Advances in sports medicine help keep people of all ages and abilities in the game of life. In 2018, the members of the AOSSM Research Committee applied newly-calibrated priorities and a nimble infrastructure to their diligent pursuit of promising opportunities in research.

The diversity of experience and perspectives represented by the distinguished members of the committee strategically inform our decision-making strength. New awards in 2018 addressed a range of important priorities as defined by the recently refreshed AOSSM Research Agenda. From the science of acellular bioactive dynamic nanofibrous scaffolds and the effects of bone marrow concentrate on intra-articular tissue to the art of improving patient-reported outcomes data, our 2018 research explored exciting initiatives that offer groundbreaking potential for everyone from all-star athletes to armchair quarterbacks.

The members of the committee and I eagerly look forward to the continued evolution of the research projects in which AOSSM, its industry partners and its individual donors have invested. Momentum is strong and results are gaining traction. At last count, AOSSM research has been showcased in more than 120 publications, received more than 700 scholarly citations and provided a sound foundation for actionable new science and technologies.

Matthew T. Provencher MD MC USNR
AOSSM Research Committee Chair
The AOSSM Research Mission

To enhance value in sports medicine through the development, promotion, and encouragement of cutting-edge research that improves patient care.

AOSSM Research Investments

- Annual Grants
  - Total $3,150,000
- One-Time Grants
  - Total $650,000
- Clinical Studies
  - Total $1,104,000
- Research Awards
  - Total $386,000
- Think Tanks
  - Total $682,000

Total
- $5,972,000

2018
- Annual Grants $220,000
- One-Time Grants $150,000
- Research Awards $31,000
- Clinical Studies $35,000
AOSSM Research Agenda

The AOSSM Research Committee introduced a new, focused research agenda in 2018. The agenda’s well-defined, strategic and operational goals ensure transparency, communication and flexibility for the development of actionable new science and innovative technologies that improve safety, prevent injuries and explore biologic enhancement of tissue healing and emerging issues and opportunities.

The agenda’s high-impact priorities begin with the advancement of biologics in sports medicine. Often viewed as the future of orthopaedics, regenerative products are ripe with potential research projects to determine their optimal use in sports medicine. Concepts range from the implementation of cellular therapies and biologics in tendons, ligaments, cartilage and to scaffolds to translational studies and multi-center clinical trials.

A re-energized focus on osteoarthritis emphasizes the pre-osteoarthritic joint, prevention of osteoarthritis in the knee and hip and the role injury plays in osteoarthritis.

Other high priorities include the development of protocols, objective criteria and standardization to prevent reinjury for return to play; the importance of patient-reported outcomes and their role in demonstrating the value of sports medicine; and determining epidemiology, long term effects, evaluation and monitoring of youth sports injuries, including early sports specialization.

The agenda reflects the unity of the 30 committee members who worked together in thoughtful deliberation.

With formal approval by the AOSSM Board of Directors, the agenda now provides vision and direction for successful grant proposals, prospective partners, relevant government agencies and biomedical researchers around the globe.

Today’s sports medicine researchers navigate a fast-paced and constantly changing health care landscape, which makes the agenda’s flexibility of pivotal importance. With inspiration from members and industry partners, AOSSM can harness the spirit of collaboration to expand and adapt its research priorities when appropriate to respond to new opportunities and breakthroughs in treatments and technologies.
AOSSM Research Grants

$5.9 million AOSSM investments in basic science, translational and clinical research

$436,000 AOSSM research investments in 2018

11 Active initiatives in the 2018 AOSSM research portfolio

Biologics

Improving Cartilage Regeneration

Biologics in Sports Medicine Grant II

After identifying biologics as the Society’s most important research priority, the AOSSM Research Committee hosted a think tank consensus conference with experts in biologics, sports medicine and other relevant disciplines. The proceedings of the conference were widely disseminated through the American Journal of Sports Medicine and the Orthopaedic Journal of Sports Medicine. Knowledge gaps were identified, prioritized and then used to stimulate grant proposals. After a competitive, peer-reviewed process, the AOSSM Biologics in Sports Medicine II Grant of $250,000 was awarded to Dr. Mauck and his team to help advance the emerging promise of biologics. RTI Surgical helped support this ground breaking research.

AOSSM gratefully acknowledges RTI Surgical for their support of this grant.

In the Mauck Laboratory at the University of Pennsylvania, principal investigator of the project “Acellular Bioactive Dynamic Nanofibrous Scaffolds to Promote Cartilage Repair,” Robert L. Mauck PhD has created a scaffold that is uniquely tuned to encourage cells that surround it to attach to the scaffold and invade its structure. The scaffold contains factors known to promote stem cell chondrogenesis and can slowly degrade, leaving behind healthy tissue. Utilizing gradients of growth factors and distinct fractions of nanofibers, the scaffold can release different agents at different times and has been proven in vitro by tracking proliferation and migration.

Dr. Mauck, with the assistance of James L. Carey MD MPH is now exploring the use of this optimized scaffold in long-term implantation studies in large animals. To adequately examine long-term fixation, the investigative team has developed a mini-arthrotomy approach combined with biodegradable pins to effectively secure the scaffold in the experimental defects. The large animal model phase of the study is evaluating several biologic compositions of the scaffold in conjunction with microfracture surgery over 12-week intervals. Ultimately the best scaffold composition from the 12-week experiments will be subjected to a controlled trial over a duration of one year.
AOSSM Research Grants

Outcomes

Improving Patient Outcomes

International Knee Documentation Committee Grant

Outcomes assessment is a way of life for physicians today. Development and dissemination of one of the premier outcomes tools—the International Knee Documentation Committee Subjective Knee Form (IKDC SKF)—has been a long-standing AOSSM endeavor. We are dedicated to enabling the integration of the IKDC SKF into physician offices to permit user friendly quality measurement. This two-phase project focused on updating the IKDC SKF for Computer Adaptive Testing (CAT) and integration into Patient Reported Outcomes Measurement Information System (PROMIS). Providing this significant investment to modernize the IKDC will help ensure it is the preferred knee outcome measurement tool in medicine.

Project to Evaluate and Update the IKDC

James J. Irrgang PhD, PT, ATC, principal investigator has made exciting progress in adapting the International Knee Documentation Committee (IKDC) Subjective Knee Form (SKF) into a patient-friendly outcome measurement tool utilizing Item Response Theory (IRT). Dr. Irrgang and his colleagues at the University of Pittsburgh are now conducting a trial to transition the SKF to a computerized adaptive test (CAT) and short forms.

Based on cognitive interviews and coding of responses from a diverse group of patients, the first phase of the project discovered several questions on the existing form that were difficult for patients to answer based on their understanding of their injuries. Revisions were then discussed with another group of patients, which resulted in a revised version of the SKF that presents no difficulties in patient comprehension of the questions. This revised version was pilot tested in a cohort of patients with different knee injuries or disease and analyzed for amenability for modification into short form versions or CAT. The results of these analyses were encouraging and indicate that the revised IKDC SKF questions display the IRT qualities necessary to produce short forms and CAT versions.

In the second phase of this project, Dr. Irrgang and his investigative team are rigorously testing the revised SKF in a representative cross-sectional cohort of 750 patients and administering the existing IKDC SKF to perform a crosswalk between the new and old versions. Participant responses will allow the investigative team to select and calibrate a final pool of questions for the IKDC SKF. In addition, this data will permit Dr. Irrgang and his team to conduct a simulated CAT to determine if an IKDC SKF CAT version and short forms are warranted.

Improving ACL Reconstruction Return to Play Outcomes through Psychologically Informed Rehabilitation

At Vanderbilt University, Kristin Archer PhD, DPT is leading this multi-site, cutting-edge, randomized controlled trial in collaboration with the Cleveland Clinic. The results are contributing to a growing collection of data that helps sports medicine physicians understand how treatment outcomes may be outweighed by psychological outcomes from injuries, surgeries and rehabilitation. Leveraging the infrastructure of the Multicenter Orthopaedic Outcomes Network (MOON), the trial is utilizing Psychologically Informed Physical Therapy (PIPT) to investigate the psychological variables that prevent an athlete’s Return to Play. This trial has the potential to redefine the transdisciplinary model of health care by addressing how physical therapists interact with patients recovering from ACL reconstruction, as well as reinforcing the importance of modifiable psychosocial factors to those patients.

The results of this study will ultimately provide insights on why patients without significant deficits in knee stability and strength do not return to their preinjury level of sport after successful surgical reconstructions.

Return to Play

Getting Back in the Game

Return to Play Clinical Research Grants

Seeing an athlete get back on the field is what a sports medicine professional loves. AOSSM’s Return to Play Clinical Research Grant in coordination with The Aircast Foundation helps individuals at all levels of play do just that. We offered a $150,000 grant to projects investigating return to play after musculoskeletal injury. Participants enrolled in Return to Play projects can come from any sport, any age, or any level of participation. Collaborative, multi-center research studies that aim to improve clinical decision making are crucial competitors for this award that ultimately allow these projects to generate high level evidence to make their discoveries relevant and applicable.

AOSSM gratefully acknowledges The Aircast Foundation for their support of this grant.
Osteoarthritis

**Developing New Ways to Rengenerate Joints and Improve Function**

**Osteoarthritis Research Grants**

This important branch of research recognizes the impact of osteoarthritis and the preponderance of post-traumatic osteoarthritis (PTOA) within sports medicine and orthopedics. In coordination with Sanofi, AOSSM offers $50,000 each year to support a research project related to early osteoarthritis (OA) and/or prevention of OA progression. These studies are not required to relate specifically to sports injuries and aim for broad applicability to OA or PTOA in the general population.

AOSSM gratefully acknowledges Sanofi for their support of this grant.

A Novel Cartilage Mimicking Hydrogel Utilizes MSC’s to Create New Cartilage

Following their success in generating new cartilage with photopolymerizable cartilage mimetic hydrogel in a rabbit animal model, Cecilia Pascual-Garrido MD led a multidisciplinary team of investigators at Washington University in a research project to reproduce their results in a horse chondral defect model. After confirming that equine mesenchymal stem cells (MSCs) enhance chondrogenesis in vitro, the team developed a stepwise surgical approach to prepare chondral defects in a group of horses. These lesions are repaired with the MSC-infused hydrogel for comparison to a microfracture repair with or without hydrogel without MSCs. After six months, the investigative team examined the new cartilage and confirmed the ability to photopolymerize the hydrogel in situ. In addition, the investigation confirms that the biomimetic hydrogel can provide chondrogenic cues for cartilage repair. The data collected from this study significantly contributes to the growing evidence base for optimal adult stem cell-based therapies using hydrogels.

Changing the Trajectory of Injury-Induced Osteoarthritis with the Hunger Hormone

In a collaboration between basic science expertise and orthopaedic sports medicine knowledge, Li Zeng PhD, of Tufts University is evaluating inflammatory activity after anterior cruciate ligament (ACL) transection in mouse models. Specifically, Dr. Zeng is investigating how ghrelin, commonly called the hunger hormone, affects inflammation. Better understanding ghrelin’s role in limiting joint destruction after injury may help alter subsequent osteoarthritis severity. Dr. Zeng along with Elizabeth Matzkin, MD, have optimized ACL transection in mice to ensure the inflammatory activity observed is a result of the ACL injury. In vitro testing of ghrelin expressing viruses confirm inhibitory effects on human chondrocytes are conducive to limiting joint destruction and subsequent osteoarthritis. Dr. Zeng and her investigative team are also examining differences in inflammation and osteoarthritis progression between male and female mice. This project ultimately will provide the primary data necessary to determine if treatment of an injured ACL with ghrelin reduces the duration of early inflammation and has a positive impact on the trajectory of osteoarthritis.

Biomarkers for BMC in Post-Traumatic Osteoarthritis

Alan Getgood MD of Fowler Kennedy Sport Medicine Clinic is leading an investigation utilizing an innovative basic science project nested in a randomized controlled trial to explore anti-inflammatory, anabolic, and/or catabolic effects of bone marrow concentrate (BMC) on intra-articular tissue. This project utilizes BMC samples from all patients to characterize BMC biomarkers, and in vitro explants from the trial’s control group are exposed to BMC to elucidate the capabilities of BMC to reduce inflammation and degradation of the articular cartilage, meniscus, and synovium.
Advancing a New Generation of Researchers

Our early career researcher grants train surgeons undertaking orthopaedic sports medicine research, as principal investigators with the assistance of an experienced supervisor and investigative team. The young investigator performs the primary role in generating the hypothesis, designing the experiment, carrying out the experiment, and interpreting the results. This $50,000 grant ideally serves as seed money to start a line of inquiry that can develop into a career dedicated to high quality research investigation.

Quantitative MRI Correlates to Severity of Patient-Reported Symptoms in FAI

Alan Zhang MD of the University of California, San Francisco is studying the role of quantitative magnetic resonance imaging (MRI) in femoracetabular impingement (FAI). The first phase results of this AOSSM Steven P. Arnoczky Young Investigator project are showcased in the Orthopaedic Journal of Sports Medicine. This first-of-its-kind cohort study reveals correlations between the pre-operative patient-reported outcomes of patients with symptomatic FAI and pre-operative quantitative MRI findings as well as operative arthroscopic findings. Dr. Zhang reports that femoral cartilage damage detected by quantitative MRI is moderately correlated with lower scores on the Hip Disability and Osteoarthritis Outcome Score (HOOS) Pain, Symptoms, and Activities of Daily Living subscales. Dr. Zhang further reports that changes detected in symptomatic patients may have more impact on FAI symptoms than other tears or cartilage damage. For phase two of this project, Dr. Zhang is following his cohort of symptomatic FAI patients at one-year post-op to determine the effects of arthroscopic femoroplasty on cartilage health. Once again, Dr. Zhang is using quantitative MRI to evaluate hip cartilage and patient-reported outcomes to compare follow-up data with published pre-op data to confirm the hypothesis that arthroscopic femoroplasty can prevent articular cartilage degeneration and improve patient-reported outcomes.

Comparing Hip Cartilage Strain Using 3D Mesh Models

Building on successful cartilage strain pattern research in the knee, ankle and shoulder, Brian Lewis MD is leading an investigative team at Duke University to assess the continuum of hip joint disease with 3D imaging in a group of healthy controls and asymptomatic controls compared to symptomatic FAI patients with cam or pincer morphology. Optimal MRI sequences to provide the necessary details in the hip are being developed by the investigative team to test multiple hypotheses with this cohort of patients and elucidate variations in cartilage strains to establish a link between FAI and the development of osteoarthritis.

Exploring the White-White Zone of the Meniscus

Jorge Chahla MD, PhD is leading an investigation at Cedars-Sinai Medical Center in New York to re-evaluate the microvasculature of the meniscus while also assessing the resident stem cell population of the previously considered avascular zone. Dr. Chahla and his team are utilizing cadaveric menisci and advanced techniques and technologies to gain an understanding of the regenerative potential of the white-white zone in order to facilitate better treatment of meniscal tears.
"In a field with rapidly evolving possibilities in imaging, biologics and potential tissue regeneration, my generation stands to revolutionize the way orthopaedics is practiced."

– Kwado Owusu-Akyaw MD

(Duke University) 2019 AOSSM Clinician Scholar Development Program delegate

Educating Patients on Outcomes Collection

Nikhil Verma MD is conducting a randomized controlled trial at Rush University Medical Center to compare patient education regarding PROs to routine e-mail reminders in order to increase compliance with post-operative completion of a simple set of PROs using electronic and web-based methods. Dr. Verma is assessing three experimental groups, pre-operative education about the importance of PROs plus e-mail reminders, pre-operative PRO education plus post-operative PRO reviews at six months plus e-mail reminders, and monetary incentives plus e-mail reminders. With all the hallmarks of a methodologically rigorous randomized controlled trial, this study will offer a unique perspective on the long-term completion of PROs.

Social Incentives for Patients Completing Patient-Reported Outcomes

Richard C. Mather III, MD, MBA from Duke University implemented a rigorous investigation to explore how to increase response rates to routine outcomes follow-up after a healthcare intervention. Utilizing carefully constructed social incentives compared to no incentives or monetary incentives, Dr. Mather and his colleagues are evaluating the results of 3,000 surveys from patients who underwent sports medicine procedures in the previous one to two years to determine if patients would complete follow-up patient-reported outcomes (PROs) when offered a personalized social incentive. The incentives are designed to match the demographics of the surveyed patients as supported by current behavioral economic practice. Dr. Mather and the investigative team anticipate that the response rate will meet or exceed monetary incentives and establish characteristics of patients who respond to social incentives. The investigative team plans to utilize their results to create a protocol for use in randomized controlled trials that will increase response rates to long-term follow-up with PROs.

Clinician Scholar Development Program

Kwadwo Owusu-Akyaw, MD, a PGY-5 orthopaedic surgery resident at Duke University, was selected by AOSSM to attend the annual AAOS / OREF / ORS Clinician Scholar Development Program (CSDP) retreat in the fall of 2018. This select group of young orthopaedic surgeons is dedicated to clinician-scientist careers. Opportunities such as the CSDP are critical to encouraging synergy and partnership amongst like-minded colleagues as we enter the next frontier of musculoskeletal care.
AOSSM Research Grant Award Recipients

Steven P. Arnoczky Young Investigator Grant Winners

2018
Jorge Chahla MD, PhD
Cedars-Sinai Medical Center, Los Angeles, CA
Revisiting the Vascularity and Stem Cell Population of the Meniscal Avascular Zone Using 3D Imaging Technique

2017
Brian Lewis MD
Duke University, Raleigh, NC
In Vivo Evaluation of Femoroacetabular Cartilage Strain

2016
Alan Zhang MD
University of California at San Francisco, San Francisco, CA
Quantitative Magnetic Resonance Imaging for Femoroacetabular Impingement of the Hip

2015
Thomas Kremen MD
Cedars-Sinai Medical Center, Los Angeles, CA
Novel In Vivo Nuclear Imaging of Stem Cells in Tendon Regeneration

2014
Perry R. Altman MD
Beaumont Hospital, Detroit, MI
Stem Cell Mobilization and Chemokine-directed Intra-articular Migration of Native Marrow-Derived Stem Cells: Acute Phase Treatment to Mitigate Post-Traumatic Osteoarthritis Following ACL Rupture

2013
Ermias Abebe MD
University of Pittsburgh Medical Center, Pittsburgh, PA
The Effects of ACL Deficiency on Meniscal Strain and Cartilage Deformation

2012
Mark C. Drakos MD
Feinstein Institute for Medical Research, Manhasset, NY
Enhancement of Achilles Tendon Repair Viscoelasticity with Blockade of Matrix Metalloproteinase

2012
Benton E. Heyworth MD
Children’s Hospital Boston, Boston, MA
Trans-Articular versus Retro-Articular Drilling of Stable Juvenile Osteochondritis Dissecans Lesions: A Multicenter Randomized Controlled Trial

Grant Impact Since 2003

- 51 grants awarded since 2003
- 120+ publications
- More than 700 citations

Average is 2.7 publications per grant
Average is 15.8 citations per grant
Sandy Kirkley Clinical Outcome Research Grant Winners

2018
Nikhil Verma MD
Rush University Medical Center, Chicago, IL
Patient Outcomes Collection: How Can We Do Better? A Randomized Trial to Determine Factors Which May Affect Patient Compliance

2017
Richard C. Mather III, MD
Duke University, Raleigh, NC
Using Social Incentives to Increase Response Rate to Routine Patient Reported Outcome Measurement after Episodic Healthcare Interventions

2016
Jason Dragoo MD
Stanford University, Stanford, CA
Autologous Stem Cell Application versus Microfracture for the Treatment of Isolated Cartilage Defects

2015
Clare Ardern PhD
La Trobe University, Melbourne, Australia
Development and Trial of a Web-Based Toolkit to Facilitate the Return to Sport Transition After Anterior Cruciate Ligament Reconstruction

2014
Drew A. Lansdown MD
University of California at San Francisco, San Francisco, CA
An Evaluation of the Effects of Rotator Cuff Tear Size on the Progression of Fatty Infiltration with a Novel Quantitative MR Imaging Technique

2013
E. Todd Schroeder PhD
University of Southern California, Los Angeles, CA
Testosterone Administration and ACL Reconstruction in Men

2012
Olufemi Ayeni MD, MSc, FRCS(C)
McMaster University, Hamilton, Ontario, Canada
Arthroscopic Treatment of Femoroacetabular Impingement: A Pilot Randomized Trial

Publications per Grant

Citations per Grant
AOSSM Research Grant Award Recipients

continued

Osteoarthritis Research Grant Winners

2018
Alan Getgood MD
Fowler Kennedy Sport Medicine Clinic, London, Ontario, Canada
Stimulation of Endogenous Repair Following ACL Reconstruction (SERFAR)

2017
Li Zeng PhD
Tufts University, Medford, MA
Investigating Early Changes of The Joint Environment in Injury-Induced Osteoarthritis Progression

2016
Cecilia Pascual-Garrido MD
Washington University, St. Louis, MO
Cartilage Repair with Mesenchymal Stem Cells (MSCs) Delivered in a Novel Chondroitin Sulfate / Polyethylene Glycol Hydrogel in an Equine Animal Model

2015
Blaine Christiansen PhD
University of California Davis, Davis, CA
Inhibition of Cathepsin K for Preventing Osteoarthritis Following Non-Invasive ACL Rupture in Mice

2014
Robert H. Brophy MD
Washington University, St. Louis, MO
Molecular Profiling of Meniscus and Articular Cartilage in Knees with and without Osteoarthritis to Identify Candidate Genes for Therapeutic Intervention

2012
Asheesh Bedi MD
University of Michigan, Ann Arbor, MI
Changes in Biomarkers of Cartilage Degeneration and Inflammation Following Arthroscopic Decompression of Femoacetabular Impingement

2009–2018 Research Grant Applications

![Bar chart showing research grant applications from 2009 to 2018]
Meniscus Allograft Transplantation Grant

2012
Scott A. Rodeo MD
Hospital for Special Surgery, New York, NY
Meniscus Allograft Transplantation: Quantifiable Predictors of Outcome

Innovative Outcomes Assessment Grant Winners

2012
Gregory D. Myer PhD
Cincinnati Children’s Hospital Medical Center, Cincinnati, OH
Optimization and External Validation of Non-invasive Outcome Prediction Algorithm for Knee Osteochondritis Dissecans in Children

2011
Stephen L. Lyman PhD
Hospital for Special Surgery, New York, NY
Validation of Electronic Knee Specific Patient Reported Outcome Instruments

2008–2018
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AOSSM gratefully acknowledges our partners in supporting sports medicine research and education.

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