Surgical Training Using Simulation

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Surgical Skills Centre at Mount Sinai Hospital
Objectives

- The Journey to becoming a Surgeon in Canada
- Introduction of UofT Department of Surgery
- Introduction of Mount Sinai Surgical Skills Centre
- Introduction of Competency-based Curriculum (CBC)
- Department of Surgery – Intensive training programs in Toronto
The Journey to becoming a Surgeon in Canada
Prior to Medical School

• Most candidates have at least 3 years of undergraduate education

• Completion of undergraduate degree is not required for all medical schools

• A completed 4 year degree is preferred
Prior to Medical School

- MCAT - Medical College Admission Test
  - Required for most Canadian schools

- GPA – Grade Point average
  - Calculated based on your grades in undergraduate, with your senior year courses weighted more heavily

- Volunteer activities
- Research experience
- Additional degrees (MSc, PhD)
Medical School

- 14 English speaking medical school in Canada
- 3 French speaking
- 20,000 applicants across Canada
- 2,150 positions across Canada in English speaking schools
- All medical schools in Canada are 4 years except University of Calgary and McMaster University (3 years)
Medical School

• First 2 years teach basic science, pathology, physiology, pharmacology, anatomy and clinical skills

• The final 2 years are clerkship
  – Most consistent of 6-12 week rotations of:
    • Internal Medicine
    • Surgery
    • Psychiatry
    • Family Medicine
    • Emergency Medicine
    • Pediatrics
    • Obstetrics and Gynecology
    • +/- Anaesthesia
Applying for Residency

• CaRMS – Canadian Residency Matching Service
  – Students apply to any residency program across Canada via one centralized service
  – Interviews are offered to applicants
  – Applicants rank their choice of program/specialty and school
  – Residency programs also rank their choice of candidate
  – Based on an algorithm (which favors the applicant), residency positions are assigned to medical students
Residency

- 2-6 years depending on specialty
- 2 years – Family Medicine/General Practice
- 4-6 years – Internal Medicine
- 5 years – Most surgical specialties
- 6 years – Neurosurgery and Cardiac Surgery

Length of residency is standard across Canada except for Competence Based Curriculum (U of T)
RCPSC

• Royal College of Physicians and Surgeons of Canada

• Final year residents write the Royal College Exam prior to graduation
Fellowship

• Not necessary in all specialties

• Most residents in surgical specialties do 1-3 years of additional training in subspecialty areas
Challenges

- Decreasing number of working hours available
- Resident lifestyle changes
- Increased focus on patient safety
- Intense financial pressure on hospitals to maximize efficiency (e.g., wait times, volume funding)
What to do?

- Continue as is
- Lengthen training programs
- Consider alternate methods of curricular delivery
Paradigm shift

- Need to de-emphasize time-based training and adopt a proficiency focus instead

- Need to supplement clinical teaching with learning opportunities outside of the OR

*“Competence”* – the trainee is able to perform the procedure independently with adequate faculty supervision
Surgeon Scientist Program (SSP)

- A program that provides research training for surgical residents who wish to pursue a career in academic surgery

- Thesis-based graduate program

- Can enter into SSP prior to, during, or at the completion of their clinical training

- Duration: At least two years in length
Surgeon Scientist Program (SSP)

• Clinical responsibilities
  – Trainees must not have regular clinical duties

• Application
  – All trainees must apply to the School of Graduate Studies and be accepted into a program leading to a MEd, MSc, or PhD

• Selection of Research Program/Supervisor
  – Supervisor should provide the best research environment regardless of surgical specialty
SSP Research Programs

• Clinical Epidemiology
• Basic Science
• Clinical Science
• Biomechanics
• Public Health
• Medical Education
• Medical Bioethics
• Health Services
Where are we?
Where are we?
Where are we?
Where are we?
Mount Sinai Hospital
Toronto, Ontario, Canada
Who we are

An Accredited Education Institute with the American College of Surgeons
Our Mission

• To change the way fundamental surgical skills are taught and evaluated.
• To establish a facility wherein surgical skills can be taught and evaluated.
• To provided a platform for continuing education in surgical skills.
• To create a laboratory for research in surgical skills acquisition.
• To create a laboratory for research and development of surgical skills innovation.
The lab then

- Opened in 1998
- Focus on Technical Skills Training for Surgical Residents
- Limited funds
- Limited commercial models available
- Less than 500 clientele

The lab now

- Still Limited Funds
- Expanded training to Undergrads, Ophthalmology, Ob Gyn, OHNS, Respirology, Emergency Medicine, Internal Medicine, Nursing, Allied Health, Outreach, and Industry
- Many commercial companies available
- More than 10,000 clientele per year!
Staff

D.H. Gales Director
Staff

D.H. Gales Director

Senior Manager
Staff

D.H. Gales Director

Senior Manager

Manager
Staff

D.H. Gales Director

Senior Manager

Manager

4 Surgical Technicians
Staff

D.H. Gales Director

Senior Manager

Manager

4 Surgical Technicians

1 Simulation Technician
Staff

D.H. Gales Director

Senior Manager

Manager

4 Surgical Technicians

1 Simulation Technician

1 Business Administrator

1 Research Coordinator
• Residents
• Undergrads
• Faculty
• Physicians
• Allied Health Care
• Nurses
• Researchers
• Industry Training
• Volunteers
Surgical activities at SSC

• Undergraduate teaching (‘Surgical Crash Course‘ and Emerg Med)

• Postgraduate Division-specific training sessions
  ▪ Competency-based Curriculum modules (Orthopaedics)
  ▪ Orthopaedic
  ▪ Vascular
  ▪ Neurosurgery
  ▪ Cardiac
  ▪ General Surgery
  ▪ Plastic Surgery
  ▪ Urology

Fellows and faculty training (FLS testing)

In this photo, a medical student inserts an aortic valve in to the heart model.
Other activities at SSC

- Department of Medicine – Emergency Medicine:
  Critical Care, Internal Medicine, Nephrology,
  Family Medicine, Cardiology

- Departments of ENT
- Ophthalmology
- Anaesthesia
- Medical Imaging
- Obstetrics and Gynecology
- Nursing
- Respirology
- Inter-professional training
Industry courses

- Allergan
- American Medical Systems:
- Avenir Medical
- Covidien
- De Puy
- Integralife
- Linvatec
- MED-EL
- Medtronic
- PharmAchieve
- Stryker
- Wright Medical Technology
- Zimmer
Additional learning opportunities at the Surgical Skills Centre

- Equipment Sign Out Privileges
- ACLS Programs
- 24 Hour Surgical Practice Room
- Team Based Learning
Surgical Skills Centre (SSC)

- Over 50 courses run annually
- 10,000 visits each year

International visitors:
- Israel
- China
- USA
- Kenya
- New Zealand
- Denmark
- Great Britain
- Argentina
- Saudi Arabia
- Kuwait
- France
- Russia
- Australia
- India
SSC Clients

- 40% Residents*
  *Surgical and non-surgical residents

- Undergrad 30%

- 20% Industry

- Other 10%
Laparoscopic Surgery
Central Line Insertion
Cardiac Surgery
Meats Used for Training

- Pork Ribs – Chest Tube
- Turkey Wing – Micro Anastomosis
- Pig Trachea – Tracheostomy
- Lamb Bones – Drilling
- Pig Heart – Cardiac Valves Insertion
- Pig Liver with Gallbladder – Lap Chole
- Turkey Leg – Tendon Repair
- Pork Belly – Suturing, Z Plasty, Skin Grafting
Model making example
Additional Training Models

- Cadaveric Specimens
- Industry Purchased Models
- Human Patient Simulators
- Virtual Reality Simulators
- Hand Made Models
Fracture Repair
And much more!
How We Deliver Education:
Live demonstrations
How We Deliver Education:
Online syllabus
How We Deliver Education: Educational videos

Knot-Tying: Two Hand Tie (Instructional - Right Handed)
How We Deliver Education:
Surgical Foundations Lectures

Surgical Example – G05

- Used a “dummy” implant to aid positioning
- Extend pocket 4.5 to 5cm from incision. X-ray may help monitor depth.
- “Dummy” implant (shorter “golf ball” implant with fingers cut off) inserted to check depth and location
  - Note: Important to push tongue into oral cavity to simulate natural tongue position
- Remove “dummy” and place “golf ball” implant or extend pocket length to 5.5 to 6cm and place “long ball” implant

Long Ball
How We Deliver Education: Continued feedback

- “Radiation safety lecture was a bit irrelevant – the way it was presented. Too much emphasis on the concepts of radiation and not enough on how to protect ourselves. More time should be spent on laparoscopic skills. Also include instrument ID for the laparoscopic instruments. Too much time spent on specialty instruments.”
- “Lisa is excellent! Answers all questions/requests promptly and very organized. Prep and drape: very valuable, especially the non-surgical (leg, head/neck) that’s more complicated. Pictures online – the websites posted during the course are good.”
How We Deliver Education:
Low faculty to learner ratios
Running a training centre takes a lot of time and coordination. Things you want to be aware of:

- Staffing issues
- Industry availability
- Organizing teachers and trainers
- Specimen coordination (especially with cadavers)
- Stocking disposables
- Storage for a wide range of large and small equipment
- Equipment rentals
- Making sure technology/equipment is up to date and in good working order
- Finances
- Knowledge of current practices, techniques, etc
Welcome to the University of Toronto Surgical Skills Centre at Mount Sinai Hospital website

Traditionally, surgical skills have been acquired in the operating room. The complexity of surgical procedures and the premium placed on surgical time have increased. We can no longer expect surgeons to acquire novel skills in the operating room.

Learn about Simulation Summit 2014
Competency-Based Curriculum (CBC)

- Pilot since 2009
- Progression through modules based on demonstrated competency in pre-determined tasks/procedures
- Strong reliance on laboratory-based training and Department of Anatomy support to supplement OR experience
CBC was designed to reflect all CanMEDS roles.
- 2009 – 3 CBC residents
- 2012 – 5 CBC residents
- 2013 – All 12 CBC residents
Figure 1. Curriculum Map for the Competency Based Curriculum.

<table>
<thead>
<tr>
<th>PHASE 1</th>
<th>Module 1</th>
<th>Module 2</th>
<th>Module 3</th>
<th>Module 4</th>
<th>Module 5</th>
<th>Module 6</th>
<th>Module 7</th>
<th>Module 8</th>
<th>Module 9</th>
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<tr>
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<td>Introduction to Basic Surgical Skills</td>
<td>Hip &amp; Basic Fractures</td>
<td>Emergency Orthopaedic Surgery</td>
<td>Medical Co-morbidities in the Surgical Patient</td>
<td>Basic Sports</td>
<td>Basic Arthroplasty</td>
<td>Intensive Care Unit</td>
<td>Core Training in Surgery</td>
<td>CanMEDS core competencies</td>
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<tr>
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<td>Sch</td>
<td>HA</td>
<td></td>
<td></td>
<td>C</td>
<td>Com</td>
<td>Prof</td>
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<table>
<thead>
<tr>
<th>PHASE 2</th>
<th>Module 10</th>
<th>Module 11</th>
<th>Module 12</th>
<th>Module 13</th>
<th>Module 14</th>
<th>Module 15</th>
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<td>Pediatric fractures</td>
<td>Spine</td>
<td>Foot &amp; ankle</td>
<td>Basic Science</td>
<td>Hand &amp; upper extremity</td>
<td>MSK medicine</td>
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<td>Man</td>
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<td>Prof</td>
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<td>Com</td>
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<th>Module 16</th>
<th>Module 17</th>
<th>Module 18</th>
<th>Module 19</th>
<th>Module 20</th>
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<td>Oncology</td>
<td>Complex trauma</td>
<td>Complex arthroplasty</td>
<td>Pediatric orthopaedics</td>
<td>Advanced Sports</td>
<td>Research</td>
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NOTE: Each color box represents an intrinsic CanMEDS role that is taught and assessed in a specific module. The medical expert role, denoted by the white box, is taught and assessed in every module.
Toronto Orthopaedic Boot Camp

- Intensive laboratory-based surgical skills program at the onset of residency
- Practice and master basic technical skills BEFORE stepping into the OR
- Demonstrate appropriate competency level before advancing to further modules
Lower stress environment

Skills are transferable to OR

Individualized program based on proficiency

Student-driven practice

Small student to teacher ratio
Curriculum

- Focus on basic technical skills:
  - Aseptic technique
  - Soft tissue handling
  - Power tool use
  - Casting/Splinting
  - Basic AO technique
• Multi-modal teaching presentations
• Hands-on practice with immediate feedback
• Cadaver, animal, and synthetic models
• Surgical simulations
• Quizzes
• Didactic readings
Unit 1: Preoperative Preparation

- Concepts of scrubbing, gowning and gloving
- Surgical draping: principles and practice
- Principles of aseptic technique
- Surgical Checklist
Unit 2: Casting – basic and advanced sessions

- Splinting - Upper Extremity
  - Short arm
  - Long arm
  - Sugar Tongue

- Splinting - Lower Extremity
  - Below the knee
  - Long Leg

- Fiberglass cast (Short arm and Below the knee)

- Circumferential cast
Unit 3: Suturing

➢ Starting with simple, progressing to advanced techniques and models

➢ Simple, horizontal and vertical mattress sutures

➢ Fascia: interrupted, running locking and non locking sutures
Unit 4: Soft Tissue Handling and Surgical Exposures

- 0800-0830 - lecture for specific area of anatomy exposure

- 3 hours of demonstration and hands-on practice on cadavers at the anatomy lab, 8 days in total

- Followed by self-directed practice at the Surgical Skills Lab on cadaveric arms and legs

- Anatomy review sessions
Unit 5: Power Tools and AO Basic Skills

- Drilling
- Sawing – oscillating and reciprocating
- Burring
- AO techniques
- Use of small and large fragment on models of increasing fidelity – sawbones → lamb bones → cadavers
Additional presentations

• Safety training

• MSK radiology seminar

• Surgical planning

• Residency responsibilities presented by a senior resident
<table>
<thead>
<tr>
<th>Day</th>
<th>Technical skills</th>
<th>Surgical Skills</th>
<th>Anatomy Lab</th>
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<tbody>
<tr>
<td>Day 1</td>
<td>Casting &amp; splint application; Thomas splint; Skin/skeletal traction; Limb prepping/draping</td>
<td>dissection</td>
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<td>Day 2</td>
<td>AO principles - small &amp; large fragment (sawbones)</td>
<td>Shoulder; Humerus</td>
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<tr>
<td>Day 3</td>
<td>Plating - small &amp; large fragment (lamb bones); Power tools; Tension band wire</td>
<td>Elbow; Forearm</td>
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<td>Day 4</td>
<td>External fixation; Principles of IM nail</td>
<td>Wrist; Hand</td>
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<tr>
<td>Day 5</td>
<td>ATLS course - all day</td>
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<tr>
<td>Day 6</td>
<td>ATLS course - all day</td>
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<tr>
<td>DATE</td>
<td>Technical skills - Surgical Skills Centre - 3 hours</td>
<td>Anatomy Lab - 3 hours</td>
<td>Instructors</td>
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<td>Day 7</td>
<td>Upper extremity dissection &amp; plating for fractures; Joint aspiration; Practice session</td>
<td>Thigh; Knee; Hip</td>
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<td>Day 8</td>
<td>Lower extremity dissection &amp; plating for fractures; Joint aspiration; Practice session</td>
<td>Tibia/fibula; Ankle/foot</td>
<td>3 instructors + 2 facilitators</td>
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<td>Day 9</td>
<td>Reduction maneuvers for fracture/dislocation; Principles of sedation; Power tools &amp; casting review</td>
<td>Anatomy review</td>
<td>3 instructors + 2 facilitators</td>
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<tr>
<td>Day 10</td>
<td>8am - 12pm - Anatomy test; Course evaluations; Hemovac drain, dressings; radiology cases presentations; 1pm - 3pm - Radiology - room 580</td>
<td>1st administration - BLUE GROUP - 8am - 10am 2nd administration - YELLOW GROUP - 11am -</td>
<td>3 instructors</td>
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<tr>
<td>Day 11</td>
<td>Exit Exam</td>
<td>7 examiners</td>
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<td>Day 12</td>
<td>Additional practice if required</td>
<td>2 instructors</td>
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Post-Test

- All residents, same 8 stations as pre-test, slightly modified

- Usually a significant improvement is shown compared to pre-test results

- Retention test – 6 and 18 months after the program to assess the long-term maintenance of the skills
Exit Exam

- Using cadavers, the residents perform procedures in a real OR progression

- Each resident is evaluated by experts using checklists and GRS

- If the results of the assessment indicate that a resident is not fully competent in certain tasks, he/she goes through a remediation process

- Remediation – additional focused training (3-5 days) one-on-one or in a small group with the instructors until competence is achieved->Retest
Exit Exam
Exit Exam

Gowning, gloving, prepping and draping
Exit Exam

Surgical approach
Exit Exam

ORIF of long bone
Bone block resection using oscillating and reciprocating saw and burr
Wound closure
Casting
GRS results show that residents from the boot camp course improved the most.
There are no significant differences in skill level post-training between the CBC and SR residents.
The CBC residents maintain their skill level for at least 6 months post-training.
Video
Video
CBC Publications


- ASE 2013 Award
TOBC evolution

- **TOBC 2009-2010**
  - First year – 3 CBC residents
  - Taught primarily by faculty
  - Exit exam to ensure that competency is achieved

- **TOBC 2011-2012**
  - All 12 incoming orthopaedic residents
  - Progressively more fellows and senior residents as instructors under faculty supervision
  - TOBC course is consistently demonstrated to be a highly effective mechanism for teaching basic technical skills
Expanding TOBC – Surgical Prep Camp 2013

- All incoming PGY1’s, N=54
- Skills relevant to all specialities
- Mandatory program
- 2 weeks all specialities, followed by division-specific phase
Surgical Prep Camp: Intensive training

- **Skills:**
  - Sterile techniques
  - Instrument handling
  - Basic and advanced suturing techniques
  - Catheterization
  - Central line, art-line, cut downs, vascular control
  - Surgical airway (trach and cric)
  - Limb and abdominal wound closure
  - Chest tube insertion
  - Basic scope skills
  - Medical imaging
Surgical Prep Camp - results

- Post-test demonstrates that majority of PGY1’s are competent in most skills
- Retention test in 7 months shows that skills are maintained well beyond initial training
- Great feedback from PGY1’s and faculty
- Using feedback to refine the future implementations of Prep Camp
Summary

- The boot camp course is a highly effective mechanism for teaching basic technical skills

- Boot camp course allows new residents to perform targeted basic technical skills at the same level as senior residents in the laboratory setting

- Skills are retained longer than 6 months post-training