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Rehabilitation R&D Progress Reports is distributed as number one each year of the *Journal of Rehabilitation Research and Development.* The mailing list is intended to cover all professionals in the rehabilitation field who are either actively involved in research, contemplate such involvement or need to remain familiar with the direction and methods of current research and the clinical application of its results.

At present, the *Journal* and the progress report annual publication are distributed free of charge, both in the United States and in foreign countries. Additions will be made to the mailing list upon request.

Editor's Note

Rehabilitation R&D Progress Reports 1987 is the fifth annual compilation of ongoing work in the field of rehabilitation research and engineering both in this country and abroad. Our goal of increasingly comprehensive coverage in each annual edition has been achieved once again. Moreover, authors have expanded their reporting of publications and patents resulting from completed research.

Several other changes and new features are included in this year's edition: the organization of progress reports under subject headings has been improved and a new subject index is included.

A true picture of progress in rehabilitation requires a broader perspective than that provided by a description of individual projects alone. This year, as a start toward reporting a broader perspective, sponsoring agencies were asked to provide information on their overall rehabilitation R&D strategies and priorities. Selected results are presented as a part of the Sponsor Index.

The availability of funds is clearly a part of the broader perspective which relates to current and future rehabilitation R&D progress. This year, as a start toward annual coverage of funding, a new section presenting a selected listing of agencies that fund rehabilitation R&D has been added. Hopefully, this information will assist researchers in locating additional support for their work.

Perhaps most significantly, *Rehabilitation R&D Progress Reports* are now online (see inside front cover) on the VA Rehabilitation Database and will be maintained on an ongoing basis. Thus, a researcher can report progress (including "breakthroughs") and within days have his or her report available to other scientists and over 300,000 system users. Ongoing reports will allow users to get a more current picture of activity and progress in rehabilitation R&D than an annual publication alone can provide. An annual hard copy report will continue to be published in January of each year and will be derived from the progress reports contained in the VA Rehabilitation Database.

The deadline for submission for inclusion in the next annual edition is September 1, 1988. Guidelines for submitting progress reports are listed on page ii.

Seldon P. Todd, Jr.

Electronic Publishing: A Technical Note

The organization and preparation of this publication was done on a database specifically designed for the production of the progress reports and the indexes. The programs used were dBase III+ (Ver 1.1) and the Norton Editor (Ver 1.3B). The operating system was IBM PC DOS (Ver 3.2) and hardware consisted of IBM PCs, XTs, ATs, and Compaq 386s. The database structure was designed by John Bowman, Chief, Technical Support. Another specially designed program, using Microsoft Quickbasic (Ver 3.0), needed in the final preparation phase of the text files was written by John J. Martin, VA Medical Center, Washington, D.C.

All heading and subheading titles have been highlighted in blue to illustrate their purpose as links. Please click on the links to be taken to the section you are looking for.

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Progress reports are presented in appropriate subject categories. VA-sponsored reports are presented first and are followed by those of other participating organizations in alphabetical order by sponsor name. Multiple reports sponsored by the same organization are listed alphabetically by principal investigator.
(*See next page for a topical listing.*)

461 *Section II.* ***SPONSOR PROGRAM SUMMARIES WITH INDEX TO PROGRESS REPORTS***

Often, individual rehabilitation R&D projects represent parts of broader, overall programs of research. Program summaries are presented for selected sponsoring agencies.

This section also contains the name and location of all sponsoring agencies and an index of the titles and page numbers of the projects sponsored by each agency.

482 *Section III.* ***FUNDING ORGANIZATIONS***

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486 *Section IV.* ***SUBJECT INDEX***

The purpose of this index is to allow readers to identify and locate particular areas of interest within the entire text of the progress reports. Key words are taken from the text of each progress report and are listed with their corresponding page numbers.

489 *Section V.* ***AUTHOR INDEX***

This is an index of all progress report investigators and directors of sponsoring organizations with corresponding page numbers.

ON THE COVER

The UNISTIK hand vehicle controller, which represents the results of a VA/NASA Interagency Agreement carried out under the sponsorship of the VA Rehabilitation Research and Development Service. Based on the design of the NASA Lunar Rover controller, the UNISTIK device allows severely disabled individuals to drive conventional vehicles. Engineering safety and reliability testing have been completed and clinical testing is under way. A progress report on the UNISTIK device is on page 144. Photographs: Courtesy of the Spinal Cord Injury Service, VA Medical Center, Seattle, WA. Cover design by Holly M. Jellison.

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263 Quantification of Mobility Performance for Functional Assessment, Diagnosis, and Therapy of Neuromuscular, Skeletal, and Synovial Joint Dysfunctions
266 Segmental Bone and Joint Replacement after Tumor Resection

267 Biomechanics of Metastatic Defects in Bone
267 A Comprehensive, Quantitative, Predictive Model of the Human Knee Joint
268 Biomechanics of Joint Motion
269 Kinematics of the Ankle and Subtalar Joint
269 Ground Reaction Torque and Subtalar Joint Function
270 Biomechanical Evaluation of the Patellofemoral Joint Under Various Degrees of Fixed Rotational Deformities of the Femur

B. Human Locomotion and Gait Training

271 WATRACK—A New System for Studying Movement
271 Development of a Posture Sensor and Sensory Biofeedback System for Use in Gait Training of the Locomotion Disabled
272 Measurements of Postural Sway
272 A Model for Postural Sway
273 The Clinical Application of Gait Analysis
273 The Effects of Proximal Tibial Osteotomy and Tibial Tubercle Elevation on Knee and Ankle Joint Loading
274 Quantitative Measures for Assessing Therapeutic Effectiveness
275 A Telemetric Data Acquisition and Processing System for Biofeedback Training and as a Diagnostic for Human Movement Training
276 Feasibility Study: Evaluation of Total Knee Replacement by Gait Analysis
277 A Clinical Gait Recording System
277 Gait Abnormalities in Hemiplegia: Their Correction by Ankle-Foot Orthoses

C. Other

278 Optimal Biomechanical Design/Development of Arm-Powered Mobility Devices
279 Biofeedback System for Postoperative Hand Rehabilitation
279 Dynamic Positional and Electromyographic Monitoring of Sitting Posture
280 Mechanics of Rising from the Seated Position
280 A New Approach to Muscle Training to Rehabilitate the Hand in Leprosy
281 Comparison of Floor Sitting and Wedge Kneeler: Their Effect on Posture and Upper Extremity Range of Motion in Children with Cerebral Palsy
282 Design of Instrumentation to Quantify Upper Extremity Motor Control of Children with Cerebral Palsy: Pilot Study

X. Wound and Fracture Healing

283 Stress Analysis of Internal Fracture Fixation of Long Bones
284 Testing of Design Parameters for a Prototype Piezoelectric Internal Fixation Plate
285 Synthetic Bone Graft Materials in Segmental Defect Fractures
286 Noninvasive Assessment of Fracture Healing
287 Enhancement of Wound Healing, Using Synthetic Skin, Electrical Stimulation and Hyperbaric Oxygen Therapy
288 Circulatory and Mechanical Response of Skin to Compression Loading
289 Morphologic and Ultrasonic Analysis of Normal and Ischemic Human Wounds
290 Altered Collagen and Wound Metabolism in Non-Healing Diabetic Ulcers
291 Edinburgh Unilateral External Fracture Fixation Device
291 Enhancement of Ulcerated Tissue Healing by Electrical Stimulation
292 Acceleration of Fracture Healing by Electrical Fields
292 A Study on Disintegration of Carpal Bones in Leprosy
293 Graded Weightbearing in Tarsal Disintegration in Leprosy

XI. Muscles, Ligaments, and Tendons

A. General Properties of Muscle

295 Decomposition Analysis of the Surface Electromyogram
296 Automatic Decomposition of the Electromyogram
297 The Myoelectric Signal Decomposition Technique
297 Surface Electrode Design
298 Myoelectric Signal Quality Analyzer
298 The Frequency Response of Skeletal Muscles: Dependence on Control Strategies and Fiber Types
299 Skeletal Muscle Reaction to Immobilization

B. Muscle Contraction

299 Decomposition of Surface-Detected Myoelectric Signals
300 Muscle Force Output During Voluntary Contractions
300 Cross-Talk Between Myoelectric Signals of Adjacent Muscles
301 Synchronization of Motor Unit Discharges
302 The Common-Drive Principle of Motor Unit Control
302 Exercise-Induced Adaptations of Skeletal Muscle Grafts
303 Motor Control in Subjects with Clinical Disorders

C. Muscle Fatigue

303 Muscle Fatigue and Back Pain
304 Muscle Fatigue and Respiratory Failure
305 Muscle Fatigue and Myoelectric Signal
305 Muscle Fatigue Monitor

306 Motor Unit Properties Investigated by Voluntary and Electrically Elicited Contractions

D. Ligaments and Tendons

306 Structural and Functional Properties of Normal and Healing Ligaments
307 Structural and Functional Properties of Normal and Healing Ligaments (Project Extension)

XII. Neurological/Vascular Disorders

A. General

309 Electrophysiological Studies on Nerve Repair and Regeneration
310 Nerve Coupler: Sutureless Peripheral Nerve Repair at the Fascicular Level
310 Factors Limiting the Tactile Perception of Form
311 Neural Pathways Involved in Tactile Discrimination
311 A New Approach in the Relief of Pain of Leprous Neuritis
312 Treatment of Leprous Neuritis by Perineurial Steroid Injection
313 Inhibitive Casting as an Adjunct to Therapy in Children with Cerebral Palsy

B. Arthritis

314 Evaluation of Osteoporosis by Ultrasound and CAT-Scan
315 Arthritis Rehabilitation Unit
315 Impact of Arthritis Self-Care for Rural Persons
316 Endurance Training with Management of Fatigue in Rheumatic Arthritis and Systematic Lupus Erythematosus
317 Multipurpose Arthritis Center: Community Component—Coping Responses to Rheumatoid Arthritis
317 General Clinical Research Center: "Riadura" and NSAID in Rheumatoid Arthritis Treatment
317 Multipurpose Arthritis Center: Professional Education in Sexual Rehabilitation of Arthritis Patients
318 Multipurpose Arthritis Center: Education Component—Arthritis Patient Education Model
319 A National Arthritis Data Source (ARAMIS)
319 Multipurpose Arthritis Center: Stanford, CA
320 Northeast Ohio Arthritis Center Support: Legal Aspects of Chronic Illness: A Study of Arthritis Patients
321 Multipurpose Arthritis Center: Community Component—Arthritis Impact Measurement Scales
321 Occupational Role Dysfunction in Illness: Comparisons with Normative Data
322 Multipurpose Arthritis Center: Problem-Oriented Educational Program for Arthritis Using Aerobic-Type Exercise
322 Study of Behavioral Aspects of Rheumatoid Arthritis
323 UCSF Multipurpose Arthritis Center: Community Component—Studies Using a Panel of Rheumatoid Arthritis Patients
324 Benefit and Cost Comparison Between a Coordinated Team Care Approach and a Traditional Office Based Approach to Outpatient Management of Rheumatoid Arthritis

C. Low Back Pain

325 Myoelectric Analysis of Human Spine Function: Myoelectric Measurement of Human Muscle Endurance
326 Evaluation of Psychophysiological Ways to Assess Chronic Low Back Pain
326 Low Back Pain Studies

D. Vascular Disorders

327 Blood Velocity and Spectra Estimations from Doppler Ultrasound
328 A Program for Evaluating the Dysvascular Patient
330 A Program for Evaluating the Dysvascular Patient (Project Extension)
331 Evaluation of Pressures Applied by Elastic Dressings
332 Postoperative Thromboembolism in Surgical Patients
332 Characterizing Atherosclerotic Lesions by Proton Spectroscopy

XIII. Head Trauma and Stroke

334 The Application of Microcomputers for the Treatment of Aphasic Adults
335 Biomechanical Measurements for Quantitative Assessment and Diagnosis of Dysphagia
336 Long-Term Effects of Topical Anesthesia in Stroke Patients: Measurement and Analysis of Neurophysiological Reflexes
337 Development and Evaluation of a Videotape Teaching Module for Nursing Students in the Clinical Setting
337 Computer-Aided Device Evaluation
338 Early Intervention with Globally Aphasic Stroke Patients Using a Computerized Visual Communication Technique
339 Stroke Clinical Center Grant: Remediation of Left-Sided Neglect
339 Treatment of Affective Deficits in Stroke Rehabilitation
340 Rehabilitative Software for Head Trauma Victims
340 Subthreshold Memory Phenomena
341 Precursors of Stroke Incidence and Prognosis
341 Sensorimotor Interactions in Motor Unit Control
342 Medication Effects on Attention and Arousal

XIV. Geriatrics

343 Age-Related Changes in Sensorimotor Performance
344 Efficacy of Injectable Collagen to Correct Glottal Insufficiency
345 Geriatric Prosthetics: Design and Development of an Improved Above-Knee Socket (Project Extension)
346 Electromyographic Incontinence Alert Device
346 Non-Auditory Factors Affecting Hearing Aid Use in Elderly Veterans
347 Integrated System for the Management of Wandering Behavior in the Memory-Impaired Elderly: An Interagency Report
348 Work Disability, Disability Management, and the Older Worker
349 Perceptual Retention and Age
349 Geriatric Medicine Academic Award
350 Studies in Idiopathic Normal Pressure Hydrocephalus
350 Respite Care for Older Adults: A Prototype
351 Epidemiology of Cardiovascular Diseases in the Elderly
351 Does Improvement in Mortality Mean Better Health?
352 The Community Adaptation of Mildly Retarded Persons: The Lives and Needs of Aging Mentally Retarded Persons
352 Learned Modification of Visceral Function in Man
352 Senile Dementia: Natural History
353 Geriatric Medicine Academic Award
353 Falls in the Elderly: Causes and Reduction
354 Improving Recovery from Cardiac Surgery
354 Cancer Control Science Program: Fox Chase Cancer Center: Cancer Education and Management for Patients
355 The Treatment of Acute Illness in Nursing Homes
355 Research in Mental Retardation: Elderly Mentally Retarded—Population Description and Service Needs
356 Older ESRD Patients: Rehabilitation and Quality of Life
357 Illness Cognition and Coping in the Elderly
357 Profile of Visual Function in Low Vision Patients
358 The Behavioral Context of Incontinence in the Elderly
358 Teaching Nursing Home: Modification of Exercise Capacity in the Elderly
359 Geriatric Medicine Academic Award
359 Geriatric Dentistry Academic Award
360 Cutaneous Mechanoreceptor System
360 Morbidity Risk Assessment in the Elderly
361 Cooperative Group Outreach Program (ECOG)
361 Assessment of the Spatial and Temporal Characteristics of Vision as a Function of Age
362 Environmental Influences on Behavior of Patients with Alzheimer's Disease

XV. Sensory Aids

A. Blindness and Low Vision

1. *General*

363 The Use of the Electroretinogram to Predict Retinal Cell Activity
363 Pupillary Function in Elderly Individuals with Impaired Night Driving Vision
364 Predicting the Visual Abilities of Partially Sighted Persons
365 Hearing Impaired Blind Veterans
365 A Voice-Output Questionnaire Administrator
367 The Physical Correlates of Tactual Perception
368 Model-Based Image Enhancement for the Visually Impaired
368 Functional Vision and Clinical Tests in Low Vision
369 Sonar Sensory Substitution—Spatial Behavior in the Blind
369 Electronic Braille Page Output Device Using Nitinol SMA
370 Psychophysics of Reading—Normal and Low Vision
370 Analysis of Navigation Without Sight
371 Profile of Visual Function in Low Vision Patients
371 Prediction of Symbol Recognition in Low Vision Patients
372 Low Vision Reading: Optimizing Visuo-Motor Performance
372 Visual Tests for Patients with Central Scotoma
373 Expansion and Enhancement of the National Blindness and Low Vision Database
373 An Optimal, Inexpensive Text Entry System for the Orthopedically and Neurologically Disabled
374 Time Use and Resource Allocations of People with Visual Disabilities: Assessment Instrumentation
375 Development and Validation of a Work Environment Visual Demands (WEVD) Protocol
375 A Robotic Hand Communication Aid for the Deaf-Blind
377 The Evaluation of Low Vision Aids and Prediction of Visual Performance
378 Sensory Aid Technology: A Career Development Intervention Strategy for Blind and Visually Impaired Persons
379 Learning Styles and Effective Teaching Technologies for Enhancing the Employment of Deaf-Blind Youth
380 Identification of Job Tasks and Management Practices Performed by Blind and Visually Impaired Persons in the Operation of the Business Enterprise Program
380 Identification of Work Assessment Technology Needs
381 Identification and Classification of the Career Transition Problems of Blind and Visually

Impaired Persons Employed as Professionals, Managers, or Technicians
381 Modification and Adaptation of the Vocational Education Readiness Test for Blind/Severely Visually Impaired Individuals
382 Cutaneous Pattern Perception
382 Normative Data for Assessing the Manual Dexterity of Visually Handicapped Adults in Vocational Rehabilitation
383 Sensory Aids for the Blind and Visually Impaired
383 An Improved Volatile Braille Display
383 Universal Job Instrumentation System
384 Specialized Vocational Aids and Devices
385 The Note-a-Braille
385 Dotless Braille Reader
386 Dexter: A Mechanical Hand for the Deaf-Blind
387 Pediatric Research
387 Applications of Evoked Potential in Rehabilitation
388 Automatic Lens Focusing for the Visually Impaired

A. Blindness and Low Vision

2. *Mobility Aids*

389 Evaluation of Electronic Travel Aids (ETAs) for Visually Impaired Individuals
389 Clinical Application Study of Training Techniques and Devices for the Blind
390 Measuring the Mobility of Blind Travelers
391 Measuring the Spatial Layout Knowledge of Visually Impaired Adults
392 Digital Techniques for Objective Analysis of Aural Acoustic Immittance
392 Establishing Design/Operational Features for Portable Blind Reading Aids
393 A Portable Navigational Aid for Blind Persons

A. Blindness and Low Vision

3. *Reading Aids*

394 Computer Vision to Guide the Blind
395 The Human Factors Design of a Large Print Display
396 Adaptation of the Amiga Personal Computer to the Visually-Impaired User
397 Braille Teaching Aid with Synthetic Speech
397 Enhancing the Reading Skills of Low Vision Individuals with Macular Loss
398 Software Development: Blissbook

B. Deafness and Hearing Impairment

399 Electroacoustical and Clinical Protocols for Evaluating Assistive Listening Devices
399 Development of a Digital Hearing Aid and Computer-Based Fitting Procedure: Phase II
401 Perception of Reverberation by the Hearing Impaired
401 Direct Measurement of Loudness Recruitment in Hearing-Impaired Veterans
402 Direct Measurement of Loudness Recruitment in Hearing-Impaired Veterans (Project Extension)
403 Rabbit ERG Responses to White-Noise Modulated Stimuli
404 Development of Materials for Computer-Assisted Instruction in Lipreading
405 Personal Computer System for Acoustic Measurements
406 Threshold Sound Pressure Levels (SPLs) for the ER-3A Insert Earphone
406 Effects of Manipulation of the Impedance of the Ear of Normal Subjects on Selected Indices of Auditory Function
408 Voice and Speech Findings in Prospective Cochlear Implant Candidates
409 Basic Mechanisms and Rehabilitative Strategies for Presbycusis
409 Changes in Frequency Organization of the Cochlea During Aging
410 An Auditory Prosthesis for Sensorineural Hearing Loss
411 Transition Study of Persons with Hearing Impairments
412 Technology for Sensory Devices for Deaf and Severely Hard of Hearing People
413 Project PALS (Places with Assistive Listening Systems)
414 AKL Spatiotemporal Representation in a Tactile Aid for the Deaf
414 Speech Perception Studies—Bimodal and Developmental
415 Tactile Communication of Speech
415 Cutaneous Communication Aids for the Deaf
416 Rehabilitation Strategies for the Hearing Impaired
416 Reading and Writing Skills in the Congenitally Deaf
416 Factors Predictive of Reading and Writing Skills in the Congenitally Deaf
417 Development of a Wearable Vibrotactile Aid—Phase II
417 The Role of the Haptic System in Communication
418 Development of a Cochlear Prosthesis
418 Wearable Multipoint Opto-Tactile Transducer for the Deaf or Blind
418 Basic and Applied Studies of Tactile Perception

C. Speech Impairment

1. *Hearing Related*

419 Measurement and Prediction of Benefit from Amplification
420 Computerized Treatment of Acquired Reading Disorders: Treatment of Alexia and Agraphia
421 Acoustic Vowel Measures Following Radiation Therapy to the Larynx
421 Language Performance in Cleft Palate Adolescents
422 The Use of Microcomputers in Diagnosis and Rehabilitation of Adult Aphasic Individuals

423 The Acquisition of Morphological Processes in American Sign Language (ASL)
423 Electrically Controlled Talking Tracheostomy Systems
424 Speech Transmission Laboratory Reports
425 Nonlinear Interaction in Voice Production
425 Glottal Source—Vocal Tract Acoustic Interaction
425 Speech Technology for the Visually Impaired: The Swedish Perspective
425 Relationship Between Changes in Voice Pitch and Loudness
426 Long-Term-Average Spectrum Analysis of Phonatory Effects of Noise and Filtered Auditory Feedback
426 Some Effects of Cochlear Implantation on Speech Production

C. Speech Impairment

2. Aphasia

427 Promoting Generalized Language Use: An Analysis of Treatment Strategies
428 An Experimental Analysis of Response Elaboration Training in Aphasia
428 Drawing: Its Use as a Communicative Aid with Aphasic and Normal Adults
429 Computer-Aided Visual Communication for Severely Impaired Aphasics
431 Technology Applications for Aphasia Rehabilitation: Lessons from Sweden, Poland, and The Netherlands
432 Efficacy of Remote Treatment of Aphasia by TEL-Communicology
433 The Influence of Mode of Stimulation on Naming Performance in Aphasia
434 Recovery from Aphasia in Stroke
434 Communication in Aphasia and Other Organic Disorders
435 Reorganization of Brain Function in Recovery from Aphasia

C. Speech Impairment

3. Other

436 Effects of Real-Time Biofeedback on Dysarthric Speech
436 Perceptual and Acoustical Characteristics of Tracheoesophageal Voice
437 Transparent Access to Sources of Computer-Based Information
438 Neuropathophysiology of Speech Motor Impairments
439 Structure and Acquisition of American Sign Language

XVI. Miscellaneous

440 Report on Phase I and Phase II: An Epidemiological Assessment of Disabled Veterans in Guam, American Samoa, and Hawaii
441 A Pilot Study on the Efficacy of Injected Cross-Linked Collagen in the Treatment of Symptomatic Glottic Insufficiency
441 Augmentative Communication for Intensive Care Unit Patients
442 Artificial Intelligence Strategies for Orthopedic Clinical Decision Making
443 Evaluation of One-Way Air Flow Valve Prostheses in Decannulation Procedures for Chronic Tracheotomized Patients
443 Psychiatric Rehabilitation in Nursing Homes
444 Assessment of the Swallow Reflex in Patients with Dysphagia
445 Dissemination of Rehabilitation Technologies
446 Rehabilitation of Neurogenic Communication Disorders in Remote Settings
447 The Relationship Between Visual Perception and Social Perception in Cerebral Palsied Children
447 Understanding Spasticity and the Effects of Rhizotomy Surgery
448 Design and Validation of a Subject/Instrument Interface to Allow Collection of Selected Pulmonary Function and Selected Metabolic Measures of Children with Cerebral Palsy
449 Protective Headwear for Disabled Children
449 Monitoring Respiratory Patterns and Their Coordination with Swallowing in Cerebral Palsy
450 Effects of Relaxed Breathing and Biofeedback on Bronchospasm in Chronic Asthma
451 The Finance of Medical Rehabilitation Services: Interim Report on the Mary E. Switzer Distinguished Research Fellowship in Medical Rehabilitation Finance
452 Information Dissemination in Communication, Control and Computer Access
453 Industry-Based Employee Assistance Program
454 Uses and Potential Uses of Information Technology by Rehabilitation Agencies
455 Disability Management and Rehabilitation: An Analysis of Programs, Costs and Outcomes
456 Epidemiological Study of Pain
457 A Neurosensory Interdisciplinary Research Program: Tactile Stimulator Development
457 Development of a Data Management System for the Family Asthma Rehabilitation Program (FARP)
458 An Innovative Approach to Continuing Health Care Education
458 Assessing the Need for Management of the Neurogenic Bowel in the Pediatric Population
459 Longitudinal Study of Public Expenditures for Services to the Handicapped