AO Skills Lab for Operating Room Personnel
Frequently asked questions (FAQs)

What happens if I plunge?
It means you have penetrated the soft tissue and can damage soft-tissue structures, such as vessels or nerves.

How do I avoid penetrating soft tissue?
The most important step to reduce plunging is the use of sharp drill bits to reduce the amount of pressure you put on the power drill, and thus the drill bit. In addition, it might be helpful to use shorter drill bits, if available, or letting the K-wire protrude less from the collar chuck. Discuss if placing yourself in a different position or holding the drill with one or two hands has any effect on plunging. If time permits, try the exercise again, modifying these factors.

Why do the tips of blunt drill bits reflect light?
Drill bits used in surgery fail first on the very tip and then, if at all, at the cutting edges. The worn off tip becomes round and the surface of this hemisphere reflects the light. Where the cutting edges can look perfect (do not reflect the light) the tip might already be blunt (reflects light).

How do drill bits become blunt?
Drill bits not only become blunt by drilling through bone; they also become blunt with friction against other tools as they go through the cleaning/sterilization process and/or when they are inappropriately stored. An everyday example is your tool box at home where drill bits are separated into compartments in order that they are not in contact with each other. This is not only for presentation purposes but also to keep them sharp by avoiding contact friction.

When perforating metaphyseal or osteoporotic bone do you feel the second cortex?
You may not feel when your drill bit passes through the second cortex, as metaphyseal and osteoporotic bone have very thin and delicate cortices. You should be particularly careful when drilling through these types of bone.
Test your surgical skill

**Soft-tissue penetration during drilling**

**Tasks**
1. Observe the difference between a sharp and a blunt drill bit
2. Drill hole through both bone cortices using sharp or blunt drill bits, or a K-wire; try to minimize soft-tissue penetration
3. Check degree of damage done by soft-tissue penetration

**Learning outcomes**
- Learn to differentiate between sharp and blunt drill bits
- Develop feeling for penetration of opposite bone cortex and compare results using blunt and sharp drill bits or K-wires
- Assess possible damage to soft tissues and neurovascular structures

**Take-home message**
- Use sharp drill bits to avoid uncontrolled penetration into muscles, nerves, and vessels
- Blunt drill bits must be replaced

**Observe the surface of the very tip of the drill bit**
- Sharp: no reflection of light on the tip
- Blunt: light is reflected on the tip

**Method**
- Plasticine representing soft tissue
- Bone

**Measurement of depth of penetration**
- Plasticine representing soft tissue
- Bone
**Frequently asked questions (FAQs)**

**Why does heat necrosis occur?**
As the drill bit or K-wire rotates and passes through the cortex, friction occurs. Ultimately friction is the source of heat production (for example, heat is created by rubbing your hands together).

**What factors influence heat generation?**
Friction is what produces the heat so all those factors that produce more friction produce more heat. Hence, by using a bigger drill bit or K-wire a greater surface area will be subjected to friction. The same thing happens with speed and feed rates: the sharpness of the instrument and the amount of pressure applied affect this rate. If you have a sharper drill tip and you put more pressure on it you will have a faster feed rate. Faster feed rates reduce the contact time of the two surfaces, thereby producing less friction and therefore less heat.

**What can I do to prevent heat necrosis due to drilling?**
The most effective way of reducing heat is by using sharp drill bits, which also have the benefit of reducing soft-tissue penetration, as seen in the station "Soft-tissue penetration during drilling". Where irrigation has a marginal influence on the heat production on the near cortex, irrigation cannot solve the problem on the far cortex. In either case, the cooling fluid cannot be directed onto the tip of the drill bit, where friction and, in consequence, heat is generated.

**How does thermal necrosis alter bone fixation?**
This can be easily understood by looking at the figure in the poster. Heat produces a conically shaped area of damage around the drill bit. This area is where the screw will get its purchase to the bone. If this area of bone is dead, it has to be remodeled with consequent loosening of screw anchorage. Dead bone is also an active culture site for infection.
Test your surgical skill

Heat generation during drilling

Tasks

1. Observe the difference between a sharp and a blunt drill bit.
2. Drill hole through both bone cortices using blunt or sharp drill bits, or a K-wire, with the assistance of the appropriate drill sleeve.
3. Leave drill bit in place with tip sticking out.
4. Observe on the screen, how the temperature develops.
5. Repeat steps 1–4 with different drill bits or K-wires and compare results.

Take-home message

- Use sharp drill bits to reduce heat generation and damage to bone.
- Blunt drill bits must be replaced.

Observe the surface of the very tip of the drill bit

<table>
<thead>
<tr>
<th>Sharp</th>
<th>Blunt</th>
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<tbody>
<tr>
<td>No reflection of light on the tip</td>
<td>Light is reflected on the tip</td>
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Learning outcomes

- Learn to differentiate between sharp and blunt drill bits.
- Predict heat distribution in bone cortex.
- Recognize and compare results from blunt or sharp drill bits or K-wires.

Take-home message

Heat generated during drilling causes conically shaped volume of damage to the cortex.

Cell necrosis as a function of temperature and duration of heat exposure

Cell necrosis

Temperature (°C)

Time of exposure (sec)
Frequently asked questions (FAQs)

Why do we have different reduction techniques?
In order to understand reduction one must also take into account what kind of fixation and stability is going to be used. In that order there will be some discussion on the difference between anatomical reduction and anatomical alignment (see next FAQ) and between absolute and relative stability (a topic discussed at station E: Fracture healing).

What is anatomical reduction and anatomical alignment?
Anatomical reduction is a technique where you put back together all the fracture fragments in their original anatomical positions to reestablish the original shape and form of the fractured bone. Anatomical reduction is used to reduce articular fractures.

Anatomical alignment refers to reestablishing the original axis of the bone without as much regard to the exact position of every fragment. It is used in metaphyseal and diaphyseal fractures.

Please check the back of both cards for station F for a complete set of FAQs for this station.
Techniques of reduction

Direct and indirect reduction

Tasks
Examine bone models; reduce fractures directly or indirectly, according to fracture pattern, location, and surgical approach

Learning outcomes
• Differentiate between direct and indirect reduction
• Relate both techniques to specific indications and bone segments

Take-home message

Direct reduction
• Fracture site is exposed, hands or instruments directly manipulate fracture fragments
• Reduction achieved is directly visible

Indirect reduction
• Fracture site is not exposed, reduction is performed by applying corrective forces and moments at a distance from the fracture
• Reduction is checked clinically or using image intensifier, x-rays

Metadiaphyseal segment
Indirect reduction to obtain
• Length
• Axial alignment
• Rotational alignment
A diaphyseal fracture is a black box
• No visualization
• No direct contact

Articular segment
Anatomical reconstruction of the joint surface

Direct reduction

Indirect reduction, ligamentotaxis
How is all this clinically relevant?
The surgical treatment of a fracture comprises three main steps that ought to be included in a complete preoperative plan: surgical approach, fracture reduction, and fracture fixation. Reducing the fracture is one of the difficult steps in this surgical process and is often underestimated. Since there are many reduction techniques and reduction-aiding devices, getting to know and adding them to your surgical arsenal is important if you want to successfully reduce any kind of fracture. Developing a refined surgical reduction technique that respects the biological principles of fracture fixation (open, closed, or minimally invasive) is a major step in becoming an accomplished surgeon.
Techniques of reduction

Use of reduction clamps

Tasks
1. Examine a variety of reduction clamps/forceps, including different locking mechanisms
2. Apply different tools at different anatomical sites

Learning outcomes
• Identify the degrees of freedom for each clamp
• Recognize difficulties in the application of the different devices
• Analyze biological advantages and shortcomings of different clamps

Take-home message
Use proper tools according to the anatomical and technical conditions
Frequently asked questions (FAQs)

How do you prevent coupling problems when removing a screw?
The main way to prevent destroying the coupling mechanism of a screw is ensuring adequate screwdriver-screw coupling when placing and removing the implant. The surgeon must feel and see that the screwdriver has fully attached to the screw and has a good grip. When removing the implant, care should be taken to check that all tissue has been removed from the coupling hole to allow perfect matching between driver and screw. Turn the driver slowly with your hands while pushing it against the screw head. Feel if there is a good catch between the screwdriver and the screw. If it feels loose, recheck its position.

Ensure the adequate tools for removing the implant are available; that is, having a screwdriver that is the right size and shape. Do not use damaged screwdrivers. Finally, do not underestimate any surgical procedure. Always use a careful surgical technique and pay attention to every detail.

What should be done if a coupling problem develops or if a screw head breaks (or is broken)?
Ensure all the necessary instruments are available for difficult implant removal. If no instruments are available, consider rescheduling the surgery or reconsider the necessity of implant removal. Always remember that the first rule of medical action is do no harm, so always carefully consider a harm/benefit analysis when faced with failed implant removal.

Finally, remember to explain to your patient before the removal surgery that there is a possibility of failure to remove the implant. That way he/she will know there is always a slight chance that, even after the procedure, the implant may not have been successfully removed.

Why not use a power drill with the hollow reamer?
Be aware of the fact that a lot of heat is produced when drilling or reaming (see station "Heat generation during drilling"). The benefit in time you might gain when using a power drill will be devoured by the damage created to the bone by heat necrosis.
**Tasks**

1. **Destroyed coupling mechanism**
   - Insert conical extraction bolt (a) in screw head and try to remove screw

2. **Broken screw removal procedure**
   - Remove bone around screw with appropriate sized hollow reamer (b)
   - Use extraction tube (c) to remove screw shaft

**Learning outcomes**

- Identify the function of different instruments to aid screw removal
- Remove screw with destroyed coupling mechanism
- Remove broken screw

**Take-home message**

- Use undamaged screwdriver
- Clean hexagonal coupling mechanism of screw head
- Everything in the removal set is left threaded

**Problem 1**

Destroyed hexagonal coupling mechanism of screw head

**Problem 2**

Broken screw, screw shaft stuck inside bone

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**Damaged implant removal**

**Challenges and solutions (Option 1)**

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**Intact**

**Destroyed**

Damaged implant removal

Challenges and solutions (Option 2)

Tasks

1. **Destroyed coupling mechanism**
   - Insert conical extraction bolt (a) in screw head and try to remove screw

2. **Broken screw removal procedure**
   - Remove bone around screw with appropriate sized hollow reamer (b)
   - Use extraction tube (c) to remove screw shaft

Learning outcomes

- Identify the function of different instruments to aid screw removal
- Remove screw with destroyed coupling mechanism
- Remove broken screw

Take-home message

- Use undamaged screwdriver
- Clean hexagonal coupling mechanism of screw head
- Do not use a power drill

Problem 1

Destroyed hexagonal coupling mechanism of screw head

Intact

Destroyed

Problem 2

Broken screw, screw shaft stuck inside bone

This option is available in Europe and the Middle East only.
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Hazards

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