

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:

[PET MRI Sport Horse Fetlock](#)

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

CO-PIs: Charlene Pige, Erin Porter (University of Florida), Natasha Werpy (Equine Diagnostic Imaging), Katie Garrett (Rood & Riddle Equine Hospital)

This study will compare 18F-NaF Positron Emission Tomography (PET) with Magnetic Resonance Imaging (MRI) for assessment of fetlock injuries in sport horses.

YEAR: 2023 TOTAL- \$116,490

[Motion Of The Proximal Sesamoid Bones On Uneven Footing](#)

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

CO-PIs: Sarah K Shaffer, Tanya C Garcia

This study proposes to determine how hoof conformation, shoeing, and uneven racetrack surfaces could contribute to fetlock breakdowns.

YEARS: 2022-2023 TOTAL- \$34,763

[Immunomodulation And Exosomes To Enhance Tendon Healing](#)

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

CO-PIs: Hilary Rice, Charles Bowlby

This study aims to characterize M1 and M2 macrophage-derived inflammatory factors and assess their impact on superficial digital flexor tendon tenocyte activities while examining the potential of extracellular vesicles/exosomes to enhance tendon healing.

YEARS: 2022-2023 TOTAL- \$74,898

[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 Whittam, 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 Orved*

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 Schaefer; 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