

Pushing the Envelope for Upper-Extremity Injuries

When orthopaedic surgeon **John Ingari** came to The Johns Hopkins Hospital two years ago, he brought 25 years of experience as a surgeon in the U.S. Air Force. What he found at Johns Hopkins was the opportunity to combine this expertise with that of clinicians across disciplines to treat patients with the most complex upper-extremity injuries.

Such conditions include scaphoid nonunions, in which there is no blood supply to the scaphoid. Ingari is preparing to publish his own technique for vascularized bone grafting in such patients. He also recently worked as part of the Johns Hopkins hand/arm transplant team, collaborating with 18 experts, including neurosurgeons and plastic surgeons, to perform a successful upper-extremity transplant.

Ingari finds Johns Hopkins is on the forefront of both limb transplant and prosthetic design. “We’re now developing prostheses that are on the verge of getting sensation back to patients. For some patients, that’s the best option. For others, it’s a transplant. We’re pushing both envelopes at once.”

He is particularly enthusiastic about the advances in understanding the basic science of chimerism, which have led to less need for anti-rejection medications in transplant patients. “There’s a lot more



John Ingari, left, operates with surgical technician Lauren Powell, middle, and orthopaedic surgery resident Lara Atwater, right.

science that needs to be done to figure out how to avoid the need for immunosuppressants altogether. We’re not there yet, but we’re pushing,” he says.

The commitment to research in the hand division is strong, with orthopaedic surgery faculty members currently involved in three multicenter trials exploring the areas of fracture care, nerve regeneration and nerve repair. “At Johns Hopkins,” Ingari says, “we’re always asking, how do we push ourselves forward?”

Ingari is also proud of the care Johns Hopkins offers to the youngest upper-extremity patients. “Pediatric patients have their own ORs, their own anesthesia team, their own nursing care facilities,” he says. “We even have separate floors for teenagers so we can really customize care by age group. The size of the institution allows that kind of specialization.”

Ingari collaborates closely with plastic surgeons like **Jaimie Shores**, working together in a neuromuscular clinic to treat brachial plexus injuries. “We have geneticists on staff to help us understand whether patients have a syndromic condition versus a birth palsy,” he says. “Some need surgery and some don’t, and we work together to figure out the best approach for each patient.”

As motivating as Ingari finds difficult cases of wrist reconstruction, elbow replacement and vascularized bone grafting, he is equally

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ADVANCES AT JOHNS HOPKINS MEDICINE



Vascularized bone grafting



Prosthetic design



Fracture care, nerve regeneration, nerve repair



Science of chimerism



Limb Transplant

“At Johns Hopkins, we’re always asking, how do we push ourselves forward?... No surgery is mundane.”
—John Ingari



Educating Leaders Through Clinical Practice

A leadership program that houses the best” is how hip and knee surgeon **Daniel Valaik** describes the orthopaedic surgery residency program at the Johns Hopkins University School of Medicine. The faculty consists of highly experienced orthopaedic surgeons like Valaik who have a passion for sharing their knowledge with the next generation.

Valaik has long been connected with Johns Hopkins, where he completed his fellowship in adult reconstruction. After serving for 26 years in the U.S. Navy, Valaik recently returned to Johns Hopkins to join the Department of Orthopaedic Surgery faculty.

Valaik’s expertise is highly valued by the Johns Hopkins orthopaedic surgery residency program, which admits six applicants each year. The program’s emphasis on clinical training is supported by a didactic curriculum for basic and clinical sciences. In addition to Grand Rounds and subspecialty teaching conferences, teaching sessions are held at Johns Hopkins Bayview Medical Center’s International Center for Orthopaedic Advancement, which houses an orthopaedic skills laboratory.

Privately owned by Johns Hopkins, the facility allows experts like Valaik to impart their surgical skills to residents, preparing them for the difficult surgeries they will face. “We model some of the most complex patients in the laboratory,” says Valaik.

In addition to an instrument development laboratory, the facility has high-tech biomechanical testing capabilities and a surgical dissection laboratory with six surgical stations fully equipped to allow residents to perform mock procedures. Here, residents become familiar with orthopaedic implants, devices and instruments, and receive

“We go through practice cases of the most complex variety, and the residents learn through hands-on experience.”
—Daniel Valaik

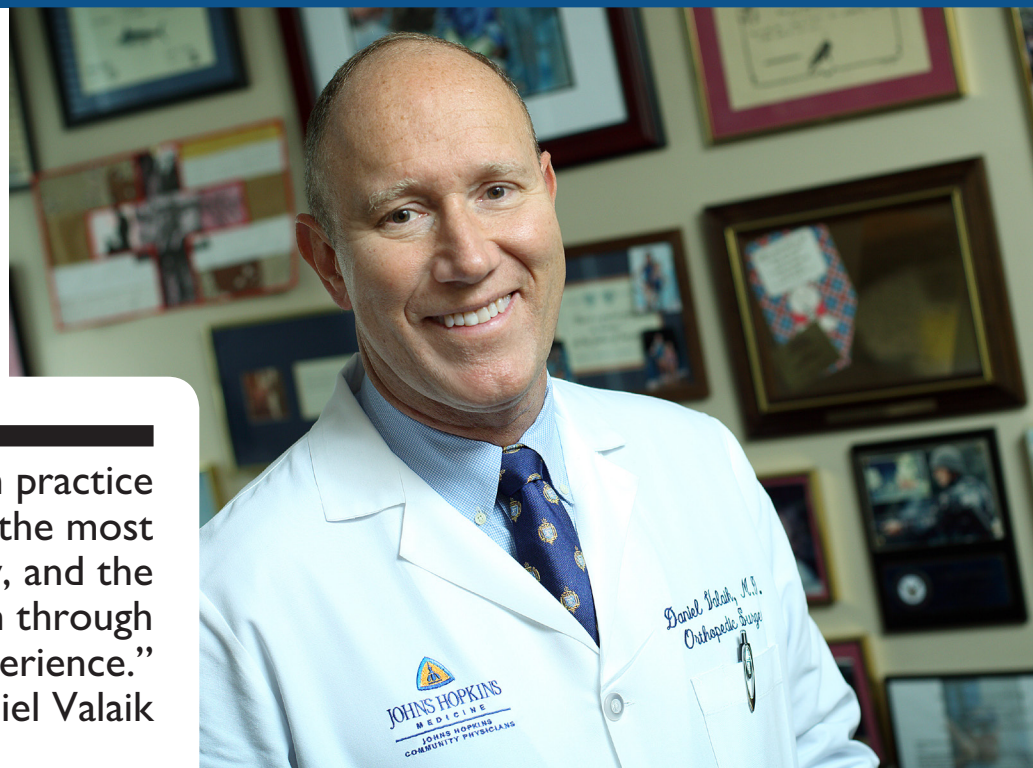
hands-on experience with orthopaedic models and fresh-frozen cadavers.

“We bring in all the instruments and implants that you would have in an actual case,” says Valaik. “We go through practice cases of the most complex variety, and the residents learn through hands-on experience.”

A tibial tubercle osteotomy in revision knee surgery is one challenging surgical approach that the residents can perform in the laboratory. This “tough revision approach,” as described by Valaik, is done step by step on a cadaver. “The tibial tubercle osteotomy requires you to precisely cut the tibial tubercle and reflect it over to obtain enhanced exposure to the knee. Meticulous repair and/or fixation of the osteotomy are also practiced by the residents.”

Teaching residents is an inspiring aspect of Valaik’s work. “These are smart young people, and they ask very good questions,” says Valaik. “I find that it keeps me on my toes. Every once in a while, they ask something that I had never thought of. This leads us to innovate and improve what we do.”

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The International Center for Orthopaedic Advancement:



Houses an orthopaedic skills laboratory and instrument development laboratory



Includes high-tech biomechanical testing capabilities



Houses a surgical dissection laboratory for mock procedures



Provides hands-on experience with orthopaedic models, fresh-frozen cadavers, orthopaedic implants, devices and instruments



Learn more about the International Center for Orthopaedic Advancement at bit.ly/IntCenter.

COMPLEX CASES

Acute Fractures: From Treatment to Prevention

What initially attracted orthopaedic surgeon and traumatologist **Babar Shafiq** to join The Johns Hopkins Hospital were the challenge of complex cases and the opportunity to care for patients with severe injuries, often with multiple comorbidities. As a Level I trauma center, the Johns Hopkins facility attracts patients with some of the most difficult fractures to manage. Some patients come to Johns Hopkins from the local and regional area via ambulance or by air after acute injury, while many others are transferred from other hospitals

when their injuries or medical problems necessitate advanced care.

Shafiq accepts referrals of patients with severe, acute traumatic injuries of the pelvis and extremities, and those who have failed fracture management, nonunions, malunions or deformity. In addition, he is able to manage patients with these injuries who also have severe medical comorbidities that put them at higher surgical risk. “I routinely receive referrals from other doctors in our hospital system and from other local and regional hospitals for patients who have a fracture but are also very sick,” says Shafiq.

The complexity of these cases requires Shafiq to team with specialists from other disciplines. “A patient may also have severe cardiac disease or have undergone an organ transplant. They may have kidney failure or a more obscure comorbidity, like osteogenesis imperfecta,” says Shafiq. The multidisciplinary team may include specialists from interventional radiology, cardiothoracic surgery, endocrinology, transplant medicine, neurosurgery and general trauma surgery.

To offer patients the best possible treatments, Shafiq performs minimally invasive pelvic, acetabular and extremity surgeries whenever possible. He also participates in numerous research efforts to improve surgical technique and patient outcomes. Teamed with fellow orthopaedic trauma surgeon **Erik Hasenboehler**, the two lead biomechanical cadaver studies to investigate the treatment of complex pelvic

Fracture Risk and Treating Metabolic Disease: **A Common Target?**

Orthopaedic surgeons who treat patients with low bone mass may be particularly interested in the work of **Ryan Riddle**, director of the Johns Hopkins Diabetes Research Center's Bone Biology Subcore.

Riddle and his team have discovered a link among the protein, sclerostin—which has a dramatic effect on bone mass—and whole-body metabolism. Riddle explains: “This protein was discovered recently by studying a small percentage of people who have very high bone mass. Their bone mass becomes so high that they start to develop nerve palsies because their nerve canals start to fill in [with bone] and they can't get nerve conduction. It's called sclerosteosis or Van Buchem disease.” Sclerostin, which is made primarily in bone, was found to dramatically increase bone mass when inhibited.

Researchers in Riddle's lab, along with the lab of colleague **Tom Clemens**, are working to understand the interaction between bone and the metabolism of the whole organism. To that end, Riddle is using a knockout mouse model that lacks sclerostin.

“As we would expect from the human studies, this mouse has dramatic increases in bone volume,” says Riddle. “But we've also discovered something else.” When they challenge the mice with a high-fat diet, the mice don't gain body fat as expected. “They don't develop the phenotypes that are

associated with diabetes in humans,” Riddle says. “They retain some of their insulin sensitivity.”

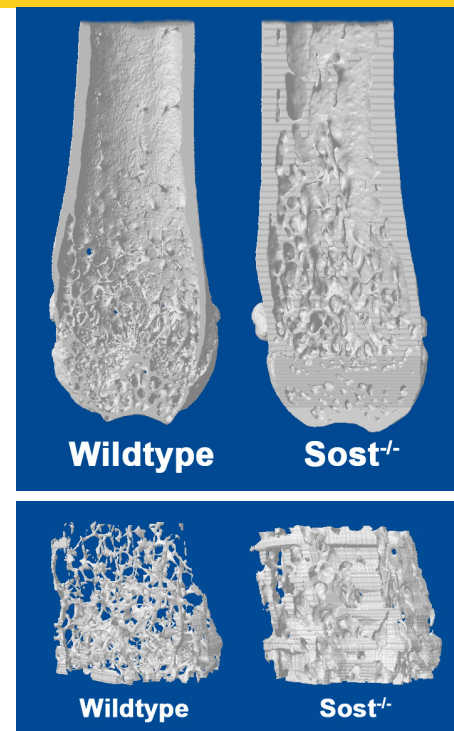
This indicates that the comorbid condition of low bone mass found in many patients with diabetes may be linked to sclerostin, potentially providing a common therapeutic target for both conditions. Riddle says this research may also be applicable to patients taking glucocorticoids, who are at risk for reduction in bone volume and increase in fat mass.

“Glucocorticoids are associated with changes in glucose homeostasis and insulin sensitivity,” he says. “One of the ways glucocorticoids influence bone is through regulating sclerostin, so we're planning to explore sclerostin in that context too.”

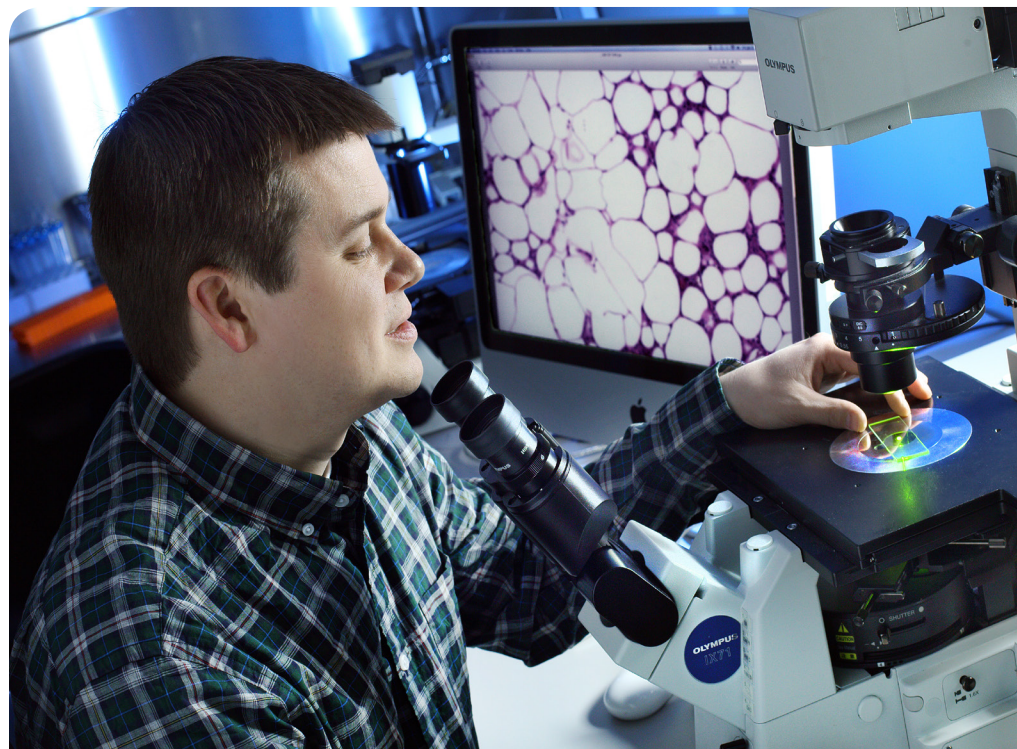
Riddle says his work benefits from the robust research environment at Johns Hopkins. “We have the ability to interact with many people in lots of different fields,” he says. “Many of our studies are exploring effects outside the skeleton, like the physiology of adipose, the liver or the pancreas. We've benefited from the ability to collaborate with investigators like **Michael Wolfgang** in the Department of Biological Chemistry and **Mehboob Hussain** in the Department of Pediatrics. They are helping us move beyond the bone, which is our area of expertise.”

This emphasis on integrative physiology is a hallmark of the work

of musculoskeletal researchers at Johns Hopkins. By expanding their teams to include experts in other fields and using the models their colleagues have developed for studying different organ systems, they not only strengthen their understanding of the musculoskeletal system, but also contribute more broadly to research that will underpin future therapies for a wide variety of common conditions. ■



Genetic manipulation of the *Sost* gene that encodes sclerostin results in the dramatic increase in bone volume evident in computer renderings of micro-computed tomography scans of the distal mouse femur, top, and vertebrae, bottom.



Babar Shafiq, left, and Andra Love, right, support a new clinic for bone health in patients over 50.

and ankle fractures. They are studying minimally invasive treatments for tibial plateau fractures and alternative techniques for the management of injuries to the syndesmosis.

During the past year, Shafiq has led the effort to design and implement a clinic to support bone health in patients over 50. The Bone and Joint Decade, a network of organizations that position musculoskeletal conditions as a public health issue and is promoted by the American Academy of Orthopaedic Surgeons, encourages orthopaedists to promote cost-effective prevention and treatment of musculoskeletal injuries and disorders. Shafiq and physician assistant **Andra Love** have partnered with **Kendall Moseley**, a bone health endocrinologist specializing in metabolic bone disease. Together, they have created a clinic that is focused on preventing secondary fractures and promoting

bone health.

“Our clinic has been running for about six months now,” says Shafiq. “We are identifying patients with fragility fractures and osteopenia or osteoporosis, and we're taking them through a diagnostic and treatment pathway to reduce their risk of future fractures.”

When a patient needs a bone health examination, Love reviews the patient's risk factors for osteoporosis and fracture history to determine the risk of secondary fracture. Education is provided to help the patient understand the roles that calcium, vitamin D and exercise play in supporting bone health. Patients are given guidance concerning fall prevention and medication options. Dual-energy X-ray absorptiometry is used to evaluate bone density and, if necessary, patients are referred to Moseley for further treatment. Together, this bone health team constitutes a fracture liaison service that offers an individualized care plan for each patient. ■

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dedicated to treating more common conditions. “No surgery is mundane,” he says. “I tell patients that small surgery is the kind somebody else has. For you, this is one of the bigger days of your life. I think that’s a philosophy shared by all of our surgeons here. We treat even the straightforward surgeries with the greatest care.” ■

Educating Leaders Through Clinical Practice

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Valaik believes that when you teach, you must not only have a mastery of the subject, but also an open mind. You must allow the residents to explore all of the possible solutions to complex problems. This is the philosophy behind developing orthopaedic expertise at Johns Hopkins: educating leaders and preparing residents to face the biggest challenges of their professional lives. ■

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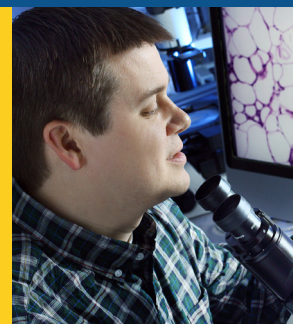
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