Mini-implants in Orthodontics

Innovative Anchorage Concepts

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Foreword

In orthodontics, a theoretical basis commonly is little more than an imaginative, after-the-fact rationalization. A century ago, orthodontists who used jackscrews argued that intermittent forces are "more physiologic". Competing orthodontists who used springs, elastics, grass line, etc. argued that continuous forces are better. Traditionally, the appliance comes first; the biological justification, if any, comes later and only in sufficient doses to "sell" the appliance. In contemporary orthodontics, a classic example would be the claims that a clever piece of plastic or a given bracket–archwire combination can speak the language of the osteoclast and osteoblast and thereby permit treatment effects that the literature argues are impossible. Implants are something of an anomaly: theory preceded and spurred the development of the appliance. The fact that bone cannot grow interstitially, combined with the success of implants in restorative dentistry, implied that implants ought to be able to enhance anchorage. In other words, there was sufficient theoretical basis to warrant investigation. Given that the history of orthodontics is strewn with the wreckage of popular but ultimately flawed "philosophies" and treatments, sound biological theory is not the enemy, but rather a veritable sixth sense, designed to protect both patient and provider. With respect to temporary anchorage devices, theory implies not only that they are worth investigating, but also that, if successful, they will revolutionize patient care and return "diagnosis and treatment planning" to its rightful position in clinical practice. Therein lies the rub. An ability to put teeth where they need to be put, rather than where the appliance du jour tends to leave them, imposes a considerable obligation on the clinician. For a given patient, where should the teeth be placed? This question is the essence of "evidence-based treatment". The fabrication of an answer will be intellectually stimulating and, it is hoped, clinically significant. The process may well presage an orthodontic "golden age" that has nothing to do with money.

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Fields of Application of Mini-Implants

In this chapter, various possibilities for clinical mini-implant applications are demonstrated. Due to the large variety of insertion sites for mini-implants, there is a bigger spectrum of indications than for the other skeletal anchorage options.

Before the different treatment options with mini-implant anchorage can be discussed, an explanation of how to couple the mini-implant to the orthodontic appliance (direct versus indirect anchorage) is required. As such, the mechanics of mini-implant anchorage should be an integral part of the orthodontic treatment planning process.

5.1 Direct versus Indirect Anchorage

In general, two different types of anchorage must be distinguished: direct and indirect. Determining the type of anchorage that is more favorable depends on the following clinical or radiological factors: local bone quality, available space (in particular for interradicular insertion) and mucosal thickness. Furthermore, the expected load on the mini-implant should be taken into consideration.

5.1.1 Direct anchorage

In a direct anchorage situation, the implant is directly connected to the dental unit(s) to be moved. In this manner, a purely mini-implant supported anchorage is the result. Depending on the treatment objective, forces can be transferred from the implant to the dental unit(s) using the following modules.

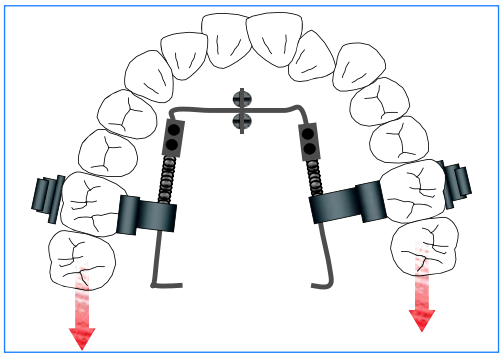
Compression Spring (Fig. 5-1)

The use of a compression spring always requires an additional arch wire or wire segment to stabilize the compression spring (open coil spring). The insertion can sometimes be difficult, and regular reactivation or a change to a new, longer spring is often required. This can often be done without removing the entire set-up by crimping a stop or using an arch lock on the arch wire or segment. It is for these reasons that tension mechanics are often preferred.

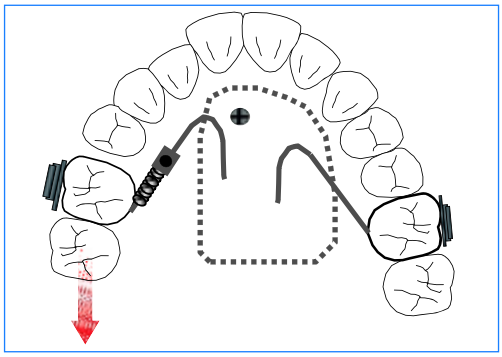
Tension Spring (Fig. 5-2)

Super-elastic nickel titanium (NiTi) springs (closed coil springs) are biomechanically more favorable than elastic chains due to their consistent and constant force delivery. Depending on the make of the tension spring and head design of the mini-implant, it may be necessary to attach the spring using a stainless steel ligature or Monkey Hook (American Orthodontics, Sheboygan, WI). Some

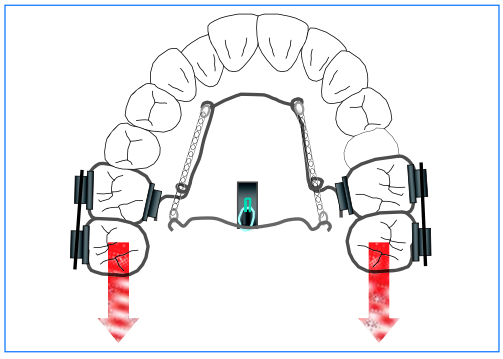
Fig. 5-1 Direct anchorage with compression spring: a compression spring is applied on a 16 x 22 NiTi segmented arch between mini-implant (interradicular between teeth 6 and 5) and tooth 3. This allows for distalization and de-rotation of the latter.

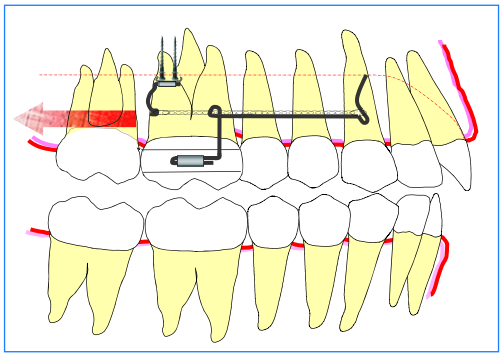


Sketch 5-58, Case 58 Maxillary molar distalization using the Keles-Slider: two mini-implants are blocked in the direction of force application to avoid anterior tipping.

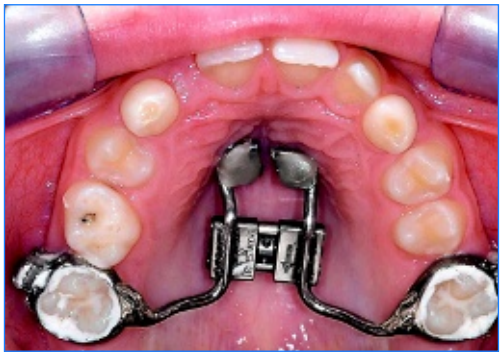


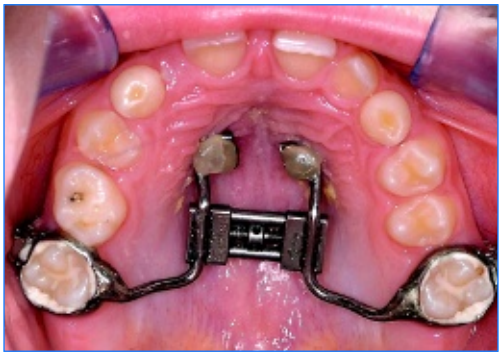
Sketch 5-59, Case 59 Distalization of the right molar with cortically anchored *Nance* button and Distal-Jet element (photo by Dr. B. Ludwig, Traben-Trarbach).

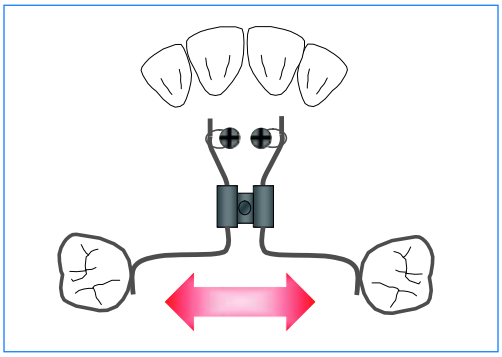




Sketch 5-60, Case 60 Maxillary molar distalization using the distal helix: two midpalatal mini-implants are coupled in the direction of force application using half a molar band and composite to avoid tipping. A transpalatal arch is inserted in the soldered Mialock. Off this TPA, bilateral springs distalize molars that are connected through a Quadhelix.







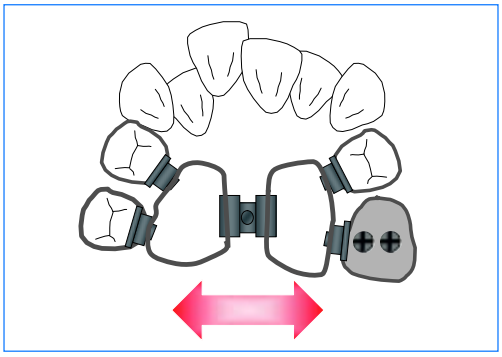
Sketch 5-61, Case 61 Rapid palatal expansion using the Duesseldorf Hybrid-Hyrax: both first molars and two anterior mini-implants serve as anchorage.

5.2.4 Dental Arch Coordination

5.2.4.1 Palatal Expansion and Rapid Palatal Expansion (RPE)

Mini-implant anchorage can also be helpful in the coordination of the maxillary and mandibular dental arches. Rapid palatal expansion (RPE) is often indicated with a maxillary transverse constriction of skeletal origin. Sometimes, however, sufficient dental anchorage cannot be established and more tipping than sutural expansion results. A frequent reason for this can be the dental age. If the required deciduous teeth are mobile, during the late phase of the mixed dentition, adequate anchorage for continuous sutural maxillary expansion is not available. This is especially true when concurrent protraction of the maxilla is planned using a facemask, as waiting for complete eruption and root formation of the premolars is not desirable. An alternative mechanism would be to use the first molars in the posterior and two mini-implants for the anterior area as an anchorage for the Hyrax expander (Dusseldorf Hybrid-Hyrax, Sketch 5-61, Case 61).

In the mutilated dentition (e.g. loss of first molars), mini-implants can be used to replace teeth as anchorage units. Since there is limited bony support in the posterior maxilla in these instances, two mini-implants should be inserted in the loading direction, next to each other, and then connected (Sketch 5-62).



Sketch 5-62 Rapid palatal expansion with reduced number of teeth: mini-implants connected with a molar band and composite in the direction of force application substitute as anchorage units for missing teeth.