Miniscrews—a focal point in practice

Six-part series by Dr Björn Ludwig, Dr Bettina Glasl, Dr Thomas Lietz & Prof. Jörg A. Lisson—Part II

Basic information on the insertion of miniscrews

Preparing for insertion

The insertion of a miniscrew is a very simple and rapid therapeutic measure. Although there are several methods that will yield good results, successful insertion requires adherence to a few important principles. The following text details those insertion steps that offer a high degree of safety for both patient and dentist (see checklist for insertion below). It should be noted that this information has been compiled and must be adapted to individual circumstances.

Checklist for insertion

Pre-operative planning and preparation:

- planning documentation (X-ray, situational models);
- marking of the mucogingival line and tooth axes on the model, determining the site of insertion;
- sterilisation of the instruments and preparation of the worksta-
tion.

Anaesthetic and assessment of the insertional site:

- anaesthetic;
- use of X-ray side; and
- control image.

Selection of the screw:

- measuring of the thickness of the mucous membrane (optional);
- determination of the length; and
- determination of the type of screw.

Transgingival penetration:

- excision of the mucous mem-

brane or perforation with the

screw.

Preparation of the bone site:

- optional marking of the bone;
- perforation of the cortical bone or deep pilot drilling, depending on the type of screw.

Insertion of the miniscrew:

- manually or by machine.

Start of orthodontic measures:

- attachment and fixing of the link-
ing elements.

Post-operative care:

- notes on care and behaviour; and
- check-up dates.

Removal of the miniscrew:

- removal of the linking ele-

ments; and
- removal of the miniscrew.

General notes on insertion

Accurate pre-operative planning is a basic requirement for successful treatment with miniscrews. Such planning includes a comprehensive anaesthesia and an accurate assessment of the findings. It is essential that the treatment be thoroughly explained to the patient.

Proper hygiene must be en-

sured throughout the entire operation. Both the dental chair and the treatment process must be prepared with this in mind. During the insertion of a miniscrew, adherence to all hygiene measures required for an invasive procedure, such as a sterile work environment, and gloves, must be ensured. All instruments required for insertion must be checked for completeness, functionality, and sterility. The patient may rinse with a disinfectant solution, or a suitable disinfectant can be locally applied. The patient should then be positioned to ensure a clear view of the operational area and ergonomically facilitate insertion for the treating dentist.

Pre-operative planning

To function correctly, a mini-

screw requires firm anchorage in the bone (primary stability) and the positioning of its head in the denser gingival tissue (gingiva alveolaris). The selection of the insertion site must take clinical and para-clinical findings into account (X-ray image, model), as well as the goal of the treatment and the resulting orthodontic ap-

plication. For interradicular inser-
tion, a bone thickness of at least 0.5 mm around the miniscrew is required. This means that for a miniscrew with an—for many reasons—optimal diameter of 1.6 mm the roots must be at least 2.5 mm from each other; thus, the bone status and the longitudi-
nal axis of the insertion site must be carefully evaluated.

Basic information regarding this is obtained by carrying out measurements on the model. It often helps to mark the vertical axis of the teeth and the progression of the muro-gingival line on the model, based on the clinical and radiological findings. This will allow for an improved assessment of the spatial circum-
stances in combination with the X-ray image. To assist the accu-
rate determination of the inser-
tion site, X-ray aids (Fig. 2.1) are available. Although their use facilitates the selection of the insertion site, they cannot re-
place other diagnostic measures.

For a successful treatment, miniscrews

must be inserted into an area in which there is no risk of damage to roots, nerves, or blood vessels (e.g., into the palate just behind the transverse line linking the two canines), the position of the screw may be freely chosen (Figs. 2.5a–c).

Anaesthesia

During the interradicular inser-
tion of a miniscrew, the sensi-
tivity of the periodontal tissue of the adjoining teeth should be re-
tained. For this reason, the fol-

owing two procedures are rec-

ommended:

a) a low-dose injection of ap-

proximately 0.5 ml anaes-

thetic (Figs. 2.4a & b), and

b) the induction of superficial anaesthesia of the mucous membrane at the insertion site, for which a topical anaesthetic gel is suitable (Figs. 2.5a & b).

Choice of screw

Measuring the thickness of the mucous membrane (optional)

A pointed sensor with an at-
tached rubber ring is used to measure the thickness of the ginc-
gival tissue in the direction of inser-
tion (Fig. 2.6). This informa-
tion may be useful when deter-
mining the final length of the screen and possibly when insert-
ning the miniscrew. When choos-
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tory and the thickness of the mu-
cous membrane in the direction of insertion play a role, in the retromolar section of the lower jaw and in the palate, the thick-

ness of the mucous membrane is often more than 2 mm. The part of the miniscrew inside the bone must be at least as large as the part outside the bone. The various di-
mensions must be taken into ac-
count.

The thickness of the bone in the direction of insertion deter-
mines the required length of the miniscrew:

- bone thickness > 10 mm: mini-
screws with a length of up to 10 mm are to be used;
- bone thickness < 10 mm and > 7 mm: miniscrews with a length of 8 mm or 6 mm are to be used; and
- bone thickness < 7 mm: miniscrews with a length of 5 mm or 4 mm are to be used.

Post-operative care:

- review of the miniscrew inser-
tion.

Anaesthetic and assessment of the insertional site:

- anaesthetic;
- use of X-ray side; and
- control image.

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Insertion of the miniscrew:

- manually or by machine.

Start of orthodontic measures:

- attachment and fixing of the link-
ing elements.

Post-operative care:

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This is because, depending on the positioning of the X-ray tube, ob-

ject, film, and/or sensor, all types of X-ray devices and images may yield some optical distortion. Interpretation of images can thus lead to false-negative or false-positive results (Figs. 2.2a–c).

Therefore, the placement of a miniscrew should always be based on the clinical findings. If a miniscrew is to be inserted into an area in which there is no risk of damage to roots, nerves, or blood vessels (e.g., into the palate just behind the transverse line linking the two canines), the position of the screw may be freely chosen (Figs. 2.5a–c).

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Post-operative care:

- review of the miniscrew inser-
tion.
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• in the lower jaw: usually 6 mm
• in the palatal region (depending on the region): 6, 8 or 10 mm; and
• in the buccal region of the upper jaw: 8 mm or 10 mm; and
• bone thickness < 6 mm: mini-screws cannot be used.

The following guidelines aid in selecting the length:
• in the buccal region of the upper jaw: 8 mm or 10 mm; and
• in the lower jaw (depending on the region): 6, 8 or 10 mm; and
• bone thickness < 6 mm: mini-screws cannot be used.

Determination of the type of thread
Self-cutting mini-screws require pre-drilling (also known as pilot drilling) appropriate to the length and diameter of the screw, as well as to the quality of the bone. A self-tapping mini-screw will find its own way into the bone and requires no pre-drilling (Figs. 2.7a & b). Bone is more or less elastic depending on site, age, and structure. However, the screw diameter, the thickness of the cortical bone, and the hardness of the bone at the insertion site limit the extent to which this method can be used. Without pre-drilling, the bone will be strongly compressed during insertion and thus suffer a related tension stress. This may result in the cracking of the bone around the insertion site. When the screw is screwed into the bone, it is subjected to high loads. Depending on the bone quality, the resistance against insertion, and the continuity of the rotational movement, high torsional forces can result. In regions with thick cortical bone and a much looser bone structure (e.g. the upper jaw), the use of self-tapping screws is recommended. In regions where the cortical bone is thick and the bone structure is dense (e.g. the anterior lower jaw) both self-cutting and self-tapping screws may be used, in each case following perforation of the compact bone.

Transgingival penetration
The mini-screw must penetrate through gingival tissue, which must thus be perforated during insertion. Two methods are used for the perforation of the gingival tissue:

a) excision of the gingival tissue; or
b) direct insertion of the screw through the gingival tissue.

There are currently no published studies that investigate the effect of these two methods on post-operative problems, histological effects, and/or the loss rate of mini-screws.

Preparation of the bone site
Protection of the bone is an important aspect. Insertion without pre-drilling results in tensile stress within the bone, which may lead to post-operative complications. Particularly in the case of crestally placed screws, bone displacement may result in a severe expansion of the periosteum. The thickness of the cortical bone, especially in the lower jaw, can have a significant effect on the torque of the screw. To ensure that the screw is not overloaded during insertion, the compact bone of the anterior lower jaw should be perforated by pre-drilling as mentioned earlier. Pre-drilling should be done at a maximum of 1,500 rpm, using a short pilot drill and water-cooling to reduce the risk of damaging the root (Figs. 2.8 a & b).

Insertion of the mini-screw
The mini-screw must be removed from its sterile packaging (Figs. 2.8 a & b) without contamination. The thread of the screw may not be touched. The screw should be inserted at a constant rotational speed (at approximately 50 rpm) and with as uniform a torque as possible.

Manual insertion
Manufacturers supply various screwdrivers and blades in several lengths for the manual insertion of the screws. Because of their dimensions, long blades pose the risk of damaging the periosteum. Insertion torque ratchets are available for use with some systems (e.g. tomas, DENTAURUM; and LOMAS, Mondeal), which provide a certain amount of control over the insertion torque.

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Machine insertion

Machine insertion requires a surgical treatment unit (the torque of which can be controlled) or at least a low-rpm dual green handpiece. Accurate setting of the torque and the number of rotations is required; the rotation rate should not exceed 30 rpm⁻¹, and the torque must be restricted to the maximum load limit of the screw.

Machine insertion helps to achieve a consistent torque during insertion but means that the operator loses perception of the bone. During manual insertion, it is possible to perceive the interaction between the screw and the bone by tactile senses. Insertion by machine is shown in Figures 2.11a–f.

Attaching the orthodontic linking elements

As no healing phase is required, load may be placed on the miniscrew immediately after insertion. The selected linking element must be prepared accordingly and attached to the head of the screw (Fig. 2.12). To avoid damage to the teeth to be moved, the load on the linking element should be between 0.5 and 2 N (about 50 and 200 g).

Basic post-operative care

The healing of the gingival tissue and hygiene status after insertion must be regularly reviewed during the entire time that the miniscrew remains in place. The patient must be informed that any manipulation of the screw head with the fingers, tongue, lips, and/or cheeks should be avoided, otherwise the screw may be prematurely lost.

Removal of the miniscrew

A miniscrew can be removed under local anaesthetic. After the linking elements have been removed, the miniscrew may be removed with the same tools used for insertion. The resulting wound requires no special care and usually heals within a short time.

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