Osseointegration of dental implants involves a controlled healing response leading to rigid fixation of the implant within bone. Once osseointegration is achieved, forces within the oral cavity are directly transferred to the implant prosthesis, the screw joint, and the surrounding bone. Finite element analysis studies demonstrate that the majority of forces are focused around the implant to the abutment connection and cortical rim of bone surrounding the implant head. (1) The lack of a periodontal ligament means that forces generated through function and parafunction need to be carefully managed to ensure the integrity of the screw joint long-term. The influence of occlusal forces on screw joints has been demonstrated in a clinical trial where six out of 10 bruxists had technical complications with fixed prostheses. (2)

**ADDITIONAL READING** | Restoration of a damaged dental implant due to removal of a fractured screw: thinking outside the box

A screw joint has been defined as two parts that are held together by a screw. (3) Applied torque to a screw within a joint develops a force within the screw called preload. (4) Preload is developed when torque applied to the screw places the shank of the screw in tension. The subsequent elastic recovery of the screw is transferred to the two separate components, pulling them together, thus creating a clamping force. If the elastic recovery of the screw is exceeded (overtightening or excessive forces on the joint), the screw will either fracture or loosen.

Screw loosening or fracture is more common with prosthetic screws compared to abutment
screws. (5) Screw complications are also more common in single-implant restorations compared with multiple units. (6) The most common implant restorations affected by screw loosening seem to be single-unit, mandibular molar implant-crowns. Occlusion can play a major role in screw loosening or fracture, depending on the prosthesis type and the design of the opposing arch (fixed versus removable, implant versus teeth or denture). The best way to reduce the incidence of screw loosening or fracture is to maximize joint clamping forces, while minimizing joint separating forces.

**Joint separating forces include:**

- Excursive contacts
- Off-axis centric contacts (angled abutments or wide occlusal table)
- Interproximal contacts, cantilever contacts
- Nonpassive frameworks (3)

It is widely recognized that a truly passive fit cannot be achieved (7,8) as there are always minor errors within digital scans or analog impression techniques. However, regardless of the technique that is used, the goal should be to minimize misfit wherever possible so that occlusal forces are not transferred to the screws themselves instead of the screw joint.

**Prevention and treatment of screw loosening or fracture**

To minimize joint separating forces, it is advised to use a surgical template designed from a restoratively driven treatment plan. This helps to ensure the implant is placed into the correct three-dimensional position to direct occlusal forces down the long axis of the screw joint. An ideal implant occlusion for full-arch prostheses should aim to have light lateral forces by keeping low cuspal angles, light anterior forces on protrusion by minimizing the overbite, and centralized contacts for molar teeth. Occlusion becomes less relevant to screw
loosening when fixed implant prostheses oppose conventional dentures. (9) Repeated screw loosening may be diagnostic of an underlying occlusal issue, a poorly fitting framework, or parafunction.

Unfortunately, there is a dearth of literature that confirms the ideal implant occlusal scheme using randomized controlled trials or even longitudinal studies. Subsequently, many of the recommendations for occlusal schemes and their effect on screw longevity and joint maintenance are based on longitudinal (10), empirical (3,11), or in vitro research.

Some authors have suggested that 2%-10% of the torque value is lost due to the settling effect. (12) Two mating surfaces are never perfectly smooth no matter how precisely they are machined. Microscopically, there will always be high and low points along the joint surfaces. After the initial torque is applied to the screw, the high points will tend to wear due to clamping and occlusal forces. The abutment and implant will come closer together, which reduces the preload on the screw and subsequent clamping force. If the clamping force then falls below the forces exerted on the joint, the screw will loosen; and if continued function occurs, the screw may fracture. Retightening the screw after a period of up to 10 minutes after initial tightening has been recommended to overcome the settling effect and thus prevent premature screw loosening. (4)

When tightening a screw, a significant part of the clamping force (90%) is lost due to friction between the contact points of the threads of the screw contacting the internal thread of the implant or abutment. (13) Without lubricant, approximately 10% of the force is transmitted to the preload. Using screw systems that have a dry lubricant (coating) of either gold or Teflon (3i Gold-Tite, Nobel Biocare TorqTite, Neoss Crystaloc) will help to reduce friction between the components and the screw, thus increasing preload and clamping force from a given torque.

If a screw does fracture, the difficulty of retrieval will depend on whether the screw is loose within the implant or abutment or if it is tightly bound within the screw threads. Hand scalers and ultrasonic scalers have been advocated to retrieve screw fragments. If the head has been stripped and a driver cannot reverse the screw, a horizontal groove cut into the screw head may provide sufficient grip to reverse the screw with a flat-head
driver or instrument. Most implant companies provide screw-retrieval kits; however, care must be taken not to burr or cut the internal fixture threads, which could render the implant unrestorable.

**ADDITIONAL READING | A unique method of debriding a full-arch, maxillary prosthesis supported by dental implants**

Andrew Mackie, BDS, DClinDent, MF GDP, RCS, MRACDS, graduated in Otago and also obtained a membership to the Royal College of Surgeons in London. Following membership examinations, he began postgraduate study toward a clinical doctorate in prosthodontics at Otago University. In 2008, he was awarded a membership to the Royal Australasian College of Dental Surgeons and began a private specialist practice (Mackie Dental Specialists) in Hamilton, New Zealand, with Periodontist Dr. Tasha Mackie. Dr. Andrew Mackie has been an external examiner for the Otago School of Dentistry and is past president of the New Zealand Association of Prosthodontists and Restorative Dentists and the Waikato Bay of Plenty branch of the New Zealand Dental Association.

**References**