VirtaMed ArthroS™
Module descriptions
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Module description

Nine motor skill training tasks on the FAST workstation guide the trainee through the first steps of arthroscopy. Basic camera navigation tasks include steadiness and image centering, horizon control and telescopyng as well as the use of different optics - using both left and right hand for camera handling as well as frontal and posterior access to the FAST shell. This very basic arthroscopy skills training also teaches periscoping. Trainees learn how to detect and center an object, probe and grasp static objects, and develop triangulation skills.

FAST – Fundamentals of Arthroscopic Surgery Training

The major American Orthopedic associations ABOS (American Board of Orthopedic Surgery), AAOS (American Academy of Orthopedic Surgeons) and AANA (Arthroscopy Association of North America) implemented a mandate in 2013 to further improve and standardize surgical education in the field of arthroscopy. They created a program called FAST (Fundamentals of Arthroscopic Surgery Training) which VirtaMed has now incorporated into the ArthroS™ surgical training simulator.

This virtual reality module is based on the Sawbones FAST workstation, which was developed with specifications and refinements from a team led by Robert Pedowitz, MD, PhD. The fusion of the Sawbones FAST dome with our virtual reality simulator offers exciting new training opportunities: surgeons can now practice the basic skills needed before they actually go on and perform complex knee or shoulder arthroscopies.

Learning objectives

- To control camera movements and to center an image
- To control image orientation (i.e. camera horizon)
- To perform basic triangulation
- To acquire steadiness of the camera and arthroscope
- To minimize unnecessary movements of the scope
- To develop ambidextrous motor skills
- To practice deliberate linear scope movements
- To track a moving target with the scope
- To correctly periscope, i.e. properly use the angled optics
- To find and grasp stationary targets
- To plan and perform deliberate object manipulation
Contributors
We would like to acknowledge the following experts who greatly contributed and helped to create the ArthroS FAST Module:
Prof. emeritus Robert A. Pedowitz

Instruments

| Arthroscope | Hook |

Grasper/Punch

Didactic module

General concepts of arthroscopy
- Equipment overview
- Imaging principles
- Clinical issues

Training cases

Image centering
- Ten VirtaTeds
- Visualize each VirtaTed for three seconds

Telescop ing
- Ten VirtaTeds with different perspective depths
- Visualize each VirtaTed for three seconds

Trace the lines
- Eight VirtaTeds moving on lines
- Center each VirtaTed and follow them on the lines
Trace the curve

- One VirtaTed, two laps
- Center the VirtaTed and follow it on the path

Horizon control

- Ten VirtaTeds
- Control the horizon of the camera for three seconds on each VirtaTed

Periscoping

- Ten VirtaTeds
- Visualize each VirtaTed for three seconds using the angled optics

Probe triangulation

- Ten VirtaTeds
- Visualize each VirtaTed for three seconds, while touching its center with the probe

Gather the stars

- Ten stars
- Grasp the stars and let them fall into the dish.

Stack the Blocks

- Align all the objects of different sizes and colors in the grid
- Maximum points: 40
Knee module
Basic skills, diagnostic, and surgical cases for knee arthroscopy

Module description
The module presents basic skills, diagnostic and surgical cases for knee arthroscopy, as well as didactic teaching slides. Nine guided basic skill training cases are fully integrated into a highly realistic simulation. Mastering these basic tasks enables trainees to perform a complete arthroscopy more easily and in an efficient, professional way. Eight patient cases with varying levels of difficulty offer the trainee the chance to perform complete diagnostic arthroscopic interventions. Patients include different meniscus lesions, unhappy triad and arthrosis grade I-III. 11 patients with various lesions in different locations provide training for the first steps in operative arthroscopy using the original operating equipment from the OR. Patients include different meniscus lesions, synovial membrane inflammations and loose body removal.

Learning objectives
▪ To navigate the camera in the knee joint
▪ To manipulate the knee joint to optimally visualize the retropatellar pouch and the medial knee joint
▪ To avoid unnecessary tool movements and unwanted contact with the cartilage surfaces in the joint
▪ To control two tools at the same time and to triangulate whilst avoiding cartilage damage
▪ To correctly use the following instruments: grasper, hook, punch and shaver

Instruments

- Arthroscope
- Hook
- Grasper/Punch
- Shaver
Contributors

We would like to acknowledge the following experts who greatly contributed and helped to create the ArthroS Knee Module:

Dr. Robert Burks (University of Utah), PD Dr. Sandro Fucentese and Dr. Stefan Rahm (Balgrist University Hospital Zurich), PD Dr. Peter Koch (Winterthur), Prof. emeritus Robert A. Pedowitz, Dr. Stephan Reppenhagen (König-Ludwig-Haus Würzburg), Prof. Dr. Michael Strobel (Sporthopaedicum, Straubing)

Didactic modules

General concepts of arthroscopy
- Equipment overview
- Imaging principles
- Clinical issues

Basic principles of knee arthroscopy
- Background and basics
- Diagnostic arthroscopy
- Therapeutic interventions

Basic skill cases

Guided Diagnostics I: Menisci
- Healthy right knee
- Step by step guided inspection of lateral and medial meniscus

Guided Diagnostics II: Knee
- Healthy right knee
- Step by step guided inspection of the entire knee

Guided Diagnostics and Palpation
- Healthy right knee
- Step by step guided inspection of the entire knee
- Learn to bring the probe to all relevant anatomical structures

Triangulation I
- Locate virtual spheres in the knee joint
- Touch all the spheres with the hook for two seconds

Triangulation II
- Locate the virtual rings in the knee joint
- Place the hook inside the rings for two seconds
Triangulation III
- Locate the virtual rings in the knee joint
- Place the hook inside the rings for two seconds

Catch the stars I
- Locate the virtual stars in the knee joint
- Use the grasper to remove the stars

Catch the stars II
- Locate the virtual stars in the knee joint
- Use the grasper to remove the stars

Guided Meniscectomy I
- Guided resection of a meniscus tear with guidance for each step
- Radial tear lateral meniscus

Guided Meniscectomy II
- Guided resection of a parrot beak meniscus tear supported by step by step instructions

Diagnostic cases

Diagnostic knee scope handling – teaching video
- Watch an expert performing a structured diagnostic knee arthroscopy
- Movie provided by Dr. R. Burks, University Salt Lake City, Utah

Pathology Unknown case
- Perform a diagnostic tour of a knee. The case will randomly select a patient example
- Discover and remember all abnormalities you observe
- Report the abnormalities discovered at the end of the diagnostic tour

Diagnostic I
- Healthy right knee
- Menisci can be palpated

Diagnostic II
- Flap tear in the lateral meniscus
- Tear can be palpated with the hook
Diagnostic III
- Bucket handle tear in the medial meniscus
- Tear can be palpated with the hook

Diagnostic IV
- Parrot beak tear in the medial meniscus
- Tear can be palpated with the hook

Diagnostic V
- Arthrosis Grade I
- Radial meniscus tear lateral meniscus and parrot beak tear medial meniscus

Diagnostic VI
- Arthrosis Grade III
- Radial meniscus tear lateral meniscus and parrot beak tear medial meniscus

Diagnostic VII
- Arthrosis Grade IV
- Radial meniscus tear lateral meniscus and parrot beak tear medial meniscus

Diagnostic VIII
- Unhappy triad
- Rupture of anterior cruciate and medial collateral ligaments
- Parrot beak tear medial meniscus

Diagnostic IX
- Medial side, Meniscus root tear

Diagnostic X
- Peripheral meniscus tear, medial compartment

Diagnostic XI
- Synovitis in the lateral recess
- Partial cartilage damage femoral and tibial side

Diagnostic XII
- Synovitis in suprapatellar pouch
- Partial cartilage damage femoral and tibial side
Diagnostic XIII
- Loose bodies

Diagnostic XIV
- Chondromalacia, partial damage to the retro patellar cartilage

Surgical cases

Meniscectomy I
- Lateral meniscus radial tear
- Remove damaged parts of the meniscus and smooth the borders with the shaver

Meniscectomy II
- Bucket handle tear in the medial meniscus
- Remove damaged parts of the meniscus and smooth the borders with the shaver

Meniscectomy III
- Parrot beak tear in the medial meniscus
- Remove damaged parts of the meniscus and smooth the borders with the shaver

Arthrosis Grade I
- Arthrosis grade I
- Radial tear lateral meniscus, parrot beak tear medial meniscus

Arthrosis Grade III
- Arthrosis grade III
- Radial tear lateral meniscus, parrot beak tear medial meniscus

Arthrosis Grade IV
- Arthrosis grade IV
- Radial tear lateral meniscus, parrot beak tear medial meniscus

Unhappy Triad
- Rupture of the anterior cruciate ligament and medial collateral ligament
- Parrot beak tear medial meniscus
Synovitis I
- Inflammations on the inner skin of the joint capsule
- Use the shaver to remove the synovitis

Synovitis II
- Inflammations on the inner skin of the joint capsule
- Use the shaver to remove the synovitis

Loose body removal I
- Find and remove two loose bodies floating in the joint with the grasper

Loose body removal II
- Find and remove the four loose bodies floating in the joint with the grasper
**ACL reconstruction (knee) module**

*Understanding mechanisms of ACL injury, reconstruction, and correct graft placement*

**Module description**

This module is for specialization in ACL reconstruction. Trainees learn how to navigate the 3D anatomy of the knee joint in relation to the relevant landmarks for ACL reconstruction and learn about the consequences and effects of graft malpositioning. Mastering correct graft positioning is paramount for safe and effective ACL reconstruction. There are six different learning cases for the ACL reconstruction module. The first two cases cover the main principles of ACL reconstruction and anatomical concepts, and the other four cases present therapeutic patient cases based on the different features and complications of ACL reconstruction surgery. The cases vary from complete ACL tear to partial rupture of the ACL.

**Learning objectives**

- To understand the mechanisms of ACL injury
- To identify and visualize anatomical landmarks using the scope and angled optics
- To locate correct grafting points for ACL reconstruction
- To manipulate the knee to access the femoral attachment site of the ACL
- To know how to place the tunnels for an anatomical ACL reconstruction
- To understand the consequences of typical graft malpositioning
- To correctly use the following instruments: grasper, hook, punch, tibia targeting tool, and shaver

**Instruments**

- Arthroscope
- Hook
Didactic modules

Principles of ACL reconstruction
- Learn basic ACL biomechanics
- Understand principles of ACL reconstruction
- Understand the mechanism of injury

Anatomical concepts
- Identify anatomical landmarks using scope and angled optics
- Understand the anatomical concepts and kinematics of the ACL
- Understand graft malpositioning consequences

Surgical cases

Guided ACL reconstruction I
- Complete ACL tear
- Patient in chronic state
- Step by step guided ACL reconstruction

ACL reconstruction I
- Complete ACL tear
- Patient in chronic state
- Trainee is free to choose sequence of procedure

ACL reconstruction II
- Complete ACL rupture
- Patient in subacute state
- Trainee is free to choose sequence of procedure

ACL reconstruction III
- Partial rupture of the ACL
- ACL is present, but knee is unstable
- Trainee is free to choose sequence of procedure
Shoulder module

Basic skill, diagnostic, and surgical cases for shoulder arthroscopy

Module description

Ten guided basic skill training cases fully integrated into a realistic simulation, as well as didactic teaching slides. Mastering these basic tasks enables trainees to perform a complete shoulder arthroscopy more easily and in an efficient, professional way. Ten different patients with varying level of difficulty offer the trainee the chance to perform complete diagnostic arthroscopic interventions. Patients include different lesions in rotator cuff and impingement syndrome. Seven patients with various lesions in various locations provide training for first steps in operative arthroscopy using original OR equipment. Patients include loose body removal, subacromial debridement and decompression.

Learning objectives

- To navigate the camera and the instruments in the glenohumeral joint and in the subacromial space
- To visualize the most important anatomical structures and to identify pathological conditions
- To get used to triangulation either in beach chair or in lateral decubitus position
- To control two tools at the same time and to triangulate whilst avoiding unnecessary tool movements and unwanted contact with the cartilage surfaces in the shoulder joint
- To perform different procedures

Instruments

- Arthroscope
- Hook
- Grasper/Punch
- Shaver
Contributors
We would like to acknowledge the following experts who greatly contributed and helped to create the ArthroS Shoulder Module:
Dr. Wolfgang Birkner (Rheinfelden), Dr. Robert Burks (University of Utah), Prof. Dr. Christian Gerber, Dr. Stefan Rahm and PD Dr. Karl Wieser (Balgrist University Hospital Zurich), Prof. emeritus Robert A. Pedowitz

Didactic modules

General concepts of arthroscopy
- Equipment overview
- Imaging principles
- Clinical issues

Basic principles of shoulder arthroscopy
- Background and basics
- Diagnostic arthroscopy
- Therapeutic interventions

Basic skills cases

Guided diagnostics glenohumeral
- Healthy right shoulder
- Guided inspection of glenohumeral joint

Guided diagnostics subacromial
- Healthy right shoulder
- Guided inspection of the subacromial space

Guided diagnostics and palpation
- Healthy right shoulder
- Guided inspection of the shoulder joint
- Learn how to bring the probe to all relevant structures

Guided 15 point shoulder examination
- Guided inspection of the healthy right shoulder joint
- Switch the scope from the posterior to the anterior portal to visualize the dorsal labrum and the subscapularis recess

Triangulation I glenohumeral
- Locate virtual spheres in the glenohumeral joint
- Touch all the spheres with the hook for two seconds
Triangulation II Subacromial
- Locate virtual spheres in the subacromial space
- Touch all the spheres with the hook for two seconds

Triangulation III Glenohumeral
- Locate the virtual rings in the subacromial space
- Place the hook inside the rings for two seconds

Triangulation IV Subacromial
- Locate the virtual rings in the subacromial space
- Place the hook inside the rings for two seconds

Catch the stars Glenohumeral
- Locate the virtual stars in the glenohumeral joint
- Use the grasper to remove the stars

Catch the stars Subacromial
- Locate the virtual stars in the glenohumeral joint
- Use the grasper to remove the stars

Diagnostic cases

Pathology Unknown case
- Perform a diagnostic tour of a shoulder. The case will randomly select a patient example
- Discover and remember all abnormalities you observe
- Report the abnormalities discovered at the end of the diagnostic tour

Diagnostic I
- Healthy right glenohumeral joint

Diagnostic II
- Healthy right subacromial space

Diagnostic III
- Acromion with bony hook
- Superficial rotator cuff tear
Diagnostic IV
- Superficial calcification of the rotator cuff
- Acromion with bony hook

Diagnostic V
- SLAP II lesion; detachment of the biceps tendon anchor system from the glenoid

Diagnostic VI
- Bankart lesion; detachment of the anterior inferior labrum from the glenoid

Diagnostic VII
- Complete rotator cuff tear
- Rupture of the supraspinatus tendon

15 Point shoulder examination
- Healthy right shoulder
- Switch scope to from the posterior to the anterior portal to visualize the dorsal labrum and the subscapularis recess

Surgical cases

Subacromial debridement
- Use shaver to debride soft tissue/bursitis from the subacromial space

Subacromial decompression I
- Locate the hook on the acromion
- Use acromionizer burr to resect the part of the acromion causing impingement

Loose body removal
- Locate the loose bodies in the glenohumeral joint
- Use the grasper to remove the loose bodies
Hip module
Basic skill, diagnostic, and surgical cases for hip arthroscopy

Module description

The ArthroS Hip module contains eight basic guided skill training cases fully integrated into realistic simulation. By mastering these tasks, trainees are more equipped to perform a complete hip arthroscopy. There are four different patients with varying levels of difficulty, which offer the trainee the chance to perform complete diagnostic arthroscopic interventions. The module features zero radiation fluoroscopy simulation for the trainee to practice how to access the hip joint and to learn to establish proper and safe portals. Patient cases include different lesions in the labrum and cartilage as well as a cam impingement. Two patient cases offer various lesions in various locations to provide training for first steps in operative arthroscopy using original OR equipment. Patient cases also include loose body removal, synovial debridement, and cam decompression.

Learning objectives

▪ To navigate the camera and the instruments in the central and peripheral aspects of the hip joint
▪ To visualize the most important anatomical structures and to identify pathological conditions
▪ To get used to triangulation either in supine or lateral position
▪ To control two tools at the same time and to triangulate whilst avoiding unnecessary tool movements and unwanted contact with the cartilage surfaces in the hip joint
▪ To learn how to establish a safe access to the hip joint using zero radiation fluoroscopy simulation

Instruments

| Arthroscope | Hook |
Guidewire

Contributors
We would like to acknowledge the following experts who greatly contributed and helped to create the ArthroS Hip Module:
Prof. Dr. Michael Dienst (OCM, Munich), Prof. Dr. Claudia Dora (Schulthess Klinik Zurich), Dr. Anil Ranawat (Hospital for Special Surgery, New York), PD Dr. Patrick Zingg (Balgrist University Hospital Zurich)

Basic skills cases

Guided diagnostics central
- Healthy left hip joint
- Guided inspection of the central compartment of the hip joint

Guided diagnostics peripheral
- Healthy left hip joint
- Guided inspection of the peripheral compartment of the hip joint

Triangulation I central
- Locate virtual spheres in the central compartment
- Carefully select the appropriate instrument portal to access the spheres
- Touch all the spheres with the hook for two seconds

Triangulation I peripheral
- Locate virtual spheres in the peripheral compartment of the hip joint
- Carefully select the appropriate instrument portal to access the spheres
- Touch all the spheres with the hook for two seconds
Triangulation II central
- Locate virtual rings in the central compartment
- Carefully select the appropriate instrument portal to access the rings
- Hook the rings with the probe and hold still for two seconds

Triangulation II peripheral
- Locate virtual rings in the peripheral compartment of the hip joint
- Carefully select the appropriate instrument portal to access the rings
- Hook the rings with the probe and hold still for two seconds

Catch the stars central
- Locate the virtual stars in the central compartment
- Carefully select the appropriate instrument portal to access the stars
- Use the grasper to remove the stars from the hip joint

Catch the stars peripheral
- Locate the virtual stars in the glenohumeral joint
- Carefully select the appropriate instrument portal to access the stars
- Use the grasper to remove the stars from the hip joint

Diagnostic cases

Diagnostic I
- Healthy left hip joint

Diagnostic II
- Labrum rupture

Diagnostic III
- Cam deformity of femoral neck

Diagnostic IV
- Cartilage flap on the acetabulum caused by cam impingement
Surgical cases

Loose body removal
- Locate the loose bodies in the hip joint
- Carefully select the appropriate portals for the grasper to access the loose bodies
- Use the grasper to remove the loose bodies

Cam decompression
- Locate the cam deformity on the femoral neck
- Use the burr to resect bone from the femoral neck until impingement is removed
- Bring the hip into flexion to control for success of the decompression
Ankle module
Basic skill, diagnostic, and surgical cases for ankle arthroscopy

Module description
The ArthroS Hip module contains six basic guided skill training cases fully integrated into realistic simulation. By mastering these tasks, trainees are more equipped to perform a complete ankle arthroscopy. There are five different patients with varying levels of difficulty, which offer the trainee the chance to perform complete diagnostic arthroscopic interventions. The module features supine and prone patient positioning as well as joint distraction capabilities. Patient cases include lesions in the cartilage as well as an impingement syndrome and loose bodies. Patient cases also interventional ankle arthroscopies including loose body removal and anterior decompression.

Learning objectives
- To navigate the camera and the instruments in the anterior and posterior aspects of the hip joint
- To visualize the most important anatomical structures and to identify pathological conditions
- To get used to triangulation either in prone or supine position
- To control two tools at the same time and to triangulate whilst avoiding unnecessary tool movements and unwanted contact with the cartilage surfaces in the ankle joint

Instruments

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<thead>
<tr>
<th>Arthroscope</th>
<th>Hook</th>
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<tr>
<th>Grasper/Punch</th>
<th>Shaver</th>
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Contributors

We would like to acknowledge the following experts who greatly contributed and helped to create the ArthroS Ankle Module:

Dr. John G. Kennedy (Hospital for Special Surgery, New York), Dr. Christoph Lampert (Orthopädie Rosenberg, St. Gallen), PD Dr. Dr. Andre Leumann (OrthoPraxis Leumann, Basel)

Basic skills cases

Guided diagnostics anterior
- Healthy left ankle joint
- Guided inspection of the anterior aspect of the ankle joint

Guided diagnostics posterior
- Healthy left ankle joint
- Guided inspection of the posterior aspect of the ankle joint

Guided diagnostics and palpation
- Healthy left ankle
- Step by step guided inspection of the entire knee
- Learn to bring the probe to all relevant anatomical structures

Triangulation I
- Locate virtual spheres in the anterior aspect of the ankle joint
- Carefully select the appropriate instrument portal to access the spheres
- Touch all the spheres with the hook for two seconds

Triangulation II
- Locate virtual rings in the anterior aspect of the ankle joint
- Carefully select the appropriate instrument portal to access the rings
- Hook the rings with the probe and hold still for two seconds

Catch the stars
- Locate the virtual stars in the anterior aspect of the ankle
- Carefully select the appropriate instrument portal to access the stars
- Use the grasper to remove the stars from the ankle joint
Diagnostic cases

Diagnostic I
- Healthy left ankle

Diagnostic II
- Osteochondritis on talus

Diagnostic III
- Bony impingement anterior

Diagnostic IV
- Posterior impingement

Diagnostic V
- Anterior soft tissue impingement

Surgical cases

Loose body removal
- Locate the loose bodies in the ankle joint
- Carefully select the appropriate portals for the grasper to access the loose bodies
- Use the grasper to remove the loose bodies

Anterior decompression
- Locate the deformity of the tibia on the anterior rim
- Use the burr to resect bone from the femoral neck until impingement is removed.