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**Education**

Bachelor of Science, Portland State University (Exercise Science)

Master of Science, Oregon State University (Human Performance-Biomechanics)

**Research Interests****Club Foot Treatment Outcomes**

Clubfoot, or congenital talipes equinovarus foot deformity, is one of the most common orthopedic problems and occurs in approximately one to six of every 1,000 live births, with some populations being more affected than others. Advances in treatment using the Ponseti method of serial casting and the French physical therapy method of treatment have resulted in improved outcomes in children with clubfoot compared with surgical posteromedial releases (PMR). Increased strength, normalized foot pressures and improved long-term functional results have driven a shift away from PMR to these more conservative and more effective treatments. This has changed clinical practice from 95 percent of cases treated with PMR to just five percent of cases treated with PMR within the last decade. Our work is continuing to focus on understanding the more demanding activities that children participate in following treatment – the running, jumping, hopping, skipping and climbing used during play – that is so crucial to normal strength and motor development in these children.

**Treatment Outcomes for Periacetabular Osteotomies**

Hip dysplasia may present in late adolescence with complaints of hip joint pain. The thigh bone may not be well seated in the hip socket, and this causes pain and excessive joint wear leading to osteoarthritis. We are studying the short, medium and long-term outcomes of periacetabular osteotomies on X-ray measures of joint position, gait performance, pain relief, strength and functional outcomes in individuals with late-adolescent dysplasia.

**Detailed Foot Motion in Gait**

Recent technical improvements in describing the movements of specific segments of the foot have lead to a better understanding of the surgical treatments to correct foot position. Feet with a very high arch (varus) or feet with a very low arch (planovalgus) can dramatically disrupt gait performance and can be painful. We have developed a detailed model of the human foot and can evaluate the dynamic motion of each segment of the foot during gait before and after a variety of orthopedic treatments. We have published work examining the effect of different slopes individuals might encounter in the community, which challenge the function of the foot, and also on the effect of walking at different speeds. Patients with foot deformities are being evaluated to determine the most effective treatments.

### **Trunk Motion and Activity Levels Following Spine Fusion for Scoliosis**

Surgical fixation to correct a curve deformity in the spine may lead to differences in how the trunk moves. The fused part obviously moves less, but other parts might move more. Also the fusion may improve the rib cage shape, making breathing easier and improving performance on activities like running, biking or other sports that require aerobic capacity. We are studying the relationships between trunk motion, pulmonary function tests, oxygen consumption on high-intensity activities like fast walking and running and exercise-level movement data within the community using remote sensors. If we can increase activity levels to make consistent exercise possible in these children, this may reduce some of the long-term health risks they might experience as adults.

### **Basic Human Gait Research**

Human gait is a remarkable collection of complex multi-segment joint interactions that are extremely energy efficient for moving about. The system is dominated by the passive dynamics of the structural anatomy, which makes controlling this system less complex. For individuals with gait pathology, moving about is more costly, both in terms of energy used and in terms of control strategies. This is because many pathologies result in joint stiffness and bony deformity that limit the natural energy transfer between segments. Several studies are underway to illuminate how humans modulate their speed and negotiate turns to illuminate intervention strategies that could be used to improve performance functional tasks like moving about in a classroom or in a kitchen.

### **Technical Gait Measures and Functional Community Ambulation**

Computerized gait analysis is capable of precisely describing the technical measures of joint motions and forces for individuals with gait pathology and how these technical measures are altered with various therapeutic interventions. However, there is little data to support the transfer of improvements in these technical measures to functional improvements on typical (frequent) or challenging (rare) tasks encountered in the community. We use small remote-sensing devices to collect information about how people walk out in the community and compare this to technical measures of gait function derived from laboratory measures. For example, do individuals treated for clubfoot have community walking endurance that is related to ankle strength and power? And, do individuals treated for late adolescence hip dysplasia return to the same level of physical activity after surgical treatment restores hip flexor strength?

### **Selected peer-reviewed publications**

**Orendurff, M. S.,** Segal, A. D., Klute, G. K., Berge, J. S., & Kadel, N. J. (2004). The effect of walking speed on center of mass displacement. *Journal of Rehabilitation Research & Development*, 41:829-34.

**Orendurff, M. S.,** Segal, A. D., Aiona, M. D., & Dorociak, R. D. (2005). Triceps surae force, length and velocity during walking. *Gait & Posture*, 21:157-163.

**Orendurff, M. S.,** Segal, A. D., Berge, J. S., Flick, K. C., Spanier, D., & Klute, G. K. (2006). The kinematics and kinetics of turning: Limb asymmetries associated with walking a circular path. *Gait & Posture*, 23:106-11.

**Orendurff, M. S.,** Rohr, E. S., Sangeorzan, B. J., Weaver, K., & Czerniecki, J. M. (2006). Ankle equinus accounts for only a small amount of the increased forefoot plantar pressure observed in patients with diabetes. Winner of best paper from the American Orthopedic Foot & Ankle Society, 2005 *Journal of Bone and Joint Surgery (British)*, 88:65-8.

**Orendurff, M. S.,** Segal, A. D., Klute, G. K., McDowell, M. L., Pecoraro, J. A., & Czerniecki, J.M. (2006). Gait efficiency using the C-leg. *Journal of Rehabilitation Research & Development*, 43:239-46.

**Orendurff, M. S.,** Rohr, E. S., Segal, A. D., Medley, J. W., Green, J. R., & Kadel, N. J. (2007). Regional foot pressure during running, cutting, jumping, and landing. *American Journal of Sports Medicine*, 36:566-71.

**Orendurff, M. S.,** Bernatz, G. C., Schoen, J. A., & Klute, G.K. (2008). Kinetic mechanisms to alter walking speed. *Gait & Posture*, 27:603-610.

**Orendurff, M. S.,** Schoen, J. A., Bernatz, G. C., Segal, A. D., & Klute, G. K. (2008). How humans walk: Bout duration, steps per bout and rest duration. *Journal of Rehabilitation Research & Development*, 45: 1077-1090.

Karol, L. A., Jeans, K. A., & El Hawary, R. (2009). Gait Analysis after Initial Nonoperative Treatment for Clubfeet: Intermediate Term Followup at age 5. *Clinical Orthopedics & Related Research*. 2009 January 22. [Epub ahead of print]

Tulchin, K., **Orendurff, M.,** Adolfsen, S., & Karol, L. (2009). The Effects of Walking Speed on Multi-Segment Foot Kinematics in Adults. In Press, *Journal of Applied Biomechanics*.

### **Honors and Activities**

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| 1996 - 2009 | Founding member, Gait and Clinical Movement Analysis Society; Communications committee member; Awards committee member.  |
| 2003        | Best Poster award (Ava Segal, first author) Gait and Clinical Movement Analysis Society Conference.  |
| 2005        | Mann Award for best clinical paper at the American Orthopaedic Foot and Ankle Society Conference, Boston, MA. (paper published in <i>Journal of Bone and Joint Surgery (Br.)</i> 2006, 88:65-8.) |
| 2007 - 2009 | Member, Research Advisory Panel, TSRHC   |