Australian Society of Orthodontists

University of Sydney

Orthodontics & Mini-screws

Creating Brighter Futures

Orthodontics & Mini-screws

Anchorage Control

Orthodontic tooth movement is a complex interaction between a biological process and a mechanical system. When a force is applied to a tooth another force is generated in the opposite direction. If this opposite force is applied to a tooth, or group of teeth, then undesirable tooth movement may result. The concept of controlling this unwanted tooth movement is known as 'anchorage control'.

Skeletal Anchorage

Anchorage control for certain tooth movements can be extremely difficult, requiring complex mechanics and bulky extra-oral appliances, occasionally compromising the treatment plan to reduce its side effects. Over the last few years there has been an exciting development in the field of anchorage whereby bone is used as an absolute anchor point. From this skeletal anchorage, forces may be applied with minimal unwanted tooth movement.

Skeletal anchorage can be achieved with bone plates (similar to those used in orthognathic surgery), osseointegrated dental and orthodontic implants and with 'mini-screw' temporary anchorage devices (TADs). There are many types and brands of mini-screw on the market but most share similar properties. An ideal mini-screw system is biocompatible, easy to apply and remove, can be used as anchorage for various tooth movements and can be loaded immediately.

Mini-screws are particularly useful for closing spaces from missing teeth, distalising or retracting teeth, intruding over-erupted teeth, correcting midline discrepancies, reducing occlusal plane cants and in most situations where insufficient tooth borne anchorage is available[1-12] (Figs 1&2).

Fig 1. Mini-screw to upright molar and close space of missing mandibular first molar: Before

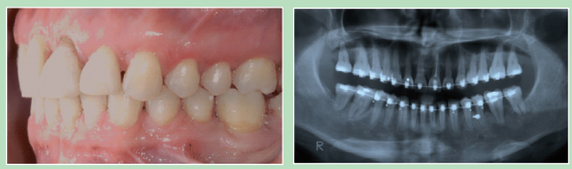

Fig 2. Mini-screw to upright molar and close space of missing first mandibular molar: After

Types of Mini-screws

Most mini-screws are manufactured from Titanium alloy or Stainless Steel. There are numerous head designs, incorporating various slots, grooves, tunnels and buttons to aid the attachment of auxiliary appliances such as ligature wires, elastic thread, elastomeric chain and Nickel Titanium coils. The mini-screws come in a variety of lengths, usually between 4mm and 12mm, as well as varying diameters from 1.2mm to 2.0mm. Some of the mini-screws have surface treatments such as sandblasting, aimed at improving contact with the bone, or highly polished collars and heads to aid gingival health and cleaning (Fig 3).

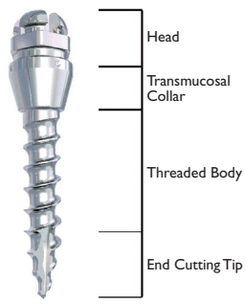

Fig 3. Typical mini-screw anatomy

Colgate® CARE COLUMN

FLUORIDES IN AUSTRALIA

In the previous two issues, sections of the Fluoride Guidelines (ADJ 2006; 51(2):195-199) addressing Community Water Fluoridation and Self-use Fluoride Products have been summarised. This issue covers Professionally Applied Fluoride Products – including varnishes, gels and foams.

Fluoride varnish contains 22.6 mg/ml (22,600ppm) fluoride. The guidelines support the benefit of this type of product for prevention of dental caries in the primary and permanent dentition. Twice yearly applications have not been linked with increased risk of dental fluorosis. It is an appropriate product to be applied by other health professions, broadening the opportunity for their use. The guidelines state "Fluoride varnish should be used for people who have an elevated risk of developing caries, including children under the age of 10, in situations where other professionally applied fluoride vehicles may be unavailable or impractical."

Fluoride gels and foams contain a high concentration of fluoride - up to 12.3 mg/gl (12,300ppm) fluoride. Professional applications in trays for four minutes show greater efficacy in the permanent than primary dentition. They offer an alternative vehicle for caries prevention for individuals at higher risk. However, they are contra-indicated for use in children under the age of 10 because of the potential risk of large amounts being ingested, despite the use of suction to evacuate excess material. The guidelines state "High concentration fluoride gels and foams (those containing more than 1.5mg/ml (1500ppm) may be used for people aged 10 years or more who are at an elevated risk of developing caries in situations where other fluoride vehicles may be unavailable or impractical."

Finally, there is recognition of the need for continuing review and revision of the guidelines for the best strategies to prevent dental caries and for the support of Australian research on the impact of fluoride vehicles and the development of new preventive interventions.

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A significant difference between mini-screw systems can be their mode of placement. Mini-screws are generally either self-tapping mini-screws or self-drilling/self-tapping mini-screws.

Self-tapping mini-screws require initial placement of a pilot hole in the bone, normally utilising a pilot drill in a handpiece. The mini-screw is then inserted by a hand screwdriver into the hole. Although this was the method for the first mini-screw systems, it has largely been superseded by the introduction of the self-drilling/self-tapping mini-screw.

The newer **Self-drilling/Self-tapping mini-screws** are able to penetrate cortical bone by hand screwing, without the need for a pilot hole. Depending on the point design, the cutting point of the mini-screw either removes the bone in its path or compresses it to the sides. The benefits of these mini-screws lie in the simplified placement procedure, reduced equipment inventory, and decreased insertion time. There are occasions however where even these self-drilling/self-tapping mini-screws need to have a pilot hole placed first, for example when extremely thick and/or hard cortical bone is encountered.

Mini–screw Selection

The recently developed self-drilling/self-tapping mini-screws are now recommended. Generally a longer mini-screw, if it can be safely inserted, provides better anchorage and is less likely to fail. The diameter of the mini-screw does not seem to be as critical; however, a wide screw has, potentially, a greater surface area and better retention. On the other hand, a wide screw has the potential to cause more tissue damage and discomfort. The 1.6mm to 2mm mini-screw are most commonly used.

Recent mini-screw head designs are multi-faceted to give a greater range of options for connecting the mini-screw to the remainder of the orthodontic appliance. Clearly it is important to decide how the mini-screw will be connected before deciding which design to select and insert.

Site Selection

Bone Density and Thickness

Bone density and thickness are the key indicators for the success of the mini-screw. Essentially, the mini-screw is held in place by its engagement with the bone, so the denser and thicker the bone, the more contact there is between the mini-screw and the bone, resulting in greater stability. Some studies have suggested that the self-drilling/self-tapping mini-screws generate a closer interaction with the bone than the self-tapping mini-screws, hence their higher success rate.

When inserting the mini-screw the aim is to engage as much of the cortical bone as possible. This could mean placing the mini-screws at an angle to maximise contact area.

Bone density and thickness vary considerably from patient to patient and even from site to site within the same patient, requiring careful assessment when considering mini-screw positioning. Generally the site must be an area where there are no significant anatomical structures that can be damaged, such as tooth roots, nerves and blood vessels.

Maxilla

Buccal maxillary bone is generally thin and of variable quality, whilst palatal bone is more favourable in both thickness and density. The anterior nasal spine and zygomatic buttress are also solid insertion points. The main nerves and vessels to avoid involve the greater palatine foramen and the incisive papilla. In younger patients it is also necessary to avoid the mid-palatal suture as the bone may not be fully developed and there is a risk of damaging the nasal septum.

Mandible

Buccal mandibular bone is usually of sufficient quality for mini-screw placement, although close proximity of the roots means care should be taken. The ramus and retromolar regions are excellent regions for mini-screw placement since there are no teeth to consider.

Soft Tissue

Failure of mini-screws has been associated with the type of soft tissue through which they have been inserted. Mini-screws inserted through attached mucosa have a higher success rate than those placed through movable and thin unattached mucosa.

Attached Mucosa

Attached Mucosa is the best area for insertion as the soft tissue is tightly bound to the underlying bone and does not twist up along the mini-screw as it is being inserted. Different areas of the mouth have varying thicknesses of attached mucosa, for example, the palatal mucosa. This must be taken into account when selecting the correct length of mini-screw.

Unattached Mucosa

Although it would be ideal to always place the mini-screws through attached mucosa, this is not always possible so careful preparation of the site may be required. This may involve raising a flap or using a tissue punch, as well as adding an auxiliary wire to the mini-screw that can penetrate through the healed mucosa. Irritation of the unattached mucosa is common and must be considered in the site selection, particularly if there are frenum interferences.

Mechanics

The position of the mini-screw must, of course, offer some mechanical advantage, taking into account the desired tooth movements and the range of action required. Immediate loading of the mini-screw has been shown to be more successful[13].

Insertion Procedure

1. Patient to rinse with a chlorhexidine mouthwash for 30 seconds.
2. Apply topical anaesthetic.
3. Apply local anaesthetic.
4. Create a positioning jig (Fig 4).
5. Take periapical radiograph to determine interradicular space (Fig 5).
6. Mark insertion point on mucosa with a sharp probe.
7. Determine mini-screw length and diameter.
8. Use tissue punch on unattached mucosa if required.
9. Place pilot drill hole if required.
10. Insert mini-screw(Fig 6).
11. Take periapical radiograph to determine correct position (Fig 7).
12. Load immediately (Fig 8).

Fig 4. Positioning jig

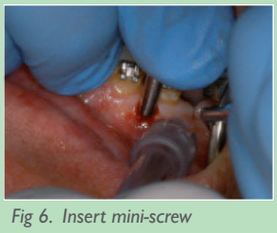

Fig 6. Insert mini-screw

Fig 8. Load immediately

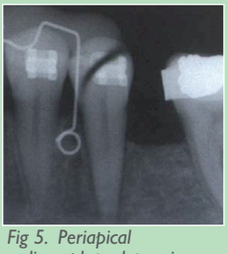

Fig 5. Periapical radiograph to determine insertion point

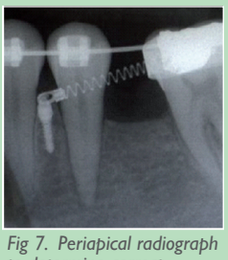

Fig 7. Periapical radiograph to determine correct position

BRIGHTER FUTURES

Australian Society of Orthodontists

Brighter Futures is published by the Australian Society of Orthodontists (NSW Branch) Inc. in conjunction with the Orthodontic Discipline at the University of Sydney.

The newsletter is intended to help keep the dental profession updated about contemporary orthodontics, and also to help foster co-operation within the dental team.

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Removal Procedure

It is important to remember that mini-screws are not osseointegrated and are simply removed by un-screwing them. Local anaesthetic is not usually required for removal. Some mini-screws are lost spontaneously and patients must be warned that a certain percentage fail immediately or part way through the procedure. When mini-screws were first developed the failure rate was as high as 60%, it is now down to only 10 to 20%.

Conclusion

Even though this technique is relatively early in development, rapid advances in its scope and application are occurring. Mini-screws have turned previously difficult or almost impossible cases into routine and predictable ones. As mini-screws improve and the technique is refined, they will become a standard feature of the orthodontist's armamentarium.

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