Fig. 1.6: The stress resistance (fracture level in Ncm) depends on the diameter of the miniscrew (according to Kyung, modification by the authors).

In recent years, the requirements for cortical anchorage techniques have been defined in the literature. However, upon closer inspection, only orthopaedic mini-implants met these requirements favourably, in terms of:

- biocompatibility;
- small size;
- simplicity of insertion and use;
- primary stability;
- immediate load capacity;
- adequate resistance against orthodontic forces;
- usability with standard orthopaedic appliances;
- independence of patient cooperation;
- clinically superior results in comparison with standard alternatives;
- ease of removal; and
- cost-effectiveness.

Mini-implants

Any form of skeletal anchorage, including miniscrews, is by definition an implant: “An implant is an artificial material implanted into the body, which is to remain there either permanently or for an extended period.”

More than thirty different terms for orthodontic screws are used in the international literature. The most common of these are mini-implant and miniscrew; while the terms minipin or pin are preferred when speaking to patients. At present, there are over thirty manufacturers of mini-screw systems (Fig. 1.5). The number of screws per system ranges from two to 154 different types. In order to assist practitioners in selecting such devices according to their practice’s needs, the most important decision-making criteria for choosing implant systems are discussed below.

Material

All miniscrews are made from pure titanium or from an alloy of titanium with aluminium or vanadium. The biocompatibility of such materials, the metal surface of which is in direct contact with the bone, has been firmly established.11–14

Osseo-integration

Brånemark was the first to define the concept of osseo-integration, which he described as “a direct functional and structural link between living bone tissue and the surface of a force-absorbing implant.”15–17 Several authors, such as Costa and Maino, view anchoring a miniscrew not as osseo-integration, but as a skeletal resistance block.18,19 In the opinion of Cope and Bumann, miniscrews are anchored by mechanical stabilisation and not by osseo-integration.20,21

Diameter of the miniscrew

The diameter of the mini-screws on the market varies between 1.2 and 2.5 mm. Diameter specifications of a screw normally refer to its outer diameter, ie, the size of the shaft, including the thread. For secure and primarily mechanical anchorage, a certain amount of bone is required around the screw. To date there have been no studies on the amount of bone actually required; the information available suggests 0.5 to 2 mm. At an interradicular level, the amount of space available prescribes the maximum diameter of the screw.

Poggio et al.22, Schnelle et al.23, and Costa et al.24–25 provide some suggestions as to the vertical space required, ie, the space between the enamel/cement interface and the mucogingival line. These investigations clearly indicate that the diameter of a miniscrew should not exceed 1.6 mm. It should be noted that the stability of a miniscrew in the bone depends on its diameter and not on its length.26–27

Length of the miniscrew

The length of the miniscrews on the market varies between 5 and 14 mm. Length specifications of a miniscrew usually refer to the shaft, ie, the threaded section.

Like the diameter, the length of the screw selected depends on the amount of bone available. Depending on the region, the total thickness of the bone is between 4 and 16 mm.28 The length of a screw is of secondary importance to the diameter when it comes to secure anchorage, as mentioned above. Various studies have shown that it is the thickness of the cortical section that plays a more important role.29,30 As far as the distribution of force over the body of the screw is concerned, FEM analyses have shown that the load is applied only in the region of the cortical bone.31–35

When selecting the length of the screw, the depth of the gingiva...