# Contents

<table>
<thead>
<tr>
<th>Section</th>
<th>Page</th>
</tr>
</thead>
<tbody>
<tr>
<td>Mission</td>
<td>2</td>
</tr>
<tr>
<td>Our Primary Areas of Research and Education</td>
<td>3</td>
</tr>
<tr>
<td>Research Advisory Committee Meeting Co-Chairs</td>
<td>4</td>
</tr>
<tr>
<td>Research Advisory Committee</td>
<td>8</td>
</tr>
<tr>
<td>SPRI’s Dr. Johnny Huard Awarded Prestigious Kappa Delta Award</td>
<td>9</td>
</tr>
<tr>
<td>The Steadman Clinic Surgeons and Physicians</td>
<td>10</td>
</tr>
<tr>
<td>2017-2018 New Physicians and Collaborations</td>
<td>11</td>
</tr>
<tr>
<td>Joint Replacement: A New Frontier for The Steadman Clinic</td>
<td>12</td>
</tr>
<tr>
<td>Center for Regenerative Sports Medicine</td>
<td>14</td>
</tr>
<tr>
<td>Department of Biomedical Engineering</td>
<td>22</td>
</tr>
<tr>
<td>Center for Outcomes-Based Orthopaedic Research</td>
<td>28</td>
</tr>
<tr>
<td>Department of Imaging Research</td>
<td>32</td>
</tr>
<tr>
<td>2017-2018 Was Award Winning for SPRI</td>
<td>36</td>
</tr>
<tr>
<td>SPRI Partners in Forming First IOC Research Center in the United States</td>
<td>39</td>
</tr>
<tr>
<td>SPRI Promotes Global Collaboration</td>
<td>40</td>
</tr>
<tr>
<td>Creating a Legacy of Education</td>
<td>41</td>
</tr>
<tr>
<td>Sports Medicine, Orthopaedic Fellowships and International Scholarships</td>
<td>42</td>
</tr>
<tr>
<td>2017-2018 Sports Medicine Fellows</td>
<td>43</td>
</tr>
<tr>
<td>2017-2018 International Scholars</td>
<td>45</td>
</tr>
<tr>
<td>Publications and Presentations</td>
<td>47</td>
</tr>
<tr>
<td>SPRI Authorship Agreement for ALL Publications</td>
<td>74</td>
</tr>
<tr>
<td>Formal Proposal Format</td>
<td>Inside Back Cover</td>
</tr>
</tbody>
</table>
Dear Friends,

I am pleased to share our second edition of the Steadman Philippon Research Institute (SPRI) Orthopaedic Research Journal. A commemoration of the ground-breaking science being produced in Vail, Colorado, this publication will take you through key research highlights of the past eighteen months.

Recognized globally for our innovative research, SPRI is celebrating thirty years of leading-edge science in 2018. Our Center for Outcomes-Based Orthopaedic Research, Center for Regenerative Sports Medicine, Department of Biomedical Engineering and Department of Imaging Research are dedicated to finding cures and enhancing lives, for people all over the world.

Excitingly, SPRI began 2017 by moving into state-of-the-art, brand-new facilities within Vail Health Hospital. Originally located in the basement of the hospital, our labs moved up—including a brand-new Center for Regenerative Sports Medicine Lab and Biomotion Lab on the first floor, and Surgical Skills and Robotics Lab on the fourth floor, right beside the clinical offices of The Steadman Clinic. This has facilitated unprecedented collaboration between SPRI scientists and clinic physicians, accelerating our bench-to-bedside approach to research. The beginning of 2017 ignited a spark for SPRI, and the past eighteen months have been tremendously productive and rewarding.

Thank you for your continued support of Steadman Philippon Research Institute. Our skilled scientists and physicians, excellent research partners and invested community make the incredible work being done at SPRI possible.

Please join us for the Fourth Annual Vail Scientific Summit, August 19–21, 2018.

Respectfully yours,

Johnny Huard, Ph.D.
Chief Scientific Officer

Johnny Huard, Ph.D.
Chief Scientific Officer
Mission

Building on our legacy of excellence in orthopaedic sports medicine, SPRI is unlocking the secrets of healing, finding cures and enhancing lives through global leadership in regenerative medicine, scientific research, innovation and education.
Our Primary Areas of Research and Education

Steadman Philippon Research Institute (SPRI) is one of the most innovative orthopaedic and sports medicine research organizations worldwide. With extensive publications and awards, SPRI is a leader in independent institutions.

SPRI’s scientists and researchers work in the following departments:

**DEPARTMENT OF BIOMEDICAL ENGINEERING** enhances patient care by focusing on injury mechanisms and prevention, develops and validates novel surgical treatments and rehabilitation techniques, and teaches advanced research protocols using state-of-the-art biomedical research techniques and technologies.

**CENTER FOR OUTCOMES-BASED ORTHOPAEDIC RESEARCH** conducts evidence- or outcomes-based research using actual clinical data that aids both physicians and patients in making better and more informed treatment decisions.

**CENTER FOR REGENERATIVE SPORTS MEDICINE** focuses on the basic science of regenerative medicine and the translation of this research into practical orthopaedic treatments.

**IMAGING RESEARCH** develops and evaluates noninvasive imaging techniques of the joints for the purpose of directing and monitoring clinical treatment and outcomes, and to enhance the clinical relevance of biomechanics research.

**SURGICAL SKILLS LABORATORY** implements new surgical technologies and trains surgeons—including SPRI’s clinical fellows—in new techniques using high-tech equipment and tools.

**EDUCATION AND FELLOWSHIP PROGRAM** administers and coordinates the clinical fellowships and international scholars programs, hosts conferences and international academic meetings, produces and distributes publications and educational media, and organizes educational outreach programs in partnership with the local school district.

SPRI’s research is widely published in professional journals and presented both in the United States and internationally to educate peers interested in advancing the field of orthopaedics. SPRI’s elite fellowship programs attract top physicians from around the world to participate in its highly sought-after training programs. With a focus on bench-to-bedside research, SPRI scientists work closely with physicians at The Steadman Clinic to develop new treatments and techniques that can be translated to patient care.
Dr. Johnny Huard is a world-renowned scientist and serves as Chief Scientific Officer and Director of the Center for Regenerative Sports Medicine at Steadman Philippon Research Institute (SPRI) in Vail, Colorado. Dr. Huard also serves as the Distinguished Professor and Vice Chair for Research in the Department of Orthopaedic Surgery at the McGovern Medical School, University of Texas Health Science Center at Houston (UTHealth) since May 1, 2015. In addition, he is the Director of The Brown Foundation Institute of Molecular Medicine Center for Tissue Engineering and Aging Research at UTHealth in Houston, Texas. Prior to his position at SPRI and UTHealth, Dr. Huard held the Henry J. Mankin Professor and Vice Chair for Musculoskeletal Cellular Therapeutics and the Director of the Stem Cell Research Center in the Department of Orthopaedic Surgery at the University of Pittsburgh for 20 years. He also held appointments in Microbiology and Molecular Genetics, Bioengineering, Pathology and Physical Medicine and Rehabilitation, Pediatrics at the University of Pittsburgh Cancer Institute (UPCI) and the University of Pittsburgh. Dr. Huard was also the Deputy Director of Cellular Therapeutic Research at the McGowan Institute for Regenerative Medicine at the University of Pittsburgh.

In his current faculty position, Dr. Huard oversees over 25 individuals including medical, graduate and undergraduate students, post-doctoral researchers, basic science faculty and staff, clinical research fellows, and technical and administrative staff. He is the Chair of SPRI’s Research Advisory Committee (RAC) and also chairs the Vail Scientific Summit annual meeting each August. This year, there are over 40 speakers from around the world participating in the annual summit, “Regenerative & Translational Medicine: A Focus on Human Clinical Applications.”

Dr. Huard’s research laboratory focuses on the identification, characterization, and clinical applications of muscle-derived stem cells for the treatment of conditions including Duchenne muscular dystrophy (DMD); critical sized long bone and cranial bone injuries; acutely injured articular cartilage and articular cartilage damaged by osteoarthritis; compartment syndrome that involves injury to the muscles, nerves, circulatory, lymphatic system vasculature, etc.; infarct injured hearts and cardiomyopathy due to DMD. Much of Dr. Huard’s stem cell research has been used clinically (over 700 patients in Canada and the United States) for the treatment of urinary incontinence and myocardial infarction and is now part of a Phase III clinical trial. Having received 76 grants over the past 20 years and leading research on five federally funded grants, Dr. Huard has a proven history of extramural research and funding. Dr. Huard has authored over 360 manuscripts including peer-reviewed articles, review articles, invited papers, and book chapters for various high-profile scientific journals including Nature Cell Biology, Nature Biotechnology, Journal of Cell Biology, Journal of Clinical Investigation, Cell Stem Cells, and more. Dr. Huard and his research team have received over 80 awards including the Orthopaedic Society’s prestigious Kappa Delta Awards (Young Investigator in 2004 and Ann Doner Vaughan Award in 2018) and was also the recipient of the University of Pittsburgh’s Chancellor’s Distinguished Research Award. He has had 800 abstracts accepted for presentation at national and international conferences. Dr. Huard currently serves on multiple editorial boards of scientific journals and reviews numerous scientific papers for a wider variety of scientific journals in his area of expertise. He serves on numerous study review groups at the National Institutes of Health and the Department of Defense.
Dr. Marc J. Philippon is the Managing Partner at The Steadman Clinic and is one of the world’s leading orthopaedic surgeons. Dr. Philippon joined The Steadman Clinic in 2005 from the University of Pittsburgh Medical Center, where he served as Director of Sports Medicine/Hip Disorders Fellowship. He also was the Director of the University of Pittsburgh Medical Center’s Golf Medicine Program. Previously, Dr. Philippon was Chief of Orthopaedic Surgery at Holy Cross Hospital in Fort Lauderdale, Florida.

Dr. Philippon is recognized by his peers in U.S. News and World Report as being among the top one percent in the nation in his specialty.

Dr. Philippon is internationally known for performing joint preservation techniques utilizing arthroscopic hip surgery to treat painful joint injury in high-level athletes who constantly use powerful hip rotation. He has treated nearly 1,000 professional and Olympic athletes successfully, many of them returning to high performance, winning Olympic Medals, setting new NFL, NHL and MLB records and winning PGA tournaments. Dr. Philippon is a consultant to the NHLPA and the Royal Spanish Tennis Federation and to many professional and Olympic organizations. In addition, Dr. Philippon serves as a member and trustee for both the U.S. Ski and Snowboard Team Foundation and the United States Olympic and Paralympic Foundations. A frequent invited speaker at national and international sports medicine and orthopaedic meetings, Dr. Philippon has also authored many peer-reviewed scientific articles. He has performed surgery in fifteen different countries and has designed many instruments to improve surgical techniques in hip surgery. In 2017, he was honored as the 21st Robert K. Kerlan MD Memorial Lecturer at the Keck School of Medicine at the University of Southern California.

Dr. Philippon initially came to the United States as a student-athlete, playing NCAA soccer and tennis on an athletic scholarship. He earned his medical degree with an academic scholarship from McMaster University Medical School in Hamilton, Ontario, Canada in 1990, and completed his orthopaedic surgery residence at the University of Miami, Jackson Memorial Hospital in 1995.

Board-certified by the American Board of Orthopaedic Surgery, Dr. Philippon is an active member of many medical organizations. He is also a Fellow with the American Academy of Orthopaedic Surgeons and is a Master Instructor with the Arthroscopy Association of North America. Dr. Philippon is an elected member of the Herodicus Society and is a founding member of the International Society of Hip Arthroscopy (ISHA). He will serve as president of ISHA in 2018–2019.

In 2012, Dr. Philippon received an Achievement Award from the American Academy of Orthopaedic Surgeons in recognition of outstanding contributions to the profession of orthopaedic surgery. In 2016, he received the 1st Annual Joseph McCarthy Award for Achievement in Advancing Knowledge and Scholarship in Hip Joint Preservation. His recognition continues as the leading researcher and surgeon in hip preservation with the “Vinci” Sports Health Award from The Vincera Foundation in 2018.

Dr. Philippon lives in Colorado with his wife and three children. He enjoys spending time with his family and participating in sports such as cycling, skiing, ice hockey, swimming, and golf.
Robert F. LaPrade, M.D., Ph.D.
Orthopaedic Complex Knee and Sports Medicine Surgeon

- Partner, The Steadman Clinic
- Chief Medical Officer and Co-Director of the Sports Medicine Fellowship Program, Steadman Philippon Research Institute
- Research Advisory Committee Member, Steadman Philippon Research Institute

Robert F. LaPrade, M.D., Ph.D., is a complex orthopaedic knee and sports medicine surgeon and partner at The Steadman Clinic in Vail, Colorado. He serves as Chief Medical Officer and Co-Director of the Sports Medicine Fellowship Program and the Director of the International Scholars Program at Steadman Philippon Research Institute. He is also the Sports Medicine Committee Chair for the International Society for Arthroscopy, Knee Surgery, and Orthopaedic Sports Medicine (ISAKOS) and is on the board of directors of the Vail Valley Surgery Center. Dr. LaPrade is on the Editorial Board of the American Journal of Sports Medicine (AJSM) and Knee Surgery, Sports Traumatology, Arthroscopy (KSSTA). Dr. LaPrade is known as one of the few specialists with extended expertise in the three main areas of medicine: clinical expertise, a lauded researcher and an outstanding educator.

Dr. LaPrade is recognized as one of the top knee surgeons in the world. Often referred to as a “doctor’s doctor,” he has specialized skills and expertise in diagnosing and treating complicated knee injuries and previously failed surgeries. He has treated athletes at all levels, including Olympic, professional (football, soccer, basketball, ice hockey, baseball, lacrosse, etc.), semi-professional and intercollegiate athletes and has returned many athletes back to full participation both after treating their new injuries or previous failed knee surgeries. Dr. LaPrade has special expertise in treating posterolateral knee injuries, PCL tears, knee dislocations, revision ACL reconstructions, meniscal transplants, MCL injuries, knee osteotomies, fresh osteoarticular allografts, articular cartilage resurfacing procedures, complex patellofemoral instability and other difficult combined and revision injuries.

Selected as “One of the Best Doctors in America” and “One of the Most Compassionate Doctors,” Dr. LaPrade is passionate about treating sports medicine injuries and is recognized for his outstanding and specialized surgical skills. Dr. LaPrade is known as a super-specialized clinician scientist who has utilized his vast and comprehensive research on sports medicine injuries to improve patient care and invent new ways to treat knee problems. Many of the surgeries that he has invented have been performed worldwide and are recognized as the gold standard for the treatment of many complex knee surgeries.

As one of the world’s most celebrated complex knee surgeons and clinical scientists, Dr. LaPrade has published more than 350 peer-reviewed scientific manuscripts, has over 12,000 citations and 125 book chapters, and has given over 1,000 professional presentations, symposia, grand rounds and instructional course lectures. He has received many awards for his research, including the OREF Clinical Research Award, considered akin to a Nobel Prize in orthopaedics, and his research team has been awarded the AOSSM Excellence in Research Award three times since 2009, the Achilles Award from ISAKOS twice, and the Cabaud Memorial Award from AOSSM. Dr. LaPrade is the most published author in the top cited orthopaedic journal, the American Journal of Sports Medicine (AJSM), with over 130 articles in AJSM alone. He is the sole author of the only comprehensive textbook on posterolateral knee injuries and has been the editor for several sports medicine textbooks. Dr. LaPrade is recognized as a pioneer in knee research, with many referrals from internationally and nationally recognized physicians because of his successful patient outcomes and his development of more effective surgical techniques for the reconstruction of complex knee injuries.

Recognized internationally as an outstanding teacher, Dr. LaPrade’s Vail International Complex Knee Course is considered to be the top international complex knee course. He has hosted several hundred sports surgeons who have observed his practice in Vail to learn clinical exam and surgical techniques. Dr. LaPrade has served as the Course Chair of national and international sports medicine and biologics related courses and has been a true mentor by involving many former SPRI fellows as faculty for these courses. He has been awarded several teaching awards, including three annual teaching awards given by the fellows at The Steadman Clinic Sports Medicine Fellowship program.
Peter J. Millett, M.D., M.Sc., is a partner at The Steadman Clinic who specializes in disorders of the shoulder, knee, elbow and sports-related injuries. Dr. Millett is a researcher and board member at Steadman Philippon Research Institute. Consistently selected as one of the “Best Doctors in America,” Dr. Millett has been ranked in the top one percent of orthopaedic surgeons by U.S. News and World Report.

As a shoulder and sports medicine specialist, Dr. Millett has treated elite athletes from the NFL, NBA, MLB, NHL, PGA, Formula One, X-Games and the Olympics. Dr. Millett is a member of the American Orthopaedic Society for Sports Medicine, the American Shoulder and Elbow Surgeons, the Orthopaedic Research Society, the Arthroscopy Association of North America, the German Arthroscopy Association, the Sports Council and the Herodicus Society. Dr. Millett was recently honored by being an invited keynote speaker at the German Shoulder and Elbow Society, where he was also made an honorary member. Dr. Millett was also honored as the keynote speaker for the British Shoulder and Elbow Society.

Among other journals, Dr. Millett serves on the editorial board of the prestigious journals, American Journal of Sports Medicine, Arthroscopy and the Journal of Shoulder and Elbow Surgery. Dr. Millett has authored over 200 peer-reviewed scientific papers and three books on orthopaedic surgery and is renowned for his work on double-row rotator cuff repair, AC joint injuries, shoulder instability and the arthroscopic treatment of glenohumeral osteoarthritis. As an innovator, Dr. Millett also has a number of patents for his inventions.

As an educator, Dr. Millett has been very involved in medical education training residents, medical students and fellows. During his career, he has trained over eighty fellows from the United States and abroad.

Dr. Millett attended the University of Scranton in Scranton, Pennsylvania and Dartmouth Medical School in Hanover, New Hampshire. While studying skeletal biology at the University of Cambridge in England, Dr. Millett earned a Master of Science (M.Sc.) degree. He completed his orthopaedic residency at Hospital for Special Surgery and Cornell University Medical Center in New York City. After a fellowship in shoulder, knee and sports medicine in Vail with Steadman Philippon Research Institute, Dr. Millett joined the faculty at Harvard Medical School, working with Professor Jon J.P. Warner. While at Harvard, Dr. Millett had a busy clinical practice and was active academically, teaching Harvard orthopaedic residents and medical students and serving as the Co-Director of the Harvard Shoulder Service and Shoulder Fellowship. While in Boston, he also started the Musculoskeletal Proteomics Research Group. In 2005, Dr. J. Richard Steadman of The Steadman Clinic and Steadman Philippon Research Institute recruited Dr. Millett to return to Vail to join the Clinic and Institute.
Research Advisory Committee

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Director, Center for Regenerative Sports Medicine
Chairman, Research Advisory Committee
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Vail, Colo.

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Chief, Shoulder Surgery Service
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Ferguson Professor and Director
Musculoskeletal Research Center
University of Pittsburgh
Pittsburgh, Penn.
SPRI’s Dr. Johnny Huard Awarded Prestigious Kappa Delta Award
A Tribute by Dan Drawbaugh, CEO of SPRI and The Steadman Clinic

Johnny Huard, Ph.D., Chief Scientific Officer and Director of the Center for Regenerative Sports Medicine at Steadman Philippon Research Institute, was honored to receive the prestigious 2018 ORS (Orthopaedic Research Society) Kappa Delta Ann Doner Vaughan Award on March 8, 2018.

Since Dr. Marc Philippon recruited Dr. Johnny Huard to Vail a few years ago, we’ve gotten to know Johnny as not just a world-class scientist, but as someone who is fueled by a personal mission to improve people’s lives. His work is generating significant advancements in regenerative medicine. All of us at Steadman Philippon Research Institute are gratified to see Dr. Huard and his staff recognized for the groundbreaking research they have accomplished over the years and recently in our laboratories in Vail.

Seventy-two years ago at its golden anniversary, the Kappa Delta Sorority announced the establishment of the Kappa Delta Research Fellowship in Orthopaedics. The Kappa Delta Awards are the first awards created to honor achievements in the field of orthopaedic research, and they are exclusively presented to people who have performed high-impact research that has had a tremendous effect on the field of orthopaedics.

Dr. Huard is not a stranger to these prestigious awards. In 2004, he was awarded the Kappa Delta Young Investigator Award for his discoveries of muscle-derived stem cells (MDSCs). This discovery was revolutionary, and for many, could be considered a top achievement in a career.

But Dr. Huard did not peak as a young investigator.

Instead, Dr. Huard has continued to expand and grow in his focus, studying regenerative medicine with MDSCs, isolating MDSCs, the biology of MDSCs, promoting angiogenesis for tissue repair, blocking angiogenesis for the repair of non-vascularized tissues, investigating stem cell depletion during aging, parabiotic pairing between normal and diseased mice, pregnancy as a form of parabiotic pairing, and of course, orthobiologics. And those are just some of the highlights of his career in research.

Dr. Huard’s Kappa Delta Award is considered a lifetime achievement award for orthopaedic research. In twenty-five years, he’s certainly achieved a lot.

Perhaps what is even more special about Dr. Huard’s lifetime achievement award is that we all know there’s so much more he’s going to achieve in his lifetime.

Congratulations to Dr. Johnny Huard on a tremendous accomplishment.
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<tr>
<th>Name</th>
<th>Specialization</th>
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<tr>
<td>Marc J. Philippon, M.D.</td>
<td>Managing Partner, Sports Medicine, Hip Disorders, Hip Arthroscopy</td>
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<td>Randy W. Viola, B.A., M.D.</td>
<td>Hand, Wrist, Elbow and Orthopaedic Trauma Specialist</td>
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<tr>
<td>Donald S. Corenman, D.C., M.D.</td>
<td>Spine and Neck Specialist</td>
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<tr>
<td>David C. Karl, M.B.A., M.D.</td>
<td>Spine, Sports and Regenerative Medicine Specialist</td>
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<td>Tom R. Hackett, M.D.</td>
<td>Knee, Shoulder and Elbow Surgeon</td>
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<td>Peter J. Millett, M.D., M.Sc.</td>
<td>Shoulder, Knee and Elbow Surgery, Sports Medicine</td>
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<tr>
<td>Thomas O. Clanton, M.D.</td>
<td>Foot and Ankle Sports Medicine</td>
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<td>Complex Knee and Sports Medicine Surgeon</td>
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<td>Hip Disorders; Preservation, Replacement and Fractures</td>
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<td>C. Thomas Haymanek, Jr. M.D.</td>
<td>Foot, Ankle and Trauma Surgery</td>
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In 2017, the teams at SPRI and The Steadman Clinic welcomed four new physicians to the organization: Dr. Raymond H. Kim, an adult joint reconstruction and knee and hip arthroplasty specialist; Dr. David A. Kuppersmith, an internal medicine physician, Dr. Joel M. Matta, a hip disorder specialist focused on preservation, replacement and fracture repair; and Dr. C. Thomas Haytmanek, a foot, ankle and trauma surgeon.

With the arrival of Dr. Kim and Dr. Matta, The Steadman Clinic expanded its orthopaedic offerings to include arthroplasty—full joint replacement—which will also translate to new research projects within SPRI. Both Dr. Kim and Dr. Matta will mentor adult reconstruction clinical fellows in the 2018-2019 class year.

In his role as The Steadman Clinic’s internal medicine physician, Dr. Kuppersmith works with a tremendous number of patients and collaborates across all clinical teams. His arrival to the organization has filled a previous absence in the clinic, as patients no longer have to seek an internist from outside of the clinic.

A former SPRI fellow, Dr. Haytmanek is the newest arrival to The Steadman Clinic. His arrival doubles the foot and ankle team, both in terms of clinical practice and research. Dr. Haytmanek’s research projects include hindfoot fusion nails, total ankle arthroplasty and cartilage repair. He and Dr. Thomas O. Clanton will mentor two foot & ankle clinical fellows in the 2018-2019 class year.

In 2018, SPRI began a collaboration with a renowned professor from Colorado State University. Working on her sabbatical with CRSM since January 2018, Nicole Ehrhart, VMD, MS, Diplomate ACVS is a professor in orthopaedic oncology at the Flint Animal Cancer Center and holds the Ross M. Wilkins MD Limb Preservation Foundation University Chair in Musculoskeletal Biology and Oncology. Dr. Ehrhart is also the Director of the Laboratory of Comparative Musculoskeletal Oncology and Traumatology and has been actively involved in limb preservation research, regenerative medicine, tissue engineering and sarcoma research for 18 years. She holds joint faculty positions in the School of Biomedical Engineering, the Cell and Molecular Biology program, the Gates Regenerative Medicine Center at the University of Colorado and The University of Colorado Cancer Center. In addition to her research, she has held several leadership positions in the American College of Veterinary Surgeons (Scientific Program Chair, Residents Forum Chair, and Examination Committee), Veterinary Society for Surgical Oncology (President), Veterinary Orthopedic Society (President) and Chair of the 2014 World Veterinary Orthopaedic Congress Organizing Committee. She is the first woman to be granted a University-Level Endowed Chair position at Colorado State University. She is actively engaged in translational bone and muscle regeneration research benefiting both human and canine patients. Since joining CRSM, Dr. Ehrhart has played a key role in introducing an academic setup in the department. Dr. Ehrhart helped submit SPRI’s first NIH R21 research proposal in collaboration with Colorado State University. She has successfully secured a philanthropic gift for CRSM and was instrumental in establishing CRSM’s journal club. She has been a vital research partner for SPRI.
Prior to Dr. Raymond Kim and Dr. Joel Matta joining The Steadman Clinic in 2017, The Steadman Clinic did not offer total joint replacement as one of its many orthopaedic procedures. The arrival of these doctors not only benefits the organization, but also directly benefits the clinic’s patients—more patients can be helped with their specific needs. Dr. Matta is a hip disorder specialist, focusing his practice on preservation, replacement and fractures, and Dr. Kim is an adult joint reconstruction specialist, focusing his work on knee and hip arthroplasty.

HIP SURGERY RESEARCH AND THE CLINICAL PRACTICE OF JOEL MATTA, M.D.

The Matta team is focused on surgical treatment of adult hip problems, including hip preservation surgery, primary and revision Anterior Approach Total Hip Arthroplasty and treatment of sequela of traumatic hip problems. Several projects related to Anterior Approach Total Hip Arthroplasty (THA) and facilitating technology are underway at SPRI, which center upon improving understanding and accuracy of acetabular cup position (anteversion and inclination) in the pelvis. For decades surgeons have been relying on direct visualization during surgery and then make direct measurements off of plain XR. However, both of these methods are imprecise or inaccurate. The team is working on three projects to not only increase awareness of these historical problems, but to also show how effective modern computer navigation methods are.

To do so, Dr. Matta and his team have reworked some mathematical formulas that calculate the true anatomic position of the acetabular component. These formulas are mathematical proofs that delineate the discrepancies between historical and the novel computer guidance technique. These proofs have enabled the team to create simple graphs that can be used easily to convert data from conventional methods to the correct anatomic data. The researchers have also created a national survey to assess how surgeons evaluate acetabular cup position and how well surgeons can evaluate cup position. JointPoint™ is one of the computer navigation programs developed to assist in surgery for THA cup placement. The team is studying observer inter-reliability and intra-observer reliability of the software, hoping to show that software is an effective and reproducible technique that surgeons can rely on for acetabular cup placement.

The Matta team is also studying how to assess femoral offset. Recreating the biomechanics of the hip during a THA is fundamental for a patient to have an excellent result, and having the correct femoral offset is a large part of that goal. Traditionally, evaluating the femoral offset consistently without advanced imaging has been difficult. The team is defining landmarks on the greater trochanter of the femur, and these newly described “lines” on an XR of the hip allow surgeons to quickly evaluate offset intraoperatively using fluoroscopy.

This project is defining these landmarks and also studying their relationship to femoral version, which is related to femoral offset on XR evaluation.

The supine position on the radiolucent orthopedic table used with Anterior Approach THA makes use of software enhanced radiography efficient and repeatable. Dr. Matta’s hope is to continue to make hip surgery more successful and to provide surgeons with tools that they can use to improve their individual results and precision.

The team is also beginning a clinical review of the consecutive series of Anterior Approach THA performed by Dr. Matta in over 4,000 hips over the past 22 years.

RAYMOND H. KIM, M.D., AND JOINT REPLACEMENT RESEARCH

Dr. Raymond H. Kim joined The Steadman Clinic to build The Steadman Clinic Joint Replacement Institute and to serve as the Medical Director for the Vail Health Total Joint Service Line. The Steadman Clinic Joint Replacement
Institute specializes in outpatient knee and hip replacements. Since starting the joint replacement program, Dr. Kim has performed over 1,000 joint replacements, half of these being performed as outpatient procedures. Much of the success of the outpatient joint replacement program is based upon Dr. Kim’s research including these recent studies:


Metal Artifact Reduction Sequence MRI Abnormalities in Asymptomatic Patients with a Ceramic-on-Polyethylene Total Hip Replacement. Jennings JM, Martin JR, Raymond H. Kim, Yang CC, Miner TM, Dennis DA. J Bone Joint Surg Am. 2017; Apr 5; 99(7): 593-598.


The focus of the Center for Regenerative Sports Medicine (CRSM) is to understand basic stem cell biology and translate that knowledge to the clinic to aid in the healing and regeneration of a variety of tissues. The team concentrates on gene therapy, tissue engineering and regenerative medicine applications based on the use of muscle-derived stem cells (MDSCs) and adipose-derived stem cells (ADSCs).

CRSM's internationally diverse group of investigators focus their attention on a variety of areas of specialization using MDSCs and ADSCs including Duchenne muscular dystrophy, critically sized long bone and cranial defects, acutely injured and osteoarthritic articular cartilage lesions, injured ligaments and meniscal tears, compartment syndrome in injured limbs involving damage to the muscles, nerves, circulatory, and lymphatic system vasculature and infarct injured and cardiomyopathic hearts.

The team continues to investigate a variety of agents to prevent the formation of fibrosis and promote angiogenesis following muscle injuries and disease. In addition, the team's orthobiologics research—including platelet-rich plasma (PRP) and bone marrow concentrate (BMC)—is helping to refine these treatments for clinical applications.
Achievements

Dr. Huard and his research team have published more than 360 peer-reviewed papers and 82 book chapters and have produced 800 abstracts. In 2017 and the first half of 2018, the team produced over 35 research articles, and 75 posters and research presentations.

Dr. Huard has received 85 awards, 12 noted honors and covers, 13 finalists and nominees thus far. In 2017, he received 2287 citations and in the first half of 2018, Dr. Huard received 1178, totaling 33,892 overall in his publishing career. Dr. Huard’s h-index is 98 with an i10 index of 319.

In March 2018, Dr. Huard was presented with the prestigious Kappa Delta Ann Doner Vaughan Award for 25 years of high-impact research and discoveries in the field of orthopaedics. This monumental achievement is akin to a lifetime achievement award and builds upon Dr. Huard’s notable career as a researcher and scientist.

ONGOING PROJECTS

With an enduring focus on translational regenerative medicine, CRSM continues to investigate basic science studies that will have direct impact on orthopaedic care. The team’s emphasis on exploring orthobiologics includes ongoing work on optimizing platelet-rich plasma (PRP), the efficacy of bone marrow concentrate (BMC) and delivering biologics and drug therapy via microspheres and much more. The team is involved in multidisciplinary projects that research future clinical translation of muscle-derived stem cells (MDSCs) and adipose-derived stem cells (ADSCs).

CRSM works with the other SPRI departments to build comprehensive research studies, including analyzing clinical outcomes with the Center for Outcomes-Based Orthopaedic Research (COOR) and conducting anatomical and biomechanical studies with the Department of Biomedical Engineering. This multifaceted approach will ultimately help physicians diagnose and treat orthopaedic injuries and diseases.
As true pioneers in microsphere technology, the University of Wisconsin scientists produce the biomimetic microspheres and send them to SPRI for continued research. Once at CRSM, the team creates a model consisting of MDSCs and human umbilical vein cells. As the cells transform and multiply in a petri dish in the lab, the microspheres bond to them and regulate cellular changes.

Since the research project began, the scientists have found that the microspheres process can eliminate detrimental factors in the blood that impede healing. This important discovery suggests that using microsphere therapy with microfracture surgery will help cartilage heal and repair much faster than with surgery alone.

NEW PERSPECTIVE ENHANCES APPROACH TO CARE

The CRSM team continues to conduct this vital research on microsphere therapy, both looking ahead toward the potential applications in orthopaedic procedures and looking back at the legacy of techniques pioneered by The Steadman Clinic’s physicians and validated through SPRI. The team’s microsphere studies extend beyond cartilage research and include investigating a variety of agents, including losartan, suramin, relaxin and decorin to prevent the formation of fibrosis and promote tissue regeneration. With the goal of translating these therapies into patients, CRSM endeavors to conduct clinical trials and seek FDA approvals.
Enhancing Cartilage Regeneration

Knowing that the FDA-approved drugs Avastin and Losartan eliminate growth factors in the tissue repair process, Dr. Huard and his team have investigated the application to joints. In using Avastin and Losartan, the team discovered that the drugs blocked the factors that hampered cartilage growth, by blocking angiogenesis and fibrosis. These findings were validated in animal models with chondral defects.

After this promising research, the CRSM team is considering whether infusing Avastin and Losartan with microspheres could produce even better outcomes. For this ongoing research, a concentrate will be injected into the injured knees of several animal models. The technique of using Avastin and Losartan could promote healing because of the sustained drug release, but the team will explore if taking the drug alone or through the microsphere process boosts healing the most.

Optimizing Platelet-Rich Plasma (PRP)

Clinicians and scientists have used PRP for treatment and research for years, but the biologic therapy has not been without its drawbacks. With no storage solution to maintain PRP’s biological activity, patients have had to be treated within 24 hours of draw.

The CRSM team has investigated whether freezing PRP effectively stores it for safe future use. The team drew samples from 25 healthy donors and prepared two different types of PRP—Leukocyte-rich PRP with elevated white blood cells for treating damaged soft tissues and Leukocyte-poor PRP with fewer white blood cells for treating joint injury. After drawing, the biological factors in the two PRP preparations were analyzed and the remaining samples were frozen and stored at -80 degrees Celsius. The frozen PRP samples were tested at different times to determine if freezing impacted the factors in the two preparations. The research team found that freezing had influenced biological factors within the two PRP preparations compared to fresh samples. The team will further investigate approaches to minimizing the detrimental impact of freezing on PRP preparations for optimal clinical uses.

While studying in vitro models, CRSM will also study the effect of freezing PRP for longer periods of time to determine its biological potential. Knowing that younger people have more regenerative cells, this research could encourage people to bank and freeze their PRP at a young age and use the healing therapies years later, when needed.
Bone Marrow Concentrate (BMC) Combats Hip Osteoarthritis

With 1 in 4 adults over the age of 50 affected by osteoarthritis, CRSM researchers and physician investigators are exploring innovative musculoskeletal treatments to diminish hip pain and functional limitations caused by the debilitating joint disease. With Steadman Clinic physician Thos A. Evans, MD as primary investigator, CRSM is working on concentrating the regenerative factors of bone marrow to harness its biological potential.

Twenty-four patients suffering from hip osteoarthritis participated in a clinical study, undergoing a single BMC injection. The marrow was extracted from each patient’s pelvic bone with a needle and syringe, and was processed via centrifuge to create the aspirate concentrate.

In collaboration with the Center for Outcomes-Based Orthopaedic Research (COOR), pain scores and hip function data following patient procedures occurred at one-month, three-month and six-month intervals. As early as three weeks after their injections, patients reported significant reduction of hip pain, which continued to improve through their six-month follow-ups.

Philanthropy and Grants

Since the beginning of 2017, CRSM has been awarded 12 major philanthropic gifts and 4 new grants, in addition to continued funding of 4 other grants. The new grants include:

**National Institutes of Health**, “Biomimetic Coacervate Delivery of Muscle Stem Cells to Improve Cardiac Repair”

**Musculoskeletal Transplant Foundation (MTF)**, “Can We Improve Meniscal Healing in the Avascular Zone? Fibrin Clot Augmentation with Stem Cells and Anti-Fibrotic Drugs”

**National Institutes of Health**, “Muscle Stem Cells Reprogrammed Through Genome Engineering for Autonomously Regulated Anti-Fibrotic Therapy”

**National Institutes of Health**, “Effects of Circulating Factors and Progenitors on Wound Healing during Pregnancy”
The commonly used stain, hematoxylin and eosin, showing regeneration of damaged muscle tissue.

Image showing muscle-derived stem cells transformed into cartilage upon treatment with bone morphogenic protein-9.

Image showing a large blood vessel in ulnar collateral ligament tissue stained for progenitor marker and smooth muscle.

Image showing the expression of platelet-derived growth factor receptor alpha, which has an important role in organ development and wound healing.

Image showing the expression of platelet-derived growth factor receptor alpha, which has an important role in organ development and wound healing.

Adipose/Fat derived stem cells (ADSCs) accumulating fat droplets and transformation into mature fat cells. These stem cells are believed to have greater impact on better aging and clinical implications.

Transfection, a method used to transfer genetic material into cells and make the DNA/RNA function inside the cells. Picture showing the gene expression.
Sabrina also worked with characterizing and studying biomarkers in synovial fluid of patients with ACL tears and worked with a veterinarian at Colorado State University to identify and measure systemic markers and biological ailments that are influenced by volumetric muscle loss repair. These changes could be utilized as a non-invasive tool to monitor muscle healing.

After making an impact in the orthopaedic and regenerative medicine world, Sabrina has accepted a graduate assistant position for the Minnesota State University volleyball team where she will pursue a master’s degree in exercise physiology while coaching NCAA volleyball.

MATTHEW POTTER
As a research technician, Matthew Potter investigated adipose-derived stem cells and their regenerative medicine applications, specifically in relation to aging. During his time at SPRI, Matthew refined his molecular biology laboratory techniques and helped to shape the direction of CRSM research projects with the support and guidance of the studies’ principle investigators.

After his dedicated research to regenerative medicine at SPRI, Matthew has begun medical school at the Medical College of Georgia where he plans to incorporate a career in research alongside his clinical pursuits.

Matthew is the second investigator that departed CRSM to join a medical school, following Andi Liebowitz, one of the first research technicians to join CRSM in 2015. She is now attending medical school at Columbia University. The CRSM team is very proud to educate and produce the next generation of scientists and medical doctors.
ProofPoint Biologics

A unique bridge between clinical and research practices, ProofPoint Biologics was founded in 2017. With a focus on an evidence-based biologics approach, ProofPoint’s work with CRSM includes collecting a research sample from each clinic patient receiving PRP and BMC treatment. The de-identified samples are beneficial to research efforts for several reasons. First, the collected samples allow scientists to develop a biobank to improve the understanding of PRP and BMC’s biological composition and potential. In investigating these patient samples, scientists can also validate and optimize PRP and BMC, which ultimately helps to refine these biologic treatments for their best clinical applications.

An experienced CRSM researcher, Kaitie Whitney joined ProofPoint Biologics as a Research and Development Senior Researcher. In this role, Kaitie leads several research projects focused on studying the biological and clinical effects of autologous biologics including PRP and BMC. As these therapies show enormous promise for various musculoskeletal conditions, further research is warranted to fully harness their biological potential. Under CRSM, ProofPoint Biologics is on the forefront of research by conducting translational, evidence-based clinical research to develop, optimize and validate clinical applications of PRP and BMC therapies. Kaitie’s research is made possible through the distinctive partnership between ProofPoint Biologics, The Steadman Clinic and SPRI’s Center for Regenerative Sports Medicine. As Chief Scientific Officer of SPRI, Dr. Huard oversees ProofPoint Biologics and works closely with Kaitie Whitney and Kelly Adair (SPRI COO) to optimize the evidence-based biologics approach of ProofPoint Biologics.

Conferences

The third Annual Vail Scientific Summit took place in August 2017 in Vail, Colo. The continued focus of the summit is to not only share science, but to also spark collaborations with other scientists and clinicians from all over the world. More than 60 speakers joined the third iteration of the Vail Scientific Summit, making it a landmark event for SPRI.

Education and Public Outreach

CRSM’s technical staff continued their engagement with the Education and Public Outreach (EPOC) programs by participating in laboratory tours and working on intensive research projects with local Eagle County high school students. As mentors, the staff taught the students how to design and execute their own research experiments.

Collaborative Efforts

CRSM has continued its musculoskeletal collaborations with the Mike Shannon Network—working with Northwestern University and the Mayo Clinic—and the Steven Read Network, through which the team is working with the University of California, San Francisco on next generation microfracture research. This year, the CRSM team also launched an industrial collaboration with Celltex on the biological and regenerative medicine application of adipose-derived stem cells.

Additional philanthropic funding from generous benefactors has allowed CRSM to study innovative therapies for cartilage repair, better aging through adipose-derived stem cells, gene editing and Duchenne muscular dystrophy, rotator cuff repair, characterizing stem cell populations, anti-aging drugs and stem-cell-based therapies for ACL repair.

Dr. Huard and his team continued their collaboration with UTHouston Orthopaedics, working on a variety of studies focused on improving the care of musculoskeletal conditions and boosting the body’s natural healing powers.

Projections

Thanks to a philanthropic gift, CRSM will be receiving a new flow cytometry machine that will greatly enhance its basic science characterization studies. Bringing this machine in house will reduce time and expenses associated with outsourcing experiments.

Under Dr. Huard’s leadership, CRSM submitted over 26 new grant proposals in 2017 and is focused on submitting more in 2018 and 2019, at the federal, foundation, private and public level.

In August, Dr. Huard and CRSM will host the fourth Annual Vail Scientific Summit under the title “Regenerative & Translational Medicine: A Focus on Human Clinical Applications.” As in past years, the team anticipates abundant sharing of ideas and collaborations to arise from the conference.
With the launch of the new, state-of-the-art Biomotion Lab, the team is able to investigate human movement mechanics using 3D analysis of movement. The studies being performed in the lab focus on proactively preventing injury by evaluating movement efficiency, assessing dynamic joint function, evaluating surgical and physical therapy outcomes, managing rehabilitation progression, measuring the effectiveness of equipment, studying pathologies and their influence on sports performance and enhancing performance techniques for athletes.

The new Biomotion Lab is complemented by the innovative robotics laboratory that uses mechanical equipment to investigate and answer research questions through a testing medium that reproduces the natural movement of joints. The robotic arm is equipped with a universal force torque sensor that allows BME researchers to test cadaveric human joints, gaining insights into their kinematics. Evaluating joints in this way increases accuracy, repeatability and autonomy. The Robotics Lab also allows researchers to perform cutting studies to identify the effects of tendons and ligaments on joint movement. Additionally, the robot allows for enhanced reconstruction studies to evaluate surgical procedures.

In focusing on movement, BME prioritizes preventing injuries alongside discovering the best course for treatment. This exemplifies SPRI’s focus on bench-to-bedside research, as the scientists are committed to helping patients improve their quality of life and return to physical activity.

**Metrics of Success**

The Department of Biomedical Engineering evaluates its success on four distinct performance objectives:

- Receiving awards that validate the team’s research excellence, impact and overall contribution to orthopaedics and sports medicine
- Presenting studies at renowned conferences—both nationally and internationally—in front of diverse audiences around the world
- Submitting and receiving acceptance for publication in high-impact, peer-reviewed journals
• Involvement in the community via outreach programs to educate students and community members in the fields of orthopaedic sports medicine and science through hands-on learning and mentorship

Achievements

With its direct impact on injury prevention techniques and treatment for all individuals, BME’s research is incredibly valuable for scientists, surgeons and physicians all over the world. In being a major contributor to the orthopaedic sports medicine community, BME prioritizes presenting at conferences, publishing in top-tier journals and engaging the community in its research efforts.

In 2017, the BME department was honored with three major awards, the most ever in the history of the department. For the past six years, BME has earned at least one major national or international award, which is a remarkable achievement.

25 Publications in 2017

13% increase in publications since 2016

10 publications in The American Journal of Sports Medicine, the top journal in orthopaedics based on 1- and 5-year Impact Factors
AWARD HIGHLIGHT: ACHILLES ORTHOPAEDIC SPORTS MEDICINE AWARD

The Achilles Orthopaedic Sports Medicine Research Award recognizes the researchers who have performed the most outstanding clinical or laboratory research in the field of sports medicine, including the care and prevention of injuries.

TARGETING FAI WITH BIOMOTION RESEARCH

With many young athletes plagued by severe hip injuries due to femoroacetabular impingement (FAI), BME scientists are utilizing its state-of-the-art Biomotion Lab to identify the factors that cause the symptoms of FAI and then develop the strategies not only to avoid the defect, but to also treat patients with FAI symptoms. Previous FAI studies focused primarily on studying bone shape, but the BME team hypothesizes that the combination of bone shape and motion lead to FAI symptoms.

The clinical study includes 120 adult recreational athletes participating in high-risk FAI sports like skiing. Many of the individuals in the study will already have the hip defect associated with FAI and/or hip pain. Through analyzing the athletes’ anatomy with the advanced 3D imaging of the Biomotion Lab, BME researchers are assessing joint function and creating

Based on SPRI’s findings, a screening tool will be developed to identify individuals who are prone to FAI-related hip injuries. The tool will not only be designed with injury prevention in mind, but it will also be a treatment tool for clinicians.
animated 3D computer models of how each subject’s hip joint moves during different activities. This data will help the BME team pinpoint the precise combinations of motion and anatomy that cause impingement and can lead to joint damage.

In collaboration with the Center for Outcomes-Based Orthopaedic Research (COOR), BME is tracking the participants in this study for three years by collecting data on the subjects’ hip pain and function loss. The Imaging Research team is also involved in the study, reviewing MRI scans for changes in hip labrum and cartilage. These follow-ups will help identify the specific factors causing injury. Determining the intersection of anatomy and movement will help people alter their activities to prevent hip damage.

**INVESTIGATING HIP MICROINSTABILITY**

Hip microinstability is small abnormal movements within the hip that can cause damage to structures inside the hip. This damage can result in pain and lead to arthritis. As there is currently no evidence-based measure for accurate diagnosis, early detection of hip microinstability is difficult—it often goes undiagnosed until symptoms overwhelm the patient. Without a defined treatment of the disorder, hip microinstability is an extremely challenging defect for afflicted patients and physicians trying to treat.

Using the leading-edge Robotics Lab, BME researchers launched a first-of-its-kind microinstability study with a cadaver study of 16 healthy hip specimens. Researchers measured rotation and range of motion of the femur and pelvis of the specimens. The scientists then injured the soft tissue surrounding the joint in half of the hips and tore the labrum in the other hips. The robot tests were repeated on the injured hips. From here, data will be analyzed to determine if hip microinstability is caused by tissue damage around the hip joint.

The Imaging Research team is using MRI technology to create 3D models of the hip before and after injury. After all of the robotics testing is complete, scientists will use the specimens to validate the 3D models.

As the study continues, BME will work to establish the objective criteria for diagnosing microinstability as well as identifying risk actors. This will be developed into treatment and prevention protocols, which is vital for clinicians as hip microinstability often begins in young athletes.
**Education and Public Outreach**

BME researchers have a continuing presence within SPRI’s Education and Public Outreach (EPOC) programs.

- For Eagle County fifth graders, BME leads interactive tours through its laboratories, including Biomotion and Robotics.
- Researchers visit local middle schools and participate as judges in science fairs.
- BME provides one-on-one mentorship to students chosen for the selective high school Science Club.
- BME led the first-ever Summer Scholars program in June 2018, creating an intensive week-long STEM course for 20 top science students in Eagle County.

**Projections**

With its new laboratory spaces, BME will be able to continue researching biomechanics, musculoskeletal mechanics, biomedical imaging and orthopaedic engineering in innovative new ways. The team will continue its vital studies involving hips, shoulders, knees and ankles. With a persistent focus on preventing injuries and developing best-in-class treatments, BME remains committed to a bench-to-bedside project focus.

BME collaborates across SPRI and The Steadman Clinic to create a comprehensive focus to its research studies. With its physician investigators and with the help of teams like Imaging Research and the Center for Outcomes-Based Orthopaedic Research (COOR), BME will identify the causes of musculoskeletal and orthopaedic conditions and strategize on the best ways to treat them.

As community outreach and education are central to BME’s performance objectives, the team will remain committed to educating students and local community members about the advanced science being performed at SPRI.
For 26 years, the Center for Outcomes-Based Orthopaedic Research (COOR) has been tracking and studying patient outcomes. The dedicated research staff at COOR is now following nearly 38,000 surgeries. In addition, over 145,500 patient-centered outcomes surveys have been collected and are being tracked.

Achievements

COOR enjoyed its most productive publishing year in 2017, which included 59 PubMed-indexed studies, featuring 26 on patient outcomes from The Steadman Clinic. Nineteen of COOR’s publications were featured in COOR’s top target journals, including The American Journal of Sports Medicine, which is the highest impact journal for orthopaedic sports medicine.

In 2018, COOR was awarded the prestigious AOSSM The American Journal of Sports Medicine (AJSM) Systemic Review Award, which is given to the best systemic review paper submitted to AJSM during a calendar year. Published in 2017, this paper was entitled “High Rates of Osteoarthritis Develop After Anterior Cruciate Ligament Surgery: An Analysis of 4108 Patients.”

Published 10-year outcomes of Dr. Philippon’s femoroacetabular impingement (FAI) was a landmark event for COOR. The overwhelmingly positive outcomes prompted an editorial from The Journal of Bone and Joint Surgery, which modified the editor’s initial skepticism. This validated Dr. Philippon’s groundbreaking work in hip arthroscopy and highlighted the importance of tracking patient outcomes.
A CLOSER LOOK AT ARTHROSCOPY OUTCOMES

SPRI Co-Chair and Managing Partner of The Steadman Clinic Dr. Marc J. Philippon is a true pioneer when it comes to hip arthroscopy. Maintaining the principle that in the correctly selected patient, joint preservation is the best solution rather than total replacement, Dr. Philippon and his team launched a 10-year study following 145 patients who underwent arthroscopic surgery to treat femoroacetabular impingement (FAI)—the defect in the hip joint caused by extra bone on the pelvis and thigh bone around the hip joint. FAI can cause the bones to rub, which triggers pain and injury. It can ultimately lead to the development of cartilage and labral injuries.

In the study, half of the patients had hip labral repair while the others had labral debridement. Both arthroscopic procedures are designed to lessen hip pain, improve function and reduce the patient’s need for a total hip replacement. Prior to launching this study, data on long-term outcomes after hip arthroscopy was limited, making this research vital for the orthopaedic community.

For 10 years following the patients’ arthroscopy, COOR followed the progress of the study’s participants, collecting data regarding their symptoms, pain levels and range of motion. The findings indicated that both surgeries produced significant improvements in patient outcomes and satisfaction. Nearly all patients reported improved hip function and reduced pain. The study confirmed previous arthroscopy research that indicated some patients will still need full replacement—often those with advanced arthritis or patients of advanced age.
The overwhelming conclusion of the study is that, in the properly selected patients with FAI, patients return to excellent function and are happy with the results, reporting a 10 out of 10 on patient satisfaction with their outcomes. In filling the gap in the previously limited hip arthroscopy outcomes research, this study will benefit patients all over the world.

A MILESTONE PUBLICATION

In 2017, Dr. Philippon participated on a study team that published a randomized control trial comparing hip arthroscopy to physical therapy. The study was published in June 2018 in *The Lancet*, the world’s leading independent medical journal. *The Lancet* consistently ranks in the top three for high-impact medical journals, with an impact factor of 53.254. For this publication, Dr. Philippon served on the panel of an international clinical study, UK FASHion Study Group. This study provided top-level evidence of the success of hip arthroscopy. In addition, COOR’s Director of Hip Research, Karen Briggs, was honored when she was asked to provide independent commentary about the findings in the form of an editorial, also published in *The Lancet*.

PREDICTING LONG-TERM RECOVERY

After tracking patient outcomes following rotator cuff surgery, COOR has been able to create a model to predict probable outcomes in future patients undergoing surgery. The team used this model to design a predictive modeling app that will benefit physicians and patients. With Dr. Peter Millett as principal investigator of the shoulder modeling study, the team analyzed data from over 500 of Dr. Millett’s patients who had rotator cuff repair between 2005 and 2014. The diverse group of patients had varied types of joint damage.

COOR gathered pre- and post-op data on 12 distinct variables including age, injury details and imaging results. For at least two years following treatment, participants were followed to keep track of their outcomes. The vast majority achieved superb outcomes and only a few required future surgical intervention.
Building off of the rigorous science compiled, COOR Director Grant Dornan and his team built the modeling app from the study. Now, clinicians enter key patient data into the app to get a preview of the patient’s likely recovery based on the study’s participants. This information will improve patient treatment selection and educate them with concrete, tangible data.

Clinicians all over the world can access the app, and over the next year, they will test the app in clinical settings and provide feedback for validating the models and fine-tuning the app as the patient database increases. The app is exemplary of SPRI’s focus on creating a global impact with its research and innovations.

**DECADES OF EVIDENCE ON ACL RECONSTRUCTION**

Research from COOR has helped validate the work and legacy of Dr. J. Richard Steadman, SPRI Co-Chair and Founder of The Steadman Clinic. In the 1990s, the standard clinical opinion was that patients over age 40 were too old for ACL reconstruction. They were informed to modify their activity levels instead. Breaking the mold, Dr. Steadman believed that a person’s age should not impact their consideration for ACL repair.

COOR’s study on ACL outcomes isolated 77 of Dr. Steadman’s patients age 40 and older who’d had ACL reconstruction between 1984 and 1993. The mean age of the study participants was 44 at the time of surgery, with some patients as old as 65. All patients in the study had high activity levels prior to surgery.

Of the 77 individuals in the study, more than 98 percent reported excellent results 10 years after surgery, and after 20 years, 84 percent said their ACLs were still doing well. The patients reported high function and activity levels after surgery and reported good function in their knees. Impressively, the median score on a 10-point patient satisfaction score, with 10 being the most satisfied, was 10. Despite the prevailing notion of physicians in the 1990s, only 19 of 77 patients needed an eventual total knee replacement.

These outcomes prove that people who have ACL reconstruction after age 40 can expect to return to their pre-injury activity levels and maintain good function in their knees for 20 years.

Twenty years of data on one procedure by one surgeon is rare in the outcomes research community, and COOR utilized the opportunity to create a validating outcomes study. The result of the team’s findings is a unique snapshot into what a patient can expect 20 years after ACL reconstruction.

**Projections**

COOR continues to track patient outcomes each day, enhancing the robust 26-year database. Completing vital outcomes studies not only endorses procedures being performed in The Steadman Clinic, but also helps validate evidence-based procedures for patients all over the world.

With great results from COOR’s rotator cuff predictive modeling app, the team will look to use similar models in new categories, including shoulder instability. Predictive modeling is an increasingly valuable tool for physicians, in terms of diagnosis and treatment selection, and for patients, in regard to their education and care.
With a state-of-the-art Skyra 3.0 T magnetic resonance imaging (MRI) scanner, the Imaging Research team performs leading-edge research while applying imaging tools to improve patient outcomes. The improved and accurate 3T imaging allows the team to help provide precise diagnoses for injuries that affect the meniscus, labrum, cartilage, ligaments and tendons.

Imaging Research can assist physicians with diagnoses and plans for treatment. 3T imaging can also be used to monitor treatment and evaluate a patient’s recovery. One of the primary goals of the Imaging Research team is to develop a comprehensive understanding of a patient’s issues and how they can effectively be treated.

The Skyra 3T MRI provides higher resolution images at a greater speed than lower field scanners. The higher resolution allows for a more accurate evaluation of injuries and the faster speed allows for quicker patient examinations, reducing the chance for compromised images due to movement.

Imaging Research is a multifaceted department that enhances both the research being performed at SPRI and the diagnoses of patients at The Steadman Clinic.
RESEARCH INITIATIVES

With continued research on quantitative magnetic imaging research, the Imaging Research team continues to investigate the properties of tissues. By obtaining images of tissue before macroscopic tears occur, Imaging Research is able to assess whether there has been prior degradation or tissue injury. Recognizing the injury process at an earlier stage can make conditions more treatable, either by slowing the process or reversing it. Because long-term treatment can be difficult after a macroscopic tear has occurred, proactive imaging could provide an answer for physicians and patients.

EVALUATING ANKLE INJURIES

Traditionally, the severity of ankle injuries has been difficult to diagnose. The Imaging Research Team created an evidence-based measure for determining the damage of an injured ankle.

Knowing the key to developing an injury diagnosis tool was to understand the composition of a healthy ankle, the team investigated uninjured ankles, focusing on the peroneal tendon on the outside of the ankle. This tendon is a common source of ankle pain and disability.

The study involved 24 people with healthy ankles, ages 23 to 64. The team took MRI scans of each person’s ankle in different positions and measured MRI-mapping values in each peroneal tendon. The values provided a clearer picture of what an uninjured tendon looked like, creating a baseline for comparing injured tendons. The research team anticipates studies that will show that the greater the difference between the injured tendon and baseline, the greater the damage.

This baseline study shows that quantitative MRIs provide a more accurate evaluation of injuries than conventional MRIs. The study also makes it easier for physicians to detect damage in an ankle earlier and can treat milder symptoms more effectively.

The team will continue to evaluate the baseline and begin mapping other ankle tendons. This quantitative mapping will provide an objective tool that could lead to new standard treatments for injured ankles.
CONGRATULATIONS,

Dr. Charles P. Ho

Charles P. Ho, M.D., Ph.D. has served as Director of the Imaging Research team at SPRI for many years. With extensive experience in musculoskeletal and sports medicine imaging and research, specifically in musculoskeletal MRI, Dr. Ho has provided tremendous leadership and expertise to both SPRI and The Steadman Clinic. His research at SPRI has led to better injury diagnosis and treatment plans, and has helped support the interdisciplinary research efforts of the Institute.

Dr. Ho has accepted a visiting professor position in Radiology-Diagnostics at the University of Colorado School of Medicine. Dr. Ho will be using his expertise as both an M.D. and Ph.D. in his role as professor while continuing to support SPRI as Director of Imaging Research.

MRI AS A CT-SCAN SUBSTITUTE

Computed tomography (CT) scans have been industry standard for diagnosing injured bones in a joint, because they provide clear, sharp images of bones. CT scans are less effective in showing soft tissues, which is where MRI scans are more commonly used. When patients have a joint injury, it’s typical that they need both a CT and MRI scan to diagnose their injuries. The Imaging Research team at SPRI is investigating whether MRI scans can be used to assess both soft and hard tissues.

The team took CT and MRI scans of an uninjured cadaver knee and manually created 3D bone models on the computer. In collaboration with the University of Queensland and Commonwealth Scientific and Industrial Research Organisation in Australia, which created automatic computer models, the team evaluated both types of models. Although the models were produced with different methods, they were similar.

The team compared the MRI and CT bone models and saw that the models were very similar. An MRI can provide much more accurate models for diagnosis and treatment planning for joint injuries than was previously thought. This finding suggests that patients could forego CT scans, even with bone injuries.

This research is an example of the first real quantitative and qualitative data about MRI-based bone modeling.

Imaging Research presented results of this study in additional joints (hip, shoulder, ankle) at the 2018 Orthopaedic Research Society conference in New Orleans, LA in March.
The groundbreaking research being conducted at SPRI is advancing orthopaedic care around the globe. The past eighteen months have produced many awards and honors for the Institute, including those highlighted here.

**Center for Regenerative Sports Medicine (CRSM)**

CRSM has been honored with numerous awards, including the prestigious Kappa Delta Award presented to CRSM Director Johnny Huard, Ph.D., in March 2018. The award celebrated his 25 years of high-impact research in orthopaedics.

Sports Medicine Fellow Sandeep Mannava, M.D. was honored as the winner of the 2018 AOSSM Fellow Research Award in Basic Science for his study, “Influence of Naproxen, Age and Body Mass Index on the Biological Composition of Leukocyte Rich Platelet-Rich Plasma: A Prospective, Therapeutic, Cohort Study.”

The CRSM team has also featured:

- 2,105 new citations and 11 articles or book chapters published
- 37 abstracts accepted for Orthopaedic Research Society (ORS) meeting
- New Investigator Award Finalist for three studies, ORS
- 2017 Joe and Bettie Ward Award for Excellence in the Biology of Aging Studies
- 2017 Best PCR Award, Best Talk and Best Poster Award, Southwest Regional Symposium, ORS

**Biomedical Engineering (BME)**

The BME team has enjoyed award success in 2017 and 2018 including several major awards. The team earned three major awards in 2017, the most ever in a single year for BME. The team has now celebrated six consecutive years in which the team has been honored with one major national or international research award. Major awards include:

- 2017 International Society of Arthroscopy, Knee Surgery and Orthopaedic Sports Medicine (ISAKOS) Achilles Sports Medicine Research Award for outstanding clinical or laboratory research in the field of sports medicine
- 2017 American Orthopaedic Society for Sports Medicine (AOSSM) Cabaud Memorial Award for the best paper submitted concerning hard or soft tissue biology, in-vitro research, laboratory or “bench-type” research, or in-vivo animal research
- 2017 Best Scientific Exhibit, American Academy of Orthopaedic Surgeons (AAOS) for one of the best scientific exhibits at the AAOS annual meeting
- 2018 AOSSM William A. Grana Award for Best Original Research for the most outstanding original research paper that appeared in the *Orthopaedic Journal of Sports Medicine*
- 2018 AOSSM Cabaud Memorial Award for the second consecutive year
COOR received several major honors in 2017 and 2018, validating the importance of outcomes-based research in the orthopaedic community.

Key highlights include:

• 2017 AOSSM Annual Meeting Poster Awards – Third Prize
• 2017 International Society of Hip Arthroscopy (ISHA) Basic Science Trainee Award Finalist
• 2017 ISHA Richard Vallar Award for Excellence in Clinical Research Finalist
• 2018 AOSSM *American Journal of Sports Medicine* Systemic Review Award for the best systemic review paper submitted to AJSM during a calendar year
SPRI’s focus on bench-to-bedside research is exemplified with its physician investigators from The Steadman Clinic. From the faculty mentors of SPRI’s elite clinical fellowship program to those conducting research, these physicians are helping to support SPRI’s mission.

**Dr. Peter J. Millett** was presented with an Achievement Award from the American Academy of Orthopaedic Surgeons (AAOS) in 2017, which celebrates his contributions to education, research and advocacy in orthopaedics.

At the AAOSM annual meeting, **Dr. Robert F. LaPrade** was honored with the prestigious Cabaud Memorial Award on July 19, 2017. This award recognized his leadership in the field of orthopaedic research and his work into studying the effects of PRP on MCL healing.

In December 2017, **Dr. Matthew Provencher** was recognized with the renowned Col. Brian Allgood Memorial Leadership Award, given to the person who best exemplifies Col. Allgood’s attributes of selfless leadership, commitment to excellence in military orthopaedics and loyalty to the ideals of duty, honor and country.

In May 2018, **Dr. Marc J. Philippon** was presented with the “Vinci” Sports Health Award for advancements and contributions to the field of hip preservation by The Vincera Foundation.
In 2014, the United States Olympic Committee (USOC) partnered with The Steadman Clinic and Steadman Philippon Research Institute. This partnership named The Steadman Clinic one of only two National Medical Providers for Team USA and provided invaluable resources to SPRI in the form of an extensive athlete database. This arrangement has helped SPRI fulfill its goals in creating the best evidence-based treatments and studying ways to prevent injuries before they happen.

In October 2017, the International Olympic Committee (IOC) appointed the United States as a research center for the prevention of injury and protection of athlete health, joining just nine other appointed countries. The United States research center—the United States Coalition for the Prevention of Illness and Injury in Sport—is a joint research venture between SPRI, the USOC Sports Medicine Division and the University of Utah.

This historic coalition brings together highly experienced researchers from within each organization as an interdisciplinary team to foster collaborative research in support of the IOC’s goals in the areas of injury prevention and athlete protection.

As a part of this coalition, SPRI is working with nine other research nations to help protect athlete health. If SPRI, as part of the US Coalition, discovers an injury prevention treatment, it will share that discovery with every nation. This is the global, Olympic spirit, and SPRI is proud to be a part of it.

In addition to this exciting partnership with the IOC, the organizations have extended their USOC partnership to 2028, which will go through the Los Angeles Summer Games. This was a unanimous vote by the Partners of The Steadman Clinic and a unanimous vote of Steadman Philippon Research Institute’s Board of Directors.

Both relationships, with the IOC and USOC, position SPRI as a true global leader in research.
Each year, Steadman Philippon Research Institute hosts two major academic symposiums—the Vail Scientific Summit and Injury Prevention Symposium. The Summit was in its third year in 2017, and the Symposium wrapped its second annual meeting in May 2018.

VAIL SCIENTIFIC SUMMIT

From August 23-26, 2017, SPRI hosted its Third Annual Vail Scientific Summit. The conference featured over 60 speakers, which included top physicians, scientists, surgeons and researchers. The forward-looking, collaborative event celebrated the benefits of a strong connection between science and medicine, which was exemplified by the discussions sparked by the conference panels.

The Third Annual Vail Scientific Summit included a special session dedicated to The Steadman Clinic’s physicians, in which they outlined the clinical applications of regenerative medicine. This called to the translational nature of the orthopaedic research being discussed at the summit.

Much of the event was centered around encouraging new collaborations while building on existing ones. This created a full, cohesive summit that reinforced SPRI’s position as an innovative leader in orthopaedic research and regenerative medicine.

The Fourth Annual Vail Scientific Summit, entitled “Regenerative & Translational Medicine: A Focus on Human Clinical Applications” is scheduled for August 19-21, 2018 at the Vail Marriott Mountain Resort.

INJURY PREVENTION SYMPOSIUM

SPRI and the USOC, its partner, hosted the Second Annual Injury Prevention Symposium May 3-5, 2018. Defined by a spirit of collaboration, the event addressed current research and clinical applications for sustaining athlete health throughout sports and exercise disciplines, across all ages.

The event featured an inspiring keynote address from Julia Mancuso, the most decorated female American alpine Olympic skier and one of only three Team USA athletes to medal in three consecutive winter Olympic Games. She spoke just two days after receiving a total hip replacement at The Steadman Clinic.

The symposium included panel discussions by a variety of professionals from different disciplines, providing unique insights into the topics of injury prevention and preserving athlete health. This allowed for a welcoming and insightful exchange of ideas from surgeons, scientists, physical therapists and other professionals, which highlights the Olympic spirit of working together and sharing ideas.

The Third Annual Injury Prevention Symposium will be held May 2-4, 2019.
Creating a Legacy of Education

Each year, SPRI educates more than 1,000 individuals from elementary school through career professionals. The multifaceted approach to education includes elite clinical fellowships and research appointments for international scholars, inspiring youth engagement programs, lecture series throughout the year and much more.

EDUCATION AND PUBLIC OUTREACH COMMITTEE (EPOC)

EPOC’s program offerings include tours for local fifth grade students, featuring visits to SPRI’s state-of-the-art laboratories including Biomotion, Regenerative Medicine, Robotics and Surgical Skills.

For students in middle school, SPRI researchers travel to schools for interactive sessions and participate in judging local science fair projects.

After being selected by their high school science teachers, 10 local juniors and seniors participate in a year-long Science Club, performing hands-on research. In 2018, the high school program expanded to include a Summer Scholars program, which provides an intensive Science, Technology, Engineering & Mathematics (STEM) course to 20 top science students from local schools.

Now, students of all ages in Eagle County can participate in tutoring and shadowing programs with SPRI scientists.

OPPORTUNITIES FOR COLLEGE STUDENTS

SPRI offers unique opportunities for undergraduate and graduate students. Each year, fifteen or more college, graduate or medical students work in research assistantships, which represent 35 percent of SPRI’s workforce. While in these assistantships, students have the opportunity to co-author publications for high-impact journals and attend SPRI’s nationally acclaimed academic conferences.

EDUCATING THE COMMUNITY

Citizens of Eagle County and SPRI benefactors have enrichment opportunities at SPRI. They enjoy tours of SPRI’s leading-edge laboratories and can participate in research studies being performed in Vail. Members of the community and SPRI donors are also invited to attend SPRI’s academic conferences.

PROFESSIONAL EDUCATION OFFERINGS

Through its meetings and academic symposia, SPRI reaches more than 400 professionals in the fields of orthopaedics, sports medicine, regenerative medicine and more each year. The conferences serve as professional development, continuing education and tremendous networking opportunities for all participants.
Part of SPRI’s educational opportunities include elite clinical fellowships and research positions for surgeons from all over the world. Committed to training tomorrow’s orthopaedic experts, SPRI’s post-residency programs are considered some of the world’s best. Physicians from as far away as Asia and South America come to Vail to learn from SPRI’s renowned surgeons and researchers.

This year, SPRI selected seven surgeons to the world-renowned, ACGME-accredited Sports Medicine Fellowship. Two additional orthopaedic surgeons were selected for orthopaedic fellowships, including one Foot & Ankle Fellow and one Adult Reconstruction Fellow. Additionally, six scholars from around the world joined SPRI for appointments as International Scholars. Both groups spent twelve months working toward one goal—expanding their knowledge to help patients heal better and faster.

While in Vail, fellows and scholars have the unique opportunity to perform research in their respective areas of interest, including biomechanics, basic science, imaging and clinical research. The post-residents refine their orthopaedic skills and investigate the causes, prevention and cure of degenerative diseases, as well as the treatment and prevention of joint injuries. The fellows and scholars not only advance their own knowledge and expertise, but also improve patient care through their own research. The physicians also have the opportunity to refine their skills in SPRI’s Surgical Skills Lab.

SPRI currently maintains a network of more than 225 fellows in communities around the world who often serve in academic positions at leading universities and in private practices.
2017-2018 Sports Medicine Fellows

J.P. BEGLEY, M.D.

Dr. Begley graduated from Johns Hopkins School of Medicine. He completed an orthopaedic surgical residency at NYU Hospital for Joint Diseases. During that time, he served as team physician for the NYU and Long Island University’s men’s and women’s basketball programs. Dr. Begley also provided medical care for the NYC Public High School Athletic League and the Alvin Ailey Dance Theater. His research interests include hip arthroscopy outcomes data, shoulder instability and athletic performance after surgery.

ANDREW BERNHARDSON, M.D., M.C., U.S.N.

Dr. Bernhardson graduated from the U.S. Naval Academy and attended medical school at the University of Minnesota. After graduation, he served as battalion and regimental surgeon with the U.S. Marine Corps in Afghanistan. Dr. Bernhardson completed his orthopaedic residency at the Naval Medical Center San Diego. He was also selected as the AOSSM representative to the AAOS Clinical Scientist Career Development Program in 2015.

PATRICK BUCKLEY, M.D.

Dr. Buckley received a bachelor’s degree in biology from Villanova University where he graduated cum laude. He also graduated cum laude from Jefferson Medical College. While there, he was vice president of Alpha Omega Alpha. Dr. Buckley completed his orthopaedic surgery residency at Thomas Jefferson University Hospital. He was the team physician for the Philadelphia Phillies and Villanova University athletics. His research interests include sports following ACL reconstruction and treatment of the throwing athlete.

BLAKE DANEY, M.D.

Dr. Daney graduated cum laude from Miami University with a bachelor’s degree in Zoology. He received his medical training at West Virginia University. There, he was inducted into Alpha Omega Alpha and Gold Humanism Honor Society. Dr. Daney completed his residency at Cleveland Clinic Akron General. His research interests include biomechanics, articular cartilage injuries and upper extremity nerve compression. He is a founding board member of Project CHASM, which provides medical care for the homeless.
2017-2018 Sports Medicine Fellows

BRENDAN HIGGINS, M.D., M.S.

Dr. Higgins graduated with a degree in Oceanography from the U.S. Naval Academy. Upon graduation, he was commissioned as an officer in the U.S. Marine Corps. He served as a platoon commander during Operation Iraqi Freedom. Dr. Higgins completed medical school at Georgetown University and his orthopaedic residency at Dartmouth Hitchcock Medical Center. He also earned a master’s in Healthcare Leadership at Dartmouth. His research interests include total hip arthroplasty and cervical spine surgery.

CATHERINE LOGAN, M.D., M.B.A., M.S.

Dr. Logan attended Syracuse University, studying Health and Exercise Science. She earned a master’s in Physical Therapy from the Medical College of Virginia. She practiced as a physical therapist at Johns Hopkins Hospital before enrolling at Tufts University School of Medicine where she earned a joint MD and MBA degree. At Tufts, Dr. Logan started a nonprofit that provides science education for underserved Boston youth. She received orthopaedic surgery training through the Harvard Combined Orthopaedic Residency Program where she served as editor-in-chief of the Orthopaedic Journal. Her research interests include discoid meniscus and return-to-play protocols.

CONNOR ZIEGLER, M.D.

Dr. Ziegler attended Gustavus Adolphus College where he was an Academic All-American swimmer, conference champion and NCAA finalist. He received the NCAA Post-Graduate Scholarship and was named to ESPN The Magazine’s Academic All-America Men’s At-Large Team. Dr. Ziegler attended medical school at the University of Minnesota. He completed residency at the University of Connecticut. His research interests include ACL and PCL reconstruction and total shoulder arthroplasty. He has published in numerous peer-reviewed journals.

2017-2018 FOOT & ANKLE FELLOW

JESS MULLENS, M.D.

Dr. Mullens graduated from Berry College with a bachelor’s in biology. He interned at the National Cancer Center in South Korea. Dr. Mullens earned his medical degree at the University of Alabama School of Medicine, where he was inducted into Alpha Omega Alpha. Dr. Mullens completed his residency at the University of South Alabama. He was elected Resident Scholar by the American Orthopaedic Foot and Ankle Society. His research interests include sports-related ankle injuries and gait analysis of the foot and ankle.
2017-2018 ADULT RECONSTRUCTION FELLOW

JAKUB TATKA, M.D.

Dr. Tatka received his bachelor’s from Connecticut College where he studied music and technology. He attended Stony Brook School of Medicine where he was involved in medical missions in South America. He established an annual mission to Peru, which is now in its ninth year. During his residency, Dr. Tatka was chosen as Administrative Chief Resident. His research interests include Dupuytren’s Disease and PCL reconstruction.

2017-2018 International Scholars

BURAK ALTINTAS, M.D.

Dr. Altintas earned his medical degree from Heidelberg University in Germany. He worked at Sporthopaedicum in Germany after completing his orthopaedic surgery residency. Dr. Altintas’s research interests include shoulder instability and other traumatic and degenerative shoulder conditions. He has published several research papers on shoulder and elbow disorders in peer-reviewed orthopaedic journals.

IONNA BOLIA, M.D., M.S.

Dr. Bolia came to SPRI from the University of Athens School of Medicine, Department of Orthopaedic Surgery. She received her medical degree from Aristotle University of Thessaloniki School of Health Sciences in Greece. She also earned a master’s degree in molecular and applied physiology. Dr. Bolia is focused on hip arthroscopy and is preparing for the U.S. Medical Licensing Examination and plans to apply for a medical residency in the United States.

LORENZO FAGOTTI, M.D.

Dr. Fagotti completed his residency at the Santa Casa de São Paulo School of Medicine in Brazil. He was a fellow at the Hospital das Clínicas da Faculdade de Medicina da Universidade de São Paulo. He was involved in hip research studies at SPRI, focusing on hip arthroscopy, biomechanical and anatomical studies. Dr. Fagotti is applying for the Ph.D. program at the Santa Casa de São Paulo School of Medicine.
GILBERT MOATSHE, M.D.

Dr. Moatshe completed his residency at Oslo University Hospital in Norway and is working on a Ph.D. in collaboration with SPRI and the University of Oslo. In his second year at SPRI, Dr. Moatshe focused his research on arthroscopy and sports medicine, with an emphasis on treating knee injuries.

GILBERTO NAKAMA, M.D., M.S.

Dr. Nakama completed his master’s degree at the Federal University of São Paulo in Brazil. He completed his medical residency and knee surgery specialization at the University of São Paulo as well. Dr. Nakama is focused on knee and translational regenerative medicine research.

HAJIME UTSUNOMIYA, M.D., PH.D.

In his second year at SPRI, Dr. Utsunomiya is specializing in stem cell research. His research focuses on using shoulder stem cells to treat rotator cuff tears. He is assisting Dr. Johnny Huard, SPRI’s Chief Scientific Officer, with his regenerative medicine research and Dr. Marc Philippon, SPRI’s Co-Chair.

Not only are SPRI’s fellows and scholars advancing their own knowledge and expertise, but they are also improving patient care provided by orthopaedic physicians around the world, thanks to the groundbreaking research they are investigating at SPRI.

SPRI’s vast network of fellows and scholars spans the globe, ensuring SPRI’s global legacy of education.
Publications and Presentations

SPRI was prolific in its publications and presentations in 2017-2018. Many of the Institute’s publications were published in high-impact, peer-reviewed medical journals, and presentations were given on a global stage.
Publications


Publications & Presentations


Publications & Presentations


Bolia I, Briggs K, Ho CP, Philippon MJ. Poster. Factors and clinical outcomes associated with fibrocystic changes of the femur as identified by MRI in the hip. AANA Annual Meeting, Chicago, IL, April 2018.


Callanan M, Provencher MT. The Influence of Cervical Spine Injuries on Performance Outcomes in Prospective NFL Athletes. AAOS March 2018.


Chahla J, Dean CS, Matheny LM, Mitchell JJ, Cinque ME, LaPrade RF. Double-Bundle PCL Reconstruction: A Prospective Study Of Two-Year Patient Reported Outcomes With Stress Radiographs.


Chahla J, Dean CS, Matheny LM, Mitchell JJ, Cinque ME, LaPrade RF. Two-tunnel Transtibial Repair of Radial Meniscus Tears Produces Comparable Results to Inside-Out Repair of Vertical Meniscus Tears.


Chen W, Chen H, Yifei Wang, Mu X, Huard J. Osteogenic Differentiation of Human Adipose Derived Stem Cells is Enhanced by Stem Cell Factor (SCF) through the mTOR Pathway. ORS annual meeting. San Diego, CA March 19-22, 2017.


Clanton TO, Matheny LM. Reliability and Validity of Scores from the Foot and Ankle Ability Measure: A Rasch Analysis. 18th biennial meeting of the European Society of Sports Traumatology Knee Surgery and Arthroscopy (ESSKA) Congress biennial meeting. Glasgow, Scotland, May 9-12, 2018.


LaPrade RF. Meniscal Root Tears – What are they and Why you need to Fix them. ISAKOS, Shanghai China, June 6, 2017.

LaPrade RF. PCL Double Bundle Reconstruction: Only Way to Go. ISAKOS, Shanghai China, June 8, 2017.

LaPrade RF. Meniscal Root Tears – What are they and Why you need to Fix Them. ISAKOS, Shanghai China, June 6, 2017.

LaPrade RF. PCL Double Bundle Reconstruction: Only Way to Go. VICKS, Vail, CO, June 10, 2017.


LaPrade RF. Case Based Approach to Complex MLI Knee: PCL, PLC, MCL. AAOSSM, Toronto ON, Canada. July 21, 2017.

LaPrade RF. Meniscal Considerations: Root vs Complete Repair. Smith and Nephew Event, Massachusetts, Aug. 27, 2017.


LaPrade RF. Radial Tears of the Menisci – New Techniques and Why We Need to Repair These. Brazil, Sep. 28, 2017.


LaPrade RF. Radial Tears of the Menisci – New Techniques and Why We Need to Repair These. Sao Paulo, Brazil, Sep. 27, 2017.

LaPrade RF. Posterolateral Corner Injuries: No Longer the Dark Side of the Knee. Sao Paulo, Brazil, Sep. 27, 2017.


LaPrade RF. The Posterolateral Corner of the Knee- No Longer the Dark Side. Polish Arthroscopy Society Congress, Nov.17, 2017.


LaPrade RF. Que es lo que no vieron o hicieron mal en multiligamentarias que me derivan. Buenos Aires, Argentina, Dec. 3, 2017.


LaPrade RF. Bone Marrow Aspirate Concentrate Harvesting and Processing Technique. Arthroscopy Techniques, Vol. 6, issue 2, e441–e445 (Published online: April 10, 2017), AANA Chicago 2018.


LaPrade RF. Treatment of Combined PCL and Posterolateral Knee Injuries: Case-Based. 17th Brazilian Knee Surgery Congress. April 14, 2018.

LaPrade RF. Multiple Ligament Injuries Involving the PCL – Workup and Treatment Schedule. 17th Brazilian Knee Surgery Congress. April 12, 2018.

LaPrade RF. Treatment of Combined PCL and MCL Injuries. 17th Brazilian Knee Surgery Congress. April 14, 2018.


Morris ER, Liebowitz AB, Scibetta AC, Mu X, Huard J. Regulation of pro-inflammatory mediators and intracellular lipid accumulation in progeria muscle stem cells with mechanical stimulation. ORS annual meeting. San Diego, CA March 19-22, 2017.


Philippon, MJ. Hip Labral Repair; surgical demonstration. ISAKOS Biennial Meeting, Shanghai, China, June 2017.

Philippon, MJ. Hip Pain in the athlete: evidence-based tools for diagnosis: Evidence Based Algorithm for the Diagnosis and Treatment of the Hip Pain in the Athlete. ISAKOS Biennial Meeting, Shanghai, China, June 2017.


Philippon, MJ. Hip Labral Repair; surgical demonstration. ISAKOS Biennial Meeting, Shanghai, China, June 2017.

Philippon, MJ. Hip Pain in the athlete: evidence-based tools for diagnosis: Evidence Based Algorithm for the Diagnosis and Treatment of the Hip Pain in the Athlete. ISAKOS Biennial Meeting, Shanghai, China, June 2017.

Philippon, MJ. Advances in Hip Arthroscopy Over the last 10 Years. Distinguished Visiting Professor for Senior Resident Graduation. University of CA at Davis, Sacramento CA, June 2017.


Philippon, MJ. Advances in Hip Arthroscopy over the Last 10 Years. Kerlan Lecture. USC Keck School of Medicine, Los Angeles, CA, Oct. 2017.


Philippon, MJ. Hip Arthroscopy: Advancement over the last 10 years. China Hip Arthroscopy Course, Shanghai, China, April 2018.


Philippon, MJ; Bolia IK, Briggs KK. Clinical Outcomes Following Arthroscopic Labral Augmentation Compared to Matched Cohort of Labral Reconstruction. AANA Annual Meeting, Chicago, IL, April 2018.


Provencher MT. Humanitarian Assistance and Disaster Relief - Leadership Lessons from the Navy to Improve Medical Care. Inaugural Alpha Omega Alpha Visiting Professorship Address. Dartmouth–Hitchcock Medical Center, Lebanon, NH. May 2018.

Provencher MT. Shoulder instability - a radiographic and clinical journey to improve outcomes. Dartmouth–Hitchcock Medical Center, Lebanon, NH. May 2018.


Provencher MT. Panelist. Instability; Anterior Instability in the Young Athlete. Discussion with Audience Participation. 35th Annual San Diego Course, Hilton BayFront, San Diego, CA, June 2018.

Provencher MT. Simple Bankart Repair Works the Best. 35th Annual San Diego Course, Hilton BayFront, San Diego, CA, June 2018.

Provencher MT. Classification of Instability: Can We Agree on Anything? Discussion with Audience Participation. 35th Annual San Diego Course, Hilton BayFront, San Diego, CA, June 2018.


Provencher MT. Panelist. Case Presentation with Audience Polling. Mid Shaft Clavicle Fracture: Sling vs Figure 8 vs Pin vs Plate and Acromioclavicular Separation: Non Operative vs Operative. 35th Annual San Diego Course, Hilton BayFront, San Diego, CA, June 2018.


Provencher MT. Panelist. The Throwing Athlete Discussion and Audience Participation. 35th Annual San Diego Course, Hilton BayFront, San Diego, CA, June 2018.


Scibetta AC, Gao X, Lu A, Huard J. Bone Morphogenetic Protein-9 (BMP9) is Superior to BMP2, 6 and 7 to Enhance the Chondrogenic Potential Of HMDCSCs. ORS annual meeting. San Diego, CA March 19-22, 2017.


Sinha KM, Lu A, Andrew R, Huard J. Hypoxia inducible factor 1α (Hif1α) promotes the muscle regeneration capacity of MRL/MpJ mouse. ORS annual meeting. San Diego, CA March 10-13, 2018.


Steineman BD, Moulton SG, Donahue TL, Dean CS, LaPrade RF. Coronal and Sagittal Plane Investigation of the Tibial ACL and Anterolateral Meniscal Root Insertion Overlap Relationship. Summer Biomechanics, Bioengineering and Biotransport Conference.


Utsunomiya H, Locks R, Chahla J, Bolia I, Briggs K, Philippon MJ. Does the center edge angle affect hip arthroscopy outcomes? 2 to 6 years outcomes of patients older than 30 years old and with center edge angle less than 30 degrees. ePoster. ISAKOS Biennial Meeting, Shanghai, China, June 2017.


Steadman Philippon Research Institute

Guidelines for Research, Information Dissemination and Authorship
Preamble

This statement provides general guidelines for the conduct and presentation of research done under the umbrella of Steadman Philippon Research Institute (SPRI or Institute) and which uses any SPRI resources whatsoever. These guidelines are intended to help strengthen the quality of research, both written and orally presented, that is produced by SPRI. This statement affects all SPRI employees, the Steadman Clinic (Clinic) attending physicians, Clinic Fellows, International Research Scholars, visiting surgeons, consultants, interns, students, and other visitors in perpetuity. It also provides guidance and assurances to all collaborators (e.g., universities, private laboratories, commercial entities, etc.) involved in research projects with SPRI.

Guidelines for Conducting Research

1. Internal Research Proposals
Before beginning any research project which uses any Institute resources, the Principal Investigator (PI) who is an Institute employee or Clinic attending must submit a written proposal to his/her SPRI Department Director, or if the PI is not an Institute employee, then to the Department Director who will be providing the necessary support, for internal review and approval. If the proposal is from other than a SPRI employee or Clinic attending and does not require support from a specific department, then the proposal must be submitted to the Chief Scientific Officer (CSO) for review and approval. Research proposals (protocols) should follow a standard format (see Appendix) and must be signed by the SPRI Department Director and all participants who are listed on the written protocol or proposal. Furthermore, all research and grant proposals must be signed by the Department Director before the proposals can be submitted to the IRB or the outside granting/funding agency. After the Department Director has approved and signed the proposal, it must then be sent to the CSO for review before submission to the IRB or the outside granting/funding agency. A detailed study format for proposals requiring Institutional Review Board (IRB) approval, outside funding review, etc., is at the Appendix. If desired, a more formal proposal may be submitted, provided it contains all of the requested information and essential elements, including all elements of informed consent required by Federal regulations and the responsible IRB. The CSO and responsible SPRI Department Director will determine whether the submitted proposal is approved or if the proposal requires further refinement before the investigator is given approval to conduct the study. The CSO and Department Director may also seek additional review from other sources/individuals as a part of this decision making process.

2. The Role of the Principal Investigator (PI)
The Principal Investigator has overall responsibility for the conduct and completion of the study project. The PI may delegate any part of the study project to another individual, but the responsibility for its completion may not be delegated. It is also the responsibility of the PI to assure that the study stays within its deadlines and budget.

To be the PI of a SPRI in-house study, that person must be one of the following:
1. Director of one of the SPRI research departments;
2. An MD, including The Steadman Clinic permanent attendings;
3. A DVM; or,
4. A PhD.
Those specifically prohibited from being a PI include Clinic Fellows, International Research Scholars, interns, part-time employees, and visitors. In the case of collaborative studies which are performed at a university or other outside agency, it is anticipated that the PI or co-PI will be a faculty or staff member at that university or agency, especially if the study involves use of animals or human subjects.
The PI sets the hypothesis for the study and supervises the experimental design (power analysis, sample size determination, etc.) and conduct of the research. The PI is ultimately responsible for the reports and publications and must confirm their accuracy and authenticity. Specific criteria include:

1. The PI must be aware of all aspects of the science being done in the study.
2. The PI is present on site and supervises the laboratory in which the research is carried out, especially if the research is conducted at a university or other agency.
3. The PI has overall responsibility and is in charge of the project.
4. Once the PI is established (and it must be established prior to submission to the IRB or for funding or commencement of the project), he/she has full responsibility for all aspects of the study, including obtaining all regulatory approvals, both initial and any required periodic reviews.
5. Because the PI may not necessarily be the person who had the original idea for the project, there needs to be a clear understanding as to what role the person with the idea serves in the study. For example, the person who had the original idea may not meet the qualifications to be a PI, or the person with the idea may not desire to serve as the PI for other reasons.
6. The PI is not necessarily the first author of any subsequent publications. NOTE: Publication of the results is a separate matter and is addressed below.
7. The PI may re-assign projects, authority for certain functions, authorship requirements and rights, etc. The PI may not delegate or re-assign ultimate responsibility for the project.

Although NIH typically does not allow co-principal investigators, one (maximum) co-principal investigator may be necessary for some specific purpose. If there is a co-principal investigator, then it must be clearly and unambiguously specified in writing in both the protocol and the informed consent form (if applicable) which co-PI is responsible for which aspects of the study. Except as noted above, a co-principal investigator in a different institution is to be discouraged unless there is a clear and compelling reason.

If there is a clinical study directed from The Steadman Clinic or SPRI, a staff member permanently affiliated with the Clinic or SPRI and qualified to be a PI as noted above will be the PI of record rather than a Fellow or International Research Scholar. Fellows and Scholars typically are only present for a maximum of 12 months, and they may lack the necessary time for project completion. If a Fellow or Scholar designs a definitive project that can be done within the period of the fellowship, then the PI would still be responsible for oversight.

All individuals who have a major role in the research study and who are not the PI should be listed in all documents as co-investigators. A co-investigator is a person who contributed significantly to the study idea, has secondary responsibility for a part of the study, and will significantly contribute to the study throughout its conduct.

Those who have less than a major role may be listed as a research associate. A research associate is someone who brings additional expertise and responsibility to the study and does not fall under the direct supervision of one of the investigators. Anyone involved in the study who does not qualify as an investigator and who works under the direct supervision of an investigator does not need to be listed on the research protocol.

NOTE: It is emphasized here that authorship and author order on any subsequent publications are completely separate from the research protocol itself. Authorship is discussed below.

3. Study Approval
A proposed research project is eligible for approval after:
1. Its goals/objectives/premise are clearly stated and deemed relevant to the clinical/medical community as well as the Clinic and/or Institute;
2. The study’s key activities are listed, with timelines attached to each activity;
3. The projected starting and ending times of the study are established;
4. Staff requirements/time allocation are determined and related to the tasks needed;
5. The budget is developed, including both expenses as well as projected support/income;
6. The degree of difficulty to complete the study is described accurately. A justification for additional/new equipment, computer software, etc., is required along with a statement of whether staff has the knowledge and skill required to complete the project feasibly;
7. The SPRI Department Director and CSO have given approval;
8. All necessary regulatory and oversight approvals (e.g., IRB, Animal Care Committee, etc.) have been obtained; and,
9. Any clinical study must have The Steadman Clinic Service Chief’s review and approval signature. The review and approval does not mean that the Service Chief is necessarily a part of the study. Furthermore, this review and approval has nothing whatsoever to do with authorship of any publications that may result from the study. This requirement does not pertain to non-clinical (i.e., laboratory) studies. As of the date of this document, the Service Chiefs are Dr. Marc Philippon (Hip), Dr. Randy Viola (Hand), Dr. Don Corenman (Spine), Dr. David Karli (Regenerative Medicine), Dr. Tom Hackett (Knee, Shoulder, Elbow), Dr. Peter Millett (Shoulder, Knee, Elbow), Dr. Tom Clanton (Foot and Ankle), Dr. Robert LaPrade (Knee), Dr. Thos Evans (Regenerative Medicine), Dr. Matthew Provencher (Shoulder, Knee), Dr. Raymond Kim (Arthroplasty), Dr. David Kuppersmith (Internal Medicine), Dr. Joel Mata (Arthroplasty), and Dr. Thomas Haytmanek (Foot and Ankle).

At the time of approval, the project will be placed on a priority list of other research projects within both the originating Department and the Institute.

4. IRB Approval
Once the proposal has been approved internally as noted above, and if the study requires human subjects or use of human tissue, the investigators must submit the proposal for IRB approval. It is the responsibility of the PI to see that IRB approval is obtained, if appropriate, in a timely fashion. No study may begin without IRB approval if required. If a study requires IRB approval, then a Department Director or permanent staff member with M.D., D.V.M., or Ph.D. credentials must act as PI for purposes of medical intervention and judgment.

5. Obtaining Informed Consent from Participants of Approved Studies
Only individuals with the following degrees or who hold the designated position are permitted to obtain informed consent from a participant in an approved study:

• MD (including Clinic Fellows and International Research Scholars)
• DVM
• PhD
• RN
• PA
• Department Directors

Staff members, research interns and Athletic Trainers (ATC) who do not possess one of the above degrees are not permitted to obtain informed consent from a study participant.

6. Project Funding
If the project is approved but does not yet have funding, but requires external funding, the PI must immediately send a copy of the proposal to the CEO, CSO, and CFO, who will then work with the Development Department in identifying and approaching potential funding sources.

7. Conference Presentations and Abstracts
Once the study data are analyzed and a report is prepared, all researchers (excluding outside collaborators such as university researchers or private laboratory scientists) are encouraged to present their work to an internal group of their peers before any presentations are made at a scientific meeting. To schedule a presentation, please see the Institute CEO or CSO. This presentation will be reviewed in light of the intended audience and the desired impact. It is likely that the presentation will be
Guidelines for Research, Information Dissemination and Authorship

held at an open meeting for all Institute and Clinic staff. The spirit of this recommendation is to help insure preparedness and give ample time to incorporate edits and suggestions to improve the presentation.

In the case of a public relations related request (article or presentation) from an outside group, the Department Director in conjunction with the Institute CSO will determine when and if the request will be met.

Conference papers should be directed to the most appropriate audience and meeting. A scientific paper, once presented to a national or international meeting, should not be presented in exactly the same format to additional meetings of the same constituency as original research and data. Presenting a paper at a clearly local or regional meeting does not preclude presenting the same paper to a national or international meeting. Presenting the same paper to different audiences at multiple meetings may be acceptable if all authors agree. This guideline does not preclude presentation multiple times as a portion of an invited presentation.

Authorship guidelines for conference presentations should be identical to the guidelines for papers submitted for publication to peer-reviewed journals (see below). All authors must meet the same criteria of substantial contribution to the paper, justifying inclusion as an author for the conference paper for presentation as well as for the manuscript submitted for publication. Anyone who is not an author of a paper is precluded from presenting it at a national or international meeting unless there are unforeseen or extenuating circumstances in which no author of the paper is available. The act of presenting the paper does not justify changing authorship or order of authorship for the conference paper or for the manuscript submitted for publication.

8. Publications
To maintain the highest level of research quality, the responsible Institute Department Director and, if a clinical study, the Clinic Service Chief (even if the Department Director or Clinic Service Chief is not an author) and all authors and co-authors of the material must review and give written feedback of all written products representing SPRI before they are submitted for publication or presentation. Additionally, the PI is strongly encouraged to seek responses from appropriate members of the Research Advisory Committee (RAC) as well. This requirement covers all manuscripts, papers, and public relations pieces. The same is also encouraged for abstracts and presentations. Furthermore, the PI and corresponding author will review with all authors any comments received from journal editors, reviewers, and referees to help determine why an article is accepted or rejected. Revised articles should go through the same review process as for initial submission.

9. Ownership of Study Data (Rights and Responsibilities)
SPRI owns all study data generated in all Steadman Clinics and SPRI laboratories if any Institute resources were used in any manner whatsoever. The Institute owns all rights to all data, findings, and material, written or otherwise, which were created during any part of studies undertaken in the Institute’s facilities. This policy applies in perpetuity. The Institute cannot claim ownership to data that have been generated in a collaborating laboratory under the directorship of a Principal Investigator who is not an Institute staff member. In other words, each collaborating PI would own the data that are generated by his/her respective laboratories. If the Institute contracts with any outside organization to perform a specific study for a fee, then all data generated under the contract are property of the Institute. To limit potential problems, it is necessary that these issues be clarified and agreed upon in writing before any collaborative study is to begin.

The Principal Investigator (or Director of the outside laboratory) is responsible for the validity of data and veracity of the report. While all those involved in the study have equal rights to access the data, no one (laboratory staff or collaborators) should be permitted to disseminate the data (in published or presentation format) without the express written approval of SPRI. This prior approval is particularly important when it comes to the correct interpretation of the findings. For example, in a presentation, one could present (or discuss) the data wrongly if one is not fully aware of the background and does not comprehend the meaning of the data fully. Hence, that is why such a responsibility for the Principal Investigator (or Director of the laboratory) exists.
In the case of contract research, a company which paid for the project may wish to have partial or complete ownership of the data generated by the Institute. As such, the said company must cover all costs for the research done (including appropriate overhead), and a mutually acceptable written agreement should be signed beforehand. However, an unrestricted gift to SPRI or sponsorship of SPRI from an industrial/commercial concern does not entitle the company to the ownership of any data generated using such funds. Data are also owned by SPRI when generated on site by Ph.D. candidates, International Research (Visiting) Scholars, and research Fellows/Interns who are sponsored by an individual or commercial concern.

If any investigator, attending surgeon, Fellow, or participating staff member should leave the Institute’s or Clinic’s employment at any time, that individual must leave all materials, including equipment and data, with the Institute, unless and only unless, written permission is granted in advance from the Principal Investigator (or Director of the laboratory) as well as the Institute CEO and CSO. With written permission, the individual may take a copy of the material for the purpose of completing his/her analysis, writings, etc. All materials, original data, equipment, etc., will remain the property of SPRI in perpetuity. Furthermore, that individual is still required to follow all guidelines set forth in this document regarding presentation and/or publication of said data. All publications and presentations as a result of the work supported in any part by or done in the Institute must acknowledge the Institute. These guidelines on ownership of data also apply to former Fellows who already have or may in the future wish to access data owned by SPRI. Penalty for not abiding by these SPRI guidelines will preclude former Fellows, employees, and others temporarily associated with SPRI from having access to data in the future. Acts of misconduct may be referred to the Research Advisory Committee for recommendations for further sanctions.

10. Research Conducted Outside of the Institute
In the case of research funded by the Institute and conducted by an outside university or organization, a liaison for each organization will execute a Scope of Services Agreement or an appropriate Memorandum of Understanding. The liaison for each organization shall be a current permanent employee. In the case of SPRI, the liaison shall be the CSO. The Institute will not pay overhead surcharges to any organization conducting research in its behalf or at its request.

In the case of an Institute employee involved in research which is not conducted under the Institute’s auspices and for which the Institute may or may not receive credit, the individual must inform the CEO and CSO in writing prior to involvement. The Institute has a right to limit time spent on such projects, assuming such work is performed during normal working hours or if it might affect the employee’s work-related performance. In certain circumstances, the Institute has a right to ask for and receive acknowledgment in the project.

11. Contesting Decisions Made During the Study Preparation
Should any individual involved in a study wish to dispute a decision he/she cannot resolve with the PI or the Department Director, that individual must submit a timely query in writing to the Institute CSO. At that time the CSO will consult with the Department Director and Principal Investigator to arrive at a decision in an expedited manner. The Institute CSO may consult the Institute CEO and/or a managing partner of the Clinic; however, the Institute CEO and CSO shall have sole authority to act as the judge for final resolution.

The Institute recognizes the issues raised in such publications as the Guide to the Ethical Practice of Orthopaedic Surgery, the New England Journal of Medicine’s policy on authorship, the authorship policy of The Journal of Bone and Joint Surgery, and the International Committee of Medical Journal Editors (ICMJE) on authorship and contributorship. It is the purpose of this section of the SPRI Guidelines for Research, Information Dissemination, and Authorship to discuss authorship in particular, but also to identify possible authorship abuse and how to resolve such problems and abuse. Table 1 defines types of authorship abuse.
### Table 1. Types and descriptions of authorship abuse [Ref. 6]

<table>
<thead>
<tr>
<th>Type of Authorship Abuse</th>
<th>Description</th>
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<tr>
<td>Coercion authorship</td>
<td>Use of intimidation tactics to gain authorship. Arguably a serious form of scientific misconduct.</td>
</tr>
<tr>
<td>Honorary, guest, or gift authorship</td>
<td>Authorship awarded out of respect or friendship, in an attempt to curry favor and/or to give a paper a greater sense of legitimacy.</td>
</tr>
<tr>
<td>Mutual support authorship</td>
<td>Agreement by two or more investigators to place their names on each other’s papers to give the appearance of higher productivity.</td>
</tr>
<tr>
<td>Duplication authorship</td>
<td>Publication of the same work in multiple journals.</td>
</tr>
<tr>
<td>Ghost authorship</td>
<td>Papers written by individuals who are not included as authors or acknowledged.</td>
</tr>
<tr>
<td>Denial of authorship</td>
<td>Publication of work carried out by others without providing them credit for their work with authorship or formal acknowledgment. A form of plagiarism and therefore scientific misconduct.</td>
</tr>
</tbody>
</table>

Generally speaking, the naming of authors to articles from the Institute will abide by the following standards:

**Definition of Authorship**

An “author” is generally considered to be someone who has made substantive intellectual contributions to a published study. An author must take responsibility for at least one component of the work, should be able to identify who is responsible for each other component, and should ideally be confident in their co-authors’ ability and integrity. Authorship credit should be based on 1) substantial contributions to conception and design, acquisition of data, or analysis and interpretation of data; 2) drafting the article or revising it for important intellectual content; and 3) critical revision and final approval of the version to be published. Authors should meet conditions 1, 2, and 3, above. All persons designated as authors should qualify for authorship as detailed above, and all individuals who qualify should be listed.

Individuals who have contributed to only one segment of the study or have contributed only cases or case material should be credited in a footnote, and such individuals should not be considered or listed as authors. Merely proposing a new idea or hypothesis, without active participation in the study, does not qualify that individual for authorship. Acquisition of funding, collection of data, or general supervision of the research group alone does not constitute authorship.

Table 2 summarizes authorship requirements.

**Table 2. ICMJE requirements for authorship and examples of contributions that do not qualify for authorship [Ref. 6]**

**Requirements for authorship**

“Authorship credit should be based on
1) substantial contributions to conception and design, or acquisition of data, or analysis and interpretation of data; and
2) drafting the article or revising it critically for important intellectual content; and
3) final approval of the version to be published; and
4) Agreement to be accountable for all aspects of the work in ensuring that questions related to the accuracy or integrity of any part of the work are appropriately investigated and resolved.
Authors should meet all conditions 1, 2, 3 and 4.”
All authors should be able to take public responsibility for their contribution to the work.

Examples of contributions that do not qualify for authorship but that should be acknowledged in the paper

1) Providing funding, technical advice, reagents, samples, or patient data.
2) Providing students or technical personnel who perform studies.
3) Routine collection of data.
4) General supervision of the research group.

Responsibility of Authors

Individuals listed as authors must be thoroughly familiar with all aspects of the study and should be willing to take responsibility for the accuracy and content of the portion of the manuscript to which he/she contributed. That is, each listed author should have participated sufficiently in the work to take public responsibility for appropriate portions of the content.

Table 3 summarizes the requirements and responsibilities of all categories of authors.

Table 3. Requirements and responsibilities of all co-authors [Ref. 6]

<table>
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<th>Author Category</th>
<th>Contribution and Responsibility to the Work and Publication</th>
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<tr>
<td>First author</td>
<td>Fulfills ICMJE authorship criteria. Performs bulk of the experimental work and manuscript preparation.</td>
</tr>
<tr>
<td>Senior author</td>
<td>Fulfills ICMJE authorship criteria. Typically the last person on an authorship list. Directs, oversees, and guarantees the authenticity of the work. Takes responsibility for the scientific accuracy, valid methodology, analysis, and conclusions of all work described in the paper. Able to explain all of the results described in the paper.</td>
</tr>
<tr>
<td>Corresponding author</td>
<td>Fulfills ICMJE authorship criteria. Typically assumed by the first or senior author. Must be a permanent employee of SPRI or a Steadman Clinic attending. Communicates with editors and readers. Provides specific information on the contributions of all coauthors to the paper. Ensures that all authors are aware of and approve the submission of the manuscript, its content, authorship, and order of authorship.</td>
</tr>
<tr>
<td>Middle/contributing author</td>
<td>Fulfills ICMJE authorship criteria. Contributions do not rise to those of first or senior author. Order of middle/contributing authors should reflect their relative contributions to the paper.</td>
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Order of Authors

Author order must be determined and agreed to prior to commencement of writing a manuscript. Prior to manuscript submission, the Department Director, participating Attending Surgeon(s), and participating Senior Staff are required to meet to determine and agree upon the final author order and contributorship per the above definition. This agreed upon final determination will ensure that all listed authors meet the above authorship definition and criteria prior to manuscript submission.
Authors will be listed in the order of importance to the execution of the three study segments listed above: Plan, do, write. The PI (or senior author) has the right to determine order of authors, but typically the first author should be that individual who has contributed the most overall effort followed in succession by the individual who contributed the second most, and so on. Such author order is separate from and not to be confused with investigator order as it appears on the research protocol. It is extremely important to realize that “gift authorship” or adding any author who has not participated as noted above is considered literary fraud and must not be allowed to occur. Original signatures of all authors are required on copyright releases, conflict of interest and disclosure forms, or on memoranda of agreement. The corresponding author for any manuscript coming from SPRI must always be a permanent employee of SPRI or The Steadman Clinic. That is, the corresponding author may not be a Fellow, an International Research Scholar, an intern, a visitor, or any other individual holding a temporary position within SPRI or the Clinic.

Authorship Dispute Resolution and Adjudication Subcommittee
Should any individual who is a co-author on a manuscript wish to dispute an authorship decision he/she cannot resolve with the first author or senior author, that individual must submit a timely query/complaint in writing to the SPRI RAC Chairman. At that time the SPRI RAC Chairman will consult with the Department Director and the first author and senior author to arrive at a resolution of the dispute. If a satisfactory resolution cannot be reached, the SPRI RAC Chairman will appoint three (3) extramural RAC members who are and must be free of any involvement or conflict of interest with the subject manuscript to serve on a RAC Authorship Dispute Resolution and Adjudication Subcommittee. The SPRI RAC Chairman will provide the written complaint to the subcommittee and describe what actions have been taken along with any other pertinent facts. The subcommittee will then function independently by reviewing the facts presented, having teleconferences with the parties involved if deemed appropriate, and taking any other actions necessary. The subcommittee will then attempt to mediate an agreement between the parties to reach a final resolution. If a resolution cannot be reached, the subcommittee will make a specific recommendation to the SPRI RAC Chairman. The SPRI RAC Chairman will then consult with the Institute CEO and/or a managing partner of the Clinic on the recommendations of the subcommittee; however, the Institute CEO and SPRI RAC Chairman shall have sole authority to determine the final resolution of the dispute. Table 4 further describes means to minimize and resolve authorship disputes. It also outlines additional actions that the Authorship Dispute Resolution and Adjudication Subcommittee may take if deemed necessary and appropriate.

Table 4. Recommendations for minimizing and resolving authorship disputes

1. All research institutions, journals, and scientific societies should have in place formal authorship policies. This present document is intended to serve as the formal authorship guidelines for Steadman Philippon Research Institute. The threshold for authorship on a scientific paper should be a direct and significant intellectual contribution to the study. [Refs. 1-8] All authors should have contributed to the writing of the manuscript. At a minimum, each author should have written at least the portion of the manuscript in which his/her contribution is discussed and should be able to take public responsibility for that contribution. [Refs. 1-7]

2. This present document sets forth how extramural members of the SPRI Research Advisory Committee (RAC) will serve as an Authorship Dispute Resolution and Adjudication Subcommittee of the RAC. The Authorship Dispute Resolution and Adjudication Subcommittee will be free from all real and perceived conflicts of interest. This subcommittee will be composed of three disinterested extramural RAC members appointed by the RAC Chairman. A different subcommittee may be constituted for each incidence that requires adjudication.
3. The Authorship Dispute Resolution and Adjudication Subcommittee will not be the final decision making body in authorship disputes. Rather, the role of this subcommittee is to provide a fresh set of eyes on the problem and to assist the individuals involved in the dispute to arrive at an ethical and professional solution.

4. The Authorship Dispute Resolution and Adjudication Subcommittee will have the authority to recommend that disciplinary action be pursued if clear evidence of abusive authorship practices is uncovered. “Coercion authorship” and “denial of authorship” (see Table 1) should be treated as scientific misconduct and be referred to appropriate institutional authorities for further investigation and disciplinary action.

5. All letters of submission accompanying manuscripts submitted by the corresponding author should include an authorship verification statement that is signed by each co-author and that describes his/her specific contributions.

6. The specific roles of all co-authors should be included in the published article, depending upon specific journal requirements. Deliberate falsification of the description of co-author contributions should be viewed as scientific misconduct.

7. Every effort should be made to avoid authorship problems from the outset. Authorships should be negotiated and defined in writing at the beginning of an investigation. Frequent communication between all co-authors should occur while study investigations are ongoing. Authorship should be discussed regularly and redefined in writing if necessary. These actions will obviate the need for the Authorship Dispute Resolution and Adjudication Subcommittee to become involved.

References

5. Who did what?: (Mis)perceptions about authors' contributions to scientific articles based on order of authorship, J Bone Joint Surg, 2003.
SPRI Authorship Agreement for All Publications

Check one box:

☐ Start of study       ☐ Start of manuscript preparation       ☐ Interim (if necessary)
☐ Prior to manuscript submission       ☐ Revision

Working Title of Paper: ____________________________________________

PI of Study: _________________________________________________________

Proposed Author Order _____________________________________________

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In keeping with the International Committee of Medical Journal Editors (ICMJE) on authorship and contributorship, I attest that I have contributed to the following.

(INITIAL all that apply in the numbered line that corresponds to your number above):

1.____|2.____|3.____|4.____|5.____|6.____|7.____ Study conception OR
1.____|2.____|3.____|4.____|5.____|6.____|7.____ Study design OR
1.____|2.____|3.____|4.____|5.____|6.____|7.____ Data collection OR
1.____|2.____|3.____|4.____|5.____|6.____|7.____ Data analysis and interpretation

AND

1.____|2.____|3.____|4.____|5.____|6.____|7.____ Drafting initial manuscript OR
1.____|2.____|3.____|4.____|5.____|6.____|7.____ Editing initial draft of the manuscript

AND

1.____|2.____|3.____|4.____|5.____|6.____|7.____ Approval of the final manuscript to be published

AND

1.____|2.____|3.____|4.____|5.____|6.____|7.____ Finally, I agree with and will be accountable for the findings and conclusions presented in this paper.

Corresponding Author _____________________________________________ Signature ______________________________

Department/Laboratory Director ____________________________________ Signature ____________________________

Chief Scientific Officer Signature _________________________________

Date _______________________________
This format should be followed for all formal proposals, submissions to Institutional Review Boards, and proposals for outside funding. If a reviewing body has a specific format that must be followed, then that format must take precedence. (Additional formatting information and requirements are available from the Vail Health IRB administrator.)

**TITLE PAGE:** Include title of the proposal, principal investigator, all co-investigators, name of institution(s), contact information for PI, and proposed initiation and completion dates.

**ABSTRACT:** Briefly state the problem, hypothesis, specific aims, methods, expected results, and significance.

**INTRODUCTION AND BACKGROUND:** State the problem clearly and in detail, including the significance of the problem. Provide a thorough review of the literature on this problem. Either attach the literature search or state when it was completed. Cite only pertinent references.

**PREVIOUS WORK BY THE AUTHORS:** Describe any work already completed. Cite published literature by the authors.

**HYPOTHESIS:** State clearly the hypothesis/null hypothesis of this study and what specific question is to be answered. Include the purpose and specific aims of this study.

**OBJECTIVES/STUDY QUESTION:** Be specific.

**CLINICAL RELEVANCE:** Provide a clear statement of how results of this study will influence clinical practice.

**MATERIALS AND METHODS:** Give specific details of how the study will be carried out (i.e., the study design). Describe resources to be used. Explain and justify the sample size, including a power analysis. State how the data obtained will be analyzed, including statistical tests to be used. Describe the subjects or patients. For the inclusion criteria, describe clearly the patient/subject population to be included. For the exclusion criteria, be specific and include the following statement: “No exclusion criteria shall be based on race, ethnicity, gender, or HIV status, unless exceptions are stated and justified.”

**RISKS AND BENEFITS:** State any anticipated risks to human subjects if applicable. State if there are any direct benefits for subjects enrolled in this study (there rarely are any). State a justification for use of animals if applicable. If radiation is involved, you must use the standard Vail Health IRB verbiage.

**CONFIDENTIALITY:** Explain how data and patient/subject privacy will be protected.

**REFERENCES:** List pertinent references cited above. Use a standard medical journal format.

**BUDGET:** Provide a detailed budget and justification for additional expenditures. Include human resources.

**SIGNATURE PAGE:** Include the signatures of the PI, all co-investigators, the Department Director who will be called upon to provide support to the study if not an investigator, and the Clinic Service Chief (noted above), if applicable for a clinical study.