

Differential recovery of the electroretinogram, visually evoked cortical potential, and electrically evoked cortical potential following vitrectomy: Implications for acute testing of an implanted retinal prosthesis

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Purpose of the Work. A retinal prosthesis has the potential to restore vision to blind veterans. Implantation of a prosthesis may require removal of the fluid within the back of the eye (i.e., vitreous humor). We performed this experiment to determine how quickly the retina recovers its function following removal of the vitreous humor. **Procedures.** We performed studies of the electrical function of the retina and optic nerve following removal of the vitreous humor in 15 rabbit eyes. **Results.** Removal of the vitreous humor produced declines of 49, 25, and 41 percent in the strength of three different tests that measured the responsiveness of the retina and optic nerve. Removal of the vitreous humor also produced slower responses of the nerve tissue. Many of these changes persisted for at least 90 min following removal of the vitreous humor. **Relevance to the Veteran Population.** The most common form of blindness among veterans is age-related macular degeneration. We are developing a retinal prosthesis as a potential treatment for macular degeneration. This study reveals a temporary, vitrectomy-induced subnormal responsiveness of the retina. Failure to consider this effect could lead to a false conclusion that an implanted prosthesis is not adequately stimulating the retina.

Sandra R. Montezuma, MD

Comparison of manual and computer-automated procedures for tinnitus pitch-matching

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Purpose of the Work. Tinnitus is a major international problem. Yet, there are no accepted clinical techniques to quantify the perceptual aspects of the disorder. Our overall efforts are to develop clinical methodology to accurately and reliably quantify the phantom sensation of tinnitus. The work presented here is specifically directed toward

determining a uniform method for obtaining tinnitus pitch matches routinely in the clinical environment. **Subjects and Procedures.** Three techniques for tinnitus pitch-matching were performed. Two methods were computer-automated (Binary and Subject Guided) and the third was a traditional manual technique. Forty-two subjects with chronic tinnitus were each tested repeatedly over two sessions. **Results.** Each technique provided excellent response reliability for about half of the subjects. The most reliable subjects, however, differed widely between the different methods. Analyses based on each subject's multiple pitch matches revealed the range of pitch matches, which spanned about 2 1/3 octaves for half of the subjects. These findings suggest that it may be more appropriate to specify the range of tinnitus pitch matches rather than a single pitch match. **Relevance to the Veteran Population.** The ability to accurately quantify the perceptual attributes of tinnitus would be a major step in providing effective clinical management for veterans with tinnitus. Further development of the automated technique would make such a service available to audiology clinics throughout the Department of Veterans Affairs healthcare system. This would allow veterans to receive routine tinnitus testing uniformly across clinics and would establish a means of assessing the validity of claims submitted for compensation of benefits.

James A. Henry, PhD

A comparison of four electrical stimulation types on Staphylococcus aureus growth in vitro

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Purpose of the Work. This study evaluated the efficacy of common electrical stimulation (ES) types on bacterial growth in vitro under clinically relevant conditions. **Procedures.** Four types of ES were each applied to a separate set of culture plates containing Staphylococcus aureus for 1 h at 37° C on 3 consecutive days. After ES treatment, the zone of inhibition surrounding each electrode was measured. **Results.** Zone of inhibition measurements showed a significant inhibitory effect for continuous microamperage direct current and high-voltage pulsed

current ($p < 0.05$), but not for low-voltage monophasic milliamperage pulsed current and low-voltage biphasic milliamperage pulsed current. Differences in bacterial growth inhibition were not found for polarity and time. **Relevance to the Veteran Population.** Many patients, including veterans, suffer from spinal cord injury, amputations, stroke, and brain injury, which typically result in limited mobility that may lead to the formation of chronic pressure ulcers. In addition, many veterans also have chronic leg ulcers caused by diabetes and arterial and venous insufficiency. ES is the only adjunctive therapy recommended to enhance healing of more advanced pressure ulcers. Our in vitro study demonstrates a novel system that can simultaneously investigate multiple ES types. This study also gives further evidence that some ES types result in a bacterial inhibitory effect that may contribute to enhanced wound healing rates.

Harold L. Merriman, PhD, MPT

A comparative study of the effects of electrical stimulation and laser treatment on experimental wound healing in rats

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Purpose of the Work. This study, conducted at the Experimental and Clinical Research Centre of Erciyes University (Kayseri, Turkey), investigated the effects of electrical stimulation (ES) and laser treatment on wound healing in rats. **Subjects and Procedures.** The study included 124 healthy female Swiss-Albino rats, divided into four groups. After a 6 cm linear incision was made at the dorsal skin of all the rats, Group 1 received ES for 30 min per day, Group 3 received gallium arsenide (GaAs) laser therapy for 10 min per day, and Groups 2 and 4, considered the control groups, received sham treatment. All groups were treated for 10 days. Histopathologic and biochemical evaluations were performed on the 4th and 10th days, and wound-breaking strength was measured for biomechanical evaluation on the 25th day. **Results.** Histopathologic and biochemical results show both the ES and laser treatment to be significantly effective in all phases of wound healing compared with control groups. In the inflammatory phase, ES was found to be even more effective than laser treatment, with more significant results. Although both ES and laser treatment proved effective in the maturation phase (increasing wound-breaking strength compared with their control

groups), there was no statistically significant difference between the two treatment groups. **Relevance to the Veteran Population.** Studies on wound healing increase our knowledge and understanding of pressure ulcers, diabetic ulcers, open wounds, venous ulcers, graft ulcers, incisions, lacerations, and burns. Most of these conditions can be found in the veteran population. ES and laser treatment are two important physical modalities that are widely used in physical and rehabilitation medicine; the literature reports that they accelerate and facilitate wound healing and increase scar quality. From this study, we conclude that both ES and laser treatment can be used successfully for pressure ulcers and chronic wounds, in combination with conventional therapies such as daily care and debridement of wounds; however, ES is more beneficial than laser treatment during the inflammatory phase.

Hüseyin Demir, MD

Unresolved legal and ethical issues in research of adults with severe traumatic brain injury: Analysis of an ongoing protocol

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Purpose of the Work. This paper synthesizes federal and state laws and bioethics literature with observations from an ongoing research protocol to identify, define, and clarify the unresolved legal and ethical issues regarding research involving adults with traumatic brain injury (TBI). **Procedures.** Solutions that protect rights and minimize unnecessary impediments to valuable clinical and scientific inquiry are illustrated with this ongoing research protocol. **Results.** The research protocol identifies five areas of law impacting adults with TBI: advanced directives, healthcare surrogacy acts, probate acts, power of attorney acts, and the Health Insurance Portability and Accountability Act. The published bioethics literature and responses from local Human Subject Institutional Review Boards (IRBs) suggest that the unresolved ethical issues in research include defining vulnerability, defining informed voluntary consent, determining competency and/or decision-making capacity, using caregivers as subjects, and using multisite cooperative studies. Collaboration with IRB members and administrators as well as legal and research ethic scholars developed procedures that protect rights while avoiding unnecessary impediments to research. **Relevance to the Veteran Population.** A need

continues for clear and consistent regulatory guidance regarding research involving veterans and civilians with cognitive impairments. In lieu of regulatory guidance, carefully researched solutions for critical peer review are needed. This body of literature could serve to guide future multisite investigations of cognitive impairments involving veterans.

Theresa Louise-Bender Pape, DrPH, MA, CCC-SLP/L

Testing of elastomeric liners used in limb prosthetics: Classification of 15 products by mechanical performance

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Purpose of the Work. This study provides information of utility for elastomeric liner prescription and fitting by comparing the mechanical performance of different liner products. **Procedures.** Commercially available elastomeric liners were tested under compression, friction, shear, and tension with the use of custom instrumentation. Test results were grouped by their responses so that similarities and differences among products could be compared. **Results.** A wide range of unique materials was found—out of the 15 materials, only 10 were unique classification sets. Silicone gel liner products were more similar to each other than were silicone elastomer products. A urethane liner had the highest coefficient of friction with a skin-like material of any liner tested, which means that it experienced the least slip. **Relevance to the Veteran Population.** The quantitative data provided here should assist prosthetists toward better matching their elastomeric liner prescriptions with the needs of their amputee patients.

Joan E. Sanders, PhD

Load-shifting brace treatment for osteoarthritis of the knee: A minimum 2 1/2-year follow-up study

Nicholas J. Giori, MD, PhD

Purpose of the Work. This study was done to evaluate the success of load-shifting bracing for osteoarthritis of the knee as measured primarily by length of brace use. Secondary outcome measures were pain relief, function, conversion to total knee replacement, and complications caused by bracing. **Subjects and Procedures.** This was a retrospective cohort study of patients who were issued a load-

shifting brace for primarily unicompartmental knee osteoarthritis from 1997 to 1999 at a single institution. The computerized medical record was reviewed and patients were surveyed by telephone. **Results.** Forty-six patients (49 knees) with a minimum 2-year follow-up (average 3.3 years) were reviewed. Kaplan-Meier survivorship analysis revealed that load-shifting brace use had a survival of 76% at 1 year, 69% at 2 years, and 61% at 3 years. Younger patients had a higher likelihood of longer brace use than older patients. One patient had ipsilateral leg swelling and a pulmonary embolus after initiating bracing. **Relevance to the Veteran Population.** Osteoarthritis is the most common diagnosis in the orthopedic clinic among veterans. The knee is the most commonly affected joint, and primarily unicompartmental knee osteoarthritis is a common arthritis pattern at the knee. Understanding the success of this treatment modality in veterans can guide future treatment.

Nicholas J. Giori, MD, PhD

Comparison of the Easy Strutter Functional Orthosis System and axillary crutches during modified 3-point gait

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Purpose of the Work. The Easy Strutter Functional Orthosis System (ESFOS) was designed to improve assistive device ambulatory efficiency. This study compared the ESFOS to axillary crutches during modified 3-point gait on flat surfaces and stairs. **Subjects and Procedures.** Thirty-eight subjects (40–65 years of age) at ≥ 1 year after unilateral total knee or hip replacement participated in this study. Heart rate, mean peak palmar, and plantar force magnitude and onset timing were monitored during self-directed pace ambulation. Between trials, subjects responded to questions on perceived exertion, stability/security, and comfort. One-way analyses of variance were used to evaluate condition differences for ratio/interval data ($p \leq 0.01$). Wilcoxon signed rank tests were used to evaluate condition differences for ordinal data. **Results.** Statistically significant differences were noted for mean peak palmar forces (reduced 45% and delayed 31%), mean peak plantar force onsets (delayed 30%), and energy expenditure index (EEI) (reduced 25%). Subjects preferred the ESFOS to axillary crutches for comfort and security/stability on flat surfaces and stairs ($p \leq 0.001$). Results suggest greater ambulatory gait efficiency during ESFOS use. **Relevance to the Vet-**

eran Population. Since many veterans have cardiopulmonary or musculoskeletal system functional impairments, or experience otherwise reduced aerobic system capacity, finding ambulatory assistive devices that require less effort during flat surface and stair ambulation is desirable. The greater ambulatory gait efficiency observed during ESFOS use provides support for this device. Further study is indicated with other patient populations.

John Nyland, PT, EDD, SCS, ATC

Computational method to evaluate ankle postural stiffness with ground reaction forces

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Purpose of the Work. This study obtained ankle postural stiffness in quiet standing for normal subjects to ultimately evaluate ankle postural stiffness for the elderly and patients. For this purpose, we formulated a new method that better evaluates postural sway and, in addition, computes ankle moment and ankle postural stiffness directly from the measured ground reaction force. **Subjects and Procedures.** We collected balance data on four healthy adult subjects (two males and two females, ages between 29 and 70) to demonstrate the use of our computational method for generating center of mass (COM), ankle postural stiffness, and other information. Our procedures involved obtaining the raw data of the measured ground reaction forces for sensory organization test with an EquiTest device; developing formulas for calculating subjects' body segment lengths and inertial parameters as functions of subjects' heights and weights using anthropometric data taken from the literature; using the data in our computation model to find the COM displacement, ankle moment, and postural stiffness at the ankle; and comparing the results from our model with those reported by the device. **Results.** We developed a computational model to study postural sway and ankle postural stiffness with the measured ground reaction forces. Ankle moment and ankle postural stiffness were computed based on ankle strategy. The results for one of the male subjects are presented in the paper. Similar results are obtained for the other three subjects. Our computation of COM for quiet standing generated direct and detailed information of the sway motion. The computational method we developed has two important features: (1) the solution was obtained without either filtering or numerical integration and (2) the method included shear force and rotation of the plat-

form. This computational method can also be applied to the situations where the platform is fixed and inclined. Combining the computed ankle moment with the computed sway angle, we obtained the ankle postural stiffness through linear regression. Our computation of COM for sway-referenced motion also corrects the oversimplification in the machine's calculation. **Relevance to the Veteran Population.** Postural control is a fundamental issue in understanding the causes of falls, which is the leading cause of injury-related deaths for older Americans, especially among veterans with chronic fatigue, Gulf War syndrome, diabetes, Parkinson's disease, etc. Only limited treatment options exist. Plastics technology has replaced the double upright brace with adjustable Klenzac ankle joint with a rigid plastic molded brace, affording the clinician with little opportunity to "tune" the brace to the specific needs of the patient. Furthermore, there is no scientific theory to guide the adjustment of the flexibility at the ankle, which relies only on the judgment and experience of the orthotist and physician. We plan to extend this research to study the effective adjustment and design of ankle-foot orthoses. At present, this work can be used to obtain information about patients undergoing rehabilitation therapies as a means of making conclusions concerning treatment efficacy.

Zhiming Ji, PhD

Identification of key pinch forces required to complete functional tasks

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Purpose of the Work. This study established the target pinch force requirements necessary to accomplish simple activities of daily living tasks requiring lateral (or "key") pinch. Once identified, these target pinch force magnitudes can be used as a quantitative measure of surgical outcome with functional significance for tetraplegic individuals. **Subjects and Procedures.** Pinch force magnitude and the ability to perform the tasks were recorded in 14 individuals with spinal cord injury (SCI) resulting in pinch force deficits. **Results.** The results of this study define pinch force requirements that have the power to predict, with great confidence, whether an individual has sufficient pinch force magnitude to complete each task. **Relevance to the Veteran Population.** This study aims to improve the

information available to tetraplegic veterans considering tendon transfer surgeries to improve their functional independence. Currently, over 183,000 individuals are affected with SCI in the United States. Because SCI affects many U.S. veterans, many Department of Veterans Affairs Hospital Medical Centers focus on the treatment of SCI and also an organization exists specifically for veterans with SCI (Paralyzed Veterans of America).

Niels Smaby, MS

Attributional style and symptoms as predictors of social function in schizophrenia

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Purpose of the Work. While the attributions of people with schizophrenia have been hypothesized to affect social behavior, contradictory predictions can be made about what attributions contribute to social dysfunction. It is possible that attributing undesirable events to internal, stable, and global factors might lead to poorer social function or that attributing events in general to internal, stable, and global factors might lead to better social function. **Subjects and Procedures.** Forty veterans in a postacute phase of schizophrenia were administered the Attributional Style Questionnaire, the Positive and Negative Syndrome Scale, and the Quality of Life Scale. **Results.** Stepwise multiple regressions controlling for age and education indicated that lesser negative symptoms and the tendency to make stable attributions for life events in general predicted more frequent social contacts, a higher quality of social interaction, and better community participation. **Relevance to the Veteran Population.** These results suggest that attribution style may affect social function among veterans with schizophrenia.

Paul H. Lysaker, PhD

Use of Rasch person-item map in exploratory data analysis: A clinical perspective

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Purpose of the Work. Our goal is to develop a vision function questionnaire that captures the difficulty that patients with low vision have performing daily activities. **Subjects and Procedures.** A new, 48-item vision function questionnaire, the Department of Veterans Affairs (VA) Low Vision Visual Functioning Questionnaire (VA LV VFQ-48), is being administered to approximately 400 patients. A preliminary statistical analysis was conducted after the VA LV VFQ-48 was administered to 117 subjects, to determine if the activities included on the questionnaire vary in difficulty from easy to hard and if the questionnaire can be used to assess patients with different amounts of vision loss. **Results.** The questionnaire includes 48 activities, which vary in difficulty from easy to hard. The questionnaire performed well to measure the difficulty that subjects with moderate to severe vision loss experience performing daily activities. **Relevance to the Veteran Population.** The VA LV VFQ-48 can be used to assess patients' needs before they enter a VA low-vision rehabilitation or blind rehabilitation program. The questionnaire can also be used to measure the outcomes of these programs and to compare the effectiveness of different rehabilitation strategies and prosthetic devices.

Joan Stelmack, OD

