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Effects of Systemic Vibratory Therapy in an Older Individual With Hip Osteoarthritis: A Case Report

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Background: Systemic vibratory therapy (SVT) is a clinical intervention in which individuals are exposed to mechanical vibrations transmitted through contact with the base of a functioning vibrating platform. SVT has been investigated in older individuals with various clinical conditions, with promising results reported in some populations. However, evidence regarding the effects of SVT specifically in individuals with hip osteoarthritis (HOA) remains limited. Therefore, further investigation is warranted to explore the potential effects of this intervention in this population.

Case Report: We present a 73-year-old man with bilateral HOA, intense pain in both hips, moderate pain in both knees, and difficulty walking for 2 years. He was using analgesic and anti-inflammatory medications for pain control. He underwent SVT and showed improvement in clinical and functional outcomes after 10 sessions.

Conclusions: The findings of this case suggest that SVT may be associated with reduced pain and maintenance or improvement in function and quality of life in an older individual with HOA. However, studies with larger samples and more robust methodological designs are needed to determine the effects of SVT and to establish specific clinical protocols for this population.

Key words: Hip osteoarthritis; whole-body vibration; vibratory therapy; pain; function

BACKGROUND

Osteoarthritis (OA) is commonly viewed as a whole-joint disorder affecting cartilage, bone, synovium, and surrounding muscles. OA results from a complex interplay of systemic inflammation and local mechanical stress, which disrupts the balance between joint degradation and repair and ultimately results in joint failure (1).

The hip joint is one of the largest weight-bearing joints in the body, second only to the knee, and is commonly affected by OA (2). In hip osteoarthritis (HOA), the articular cartilage and the entire joint are affected, with progressive loss of articular cartilage, subchondral cysts, osteophyte formation, periarticular

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ligament laxity, muscle weakness, and possible synovial inflammation (3).

HOA can be classified according to etiology, time of onset, severity, and clinical course (4). In primary HOA, cartilage degradation may be idiopathic and develops in association with dynamic friction between the articular surfaces. In secondary HOA, joint degeneration results from preexisting conditions, including developmental dysplasia of the hip, growth-associated disorders, fracture, osteonecrosis of the femoral head, and inflammatory or metabolic synovial disorders (5).

The prevalence of HOA is reported to be higher among men before age 50 and among women after age 50 (6).

Common symptoms of HOA include an insidious onset of groin pain that can radiate to the gluteal region and knees and is exacerbated by physical activity (7). Individuals may also develop decreased hip range of motion, altered gait biomechanics, limping, reduced mobility, and severe physical disability that can lead to loss of independence and increased use of health care services (8), resulting in poorer quality-of-life scores (9).

The therapeutic approach to HOA aims to alleviate pain, preserve joint function, and improve quality of life (10). Pharmacologic treatments, such as analgesics, nonsteroidal anti-inflammatory drugs (NSAIDs), and intra-articular corticosteroids, are often prescribed to control pain and inflammation associated with HOA (11). However, these medications may be associated with adverse effects, such as gastric ulcers, hypertension, and kidney injury, and do not modify disease progression (12). Therefore, because of the risk of adverse events associated with NSAIDs, nonpharmacologic interventions play an important role in HOA management (13). Therapeutic exercise, physical therapy, weight loss, and patient education are recommended to improve muscle strength, joint mobility, and biomechanics, thereby reducing load on affected joints and relieving pain (14).

Physical exercise may postpone the need for total hip arthroplasty in people with HOA (16). In this context, systemic vibratory therapy (SVT) has been explored as a form of physical exercise in older individuals and in people with clinical conditions, including knee osteoarthritis (KOA) (17).

During SVT, mechanical vibration is transmitted to an individual in contact with the base of a vibrating platform (VP), generating whole-body vibration exercise (WBVE) (18). To apply this therapeutic modality, biomechanical parameters of the VP must be specified, including frequency (Hz), peak-to-peak displacement (mm), positioning on the platform, number of sets and repetitions, work and rest intervals, and weekly frequency (19,20).

SVT has demonstrated potential effects in older individuals with KOA (21,22). However, its effects in individuals with HOA remain unclear.

CASE REPORT

A 73-year-old man with primary bilateral HOA (grade 1 according to the Kellgren-Lawrence classification) had a height of 1.75 m, body mass of 69.7 kg, body mass index of 22.8 kg/m^2, waist circumference of 87 cm, hypertension, type 2 diabetes mellitus, interapophyseal arthrosis of the lumbar spine, and a low score on the International Physical Activity Questionnaire Short Form (23). He was right-side dominant and reported intense pain in the right and left hips (Numeric Rating Scale [NRS] score, 8/10) and knees (NRS score, 6/10) for 2 years, with impaired walking ability, while using analgesic and anti-inflammatory medications for pain control. Although he reported pain in both knees, no radiographic signs suggestive of knee OA were found. Participants were advised, as part of the approved research protocol, to refrain from using analgesics or nonsteroidal anti-inflammatory drugs (NSAIDs) throughout the 5-week SVT intervention period, in order to minimize potential confounding effects on pain-related outcomes. This medication restriction was medically supervised, and participants were monitored throughout the intervention for any clinically relevant worsening of pain or other adverse symptoms.

The patient was informed about all stages of the study and provided written informed consent. This report was approved by the Ethics Committee (Certificado de Apresentação para Apreciação Ética – CAAE, No. 30649620.1.0000.5259) and was conducted in accordance with the CARE guidelines (25).

A medical history was obtained to identify comorbidities and clinical factors that could compromise the patient's safety during the SVT intervention.

Radiographic examinations included (1) weight-bearing anteroposterior and lateral views of both knees, (2) axial patellar views, (3) anteroposterior views of the hips, and (4) anteroposterior and standing lateral views of the lumbosacral spine to evaluate knee or hip osteoarthritis or other abnormalities. Examinations were performed using a Shimadzu General Radiographic System X-ray Tube Stand FH-20HR (Shimadzu Corpora-

tion) and were reviewed by a physician on the clinical team. Radiographs were obtained on the first day.

Pain was assessed with the NRS before and after the SVT intervention and at follow-ups 1 and 2. Function was assessed with the Timed Up and Go (TUG) test (26) and the Short Physical Performance Battery (SPPB) (27) before and after the intervention and at follow-ups 1 and 2. Symptoms and functional disability of the hips and knees were evaluated with the Lequesne Functional Index (LFI) (28). Quality of life was assessed with the Western Ontario and McMaster Universities Osteoarthritis Index (WOMAC) (29) before and after the intervention and at follow-ups 1 and 2 (Fig. 1). Follow-up 1 and follow-up 2 were conducted 15 and 30 days, respectively, after the final intervention session.

The patient was instructed to sit on a height-adjustable chair (Poltrona Van de Velde Aquarius) in front of the VP, with bare feet on the platform base and arms extended with hands resting on the knees to facilitate transmission of mechanical vibration to the whole body. The knees were positioned at 90 degrees of flexion, measured with a goniometer (Carci). The patient completed 10 SVT sessions. The biomechanical parameters were (1) peak-to-peak displacements of 2.5, 5.0, and 7.5 mm; (2) a frequency of 5 Hz in the first session, increased by 1 Hz per session to 14 Hz in the final session; (3) 3 bouts of 3 minutes of mechanical vibration with 1 minute of rest after each bout; (4) 2 sessions per week; and (5) 5 weeks of treatment (30,31). The total daily intervention time was 11 minutes. A side-alternating VP was used (Nova Plate Fitness Evolution; DAF Produtos Hospitalares Ltda). The patient was instructed to report any discomfort. Biomechanical parameters were measured with an EMG832WF Digital Accelerometer (EMG System do Brazil) (Fig. 2).

DISCUSSION

Hip pain, measured with the NRS before and after SVT, generally decreased across most SVT sessions.

For knee pain, measured with the NRS before and after SVT, clinical improvement was observed in the right knee during the first SVT session; pain was generally stable during the remaining sessions.

At the final assessment and follow-ups 1 and 2, hip and knee NRS pain scores did not show progression.

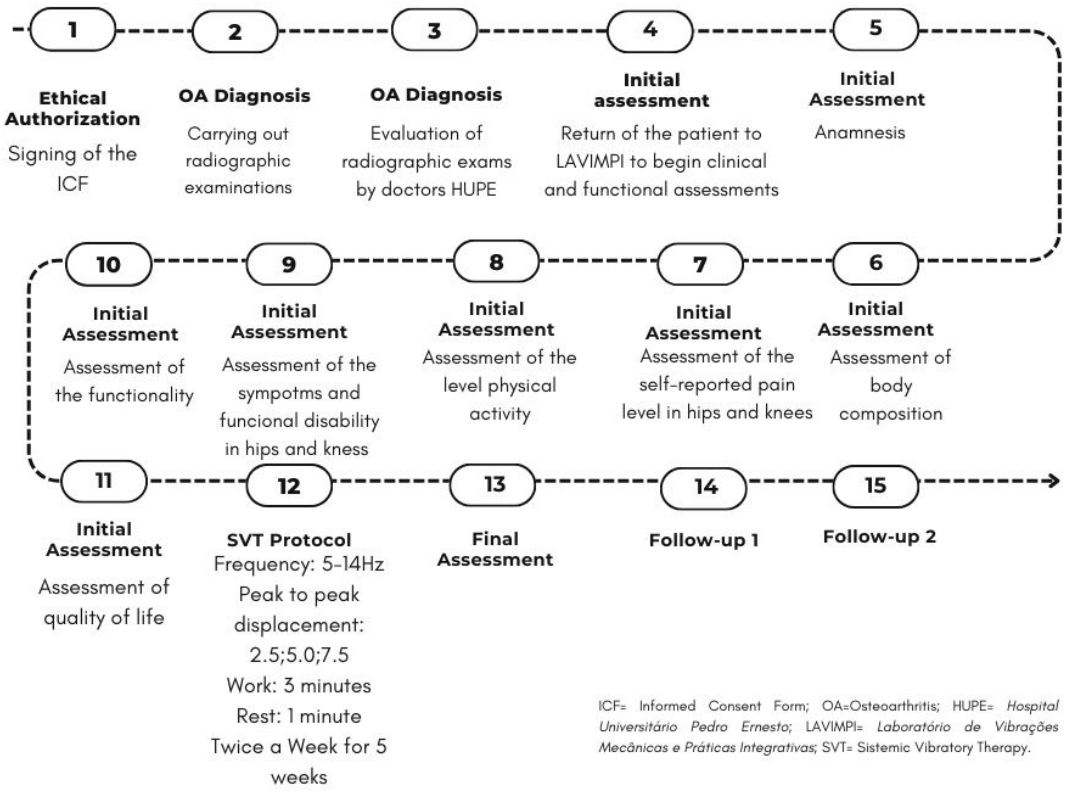


Fig. 1. Steps of the study.

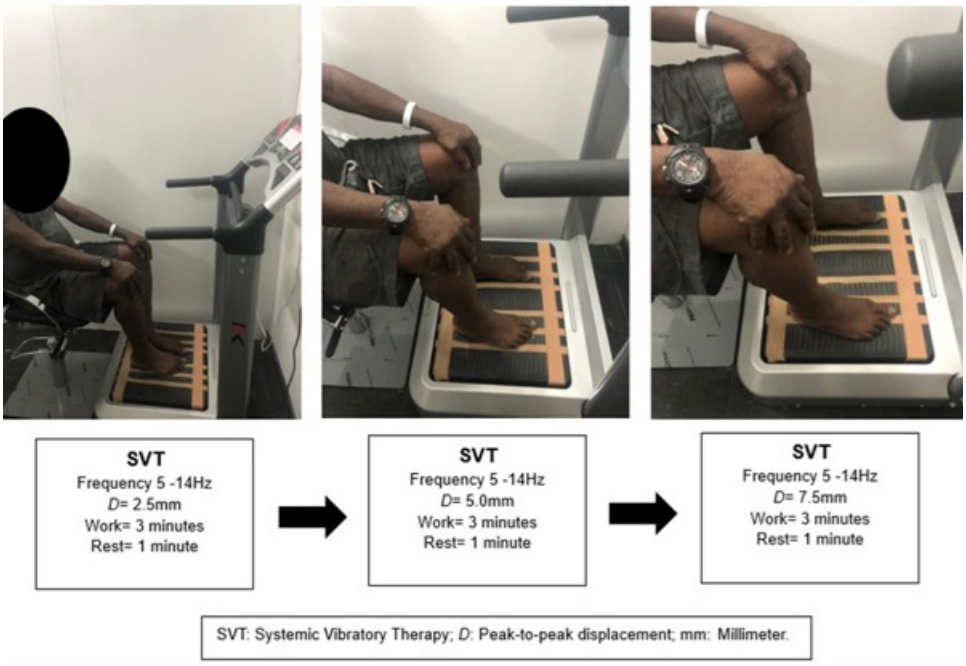


Fig. 2. Systemic vibratory therapy intervention.

TUG performance improved, with a 13.80% reduction in test time at the final evaluation compared with the initial assessment. At follow-up 1, test time decreased by 22.47%, and at follow-up 2, by 14.96%. Overall, execution time decreased across evaluations.

For the SPPB static balance domain, the score decreased at the final evaluation but returned to the initial score at both follow-ups.

For the SPPB walking speed domain, test execution time decreased at the final assessment and follow-up 1 but increased at follow-up 2.

For the SPPB lower-limb muscle strength domain, test execution time increased from the initial assessment through follow-up 1 but decreased at follow-up 2.

The total SPPB score indicated moderate performance at all assessments.

For the total SPPB score (higher scores indicate better performance), the patient scored 75% at the initial assessment, 66.67% at the final evaluation, and 75% at both follow-ups. Thus, performance declined slightly at the final evaluation and returned to baseline during follow-up.

For the LFI pain or discomfort domain, pain or discomfort decreased at the final assessment and remained reduced during follow-up.

For the LFI maximum distance walked domain, maximum walking distance increased at the final assessment and remained improved through follow-up 2.

For the LFI activities of daily living domain, activities of daily living improved at the final assessment and remained improved through follow-up 2.

For the total LFI score (lower scores indicate better function), the patient scored 56.25% initially, 18.75% at the final evaluation, 25% at follow-up 1, and 27.08% at follow-up 2. The score improved markedly at the final evaluation, with some loss of improvement during follow-up.

The total WOMAC score suggested improved quality of life through follow-up 1; this improvement was not maintained at follow-up 2.

The WOMAC pain domain showed a reduction in pain at the final evaluation that persisted through follow-up 2.

The WOMAC stiffness domain suggested worsening stiffness at follow-up 2.

The WOMAC physical function domain showed improvement at the final evaluation through follow-up 1; this improvement was not maintained at follow-up 2.

For the total WOMAC score (higher scores indicate worse outcomes), the patient scored 18.44% initially, 15.19% at the final evaluation, 1.08% at follow-up 1, and 20.62% at follow-up 2. These results suggest initial improvement followed by decline at the second follow-up.

The results of this case suggest that SVT may be a nonpharmacologic strategy for managing symptomatic HOA. Throughout the SVT intervention, the patient was monitored and reported no discomfort or adverse effects and did not use analgesics or NSAIDs.

The presence of knee pain despite unremarkable knee radiographs may represent a clinical challenge

in patients with HOA, as hip osteoarthritis can present with referred pain to the knee due to shared sensory innervation and neural pathways (32).

Physiologic responses to SVT are influenced by parameters including frequency, peak-to-peak displacement, exposure time, treatment frequency, number of sessions, and positioning (18-20).

The SVT protocol should be tailored to the patient's clinical condition. The seated position used in this study may reduce mechanical loading of the hips and knees and improve comfort and adherence during the 10 sessions.

Salmon et al (33) evaluated a single SVT session in people with knee osteoarthritis using a triplanar VP at 35 Hz with 4-6 mm displacement, a standing position with slightly flexed knees, and 10 sets of 1 minute of vibration and 1 minute of rest. Two participants withdrew because of increased knee and ankle pain.

Optimal SVT requires careful consideration of biomechanical parameters and patient positioning. For individuals with HOA who experience pain during weight-bearing activities and muscle weakness, a seated position may reduce joint stress and improve treatment adherence (31).

In this case, self-reported hip and knee pain decreased and TUG test time improved after SVT, with some improvements persisting through follow-ups 1 and 2.

Neto et al (30) evaluated SVT alone or combined with auriculotherapy (Shenmen, Kidney, and Knee points) in individuals with KOA and reported reduced pain with these interventions.

Moura-Fernandes et al (31) evaluated a single SVT session in individuals with KOA using similar biomechanical parameters (5 Hz; peak-to-peak displacement of 2.5, 5.0, and 7.5 mm; 3 minutes of vibration; and 1 minute of rest) and reported reduced pain and improved TUG performance.

The observed improvements in pain and functional mobility in this case suggest the potential of SVT as a nonpharmacologic intervention for HOA symptoms.

Surgical treatment such as total hip arthroplasty may be indicated for advanced HOA but can be associated with postoperative complications, making effective nonpharmacologic strategies desirable for symptom management (2,34).

SPPB results showed a slight decline at the final evaluation with return to baseline at follow-ups 1 and 2, whereas LFI scores improved at the final evaluation with partial loss of improvement at follow-ups 1 and 2. These findings are not entirely concordant and should be interpreted cautiously in a single-patient case report.

Sievänen et al (35) evaluated 10 weeks of WBVE in 130 older adults at risk of falls and found no significant differences in SPPB scores.

In contrast, Zhuang et al (36) evaluated 12 weeks of WBVE in 14 older adults with sarcopenia and observed improvements in total SPPB score.

Wang et al (37) suggested that WBVE combined with quadriceps resistance exercise over 2 weeks improved function, as assessed by the LFI, in 49 older adults with KOA.

WOMAC scores in this study indicated an improvement up to Follow-up 1, followed by a deterioration at Follow-up 2, 30 days after the final SVT intervention. The WOMAC assesses pain, stiffness, and physical function. The deterioration observed at Follow-up 2 may potentially have been influenced by several factors, including changes in physical activity and lifestyle behaviors during the COVID-19 pandemic (38), vitamin D status (39), depression (40), or other psychological factors. However, these variables were not assessed in the present study; therefore, their potential contribution to the observed changes in WOMAC scores remains speculative and cannot be confirmed.

In addition, Wang et al (41), in a systematic review, reported that WBVE did not significantly reduce WOMAC pain or stiffness subscale scores in patients with knee osteoarthritis.

These findings, together with previous research on SVT in KOA, highlight the need for further investigation of SVT in individuals with HOA.

Research into SVT for HOA may be relevant because of the burden of HOA and the need for effective nonpharmacologic treatment options. Further research should evaluate the mechanisms, long-term effects, and optimal SVT parameters in HOA.

Although this report describes clinical and functional findings in only 1 patient, the observations may inform future research. Larger studies with diverse populations, longer follow-up, and appropriate comparison groups are needed to evaluate the efficacy and safety of SVT in HOA and to identify optimal treatment parameters.

Limitations

Limitations of this study include its single-patient design, short follow-up period, lack of assessment of physical activity during follow-up, and limited information regarding potential factors that may have

influenced the follow-up outcomes. These limitations preclude generalization of the findings and prevent causal inferences regarding the observed changes over time. A potential strength of this report is the detailed description of the SVT protocol and the serial clinical assessments performed throughout the intervention and follow-up periods. A potential strength is the detailed description of the SVT protocol and serial clinical and functional assessments.

CONCLUSIONS

In our case, 5 weeks of SVT was associated with changes in pain, function, and quality-of-life measures in an older patient with HOA. Because this is a single case report, further studies using standardized protocols and longer follow-up are needed to determine whether these findings are reproducible and clinically meaningful.

Author Contributions

Conceptualization, M.C.M.F. and M.B.F.; Methodology, D.C.S.C., L.P.O. and M.B.F.; Formal Analysis, M.A.S.G.; Investigation, M.C.M.F.; Writing—Original Draft Preparation, M.C.M.F, A.R.S.; Writing—Review & Editing, A.S., R.T., and M.B.F.; Visualization, B.A.G., L.P.O. and A.P.M.; Supervision and Project Administration, R.T; D.C.S.C., and M.B.F. All authors have read and agreed to the published version of the manuscript.

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