THE ORTHOPEDIC ATHLETIC TRAINER'S HANDBOOK

A DISSERTATION SUBMITTED TO THE GRADUATE DIVISION OF THE UNIVERSITY OF HAWAI'I AT MĀNOA IN PARTIAL FULFILLMENT OF THE REQUIREMENTS FOR THE DEGREE OF

DOCTOR OF PHILOSOPHY

IN

EDUCATION

JULY 2017

By

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DEDICATION

This handbook is dedicated to all athletic trainers everywhere.

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ACKNOWLEGEMENTS

I would like to express my sincere gratitude to my chairperson, advisor, and mentor Dr. Iris Kimura, PhD, ATC, PT. Constantly teaching your students beyond the bounds of the classroom; your vision, imagination, and perseverance bring collaboration, opportunity, and hope. Mahalo.

I would also like to acknowledge my dissertation committee members Dr. Ronald Hetzler, PhD, FACSM, Dr. Nathan Murata, PhD, Dr. Charles Morgan, PhD, and Dr. Joannie Dobbs, PhD with a profound thank you for your support, wisdom, and integrity. Each of you has been an inspiration to me, and your scholarship and leadership are examples to follow.

Mahalo to my colleagues and teammates for your energy and work, especially Jaco Van Delden, Sheila Masuda, Morgan Kocher, Nick DePhillipo, Adam Slabicki, and Devon Cataldi. I could not have realized this dream without your selfless and generous support and assistance. Thank you.

ABSTRACT

Athletic trainers (ATs) are comprehensive health care providers educated with a medically based education model. They are trained professionals providing comprehensive patient care in five domains of clinical practice: (1) prevention, (2) clinical evaluation & diagnosis, (3) immediate & emergency care, (4) treatment & rehabilitation, and (5) organizational/professional health & wellbeing. Recent literature describes the benefits of ATs working in the orthopedic practice; outlining their clinical effectiveness, demonstrating their return on investment, and emphasizing their overall value.[1] [2]

However, in order for ATs to successfully perform in the orthopedic occupational setting, educational curricula and resources are needed to enhance the orthopedic ATs functions, duties, and responsibilities. The Orthopedic Athletic Trainer's Handbook was created with this intention. It includes illustrations, images, and appendices as references to assist the orthopedic AT's practice.

The Orthopedic Athletic Trainer's Handbook is composed of basic and advanced concepts founded on the clinical domains of athletic training – specifically from the fields of orthopedic technology and emergency medical technology.

Part I describes information regarding educational and national requirements for certification in the aforementioned areas, as well as background on current development of national standards for athletic training educational curricula and suggested routes aimed at reimbursement for services.

Part II is the handbook itself: an illustrated comprehensive reference designed to provide quick, concise, and helpful information for orthopedic athletic trainers when they need it most. Divided into sections for easy reference, the handbook includes checklists, mnemonics, diagrams, and protocols to guide the athletic trainer in the field or clinic.

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GLOSSARY

Athletic trainer:	An allied health professional experienced, skilled, and educated incomprehensive patient care in five domains of clinical practice – prevention, clinical evaluation & diagnosis, immediate & emergency care, treatment & rehabilitation, and organizational/professional health & wellbeing.
Education:	Knowledge and development through process.
Kinesiology:	Principles of mechanics and anatomy of human movement.
Orthopedic:	Treatment of illness and injuries that affect bones and muscles.
Rehabilitation:	Bringing back to a healthy condition.

LIST OF ABBREVIATIONS & ACRONYMS

ACLS:	Advanced cardiac life support
AED:	Automated external defibrillator
AMA:	American Medical Association
ASOP:	American Society of Orthopedic Professionals
AT:	Athletic trainer
BP:	Blood pressure
BLS:	Basic life support
CAATE:	Commission on Accreditation of Athletic Training Education
CPR:	Cardiopulmonary resuscitation
C.S.M.	Circulatory, sensory, and motor function
C.T.C.	Color, temperature, condition
DME:	Durable medical equipment
EMR:	Electronic medical records
EMT:	Emergency medical technician
HEP:	Home exercise program
HHS:	Health & Human Safety
HRSA:	Health Resources Services Administration
ICD:	International Statistical Classification of Diseases
IV:	Intravenous
LE:	Lower extremity
OTC:	Certified Orthopedic Technologist
MOI/NOI:	Mechanism of injury / nature of illness
NAOT:	National Association of Orthopedic Technologists
NATABOC:	National Athletic Trainer's Association Board of Certification
NBCOT:	National Board of Certified Orthopedic Technologists
ROT:	Registered Orthopedic Technologists
UE:	Upper extremity

PART I

PART I. THE ORTHOPEDIC ATHLETIC TRAINER & FUTURE POTENTIAL

Athletic trainers (ATs) are highly qualified, multi-skilled emergency health care professionals who collaborate with physicians to provide management of acute, chronic, and other medical conditions. Athletic trainers work under the direction of physicians as prescribed by state licensure statutes and practice acts.[3] They are responsible for on field and off field emergency care and injury management in schools, colleges/universities, professional sports, hospitals, healthcare facilities, orthopedic practices, and sports related settings. The National Athletic Trainer's Association (NATA) role delineation identifies athletic training responsibilities to encompass prevention, examination, diagnosis, treatment and rehabilitation of emergent, acute or chronic injuries and medical conditions. The American Medical Association, the Health Resources Services Administration, and the Department of Health and Human Services have all recognized athletic training as an allied health care profession.

The NATA has worked tirelessly since the early 1970's to standardize the educational base of all education programs; however, challenges remain in obtaining third-party reimbursement for services regardless of state licensure.[4] Advances in the medical profession require the athletic training profession to regularly update, increase, improve, and expand curricular requirements. Athletic trainers have earned state licensure status in all 49 states except for California. On January 9, 2017 The U.S. House of Representatives approved Bill H.R.302. The companion bill the Sports Medicine Licensure Clarity Act (s.808), intended to protect ATs and other sports medicine professionals, was recently re-introduced by the NATA to the United States Senate.

The National Athletic Trainers' Association Commission on Accreditation of Athletic Training Education (CAATE) received recognition by the Council for Higher Education and is now taking the lead for the development and maintenance of the curricular content as part of the Standards for Accreditation of Professional Athletic Training Programs. These standards describe the minimum expectations for curricular content in the professional preparation of ATs.[5] They are organized by sections and include core competencies and client/patient care competencies. Core competencies are further

categorized to include evidence-based practice, professional education and collaborative practice, quality improvement, healthcare informatics, professionalism, and patient-centered care. Client/patient care competencies are further categorized to include plan of care; examination, diagnosis, and intervention; and prevention, health promotion, and wellness. The implementation of the new standards will apply to all professional AT programs regardless of degree level.[6]

Athletic Trainers who choose to pursue employment in orthopedic related situations must be educated in curricula designed in accordance to these aforementioned standards and be provided experiences that will allow them to work integrally with orthopedic and other vital healthcare providers. The goal is to efficiently, effectively deliver, and coordinate all aspects of injury management to increase patient outcomes and satisfaction. Therefore it is crucial that ATs utilize educational curricula and resources in the adjacent professions including but not limited to emergency medical technology and orthopedic technology including certification requirements. The following two sections present examples of specific requirements for two certifications that allow companion and advanced curricula, experiences, and skills, relating them to the professional preparation Standards. Examples of certification verification are included in Appendices H – J.

Emergency Medical Technology

The emergency medical technician (EMT) provides basic and advanced life support to patients in the pre-hospital emergency setting. Specific EMT functions include establishment and maintenance of airway, administration of cardiopulmonary resuscitation (CPR), control of hemorrhage, treatment of shock, immobilization of fractures, bandaging of wounds, assisting in childbirth, management of patients with behavioral disorders, and initiation of treatment for poisoned and burned victims. Qualified graduates of an EMT education program can take the National Registry Examination for certification.[7]

The National Registry of Emergency Medical Technicians (NREMT) was established in 1970 shortly after the revolutionary paper from the National Academy of Science in 1966

entitled, “Accidental Death and Disability” which proposed the need for further research, education, and training to care for “the neglected disease of modern society.”[8] Athletic trainers provide immediate care for emergent injuries and illnesses and are often the first responders during athletic events. Athletic trainers who are dual credentialed and licensed as EMTs offer the community increased competency and advanced clinical practice in the field of orthopedic & sports medicine. Furthermore, dual licensure as an allied health care professional may increase value while limiting liability. The NATA convened an Inter-Association Task Force in 2006 to develop recommendations on emergency preparedness for specific conditions.[9] Further comprehensive emergency planning and education is needed to ensure ATs are equipped and prepared in administering immediate care of the injured athlete. Part II of the Orthopedic Athletic Trainer’s Handbook includes content from the EMT course of study appropriate to these designated needs.

Along with clinical rotations, the EMT course of study is 170 hours in length divided into several modules: preparatory, airway management, patient assessment, medical emergencies, trauma emergencies, infants and children, and EMT operations. These modules are outlined below:

- ***Preparatory*:** Emergency Medicine Systems, the role of the EMT, the safety and well-being of the EMT, legal and ethical issues, basic anatomy and physiology, techniques of lifting and moving patients.
- ***Airway management*:** airway anatomy, airway management techniques, oxygen, and oxygen equipment.
- ***Patient assessment*:** assessment of the medical and trauma patients, vital sign assessment, taking a patient history, documentation, and communication.
- ***Medical emergencies*:** pharmacology, respiratory, cardiac, diabetic, allergy, poisoning and overdose, environmental, behavioral, and obstetric & gynecological emergencies.
- ***Trauma emergencies*:** bleeding and shock, soft tissue and musculoskeletal injuries, injuries to the head, neck, spine, chest and abdomen.

- ***Infants & children*****:** physical and physiological differences between adult and pediatric patients, pediatric medical and trauma emergencies.
- ***EMT operations*****:** ambulance operations, rescue and extrication, multiple patient situations, and hazardous materials situations.

At the conclusion of each module there are written examintations and when appropriate practical examinations. A passing grade is 70% or higher must be earned on the final written and final practical examination for the course for certification.

Emergency medical technicians must have a current CPR certification at the level of BLS Healthcare Provider. Successful completion of the aforementioned coursework and acceptable performance during clinical rotations (reviewed by the clinical director) will allow eligibility to take the national certifying EMT examination, regulated by the NREMT.

Other United States' eligibility criteria include 18 years of age, ability to read, understand & communicate in English, freedom from addiction to alcohol or any drug, ability to lift and carry 125 pounds, and no physical or mental defects or disease which might impair one's ability to provide emergency care within the scope of the EMT's training and responsibility, or which might jeopardize the health of another.

The state licensure examination process has two parts. Part one is the practical examination, which consists of practical stations: patient assessment, CPR and AED (defibrillation), splinting, and immobilization. Clinical instructors assess and score competency. Part two is the written examination, which consists of computerized multiple-choice questions covering the cumulative knowledge of the EMT.

Completion of the EMT course of study prepares the AT; fulfilling specific curricular content standards in client/patient care competencies. For example, Standard 40 defines the ability to "assess the patient's status on an on-going basis and adjust care accordingly with consideration of patient goals." Standard 44 defines the ability to "evaluate and manage patient(s) with acute conditions including triaging conditions that are life-threatening or otherwise emergent." Furthermore, Standards 48 & 49 include education about pharmacological agents, while Standard 66 defines the ability to "Develop,

implement, and revise policies that pertain to the prevention, preparedness, and response to medical emergencies and other critical incidents."[3] Content appropriate to these Standards for Curricular Content are presented in Part II of the Orthopedic Athletic Trainer's Handbook.

Orthopedic Technology

The orthopedic technologist (OT) is a specifically trained allied health care professional who assists the orthopedic surgeon in the practice of medicine. An OT is an extension of the orthopedic surgeon and assists in the care of sick and disabled persons. Orthopedic technologists must have the ability to relate well to other people, be considerate of their conditions and able to communicate with patients in understanding their anxieties and fears. An OT is familiar with routine office and departmental procedures and is able to perform certain basic nursing functions.

Orthopedic Technologists are experts in plaster and synthetic cast application, and have the skill to remove casts with care and fragility. They are equipped with the general principles of traction techniques, are able to prepare specific types of traction requested by the orthopedic surgeon and to assess patients in traction, making adjustments as necessary. The OT may perform as a first assistant to the orthopedic surgeon in the operating room, including preparing for surgical procedures, and assembling the environment and equipment to the specifications of the orthopedic surgeon. The OT is also able fit, adjust, and educate on the use of ambulatory devices and walking aids. The OT also applies simple braces, prosthetics, performs minor adjustments and repairs, and fabricates splints for various conditions under the direction of the orthopedic surgeon.[10]

In 2012 a task analysis was completed to describe performance activities required of competent OTs.[11] Of the 263 professional OTs surveyed in that analysis, 51 were dual-certified as ATs, showing some synergy of professional designation and skill. To become a board certified orthopedic technologist, one must pass the certified orthopedic technologist (OTC) examination by the National Board for Certification of Orthopedic

Technologists (NBCOT). An approved eligibility routes to sit for the examination is available for ATs:

- ***Eligibility Route C:*** The NBCOT has recognized that certified/licensed athletic trainers have met many of the requirements and guidelines that coincide with the orthopedic technologists. Therefore a special eligibility route has been created:
    - Athletic trainers must have a minimum of 1,040 hours of full time employment specific to orthopedic technology and in accordance with the current examination breakdown under the direct supervision of a physician specializing in the musculoskeletal system.
    - To be eligible to sit for the exam, the AT must include a copy of his/her current NATABOC card and/or athletic trainer certificate/license. Additionally, a letter from the supervising orthopedic surgeon attesting to the successful completion of 1,040 medical hours specific to orthopedic technology in accordance with current examination breakdown must be submitted.

Athletic trainers who are dual credentialed and registered as certified orthopedic technologists offer the community increased competency and advanced clinical practice in the field of orthopedic & sports medicine. Furthermore, dual licensure as an allied health care professional may increase value and reimbursement while limiting liability.

The American Society of Orthopedic Professionals (ASOP) awards the professional title of registered orthopedic technologist (ROT) to candidates who pass the computer-based examination. This examination is focused on office-based orthopedic procedures including casting & bracing and is free to all ASOP members. Athletic Trainers are welcomed to apply for the examination to further the career advancement for athletic trainers in orthopedics.

The orthopedic extender position for the athletic trainer continues to be a growth opportunity within the athletic training profession, and may increase the marketability of

ATs in the healthcare industry. For example, the AT as an orthopedic extender combined with the ROT credential establishes a revenue-generating source for the physician. Ultimately, this value added component maintains their economic worth to the orthopedic practice.[12]

Completion of an Orthopedic Technologist course of study augments the ATs professional skills, while fulfilling specific CAATE curricular content standards in client/patient care competencies. For example, Standard 47 defines the ATs ability to "select, fabricate, and/or customize prophylactic, assistive, and restrictive devices, materials and techniques into the plan of care; including the following: durable medical equipment, orthotic devices, taping, bracing, splinting, protective padding, and casting."[3] Part II of the Orthopedic Athletic Trainer's Handbook includes content from the OTC/ROT course of study appropriate to these standards for curricular content.

Other standards for curricular content that are appropriately addressed in Part II include those which outline the ability to select and incorporate interventions designed to address a patient's identified impairments, and develop, implement, and assess the effectiveness of programs to reduce injury risk. Furthermore, the use of biometrics and physiological monitoring systems with translation of data into effective preventive measures is another curricular standard that is addressed. Other content includes clinical interventions, performance enhancement, inventory management, and operation of athletic training services.[3] Incorporating information pertinent to the CAATE's curricular content standards, Part II is presented as an illustrated reference designed concisely for orthopedic athletic trainers.

PART II

PART II. THE ORTHOPEDIC ATHLETIC TRAINER'S HANDBOOK

Pediatric Sports Medicine

Caring for young athletes offers specific challenges to the orthopedic athletic trainer, including fracture management, growth plate involvement, obtaining assent, and other special considerations. Figure 1 shows an in tact short leg cast – treatment for an eversion ankle sprain. Figures 2a and 2b illustrate Salter-Harris classifications of fractures involving the growth plates.[13]

Figure 1. Short Leg Cast

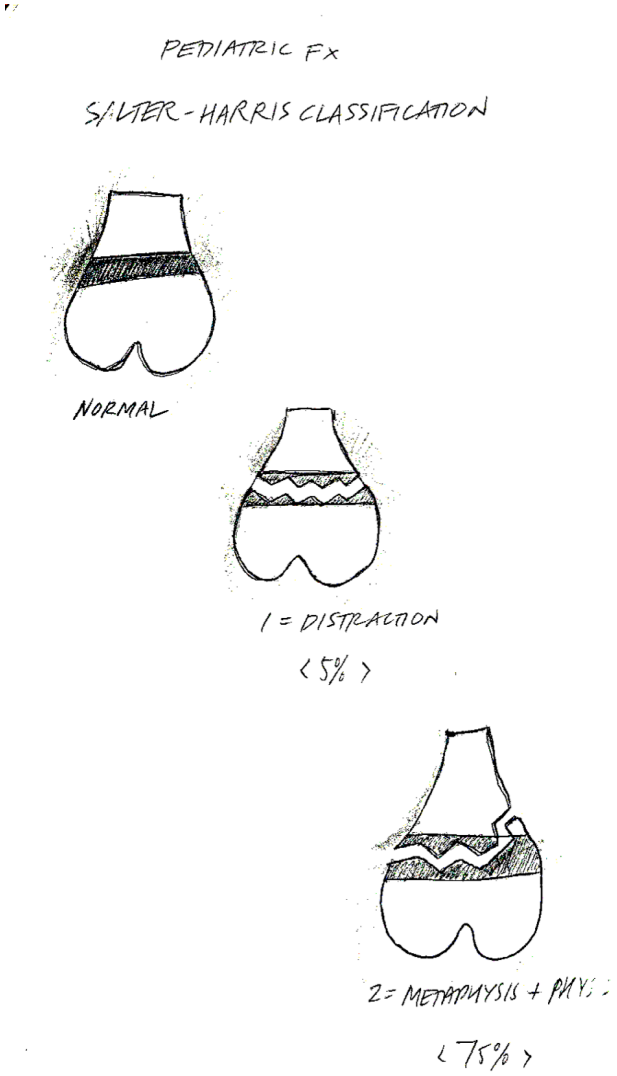

Figure 2a. Salter-Harris Fracture Classifications

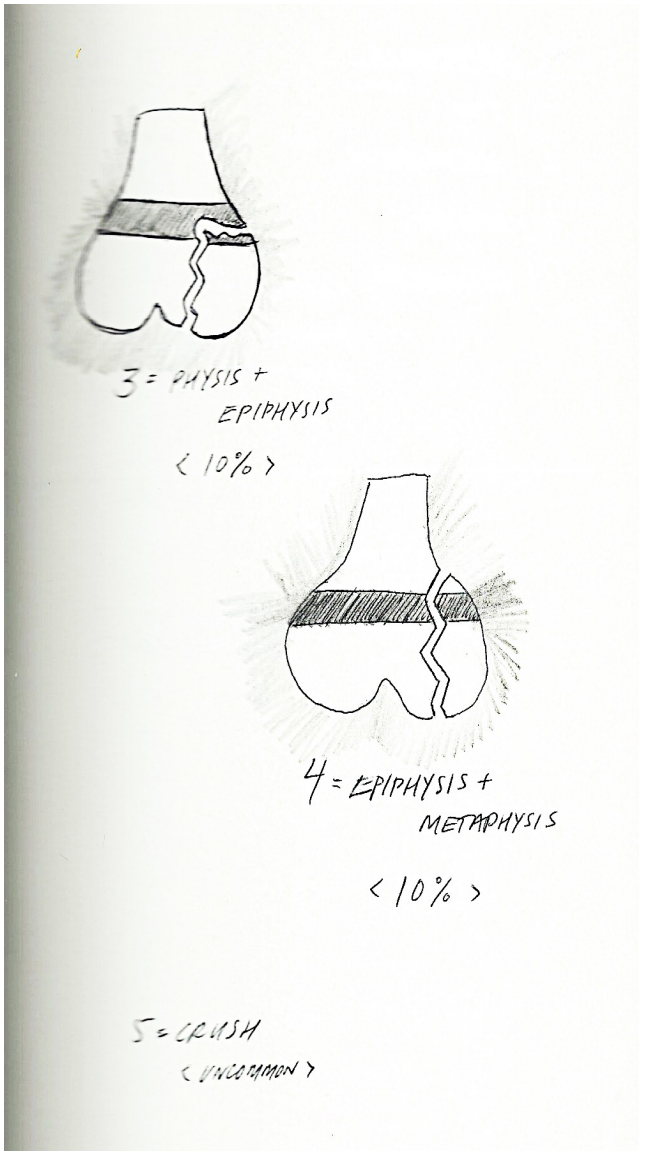

Figure 2b. Salter-Harris Fracture Classifications

Fracture Classification

T	Type	simple | spiral | oblique | compound
C	Comminution	non | mild | severe
L	Location	proximal | distal | physeal
D	Displacement	translation (%) | angulation (°) | shortening (cm)

Orthopedic Splinting

Generally, splinting is used to immobilize and protect injured joints and soft tissue, limit pain, and encourage healing, restriction, while allowing circulation.

Guidelines:

- Check and document presence and normalcy of circulatory, sensory, and motor function of the injured extremity *before* and *after* application.
- Splint distal and proximal to the injured area.
- Splint in position of function.
- Dress superficial wounds.
- Select appropriate splinting material.
- Measure first; then apply the splint.

Indications:

- Fractures
- Dislocations
- Sprains
- Tendon injury

Contraindications:

- Neurological compromise
- Vascular compromise
- Open fractures

Splint Materials:

- Vacuum splints
- SAM splints
- Ortho-Glass® splints
- Fiberglass
- Plaster
- Ace wraps
- Webril™/ bias
- Scissors
- Towel
- Tape measure

Figure 3 illustrates application steps for a stirrup splint using Ortho-Glass® and ace wraps. This technique may be appropriate for ankle and malleolar fractures, and can also be used in conjunction with a posterior leg splint for complex injuries such as Weber fractures, Maisonneuve fracture, and Tillaux fracture.

Figure3. Stirrup Splint Application

Figure 4 illustrates application steps for a posterior leg splint using Ortho-Glass® and ace wraps. This technique may be appropriate for isolated, non-displaced fractures, foot fractures or sprains, mild ankle sprains, or Achilles tendon injuries.

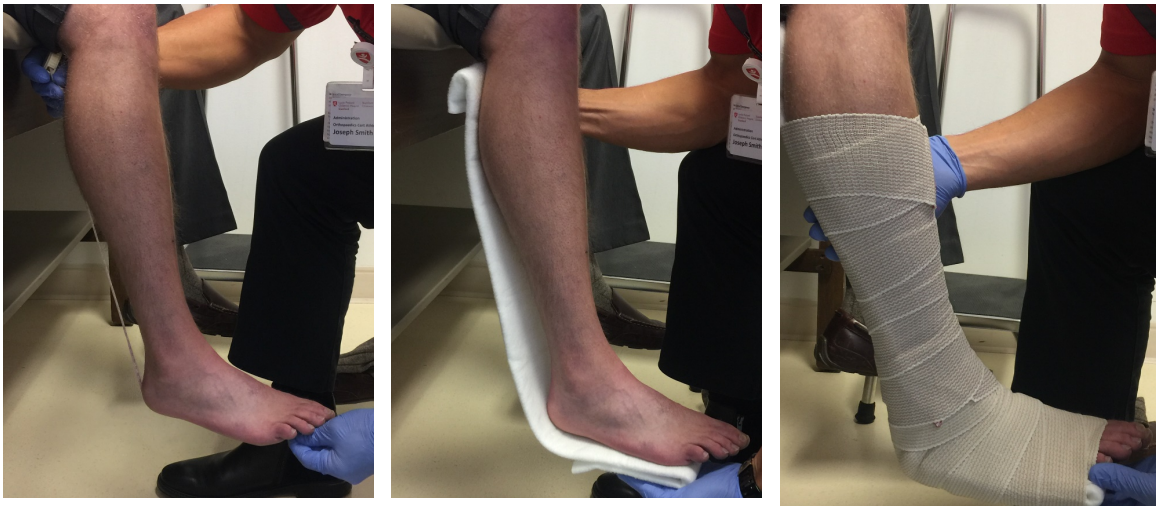

Figure 4. Posterior Leg Splint Application

Straight leg splints or knee immobilizers can be used for acute athletic injuries to the knees, including ligament injuries, patellar instability, quadriceps and hamstring injuries, or joint inflammation.

Figure 5 illustrates application steps for a volar splint using Ortho-Glass® and ace wraps. This technique may be applicable treatment for soft tissue injuries of the wrist, carpal fractures or dislocations.

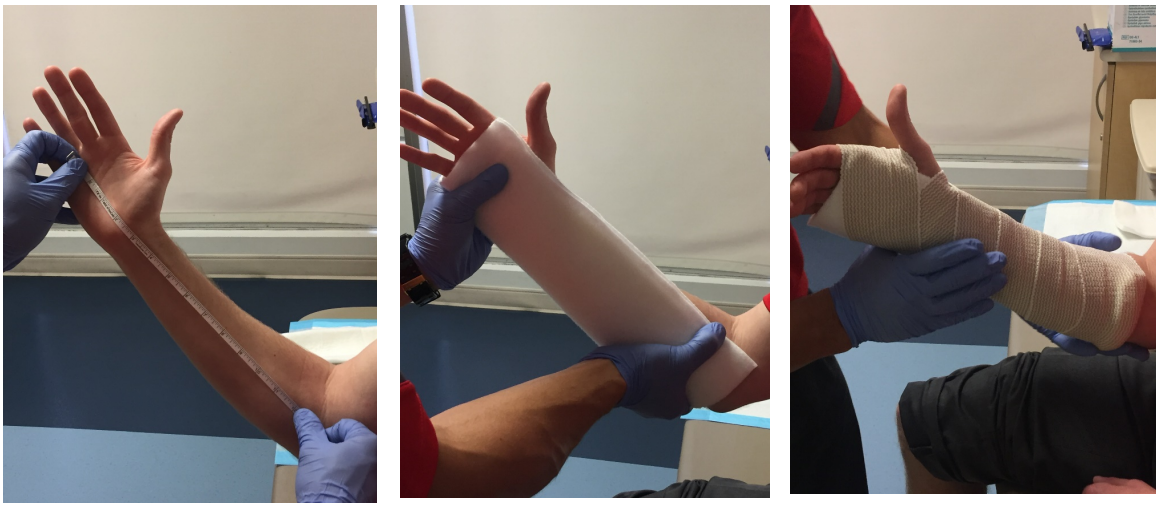

Figure 5. Volar Splint Application

Figure 6 illustrates application steps for an ulnar gutter splint with Ortho-Glass® and ace wraps. This technique may be applicable treatment for stable fractures of the 4th or 5th metacarpal or phalanx, or boxer's fracture.

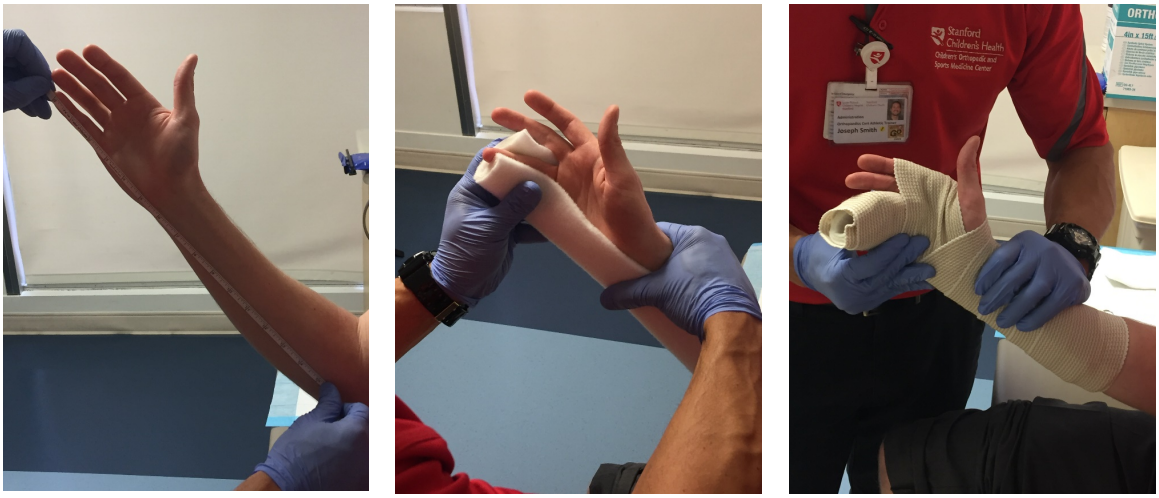

Figure 6 Ulnar Gutter Splint Application

Figure 7 illustrates application steps for a radial gutter splint with Ortho-Glass® and ace wraps. This technique may be applicable treatment for stable fractures of the 2nd or 3rd metacarpal or phalanx.

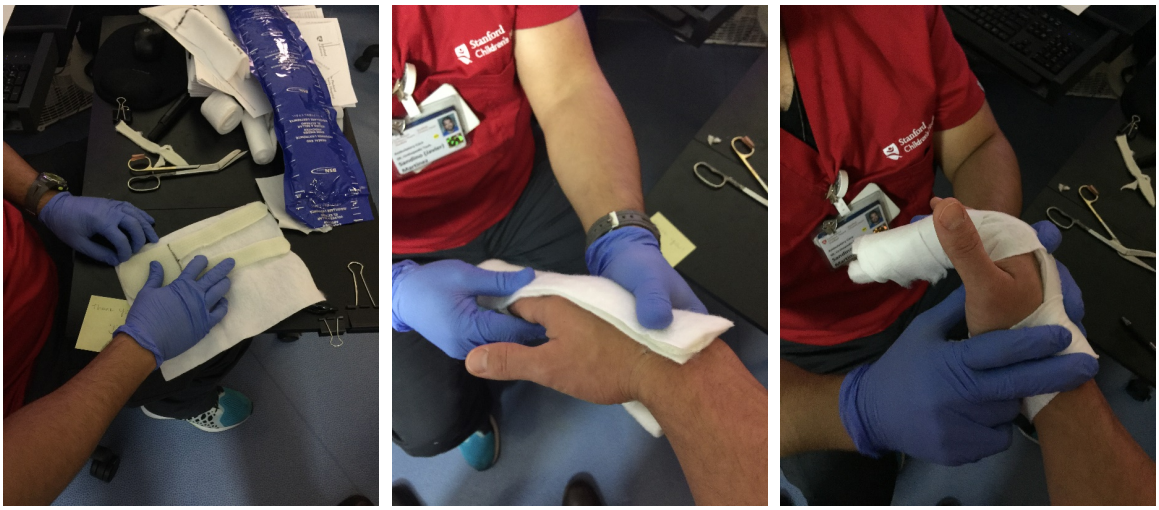

Figure 7. Radial Gutter Splint Application

Figure 8 illustrates application steps for a thumb spica splint with Ortho-Glass®. This technique may be applicable treatment for scaphoid fracture or 1st metacarpal fracture, dislocation, or tendon/ligament injury.

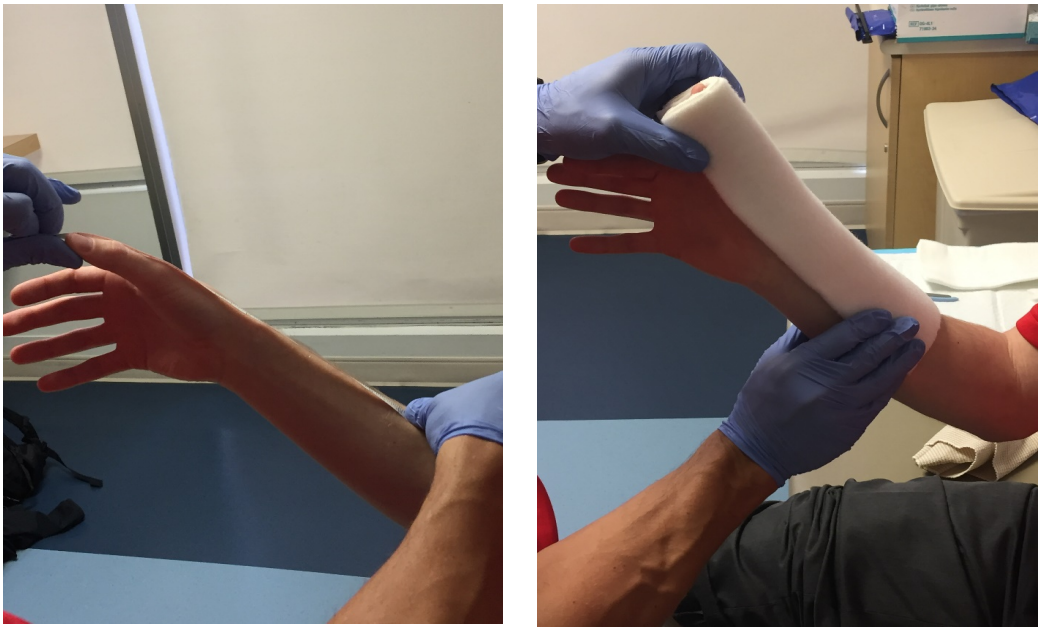

Figure 8. Thumb Spica Splint Application

Figure 9 illustrates the application of a Stax-type finger splint for phalanx fracture.

Figure 9. Finger Splint

Figure 10 illustrates application of a posterior long arm splint with Ortho-Glass® and ace wraps. This technique may be applicable treatment for stable elbow fractures, forearm fractures, and wrist injuries.

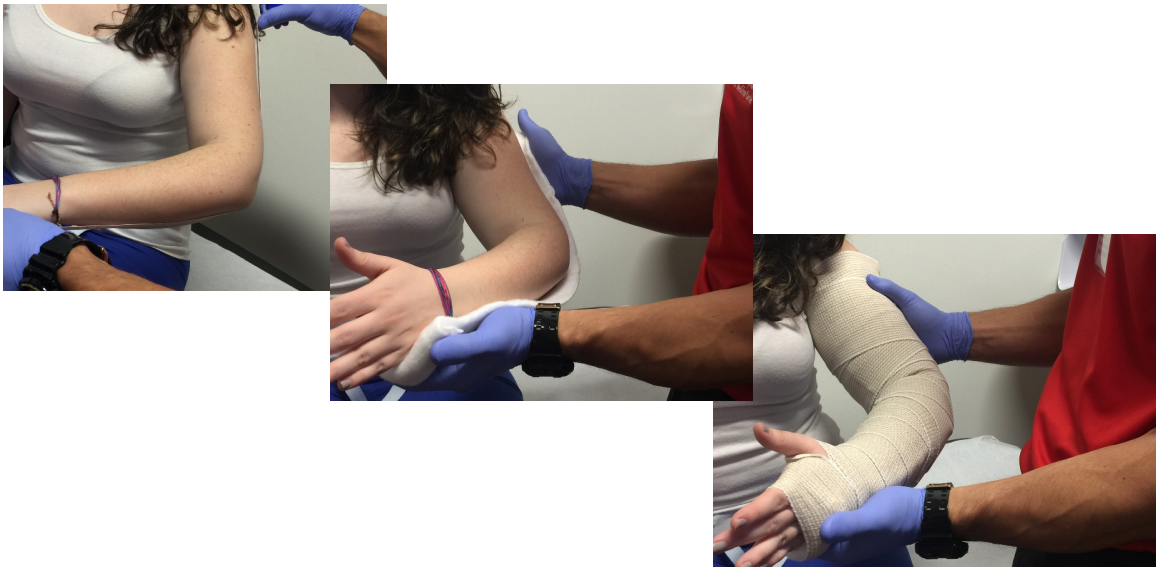

Figure 10. Posterior Long Arm Splint Application

Figure 11 illustrates application of a double sugar tong splint with Ortho-Glass® and ace wraps. This technique may be applicable treatment for elbow and forearm fractures, distal radius fractures, or humerus fractures.

Figure 11. Double Sugar Tong Splint Application

Orthopedic Casting & Bracing

Varieties of casts and durable medical equipment (DME) may be appropriate in the treatment of orthopedic athletic injuries. A well-stocked casting room may be helpful for quality orthopedic care. Figure 12 shows commonly stocked casting and bracing products and equipment. Inventory may include the following items:

- Splinting materials
- Padding and stockinet
- Fiberglass, soft cast, plaster
- Slings
- Cast shoes
- Walking and post-op boots
- Wrist braces
- Ankle braces

- Knee braces
- Cast saw and spreaders
- Scissors

Figure 12. Cast Room Inventory

Figure 13 shows a long arm cast. This technique may be used in the treatment of both-bone forearm fractures (BBFF), wrist fractures, and elbow fractures.

Figure 13. Long Arm Cast

Figure 14 illustrates a Munster cast. This technique, which allows some elbow flexion and extension range of motion while limiting supination and pronation, may be used in the treatment of nightstick fractures.

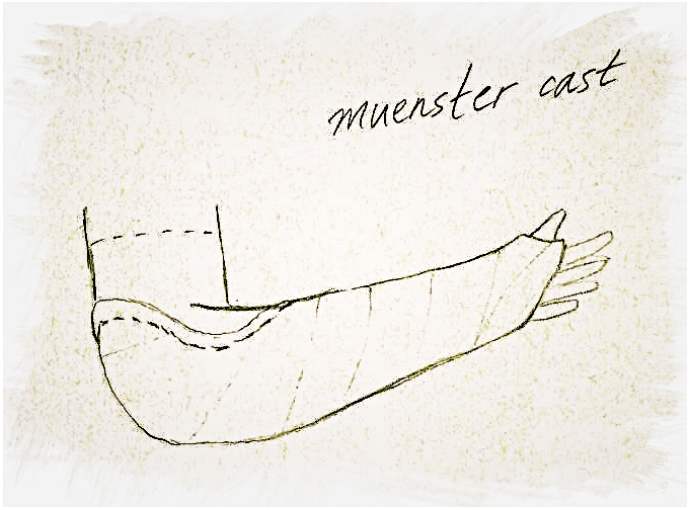

Figure 14. Munster Cast

Figure 15 illustrates a short arm waterproof cast technique using fiberglass. Used for treating wrist sprains, torus (buckle) fractures, and distal ulna fractures, this technique provides a waterproof immobilization option.

Figure 15. Waterproof Short Arm Cast Application

Figure 16 illustrates application of a thumb spica cast. This technique may be used in the treatment of scaphoid fractures, 1st metacarpal fractures or sprains.

Figure 17 shows a short leg cast. This technique may be applicable in the treatment of ankle and foot fractures, tibia-fibular fractures, and syndesmotic injuries. Long leg casts may also be used. Distinction should be made between weight bearing and non-weight bearing casts.

Figure 16. Thumb Spica Cast

Figure 17. Short Leg Cast

The following braces and durable medical equipment may be useful in the treatment of specific orthopedic conditions:

- Ankle lace-up brace
- Low / high boots
- Knee patellar stabilizing brace
- Knee hinge brace
- Knee immobilizer
- Wrist brace
- Thumb spica brace
- Knuckle orthotic brace
- Shoulder stabilizer brace
- Lumbar brace

Athletic Strength & Conditioning

Athletic trainers are specialists in the application of strength training and conditioning programs for sports performance. Variables such as timing, frequency, and quality may be considered when implementing any training program. Neuromuscular control is activated through warm-up movement patterns that may prepare the athlete for sports performance. Examples of warm-up and training programs for sports preparation are included in Appendix A – C. Furthermore, biomechanical running analysis can be accomplished with simple equipment. Integrating a strength and flexibility assessment with a dynamic treadmill running analysis may add beneficial insights to any running training program. An assessment data sheet is provided in Appendix D for the strength & flexibility assessment, while the dynamic treadmill assessment data sheet is provided in Appendix E. Original research projects investigating functional performance testing and lower extremity baseline testing are included in Appendices F & G.

Core Strengthening: For lumbar-pelvic stability, a sequence of exercises may be beneficial:

- Dead bugs / Bird dog (3 minute each side)
- Bridging (single leg with knee extension, abduction, and circling)
- Supermans
- Plank with push-up, knee to opposite elbow

With the use of a Swiss ball:

- Scissors
- On knees: side-to-side
- Knees to chest
- Bridge on ball
- Kickbacks
- V-ups
- Side kicks
- Supermans

A slide board or Flowin® board can be used to develop and maintain scapula-humeral rhythm and dynamic stability of the upper extremity as well as hip dynamic stability (Figure 18):

- Shoulder extensions
- Shoulder flys (abduction)
- Shoulder circles
- Shoulder oblique slide
- Bridge running
- Lunges
- Hip abduction & adduction

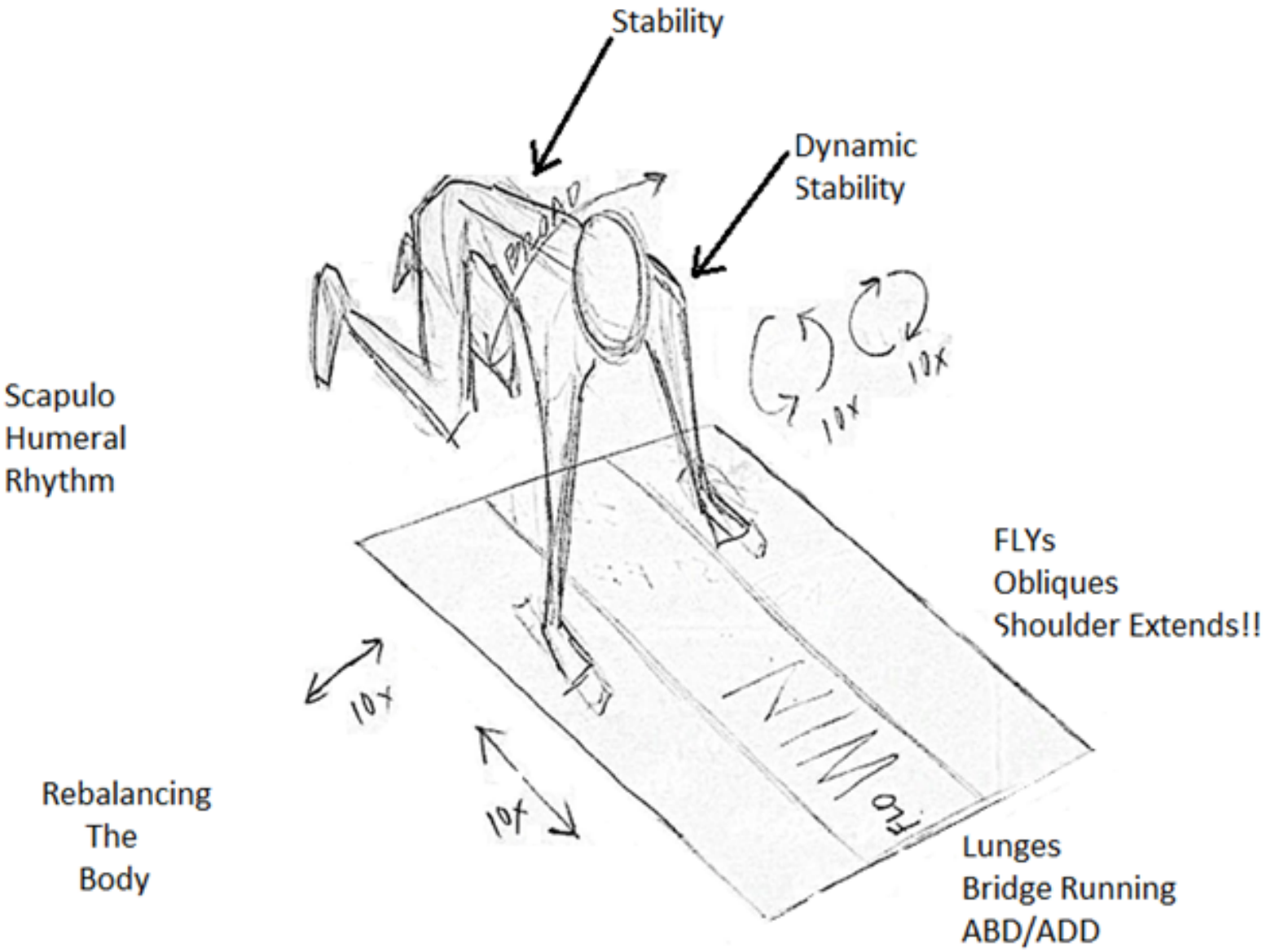

Figure 18. Dynamic Stability

Orthopedic Clinical Skills

When working alongside an orthopedic physician or within the orthopedic clinic, athletic trainers are constantly refining their clinical skills. Included in the orthopedic athletic trainer's skillset are the following:

- History & physical examination
- Radiology knowledge
- Orthopedic technology application
- Durable medical equipment (DME) application
- Home exercise program (HEP) instruction
- Strength & conditioning
- Patient education
- Concussion management
- Extension of clinic - emergency (sideline) medical care

History Taking: Communicating compassionately with patients while obtaining a thorough history of the injury is a vital skill that sets the tone for effective treatment plans and initiating recovery. The following scaffolding may be utilized to sort and support the important information:

- Age | sex | grade | sport
- Chief complaint
- Date of injury (date of surgery)
- Mechanism of injury
- Onset of injury
- Provocation of injury
- Quality of symptoms
- Radiating symptoms
- Severity of symptoms
- Time of symptoms
- Treatment to date
- Immobilization
- Radiological studies
- Goals & expectations
- Allergies
- Medications
- Past medical history

Physical Examination: The orthopedic athletic trainer must be well versed with clinical physical examinations for all joints and anatomical areas. The components of an essential physical examination are listed here:

- Inspection
- Palpation
- Range of motion
- Manual muscle testing
- Special testing
- Functional testing
- Contralateral comparison

Radiology: The orthopedic athletic trainer must also be familiar with radiological media, orders, requisitions, authorizations, views, diagnosis codes, etc. Figure 19 shows a lateral hand X-ray of a 3rd metacarpal fracture. Radiology requests are signed orders by a physician. The International Statistical Classification of Diseases and Related Health Problems (ICD) code is necessary information; therefore, familiarization with diagnoses is an orthopedic athletic trainer's asset. Clinical reasons for X-rays include bony deformity, alignment, healing, or progression.

Figure 19. Lateral Hand X-ray

Impact of the Orthopedic Athletic Trainer

The orthopedic athletic trainer can add tremendous impact and value to the organization and community. Quantitative and qualitative outcomes may demonstrate these contributions.[14 15 16 17]

Clinical Outcomes:

- Patient satisfaction
- Productivity & revenue generation
- Surgical referral management
- MRI / imaging referrals
- Closing electronic medical record (EMR) encounters & claim dropping
- Quality & completeness of insurance documentation
- Home exercise instruction
- Casting / durable medical equipment application

Narrative Outcomes:

- Analytic scores
- Care continuum / quality of patient care
- Clinical efficiency
- Patient flow
- Physician – patient face time
- Communication with referral sources
- Patients' willingness to refer
- Physician practice & quality of life
- Clinical referrals
- Community visibility

Emergency Medical Equipment Preparation

While providing safety and security during athletic events and performances, the orthopedic athletic trainer relies on an inventory of equipment, tools, and supplies in the delivery of athletic training services. A detailed and sorted inventory list is provided below. Figure 28 illustrates a stocked medical athletic training supply kit.

Emergency Supplies:

I. AED
II. Airway kit + suction
III. Monitor
IV. Spine board + C-collar
V. Spider straps + head bed
VI. Crutch bag
VII. Crutches (short)
VIII. Crutches (tall)
IX. Cooler (ice)
X. Slings/triangular
XI. Splinting material
XII. Emergency blanket (Mylar)
XIII. Tourniquet
XIV. Ice bags

Figure 20. Athletic Training Kit

DME:

I. Air Cast (2)
II. Knee IROM
III. Knee brace (MCL)
IV. Ankle Braces (ASO)
V. C-Collar

First Aid:

I. Gauze
II. Roller gauze
III. Sutures
IV. Antibiotic
V. Saline
VI. Wound wash
VII. Abdominal pads
VIII. Nose plugs
IX. Vaseline stick
X. Betadine swabs
XI. Xeroform
XII. Tegaderm

Therapy Tools:

I. Thera-band
II. Jaeger Bands
III. TRX
IV. Swiss ball
V. Bodyblade®
VI. Thera Cane
VII. Straps
VIII. Cupping set
IX. Cuff weights

Tape:

I. Coach 1.5”
II. Elastikon®2”
III. PowerFlex®
IV. Cover strip
V. Stretch 1.5”
VI. Pre-wrap
VII. Duct tape
VIII. Ace wraps

Miscellaneous:

I. BP cuff
II. Stethoscope
III. Pen Light
IV. Scissors/shears
V. Tuning fork
VI. Tape measure
VII. Reflex hammer

Medications:

I. EpiPen®
II. Diphenhydramine
III. NSAIDS
IV. Analgesics
V. Topicals
VI. Electrolytes
VII. TUMS
VIII. IV kit
IX. Oral rehydration
X. Others…

SIDELINE KIT	
FIRST AID	BANDAGES
STERILE FLUSH	SAM SPLINT
HAND SOAP	ELASTIC BANDAGES
GAUZE 4"X4"	TRIANGULAR BANDAGE
STERILE SPONGES 4"X4"	TOURNIQUET
ABDOMINAL PADS 5"X9"	THE EMERGENCY BANDAGE
BLEEDSTOP BANDAGE	ADHESIVE TAPE ROLL
EYE PAD	SLING
TONGUE DEPRESSOR	NOSE PLUGS
BANDAGE STRIPS	
EXAM GLOVES	INSTRUMENTS
CPR MASK	EMT SHEARS / EXTRACTOR
OPA + NPA	SS HEMOSTAT
	TWEEZERS
TOPICALS	SUTURE SET
FIRST AID CREAM PACK	STETHOSCOPE
TRIPLE ANTIBIOTIC PACK	PEN LIGHT
BURN AID PACK	
ALCOHOL WIPES	MEDS
IODINE WIPES	NSAIDS
ANTISEPTIC BZK WIPES	ANALGESICS
CLEAN WIPES	OTHER
LIP TREATMENT	
	PEN
	PCR

Table 1. Sideline Kit Inventory

Figure 21 illustrates the essential spine board preparation and the vital emergency equipment list to respond to a code scenario. The code gear may vary based on technician or paramedic level and may include suction catheters, airway kit and adjuncts, laryngoscopes, endotracheal tubes, oxygen and masks, intravenous/interosseous kits and fluids/medications, bandages and dressings, cardiac monitor, electrodes, alcohol swabs, lancets, glucometer, stethoscope, blood pressure cuffs, and pen light.

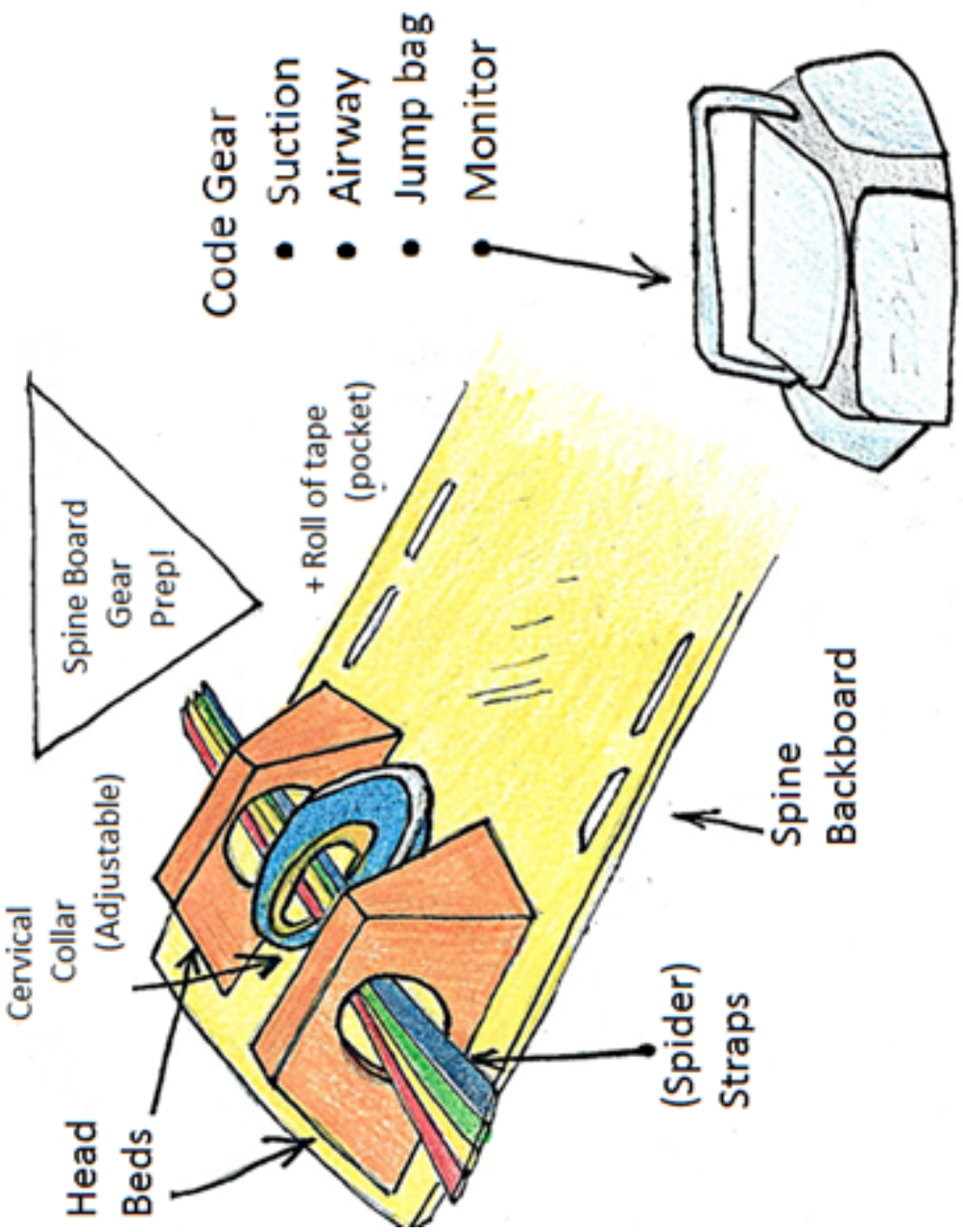

Figure 21. Spine Board Preparation

Emergency Medical Patient Assessment

Priority in any emergency situation goes to safety of the scene. Taking body substance isolation precautions by donning appropriate personal protective equipment is paramount to any successful emergency response. With a safe scene and safe equipment, the orthopedic athletic trainer is then directed to patient care, beginning with the primary assessment of the patient. [18]

Primary Assessment: The ENAMES algorithm provides an effective mnemonic for training a systematic approach to managing emergency response, a critical clinical area for athletic trainers:

- Environment?
- Number of patients?
- Additional resources?
- Mechanism of Injury (or Nature of Illness)
- Extrication plan
- Spinal precautions necessary? Immobilization?

ENAMES is followed by a quick transition period involving the following assessment:

- General impression of the injured person and area
- Level of consciousness (AVPU scale)
- Chief complaint?
- Any apparent life threats?

ABC's can then be given the proper medical attention:

- Airway
    - Is it open?
    - Is it clear?
    - Is it maintained?

- Breathing
    - Is he breathing?
    - Is it adequate?
    - Provide oxygen?
    - Expose & treat + breath sounds
- Circulation
    - Check pulses
    - Skin signs
    - Check for bleeding
    - Treat for shock
- Decide on transport to the hospital
    - Begin secondary assessment / rapid trauma assessment.

Figure 22 illustrates this and includes the mnemonic for communicating to receiving facilities the status of an injured patient – MIVT: Mechanism of injury & Mentation, Injuries, Vital signs, Treatments initiated.

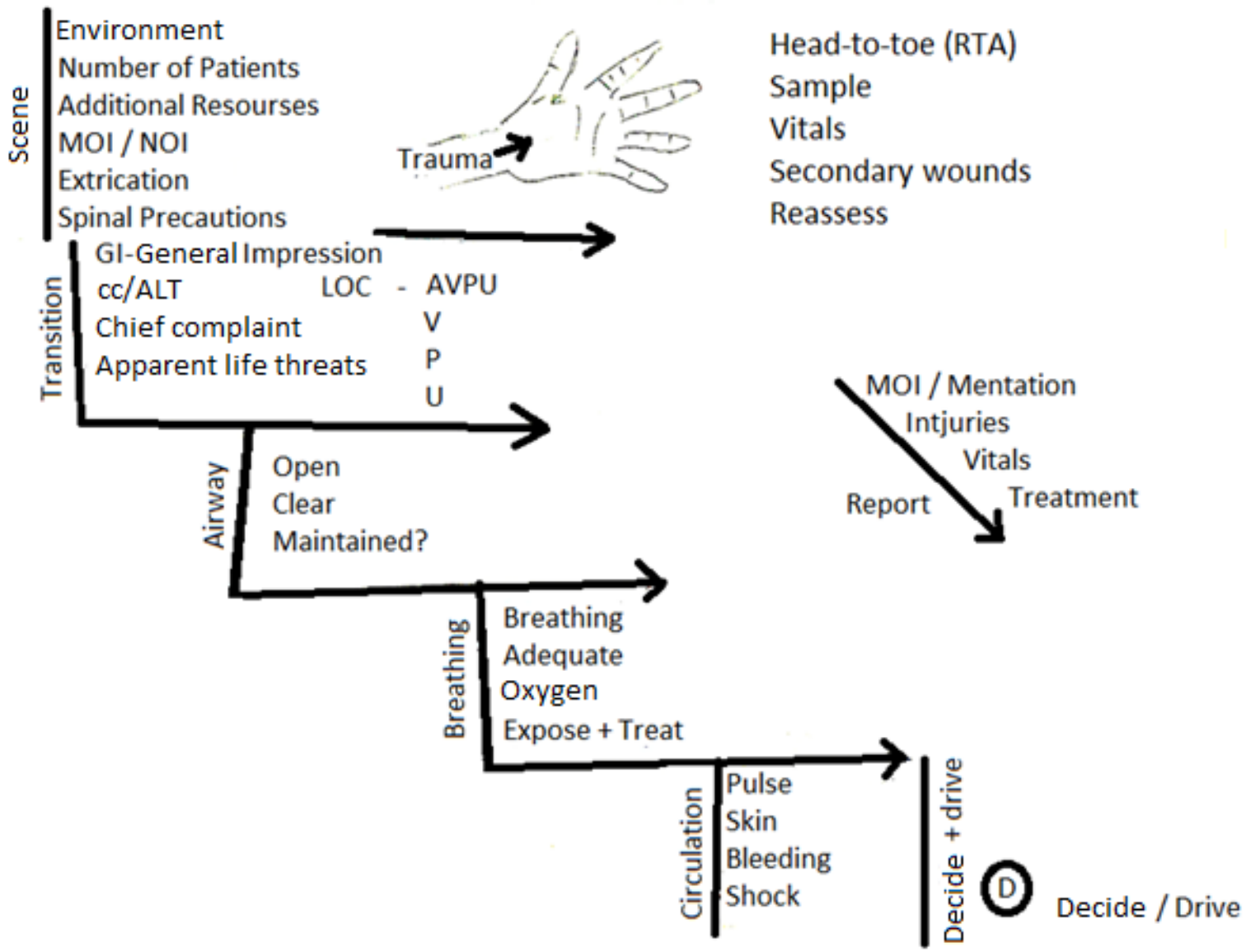

Figure 22. Primary Assessment

S Signs & Symptoms

A Allergies

M Medications

P Past medical history

L Last oral intake

E Events prior to the incident

O Onset

P Provocation & Palliation

Q Quality

R Radiation

S Severity

T Time

P Progression

A Associated with chest pain?

S Sputum

T Talk

E Exercise tolerance

Secondary Assessment: The secondary assessment (Figure 23) includes five "fingers":

- Head-to-toe rapid trauma assessment (RTA)
- SAMPLE history taking
- Vital signs (VS)
- Treating any secondary wounds/injuries
- Reassess every 3-5 minutes.

The head-to-toe RTA assesses the vital areas for life and other anatomical areas for injuries categorized with the help of the mnemonic DCAP-BTLS: deformities, contusions, abrasions, punctures, bruising, tenderness, lacerations, swelling. It begins with inspection and palpation of the head and neck (have a cervical collar applied if necessary), including inspection of the eyes, ears, nose, and mouth with a penlight. Pupils should be assessed, and the chest inspected and palpated. Breath sounds are assessed with a stethoscope on the skin at all auscultation sites. The abdomen, pelvis, and back are also assessed. The abdomen is assessed for tenderness, rigidity, or distention (TRD). The extremities are evaluated for bony injuries causing tenderness, instability, or crepitus (TIC). Distal circulatory, sensory, and motor function should also be documented for presence and normalcy. The head-to-toe RTA should be followed by SAMPLE history taking.

SAMPLE history taking (mnemonic for Signs & Symptoms, Allergies to medications, Medications, Past medical history, Last oral intake, and Events leading up to or causing the injury) provides a useful framework for the collection of pertinent information for helping the patient. The OPQRST mnemonic can also be used to target information around the chief complaint in order to help the patient with the greatest amount of good: Onset, Provocation, Quality, Radiation, Severity (0-10), Time. Initial assessment of a patient with a chief complaint of shortness of breath can be guided by the mnemonic PASTE: Progression of the symptoms, Associated chest pain?, Sputum, Talk tolerance, Exercise tolerance.

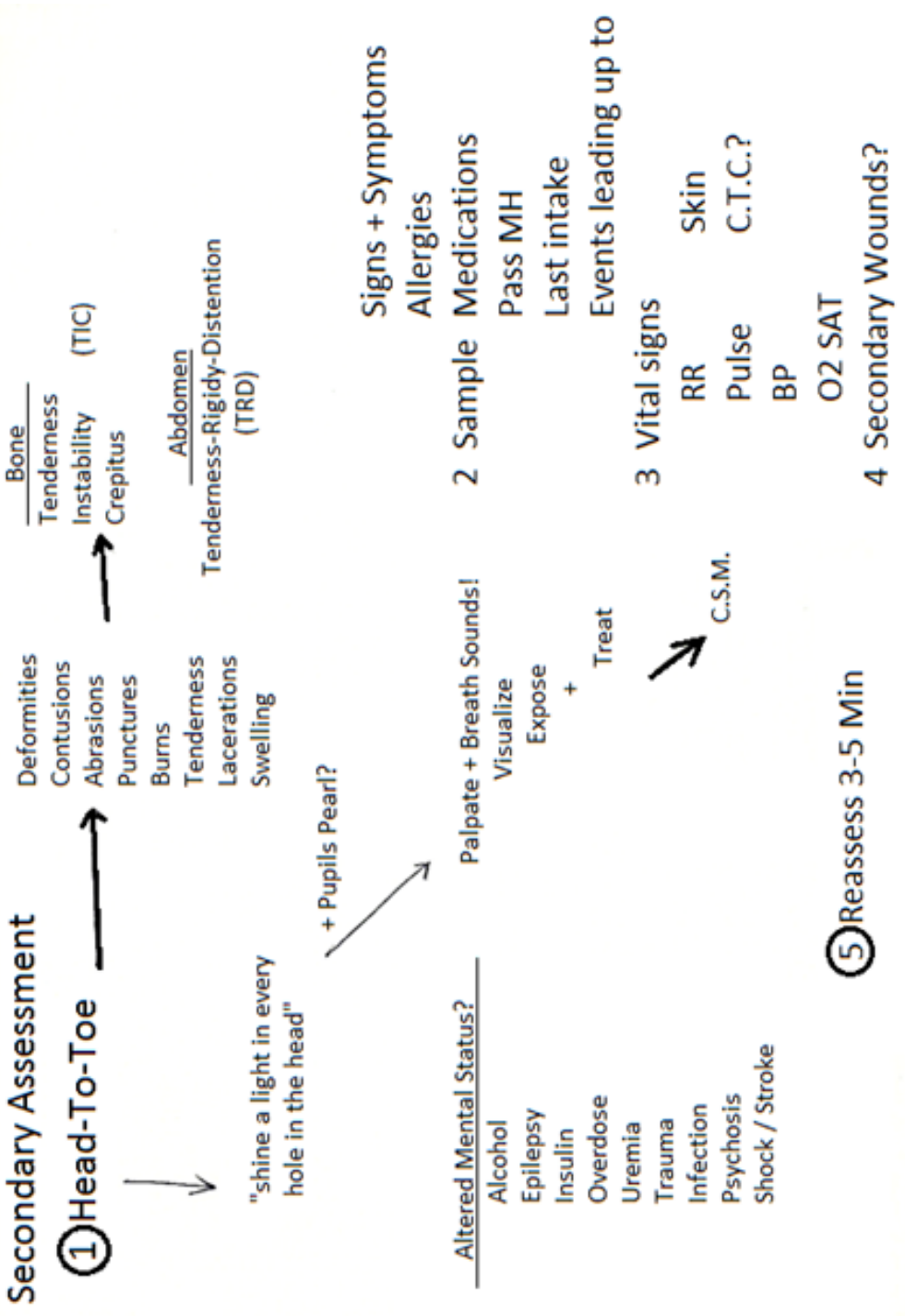

Figure 23. Secondary Assessment

All vital signs should be assessed and a cardiac monitor attached to the patient if indicated. All secondary wounds can then be treated and cared for. Reassessment of the patient should be accomplished every 3-5 minutes.

Vital Signs:

Respiration (RR)	rate | quality | rhythm | effort | noise | depth
Pulse	rate | strength | regularity
Blood Pressure (BP)	systolic | diastolic
Skin	condition | temperature | color (C.T.C.)
Capillary refill (O_2Sat)	< 2 seconds
Pupils	equal | regular | reactive to light
Level of consciousness	alert | verbal | pain | unresponsive mental status

Normal Resting Heart Rates:

Adults	60-100 bpm
Children	70-150 bpm
Infants	100-160 bpm

Normal Resting Respiration Rates:

Adults	12 - 20 bpm
Children	15 - 30 bpm
Infants	25 – 50 bpm

Normal Systolic Blood Pressure Ranges:

Adults	90 – 140 mmHg
Children	80 – 110 mmHg
Infants	50 – 95 mmHg

Causes of Low Blood Pressure:

Hypovolemic	Loss of blood | Loss of vascular tone
Cardiogenic	Cardiac pumping problem

Level of Consciousness:

A	Alert person | place | time | event
V	Verbal – responsive to verbal stimuli
P	Pain – responsive to painful stimuli
U	Unresponsive

Pupils:

P	Pupils
E	Equal
A	And
R	Regular
L	Light – reactive to light

Abnormal Pupillary Reactions:

- Fixed, no reaction to light
- Dilate with light
- Constricts with dark
- Sluggish reaction
- Unequal in size
- Unequal with light of when light is removed

Auscultation of the Lungs:

I. Upper – right and left between scapula
II. Middle
III. Lower
IV. Mid – clavicular
V. Mid – axillary

<u>Specific Emergency Conditions</u>

- Respiratory emergency
- Cardiovascular emergency
- Neurologic emergency
- Abdomen emergency
- Diabetic emergency
- Allergic reactions & envenomation
- Environmental emergency

***Respiratory Emergency*:**

Dyspnea

- Upper airway infection
- Chronic Obstructive Pulmonary Disease
    - Bronchitis
    - Asthma
        - Wheezing
    - Emphysema
        - Rhonchi and wheezing often present
- Pneumothorax - spontaneous
    - Trauma
- Anaphylactic reaction
    - Wheezing
- Pleural effusion
- Mechanical obstruction of airway
- Pulmonary embolism
    - Hemoptysis
- Hyperventilation
    - High blood glucose | aspirin overdose | severe infection (acidosis)
- Acute Pulmonary edema
    - Exacerbated by supine position
    - Rales often present

Cardiovascular Emergencies:

Angina Pectoris

- Crushing, squeezing discomfort
- Usually lasts < 15 minutes
- Usually asymptomatic with rest

Heart Attack (Acute Myocardial Infarction)

- Opening blocked artery within one hour can prevent damage
- Does not resolve in a few minutes
- Can last 30 minutes to several hours
- May not resolve with rest or nitroglycerine
- Symptoms:
    - Weakness, nausea, sweating, pain in lower jaw, neck, arms, back, abdomen
    - Sudden arrhythmia with syncope
    - Dyspnea
    - Pulmonary edema
    - Sudden death

Cardiogenic Shock

- Heart lacks power to force blood through circulation
- Can lead to pulmonary edema, rales

Congestive Heart Failure

- Ventricles damaged
- Heart tries to compensate
- Increased heart rate
- Enlarged left ventricle

Medications often prescribed:

- Furosemide
- Digoxin
- Amiodarone

Medications

- Aspirin
- Nitroglycerine
  - Contraindications
    - Systolic <100 mmHg
    - Head injury
    - Maximum dose taken within one hour

Neurological Emergencies:

Cardiovascular Accident

- Interruption of blood flow to the brain

Stroke

- Loss of brain function that results
- Potential results
  - Thrombosis – clotting of cerebral arteries
  - Arterial rupture – rupture of cerebral arteries
  - Cerebral embolism

Hemorrhagic Stroke

- Bleeding in the brain

Ischemic Stroke

Transient Ischemic Attack

Symptoms:

- Left hemisphere
  - Aphasia
    - Receptive: Ability to speak but unable to understand speech.
    - Expressive: Inability to speak correctly but able to understand speech.
- Right hemisphere
  - Dysarthria

Cincinnati Stroke Scale

I.	Facial droop	Smile
II.	Arm drift	Arms out, palms up, eyes, closed
III.	Speech	Repeat, "The sky is blue in Cincinnati."

Seizures

- General (grand mal) | Absence (petit mal) | Status Epilepticus
- Usually last 1 – 5 minutes
- May experience aura or metallic test

Causes

- Congenital (Epilepsy)
- High fever
- Structural problems in the brain
- Metabolic disorders
- Chemical disorders (poison, drugs)

Recognition

- Cyanosis
- Abnormal breathing
- Possible head injury
- Incontinence
- Severe muscle twitching
- Postictal state of unresponsiveness & deep, labored respirations

Acute Abdominal Injury:

Symptoms

- Ileus – paralysis of muscle contractions, abdominal distention
- Bowel changes
- Emesis
- Nausea & vomiting
- Distention
- Anorexia
- Loss of body fluid into peritoneal cavity
- Fever
- Tenderness

Diabetic Emergencies:

Diabetes

- Type I No production of insulin
- Type IINon-insulin dependent diabetes

Normal Glucose Levels

Adults	80 – 120 mg/dL

Hyperglycemia

- Diabetic ketoacidosis
  - Vomiting
  - Abdominal pain
  - Kussmaul respirations
  - Unconsciousness
- Diabetic coma
  - Kussmaul respirations
  - Dehydration
  - Fruity breath odor
  - Rapid, weak pulse

Hypoglycemia

- Diabetic Shock
  - Normal or rapid respirations
  - Pale, moist, clammy skin
  - Diaphoresis
  - Dizziness, headache
  - Rapid pulse
  - Normal to low blood pressure
  - Altered mental status
  - Anxious of combative behavior
  - Hunger
  - Seizure, fainting, coma

Vital Sign	Hyperglycemia	Hypoglycemia
Respiration	Deep, rapid	Normal to rapid
Pulse	Normal to rapid	Normal to rapid
Skin	Warm, dry	Pale, clammy
Blood Pressure	Normal	Low

Table 2. Diabetic Emergencies: Vital Signs

Allergic Reactions & Envenomation:

Allergens

- Envenomation
- Medications
- Plants
- Food
- Chemicals

Symptoms of Allergic Reaction

- Itching, burning
- Urticaria (hives)
- Wheezing
- Wheals
- Bronchospasm
- Dyspnea
- Low blood pressure

EpiPen

- Adult = 0.3 mL
- Child = 0.15 mL

Environmental Emergencies:

Hypothermia

- Shivering
- Rapid pulse
- Rapid respirations
- Red skin, pale, or cyanotic
- Core temperature <95°

Local Cold Exposure

- Frost nip
- Frost bite

Heat Exposure

- Heat cramps
- Heat exhaustion
- Heat stroke

Advanced Cardiac Life Support

The orthopedic athletic trainer is constantly challenged to update basic life support (BLS) and advanced cardiac life support (ACLS) training.

The useful VOMIT mnemonic can be helpful for ACLS response:

- Monitor Vital signs
- Administer Oxygen
- Attach leads to cardiac Monitor
- Initiate Intravenous access
- Think & Treat the condition + TRANSPORT

Pharmacology

Orthopedic procedures and surgical procedures may involve pharmacology. Included in this handbook are the classifications of medications:

- Narcotic Analgesics
  - Morphine
  - Aspirin
  - Meperidine (Demerol)
  - Fentanyl citrate
  - Nitrous oxide
  - Etomidate
- Narcotic antagonist
  - Naloxone HCL (Narcan)
- Neuromuscular blocking agents
  - Vecuronium
  - Succinylcholine
- Carbohydrates
  - Dextrose 50%
- Vitamins
  - Thiamine
- Hormones
  - Oxytocin
  - Vasopressin
  - Glucagon
- Steroids
  - Decadron
- Gas
  - Oxygen
- Calcium blockers
  - Verapamil
- Electrolytes
  - Calcium chloride
  - Magnesium sulfate
- Beta blockers
  - Propranolol
  - Labetalol
- Diuretics
  - Mannitol
  - Lasix (Furosemide)
- Antiarrhythmic agents
  - Procainamide
  - Adenosine
  - Amiodarone
  - Lidocaine
- Sympathomimetic
  - Isoproterenol
  - Albuterol
  - Epinephrine
  - Dopamine
- Nitrate
  - Amyl nitrite
  - Nitroglycerine
- Cardiac glycoside
  - Digoxin
- Anti-coagulant
  - Heparin
  - Aspirin
- Anti-emetic
  - Zofran
- Adsorbent

    - Activated charcoal
- Parasympatholytic (anti-cholinergic)
    - Atropine
    - Atrovent-Ipratropium
- Fibrinolytic
    - Tissue plasminogen activator
- Antihistamine
    - Diphenhydramine
- Cholinesterase inhibitor
    - (2-Pam) Pralidoxime
- Alkalizing agent
    - Sodium bicarbonate
- Vasoconstrictors
    - Epinephrine
- Local Anesthetics
    - Lidocaine
    - Bupivacaine
- Conscious sedation
- Sedatives (anti-anxiety)
    - Benzodiazepines
    - Diazepam
    - Midazolam
    - Flumazenil
    - Ketamine
    - Propofol
- Regional Blocks
    - Digital/wrist/elbow
    - Axillary/ankle/popliteal

Other common medications in sports medicine include cough and cold medications such as decongestants, antitussives, antihistamines, and expectorants. Narrow and broad antibiotics, antiviral, and antifungal agents may also be prescribed.

APPENDIX A

LOWER EXTREMITY ADVANCED PERFORMANCE PROGRAM

Warm-up
1. Jogging
2. Side shuffle
3. Carioca
4. Backpedal
5. Striders (relaxed running)

Strengthening
1. Squats (30 sec)
2. Walking lunges
3. Glute-Hamstring Bridges (30 sec)
4. Single leg walking Russian Dead Lift
5. Single leg toe-raises + squat (10 reps per side)

Plyometrics
1. Double leg forward/backward hops over line (30 sec)
2. Double leg lateral hops over line (30 sec))
3. Double leg 180 degree hops over line (30 sec)
4. Tuck jumps or Scissor jumps (30 sec)
5. Single leg forward/backward hops over line (30 sec)
6. Single leg lateral hops over line (30 sec)

Agility
1. Deceleration cutting
2. Change of pace + direction
3. Bounding run

Extra Credit: Core + Stretching
1. Planks on forearms
2. Push-ups
3. Abdominals / Obliques
4. Calf stretch (Frankenstein)
5. Quadriceps stretch (Flamingoes)
6. Figure 4 hamstring stretch (walking)
7. Inner thigh stretch (Under the Fence)
8. Hip flexor stretch (walking)

APPENDIX B

UPPER EXTREMITY PERFORMANCE | WARM-UP PROGRAM

PRIMING

1. Jogging
2. Side shuffle
3. Carioca
4. Backpedal
5. Hops (forward/backward) 30 sec
6. Hops (side/side) 30 sec
7. Increase speed to 75%

HIP MOBILITY

1. Open/close gate (forward/backward)
2. Under the fence
3. Flamingoes / Frankensteins
4. Walking figure 4 stretch
5. World's greatest stretch
6. Hip matrix (3-way)

THORACIC MOBILITY

1. Quadruped External Rotation (8x each side)
2. External Rotation Windmill (8x3 sec holds each side)
3. Thoracic twists (4 way each side)

SHOULDER WARM-UP (5 REPS)

1. Circles
2. Hugs
3. Field goals
4. Genie stretch
5. Forearm Stretch

SHOULDER ACTIVITATION W/ TUBING (8 REPS)

1. ER/IR
2. ER/IR (90/90)
3. Extension
4. Horizontal extension
5. ER eccentric
6. Forward Spike (D1)
7. Reverse Spike (D2)
8. Lower trap
9. Dynamic stability

APPENDIX C

RUNNING PERFORMANCE | PREPARATION PROGRAM

CORE STREGTH & STABILITY

1. Bird-Dog (in-sync/out-of-sync) 10x
2. Plank on forearms
3. Side plank
4. Bridge sequence
5. Clam shells
6. Dead Bug (in-sync/out-of-sync) 10x
7. V-ups
8. Sit-ups

STRENGTHENING

1. Squats
2. Lunges
3. Side lunges
4. Step-ups
5. Bounding runs

RUNNING DRILLS

1. Arm swings
2. Jog
3. Carioca
4. Kick backs
5. High knees
6. Frankensteins
7. Flamingoes
8. Over the fence/Under the fence
9. Paws
10. Strides
11. Chi-Running

EXTRA CREDIT: CORE & STRETCHING

1. Push-ups
2. Abdominal curls
3. Abdominals obliques
4. Calf stretch
5. Quadriceps stretch
6. Figure-4 hamstring stretch
7. Inner thigh stretch
8. Hip flexor stretch

APPENDIX D

RUNNING PERFORMANCE ASSESSMENT

STANDING

Alignment

Notes:

☐ Normal

☐ Genu Valgum

☐ Genu Varum

Lumbar Spine ROM

Notes:

☐ Normal

☐ Flexion

☐ Extension

☐ Right Rotation

☐ Left Rotation

☐ Right Side Flexion

☐ Left Flexion

Single Leg Balance (30 sec)

Notes:

LEFT	**RIGHT**
☐	☐

Single Leg Heel Raise (25 reps)

Notes:

LEFT **RIGHT**

☐ ☐

Ankle Mobility (Y-Balance)

Notes:

☐ Normal

☐ Right stance leg

☐ Left stance leg

SUPINE

Hip Flexor Strength (90° hip flexion)

Notes:

LEFT **RIGHT**

☐ ☐

Quadriceps Strength (90° hip flexion)

Notes:

LEFT **RIGHT**

☐ Normal ☐ Normal

Hamstring Flexibility (popliteal angle)

Notes:

LEFT **RIGHT**

☐ ☐

Abdominal Strength (Double Leg Lowering Test, angle from table)

0-15° = 5 | 15-45° = 4 | 45-75° = 3 | 75-90° = 2 | unable to maintain neutral =1

Notes:

☐ Normal

☐ Abnormal

☐ Score: 1 2 3 4 5

Hip Flexor Flexibility (Thomas Test)

Notes:

LEFT **RIGHT**

☐ ☐ ☐ Psoas

☐ Rectus

☐ ITB

PRONE

Knee Flexion Strength (Hamstrings)

Notes:

LEFT **RIGHT**

☐ ☐

Hip Extension Strength

Notes:

LEFT **RIGHT**

☐ ☐

Prone Passive Knee Flexion Flexibility (Quadriceps)

Notes:

LEFT **RIGHT**

☐ ☐

SIDELYING

Ober's Test

Notes:

LEFT **RIGHT**

☐ ☐

Hip Abduction Strength

Notes:

LEFT **RIGHT**

☐ ☐

STANDING

Single Leg Squat

Notes:

LEFT **RIGHT**

☐ ☐

APPENDIX E

RUNNING TREADMILL ASSESSMENT

TREADMILL SPEED (mph): _____

STRIDE CADENCE (strides/minute) _____

SINGLE LEG STEP DOWN

LEFT	**RIGHT**	**Notes:**
☐ Normal	☐ Normal	
☐ Hips	☐ Hips	
☐ Leaning	☐ Leaning	
☐ Knee dynamic valgus	☐ Knee dynamic valgus	

KNEE AND DISTAL - POSTERIOR VIEW

Heel Valgus (Toe Sign/Pronation) **Notes:**

LEFT _____° RIGHT _____°

Heel Varus (Supination) **Notes:**

LEFT _____° RIGHT _____°

Base of Stance **Notes:**

☐ Normal ☐ Wide ☐ Narrow

Impact of Running **Notes:**

☐

PELVIS AND DISTAL – POSTERIOR VIEW

Knee Alignment **Notes:**

LEFT **RIGHT**

☐ ☐

Hip Motion **Notes:**

LEFT **RIGHT**

☐ ☐

Hip Rotation **Notes:**

LEFT **RIGHT**

☐ ☐

FULL BODY - POSTERIOR VIEW

Trunk Posture **Notes:**

☐

Scapular Alignment **Notes:**

LEFT **RIGHT**

☐ ☐

Arm Motion **Notes:**

LEFT **RIGHT**

☐ ☐

PELVIS AND DISTAL – LATERAL VIEW

Foot Contact **Notes:**

LEFT **RIGHT**

☐ Heel ☐ Heel

☐ Midfoot ☐ Midfoot

☐ Toe ☐ Toe

FULL BODY - LATERAL VIEW

Knee Flexion (Kickback Angle) **Notes:**

LEFT _____° RIGHT _____°

Stride Length **Notes:**

LEFT _____° RIGHT _____°

Knee Extension **Notes:**

LEFT **RIGHT**

☐ ☐

Hip Extension **Notes:**

LEFT **RIGHT**

☐ ☐

Arm Cradle **Notes:**

LEFT **RIGHT**

☐ ☐

Vertical Inertia **Notes:**

☐

Forward Lean **Notes:**

☐

Stride Initial Contact **Notes:**

☐

IJSPT

ORIGINAL RESEARCH

PROSPECTIVE FUNCTIONAL PERFORMANCE TESTING AND RELATIONSHIP TO LOWER EXTREMITY INJURY INCIDENCE IN ADOLESCENT SPORTS PARTICIPANTS

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ABSTRACT

Background: Due to the high number of adolescent athletes and subsequent lower extremity injuries, improvements of injury prevention strategies with emphasis on clinic-based and practical assessments are warranted.

Purpose: The purpose of this study was to prospectively investigate if a battery of functional performance tests (FPT) could be used as a preseason-screening tool to identify adolescent athletes at risk for sports-related acute lower extremity injury via comparison of injured and uninjured subjects.

Methods: One hundred adolescent volleyball, basketball and soccer athletes (female, n=62; male, n=38; mean age = 14.4±1.6) participated. The FPT assessment included: triple hop for distance, star excursion balance test, double leg lowering maneuver, drop jump video test, and multi-stage fitness test. Composite scores were calculated using a derived equation. Subjects were monitored throughout their designated sport season(s), which consisted of a six-month surveillance period. The schools certified athletic trainer (ATC) recorded all injuries. Subjects were categorized into groups according to sex and injury incidence (acute lower extremity injury vs. uninjured) for analysis.

Results: Mean FPT composite scores were significantly lower for the injured compared to the uninjured groups in both sexes (males: 19.06±3.59 vs. 21.90±2.44; females: 19.48±3.35 vs. 22.10±3.06 injured and uninjured, respectively)($p < .05$). The receiver-operator characteristic analysis determined the cut-off score at ≤20 for both genders (sensitivity = .71, specificity = .81, for males; sensitivity = .67, specificity = .69, for females)($p < .05$) for acute noncontact lower extremity injuries. Significant positive correlations were found between the FPT composite score and the multi-stage fitness test in male subjects ($r = .474$, $p = .003$), suggesting a relationship between functional performance, aerobic capacity, and potential injury risk.

Conclusion: A comprehensive assessment of functional performance tests may be beneficial to identify high-injury risk adolescents prior to athletic participation.

Keywords: Adolescent, injury risk, pre-participation, screening

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Acknowledgements
The research team would like to extend our sincere gratitude to the administration and student-athletes at Hanalani School in Oahu, Hawaii.

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A BRIEF LOWER EXTREMITY GRADING SYSTEM (LEGS) TO EVALUATE BASELINE LOWER EXTREMITY ANALYTICS IN HIGH SCHOOL ATHLETES

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BACKGROUND

In the United States of America, more than half of all high school students participate in some form of athletics each year, making up a population of over 7 million adolescent student-athletes.[1] High school athletes sustain an estimated 1.5 million injuries each year with the ankle and knee being the most common sites of injury.[2-5]

Acute non-contact lower extremity injuries result in impairments in balance, power of the single limb, and jump-landing mechanics. Evidence supports that it is important to assess neuromuscular impairments following injury and for safe return to sport after injury rehabilitation. Currently, no brief comprehensive clinical tool exists for this purpose.

The purpose of this study was to describe and provide the initial data for the establishing age-specific scores of a novel, brief clinical lower extremity grading system (LEGS) of neuromuscular components as a baseline pre-season assessment for United States' high school-aged sports participants to assess risk of injury and performance potential. making.

METHODS

Two hundred and fourteen male (n=91) and female (n=123) athletes between the ages of 12 and 17 years were recruited from San Francisco bay area public schools.

As participants in high school athletics, all subjects played at least one of three sports: soccer (n=101), cheerleading (n=29), or basketball (n=84). These specific sports were selected based upon the common occurrence of noncontact acute lower extremity injuries involved with sport participation and high-risk maneuvers.[2]

RESEARCH DESIGN

- The LEGS employed in this study consisted of brief assessments in the following three domains: (1) dynamic balance, (2) jump-landing mechanics, and (3) lower limb power as measured by the Y-balance test (YBT), drop-jump video test (DJVT), and triple crossover hop for distance test (TXHD), respectively.
- Standard normal distribution was calculated for all scores to enable percentile rankings to be established for all participants. Each participant's score was also averaged to present an overall LEGS percentage score. Scores were also used in analysis and correlated to sex, gender, body mass index, age, and sport.

RESULTS

The three directions from the YBT were averaged for each limb, normalized for limb length, then an average was taken between limbs to describe dynamic stability of the stance leg. The highest score for boys and girls was 114 and 119 cm, respectively.

From the DJVT, the highest possible score (knee separation distance/hip separation distance) from the DJVT was 100 for both boys and girls. Highest averaged scores for boys' and girls' TXHD test were 683 and 538 cm, respectively.

Overall mean YBT value was 94.6 cm with a standard deviation of 9.1 cm. Overall mean DJVT value was 80.2 cm with a standard deviation of 15.2 cm. Overall mean TXHD value was 453.4 cm with a standard deviation of 88.7 cm. These values are presented in the table below.

	YBT (cm)	*DJVT (cm)*	*TXHD (cm)*
MAX (boys, n = 91)	**114.0**	**100.0**	**683.0**
MAX (girls, n = 123)	**116.0**	**100.0**	**538.0**
MEAN (all, N = 214)	**94.6**	**80.2**	**453.4**
SD (all, N = 214)	**9.1**	**15.3**	**88.7**

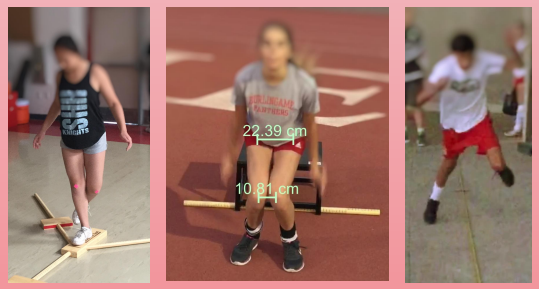

Figure1. Y-balance test, drop-jump video test, and triple crossover hop for distance test.

DISCUSSION

The Lower Extremity Grading System (LEGS) is presented as a clinical tool used for evaluating neuromuscular control analytics for use during baseline or return to play decision making process in adolescent athletes.

This biometric scale provides measurements and analysis of neuromuscular physical characteristics. Standard normal distribution of age-related scores enables comparative percentile rankings to describe relative lower extremity neuromuscular function with objective values.

Percentile rankings for all participants were calculated for each test score and overall averages of percentile rankings ranged from 8% to 89%. This method provides initial data for age and sports specific values for future comparison and further scientific analyses.

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ACKNOWLEDGEMENTS

The research team would like to extend our sincere gratitude to the administration, athletic departments, and student-athletes of the San Mateo Unified High School District, especially Matthew Smith, MA, ATC, and Sara Golec, MS, ATC.

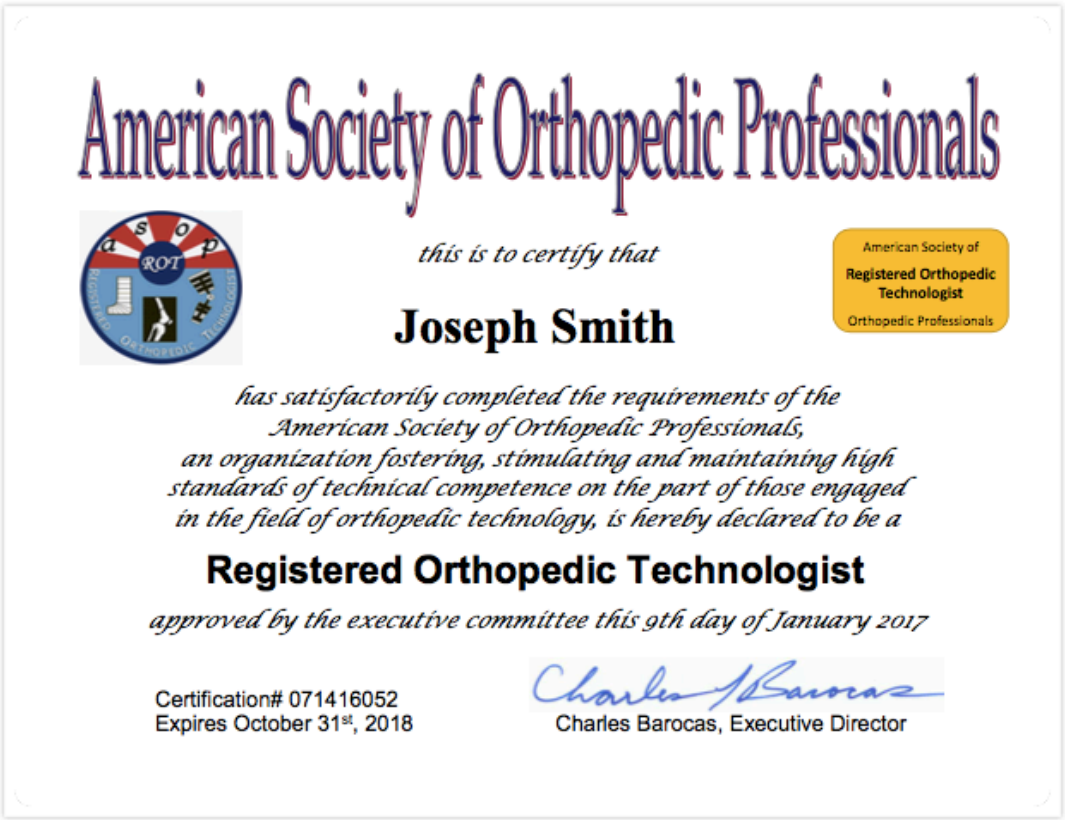
APPENDIX H


CALIFORNIA
EMERGENCY MEDICAL TECHNICIAN
Joseph H Smith
Registry Number: E008821
Effective: 06/17/2015
Expiration: 06/30/2017
Status: Active

APPENDIX I


National Board for Certfication of Orthopaedic Technologists, Inc.
Certification Number: 16-0825
Certification Valid
08/23/2016 Through 12/31/2022
Joseph H. Smith
Orthopaedic Technologist Certified
OTC

APPENDIX J



American Society of Orthopedic Professionals

this is to certify that

Joseph Smith

American Society of
Registered Orthopedic Technologist
Orthopedic Professionals

has satisfactorily completed the requirements of the American Society of Orthopedic Professionals, an organization fostering, stimulating and maintaining high standards of technical competence on the part of those engaged in the field of orthopedic technology, is hereby declared to be a

Registered Orthopedic Technologist

approved by the executive committee this 9th day of January 2017

Certification# 071416052
Expires October 31st, 2018

Charles Barocas, Executive Director

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ABSTRACT

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