# Factors Influencing Orthodontic Miniscrew Placement in the Posterior Maxilla: A Narrative Review of Anatomical, Skeletal and Clinical Considerations

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## ABSTRACT

**Background:** Orthodontic miniscrews placed in interradicular bone are widely used for skeletal anchorage, but the bone available between adjacent roots in the posterior maxilla varies across sites, populations, and skeletal patterns. **Objective:** This narrative review synthesised anatomical and clinical factors reported to influence interradicular space and miniscrew outcomes in the posterior maxilla. **Methods:** PubMed, ScienceDirect, and Google Scholar were searched for peer-reviewed, English-language articles reporting cone-beam computed tomography (CBCT) measurements or clinical outcomes relevant to miniscrew placement in the maxillary posterior segment, without year restriction. Case reports, conference abstracts, and articles without full-text access were excluded. Thirty sources were synthesised thematically. **Results:** Anatomical findings varied by tooth site, buccal or palatal aspect, imaging modality, skeletal pattern, age, and population. Palatal dimensions generally exceeded buccal ones, and buccal cortical thickness fell below 1 mm at several premolar and molar sites. The second premolar–first molar and first–second molar intervals were often reported as potentially favourable, yet findings conflicted between studies, particularly for the buccal first–second molar interval. Panoramic radiography underestimated distances compared with CBCT, and sinus proximity remained a site-specific vertical constraint. Clinical outcomes were reported separately: success rates of approximately 85% to over 90% came mainly from clinical series expressed per miniscrew, whereas pooled analyses reported failure rates from under 10% to over 30%. Definitions of success, follow-up, and populations differed, and outcomes were associated with insertion torque, root proximity, and insertion technique. **Conclusion:** The included studies were heterogeneous, and a narrative review cannot provide pooled estimates or a universal threshold. No tooth interval or safe-zone map should be regarded as favourable for every patient. Site selection should be individualised, with CBCT assessment where clinically justified, alongside attention to anatomical aspect, skeletal characteristics, sinus proximity, and insertion technique.

**Keywords**: Interradicular space; Posterior maxilla; Orthodontic miniscrew; Cone-beam computed tomography; Cortical bone thickness

## INTRODUCTION

Miniscrews are widely used as orthodontic anchorage devices because they allow tooth movement without heavy reliance on patient cooperation, with reported success rates of roughly 83.9% to 89% and generally mild postoperative discomfort (Kuroda et al., 2007). Interradicular bone is one of the sites most frequently recommended for placement in both jaws (Poggio et al., 2006). The clinical problem is that placement between roots leaves little margin for error. Inadequate bone thickness and unfavourable root proximity are among the most consistent predictors of miniscrew failure (Chen et al., 2009), and root damage is one of the recognised complications of placement (Kravitz & Kusnoto, 2007). Selecting a site that is both safe and stable is therefore a central part of treatment planning.

Site assessment involves several related but distinct parameters. Interradicular distance is the mesiodistal space between adjacent roots at a given level. Cortical bone thickness is the thickness of the outer cortical plate at the insertion point. Alveolar bone width and height describe the buccolingual and vertical dimensions of the

supporting bone, with height in the posterior maxilla limited by the sinus floor. Bone density describes the quality of that bone, and it varies between sites independently of thickness (Rossi et al., 2017). Primary mechanical stability is the stability achieved at insertion, and it is influenced by insertion torque (Miyawaki et al., 2003). as well as by the bone characteristics above. These parameters do not necessarily move together. A site with adequate interradicular distance may still have thin cortical bone, limited height, or low density, and adequate dimensions alone do not guarantee a stable miniscrew.

The posterior maxilla presents particular challenges. The maxillary cortex is thinner than the mandibular cortex at every interdental site (Baumgaertel & Hans, 2009). At several premolar and molar sites the average buccal cortical thickness falls below 1 mm, and root proximity at these sites increases the risk of root contact (Lim et al., 2008a). The maxillary sinus adds a vertical constraint, since its floor lies close to the roots of the posterior teeth (Altaweel et al., 2022) and can influence which interradicular sites are suitable (Liu et al., 2017). Findings from the mandible cannot be transferred automatically to this region. Cortical thickness in the maxilla follows a different pattern from that in the mandible (Baumgaertel & Hans, 2009) , and alveolar bone volume at maxillary sites has not necessarily followed the mandibular pattern (Lee et al., 2009).

Variation within the posterior maxilla is also considerable. Pooled CBCT data show that the bone available between adjacent roots differs from site to site (Tepedino et al., 2017). Reported values differ by population(Dharmadeep et al., 2020; Golshah et al., 2021; Gupta et al., 2025), sagittal skeletal pattern (Chaimanee et al., 2011) , and vertical facial pattern (Hasani et al., 2023). Together, these findings argue against a single universal safe zone.

Existing safe-zone maps and pooled analyses have commonly combined anterior and posterior sites, or maxillary and mandibular sites (Poggio et al., 2006; Tepedino et al., 2020). Studies that focus on the posterior maxilla tend to report anatomical measurements from a single population or imaging modality (Valizadeh et al., 2022). To our knowledge, few reviews have integrated anatomical findings specific to this region with factors that determine clinical success. These include population and skeletal variation, imaging modality, sinus proximity, insertion torque, and complications. Anatomical suitability and clinical outcome have also not always been clearly distinguished.

This narrative review therefore aims to (1) summarise reported variation in cortical bone thickness and interradicular space at posterior maxillary sites, distinguishing the buccal and palatal aspects; (2) examine how population, skeletal pattern, sex, and imaging modality are associated with this variation; (3) describe sinus proximity as a vertical constraint; and (4) distinguish anatomical suitability from clinical outcomes by reviewing the reported influence of insertion torque, root proximity, insertion technique, and complications.

## MATERIAL AND METHODS

This review followed established guidance on constructing a narrative literature review, prioritising thematic synthesis of heterogeneous evidence over statistical pooling of outcomes (Green et al., 2006). The search strategy was informed by the scope used in prior CBCT-based mapping efforts, which typically combined electronic database searching with manual reference screening (Tepedino et al., 2020).

PubMed, ScienceDirect and Google Scholar were searched using combinations of the terms “interradicular space”, “posterior maxilla”, “cortical bone thickness”, “cone-beam computed tomography” and “orthodontic miniscrew” (Green et al., 2006). Articles were included if they reported original measurements or clinical outcomes relevant to miniscrew placement in the maxillary posterior segment, consistent with the scope first described for anchorage devices of this type (Kuroda et al., 2007). Case reports, conference abstracts and articles without full-text access were excluded, in line with recommended practice for keeping a narrative review methodologically transparent (Green et al., 2006). Findings from the 31 included sources were then grouped thematically according to the factor primarily addressed, following the same logic used in prior reviews of factors affecting miniscrew success (Chen et al., 2009).

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# RESULT

## Variability Cortical Bone Thickness in Posterior Maxilla

Evidence from the CBCT studies included in this review indicates that buccal cortical bone thickness in the

posterior maxilla varies substantially across different anatomical sites. In general, the buccal cortex is thinnest near the alveolar crest and increases progressively toward the root apex (Holmes et al., 2015); direct measurements at 2, 4 and 6 mm from the crest, however, reveal a more complex pattern. Unlike the mandible, where thickness increases fairly consistently with distance from the crest, the maxillary buccal cortex reaches its thinnest point at the 4-mm level (Baumgaertel & Hans, 2009). By contrast, the palatal aspect consistently offers considerably greater cortical bone thickness than comparable buccal sites in the same patients (Kang et al., 2007).

At several premolar and molar sites the average buccal cortical thickness falls below 1 mm, raising the risk of root contact when insertion angulation is not carefully controlled, a risk compounded by root proximity at several maxillary interradicular sites (Lim et al., 2008b). Soft-tissue thickness adds a further, often overlooked, constraint, since mucosal bulk reduces the working depth actually available to the clinician even when the underlying bone appears adequate (Truong et al., 2022).

## Variability in Interradicular Space and Candidate Insertion Sites

Safe-zone mapping studies converge on the posterior maxilla having several regions of potentially favourable interradicular dimensions, most consistently the second premolar–first molar and first–second molar intervals, where space is generally considered adequate for standard miniscrew diameters (Poggio et al., 2006). This space, however, is far from uniform. In a Nepalese sample, the interradicular area between the first and second molars was consistently the widest of all tooth pairs examined (Gupta et al., 2025), whereas a study focused specifically on the posterior maxillary arch found the buccal interradicular distance at that same interval to be the smallest, with the palatal aspect offering substantially more room (Valizadeh et al., 2022).

Taken together, these apparently conflicting findings show that assessment of a candidate site cannot rely on the tooth pair alone: the anatomical aspect buccal versus palatal must also be specified, a pattern corroborated by a meta-analysis showing that palatal interradicular space exceeds buccal space at nearly all comparable maxillary sites (Tepedino et al., 2020).

## Population-Specific Variation in Miniscrew Safe Zones

### European Population

One of the earliest anatomical maps of miniscrew safe zones, built from volumetric tomographic images of the maxilla and mandible, located the greatest mesiodistal bone width on the palatal side between the second premolar and first molar, and the least available bone in the maxillary tuberosity region (Poggio et al., 2006). This early mapping established that bone availability is not distributed evenly across the maxilla, with substantial variation between premolar, molar and tuberosity sites and between the buccal and palatal aspects variation later shown, in predominantly Caucasian samples, to extend beyond thickness to cortical bone density itself (Rossi et al., 2017). In practice, this means a site with apparently sufficient interradicular width may not offer the same mechanical support as another site of similar dimensions, since bone quality, and not only quantity, differs between locations.

### East Asian Population

A CBCT study of Chinese adults developed a protocol for bicortical miniscrew placement by evaluating interradicular distances and bone thickness at multiple maxillary sites, again identifying the second premolar–first molar interval as the most favourable (Shendy et al., 2024). The same study cautioned that horizontal width alone is insufficient to judge safety: at intermolar sites, insertion planes more than 6 mm above the

cementoenamel junction carried a risk of maxillary sinus penetration, underscoring the need to weigh vertical alongside horizontal dimensions in this region (Shendy et al., 2024).

Comparable regional variation has been reported in Korean adults, where alveolar bone volume differed among maxillary sites without necessarily following the pattern seen in the mandible (Lee et al., 2009). Together, these findings caution against generalising anatomical characteristics from one East Asian population to another; while the second premolar–first molar region is frequently favourable, population- and site-specific verification remains important.

**Middle Eastern Population**

A CBCT study of Persian adults compared interradicular distance and alveolar bone thickness across three sagittal skeletal patterns and found the largest maxillary interradicular distance between the central incisors in Class I and Class III patients, but shifted toward the premolar region in Class II patients (Golshah et al., 2021). Statistically significant differences by skeletal classification were also observed at several posterior maxillary sites, indicating that skeletal pattern not ethnicity alone can shift the location of the most favourable insertion site, and that pretreatment sagittal evaluation may usefully inform site selection (Golshah et al., 2021).

**Southeast Asian Population**

A comparative CBCT study of Thai patients with Class I and Class II skeletal patterns, one of relatively few population-specific investigations from Southeast Asia found that Class II patients had narrower interradicular space at several maxillary buccal sites than the safe-zone patterns generally reported in the literature (Chaimanee et al., 2011; Khumsarn et al., 2016).

**Cross-Modality Comparison: Panoramic Radiography versus CBCT**

Imaging modality itself appears to influence reported interradicular values. A study comparing panoramic radiography with CBCT in the same sample found that panoramic radiographs systematically underestimated interradicular space relative to CBCT, and accordingly developed calibrated safe-zone maps specifically for panoramic imaging (Tepedino et al., 2018). This distinction matters when comparing safe-zone data across studies: a population assessed by panoramic radiography may appear to have narrower zones than one assessed by CBCT even without any true anatomical difference. Because panoramic radiography remains more accessible than CBCT in many clinical and research settings, interpretation of panoramic measurements should account for potential magnification and distortion, ideally using appropriate calibration methods (Tepedino et al., 2018).

**Skeletal Pattern, Growth Pattern, and Sex**

**Sagittal Skeletal Pattern**

Sagittal skeletal classification consistently emerged as a modifier of interradicular space: Thai Class II patients showed narrower interradicular dimensions at several maxillary buccal sites than Class I patients (Chaimanee et al., 2011), and Persian adults showed significant site-specific differences by skeletal classification (Golshah et al., 2021). A location favourable in a Class I reference sample should therefore not be assumed to offer equivalent space in Class II or Class III patients.

**Vertical Growth Pattern**

Vertical growth pattern also appears relevant, as hyperdivergent adults have significantly thinner cortical bone at several maxillary sites than hypodivergent adults of similar age (Hasani et al., 2023), suggesting that facial pattern could serve as a simple screening factor prompting closer anatomical assessment before a site is finalised.

### Sex-Related Differences

Sex-related differences have also been documented, with male patients showing significantly greater coronal and middle bone width at the first molar region than female patients (Alkhames et al., 2024). These differences may be relevant in anatomically borderline cases but should not, on their own, determine insertion site or screw dimensions; sex is better regarded as one of several contributing factors rather than a primary criterion.

### Maxillary Sinus Proximity and Vertical Safety Considerations

Beyond interradicular width and cortical thickness, sinus proximity imposes a further, region-specific constraint. The distance between the maxillary sinus floor and the apices of the posterior teeth increases significantly with age, while sex and jaw size show no significant effect (Altaweel et al., 2022), suggesting that older patients may afford slightly more vertical room than younger patients, even though individual variation remains substantial. This vertical dimension interacts with horizontal site selection, as the Chinese CBCT study noted above found a risk of sinus penetration at molar sites when insertion was planned more than 6 mm above the CEJ (Shendy et al., 2024) a reminder that a horizontally favourable site is not automatically safe if its vertical relationship with the sinus is unfavourable.

### Factors Affecting Miniscrew Stability and Clinical Success

Adequate interradicular space alone does not guarantee successful placement. Higher insertion torque is associated with greater primary stability, although excessively high torque increases the risk of screw fracture during insertion (Miyawaki et al., 2003). Reported success rates in clinical case series range from approximately 85% to over 90%, with root contact the most common cause of early failure [16], while pooled survival analyses of temporary anchorage devices show a wider range from under 10% to over 30% failure depending on population and insertion site (Schätzle et al., 2009). The most frequently reported complications are soft-tissue irritation, root damage and screw loosening (Kravitz & Kusnoto, 2007), reinforcing that anatomical site selection must be paired with careful insertion technique to minimise preventable complications.

### Clinical Implications for Orthodontic Treatment

These anatomical and clinical factors carry direct treatment implications. A clinical case series using posterior maxillary microscrew anchorage for open-bite correction achieved successful molar intrusion without significant complications in most patients (Park et al., 2006), demonstrating that careful site selection translates into favourable outcomes. Posterior maxillary intrusion with miniscrews has nonetheless been associated with measurable external apical root resorption (Al-Falahi et al., 2018), indicating that successful treatment depends not only on choosing an anatomically safe site but also on controlling the magnitude and duration of applied force.

## DISCUSSION

The findings of this narrative review indicate that orthodontic miniscrew placement in the posterior maxilla is influenced by the interaction of anatomical, population-related, skeletal, imaging, and clinical factors. Although the second premolar–first molar and first–second molar regions are frequently identified as potential insertion sites, their suitability cannot be determined solely by the tooth interval. Variations in buccal and palatal bone dimensions, cortical bone thickness, root proximity, and the relationship with the maxillary sinus indicate that miniscrew site selection requires a comprehensive assessment of individual anatomical conditions rather than reliance on a universal safe-zone map.

One of the main findings concerns the variability of buccal cortical bone thickness in the posterior maxilla. The included studies reported that cortical thickness differs between anatomical sites and measurement levels, with some premolar and molar sites presenting an average thickness of less than 1 mm [5,7,21]. This finding is clinically relevant because cortical bone contributes to the primary stability of miniscrews. However, the relationship between measurement level and cortical thickness is not uniform throughout the maxilla. Baumgaertel and Hans [5] reported a different thickness pattern in the maxilla compared with the mandible,

demonstrating that anatomical characteristics established for one region should not automatically be extrapolated to another. Furthermore, the greater cortical thickness generally reported on the palatal aspect suggests that this region may provide more favourable anchorage conditions than comparable buccal sites [20]. Nevertheless, cortical thickness should not be considered independently of interradicular width, soft-tissue thickness, and the intended insertion trajectory.

The variability in interradicular space further demonstrates why the identification of suitable insertion sites remains challenging. Previous safe-zone mapping studies have frequently identified the second premolar–first molar and first–second molar intervals as favourable locations for miniscrew placement [2,11]. However, the findings of Valizadeh et al. [3] indicate that the buccal interradicular distance between the first and second molars may be limited, whereas the corresponding palatal region provides greater space. This apparent discrepancy with findings from other populations highlights the importance of distinguishing between anatomical aspects when interpreting interradicular measurements. Tepedino et al. [4] similarly reported that palatal interradicular space generally exceeds the corresponding buccal space across comparable maxillary sites. Therefore, identifying a potentially favourable tooth interval is only the first step; the precise insertion aspect and individual anatomical dimensions must also be evaluated before selecting a miniscrew site.

Population-specific anatomical variation provides another important explanation for the differences observed between safe-zone studies. Research involving European, East Asian, Middle Eastern, and Southeast Asian populations has demonstrated that the distribution of available interradicular bone differs across anatomical sites and study populations [2,6,10–12,23,24]. Although the second premolar–first molar region is frequently reported as favourable, this finding should not be interpreted as evidence that the same site will provide equivalent conditions in every population. Moreover, differences in skeletal classification may contribute to the observed variation. Golshah et al. [10] reported significant site-specific differences in interradicular distance and alveolar bone thickness among Persian adults with different sagittal skeletal patterns, while Chaimanee et al. [12] identified narrower interradicular dimensions at several maxillary buccal sites in Thai patients with Class II skeletal relationships compared with those with Class I relationships. These findings suggest that population characteristics and skeletal morphology may jointly influence the anatomical availability of suitable insertion sites. Consequently, safe-zone recommendations derived from a particular population should be applied cautiously to patients with different anatomical and skeletal characteristics.

In addition to sagittal skeletal relationships, vertical facial growth pattern and sex may contribute to anatomical variation. Hyperdivergent adults have been reported to exhibit thinner cortical bone at several maxillary sites than hypodivergent adults [13]. This difference may be relevant when assessing potential anchorage sites because reduced cortical thickness could affect primary stability. Sex-related differences have also been reported, with male patients demonstrating greater bone width at selected regions of the maxillary first molar [27]. However, these findings do not establish facial growth pattern or sex as independent determinants of miniscrew success. Rather, they indicate that these characteristics may provide supplementary information during pretreatment assessment. Their clinical relevance should therefore be considered alongside direct anatomical measurements and other factors affecting miniscrew stability.

Imaging modality is an important consideration when assessing interradicular space for orthodontic miniscrew placement. Tepedino et al. [26] reported that panoramic radiography underestimated interradicular distances compared with cone-beam computed tomography (CBCT) in the investigated sample. This difference may be attributed to the limitations of panoramic radiography, including magnification and distortion, which can affect the accuracy of anatomical measurements. In contrast, CBCT provides three-dimensional images that allow interradicular space to be assessed more accurately by reducing the limitations associated with two-dimensional imaging. Therefore, CBCT may provide more reliable anatomical information for identifying potential miniscrew insertion sites. However, measurements obtained from panoramic radiographs should be interpreted cautiously and should not be directly compared with CBCT measurements without considering the differences between imaging modalities.

Beyond horizontal interradicular dimensions, the relationship between the posterior maxillary teeth and the maxillary sinus imposes an additional anatomical constraint. Altaweel et al. [17] reported that the distance between the sinus floor and the apices of posterior teeth increased with age, although considerable individual

variation remained. Furthermore, the findings discussed by Shendy et al. [23] indicate that insertion height may influence the risk of sinus penetration at molar sites. These observations demonstrate that a site with sufficient horizontal space is not necessarily safe when its vertical relationship with adjacent anatomical structures is unfavourable. Therefore, miniscrew planning should consider both horizontal and vertical dimensions, particularly in the posterior maxilla, where the roots and maxillary sinus may be closely related.

Importantly, anatomical suitability does not independently guarantee successful miniscrew placement. The reviewed evidence indicates that clinical outcomes are also influenced by insertion torque, screw angulation, root proximity, and insertion technique [15,16]. Although greater insertion torque may improve primary stability, excessive torque can increase the risk of screw fracture [15]. Root contact has also been identified as a major contributor to early miniscrew failure, while soft-tissue irritation, root damage, and screw loosening represent additional complications [16,28]. These findings explain why a seemingly favourable insertion site may still result in an unsuccessful outcome if the insertion trajectory or mechanical conditions are inappropriate. Thus, anatomical assessment and careful clinical execution should be regarded as complementary components of miniscrew treatment planning.

The clinical implications of these findings extend beyond initial miniscrew placement. Posterior maxillary miniscrews have been used successfully to provide anchorage for molar intrusion in patients with anterior open bite [29]. Nevertheless, external apical root resorption has also been reported following maxillary posterior tooth intrusion using miniscrew anchorage [30]. This indicates that successful anchorage does not eliminate the potential biological risks associated with orthodontic tooth movement. Consequently, appropriate site selection should be accompanied by careful control of force magnitude and duration, together with clinical monitoring throughout treatment.

Several limitations should be considered when interpreting this review. First, as a narrative review, the synthesis was based on thematic interpretation of heterogeneous studies rather than a quantitative meta-analysis. Differences in study populations, anatomical measurement sites, imaging modalities, and outcome definitions may limit direct comparisons between findings. Second, the available evidence does not establish a single anatomical threshold that can reliably predict clinical success across all populations and insertion sites. Third, the findings from individual population studies may not be generalisable to other populations without further investigation. Future research should therefore prioritise standardised anatomical measurements, clearer differentiation between buccal and palatal sites, and the integration of anatomical findings with clinical outcomes. Studies involving underrepresented populations would also help clarify how population-specific anatomical characteristics influence miniscrew site selection.

Overall, the evidence indicates that miniscrew placement in the posterior maxilla requires an individualised approach that integrates interradicular space, cortical bone thickness, anatomical aspect, skeletal and growth patterns, imaging modality, and proximity to the maxillary sinus. Although certain regions are frequently identified as potentially favourable, their suitability cannot be generalised across all patients. Consideration of population-specific anatomical variation, combined with appropriate imaging interpretation and careful insertion technique, may support more informed site selection and help minimise preventable complications.

## CONCLUSION

Anatomical factors affecting miniscrew placement in the posterior maxilla vary according to tooth site, buccal or palatal aspect, imaging modality, population, and skeletal pattern. Although the first-to-second molar region and palatal aspect often provide more favourable anatomical conditions, no universal safe zone can be applied to all patients. Therefore, individual anatomical assessment and appropriate imaging are essential for selecting suitable insertion sites and minimising potential complications.

## REFERENCES

1. Al-Falahi, B., Hafez, A. M., & Fouda, M. (2018). Three-dimensional assessment of external apical root resorption after maxillary posterior teeth intrusion with miniscrews in anterior open bite patients. *Dental Press Journal of Orthodontics*, *23*(6), 56–63. https://doi.org/10.1590/2177-6709.23.6.056-063.oar

2. Alkhames, H. M., Ali, R. M. M., Alzouri, S. S., & Bayome, M. (2024). Assessment of Posterior Maxillary Alveolar Bone for Immediate Implant Placement: A Quantitative and Qualitative Analysis. *European Journal of Dentistry*, *18*(3), 877–882. https://doi.org/10.1055/s-0043-1777049
3. Altaweel, A. A., Saad Sowairi, S. M., Saaduddin Sapri, A. M., Saeedi, S. A., Alamri, A. H., Alnobi, A. A., Fahad Alsharif, M., Mohsen A Altokhi, A., & Abbas, H. (2022). Assessment of the Relationship between Maxillary Posterior Teeth and Maxillary Sinus Using Cone-Beam Computed Tomography. *International Journal of Dentistry*, *2022*. https://doi.org/10.1155/2022/6254656
4. Baumgaertel, S., & Hans, M. G. (2009). Buccal cortical bone thickness for mini-implant placement. *American Journal of Orthodontics and Dentofacial Orthopedics*, *136*(2), 230–235. https://doi.org/10.1016/j.ajodo.2007.10.045
5. Chaimanee, P., Suzuki, B., & Suzuki, E. Y. (2011). Safe Zones for miniscrew implant placement in different dentoskeletal patterns. *Angle Orthodontist*, *81*(3), 397–403. https://doi.org/10.2319/061710-111.1
6. Chen, Y., Kyung, H. M., Zhao, W. T., & Yu, W. J. (2009). Critical factors for the success of orthodontic mini-implants: A systematic review. In *American Journal of Orthodontics and Dentofacial Orthopedics* (Vol. 135, Number 3, pp. 284–291). https://doi.org/10.1016/j.ajodo.2007.08.017
7. Dharmadeep, G., Naik, M. K., Reddy, Y. M., Cheruluri, S., Raj, K. P., & Reddy, B. R. (2020). Three-dimensional evaluation of interradicular areas and cortical bone thickness for orthodontic miniscrew implant placement using cone-beam computed tomography. *Journal of Pharmacy and Bioallied Sciences*, *12*(5), S99–S104. https://doi.org/10.4103/jpbs.JPBS_36_20
8. Golshah, A., Salahshour, M., & Nikkerdar, N. (2021). Interradicular distance and alveolar bone thickness for miniscrew insertion: a CBCT study of Persian adults with different sagittal skeletal patterns. *BMC Oral Health*, *21*(1). https://doi.org/10.1186/s12903-021-01891-8
9. Green, B. N., Johnson, C. D., & Adams, A. (2006). *Writing narrative literature reviews for peer-reviewed journals: secrets of the trade*.
10. Gupta, S. P., Niroula, D., & Budha Magar, N. (2025). Assessment of interradicular areas and cortical bone thickness for orthodontic mini-implant placement: a cone-beam computed tomography study. *BMC Oral Health*, *25*(1). https://doi.org/10.1186/s12903-025-06251-4
11. Hasani, M., Afzoon, S., Karandish, M., & Parastar, M. (2023). Three-dimensional evaluation of the cortical and cancellous bone density and thickness for miniscrew insertion: a CBCT study of interradicular area of adults with different facial growth pattern. *BMC Oral Health*, *23*(1). https://doi.org/10.1186/s12903-023-03440-x
12. Holmes, P. B., Wolf, B. J., & Zhou, J. (2015). A CBCT atlas of buccal cortical bone thickness in interradicular spaces. *Angle Orthodontist*, *85*(6), 911–919. https://doi.org/10.2319/082214-593.1
13. Kang, S., Lee, S. J., Ahn, S. J., Heo, M. S., & Kim, T. W. (2007). Bone thickness of the palate for orthodontic mini-implant anchorage in adults. *American Journal of Orthodontics and Dentofacial Orthopedics*, *131*(4 SUPPL.). https://doi.org/10.1016/j.ajodo.2005.09.029
14. Khumsarn, N., Patanaporn, V., Janhom, A., & Jotikasthira, D. (2016). Comparison of interradicular distances and cortical bone thickness in Thai patients with class I and class II skeletal patterns using cone-beam computed tomography. *Imaging Science in Dentistry*, *46*(2), 117–125. https://doi.org/10.5624/isd.2016.46.2.117
15. Kravitz, N. D., & Kusnoto, B. (2007). Risks and complications of orthodontic miniscrews. *American Journal of Orthodontics and Dentofacial Orthopedics*, *131*(4 SUPPL.). https://doi.org/10.1016/j.ajodo.2006.04.027
16. Kuroda, S., Sugawara, Y., Deguchi, T., Kyung, H. M., & Takano-Yamamoto, T. (2007). Clinical use of miniscrew implants as orthodontic anchorage: Success rates and postoperative discomfort. *American Journal of Orthodontics and Dentofacial Orthopedics*, *131*(1), 9–15. https://doi.org/10.1016/j.ajodo.2005.02.032
17. Lee, K. J., Joo, E., Kim, K. D., Lee, J. S., Park, Y. C., & Yu, H. S. (2009). Computed tomographic analysis of tooth-bearing alveolar bone for orthodontic miniscrew placement. *American Journal of Orthodontics and Dentofacial Orthopedics*, *135*(4), 486–494. https://doi.org/10.1016/j.ajodo.2007.05.019
18. Lim, J. E., Won, H. L., & Yoon, S. C. (2008). Quantitative evaluation of cortical bone thickness and root proximity at maxillary interradicular sites for orthodontic mini-implant placement. *Clinical Anatomy*, *21*(6), 486–491. https://doi.org/10.1002/ca.20671

19. Liu, H., Wu, X., Yang, L., & Ding, Y. (2017). Safe zones for miniscrews in maxillary dentition distalization assessed with cone-beam computed tomography. *American Journal of Orthodontics and Dentofacial Orthopedics*, *151*(3), 500–506. https://doi.org/10.1016/j.ajodo.2016.07.021
20. Miyawaki, S., Koyama, I., Inoue, M., Mishima, K., Sugahara, T., & Takano-Yamamoto, T. (2003). Factors associated with the stability of titanium screws placed in the posterior region for orthodontic anchorage. *American Journal of Orthodontics and Dentofacial Orthopedics*, *124*(4), 373–378. https://doi.org/10.1016/S0889-5406(03)00565-1
21. Park, H. S., Kwon, O. W., & Sung, J. H. (2006). Nonextraction treatment of an open bite with microscrew implant anchorage. *American Journal of Orthodontics and Dentofacial Orthopedics*, *130*(3), 391–402. https://doi.org/10.1016/j.ajodo.2005.07.014
22. Poggio, P. M., Incorvati, C., Velo, S., & Carano, A. (2006). "'Safe Zones'": A Guide for Miniscrew Positioning in the Maxillary and Mandibular Arch. In *Angle Orthodontist* (Vol. 76, Number 2).
23. Rossi, M., Bruno, G., De Stefani, A., Perri, A., & Gracco, A. (2017). Quantitative CBCT evaluation of maxillary and mandibular cortical bone thickness and density variability for orthodontic miniplate placement. *International Orthodontics*, *15*(4), 610–624. https://doi.org/10.1016/j.ortho.2017.09.003
24. Schätzle, M., Männchen, R., Zwahlen, M., & Lang, N. P. (2009). Survival and failure rates of orthodontic temporary anchorage devices: A systematic review. *Clinical Oral Implants Research*, *20*(12), 1351–1359. https://doi.org/10.1111/j.1600-0501.2009.01754.x
25. Shendy, M. A., Abouelnour, A., Magdi, M., Monem, A., Allah, A., Elkabbany, S., Ali, M. M., Shehata, A., Ammar, M., Mwafey, M., Abozaid, H. M., Elshamy, A. M., Abol-Khair, H. A., Sabry, I., Sayed, E., & Mangoud Badr, A. (2024). Evaluation of maxillary first permanent molar periodontal condition after using three types of rapid maxillary expanders (conventional, hybrid and MSE) after6 months in adolescents. Randomized controlled trial. *International Journal of Medical Toxicology & Legal Medicine*, *27*(3S). https://ijmtlm.orghttps://ijmtlm.org482
26. Tepedino, M., Cattaneo, P. M., Niu, X., & Cornelis, M. A. (2020). Interradicular sites and cortical bone thickness for miniscrew insertion: A systematic review with meta-analysis. In *American Journal of Orthodontics and Dentofacial Orthopedics* (Vol. 158, Number 6, pp. 783-798.e20). Mosby Inc. https://doi.org/10.1016/j.ajodo.2020.05.011
27. Tepedino, M., Cornelis, M. A., Chimenti, C., & Cattaneo, P. M. (2018). Correlation between tooth size-arch length discrepancy and interradicular distances measured on CBCT and panoramic radiograph: An evaluation for miniscrew insertion. *Dental Press Journal of Orthodontics*, *23*(5), 39.e1-39.e13. https://doi.org/10.1590/2177-6709.23.5.39.e1-13.onl
28. Truong, V. M., Kim, S., Kim, J., Lee, J. W., & Park, Y. S. (2022). Revisiting the Complications of Orthodontic Miniscrew. In *BioMed Research International* (Vol. 2022). Hindawi Limited. https://doi.org/10.1155/2022/8720412
29. Valizadeh, S., Zafarmand, A. H., Hassan Yazdi, S., & Ghazizadeh Ahsaie, M. (2022). Quantitative Assessment of Posterior Maxillary Arch for Orthodontic Miniscrew Insertion Using Cone Beam Computed Tomography: A Cross-Sectional Analysis. *International Journal of Dentistry*, *2022*. https://doi.org/10.1155/2022/8257256
30. Vasiljevic, M., Selakovic, D., Rosic, G., Stevanovic, M., Milanovic, J., Arnaut, A., & Milanovic, P. (2024). Anatomical Factors of the Anterior and Posterior Maxilla Affecting Immediate Implant Placement Based on Cone Beam Computed Tomography Analysis: A Narrative Review. In *Diagnostics* (Vol. 14, Number 15). Multidisciplinary Digital Publishing Institute (MDPI). https://doi.org/10.3390/diagnostics14151697