BIOMECHANICS RESEARCH DEPARTMENT
LABORATORIES
Our Biomechanics Research Department Laboratories are concentrat on several areas of research focus:
• Biplane Fluoroscopy
• Motion Analysis
• 6-Degree of Freedom Robotics
• Dynamic Testing
• Quantitative Anatomy
• In-Vivo Outcome Models

BioMotion Laboratory
The goal of the BioMotion Laboratory is to accurately measure the motions, forces and muscle activation patterns needed to perform sports activities and rehabilitation exercises in normal, injured, and treated patients. This information can be used to document the effectiveness of treatments such as surgery, physical therapy, or bracing and to help understand injury mechanisms in specific sports such as hockey, golf, soccer, tennis, and baseball. The lab consists of two general data collection areas: the sports performance area and the biplane fluoroscopy area.

Biplane Fluoroscopy System
We have a one-of-a-kind, patented, stereoscopic x-ray system able to assess bone motion inside a joint by recording x-ray movies at high speeds (up to 1000 frames per second) and high resolution (1024 x 1024 pixels) from two views. A highly accurate tool able to detect subtle three-dimensional effects of injury and surgical reconstruction on joint motion of patients while they perform a motion. Constructed from two synchronized C-arms (Philips Medical Systems) with 30 cm image intensifiers.

Sports Performance area
The sports performance area currently is designed as a hockey arena with commercial grade artificial ice and NHL grade dasher boards. However, the flooring is designed such that the artificial ice tiles can quickly be removed and replaced with any other sports surface such as artificial turf or sports court flooring, to assess sporting activities such as baseball, golf, tennis, and soccer.

Motion Capture System
Our 10-camera motion capture system (Motion Analysis Corp.) measures performance of sports movements and rehabilitation exercises and includes a 32-channel analog data collection module. Data analysis is performed on both Cortex (Motion Analysis Corp.) and The MotionMonitor (InnSport). The camera mounts are designed so that the focus area can be quickly switched between the sports performance and the biplane fluoroscopy area in order to focus on another part of the laboratory.

Force Plates
Two force plates (FP4060; Bertec) are incorporated into the floor of the sports performance area and mounted on a custom designed frame allowing for quick reconfiguration of the force plate for a particular sport. A third force plate is incorporated into the floor of the biplane fluoroscopy area.

EMG systems
The laboratory is equipped with an 8-channel bench top (Bagnoli-8, Delays) and a 16-channel wireless (MyoMonitor, Delays) EMG system integrated with the motion capture system. Both systems have surface and indwelling electrode capabilities.
Biomechanical Testing Laboratory
The goal of the Biomechanical Testing Laboratory is to advance patient care and set global standards in orthopaedic research. We are currently focused on validating novel surgical treatments and utilizing advanced research protocols using state-of-the-art research techniques and technologies.

Instron ElectroPuls E10000
Utilizing linear motor technology, this state-of-the-art ElectroPuls system is capable of running a range of testing conditions: slow-speed static to high-frequency dynamic tests at over 100 Hz. From evaluating the tensile strength of soft tissues to fracture mechanics, the ElectroPuls systems provide a superior axial and rotary testing platform. This device is capable of displacements and forces in independent or combined linear and rotational directions. This industry standard device will be used to test fixation strength, surgical procedures, and joint reconstruction techniques. Additionally, the Instron pneumatic wedge action grips that optimize testing conditions.

KUKA KR60
Our six-degree of freedom robot is highly accurate and repeatable. Utilizing force/torque control, and capable of large displacement motions which are executed with simultaneous control of measured forces. This provides a flexible tool for experimentation that can be used to duplicate clinical exams or optimize and validate surgical reconstruction techniques. Testing of cadaveric knees, shoulders, and hips will be our area of focus and expertise. Force and position feedback are repeatable with a force accuracy of 0.02% and a torque accuracy of 0.01% utilizing the ATI Industrial Automation multi-axis force/torque sensor system.

TruVidia HD In-light Camera
This in-light high definition camera captures and transmits razor sharp, true-to-life images with 1080 lines of resolution and 2 million pixels. TruVidia HD images are more than twice as clear as those available from standard definition cameras. This in-light camera provides an optimal condition for conducting anatomical studies and records HD video for surgical skills courses.

Tekscan K-Scan Joint Pressure Measurement System
The Tekscan K-Scan Joint Pressure Measurement System allows the researcher to view real-time pressure distribution (static or dynamic) in joint research, for playback and analysis with sampling rates of up to 100 Hz. K-Scan uses paper-thin pressure/force/contact area measurement sheets inserted within joints between adjacent articulating bones. The captured interface data provides a better understanding of how the articulating bones' contact surfaces function, articulate, and load.

Polhemus Liberty
The Polhemus Liberty 6 Degree-of-Freedom tracking technology is the fastest and most accurate electromagnetic tracker available. With scalable support for up to 16 sensors, it is the indisputable forerunner in tracking technology. The technology works in conjunction with the system's AC magnetics to deliver improved signal-to-noise ratios, and offers remarkable accuracy of 0.03mm root mean squared for X, Y and Z position and 0.15° root mean squared for orientation.
Machine Shop

Mechanical prototypes and testing apparatuses for our high level research are custom designed and built within this area. Capable of machining varieties of metal, plastic, and wood, this highly-functional shop has the capability of fabricating fixtures to support the ongoing research in the laboratory. Quick turnaround times for developing prototypes and customizing fixtures will ensure well-executed tests which will improve our success and throughput for our research.

Noteworthy shop machinery and their capabilities include:

- **Vertical Endmill** – This 9” x 42” manual mill provides the capability of machining a variety of shapes, slots, or grooves to be cut into materials with precision accuracy.
- **Lathe** – The 13” x 40” variable-speed manual lathe can produce an array of cylindrical or circular parts to be fabricated with precise diameter sizes, grooves, and custom shapes.
- **Drill Press** – This 18” drill press is used to create round holes and even screw threads for any type of material.
- **Bandsaw** – The 17” variable-speed bandsaw creates straight or curved cuts on a variety of materials.
- **Table Saw** – This table saw uses a 16” circular saw blade to quickly make straight and consistent cuts out of wood to a precise size.

Surgical Skills Laboratory

Our Surgical Skills Laboratory is an advanced training facility located on-site at the Steadman Philippon Research Institute. The laboratory provides a complete simulated operating room environment with up to 10 arthroscopy training stations. Each station has electricity, vacuum, water, and data capabilities easily accessible from a custom panel above the station. Each individual station is also wired for audio-visual connectivity with two flat screens located nearby in the same room and conference rooms to maximize the surgical skills learning environment.

**In Vitro Preparatory Room**

Adjoining the Surgical Skills Laboratory is our preparatory room, which includes ample storage for surgical tools and freezer space. The dishwasher aids in sanitizing equipment after use, while the stainless steel countertop and fume hood provide a safe and simple working space.

Conference Room

Conference rooms are available with audio-visual connectivity to the surgical dissection and adjoining surgical skills laboratory. Our conference rooms can accommodate up to 60 people for classroom style conferences 20 people for a board room style conference, and 12 people for a brief introduction of the day’s events prior to entering the adjacent laboratories. All of our conference rooms provide the ability to see up close and personal advanced dissections, a live surgical skills demonstration, or live surgery in our operating rooms.

Office Area

Our offices accommodate our research intern staff and visiting surgeons in a quiet space to enhance a collegial working environment.