Literature Survey

Contents

1. Editor's Note

During the past decade, the promotion of physical fitness as a major benefit to health promotion and health maintenance has gained increasing momentum. Levels of physical fitness have been shown to be inversely associated with heart disease, stroke, type 2 diabetes, high blood pressure, and colon cancer.
Several studies also have noted that good-to-high levels of physical fitness (muscular strength, endurance and cardio respiratory fitness) can offset the decline in function that occurs during the natural ageing process and can assist people in maintaining their physical independence in later adulthood.

The biggest challenge ahead for exercise scientists will be to find ways to get people with disabilities more involved in physical activity, particularly persons with mental retardation, Alzheimer's disease, stroke, cerebral palsy, spina bifida, spinal cord injured, autism, and traumatic brain injury.

There is a pressing need for the public health community to begin to develop exercise guidelines for persons with disabilities and for consumers to use this information to become more involved in maintaining their health and well being.

As part of this development we found that the medical literature survey emphasizes cycling as one of the best activities for the above populations. We collected the following abstracts of current literature all pertaining to cycling as part of general activities and rehabilitation programs.

Simona Bar-Haim MSc, Pt

2. Abstracts

A. Spinal Cord Injury Rehabilitation

Mechanisms leading to restoration of muscle size with exercise and transplantation after spinal cord injury.

Dupont-Versteegden EE, Murphy RJ, Houle JD, Gurley CM, Peterson CA.

Am J Physiol Cell Physiol. 2000 Dec;279(6):C1677-84.

Department of Geriatrics, University of Arkansas for Medical Sciences, Little Rock, Arkansas 72205, USA.

We have shown that cycling exercise combined with fetal spinal cord transplantation restored muscle mass reduced as a result of complete transection of the spinal cord. In this study, mechanisms whereby this combined intervention increased the size of atrophied soleus and plantaris muscles were investigated. Rats were divided into five groups (n = 4, per group): control, nontransected; spinal cord transected at T10 for 8 wk (Tx); spinal cord transected for 8 wk and exercised for the last 4 wk (TxEx); spinal cord transected for 8 wk with transplantation of fetal spinal cord tissue into the lesion site 4 wk prior to death (TxTp); and spinal cord transected for 8 wk, exercised for the last 4 wk combined with transplantation 4 wk prior to death (TxExTp). Tx soleus and plantaris muscles were decreased in size compared with control. Exercise and transplantation alone did not restore muscle size in soleus, but exercise alone minimized atrophy in plantaris. However, the combination of exercise and transplantation resulted in a significant increase in muscle size in soleus and plantaris compared with transection alone. Furthermore, myofiber nuclear number of soleus was decreased by 40% in Tx and was not affected in TxEx or TxTp but was restored in TxExTp. A strong correlation (r = 0.85) between myofiber cross-sectional area and myofiber nuclear number was observed in soleus, but not in plantaris muscle, in which myonuclear number did not change with any of the experimental manipulations. 5'-Bromo-2'-deoxyuridine-positive nuclei inside the myofiber membrane were observed in TxExTp soleus muscles, indicating that satellite cells had divided and subsequently fused into myofibers, contributing to the increase in myonuclear number. The increase in satellite cell activity did not appear to be controlled by the insulin-like growth factors (IGF), as IGF-I and IGF-II mRNA abundance was decreased in Tx soleus and plantaris, and was not restored with the interventions. These results indicate that, following a relatively long postinjury interval, exercise and transplantation combined restore muscle size. Satellite cell fusion and restoration of myofiber nuclear number contributed to increased muscle size in the soleus, but not in plantaris, suggesting that cellular mechanisms regulating muscle size differ between muscles with different fiber type composition.

Modes, benefits, and risks of voluntary an delectrically induced exercise in persons with spinal cord injury.

Jacobs PL, Nash MS.

J Spinal Cord Med. 2001;24(1):10-8.

Department of Neurological Surgery, and The Miami Project to Cure Paralysis, University of Miami School of Medicine, Florida 33136, USA. pjacobs@miamiproj.med.miami.edu

BACKGROUND: Sedentary lifestyles and physical deconditioning are commonly reported among persons with spinal cord injury (SCI), although many forms of exercise have been shown to be beneficial. For individuals unable to perform voluntary exercise, involuntary exercise by electrically stimulated contractions has been used to train individual body segments, invoke cycling movements with or without arm propulsion, and stimulate ambulation. OBJECTIVE: To evaluate the benefits and risks associated with various modes of exercise in persons with SCI. METHODS: Literature review. FINDINGS: Electrical stimulation of local muscle sites increases muscle mass and circulation and favorably alters muscle fiber composition. Electrically stimulated cycling has been observed to improve fitness, lower-extremity circulation, and circulatory response to ischemia and to reverse cardiac muscle atrophy in persons with tetraplegia. Electrically stimulated ambulation improves upper-extremity endurance, lower-extremity circulation, and perception of body image. Studies of arm and wheelchair ergometry show increased arm endurance and decreased cardiovascular risks associated with hyperlipidemia, while resistance training of the upper extremities improves strength and endurance. Because autonomic hyperreflexia, orthostatic intolerance, thermal dysregulation, and fracture are associated with exercise in SCI, risk reduction strategies and prompt intervention are required. CONCLUSIONS: Well-designed programs of exercise are beneficial for persons with tetraplegia and paraplegia. Risks and benefits vary with level of injury. Programs need to address prevention of and intervention for potential adverse effects associated with exercise in individuals with spinal cord dysfunction.

Improved work capacity but unchanged peak oxygen uptake during primary rehabilitation in tetraplegic patients.

Hjeltnes N, Wallberg-Henriksson H.

Spinal Cord. 1998 Oct;36(10):691-8.

Sunnaas Hospital, Nesoddtangen, Norway.

Individuals with cervical spinal cord lesions are characterised by markedly decreased aerobic capacity, accompanied by increased risk of developing cardiovascular disease. The aim of this study was to evaluate the effects of a primary rehabilitation programme that included three sessions of arm cycling per week on the endurance capacity in 10 male tetraplegic subjects (injury level C6-C8; eight ASIA-A and two ASIA-B). Peak oxygen uptake (peak VO2) was measured three times (at T1 approximately 99 +/- 10 days after injury. T2 approximately 2 months after T1, and at T3 approximately 2 months after T2). Ten paraplegic patients admitted to the hospital for primary rehabilitation served as controls. In the tetraplegic patients, mean peak load increased (22 +/- 2, 32 +/- 5, and 32 +/- 7 watt, at T1, T2 and T3 respectively) ($P < 0.01$), while

mean peak VO2 did not change during the study (0.78 +/- 0.07, 0.86 +/- 0.08, and 0.81 +/- 0.06 1 x min-1, at T1, T2 and T3, respectively) (ns). In contrast peak VO2 was significantly higher in the paraplegic control group (1.37 +/- 0.08, 1.64 +/- 0.10 and 1.75 +/- 0.08 1 x min-1, respectively) ($P < 0.001$), and increased significantly during the study period ($P < 0.001$). Mean heart rate (HR) and mean stroke volume (SV), measured at corresponding submaximal work loads during the study did not change significantly in the tetraplegic patients. Mean systolic blood pressure (SBP), recorded immediately after peak arm exercise was low at all three tests (93 +/- 8, 89 +/- 6 and 84 +/- 6 mmHg) in the tetraplegic group. However, both muscle strength and 'activities of daily life' index improved significantly during the study period. Our results suggest that functional improvement in tetraplegic patients is not necessarily followed by aerobic metabolic improvement. We conclude that more time should be spent on arm endurance training, or training methods which activate larger muscle groups and/or increases blood pressure.

Myosin heavy chain isoform and ubiquitin protease mRNA expression after passive leg cycling in persons with spinal cord injury.

Willoughby DS, Priest JW, Jennings RA.

Arch Phys Med Rehabil. 2000 Feb;81(2):157-63.

Comment in:

- Arch Phys Med Rehabil. 2000 Jul;81(7):1000-2 PMID: 10896021

Department of Kinesiology, Texas Christian University, Fort Worth 76129, USA.

OBJECTIVE: To determine the effects of passive leg cycling exercise on myosin heavy chain (MHC) isoform and ubiquitin (UBI) protease mRNA expression in patients with spinal cord injury (SCI). STUDY DESIGN: Case series. INTERVENTION: Eight SCI subjects (5 men, 3 women) participated in a 12-week exercise program involving the Psycle ergometer. Training occurred 2 days a week at 75% of each subject's maximum heart rate. Anthropometric measures (body weight, thigh girth, and body mass index) and muscle biopsy specimens were obtained before and after training. Analyses were performed to determine the mRNA expression of types I, IIa, and IIx MHC, as well as UBI, a UBI-conjugating enzyme (E2), and 20S proteasome (20S). RESULTS: Despite small increases, paired t tests ($p < .05$) to assess changes from pretraining to posttraining failed to locate significant differences for the three anthropometric measures. For mRNA expression, there were significant increases in expression of MHC types IIa and IIx and significant decreases in expression for UBI, E2, and 20S. CONCLUSION: Exercise using passive leg cycling increases the expression of fast MHC isoforms while concomitantly decreasing proteolytic activity associated with muscle degradation, thus helping to possibly ameliorate muscle atrophy in patients with SCI.

Expression of the stress proteins, ubiquitin, heat shock protein 72, and myofibrillar protein content after 12 weeks of leg cycling in persons with spinal cord injury.

Willoughby DS, Priest JW, Nelson M.

Arch Phys Med Rehabil. 2002 May;83(5):649-54.
Department of Kinesiology, Texas Christian University, Fort Worth, TX 76129, USA. d.willoughby@tcu.edu

OBJECTIVE: To determine the effects of leg cycling exercise on ubiquitin (UBI), heat shock protein 72 (HSP-72) mRNA, protein expression, and myofibrillar protein content in individuals with spinal cord injury (SCI). DESIGN: Case series. SETTING: Motor behavior laboratory. PARTICIPANTS: Seven subjects with motor-complete SCI (4 men, 3 women). INTERVENTION: A 12-week exercise program involving an electromagnetically braked recumbent bicycle ergometer, which allowed for passive exercise of the legs. Training occurred 2 days a week at approximately 75% of each subject's maximum heart rate. MAIN OUTCOME MEASURES: Total body mass (TBM) and muscle biopsies were obtained pre- and posttraining. The mRNA and protein expression of UBI, HSP-72, and myofibrillar protein content were determined. RESULTS: Nonsignificant increases ($P > .05$) of 2.45% were observed for TBM. There were significant increases ($P < .05$) in the expression of both HSP-72 mRNA (33.71%) and protein (30.23%). For UBI, there were also significant decreases ($P < .05$) in the expression of both mRNA (26.86%) and protein (69.43%). Myofibrillar protein content increased significantly ($P < .05$, 41.86%). CONCLUSION: Leg cycling exercise in SCI increases myofibrillar protein content, possibly because of up-regulation in the expression of HSP-72 with concomitant down-regulation in the expression of UBI.

Knee kinetics during functional electrical stimulation induced cycling in subjects with spinal cord injury: A preliminary study

John C. Franco, MD, MS; Karen L. Perell, PhD; Robert J. Gregor, PhD; A.M. Erika Scremin, MD

Abstract - The purpose of this preliminary study was to describe pedal effectiveness parameters and knee-joint reaction forces generated by subjects with chronic spinal cord injury (SCI) during functional electrical stimulation (FES)-induced bicycling. Three male subjects (age 33--36 years old), who were post-traumatic SCI (ASIA-modified level A, level T4-C5) and enrolled in an FES rehabilitation program, signed informed consent forms and participated in this study. Kinematic data and pedal forces during bicycling were collected and effective force, knee-joint reaction forces, knee generalized muscle moments, and knee-joint power and work were calculated. There were three critical findings of this study: 1) pedaling effectiveness was severely compromised in this subject population as indicated by a lack of overall positive crank work; 2) knee-joint kinetics were similar in magnitude to data reported for unimpaired individuals pedaling at higher rates and workloads, suggesting excessive knee-joint loading for subjects with SCI; and 3) shear reaction forces and muscle moments were opposite in direction to data reported for unimpaired individuals, revealing an energetically unfavorable knee stabilizing mechanism. The critical findings of this study suggest that knee-joint kinetics may be large enough to produce a fracture in the compromised lower limbs of individuals with SCI.

B. Geriatrics and CVA Rehabilitation

Muscle strengthening and physical conditioning to reduce impairment and disability in chronic stroke survivors.

Teixeira-Salmela LF, Olney SJ, Nadeau S, Brouwer B.

Arch Phys Med Rehabil. 1999 Oct;80(10):1211-8.

Universidade Federal de Minas Gerais, Brazil.

OBJECTIVE: To evaluate the impact of a program of muscle strengthening and physical conditioning on impairment and disability in chronic stroke subjects. DESIGN: A randomized pretest and posttest control group, followed by a single-group pretest and posttest design. SUBJECTS: Thirteen community-dwelling stroke survivors of at least 9 months. INTERVENTION: A 10-week (3 days/week) program consisting of a warm-up, aerobic exercises, lower extremity muscle strengthening, and a cool-down. MAIN OUTCOME MEASURES: Peak isokinetic torque of the major muscle groups of the affected lower limb, quadriceps and ankle plantarflexor spasticity, gait speed, rate of stair climbing, the Human Activity Profile (HAP), and the Nottingham Health Profile (NHP) were recorded twice for the treatment group and three times for the control group. RESULTS: Significant improvements were found for all the selected outcome measures (HAP, NHP, and gait speed) for the treatment group ($p < .001$). In terms of overall training effects, the 13 subjects demonstrated increases in strength of the affected major muscle groups, in HAP and NHP profiles, and in gait speed and rate of stair climbing without concomitant increases in either quadriceps or ankle plantarflexor spasticity. CONCLUSIONS: The 10-week combined program of muscle strengthening and physical conditioning resulted in gains in all measures of impairment and disability. These gains were not associated with measurable changes of spasticity in either quadriceps or ankle plantarflexors.

High-intensity cycling exercise after a stroke: a single case study.

Dawes H, Bateman A, Wade D, Scott OM.

Clin Rehabil. 2000 Dec;14(6):570-3.

Rivermead Rehabilitation Centre, Oxford, UK.

Aerobic exercise training has demonstrated positive effects after brain injury. However, therapists express concern regarding the use of effortful exercise in individuals presenting with spasticity or involuntary muscle activity. This study aimed to address this concern and to evaluate whether an intervention of maximal intensity cycling exercise impaired an individual's ability to actively extend his hemiparetic elbow. Using a single case design, it was shown that active elbow extension improved during the period of this investigation, and was not impaired immediately following maximal cycling exercise.

Influence of daily activity on changes in physical fitness for people with post-stroke hemiplegia.

Fujitani J, Ishikawa T, Akai M, Kakurai S.

Am J Phys Med Rehabil. 1999 Nov;78(6):540-4.

Tokyo Metropolitan Rehabilitation Hospital, Japan.

To investigate the influence of daily activity on changes in the physical fitness of people with post-stroke (cerebrovascular disorders) hemiplegia, we evaluated the follow-up exercise load test of 30 ambulatory male patients with post-stroke hemiplegia. Between the times of the two tests, patients had no special supervised training. They were advised by their physicians to exercise according to the result of an exercise-loading test. We determined peak oxygen uptake and O2 consumption at the ventilatory threshold point. After 9.4 months, the mean peak oxygen uptake improved significantly from 17.7 to 21.1 ml/min/kg, and ventilatory threshold point also improved significantly from 11.4 to 13.6 ml/min/kg. Among the nine subjects who returned to their jobs, subjects who previously went to their offices by public transportation showed more improvement in ventilatory threshold point level than did subjects who previously walked to their offices. Among the 21 subjects who did not return to work, those who exercised regularly (primarily by walking) showed more improvement of peak oxygen uptake level than did subjects who did not exercise regularly. In conclusion, people with hemiplegia who are living in the community can improve their physical fitness without formal supervised training by simply increasing their daily activities.

The effects of high-intensity and low-intensity cycle ergometry in older adults with knee osteoarthritis.

Mangione KK, McCully K, Gloviak A, Lefebvre I, Hofmann M, Craik R.

J Gerontol A Biol Sci Med Sci. 1999 Apr;54(4):M184-90.

Department of Physical Therapy, Beaver College, Glenside, Pennsylvania 19038, USA. kline@castle.beaver.edu

BACKGROUND: People with osteoarthritis (OA) of the knee experience pain and deconditioning that lead to disability. This study challenged the clinical belief that repetitive lower extremity exercise is not indicated in persons with knee OA. The effects of high-intensity and low-intensity stationary cycling on functional status, gait, overall and acute pain, and aerobic capacity were examined. METHODS: Thirty-nine adults (71+/-6.9 years old) with complaints of knee pain and diagnosis of OA were randomized to either a high-intensity (70% heart rate reserve [HRR]) or low-intensity (40% HRR) exercise group for 10 weeks of stationary cycling. Participants cycled for 25 minutes, 3 times per week. Before and after the exercise intervention they completed the Arthritis Impact Measurement Scale 2 for overall pain assessment, underwent timed chair rise, 6-minute walk test, gait, and graded exercise treadmill tests. Acute pain was reported daily with a visual analog scale and the Western Ontario and McMaster Universities Osteoarthritis Index scale. RESULTS: Analysis of variance revealed that participants in both groups significantly improved in the timed chair rise, in the 6-minute walk test, in the range of walking speeds, in the amount of overall pain relief, and in aerobic capacity. No differences between groups were found. Daily pain reports suggested that cycling did not increase acute pain in either group. CONCLUSIONS: Cycling may be

considered as an alternative exercise modality for patients with knee OA. Low-intensity cycling was as effective as high-intensity cycling in improving function and gait, decreasing pain, and increasing aerobic capacity.

Exercise recommendations after total joint replacement: a review of the current literature and proposal of scientifically based guidelines.

Kuster MS.

Sports Med. 2002;32(7):433-45.

Department of Orthopaedic Surgery and Traumatology, Kantonsspital, St. Gallen, Switzerland. mskuster@bluewin.ch

This article presents a literature review of the current recommendations regarding sports after total joint replacement and also suggests scientifically based guidelines. Patients should be encouraged to remain physically active for general health and also for the quality of their bone. There is evidence that increased bone quality will improve prosthesis fixation and decrease the incidence of early loosening. To recommend a certain activity after total knee or hip replacement, factors such as wear, joint load, intensity and the type of prosthesis must be taken into account for each patient and sport. It has been shown that the reduction of wear is one of the main factors in improving long-term results after total joint replacement. Wear is dependent on the load, the number of steps and the material properties of total joint replacements. The most important question is, whether a specific activity is performed for exercise to obtain and maintain physical fitness or whether an activity is recreational only. To maintain physical fitness an endurance activity will be performed several times per week with high intensity. Since load will influence the amount of wear exponentially, only activities with low joint loads such as swimming, cycling or possibly power walking should be recommended. If an activity is carried out on a low intensity and therefore recreational base, activities with higher joint loads such as skiing or hiking can also be performed. It is unwise to start technically demanding activities after total joint replacement, as the joint loads and the risk for injuries are generally higher for these activities in unskilled individuals. Finally, it is important to distinguish between suitable activities following total knee and total hip replacement. To recommend suitable physical activities after total knee replacement, it is important to consider both the load and the knee flexion angle of the peak load, while for total hip replacement, which involves a ball and socket joint, the flexion angle does not play an important role. During activities such as hiking or jogging, high joint loads occur between 40 and 60 degrees of knee flexion where many knee designs are not conforming and high polyethylene inlay stress will occur. Regular jogging or hiking produces high inlay stress with the danger of delamination and polyethylene destruction for most current total knee prostheses. Based on these design differences between hip and knee replacements it is prudent to be more conservative after total knee arthroplasty than after total hip arthroplasty for activities that exhibit high joint loads in knee flexion.

Lower extremity general muscle moment patterns in healthy individuals during recumbent cycling.

Gregor SM, Perell KL, Rushatakankovit S, Miyamoto E, Muffoletto R, Gregor RJ.

Clin Biomech (Bristol, Avon). 2002 Feb;17(2):123-9.

VA Greater Los Angeles Healthcare System, West Los Angeles Healthcare Center, PM&R Gait Laboratory (117G), 11301 Wilshire Boulevard, Los Angeles, CA 90073, USA.

OBJECTIVE: The purpose of this study was to compare lower extremity generalized muscle moments across two workloads during recumbent bicycling in younger and older healthy adults. DESIGN: The study design was a comparative investigation of cycling patterns. BACKGROUND: Biomechanical data regarding muscle activation, kinematic, and kinetic patterns have been presented for upright cycling, but only a few studies have evaluated biomechanical patterns during the alternative configuration of recumbent cycling. METHODS: Twenty-four healthy adults, classified by age into two different groups, under 35 and over 50 years of age, rode a recumbent bicycle at a constant cadence (60-65 rpm) and at two different resistances (0.5 and 1.0 kg m) while kinematic and kinetic data were recorded. General muscle moments were calculated using joint kinematic and kinetic data via inverse dynamic equations. RESULTS: The ankle general muscle moment remained plantar flexor throughout the pedaling cycle; the knee general muscle moment remained flexor throughout the cycle, except during the power phase of the higher workload where an extensor general muscle moment was observed; and the hip general muscle moment was extensor with a transient flexor general muscle moment period during the recovery phase. Increased workload led to increases in ankle plantar flexor and knee extensor general muscle moment magnitudes, but no changes at the hip. Age had no effect on general muscle moment magnitudes or patterns. CONCLUSIONS: Configurational differences between the upright and recumbent bicycle do not affect patterns, but the total output requirements do affect the magnitudes of the general muscle moments. RELEVANCE: Based on previous studies, the recumbent bicycle appears to be a safe rehabilitation tool for post-cerebrovascular accident and cardiorespiratory patients, but in order to more properly and efficiently use the recumbent bicycle as a rehabilitation tool, normative biomechanical data are necessary. The current study is the first such investigation to report normative data of lower extremity general muscle moment patterns during recumbent cycling. Effects of age and workload were also demonstrated.

High-intensity cycling exercise after a stroke: a single case study.

Dawes H, Bateman A, Wade D, Scott OM.

Clin Rehabil. 2000 Dec;14(6):570-3.

Rivermead Rehabilitation Centre, Oxford, UK.Aerobic exercise training has demonstrated positive effects after brain injury. However, therapists express concern regarding the use of effortful exercise in individuals presenting with spasticity or involuntary muscle activity. This study aimed to address this concern and to evaluate whether an intervention of maximal intensity cycling exercise impaired an individual's ability to actively extend his hemiparetic elbow. Using a single case design, it was shown that active elbow extension improved during the period of this investigation, and was not impaired immediately following maximal cycling. exercise.

C. Pediatric Rehabilitation

Effect of isokinetic strength-training on functional ability and walking efficiency in adolescents with cerebral palsy.

MacPhail HE, Kramer JF.

Dev Med Child Neurol. 1995 Sep;37(9):763-75.

Department of Physical Therapy, University of Western Ontario, London, Canada.

This study investigated changes in knee extensor and flexor strength of 17 mildly involved adolescents with cerebral palsy in response to an eight-week isokinetic strength-training program. Peak torque and work were used as strength outcome measures. Subsequent changes in gross motor function and walking efficiency were evaluated. The significant strength gains of 21 to 25 per cent observed were similar in magnitude to those previously reported for able-bodied individuals. A significant number of subjects showed an increase in gross motor ability. However, walking velocity and walking efficiency were unchanged. Strength gains of 15 to 17 per cent were maintained for three months after the cessation of isokinetic training.

Cycling patterns in children with and without cerebral palsy.

Kaplan SL.

Dev Med Child Neurol. 1995 Jul;37(7):620-30.

Program in Physical Therapy-SHRP University of Medicine and Dentistry of New Jersey, Newark 07107, USA.

Pedaling smoothness and electromyography patterns were quantified in children with spastic diplegic cerebral palsy (CP) and a cohort of children with typical development. Video analysis of the pedaling rhythm yielded equivalent time periods for the control group and irregular time periods in the group with CP, with greater time spent at the bottom of the pedaling cycle. Electromyography patterns of the tibialis anterior, rectus femoris, medial hamstring and lateral gastrocnemius muscle groups yielded greater percentages of muscle activity time and co-contraction time at both the ankle and knee in the group with CP; however, the control group had longer ankle co-contraction times than were expected from previous adult studies.

Functional outcomes of strength training in spastic cerebral palsy.

Damiano DL, Abel MF.

Arch Phys Med Rehabil. 1998 Feb;79(2):119-25.

Department of Orthopedics, University of Virginia Health Sciences Center, Charlottesville, USA.

OBJECTIVE: To determine clinical effectiveness of strength training in children with spastic cerebral palsy. DESIGN: Prospective before and after trial in which subjects participated in a 6-week strength training program. All received before and after

isometric strength evaluation of eight muscle groups in both lower extremities with a hand-held dynamometer, 3-D gait analysis at free and fast speeds, administration of the Gross Motor Function Measure (GMFM), and assessment of energy expenditure during gait. SETTING: Pediatric rehabilitation center at a tertiary care hospital. PATIENTS: Eleven children met inclusion criteria for participation. Six had spastic diplegia, were limited community ambulators, and demonstrated less than 50% of normal muscle strength. Five had spastic hemiplegia and demonstrated a 20% strength asymmetry in at least two muscles across extremities. RESULTS: Each group had significant strength gains in the muscles targeted. The entire cohort had higher gait velocity primarily as a result of increased cadence, with greater capacity to walk faster. GMFM Dimension 5 also improved, with no change in energy expenditure. Asymmetry in strength improved in hemiplegia, with no change in asymmetry in support times or joint motion across extremities. CONCLUSIONS: This study reinforced the relationship of strength to motor function in cerebral palsy and further demonstrated the effectiveness of strengthening in this population.

Testing and evaluation of a hip extensor tricycle for children with cerebral palsy.

Bloswick DS, Brown D, King EM, Howell G, Gooch JR.

Disabil Rehabil. 1996 Mar;18(3):130-6.

Department of Mechanical Engineering, University of Utah, Salt Lake City 84112, USA.

The design and testing of a modified tricycle (hip extensor tricycle) designed to isolate and exercise the hip extensor muscles in children with cerebral palsy is presented. Initial laboratory tests involved stability evaluation and EMG studies of two normal children. Field evaluation involved five children diagnosed with cerebral palsy who were given hip extensor tricycles for home use during an 8-week test period. The hip extensor strength and gait pattern of the subjects were recorded at 2-week intervals. The clinical tests indicated that the hip extensor tricycle was more stable, and resulted in more hip extensor muscle activity, than the traditional therapeutic/exercise tricycle. A panel of experts judged that the gait patterns of four of the five subjects improved during the course of the study. Parent evaluations indicated that the use of the hip extensor tricycle improved the subjects' physical condition, coordination, sense of accomplishment, and self-esteem.

Outpatient exercise training in children with cystic fibrosis: physiological effects, perceived competence, and acceptability.

Gulmans VA, de Meer K, Brackel HJ, Faber JA, Berger R, Helders PJ.

Pediatr Pulmonol. 1999 Jul;28(1):39-46.

Department of Pediatric Physiotherapy, Wilhelmina Children's Hospital, University Hospital for Children and Youth, Utrecht, The Netherlands. v.gulmans@wkz.azu.nl

Exercise training is currently advocated as part of the treatment of patients with cystic fibrosis (CF). However, data are few that document physiologic benefits or changes in patients' perceptions of long-term training programs in children with CF. The aim of this study was to investigate the effects and acceptability of a home cycling program in children with CF. Fourteen patients (9 boys, 5 girls) with CF, mean (SD) age 14.1 (2.0) years, with mild to moderate impairment of lung function (forced expiratory volume in 1 s, mean (SD) 58.3 (16.3)% of predicted) were studied for 1 year. The first half of the study year was used to obtain baseline values at 0 and 6 months. During the second half of the year, a cycle program was carried out 5 times a week, for 20 min each day at a level of work that resulted in a heart rate of 140-160 beats/min. Once a week the cycle program was supervised by a physiotherapist. Measurements were repeated at 12 months. Effects of the exercise program were measured in terms of lung function, nutritional status, growth, muscle strength, exercise performance, perceived competence, and attitude towards the training program. Differences between the changes during the 6-month training period as compared to the 6-month control period were analyzed by multivariate statistics and nonparametric tests. Statistically significant differences ($P < 0.05$) between the two periods were found with respect to muscle strength of knee extensors and ankle dorsiflexors, and with respect to maximal oxygen consumption per kg body weight as well as per kg fat free mass. All changes were positive. No adverse effects were found. Perceived competence showed significant positive changes in feelings about physical appearance, general self-worth, and Total Perceived Competence Score. Scores concerning perceived acceptability of the program were significantly lower at the end of the training period; however, patients reported that they did want to continue with other sorts of training. We conclude that an exercise training program in the home can produce beneficial effects on oxygen consumption, muscle force, and perceived competence in children with CF. However, acceptability of the program was low, suggesting that long-term adherence would be poor, and hence, other sorts of training need to be identified.

Exercise training induced alterations in prepubertal children's lipid-lipoprotein profile.

Tolfrey K, Campbell IG, Batterham AM.

Med Sci Sports Exerc. 1998 Dec;30(12):1684-92.

Department of Exercise and Sport Science, Manchester Metropolitan University, Crewe + Alsager Faculty, England. k.tolfrey@mmu.ac.uk

PURPOSE: This study examined the effect of exercise training on prepubertal children's (ET, N = 28) lipid-lipoprotein profile, relative to a maturity matched control group (CON, N = 20). METHODS: Training for ET involved stationary cycling for 30 min, 3 times.wk-1 for 12 wk, at 79.3 +/- 1.2% (mean +/- SD) peak heart rate (HR). Controls maintained

their usual lifestyle pattern. Plasma concentrations of total triacylglycerol (TG), total cholesterol (TC), and high-density lipoprotein (HDL)-cholesterol (HDL-C) were determined pre- and postintervention. Low-density lipoprotein (LDL)- cholesterol (LDL-C) was subsequently estimated from these concentrations, and the ratios TC/HDL-C and LDL-C/HDL-C were also calculated. There were no pretest differences ($P > 0.05$) for any of these blood analytes between groups. The following, potentially, confounding variables were also measured: peak VO2, percent body fat (%BF), dietary composition, and habitual physical activity. These variables, with pretest HDL-C, were included as covariates in two-way split plot ANCOVA analyses. Dietary variables were not included as covariates as they were not related to any of the blood analytes. RESULTS: There were no differences over time or between groups for TG and TC ($P > 0.05$). LDL-C decreased in ET (-10.2%) but remained unchanged in CON (0.3%) over the intervention period ($P < 0.05$). HDL-C increased in ET (9.3%) but decreased in CON (-8.9%) ($P < 0.01$). A similar, but inverted, pattern of change ($P < 0.01$) was revealed for both ratios, TC/HDL-C (-11.6% vs 6.3%, ET and CON, respectively), and LDL-C/HDL-C (-17.2% vs 8.0%, ET and CON, respectively). The favorable alterations in the lipid-lipoprotein profile for ET were independent of alterations in peak VO2 (group x time interaction, $P < 0.05$), %BF (main effect time, $P < 0.01$), and habitual physical activity (group x time interaction, $P < 0.01$). CONCLUSIONS: In conclusion, the favorable alterations in the lipoprotein profile seen in this study would suggest that it is possible to influence the prepubertal lipoprotein profile independent of alterations in confounding variables such as body composition, cardiorespiratory fitness, and habitual physical activity.

New muscle power test in neuromuscular disease. Feasibility and reliability.

Tirosh E, Bar-Or O, Rosenbaum P.

Am J Dis Child. 1990 Oct;144(10):1083-7.

Hannah Khoushy Child Development Center, Haifa, Israel.

We studied the feasibility, reliability, and reproducibility of an "all-out" 30-second cycling or arm cranking test of muscle power and muscle endurance (the Wingate Anaerobic Test) in 66 girls and boys aged 5 to 18 years old who had cerebral palsy or a myopathy. The arm and leg tests, given in duplicate, were feasible in 94% and 61% of subjects, respectively. Reliability coefficients exceeded .95 in patients with spastic cerebral palsy and myopathies and were somewhat lower in those with athetotic cerebral palsy. Means and SDs were similar in both trials. We conclude that the Wingate Anaerobic Test is feasible, highly reliable, and reproducible in these patients.

Outpatient exercise training in children with cystic fibrosis: physiological effects, perceived competence, and acceptability.

Gulmans VA, de Meer K, Brackel HJ, Faber JA, Berger R, Helders PJ.

Pediatr Pulmonol. 1999 Jul;28(1):39-46.

Department of Pediatric Physiotherapy, Wilhelmina Children's Hospital, University Hospital for Children and Youth, Utrecht, The Netherlands. v.gulmans@wkz.azu.nl

Exercise training is currently advocated as part of the treatment of patients with cystic fibrosis (CF). However, data are few that document physiologic benefits or changes in patients' perceptions of long-term training programs in children with CF. The aim of this

study was to investigate the effects and acceptability of a home cycling program in children with CF. Fourteen patients (9 boys, 5 girls) with CF, mean (SD) age 14.1 (2.0) years, with mild to moderate impairment of lung function (forced expiratory volume in 1 s, mean (SD) 58.3 (16.3)% of predicted) were studied for 1 year. The first half of the study year was used to obtain baseline values at 0 and 6 months. During the second half of the year, a cycle program was carried out 5 times a week, for 20 min each day at a level of work that resulted in a heart rate of 140-160 beats/min. Once a week the cycle program was supervised by a physiotherapist. Measurements were repeated at 12 months. Effects of the exercise program were measured in terms of lung function, nutritional status, growth, muscle strength, exercise performance, perceived competence, and attitude towards the training program. Differences between the changes during the 6-month training period as compared to the 6-month control period were analyzed by multivariate statistics and nonparametric tests. Statistically significant differences ($P < 0.05$) between the two periods were found with respect to muscle strength of knee extensors and ankle dorsiflexors, and with respect to maximal oxygen consumption per kg body weight as well as per kg fat free mass. All changes were positive. No adverse effects were found. Perceived competence showed significant positive changes in feelings about physical appearance, general self-worth, and Total Perceived Competence Score. Scores concerning perceived acceptability of the program were significantly lower at the end of the training period; however, patients reported that they did want to continue with other sorts of training. We conclude that an exercise training program in the home can produce beneficial effects on oxygen consumption, muscle force, and perceived competence in children with CF. However, acceptability of the program was low, suggesting that long-term adherence would be poor, and hence, other sorts of training need to be identified.

D. Cardiac and Pulmonary Rehabilitation

Resistance versus endurance training in patients with COPD and peripheral muscle weakness.

Spruit MA, Gosselin R, Troosters T, De Paepe K, Decramer M.

Eur Respir J. 2002 Jun;19(6):1072-8.

Respiratory Rehabilitation and Respiratory Division, University Hospital Gasthuisberg, Leuven, Belgium.

The effects of endurance training on exercise capacity and health-related quality of life (HRQL) in chronic obstructive pulmonary disease (COPD) patients have been studied thoroughly, while resistance training has been rarely evaluated. This study investigated the effects of resistance training in comparison with endurance training in patients with moderate to severe COPD and peripheral muscle weakness (isometric knee extension peak torque <75% predicted). Forty-eight patients (age 64+/-8 yrs, forced expiratory volume in one second 38+/-17% pred) were randomly assigned to resistance training (RT, n=24) or endurance training (ET, n=24). The former consisted of dynamic strengthening exercises. The latter consisted of walking, cycling and arm cranking. Respiratory and peripheral muscle force, exercise capacity, and HRQL were re-evaluated in all patients who completed the 12-week rehabilitation (RT n=14, ET n=16). Statistically significant increases in knee extension peak torque (RT 20+/-21%, ET 42+/-21%), maximal knee flexion force (RT 31+/-39%, ET 28+/-37%), elbow flexion force (RT 24+/-19%, ET 33+/-25%), 6-min walking distance (6MWD) (RT 79+/-74 m, ET 95+/-57 m), maximum workload (RT 15+/-16 Watt, ET 14+/-13 Watt) and HRQL (RT 16+/-25 points, ET 16+/-15 points) were observed. No significant differences in changes in HRQL and 6MWD were seen between the two treatments. Resistance training and endurance training have similar effects on peripheral muscle force, exercise capacity and health-related quality of life in chronic obstructive pulmonary disease patients with peripheral muscle weakness.

Is severe left ventricular dysfunction a contraindication to participation in an exercise rehabilitation programme?

Digenio AG, Cantor A, Noakes TD, Cloete L, Mavunda D, Esser JD.

S Afr Med J. 1996 Sep;86(9):1106-9.

Johannesburg Cardiac Rehabilitation Centre, Department of Health and Housing, Israel.

OBJECTIVE: To evaluate the effects of an exercise training programme on patients with chronic left ventricular dysfunction. DESIGN: Intervention, before and after the trial. SETTING: Johannesburg Cardiac Rehabilitation Centre, a phase III community-based cardiac rehabilitation facility. PATIENTS: A consecutive sample of 28 patients who were recovering from acute myocardial infarction and who had a left ventricular ejection fraction of 30% or less. Twenty two patients completed the exercise training programme. INTERVENTION: A medically supervised exercise training programme of 6 months' duration. Type of exercise: walking, jogging or cycling. Intensity: 65-85% of the patient's maximal heart rate achieved during treadmill testing. Duration: 30-45 minutes. Frequency: 3 times a week. Patients who attended fewer than 60% of all prescribed

sessions were considered drop-outs. MAIN OUTCOME MEASURES: Haemodynamic, left ventricular function and effort tolerance parameters before and after training. RESULTS: Patients who completed the exercise training programme showed a significant improvement in maximal exercise capacity and a significant reduction in their cardiovascular demands during submaximal exercise. Peak oxygen consumption was increased by 12% after training (19.4 +/- 3 v. 21.8 +/- 4.8 ml/kg/min; P < 0.05) and exercise time to exhaustion by 33% (527 +/- 171 v. 700 +/- 186 seconds; P < 0.001). The double product at the same submaximal workload was significantly reduced (214 +/- 52 v. 194 +/- 44 beats/min x mmHg x 10(2); P < 0.05). These benefits were achieved without any adverse effects on resting (25.4 +/- 5 v. 28.5 +/- 7.9%; P < 0.05) or exercise (27.3 +/- 7.7 v. 29.9 +/- 9.5%; P > 0.05) left ventricular ejection fraction. CONCLUSIONS: Our results show that patients with chronic left ventricular dysfunction can benefit from an exercise training programme and that those benefits can be achieved without risk of further deterioration in left ventricular function. Physical training constitutes another therapeutic option which could be added to the comprehensive management of these patients.

Hemodynamic responses during aerobic and resistance exercise.

Karlsdottir AE, Foster C, Porcari JP, Palmer-McLean K, White-Kube R, Backes RC.

J Cardiopulm Rehabil. 2002 May-Jun;22(3):170-7.

Department of Exercise and Sport Science, University of Wisconsin-La Crosse, 54601, USA.

PURPOSE: Resistance training has become an accepted part of cardiac rehabilitation programs. Because of the potential for a high afterload to have a negative impact on left ventricular function, there has been concern regarding the safety of resistance training for patients with congestive heart failure. METHODS: This study addressed this concern by studying 12 healthy volunteers, 12 patients with stable coronary artery disease, and 12 patients with stable congestive heart failure during upright cycling at 90% of ventilatory threshold, and during one set of 10 repeated leg presses, shoulder presses, and biceps curls at 60% to 70% of 1-repetition maximum. Left ventricular function was measured by echocardiography. RESULTS: The pattern of changes in heart rate, blood pressure, left ventricular ejection fraction, wall thickness, and left ventricular internal diameters was similar across all three groups of subjects, although there were large differences in absolute values. Despite elevations in diastolic and mean arterial pressures during resistance exercise, there was no evidence of significant rest-to-exercise deterioration in left ventricular function during leg press (ejection fraction, 60%-59%, 56%-55%, and 38%-37%), shoulder press (66%-65%, 59%-53%, and 38%-35%), or biceps curls (63%-58%, 53%-54%, and 35%-36%), as compared with cycle ergometry (63%-69%, 51%-57%, and 35%-42%) in the healthy control subjects, the patients with coronary artery disease, and the patients with congestive heart failure, respectively. CONCLUSIONS: Left ventricular function remains stable during moderate-intensity resistance exercise, even in patients with congestive heart failure, suggesting that this form of exercise therapy can be used safely in rehabilitation programs.

E. Hemodialysis Patients Training

Assessing the efficacy of exercise training in patients with chronic disease.

Koufaki P, Nash PF, Mercer TH.

Med Sci Sports Exerc. 2002 Aug;34(8):1234-41.

Centre for Biophysical and Clinical Research into Human Movement, Department of Exercise and Sport Science, Manchester Metropolitan University, Alsager Campus, Hassall Road ST7 2HL, Alsager Stoke on Trent, UK. P.Koufaki@mmu.ac.uk

PURPOSE: The purpose of this study was to evaluate the meaningfulness of exercise training responses in patients with end stage renal disease (ESRD). METHODS: Eighteen ESRD patients [(mean +/- SD); 54.3 +/- 17.1 yr] completed a training regime progressing to accumulate 40 min of stationary cycling, three times per week for 6 months. .VO(2peak) determined via incremental cycle ergometer protocol, and .VO(2) kinetics determined from a transition from unloaded pedalling to an exercise intensity corresponding to 90% of VT, were assessed at baseline and at 3 and 6 months of training. RESULTS: Repeated measures analysis of variance revealed significant changes ($P < 0.05$) on the time factor for .VO(2peak), VO(2)-V(T), and .VO(2) kinetics. Post hoc analysis revealed that .VO(2peak) and .VO(2) kinetics significantly ($P < 0.05$) improved at 3 months of training with no further improvements thereafter. Analysis of individual subject response data revealed that after 3 months of training, 61% of the patients improved .VO(2peak) by greater than the standard error of measurement (SEM = 0.07 L.min(-1)). At 6 months of training, approximately 89% of the patients improved by more than the SEM .VO(2) kinetics improved by more than the SEM (12.3 s) at 3 months of training in approximately 55% of the patients, with no increase in the number of patients exhibiting faster time constants after 6 months of training. CONCLUSION: Although conventional statistical analyses indicate that exercise training favorably alters .VO(2peak) and oxygen uptake kinetics of patients with ESRD, it is apparent that considerable interindividual variability exists in the response to training. Consideration of the SEM data underscores the heterogeneity of adaptive response in this patient group and may be valuable in assessing the efficacy of therapeutic exercise rehabilitation.

Exercise during hemodialysis decreases the use of antihypertensive medications.

Miller BW, Cress CL, Johnson ME, Nichols DH, Schnitzler MA.

Am J Kidney Dis. 2002 Apr;39(4):828-33.

Renal Division, Department of Medicine, and Health Administration Program, Washington University School of Medicine, St. Louis, MO, USA. bmiller@im.wustl.edu

Most hemodialysis patients require antihypertensive therapy. Aerobic exercise has been suggested as a nonpharmacologic treatment for hypertension in many patient populations, including those with chronic renal failure. To test the effectiveness of this therapy in an outpatient long-term hemodialysis clinic, the hemodialysis staff instituted a stationary cycling program during dialysis and offered the program to all patients (n = 107). Forty patients agreed to participate, and 35 nonexercising patients served as controls. Patients performed stationary cycling during each hemodialysis treatment. Predialysis blood pressures, postdialysis blood pressures, and antihypertensive

medication use were recorded during a 6-month period. Costs of the medication were analyzed at the end of the study. Of participants, 24 (60%) completed 6 months of exercise with a mean increase in total cycling time from 16.9 min/session to 45.5 min/session. No serious adverse events were reported. Predialysis and postdialysis blood pressures were not statistically different between the two groups at month 0 or month 6, but 13 (54%) in the exercise group had a reduction in antihypertensive medication versus 4 (12.5%) in the control group (P = 0.008). The average relative benefit of exercise was a 36% reduction in antihypertensive medications (P = 0.018) with an average annual cost savings of $885/patient-year (P = 0.005) in the exercise group. Stationary cycling is safe during hemodialysis and can lead to significant reductions in blood pressure medication use and cost savings, justifying the initial capital cost of equipment and small incremental increase in staff time.

Low-functioning hemodialysis patients improve with exercise training.

Painter P, Carlson L, Carey S, Paul SM, Myll J.

Am J Kidney Dis. 2000 Sep;36(3):600-8.

Department of Physiological Nursing and the School of Nursing, University of California at San Francisco, 94143-0116,USA. painter@itsa.ucsf.edu

The Renal Exercise Demonstration Project provided two different approaches to exercise programming to a group of hemodialysis patients. Physical functioning and self-reported health-related quality of life were measured at baseline, after 2 months of independent exercise, and again after 2 months of in-center cycling. This study compares the responses to intervention of patients who initially scored low (<34) on the Physical Component Scale (PCS) on the Medical Outcomes Study Short-Form 36 questionnaire to those who initially scored higher (>34) on the same scale. The high-PCS group scored higher on all physical function tests (normal gait speed, fast gait speed, and sit-to-stand test) at each testing time than the low-PCS group. The high-PCS group improved only on the sit-to-stand test, whereas the low-PCS group improved in all three physical function tests. There were significant differences between the groups in change over time in all the physical scales and the PCS over time, with the low-PCS group showing improvements in response to the intervention and the high-PCS group showing no change over time. No differences in change over time were noted between the groups on the mental scales in either group. We conclude that low-functioning hemodialysis patients can benefit from exercise counseling in both objective measures of physical functioning and self-reported physical functioning. The impact of such interventions seems to be more profound in the lowest functioning patients.

Physical functioning and health-related quality-of-life changes with exercise training in hemodialysis patients.

Painter P, Carlson L, Carey S, Paul SM, Myll J.

Am J Kidney Dis. 2000 Mar;35(3):482-92.

University of California at San Francisco, Department of Physiological Nursing, San Francisco, CA 94143-0116, USA. painter@itsa.ucsf.edu

The Renal Exercise Demonstration Project was designed to test the effects of two different approaches to exercise programming on the levels of physical activity, physical functioning, and self-reported health status in hemodialysis patients. Two hundred eighty-six patients were recruited for participation. Intervention patients were given individually prescribed exercise for 8 weeks of independent home exercise, followed by 8 weeks of incenter cycling during dialysis. Physical performance testing was performed at baseline and after each intervention using gait speed, sit-to-stand test, and 6-minute walk. The Medical Outcomes Study Short Form 36-item (SF-36) questionnaire was used to assess self-reported health status. The intervention group showed increased participation in physical activity. There were significant differences between the intervention and nonintervention groups in change over time in normal and fast gait speed, sit-to-stand test scores, and the physical scales on the SF-36, including the physical component scale. The intervention group improved in these test results, whereas the nonintervention group either did not change or declined over the duration of the study. It is clear that improvements in physical functioning result from exercise counseling and encouragement in hemodialysis patients. Because self-reported physical functioning is highly predictive of outcomes in hemodialysis patients, more attention to patients' levels of physical activity is warranted.

F. General Rehabilitation

Electromyographic timing analysis of forward and backward cycling.

Eisner WD, Bode SD, Nyland J, Caborn DN.

Med Sci Sports Exerc. 1999 Mar;31(3):449-55.

Physical Therapy Program, College of Allied Health Professions, University of Kentucky, Lexington 40536-0284, USA.

PURPOSE: Backward walking to running progressions are becoming a popular, nontraditional component of functional knee rehabilitation programs. The purpose of this electromyographic (EMG) and motion analysis study was to compare the activation duration of the vastus medialis, vastus lateralis, rectus femoris, medial hamstrings, lateral hamstring, tibialis anterior, and gastrocnemius muscles during forward and backward cycling. We hypothesized that the hamstrings would demonstrate greater activation duration during backward cycling. METHODS: The right lower extremity of 12 healthy subjects (6 male and 6 female) was instrumented with surface EMG electrodes and retroreflective markers to confirm lower extremity kinematic consistency between conditions. RESULTS: Statistical analysis of hip, knee, and ankle kinematics (200 Hz sampling rate) and gender failed to reveal significant differences between conditions ($P > 0.05$). Quadrant analysis of muscle activation duration with Bonferroni corrections for multiple comparisons revealed that medial and lateral hamstring activation duration was greater during the early recovery phase (quadrant III) of backward cycling than forward cycling ($P < 0.00156$). Rectus femoris activation duration was greater in the early propulsive phase of backward cycling (quadrant 1) ($P < 0.00156$) and in the early recovery phase of forward cycling (quadrant III) ($P < 0.00156$). CONCLUSIONS: These findings lend support for the use of backward cycling during the early recovery phase (quadrant III) to achieve a selective hamstring muscle response of relatively decreased patellofemoral stress and anterior cruciate ligament strain.

Activation of the insular cortex during dynamic exercise in humans.

J.W. Williamson, A.C.L. Nobrega, **R. McColl**, D. Matthews, P.Winchester, L. Friberg, J.H. Mitchell.

University of Texas Southwestern Medical Center, Departments of Physical Therapy, Radiology, Neurosurgery, and the Moss Heart Center, Dallas, TX 75235, USA

1. The insular cortex has been implicated as a region of cortical cardiovascular control, yet its role during exercise remains undefined. The purpose of the present investigation was to determine whether the insular cortex was activated during volitional dynamic exercise and to evaluate further its role as a site for regulation of autonomic activity.
2. Eight subjects were studied during voluntary active cycling and passively induced cycling. Additionally, four of the subjects underwent passive movement combined with electrical stimulation of the legs.
3. Increases in regional cerebral blood flow (rCBF) distribution were determined for each individual using single-photon emission-computed tomography (SPECT) co-registered with magnetic resonance (MR) images to define exact anatomical sites of cerebral activation during each condition.

4. The rCBF significantly increased in the left insula during active, but not passive cycling. There were no significant changes in rCBF for the right insula. Also, the magnitude of rCBF increase for leg primary motor areas was significantly greater for both active cycling and passive cycling combined with electrical stimulation compared with passive cycling alone.
5. These findings provide the first evidence of insular activation during dynamic exercises in humans, suggesting that the left insular cortex may serve as a site for cortical regulation of cardiac autonomic (parasympathetic) activity. Additionally, findings during passive cycling with electrical stimulation support the role of leg muscle afferent input towards the full activation of leg motor areas.

[*Journal of Physiology* (1997), **503.2**, *pp.* 277-283.]

Can brain-injured patients participate in an aerobic exercise programme during early inpatient rehabilitation?

Jackson D, Turner-Stokes L, Culpan J, Bateman A, Scott O, Powell J, Greenwood R.

Clin Rehabil. 2001 Oct;15(5):535-44.

Regional Rehabilitation Unit, Northwick Park Hospital, Harrow, Middlesex, UK. dmj1@soton.ac.uk

OBJECTIVE: We investigated the capacity of brain-injured patients to participate in an aerobic exercise programme early after injury. DESIGN: Retrospective analysis of exercise achievements in patients participating in a randomized controlled trial. SETTING AND SUBJECTS: Ninety patients participated in an exercise training programme on a cycle ergometer at four inpatient neurological rehabilitation units for younger patients. At intake, impairments and function were rated on: Motricity Index, Ashworth Scale, Berg Balance Scale, Barthel Index and Functional Independence Measure. INTERVENTIONS: Patients cycled for up to 30 minutes three times weekly for 24-36 sessions over 12 weeks. MAIN OUTCOME MEASURES: Exercise performance was measured by: (a) number of sessions to achieve a cycling time of 30 minutes, (b) overall mean cycling time per session over 24 sessions and (c) mean time per session cycling at >60% of age predicted maximum heart rate (HR max) over 24 sessions. RESULTS: Fifty-five patients completed 24 sessions. Thirty-five withdrew, largely for logistic reasons, before completing training; they were significantly less disabled than the 55 who remained. Forty-four of the 55 patients trained for an average of at least 20 minutes per session, 18 training at >60% HR max for this time. There were no differences in performance on the three exercise parameters between two groups of patients with baseline Barthel scores of < or = 12 and > or = 13. CONCLUSIONS: Brain-injured patients with a range of disabilities have the capacity to participate in an exercise programme during early inpatient rehabilitation, though some may take longer to achieve adequate intensity of aerobic exercise.

3. Clinical Studies

A. The Tricycle as a mobility Tool for the child with Brain Damage

Levitus C.,(physiotherapy)
Dar M., Keren Y (physiotherapy)

ALYN - Children Rehabilitation Medical Center, Jerusalem Israel.

Introduction - Presentation of the Topic:

Mobility is one of the most basic and vital human function. The purpose of adjusting a mobility tool to a handicapped person is to allow the person to achieve maximum functional efficiency (1). The ability to function with the proposed apparatus depends on the physiological, motoric and cognitive attributes and reserves of the handicapped person, on the one hand, and on the physical and social conditions of his environment on the other hand (2).

The tricycle is a mobility tool with which children are familiar and which they love. The possibility to provide handicapped child with a mobility tool, which at the same time serves him as a game and fits his surroundings, removes a great emotional impediment to the child's use of such an aid.

Clinical observations have shown that children, who use aids such as a walker or wheelchair to get around, move more rapidly and with greater energetic efficiency on a tricycle than with their personal mobility tool. We also observed children who were absolutely immobilized when using ordinary means but rode independently over great distances on a tricycle. The literature does not contain much information regarding the use of the tricycle as a therapy and mobility tool for children. One of the few studies published, which examined the efficacy of exercising with a tricycle for strengthening the extensors of children with cerebral palsy, describes the children's obvious enjoyment of tricycle riding (3).

Object of the Study: To examine the possibility of using the tricycle as an effective mobility tool for the mobility-challenged child.
Specific aims:

1. To measure the energetic efficiency of a tricycle adjusted to a handicapped child, against his personal mobility tool.
2. To evaluate the functional benefit from using the tricycle as a mobility tool for children: distance and speed of mobility with the tricycle as compared to the child's personal mobility tool.
3. To determine the degree of functional independence conferred by the mobility tool (tricycle versus personal mobility tool)

Contribution to ALYN:
An objective examination of a new approach to mobility therapy and adjustment in handicapped children. The mobility adjustments can be made at the ALYN laboratory.

Population and Methods:

Population:

Fourteen children suffering from central brain damage, cerebral palsy and severe post-traumatic brain injury, including children with dystonic, ataxic and spastic symptoms and slight to severe forms of hemiplegia and quadriplegia.
The study will include children who use an aid to get around (aid: wheelchair, walker, crutches).

Work and Evaluation Methods:

The adjustment of a tricycle to a child will be done by means of a system consisting of two parts:

The first - a fixed seat elevated about a meter above the ground.
The second - the APT (Active Passive Trainer) wheel of Kibbutz Tzora.
The wheel will be installed on a frame enabling the entire apparatus to move up, down, forwards and backwards (relative to the seat). Various pedal lengths and thigh supports can be adjusted to the wheel.

Adjustment method: Each child will try out three initial basic positions: straightened hip extensor (0°), bent hip extensor (90°) and intermediate position (45°).
In each position the child will try out different rotation axes: minimal knee movement, intermediate state, and maximal knee movement.
The order of the tests will be set at random for each child between and during positions.
Each position will be given a pedaling adjustment period of 30 minutes, after which the child will pedal for another 30 minutes.

Criterion for determining the optimal wheel: Heart rate/number of rotations per unit time (minimum ratio). Based on the "prescription" obtained, a tricycle will be adjusted to the child.

Word method: On the day of adjustment of the tricycle, the child will undergo, in addition, a short training session in which he will be taught how to mount and dismount from the tricycle and practice moving by means of the tricycle along the hospital's corridors.

Each child will undergo a series of evaluations (described below) with his personal mobility tool and with the adjusted tricycle. The evaluation procedure in respect of each mobility tool will be performed on separate days. The time of the procedure during the day and the order of the evaluations will remain the same.

Evaluation methods:

1. Measurement of the heart rate at rest and in action by means of a polar pulse, for calculating the energy consumption index (according to the difference between the pulse in action and at rest dividing by the speed of mobility comfortable speed for the child and maximum speed, see par. 2)
2. Speed mobility: Mobility at a comfortable speed, and mobility at a high speed along a course of 12m. The middle 10m. will constitute the distance for measurements of the child's speed of mobility using the tricycle and his mobility

tool.

3. Distance of mobility: along the hospital corridor. The child will be asked to move until he feels tired (grade 13 on BORG scale - somewhat difficult).
4. Functioning around the mobility tool. Specific function:
   Accessing the mobility tool from a chair' and vice versa.
   Accessing the WC: entry, transit, exit.
   Accessing of dining table: functioning in a table environment.
   The performance will be graded according to the FIM categoric scale.

Bibliography:

1. Assisted technologies. Cook and Hussey. Mosby. 1995.
2. Warren CG: Powered mobility and its implication. J. Rehab Res Devel: 74-95, 1990.
3. Evaluation of the hip extensor tricycle in improving gait in children with cerebral palsy. King et al. Dev Med and Child Neur. 1993:35:1048-1054.

B. Exercise with the Active Passive Trainer

A Professional Background
by Panturin E. RPT. MEd.

Lecturer - Faculty of Physiotherapy, Sackler Scool of Medicine, Tel Aviv University, Israel.
Senior Instructor IBITA - International Bobath Instructor Association.

A model describing the disabling process has recently been published, as a modification of the World Health Organization's International classification of impairment, disability and handicap (1980).

This model was produced jointly by the National Center for Medical Rehabilitation and National Institutes of Health in 1993, and offers 5 dimensions of the disabling process, pathophysiology, impairments, functional limitations, disabilities and societal limitations.

1. **Pathophysiology:** Underling medical or injury processes at cellular and tissue levels.
2. **Impairment:** Organic and systemic disorders which may potentially impair function of the organism or person. Impairment may not be recognized at the site of lesion, but result from it. It must be remembered that impairments can lead to further (secondary) impairments.
3. **Functional limitations:** A combination of impairments in one or more systems may lead to functional limitations. They involve whole body function.
4. **Disabilities:** Failure to fulfill normal life roles and quality of life.
5. **Societal limitations:** Referred to as "handicap" by the WHO - resulting when societal barriers prevent the individual from functioning at the highest level he or she is capable of achieving.

The daily functions of man demand movement. Control of movement demands co-operation between the nervous, muscular, connective tissue and skeletal systems. For normal function, besides control of the nervous system, a person needs muscle power and endurance, full range of movement of the joints, muscles, ligaments, connective tissue and the nervous system.

Moving synovial joints prevents biomechanical and histological changes in the soft tissues around the joint, and decreases elasticity of the capsule and ligaments (Akeson et al 1980). This allows free movement and, in other words, can decrease impairments and delay or avoid secondary impairments.

A muscle kept in a shortened position for a long period shows:

a) Changes in its composition - loss tissue protein (William & Goldspink 1978) loss of sarcomere (component of muscle fiber) and increased amounts of connective tissue;
b) Increased passive-elastic stiffness (William & Goldspink 1978, 1984), causing remodeling of connective tissue to match the new, shortened muscle length. This restriction of movement (Light et al 1984) causes impairment which, if prevented, would not lead to secondary impairment.

Muscle contraction causes normal tension on bone to which it is connected, affecting bone density (Bassett 1977) and preventing osteoporosis. Osteoporosis often appears following long periods f immobility. In order to develop muscle strength, it is necessary to exercise enables tired muscle to revive and, together with improved muscle strength, endurance increases.

Connective tissues and skin. Non-mobile connective tissue has a tendency to shorten (Kisner & Colby 1987), as does the skin, e.g. scar tissue following burns or other tissue damage (trauma or surgery). This also may lead to contractures - in other words - impairment.

The nervous system: The entire nervous system is a continuous tissue tract. It forms an (Butler 1991), which means that a restriction appearing in one part of the body may cause limitation in another part of the body. Movement also influences the interaction between the nervous system and other tissues in the body. Nerve cell send messages to target tissues in various ways (electrical and chemically). One method of transport is via the axopalsm (the substance within the axon) from the nerve cell to target tissue. These messages are responsible, amongst other things, for the well being of the target tissue. The target tissue itself also sends messages to the nerve cell' via the axoplasm, regarding its condition. The axoplasm is a viscous substance, which, amongst other characteristics, can change its viscosity - is lower when the nerve is moving, enabling the messages to transfer normally. If man does not move the viscosity of the axoplasm increases and the speed of transport is greatly reduced, slowing down the messages sent in both directions, and ultimately causing trophic changes in the target tissue.

There are various factors influencing balance, which are very important to consider in order to prevent falls (especially in the frail person). Besides the sensory systems (vestibular, visual, somato-sensory), many other systems affect balance e.g. the effects of range of movement of joints and soft tissues and muscle strength (Shumway-Cook 1994).

General Physical Fitness: To develop or improve general physical fitness (cardio-vascular system) it is necessary to activate large groups of muscles for between 15-45 minutes or more (Fox & Mattews 1987, Kisner & Colby 1987). Thus it can be concluded that, fulfilling functional demands requires passive and active elements. Passive movement (at varying speeds) should be available, while maintaining safety of moving joints. Active movement should be graded and use different muscle groups. To attain this, a suitable mechanical device may be used.

Many people over the age of 65 display symptomatic, degenerative changes in different joints. For example - osteoarthritic changes in the knee cause pain, reduction in movement and function leading to contractures and muscle wasting (secondary impairment) (Coni et al 1988).

Increasing age (often accompanied by less active life style) causes loss of nerve cells, loss of muscle mass, muscle wasting, and reduction of elasticity of lung tissue (which in turn causes reduction of lung capacity and function). In other words, there is impairment, which, if not attended to, will develop into secondary impairment.

In conclusion, it may be said that, appropriate exercise in mobility, strength and endurance may help to improve, or maintain the functional ability of the older or frail person or people with various pathologies.

Bibliography

Akeson WH, Amiel D, Woo S. "Immobility Effect of Synovial Joints, The Pathomechanics of Joint Contractures" Biorheology, Vol: 17, 95-110, 1980.
Bassett CWIB. "Effects of Force on Skeletal Tissue". In Downey JA, Darling RC Physiological Basis of Rehabilitation Medicine W.B. Saunders, Phila., 1971.
Butler DS. Mobilisation of the Nervous System. Churchill Livingstone 1991.
Coni C. Davision W, Webster S. Lecture Notes on Geriatrics. Blackwell Scientific Pub.'88.
Fox E, Matthews D. The Physiological Basis of Physical Education and Athletics, 3rd Edtion., Saunders College Publ., Phila., 1987.
Kisner C, Colby IA. Therapeutic Exercise. F.A. Davis Co., Phila., 6th Print 1987.
Light KE, Nuzik S, Personius W., Barstrom A. "Low Loading Prolonged Stretch Versus High Load Brief Stretch in Treating Knee Contractures" Phys. Ther, Vol. 64 March 1984.
Shumway-Cook A. "Vestibular Rehabilitation in Traumatic Brain Injury" In: Herdman SJ Vestibular Rehabilitation. F.A. Davis &Co., Phila., 1994.
Williams PE. Goldspink G. "Changes in Sarcomere Length and Physiological Properties in Immobilized Muscle." Journal of Anatomy. London 138: 342-350, 1984.

C. Effects of exercising with an Active Passive Trainer on the rate of mobility of frail elderly residents of retirement homes

Botnero T., Cohen I.

Department of Physiotherapy graduate program, The Sackler school of medicine
Tel Aviv University.

September 1995

Abstract

With advancing age a slowing down in performance is seemingly unavoidable. But it is generally accepted today that physical activity will in all likelihood delay the rate of aging and thus improve the quality of life.

In this study we have checked the benefits gained by exercising against resistance with the APT, in order to improve the walking speed of frail residents in retirement homes.

Twenty-six such residents between the ages of seventy-six and ninety-three were examined. Their walking speed and their pulse rates were measured prior to a program of exercise consisting of twelve 10-15 minute lessons, and at its conclusion. Results showed and average improvement of 29% in the number of passive patients.

At the start of the program and at its conclusion a subjective evaluation was made in order to assess the degree of the patient's independence in daily tasks. The categories ranged from independence to total dependence. An increase of 127% in the number of independent patients was shown as well as a reduction of 29% in the number of passive patients.

We may conclude that exercise on the APT improves the mobility rate and therefore the degree of self-sufficiency in the performance of daily tasks.

Introduction

The ever-expanding geriatric population of the world calls for greater attention to the health requirements of the elderly. Older people must be made aware of the fact that increased life span and an enhanced quality of life are dependent on constant activity of both body and mind. It is undoubtedly easier to prevent disease than to treat it, and likewise indisputably cheaper. Therefore sustaining the ability of the elderly to function unaided is and issue of fundamental importance to public health.

Professionals trained in the treatment of the geriatric population are well aware of the direct relation between the mobility of the elderly and their general sense of well-being. Speed of walking is a reliable indicator of self-sufficiency and thus it may be assumed that exercise designed to improve walking and particularly its rate, will serve as a boost in functional performance.

The aim of this study was therefore to examine the improvement in walking speed after

exercising on the active passive trainer (APT). Further objectives were to check the effects of APT exercising on:
1. The pulse rate at rest and after exertion; and
2. The level of daily performance.

Methods Used

Survey Location and Population

This study was done at the physical health institute of the Mish'an Retirement Home in Ramat Efal, during the months of January through May 1995.

Twenty-six elderly patients (three men and twenty-three women) ranging in age from 76 to 93, who had agreed to participate in the study, were examined. Six of them dropped out of various reasons.

All participants in the study suffered from difficulties in walking: 12 walked with the aid of a walker, five used a single cane, one used two canes, and two walked without any walking aids.

Data Collection

The study was carried out in three stages:
a. A pre-test examination and collection of background data;
b. 12 twice-weekly exercise sessions on the APT device;
c. Post-test examination.

Identical checks performed before and after the exercise sessions.

Variables measured were:

a. Speed of walking;
b. Pulse rate at rest;
c. Pulse rate immediately after walking;
d. The patient's subjective appraisal of his own performance ability.

Results of Walking Speed and Pulse Rate

The results of measurements carried out on all patients before and after the study period.

Patient	Age	Walking Aid	Walking		Speed	Pulse rate		Pulse rate	
			Before	After	%	Before	After	Before	After
1	84	Walker	101	84	20	70	70	78	78
2	89	Walker	53	47	12	84	84	94	90
3	85	Walker	17	12	42	80	80	96	88
4	82	Walker	25	15	67	84	80	96	82
5	80	Walker	13	11	18	68	60	80	62
6	85	Walker	38	21	81	72	72	74	76
7	93	Walker	18	11	64	76	74	90	78
8	84	Walker	48	32	50	80	80	96	88
9	80	Walker	59	43	37	84	82	90	90
10	90	Walker	43	34	26	82	82	96	88
11	82	Walker	52	38	37	78	78	88	84
12	87	Walker	49	35	40	80	80	92	88
13	83	One cane	10	8	25	90	88	94	90
14	86	One cane	7	6	17	68	68	72	70
15	86	One cane	12	9	33	70	70	90	76
16	73	One cane	31	18	72	84	84	98	90
17	78	One cane	38	29	31	78	78	86	86
18	87	Two canes	29	9	222	66	60	70	66
19	85	No aid	12	10	20	83	80	94	88
20	76	No aid	13	11	18	72	74	80	80
Average	**84**		**34**	**24**	**42**	**77**	**76**	**88**	**81**

Effects of Exercise on the Walking speed:
The average walking time was reduced from 33.57 seconds before the exercise program to 24.14 seconds after the program, representing a 42% increase in the average walking speed.

Effects of Exercise on Resting Pulse Rate:
No change occurred in the resting pulse rate.

Effects of Exercise on the Pulse Rate after exertion:
The pulse examination immediately after walking the track showed that the average had decreased from 87.7 to 81.3 three quarter to the 20 patients that participated in the exercise program had a lower pulse rate after exertion.

Review of subjective estimate of daily function

Mobility

	Before Exercise Program				After Exercise Program			
Level of performance*	**1**	**2**	**3**	**4**	**1**	**2**	**3**	**4**
Getting out of bed	-	4	6	10	-	-	2	18
Getting out of chair		4	7	9	-	-	1	19
Walking	-	2	7	11	-	-	1	19
Climbing stairs	12	1	6	-	-	1	3	16
Climb an incline	2	3	10	4	-	1	3	16
Leaving the ward	10	4	6	1	8	2	1	9
Total Number	**25**	**18**	**42**	**35**	**8**	**4**	**11**	**97**

Daily Activities

	Before Exercise Program				After Exercise Program			
Level of performance*	**1**	**2**	**3**	**4**	**1**	**2**	**3**	**4**
Putting on socks	1	4	8	7	1	1	5	13
Putting on shoes	1	2	7	10	-	-	2	18
Total Number	**2**	**6**	**15**	**17**	**1**	**1**	**7**	**31**

*Level of performance
1-dependent
2-partially dependent
3-partially independent
4-independent

Discussion and Conclusions

Aging is an integral part of life reached only by the lucky few. Studies dealing with the issue of old age show that physical activity by the elderly is the safest and most effective way to "age gracefully".

In this study we have shown that a program of exercise on the APT (exercise against resistance) considerably improves the walking rate in the elderly and frail. Furthermore there is an improvement in level of independence when performing daily activities.

D. Experience with Active Passive Trainer (APT)

Hiroshima University Medical Department,
Health Science Kotaro Kawaguchi, Japan.

May, 1996

Key Words

APT upper extremity ergometer VO2-Kgm correction

Introduction

For the exercise therapies of patients with some kind of disability of the lower extremities, the upper extremity ergometer are often used.
Recently much research has been conducted for the exercise physiology with the upper extremity ergometers and this research is producing inconsistent results for the upper and lower extremity exercises.

Many of the upper extremity ergometers are quite expensive and require special skill to operate.

For this research we got the chance to use the upper extremity ergometer, which is light weight, easy to operate and affordable. With this ergometer, we measured VO2 changes against the various loads and also measured the same with the bicycle ergometer.

Explanation of APT

APT (Active Passive Trainer, manufactured by Tzora Health Care Products) is compact and light weight (about 10 kgs) and quite portable. It can set the load with the combination of the number of the handle rotation (r.p.m) and the load levels. Five load levels are available.

The load setting procedure is easy, just pushing the buttons. By changing the handles to foot pedals, the exercise for the lower extremities can also be done, with the electric motor, the arms on the machine move automatically which allows the passive exercise to be done.

Research Method

Ten (10) healthy males, ages 24.4 +- 3.7 and the weights 67.2 +- 7.3 kgs, without cardiopulmonary disorder, participated in this research.

First, VO2 were measured with the bicycle ergometer. The load was set with 25w, 50w, 75w, 100w and 150w. with each load 2 minutes exercise was done. In between each exercise, 3 minutes.

Second, VO2 were measured with APT. the participants set on the chair and the height of the arms was adjusted to the level of the shoulder. The participants gripped the arm

handles with their arms almost straightly extended. The load was 6w, 12w, 24w, 72w, and 144 w.

2 minutes exercise was done for each load and after each exercise, 3 minutes rest was taken.

The result was presented on the graphs.

To get VO2 values, the aero monitor, AE280S from Minato Inc. was used. The average VO2 for the last 30 seconds of each 2 minutes exercise was designated as VO2 value for the respective exercise with the various loads.

Results and conclusions

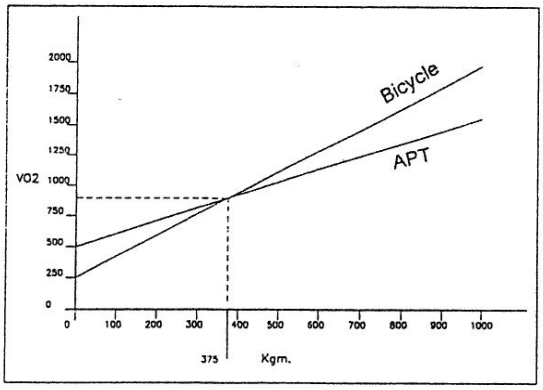
1. Peak VO2

Bicycle ergometer	1,830	97.5 ml/m
APT	1,482.5	179.6 ml/m

$p<0.05$

2. VO2/load

See the graphic presentation below.



APTJAP.DOC

With regard to the VO2 comparison between one with the upper extremity ergometer and one with the lower extremity ergometer, ACSM reports that VO2 with the lower extremity ergometer will be about 1.5 times larger than VO2 with the upper extremity ergometer. Because the upper extremity ergometer requires the involvement of more muscle groups due to the fix of the upper body.

However, in Japan, there are many opposing researched – larger VO2 with the lower extremity ergometer, comparing the peak VO2, AT and Vt.

Our research resuted in the larger peak VO2 with the bicycle ergometer than one with APT. however, as you can see from the graph, up to 375 kgm (62.5W), vo2 values were larger with APT and from that 375 kgm point on, vo2 values were larger with the bicycle ergometer.
By continuing to take vo2 data with various patients, we would like to re-evaluate this graphic result.

APT, which we used for this research, is the excellent upper extremity ergometer for

training, setting the load with the combination of 5 different load levels and the various r.p.m . The correlation between vo2 and the load was 0, 912 (r=0.912) with our research result and showed very high correlation.

We believe that the APT can be used as the evaluation equipment with the reference to the graphic presentation for vo2 data. So, we would like to prepare the similar vo2 data for female and elderly people.

E. Project for the Development of Programs for Sheltered Welfare Patients

The "Ruhama" Hostel, Kfar Sabah,

The Department for the Treatment of the Mentally Disabled
Ministry of Labor and Welfare

Developing programs for sheltered patients

This project is financed by the fund for the disability allowances of the Ministry of Labor and Welfare, under the supervision of the department for the diagnosis and advancement, headed by Dr. Haya Aminadav. The team conducting the project consists of Dr. Haya Aminadav, Ms. Zehava Dashdus (National Inspector of Nutrition), and Dr. Yoav Metrik, chief physician in the department for treatment of the mentally disabled

The project team:
Sarah Eshed – Music therapist
Sharon Tishler – Occupational therapist
Freda Kornbrot – Communications clinician
Carmit kahana – Physical therapist

The Ruhama Hostel in Kfar Saba

The hostel, established in 1940, was the first of its kind in Israel. 191 sheltered welfare inmates reside there today, with full board and lodging. The hostel is in the process of building and renewal, which will provide a wide range of facilities including living quarters and remedial treatment units.

The Project Population

20 patients aged 21-50, the majority of whom are confined to adapted wheelchairs, live in the "Lemon" nursing unit. Most are severly retarded and have a low level of performance. None of the patients are independently mobile and all require constant care and aid in their daily activities.

Project Aims:

- Diagnosis and determination of the performance potential of the "Lemon" nursing unit patients.
- Assistance to mentally retarded patients in developing their potential capabilities and mobility skills.
- Introduction of remedial care into the daily life of the patients.
- Improvement of their quality of life.
- Enrichment of their daily routine

- Multi-proffesional teamwork in conjuction with the unit caregivers.

- Location and introduction of advanced facilities and equipment for daily use in the unit.

Advantages in Use of the APT Device:

- Two-directional passive activation, adapted to the particular difficulties of the patient.
- Independent activation, as required by the therapy program and the daily routine of the patient.
- Adjustment of accessories, and individual support to each patient. Gradual withdrawal of support as the patient progresses and gains self-confidence in his actions.
- Raising and/or adjusting the speed of operation as required by the therapy.
- Functional improvement according to the personal program of each patient.
- Increased interest and performance in the daily activities of the patient.

Plan for APT Activation in the House

- Comprehensive diagnosis of the exact range of movement of each patient.
- Patient and staff familiarity with the device.
- Appropriate program of treatment for each patient.
- Convenient placing of device.
- Program for daily routine and regular remedial care.

Problems in operating the APT in the "Lemon" house:

- Helping patients to become familiar with the device took far longer than anticipated.
- Physical difficulties with lower limb use on patients confined to customized wheelchairs.
- The poor conditions of the "lemon" house.

Interim conclusions

Of the 20 patients in the house:

- Three did not commence treatment at all – two lay prone in wheelchairs, and reacted pathologically.

- Three train completely independently with the device.

- Three train with the device, alternating from side to side.

- Four train on both sides, but require constant support and accompaniment.
- Five require only minimal supervision and support.
- Three are treated lying down as well as sitting up.

F. Tracking the use of APT. Active / Passive Exercise machine

Sample group of army disabled

Smolinski Z., Biomedical Engineer

April 1994.

Introduction

The **APT. Active / Passive Exercise Machine** is intended to activate the hands and feet. APT. is made so that it can be used in an active manner (that it, the user trains his muscles against a defined force, like the operation of fitness machines), or in a passive manner (that is, the electronic system of the machine activates the user's hands and feet in a manner whose speed and range of motion are controlled). In addition, the machine may be operated in a combined manner – active/passive – in which the user uses the electronic system while activating his muscles. The APT may be used while either sitting or lying down.

The active/passive exercise machine was given to a group or 10 severely handicapped army disabled, who have functional problems in their hands and feet, resulting from damage to one of the vertebrae in the spine, or from injury to the head.
Table 1 gives the details of the sample group. The machine was given to each disabled personally, after having received detailed instructions regarding its use. The machine was given for a period of three months. It was decided that during this time, the use each group member made of the machine would be tracked. The tracking was conducted via periodic telephone conversations, and listening to the subjective opinion of each user. In the telephone interviews, each user was asked to supply information regarding several topics:

- Duration of use in each exercise session
- Frequency of use
- Methods of use – active, passive or combined
- Levels of difficulty chosen by the user
- Physiological changes if there are any
- Critical comments
- General opinion

The aims of the tracking were:

- To locate mechanical problems and provide immediate answers to them
- To teach various means of using the machine
- To identify special needs
- To consolidate recommendations for continued development

The Sample Group

The sample group included 10 disabled with a high level of disability, who were selected randomly by the rehabilitation division of the ministry of defense.
Below are the group's details:

Table 1: The Sample Group

User's code	Yr. of birth	Injury type	Injury year	Date Machine Received	Comments
1	1953	Head	1973	8.2.94	Partial paralysis
2	1961	Back, C6	1984	31.1.94	Partial paralysis, spasm
3	1953	Head	1980	31.1.94	Partial paralysis
4	1933	Back, C6	1954	1.2.94	Partial paralysis, spasm
5	1952	Back, D2-3	1972	31.1.94	Spasm
6	1973	Back, C5	1992	26.1.94	Partial paralysis, strong spasm
7	1960	Back, C5-6	1980	31.1.94	Spasm
8	1940	Back, L2	1960	26.1.94	Partial paralysis
9	1938	Back, L1	1962	11.2.94	Partial paralysis
10	1969	Back, C6-7	1991	15.2.94	Weak spasm

Characteristics of use

Table 2 shows the usage characteristics of each of the participants in the sample group. The table presents the user's code, the time of usage in each session, the frequency of use, separately for hands and feet. The meaning of the term "active" is that the user operates the machine using only his muscles. The meaning of the term "passive" is that the motor of the machine moves the user's hands or feet. The meaning of the term "combined" is that the user operates the machine using both the strength of his muscles and the motor of the machine.

User's code	Hands			Feet		
	Time	Frequency	Character	Time	Frequency	Character
1				15-20 mins	Everyday	Passive level 5
2	25 mins	2-3 times a week	Active level 2			
3				5 mins	Twice a week	Active and passive level 1-5
4	10 mins	Twice a day	Active level 4	30 mins	Twice a day	Passive levels 2-4
5	10 mins	Almost every day	Active level 4	10 mins	Almost everyday	Passive level 4
6	15-30 mins	Everyday	Active level 1-2	30 mins	1-2 times a week	Passive level 5
7	20 mins	1-2 times a day	Active level 3-5	20 mins	1-2 times a day	Passive level 5
8	10-15 mins	1-3 times a week	Active level 5	10-15 mins	1-2 times a week	Combined level 5
9				10-20 mins	3 times a week	Combined level 5
10	20 mins	Everyday	Active level combined level 3			

Subjective evaluation

In this section, we will present some of the user's comments, as expressed by them during the telephone interview. The comments include the subjective opinion by the sample group members of the operation of the exercise machine, as well as suggestions for improvement. It must be noted that each of the group members expressed much satisfaction with the machine and its operation, and all them would like to have the machine remain at their disposal. The name of each speaker is not noted in this report, but exists on the interview sheets.

Positive comments:

"The machine is excellent".
"It relaxes the legs in a fantastic way"
"Overall greatly enjoying the product. The previous machine was primitive and this is at another level".
"Very comfortable to use".
"Very good for the blood flow to the legs".
"Simply wonderful".
"During a spasm, the machine stops working and changes direction and that relaxes the spasm".
"Satisfied with the machine".
"The frequency of use went up with time, from three times a week to everyday, and from 5 minutes of use to 10 minutes each time".
"Relaxes the shoulders well"

"The spasm relaxes after use"
"Feel better in the whole body"
"Great for the hands"
"The machine is light and can be moved from place to place"

Critical comments:

"Its good that the machine is light and portable, but it is not sufficiently attached to the ground"
"I want a head switch"
"Use it for the hands only because of inconvenience in lifting and lowering the machine"
"Even though the machine is relatively light, it is heavy for a woman. Would very much like a mechanism that would allow raising and lowering the machine for use with hands and feet"
"During use on the bed, the machine slides"
"The straps don't connect the machine well enough to the cart, and it slides".

G. Prescribing physical activity for older patients.

Kligman EW, Pepin E.

Geriatrics. 1992 Aug;47(8):33-4, 37-44, 47.

Department of Family and Community Medicine, Arizona Center on Aging, University of Arizona College of Medicine, Tucson.

Regular exercise is an effective nonpharmacologic therapy for stress, sleep disorders, depression, and anxiety, as well as such chronic conditions of aging as hypertension, obesity, diabetes mellitus, coronary artery disease, hyperlipidemia, and constipation. Pre-exercise office assessment of cardiac risk, possible limitations, and contraindications is advised. A balanced fitness training program includes activities to increase flexibility, strength, and cardiovascular endurance. The most effective exercise prescription begins with a type of aerobic activity the patient enjoys. A prescribed schedule of stepwise increments in frequency, duration, and intensity gradually leads to a maintenance level of fitness.

Publication Types:

Gait variability and fall risk in community-living older adults: a 1-year prospective study.

Hausdorff JM, Rios DA, Edelberg HK.

Arch Phys Med Rehabil. 2001 Aug;82(8):1050-6.

Gerontology Division, Beth Israel Deaconess Medical Center and Division on Aging, Harvard Medical School, Boston, MA 02215, USA. jhausdor@caregroup.harvard.edu

OBJECTIVE: To test the hypothesis that increased gait variability predicts falls among community-living older adults attending an outpatient clinic. DESIGN: Prospective, cohort study. SETTING: Three outpatient geriatric clinics. PARTICIPANTS: Fifty-two community-living, ambulatory men and women aged > or = 70 years. INTERVENTIONS: Not applicable. MAIN OUTCOME MEASURES: Subjects walked at a normal pace for up to 6 minutes wearing force-sensitive insoles that measured the gait rhythm on a stride-to-stride basis. Afterward, subjects reported fall status on a weekly basis for 1 year. The primary outcomes were the association between measures of the stride-to-stride fluctuations in gait rhythm and (1) subsequent falls during a 12-month follow-up period and (2) potential contributing factors. RESULTS: Almost 40% of the subjects reported falling during the 12-month follow-up period. Stride time variability was 106 +/- 30 ms in subjects who subsequently fell (n = 20) and 49 +/- 4 ms in those who did not experience a fall (n = 32) during the 12-month follow-up period ($p < .04$). Logistic regression also showed that stride time variability predicted falls ($p < .05$). Stride time variability correlated significantly with multiple factors including strength, balance, gait speed, functional status, and even mental health, but these other measures did not discriminate future fallers from nonfallers. CONCLUSIONS: These findings show both the feasibility of obtaining stride-to-stride measures of gait timing in the ambulatory setting and the potential use of gait variability measures in augmenting the prospective evaluation of fall risk in community-living older adults.

MeSH Terms:

The effect of strength and endurance training on gait, balance, fall risk, and health services use in community-living older adults.

Buchner DM, Cress ME, de Lateur BJ, Esselman PC, Margherita AJ, Price R, Wagner EH.

J Gerontol A Biol Sci Med Sci. 1997 Jul;52(4):M218-24.

Department of Health Services, University of Washington, Seattle, USA. buchner@u.washington.edu

BACKGROUND: The study tested the effect of strength and endurance training on gait, balance, physical health status, fall risk, and health services use in older adults. METHODS: The study was a single-blinded, randomized controlled trial with intention-to-treat analysis. Adults (n = 105) age 68-85 with at least mild deficits in strength and balance were selected from a random sample of enrollees in a health maintenance organization. The intervention was supervised exercise (1-h sessions, three per week, for 24-26 weeks), followed by self-supervised exercise. Exercise groups included strength training using weight machines (n = 25), endurance training using bicycles (n = 25), and strength and endurance training (n = 25). Study outcomes included gait tests, balance tests, physical health status measures, self-reported falls (up to 25 months of follow-up), and inpatient and outpatient use and costs. RESULTS: There were no effects of exercise on gait, balance, or physical health status. Exercise had a protective effect on risk of falling (relative hazard = .53, 95% CI = .30-.91). Between 7 and 18 months after randomization, control subjects had more outpatient clinic visits ($p < .06$) and were more likely to sustain hospital costs over $5000 ($p < .05$). CONCLUSIONS: Exercise may have beneficial effects on fall rates and health care use in some subgroups of older adults. In community-living adults with mainly mild impairments in gait, balance, and physical health status, short-term exercise may not have a restorative effect on these impairments.

Publication Types:

Age-related changes in spatial and temporal gait variables.

Grabiner PC, Biswas ST, Grabiner MD.

Arch Phys Med Rehabil. 2001 Jan;82(1):31-5.

Clinical Biomechanics and Rehabilitation Laboratory, Department of Biomedical Engineering, Lerner Research Institute, Cleveland Clinic Foundation, Cleveland, OH, USA.

OBJECTIVE: To extend recent findings describing the effect of age on spatial and temporal gait variables. DESIGN: Experimental. SETTING: A gait analysis laboratory. PARTICIPANTS: Two experiments with healthy nonfallers were conducted. Experiment 1 included 33 subjects (n = 15, 72.13 +/- 3.96yr; n = 18, 25.06 +/- 4.02yr); and experiment 2 included 24 subjects (n = 14, 75.57 +/- 6.15yr; n = 10; 28.10 +/- 3.48yr). INTERVENTIONS: The effect of age, walking velocity, shoe condition, and performance of an attention-splitting task on gait variables was investigated. MAIN OUTCOME MEASURES: Temporal and spatial gait variables were quantified using an instrumented

surface across which subjects walked. The independent variables were walking velocity variability, stride length variability, stride width variability, and stride time variability. RESULTS: Stride width variability of older adults was significantly larger than that of younger adults in both experiments. The remaining gait variables demonstrated nonsystematic or no age-related differences. CONCLUSIONS: With the exception of stride width variability, the variability of the remaining gait variables of interest were insensitive to the speed at which subjects walked, whether the subjects were wearing shoes or not, and performing an attention-splitting task while walking. These findings contribute to an emerging interpretive framework established by similar work published by others regarding gait variability.

MeSH Terms:

- Adult
- Aged

A comparison of community-based resistance exercise and flexibility exercise for seniors.

Barrett CJ, Smerdely P.

Aust J Physiother. 2002;48(3):215-9.

St George Hospital, Sydney.

Progressive resistance training has positive effects on the health of elderly people, however exercise programs for seniors frequently focus on other forms of exercise. This study is a randomised trial with a blinded assessor comparing a community based progressive resistance training program (n = 20) with a flexibility program (n = 20), both one hour twice weekly for 10 weeks. Outcomes were strength, gait, balance and quality of life. Progressive resistance training had a greater effect than flexibility training on right sided quadriceps strength (mean difference between groups = 7.7%; 95% CI 3.6-11.8%, p < 0.003 MANOVA), left sided quadriceps strength (mean difference = 9.9%; 95% CI 5.6-14.2%, p < 0.003 MANOVA), left sided biceps strength (mean difference = 15.2%; 95% CI 11.7-19.2%, p < 0.003 MANOVA), functional reach (mean difference = 11.7%; 95% CI 7.1-16.3%, p < 0.003 MANOVA) and step test (mean difference = 8.6%; 95% CI 3.8-13.4%, p < 0.003 MANOVA). Neither group had improvements in SF36 quality of life measures. Results suggest progressive resistance training produces greater strength, gait and balance improvements in elderly people than a flexibility exercise program.

Publication Types:

A randomized trial comparing aerobic exercise and resistance exercise with a health education program in older adults with knee osteoarthritis. The Fitness Arthritis and Seniors Trial (FAST).

Ettinger WH Jr, Burns R, Messier SP, Applegate W, Rejeski WJ, Morgan T, Shumaker S, Berry MJ, O'Toole M, Monu J, Craven T.

JAMA. 1997 Jan 1;277(1):25-31.

Comment in:

- JAMA. 1997 Jan 1;277(1):64-6 PMID: 8980213

Department of Internal Medicine, Bowman Gray School of Medicine, Winston-Salem, NC, USA.

OBJECTIVE: To determine the effects of structured exercise programs on self-reported disability in older adults with knee osteoarthritis. SETTING AND DESIGN: A randomized, single-blind clinical trial lasting 18 months conducted at 2 academic medical centers. PARTICIPANTS: A total of 439 community-dwelling adults, aged 60 years or older, with radiographically evident knee osteoarthritis, pain, and self-reported physical disability. INTERVENTIONS: An aerobic exercise program, a resistance exercise program, and a health education program. MAIN OUTCOME MEASURES: The primary outcome was self-reported disability score (range, 1-5). The secondary outcomes were knee pain score (range, 1-6), performance measures of physical function, x-ray score, aerobic capacity, and knee muscle strength. RESULTS: A total of 365 (83%) participants completed the trial. Overall compliance with the exercise prescription was 68% in the aerobic training group and 70% in the resistance training group. Postrandomization, participants in the aerobic exercise group had a 10% lower adjusted mean (+/- SE) score on the physical disability questionnaire (1.71 +/- 0.03 vs 1.90 +/- 0.04 units; P<.001), a 12% lower score on the knee pain questionnaire (2.1 +/- 0.05 vs 2.4 +/- 0.05 units; P=.001), and performed better (mean [+/- SE]) on the 6-minute walk test (1507 +/- 16 vs 1349 +/- 16 ft; P<.001), mean (+/-SE) time to climb and descend stairs (12.7 +/- 0.4 vs 13.9 +/- 0.4 seconds; P=.05), time to lift and carry 10 pounds (9.1 +/- 0.2 vs 10.0 +/- 0.1 seconds; P<.001), and mean (+/-SE) time to get in and out of a car (8.7 +/- 0.3 vs 10.6 +/- 0.3 seconds; P<.001) than the health education group. The resistance exercise group had an 8% lower score on the physical disability questionnaire (1.74 +/- 0.04 vs 1.90 +/- 0.03 units; P=.003), 8% lower pain score (2.2 +/- 0.06 vs 2.4 +/- 0.05 units; P=.02), greater distance on the 6-minute walk (1406 +/- 17 vs 1349 +/- 16 ft; P=.02), faster times on the lifting and carrying task (9.3 +/- 0.1 vs 10.0 +/- 0.16 seconds; P=.001), and the car task (9.0 +/- 0.3 vs 10.6 +/- 0.3 seconds; P=.003) than the health education group. There were no differences in x-ray scores between either exercise group and the health education group. CONCLUSIONS: Older disabled persons with osteoarthritis of the knee had modest improvements in measures of disability, physical performance, and pain from participating in either an aerobic or a resistance exercise program. These data suggest that exercise should be prescribed as part of the treatment for knee osteoarthritis.

Publication Types:

- Clinical Trial
- Multicenter Study
- Randomized Controlled Trial

MeSH Terms:

Short-term training effects on left ventricular diastolic function and oxygen uptake in older and younger men.

Harris SK, Petrella RJ, Overend TJ, Paterson DH, Cunningham DA.

Clin J Sport Med. 2003 Jul;13(4):245-51.

Department of Family Medicine, Faculty of Medicine, School of Kinesiology, University of Western Ontario, London, Ontario, Canada.

OBJECTIVE: To determine the effect of plasma volume change with short-term training and diuresis on left ventricular diastolic filling and exercise oxygen uptake (VO(2)) in older versus younger men. METHODS: Eleven older (68 +/- 5 y) physically active (maximal oxygen uptake [VO(2max)] = 25.9 +/- 3.6 mL. kg-1. min-1) and 10 younger sedentary males (24 +/- 5 y, VO(2max) 40.5 +/- 5.0 mL. kg-1. min-1) were randomly assigned to 5 consecutive days of (1) 1 h/d high intensity stationary cycling (EXER); (2) 100 mg/d spironolactone (DIUR); and (3) exercise and diuretic (EXDI). Each treatment was separated by a 21-day washout. Doppler echocardiographic indices of left ventricular diastolic filling including peak early and atrial transmitral flow velocity and isovolumic relaxation time; percent change in plasma volume; submaximal VO(2) kinetics; and VO(2max) were determined at baseline and 48 hours after each treatment. RESULTS: Plasma volume was increased more in the young following EXER (8.92 +/- 7.6 vs. 6.2%, P = 0.038) and decreased more in the older group following DIUR (-11.5% vs. -3.54 +/- 9.0, P < 0.001). There was no significant difference between groups after EXDI. Significant changes in peak early flow velocity with EXER in older subjects were not reflected in any other changes in left ventricular diastolic filling across conditions. No changes in left ventricular diastolic filling were observed in the young group with any condition. VO(2max) and VO(2) kinetics were unchanged under all conditions from baseline in both groups. CONCLUSIONS: These results suggest that exercise VO(2) responses either at maximal or submaximal workrates are not limited by alterations in left ventricular pump function in physically fit older adults.

PMID: 12855928 [PubMed - in process]

From PubMed

Effects of aerobic exercise training in community-based subjects aged 80 and older: a pilot study.

Vaitkevicius PV, Ebersold C, Shah MS, Gill NS, Katz RL, Narrett MJ, Applebaum GE, Parrish SM, O'Connor FC, Fleg JL.

J Am Geriatr Soc. 2002 Dec;50(12):2009-13.

Comment in:

- J Am Geriatr Soc. 2002 Dec;50(12):2089-91 PMID: 12473025

Division of Geriatrics and Cardiology, University of Michigan Medical School and Veterans Affairs Ann Arbor Healthcare System/Geriatric Research Education and Clinical Center (11G), Ann Arbor 48105, USA. pvait@umich.edu

OBJECTIVES: To assess the ability of sedentary, frail subjects aged 80 and older to train in a community-based exercise program and to evaluate clinical factors that predict improvements in peak oxygen consumption (VO2peak). DESIGN: Pretest, posttest. SETTING: Charlestown Retirement Community, Catonsville, Maryland PARTICIPANTS: Twenty-two (11 male, 11 female; mean age +/- standard deviation = 84 +/- 4.0, range 80-92) self-referred. INTERVENTION: Six months of moderate-intensity aerobic exercise training, two to three sessions/week, 20 to 30 minutes per session. Training modes included treadmill walking and/or stationary cycling. MEASUREMENTS:

Baseline and follow-up maximal exercise treadmill tests (ETTs) with electrocardiogram monitoring and respiratory gas analysis. RESULTS: Six months of aerobic exercise training resulted in significant increases (mean +/- standard deviation) in ETT duration (11.9 +/- 3.3 vs 15.9 +/- 4.3 minutes; P =.01), VO2peak (1.23 +/- 0.37 vs 1.31 +/- 0.36 L/min; P =.04), and oxygen pulse (9.3 +/- 2.8 vs 10.1 +/- 3.2; P =.03). Mean heart rate was significantly lower during submaximal ETT stages 1 through 4 (P <.05), and resting systolic blood pressure decreased (146 +/- 18 vs 133 +/- 14 mmHg; P =.01) after training. Multiple regression analysis indicated that baseline VO2peak (r = 0.75, P =.002) and the total amount of time spent in exercise training (r = 0.55, P =.008) were independent predictors of the training-related improvements in VO2peak. CONCLUSION: Subjects aged 80 and older can increase aerobic capacity and reduce systolic blood pressure in a community-based exercise program of moderate intensity. The most important predictors of change in VO2peak were baseline VO2peak and the time spent in exercise training. Subjects with a lower baseline VO2peak had the greatest improvements in VO2peak after training.

MeSH Terms:

- Aged
- Aged, 80 and over/*physiology
- Electrocardiography
- *Exercise
- Exercise Test
- Female

4. Testimonials

A. Professionals

Report on the use of the Active Passive Trainer

Obeten R, MCSP, SRP., Chartered Physiotherapist.

The Royal Buckinghamshire Hospital

International Spinal Injuries & Rehabilitation Centre

Physiotherapy Department

We have been using APT's in our department for nearly two years. ISU Is a busy private residential rehabilitation centre specializing in the rehabilitation of spinal injuries, with an increasing number of neurological cases like strokes and MS.

We have two APT's, one set up for legs, the other for arms. The legs one can be used in sitting or lying, the arm one can be used in sitting or standing. The range of movement achieved is determined by the angle at which the machine is set and the position, ie height and distance, of the user.

Both APT's are used a lot and are popular with patients and therapists alike. We have them set up in the gym so that the patients using them are still part of the general activities. However, because they are relatively easy to carry they are often used in the bedrooms, or taken away for home use by outpatients at weekends. As a spinal unit we often have patients confined to bed for the healing of pressure sores. With careful positioning of the patient we can set up the APT for use on the bed, giving steady safe exercise for as long as the user can tolerate.

We find the APT's most effective for:

Legs

1. Continuous passive movements, the effects of which are, reduction of spasm.
   Increased circulation/ reduction of oedema.
   Joints put through mid-range of movement, which can be altered by positioning.
   Gentle stretch on Tendo-Achilles.
   Pressure through feet.

Report on use of APT - 2

Gentle sitting balance practice.
Encouraging trunk movements.
Feeling of well-being after use. This has been reported by all users whatever their disability and sensation or lack of it.

2. Active movement, assisted or against resistance, the effects of which are,
   All the above-mentioned plus an aerobic effect.
   Increased strength in working muscles.
   Encouragement of very weak muscled to work.
   Improvement in sitting balance

Arms

1. Continuous passive movements, the effects of which are,
   All joints put through good range of movements, depending on.
   Positioning.
   Increased circulation.
   Reduction of spasm.
   Encouragement of shoulder and trunk movement.
   Sitting balance exercise.
   Standing balance exercise.
   Encouragement of good hand grip.
   Feeling of well-being after use.

2. Active movement, assisted of resisted, with the effects of,
   All the above-mentioned plus and aerobic effect.
   Increased strength in working muscles.
   Encouragement of weak muscles.

Patients with weak arm/shoulder girdles seem to get satisfaction from working against the APT. Patients with stiff, painful upper limbs or body get relief and relaxation from the gentle, but possibly increasing movements from the APT.

Conclusion

This is a very useful piece of equipment. It can be used in a variety of ways. It is a great advantage to be able to switch from passive to active and vice versa so easily. It is safe. The versatility of the controls mean that a user can go right through from passive movements to quite hard active resisted exercise involving large parts of the body.

Report on the use of the APT – 3

The only 'minus points' we have found are that it would be useful to have some sort of carrying handle for domiciliary visits; and the machine needs to be fixed against something solid like a wall during use to prevent creeping.

Reports on the use of APT Hadassa Medical Organization Jerusalem

5th July, 1994

Mrs. Mira Jaspan
Sales Manager
Tzora Health Care Products
D.N. Shimshon 9905

Dear Mrs. Jaspan,

In reply to your letter from 16.6.94 (ref no. 32/242) concerning your APT.

We have been using the APT since 1991. We like the improvements you have implemented. (Quick-release grips, improved strapping for footrests and safety discs)

The APT's are used for patients that suffer from muscle weakness, restricted range of movement, poor physical fitness and heart rehabilitation. The unit is used by both young and the elder.

The main use is with patients that are hospitalized for general rehabilitation, geriatric rehabilitation, day care and out patients.

Yours sincerely,

Yehudit Marcus
Manager Physiotherapy Services

Copies:
Prof. Misahl
Prof. Shako

APT

The **APT** has been in use in Hadassa Hospital since the beginning of its development – in many different departments of the hospital…inpatients as well as outpatients. The departments it has been used in include: Rehabilitation, Cardiac Care Unit, Orthopaedics, Hematology, Plastic Surgery, RICU, Internal Medicine, Pediatrics, Pulmonary Rehabilitation, and out patients including the regular Outpatient Clinic and the Rehabilitation Day Hospital. We also have plans to start using it in the Dialysis Unit.

The reasons for using the **APT** are many and diverse.
The active mode can be used to increase strength, endurance, range of motion and cardiovascular endurance.
The passive mode can be used for assisting the weak, increasing range of motion and for possibly balancing abnormal muscle tone. Strengthening of bone has been shown to occur through muscle activity and perhaps this can be achieved with the **APT**. In addition, there are many advantages to the APT due to its lightweight, mobility and ease in changing the moving parts.

Janet Berman – Senior Physiotherapist.

Hadassa Hospital, Jerusalem

January 1999

Technique of the use of the APT, Maon Nechim, Netanya

19th July, 1994

Maon Nechim Netanya is a residential center for the Physically Disabled. It was established in 1976 by ILAN, the Israel Foundation for Handicapped Children, and is run by the Israel Ministry of Social Services. The facility is geared to the population of young handicapped adults, ranging from the age of 20-50 years. The degree of disability of each resident varies, as do their diagnoses. Multiple Sclerosis, progressive Muscular Oystrophy and Cerebral Palsy are a few of the conditions of the residents. Their functional capacities range from mildly disabled to totally dependent.

The Maon provides a home for its 58 residents with a wide range of treatment and services include physical and occupational therapy.

The Physical Therapy department of the Maon has used the APT with 36 residents. Our system consists of the following techniques:

1. The therapist determines which extremity (upper and/or lower) should be used, according to the patients' abilities.
2. The appropriate attachment is fitted to the APT. for example, if a person needed assistance in operating his legs (due to spasticity of the legs as seen in cerebral palsy) the high support footrest are used.
3. The patient is taken through the PASSIVE MODE, at first using the smallest rotation radius. We hand-assist his legs through the motion until be becomes accustomed to the movement. We gradually decrease hand contact until he operates his legs independently.
4. If the user succeeded rotating his legs at a selected level, the degree of mechanical assistance was reduced by selecting a lower speed. At this stage the users used a combined PASSIVE/ACTIVE MODE, by increasing the rotation speed actively.
5. Some of the users were able to operate in the ACTIVE MODE. Others, however, were not, and therefore only worked in the PASSIVE MODE.
6. This process is repeated on the other extremities.

Using this technique, we found that residents with levels of spasticity ranging from mild to severe were able to relax their extremities and execute normal motions which they would not otherwise have been able to do.

For each resident that the APT was used, we recorded the mode used, speed or resistance level (1 to 5), direction of movement and attachment used.

We found that the key element in success was taking the user through the motion, using hand contact, until he became accustomed to executing the movement on his own.

E. martin
Physical therapist

APT user's comments:

Hadassa Hospital – Ein Karem and Har Ha-tsofim Jerusalem Yehudit Marcus – Head of Physiotherapy

Patients: APT is used in the P.T. departments at both hospitals as an aid to the physical therapy program – musculo-skeletal problems, neurological problems, heart and lung transplant patients, heart rehabilitation. Patients range in age from 7 years to 85 years.
APT use: Used for hands and legs in all modes. Treatment varies from daily use to twice weekly sessions. The APT is used daily for 20-25 patients with sessions lasting from 15-30 minutes.
Indications: Muscle strengthening, cardio vascular training, increasing range of motion (ROM), general warm up exercise prior to specific treatment. The staff like the unit and enjoy working with it.
NB: Two units are placed at each hospital. Two of these have been in use for two years following initial product testing and evaluation.

Bet Rivka – Petach Tikva
Dr. Daniel Gotlieb,

Patients: About 25 elderly stroke patients in the rehabilitation ward.
APT use: Two to four patients daily for 20-30 minute sessions. The APT is used for hands and feet in both the active and the passive mode.
Results: Generally positive results are reported by the staff.

Neot La Guardia – Tel Aviv (Private hospital)

Patients: Mainly elderly, following CVA, Parkinson's disease, and general deterioration. Average age about 70.
APT use: 5-6 patients daily for daily sessions of about 15-20 minutes. Used mainly for the lower body in the active and the passive mode.
Results: Therapists report good overall results.

Ramat Efal – Tel Aviv (Home for the elderly)
Teva Bitansky P.T.

Patients: Elderly with functional problems due to old age. Average age 70-80.
APT use: 10-12 patients per day for about 15-20 minutes per session. Mostly used for the legs at the lower levels of difficulty. Individual sessions about 4-6 times a week.
Results: Improvement in mobility following treatment.
Reported improvement in ability to perform more daily functions independently, e.g. dressing.
Patients enjoy using the APT and look forward to their sessions.

Institute for the Handicapped – Netanya
Rosie Nakash P.T.

Patients: Paraplegics, quadriplegics, C.P., M.S., P.M.D. Ages between 25-55.
APT use: 2-3 patients daily for sessions of between 20-30 minutes. Use is made of both hand and leg functions in active and passive mode. The APT has been mounted on a stand and allows easy use at different heights as required.
Results: Objective functional improvement and also subjective feeling of well being and easing of tonus following treatment.

B. Patients

Testimonials by APT users with Multiple Sclerosis

February 9, 1996

Dear Mr. Gordon,

I have been riding the Power Trainer P/A daily for over four years and have never felt better. The Power Trainer keeps my muscle tone that is essential to fighting multiple sclerosis that I have lived with over 25 years – "not bad for a 70 year plus Floridian." Keep well and good bless you and yours.

Sincerely
Don Lowe.

August 15, 1996

We love your product! My daughter who has multiple sclerosis rides your power trainer morning and evening every day. It has done amazing things to minimize her spasms and given her great muscle tone in her legs. She is now standing with the aid of crutches and leg supports. We don't feel that she would have made this much progress had it not been for the power trainer. It has also been very good for her mental state and she feels much better after exercising. Keep up the good work!

Dan Jensen

June 25, 1995

Dear Mr. Gordon,

I am writing regarding the benefits I have received after using the power trainer. I could not find any other equipment that I could use independently without the aid of a physical therapist. But the power trainer was introduced to me and I soon found that someone had designed a piece of equipment with the physically disabled in mind. My cardiovascular system was totally inadequate. Other benefits that I have received are of a psychological nature. My self-esteem has greatly increased as well as my motivation. I have used the power trainer for almost 4 years now and I feel it has been a turning point in my life. I want to thank you for helping me find myself.

Michael Pusateri.