Welcome to the 2017 Paul R. Lipscomb Alumni Society Graduate Research Symposium

This outstanding gathering is an opportunity for our department to highlight scientific as well as clinical research, and to reconnect with clinical faculty and alumni who have served our department over the years. Our special guests this year are: Dr. Frank Luyten, M.D., Ph.D., Professor and Chairman of the Division of Rheumatology at the University Hospitals Leuven; Director of the Laboratory for Skeletal Development and Joint Disorders, and Co-Director and Clinical Director of the Stem Cell Institute at KU Leuven, Belgium.; and Dr. Marc Philippon, M.D. Managing Partner at The Steadman Clinic, Co-Chairman, Director of Sports Medicine Fellowship and Director of Hip Research at the Steadman Philippon Research Institute and Adjunct Associate Professor of Orthopaedic Surgery with the University of Pittsburgh School of Medicine.

Most importantly, this is an occasion to commemorate the graduation of 4 residents into the ranks of orthopaedic surgery. While always a bittersweet occasion, this day validates the wonderful camaraderie and continuity of our field.

Thank you for being part of this memorable event.
ORTHOPAEDIC SURGERY CHAIRS

Paul R. Lipscomb, M.D.
Professor Emeritus
Chair 1969-1979

Michael W. Chapman, M.D.
Professor Emeritus
Chair 1979-1999

George T. Rab, M.D.
Professor Emeritus
Chair 1999-2006

Paul E. Di Cesare, M.D., FACS
Professor
Michael W. Chapman Chair
2006-2011

Richard A. Marder, M.D.
Professor
Michael W. Chapman Chair
Chair 2011–present
VISITING PROFESSORS

1982 — Robert B. Winter, M.D.
1983 — Anthony Catterall, M.D.
1984 — Euguene E. Bleck, M.D.
1985 — Paul P. Griffin, M.D.
1986 — M. Mark Hoffer, M.D.
1987 — Robert B. Salter, M.D.
1988 — Colin F. Moseley, M.D.
1989 — James R. Gage, M.D.
1990 — James F. Kellman, M.D.
1991 — David S. Bradford, M.D.
1992 — Adrian E. Flatt, M.D.
1993 — Augusto Sarmiento, M.D.
1994 — M. Mark Hoffer, M.D.
1995 — James R. Andrews, M.D.
1996 — James R. Urbaniak, M.D.
1997 — Stuart L. Weinstein, M.D.
1998 — Robert A. Mann, M.D.
1999 — Joseph M. Lane, M.D.
2000 — Andrew J. Weiland, M.D.
2001 — Joel M. Matta, M.D.
2002 — Terry R. Trammell, M.D.
2003 — Kaye E. Wilkins, M.D.
2004 — Richard Gelberman, M.D.
2005 — Robert H. Hensinger, M.D.
2006 — James Heckman, M.D.
2007 — Thomas A. Einhorn, M.D.
2008 — Joseph A. Buckwalter, M.D.
2009 — Peter J. Stern, M.D.
2010 — Joseph Borrelli, Jr., M.D.
2011 — Keith Bridwell, M.D.
VISITING PROFESSORS

2012 — Gary G. Poehling, M.D.
2013 — Robert Anderson, M.D.
2014 — Jeffrey Eckardt, M.D.
2015 — J. Tracy Watson, M.D.
2015 — Matthew L. Warman, M.D.
2016 — Stuart B. Goodman, M.D.
2016 — Cosimo De Bari, Ph.D.
2017 — Frank Luyten, M.D., Ph.D.
2017 — Marc Philippon, M.D.
Frank Luyten, M.D., Ph.D.

Rheumatologist, tenured full Professor and Head of the Division of Rheumatology — University Hospitals Leuven

Director of the Laboratory for Skeletal Development and Joint Disorders and of Prometheus — Tissue Engineering Division of Leuven Research and Development

Co-Director and Clinical Director of the Stem Cell Institute — KU Leuven, Belgium.

Frank P. Luyten, M.D., Ph.D., is a board certified Rheumatologist, tenured full Professor and Head of the Division of Rheumatology at the University Hospitals Leuven; Director of the Laboratory for Skeletal Development and Joint Disorders and of Prometheus, the Tissue Engineering Division of Leuven Research and Development; co-Director and Clinical Director of the Stem Cell Institute at the KU Leuven, Belgium.

Dr. Luyten obtained his M.D., Ph.D. degree and Board Certification in Rheumatology at the University of Ghent, Belgium in 1986. He spent his postdoctoral training at the National Institute of Dental Research, National Institutes of Health in Bethesda, USA between 1986 and 1991. He subsequently became group leader of the Developmental Biology Unit at the Bone Research Branch of the NIDR, NIH, Bethesda, MD, USA till 1997. He accepted the position of Head of the Division of Rheumatology at the University Hospitals Leuven and Professor at the KUL, Belgium in the fall of 1997.
Research Expertise: He discovered molecular partners in both BMP and Wnt signaling pathways and their role in skeletal and joint biology and human arthritic diseases. Expertise in regenerative medicine supported by contributions in the field of cellular therapeutics and adult stem cells for the regeneration of skeletal tissues. Clinical expertise mostly in the field of osteoarthritis and osteoporosis.

Some Senior International Activities at Present:

- ERC Advanced Grant holder 2012-2017
- Member of the Interdisciplinary Panel, FWO research council, BE
- Member of the Editorial Board of Bone
- Co-Founder, scientific and medical advisor of TiGenix (Haasrode, BE)
- Member of the board of directors of PharmaCell (Maastricht, NL)
- Medical and/or scientific advisor of AstraZeneca UK Limited, Stealthyx (UK), Beta-Cell (BE)
Dr. Marc Philippon is the managing partner at The Steadman Clinic and the Co-Chair of the Steadman Philippon Research Institute. One of the world’s leading orthopaedic surgeons, Dr. Philippon is internationally known for performing joint-preservation techniques utilizing arthroscopic hip surgery to treat painful joint injury in high-level athletes.

He has treated more than 1,000 professional and Olympic athletes, successfully returning them to winning Olympic Medals, PGA tournaments, and setting NFL, NHL and MLB records. He is a consultant to the NHL Players Association, the Royal Spanish Tennis Federation, and to many professional and Olympic organizations including the US Ski and Snowboard Team Foundation and a Trustee for the US Olympic and Paralympic Foundation.

As a thought leader, Dr. Philippon is frequently invited to speak at National/International Sports Medicine and Orthopaedic meetings, and has authored many peer-reviewed scientific articles. Dr. Philippon is recognized by his peers in US News and World Report as being
among the top one percent in the nation in his specialty.

Dr. Philippon treats a variety of hip disorders, but much of the international recognition he has received comes from his innovative, arthroscopic treatment of a condition called femoroacetabular impingement (FAI) which affects 10-20 percent of the general population.

Presently, Dr. Philippon is leading the effort to accelerate advances in regenerative sports medicine and stem cell research.

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 and Director of Sports Medicine/Hip Disorders Fellowship. He also was the Director of the University of Pittsburgh Medical Center’s Golf Medicine Program.

Previously he was Chief of Orthopaedic Surgery at Holy Cross Hospital in Fort Lauderdale, Florida. He initially came to the United States as a student-athlete playing soccer and tennis at the NCAA level 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 residency at the University of Miami, Jackson Memorial Hospital in 1995.
Robert H. Allen, M.D.
Professor, Hand, Upper Extremity, and Microvascular Surgery

Kyriacos A. Athanasiou, Ph.D., Ph.M.
Professor, Orthopaedic Research and Biomedical Engineering

Christopher O. Bayne, M.D.
Assistant Professor, Hand, Upper Extremity, and Microvascular Surgery

Blaine A. Christiansen, Ph.D.
Associate Professor, Orthopaedic Research Laboratory

Jonathan G. Eastman, M.D.
Assistant Professor, Trauma Service

Ellen P. Fitzpatrick, M.D.
Assistant Professor, Trauma Service

David P. Fyhrie, Ph.D.
Professor, Orthopaedic Research Laboratory

Mauro Giordani, M.D.
Professor and Chief of Adult Reconstructive Service

Eric Giza, M.D.
Associate Professor, Chief of Foot and Ankle Service

Dominik R. Haudenschild, Ph.D.
Associate Professor, Orthopaedic Research Laboratory

Brian M. Haus, M.D.
Assistant Professor, Pediatric Orthopaedic Service

Maury L. Hull, Ph.D.
Orthopaedic Surgery and Professor Emeritus, Department of Mechanical and Aerospace Engineering

Yashar Javidan, M.D.
Assistant Professor, Adult and Pediatric Spine Service

Eric O. Klineberg, M.D.
Professor, Adult and Pediatric Spine Service

Christopher D. Kreulen, M.D.
Assistant Professor, Foot and Ankles Service

J. Kent Leach, Ph.D.
Professor, Orthopaedic Research Laboratory, and Biomedical Engineering

Cassandra A. Lee, M.D.
Associate Professor, Sports Medicine Service

Mark A. Lee, M.D.
Professor, Trauma Service
Holly B. Leshikar, M.D.
Assistant Professor, Pediatric Orthopaedic Service

Richard A. Marder, M.D.
Professor, Chief of Sports Medicine Service, and Michael W. Chapman Chair

Sean M. McNary, Ph.D.
Assistant Adjunct Professor, Orthopaedic Research Laboratory

John P. Meehan, M.D.
Professor, Adult Reconstructive Service

Gavin C.T. Pereira, M.B.B.S., F.R.C.S.
Associate Professor, Adult Reconstructive Service

A. Hari Reddi, Ph.D.
Distinguished Professor, Lawrence J. Ellison Chair of Molecular Biology, Director of Orthopaedic Research Laboratories

Rolando F. Roberto, M.D.
Professor, Chief of Adult and Pediatric Spine Service, and Executive Vice Chair

Robert M. Szabo, M.D., M.P.H.
Professor, Chief of Hand, Upper Extremity, and Microvascular Surgery

Steven W. Thorpe, M.D.
Assistant Professor, Chief of Orthopaedic Oncology

James M. Van Den Bogaerde, M.D.
Associate Professor, Sports Medicine Service

Barton L. Wise, M.D.
Associate Professor, Orthopaedic Research, and Internal Medicine

Philip R. Wolinsky, M.D.
Professor, Chief of Trauma Service

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FACULTY
Shriners Hospital for Children, Northern California

Jennette L. Boakes, M.D.
Clinical Professor Pediatric Orthopaedic Service

Jon R. Davids, M.D.
Clinical Professor, Assistant Chief of Pediatric Orthopaedic Surgery

Michelle A. James, M.D.
Clinical Professor, Chief of Pediatric Orthopaedic Service

Vedant A. Kulkarni, M.D.
Assistant Clinical Professor, Pediatric Orthopaedic Service

Joel A. Lerman, M.D.
Associate Clinical Professor, Pediatric Orthopaedic Service
Friday, June 16, 2017

7:00 AM  Continental Breakfast

7:20 AM  Welcome - Department Chair
          Richard A. Marder, M.D.

7:35 AM  Introduction of Guest Speaker (Research)
          A. Hari Reddi, Ph.D.

7:35 AM  BASIC SCIENCE VISITING PROFESSOR:
          Frank Luyten M.D., University Hospitals Leuven,
          Belgium - Tissue Engineering of Bone and
          Cartilage: Clinical Translation

8:40 AM  RESEARCH FACULTY
          Blaine A. Christiansen, Ph.D. – Systemic Bone Loss
          after Fracture: What We Know and What it Might
          Mean

8:55 AM  Introduction of Guest Speaker (Clinical)
          Cassandra Lee, M.D.

9:00 AM  VISITING PROFESSOR:
          Marc Philippon, M.D., Ph.D. - Steadman Philippon
          Research Institute, Vail - Advances in Hip
          Arthroscopy Over the Last 10 years

10:00 AM  Break / Department Photos

10:45 AM  2016-2017 DICKENSON RESEARCH RESIDENT:
          Trevor J. Shelton, M.D. – Is There a Tibial Compart-
          ment Force Target Associated with Better Patient
          Reported Outcomes After Kinematically Aligned
          Total Knee Arthroplasty?
11:00 AM  RESIDENT: Garin G. Hecht, M.D.
CT Scans Can Predict Which Stable Intertrochanteric Hip Fractures Are at Risk for Excessive Shortening and Implant Failures

11:15 AM  RESIDENT: Clayton T. Hodges, M.D.
Where Should Cross-Sectional Area of Hamstrings Tendons on Preoperative Magnetic Resonance Imaging Be Measured to Predict Graft Diameter for Anterior Cruciate Ligament Reconstruction?

11:30 AM  ALUMNUS: Thomas W. Powers, M.D. (Class of 2014)
My First Job After Training

11:45 AM  RESIDENT: Justin F. Lucas, M.D.
A Biomechanical Comparison of Retrograde Superior Ramus Screws

12:00 PM  RESIDENT: John Ryan Taylor, M.D.
Donor Age Effect on Biomechanical Properties in Bone-Patellar Tendon-Bone Allografts

12:15 PM  Adjournment
Garin H. Hecht, M.D.
Chief Resident

**Education:**
University of Michigan Medical School
*M.D.* (2012)
University of California, Davis
*B.S. Exercise Biology* (2007)

**Next Step:**
Fellowship — Harborview Medical Center, Seattle, WA,
Orthopaedic Trauma

**Career Objective:**
Academic Orthopaedic Traumologist
Personal Statement:

I am very proud to graduate from the UC Davis Orthopaedic Residency Program. Our program is defined by our residents, and in particular, working together in teams to care for a diverse patient population with complex orthopaedic pathology. While the structure of our training program forces us to work together to get the job done and best learn our craft, we also do it because we’ve chosen to create this team-driven environment. This was the tradition I walked into when I started residency 5 years ago, and I believe in it.

Our program is not easy; rather, we have high expectations and standards set for us. At times, it can be all-encompassing, but what other way is there to learn how to be an excellent orthopaedic surgeon within a finite supervised training period? We all need support in our lives to thrive in this training environment. My wife, Michelle, is incredible. We have always shared our goals and aspirations, as well as our challenges and frustrations. While I look forward to the next phase in our lives together, I also reflect fondly on these last 5 years because I think we’ve done a pretty good job! Additionally, I have had an excellent class of co-residents to train with. Each of you continuously impresses me, and you guys have pushed me to be better. Our camaraderie has been equally important, and I look forward to sharing stories in the future.

Finally, the mentorship – both clinical and academic – that I have received as a UC Davis Orthopaedic Resident has been tremendous. It has exceeded my expectations and has driven me to develop my career goals and become a capable physician and surgeon with the toolset and training to succeed. Our faculty’s wide-ranging teaching and mentorship styles have given me a foundation to build upon, so that I, in turn, can teach and mentor others in these same ways during my career. Thank you for your training, guidance, and wisdom.
Research Topic:

Title:
CT Scans Can Predict Which Stable Intertrochanteric Hip Fractures are at Risk for Excessive Shortening and Implant Failures

Authors:
Garin Hecht, M.D.; Augie Saiz, M.D.; Trevor Shelton, M.D.; Parker Goodell, B.S., M.P.H.; Philip Wolinsky, M.D.

Background:
Implant-related failures and excessive shortening of intertrochanteric hip (IT) fractures place geriatric patients at risk for poor functional recovery and additional procedures. The morphology of the fracture, in particular the lateral wall (LW), can be difficult to assess on x-rays due to displacement, rotation and/or comminution of the fragments. We hypothesized that: a) computed tomography (CT) measurements of the lateral wall are superior to x-ray measurements in predicting hardware failures with treatment of IT fractures, and b) CT measurements of injury-induced impaction of the lateral wall can predict excessive shortening of IT fractures as they heal.

Methods:
A retrospective analysis was performed on 141 patients who met our inclusion criteria: an AO/OTA 31A1 or 31A2 fracture treated with a sliding hip screw (SHS) or a cephalomedullary (CMN) nail, pre-operative x-rays and a CT scan, and at least 6 weeks of follow up or development of immediate failure. The Lateral Wall Thickness (LWT) was measured on x-rays using
previously described techniques. Four novel CT-based measurements were made that quantified the cross-sectional thickness and area of the intact lateral wall of the shaft as well as the amount of impaction of the proximal fragment into the lateral wall (Figure 1).

Results:
105 patients were treated with a CMN, and 36 with a SHS. The inter-observer reliabilities (ICCs) of the CT measurements were all better than the LWT (ICC = 0.63) (Figure 1). There was a poor correlation between plain film LWT and all CT measurements. 15 patients had implant failures (6 CMN, 9 SHS). Failures with CMN had no associations with x-ray or CT measurements. However, all-cause failures in the SHS group were significantly associated with all of the CT measurements (P < 0.05), but not LWT measurements (P = 0.66).

11 fractures shortened more than 15 mm (6/36 SHS, 5/105 CMN, P = 0.0268). Only the Coronal Thin Point (CTP) CT measurement predicted shortening excessive shortening in the SHS group (P = 0.0375), and no measurement predicted shortening in the CMN group. A receiver-operator curve (ROC) was used to detect a cutoff threshold of 9 mm on the CTP measurement that predicts excessive shortening (sensitivity 89.7%, specificity 66.7%; P = 0.161).
Conclusion:
When x-ray assessments of fracture stability guide implant choice for treatment of IT fractures, implant failures and excessive shortening are uncommon, but they still do occur. Our study shows that analysis of the lateral wall and degree of fracture impaction on CT scans can predict patients treated with SHS that are at risk for implant failures and/or shortening > 15 mm. Specifically, the CTP measurement should be considered when making implant choices: it is simple to perform, has excellent interobserver reliability, and is predictive of both implant failures and excessive shortening of IT fractures treated with sliding hip screws.
Figure 1: A) Axial CT measurements were made where the lag screw will cross the fracture with a 130° implant. B) Mid-axial Lateral Wall Thickness (ICC = 0.72). C) Average Axial Lateral Wall Thickness (ICC = 0.81). D) Lateral Wall Axial Area (ICC = 0.79). E) Coronal Thin Point (CPT) is measured on coronal reconstructions at the thinnest point between the lateral cortex of the shaft and the distal extent of the proximal fragment (ICC = 0.83).
Clayton T. Hodges, M.D.
Chief Resident

Education:
Ohio State University College of Medicine
M.D. (2012)
University of California, Santa Barbara
B.S. Microbiology (1999)

Next Step:
Fellowship — UC Davis, Sports Medicine

Career Objective:
Offer patients excellent care for sports medicine problems ranging from routine to complex
**Personal Statement:**
I would like to thank the faculty, the administrative staff and my co-residents, both past and present, for the training and support I received during the past five years. I want to thank my wife and family for sticking by me along the rough road of medical school and residency.

**Research Topic:**

**Title:**
Where Should Cross-Sectional Area of Hamstrings Tendons on Preoperative Magnetic Resonance Imaging Be Measured to Predict Graft Diameter for Anterior Cruciate Ligament Reconstruction?

**Authors:**
Clayton Hodges, M.D.; Trevor Shelton, M.D.; Cyrus Bateni, M.D.; Steve Henrichon, M.D.; Richard Marder, M.D.; Cassandra Lee, M.D.; Brian Haus, M.D.

**Background:**
To prevent failure of ACL reconstruction with hamstring autograft, a graft diameter $\geq 8$ mm is desired. There has been recent interest in measuring gracilis tendon (GT) and semitendinosus (ST) cross-sectional area on preoperative magnetic resonance imaging (MRI) to predict autograft size to determine appropriate graft size preoperatively. The purposes of this paper were to: 1) Determine whether combined cross-sectional areas of GT + ST measured at the medial epicondyle, the tibiofemoral joint line, and the proximal tibial physeal scar have different correlations to intraoperative hamstring autograft measurements and 2) Develop a predictive model to facilitate whether hamstring autograft will be of sufficient size at the time of reconstruction.
Methods:
A retrospective chart review was performed of patients who underwent ACL reconstruction from January 2010 to December 2016. Included patients 13-65 years of age who underwent primary hamstring autograft ACL reconstruction, had preoperative MRI of affected knee demonstrating ACL tear, graft was not truncated at the time of surgery, and graft size was recorded in the operative report. There were 112 patients included in this study (60 females, 52 males; 25 ± 10 years, BMI 25 ± 5 kg/m2). Combined cross-sectional area of GT and ST were measured on axial slices of preoperative MRI at three locations: medial epicondyle, tibiofemoral joint line, and proximal tibial physeal scar by both an attending radiologist and a senior radiology resident. Intraclass correlation (ICC) was used to determine interobserver reliability of these measurements. Correlation of intraoperative graft size to combined cross-sectional area of GT + ST was determined using Pearson’s correlation coefficient (r). Previously described statistical methods compared correlation coefficients from each of the three levels. A receiver operating characteristic (ROC) was used to establish a cutoff threshold that would predict a graft size ≥ 8 mm.

Results:
There was good interobserver reliability at the medial epicondyle (ICC = 0.6657), the tibiofemoral joint line (ICC = 0.6941), and the tibial physeal scar (ICC = 0.6433). Pearson’s correlation coefficients were r = 0.4257 at the medial epicondyle, r = 0.3861 at the level at the joint line, and r = 0.2925 at the level of the tibial
physis (Figure 1). The medial epicondyle had a stronger correlation to graft size than the tibial physis ($p = 0.0466$) and trended towards a stronger correlation compared to the joint line ($p = 0.0944$). There was no difference in correlation between the joint line and tibial physis ($p = 0.6736$). The area under the curve was 0.8052 indicating good predictive value for the ROC curve to determine whether the hamstring autograft size is $\geq 8$ mm based on the combined cross-sectional area of the GT + ST (Figure 2). The best cutoff threshold for balancing sensitivity and specificity was 17.3 mm$^2$. A combined cross-sectional area $\geq 17.3$ mm$^2$ results in a $\geq 68\%$ probability that the hamstring autograft will be $\geq 8$ mm while a combined cross-sectional area $\geq 22.1$ mm$^2$ results in a $> 90\%$ probability of a hamstring autograft being $\geq 8$ mm (Figure 3).

Conclusions:
Cross-sectional area measurements of GT + ST at the medial epicondyle correlate most closely to hamstring autograft size than measurements at the joint line or the proximal tibial physeal scar. This increased correlation reached statistical significance with regard to measurements at the medial epicondyle vs. tibial physeal scar with a trend towards significance in regard to measurements at the medial epicondyle vs the tibiofemoral joint line. Surgeons performing ACL reconstruction should be aware that the best cutoff threshold to balance sensitivity and specificity is a combined cross-sectional area of 17.3 mm$^2$ at the medial epicondyle; however, combined cross-sectional area measurements greater than 22.1 mm$^2$ at the medial epicondyle have more than a 90% probability of being adequate for hamstring autograft.
Figure 1: Plot of graft diameter and MRI gracilis tendon + semitendinosus area at the level of the medial epicondyle, the joint line, and the tibial physis. Pearson correlation coefficients (r) are provided for each level and 95% confidence intervals. The medial epicondyle had a stronger (A) correlation compared to the tibial physis (B) but not compared to the joint line (A, B).

Figure 2: Receiver operating characteristic (ROC) curve
showing the true positive rate (sensitivity) against the false positive rate (1 – specificity) for combined cross-sectional area. The area under the curve was 0.8052 indicating good predictive value for the ROC curve to determine whether the hamstring autograft size will be ≥ 8 mm based on the combined cross-sectional area for of the gracilis tendon and semitendinosus tendon. The best cutoff threshold for balancing sensitivity and specificity was 17.3 mm².

**Figure 3**: Plot of probability of the hamstring autograft diameter being ≥ 8 mm versus the combined cross-sectional area of the gracilis tendon and semitendinosus at the level of the epicondyle. The ROC cutoff threshold of 17.3 mm² yields a probability of 68% that the hamstring autograft will be ≥ 8 mm. A combined cross-sectional area of ≥ 22.1 mm² gives a > 90% probability of a hamstring autograft being ≥ 8 mm.
Justin F. Lucas, M.D.
Chief Resident

Education:
Tulane University School of Medicine
M.D. (2012)
California Polytechnic State University
M.S. Polymers and Coatings Science (2007)
California Polytechnic State University
B.S. Biochemistry (2007)

Next Step:
Fellowship – Harborview Medical Center, Seattle, WA,
Orthopaedic Trauma

Career Objective:
To be a master surgeon. To push the limits of what is
the current state of orthopedic trauma. To educate and
inspire others to pursue their dreams.
Personal Statement:

After five short but long years, it is with great pride that I call myself a graduate of the UC Davis Orthopaedic Surgery Residency Program. It has not been an easy journey to say the least, but one that I am repeatedly thankful for having the privilege to participate in.

Since starting residency, I have slowly begun to develop into the physician and surgeon that I will eventually become. I could not have done this without the dedication and support shown to me by the faculty in our program. Thank you to all for pushing me, helping me to reach my potential, and making me better day, in and day out.

To the residents that I have been fortunate enough to work with as part of a team, thank you for your patience, cooperation, and most of all the laughs. It’s never work if you are having fun.

Lastly, no one deserves more credit for my accomplishments to date than my family. They have always been there for me with words of wisdom and encouragement, steering me along the correct path, and motivating me to succeed. Mom, Dad, Eden and Julian – Thank you and I love you.
Research Topic:

Title:
A Biomechanical Comparison of Retrograde Superior Ramus Screws

Purpose:
While it has become increasingly common to stabilize posterior pelvic ring disruptions with percutaneous iliosacral or transiliac transsacral screws, the ideal fixation construct for concurrent anterior pelvic ring injuries is unclear. Multiple variables including but not limited to fracture location, fracture comminution, bone quality, size of superior ramus osseous fixation pathway, accompanying pelvic ring or acetabular injuries, open wounds or presence of bowel or bladder injury all contribute to deciding whether a surface implant, intraosseous implant, or any implant should be utilized. Percutaneous fixation using intramedullary screws is beneficial due to its minimally invasive nature, low associated blood loss, and ability to provide stable fixation. Several prior studies have investigated the biomechanical advantages of plate versus ramus screw fixation. The results from these investigations have been mixed and is felt to be attributed to the variable screw size and screw length tested in each study. The purpose of this study is to investigate the biomechanical performance of different size and length retrograde superior ramus screws.

Methods:
A vertical superior ramus fracture was created in osteoporotic composite hemipelvis bone models (Sawbones, Vashon Island, WA) using reproducible anatomic landmarks. Instability was conferred through removal of a
1cm inferior ramus segment. The fractures were reduced and stabilized using a standard fixation sequence. Four groups were created by inserting either a solid 4.5mm (Depuy Synthes, Paoli, PA) or 7.0 mm cannulated screw (Zimmer, Warsaw, IN) of either 80 mm or 140 mm in length. Two additional groups were created with one intact group and one unstabilized osteotomy group. Testing was performed by axial loading applied through the acetabulum using a 32mm stainless steel ball seated within a PMMA mold. Samples were cyclically loaded at a rate of 1.5 Hz to a peak load of 1900N for 5000 cycles. Data was acquired at regularly spaced intervals and included whole construct displacement at unload (60 N) and max load (1900 N). At the end of cyclic loading, load to failure was performed. The residual stiffness and residual yield strength of the constructs was calculated. The difference of mechanical properties between groups was evaluated using an ANOVA (p<0.05).

Results:
After 100 cycles of loading there was no significant difference in displacement between any group irrespective of loading force. The displacement at unload at 5000 cycles was not significantly different among screw configurations.

The displacement at max load at 5000 cycles for 4.5 mm short screws was significantly greater than 4.5 mm long and 7.0 mm short and trending toward significance for 7.0 mm long screws.
After 100 cycles, there was no significant difference in stiffness between the 4.5 mm short screws and the osteotomy model. At 5000 cycles the 4.5 mm short screws had a significantly lower stiffness than the 4.5 mm long,
long, 7.0 mm short, and 7.0 mm long screws, and the intact model and were not significantly different from the osteotomy model. Both 4.5 mm short screws and 7.0 mm short screws were found to have a significantly lower stiffness than long screws of either configuration. Lastly there was no significant difference in stiffness between the 4.5 mm long and 7.0 mm long screws when compared to the intact model.

**Conclusion:**
Short 4.5 mm screws were significantly inferior in regards to resistance of displacement when compared to the other screw configurations. Additionally, after 5000 cycles, the mechanical properties of 4.5 mm short screws were no different than unstabilized controls. While not statistically significant, there is a notable increase in mechanical properties of long screws compared to short. The 7.0 mm long group is biomechanically similar to the intact sawbone. Additional studies are needed to further assess the biomechanical and clinical impact of varying retrograde intramedullary screw constructs.
John Ryan Taylor, M.D., M.P.H.
Chief Resident

Education:
University of Utah School of Medicine
M.D. (2012)
University of Utah
Utah State University
B.S. Public Health (2006)

Next Step:
SCOI Fellowship Program in Sports Medicine, Arthroscopy, and Reconstructive Surgery.

Career Objective:
Looking to return to Utah to join a practice after fellowship, but open to other possibilities. I would love to be a team doctor at the collegiate level if ever given the opportunity.
Personal Statement:

Vince Lombardi once said “The achievements of an organization are the results of the combined effort of each individual.” Our program has a rich tradition of excellence. We have a reputation of toughness, hard work, dedication, and skill. Many of our predecessors have accomplished great things before us, and there will be, no doubt, many more to carry on this tradition in the years to come. I am humbled to follow in the footsteps of those that have gone before me. I consider it the upmost honor to be among the graduates of the UC Davis Orthopaedic Surgery Program, and will strive to carry on this tradition.

I have so many people to thank, I don’t know where to start. First and foremost, I want to thank my wife Monica. She is my rock, my biggest support, and the person I lean on most in life. I wouldn’t be here if it wasn’t for her. She has worked every bit as hard as I have these past 5 years, and I owe her more than she knows. She is the glue that holds our family together. I am grateful for her patience with me, and for the patience of my children Jaxon, Parker, and Kate. I feel like I am the luckiest guy in the world to have them in my life.

I also want to thank my parents, Mike and Tamie, for all the love and support over the years. I want to thank my brother, sisters, and Monica’s parents as well. Thank you for always believing in me, and helping me out along the way.

Finally, I want to thank all our faculty and staff at UC Davis. I will remember and implement the principles you worked so hard to teach me. I hope I can make you proud. Thank you, Dr. Marder, and Dr. Roberto, for giving me a chance to be a part of this residency program. Thank you, Margaret, for putting up with us residents and always keeping us on track. Each one of you has influenced me to become a better physician and surgeon. I will forever be grateful to you. I wish you all my very best. Until we meet again!
Research Topic:

Title:  
Donor Age Effect on Biomechanical Properties in Bone-Patellar Tendon-Bone Allografts

Authors:  
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Purpose:  
Bone-patellar tendon-bone (B-PT-B) autografts are considered by many surgeons to be the gold-standard for anterior cruciate ligament (ACL) reconstruction as these tendons possess greater tensile strength than the native ACL and offer improved fixation strength derived from the terminal bone plugs. Allograft-based reconstruction has the benefit of decreasing surgical procedure length, post-operative pain, and enhancing cosmesis. Additional issues associated with B-PT-B autografts, such as donor site morbidity, quadriceps weakness, and kneeling pain, may be minimized. It is generally assumed that the tensile properties of allografts decline with age, leading to a preference for younger tendons (~15 to 25 years old) for use in reconstruction. Notwithstanding, the literature lacks any detailed studies with sufficient statistical power to support this claim, and no studies have looked at the effects of aging on viscoelastic properties of patellar tendons. Accordingly, the purpose of this investigation was to determine whether aging imparts a clinically significant effect on the viscoelastic, structural, and material properties of B-PT-B allografts by evaluating these properties in allografts obtained from younger (15 to 31 years of age) and older (51 – 65 years of age) donors.
**Methods:**

A total of 184 tendons were obtained from national tissue banks: 92 tendons from younger donors, defined as 15 to 31 years of age, and 92 tendons from older donors, defined as 51 and 65 years of age. These tendons were unprocessed, fresh-frozen, and otherwise unadulterated. A power analysis suggests this sample size can resolve an effect size of 0.50 at 92% power, or a difference of ~4 MPa between the ultimate tensile strengths of younger and older allografts. Specimens were stored fresh frozen at -80°C. On the day before mechanical testing, the specimens were thawed in phosphate buffered saline (PBS) and the middle third of the patellar tendon was trimmed with a scalpel to a width of 10 mm while under 10 N of tension. A surgical oscillating saw was utilized to trim the bone blocks from the patella and tibial tubercle to a standard width, length, and thickness of 15 mm, 25 mm, and 15 mm, respectively. A Kirschner wire (2.38 mm dia.) was drilled through each bone block along the A/P direction to increase the potting strength. The bone blocks were potted in polymethyl methacrylate (PMMA, COE Tray, GC America), taking care to prevent contact of the PMMA with the tendon. The potted allografts were stored in PBS at 4°C overnight until testing.

Prior to testing, the tendons were equilibrated in a 37°C PBS bath for 15 min before pre-stressed to 10 N in a custom fixture. The gage length, defined as the distance between PMMA-potted bone blocks, was measured with digital calipers. The cross-sectional area of the tendon was measured and averaged across the proximal third, middle third, and distal third using a custom area micrometer. The patellar tendons were then loaded into a material testing system (MTS 858, MTS Systems),
immersed in a $37 \pm 1^\circ$C PBS bath, and pre-stressed to 10 N to remove tendon laxity. The allografts were preconditioned to mimic the loading that occurs during surgery and rehabilitation. Specimens were loaded for 90 N for 1 min, at a strain rate of 10 mm/min; followed by 1,000 cycles of cyclic loading (1 Hz) between 50 and 250 N. Following preconditioning, a creep load of 500 N was applied at a loading rate of 100 mm/min for 15 min. The allograft was allowed to recover for 15 min at a pre-load of 10 N before it was pulled to failure at a strain rate of 100% per second. Viscoelastic (creep displacement and creep strain), structural (ultimate load, linear stiffness, and ultimate displacement), and material (ultimate tensile stress, elastic modulus, and ultimate strain) properties were determined. Groups were tested for statistically significant differences ($p < 0.05$) using a two-way t-test.

**Results:**
Preliminary results from this ongoing study are presented for a sample size of $n = 6$ specimens for each group. The average age (Table 1) of the younger group was $25 \pm 4$ years, while the older group averaged $60 \pm 4$ years. There were no differences ($p > 0.26$) between the gage lengths and cross-sectional areas of the younger and older allograft groups. With regards to viscoelastic properties (Table 1), the younger tendons trended to deform less than the older group under a creep load of 500 N; however, these differences did not reach statistical significance ($p > 0.05$). There were no significant differences observed between younger and older allografts in the structural properties (Table 2) measured: ultimate load, linear stiffness, and ultimate displacement. However, there were significant differences between younger and older allografts for two material properties (Table 2): ultimate tensile stress and elastic modulus. The younger
tendons were stronger and stiffer than older tendons, with no differences in ultimate strain.

**Conclusion:**
These preliminary results suggest that aging influences the ultimate tensile strength and elastic modulus of B-PT-B allografts. Additional work will be performed to increase the sample size, and enhance the statistical power of this investigation. Based on these initial results, surgeons may want to consider donor age when performing ACL reconstruction with B-PT-B allografts, as tendons obtained from younger adults may be stronger and stiffer than older adults. Lastly, the viscoelastic properties of B-PT-B allografts merit greater study as it may impact clinical outcomes such as joint laxity.

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<tr>
<th></th>
<th>Background</th>
<th>Viscoelastic Properties</th>
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<tbody>
<tr>
<td></td>
<td>Age</td>
<td>Gage Length (mm)</td>
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<tr>
<td>Young</td>
<td>25 ± 4</td>
<td>56 ± 6</td>
</tr>
<tr>
<td>Old</td>
<td>60 ± 4</td>
<td>50 ± 12</td>
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<tr>
<td><em>P</em>-value</td>
<td>&lt; 0.01</td>
<td>0.34</td>
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Table 1: Background and viscoelastic properties of young (15-31 yrs) and old (51-65 yrs) bone-patellar tendon-bone allografts (n=6).

<table>
<thead>
<tr>
<th></th>
<th>Structural Properties</th>
<th>Material Properties</th>
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<tbody>
<tr>
<td></td>
<td>Ultimate Load (N)</td>
<td>Ultimate Displac. (mm)</td>
</tr>
<tr>
<td>Young</td>
<td>2,544 ± 501</td>
<td>9.3 ± 0.6</td>
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<tr>
<td>Old</td>
<td>1,964 ± 505</td>
<td>8.7 ± 0.8</td>
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<td><em>P</em>-value</td>
<td>0.07</td>
<td>0.12</td>
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Table 2: Structural and material properties of young (15-31 yrs) and old (51-65 yrs) bone-patellar tendon-bone allografts (n=6).