Case Series

Effect of Perturbation Training and Dynamic Resistance Exercises in Patients with Grade II Knee Osteoarthritis: Case Report

Madhuripu P[1], M.Premkumar[2], Aishwarya Nitin Sonwane[3], Kamalakannan R[4], Arun Krishnan[5]

[1]Associate Professor cum PhD Research Scholar, Institute of Physiotherapy, Srinivas University, Mangaluru, India. ORCID ID: 0000-0002-7639-4697, [2]Associate Professor cum PhD Research Scholar, Institute of Physiotherapy, Srinivas University, City Campus, Pandeshwar, Mangaluru, Karnataka, ORCID ID: 0000-0001-6182-2014, [3]Assistant Professor, Institute of Physiotherapy, Srinivas University, City Campus, Pandeshwar Campus, Mangaluru, Karnataka, ORCID ID: 0000-0001-9471-7763, [4]Associate Professor cum PhD Research Scholar, Institute of Physiotherapy, Srinivas University, Mangaluru, India. ORCID ID: 0000-0003-0018-3188, [5]Senior Physiotherapist, Department of Physical Medicine and Rehabilitation, Qatar Redcrescent Al Hemalia Health Center.

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Abstract

Osteo Arthritis of the knee manifests as stiffness, mobility restriction, and difficulty with daily activities. Perturbation training, a method for fostering the growth of motor abilities, whereas resistance training improves physical function, reduces OA pain, and lowers self-reported disability. This study is to analyze and understand the effect of perturbation training and dynamic resistance exercise training on muscle strength and knee extension range of motion in grade II knee osteoarthritis. Grade II Osteoarthritis knee patient was recruited for this study. 20 sessions of perturbation training with dynamic resistance exercises for the affected knee joint for 30 minutes, session with 5 sessions per week were given. Pre and Post Intervention values of muscle strength of 1 Repetition Maximum for knee extensor and knee extension range of motion was taken and analyzed. This case study results had shown significant improvement in the outcome of muscle strength in 10 RM and knee extension ROM after the combined intervention of perturbation training and resistance exercise for Grade II OA Knee Patients. Thus this study may be concluded that there was a significant improvement in knee extensor muscle strength (1 RM) in the affected knee joint in a patient with grade II knee osteoarthritis after combined intervention perturbation training and dynamic resistance exercises.

Keywords: Grade II OA Knee, Perturbation Training, Resistance Exercise, 10 RM, Knee extension ROM.

Corresponding Author: Madhuripu P, Associate Professor cum PhD Research Scholar, Institute of Physiotherapy, Srinivas University, Mangaluru, India.

E-mail: madhuripu@gmail.com

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Introduction

Osteoarthritis is a degenerative arthritis and a diverse group of conditions that produces joint signs and symptoms which are linked to deterioration of articular cartilage, apart from bone and at the joint margins deteriorations[1]. Although joint wear and tear is the most common cause, inflammatory, metabolic, and mechanical factors can also contribute to degenerative joint disease. Numerous environmental factors, such as profession and associated traumas, can start different disease processes.[2]

The severity of the condition might vary, but it typically affects stressful joints and results in articular cartilage damage, subchondral bone remodeling, the development of osteophytes, and subchondral cysts.[3]

Knee osteoarthritis is a common disorder in elderly adults that causes substantial functional restrictions and hardship. Physical limitations related to OA in the knee also include pain, loss of motion, and decreased quadriceps muscle strength.[3]

Secondary OA is characterized by a slow loss of cartilage in the joints, followed by restoration and bone thickening, and develops as a result of trauma, obesity, or inflammatory joint issues.[4]

Perturbation techniques are excellent techniques in patients with knee OA. The intensity should be minimized to nullify stress on knee joint structures, whose outcomes are pain, edema, and inflammatory changes. Perturbation training, a method for fostering the growth of motor abilities that guard against damaging knee stress, promotes knee stability and balance in a controlled way for the purpose of rehabilitation.[5,6.]

Perturbation improves proprioceptive impulse propagation to the muscle, decreasing injury and boosting performance. Perturbation exercise training is intended to stress the neuromuscular system, which helps with balance and daily functions.[7] Resistance training (RX) improves physical function, reduces OA pain, and lowers self-reported disability [8,9,10] Resistance exercises (RE) stand out among the many different forms of workouts, and their effectiveness necessitates special consideration.[12,13]

Since muscle weakness is the primary OA symptom, RE treatments have recently been advised.[14] Thus, there is sufficient evidence to support the benefit of muscle strength training methods in slowing disease development.[15]

Research article in 2012 **s**tated that dynamic exercise with resistance play an important role in treating the pathological mechanisms of knee joint osteoarthritis, added strength and power of the extensor muscle activation of muscle related to balance and pathomechanics and loading in cartilaginous structures. Dynamic resistance exercises can be modified based on symptoms and instruments.[16]

Lot of research work has been done and available to disclose the effectiveness of perturbation training and dynamic resistance exercise to improve the condition of osteoarthritis of the knee joint. But at the same time there are very limited study and publications are available on the combination of both these techniques in the functional outcome grade II osteoarthritis of the knee joint.

OBJECTIVE OF THIS STUDY:

To analyze and understand the effect of perturbation training and dynamic resistance exercise training on muscle strength and knee extension range of motion in grade II knee osteoarthritis.

Methodology

It is a single case study. A 52 – year – old male patient was diagnosed grade II Knee Osteoarthritis based on X ray of the knee joint of the patient (Kellergen Lawrence Classification) (Figure 1) by Orthopedic Physician referred to Abhinav Physiotherapy and Rehabilitation Centre for physiotherapy intervention. His demographic profile was undertaken including vitals and BMI. Patient's informed consent was taken. His pain in VAS, Muscle strength in 1 Repetition Maximum (1RM), Knee Extension Range of Motion was measured and documented for analysis (See Table 1). He has been recruited for treatment. He had been given perturbation training and dynamic resistance exercise training for 30 minutes a session, 4 sessions for a week for 4 weeks.

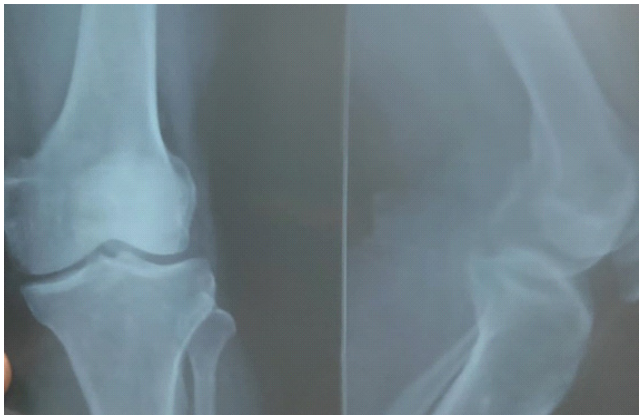

Figure 1: Grade II Osteoarthritis of Knee Joint (Source: Author)

Intervention Procedure:

Perturbation Training: A perturbation is a small change in a movement. Participants stood on a foam surface with single leg support while the therapist attempted to perturb the participants balance in various directions. Participants stood on the wobble board with double limb support and the therapist applied perturbations of the wobble board in a random fashion. After 10 to 30 seconds of perturbations on each leg, the patient switched feet and the technique were repeated. It will be done for a 30 minutes after a session of 30 repetitions. Double leg foam balance activity, Tilt board balance training, Roller board (See Figure 2)[17, 18]

Dynamic Resistance Exercises for Knee Extension: Dynamic resistance exercise is a technique, load and repetition structure with guidance of progression is a suitable alternative for patients with knee osteoarthritis. Dynamic resistance exercises were given by using weight cuffs. Patients 10 RM will be measured. 3 sets of 10 repetitions with 5 – 10 seconds held as instructed by the therapist will be given to the patients. 16 sessions of dynamic resistance exercise with perturbation training will be given to the patients of experimental group (See Figure 3).[12,13,19]

Figure 2: Subject performing perturbation training for knee joint in balance board (Source: Author)

Figure 3: Subject performing dynamic resistance exercise for knee joint in balance board (Source: Author)

Outcome measures:

Knee extensor muscle strength in 1 Repetition Maximum (1 RM) and knee extension range of motion were measured pre and post intervention in a combination of perturbation training and dynamic resistance exercise training to the patient.

Table 1: Outcome Measures (Source: Author)

Intervention	1 RM (in Kgs)	Knee extension Range of Motion (in degrees)	Visual Analogue Scale for Pain
Pre Intervention	10 Kgs	-10	9
After 1 Week	10 Kgs	-10	8

Continue.....

After 2 Weeks	12 Kgs	-8	7
After 3 Weeks	13 kgs	-8	5
Post Intervention (After 4 Weeks)	13 kgs	-5	5
Follow up 1 (After 8 Weeks)	14 Kgs	-5	4
Follow up 2 (After 20 Weeks)	14 Kgs	-5	4

Data Analysis and Results

Pre intervention, after 1 week, 2 weeks, 3 weeks, 4 weeks, and follow-up 1 (after 12 weeks), follow-up 2 (after 20 weeks) Measurements were taken for analysis. There was significant improvement in both outcome measures of 1 RM and knee extension range of motion progressively. In follow-up 1 and 2 after 12 and 20 weeks, respectively, improved 1 RM and knee extension range of motion was maintained (See Table 1)

The data analysis and results of this study demonstrate that there is uniformity of pre-intervention factors of extensor muscle strength and knee extension lag range. The improvement is a significant improvement in the strength of extensor muscle and knee extension lag range.

Discussion

Implementing rehabilitation regimens for knee OA patients using perturbation training methodologies increases therapeutic success by allowing patients to return to higher activity levels in less time. Although it is difficult to declare perturbation training approaches may assist patients to build and alter neuromuscular control mechanisms, allowing for functional performance (higher levels) than would otherwise be possible. A method of physical therapy comprising perturbation exercises was well tolerated in a symptomatic knee OA group .In comparison to other physical therapy or medicinal techniques; it was also linked to better pain, function, and balance, as well as falls.[17]

This study's findings showed that perturbation training improves the functional outcomes of muscular strength and knee extension lag in people with OA knees. Several recent research have also published comparable findings.[18,19] The results of this study demonstrate that when completing dynamic resistance exercise training and perturbation training in OA knee patients, there is a significant increase in the strength of the knee extensor muscles and extension lag range. The upshots of this study propose that combination perturbation training and dynamic resistance exercise increases knee joint functional outcomes in the form of knee extensor muscle strength and extension lag range, as well as boosting knee balance through proprioception and kinesthetic awareness, as reported in some recent studies.

Conclusion

There was significant improvement in muscle strength (1 RM) and knee extensor muscle strength in the affected knee joint in a patient with grade II knee osteoarthritis after combined intervention perturbation training and dynamic resistance exercises for knee joints for 16 sessions within the span of 4 weeks. Perturbation training will be preferable intervention for grade II knee osteoarthritis, because of perturbation training improves proprioceptive impulse propagation to the muscle, decreasing injury and boosting performance.

CRediT AUTHORSHIP CONTRIBUTION STATEMENT:

Author a: Conceptualization, Formal Analysis, Methodology, Writing – Original Draft, Project Administration.

Author b: Conceptualization, Investigation, Writing – Original Draft, Writing – Review and Editing, Investigation, Project Supervision.

Author c: Formal Analysis, Data Collection, Methodology, Investigation.

Author d: Formal Analysis, Data Collection, Methodology, Investigation.

Author e: Formal Analysis, Data Collection, Methodology, Investigation.

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Dr. B. Pradeep Kumar, Consultant Physiotherapist, Abhinav Physiotherapy Centre, Madurai, Tamilnadu.

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