ABOS-ALIGNED VR BOOTCAMP CURRICULUM

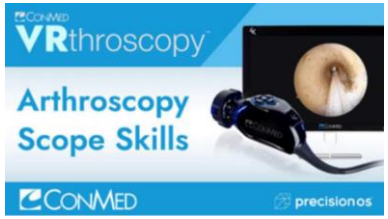
The following tables outline a roadmap for orthopedic surgery residents. Each activity is designed to last approximately one hour to maximize learning while minimizing fatigue. This schedule is a guideline; residents are encouraged to repeat modules as needed to achieve proficiency and confidence.

Foundational Activities - Anatomy, Imaging, and the Surgical Environment

These first activities are dedicated to the fundamental building blocks upon which all subsequent surgical skills are built. Residents will gain proficiency in navigating the virtual operating room, understanding patient positioning, mastering C-arm fluoroscopy, exploring surgical anatomy, and learning the basic mechanics of arthroscopy.

Activity	Theme	Primary VR Application(s) & Focus	Relevant ABOS Module(s) & Objectives	Estimated Time	Concepts Covered
#1 ☐	The Virtual Operating Room and Patient Positioning	**VR Applications:** BodyWorks Anatomy Studio & FractureLab 	**Module 1: Sterile Technique and Orthopaedic Room Set Up** Focus: Familiarize with the virtual environment. Explore the relationship between the virtual patient, and equipment. Practice repositioning the virtual patient. Use the virtual marker to plan and draw mock surgical incisions on the 3D patient model. Explore FractureLab cases where supine, and beach chair patient positions can be studied.	45-60 minutes	• Knowledge of patient positioning (Supine, Beach chair). • Ability to select and set-up the proper OR table for most common orthopaedic procedures. • Ability to position patients in the most common configurations for orthopaedic procedures.

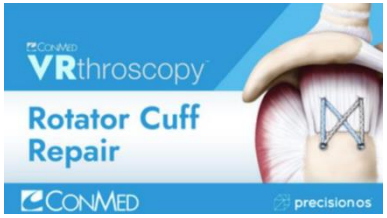
					
#2 ☐	C-Arm Proficiency and Fluoroscopic interpretation	**VR Applications:** Pelvis Imaging (C-arm Tutorial) & FractureLab  	**Module 9: Fluoroscopic Knowledge and Skills** Focus: Complete the integrated C-arm tutorial (*Case 1 AO Pelvis imaging*) to learn controls. Utilize FractureLab cases to explore radiographic projections for the wrist, shoulder and ankle.	60 minutes	• Understand the appropriate uses of fluoroscopy. • Acquire the ability to obtain standard fluoroscopic views. • Navigate a C-arm for optimal fluoroscopic images.
#3 ☐	Surgical Approaches and Soft Tissue Planes	**Primary VR Applications:** Tornier Approach (Deltopectoral) and BodyWorks Anatomy Studio 	**Module 4: Soft Tissue Handling and Dissection** Focus: In the Tornier Approach module, practice the initial steps of the deltopectoral approach: marking the incision, incising, identifying the cephalic vein, and placing retractors. BodyWorks Anatomy Studio, use the "Surgical Anatomy" sub-feature to	60 minutes	• Demonstrate how to plan a surgical approach, utilizing bony landmarks, with attention to important structures. • Dissect soft tissue using appropriate techniques, which allows identification of surgical planes (simulated).

			explore the dissected deltopectoral interval and identify neurovascular structures.		• Demonstrate sharp and blunt dissection (simulated) and identification of different tissue types.
#4 ☐	Fundamentals of Arthroscopic Camera Control	**Primary VR Application:** Arthroscopy Scope Skills 	**Module 14 (FAST 1): Basic Principles of Arthroscopy** Focus: Use both 30° and 70° virtual arthroscopes. Precisely move the camera to acquire virtual targets, practicing the four fundamental camera movements: telescoping, rotating, pivoting, and periscoping. Aim to improve time and accuracy scores with both dominant and non-dominant hands.	45-60 minutes	• Become familiar with the angled arthroscope (30- and 70-degree scope). • Develop ambidextrous motor skills for basic scope manipulation.
#5 ☐	Introduction to Diagnostic Arthroscopy and Triangulation	**Primary VR Application:** Shoulder Arthroscopy 	**Module 15 (FAST 2): Basic Triangulation Skills** Focus: Perform a diagnostic tour of the glenohumeral joint. Create a virtual posterolateral portal using the spinal needle tool. Insert the arthroscope and systematically visualize all 21 internal landmarks. This introduces the concept of triangulation: coordinating the camera's view with anatomical targets.	60 minutes	• Steadiness of the camera and arthroscope. • Image orientation (i.e., control of the horizon). • Telescoping (i.e., pistoning). • Periscoping (i.e., proper use of the 30-degree arthroscope). • Basic probe triangulation

Upper Extremity Activities - Fracture Fixation & Advanced Arthroscopy

This group of activities focuses on applying foundational skills to common upper extremity pathologies. Residents will learn the principles of K-wire fixation for distal radius fractures and be introduced to the key steps of arthroscopic soft tissue repair in the shoulder.

Activity	Theme	Primary VR Application(s) & Focus	Relevant ABOS Module(s) & Objectives	Estimated Time	Concepts Covered
#6 ☐	Principles of K-Wire Fixation	**Primary VR Application:** FractureLab 	**Module 10: K-Wire Techniques** Focus: Practice provisional fixation using K-wires under C-arm guidance. Utilize the "sawbones mode" to first understand the 3D trajectory of the wires without visual obstruction, then apply that understanding within the soft tissue constrained environment.	60 minutes	• Learn how to use the wire driver (simulated). • Place the K-wire under direct visualization (in sawbones mode). • Place the K-wire with fluoroscopy. • Manipulate the K-wire and change direction under direct visualization and fluoroscopy. • Learn to distinguish cortical and cancellous bone penetration.
#7 ☐	Fracture Reduction and Stability	**Primary VR Application:** Orthopedic Trauma: Distal Radius CRPP	**Module 12: Principles and Techniques of Fracture Reduction** Focus: Perform a closed reduction and percutaneous pinning of a distal radius fracture. Focus on the application's performance metrics, which score the	45-60 minutes	• Understand the meaning and assessment of an accurate fracture reduction. • Respect for the soft tissue envelope

			relative position of K-wires, starting points, and whether wires cross proximal or distal to the fracture line.		(simulated by percutaneous technique). • Effectively utilize skills learned in the Fluoroscopy and K-wire modules to provisionally fix a fracture.
#8 ☐	Introduction to Suture Anchor Placement	**Primary VR Application:** Rotator Cuff Repair 	**Module 16 (FAST 4): Suture Anchors** Focus: This is an introduction to suture anchor placement. Navigate to the anchor placement steps using the numbered step buttons on the instruction panel and place both medial and lateral row anchors into the humeral head. Toggle the skin off to assist in visualizing. Focus on achieving the correct insertion trajectory ("deadman's angle") and depth, using the application's direct scoring on these metrics.	45 minutes	• Ability to identify the appropriate angle of insertion of a suture anchor. • Ability to insert a suture anchor to appropriate depth. • Ability to pre-test the anchor by a tensile load (simulated).
#9 ☐	Introduction to Arthroplasty: Humeral Preparation	**VR Applications:** Tornier Performed Humeral System Application & PrecisionOS Connect 	**Module 15: Basic Arthroplasty Skills** Focus: Practice the initial steps of humeral preparation for arthroplasty. Use the virtual cut guide to resect the humeral head with the correct version. Take note of the retractor positions to protect soft tissue. Place the guidewire and use the reamer to prepare the proximal humerus for a stem implant.	60 minutes	• Understand the use of bone saws and various blades to perform bone cuts. • Demonstrate the ability to properly place jigs and prepare to make bone cuts. • Demonstrate the ability to use

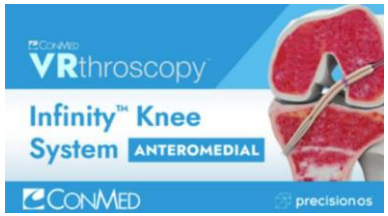
			Load into the Shoulder Arthroplasty case in PrecisionOS Connect and practice freehand cutting of the humeral head.		femoral reamers (humeral analogue). • Understand how to protect surrounding soft tissues.
#10 ☐	Introduction to Arthroplasty: Glenoid Preparation	**VR Applications:** Tornier Perform Glenoid System & Zimmer Biomet Augmented Baseplate  	**Module 15: Basic Arthroplasty Skills** Focus: Practice the fundamental steps for an *anatomic* glenoid case. Focus on correctly sizing the glenoid, reaming the surface, and positioning the trial implant. Pay attention to the scoring based on alignment and avoiding mistakes like over-reaming or incorrect positioning. The Zimmer Biomet Augmented Baseplate application contains 3D models within the case lobby that you should explore. Each glenoid pathology requires a unique preparation for arthroplasty.	60 minutes	• Understand the use of reamers to accurately and safely perform bone preparation for arthroplasty. • Assess appropriate depth and orientation of reaming. • Demonstrate the ability to protect surrounding soft tissues while performing bone cuts.

Lower Extremity & Pelvis Activities - Trauma and Fixation

This series of activities transitions to the lower extremity, focusing on large bone fracture management, hip and knee arthroscopy, and advanced fluoroscopic navigation skills.

Activity	Theme	Primary VR Application(s) & Focus	Relevant ABOS Module(s) & Objectives	Estimated Time	Goals/Objectives
#11 ☐	Anterior Hip Surgical Approach	**VR Applications:** Anterior Hip Approach & BodyWorks Anatomy Studio  	**Module 4: Soft Tissue Handling and Dissection; Module 15: Basic Arthroplasty Skills** Focus: Learn the key steps of the Smith-Peterson direct anterior approach to the hip. Practice incision planning, retractor placement, and identification of key intervals and structures at risk. Use BodyWorks to reinforce the 3D anatomy of the approach before and after the procedural simulation.	60 minutes	• Demonstrate how to plan a surgical approach, utilizing bony landmarks. • Dissect soft tissue using appropriate techniques, which allows identification of surgical planes (simulated). • Understand bone anatomy of the hip with respect to arthroplasty. • Understand how to protect surrounding soft tissues.
#12 ☐	Traction and Femur Fracture Reduction	**Primary VR Application:** Proximal Femoral Nail	**Module 6: Traction Techniques; Module 12: Principles and Techniques of Fracture Reduction** Focus: Focus on the initial step of fracture reduction. Use the virtual traction boot to manipulate the leg	60 minutes	• Understand the indications for skeletal traction (conceptual). • Demonstrate the ability to accurately place a traction pin (guidewire) across a

			(traction, rotation, adduction/abduction) to achieve acceptable alignment of proximal femur fracture fragments under live C-arm guidance. Complete this by accurately placing the guidewire through the fracture.		simulated bone/extremity. • Understand the importance of pre-operative planning and assessment of fracture position.
#13 ☐	Intramedullary Fixation	**Primary VR Application:** Proximal Femoral Nail 	**Module 11: Techniques Basic to Internal Fixation of Fractures** Focus: Proceed with fixation. Perform the complete sequence of intramedullary nailing: placing the guidewire, reaming, inserting the nail, and placing interlocking screws. Focus on the guidewire accuracy score and number of x-rays taken.	60 minutes	• Using a drill to place screws to fix fractures. • The ability to use a tap (simulated by reaming). • The ability to place screws in a precise location controlled by single plane or bi-planar fluoroscopy.
#14 ☐	Percutaneous Hip Fixation (SCFE)	**Primary VR Application:** Slipped Capital Femoral Epiphysis (SCFE) 	**Module 10: K-Wire Techniques; Module 12: Principles and Techniques of Fracture Reduction** Focus: Select the "moderate" severity case. Manipulate the hip on the virtual traction table. Under bi-planar C-arm guidance, insert a single cannulated screw into the femoral head without violating the joint, reinforcing 3D spatial reasoning.	45-60 minutes	• Place the K-wire with fluoroscopy. • Understand common surgical approaches (percutaneous). • Develop psychomotor skills to accurately navigate a wire to a precise location using bi-plane fluoroscopic control.
#15 ☐	Diagnostic Knee Arthroscopy	**Primary VR Application:** Infinity Knee System (Anteromedial ACL)	**Module 15 (FAST 2/3): Basic Triangulation Skills & Basic Interventional Arthroscopy** Focus: Use this module for a comprehensive diagnostic knee tour.	60 minutes	• Demonstrate creation of safe portals and articulate associated risks. • Touch and probe of a stationary target.

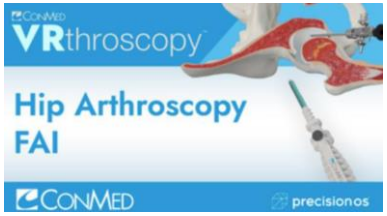
			Practice portal entry, mobilize the knee to open compartments, and systematically visualize all internal structures (menisci, ligaments, cartilage). Reinforce triangulation skills.		• Develop ambidextrous motor skills. • Understand the relationships between surface anatomy and basic arthroscopy portals.
#16 ☐	Introduction to Robotic-Assisted Arthroplasty	**Primary VR Application:** ROSA Knee System 	**Module 15: Basic Arthroplasty Skills (TKA & THA)** Focus: Focus on the initial, critical steps of robotic-assisted TKA: landmark registration. The resident will use the virtual pointer to identify and register key anatomical landmarks on the distal femur and proximal tibia. The goal is to accurately place the registration points within the target zones, reinforcing understanding of knee anatomy and alignment principles.	60 minutes	• Understand bone anatomy of the knee with respect to arthroplasty. • Demonstrate the ability to properly place jigs (analogous to landmark registration pins) and prepare to make bone cuts. • Describe varus and valgus alignment, rotation measurements, and flexion/extension balancing.
#17 ☐	Principles of Revision Knee Arthroplasty	**Primary VR Application:** Persona Revision Knee System 	**Module 15: Basic Arthroplasty Skills (TKA & THA)** Focus: Understand the key steps and sequencing of a revision TKA. Practice intramedullary reaming, positioning of guides, and marking for both the proximal tibia and distal femur in a revision scenario. Focus on one of the pathological cases to understand the decision-making process for component selection and placement.	60 minutes	• Understand the use of bone saws and various blades to perform bone cuts. • Demonstrate the ability to properly place jigs and prepare to make bone cuts.

					• Demonstrate the ability to use femoral reamers. • Understand the preparation and curing process of bone cement (cognitive).

Activities for Spine, Advanced Procedures, and Synthesis

These final activities introduce some basic spine procedures, explore analogous skills for advanced concepts like osteotomy and compartment syndrome, and culminate in a final reflective capstone exercise.

Activity	Theme	Primary VR Application(s) & Focus	Relevant ABOS Module(s) & Objectives	Estimated Time	Goals/Objectives
#18 ☐	Spine Navigation and 3D Spatial Awareness	**VR Applications:** Non Operative Spine & X360  	**Module 1: Patient Positioning; Module 9: Fluoroscopic Knowledge and Skills** Focus: Work with a prone-positioned patient. Place a spinal needle accurately into the L5-S1 disc space by interpreting simultaneous AP and lateral C-arm views to guide the needle tip in 3D space. X360 case 1 will allow you to explore the positioning and setup for a lateral patient.	45 minutes	• Be able to safely position patients in the prone, and lateral configurations. • Develop psychomotor skills to accurately navigate a wire/needle to a precise location using bi-plane fluoroscopic control. • Understand general and site-specific fluoroscopic anatomy.
#19 ☐	Pedicle Screw Fixation	**Primary VR Application:** CIOS Spin: Case 4	**Module 11: Techniques Basic to Internal Fixation of Fractures** Focus: Insert pedicle screws in a patient with hyperlordosis. Control the C-arm to obtain optimal "en face" views of the pedicle. Accurately guide the wire and subsequent screw down	60 minutes	• The ability to place screws in a precise location controlled by fluoroscopic control. • Assess position of hardware/surgical instruments fluoroscopically.

			the pedicle corridor, avoiding a breach.		
#20 ☐	Introduction to Bone Resection (Osteotomy Analogue)	**Primary VR Application:** Hip Arthroscopy: FAI 	**Module 8: Bone Handling Techniques - Osteotomy** Focus: Use a high-speed virtual burr to resect a cam lesion under arthroscopic guidance. Learn to control the burr to remove pathological bone while preserving healthy adjacent articular cartilage. The scoring mechanism penalizes removal of healthy bone.	60 minutes	• Understand the characteristics and techniques related to the instruments used for osteotomy (burr as an analogue). • Understand the technique to mitigate soft tissue trauma.
#21 ☐	Anatomic Landmark Identification for Joint Aspiration & Injection	**Primary VR Application:** BodyWorks Anatomy Studio 	**Module 16: Joint Aspiration and Injection** Focus: Use the virtual marker to identify and draw key anatomic landmarks for common joint injections (e.g., knee, subacromial space). Use the virtual spinal needle to simulate the correct trajectory and entry point for these injections, aiming for the virtual joint space. This reinforces 3D spatial awareness of joint anatomy.	45-60 minutes	• To demonstrate knowledge and drawing of anatomic landmarks for the shoulder, elbow, wrist, knee and ankle.

#22 ☐	Bootcamp Synthesis and Self-Reflection	**Primary VR Application:** None	Focus: Conclude the bootcamp with a structured self-reflection. Residents should review the catalogue of applications they have used. Using a personal log or a document, they should reflect on each key application, documenting: 1. The most significant skill or concept learned. 2. How the simulation changed their perspective on the procedure or anatomy. 3. An area of personal growth they recognized through the module.	60 minutes	• Synthesize knowledge gained across multiple foundational modules. • Perform a structured self-assessment of technical skill acquisition and identify areas of strength. • Articulate areas for continued practice and future learning. • Reflect on the role of simulation in developing surgical competence and patient safety.