News and modifications in the Original-Instrumentation of the Association for the Study of Internal Fixation (ASIF)

The AO/ASIF 4.5 mm Self-tapping Cortex Screw

1. Characteristics of Self-tapping Screws

The term self-tapping screw refers to screws which can be inserted into a predrilled hole directly without first tapping a thread. Self-tapping screws fall into two categories: Thread-cutting and thread-forming types.

In hard cortical bone thread-cutting screws perform much better than thread-forming (squeezing) screws, causing much less damage to the bone's microstructure and requiring less insertion torque and axial force. Self-tapping bone screws for diaphyseal application are therefore ideally thread cutting.

The AO/ASIF 4.5 mm self-tapping screws are thread-cutting (Fig. 1). An experimental comparison of insertion torque (Fig. 2) and pullout force (Fig. 3) of the self-tapping screw with the standard 4.5 mm Cortex screw and the standard tap shows that:

* The insertion torque of the self-tapping screw is comparable to that of the standard 4.5 mm Cortex screw in a pretapped hole.
* The pullout force of the self-tapping screw is comparable to that of the standard 4.5 mm Cortex screw in a pretapped hole.

2. Design features of the AO/ASIF 4.5 mm Self-tapping Cortex Screw

The 4.5 mm Self-tapping Cortex Screw has essentially the same design as the standard AO/ASIF 4.5 mm Cortex Screw, with the following additional features:

* Three short, large volume, cutting flutes
* A tip with a slightly tapered core diameter.

3. Application Technique:

3.1 Basic technique

The technique for insertion of a self-tapping screw is recommended as follows:

1. Drill a pilot hole using the drill bit 3.2 mm.
2. The self-tapping screw shall be inserted using the AO/ASIF Small Air Drill. Tests show that the heat generated temperature during insertion is independent of the machine speed (see Fig. 5).

To hold the bone temperature as low as possible, cooling the bone and the screw by the application of saline solution during the insertion procedure is advantageous.

Insert the screw using the AO/ASIF Large Hexagonal Screwdriver Shaft 314.15 for the small air drill.
3.2 Three-fluted drill bits
To provide exact drilling of the pilot hole three-fluted drill bits are recommended.

3.3 Lag screw
If a self-tapping screw is used as a lag screw especially in the critical area (oblique insertion through a plate) the next longer available screw should be used (add 2 mm to the measured length).

3.4 Direction
It is recommended that the direction of the screw be adjusted exactly to the axis of the pilot hole. The accuracy of machine insertion is better than that by hand insertion.

3.5 Hard bone
In hard and brittle bone the screw may be inserted by hand similarly to a tap.

3.6 Reinsertion
In the case of reinsertion into a pretapped hole the screw should be inserted by hand to avoid tapping a new thread.

3.7 Removal after healing
It is recommended to drive home the screw again about one third of revolution and break the bone chips off if strong bone ingrowth into the cutting flutes has occurred. Then the screw may easily be removed.

4. Experimental results

The *insertion torque* of the 4.5 mm self-tapping screw is in the range of 1 to 1.5 Nm (for human cortical bone of regular thickness and quality). This is about twice the value for a tap, but it is in the same range as the insertion torque of a pretapped screw. Inserting a standard screw without tapping (self-squeezing) leads to a value of 2.5 to 4 Nm!

![Insertion torque of STS](image)

Fig. 2 Insertion torque of self-tapping screw, pretapped screw, tap, and untapped screw in human cadaver femur (n=10).

The *pull out force* per mm cortex for the self-tapping screw (full thread engaged, cutting flutes not positioned in the cortex) is in the same range as for the standard screw among 400 and 550 N/mm. The low pullout force shown by the untapped screw is due to local micro damage to the bone's structure caused during screw insertion.

![Pullout Force of STS](image)

Fig. 3 Pull out force of self-tapping screw, pretapped screw and untapped screw in human cadaver femur (n=10).
The heat generated during introduction of the self-tapping screw causes increase in temperature (Fig. 4) at the screw tip. The surrounding bone does not reach this temperature. Starting at body temperature (37°C) instead of room temperature (22°C) shift the values linearly by 15°C.

An infra red camera was used to measure the increase in surface temperature of the bone (S=self-tapping screw, T=Tap). The diagram (Fig. 5) shows that the increase in surface temperature in relation to the initial temperature depends not on the rate of insertion. Starting at body temperature instead of room temperature does not change the results.

5. Clinical observations

The application of self-tapping screws has one main clinical advantage: The number of steps and necessary instruments is reduced, thereby decreasing the operation time. Furthermore, a very tight fit of screw thread to bone is ensured as the screw cuts its own thread.

Clinical experience with the 4.5 mm Cortex screw shows that it performs comparably to the standard screw, with the additional convenience of eliminating the tapping step:

* Use of the small air drill for screw insertion provides improved coaxial alignment and precision.

* The drill should be stopped before the screwhead is completely seated on the plate.

* It is recommended that the self-tapping screws selected be 2 mm longer than measured. This will ensure that the cutting flutes extend beyond the opposite cortex. This is especially important when the screws are inserted obliquely to the axis of the plate.
6. Catalogue

6.1 Implants, stainless steel

![Image of a screw](image-url)

**Fig. 6 The 4.5 mm AO/ASIF Self-tapping Cortex Screw**

6.2 Instruments

- **314.15** Large Hexagonal Screwdriver Shaft for small air drill

Additionally recommended:

- **315.29** Three-fluted drill bit, 3.2 mm dia., 195/170 mm
- **315.31** Three-fluted drill bit, 3.2 mm dia., 145/120 mm

6. References

