Graduate Research Symposium

June, 24, 2022 | 7:00 AM - 2:15 PM
Medical Education Building LH 1222

UC DAVIS HEALTH | Department of Orthopaedic Surgery

Program Notes

AGENDA

7:00 AM **Continental Breakfast**

7:30 AM **Welcome – Department Chair, R. Lor Randall, M.D., F.A.C.S., F.A.O.A.**

7:35 AM **Introduction of Guest Speaker (Mechanistic), R. Lor Randall, M.D.**

7:40 AM **Anu and Hari Reddi Graduation Lectureship Visiting Professor: Michael T. Longaker, M.D., M.B.A., D.Sc. (Hon), F.A.C.S.** *"Wound Repair, Fibroblasts, Heterogeneity and Fibrosis"*

8:40 AM **Introduction of Research Resident, Mark A. Lee, M.D.**

8:45 AM **2021-2022 DICKENSON RESEARCH RESIDENT: Edmond F. O'Donnell, III, M.D., Ph.D.**
"Targeting Soft Tissue Sarcoma Cancer Stem Cells Improves Doxorubicin Sensitivity In Vitro"

9:00 AM **Introduction of PGY-5 Residents: Barton Wise, M.D., M.Sc., F.A.C.P.**

9:05 AM **RESIDENT: Zachary R. Hill, M.D.**
"Loose Body Versus Trochlear Biopsy Matrix-Induced Autologous Chondrocyte Implantation (MACI) MOCART Scores and IKDC Reported Outcomes in Pediatric Patients"

9:20 AM **RESIDENT: Marcus A. Shelby, M.D.**
"Effect of Socioeconomic Disparities on Adolescent Idiopathic Scoliosis Outcomes"

9:35 AM **RESIDENT: James P. Reynolds, M.D.**
"Incidence and Risk Factors Including Radiographic Evaluation for Developing Adjacent Segment Disease Following Lumbar Spinal Fusion for Degenerative Conditions"

9:50 AM **RESIDENT: Donald T. Kephart, M.D.**
"Gait Analysis at Your Fingertips: Accuracy and Reliability of Mobile App Enhanced Observational Gait Analysis in Children with Cerebral Palsy"

10:05 AM **RESIDENT: Christopher T. Holland, M.D., M.S.**
"Predicting Meniscal Repairability using Magnetic Resonance Imaging"

10:20 AM **Department Photo (outside Medical Education Building)**

10:40 AM **Introduction of Visiting Professor (Clinical), R. Lor Randall, M.D.**

10:45 AM **Elizabeth C. and Michael W. Chapman Lectureship Visiting Professor: John M. Flynn, M.D.**
"Restless to do Better: Adventures in the Land of Quality, Safety and Value Improvement for Pediatric Spine Care"

11:45 AM **Working Lunch (Case Presentations)**

12:30 PM **Introduction of PGY-2 Residents: Mark Lee, M.D.**

12:35 PM **RESIDENT: Maarouf A. Saad, M.D.**
"*Does Standardized Preoperative Planning Improve Resident Performance in Orthopaedic Trauma Surgery?"*

12:45 PM **RESIDENT: Weston K. Ryan, M.D.**
"Sonographic Evaluation of Flexor Pulley System in the Uninjured Recreational Climber: What is Normal?"

12:55 PM **RESIDENT: Gregory J. Harbison, M.D., M.S.**
"Comparison of Biomechanical Function of Cruciate Retaining Medial Pivot Implants in Kinematically Aligned Total Knee Arthroplasty Performed on Non-arthritic Cadaver Knees"

1:05 PM **RESIDENT: Patrick M. Wise, M.D.**
"Timing of Fracture Fixation in Burn Patients: A 22 Year Retrospective Analysis"

1:15 PM **RESIDENT: Kelsey L. Millar, M.D.**
"Validation and Establishment of Normative Values for an Interactive Smartphone Tool Measuring Thumb Function in Preschool-Aged Children"

1:25 PM **Introduction of 2020 Lipscomb Alumni Guest Panel: David Manske, M.D.**

1:30 PM **Examining the Various Practice Settings: A Panel Discussion**
Private Practice – Ruwan P. Ratnayake, M.D. (Residency Class of 2019)
Academics – Yashar Javidan, M.D. (Spine Fellow - Class of 2015)
Kaiser Permanente – Jacob H. Fennessy, M.D., M.S. (Residency Class of 2019)

2:15 PM **Adjournment**

WELCOME TO 2022
LIPSCOMB-CHAPMAN 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 John M. Flynn, M.D., Children's Hospital of Philadelphia and Michael Longaker, M.D., Stanford University School of Medicine.

Most importantly, this is an occasion to commemorate the graduation of five outstanding 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.

ANU AND A. HARI REDDI ORTHOPAEDIC RESEARCH LECTURESHIP

A. Hari Reddi, Ph.D.
Professor

Dr. A. Hari Reddi was recruited to UC Davis in 1997 as the Lawrence J. Ellison Endowed Chair by Dr. Michael W Chapman. Dr. Reddi was previously the Virginia Percy Chair at Johns Hopkins University School of Medicine in the Department of Orthopaedic Surgery (1991-1997), Chief of Bone Cell Biology Section in the NIH (1977-1991) and Assistant Professor in the Ben May Laboratory for Cancer Research in the University of Chicago (1972-1977). He is well known for his research on Bone Morphogenetic Proteins (BMPs) and regeneration of bone and cartilage. He was the recipient of the inaugural Marshall R. Urist Award of the Orthopaedic Research Society (ORS) in 1997 and the Nicolas Andry Award of the Association of Bone and Joint Surgeons in 1999. Dr. Reddi was elected as a Fellow of the National Academy of Inventors in 2015. Today we announce the inaugural resident graduation symposium lecture established in his honor. The A. Hari Reddi Orthopaedic Research Lectureship was established to honor his career and continued legacy within the Department of Orthopaedic Surgery.

RESEARCH VISITING PROFESSOR

Michael T. Longaker, M.D.

Deane P. and Louise Mitchell Professor in the School of Medicine and Professor, by courtesy, of Materials Science and Engineering
Surgery - Plastic & Reconstructive Surgery
Stanford University School of Medicine
Lucile Salter Packard Children's Hospital

Dr. Michael T. Longaker joined the Stanford University School of Medicine on September 1, 2000 as Director of Children's Surgical Research in the Department of Surgery, Division of Plastic and Reconstructive Surgery and the Lucile Salter Packard Children's Hospital. In 2003, he was named the Deane P. and Louise Mitchell Professor and in 2010 became Vice Chair of the Department of Surgery. As Director of Program in Regenerative Medicine and Co-Director of the Institute for Stem Cell Biology and Regenerative Medicine, and Director of the Children's Surgical Research, Dr. Longaker has the responsibility to develop research programs in the broad areas of developmental biology, epithelial biology and tissue repair, tissue engineering, and stem cell biology. Prior to joining Stanford, Dr. Longaker was the John Marquis Converse Professor of Plastic Surgery and held the positions of Director of Surgical Basic Science and Director of Plastic Surgery Research at the Institute of Reconstructive Plastic Surgery at the New York University School of Medicine.

Dr. Longaker's extensive research experience includes the cellular and molecular biology of extracellular matrix with specific applications to the differences between fetal and post-natal wound healing, the biology of keloids and hypertrophic scars, the cellular and molecular events in craniofacial development and stem cell biology. He brings to Stanford his unique understanding of wound healing, fetal wound healing research, developmental biology, tissue engineering, and stem cell biology.

ELIZABETH C. AND MICHAEL W. CHAPMAN LECTURESHIP

Betty and Michael Chapman, M.D.
Professor
Emeritus Chair

Dr. Michael Chapman's modern, aggressive approaches to the treatment of patients with multiple system injuries resulted in improved recovery times and outcomes for severe fractures, earning him recognition as one of the founding fathers of modern trauma surgery. Dr. Michael "Mike" Chapman and his wife, Mrs. Elizabeth "Betty" Chapman have been long time supporters of UC Davis Health and the Department of Orthopaedic Surgery. Dr. Chapman, is a UC Davis alumnus and chairman emeritus of the Department of Orthopaedic Surgery at UC Davis Medical Center. In 1991, the Chapman's established the Michael W. & Elizabeth C. Chapman Endowed Research Fund to support research in the Department of Orthopaedic Surgery. Dr. Chapman is a former trustee and chair of the UC Davis Foundation Board (2001 – 2007, 2010 – 2016). Mike and Betty were instrumental in securing many multi-million-dollar gifts to the medical school from alumni, friends, and grateful patients as well as cultivating donors for the Mondavi Center (performing arts center). Dr. Chapman is the 2018 recipient of the UC Davis Medal, the highest honor UCD bestows on individuals to celebrate extraordinary contributions that embody the campus' vision of excellence. Mike and Betty are members of UC Davis CAAA, Davis Chancellor's Club, UCD Shields Society, UCDH Heritage Circle, Leadership Giving Society, life-long supporters of the Mondavi Center's producers Circle, and namesake to the Lipscomb-Chapman Orthopaedic Alumni Society. The annual resident graduation symposium clinical lecture is named in honor of their tremendous service to UC Davis Health and Orthopaedics.

CLINICAL VISITING PROFESSOR

John M. Flynn, M.D.

Chief of the Division of Orthopaedics at Children's Hospital of Philadelphia

John M. Flynn, MD, is Chief of the Division of Orthopaedics at Children's Hospital of Philadelphia and a nationally recognized leader in the field of pediatric orthopaedic surgery. He holds the Richard M. Armstrong Jr. Endowed Chair in Pediatric Orthopaedic Surgery. Dr. Flynn earned his bachelor's degree in natural sciences from Johns Hopkins University, Baltimore, MD, and his medical degree from the University of Pittsburgh School of Medicine, Pittsburgh, PA. He completed his surgical training in the Harvard Combined Orthopaedic Surgery Program, followed by a pediatric orthopedic fellowship at A.I. DuPont Hospital for Children, Wilmington, DE.

Dr. Flynn's clinical focus includes spine deformity, early onset scoliosis/thoracic insufficiency, fractures, and hip disorders. He is the author of over 300 peer reviewed papers, reviews and chapters, and editor of the seminal texts in pediatric orthopaedics: *Lovell and Winter's Pediatric Orthopaedics, Rockwood's Fractures in Children, Operative Techniques in Pediatric Orthopaedics*, as well as *OKU 10 and Staying Out of Trouble in Pediatric Orthopaedics*. A winner of multiple teaching awards, Dr. Flynn lectures nationally and internationally on management of spinal disorders, pediatric fracture care, safety and value in spine care, and life-work integration for surgeons.

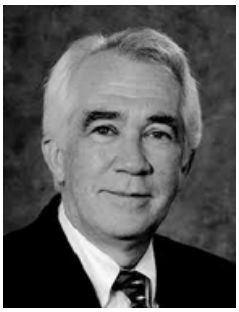
Dr. Flynn has served as President of Pediatric Orthopedic Society of North America, Chair of the International Pediatric Orthopaedic Symposium, Chair of AAOS CME Courses Committee, President of the Children's Spine Study Group and Vice President of the American Board of Orthopaedic Surgery. He is currently President of the Pediatric Spine Foundation, and serves on the Board of Trustees for JBJS, Tower Hill School and CHOP's Children's Surgical Associates. He has been inducted into the University of Pennsylvania Medicine's Academy of Master Clinicians.

Dr. Flynn's greatest passion is his family: wife Mary, and children Erin, Colleen, John and Kelly. His hobbies include outdoor sports, rowing and biking, backyard farming and reading books that impart great wisdom.

ORTHOPAEDIC SURGERY CHAIRS

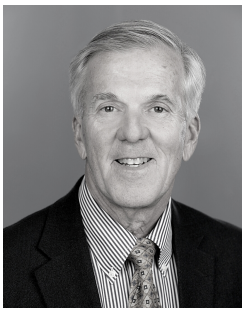
Paul R. Lipscomb, M.D.
Professor
Emeritus Chair
1969-1979

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., F.A.C.S.
Professor and Chair
Michael W. Chapman Chair
2006-2011



Richard A. Marder, M.D.
Professor and Chair
Michael W. Chapman Chair
2011– 2018

R. Lor Randall, M.D., F.A.C.S., F.A.O.A.
Professor and Chair
The David Linn Endowed Chair
2018– 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. Winstein, 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.
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 P. Luyten, M.D., Ph.D.
2017— Marc J. Philippon, M.D.
2018 — Michael W. Chapman, M.D.
2018 — Joseph A. Buckwalter, M.D.
2019 — Nobel Laureate, Mario R Capecchi, Ph.D.
2019 — Thomas P. Vail, M.D.
2021 — Todd J. Albert, M.D.
2021 — Pamela G. Robey, Ph.D.
2022 — John M. Flynn, M.D.
2022 — Michael T. Longaker, M.D.

FACULTY

Adult Reconstruction Service

Mauro Giordani, M.D.
Professor, Chief of Service, Fellowship Director
John Meehan, M.D.
Professor
Gavin C. Pereira, M.D., (M.B.B.S), F.R.C.S. (Eng), F.A.A.O.S.
Associate Professor, Interim Chief Value Officer

Foot and Ankle Service

Eric Giza, M.D.
Professor, Chief of Service, Fellowship Director, Assistant Chief Wellness Officer
Christopher Kreulen, M.D., M.S.
Associate Professor

Hand and Upper Extremity Service

Robert Allen, M.D.
Professor
Christopher Bayne, M.D.
Associate Professor, Chief of Service
Michelle James, M.D.
Professor, Chief of Orthopaedic Surgery, Shriners Hospitals for Children
Claire Manske, M.D.
Assistant Professor, Shriners Hospitals for Children
Robert Szabo, M.D., M.P.H., F.A.O.A.
Distinguished Professor of Orthopaedic Surgery and General Surgery, Fellowship Director

Musculoskeletal Oncology Service

Janai Carr-Ascher, M.D., Ph.D.
Assistant Professor
R. Lor Randall, M.D., F.A.C.S., F.A.O.A.
Professor and Chair, The David Linn Endowed Chair, Fellowship Director
Steven Thorpe, M.D.
Assistant Professor, Chief of Service, Residency Selection Director

Pediatrics Service

Brian Haus, M.D.
Associate Professor, Chief of Service
Holly Leshikar, M.D., M.P.H.
Assistant Professor
Amanda Whitaker, M.D.
Assistant Professor

Spine Service

Yashar Javidan, M.D.
Associate Professor, Fellowship Director
Eric Klineberg, M.D.
Professor, Chief of Service, Vice Chair of Administration
Hai Le, M.D., M.P.H.
Assistant Professor
Rolando Roberto, M.D.
Professor, Chief of Diversity and Outreach Officer

Sports Medicine Service

Nicole Friel, M.D.
Assistant Professor, Shriners Hospitals for Children
Cassandra Lee, M.D.
Professor, Chief of Service, Residency Program Director
Richard Marder, M.D.
Professor
James Van den Bogaerde, M.D.
Professor

Trauma Service

Ellen Fitzpatrick, M.D.
Assistant Professor, Orthopaedic Medical Course, Instructor of Record
Sean Campbell, M.D.
Assistant Professor
Mark Lee, M.D.
Professor, Chief of Service, Fellowship Director, Vice Chair of Education
Gillian Soles, M.D.
Associate Professor

Research Faculty

Blaine Christiansen, Ph.D.
Associate Professor
David Fyhrie, Ph.D.
Professor
Dominik Haudenschild, Ph.D
Professor
Maury Hull, Ph.D
Professor
J. Kent Leach, Ph.D.
Lawrence J. Ellison Endowed Professor of Musculoskeletal Research, Professor of Orthopaedic Surgery and Biomedical Engineering, Vice-Chair of Research
Polly Fu Teng, M.D.
Assistant Professor
Barton L. Wise, M.D., M.Sc. F.A.C.P.
Professor

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
Nicole A. Friel, M.D.
Assistant Clinical Professor, Pediatric Orthopaedic Service
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
Mary Claire Manske, M.D.
Assistant Clinical Professor, Pediatric Orthopaedic Services
Candice McDaniel, M.D.
Assistant Clinical Professor, Pediatric Orthopaedic Services
Debra J. Templeton, M.D.
Associate Clinical Professor, Pediatric Orthopaedic Service

Edmond F. O'Donnell, M.D., Research Resident

Education:
Albert Einstein College of Medicine, MD – 5/2019
Oregon State University, PhD 6/2013
Oregon State University, BA Biochemistry & Biophysics – 6/2006

Title: Targeting soft tissue sarcoma cancer stem cells improves doxorubicin sensitivity in vitro

Research Mentor: Janai Carr-Ascher MD PhD, Department of Hematology & Oncology, UC Davis Medical Center

Soft tissue sarcomas (STS) are rare tumors encompassing over 70 distinct histopathological subtypes that share a common treatment strategy comprising surgical resection, radiation, and chemotherapy in certain situations. Disease progression and failure to respond to anthracycline based chemotherapy, a standard first-line agent, is associated with poor outcomes. Recurrence and chemo-resistance represent significant barriers to improving patient survival.

Cancer stem cells are a specialized type of cell that persist and repopulate tumors after treatment and drive resistance in various forms of cancer. We are interested in the contribution of STS-CSCs to doxorubicin chemo-resistance in complex-karyotype STS. Specifically, we hypothesized the presence of a common genetic signature across unique STS subtypes involved in CSC-regulation that could be targeted to improve the efficacy of existing treatment regimens. To identify and isolate STS-CSCs, we used the Aldefluor assay coupled with fluorescent activated cell sorting (FACS). High aldehyde dehydrogenase (ALDH) activity is a well-established marker of stem cell populations. The Aldefluor assay fluorescently labels cells with high and low ALDH activity as bright and dim, representing CSCs and non-CSCs, respectively.

We first used the Aldefluor assay to profile the abundance of CSCs in five complex-karyotype STS cell culture models, including dedifferentiated liposarcoma, leiomyosarcoma, and undifferentiated pleomorphic sarcoma. In order to gain insight into the molecular pathways active in STS-CSCs, Aldefluor-bright and -dim populations were isolated by FACs and analyzed by RNA-sequencing. Differential gene expression analysis identified a small subset of commonly upregulated genes among the STS cell lines tested and shared across CSCs. Gene-set enrichment analysis of upregulated genes in STS-CSCs further identified a signature for Enhancer of Zeste homolog 2 (EZH2), part of the polycomb repressive complex 2 (PRC2) and a histone methyltransferase responsible for H3K27 methylation. As an epigenetic modulator, increased EZH2 expression and PRC2 activity functions to decrease activity of genes involved in growth suppression, thereby conferring oncogenic activity. At present, EZH2 can be targeted with the small molecule tazemetostat, an FDA-approved treatment for metastatic and locally advanced epithelioid sarcoma as well as follicular lymphoma.

To evaluate the possibility of EZH2-mediated differences in chromatin accessibility between CSCs and non-CSCs, we performed ATAC (assay for transposase-accessible chromatin)-seq analysis. In ATAC-seq, a transposase inserts sequencing adapters into areas of open chromatin, but not in areas of inaccessible chromatin, such as regions with increased histone methylation. In this way, areas of more accessible chromatin generate increased numbers of sequencing reads, which can be compared between different cell lines and conditions. ATAC-seq analysis of Aldefluor bright and dim cells isolated from five STS cell lines identified numerous areas of shared, differentially accessible chromatin unique to CSCs. We further evaluated differential chromatin accessibility surrounding transcription start-sites in CSCs and non-CSCs. Comparison of

ChIP (chromatin immunoprecipitation)-sequencing data specific for the histone methylation target of EZH2 (H3K27me3) with our ATAC-seq data showed a strong correlation between datasets, indicating that EZH2 is involved in regulating chromatin in a CSC-specific manner.

In order to test the effects of EZH2 inhibition on STS-CSCs, we generated doxorubicin resistance STS cell lines by serial selection with increasing concentrations of doxorubicin. We identified a positive correlation between CSC abundance and doxorubicin IC50 in doxorubicin resistant cell lines by Aldefluor assay and soft-agar colony formation assays. Co-treatment of doxorubicin and tazemetostat was not only synergistic in the parent cell lines, but rescued doxorubicin chemosensitivity in resistant lines. These data confirm the presence of shared genetic programs across distinct subtypes of STS that are unique to CSCs and amenable to therapeutic targeting.

Chief Resident Abstract Presentations

Zachary R. Hill, M.D.
"Loose Body Versus Trochlear Biopsy Matrix-Induced Autologous Chondrocyte Implantation (MACI) MOCART Scores and IKDC Reported Outcomes in Pediatric Patients"

Marcus A. Shelby, M.D.
"Effect Of Socioeconomic Disparities on Adolescent Idiopathic Scoliosis Outcomes"

James P. Reynolds, M.D.
"Incidence And Risk Factors Including Radiographic Evaluation for Developing Adjacent Segment Disease Following Lumbar Spinal Fusion For Degenerative Conditions"

Donald T. Kephart, M.D.
"Gait Analysis at Your Fingertips: Accuracy and Reliability of Mobile App Enhanced Observational Gait Analysis in Children with Cerebral Palsy"

Christopher T. Holland, M.D., M.S.
"Predicting Meniscal Repairability using Magnetic Resonance Imaging"

Zachary R. Hill, M.D.

Education
Loma Linda University School of Medicine – M.D. 2017
California State University, Fresno – B.S. Biology, 2012

Next Steps: Orthopaedic Sports Medicine Fellowship at Emory University
Career Objective: To provide excellent orthopaedic care to the community. Becoming a team physician to help young athletes through their injuries, and mentor them throughout their college careers. Serve as a pillar in the community as a physician, husband, and father.
Spouse: Meghan Hill

Personal Statement: It is hard to believe that five years of residency have now come to pass. They have been the longest days, but the shortest years. I am so proud to have such an amazing cohort of residents around me, and most importantly, the absolute best wife to help me through it. Thank you to all of our attending physicians for trusting me with your patients and teaching me how to care for patients as a whole person and not just on the OR table. The knowledge you have shared with me will help many patients in the future. As I reflect on my time here, I can't help but overstate how fortunate I am to be a part of the family here. I came to UC Davis to become a competent and safe surgeon who will serve my community with the best in orthopaedic care. I can honestly say, I received that and more. I have gained friends, mentors, and colleagues who will be with me through this lifelong career of service. Thank you UC Davis Department of Orthopaedics.

Abstract
Loose Body Versus Trochlear Biopsy Matrix-Induced Autologous Chondrocyte Implantation (MACI) MOCART Scores and IKDC Reported Outcomes in Pediatric Patients

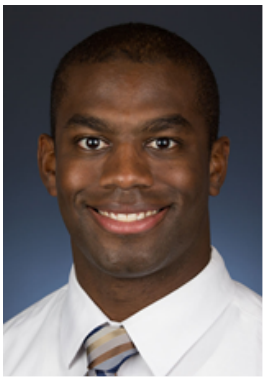
Background: Matrix-induced autologous chondrocyte implantation (MACI) has shown promising results in the treatment of osteochondral defects of the knee. A recent study showed similar viability comparing chondrocytes harvested from the intercondylar notch compared to those harvested from osteochondral loose bodies. However, there is limited evidence assessing how these different biopsies perform clinically. The goal of this study was to compare both radiographic and patient reported outcomes in patients with femoral osteochondral lesions treated with MACI using either a standard intercondylar notch biopsy or an osteochondral loose body biopsy.

Methods: A retrospective study was performed on all pediatric ACI procedures performed from 2014 to 2017 at a single institution. Patients were divided into two groups: one group had cartilage derived from a standard intercondylar notch biopsy (n=9) and the other group had cartilage derived from an osteochondral loose body found within the ipsilateral knee (n=10). At a minimum of one-year post-implantation, MRIs of the operative knee were performed and the MOCART 2.0 knee score was used to assess the integrity and quality of the cartilage repair tissue. Interclass correlation coefficients (ICC) were calculated between the two groups. International Knee Documentation Committee (IKDC) outcome scores were determined at a minimum two-years post-implantation.

Results: The ICC between three independent examiners for the MOCART scoring was excellent at 0.94. With regards to the MOCART score, the loose body group had an insignificant 17-point lower median score at 63 (IQR 59-89) compared to the intercondylar group at 80 (IQR 65-09) (p=0.15). There was no difference in IKDC scores with the loose body group having a median score of 82 (IQR 65-95) and the intercondylar group having a median score of 84 (IQR 53-99) (p=0.90).

Conclusion: These results demonstrate that osteochondral loose bodies can be used as viable harvest site in MACI procedures with no difference in functional and radiographic outcomes at two years post-implantation. This may limit both short and long-term donor site morbidity.

Marcus A. Shelby, M.D.



Education:
Case Western Reserve University School of Medicine – M.D. 2017
Washington University in Saint Louis – B.A. Biology, 2012

Next Steps: Pediatric Orthopaedic Fellowship at Cincinnati Children's
Career Objective: Become a knowledgeable and compassionate physician and surgeon that will teach and mentor the next generation
Spouse: Alyssa Shelby
Pets: 2 dogs (Bronn and Ned), 1 cat (Sansa)

Personal Statement: From the time I rotated at UC Davis, I could tell that this was the place for me. It was an honor to be able to join this program and learn from such esteemed faculty. Thank you for trusting me with your patients. I promise to hold myself to the same standards you have expected of me. My co-residents here are some of the most passionate and intelligent people I have met. I am privileged to have spent the past 5 years with such an amazing crew. The bonds I have formed will truly last a lifetime. Most importantly, I would like to thank my wife Alyssa, my family, and my various mentors for providing the love, support, and encouragement to get me to this stage in my career. I leave here not only a better physician and surgeon, but a better person because of you all.

Abstract
Effect of socioeconomic disparities on adolescent idiopathic scoliosis outcomes

Marcus Shelby, MD[1], Adam Bacon, BS[1], Zachary L. Boozé, BS[1], Hai Le, MD[1,2], Rolando Roberto, MD[1,2]
[1]University of California, Davis, Sacramento, CA, USA [2]Shriners Children's Hospital Northern California, Sacramento, CA, USA

Study Design
Retrospective case series

Objectives: To determine whether gender, race, ethnicity, and social determinants of health as measured by the child opportunity index (COI) and social deprivation index (SDI) affect curve severity at initial treatment or surgical outcomes for idiopathic scoliosis among children aged 11 to 18 years.

Methods: We retrospectively evaluated patients who underwent surgery for idiopathic scoliosis at a single pediatric deformity center between 2015 to 2020. Only patients aged 11 to 18 years with idiopathic scoliosis were included. Basic demographics including age, gender, ethnicity, race, and payer category were obtained. Primary outcomes were initial Cobb angle magnitude and Cobb angle magnitude at time of surgery. COI and SDI using aggregated Zip Code Tabulation Area (ZCTA) were also obtained. COI measures neighborhood resources for children and covers three domains: education, health and environment, and social and economic. Higher COI indicates greater neighborhood resources. SDI measures levels of disadvantage based off of seven demographic characteristics, with higher SDI indicating higher deprivation. Secondary outcomes were proportion of children who were braced before surgery, time from initial presentation to surgery, and percentage of curve correction after surgery. Chi square tests were performed for categorical data, while independent t-test and one-way analysis of variance (ANOVA) were performed for continuous data, with significance set at 0.05.

Results: Between 2015-2020, 249 patients met study criteria and were included. Mean age was 14.3years, with 80.7% females. Among the patients, 25.3% were Hispanic, while 69.1% were Non-Hispanic. Race was distributed as follows: 69.1% White, 7.6% Black, and 8.4% Asian. When comparing gender, females underwent surgery at a younger age than males. There were no other additional differences. When comparing ethnicity, percentage of curve correction was lower among Hispanics, and state-normed COI was lower while SDI was higher among Hispanics. There were no other differences in curve severity at presentation or surgical outcomes. There were no differences in severity at presentation or outcomes with regards to race. When comparing payor type, those with state-funded insurance were noted to have lower COI and higher SDI when compared to those with private insurance. No other significant differences were found. There were weak correlations between state-normed COI and SDI and initial curve magnitude.

Conclusion: Ethnicity and insurance status for children undergoing idiopathic scoliosis surgery correlates with socioeconomic status. However, there was no relationship found with severity at presentation or clinical outcomes. Additional research needs to be done to assess whether there are other influences on scoliosis treatment and outcomes.

James P. Reynolds, M.D.

Education
Virginia Commonwealth University School of Medicine – MD 2017
University of Virginia, Charlottestville – BS, Biomedical Engineering, 2010

Next Steps: Spine Fellowship - Ortho Carolina Spine Center, Charlotte, NC
Career Objective: To be an excellent father, husband, and an Orthopaedic Spine surgeon
Spouse: Kristin Reynolds
Children: James Foster Reynolds

Personal Statement: First and foremost, I want to thank my wife Kristin who has supported me throughout medical school and residency. She moved with me from our home in Virginia to take on the challenges that residency had in store for us. Her support and unwavering commitment to me and now our son are the foundation of our family. Additionally, I want to thank my mother and father for believing in me and encouraging me to chase my dreams from a young age.

My journey to UC Davis started as a medical student 6 years prior. As a medical student, I could appreciate the comradery between the residents and recognized the program as being able to develop medical student graduates into outstanding orthopedic surgeons. I have an enormous amount of respect for my co-residents, in particular my class who has been there every step of the way through this journey. My co-residents and their spouses have welcomed me and my wife into their lives and we will have lifelong friendships going forward.

The program itself has been the most challenging period of my life which I think is critical to create confident and skilled surgeons. I want to thank the faculty for pushing us to achieve higher standards and for allowing us to take care of your patients. The knowledge, experience and skills that I have developed over the last 5 years have set me up for a successful fellowship and career thereafter.

Abstract
Incidence and risk factors including radiographic evaluation for developing adjacent segment disease following lumbar spinal fusion for degenerative conditions.

James Reynolds MD, Wyatt Vander Voort MD, Edmond O'Donnell MD PhD, Elias Jbeily BA, Javidan Yashar MD, Rolando Roberto MD, Hai Le MD, Eric Klineberg MD,MS

Purpose: To compare risk factors for developing adjacent segment disease following short one or two level lumbar fusions for degenerative conditions. To evaluate for radiographic parameters specifically which may be utilized to predict development of clinically significant adjacent segment disease.

Methods: A retrospective review was conduced of all patients undergoing one or two level primary lumbar or lumbosacral spinal fusion for degenerative conditions. Patients with infectious, pathologic or traumatic indications for fusion were excluded. Baseline demographic data such as BMI, smoking status, charleson comorbidity index, age at index procedure were collected on all patients. Sagittal spinal alignment parameters were also measured using preoperative and postoperative radiographs. Similar alignment parameters were also measured at 2 years, 5 years and 10 year postoperative timepoints for reference. The primary outcome measure was revision surgery.

Results: A total of 222 patients met inclusion criteria with 46 patients undergoing revision surgery for adjacent segment disease at our institution resulting in a 20.7% revision rate, for whom the average time to revision was 45 months. 84.2% of the index procedures were two level fusions, only 15.8% were single level fusions procedures. 51.8% of the patients underwent an interbody fusion as well as posterolateral instrumentation and fusion. Between the patients who underwent revision surgery for adjacent segment disease, there was no statistical difference between the presence of interbody fusion and posterolateral fusions alone. With regard to sagittal mechanical alignment parameters, there was no statistical difference between the lumbar lordosis

Conclusion: In our study population of patients undergoing a one or two level lumbar spinal fusion for degenerative conditions, there were no specific risk factors that could be associated with the need for revision surgery. In contrast to the literature on longer fusion constructs, a sagittal alignment mismatch of pelvic incidence to lumbar lordosis was not a risk factor for developing adjacent segment disease.

Donald T. Kephart, M.D.

Education
Emory University School of Medicine – MD 2016
Dartmouth College – BS, Environmental Studies, 2011

Next Steps: Pediatric Orthopaedics Fellowship at The Hospital for Sick Children, Toronto
Career Objective: I would like to be in a practice where I can care for children with both acute and chronic orthopaedic problems, especially those with neuromuscular disease. I want to partner with families and other members of the care team to collaboratively determine the most appropriate treatment plan for each child, and, execute that plan in a technically sound, compassionate manner.
Spouse: Torryn
Pets: Dog, Grady

Personal Statement: It has been an incredible privilege to train in orthopedic surgery at UC Davis. I have had the opportunity to work with and learn from a superbly skilled faculty at UC Davis, Kaiser and Shriners. I've cared for, what, at times, seemed like an insurmountable volume and overwhelming complexity of patients and pathology. Nonetheless, I persevered. However, I didn't do it alone. I had an incredible amount of support throughout the way. My lovely bride, Torryn, despite her challenging work in the PICU, is a constant anchor. My parents, Murray and Cindy, who, by example, taught me calm and kindness, continue to encourage me. My co-residents have made the unbearable bearable by sharing the experience, both in and out of the hospital. Nurses, hospital staff and physicians in other departments have been incredible partners in patient care. Faculty have demonstrated remarkable patience with me in the OR, and, have taken time out of their lives to share their knowledge with me and to help advance my career. Most importantly, patients have entrusted my fellow trainees and me with the honor of caring for them; and in so doing, learning the craft of orthopedics. As I contemplate the world beyond Sacramento, I am so grateful for the strong foundation I have been afforded.

Abstract
Gait Analysis at Your Fingertips: Accuracy and Reliability of Mobile App Enhanced Observational Gait Analysis in Children with Cerebral Palsy

Donald T. Kephart, MD[1], S. Reed Laing, BA[2], Anita Bagley, PhD, MPH[2], Jon R. Davids, MD[3], Vedant A. Kulkarni, MD4

Background: Three-dimensional gait analysis (3DGA) allows for quantification of gait deviation that can inform decision-making for orthopaedic surgery in children with cerebral palsy (CP). Where 3DGA is unavailable, observational gait analysis (OGA) guided by the Edinburgh Visual Gait Score (EVGS) has been shown to have acceptable reliability. The addition of mobile app enhanced analysis may improve the OGA method. This study prospectively evaluates the accuracy and reliability of mobile app enhanced OGA when compared to the gold standard of 3DGA in children with CP.

Methods: All subjects gave their informed consent for this IRB approved prospective study. Slow-motion video was captured on an iPhone 8S while simultaneous 3DGA was acquired using a 12-camera infrared system at a children's hospital Motion Analysis Center. Using the Dartfish Express app on an iPad Pro, two observers made 17 quantitative measurements per limb guided by the EVGS (Figure 1). Inter-class correlation coefficient

(ICC) was used to compare reliability between observers and between methods. Pearson Correlation was used to assess the impact of transverse plane deviations on the accuracy of sagittal plane measurements.

Results: Ten subjects with CP were recruited for the study (7M, 3F; GMFCS II = 8, GMFCS III = 2; Mean 12.4y, range 7.7y to 16.4y). All subjects had significant gait deviation as measured by the Gait Profile Score (GPS), with a mean GPS of 14.10 (SD 4.18), nearly three times greater than the reference normal of 5.2 (SD 1.9). There was excellent overall reliability between raters (ICC 0.95) using mobile app enhanced OGA, and good overall reliability between OGA and 3DGA (ICC 0.89). For individual measurements, the reliability was excellent (ICC > 0.9) for 6 measures, good (ICC 0.75 – 0.9) for 5 measures, moderate (ICC 0.5 – 0.75) for 5 measures, and poor (ICC < 0.5) for 1 measure. The mean error between OGA measurement and 3DGA was 7.02° (SD 6.86°), with foot progression angle (FPA) and knee progression angle (KPA) having among the highest mean errors (12.85° and 10.33°, respectively) (Table 1). Out of plane measurements substantially affected accuracy of the OGA method. If the FPA or KPA was greater than 20°, the accuracy of mid- stance ankle and knee position had substantially lower reliability and accuracy.

Conclusion: Mobile-enhanced OGA has good reliability between raters, allowing for enhanced communication about gait deviations in children with cerebral palsy using widely available technology. When compared to 3DGA, mobile-enhanced OGA has clinically acceptable measurement errors in the sagittal plane but should be used with caution to quantify transverse plane deviation. When rotation of the body segment exceeds 20°, sagittal plane measurements become out of plane, resulting in decreased accuracy and reliability.

Christopher T. Holland, M.D., M.S.

Education
University of California, Riverside School of Medicine – MD 2017
University of California, Riverside – MS Biochemistry and Molecular Biology, 2012
University of California, Riverside – BS Biological Sciences: concentration in Medical Biology, 2011

Next Steps: Arthroplasty Fellowship, Duke University
Career Objective: To pursue a career in academic medicine, striving to be an excellent surgeon, with a goal of contributing to the advancement of Orthopaedics and Arthroplasty through research and education.
Spouse: Ana Holland, MD
Children: Lucas Jacob Holland, Naomi Grace Holland

Personal Statement: Every day I am grateful for the opportunity I was given to train at UC Davis. I have met lifelong mentors, colleagues and friends throughout my journey. My mentors have fostered a passion to pursue excellence in the field of Orthopaedics, and I have been trained by excellent surgeons, clinicians and leaders in the field. I want to thank both of my parents, Paul and Aida Holland for setting the foundation to pursue my dreams, I am eternally grateful for your love and support. My wife Ana Holland for the continued support throughout what was undoubtedly a trying time as we both were residents, yet she shouldered the role of an amazing wife, mother, partner and doctor throughout it all, I would not have thrived in my training without you as my rock. And to my sister Kasandra Orme, who has been there from the beginning and advocated for me every step of the way. To my co-residents, we have had an amazing run and I couldn't imagine doing this with any other group of people, I appreciate you all so much and I am honored to have trained with you. Throughout my journey I have learned something from each one of the Attendings here at UC Davis, and with every clinical encounter or operating room experience I have been guided by their experience and skill. My future patients will benefit from the time, the grace and the patience with which you all have given to me throughout my residency. Thank you for letting me play a small part in taking care of your patients and for the lessons learned doing so. I look forward to an exciting, stimulating and rewarding career in orthopaedic surgery.

Abstract
Predicting Meniscal Repairability using Magnetic Resonance Imaging

Christopher Holland, MD; Dillon Chen, MD; Cyrus Bateni, MD; Cassandra Lee, MD

Background: Historically magnetic resonance imaging (MRI) results have only been used to identify a meniscal tear, with the intra-operative findings dictating whether a meniscal repair could be performed. Consistently predicting meniscal reparability based on MRI would allow for more efficient surgical workflow and enhance patient care by tempering post-operative expectations. The purpose of our study is to analyze whether current advanced MRI technologies can be used to predict if a meniscal tear is repairable in the operating room.

Methods: We retrospectively identified patients who underwent a meniscectomy or meniscal repair at a single center between January 1, 2010 and September 1, 2018. Patients without an available pre-operative MRI, an MRI from an outside institution, or if a time lapse of more than 3 months between MRI and surgery had occurred, were excluded. 202 knees were included in the analysis, imaging review was completed by three blinded reviewers, two board certified Musculoskeletal (MSK) Radiologists and one Subspecialty Sports

Orthopaedic Surgeon. Previously validated arthroscopic criteria were used to score the repairability of the meniscal tear on a scale of zero to four, with one point awarded for each of the following criteria – within 4mm of the meniscosynovial junction, tear larger than 10mm in length, intact inner meniscal segment, and >50% thickness of meniscal involvement. Tears with a score of 4 were predicted to be repairable.

Results: Out of 202 knees, 134 underwent meniscectomies and 68 underwent meniscal repair. No significant difference existed between age, sex or location of tear. The ability to predict repairability based on MRI criteria was not consistently demonstrated. The MSK Radiologists (k=0.08, k=0.35), and Orthopaedic Surgeon (k=0.44) showed poor and moderate correlation, respectively, in identifying repairable meniscal tears. When analyzed independently, type and nature of tears did not increase the ability to predict repairability. When evaluated by the Orthopaedic Surgeon, a meniscal tear undergoing concomitant anterior cruciate ligament (ACL) reconstruction, MRI had moderate predictive correlation (k=0.53).

Conclusion: The use of MRI to consistently predict the repairability of meniscal tears was not demonstrated. Moderate correlation did exist for one of the raters, and this increased for patients with meniscal tears undergoing ACL reconstruction. Using established arthroscopic criteria to predict the repairability of meniscal tears on MRI has not consistently been effective, future analysis of MRI criteria for predictive value of meniscal repairability should continue to be investigated.

	Reviewer 1 Predictions		Reviewer 2 Predictions		Reviewer 3 Predictions	
Procedure	Meniscectomy	Repair	Meniscectomy	Repair	Meniscectomy	Repair
Meniscectomy n=134	46	88	122	12	116	18
Repair n=68	16	52	40	28	31	37

*Each reviewer scored the knee two separate occasions for intra-observer reliability measurement.

Four Criteria - Predictors for Meniscal Repair, %
n=202

	Correlation Coefficient				Predictive Value	
	κ	Accuracy	Sensitivity	Specificity	Positive	Negative
Reviewer 1	0.07	49	76	34	37	74
Reviewer 2	0.35	74	41	91	70	75
Reviewer 3	0.44	76	54	87	67	79

Independent Variable - Distance to Menisco-capsular Junction <4mm, %
n=202

	Correlation Coefficient				Predictive Value	
	κ	Accuracy	Sensitivity	Specificity	Positive	Negative
Reviewer 1	0.07	41	97	13	36	90
Reviewer 2	0.38	75	45	90	70	76
Reviewer 3	0.24	59	83	46	44	84

Independent Variable – 10mm Meniscal Segment, %
n=202

	Correlation Coefficient				Predictive Value	
	κ	Accuracy	Sensitivity	Specificity	Positive	Negative
Reviewer 1	0.001	40	81	19	34	66
Reviewer 2	0.096	46	88	25	37	81
Reviewer 3	0.057	49	67	40	36	71

Independent Variable – Intact Meniscal Segment, %
n=202

	Correlation Coefficient				Predictive Value	
	κ	Accuracy	Sensitivity	Specificity	Positive	Negative
Reviewer 1	0.06	40	96	12	35	86
Reviewer 2	0.09	48	81	31	37	76
Reviewer 3	0.44	72	86	65	55	90

Independent Variable – Greater than 50% Meniscal Involvement, %
n=202

	Correlation Coefficient				Predictive Value	
	κ	Accuracy	Sensitivity	Specificity	Positive	Negative
Reviewer 1	0.013	35	98	4	34	79
Reviewer 2	0.042	38	99	8	35	91
Reviewer 3	0.22	57	86	42	43	85

Bucket Handle Tears – 43 tears were identified by all 3 reviewers as "Bucket Handle Meniscal Tears"

- **22/43 tears underwent Meniscal Repair – 51.2%**

Subgroup Analysis - Bucket Handle Tears
Four Criteria - Predictors for Meniscal Repair, %
n=43

	Correlation Coefficient				Predictive Value	
	κ	Accuracy	Sensitivity	Specificity	Positive	Negative
Reviewer 1	0.03	53	95	7	53	60
Reviewer 2	0.26	62	43	83	73	58
Reviewer 3	0.40	71	77	64	69	72

PGY2 Research Project Presentations

Maarouf A. Saad, M.D.
"Does Standardized Preoperative Planning Improve Resident Performance in Orthopaedic Trauma Surgery?"

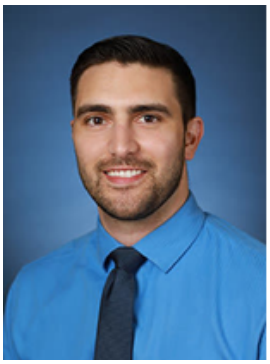
Weston K. Ryan, M.D.
"Sonographic Evaluation of Flexor Pulley System in the Uninjured Recreational Climber: What is Normal?"

Gregory J. Harbison, M.D.
"Comparison of Biomechanical Function of Cruciate Retaining Medial Pivot Implants in Kinematically Aligned Total Knee Arthroplasty Performed on Non-arthritic Cadaver Knees"

Patrick M. Wise, M.D.
"Timing Of Fracture Fixation In Burn Patients: A 22-Year Retrospective Analysis"

Kelsey L. Millar, M.D.
"Validation and Establishment of Normative Values for an Interactive Smartphone Tool Measuring Thumb Function in Preschool-Aged Children"

Maarouf A. Saad, M.D, PGY-2



Education:
Yale School of Medicine, MD – 5/2020
University of California, Davis, BS - Human Biology – 6/2015

Research Project:

Does Standardized Preoperative Planning Improve Resident Performance in Orthopaedic Trauma Surgery?

Background:
The primary aim of our study is to investigate the utility of standardized preoperative planning, versus standard planning techniques, and its effects on resident performance in the operating room. Residents enrolled in our study will complete a standardized preoperative planning template prior to participating in orthopaedic trauma cases and will be evaluated by faculty members after each case. Evaluations will be based on the quality of resident plans, understanding of the case, and operative performance.

Weston K. Ryan, M.D., PGY-2

Education:
University of Colorado, School of Medicine, MD – 5/2020
Syracuse University, BS -Bioengineering – 5/2015

Research Project: Sonographic Evaluation of Flexor Pulley System in the Uninjured Recreational Climber: What is Normal?

Background:
Rock climbing is a popular and growing recreational sport throughout the world. The nature of the sport places supra-physiologic loads across the soft tissues of the fingers, predisposing to injury as well as compensatory adaptive changes in native anatomy over time. Ultrasound characterization of these structures is mostly done in cadavers, or elite level climbers, which comprise a small percent of the total population of active rock climbers. Rather, this study looks to assess the epidemiologic characteristics as well as ultrasonographic anatomy of the more predominant “recreational” climber. Better global understanding of the uninjured recreational climber is needed to recognize factors that may optimize diagnosis and treatment strategies, and to establish if and how this population’s anatomy differs to best interpret imaging studies.

Gregory J. Harbison, M.D., PGY-2

Education:
University of Hawaii, John A. Burns School of Medicine, MD – 5/2020
Colorado State University, MS -Environmental & Radiological Health Sciences – 5/2016
Colorado College, BA, Biology, Minor Chemistry and Asian Studies - 5/2011

Research Project:
Comparison of Biomechanical Function of Cruciate Retaining Medial Pivot Implants in Kinematically Aligned Total Knee Arthroplasty Performed on Non-arthritic Cadaver Knees

Background:
The purpose of this study is to quantitatively compare the biomechanics of cruciate retaining implants in KA TKA to the native knee. Through this comparison, future KA TKA implant designs may be improved. In this study, we will compare the tibiofemoral compartmental pressure forces and ligamentous laxity of a non-arthritic cadaver specimen. Next, we will implant a medial pivot cruciate retaining TKA implant using kinematic alignment and again, measure the tibiofemoral compartmental pressure forces and ligamentous laxity.

Patrick M. Wise, M.D., PGY-2

Education:
Penn State College of Medicine, MD – 5/2020
Albright College, Davis, BS - Biochemistry – 5/2015

Research Project:
Timing Of Fracture Fixation In Burn Patients: A 22-Year Retrospective Analysis

Patrick Wise, Anastasiya Ivanko, Wyatt Vander Voort, Jacob Priester, Mark Lee, Tina Palmieri

Background:
Burn fracture injuries, associated with significant morbidity and mortality, affect both the military and civilian populations. Currently there is little evidence to guide the definitive treatment of fractures in these burn patients. One common management pathway aims for fracture treatment within 48 hours of injury to lower infection risk, improve union rates, and improve outcomes for patients. Unfortunately, little evidence exists to support this strategy. Furthermore, this timeframe to definitive fixation may be impractical, especially in the military environment where intertheater transfers can take over 48 hours following injury.

Burn patients have not been well represented in studies that support the early fixation of major fractures in polytrauma patients. In this 22-year retrospective analysis we will compare union rates and overall outcomes between burn patients who had fractures definitively fixed within and after 48 hours. We hypothesize that fractures fixed after 48 hours will have a higher incidence of nonunion.

Kelsey L. Millar, M.D., PGY-2

Education:
University of California, Davis School of Medicine Rural-PRIME Track, MD – 5/2020
Arizona State University, BS -Kinesiology – 5/2015

Research Project:
Validation and Establishment of Normative Values for an Interactive Smartphone Tool Measuring Thumb Function in Preschool-Aged Children

Background:
The thumb constitutes an important part of hand function, but there are few to no clinical assessments or tools to assess thumb function specifically in children. Clinical measurements, such as range of motion and strength do not necessarily assess thumb function. The single functional test that has been validated in children and used to assess thumb function requires significant administration and scoring time1, 2, 3, 4. A thumb assessment tool that is quick and easy to administer would be particularly useful in the preschool age population as this is the age when children with thumb differences undergo surgical intervention4. Such a tool would allow providers to assess the effect of congenital hand differences on thumb function as well as compare thumb function pre- and post- surgical intervention. Singh et al. has developed an interactive tool, Barnyard ThumbP (iPhone-based application), to assess thumb function in the pediatric population that has been shown to be both feasible and reliable5. The first purpose of this study is to validate the use of this tool in the preschool age population, and we hypothesize that scores on Barnyard ThumbP will correlate with scores on the Functional Dexterity Test.

The second purpose of this study is to establish normative values for age, and we hypothesize that the scores on Barnyard ThumbP will positively correlate with age.

Methods:
This is a prospective single center cohort study of children ages 2-5 years old who will be recruited through clinic visits at Shriners Hospital for Children Northern California. Children with normally developing hand function as well as children with congenital thumb hypoplasia will be included in this study. Normally developing children will be screened using a brief checklist to verify no existing neurological, musculoskeletal, or cognitive disorders as well as no prior upper extremity trauma. Children with congenital thumb hypoplasia will be screened by the pediatric orthopaedic hand surgeons at the institution to verify diagnosis and inclusion in the study. Participating children will complete the Barnyard ThumbP iPhone application, which measures how many animals are touched on the screen, and analyzes where the child is able to touch, time to touch the animal, and accuracy of touch. Each participant will complete the 3-minute Barnyard ThumbP twice 10 minutes apart. Each child's thumb opposition/range of motion as measured by Kapandji score, as well as pinch strength, will be recorded. Each child will also complete the Functional Dexterity Test (FDT). Reliability will be assessed by test -retest performance (Trial 1 versus Trial 2) using interclass correlation coefficients. Criterion and construct validity will be assessed by comparing Barnyard ThumbP performance with FDT, Kapandji score, and pinch strength using Pearson's correlation coefficient. Discriminant validity will be assessed by comparing Barnyard ThumbP performance between normally developing children versus children with congenital thumb hypoplasia using student's t-test.

References:

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Huge thank you to our Resident Program Leadership

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