the literature [50].

Patients generally find mini-screws put without flap surgery to be more preferable compared to miniplates or other surgically implanted devices.

Their research revealed that the use of miniscrew implantation, namely using the transgingival technique, led to significantly reduced levels of pain compared to alternative methods.

## CONCLUSION

Awareness of the variables that influence the stability of temporary intraoral skeletal anchorage devices has grown in importance in modern orthodontics; thus, understanding the factors that influence their stability, it is critical to achieve their full potential.

The latest research indicates that for orthodontic mini-screw survival, factors such as bone quality and quantity, the use of mini-screws with dimensions of at least 1.2 × 8 mm, and minimizing the risk of inflammation become essential. On the other hand, factors like age and gender do not have a significant influence on the loosening of micro-screws, which tends to occur more frequently in the mandible.

Enhancing proficiency in surgical methods enhances the stability of implanted micro-implants. Therefore, it is crucial to expedite the learning process to optimize the survival rates of orthodontic mini-screws.

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