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

As this is a more advanced technique, this module should be completed after first completing modules: 9 (Fluoroscopic Knowledge and Skills), 10 (K-Wire Techniques), 11 (Techniques Basic to Internal Fixation of Fractures), and 13 (External Fixation). The ability to obtain and hold a fracture in a reduced position is a skill fundamental to the management of traumatic skeletal injury. The use of a variety of techniques and instruments may be utilized to facilitate the reduction of a fracture. This module provides basic education introducing learners to the principles and techniques of fracture reduction.

PGY1s do not have any experience with these skills when they begin Orthopaedic residency training. They are acquired at different rates by different learners. Currently, there are few training techniques to teach fracture reduction skills.

Current educational approach to address need or problem

The current educational approach to fracture reduction is largely through background reading of the relevant literature with historic rationale for a variety of reduction techniques. This is often followed by an apprentice-style or observational learning experience in which techniques are demonstrated by upper level residents or faculty as they treat patients. When the learner is judged able, she/he often attempts reduction maneuvers independently or with minimal immediate feedback from the observer. Reduction skills are first acquired on easier fractures.

Ideal educational approach to address need or problem

Ideally, the learner(s) participates in a didactic experience to understand the relevant background and cognitive knowledge to support the skills exercises. This would be followed by a skills training session which would consist of introduction to the use of instruments, and hands on exercises with increasing levels of difficulty progressing to an intra-articular distal tibia fracture model with soft-tissue envelope. The necessary skills to plan and execute fracture reduction and to assess the quality of fracture reduction would be practiced in a training environment. In this way, learners could become comfortable with the equipment and the planning and execution necessary to achieve accurate fracture reductions. In addition, practicing on a model would increase technical skill and hand eye coordination. Ideally, skill would be assessed on the model, and residents would achieve a level of proficiency through repeated practice.

Goals and Objectives

Specific educational goals

The learner will understand:

- The meaning and assessment of an accurate fracture reduction.
- The importance of pre-operative planning.
- The interaction of direct and fluoroscopic assessments of reduction.
- The limits of varying surgical approaches as they relate to the fracture.
- The appropriate placement of reduction aids and devices based upon the obliquity of the fracture and other aspects of fracture displacement.
- Respect for the soft tissue envelope.
- The difference between temporary versus definitive reduction

**Specific cognitive, affective, psychomotor task objectives**

- Demonstrate understanding of pertinent anatomy as it relates to the fractured limb (eg. distal tibia anatomy)
- Understand common surgical approaches, and differences between limited and open techniques as they relate to fracture reduction
- Understand surgical principles of limited approach techniques including increased importance of fluoroscopic assessment
- Effectively utilize skills learned in the Fluoroscopy and Basics of ORIF modules to effectively reduce and provisionally fix (with K-wires) a distal tibia articular fracture model (with soft-tissue envelope) through a limited anterior approach.

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**Syllabus Development**

**Assumptions**

It is assumed that the learner will have very little knowledge or experience in the reduction of fractures. Further the learner will have very little to no direct experience in the reduction of intra-articular fractures with limited exposure.

**Suggested readings**


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**Description of laboratory module**

The module will consist of required background reading, and video demonstrations of fracture reduction techniques. Following the background and introduction, learners will have the opportunity to participate in fracture reduction exercises of increasing levels of difficulty.

**Description of techniques and procedures**

This lab will consist of a variety of exercises. It will begin with a discussion of fracture reduction. Included will be review of the concepts of reduction including the use of traction, manipulation, and ligamentotaxis. It will include a review of the basic surgical instruments utilized for fracture reduction (tenaculums, hemostat, lion jaw). We will discuss the variety of surgical scenarios in which reduction techniques and instruments are utilized. Following this the learner will have the opportunity to participate in fracture reduction exercises of increasing difficulty. Starting with a reduction of an oblique fibula fracture, and then progressing into reduction of a 3-segment articular fracture model of the distal tibia complete with a soft-tissue envelope. Learners will be required to perform this reduction (3-segment articular fracture model) in a realistic environment, which will include standard fracture reduction instruments, and fluoroscopic assessment of reduction of the model, combined with limited approaches through a limited incision to the soft tissue envelope. The session will be observed and/or video recorded and assessments will be made on efficiency of motion, articular reduction, and others aspects of completing the procedure.

**Description of Techniques and Procedure**

1. Discuss the importance of preoperative planning, understanding the position of fragments, understanding the muscular forces and instruments available for reduction. Discuss the concept of reduction using radiographic imaging and direct visualization. Assess the position of fracture fragments on preoperative imaging studies. Complete a surgical reduction plan. *(see initial discussion in video #2)*
2. The first hands on exercise should be a reduction of an oblique lower leg fracture model without a soft tissue envelope. In this exercise, residents can learn the basic techniques of anatomically reducing a fracture using clamps and other reduction instruments.

3. *Video #1* will introduce the learner to a 3 segment distal tibia fracture model and the equipment necessary to reduce the fracture. Additionally it will highlight the aspects of the soft tissue surrogate 3 segment articular fracture model.

4. The next exercise will be the 3-segment distal tibia fracture model without a soft tissue envelope. Using this model, learners will use the same instruments necessary in the more complex model to follow. This will include large tenaculum reduction forceps, and K-Wire fixation techniques. Practice on this model will prepare learners for the final, more difficult, exercise that follows.

5. The learner should now be prepared to plan the more complex 3 segment articular fracture reduction within a soft tissue envelope using fluoroscopic guidance. *Video #2*, is an expert video where 1 reduction and fixation strategy is demonstrated. *Video #3* demonstrates junior level residents performing this exercise, highlighting common errors in techniques that have been observed.

6. Learners should now be given an opportunity to perform the exercise on the 3-segment distal tibia model inside a soft tissue envelope. A 15 Minute time limit is suggested. Assessments may include; ability to complete the exercise, time to completion, accuracy of reduction, and OSATS and checklist assessment of performance live or through video recording by a faculty member.

Common errors and prevention strategies *(see video #3)*

1. Poor preoperative plan

2. Inadequate assessment of fracture position

3. Lack of reduction of fracture

4. Overuse or unsafe use of fluoroscopic imaging

5. Poor soft-tissue handling leading to unnecessary collateral injury

6. Inadequate temporary fixation of fracture

7. Dangerous (lack of understanding of underlying anatomy) placement of reduction instruments and subsequent hardware

Demonstrate expert performance

An example video *(video #2)* describing and demonstrating the fracture reduction is available for learner review (expert performance). This video includes a discussion of the techniques. Additionally a video discussing common errors and mistakes made by junior residents completing this exercise is available *(see video #3)*. These videos will guide residents through the recommended exercises for this module.

Recommendations for motor skills practice

1. Effectively utilize reduction instruments with fractured surrogate bone models

2. Carefully place reduction instruments with consideration of soft-tissue constraints.

3. Carefully consider placement of reduction aids with respect to subsequent fixation devices

4. Consider reduction and fixation strategies in advance (resist trial and error approach)

5. Review the videos and repeat the exercise

Supplies and station setup

a. Fractured surrogate bone models

b. Surrogate bone model of a distal tibia articular fracture with a soft-tissue envelope

c. Reduction instruments, including large and small tenaculums

d. K-wire driver and K-wires

e. Fluoroscopy unit and Tech

f. Radiolucent OR Table
Suggested duration for completion of module

Background reading and video review should be accomplished in 2 hours. Motor skill practice and use of instruments on oblique fibula module (1-2 hours). Motor skill practice and assessment on Sawbones distal tibia articular fracture model with soft-tissue envelope (2 hours).

Estimated budget

a. Sawbones-Fibula Fracture Oblique (6) - 200$

b. Sawbones-Distal Tibia without envelope (6) - 400$

c. Sawbones-Distal Tibia Fracture with Articular Surface and Envelope (6) - 1400$

d. It is possible to use individual models multiple times.

e. Fluoroscopy and technician usage (varies by institution)

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.

Learner Evaluation and Feedback

Methods of performance assessment

Learners are assessed in their ability to accurately reduce and provisionally fix a three-segment distal tibia articular fracture model. Assessment metrics utilized will be direct or video assessment of skills and techniques in reducing the fracture as scored by OSATS and standardized checklists. Time to completion and quality of articular reduction and respect for the soft tissue envelope should also be assessed.

Suggested proficiency benchmarks

Particularly if time limited, and with appropriate attention to the soft tissue envelope, this is a difficult exercise for junior level learners. Practice with various reduction strategies, and multiple discrete attempts may be necessary. After sufficient practice, the learner should be able to perform in a safe manner, an adequate distal tibia articular fracture reduction with limited direct and fluoroscopic assessment. The fracture should be appropriately secured with K-wire provisional fixation through safe corridors. OSATS scores determined from either real-time scoring or video review will provide objective information on proficiency of this module.

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, noting the specific steps of fracture reduction in an operating room environment.