

## Skills Lab Faculty Guide

# Torque measurement of bone screws

Imagine you are treating a forearm fracture by open reduction and internal plate fixation. An adequate fracture reduction has been achieved and the plate has been placed correctly. Your trainee tightens the screws. It is a simple task that you have done many times, so you have developed a feel for knowing when the screw is tight enough. The trainee, on the other hand, has not had much experience, so there is a good chance he/she might under- or overtighten the screw, leading to an unsatisfactory outcome.

At this station, the participants get the chance to develop a feel for optimal tightening of the screw in a safe environment. As the torque applied is measured and displayed on the

screen, the participants receive immediate feedback on their action and you can discuss the outcomes with them. You can talk about how insufficient screw holding when undertightening—or destruction of the thread in the bone cortex when overtightening—impacts the fracture healing.

There are three artificial bone qualities available (normal, soft or osteoporotic, and hard), so the participants can feel the difference between healthy and osteoporotic bones. The foam holder represents soft tissue and allows for a more clinical feel, while the hard holder filters all external movements.



When the participants are using the screwdriver, you can also talk about the importance of coupling and what can happen if the tool is misused, with special attention to future implant removal.

### Learning outcomes

After completing this station, participants will be able to:

- Feel and achieve optimal torque in different bone qualities
- Practice over- and undertightening of screws
- Investigate potential problems when inserting the screwdriver into the screw head

### Take-home message

- Optimal torque should be between 60% and 85% of maximum torque

### Station sequences (your tasks)

#### When you arrive at the station for the Skills Lab module:

- Familiarize yourself with the poster, which includes information about the station learning outcomes and tasks.
- Check the set-up before participants arrive.
- The wireless screwdriver should be on the table.
- The display box with the three artificial bone quality models as well as enough bones of each quality should be on the table.
- Check that the monitor is on and the screen shows „Ready for torque measurement.“

#### During the group activity (to be repeated for each group):

- Explain the task to participants and introduce the different bone qualities and holders.
- Explain to participants that the screwdriver needs to be correctly inserted into the screw head; otherwise the coupling mechanism of the screw will be destroyed.
- Tell participants to tighten the screw to the point they think is optimal. Check if participants pay attention to coupling when placing the screwdriver (note this for discussion).
- As soon as the participant tells you that they have reached the amount of optimal torque, press the button on the screen to record the amount of torque applied. The participant should leave the screwdriver inside the coupling mechanism of the respective screw.

- Now ask the participant to strip the screw and to describe the feeling of losing fixation: make sure that a crackling sound can be heard and that the participant turns the screwdriver after the screw loosens by at least one more turn.
- Press the button on the screen again to display the percentage of torque applied to tighten the screw versus the torque needed to strip the screw.
- Assist participants to interpret the achieved result.

#### Discussion points

- Summarize the take-home message.
- Briefly restate the findings of the exercise:
  - Did all participants pay attention to properly inserting the screwdriver into the screw head?
  - Were there recurring problems under- or overtightening the screws?
  - What do the findings of this exercise imply for older patients?

#### While participants are changing tables:

- Ensure that the monitor is set to „Ready for torque measurement.“
- Exchange bone models when all screws are tightened.

#### Before you leave the station after the Skills Lab module:

- Ensure that the screw driver is back on the table.

## Frequently asked questions (FAQs)

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### Topic: using a screwdriver

#### **What is coupling?**

Adequate coupling allows better control and torque application. It prevents the destruction of the coupling mechanism, which, if damaged, will present problems at the time of implant removal.

#### **How do I hold a screwdriver properly?**

Holding the screwdriver with two fingers, or with the whole hand, are the two most commonly used methods. Try these or a different method, and then discuss which technique allows more control and torque delivery.

### Topic: tightening screws

#### **What is the importance of obtaining optimal torque when tightening a screw?**

Since implants are mechanical devices they function best under specific conditions. For cortex screws it has been proven that applying 60–85% of the maximal torque the bone allows, ensures adequate bone purchase without losing fixation (stripping of screws in overtightening, or a loose plate or screw in undertightening).

#### **What happens if a screw is undertightened or stripped? Which is worse?**

In both cases you lose fixation. If it is undertightened the screw will have some fixation although it will not be optimal, because load transfer through friction will be diminished. If you strip a screw it loses almost all of its fixation strength. So stripping a screw is worse than undertightening it.

#### **Why can we not use a device that will allow us to restrict torque application on a cortex screw?**

Purchase and fixation of cortex screws depends both on the screw and the bone quality. Since bone quality varies greatly from person to person it is impossible to develop such a device.

#### **Is there any difference in tightening unlocked versus locked screws?**

Locked screws fix directly to the plate; you do not get the feeling of cortical purchase that you get with cortex screws because they engage in the plate directly.

#### **Does it make a difference which screw on the plate is wrongly tightened?**

The screws immediately on either side of the fracture resist most of the pullout force on a plate, so it makes a difference to the plate fixation if you over- or undertighten these screws in particular.

#### **What can be done if we accidentally strip a screw?**

A stripped screw is useless, and can be either removed (and the plate hole left empty) or the screw can be repositioned in a different direction.

#### **How can I achieve the skill of optimally tightening screws?**

Practice either in simulations (as in this exercise), during surgery with an attending surgeon, or in surgery alone (by trial and error).