Influence of inter-root septum width on mini-implant stability

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Abstract

Objective: The purpose of this study was to evaluate the influence of the inter-radicular septum width in the insertion site of self-drilling mini-implants on the stability degree of these anchorage devices. **Methods:** The sample consisted of 40 mini-implants inserted in the inter-radicular septum between maxillary second premolars and first molars in 21 patients to provide skeletal anchorage for anterior retraction. The post-surgical radiographs were used to measure the septum width in the insertion site (ISW). In this regard, the mini-implants were divided in two groups: group 1 (critical areas, ISW≤3 mm) and group 2 (non-critical areas, ISW>3 mm). The degree of mobility (DM) was monthly quantified to determine mini-implant stability, and the success rate of these devices was calculated. This study also evaluated the sensitivity degree during miniscrew load, amount of plaque around the miniscrew, insertion height, and total evaluation period. **Results:** The results showed no significant difference in mobility degree and success rate between groups 1 and 2. The total success rate found was 90% and no variable was associated with the miniscrew failure. Nevertheless, the results showed that greater patient sensitivity degree was associated to the mini-implant mobility and the failure of these anchorage devices happened in a short time after their insertion. **Conclusion:** Septum width in the insertion site did not influence the self-drilling mini-implant stability evaluated in this study.

Keywords: Orthodontic anchorage procedures. Dental implants. Dental radiography. Tooth root.

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Editor´s summary

Mini-implants feature a considerable clinical failure rate due to early or late instability. Thus, research has been searching for the risk factors associated with failure in the stability of skeletal anchorage devices. This study aimed to compare the stability and success rate of self-tapping mini-implants placed in inter-radicular septa with critical and non-critical mesiodistal dimensions, i.e., septa with width equal to or smaller than 3 mm and greater than 3 mm, respectively.

Twenty-one patients were selected who were undergoing orthodontic treatment and needed anchorage for anterior retraction, totaling 40 mini-implants. The devices were inserted in the inter-radicular septum between maxillary second premolars and first molars. The sample was divided into two groups: Group 1 (critical areas) and group 2 (non-critical areas), and septum width at the insertion site was measured on post-operative radiographs. Mini-implant stability was evaluated monthly by assessing the degree of mobility by means of a very specific and sensitive methodology.

The results revealed that the mini-implants in Groups 1 and 2 had a similar degree of mobility. No association was noted between mini-implant success rate and septum width at the insertion site. As yet, the literature has not reached consensus on the minimum distance required between mini-implants and tooth roots. Most studies merely speculate on the ideal "safety margin," but fail to show accurate values for such distance. It is speculated that this lack of correlation between septum width and mini-implant success rate is directly linked to the use of three-dimensional radiographic-surgical guides, which enable highly accurate and safe mini-implant insertion.

Questions to the authors

1) How can orthodontists ensure that a mini-implant is successfully inserted in a region of narrow interdental bone septum?

Despite the high success rate of mini-implants, even when installed in narrow septa, and although the installation procedure is apparently simple, orthodontists should strive to be as thorough as possible since this procedure is extremely technique-sensitive. The keys to success when inserting mini-implants in critical areas are: Accurate diagnosis by means of standardized bitewing radiographs or CT scans so that selection of insertion site and mini-implant diameter are carefully defined, use of a three-dimensional surgical guide, particularly for orthodontists who are new to mini-implants and, finally, professionals should not underestimate any surgical technique detail as these are essential for success in the use of mini-implants.

2) Are the rates of accidents and complications higher in regions of narrow bone septum?

Yes. These insertion areas are considered critical due to a higher rate of accidents and complications since the chance of tooth root contact or perforation increases considerably. Damage to tooth roots is mainly due to incorrect determination of the site and/or angle of insertion of the mini-implant in the bone tissue, and when faced with a narrow bone septum any deviation from this insertion angle, however small, can lead to contact between mini-implant and tooth root, and even to tooth loss. Besides, one must consider that close proximity of the mini-implant to the tooth root in narrow septa also renders more frequent the encroachment of periodontal ligament space during the insertion procedure, which may affect the stability of this anchorage device. Therefore, the use of surgical guides is mandatory

for accurate insertion of mini-implants in critical areas. Moreover, selection of mini-implant diameter in narrow septa should be thorough and take into account, when measuring septum width on bitewing radiographs or CT scan sections, the periodontal ligament space of adjacent tooth roots (approximately 0.25 mm each). As a result, the rates of accidents and complications in septa with critical width can be reduced.

3) Research in the area of mini-implants has intensified in recent years. What issues still need further clarification as regards mini-implant stability?

The number of scientific works involving orthodontic mini-implants is indeed experiencing continuous growth. However, there are important methodological difficulties to be overcome by scientific studies that focus on this topic. Actually, the variables that influence mini-implant stability are numerous, and therefore difficult to study in isolation because they involve issues related to the patient, the clinician and the mini-implant features. To further complicate matters, most of these studies are not prospective, and as a consequence samples are poorly standardized, with strict selection criteria, and the fact that a large number of variables are included yields sharply conflicting results in the literature. Thus, studies are inconclusive or show widely divergent conclusions regarding the definition of variables that determine the stability or loss of these anchorage devices. The number of histological studies in animals has been growing and as a result some important factors have been brought to light concerning the understanding of peri-implant bone remodeling, the presence of osseointegration and extension of the bone/metal contact surface, but small sample sizes preclude the extrapolation of results. Many findings, therefore, are still mere speculation. It should also be noted that the results achieved in these animal studies cannot be fully extrapolated to humans because differences between these organisms do not reproduce the same biological events. In summary, the theme of "mini-implant stability" still comprises an untold number of issues to be addressed and explained. It is essential that further studies be conducted with well defined methodologies and purposes to progressively enhance the understanding of variables that need to be controlled by clinicians if these devices are to provide excellent stability and success in orthodontic treatment.

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