Miniscrews—a focal point in practice

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

Compl ications and risks

Preliminary remarks

The use of miniscrews facilitates many aspects of orthodontic treatment and in some cases actually makes such treatments possible. But miniscrew-based treatments, in common with all medical procedures, are not without their problems, complications and risks. It should be borne in mind that medical progress is only possible thanks to the pioneers and patients who are willing to enter uncharted regions. The major phase of miniscrew trials began in 2000. Today, the use of miniscrews is becoming increasingly established and consolidated, which means that the potential and limitations of miniscrews are also ever more apparent.

Fig. 1: There are many possible causes of the premature loss of miniscrews. The most common of these are preparation-related.

An individual experience that counts. There must be a willingness to learn, not only from one’s own mistakes, but also from those of others. The success rate should be well above 90 per cent, although a practitioner is unlikely to achieve this when starting using miniscrews. There is a clearly demonstrable learning curve in connection with this form of treatment, particularly with regard to the insertion procedure. The cause of most problems lies within the surgical procedure itself.

Iatrogenic problems

As Figure 1 and Table 1 show, there is a wide range of possible causes of the loss of a miniscrew. In view of their diversity, it is only possible to consider a few aspects in the following discussion.

Planning and organisation

Careful planning is undoubtedly one of the main keys to success. The same documentation and information required for other orthodontic procedures are perfectly adequate when planning a miniscrew treatment. The choice of biomechanical concept for the approach should be based on medical history, assessment findings (including possible complications, see Overview 1), diagnosis, and treatment objectives. The general contraindications have been adopted from those that apply to implant procedures. The actual effect of these disorders and conditions on the success rate of the miniscrew procedures has not yet been determined.

Screw location

The best site for the screw should be selected on the basis of the biomechanical concept. The following should be considered:

- There should be at least 0.5 mm bone around the screw on all sides.
- The screw head should be positioned in an inflammation-free, attached gingiva.

It is most important to determine the quantity and quality of the bone at the selected site of insertion. This will provide initial indications of the quality to be expected (Fig. 2). However, an X-ray will only provide limited information in this respect, although it will make it possible to assess the spatial situation in two dimensions. This prevents or reduces the risk of damaging a root (Fig. 3).

In the case of X-ray plates (particularly dental films), the direction of exposure, distortions arising from this and the possible loss of information must all be taken into account (Figs. 4a & b). The spatial situation can also be assessed by reproducing the musingual line, the tooth axes and roots on a model (Fig. 5). Information on the maximum length of screw that can be used can be obtained by measuring the model along the insertion axis (Fig. 6a).

This simple procedure helps prevent the risk of miniscrew perforation on the oral side (Figs. 6b & c). The required direction of teeth movement must also be considered during planning. This causes the resultant spatial situation to change during the course of treatment. A miniscrew must not interfere with or obstruct the desired movement (Fig. 7).

If the orthodontist is not to insert the miniscrews personally, a good line of communication with the surgeon must be maintained.

Table 1: Classification of bone quality according to March (1990) and Lehnhard & Zarb (1994).
Overview 1

Local contraindications:
- Quantitative and qualitative deficiency of bone at the insertion site
- Improper— in the mobile mucosa
- on the lingual side of the mandible
- Infringement wounds
- Dental fractures or deciduous teeth
- Poor oral hygiene
- Recent history of oral surgery
- Oral tumors
- Radiation therapy of the cranial region

General contraindications:
- Compromised immune system
- Therapy with corticosteroids
- Blood coagulation disorders
- Untreated endocrine disorders
- Rheumatic diseases
- Diseases or defects of the skeletal system
- Hepatic cirrhosis

Overview 2

Miniscrews with depth stop

### Name of screw
- Aarhus Mini implant
- Allochrome
- Ancol
- Biomet
- Infibrax
- Lüding/AML
- S.I.K. implant System
- SF Screw System
- torus-implan

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* Screw type / system: a standard one-piece head
* as available in form of insertion

Otherwireshape, there is a risk of problems of the sort illustrated in Fig. 7. Here, it is no longer possible to achieve the aim of treatment (mesialisation of the molar). This is because the screws are in the way and as they are in the wrong location, the drills are too short and thus ineffective. The correct position for the screws would have been between teeth 5 and 4. This problem arose because of a misinterpretation and lack of communication between the orthodontist and oral surgeon with regard to the aim of treatment and the positioning of the screws. The surgeon was unwilling to take risks and inserted the screws where there was plenty of space. Perfectly understandable from the surgeon’s point of view, but a mistake in this case—a iatrogenic error!

It is only possible to test the bone quality at the selected site immediately prior to insertion. In regions in which the bone quality is likely to be DS or D4 (Fig. 2), a probe should be first inserted in the bone. If the probe penetrates deeply into the bone, the bone quality is adequate for the insertion of a miniscrew. A different site should be selected.

The miniscrew must not be in contact with the tooth root. If this happens, the physiological movement of the tooth can cause persistent micro-movements of the screw (Fig. 5). This impairs the healing process and means that secondary stability will not be achieved. No persistent complications will occur. Numerous histological examinations have demonstrated that there is complete healing of the periodontal ligament after the removal of a screw.

Some miniscrews have depth stops (Overview 2). It should be

Checking the potential causes of the loss of miniscrews

There are many possible causes, but the probability of these occurring differs greatly.

### Table 1

<table>
<thead>
<tr>
<th>Cause of Loss</th>
<th>Grade of Probability</th>
<th>Source of Information</th>
</tr>
</thead>
<tbody>
<tr>
<td>Insufficient 'feeling' for bone and screw</td>
<td>High</td>
<td>Study</td>
</tr>
<tr>
<td>Insertion of a miniscrew too long or too far</td>
<td>Medium</td>
<td>Study</td>
</tr>
<tr>
<td>Insertion of a miniscrew in a poorly prepared hole</td>
<td>Low</td>
<td>Study</td>
</tr>
<tr>
<td>Insufficient bone or space</td>
<td>High</td>
<td>Empirical</td>
</tr>
<tr>
<td>Insufficient bone or space</td>
<td>Medium</td>
<td>Empirical</td>
</tr>
<tr>
<td>Insufficient bone or space</td>
<td>Low</td>
<td>Empirical</td>
</tr>
</tbody>
</table>

1. Objective causes
   1.1. Structural causes
   - Dependence on pre-existing causes controlled by the practitioner only in the selection of system

2. Pre-operative causes
   2.1. Planning
   - Selection of the insertion site and the appliance

3. Intra-operative causes
   3.1. Direct anchorage
   - Intra-operative causes

4. Post-operative causes
   4.1. Process-related causes
   - Local overheating of bone due to lack of contact with root

5. Intraoperative causes
   5.1. Iatrogenic causes
   - Iatrogenic causes

6. Iatrogenic causes
   - Iatrogenic causes

7. System-related causes
   - System-related causes

8. Product-related causes
   - Product-related causes

9. Other causes
   - Other causes

A Mark of the information relating to the potential causes of miniscrew loss is not derived from studies but from the experiences reported by various authors. That miniscrews are implants must also be taken into account. For this reason, it is highly probable that a great deal of the information relating to certain factors can only be assumed to be likely to cause the failure of miniscrews—but there is no empirical evidence to confirm this.
any stability commences shortly after insertion (Fig. 9). If this process is persistently inhibited (e.g. by micro-movements of the screw), the screw may be lost.

**Force application**

It is probable that using a miniscrew immediately or later to apply force has no influence on the failure rate. Forresses applied should be such that no damage is caused to the teeth to be moved. When a miniscrew is coupled to elastic chains or springs, micro-movements of the screw can result. The distance between miniscrew and the site of application of force of any springs directly attached to it should be kept to a minimum. Otherwise, these will be ineffective (Fig. 7).

**Post-operative complications**

**Inflammation**

There is a high probability that a miniscrew will fail if peri-mucosal, peri-implantitis develop. It is thus important to ensure that the patient is appropriately informed (which includes instructions on oral hygiene) and that adequate hygiene is maintained in the area around the miniscrew. A normal toothbrush should be used for this purpose. There is evidence that electric toothbrushes, particularly those with rotating heads, can loosen miniscrews, which can cause failure. In addition to the cleaning technique itself, the frequency and intensity of cleaning are undoubtedly also important. Very frequent cleaning that results in persistent micro-movement of the screw could well be disadvantageous.

**Liability insurance**

Orthodontists who wish to insert miniscrews themselves in their practices are frequently unsure about aspects of indemnity insurance. Policies available cover claims ranging from €1.5 to €5 million. When deciding on the extent of cover required (and thus the premiums that will need to be paid), the particular circumstances of the practice need to be considered. An indemnity insurance policy will also cover the practice’s personnel but not differentiate between dental practices and orthodontic practices as far as their policies are concerned.

In cases in which an orthodontist is planning to personally insert miniscrews (an approach that has many advantages), this is usually automatically covered by the policy. This is what the policy refers to when specifying ‘with implants’ or ‘with surgery’. In any case of doubt, however, policyholders should always contact their insurers and inform them of the extent, or the range of treatments provided, particularly if the policy does not specifically cover surgical or implant procedures. In this case, the annual premium is likely to be increased by €20 to €50 (applicable at time of writing, June 2007). In order to protect themselves should a claim of negligence be made, orthodontists should ensure that they follow certain basic rules.

**Summary**

The main parameters that determine the clinical success of a procedure are the bone quality and space available at the planned insertion site, the use of an insertion technique suitable for the system employed, and the use of a carefully considered biomechanical concept and the prevention of inflammation around the miniscrew. There are many reasons for failure, and these are interconnected, rather like the pieces of a jigsaw puzzle (Fig. 10).

**Concluding remarks**

These six articles cover many aspects of bone anchorage using miniscrews. The authors hope that they have achieved the objectives set out at the beginning of the series and provided the (as yet undecided) practitioner with a compendium of new information and experiences. However, it is not possible to discuss all aspects in detail, even in an extensive series of articles; thus, we refer interested practitioners to the relevant literature. But all theory remains just that if it is not applied in practice. We should be pleased if you, our readers, found the courage to use miniscrews routinely in your work. And we – Dr Ludwig, Dr Glasl (both Traben-Trarbach) Dr Lietz (Neulingen) and Prof. Lisson (Clinic of Orthodontics, Saarland University Hospital) – wish you every success.

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