Bionik InMotion Publications List

Stroke

Carolin I Dohle, Avrielle Rykman, Johanna Chang and Bruce T Volpe “Pilot study of a robotic protocol to treat shoulder subluxation in patients with chronic stroke.” journal of neuroengineering and rehabilitation august 5 2013

“Electromechanical and Robot-Assisted ARM training for improving general activities of daily leaving, arm function, and arm muscle strength after stroke.” The cochrane Collaboration, The Cochrane Library , 2012 issue 6

Norouzi-Gheidari, N, et al., “Effects of Robot-Assisted Therapy on Stroke Rehabilitation in Upper Limbs: Systematic Review and Meta-Analysis of the Literature,” VA Journal of Rehabilitation Research and Development, 49 (4) 479-496 (2012)

Dipietro L, Krebs H.I, Volpe B.T, Stein J, Bever , S.TMernoff, Fasoli S.E, Hogan N “Learning, not Adaptation, Characterizes Stroke Motor Recovery: Evidence from Kinematic Changes Induced by Robot-Assisted Therapy in Trained and Untrained Task in the Same Workspace” IEEE Trans Neural Syst Rehabil Eng. 2012 Jan;20(1):48-57. Epub 2011 Dec 16

Conroy SS, Whitall J, Dipietro L, Jones-Lush LM, Zhan M, Finley MA, Wittenberg GF, Krebs HI, Bever CT. “Effect of gravity on robot-assisted motor training after chronic stroke: a randomized trial”.
Arch Phys Med Rehabil. 2011 Nov;92(11):1754-61. Epub 2011 Aug 17.

Wagner, T, et al., “An Economic Analysis of Robot-Assisted Therapy for Long-Term Upper-Limb Impairment After Stroke,” Stroke, Journal of the American Heart Association , Vol. 42 No. 9 September (2011)

Dept. of Veterans Affairs and Dept. of Defense, Management of Stroke Rehabilitation Working Group. “VA/DoD Clinical Practice Guideline for the Management of Stroke Rehabilitation, Guideline Summary.” Washington, D.C.: Government Printing Office, October (2010) Vers. 2.0, p. 37 URL: http://www.healthquality.va.gov.

Lo, A.C., et al., “Robot Assisted Therapy for Long-Term Upper-Limb Impairment After Stroke,”
New England Journal of Medicine, 362(19):1772-83.

Miller, E.L., et al., on behalf of the American Heart Association Council on Cardiovascular Nursing and the Stroke Council, “Comprehensive Overview of Nursing and Interdisciplinary Rehabilitation Care of the Stroke Patient:
A Scientific Statement From the American Heart Association,” Stroke, 41:2402-2448, (2010)

Edwards, D.J., et al., “Raised Corticomotor Excitability of M1 Forearm Area Following Anodal tDCS is Sustained During Robotic Wrist Therapy in Chronic Stroke,” Restorative Neurology Neuroscience, 27:199-2007 (2009)

Dipietro, L., et al., “Submovement Changes Characterize Generalization of Motor Recovery after Stroke,”
Motor Cortex 45(3):318-24 (2009)

Krebs, HI, et al., Transport of the Arm and Manipulation of Objects in Chronic Stroke:
A Pilot Study, NeuroRehabilitation, 23:81-87 (2008).

Hesse, S., et al., “A mechanical arm trainer for the treatment of the severely affected arm after stroke:
A single-blinded randomized trial,” American Journal of Rehabilitation, 87:10:779-788 (2008)

Krebs, H.I., et al., “Transport of the Arm and Manipulation of Objects in Chronic Stroke: A Pilot Study,”
NeuroRehabilitation, 23:81-87 (2008)

Kwakkel, G., et al., “Effects of Robot-assisted therapy on upper limb recovery after stroke: A Systematic Review,”
Neurorehabilitation and Neural Repair 22:2:111-121 (2008)

Volpe, B.T., et al., “Intensive Sensorimotor arm training mediated by therapist or robot improves hemiparesis in patients with chronic stroke,” Neurorehabilitation and Neural Repair 22:3:305-310 (2008)

Krebs, H.I., et al., “Robotic Rehabilitation in Sub-Acute Stroke: A Comparison of Robotic Therapy in Multiple Sites”
Medimond (2007)

Dipietro, L., et al., “Changing motor synergies in chronic stroke,” Journal of Neurology, 98:757-768 (2007)

Masis, L., et al., “Design and Characterization of Hand Module for Whole-Arm Rehabilitation Following Stroke,”
IEEE/ASME Transactions on Mechatronics, 12(4) 399-407 (2007)

Palazzolo, J.J., et al., “Stochastic Estimation of Arm Mechanical Impedance during Robotic Stroke Rehabilitation,”
IEEE Transaction Neural System and Rehabilitation Engineering; 15(1) 94-103 (2007)

MacClellan, L.R., et al., “Robotic Upper Extremity Neuro-Rehabilitation in Chronic Stroke Patients,”
VA Journal of Rehabilitation Research and Development 42(6)717-722 (2005)

Daly, J., et al., “Response to Upper Limb Robotics and Functional Neuromuscular Stimulation Following Stroke,”
VA Journal of Rehabilitation Research and Development, 42(6)723-735 (2005)

Finley, M.A., et al., “Short Duration Upper Extremity Robotic Therapy in Stroke patients with Severe Upper Extremity Motor Impairment,” VA Journal of Rehabilitation Research and Development, 42(5):683-692 (2005)

Dipietro, L., et al., “Customized Interactive Robotic Treatment for Stroke: EMG-Triggered Therapy,”
IEEE Transaction Neural System and Rehabilitation Engineering, 13:3:325-334 (2005)

Rohrer, B., et al., “Submovements Grow Larger, Fewer, and More Blended during Stroke Recovery,”
Motor Control, 8:472-483 (2004)

Stein, J., et al., “Comparison of Two Techniques of Robot-Aided Upper Limb Exercise Training after Stroke,”
American Journal Physical Medicine Rehabilitation, 83:9:720-728 (2004)

Volpe, B.T., et al., “Robotics and Other Devices in the Treatment of Patients Recovering from Stroke,”
Cur Artheroscler Rep, 6:314-319 (2004)

Krebs, H.I., et al., “Notes on Rehabilitation Robotics and Stroke,” In F. Lofaso, A. Roby-Brami, J.F. Ravaud (Eds).
Technological Innovations and Handicap, Frison Roche, pp.177-194 (2004)

Fasoli, S.D., et al., “Does Shorter-Rehabilitation Limit Potential Recovery Poststroke?”
Neurorehabilitation & Neural Repair. 18 2:88-94 (2004)

Fasoli, S.D., et al., “Robotic Therapy for Chronic Motor Impairments after Stroke: Follow-up Results,” Archives of Physical Medicine Rehabilitation: 85:1106-1111 (2004)

Ferraro, M., et al., “Robot Aided Sensorimotor Arm Training Improves Outcome in Patients with Chronic Stroke,”
Neurology. 61:1604-1607 (2003)

Hogan, N., et al., “Technology for Recovery after Stroke,” In J. Bogousslavsky, M.P. Barnes, B. Dobkin (eds.),
Recovery after Stroke, Cambridge Press (2003)

Fasoli, S.D., et al., “Effects of Robotic Therapy on Motor Impairment and Recovery in Chronic Stroke,
Archives of Physical Medicine and Rehab, 84:477-82 (2003)

Rohrer, B., et al., “Movement Smoothness Changes during Stroke Recovery,” Journal of Neuroscience, 22:18:8297-8304 (2002)

Krebs, H.I., et al., “Robot-Aided Neuro-Rehabilitation in Stroke: Interim Results on the Follow-up of 76 Patients and on Movement Performance Indices,” In Mounir Mokhatari (ed), Integration of Assistive Technology in the Information Age. IOS Press, Assistive Technology Research Series, Amsterdam (2000)

Volpe, B.T., et al., “Robot Training Enhanced Motor Outcome in Patients with Stroke maintained over 3 years,”
Neurology 534874-1876 (1999)

Aisen, M.L., et al., “The Effect of Robot Assisted Therapy and Rehabilitation Training on Motor Recovery Following a Stroke,” Archive of Neurology, 54:443-336 (1997)

Upper-extremity

Finley, M.A., et al., “The Effect of Repeated Measurements using an Upper Extremity Robot on Healthy Adults,”
Journal of Biomechanics 25:2:103-110 (2009)

Lonini, L., et al.,“An Internal Model for Acquisition and Retention of Motor Learning during Arm Reaching,”
Neural Computation 21:7:2009-2007 (2009)

Krebs, H.I., et al., “A Paradigm Shift for Rehabilitation Robotics,” IEEE-EMBS Magazine 27:4:61-70 (2008)

Krebs, H.I., et al., “Robot-Aided Neurorehabilitation: A Robot for Wrist Rehabilitation,”
IEEE Transaction Neural Systems and Rehabilitation Engineering, 15(3) 327-335 (2007)

Krebs, H.I., et al., “Therapeutic Robotics: A Technology Push,”
Proceedings of IEEEI, Special Issue on Medical Robotics, 94(9) 1727-1738 (2006)

Hogan, N., et al., “Motions or Muscles? Some Behavioral Factors Underlying Robotic Assistance of Motor Recovery,” VA Journal of Rehabilitation Research and Development, 43(5) 605-618 (2006)

Krebs, H.I., “Those Magnificent Men and Their Flying Machines,” Guest Editorial.
VA Journal of Rehabilitation Research and Development, 43(5) IX-XI (2006).

Krebs, H.I., et al.,“Robotic Rehabilitation Therapy,”
Wiley Encyclopedia Biomedical Engineering, John Wiley & Sons, Inc (2006)

Fasoli, S.E., et al., “Functionally-Based Rehabilitation Robotics: A Next Step?”
International Journal of Assistive Robotics and Mechatronics, John Wiley & Sons, Inc (2006)

Krebs, H.I., et al., “Rehabilitation Robotics, Orthotics, and Prosthetics Chapter 48, In M.E. Selzer, S. Clarke, L.G. Cohen, P.W. Ducan, F.H. Gage (Eds), Textbook of Neural Repair and Rehabilitation, Cambridge University Press (2006)

Stein, J., et al., “Clinical Applications of Robots in Rehabilitation,”
Critical Reviews in Physical and Rehabilitation Medicine, 17 (3) 217-230 (2005)

Krebs, H.I., et al., “Rehabilitation Robotics: Pilot Trial of a Spatial Extension for MIT-MANUS,”
Journal of NeruoEngineering and Rehabilitation, Biomedcentral, 1:5 (2004)

Hogan, N., et al., “Interactive Robots for Neuro-Rehabilitation,” In Platz (Ed).
Special issue on Motor System Plasticity, Recovery and Rehabilitation, Restorative Neurology & Neuroscience (2004)

Krebs, H.I., et al., “A Wrist Extension to MIT-MANUS,” In Z. Bien and D. Stefanov (Eds.), Advances in Human-Friendly Robotic Technologies for Movement Assistance / Movement Restoration for People with Disabilities. Springer-Verlag (2004)

Henriques, D., et al., “Bias and sensitivity in the haptic perception of geometry,”
Exp Brain Res (2003) 150:95-108

Krebs, H.I., et al., “Rehabilitation Robotics: Performance-based Progressive Robot-Assisted Therapy,”
Autonomous Robots, Kluwer Academics 15:7-20 (2003)

Krebs, H.I., et al., “Robotic Applications in Neuromotor Rehabilitation,”
Robotica. 21:3-11 (2003)

Malfait, N., et al., “Transfer of Motor Learning Across Arm Configurations,”
Journal of Neuroscience, 22(22): 9656-9660, November 15, (2002)

Hogan, N., “Skeletal Muscle Impedance in the Control of Motor Actions,”
Journal of Mechanics in Medicine and Biology 2(3&4) 359-373 (2002)

Krebs, H.I., et al., “Robot-Aided Neuro-Rehabilitation: From Evidence-Based to Science-Based Rehabilitation,”
Topics in Stroke Rehabilitation. 8:454-70 (2002)

Krebs, H.I., et al., “Increasing Productivity and Quality of Care Robot-Aided Neurorehabilitation,”
VA Journal of Rehabilitation Research and Development, 37:6:639-652, (2000)

Krebs, H.I., et al., “Robotic Applications in Neuromotor Rehabilitation. Robot Aided Sensorymotor Stimulation,”

Neurology, 54:1938-1944, (2000)

Hogan, N., et al., “Arm Movement Control is both Continuous and Discrete,”
Cognitive Studies. Bulletin of the Japanese Cognitive Science Society, 6:3.254-273

Krebs, H.I., et al., “Quantization of Continuous and Arm Movements in Humans with Brain Injury,”
Proceedings of National Academy Of Sciences of the United States of America
96:4645-4649, (1999)

Krebs, H.I., et al., “Robot-Aided Neuro-Rehabilitation,”
IEEE-Transactions on Rehabilitation Engineering, 6:1:75-87; (1998)

Krebs, H.I., et al., “Robot-Aided Functional Imaging: Application to a Motor Learning Study”
Human Brain Mapping; John Wiley & Sons, 6:59-72 (1998)

Lower-Extremities

Roy, A., et al., “Robot-Aided Neurorehabilitation: A Robot for Ankle Rehabilitation,”
IEEE – Transaction Robotics 25:3:569-582 (2009)

Forrester, LW, et al, “Ankle Training With a Robotic Device Improves Hemiparetic Gait After a Stroke,”
Neurorehabilitation and Neural Repair, Vol 25, No 4, May (2011)

Anindo, R, et al., “Measurement of passive ankle stiffness in subjects with chronic hemiparesis using a novel ankle robot,” Journal Neurophysiology 105:2132-2149, (2011)

Cerebral Palsy

Frascarelli, F, et al., “The impact of robotic rehabilitation in children with acquired or congenital movement disorders,” European Journal of Physical Rehabilitation Medicine, (2009) 45: 135-41

Fasoli, S.E., et al., “Robotic therapy and botulinum toxin type A: A novel intervention approach for cerebral palsy,”
American Journal of Rehabilitation, 87:8:1-4 (2008)

Krebs, HI, et al., “Robot-assisted task-specific training in cerebral palsy, “
Developmental Medicine and Child Neurology, 51 (Suppl. 4)

Children

Mast, J., et al., “Robot Assisted Therapy in Pediatrics: A Pilot Study.
Developmental Medicine and Child Neurology Supplement, September (2009)

Krebs, H.I., et al., “Robot-Assisted Task Specific Training,”
Development Medicine & Children Neurology. October, 51(4): 140-145.

Fasoli, S.E., et al., “Upper Limb Robotic Therapy for Children with Hemiplegia,”
American Journal of Rehabilitation, 87:11 9292-936 (2008)

Spinal Cord Injury

Improvement in Strength and Function
A pilot study of two patients with incomplete spinal injuries, level C4-6, that had occurred greater than two years ago, was conducted at Burke Rehabilitation Hospital. Patients received treatment on the InMotion ARM™ robot for 18 sessions over 6 weeks with one arm followed by 18 sessions over 6 weeks with the other arm. Patients showed changes greater than 10% in Fugl-Meyer Scores and 20% in the Motor Power Scales. The study also showed that while one arm was treated, both arms showed comparable improvement.

Krebs, H.I., Dipietro, L., Levy-Tzedek, S., Fasoli, S., Rykman, A., Zipse, J., Fawcett, J., Stein, J., Poizner, H., Lo, A., Volpe, B.T., Hogan, N., “A Paradigm Shift for Rehabilitation Robots,” IEEE-EMBS Magazine, 27:4:61-70 (2008)

Multiple Sclerosis (MS)

A pilot study of two MS patients at the West Haven VA Medical Center has shown that treatment with the InMotion AnkleBot twice a week for twelve total sessions resulted in significant improvement in torque production at the ankle and movement accuracy. Although the training did not include gait activities the researchers noted carry over improvement in gait function when measured through six-minute walk tests.

(Krebs, H.I., Dipietro, L., Levy-Tzedek, S., Fasoli, S., Rykman, A., Zipse, J., Fawcett, J., Poizner, H., Lo, A., Volpe, B.T., Hogan, N., “A Paradigm Shift for Rehabilitation Robots,” IEEE-EMBS Magazine, 27:4:61-70 (2008)

Parkinsons

Krebs, H.I., et al., “Procedural Motor Learning in Parkinson’s Disease,”
Experimental Brain Research. 141:425-437 (2001)

Levy-Tzedeck, et al., “Parkinson’s Disease: A Motor Control Study Using a Wrist Robot,”
Advance Robotics, 21(10) 1201-1213 (2007)

Book Chapters

Dietz, Volker; Nef, Tobias; Rymer, William Zev (Eds.)2012, “Neurorehabilitation Technology”
Chapter 8 Forging Mens et Manus: The MIT Experience in Upper Extremity Robotic Therapy

Stein, J., et al., “Technological Aids for Motor Recovery,” Chapter 19 in

Stroke Recovery and Rehabilitation, Demos Press 2008

Krebs, H.I., Hogan, N., “Robotic Rehabilitation Therapy,” Editor, Metin Akay, Wyley Encyclopedia of Biomedical Engineering, 2006

Krebs, H.I., et al., “Rehabilitation Robotics, Orthotics, and Prosthetics: In Selzer, M.E., Clarke, S., Cohen, L.G., Duncan, P.W., Gage, F.H., (eds), Textbook of Neural Repair and Rehabilitation, Chapter 48, Cambridge University Press, 2006

Krebs, H.I., et al., “Notes on Rehabilitation Robotics and Stroke,” In: F. Lofaso, A., Roby-Brami, J.F., Ravaud (eds),
Technological Innovations and Handicap, Frison Roche, 177-194, 2004

Hogan, N., Krebs, H.I., “Interactive Robots for Neuro-Rehabilitation,” In: Platz (ed), Special Issue on Motor System Plasticity, Recovery, and Rehabilitation, Restorative Neurology and Neuroscience, 2004

Krebs, H.I., et al., “A Wrist Extension to MIT-Manus,” In: Z. Bien and D. Stefanov (eds), Advances in Human-friendly Robotic Technologies for Movement Assistance / Movement Restoration for People with Disabilities, Springer-Verlag, 2004

Hogan, N., et al., “Technology for Recovery after Stroke,” In: Bogousslavsky, J., Barnes, M.P., Dobkin, B., (eds),
Recovery after Stroke, Chapter 30, Cambridge University Press, 2003

Volpe, B.T., et al.,“Robot aided sensori-motor training in stroke rehabilitation,” In: Barnett, H.J.M., Bogousslavsky, J., Meldrum H. (Eds), Advances in Neurology. Ischemic Stroke Lippincott, Williams & Wilkins 2003

Hogan, N., and Breedveld, P.C. “The Physical Basis of Analogies in Physical System Models,” In: Bishop, R.H., (ed).
The Mechatronics Handbook, CRC Press, Chapter 15

Krebs, H.I., et al., “Robot-Aided Neuro-Rehabilitation in Stroke: Interim Results on the Follow-up of 76 Patients and on Movement Performance Indices,” In: Mounir Mokhtari (ed), Integration of Assistive Technology in the Information Age, IOS Press, Assistive Technology Research Series, Amsterdam, 2001

Reinkensmeyer, D.J., et al., “Rehabilitators, Robots and Guides: New Tools for Neurological Rehabilitation,” In: Winters, J.M., Crago, P.E. (eds) Biomechanics and Neural Control of Movement, Springer-Verlag, 2000