Implementing the ABOS Surgical Skills Modules for PGY I Residents

Thomas Baker DO
Program Director
Columbus, Ohio

Backround

- Orthopedic surgery requires a high degree of technical skill
- Skills are acquired during residency and fellowship training through an **apprenticeship model** largely unchanged for over a century
- ABOS and ACGME RRC summit to “Reboot” orthopedic education

Summit Goals

- Review simulation in other surgical GME
- Review the status of orthopedic simulation
- Develop a curriculum- PGY year to target; etc
- Simulation Development for orthopedics: cost effective simulations to train basic orthopedic skills, identify skills modules
- Validation
- Finances
- Program requirements and Certification: ABOS/RRC requirement and a metric for ABOS certification and maintenance of certification

2011 Resident and Program Director Survey- Karam/ Marsh JBJS 2012

- Only 50% residency programs have a skills lab and program
- There was a high interest among PD's in a skills curriculum
- Most PD's have little knowledge of **budget** for skills training or the knowledge of the **cost** of a skills lab
- Cost is a cjhallenge to the expansion of skills programs
- 59.04% of PD's were interested in a standardized simulation of surgical skills curriculum for residents

Barriers to Skills Program

- **Lack of funding** – 87.3%
- Lack of available curriculum- 34.2%
- Lack of faculty/instructor interest- 20.3%
- Lack of dedicated space 16.5%
- Lack of resident interest- 3.8%

ABOS/RRC Laboratory Surgical Skills Required Beginning Academic Year 2013- 2014

Requirements include:

A curriculum with goals and objectives

Assessment metrics

A dedicated space for the skills lab

Training in basic skills required of residents for emergency care and to prepare residents for future participation in surgical procedures

See ACGME Program Requirements for GME in Orthopedic Surgery sections IV.A.6.a).(2)- IV.A.6.a).(2).(b),(iii)

ABOS skills taskforce **Modules**

- Sterile technique and OR set-up
- Knot tying & suturing
- Microsurgical suturing
- Soft tissue handling techniques
- Casting and splinting
- Traction
- Compartment syndrome
- Bone handling techniques

Modules

- Fluoroscopy
- K-wire techniques
- Basic techniques in ORIF
- Principles and techniques of fracture reduction
- External fixation
- Basic Arthroscopic Skills
- Basics of Hip and Knee Arthroplasy
- Joint Injection
- Patient safety

Skill modules

- Excellent modular descriptions with goals and objectives
- Each module designed to train residents over a half to full day
- Options for low cost versus expensive cadavers
- Instruction in accepted techniques
- Assessment metric for skills for individual residents: guidance practice until performance within time standards; videotape; pass or needs more practice
- Post lab resident briefing and survey

COST

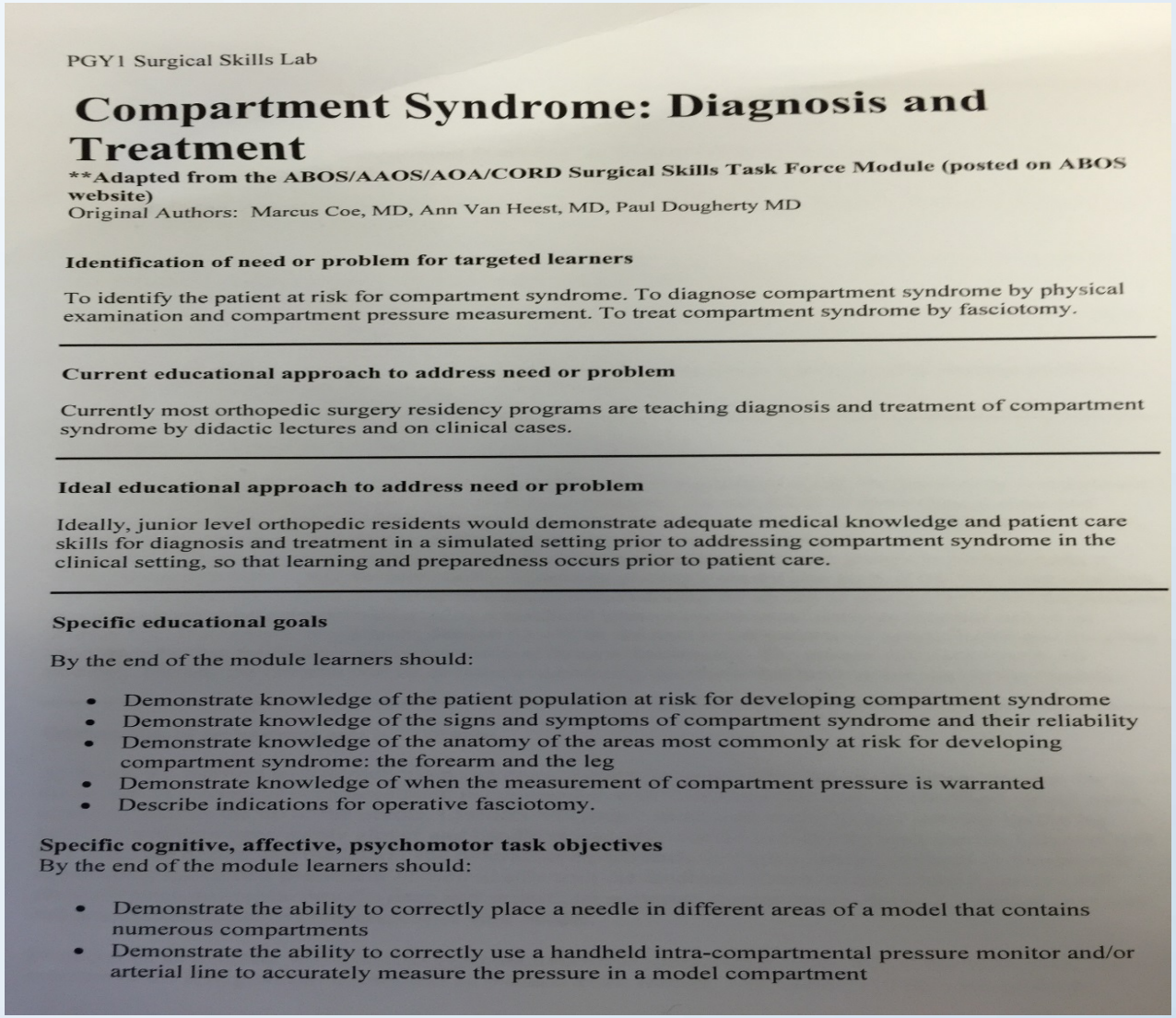
Estimated Equipment, Etc

- Bone Surrogate: $ 8000
- Cadaver Costs: $10,000
- Fluoroscopy Time: $ 300
- Equipment: $ 1000
- Animal Model: $ 700
- Vid/Org. Assistant: $ 1000
- Lab Assistant: $ 1,500
- Total: $ **22,500**

Time Allocation

- Lab assistant- 120 hours
- Video/ Organizational assist- 60 hours
- Faculty Time per Module- 6-8 hours /day for 1-2 staff
- Total Faculty Time- **102 hours**

Module example- Compartment Syndrome



PGY1 Surgical Skills Lab

Compartment Syndrome: Diagnosis and Treatment

****Adapted from the ABOS/AAOS/AOA/CORD Surgical Skills Task Force Module (posted on ABOS website)**

Original Authors: Marcus Coe, MD, Ann Van Heest, MD, Paul Dougherty MD

Identification of need or problem for targeted learners

To identify the patient at risk for compartment syndrome. To diagnose compartment syndrome by physical examination and compartment pressure measurement. To treat compartment syndrome by fasciotomy.

Current educational approach to address need or problem

Currently most orthopedic surgery residency programs are teaching diagnosis and treatment of compartment syndrome by didactic lectures and on clinical cases.

Ideal educational approach to address need or problem

Ideally, junior level orthopedic residents would demonstrate adequate medical knowledge and patient care skills for diagnosis and treatment in a simulated setting prior to addressing compartment syndrome in the clinical setting, so that learning and preparedness occurs prior to patient care.

Specific educational goals

By the end of the module learners should:

- Demonstrate knowledge of the patient population at risk for developing compartment syndrome
- Demonstrate knowledge of the signs and symptoms of compartment syndrome and their reliability
- Demonstrate knowledge of the anatomy of the areas most commonly at risk for developing compartment syndrome: the forearm and the leg
- Demonstrate knowledge of when the measurement of compartment pressure is warranted
- Describe indications for operative fasciotomy.

Specific cognitive, affective, psychomotor task objectives

By the end of the module learners should:

- Demonstrate the ability to correctly place a needle in different areas of a model that contains numerous compartments
- Demonstrate the ability to correctly use a handheld intra-compartmental pressure monitor and/or arterial line to accurately measure the pressure in a model compartment

Compartment Syndrome

- Demonstrate the ability to successfully perform a fascial release of the lower leg and the forearm/hand on a cadaver (if available)

Suggested readings

Schmidt, Andrew: "Acute Compartment Syndrome" in *Evidence-Based Orthopaedics* edited by Mohit Bhandari, 2011. Pages 627-635

Twaddle, Bruce; Amendola, Annunziato: "Chapter 13-Compartment Syndromes" in *Skeletal Trauma, Fourth Edition* edited by Bruce Browner, 2008.

McQueen MM, Court-Brown CM. Compartment monitoring in tibial fractures. The pressure threshold for decompression. Journal of Bone and Joint Surgery British 1996; 78:99-104.

McQueen MM, Gaston P, Court-Brown CM. Acute compartment syndrome. Who is at risk? Journal of Bone and Joint Surgery British 2000;82:200-3.

Ulmer T. The clinical diagnosis of compartment syndrome of the lower leg: are clinical findings predictive of the disorder? Journal of Orthopaedic Trauma 2002;16: 572-7.

Description of laboratory module

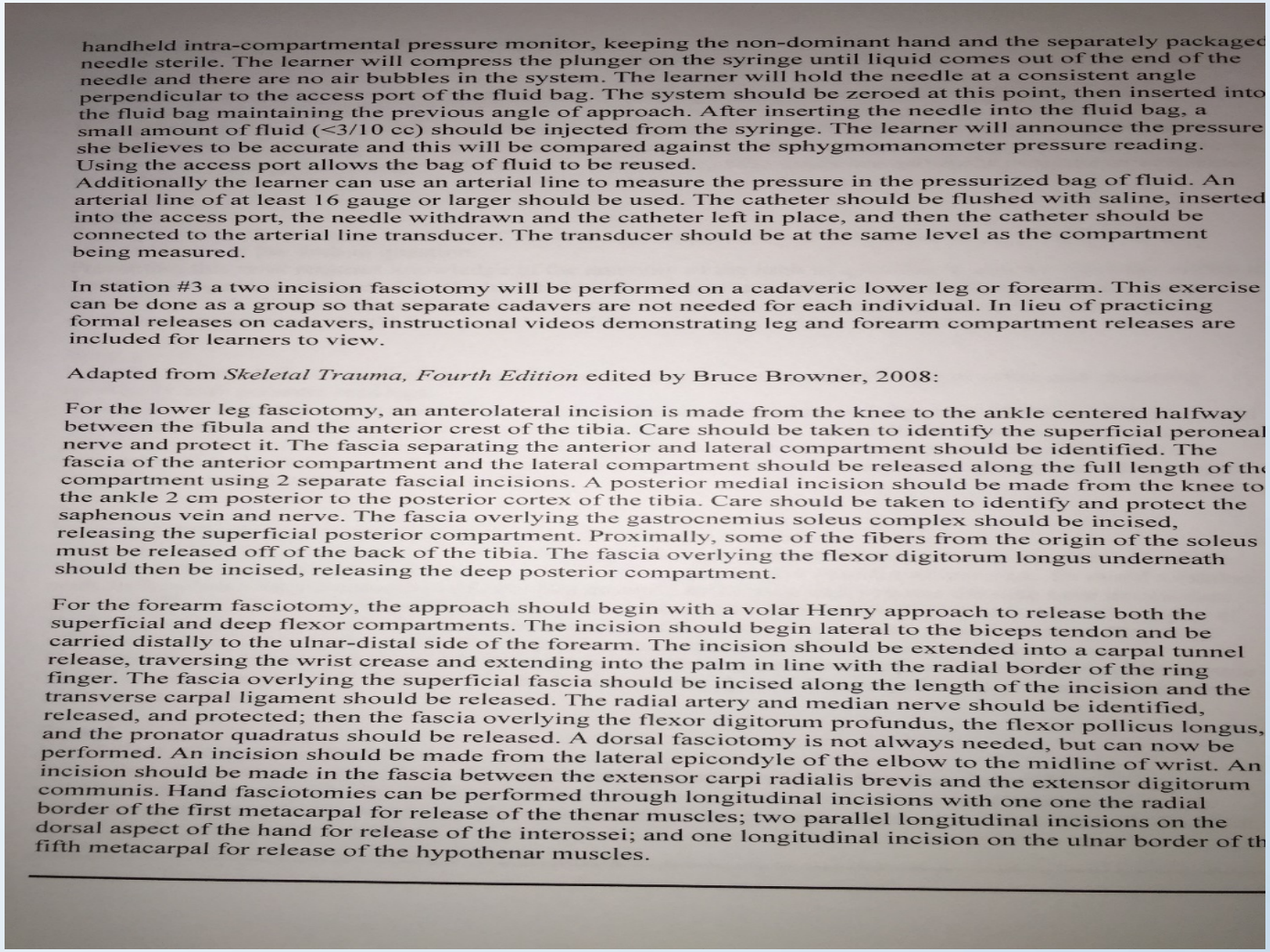
The module will begin with a 20 minute review of the patient population at risk for developing compartment syndrome, the signs and symptoms of compartment syndrome, the reliability of these clinical signs and symptoms in isolation and aggregate, the anatomy of the forearm and lower leg, the indications for use of compartment pressure measurement, and the indications for surgical fasciotomy.
The next 1.5 hours will be devoted to dividing the learners into three different groups to perform tasks at three stations. Station #1 will be dedicated to accurately placing a needle into each of the four compartments of a lower leg model. Station #2 will be devoted to demonstrating the ability to accurately record the pressure in a pressurized compartment model using a handheld intra-compartmental pressure monitor and/or an arterial line. If a cadaver is available, Station #3 will be devoted to demonstrating proper technique for a two incision lower leg fasciotomy and a two incision forearm fasciotomy. The groups will rotate every 30 minutes. The last ten minutes will be devoted to answering questions that have arisen during the module.

Description of techniques and procedures

At station #1, learners will sterilely prep and drape a lower leg model that has the ability to localize the tip of the needle. A model has been developed in conjunction with Sawbones that uses an electrical circuit and a screen to localize the tip of the needle. Learners will prep a small area medially and laterally on the leg. Learners will then open sterile gloves and handle the model's needle as if the tip were sterile. Learners will then place the needle into the lateral and anterior compartments through a lateral approach. Learners will demonstrate the correct placement of their needle with the feedback screen on the model. Learners will similarly place the needle into the deep and superficial posterior compartments through a medial approach and demonstrate the correct placement of their needle.

In station #2 an overseer will use a sphygmomanometer to pressurize a 500cc bag of normal saline. The pressure of the sphygmomanometer will be blinded to the learner. The learner will then assemble the

Compartment Syndrome



handheld intra-compartmental pressure monitor, keeping the non-dominant hand and the separately packaged needle sterile. The learner will compress the plunger on the syringe until liquid comes out of the end of the needle and there are no air bubbles in the system. The learner will hold the needle at a consistent angle perpendicular to the access port of the fluid bag. The system should be zeroed at this point, then inserted into the fluid bag maintaining the previous angle of approach. After inserting the needle into the fluid bag, a small amount of fluid (<3/10 cc) should be injected from the syringe. The learner will announce the pressure she believes to be accurate and this will be compared against the sphygmomanometer pressure reading. Using the access port allows the bag of fluid to be reused.
Additionally the learner can use an arterial line to measure the pressure in the pressurized bag of fluid. An arterial line of at least 16 gauge or larger should be used. The catheter should be flushed with saline, inserted into the access port, the needle withdrawn and the catheter left in place, and then the catheter should be connected to the arterial line transducer. The transducer should be at the same level as the compartment being measured.

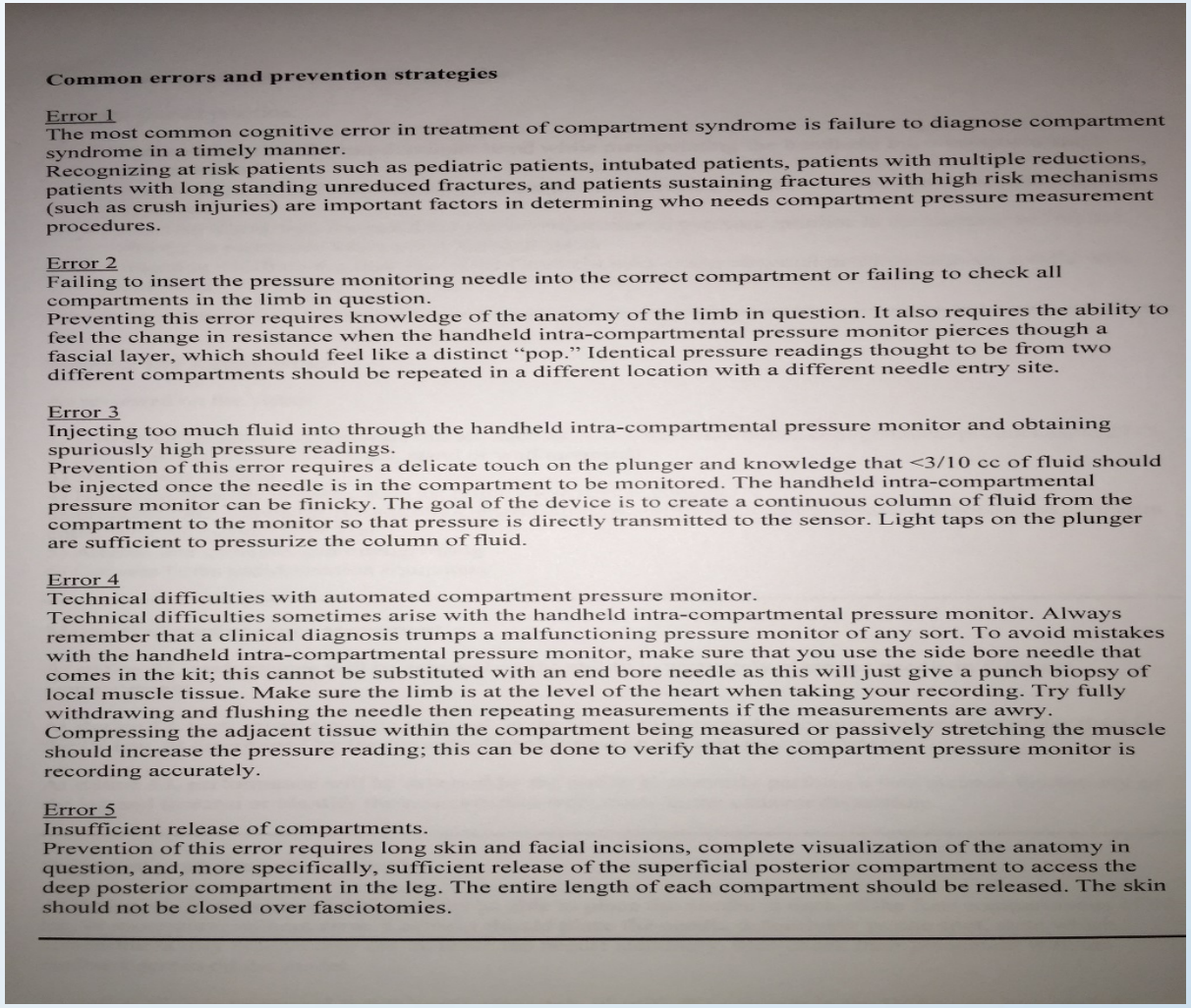
In station #3 a two incision fasciotomy will be performed on a cadaveric lower leg or forearm. This exercise can be done as a group so that separate cadavers are not needed for each individual. In lieu of practicing formal releases on cadavers, instructional videos demonstrating leg and forearm compartment releases are included for learners to view.

Adapted from *Skeletal Trauma, Fourth Edition* edited by Bruce Browner, 2008:

For the lower leg fasciotomy, an anterolateral incision is made from the knee to the ankle centered halfway between the fibula and the anterior crest of the tibia. Care should be taken to identify the superficial peroneal nerve and protect it. The fascia separating the anterior and lateral compartment should be identified. The fascia of the anterior compartment and the lateral compartment should be released along the full length of the compartment using 2 separate fascial incisions. A posterior medial incision should be made from the knee to the ankle 2 cm posterior to the posterior cortex of the tibia. Care should be taken to identify and protect the saphenous vein and nerve. The fascia overlying the gastrocnemius soleus complex should be incised, releasing the superficial posterior compartment. Proximally, some of the fibers from the origin of the soleus must be released off of the back of the tibia. The fascia overlying the flexor digitorum longus underneath should then be incised, releasing the deep posterior compartment.

For the forearm fasciotomy, the approach should begin with a volar Henry approach to release both the superficial and deep flexor compartments. The incision should begin lateral to the biceps tendon and be carried distally to the ulnar-distal side of the forearm. The incision should be extended into a carpal tunnel release, traversing the wrist crease and extending into the palm in line with the radial border of the ring finger. The fascia overlying the superficial fascia should be incised along the length of the incision and the transverse carpal ligament should be released. The radial artery and median nerve should be identified, released, and protected; then the fascia overlying the flexor digitorum profundus, the flexor pollicus longus, and the pronator quadratus should be released. A dorsal fasciotomy is not always needed, but can now be performed. An incision should be made from the lateral epicondyle of the elbow to the midline of wrist. An incision should be made in the fascia between the extensor carpi radialis brevis and the extensor digitorum communis. Hand fasciotomies can be performed through longitudinal incisions with one one the radial border of the first metacarpal for release of the thenar muscles; two parallel longitudinal incisions on the dorsal aspect of the hand for release of the interossei; and one longitudinal incision on the ulnar border of the fifth metacarpal for release of the hypothenar muscles.

Compartment Syndrome



Common errors and prevention strategies

Error 1
The most common cognitive error in treatment of compartment syndrome is failure to diagnose compartment syndrome in a timely manner.
Recognizing at risk patients such as pediatric patients, intubated patients, patients with multiple reductions, patients with long standing unreduced fractures, and patients sustaining fractures with high risk mechanisms (such as crush injuries) are important factors in determining who needs compartment pressure measurement procedures.

Error 2
Failing to insert the pressure monitoring needle into the correct compartment or failing to check all compartments in the limb in question.
Preventing this error requires knowledge of the anatomy of the limb in question. It also requires the ability to feel the change in resistance when the handheld intra-compartmental pressure monitor pierces though a fascial layer, which should feel like a distinct "pop." Identical pressure readings thought to be from two different compartments should be repeated in a different location with a different needle entry site.

Error 3
Injecting too much fluid into through the handheld intra-compartmental pressure monitor and obtaining spuriously high pressure readings.
Prevention of this error requires a delicate touch on the plunger and knowledge that <3/10 cc of fluid should be injected once the needle is in the compartment to be monitored. The handheld intra-compartmental pressure monitor can be finicky. The goal of the device is to create a continuous column of fluid from the compartment to the monitor so that pressure is directly transmitted to the sensor. Light taps on the plunger are sufficient to pressurize the column of fluid.

Error 4
Technical difficulties with automated compartment pressure monitor.
Technical difficulties sometimes arise with the handheld intra-compartmental pressure monitor. Always remember that a clinical diagnosis trumps a malfunctioning pressure monitor of any sort. To avoid mistakes with the handheld intra-compartmental pressure monitor, make sure that you use the side bore needle that comes in the kit; this cannot be substituted with an end bore needle as this will just give a punch biopsy of local muscle tissue. Make sure the limb is at the level of the heart when taking your recording. Try fully withdrawing and flushing the needle then repeating measurements if the measurements are awry.
Compressing the adjacent tissue within the compartment being measured or passively stretching the muscle should increase the pressure reading; this can be done to verify that the compartment pressure monitor is recording accurately.

Error 5
Insufficient release of compartments.
Prevention of this error requires long skin and facial incisions, complete visualization of the anatomy in question, and, more specifically, sufficient release of the superficial posterior compartment to access the deep posterior compartment in the leg. The entire length of each compartment should be released. The skin should not be closed over fasciotomies.

Compartment Syndrome

Recommendations for motor skills practice

Learners should practice:

- Maintaining a sterile non-dominant hand while manipulating the handheld intra-compartmental pressure monitor
- Stabilization of the handheld intra-compartmental pressure monitor to maintain a constant angle of approach
- Piercing fascia with the handheld intra-compartmental pressure monitor in the cadaver to feel the change in resistance when going through fascia
- Injecting <1/10 cc at a time out of the handheld intra-compartmental pressure monitor needle with one hand

---

Supplies and station setup

As reviewed on the video:

1) Lower leg compartment pressure model, such as: http://www.sawbones.com/products/product.aspx?2775
2) Sphygmomanometer (handheld, stand or wall mounted)
3) 500 cc bags of fluid
4) Handheld pressure monitor, such as: http://www.stryker.com/en-us/products/OREquipmentConnectivity/GeneralMultiSpecialtyEquipment/PressureMonitors/IntraCompartmentalPressureMonitor/index.htm
5) Arterial line catheters and tubing/wiring
6) Cadaver limbs and dissection equipment

Methods of performance assessment

At station #1, performance will be assessed on the ability to accurately place the needle in different compartments.

At station #2, performance will be assessed on the ability to accurately measure the pressure of the fluid in the IV bag, as determined by the pressure demonstrated on the sphygmomanometer.

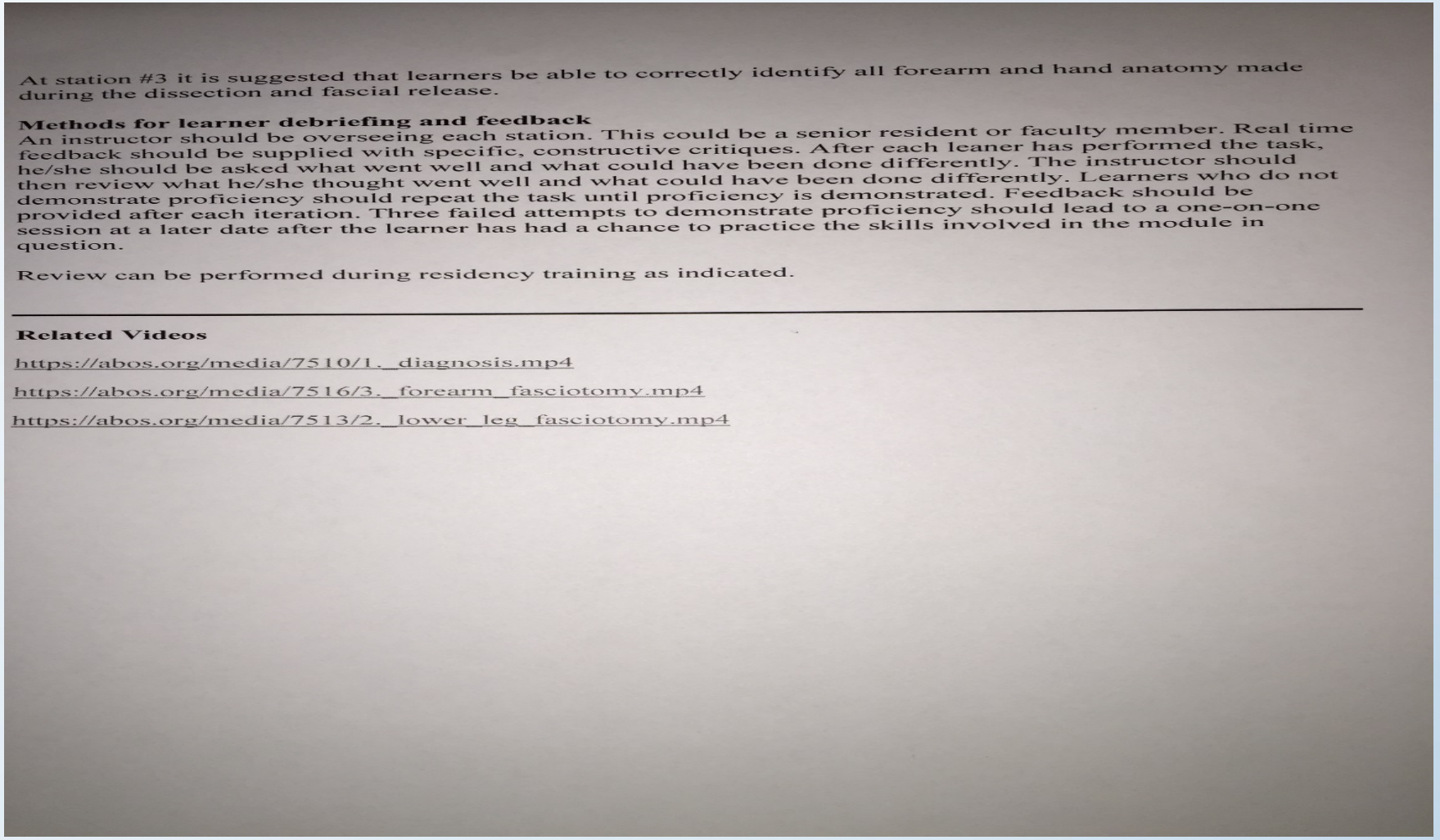
At station #3, performance will be assessed by the ability to correctly perform a two incision fasciotomy of the leg and forearm or identify the mistakes that were made in the cadaver dissection.

Suggested proficiency benchmarks

At station #1, it is suggested that learners be able to place the needle in each of the four compartments of the leg, in succession, without error. Learners should place the needle definitively in one spot, state which compartment they believe they are in, leave the needle stationary, then check their placement with the feedback screen on the model.

At station #2, it is suggested that learners accurately identify the pressure in the IV bag, on two separate occasions, within 5 mmHg of the sphygmomanometer.

Compartment Syndrome



At station #3 it is suggested that learners be able to correctly identify all forearm and hand anatomy made during the dissection and fascial release.

Methods for learner debriefing and feedback
An instructor should be overseeing each station. This could be a senior resident or faculty member. Real time feedback should be supplied with specific, constructive critiques. After each leaner has performed the task, he/she should be asked what went well and what could have been done differently. The instructor should then review what he/she thought went well and what could have been done differently. Learners who do not demonstrate proficiency should repeat the task until proficiency is demonstrated. Feedback should be provided after each iteration. Three failed attempts to demonstrate proficiency should lead to a one-on-one session at a later date after the learner has had a chance to practice the skills involved in the module in question.

Review can be performed during residency training as indicated.

Related Videos

https://abos.org/media/7510/1._diagnosis.mp4

https://abos.org/media/7516/3._forearm_fasciotomy.mp4

https://abos.org/media/7513/2._lower_leg_fasciotomy.mp4

One Lucky Program Director

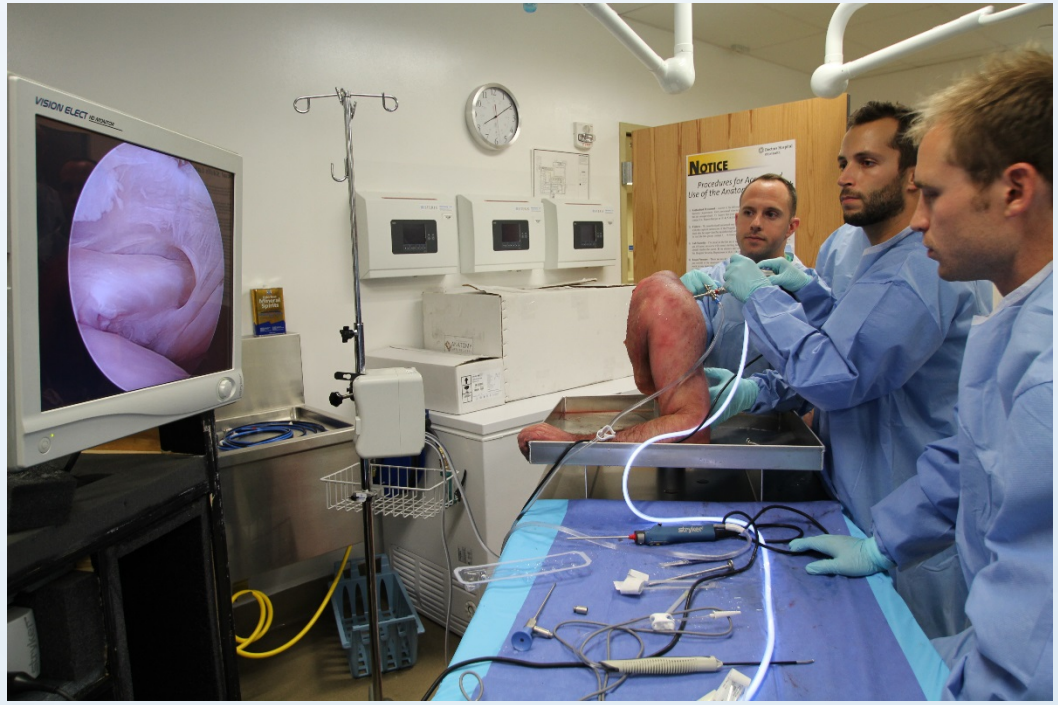
DOCTORS HOSPITAL FACILITY:

Large Wet Simulation Lab with storage of cadaver

4 station operating tables with overhead OR lights with video

- Surgical equipment with drills, saws, arthroscopy towers,etc
- 4 stations for microsurgery microscopes
- Mobile fluoroscopy x-ray unit on site
- Fluoroscopy tech who also sets up and assists cleanup
- 4 Compartment pressure devices
- Prep room and Debriefing room

Doctors Sim Lab



Doctors Sim Lab

In Addition

- Two Orthopedic Program Directors with whom we have collaborated to organize our city wide PGY I Simulation Lab
- Dr Joel Mayerson PD at The Ohio State University
- Dr Richard Fankhauser PD at Mt Carmel Hospital
- We began a dialogue and toured each of our sim lab facilities deciding to collaborate for the year 2014-2015 using each facility and combing faculty for the modules
- Each facility absorbed its individual costs
- All PGY I residents had protected time from 1:00- 5:00 with attendance mandatory
- Dates from Monday, October 20-24; Monday, October 27- 31; and Monday, November 3- Thursday, November 6 were chosen
- 12 total PGY I residents participated (5 from OSU, 5 from DH,and 2 from MCH)

Structure and Process

- Three facilities within 20 minutes of each other
- Faculty assignments were made at each facility with some faculty assisting at other facilities
- Chief residents from each program were utilized as assistants
- Took advantage of the strengths of each facility
- Faculty assignments were based on availability and willingness to participate
- OSU coordinator coordinated with the individual lab directors and program directors to facilitate the activities

Curriculum and Assignments- Week One

Revised 9/18/14

PGY1 SURGICAL SKILLS LAB MONTH
October 20 – November 16, 2014

Note: Time for all sessions is 1:00 – 5:00 pm

Week of October 20 – 24, 2014

	Monday, October 20, 2014	Tuesday, October 21, 2014	Wednesday, October 22, 2014	Thursday, October 23, 2014	Friday, October 24, 2014
Activity	Arthroplasty	Arthroplasty	Arthroscopy	Arthroscopy	Summa Oncology Course
Location	Ohio State Clinical Skills Center	Ohio State Clinical Skills Center	Mt. Carmel	Mt. Carmel	[redacted]
Programs Participating	OSU, Mt. Carmel and Doctors	OSU, Mt. Carmel and Doctors	OSU, Mt. Carmel and Doctors	OSU, Mt. Carmel and Doctors	
Preceptors	Dr. Glassman (OSU) Chief Residents	Dr. Glassman (OSU) Dr. Chambers (MC) Chief Residents	Dr. Fankhauser (MC) Dr. Steensen (MC) Dr. Robert Turner (MC) Dr. Trinh (MC) Chief Residents	Dr. Fankhauser (MC) Dr. Steensen (MC) Dr. Tim Miller (OSU) Dr. Robert Turner Dr. Trinh Chief Residents	

Week Two

Revised 9/18/14

Week of October 27 – 31, 2014

	Monday, October 27, 2014	Tuesday, October 28, 2014	Wednesday, October 29, 2014	Thursday, October 30, 2014	Friday, October31, 2014
Activity	Ex Fix, KWire, Traction	Trauma Scenarios	Trauma OSCE	Basic ORIF Skills	Bone Handling and Fracture Reduction Techniques
Location	Ohio State Clinical skills lab Procedures Lab B	Ohio State Clinical Skills Lab Trauma Bay Sim Lab 1 and 2	Ohio State Trauma Bay Sim Lab 3 and 4	Ohio State Clinical Skills Lab Procedures Lab B ** Note start time is 1:30 pm this day only **	Ohio State Clinical skills lab
Programs Participating	OSU, Mt. Carmel and Doctors	OSU, Mt. Carmel and Doctors	OSU, Mt. Carmel and Doctors	OSU, Mt. Carmel and Doctors	OSU, Mt. Carmel and Doctors
Preceptors	Dr. Phieffer (OSU) Chief Residents	Dr. Phieffer (OSU) Dr. Vazquez (OSU Gen Surg) Chief Residents	Dr. Phieffer (OSU) Chief Residents	Dr. Phieffer (OSU) Dr. Fowler (MC) Chief Residents	Dr. Fowler (MC) Dr. Phieffer (OSU) Chief Residents

Week Three

Revised 9/18/14

Week of November 3 – 7, 2014

	Monday, November 3, 2014	Tuesday, November 4, 2014	Wednesday, November 5, 2014	Thursday, November 6, 2014	Friday, November 7, 2014
Activity	Compartment Syndrome/Fasciotomy	Fluoroscopy	Joint Aspirations	Dissections/Approaches (LE and UE)	FREE DAY TO PREPARE FOR OITE – NO ACTIVITIES
Location	Doctors Hospital	Doctors Hospital	Doctors Hospital	Doctors Hospital	[redacted]
Programs Participating	OSU, Mt. Carmel and Doctors	OSU, Mt. Carmel and Doctors	OSU, Mt. Carmel and Doctors	OSU, Mt. Carmel and Doctors	
Preceptors	Dr. Taylor Chief Residents	Doctors Sim Lab Manager Chief Residents	Dr. Fischer (MCHS) Additional faculty TBD Chief Residents	Dr. Taylor Additional faculty TBD Chief Residents	

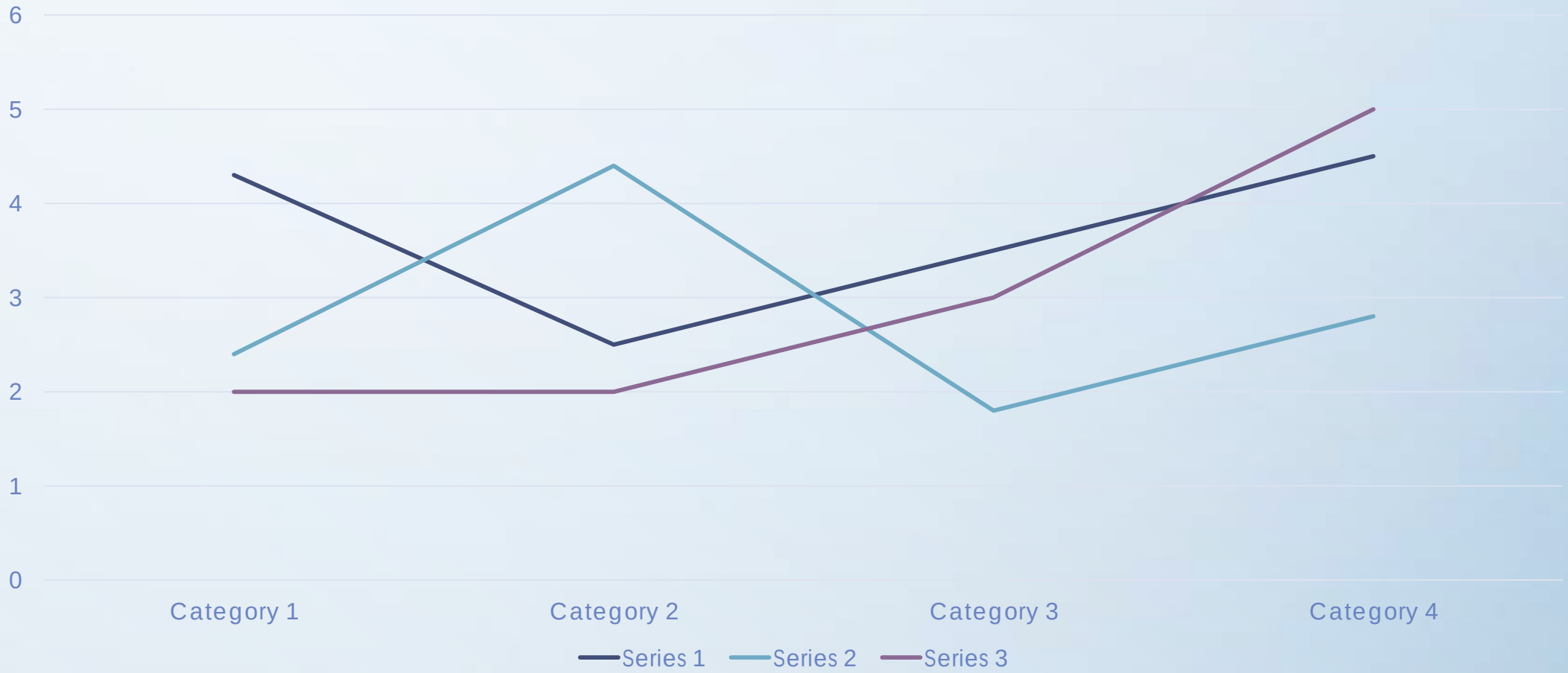
Advantages

- Comradery among residents, faculty, coordinators
- Integrating into ACGME –DH
- Shared costs
- Shared faculty
- Potential for more collaboration
- Potential for more cadaver
- Potential for grants from vendors to help with cost
- **Less stress on each program director**

Title and Content Layout with List

- Add your first bullet point here
- Add your second bullet point here
- Add your third bullet point here

Title and Content Layout with Chart

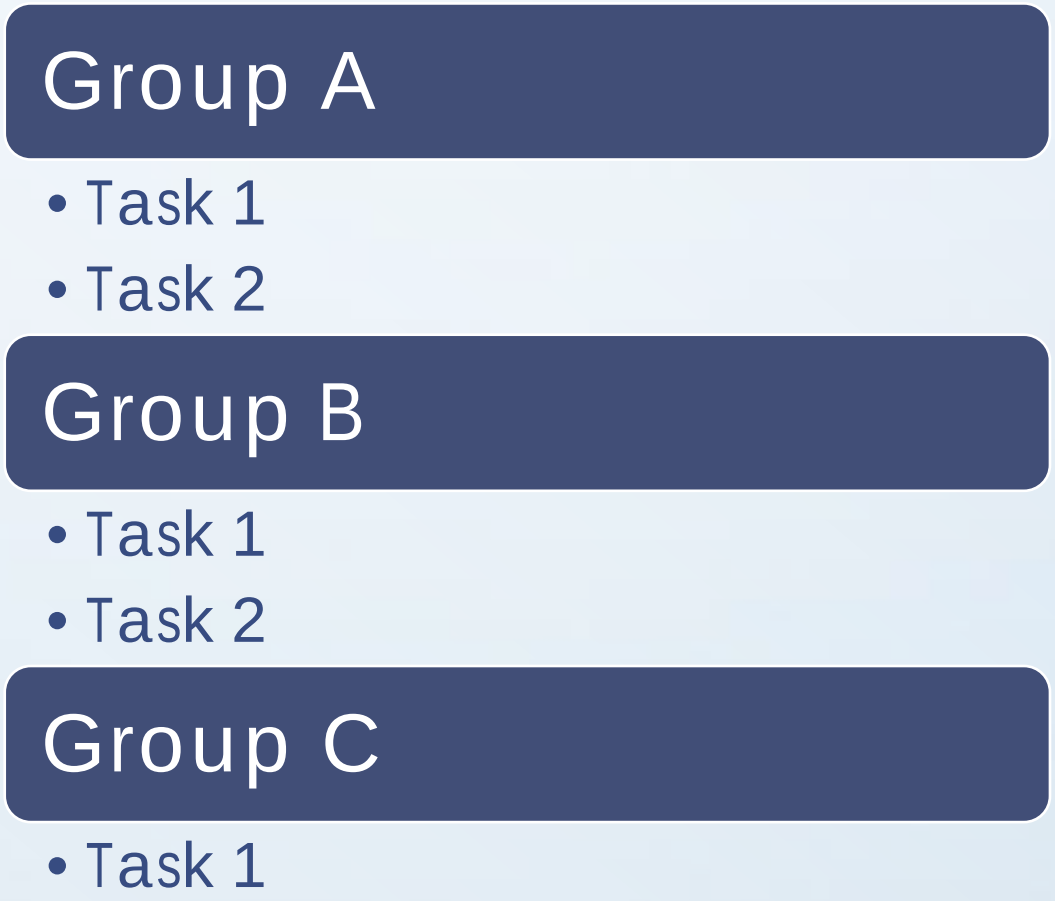


Two Content Layout with Table

- First bullet point here
- Second bullet point here
- Third bullet point here

	Group A	Group B
Class 1	82	95
Class 2	76	88
Class 3	84	90

Two Content Layout with SmartArt



- First bullet point here
- Second bullet point here
- Third bullet point here