Techniques Basic to Internal Fixation of Fractures

Problem Identification and Needs Assessment

Identification of targeted learners
Targeted learners will include PGY1 Orthopaedic Surgery residents with potential inclusion of PGY2 residents and ER/OR staff.

Identification of need or problem for targeted learners
Basic techniques in ORIF is an introduction to basic skills necessary for the surgical management of fractures. These are basic techniques required to place fixation devices in the management of fractures. This module provides basic skills education in the use of power drills, depth gauges, taps and in the placement of directed screws.

Most PGY1s do not have these skills when they begin Orthopaedic residency training. They are acquired at different rates by different learners. Many of the skills are not intuitive or are not part of previous training prior to entering residency. They are fundamental to fracture surgery and to basic equipment used in many other surgical procedures in orthopaedics.

Current educational approach to address need or problem
The current educational approach to the acquiring basic fracture skills is reading relevant literature, followed by an apprenticeship based learning experience in which the techniques are demonstrated by upper level residents or faculty in the operating room environment. When the resident is judged able, she/he is observed performing the procedure with immeditate feedback from the observer.

Ideal educational approach to address need or problem
Ideally, the learner(s) should be provided background information in one or more didactic sessions to gain understanding of the relevant concepts relating to equipment and instrumentation required to manage fractures. This would be followed by a skills training session. This session would consist of a review of the equipment utilized (drill, depth gauge, tap screw driver etc.). The learner would then have an opportunity to review and practice a variety of skills of increasing difficulty. The skills would be organized into discrete exercises and there would be assessments associated with each of these skills. Residents would train to a pre-determined level of proficiency prior to working on actual patients in the operating room.

Goals and Objectives

Specific educational goals
- The learner will obtain the related cognitive knowledge and observe, practice and demonstrate a level of proficiency in the basic skills of fixing a fracture.
- These exercises will not reproduce material from basic fracture courses (plates, intramedullary nails).
- The learner will understand the pitfalls and common errors encountered when using orthopaedic equipment essential to fix fractures.

Specific cognitive, affective, psychomotor task objectives
The learner will demonstrate:
Using a drill as it typically is used to place screws to fix fractures including:
  a. Accurately targeting the far cortex
  b. Drilling obliquely
  c. Not past pointing beyond far cortex

- The ability to use a depth gauge.
- The ability use a tap.
- The ability to drill, measure, tap and place screws through limited incisions in the soft-tissue envelope.
- Respect for soft tissues and anatomical constraints.
- The ability to place screws in a precise location controlled by single plane fluoroscopy.
- The above skills in increasingly difficult bone and soft tissue simulations.

**Syllabus Development**

**Assumptions**
It is assumed that the learner will have little or no knowledge or skill using orthopaedic surgical instruments basic to fracture fixation.

**Suggested readings**
- Rockwood & Green Fractures in Adults, 7th edition. Chapter 1: Biomechanics of Fractures and Fracture Fixation. Pg 3-38
- Manual of Internal Fixation. Techniques recommended by the AO-ASIF Group, 3rd edition. Chapter 1: Basic Aspects of Internal Fixation Pg. 107

**Description of laboratory module**
This lab will consist of a variety of surgical skill building exercises with increasing levels of difficulty. It will include: background reading, video review, dedicated practice in the skills lab and video and direct observation based assessments of proficiency. These exercises are designed to expose the residents to increasingly difficult tasks focusing on drilling and inserting screws that closely simulate the operating room experience. Participants will begin by learning how to use the equipment properly with a basic bone surrogate model, understand the feel of unicortical drilling, practice directional drilling and drill to a specific point on an exposed PVC pipe-model of a long bone. Residents will practice on the PVC pipe-model with a surrogate soft tissue envelope. The final 2 tasks of placing a periarticular screw and syndesmosis screw in a cadaver ankle will be performed with the assistance of a mini c-arm.

All exercises are illustrated by videos. The videos provide overall guidance for the exercise and are specifically designed to orient the learner to the targeted skills, exercises and related techniques.

**Description of techniques and procedures**

1. **Bone surrogate Drilling, Depth gauge, Tap, and Screw (see video #1)**

   In this exercise, residents will learn basic skills in utilizing the equipment necessary to fix fractures, ranging from basic drilling, drilling at an oblique angle, measuring depth with a depth gauge, using a tap, as well as inserting the screw. Residents will learn proper technique for each of these as demonstrated by a senior faculty surgeon in video #1. This exercise will be performed on a PVC pipe bone surrogate model.

2. **Unicortical vs Bicortical Drilling (see video # 2)**

   In this exercise residents will practice drilling through only one cortex and will learn to understand the feel of unicortical vs bicortical drilling. Proper technique and demonstration of the exercise is seen in video # 2. This exercise will be performed on a plywood-foam “sandwich” model.

3. **Directional drilling (see video # 3)**

   In this exercise residents will develop skills in drilling at oblique angles to a specific point on the far side of the bone model. They will be given points on one side of the exposed PVC bone surrogate model to start drilling, with corresponding objective points on the far side, with the intention of developing coordination of their drilling path for screw placement. This exercise is demonstrated in video 3.

4. **PVC Pipe with Soft Tissue Envelope Surrogate (see video # 4)**

   In this exercise residents will learn to drill and place screws in a PVC model with a soft tissue...
envelope surrogate. This more difficult exercise is demonstrated in video #4 where a faculty member demonstrates how the surrogate soft tissue envelope limits visibility, and allows the residents to practice placement of a screw through a limited incision approach. An oblique screw is also placed and residents are encouraged to use this model to practice multiple screw placements in various orientations and with various sizes of soft tissue incision.

5. Cadaver (see video # 5 a and b)
In this final exercise, residents will be asked to place periarticular and syndesmosis screws in a cadaver lower leg. This is a difficult and also realistic exercise and practice will improve performance. Demonstrated by a senior faculty member in video 5 (a, & b), this relatively high level technique will develop the residents’ skills in placing a screw through a limited incision while utilizing mini C-arm fluoroscopic assessment for accurate placement.

**Common errors and prevention strategies**

1. Lacking control of forward pressure of drill, firmly advancing drill through far cortex without plunging
2. Floundering with depth gauge
3. Incomplete tapping of far cortex
4. Inappropriate angle of approach with tap and screw
5. Eccentric or inappropriate eccentric motion when placing the screw
6. Inability to accomplish tasks with limited visualization
7. Inability to drill and place screws on oblique surfaces or in precise controlled directions
8. Inability to accomplish tasks when guided by fluoroscopic control

**Demonstrate expert performance**

Videos demonstrating the exercises have been created by senior faculty members. They include discussion of the many common errors and techniques and how to avoid them. These videos will guide residents through the recommended exercises for this module.

**Recommendations for motor skills practice**

1. Be able to place a screw quickly and efficiently
2. Avoid plunging with a drill or a power tap
3. Using a drill and a tap with a sleeve
4. Oblique and directional drilling
5. Spend time working around soft tissue and with limited visualization
6. Spend time finding the drill hole with the depth gauge
7. Use all available time, especially with more difficult tasks
8. Using different types of screws
9. Motor function and surgical skill will only improve with practice. Continue to repeat practice of the technique at each station as time allows.
10. Poor practice technique leads to poor OR technique. “Practice doesn’t make perfect, perfect practice makes perfect”.

**Supplies and station setup**

a. Table with vice
b. Bone surrogate long bone (s)
c. Cadaver limb preferably ankle (s)
d. Mini C-arm
e. AO small fragment set
f. Power driver and batteries
g. ¾ inch foam, 1/8 inch plywood squares, 4 small C-clamps
   -Foam and plywood to be cut to form a plywood “sandwich” around the foam, held together by the small clamps.
h. ¾ inch or 1inch PVC pipe, PVC pipe insulation
   -PVC pipe wrapped in insulation is to be put in vice as demonstrated in video 4.

**Suggested duration for completion of module**

Background reading and video review should be accomplished in 2 hours. Practice on bone surrogate and PVC pipe within the modules should be accomplished in 2 hours. Practice on
cadavers with mini C-arm 2 hours. Complete video assessment with OSATs 1 hour.

**Estimated budget**

a. Foam, plywood, Bone surrogate models, PVC pipe ($50-100 )

b. One cadaver foot and ankle per three learners for practice and one for assessment – ($500 )

c. mini C-arm time – estimate four hours necessary for full practice and assessment – (variable depending on institution)

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**Learner Evaluation and Feedback**

**Methods of performance assessment**

Learners are assessed in their ability to utilize orthopaedic equipment in a safe and efficient manner. In addition they will be assessed on their ability to utilize the equipment effectively to place bone screws in a variety of increasing challenging soft-tissue scenarios.

**Suggested proficiency benchmarks**

1. Simple assessment – Resident consistently can hit a 1cm diameter circle on the far side of a 1 inch PVC pipe with a drill bit from an oblique angle, using proper depth and screw length within an acceptable number of attempts.

2. Complex assessment – Resident can place a screw close to and parallel to the subchondral surface of the distal tibia through a small incision using mini C flouro and appropriate technique. OSATS and checklist. Video or direct observation.

**Methods for learner debriefing and feedback**

Learners will provide curriculum feedback using a web-based, anonymous tool assessing module didactic content, expert video quality and usefulness of skills training.

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**Periodic Curriculum Review, Evaluation, Validation, and Refinement**

Curriculum faculty will annually review learner comments and assess potential improvements in the didactic and manual skills portion of the module. Educational validation will occur when the learner is observed and graded in the clinical setting.