

# MUSCULOSKELETAL

## Grayson-Jockey Club Research Archives



The horse's musculoskeletal system consists of the bones, cartilage, muscles, ligaments, and tendons. Their primary function is to support of the body, provide motion, and protect vital organs. There are 205 bones in the horse's skeleton. Twenty of these bones are in each foreleg and 20 in each hind limb, for a grand total of 80 bones in the four equine legs. These studies focus on joint health, arthritis, bone regeneration, and imaging advancements to make safe diagnosis in the horse.

Grayson is proud to have funded the following projects:

### Development of a Palmar Osteochondral Disease Model

Colorado State University, *Principal Investigator: Chris Kawcak*

*CO-PIs: Lauren Smanik, Kurt Selberg, Holly Stewart, Jennifer Daniels, Christine Battaglia*

The goal of this proposal is to develop an experimental model of palmar osteochondral disease in horses to better study disease progression and facilitate development of improved treatment strategies.

Year: 2022 TOTAL - \$ 95,790

### Treatment of Joint Injury With Mesenchymal Stromal

University of Guelph, *Principal Investigator: Thomas Koch*

*CO-PIs: Mark Hurtig, Keith Russell*

Evaluation of equine umbilical cord blood-derived mesenchymal stromal cells to treat joint injuries in horses.

Years: 2021-2022 TOTAL - \$ 116,960

### Optimizing Bone Growth to Reduce Equine Fracture

University of Illinois Urbana-Champaign, *Principal Investigator: Mariana Kersh*

*CO-PIs: Annette McCoy*

Reduction in distal limb fractures through exercise in young horses would have a significant positive impact on horse welfare and the economics and public perception of the horse industry.

Years: 2021-2022 TOTAL - \$ 118,583

### Injury Prediction From Stride Derived Racing Load

University of Melbourne, *Principal Investigator: Chris Whitton*

*CO-PIs: Peta Hitchens, Adelene Wong, Ashleigh Morrice-West*

By studying patterns in bone fatigue accrual over time in racehorses, we will better, and earlier, identify horses at risk of limb injury, facilitating timely evidence based preventative strategies.

Years: 2021-2022 TOTAL - \$ 189,308

### **Diagnosis Of Incipient Condylar Stress Fracture**

University of Wisconsin–Madison, *Principal Investigator: Peter Muir*

*CO-PIs: Corinne Henak, Sabrina Brounts, Carla Winsor, Jordan Gruel,*

*C Whitton - University of Melbourne*

F Malekipour - University of Melbourne, Seamus Hoey, University of Dublin

This study will save the lives of racehorses by establishing screening using fetlock CT for diagnosis of horses with a high risk of imminent serious injury for personalized clinical care.

Years: 2021-2022 TOTAL - \$ 134,951

### **Hyperthermia and Acidosis in Exertional Muscle Damage**

Oklahoma State University, *Principal Investigator: Michael Davis*

*Co-PIs: Montana Fulton, K Williamson, Waypoint Vet Ed, Warrick Bayly (Washington State)*

This project will identify an underlying cause of exercise-associated muscle fatigue and soreness and allow trainers to more precisely condition horses with fewer training days lost to muscle soreness.

Year: 2021 TOTAL - \$137,167

### **Bisphosphonates and Fatal Musculoskeletal Injury**

Cornell University, *Principal Investigator: Heidi Resink*

*Co-PIs: Eve Donnelly, Sean McDonough, Husni Mohammed, Wayne Schwark, Anthony Condo, Kira Noordwijk, Erik Taylor, Scott Palmer (NY State Game), George Maylin ( Morrisville State)*

This project looks at determining the prevalence of bisphosphonate use in racehorses and whether bisphosphonates are associated with fatal musculoskeletal injury which is essential to equine welfare and the future of racing.

Years: 2020-2021 TOTAL - \$114,006

### **Enhancing the Efficacy of MSCs for Tendon Healing**

North Carolina State University, *Principal Investigator: Lauren Schnabel*

*Co-PIs: Kristen Messenger*

This proposal examines the tendon inflammatory environment following acute injury and the effect of such an environment on mesenchymal stem cells (MSCs), with the goal of improving MSC treatment efficacy.

Years: 2020-2021 TOTAL - \$100,687

### **SDFT Adaptation in Thoroughbred Racehorses**

The Ohio State University, *Principal Investigator: Sushmitha Durgam*

*Co-PIs: Susan Stover (UC Davis), Matthew Stewart (Un of Illinois)*

The impact of training and racing on (mal)adaptations in superficial digital flexor tendon hierarchical structure will be evaluated to delineate the pathophysiology of this common injury in racehorses.

Years: 2020-2021 TOTAL - \$56,904

### **Bisphosphonate Effects on Biomarkers and Bone Metabolism**

University of California- Davis, *Principal Investigator: Heather Knych*

*Co-PIs: Carrie Finno, Mathieu Spriet, Rick Arthur, Anna Dahlgren, Kirsten Kanarr, Kelsey Seminoff*

This study will allow for development of sensitive and alternate methods for detection of bisphosphonates.

Years: 2020-2021 TOTAL - \$212,237

### **Novel Delivery of Antimicrobials into Equine Joints**

University of Melbourne, *Principal Investigator: Simon Bailey*

*Co-PIs: Ted Whitem, Jamie Wearn, Andrew Woodward*

This study is for the development and testing of, a novel (gel) carrier formulation for the antibiotic Cefuroxime, injection into horses' joints for application as a treatment of joint infections.

Years: 2020-2021 TOTAL - \$87,692

### **Diagnostic Assay for Recurrent Exertional Rhabdomyolysis**

University of Minnesota, *Principal Investigator: Molly McCue*

*Co-PIs: James Mickelson, Samantha K Beeson, Emmeline Hill (Un Dublin), Lisa Katz (Un Dublin)*

This study was to identify a comprehensive set of genetic markers that allow RER risk prediction before horses tie-up and preemptive management to decrease the frequency and severity of clinical disease.

Years: 2020-2021 TOTAL - \$137,640

### **Novel Treatment for Recurrent Exertional Rhabdomyolysis**

Michigan State University, *Principal Investigator: Stephanie Valberg*

*CO-PIs: Lorraine Sordillo, Marisa Henry, Deborah Velez-Irizarry, Jeff Gandy,*

*Joe Pagan (KY EQ Research), Clara Fenger (EQ Integrated Med)*

This project was to determine if a potent antioxidant coenzyme Q10, not subject to withdrawal times, can benefit horses with tying up by replenishing diminished muscle coQ10 levels and decreasing oxidative stress.

Year: 2020 TOTAL - \$56,942

### **Antimicrobial Properties of Equine MSCs**

Colorado State University, *Principal Investigator: Laurie Goodrich*

*CO-PIs: Steve Dow, Wayne McIlwraith, Valerie Johnson, Lynn Pezzanite, Nikki Phillips,*

*Tom Schaer (PENN), Lauren Schnabel (NCSU)*

This study was designed to validate TLR activated equine mesenchymal stem cells as an effective, novel therapy in treating multi-drug resistant infections.

Years: 2019-2020 TOTAL - \$198,056

### **Robotic CT for Assessing of Bone Morphology**

University of Pennsylvania, *Principal Investigator: Kyla Ortved*

*CO-PIs: Mary Robinson, Kathryn Wulster, Dean Richardson, Joanne Haughan, Jessica Morgan,*

*Kara Brown, Tom Schaer, Josh Benson*

The focus on screening fetlock joints using standing robotic CT and biomarker analysis to prevent catastrophic injuries in the Thoroughbred racehorse.

Years: 2019-2020 TOTAL - \$105,869

### **Standing PET of the Racehorse Fetlock**

University of California-Davis, *Principal Investigator: Mathieu Spriet*

*Co-PIs: Scott Katzman, Larry Galuppo, Sue Stover*

This project was designed to validate a Positron Emission Tomography (PET) technology for early detection of fetlock lesions in standing horses to prevent catastrophic breakdowns in racehorses.

Year: 2019 TOTAL - \$134,477

### **Racehorse Stride Characteristics- Injury and Performance**

University of Melbourne, *Principal Investigator: Chris Whitton*

*Co-PIs: Peta Hitchens, Adelene Wong*

A study to identify changes in stride characteristics of racehorses over time to determine identify those parameters that can be used as an early indicator of injury or that are key to injury development.

Year: 2019 TOTAL - \$87,737

### **Development of Limited View 3D Imaging**

Colorado State University, *Principal Investigator: Chris Kawcak*

*Co-PIs: Martine Duff, Kurt Selberg, Holly Stewart, Wayne McIlwraith, Xiaochuan Pan and Emil Sidky (UN of Chicago)*

The goal of this proposal was to develop a point-of-care, 3-dimensional imaging technique that can be used to better characterize and prevent injuries in racehorses.

Year: 2018-2019 TOTAL –198,836

### **Underlying Cause of Recurrent Exertional Rhabdomyolysis**

Michigan State University, *Principal Investigator: Stephanie Valberg*

*Co-PIs: Deborah Velez-Irizarry; ; Keri Gardner; Melissa Schott*

The aim of this study was to determine if stress-induced modification to the skeletal muscle calcium release channel forms the basis for tying up in thoroughbreds and to pinpoint a target for development of effective new treatments.

Year: 2018 TOTAL - \$57,643

### **Platelet Lysate Therapy in Infectious Arthritis**

North Carolina State University, *Principal Investigator: Lauren Schnabel*

*Co-PIs: Jessica Gilbertie; Julie Long; Tom Schaer, (U of PA)*

This proposal examined the antibacterial properties of platelets to treat joint infections in horses more effectively than conventional therapies, with the goal of reducing morbidity and mortality.

Years: 2017- 2018 TOTAL - \$101,440

### **Bone Marrow Mononuclear Cells for Equine Joint Therapy**

Virginia Maryland CVM, *Principal Investigator: Linda A. Dahlgren*

*Co-PIs: Bruno C. Menarim; Christopher R. Byron; Xin M. Luo; Anne E. C. Nichols*

The results from this study will pave the way to investigate a new cell therapy from equine bone marrow as a targeted regenerative therapy for horses suffering from arthritis.

Years: 2017- 2018 TOTAL - \$99,620

### **Synovial Oxylipid Profiles: Role Of Omega-3 Fatty Acids**

Michigan State University, *Principal Investigator: John Caron*

*Co-PIs: Lorraine Sordillo; Jeffrey Gandy; Jennifer DeVries*

This project was a first step in establishing science-based guidelines for the nature and amount of dietary polyunsaturated fatty acids that will prevent or delay osteoarthritis in horses.

Year: 2017 TOTAL - \$37,307

### **PET Imaging Of the Equine Distal Limb**

University of California, Davis, *Principal Investigator: Mathieu Spriet*

*Co-PIs: Scott Katzman; Larry Galuppo; Pablo Espinosa*

A study of Position Emission Tomography (PET) imaging as a diagnostic tool, newly available to the horse, that will allow detection of lesions not identified with other techniques.

Year: 2016-2017 TOTAL - \$82,014

### **Immune Properties of Autologous and Allogeneic BMDMSCs**

Colorado State University, *Principal Investigator: Laurie Goodrich*

*Co-PIs: Steve Dow; Aimee Colbath; C. Wayne McIlwraith; Jennifer Phillips;*

*Frank Barry (UN of Ireland)*

Designed to answer important question of whether allogeneic mesenchymal stem cells derived from bone marrow (BMDMSCs) are a viable alternative to autologous BMDMSCs in the horse. (Autologous means cells from the horse's own bone marrow; allogeneic means from another, healthy horse.)

Years: 2015-2016 TOTAL - \$115,890

### **Contrast Enhanced CT for Detection of Cartilage Injury**

Colorado State University, *Principal Investigator: Christopher Kawcak*

*Co-PIs: Bradley Nelson; Laurie Goodrich; C. Wayne McIlwraith; Myra Barrett;*

*Mark Grinstaff & Rachel Stewart ( Boston UN); Natasha Werpy (UN of FL)*

This project reviewed critical evaluation of CCECT as a method for the detection of early osteoarthritis in horses and for applications of its use in clinical patients.

Years: 2014-2015 TOTAL - \$178,226

### **Serum Biomarkers for Equine Laminitis**

University of Pennsylvania, *Principal Investigator: Hannah Galantino-Homer*

*Co-PIs: Julie Engiles; Susan Megee; Bettina Wagner -Cornell*

Years: 2013-2014 TOTAL - \$142,147

### **Acoustoelastography to Monitor Injured Equine Tendon**

University of Wisconsin–Madison, *Principal Investigator: Sabrina Brounts*

*Co-PIs: Sarah Duenwald–Kuehl; Ray Vanderby; Roderic Lakes*

Years: 2013-2014 TOTAL - \$89,344

### **Motor Responses in Equine Cervical Stenotic Myelopathy EPM**

Iowa State University, *Principal Investigator: Cody Alcott*

*Co-PIs: Nicholas Jeffery; David Wong; Brett Sponseller; Andrea Manternach*

Year: 2013 TOTAL - \$32,848



### **Detection of Lameness in Racehorses at the Gallop EPM**

University of Missouri, *Principal Investigator: Kevin Keegan*

*Co-PIs: Joanne Kramer; Marco Lopes; David Wilson; Shannon Reed; P. Frank Pai*

Year: 2013 TOTAL - \$71,422

### **Stem Cell Homing After IV Regional Limb Perfusion**

Cornell University, *Principal Investigator: Alan Nixon*

*Co-PIs: Ashlee Watts; Whitney Linnenkohl; Hussni Mohammed; Michael Scimeca*

Years: 2012-2013 TOTAL - \$150,000

### **Treatment of Experimental Equine Laminitis with Doxycycline**

Louisiana State University, *Principal Investigator: Susan Eades*

*Co-PIs: Lee Ann Fugler; Daniel Paulsen*

Years: 2012-2013 TOTAL - \$58,400

### **AAV-IRAP Gene Therapy to Prevent Osteoarthritis**

Colorado State University, *Principal Investigator: Laurie Goodrich*

*Co-PIs: David Frisbie; Natasha Werpy; C. Wayne McIlwraith; R J Samulski (UN of NC)*

Years: 2011-2012 TOTAL - \$134,635

### **Generation of Equine iPS Cells for Regenerative Therapy**

Cornell University, *Principal Investigator: Lisa A. Fortier*

*Co-PIs: John Schimenti; Lauren Schnabel*

Years: 2011-2012 TOTAL - \$97,352

### **Cell & Growth-Factor Dependent Tenogenesis**

University of California – Davis, *Principal Investigator: Martin Vidal*

*Co-PIs: Keith Baar; Kerstien Padgett*

Years: 2011-2012 TOTAL - \$80,332

### **Equine Bone Regeneration with Adults Stem Cells**

Louisiana State University, *Principal Investigator: Mandi Lopez*

*Co-PIs: Jeff Gimble (Stem Cell Lab Pennington BioMed)*

Years: 2010-2011 TOTAL - \$157,830

### **Orthopaedic & Genetic Roles in Wobblers Syndrome**

University of Kentucky, *Principal Investigator: James N. MacLeod*

*Co-PIs: Jennifer James, Stephen Reed, Neil Williams; Neil Williams; Anthony Pease (MI State UN)*

Years: 2010-2011 TOTAL - \$102,193

### **Clinical Admin of Doxycycline for Arthritis**

Cornell University, *Principal Investigator: Lisa Fortier*  
*Co-PIs: Lauren Schnabel; Thomas Divers; Mark Papich (NC State)*  
Year: 2010 TOTAL - \$63,073

### **Developing eqBMP-2 for Bone and Cartilage Repair**

University of Illinois, *Principal Investigator: Matthew Stewart*  
*Co-PIs: Dan Peck; Brendan Harley; Christopher Evans (Harvard)*  
Years: 2009-2010 TOTAL - \$87,286

### **Incidence of Nonfatal Injuries in Racing Thoroughbreds**

Colorado State University, *Principal Investigator: C.Wayne McIlwraith*  
*Co-PIs: Ashley Hill; Jeff Blea (S. CA UN); Michael Peterson (UN of MN); R. Arthur (UC-Davis)*  
Year: 2009 TOTAL - \$44,397

### **Mesenchymal Stem Cell Treatment**

Washington State University, *Principal Investigator: Robert Schneider*  
*Co-PIs: Stavros Yiannikouris; Chad Marsh; Sarah Sampson; Greg Roberts;*  
*David Frisbie & John Kisiday (CSU)*  
Year: 2009 TOTAL - \$40,570

### **Differentiated Stem cells for Cartilage Repair**

Cornell University, *Principal Investigator: Alan Nixon*  
*Co-PIs: Ashlee Watts; Kyla Ortved*  
Years: 2008-2009 TOTAL - \$147,328

### **Equine Cord Blood Stem Cells - From Farm to Point of Care**

University of Guelph, *Principal Investigator: Dean Betts*  
Years: 2008-2009 TOTAL - \$83,132

### **Effects of Joint Geometry on Fetlock Joint Disease**

Colorado State University, *Principal Investigator: Chris Kawcak*  
*Co-PIs: Christian Puttlitz; Tim Parkin; C. Wayne McIlwraith; Kenton Morgan*  
Years: 2007-2008 TOTAL - \$80,480

### **Hydroxyapatite Coatings to Prevent Pin Loosening in Horses**

Purdue University, *Principal Investigator: Timothy Lescun*  
Years: 2007-2008 TOTAL - \$69,039

### **Bactericidal Implant Analysis in a Prosthetic Infection Model**

University of Pennsylvania, *Principal Investigator: Dean Richardson*

*Co-PIs: Thomas Schaer; Noreen Hickok; Christopher Adams*

Years: 2007-2008 TOTAL - \$100,206

### **Patient-Side Constructs for Cartilage Regeneration**

Cornell University, *Principal Investigator: Lisa Fortier*

*Co-PIs: Alan Nixon; Julia Flaminio*

Years: 2006-2007 TOTAL - \$178,542

### **Growth Factor Enhanced Progenitor Cells for Tendon Healing**

University of Illinois, *Principal Investigator: Allison Stewart*

*Co-PIs: Jennifer Barrett; Matthew Steward*

Years: 2006-2007 TOTAL - \$44,320

### **MRI Characterization of the Hindlimb Suspensory Ligament**

North Carolina State University, *Principal Investigator: Michael Schramme*

*Co-PIs: Dianne Little; Anthony Pease; W. Rich Redding; Keith Linder*

Year: 2006 TOTAL - \$23,890

### **Gene Transfer of BMP-2 for Enhancing Fracture Healing**

Colorado State University, *Principal Investigator: David Frisbie*

*Co-PI: Louise Southwood*

Years: 2005-2006 TOTAL - \$74,506

### **Acceleration of Third Metacarpal Fracture Healing with rhBMP-2**

University of Wisconsin-Madison, *Principal Investigator: Mark Markel*

*Co-PIs: Ryland Edwards; Maria Faria; Yan Lu*

Years: 2005-2006 TOTAL - \$135,278

### **Culture & Characterization of Equine Marrow Stem Cells**

Louisiana State University, *Principal Investigator: Jill Johnson*

*Co-PIs: Martin Vidal; Jeffrey Gimble; Rustin Moore; Mandi Lopez*

Year: 2005 TOTAL - \$17,432

### **Molecular Therapy for Bone Healing in Horses**

The Ohio State University, *Principal Investigator: Alicia Bertone*

*Co-PIs: John Mattoon; Alan Litsky; Christopher Evans; Stephen Weisbrode; Jeffrey Bartlett*

Year: 2005 TOTAL - \$55,995



### **Tetracyclines as Therapeutics for Equine Arthritis**

Cornell University, *Principal Investigator: Lisa Fortier*

*Co-PI: R.A. Greenwald*

Year: 2004 TOTAL - \$71,544

### **Epidemiology of Proximal Sesamoid Fractures in Thoroughbreds**

University of California – Davis, *Principal Investigator: Susan Stover*

*Co-PIs: Ian Gardner; Lucy Anthenill*

Year: 2004 TOTAL - \$62,416

### **Effects of Early Exercise on Osteochondral Tissues**

Colorado State University, *Principal Investigator: Christopher Kawcak*

*Co-PIs: C. Wayne McIlwraith; Neil Broom; Elwyn Firth*

Years: 2003-2004 TOTAL - \$68,523

### **Significant Contributions to Hoof & Sole by Lamina & Bars**

Michigan State University, *Principal Investigator: Robert Bowker*

Years: 2003-2004 TOTAL - \$64,641

### **Chondroprotection for Impacted Equine Cartilage Explants**

Michigan State University, *Principal Investigator: Michael Orth*

*Co-PIs: Angela Schlueter; John Caron*

Years: 2003-2004 TOTAL - \$49,715

### **Growth Factor Gene Transduced Stem Cells for Cartilage Repair**

Cornell University, *Principal Investigator: Alan Nixon*

*Co-PIs: Paul Robbins; Chris Beinlich*

Years: 2002-2003 TOTAL - \$101,254

### **Does Suspensory Apparatus Injury or Its Risk Factors Increase Risk for Metacarpal Condylar Fracture in the Thoroughbred Racehorse?**

University of California – Davis, *Principal Investigator: Susan Stover*

*Co-PIs: Ian Gardener; Bill Johnson; Ashley Hill*

Years: 2001-2002 TOTAL - \$69,834

### **The Safety of Shockwave Therapy in Performance Horses**

Iowa State University, *Principal Investigator: Scott McClure*

*Co-PIs: Iona Scone; Richard Evans; Viren Amin; Mark Williamson*

Year: 2001 TOTAL - \$50,000

### **Basis for Pharmacologic Treatment of Flexural Deformities**

Michigan State University, *Principal Investigator: Steven Paul Arnoczky*

*Co-PI: John Stick*

Year: 2001 TOTAL - \$33,364

### **Muscle Glycogen Metabolism in Horses**

The Ohio State University, *Principal Investigator: Kenneth Hinchcliff*

*Co-PIs: Catherine Kohn; Richard Sams; Lynn Taylor; Veronique Lacombe; Steven Devor*

Year: 2001 TOTAL - \$94,967

### **Further Evaluation of the Effect of Shoeing on Impact Trauma in the Racehorse**

University of Pennsylvania, *Principal Investigator: David Nunamaker*

*Co-PIs: Barbara Dallap; Raymond Boston; Chris Ryan; Mary Hazzard; Rob Sigafos; John Fisher*

Years: 2001-2002 TOTAL - \$63,410

### **Serum Markers for Detection of Musculo-Skeletal Injury in Horses**

Colorado State University, *Principal Investigator: David Frisbie & R. Clark Billingham*

*Co-PIs: R.C. Billingham; C. Wayne McIlwraith*

Years: 2000-2001 TOTAL - \$98,792

### **Hoof Wall Epidermal Laminae: Adaptive Response to Stress**

Michigan State University, *Principal Investigator: Robert Bowker*

*Co-PI: Diane Troyer*

Years: 2000-2001 TOTAL - \$69,708

### **Intramuscular Calcium Regulation in Exertional Rhabdomyolysis**

University of Minnesota, *Principal Investigator: Stephanie Valberg & Esther Gallant*

*Co-PIs: Esther Gallant; J.R. Mickelson*

Years: 2000-2001 TOTAL - \$100,172

### **Stem Cell Induced Chondrogenesis for Cartilage Repair**

Cornell University, *Principal Investigator: Alan J. Nixon*

*Co-PIs: Chris Evans; Marcus White*

Years: 1999-2000 TOTAL - \$97,621

### **A Dynamometric Horseshoe for Assessing Forces Associated with Racing Surfaces**

University of California – Davis, *Principal Investigator: Maury Hull*

*Co-PI: Susan Stover*

Year: 1999 TOTAL - \$35,408

**Effects of Toe Grabs on the Locomotor Patterns of Galloping Horses**

Washington State University, *Principal Investigator: Marc H. Ratzlaff*

*Co-PI: David Hutton*

Year: 1999 TOTAL - \$44,411

**Gene Therapy for Equine Arthritis**

University of Pennsylvania, *Principal Investigator: Dean Richardson*

*Co-PI: Brian Foley*

Years: 1999-2000 TOTAL -\$69,100