



22

# The Bone and Joint Institute is taking its place on the world stage

Our ability to move is key to quality of life and the well-being of our communities. Through better designs of bone implants, solutions for age-related bone disease, improved methods to rehabilitate and support damaged limbs, and remote medicine, the institute is focused on improving the lives of people of all ages around the world. Hallmarks of this institute include its catalyst grant program and transdisciplinary research training awards. These programs support unique early-stage collaborative interdisciplinary research projects that aim to bring different experts and trainees together to begin to tackle complex global musculoskeletal challenges like the alarming rise in degenerative diseases requiring joint replacements and unsustainable associated cost for individuals as well as health and social systems.

In partnership with the Morrisette Institute for Entrepreneurship, the BJI also enables researchers and entrepreneurs to move new and innovative products along the commercialization path. This past year, the MSK Innovation Competition and mentorship program supported Vessl Prosthetics, a Western-born start-up company.

Looking outward, bigger and broader with respect to research priorities, BJI facilitated and supported work related to technology-enabled health care with a focus on studying remote care models. A central goal of that work is to find ways to provide better and more equitable access to care. I look forward to further advances by this group related to products and services that improve the musculoskeletal health and care experience of everyone!

**KEVIN SHOEMAKER**  
Associate Vice-President (Research),  
Western University

## A Message from the Acting Vice-President of Research

Our Western Research institutes – The [Bone and Joint Institute](#) (BJI), the [Institute for Earth and Space Exploration](#) (Western Space), the [Institute for Neuroscience](#) (WIN), and the [Rotman Institute of Philosophy](#) (Rotman) – have come together to support researchers who advance excellence in interdisciplinary research. This important work complements the strong faculty-based research programs at Western, thereby amplifying research impact and elevating the university's reputation locally, nationally and globally.

Institute programs and services enable institute members to participate in research that would otherwise not be achieved

through more traditional individual or team research work. With multiple mechanisms in place to identify important interdisciplinary research questions, support knowledge exchange, enhance interdisciplinary research training, and explore unique perspectives within and outside academia, our institutes have created a research environment that welcomes new ways of being, doing and thinking.

I look forward to seeing what they do next and encourage you to read the highlights from 2022 and to reach out to learn more about current activities as well as ways to get involved.



**BRIAN NEFF**

Acting Vice-President (Research),  
Western University

## A Message from BJI's Director

The Bone and Joint Institute is a catalyst for transdisciplinary research to support the vision of lifelong mobility through musculoskeletal health. We serve our members and partners through activities that promote innovative research ideas, train the next generation of musculoskeletal health researchers, and ensure translation of research into the clinic and the community.

2022 was filled with events to bring our community together and the delivery of programs that further our mission. We continued our successful catalyst grant and transdisciplinary training award programs that build new teams to take on exciting and novel research projects. We named a Western-grown start-up company making more

comfortable prosthetics as the winner of our annual innovation competition. Finally, we brought together researchers from across the country by hosting the bi-annual Canadian Bone and Joint Conference.

Ensuring lifelong mobility requires a broad approach across disciplines. The stories in this year's report are only a small example of the work our members are undertaking. What stands out across these stories are themes of teamwork and the support of new ideas that make a meaningful difference to patients and their communities. The Bone and Joint Institute is proud to support Western's culture of excellence in bone and joint research.

**MATTHEW TEETER**  
Director (Bone and Joint Institute),  
Western University

# Bone and Joint Institute

Pain and disability from musculoskeletal conditions prevent individuals from living their lives to the fullest. Western's Bone and Joint Institute (BJI) is focused on research excellence towards eliminating the tremendous personal and societal costs from musculoskeletal conditions.

BJI catalyzes progress and innovation through mechanisms that foster the formation of transdisciplinary teams. Together, institute researchers tackle complex challenges and move research out of the lab into clinics and communities.





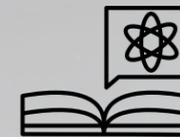
# 307

members total, including **121** faculty, **96** trainees, and **90** other members (partners, collaborators, and staff)



# \$117M\*

in multi-year funding



# 445

publications tracked in Altmetric in 2022

372 had a total of **6,694 mentions on social media**

**397** references in news stories

172 open-access papers with **citation impact of 1.35 times the world average**



# 52

prestigious awards, including **24** Research Chairs, **4** Fellows of the Royal Society of Canada, **5** Distinguished University Professors, and **9** Faculty Scholars



# 744\*

members held **406** external grants and **338** internal grants



# 42

new Tri-agency grants, totaling **\$10.78 million**

represents **11.4%** of the total number of Tri-agency grants awarded at Western and **15.7%** of total Western Tri-council funding in 2022

average **BJI member Tri-agency grant was 79% larger** than the Western average (\$90,588 versus \$50,542)



# 501

MSK papers published

**35 among the top 10%** of most cited publications in Web of Science

**166** (41.8%) were co-authored with international scholars from 45 countries/regions with **citation impact of 1.52 times the world average**

**citation counts higher than 31%** of the publications in the Web of Science



# 5

faculties are represented through members: **Schulich, Health Sciences, Engineering, Science, and Social Science**



# 4

think tanks

# Western Researchers Bring X-Ray Technology to Developing Countries



**DAVID HOLDSWORTH**  
Surgery and Medical Biophysics,  
Schulich School of Medicine & Dentistry

Roentgen discovered x-rays well over a century ago, yet nearly two-thirds of the world's population has no access to diagnostic medical imaging, according to the World Health Organization.

A startling statistic, says David Holdsworth, professor of surgery and medical biophysics in the Schulich School of Medicine & Dentistry, and one that needs to be rectified. To do just that, Bone and Joint Institute (BJI) member Holdsworth and a team of African and Canadian medical imaging experts are in the process of developing a cost-effective, portable digital x-ray system. It will help clinicians in low- and middle-income countries to provide better medical care and prevent broken bones from growing into long-term health issues.

"Road accidents are on the rise in low- and middle-income countries, and that means muscle and bone injuries are on the rise, too. Accidents account for over 90 percent of serious injuries," says Holdsworth. "If

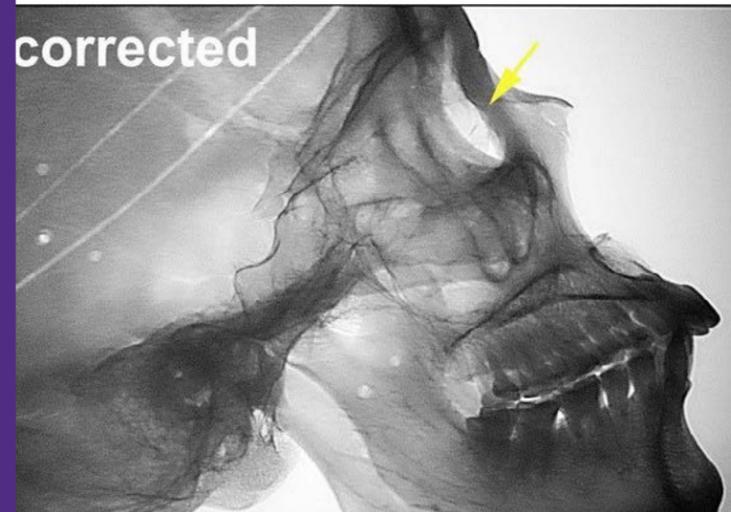
someone breaks a bone but can't get an x-ray at their rural clinic, that can lead to the fracture not setting correctly and subsequent long-term disability," says Holdsworth.

The scarcity of x-ray technology in developing countries stems from many reasons: from civil unrest, to restricted resources, or lack of reliable power. In addition, complex imaging devices that need to be operated by specialists aren't a good fit for rural and remote areas. That's why developing an x-ray system that is easy to build, maintain, and operate, is key in increasing equitable and wide-spread access to x-ray technology, says Holdsworth: "The solution is not to send obsolete equipment that we don't want anymore. It's not even collecting money and sending new equipment in boxes. It's working to develop systems that can be made and distributed and maintained locally."

Holdsworth's "bootstrap" imaging system has the potential to produce high quality digital x-ray images with minimal equipment: a portable x-ray tube, a phosphor screen, and a digital camera. State-of-the-art digital cameras are equipped with extremely sensitive image sensors that can transform even the smallest amount of light – such as the glow coming off a phosphor screen – into high quality images. Holdsworth's plan involves leveraging those advances in camera technology to capture digital x-ray images that give traditional imaging machines a run for their money.

Holdsworth says he received crucial support that helped develop and test his system through the Frugal Biomedical Innovations team, led by James Lacefield, director of the School of Biomedical Engineering at Western. The team received funding in December 2021 through Western's strategic priorities fund, a unique \$20-million funding initiative to support key areas of the university's strategic plan.

Holdsworth also just got news that he secured a competitive (<5 percent success rate) NSERC Discovery Horizons grant for \$480,000.



*To verify his proposed x-ray system, Holdsworth tested his theory with a prototype system and managed to produce high-quality x-ray images of a human skull.*

Both the grant and the idea for the x-ray system were accelerated by a Bone and Joint Institute catalyst grant in 2020, he says. The grant supported the work of Holdsworth and biological anthropology professor and BJI member Jay Stock in building a portable CT and x-ray scanner to image human bones found at archaeological sites.

"You can't just take artifacts and put them in your suitcase and scan them at home. They are

protected. But there are no scanners on site. In talking about this problem, I said something like, 'Well, you could just use a camera and phosphor and you could probably get a scan.' And through the BJI grant, we were able to set up a system to acquire x-ray images of bones. And they looked really good."

Having already conducted research that proved his theory helped tremendously in securing additional funding for related projects, Holdsworth says: "We already had data from our Bone and Joint catalyst grant demonstrating the proof of principle. And we had images. I mean, you don't have things like that just lying around in the timescale that you have to put one of these grants together."

**“Western has the potential to become a centre of excellence for research that fosters health and equity in remote, rural and low-income countries.”**

Looking towards the future, he hopes that his portable x-ray system will find many uses that serve people and places around the world, while raising Western's profile as a leader in health and equity research: "I think that Western has the potential to become a centre of excellence for research that fosters health and equity in remote, rural and low-income countries. It's a huge area of growth and there are so many opportunities."

## SERVING IMPLANT PATIENTS BY DETECTING CORROSION ON A NANOSCALE

According to the Canadian Institute for Health Information, more than 137,000 joint replacement surgeries took place in Canada in 2020, costing the healthcare system north of \$1.4 billion. And each year, 8,000 to 10,000 of these replacements are unsuccessful and require risky revision surgery that are nearly twice the price of the original surgery not to mention huge indirect cost to the patients.

Understanding why these implants fail is at the core of Yolanda Hedberg's work as a professor in the Faculty of Science. A corrosion science expert, Hedberg has dedicated her research to analyzing and predicting material deterioration that could result in health hazards or environmental pollution. Joint implants are of special interest to her as a BJI Scientist. For patients in need of joint replacements, receiving a durable implant means avoiding painful bone and tissue damage, infection, and multiple surgeries along with drastically improving their quality of life. Creating implants that can withstand the daily stress of joint movement, however, is a big challenge.

"When you think about it, joints are in motion, and this means there is a lot of wear," says Hedberg. "From an engineering perspective, it is really hard to make joint implants as good as natural joints. You have to connect different materials and that increases the risk of incompatibility, which can lead to corrosion."

Failed implants retrieved from patients can provide important clues in understanding what went wrong.



**YOLANDA HEDBERG,**  
Chemistry,  
Faculty of Science

**"We can exactly measure how much volume of mass has been lost in that implant. That is a game changer for Western and for implant retrieval-related research."**

Hedberg is planning on taking implant analysis to the next level with a new optical coordinate measuring machine. The machine can detect and map how much material has been lost due to wear and corrosion, which will provide researchers with invaluable insights into why implants fail.

"We currently use electron microscopy and optical microscopy to score corrosion severity and material deposition. An optical microscope needs to be electrically conductive, and you can only put it at a certain angle because the detector is fixed. The new instrument has many different axes. It rotates around the implant and measures the surface really fast without making contact," says Hedberg. "We can exactly measure how much volume of mass has been lost in that implant. That is a game changer for Western and for implant retrieval-related research."

To support her work, Hedberg was awarded a 2022 Catalyst Grant by the Bone & Joint Institute. The grant will provide \$30,000 to help Hedberg and her team conduct research on retrieved hip implants. The team will measure and analyze material loss due to corrosion on 129 implants of a certain design.

Hedberg hopes this interdisciplinary research project will better position the team to secure major funding to develop higher quality implants, detect faulty designs early on, and identify high risk patients.

"You already need to have funding in place to be successful in applications for other grants, and that's where the Bone and Joint Institute and their seed grants can really help. You can show in your CV that you and your co-applicants already

work together and already got grants, and it increases your chances by a lot."

### **Think Tanks to Find Synergies and Advances That Improve Patients' Lives**

In the meantime, she has joined the effort of a large interdisciplinary team at BJI that leverages many experts and methodological strengths to tackle orthopaedic infections. When implants get infected, it is difficult to assess if the implant needs to be taken out or if infection around the implant might heal itself. That often means additional surgeries, long recovery times, or even amputation in some cases.

**"The Bone and Joint Institute and their seed grants can really help. You can show in your CV that you and your co-applicants already work together and already got grants, and it increases your chances by a lot."**

Team members like Chief of Surgery at the London Health Sciences Centre and St. Joseph's Health Care Emil Schemitsch have had their eyes on equipment that could improve patient outcomes: a mass spectrometry knife, or iKnife. This would be the first at Western University. An iKnife would provide a minimally invasive way to make an informed decision and potentially spare patients the ordeal of a full revisions surgery and recovery.

To secure funding for the iKnife and other equipment that would advance Hedberg and many other researcher's work, BJI leaders prioritized think tanks to identify synergies and build cohesive large-scale programs of research in which all team members and equipment requested complemented each other towards a common goal.

Working together in this way allows experts with different backgrounds to consider multi-pronged approaches from imaging wear particles and biofilms to real time tissue analysis

in the surgical room. "This way of thinking and doing is showing promise in helping us elucidate the role of corrosion and wear in implant infections", Hedberg says.

BJI's think tanks are important mechanisms that enable the preparation of major grant applications. They support bringing researchers with a wide range of expertise together, including surgery, microbiology, medical imaging, genomics, drug delivery, materials chemistry, and biomedical engineering. Convening expert from such different fields is not easy and that is why major grant proposal never see the light of day without the institute, Hedberg says: "Requirements for major grant proposals are very complex. You need core applicants and a large number of collaborators that have to meet very specific diversity and interdisciplinary criteria. There is often a very low success rate, so you really need to check those marks."

**“The BJI was instrumental in getting a collaborative team together. Building consensus on large scale research programs has huge potential for finding solutions that will improve patient outcomes and reduce burden on health and social systems.”**

**FROM 2015 TO 2017, BJI FUNDED 17 PROJECTS, TOTALLING \$413,356 IN CATALYST GRANTS (~\$24,315 PER PROJECT.)**

**RECIPIENTS HAVE GONE ON TO SECURE MORE THAN \$6.8 MILLION OF OTHER FUNDING ATTRIBUTED DIRECTLY TO RESEARCH INITIATED BY THE CATALYST GRANT.**

## New Hope for Osteoarthritis Patients

**BJI seed money led to collaborative research on inflammation and recovery in people living with osteoarthritis.**



**TOM APPLETON**

Physiology and Pharmacology,  
Schulich School of Medicine & Dentistry

When rheumatologist and BJI Scientist Tom Appleton received catalyst funding from the Bone and Joint Institute, he never imagined the research impact those early-stage grants would eventually have. He has now seen a small amount of seed money bloom into numerous big research collaborations, more than 15 publications, and close to \$4 million in grant funding, including three Institutes of Health Research (CIHR) grants and a Canada Foundation for Innovation (CFI) grant.

"The type of work that we do here can't be done by an individual scientist or even an individual research team. It's going to take multiple teams to be able to make that happen," Appleton says. "If we didn't have the institute and the people involved, we wouldn't have been able to bring all of those resources together."

The Institute, and the many opportunities it provides for interdisciplinary, collaborative research, attracted Appleton to join the Schulich School of Medicine and Dentistry

at Western University in 2016. As a clinician scientist and now chief of the division of rheumatology at St. Joseph's Health Care London, he says launching his career here really help to propel his research program.

Institute catalyst grants really enabled him to kick things off in 2017 as he worked with a new collaborative team to examine the association of joint lining thickening with patient outcomes after total knee arthroplasty for end-stage osteoarthritis (OA). Knee osteoarthritis (OA) is a leading cause of pain and disability globally.

Staying true to a central focus on OA, he collaborated with two catalyst grant teams starting in 2019, to evaluate a new potential disease-modifying drug and delivery system as well as to measure changes in bone blood flow in patient who are healthy and those living with OA. In 2020 and 2021, he led a successful catalyst application that broadened his focus to look at associations between biology, biomechanics and pain and participated on five other teams working on topics from patient satisfaction to imaging.

Working with colleagues such as Trevor Birmingham, a professor and Canada Research Chair in Musculoskeletal Rehabilitation in Western's Faculty of Health Sciences, was key to integrating the biology of inflammation research with gait biomechanics to better understand a body's function and movement and its effects on feet, ankles, knees, hips and back.

“We had a postdoctoral fellow, Hayden Atkinson, who looked at the change of inflammation after joint realignment surgery. He showed that the amount of inflammation dramatically decreases afterwards. That was a key concept for us to be able to apply to the CIHR project grant,” says Appleton.

member Geoffrey Pickering, vascular biologist and cardiologist, Appleton will examine changes in blood vessels that feed joints and observe the behaviour of cells within tissues at an incredibly high resolution. He predicts that this will shed crucial insights into diseases like osteoarthritis.

“Catalyzation doesn't happen overnight, but it ultimately leads to bigger and better things over time,” says Appleton. “The longer you wait until you look back, the more you realize, ‘Oh my gosh, this has really fanned out into a lot of ramifying benefits from what was initially a fairly straightforward idea.’”

**“A small amount of catalyst funding in the beginning and a critical collaboration through the institute led to a big program that is going to be many years and result in whole new discoveries.”**

Appleton managed to secure \$1.3 million in funding over five years through two competitive CIHR grants with a less than 20 percent success rate. The grants will support research on the effectiveness of knee bracing, a potential treatment for people with OA, as well as the long-term benefits of High Tibial Osteotomy (HTO), a type of surgery that straightens the lower limb of patients and has shown promising results.

“A small amount of catalyst funding in the beginning and a critical collaboration through the institute led to a big program that is going to be many years and result in whole new discoveries,” says Appleton.

At the same time, BJI's support led to a \$1.25 million in funding Canada Foundation for Innovation (CFI) grant in 2021 making Western the first university in Canada equipped with single cell level molecular spatial profiling technology. Using this technology along with collaborative team

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BJI's catalyst grant was crucial because it's quite hard to get seed money otherwise, especially as a Canadian researcher. Once you have multiple publications and a product in hand, it becomes easier to find folks who want to invest in you. But before all that, you need someone to believe in you and give you that lifting hand that gets you there.

**PARHAM RASOULINEJAD**

Surgery, Schulich School of Medicine & Dentistry  
Catalyst Grant & Innovation Competition Awardee

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The culture and community is just as important as the funding at BJI. Western is recognized nationally as one of the top musculoskeletal research intensive institutions, but if you want to really build on that strength, we need to foster people's entire careers not just start them. BJI is poised to do both.

**TOM APPLETON**

Physiology & Pharmacology,  
Schulich School of Medicine & Dentistry



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