Stability in seniors as measured by a computer analyzed forceplate

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Key words : fall risk, elderly, exercise

History of Use

The Tib Trainer® has been used on patients with a variety of neurological and orthopaedic diagnoses. It can be used with adults and pediatric clients. The Tib Trainer® can be used with the low level neurologically involved patient working on sitting activities; to the high level elite athlete working on agility and plyometric training. The Tib Trainer® is designed to ONLY be used by physical therapists, assistants and other healthcare professionals on their clients. It is NOT intended to be sold to or used independently by a client/patient. Safety in the use of this product indicates the client/patient MUST be "contact guarded" at all times; particularly in the initial experiences with persons first using the Tib Trainer®.

Development of the Tib Trainer®

The Tib Trainer® originally was developed during a treatment session. A patient who had a stroke had been using an AFO in ambulation, and was improving to the point where he had potential to transition out of the brace. However, although he was able to isolate dorsiflexion during exercises, dorsiflexion was not functional during gait and therefore was still dragging his foot. The patient needed strengthening of his dorsiflexors in the function of gait. In assessing this patient, the clinical rational was that if he could somehow get resistance from the ground up during (functional) ambulation, this would facilitate the dorsiflexors via proprioceptive input. The resistance that the Tib Trainer® created when the patient tried to advance his foot and disengage the hook fastener fabric from the carpet provided feedback to the patient, and a quick stretch to the dorsiflexors. With repeated training sessions using the Tib Trainer® without the AFO, the dorsiflexors were trained to fire functionally during gait training. Benefits of this training device included: 1) Auditory feedback of the peeling away from the supporting surface that the patient received when ambulating with a Tib Trainer® on both feet. He was able to listen to the symmetry or asymmetry of his steps and make the appropriate modifications needed. 2) Each time he did not achieve adequate foot clearance, the patient received immediate sensory feedback from the hook fastener catching on the carpet. This provided a positive feedback loop every time he successfully took a step. 3) This patient had some apraxia and responded best to more automatic movements that did not require more cognitive motor planning and so the Tib Trainer® was a good tool for this patient. Eventually, the patient was able to fire his dorsiflexors functionally and no longer required the use of the AFO. Although the Tib Trainer® was originally designed to improve the functional strength of the anterior tibialis via resistance, we quickly discovered the powerful impact the Tib Trainer® had on facilitating the proprioceptors with immediate sensory feedback. The uses of the Tib Trainer® have far exceeded the original idea of just strengthening.

It can be used for: 1) balance retraining and fall

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prevention, gait training and improvement of gait deviations, 2) tri-planar training and strengthening, 3) as well as providing instant feedback, and 4) increasing proprioceptive and sensory awareness through visual, auditory and tactile input. Because the Tib Trainer® is deceptively simple in construction and use, the clinician/developer recognized that research would help stimulate clinician interest in this tool, as well as verify the developer's anecdotal evidence with a limited patient population.

Peggy Trueblood, Ph.D., P.T., the Department Chairperson at California State University, Fresno; and a former instructor for the clinician/developer, was approached with the request to conduct some research using the Tib Trainer®. In turn Dr. Trueblood offered the research opportunity to the faculty in the physical therapy department. This author took the challenge of this project to test the efficacy of the Tib Trainer® exercise equipment. Mecagni et al [2], reported the relationship of balance measures and range of motion (ROM) in community-dwelling elderly women with no health problems. That investigation sought to identify modifiable risk factors associated with balance with the goal to enable clinicians to design treatments which may reduce fall risk in elderly subjects. Correlations were found between ROM and balance in community-dwelling elderly women. This study called for additional research to determine whether treatment directed at increasing ankle ROM can improve balance[2]. The Limits of Stability (LOS) test quantifies the distance a person can intentionally weight shift the body as would be required for function and gait, without losing balance, stepping or reaching for assistance[3]. An individual's limits of stability is one indicator of fall risk, as LOS is associated with ankle ROM[4].

Method

Sample

The small sample [N=7] was drawn from male and female volunteers who attend a senior fitness program that meets 3x week. Age range was 65-85. Health histories of the sample included 1 post- CVA, and others with one or more of the following: HTN, DM, various vision limitations, and diffuse arthritis.

Instrumentation

The LOS test was chosen for its value to measure movement control, limits of actual movement stability, and limits of perceived movement stability. The LOS provided numeric scores for each trial, comprehensive scores: for each cardinal direction; and composite scores: a single numeric value representing overall component performance. Endpoint and maximum excursion measures were used for this study, the distances traveled by the center of gravity during the trials. In addition directional control, a comparison of the amount of movement in the intended direction of the target area compared to the amount of extraneous movement, was analyzed. Research questions included: Could the subject move in all cardinal directions of the LOS? What were the baseline values of the LOS? What were the post-intervention values of the LOS?

Procedure

The protocol included: a) LOS pre/post tests using a computer analyzed force plate, b) the 6-week, 2-3x week, specific intervention for the ankle in addition to the scheduled exercise class activities, c) available participants LOS were also assessed one year later to determine the duration of the training effect. The participants used the Tib Trainer® on all days each person attended the regular program. The Tib Trainer® activities included: six paths of forward walking, followed by six paths of backward walking on a 5 foot

carpet mat wearing Tib Trainer® on both feet for the walk activities. These walks were followed by six repetitions of each inversion/eversion and dorsi-flexion/plantar-flexion while wearing the Tib Trainer® on the moving foot, and guarded in single leg stance on the non-Tib Trainer® extremity. The protocol was applied to both left and right lower extremities for each subject. Participants used the Tib Trainer® an average of 16 days over 8 weeks. The duration of this routine was approximately 15 minutes each session using the Tib Trainer®.

Data analysis

T-test analysis of the data demonstrated 100% of the sample gained in balance, reaction times, and uniform directional sway patterns as measure pre-post Tib Trainer® using the Neurocom Limits of Stability tests.

Results

The participants in the study made significant gains ($p<.05$) in the pre-/post-test LOS using the brief intermittent Tib Trainer® ankle exercise protocol. The change not retained when tested with LOS one year later.

Conclusions

Participants in the study reported the training fun, challenging and confidence building

It is reported throughout the literature that adults, and older adults in particular, prefer functional activities as interventions to change motor performance. Participants significantly ($p<.05$) improved their LOS with Tib Trainer® specific training for the ankle.This change in LOS could be considered as a factor in reducing fall risk. Although specific training for the ankle using Tib Trainer® is effective in improving seniors LOS, the change was not lasting, when tested one year later. Further research is needed to determine what duration of training is required for lasting effects; or what functional activities are regularly needed to preserve the gains in LOS demonstrated by the specific training.

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