Miniscrews—a focal point in practice

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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 is generalised and must be adapted to individual circumstances.

General notes on insertion

Accurate pre-operative planning is a basic requirement for successful treatment with miniscrews. Such planning includes a comprehensive anamnesis and an accurate assessment of the findings. It is essential that the treatment be thoroughly explained to the patient. Proper hygiene must be ensured 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 miniscrew requires firm anchorage in the bone (primary stability). To function correctly, a miniscrew requires firm anchorage in the bone (primary stability). In clinical practice, it is often necessary to anchor a miniscrew in the dense gingival tissue (gingiva alveolaris). The selection of the insertion site must be determined in a manner that is clinically safe, and the X-ray images show damage to the adjoining root in the right-hand quadrant, indicating a false-positive initial interpretation of the situation. Interpretation of images of the adjoining teeth should be retained. For this reason, the following two procedures are recommended:

- a) a low-dose injection of approximately 0.5 ml anaesthetic (Figs. 2.4a & b); and
- b) a low-dose injection of approximately 0.5 ml anaesthetic (Figs. 2.4a & b); and

Fig. 2.1: X-ray positioning aid (X-ray pin, FORESTADENT) shown in situ in relation to the adjoining tooth axes.

Figs. 2.2a–c: The top image shows the initial situation. An X-ray pin was inserted into the first and second quadrants of the upper jaw (in the 6-7-8-9 region) to check the bone site, followed by the miniscrew. Both screws were inserted in a manner that is clinically safe, but the X-ray images show damage to the adjoining root in the right-hand quadrant, indicating a false-positive initial interpretation of the situation.

Fig. 2.2a–c: The top image shows the initial situation. An X-ray pin was inserted into the first and second quadrants of the upper jaw (in the 6-7-8-9 region) to check the bone site, followed by the miniscrew. Both screws were inserted in a manner that is clinically safe, but the X-ray images show damage to the adjoining root in the right-hand quadrant, indicating a false-positive initial interpretation of the situation.

Fig. 2.3a–c: The clinical image shows two miniscrews inserted into the palate in the safe zone to the distal side of the transversal line linking the two canines. The FRS and the PA image confirm the bone support in the insertion region.

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Fig. 2.4a & b: Injection pen with needle and anaesthetic cartridge, and injection of anaesthetic.

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Fig. 2.5a & b: Superficial anaesthetic device in pen form with cartridge, and application of superficial anaesthetic.

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Fig. 2.6: Measuring of the thickness of the mucous membrane in the direction of insertion. (Photo: Dr Pohl)
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). No general anaesthetic is ever required for this procedure.

**Choice of screw**

Measuring the thickness of the mucous membrane (optional).

A pointed sensor with an attached rubber ring is used to measure the thickness of the gingival tissue in the direction of insertion (Fig. 2.6). This information may be useful when determining the final length of the screw and possibly when inserting the miniscrew. When choosing the length, the bone repository and the thickness of the mucous membrane in the direction of insertion play a role; in the retromolar section of the lower jaw and in the palate, the thickness of the mucous membrane is often more than 2 mm. The part of the miniscrew inside the bone must be at least as long as the part outside the bone. The various dimensions must be taken into account.

The thickness of the bone in the direction of insertion determines the required length of the miniscrew:
- bone thickness > 10 mm: miniscrews 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 < 6 mm: miniscrews cannot be used.

The following guidelines aid in selecting the length:
- in the buccal region of the upper jaw: 8 mm or 10 mm;
- in the palatal region (depending on the region):
  - 6, 8 or 10 mm; and
  - in the lower jaw: usually 6 mm or 8 mm.

**Determination of the type of thread**

Self-cutting miniscrews 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 miniscrew 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 thin 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 miniscrew must penetrate through gingival tissue, which must thus be perforated during insertion. Two methods are used for the perforation of the gingival tissue:

- excision of the gingival tissue; or
- 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 miniscrews.

**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 peristemeum. 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–1, using a short pilot drill and water-cooling to reduce the risk of damaging the root (Figs. 2.8 a & b).

**Insertion of the miniscrew**

The miniscrew must be removed from its sterile packaging (Fig. 2.9) or the work rack (Figs. 2.10 a–d) without contamination. The thread of the screw may not be touched. The screw should be inserted at a constant rotational speed (at approximately 30 rpm–1) 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 attaining a very high torque during insertion. Thus, insertion must be carried out carefully to avoid breaking the miniscrew. Torque ratchets are available for use with some systems (e.g. tomas, DENTAL-RUM; and LOMAS, Mondeal), which provide a certain amount of control over the insertion torque.

**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, & 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 & the bone by tactile senses. Insertion by machine is shown in Figures 2.11a–f.