

## Ryan S. Gray, Ph.D.

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### **ACADEMIC BACKGROUND**

2009, Ph.D., Cellular and Molecular Biology, University of Texas at Austin  
2002, Bachelor of Science, Molecular Biology, University of Southern Mississippi

### **RESEARCH EXPERIENCE**

November 2015 – current, Assistant Professor; The University of Texas at Austin, Dell Medical School at the Dell Pediatrics Research Institute, Austin, Texas

October 2010 – October 2015, Post-doctoral fellow; Washington University School of Medicine, Developmental Biology, St. Louis, Missouri

- Research project: Genetics of vertebral column/spine defects using zebrafish as a model.
- Research supervisor: Lilianna Solnica-Krezel

July 2009 – October 2010, Post-doctoral researcher, Johns Hopkins School of Medicine, Center for Cellular Dynamics, Baltimore, Maryland

- Research project: Morphogenesis of primary mouse mammary gland organoids.
- Research supervisor: Andrew J. Ewald

2003 – May 2009, Ph.D. student; The University of Texas at Austin, Department of Cellular and Molecular Biology, Austin, Texas

- Research project: Diversity of Dishevelled genes and PCP effector genes on ciliogenesis.
- Research supervisor: John B. Wallingford

### **PERSONAL STATEMENT**

The goal of my lab is to elucidate the cellular and molecular mechanisms underlying spine development and disease. For over a decade, I have been dedicated to understanding the fundamental mechanisms of musculoskeletal/spine development and disease. I have developed a broad background in developmental biology and molecular genetics, and I am well-versed in using both the mouse and zebrafish model systems. Our current disease focus is condition known as adolescent idiopathic scoliosis (AIS) which is a complex curvature of the spine, without vertebrae dysplasia that begins during adolescence in otherwise healthy children. In my lab, we use genetic approaches in mouse and zebrafish models as well as relevant cell culture approaches to gain mechanistic understanding of spine development and the etiology of spine deformity and cartilage homeostasis. My previous work demonstrated the importance of the extracellular matrix and of embryonic notochord morphology for formation of normal spine morphology in the adult. Our forward-genetics screen in zebrafish uncovered a kinesin motor protein, which has a role in spine stability and ependymal cilia formation in the zebrafish, which we are now modeling in the mouse. We generated the first mouse model of AIS in the mouse that was informed by known human risk locus, *ADGRG6*. Mechanistic studies of this model have focused our investigation towards the identification of cartilage homeostasis and joint degeneration. We will continue to use a multi-tiered approach, combining zebrafish, mouse, and cell culture models, informed by human genomics, with the goal to inform the diagnosis of musculoskeletal disease and provide insights for therapeutic interventions of these disorders in humans.

## **AWARDS, HONORS, AND FELLOWSHIPS**

2017 ORS Spine Section Early Investigator Podium Award  
2013-2015 Standard Investigator Grant, Scoliosis Research Society  
2015 14th International Phillip Zorab Symposium Best Poster Award, British Scoliosis Society  
2012-2015 NRSA F32 Grant - 1F32AR063001-01  
2011-13 Postdoctoral Fellowship Grant from the Children's Discovery Institute - MD-F-2011-143  
2009 Best Talk Award – University of Texas at Austin Cell and Molecular Biology Retreat  
2007, 2009 Society of Developmental Biology Travel Award  
2006-2008 University of Texas at Austin Travel Award  
2004 Joint Steering Committee for Public Policy Capitol Hill Day Travel  
2002 Graduated with Honors University of Southern Mississippi  
2001-2002 Dean's List University of Southern Mississippi  
2001-2003 Beta Beta Beta Biological Honor Society

## **INSTITUTIONAL SERVICE ACTIVITIES**

### **University of Texas at Austin - Dell Medical School**

University Committees: Institutional Biosafety Committee (Fall 2016 - current); Animal Resources Advisory Committee (Fall 2016 - current).

Pediatrics Committees: Pediatric Research Committee (Fall 2016 - current); Pediatric Faculty Recruitment Committee (2017 - current).

## **PROFESSIONAL SOCIETIES**

Genetics Society of America (GSA).

The Society of Developmental Biology (SDB).

International Consortium for Spine Genetics, Development, and Disease (ICSGDD).

Texas Genetics Society (TGS).

## **MISC. POSITIONS**

2001-2001, Field Research USGS, Alagnak River Basin, AK, Julie Meka, Native Trout Program Coordinator

2001-2003, Microbiology Lab Assistant, Microbiology lab, University of Southern Mississippi, Delia Anderson, Professor

2002-2003, Undergraduate Research, University of Southern Mississippi, George Santangelo, Professor

## **JOURNAL REVIEWER**

*Nature Genetics, ELife, Nature Communications, Developmental Biology, Developmental Dynamics, PlosONE, Science Bulletin, Genetics, Journal of Bone Mineral Research, Human Genome Variation, European Spine Journal.*

## **TEACHING EXPERIENCE**

Microbiology Laboratory - The University of Southern Mississippi

Clinical Microbiology Laboratory - The University of Texas at Austin

Developmental Biology - The University of Texas at Austin

## PUBLICATIONS (reverse chronological)

1. Giampietro PF, Pourquie O, Raggio C, Ikegawa S, Turnpenny PD, Gray RS, Dunwoodie SL, Gurnett CA, Alman B, Cheung K, Kusumi K, Hadley-Miller N, and Wise CA. Summary of the first inaugural joint meeting of the International Consortium for scoliosis genetics and the International Consortium for vertebral anomalies and scoliosis, March 16–18, 2017, Dallas, Texas **Am J Med Genet. Part A**. 21 Nov 2017 | DOI: 10.1002/ajmg.a.38550.
2. Herbert AL, Fu M, Drerup CM, Gray RS, Harty BL, Ackerman SL, O'Reilly-Pol T, Johnson SL, Nechiporuk AV, Barres BA, and Monk KR. Dynein/dynactin is necessary for anterograde transport of Mbp mRNA in oligodendrocytes and for myelination in vivo. **Proc Natl Acad Sci**. 2017 Oct 24;114(43):E9153-E9162. PMID: 29073112.
3. Sanchez NE, Harty BL, O'Reilly-Pol T, Ackerman SD, Herbert AL, Holmgren M, Johnson SL, Gray RS, Monk KR. Whole Genome Sequencing-Based Mapping and Candidate Identification of Mutations from Fixed Zebrafish Tissue. **G3**. 2017; <https://doi.org/10.1534/g3.117.300212>. PMID:28855284.
4. Karner CM, Long F, Solnica-Krezel L, Monk KR, Gray RS. *Gpr126/Adgrg6* deletion in cartilage models idiopathic scoliosis and pectus excavatum in mice. **Human Molecular Genetics**. 2015; 24(15):4365-73. PMID: 25954032.
5. Buchan JG, Gray RS, Gansner JM, Alvarado DM, Burgert L, Gitlin JD, Gurnett CA, Goldsmith MI. Kinesin family member 6 (*kif6*) is necessary for spine development in zebrafish. **Developmental Dynamics**. 2014; 243(12):1646-57. PMID: 25283277.
6. Chen Q, Zhang N, Gray RS, Li H, Ewald AJ, Zahnow CA, Pan D. A temporal requirement for Hippo signaling in mammary gland differentiation, growth, and tumorigenesis. **Genes & Development**. 2014; 28(5):432-7. PMID:24589775.
7. Gray RS, Wilm TP, Smith J, Bagnat M, Dale RM, Topczewski J, Johnson SL, Solnica-Krezel L. Loss of *col8a1a* function during zebrafish embryogenesis results in congenital vertebral malformations. **Developmental Biology**. 2014; 386(1):72-85. PMID: 24333517.
8. Nguyen-Ngoc KV, Cheung KJ, Brenot A, Shamir ER, Gray RS, Hines WC, Yaswen P, Werb Z, Ewald AJ. ECM microenvironment regulates collective migration and local dissemination in normal and malignant mammary epithelium. **Proceedings of the National Academy of Sciences**. 2012; 109(39). PMID: 22923691.
9. Bhise NS, Gray RS, Sunshine JC, Htet S, Ewald AJ, Green JJ. The relationship between terminal functionalization and molecular weight of a gene delivery polymer and transfection efficacy in mammary epithelial 2-D cultures and 3-D organotypic cultures. **Biomaterials**. 2010; 31(31):8088-96. PMID: 20674001.
10. Kim SK, Shindo A, Park TJ, Oh EC, Ghosh S, Gray RS, Lewis RA, Johnson CA, Attie-Bittach T, Katsanis N, Wallingford JB. Planar cell polarity acts through septins to control collective cell movement and ciliogenesis. **Science**. 2010; 329(5997):1337-40. PMID:20671153.
11. Kieserman EK, Lee C, Gray RS, Park TJ, Wallingford JB. High-magnification in vivo imaging of *Xenopus* embryos for cell and developmental biology. **Cold Spring Harbor Protocols**. 2010; 2010(5):pdb.prot5427. PMID: 20439414.
12. Gray RS, Abitua PB, Wlodarczyk BJ, Szabo-Rogers HL, Blanchard O, Lee I, Weiss GS, Liu KJ, Marcotte EM, Wallingford JB, Finnell RH. The planar cell polarity effector Fuz is essential for targeted membrane trafficking, ciliogenesis and mouse embryonic development. **Nature Cell Biology**. 2009; 11(10):1225-32. PMID:19767740.
13. Gray RS, Bayly RD, Green SA, Agarwala S, Lowe CJ, Wallingford JB. Diversification of the expression patterns and developmental functions of the *dishevelled* gene family during chordate evolution. **Developmental Dynamics**. 2009; 238(8):2044-57. PMID: 19618470.
14. Lee C, Kieserman E, Gray RS, Park TJ, Wallingford J. Whole-mount fluorescence immunocytochemistry on *Xenopus* embryos. **CSH Protocols**. 2008. PMID: 21356778.

## PUBLICATIONS (cont.)

15. Park TJ, Gray RS, Sato A, Habas R, Wallingford JB. Subcellular localization and signaling properties of dishevelled in developing vertebrate embryos. **Current Biology**: CB. 2005; 15(11):1039-44. PMID: 15936275.

## Reviews

1. Gray RS, Cheung KJ, Ewald AJ. Cellular Mechanisms Regulating Epithelial Morphogenesis and Cancer Invasion. **Current Opinions in Cell Biology**. 2010 Oct;22(5):640-50. PMID: 20832275.
2. Gray RS, Roszko I, Solnica-Krezel L. Planar Cell Polarity: coordinating morphogenetic cell behaviors with embryonic polarity. **Developmental Cell**. 2011 Jul 19;21(1):120-33.

## Book Chapters

**The Genetics and Development of Scoliosis, 2nd Edition**. Liu Z. and Gray R.S. Chapter 5. *Animal Models of Idiopathic Scoliosis*. K. Kusumi, S.L. Dunwoodie (eds.) Springer Nature. ISBN: 978-3-319-90148-0. *in press*.

Complete List of Published Work in MyBibliography:

<http://www.ncbi.nlm.nih.gov/myncbi/browse/collection/40055821/?sort=date&direction=descending>

## INVITED PRESENTATIONS

2018, The International Consortium for Spinal Genetics Development and Disease Conference, Hong Kong University-Shenzen Hospital, Shenzhen, China, "*Defining the Pathogenesis of Idiopathic Scoliosis: A case for cartilage*".

2018, Institute of Developmental Biology & Molecular Medicine, Fudan University, Shanghai, China, "*Defining the Pathogenesis of Idiopathic Scoliosis: A case for cartilage and cilia*".

2018, 4th Annual MBS Retreat, Lady Bird Johnson Wildflower Center, Austin, TX, "*Defining the Pathogenesis of Idiopathic Scoliosis*".

2017, ORS PSRS 4th International Spine Research Symposium, Lake Harmony, PA, "*Conditional Loss of Gpr126 Causes Scoliosis and Disc Degeneration in Mouse*".

2017, International Conference on Neural Tube Defects, Austin, TX, "*Conservation of Kinesin Family Member 6 (KIF6) Function in Structural Brain Development*".

2017, Institute for Cellular and Molecular Biology Annual Retreat, Horseshoe Bay, TX "*Gpr126 is required for homeostasis of the intervertebral disc and spine*".

2017, Royal Microscopy Society, Tomography for Scientific Advancement, Austin, TX, "*Using Iodine-Contrasted  $\mu$ CT to Facilitate Imaging of Structural Brain Defects*".

2017, Southern Biosafety Association Spring Symposium, Tulane University, New Orleans, LA, "*Gene editing systems*".

2017, 11<sup>th</sup> Structural Birth Defects Meeting, Bethesda, MD, "*Conservation of KIF6 function in brain development*".

### **INVITED PRESENTATIONS (cont.)**

2017, Genomic Approaches to Understanding and Treatment of Scoliosis, Dallas, TX, "*Animal Models of Scoliosis*".

2017, New Frontiers in Pediatric Medicine: DPRI Seminar Series, Austin, TX, "*G-protein Coupled Receptor 126 Signaling for Spine Development and Disease*".

2016, Symposium on Zebrafish Models of Spine Development and Scoliosis, Durham, NC, "*Forward genetic screen in zebrafish to identify spine mutants*".

2016, 43rd Annual Meeting Texas Genetics Society, Houston, TX, "*Understanding spine development and disease: Animal models of idiopathic scoliosis*".

2015, 14th International Phillip Zorab Symposium, Edinburgh, UK, "*A forward genetic screen in zebrafish identifies multiple loci important for normal spine development*".

2014, 7th Aquatic Animal Models of Human Disease Meeting, Bastrop, TX, "*Zebrafish models of Scoliosis*".

2013, British Scoliosis Research Foundation International Phillip Zorab Symposium, London, UK, "*The Druk insertional mutant zebrafish, a model for adolescent idiopathic scoliosis*".

2013, British Scoliosis Research Foundation International Phillip Zorab Symposium, London, UK, "*Early loss of col8a1 function in zebrafish results in the dysmorphogenesis of vertebral bodies and scoliosis*".

2012, Molecular Pathways in Organ Development & Disease, Cold Spring Harbor, NY, "*The Druk Insertional Mutant Zebrafish, a Model for Adolescent Idiopathic Scoliosis*".

2010, Society of Developmental Biology Mid-Atlantic Meeting, Baltimore, MD, "*Dynamic regulation of cell motility and adhesion during mammary branching morphogenesis*".

### **POSTER PRESENTATIONS**

2107, Inaugural Musculoskeletal Regenerative Medicine and Biology: From Development to Regeneration, St. Louis, MO, "*GPR126 is Required for Homeostasis of the Intervertebral Discs and Synovial Joints in Mouse*".

2015, 14th International Phillip Zorab Symposium, Edinburgh, UK, "*Specific loss of Gpr126 in osteochondroprogenitor cells of the mouse models' adolescent idiopathic scoliosis and pectus excavatum*".

2013, Aquatic Animal Models for Human Disease and Midwest Zebrafish, Milwaukee, WI, "*Investigations of early and late onset scoliotic curvatures in zebrafish*".

2011, Society of Developmental Biology 70th Annual Meeting, Chicago, IL, "*Investigations of early and late onset scoliotic curvatures in zebrafish*".

2009, Society of Developmental Biology, 68th Annual Meeting, San Francisco, CA, "*The PCP effector protein Fuzzy is essential for targeted membrane trafficking, ciliogenesis, and mouse embryonic development*".

2008, Society of Developmental Biology. Southwest-Gulf Regional Meeting, Houston, TX, "*Distinct expression patterns and developmental functions of Dishevelled in Xenopus*".

## **POSTER PRESENTATIONS (cont.)**

2007, Society of Developmental Biology, 66th Annual Meeting/1st Pan American Cong Dev Biol, Cancun, Mexico, "*Distinct expression patterns and developmental functions of Dishevelled in Xenopus.*"

2006, Society of Developmental Biology. 65th Annual Meeting Meeting, Ann Arbor, MI, "*Subcellular localization and signaling properties of Dishevelled during Xenopus development.*"

2002, Yeast Genetics and Molecular Biology Meeting, Madison, WI, "*The affects of glucose concentration on Saccharomyces cerevisiae in  $\Delta Gcr1$  and  $\Delta Gcr2$  backgrounds*".

## **PRE- and POST-DOCTORAL TRAINEES**

Current:

Zhaoyang Liu (postdoc, 2016-)

Mia Konjikusic (UT-Austin, MBS graduate student, 2017-)

Ben Troutwine (postdoc, 2017-)

Sierra Szkrybalo (UT-Austin, MBS graduate rotation student 3rd semester, 2017)

Previous:

Naomi Stoplner (UT-Austin, MBS graduate rotation student 1st semester, 2017)

Ariel Timkovich (UT-Austin, MBS graduate rotation student 2nd semester, 2017)

## **UNDERGRADUATES MENTORED**

Current: Roberto Gonzalez, Neria Rodriguez

Previous: Yang Xue, Siyu Xiao, Judy Trihn, Dallas Miller, Ankit Hanmandlu, Debra Lee, and Kundanika Lakkadi, Tarika Srinivasan.

## **STUDENT DISSERTATION COMMITTEES**

Tim Kuka - Eberhart lab - The University of Texas (2017).

Mia Konjikusic - Gray/Wallingford labs - The University of Texas (2018).

Janani Ramachandran - Vokes lab - The University of Texas (2018).

## **GRANT SUPPORT**

### **Ongoing**

1. NIH/NIAMS, 1 R01 AR072009-01, PI Gray, "Towards a Mechanistic Understanding of Adolescent Idiopathic Scoliosis." (Impact Score:14, Percentile:1) \$1,721,500 (5-year budget).
2. Start-up funds from Dell Medical School, Dept. of Pediatrics.

### **Recently completed**

- Children's Discovery Institute, MD-F-2011-143, PI Gray, " Molecular Function of the leviathan Zebrafish Gene in the Development of the Musculoskeletal System", 12/01/2010-12/02/2012
- Scoliosis Research Society, Small-Exploratory Grant, PI Gray, "The Zebrafish Mutant Druk: A Model of Late-Onset Scoliosis", 01/01/2013-12/31/2015
- NIH/NIAMS, 5F32AR063001-02, PI Gray, " Elucidating the Cellular and Molecular Mechanisms of Late- Onset Scoliosis", 05/01/2012-04/30/2015