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Whole Body Vibration as a Physiotherapy Tool for Post-Traumatic Knee Osteoarthritis Patients: A Commentary

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Short Communication

In recent years, Whole Body Vibration (WBV) has emerged as a neuromuscular training method that uses a vibration stimulus to incite an involuntary response in muscles. As such, WBV represents a unique alternative to traditional training methods by providing similar training results requiring shorter time periods and less perceived effort [1,2]. Vibration represents a mechanical oscillatory stimulus to soft tissues and their receptors [3]. The intensity of vibration is determined by a combination of frequency, amplitude, and acceleration [1,4] which causes a reactive force in soft tissue, constituting a training stimulus [5]. Vibration therapy has shown reductions in age-related decline in muscle strength [6,7]. Studies have examined both the acute [8-10] and chronic [11-13] response to WBV in muscle strength and power. These enhanced effects on muscular strength and power have been attributed to increased neural reflex activation, including recruitment; synchronization, neuromuscular coordination, and proprioceptor response [4]. Further, the effects of WBV have also been reported to involve corticospinal and intracortical processes [14]. Among its many uses, vibration has been applied in both preventative [15,16] and rehabilitative exercise [13,17].

Anterior cruciate ligament (ACL) ruptures are the most common ligamentous injury to the knee [18]. Although predominantly seen in athletes, ACL injury is also prevalent in the physically active general population. ACL reconstruction has been linked to post-traumatic knee osteoarthritis (OA) occurrence and with ACL reconstructions reported as among the most common sports medicine procedures performed in the United States [19] it is evident that the numbers of individuals with post-traumatic knee OA is prevailing at an alarming rate. The altered arthrokinematic mechanics post ACL reconstruction result in unusual loading patterns across the articular cartilage surface of the knee joint which subsequently and significantly increase the risk of OA development [20]. Further, following ACL reconstruction there is a decline in conditioning of the musculoskeletal system, resulting in neuromuscular strength deficits. One of the major rehabilitation dilemmas faced by clinicians is quadriceps weakness [21]. Weakness in this muscle group results in diminished dynamic joint stability and functional ability. Additionally, alterations in postural control [22] are also present all of which impact the knee joint loading patterns and exacerbate a rapid progression of post-traumatic knee OA development. Interestingly, research studies utilizing WBV therapy have been conducted in ACL reconstructed patients and have provided evidence of improved proprioception, balance and strength in this population [17,23,24]. Further, a recent study by Blackburn et al. [25] reported a reduction in quadriceps arthrogenic muscle inhibition after implementation of WBV therapy thereby supporting the use of this physiotherapy tool in rehabilitation programs targeting lower extremity strength gains.

OA is a degenerative disorder characterized by loss of articular cartilage and changes in the underlying subchondral bone and synovium. The disorder involves a series of destructive inflammatory processes and the destruction of the joints integrity, resulting in pain, stiffness and functional disability for the patients suffering with this disease. Research studies investigating the effectiveness of WBV therapy in the knee OA population are limited, and although those that have been conducted provide positive results, there is still some question regarding the true benefit of WBV therapy due to the apparent conflict in study designs and protocols employed.

Trans et al. [26] were the first to report increases in muscle strength and proprioception in female knee OA patients after 8 weeks of WBV exercise. This study highlighted the suitability of WBV as an intervention therapy in OA patients. Their study reported no adverse effects of WBV, therefore showing that WBV causes minor stress to the OA joint. They also reported no subject drop outs due to the utilization of WBV as an intervention and revealed its feasibility of effectiveness in this population. Park et al. [27] conducted a study comparing a home based exercise program to WBV and found WBV was superior in improving pain reduction in knee OA patients but revealed similar improvements in lower extremity strength and balance. Further, other research studies have incorporated WBV with squat training and reported improvements in physical function, [28-30] balance, [29,30] muscular power, [30] and self-perception of disease status [28,29] alongside decreases in the inflammatory joint process [29]. Thereby, implicating that WBV may indeed have an effect in slowing OA disease progression [29,31].

Currently, the American College of Rheumatology (ACR) strongly recommends that all patients with symptomatic knee OA participate in a physical therapy exercise program [32]. However, the use of WBV therapy is not currently employed in traditional physical therapy programs despite the reported effectiveness WBV has in improving disease symptomology. Therefore, there is a need for the implementation of novel rehabilitative therapies like WBV in the non-pharmacologic approach to managing this musculoskeletal disorder. Especially considering the potential impact WBV therapy has with regards to combating the neuromuscular strength deficits and diminished dynamic joint stability present thereby improving health-related quality of life and function in the millions of people suffering with post-traumatic knee OA.

Although conflicting evidence [4,5,33] exists explaining the precise mechanism mediating the relationship between vibration and neuromuscular performance, a reflex mechanism has been postulated to describe the neuromuscular response to mechanical vibratio [4,5]. This mechanism, known as the tonic vibration reflex [4] may be responsible for inducing a joint-protective sensorimotor response during dynamic maneuvers (functional joint stability) [23]. WBV studies have demonstrated vibration therapy to be a time-saving, safe

and effective intervention for targeting neuromuscular strength deficits while improving functional capability [6,7]. Therefore, WBV may be an effective therapy in reducing the amount of functional disability or loss of lower extremity joint stability that individuals with post-traumatic knee OA suffer with on a daily basis by providing enhanced neural activation of both sensory and motor fibers and improving joint homeostasis. Further, the attractiveness of WBV therapy is the ability to apply the treatment in a low-impact manner, which is critical for individuals with impaired mobility and attenuated muscle strength such as the post-traumatic knee OA population. Optimal neuromuscular function is of utmost importance when trying to delay the development and progression of knee OA, and due to the neuromuscular training effect of WBV, its use in the post-traumatic knee OA population could be profound and effective [34,35]. Further, WBV provides a less fatiguing and less time-consuming method to enhance physical capabilities. Although OA is a chronic disease requiring extended treatment, WBV therapy has been associated with limited adverse effect and therefore has the potential for long term use in the rehabilitation of knee OA pathology [36]. The positive effects of WBV training evident from previous studies and the short training time associated with this therapy is extremely encouraging and therefore warrants the need for further utilization of this therapy tool in post-traumatic knee OA patients.

In summary, utilizing WBV therapy may provide more useful information for rehabilitation purposes in patients with post-traumatic knee OA. Additionally, by investigating the effect WBV has on daily functional activities, strength, and quality of life, further knowledge can be accumulated to aid in designing optimal intervention and prevention programs to reduce the functional disability this active aging population faces on a daily basis and may potentially delay the need for a joint replacement.

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