JMS 2022;5(2):191-199
UDC:616.314.7-089.23
DOI: 10.55302/JMS2252191t

USE OF TEMPORARY ANCHORAGE DEVICES IN INTRUSION OF SUPRAERUPTED MOLARS - case reports

Vesna Trpevska[1], Ivan Tanatarec[2], Zoran Shushak[3], Daniela Srbinoska[1], Natasha Stavreva[4]
[1]PHO University Dental Clinical Center St. Panteleimon, Department of Orthodontics, Skopje, Republic of North Macedonia,
[2]PHO DR. Tanatarec, Bitola, Republic of North Macedonia,
[3]PHO Dentoria, Ohrid, Republic of North Macedonia
[4] Department of Prosthodontics, Faculty of Dentistry,
Ss. Cyril and Methodius University in Skopje, Republic of North Macedonia.

Abstract

Early loss of mandibular permanent molars with supraeruption of maxillary permanent molars is a common clinical finding causing functional posterior occlusion problems. Rehabilitation of the stomatognathic system often requires preprosthodontic intervention with molar intrusion which is one of the most difficult movements in orthodontic mechanics requiring efficient anchorage to achieve success.

The aim of this study was to present two case reports, with orthodontic mini-implants used for molar intrusion as preprosthetic treatment, reducing the need for prosthetic crown reduction in patients with edentulous space discrepancy. With the aid of chain elastics, the force of intrusion passing through the center of resistance of the tooth, supraerupted maxillary molars were intruded approximately 0.5 mm per month. The intrusive tooth movement maintained the vitality of the intruded teeth and was not aggressive to the periodontal structures, did not cause root resorption and no change of the pulp flow was detected. In contrast to traditional orthodontics, mini-implants were demonstrated to be clinically efficient in providing sufficient anchorage against orthodontic forces. With these devices, using well-controlled magnitude and direction of the force, we reestablished successfully the functional posterior occlusion. By presenting these case reports, we emphasize the versatility of orthodontic mini-implants as a form of temporary anchorage devices (TADs) in the biomechanics of molar intrusion attempted to create interocclusal space for adequate prosthodontic restoration with osseointegrated implants and prosthesis.

Keywords: temporary anchorage devices (TADs), mini-implants, molar intrusion, edentulous space discrepancy, preprosthodontic therapy.

Introduction

In our everyday dental practice, considering the fact that first mandibular molars are often extracted due to carious decay, they are among the most frequently missing teeth in the adult dentition. As a result, the maxillary molars overerupt encroaching upon the antagonistic missing dental space and cause occlusal interferences in the mandibular movements, premature contacts in the centric relation and consequent functional problems and may result in great difficulty during prosthetic reconstruction [1-3].

The lack of prosthetic space associated with extrusion when attempting to prosthetically rehabilitate a partially edentulous mandibular dental arch, pose a major restorative challenge. Rehabilitation of the stomatognathic system reestablishing a functional posterior occlusion often requires preprosthodontic intervention with molar intrusion [4, 5].

Molar intrusion is one of the most difficult movements in orthodontic mechanics requiring efficient anchorage to achieve success. In contrast to traditional orthodontics involving conventional fixed appliances, which use the adjacent teeth for anchorage and run the risk of undesirable side-effects like reciprocal extrusion of adjacent teeth and introducing an occlusal cant, recent reports have demonstrated that mini-implants are clinically efficient in providing sufficient anchorage against orthodontic forces [6, 7].

In order to obtain a pure molar intrusive tooth movement, it is necessary the force line of action passes close or through the center of resistance (CR) of the tooth in all three planes of space. The

estimated CR of the upper molar in the horizontal plane coincides with the palatal root. If the intrusive force is applied only at one side, a moment relative to the CR will be created and either buccal or palatal tipping may be observed clinically. To prevent this adverse effect, forces must be applied both buccally and palatally relative to the CR and a well-controlled magnitude and direction of the force must be obtained. The use of mini-implants for molar intrusion and the possibility to obtain absolute anchorage has provided new perspectives for orthodontics [8, 9].

The literature has demonstrated the efficiency of this system for the intrusion of molars, as it allows the use of simpler and more effective orthodontic mechanics. Therefore, the aim of this article was to present two case reports, emphasizing the versatility of orthodontic mini-implants in the biomechanics of molar intrusion as preprosthetic treatment, reducing the need for prosthetic crown reduction.

Case 1

Diagnosis and treatment objectives

A patient came to our Clinic with a desire for limited orthodontic treatment, seeking restoration of her right posterior occlusion. Her goal was a proper occlusal restoration with placement of a dental implant at the site of her previously extracted mandibular right posterior teeth which had been missing for many years and allowed the antagonists to extrude over time.

The patient presented insufficient occlusal clearance due to the supraeruption of the teeth 3 mm occlusally, encroaching upon the mandibular edentulous space. She was medically fit and healthy and presented with Class I occlusion on both sides and minor spacing and irregularities in the maxillary front teeth position and normodivergent facial pattern. Her gingival health was fairly good (Fig. 1).

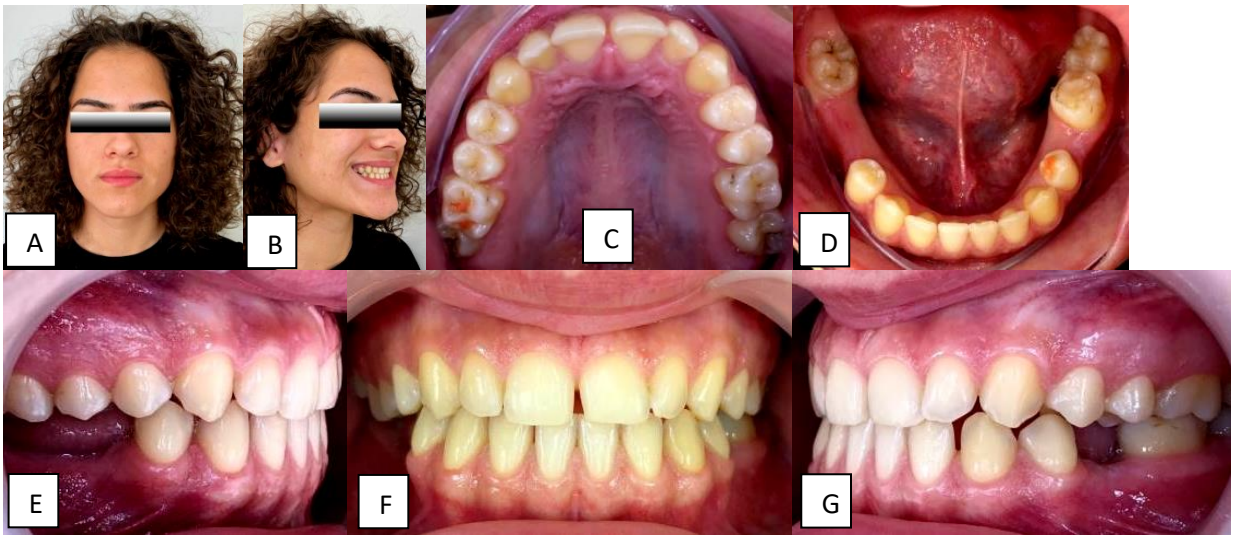

Figure 1. Pretreatment facial photographs: A) frontal view, B) side view and pretreatment intraoral photographs: (C) upper occlusal view, (D) lower occlusal view, (E) right buccal view, (F) frontal view and (C) left buccal view.

The objective of the treatment was to intrude the overerupted teeth utilizing mini-implant anchorage and subsequently regain the appropriate dental space for oral rehabilitation with osseointegrated implants and prosthesis.

Treatment plan and progress

Two mini-implants (BioMaterials Korea, Inc.-ACR Series) of 1.5 mm diameter and 8 mm length were installed: one in the palatine alveolar process and the other in the vestibular process of the maxilla in

the interdental space between the second premolar and the first molar (Fig. 2A and 2B). To avoid inadvertent palatal tipping and to favor a synchronous intrusion with the aid of chain elastics, a partial orthodontic appliance was fitted buccally to posterior dentition. The appliance set up consisted of a molar tube bonded to the upper first and second molar, brackets to the premolars and a 0.017 × 0.025-inch TMA wire (Fig. 2B). For leveling and correcting the spacing of the maxillary and mandibular teeth, we used lingual fixed appliances (Fig. 2C, 2D and 2E).

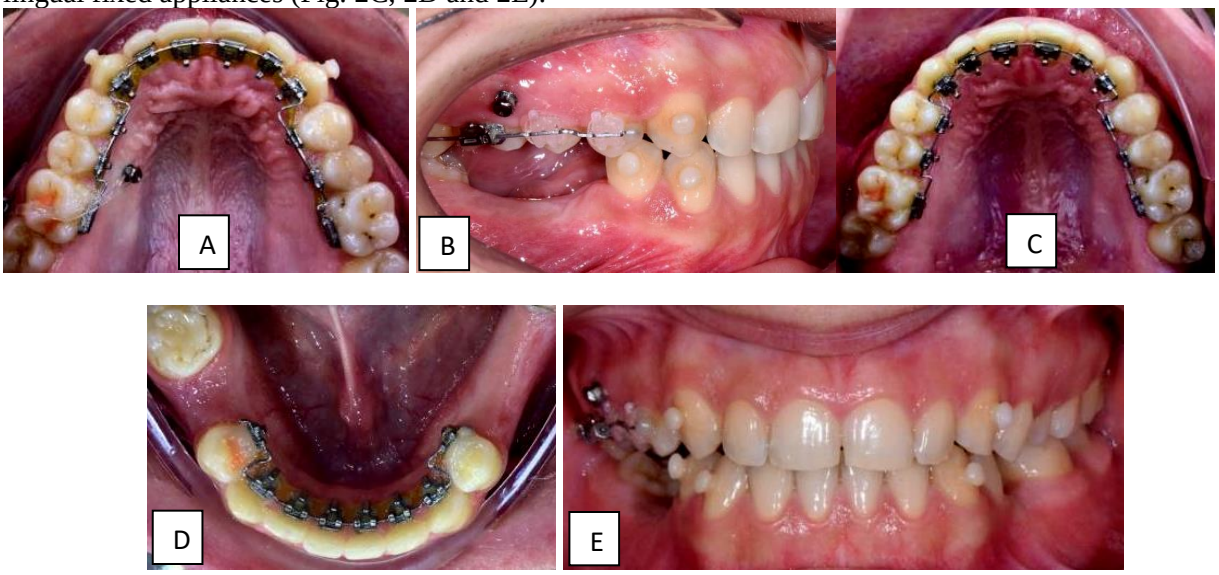

Figure 2. Intraoral view of: A) a maxillary occlusal view showing the palatinal mini-implant, B) segmented fixed appliance and vestibular mini-implant, C) lingual braces in maxilla, D) lingual braces in mandible and E) frontal view.

Figure 3. Panoramic radiograph at final treatment phase.

Treatment Results

After 6 months of treatment, approximately 2.5 mm of intrusion was achieved. Subsequently, the occlusal clearance was sufficient to rebuild the posterior occlusion by a prosthesis placed in the area of the missing antagonistic tooth. A functional occlusion was established in the right posterior dentition.

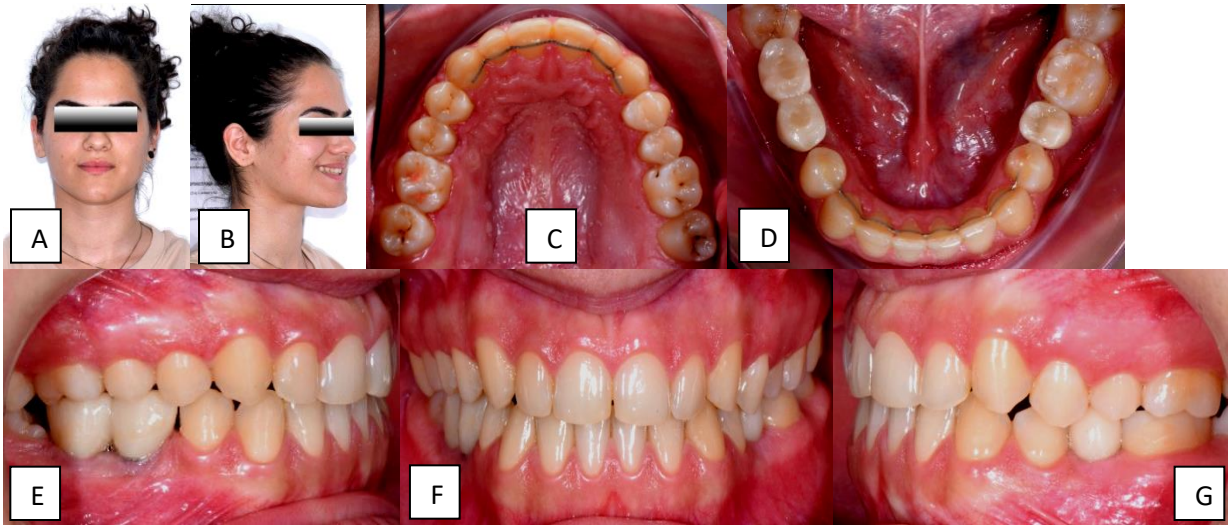

Figure 4. Post-treatment facial photographs: A) frontal view, B) side view and post-treatment intraoral photographs: (C) upper occlusal view, (D) lower occlusal view, (E) right buccal view, (F) frontal view and (G) left buccal view of restoration of posterior occlusion with osseointegrated implants and prosthesis

Case 2

Diagnosis and treatment objectives

A 65-year-old adult female patient with a supraerupted maxillary right first and second molar is illustrated. The patient's maxillary molars had overerupted 3 mm occlusally, approaching the antagonistic missing dental space. She had minor spacing and protrusion in the maxillary teeth and extracted upper left second premolar due to carious decay (Fig. 5). The patient didn't like the solution of possible crown reduction as a preprosthodontic modality; therefore, the primary objective was to intrude maxillary right first and second molar by using two mini-implants providing sufficient occlusal clearance for the placement of osseointegrated implants in order to prosthetically rehabilitate the mandibular dental arch.

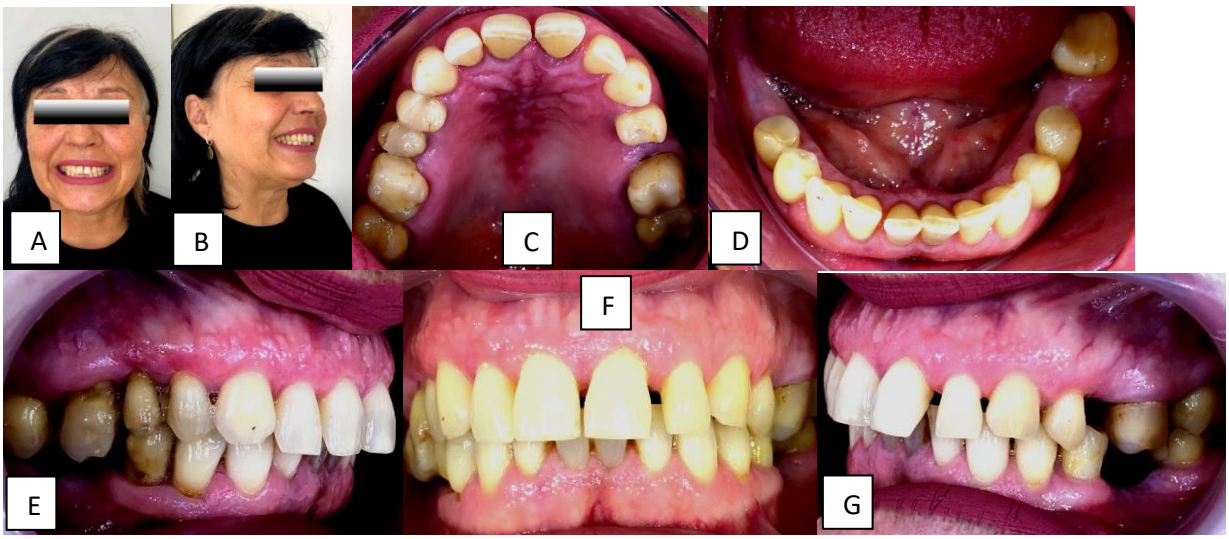

Figure 5. Pretreatment facial photographs: A) frontal view, B) side view and pretreatment intraoral photographs: (C) upper occlusal view, (D) lower occlusal view, (E) right buccal view, (F) frontal view and (G) left buccal view.

Figure 6. Pretreatment panoramic radiograph.

Treatment plan and progress

For intrusion and verticalization of the supraerupted maxillary molars, two mini-implants (BioMaterials Korea, Inc.-ACR Series) of 1.5 mm diameter and 8 mm length were inserted in the vestibular and palatine region between the upper first and second molar. With the aid of chain elastics stretched over the occlusal surface of the teeth, the force of intrusion applied was always passing through the center of resistance of the molars. The intrusive force was apically directed creating two equally large moments acting in opposite directions which canceled each other out and left only a single intrusive force directed through the center of resistance, causing bodily intrusion (Fig.7).

Figure 7. Intraoral view of: A) maxillary right quadrant illustrating the full set up in place with buccal and palatinal mini-implants, B) segmented fixed appliance and C) lingual braces and palatinal mini-implant

Treatment Results

Supraerupted maxillary molars were intruded 3 mm in 6 months (approximately 0.5 mm per month). The intrusive tooth movement maintained the vitality of the intruded teeth and was not aggressive to the periodontal structures; did not cause root resorption and no change of the pulp flow was detected. This set-up resulted in controlled intrusion of the maxillary first molar, providing sufficient occlusal clearance for the placement and restoration of a dental implant in lieu of the missing mandibular right first molar. In our case, the posterior occlusion was restored immediately after the overerupted tooth was leveled, therefore no retainer was required (Fig. 8).

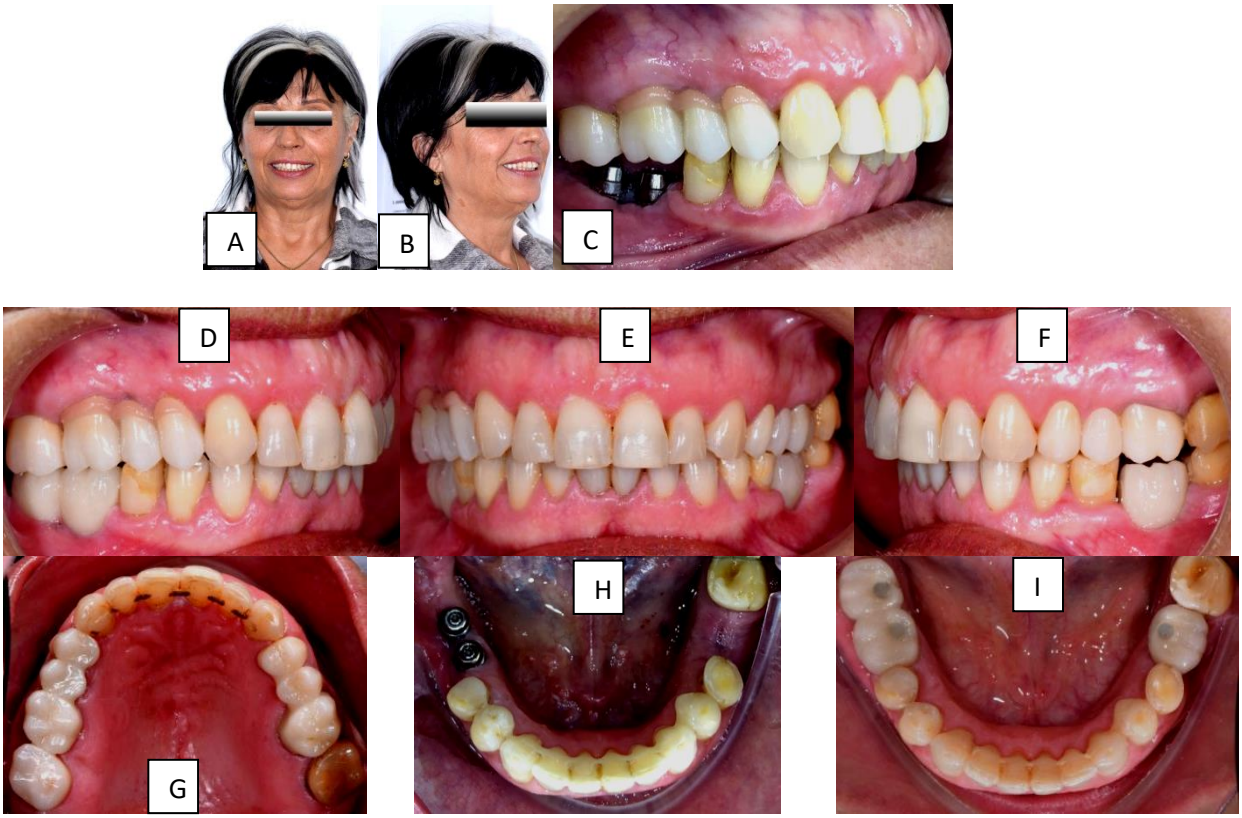

Figure 8. Post-treatment facial photographs: A) frontal view, B) side view and post-treatment intraoral photographs: (C) right buccal view with osseointegrated implants, (D) right buccal view with prosthetic restoration of right posterior occlusion, (E) frontal view, (F) left buccal view, (G) upper occlusal view, (H) lower occlusal view with osseointegrated implants, and (I) lower occlusal view with restoration with prosthesis.

Discussion

Supraerupted maxillary molars are common. It is safe to say that one will encounter them many times in an orthodontic career and need to know how to correct them. Orthodontic correction via intraoral temporary anchorage device can deliver predictable results without relying heavily on patient compliance or including other dental specialties. The use of orthodontic mini-implants in preprosthodontic management has become increasingly popular and has drawn a great interest in recent years among researchers and clinicians [10, 11].

Although there are usually multiple solutions to a problem in orthodontics, we accept that the final choice of how a problem is corrected will ultimately depend on the preferences of the treating clinician, who will diligently weigh the advantages and disadvantages of the various approaches. The method explained in this study offers several advantages over the more traditional approach [12].

On the other hand, conventional orthodontic intrusion is acceptable, but requires a longer treatment time. Quite often, patients with localized problems do not perceive the extent of the treatment difficulty, which can require even a full arch strap-up to reinforce anchor units against two overerupted upper molars. Individually designed intrusive mechanics require the splinting of either as many teeth as possible or even a full arch as one solid anchor unit to avoid unwanted movement [13].

In all treatments, the authors sought to insert the mini-implants in the vestibular and lingual regions in order to avoid undesirable moment, rotation and tipping and to obtain better torque control of the teeth [14].

This method may have a greater likelihood of screw failure because of the buccal insertion site and lingual tipping of the molar can occur if the asymmetric situation persists for too long [15].

A buccal screw failure would have no adverse effect other than lack of intrusion, if the palatal mini-implant is replaced with a transpalatal arch secured to the contralateral side and attached to the overerupted molar. Unilateral force unleashes higher stress in root apex and higher evidence for dental tipping directed to mini-implant site. The bilateral force, on the other hand, promotes more homogeneous stress distribution without evidence of dental tipping. Bilateral intrusion technique suggested a vertical movement of intrusion and lower probability of root apex resorption [16].

One caveat of single molar intrusion is the issue of changing bone levels. If patients start out with extruded bone levels around the molar, it is clear that they would benefit from intrusion because the bone levels would improve. However, if the patient has corrected bone levels, intrusion of the molar would introduce vertical osseous defects around the molar. This could be problematic because it will require lifelong periodontal maintenance. In these patients, a diligent risk-benefit analysis should be conducted, taking into account the different and also non-orthodontic treatment options, and the patient should be included in the decision-making process [17].

There is no agreement in the literature on the optimum force to be used for molar intrusion. Some authors suggest forces ranging from 30 to 100 g [18, 19], whereas others have recommended using a greater force for intrusion (150 to 500 g) [20, 21].

In this study, approximately 150 g of force was delivered from a short length of elastomeric chain. Force was carefully measured to ensure that it did not exceed the desired force level.

In regard to stationary anchorage, numerous studies have recommended loading forces of 300 grams of force or less [22-27].

Dalstra *et al.* [28] suggested loading forces of 50 g in regions of thin cortical bone and fine trabecula. Buchter *et al.* [29] reported that TADs inserted into dense mandibular bone remained clinically stable at forces up to 900 g. In regions of poor bone density, simply placing a longer screw or applying lighter force does not ensure stationary anchorage. Intrusive force should be light and continuous to produce the appropriate pressure within the periodontal ligament and minimize the risk of root resorption. Mini-implant anchorage has become one of the most effective and powerful tools for absolute anchorage, which up until now has been one of the biggest dreams of the practicing orthodontist.

This treatment approach can bring about a paradigm shift in orthodontic treatment planning in contemporary orthodontic world. By adding this new type of anchorage system to the armamentarium of the practicing orthodontists, we can broaden the domain of orthodontic treatment possibilities. Many other applications for mini-implant anchorage will be developed by creative orthodontists in the near future. Proper planning, proper insertion, achieving primary stability, proper orthodontic loading, as well as absence of inflammation and mobility, for the whole-loading time ensure success [30].

In general, mini-implant-supported intrusion appears be more advantageous than traditional approaches, providing the clinicians with a biomechanical tool to overcome a lot of disadvantages and even make avoidance of unaesthetic full-appliance therapy possible [31,32].

Conclusion

Anchorage control plays an important role in orthodontic mechanics. In contrast to traditional orthodontics, mini-implants have shown to be clinically efficient in providing sufficient anchorage against orthodontic forces.

With these devices, reestablishing a functional posterior occlusion, reducing the need for prosthetic crown reduction and a well-controlled magnitude and direction of the force can be obtained. These cases exemplified an effective mechanism using mini-implants as simplified mechanical devices to intrude supraerupted tooth in patients who seek restorative care. The prosthodontic clinician may adopt this predictable option with fewer side effects in their routine practice. Molar intrusion is finished when the tooth is leveled with adjacent teeth. This method produced an excellent control of labio-palatal maxillary molar position during intrusion with elastomeric chains attached to the mini-implants, without the need of full-arch brackets and wires. A combination of a partial fixed appliance and mini-implant may

provide a balanced force system for effective intrusion of molars. The mini-implants have been demonstrated to be an efficient option for the intrusion of maxillary and mandibular teeth necessary to correct this condition to further promote prosthetic rehabilitation of the antagonist tooth.

References

1. Sivakumar I, Sivakumar A. Intrusion of an overerupted molar using orthodontic miniscrew implant: A preprosthodontic therapy. Contemp Clin Dent. 2014; 5(3):422-424. doi:10.4103/0976-237X.137982.
2. Melsen B. Limitation in adults Orthodontics. In: Melsen B, editor. Current controversies in Orthodontics. Chicago: Quintessence; 1991. p. 147-80.
3. Yao CC, Lee JJ, Chen HY, Chang ZC, Chang HF, Chen YJ. Maxillary molar intrusion with fixed appliances and mini-implant anchorage studied in three dimensions. Angle Orthod. 2005 Sept; 75(5):754-60.
4. Yao CC, Wu CB, Wu HY, Kok SH, Chang HF, Chen YJ. Intrusion of the overerupted upper left first and second molars by mini-implants with partial-fixed orthodontic appliances: a case report. Angle Orthod. 2004 Aug; 74(4):550-7.
5. Kravitz ND, Kusnoto B, Tsay TP, Hohlt WF. The use of temporary anchorage devices for molar intrusion. J Am Dent Assoc. 2007;138:56–64.
6. Janson M. A utilização rotineira dos mini-implantes na clínica ortodôntica. In: Ortodontia em adultos: e tratamento interdisciplinar. Maringá: Dental Press; 2008. p 359-405.
7. Park HS, Bae SM, Kyung HM, Sung JH. Micro-implant anchorage for treatment of skeletal Class I bialveolar protrusion. J Clin Orthod. 2001 July; 35(7):417-22.
8. Melsen, B. Management of severely compromised orthodontic patients. In: Nanda R, ed. Biomechanics in Clinical Orthodontics. Philadelphia, Pa: WB Saunders. 1997:294–319.
9. Carollyne Mota TIAGO1 Luis PREVIDENTE1 Paulo Roberto Aranha NOUER2 Molar intrusion with orthodontic mini-implants: case reports RGO, Rev Gaúch Odontol, Porto Alegre, v.64, n.3, p. 327-332, Jul. /set. 2016.
10. Sugii, M. M., Barreto, B., Francisco Vieira-Júnior, W., Simone, K., Bacchi, A., & Caldas, R. A. (2018). Extruded upper first molar intrusion: Comparison between unilateral and bilateral miniscrew anchorage. Dental press journal of orthodontics, *23*(1), 63–70.
11. Amjad Al Taki and Mazen R Sbeih. “Bilateral Molars and Premolars Intrusion Using 2 Miniscrews and Acrylic Plate: A Case Report". Acta Scientific Dental Sci. 5.9 (2021): 116-120.
12. Sung JH, Kyung HM, Bae SM, Park HS, Kwon OW, Mc Namara Jr. A. microimplants in orthodontics. Korea: Dentos; 2006.
13. Lin JC, Liou EJ. A new bone screw for orthodontic anchorage. J Clin Orthod. 2003 Dec; 37(12):676-81.
14. Heravi F, Bayani S, Madani AS, Radvar M, Anbiaee N. Intrusion of supra-erupted molars using miniscrews: clinical success and root resorption. Am J Orthod Dentofacial Orthop. 2011 Apr; 139(4 Suppl): S170-5.
15. Pinzan-Vercelino, C., Bramante, F. S., de Araújo Gurgel, J., Vergani, E., & de Souza Gregório, R. (2017). Intrusion of maxillary molar using mini-implants: A clinical report and follow-up at 5 years. Journal of prosthetic dentistry, *118*(1), 1–4.
16. Pooktuantong O, Ogasawara T, Uezono M, Chantarawaratit P-o, Moriyama K. Optimization of Loading Condition for Maxillary Molar Intrusion with Midpalatal Miniscrews by Using Finite Element Analysis. Applied Sciences. 2021; 11(24):11749. https://doi.org/10.3390/app112411749.
17. Slabkovskaya, A., Divnich, A., Abramova, M., Slabkovsky, R., Alimova, A., & Lukina, G. (2021). Clinical and radiographic changes following orthodontic intrusion of overrupted maxillary molars with two mini-impalnts. Georgian medical news (318), 50–56.

18. Melo AC, Jawonski ME, Largura LZ, Thomé G, Souza JR, Silva MA. Upper molar intrusion in rehabilitation patients with the aid of microscrews. Aust Orthod J. 2008 May; 24(1):50-3.
19. Umemori M, Sugawara J, Mitani H, Nagasaka H, Kawamura H. Skeletal anchorage system for open-bite correction. Am J Orthod Dentofacial Orthop. 1999 Feb; 115(2):166-74.
20. Park YC, Lee SY, Kim DH, Jee SH. Intrusion of posterior teeth using mini-screw implants. Am J Orthod Dentofacial Orthop. 2003 Jun; 123(6):690-4.
21. Park HS, Jeong SH, Kwon OW. Factors affecting the clinical success of screw implants used as orthodontic anchorage. Am J Orthod Dentofacial Orthop 2006; 130(1):18-25.
22. Miyawaki S, Koyama I, Inoue M, Mishima K, Sugahara T, TakanoYamamoto T. Factors associated with the stability of titanium screws placed in the posterior region for orthodontic anchorage. Am J Orthod Dentofacial Orthop 2003; 124(4):373-8.
23. Buchter A, Wiechmann D, Koerdt S, Wiesmann HP, Piffko J, Meyer U. Load-related implant reaction of mini-implants used for orthodontic anchorage. Clin Oral Implants Res 2005; 16(4):473-9.
24. Roberts WE, Marshall KJ, Mozsary PG. Rigid endosseous implant utilized as anchorage to protract molars and close an atrophic extraction site. Angle Orthod 1990; 60(2):135-52.
25. Kanomi R. Mini-implant for orthodontic anchorage. J Clin Orthod 1997; 31(11):763-7.
26. Park HS, Bae SM, Kyung HM, Sung JH. Micro-implant anchorage for treatment of skeletal Class I bialveolar protrusion. J Clin Orthod 2001; 35(7):417-22.
27. Tseng YC, Hsieh CH, Chen CH, Shen YS, Huang IY, Chen CM. The application of mini-implants for orthodontic anchorage. Int J Oral Maxillofac Surg 2006; 35(8):704-7.
28. Dalstra M, Cattaneo P, Melsen B. Load transfer of miniscrews for orthodontic anchorage. Orthod 2004; 1:53-62.
29. Liou EJ, Pai BC, Lin JC. Do miniscrews remain stationary under orthodontic forces. Am J Orthod Dentofacial Orthop 2004; 126(1):42-7.
30. Ntolou P, Tagkli A, Pepelassi E. Factors related to the clinical application of orthodontic mini-implants. J Int Oral Health 2018; 10:103-10.
31. B Wilmes et al. Maxillary molar intrusion using mini-implants in the anterior palate “Mousetrap” versus “Mini-Mousetrap”. Seminars in Orthodontics, Vol 26, No 1, 2020: pp 11-23.
32. Baumgaertel S, Smuthkochorn S, Palomo JM. Intrusion method for a single overerupted maxillary molar using only palatal mini-implants and partial fixed appliances. Am J Orthod Dentofacial Orthop. 2016 Mar;149(3):411-5. doi: 10.1016/j.ajodo.2015.10.016. PMID: 26926029.
33. Hu, Q. W., Zhao, N., Qian, W. H., & Ma, X. Q. (2018). Shanghai kou qiang yi xue = Shanghai journal of stomatology, 27(6), 629–632.