

## Samuel C.K. Lee, PT, PhD

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### CONTACT INFORMATION:

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### RESEARCH INTERESTS:

My interest is to improve the function of individuals with central nervous system injury through the application of electrical stimulation to activate paralyzed or weakened muscles. To this end, I am interested in the use of electrical stimulation as a tool to study the physiologic characteristics of muscle and the central and peripheral nervous systems; to be applied as a rehabilitative or training method to improve muscle function and strength; and as a method to produce functional movement (FES) of impaired muscles.

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### EDUCATION:

1999-2000 University of Pennsylvania, Department of Rehabilitation Medicine, Neurorehabilitation Post-Doctoral Fellow.  
1994-1999 University of Delaware, Interdisciplinary Graduate Program in Biomechanics and Movement Sciences, Newark, DE:  
Doctor of Philosophy.  
Dissertation: Optimization of Isotonic Performance of Human Skeletal Muscle.  
1992 University of Delaware, Department of Physical Therapy, Newark, DE: Master of Physical Therapy.  
1993 Thesis Option: The Effects of a Variable-Frequency Train on Human Quadriceps Femoris Muscle During Passive Isokinetic Movements.  
1988 Boston University, College of Engineering, Boston MA: Bachelor of Science in Biomedical Engineering, 1988.  
Honors: *cum laude*  
Senior Thesis: Design and Evaluation of a Multichannel Myoelectric Signal Acquisition System.

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### LICENSURE:

Pennsylvania, Delaware, and Colorado

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### PROFESSIONAL EXPERIENCE:

2006-Present Research Assistant Professor, Department of Physical Therapy and Biomechanics and Movement Science, University of Delaware, Newark, DE.  
2000-present Research Associate, Shriners Hospital, Philadelphia, PA.  
2002-present Scientific Staff, Shriners Hospitals for Children, Philadelphia, PA.  
2002-2006 Research Scientist, Department of Physical Therapy, University of Delaware, Newark, DE.  
2001-present Adjunct Instructor, Department of Physical Therapy, Temple University, Philadelphia, PA.  
1999-2000 Post-Doc Fellow, Dept. Rehabilitation Medicine, University of Pennsylvania, Philadelphia, PA.  
1994-present Contract Physical Therapist, Self-Employed.  
1994-1999 Research Assistant, Department of Physical Therapy, University of Delaware, Newark, DE.  
1994 Staff Physical Therapist, Spaulding Rehabilitation Hospital, Boston, MA.  
1993-1994 Research and Staff Physical Therapist, Whittier Rehabilitation Hospital, Haverhill, MA.  
1992-1993 Physical Therapist, Self-Employed, DE, and Kathy Shapiro Pediatric Physical Therapy, Inc., MD.  
1993 Pediatric Fellowship, Georgetown University Child Development Center, Washington, D.C.  
1992 Teaching Assistant, Department of Physical Therapy, University of Delaware, Newark, DE.

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### RESEARCH EXPERIENCE:

1994-1999 Dissertation: Optimization of Isotonic Performance of Human Skeletal Muscle, University of Delaware, Newark, DE.  
1992-1993 Thesis Option: The Effects of a Variable-Frequency Train on Human Quadriceps Femoris Muscle During Passive Isokinetic Movements, University of Delaware, Newark, DE.  
1988-1990 Senior Research Assistant, NeuroMuscular Research Center, Boston University, Boston, MA.  
1987-1988 Senior Thesis: Design and Evaluation of a Multichannel Myoelectric Signal Acquisition System, Boston University, Boston, MA.

## PUBLICATIONS:

### *Manuscripts in Review:*

- Lauer RT, Johnston TE, Smith BT, **Lee SCK**. Lower Extremity Muscle Activity during Cycling in Adolescents with and without Cerebral Palsy. Submitted to *Clinical Biomechanics*, July 2007, in review.
- Chou L, **Lee SCK**, Johnston TE, Binder-Macleod SA. The Effectiveness of Progressively Increasing Stimulation Frequency and Intensity to Maintain Paralyzed Muscle Force during Repetitive Activation Submitted to *Experimental Neurology*. March, 2007
- Johnston TE, Prosser LA, **Lee SCK**. Differences in Pedal Forces during Recumbent Cycling in Adolescents with and without Cerebral Palsy, *Arch Phys Med Rehabil*, April, 2007

### *Manuscripts in Preparation:*

- Lee SCK**, Ding J, Prosser L, Wexler AS, Binder-Macleod SA. A mathematical model that predicts the force-frequency relationship of individuals with cerebral palsy.

### *Journal Articles:*

- Johnston TE, Barr AE, **Lee SCK**, Biomechanics of recumbent cycling in adolescents with cerebral palsy with and without the use of a fixed shank guide, *Gait Posture* (2007), doi:10.1016/j.gaitpost.2007.07.001 [epub ahead of print].
- Lee SCK**, Braim A, Becker CN, Prosser L, Tokay A, Binder-Macleod SA. Diminished fatigue at reduced muscle length in human skeletal muscle. *Muscle Nerve*, 2007 [in press].
- Ding J, Chou L, Kesar T, **Lee SCK**, Johnston TE, Wexler AS, Binder-Macleod SA. A mathematical model that predicts the force-intensity and force-frequency relationships of individuals following spinal cord injuries. *Muscle Nerve*, 36(2):314-222, 2007
- Johnston TE, Barr AE, **Lee SCK**. The biomechanics of submaximal recumbent cycling in adolescents with and without cerebral palsy. *Phys Ther*, 2007;87:572-585.
- Scott WB, **Lee SCK**, Johnston TE, Binkley J, Binder-Macleod SA. Effect of electrical stimulation pattern on the force response of paralyzed human quadriceps muscle. *Muscle Nerve*, 2007 Apr;35(4):471-8.
- Stackhouse SK, Binder-Macleod SA, Stackhouse CA, McCarthy JJ, **Lee SCK**. Neuromuscular electrical stimulation versus volitional isometric strength training in children with spastic diplegic cerebral palsy: a preliminary study. *Neurorehabil, Neural Repair*, March 16, 2007, epub ahead of press.
- Scott WB, **Lee SCK**, Johnston TE, Binkley J, Binder-Macleod SA. Contractile properties and the force-frequency relationship of the paralyzed human quadriceps muscle. *Phys Ther*, 86(6):788-99, 2006.
- Kebaetse MB, **Lee SCK**, Johnston TE, Binder-Macleod SA. Strategies that improve paralyzed human quadriceps femoris muscle performance during repetitive, non-isometric contractions. *Arch of Phys Med Rehabil*, 86(11):2157-64, 2005.
- Stackhouse SK Binder-Macleod SA, **Lee SCK**. Voluntary muscle activation, contractile, and fatigue properties in children with and without cerebral palsy. *Muscle Nerve* 31:594-601, 2005.
- Scott WB, **Lee SCK**, Johnston TE, Binder-Macleod SA. Switching stimulation patterns improves performance of paralyzed human quadriceps muscle. *Muscle & Nerve* 31(5):581-8, 2005.
- Ding J, **Lee SCK**, Johnston TE, Wexler AS, Scott WB, Binder-Macleod SA: A mathematical model that predicts isometric muscle forces for individuals with spinal cord injuries. *Muscle Nerve* 31(6):702-12, 2005.
- Stackhouse SK, Stevens JE, **Lee SCK** Pearce, KM, Snyder-Mackler L, Binder-Macleod SA. Maximum voluntary activation in non-fatigued and fatigued muscle of young and elderly individuals. *Phys. Ther.* 81: 1102-09, 2001.
- Kebaetse MB, **Lee SCK**, Binder-Macleod SA. A novel stimulation pattern improves performance during repetitive dynamic contractions. *Muscle Nerve* 24:744-52, 2001.
- Stackhouse SK, Dean JC, **Lee SCK**, Binder-Macleod SA. Measurement of central activation failure of the quadriceps femoris in healthy adults. *Muscle Nerve* 23:1706-12, 2000.
- Lee SCK**, Becker CN, and Binder-Macleod SA. Activation of human quadriceps femoris muscle during dynamic contractions: Effects of load on fatigue. *J. Appl. Physiol.*, 89(3):926-36, 2000.
- Lee SCK**, Binder-Macleod SA. Effects of activation frequency on dynamic performance of human fresh and fatigued muscles. *J. Appl. Physiol.*, 88(6):2166-75., 2000.
- Lee SCK**, Becker CN, Binder-Macleod SA. Catchlike-inducing train activation of human quadriceps femoris muscle during isotonic contractions: Burst modulation. *J. Appl. Physiol.* 87(5):1758-67, 1999.
- Lee SCK**, Gerdomb ML, Binder-Macleod SA. Effects of length on the catchlike property of human quadriceps femoris muscle. *Phys. Ther.* 79(8):738-48, 1999.
- Binder-Macleod SA, **Lee SCK**, Kucharski LJ, and Russ D. Effects of activation pattern on human skeletal muscle fatigue. *Muscle Nerve*. 21:1145-52, 1998.
- Binder-Macleod SA, **Lee SCK**, Fritz AD, and Kucharski LJ. A new look at the force-frequency relationship of human skeletal muscle: Effects of fatigue. *J. Neurophysiol.* 79:1858-68, 1998.
- Binder-Macleod SA, **Lee SCK**, and Baadte SA. Reduction of the fatigue-induced force decline in human skeletal muscle by optimized stimulation trains. *Arch. Phys. Med. Rehabil.* 78:1129-37, 1997.

- Binder-Macleod SA, and **Lee SCK**. An assessment of the efficacy of functional electrical stimulation in the treatment of hemiplegia. *Topics in Stroke Rehabilitation*. 3(4):88-98, 1997.
- Binder-Macleod SA, and **Lee SCK**. Catchlike property of human muscle during isovelocity movements. *J. Appl. Physiol.*80(6):2051-59, 1996.
- Lee SCK**. "Leave your shoes at the door: A perspective on Korean culture". *Pediatric Phys. Ther.* 7(3):135-7, 1995.

### Abstracts:

- Johnston, TE, **Lee SCK**, Barr AE. The biomechanics of cycling in adolescents with and without cerebral palsy has been accepted for the Gossman Graduate Student Forum sponsored by the Section on Research at the 2007 APTA Combined Sections Meeting in Boston, February 14-18, 2007
- Smith, B, **Lee SCK**, McCarthy, Prosser, L Patel, B, Davis, R. An Implanted Radio Frequency Microstimulator for Muscle Excitation Sized for Pediatric Applications: An Evaluation Using a Canine Model. Annual International Steel Conference, Orlando, FL, Nov 2006.
- Rosen, Sarah, Tucker, Carole, Lee, SCK. Gait energy efficiency in children with cerebral palsy. 28<sup>th</sup> IEEE EMBS Annual International Conference, New York City, New York, USA, Aug. 30- Sept. 3, 2006.
- Johnston TE, **Lee SCK**, Smith BT, Lauer RT, Slater E. Muscle activation patterns during cycling in adolescents with without cerebral palsy. *Dev Med Child Neurol*, Supplement No. 106(48):SP35, p.43, 2006.
- Lee SCK**, Johnston TE, Bhowmik M, Ginder M, Greising J, Kleinberg M, Lind D, Stackhouse C. An instrumented recumbent cycle for studying cycling biomechanics. American Academy of Cerebral Palsy and Developmental Medicine Conference, Sept. 2005.
- Lee SCK**, Ding J, Stackhouse SK, Binder-Macleod SA. A predictive model of muscle forces for children with cerebral palsy. 10<sup>th</sup> Annual Meeting of the International Functional Electrical Stimulation Society. Montreal, Canada, July 5-8, 2005, 288-290.
- Lee SCK**, Stackhouse SK, Stackhouse CA, Schaefer M, McCarthy JJ, Smith BT. Neuromuscular electrical stimulation and volitional strength training in children with cerebral palsy: A preliminary study. *Proceedings of the 9<sup>th</sup> Annual International Functional Electrical Stimulation Society Conference*, Bournemouth, England, September 6-9, 2004, p71-73.
- Stackhouse SK, Binder-Macleod SA, McCarthy JJ, **Lee SCK**. "Neuromuscular electrical stimulation and volitional isometric strength training of the quadriceps femoris and triceps surae in children with spastic diplegic cerebral palsy: A preliminary study. *Dev Med Child Neurol Supplement* No.99, 46:F4 p19-20, 2004.
- Loughton-Stackhouse C, **Lee SCK**, Schaefer M, Stackhouse SK, Vishnevetsky D, McCarthy JJ, Smith B. The effects of electrical stimulation vs. volitional strength training on gait in children with cerebral palsy. Annual Meeting of the Gait Clinical Movement Analysis Society, Lexington, KY, April 21-24, 2004.
- Lee SCK**, Stackhouse SK, Ronan TA, Parker KW, McCarthy JJ, Binder-Macleod SA, Smith BT. Preliminary results of percutaneous neuromuscular electrical stimulation for strength training in children with cerebral palsy. *Proceedings of the 8<sup>th</sup> Annual Conference of the International Functional Electrical Stimulation Society*, Queensland, Australia, July 1-5, 2003.
- Stackhouse SK, **Lee SCK**, Schaefer MK, McCarthy JJ, Smith BT, Binder-Macleod SA. Percutaneous electrical stimulation for strength training the quadriceps femoris and triceps surae muscles in two children with spastic diplegic cerebral palsy. 33<sup>rd</sup> Neural Prosthesis Workshop, National Institute of Neurological Disorders and Stroke, National Institutes of Health Bethesda, MD, October 16-18, 2002.
- Lee SCK**, Stackhouse SK, Smith BT, Binder-Macleod SA. Contractile and fatigue characteristics of quadriceps femoris muscle in children with and without cerebral palsy. *Developmental Medicine & Child Neurology, Supplement* 91, 44(8):38-39, 2002.
- Johnston T, **Lee SCK**, Pierce S, Smith BT. Energy cost of walking in children with cerebral palsy: relation to gross motor function classification system level. *Developmental Medicine & Child Neurology, Supplement* 91, 44(8):35, 2002.
- Ding J, Wexler, AS, **Lee SCK**, Binder-Macleod, SA. A predictive model of muscle forces for children with spinal cord injuries. *Proceedings of the IEEE 28<sup>th</sup> Annual Northeast Bioengineering Conference*. Drexel University, Philadelphia, PA, April 20-21, 2002, pp 21-22.
- Stackhouse SK, **Lee SCK**, Smith BT, Binder-Macleod SA. Use of a topical anesthetic during the assessment of voluntary muscle activation in children with cerebral palsy. *Neurology Report* 25(4): 148, 2001.
- Lee SCK**, Stackhouse SK, Binder-Macleod SA, Smith BT. Contractile and fatigue characteristics of the quadriceps femoris muscle in children with and without cerebral palsy. *Neurology Report* 25(4): 131-132, 2001.
- Lee SCK**, Binder-Macleod SA. Variable-frequency train activation of human quadriceps femoris muscle during isotonic contractions: frequency characteristics. *Phys. Ther.* 79(5):S77, 1999.
- Lee SCK**, Pearce KM, Snyder-Mackler L, Binder-Macleod SA. Maximum voluntary recruitment in fresh and fatigued muscle of younger and elder individuals. *The FASEB Journal*. 13(5):A690, 1999.
- Lee SCK**, Braim A., Becker C, Binder-Macleod SA. Effects of length on fatigue of human skeletal muscle. *The FASEB Journal*. 11(3):A75, 1997.
- Lee SCK**, Cullen ML, and Binder-Macleod SA. Effects of muscle length on the catchlike property in fresh and fatigued human muscle. *Med. Sci. Sports Exerc.* 28(5 supplement):S140, 1996.
- Binder-Macleod SA, Kucharski LK, and **Lee SCK**. Effects of the catchlike property on the fatigue of human muscle. *Med. Sci. Sports Exerc.* 28(5 supplement):S139, 1996.
- Binder-Macleod SA, Kucharski LK, and **Lee SCK**. Fatiguing effects of the catchlike property in human muscle. *The FASEB Journal*

10(3):A1, 1996.

Binder-Macleod SA, and **Lee SCK**. Catchlike property of human muscle during shortening and lengthening contractions. *Soc. Neurosci. Abstr.* 19(1):154, 1993.

### **Article Critiques:**

**Lee SCK**. Applicability of the hierarchical scales of the Tufts Assessment of Motor Performance for School-Aged Children and Adults with Disabilities. *Phys. Ther.* 72(3):191-202. In *Pediatric Phys. Ther.* 4(4):208-210, 1992.

### **Book Reviews:**

**Lee SCK**. Extraordinary children, ordinary lives: stories behind special education case law. By R. Martin, Champaign, Illinois, Research Press, 1991. In *Pediatric Phys. Ther.* 4(3): 156, 1992.

## **PRESENTATIONS**

### **Platform Presentations:**

- Lee, SCK**, Stanger M. Efficacy and use of NMES and FES in children with cerebral palsy. 59<sup>th</sup> Annual Meeting of the American Academy for Cerebral Palsy and Developmental Medicine, Sept 14-17, Orlando, FL, 2005.
- Johnston TE, **Lee SCK**, Tucker CA. Physical fitness in children with cerebral palsy classified as GMFCS Levels III and IV. 59<sup>th</sup> Annual Meeting of the American Academy for Cerebral Palsy and Developmental Medicine, Sept 14-17, Orlando, FL, 2005.
- Lee SCK**, Stackhouse SK, Stackhouse CA, Schaefer M, McCarthy JJ, Smith BT. Neuromuscular electrical stimulation and volitional strength training in children with cerebral palsy: A preliminary study. International Functional Electrical Stimulation Society. Bournemouth, England, September 6-9, 2004.
- Lee SCK**, Johnston TE. Neuromuscular and functional electrical stimulation for therapeutic and functional applications. 58th Annual Meeting of the American Academy of Cerebral Palsy and Developmental Medicine, Los Angeles, California, September 29-October 2, 2004.
- Stackhouse SK, Binder-Macleod SA, McCarthy JJ, **Lee SCK**. Neuromuscular electrical stimulation and volitional isometric strength training of the quadriceps femoris and triceps surae in children with spastic diplegic cerebral palsy: a preliminary study. 58th Annual Meeting of the American Academy of Cerebral Palsy and Developmental Medicine, Los Angeles, California, September 29-October 2, 2004.
- Johnston TE, Pierce SR, **Lee SCK**. A primer on the use of NMES for therapeutic and functional application. NMES for Strength Association. Nashville, TN, Feb 5-8. 2004.
- Banks K, Gieringer R, Musket M, Stackhouse SK, Eastlack ME, **Lee SCK**. Comparison of stimulation patterns used to assess voluntary muscle activation of the quadriceps femoris. Combined Sections Meeting of the American Physical Therapy Association. Tampa, FL, 2003.
- Banks K, Gieringer R, Musket M, Stackhouse SK, Eastlack ME, **Lee SCK**. Comparison of two methods to quantify voluntary muscle activation of the quadriceps femoris in young adults. Combined Sections Meeting of the American Physical Therapy Association. Tampa, FL, 2003.
- Ding J, Wexler, AS, **Lee SCK**, Binder-Macleod SA. A predictive model of muscle forces for children with spinal cord injuries. Proceedings of the IEEE 28<sup>th</sup> Annual Northeast Bioengineering Conference. Drexel University, Philadelphia, PA, April 20-21, 2002, pp 21-22.
- Lee SCK**, Stackhouse SK, Binder-Macleod SA, Smith BT. Contractile and fatigue characteristics of quadriceps femoris and triceps surae muscle in children with and without cerebral palsy. Combined Sections Meeting of the American Physical Therapy Association. Boston, MA, Feb 20-24, 2002
- Lee SCK**, Becker CN, Binder-Macleod. Activation of human quadriceps femoris muscle during isotonic contractions: Effects of load on fatigue. Combined Sections Meeting of the American Physical Therapy Association. New Orleans, LA, Feb 2-6, 2000.
- Kebaetse MB, **Lee SCK**, Binder-Macleod SA. Force optimization in human quadriceps isotonic muscle contraction during knee movement. Combined Sections Meeting of the American Physical Therapy Association. New Orleans, LA, Feb 2-6, 2000.
- Stackhouse SK, Binder-Macleod SA, Dean JC, **Lee SCK**. Detection of central activation failure of the quadriceps femoris in young, healthy adults. Combined Sections Meeting of the American Physical Therapy Association. New Orleans, LA, Feb 2-6, 2000.
- Lee SCK**, Binder-Macleod SA. Variable-frequency train activation of human quadriceps femoris muscle during isotonic contractions: Frequency characteristics. Scientific Meeting & Exposition of the American Physical Therapy Association, Washington, D.C., June 5-8, 1999.
- Lee SCK**, Pierce KM, Snyder-Mackler L, Binder-Macleod SA. Maximum voluntary recruitment in fresh and fatigued muscle of young and elder individuals. Combined poster and oral presentation. Experimental Biology 99, Washington D.C., April 17-21, 1999.
- Lee SCK**, Becker CN, Binder-Macleod SA. Variable-frequency train activation of human quadriceps femoris muscle during isotonic contractions: burst modulation. Combined Sections Meeting of the American Physical Therapy Association, Seattle, WA, February 3-7, 1999.

**Lee SCK**, Braim A, Becker CN, Binder-Macleod SA. Effects of length on fatigue of human skeletal muscle. Combined poster and oral presentation. *Experimental Biology 97*, New Orleans, LA, April 6-9, 1999.

**Lee SCK**. Design and Evaluation of a Multichannel Myoelectric Signal Acquisition System. Annual Biomedical Engineering Project Conference, Boston University, Boston, MA, April 1988.

### **Poster Presentations:**

Ding J, **Lee SCK**, Tokay A, Prosser L, Stackhouse S, Wexler AS, Binder-Macleod SA. Modeling isometric contractions of leg muscles for children with cerebral palsy. Presented at the 3<sup>rd</sup> Annual Center for Biomedical Engineering Research Symposium, University of Delaware, Newark, DE.

**Lee SCK**, Johnston TE, Bohmik M, Ginder M, Greising J, Kleinberg M, Lind D, Stackhouse C. An instrumented recumbent cycle for studying cycling biomechanics. 59<sup>th</sup> Annual Meeting of the American Academy for Cerebral Palsy and Developmental Medicine, Sept 14-17, Orlando, FL, 2005.

Stackhouse CA, **Lee SCK**, Schaefer M, Stackhouse SK, McCarthy JJ, Smith B, Binder-Macleod SA. The effects of electrical stimulation vs. volitional strength training on gait in children with cerebral palsy. Combined Sections Meeting of the American Physical Therapy Association, New Orleans, LA, 2005.

Scott W, **Lee SCK**, Johnston TA, Binkley J, Binder-Macleod SA. Contractile properties and the force-frequency relationship of the paralyzed human quadriceps muscle. Combined Sections Meeting of the American Physical Therapy Association, New Orleans, LA, 2005.

Johnston TE, **Lee SCK**, Smith BT, Betz RR. Strengthening of a partially denervated muscle using percutaneous electrical stimulation: A case report. 50<sup>th</sup> Annual Conference of the American Paraplegia Society, September 7-9, Las Vegas, NV, 2004.

Kebaetse M, Binder-Macleod SA, **Lee SCK**, Johnston T. Paralyzed skeletal muscle performance during electrically elicited, repetitive, non-isometric contractions. 50<sup>th</sup> Annual Conference of the American Paraplegia Society, September 7-9, Las Vegas, NV, 2004.

Ding J, **Lee SCK**, Johnston TE, Wexler AS, Scott WB, Binder-Macleod SA. A predictive mathematical force model for spinal cord injured patients. 50<sup>th</sup> Annual Conference of the American Paraplegia Society, September 7-9, Las Vegas, NV, 2004.

Bohmik M, Ginder M, Kleinberg M, Greising J, Lind D, Johnston T, Lauer R, **Lee SCK**. Instrumented bicycle pedals for use in a functional electrical stimulation study for children with cerebral palsy. Drexel University, Research Day, March 4<sup>th</sup>, 2004.

Yapsuga KN, Larson KM, **Lee SCK**. Reliability of methods to assess voluntary activation, contractile properties and fatigability of the quadriceps femoris muscle in healthy adults. Combined Sections Meeting of the American Physical Therapy Association. Nashville, TN, 2004.

Yapsuga KN, Larson KM, Stackhouse SK, Schaefer MK, **Lee SCK**. The effects of strength training the quadriceps femoris and triceps surae muscles using percutaneous electrical stimulation in children with spastic diplegic cerebral palsy: a preliminary study. Combined Sections Meeting of the American Physical Therapy Association, Nashville, TN, 2004.

**Lee SCK**, Stackhouse SK, Ronan TA, Parker KW, McCarthy JJ, Binder-Macleod SA, Smith BT. Preliminary results of percutaneous neuromuscular electrical stimulation for strength training in children with cerebral palsy. The 8<sup>th</sup> Annual Conference of the International Functional Electrical Stimulation Society, Queensland, Australia, July 1-5, 2003.

**Lee SCK**, Stackhouse SK. Electrical stimulation for strength training the quadriceps femoris and triceps surae muscles in a child with spastic diplegic cerebral palsy. National Center for Medical Rehabilitation Research Training Workshop, Silver Spring, MD, December 9-10, 2003.

Stackhouse SK, **Lee SCK**, Schaefer MK, McCarthy JJ, Smith BT, Binder-Macleod SA. Electrical stimulation for strength training the quadriceps femoris and triceps surae muscles in two children with spastic diplegia cerebral palsy. Combined Sections Meeting of the American Physical Therapy Association. Tampa, FL, 2003.

**Lee SCK**, Stackhouse SK, Smith BT, Binder-Macleod SA. Contractile and fatigue characteristics of quadriceps femoris muscle in children with and without cerebral palsy. 56<sup>th</sup> Annual Meeting of The American Academy for Cerebral Palsy and Developmental Medicine, New Orleans, LA, September 11-14, 2002.

Johnston TE, **Lee SCK**, Pierce SR, Smith BT. Energy cost of walking in children with cerebral palsy: relation to gross motor function classification system level. 56<sup>th</sup> Annual Meeting of the American Academy for Cerebral Palsy and Developmental Medicine, New Orleans, LA, September 11-14, 2002.

Stackhouse SK, **Lee SCK**, Smith BT, Binder-Macleod SA. Use of a topical anesthetic during the assessment of voluntary muscle activation in children with cerebral palsy. *Neurology Report 25*(4): 148, 2001.

**Lee SCK**, Vandenborne K. Quantification of metabolism during functional electrical stimulation of the tibialis anterior muscle using <sup>31</sup>P Magnetic Resonance Spectroscopy. NCMRR Trainee Conference, National Institutes of Health, Bethesda, MD, November 7-8, 1999.

**Lee SCK**, Cullen ML, Binder-Macleod SA. Effects of muscle length on the catchlike property in fresh and fatigued human muscle. American College of Sports Medicine 43<sup>rd</sup> Annual Meeting, Cincinnati, OH, May 29 - June 1, 1996.

Lee, SCK, Kurcharski LK, and **Lee SCK**. Effects of the catchlike property in human muscle. American College of Sports Medicine 43<sup>rd</sup> Annual Meeting, Cincinnati, OH, May 29 - June 1, 1996.

Binder-Macleod SA, Kurcharski LK, **Lee SCK**. Fatiguing effects of the catchlike property in human muscle. *Experimental Biology 96*, Washington, D.C., April 14-17, 1996.

Binder-Macleod SA, **Lee SCK**. Catchlike property of human muscle during shortening and lengthening contractions. Society for Neuroscience 23<sup>rd</sup> Annual Meeting, Washington, D.C., November 7-12, 1993.

### **Lectures:**

FES – NMES for Posture Control and Movement. University of Delaware, Department of Physical Therapy, Newark, DE, March 18, 2004.

Physiologic Measures of Muscle Function. Rehabilitation Medicine Resident's Seminar Series. Hospital of the University of Pennsylvania, Philadelphia, PA, November 17, 1999.

Neuromuscular Electrical Stimulation for Control of Posture and Movement: FES for Grasping, Reaching and Shoulder Control. University of Delaware, Department of Physical Therapy, Newark, DE, March 18, 1998; March 15, 1999; March 16, 2000.

Neuromuscular Electrical Stimulation for Control of Posture and Movement: FES for Standing and Ambulation. University of Delaware, Department of Physical Therapy, Newark, DE, March 16, 1988; March 15, 1999; March 13, 2000.

Muscle Fatigue. Beaver College, Department of Physical Therapy, Glenside, PA, October 30, 1997.

Skeletal Muscle Adaptations to Injury, Disease, Disuse, and Training. Beaver College, Department of Physical Therapy, Glenside, PA, October 23, 1997.

Skeletal Muscle Metabolism. Beaver College, Department of Physical Therapy, Glenside, PA, October 16, 1997.

Neuromuscular Electrical Stimulation for Control of Posture and Movement. University of Delaware, Department of Physical Therapy, Newark, DE, March 17, 1997.

### **Invited Presentations:**

Advances in Use of Electrical Stimulation for Cerebral Palsy to Improve Strength and Mobility. Eastern Carolina University, Department of Physical Therapy, Greenville, NC, December 15, 2006.

Functional Electrical Stimulation for Strengthening in CP, Brachial Plexus Injury: Early Therapeutic and Surgical Intervention. Joint educational conference. July 23, 2007. Children's Developmental Services Agencies, Wilmington, NC – host site; Eastern Carolina University, Greenville, NC (Videoconference site); TelAbility, Chapel Hill, NC, (Videoconference Site).

Advances in Use of Electrical Stimulation for Cerebral Palsy to Improve Strength and Mobility Alfred I. duPont Hospital for Children, 2007 Pediatric Physical Therapy Conference., Wilmington, DE May 3, 2007

Electrical Stimulation: from Research to Intervention , Children's Hospital of Philadelphia, Lynette Byarm Fellowship Lecture Series Course: Philadelphia, PA, April 4, 2007.

Advances in Use of Electrical Stimulation for Cerebral Palsy to Improve Strength and Mobility. AI DuPont Hospital for Children, Wilmington, DE February 26, 2007.

Advances in Use of Electrical Stimulation for Cerebral Palsy to Improve Strength and Mobility. Thomas Jefferson University, Philadelphia, PA, February 21, 2007.

Advances in Use of Electrical Stimulation for Cerebral Palsy to Improve Strength and Mobility. Kennedy Krieger Institute, Baltimore, MD, December 15, 2006.

Advances in Use of Electrical Stimulation for Cerebral Palsy to Improve Strength and Mobility. Jardine Academy for Cerebral Palsy. Union, NJ, December 13, 2006.

Advances in Use of Electrical Stimulation for Cerebral Palsy to Improve Strength and Mobility. Shriners Hospitals for Children. Tampa, FL, Sept 25, 2006

Strength Training Using NMES for Children with Cerebral Palsy. University of Delaware, Department of Physical therapy, Newark, DE, Sept 8, 2006

Neuromuscular Electrical Stimulation and Volitional Strength Training in Children with Cerebral Palsy. Denver Children's Hospital, Denver, Co, March 22, 2006.

Neuromuscular Electrical Stimulation and Volitional Strength Training in Children with Cerebral Palsy". Regis University, Denver, Co, March 22, 2006.

Neuromuscular Electrical Stimulation and Volitional Strength Training in Children with Cerebral Palsy. Children's Hospital of Pennsylvania, Philadelphia, PA. March, 30, 2006

Advances in Use of Electrical Stimulation for Cerebral Palsy to Improve Strength and Mobility. Pittsburgh Marquette Challenge Continuing Education Series fundraiser for the Foundation for Physical Therapy. Pittsburgh, PA, February 25<sup>th</sup>, 2006.

Advances in Use of Electrical Stimulation for Cerebral Palsy to Improve Strength and Mobility. The 11<sup>th</sup> Annual Conference of The Division of Pediatric Orthopaedics and The Kluge Children's Rehabilitation Center and Research Institute at the University of Virginia, December 2-3, 2005.

Management Strategies for Motor Impairments in Children with Neuromuscular Conditions. Charlottesville, VA, December 2<sup>nd</sup> – 3<sup>rd</sup>, 2005.

A Primer on the Use of NMES for Therapeutic and Functional Application: NMES for Strength Training in Children with Neuromuscular Disorders: 2004 Missouri Physical Therapy Association Spring Conference, Lake of the Ozarks, MO, April 16-18, 2004.

NMES for Strength Training in Children with Spastic Diplegic Cerebral Palsy. Shriners Hospitals for Children Annual Cerebral Palsy Conference. – Strategies to Improve Quality of Care for the Child with Cerebral Palsy. Shriners Hospitals for Children,

- Philadelphia, PA, April 11, 2003.
- Voluntary Activation, Contractile and Fatigue Characteristics of Quadriceps Femoris and Triceps Surae Muscles in Children with and without Cerebral Palsy. Temple University Neuroscience Seminar Series. Philadelphia, PA, October 25, 2002.
- Optimization of Isotonic Performance of Human Skeletal Muscle. The Society for Physical Regulation in Biology and Medicine, 19<sup>th</sup> Annual Meeting, Miami, FL, January 5-8, 2000.
- Optimization of Isotonic Performance of Human Skeletal Muscle. American Physical Therapy Association - Pennsylvania Chapter Research Seminar Series, Magee Rehabilitation Hospital, Philadelphia, PA, October 13, 1999.
- Optimization of Isotonic Performance of Human Skeletal Muscle. Research Seminar Series, University of Pennsylvania, Department of Rehabilitation Medicine, Philadelphia, PA, July 23, 1999.
- Variable-frequency Train Activation of Human Quadriceps Femoris Muscle During Isotonic Contractions: Burst Modulation. Research Seminar Series, Cleveland, OH, May 26, 1999.

## AWARDS:

- 2003 - Honoree, American Physical Therapy Association , Profiles in Excellence, April, 2003
- “Best Poster Presentation” for the poster: Ding J, **Lee SCK**, Tokay A, Prosser L, Stackhouse S, Wexler AS, Binder-Macleod SA Modeling Isometric Contractions of Leg Muscles for Children with Cerebral Palsy. Presented at the 3<sup>rd</sup> Annual Center for Biomedical Engineering Research Symposium, University of Delaware, Newark, DE, 2006.
- Nominated for the 2005 Gayle G. Arnold Award for Excellence in the Care of Children with Cerebral Palsy for the paper entitled: “Neuromuscular Electrical Stimulation and Volitional Isometric Strength Training of the Quadriceps Femoris and Triceps Surae in Children with Spastic Diplegic CP”. Presented at the 58<sup>th</sup> Annual Meeting of the American Academy for Cerebral Palsy and Developmental Medicine, Los Angeles, CA, September 29 – October 2, 2004.
- Mentored Drexel University Senior Design Project: Bohmik M, Ginder M, Kleinberg M, Greising J, Lind D, **Lee SCK**. Instrumented bicycle pedals for use in a functional electrical stimulation study for children with cerebral palsy. Electrical and Computer Engineering Department, Drexel University, 2003-2004 Academic Year. Research Day, March 4<sup>th</sup>, 2004. Awarded 1<sup>st</sup> place project in the Electrical and Computer Engineering Department. Awarded 3<sup>rd</sup> place project (\$500) in the overall Drexel Engineering Department competition and a private industry award (Cisco Systems \$500).
- “Best Poster” for the poster: The effects of electrical stimulation vs. volitional strength training on gait in children with cerebral palsy. Gait and Clinical Motion Analysis Society Annual Meeting, Lexington, KY, April, 2004.
- “Chattanooga Research Award”. American Physical Therapy Association, 2002 for the article: Stackhouse SK, Stevens JE, Pearce KM, **Lee SCK**, Snyder-Mackler L, Binder-Macleod SA. Maximum voluntary activation in fresh and fatigued muscle of young and elder individuals. *Phys. Ther.* May 2001, *Phys. Ther.* 81:1102-09, 2001.
- “Outstanding Student Presentation, Muscle Fatigue Poster/Discussion” for the presentation: Maximum Voluntary Recruitment in Fresh and Fatigued Muscle of Young and Elder Individuals. Federation of American Societies for Experimental Biology, Experimental Biology 99, Washington, D.C., April 19, 1999.
- “Top 10 Speaker”. Annual Biomedical Engineering Project Conference, Boston University, Boston, MA, April, 1988.

## GRANTS:

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|------------|---|
| 2004-2009  | National Institutes of Health. NICHD: R01 HD043859: Strength Training Using NMES for Children with CP. Principal Investigator. \$1,528,875 (5 years direct and indirect; annual direct costs \$202,500).  |
| 2004-2006  | United Cerebral Palsy Foundation. Trabecular Microarchitecture and Geometric Structure of Bone in Children with Cerebral Palsy, co-investigator, \$99,882 (2 years direct and indirect; directs 2004 \$49,930; 2005 \$49,952).                          |
| 2004- 2007 | Shriners Hospitals for Children Grant #8530: Strength Training Using Electrical Stimulation for Children with Cerebral Palsy, Principal Investigator, \$362,211 (3 years direct and indirect; directs 2004: \$206,977; 2005: \$40,350; 2006: \$43,430). |
| 1998-1999  | Foundation for Physical Therapy Doctoral Research Award, \$7,500.   |
| 1997-1998  | Foundation for Physical Therapy Doctoral Research Award, \$10,000.  |
| 1996-1997  | Foundation for Physical Therapy Doctoral Research Award, \$8,370.   |
| 1996-1997  | University of Delaware Office of Graduate Studies Competitive Fellowship, \$21,690.   |
| 1995-1996  | Foundation for Physical Therapy Doctoral Research Award, \$5,000.   |
| 1995-1996  | American Physical Therapy Association Post-professional Doctoral Scholarship, \$13,291.   |

## PROFESSIONAL SERVICE:

### *Manuscript Reviewer:*

- Journal of Orthopedic Research
- The Journal of Orthopaedic & Sports Physical Therapy
- Muscle and Nerve
- IEEE Transactions on Neural Systems and Rehabilitation Engineering

Medicine & Science in Sports & Exercise  
 Clinical Neurophysiology  
 Physical Therapy  
 Journal of Pediatric Physical Therapy  
 American Physical Therapy Association  
 Archives of Physical Medicine and Rehabilitation  
 Neuromodulation

**Committee Service:**

APTA Pediatric Research Summit: Promotion of Fitness & Prevention of Secondary Complications for Children with Cerebral Palsy.  
 Sponsored by the Section on Pediatrics of the American Physical Therapy Association.

Search committees:

Full time occupational therapist, Department of Physical Therapy and the Early Learning Center, University of Delaware, 2004  
 Full time occupational therapist, Department of Physical Therapy and the Early Learning Center, University of Delaware, 2005  
 Full time speech and language pathologist, Department of Physical Therapy and the Early Learning Center, University of Delaware, 2005

**APPOINTMENTS/ELECTIONS**

Nominating committee member for the Section on Research of the American Physical Therapy Association

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**DISSERTATION COMMITTEES**

**Li-Wei Chou, PT, PhD Student.** Biomechanics and Movement Science 2001 – present, University of Delaware, Newark, DE.

**Project Title:** New Strategies To Maintain Paralyzed Muscle Force Output During Repetitive Electrically Elicited Contractions.

**Therese Johnston, MSPT, PhD.** Department of Physical Therapy, 2000-2006, Temple Univeristy, Philadelphia, PA, Newark, DE.

**Project Title:** The Biomechanics Of Cycling In Children With And Without Cerebral Palsy.

**Wayne Scott, MPT, PhD.** Biomechanics and Movement Science, 1999-2004. University of Delaware, Newark, DE.

**Project Title:** Electrically Elicited Quadriceps Femoris Muscle Performance In People With Spinal Cord Injury.

**Mike Kebaetse, PT, PhD.** Biomechanics and Movement Science, 1998-2004. University of Delaware , Newark, DE.

**Project Title:** Strategies That Improve Skeletal Muscle Performance During Electrically Elicited, Repetitive Non-Isometric Contractions In Healthy Subjects And Subjects With Spinal Cord Injury.

**Scott Stackhouse, PT, PhD -** Biomechanics and Movement Science, 1998- 2003. University of Delaware, Newark, DE.

**Project Title:** Neuromuscular Electrical Stimulation Of The Quadriceps Femoris And Triceps Surae Muscles In Children With Spastic Diplegic Cerebral Palsy.

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**MENTORED RESEARCH PROJECTS**

**Kari Vander Wiele, Andrea Nichol, Jamie Iwanczewski.** Department of Physical Therapy, Arcadia University, Glenside, PA, present.

**Project Title:** Comparison Of Two Methods To Estimate Central Activation Of The Quadriceps Femoris Muscle In Healthy Adults.

**Lauren Edwards, Sarah Wright.** Department Of Physical Therapy, Arcadia University, Glenside, PA, Present.

**Project Title:** “Strength Training In Children With CP: Relationships Of Strength To Function.”

**Heather Boyd, Jared Hoover, Kristin Lowe.** Department of Physical Therapy, Arcadia University, Glenside, PA, present.

**Project Title:** The Development Of A Cardiovascular Fitness Assessment Protocol During Stationary Cycling In Children With And Without Cerebral Palsy – A Pilot Study.

**Stephanie McBride, DPT and Patricia Young-Swidorski, DPT.** Department of Physical Therapy, Arcadia University, Glenside, PA, 2004.

**Project Title:** The Development Of A Cardiovascular Fitness Assessment Protocol During Stationary Cycling In Children With And Without Cerebral Palsy: A Pilot Study.

**M. Bhowmil, M. Ginder, J., Greising, M., Kleinberg, D. Lind.** Department of Engineering, Drexel University, Philadelphia, PA, 2004.  
**Project Title:** Instrumented Bike Pedals for Use In Functional Electric Stimulation. Submitted to Dr. Allon Guez, Dr. Samuel C.K. Lee and the Senior Design Project Committee of the Electrical and Computer Engineering Department of Drexel University.

**Chris Gorrell, DPT** Department of Physical Therapy, Arcadia University, Glenside, PA, 2003.  
**Research Project:** Muscle Contractile And Activation Characteristics Of Children With And Without Spastic Diplegic Cerebral Palsy.

**Kristine N. Yapsuga, DPT; Kristine M. Larson, DPT.** Department of Physical Therapy, Arcadia University, Glenside, PA, 2003.  
**Research Project:** Reliability Of Methods To Assess Voluntary Activation, Contractile Properties And Fatigability Of The Quadriceps Femoris Muscle In Healthy Adults.

**Kevin Banks, MSPT; Matt Muskett, MSPT; Bob Gieringer, MSPT;** Department of Physical Therapy, Arcadia University, Glenside, PA, 2002.  
**Project Title:** Comparison Of Two Methods To Estimate Central Activation Of The Quadriceps Femoris Muscle In Healthy Adults.

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## **MEMBERSHIPS:**

### ***Professional:***

American Physical Therapy Association, American Academy of Cerebral Palsy and Developmental Medicine, International Functional Electrical Stimulation Society

### ***Personal:***

Vintage Sports Car Club of America, Vintage Racers Group, BMW Motorcycle Owners Association, Daimler & Lanchester Owner's Club of North America, Lambretta Club of USA

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