



A Modular Interactive Virtual Surgical Training Environment

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Contents

- Why an Interactive Virtual Surgical Training Environment?
- Key Femoral Surgical Procedures
- An Instructional Plan
- Force Feedback
- Virtual Reality Environment
- A Training Experiment
- Conclusions

The Need

- Current training relies on:
 - Supervised practice
 - Live patients

- Problems:
 - Live patients
 - Balance the needs of safety and training

The Benefits

- Actual training possible
- Hands-on experience
- Reduced training costs
- Reduced medical errors
- Safer environment
- Practice basic surgical techniques
- Performance metrics possible

Femoral Surgical Overview

- I am not a Medical Doctor!
- Femoral injuries are common in body armor clad soldiers
- Fluoroscope is the only sensing tool.

- Guide
- Drill
- Tap
- Pin



Instructional Keys

- Initial learning must take place on a deep level.
- Requires integrated, task-specific constituent skills.
- Learning is most effective in a dynamic environment.
- Enables mastery of component skills.
- Enables mastery of procedural application.
- Closely replicates actual procedure.

Instructional Plan

1. Identify Fluoroscopy Images to Rotation of Bone
2. Start Point Placement
3. Placement Point of Distal Interlock
4. Screw Placement Distal Interlock
5. 3-D Orientation Screw Displacement
6. Practice Drilling

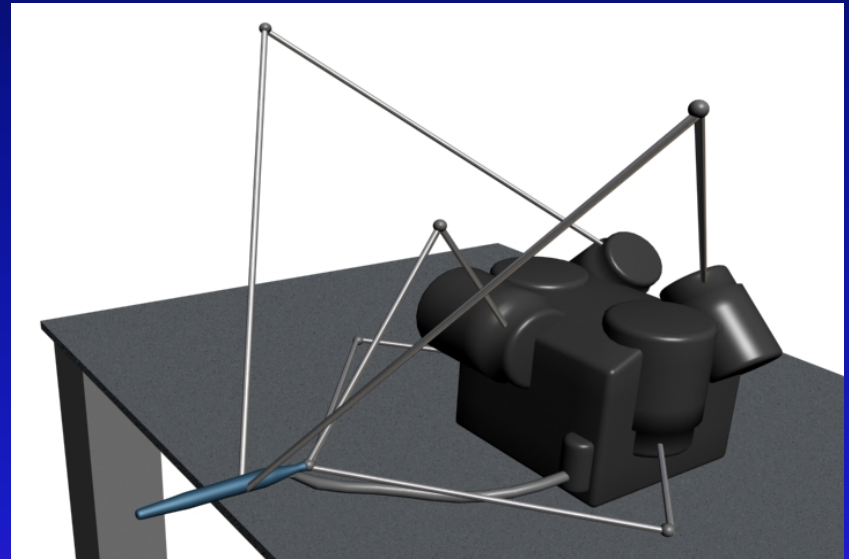
Combination of above six components results in a procedural training session for femoral repair.

Metrics

- Number of attempts
- Soft tissue damage
- Systematic processes used
- Path variance
- Path depth
- Number of fluoroscopy images used
- Logical path to point of distal interlock
- Drilling force
- Overall placement of screw in femur

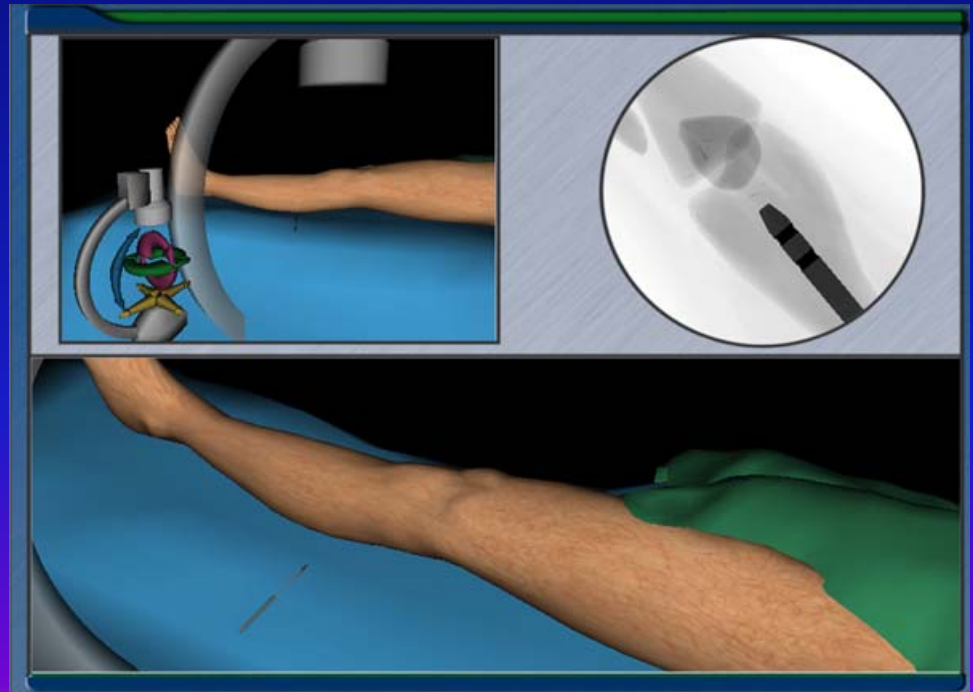
Force Feedback System

- Simulates skin and bone contact
 - Requires six degrees of freedom:
 - Orientation
 - Position
 - Skin contact point
 - Skin contact vector
 - Bone surface
-
- Various surgical objects and devices



Virtual Reality System

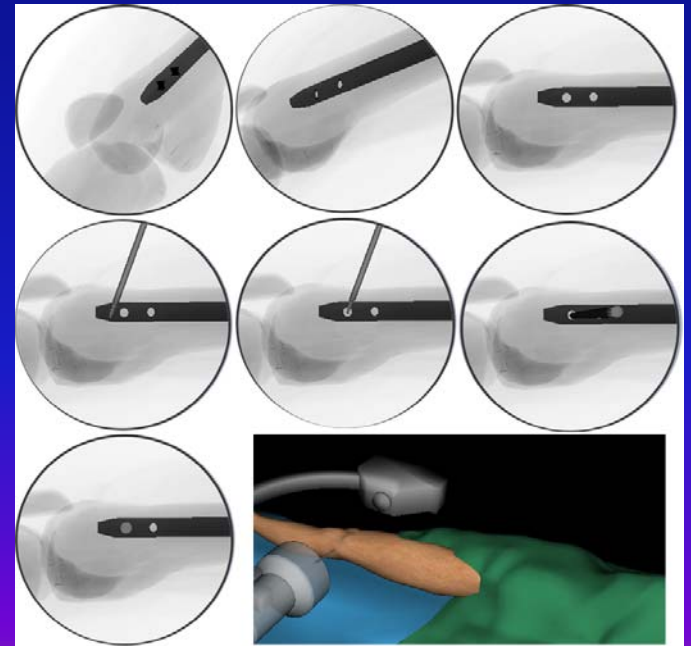
- Current simulation is of the leg (femur)
- Fluoroscope translation and orientation
- Models include skin, muscle bone, and circulatory system
- Surgical view, rotation and zoom
- Fluoroscopic views
- Can be augmented by latex leg and surgical table



Training Experiment

- Simulates the proximal interlock procedure
- Start point displacement experiment
- Metrics: total time, number of movements, total travel distance, and number of images

	Initial	After
Time	10 min	3 min
# m	63	15
Dist	563 mm	160 mm
# im	54	12



Conclusions

- Components: instructional environment, Haptic system, and virtual reality system
- Six example training modules
- Specific metrics created
- Can be expanded to other medical techniques for training
- Hurdles:
 - Using actual instruments
 - Full range of motion
 - Surgical complications

Questions? & Contact Info

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