# THE IMPACT OF DIFFERENT PHYSIOTHERAPY METHODS ON IMPROVING FUNCTION IN GRADE II PATELLAR CHONDROMALACIA: A COMPARATIVE CASE ANALYSIS

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**Abstract**

*Patellar chondromalacia represents a prevalent form of knee joint pathology, particularly among physically active young women (Smith et al., 2017). However, the scientific literature remains deficient in data regarding the comparative efficacy of diverse physiotherapy techniques. The principal objective of this investigation was to assess the differential effects of various physiotherapy methods on alterations in knee function in the context of Grade II patellar chondromalacia. Findings indicate that when contrasting physiotherapy and shockwave therapy against balance and muscle strength training conducted on a motorized HUBER 360 platform, physiotherapy, and shockwave therapy were notably superior in augmenting the strength of the thigh and gluteal muscles. Training on the motorized HUBER 360 platform exhibited greater efficacy in alleviating pain in the femur-patella joint and enhancing the range of motion in the knee joint. Nevertheless, both interventions had no discernible impact on the progression of femur-patella joint damage or alterations in the femur-patella Q angle.*

**Keywords:** *patellar chondromalacia, physiotherapy, shockwave therapy, motorized HUBER 360 platform.*

**Introduction**

Patellar chondromalacia is characterized by the degeneration of articular cartilage on the patellar surface (Hyuck et al., 2022) and affects approximately 23% of the global population (Smith et al., 2017). This condition is more prevalent among women due to an increased Q angle (Hyuck et al., 2022). Individuals diagnosed with patellar chondromalacia commonly present with pain, resulting from the friction between the patella and the femur (Vijayalakshmi et al., 2019). Physiotherapeutic interventions in managing patellar chondromalacia typically involve the enhancement of the quadriceps femoris muscle strength (Hyuck et al., 2022). Weakness in the inner part of the quadriceps and excessive activation of the outer part are fundamental factors contributing to patellar instability and pain (Mellinger et al., 2019). Physiotherapy strives to optimize the activation of the inner vastus medialis muscle, hip adductors, and external hip rotators (Alarab et al., 2019).

Extracorporeal shockwave therapy is increasingly employed to treat various musculoskeletal conditions, demonstrating effectiveness in pain reduction and acceleration of the healing process (Schroeder et al., 2021). The therapy reduces the transmission of pain signals to the brain due to hyperstimulation of the afflicted region (Muaidi, 2020). Extracorporeal shockwave therapy is typically administered every week for four weeks, entailing 2000 impulses, a frequency of 10 Hz, and an energy flux density of 0.6 mJ/mm², with each session lasting 10 minutes (Hammam et al., 2020).

Training on the multidirectional motorized HUBER 360 platform significantly augments proprioception, enhances equilibrium, and amplifies the strength of both deep and superficial thigh muscles, thereby leading to pain reduction (Gherghel et al., 2019). Furthermore, these exercises bolster dynamic stability, which correlates directly with the increase in strength of the thigh and gluteal muscles, as the rectus femoris and posterior thigh muscles are responsible for sustaining dynamic stability (Carvalho et al., 2013).

Pain stemming from patellar chondromalacia represents a prevalent source of anterior knee pain among active adolescents and individuals under 60 years of age (Gaitonde et al., 2019). Scientific literature offers limited investigations into the effects of shockwave therapy and balance training on a motorized HUBER 360 platform to functional improvement in cases of Grade II patellar chondromalacia. Consequently, this study will employ physiotherapy and shockwave therapy in conjunction with balance training on the HUBER 360 platform to assess the influence of these rehabilitation modalities on functional alterations in Grade II patellar chondromalacia cases.

**Methods and Study Design:**

Study Population: The study involved a single female participant aged 22 years, who conformed to the predefined selection criteria: (1) a radiologically confirmed Grade II patellar chondromalacia; (2) a positive Clarke's test; (3) a history of engaging in physical activity at least twice per week; (4) a self-reported subjective pain rating on the visual analogy scale not less than 4 scores.

***Assessment of Knee Pain***: The quantification of knee pain was executed using a visual analogy pain scale, which represents a psychometric, linear scale for the subjective evaluation of pain. This scale extends from 0 to 10, where 0 signifies an absence of pain, and 10 denotes intolerable pain. The participant autonomously assessed her level of pain on this scale, utilizing the numerical continuum to denote her subjective pain experience.

***Assessment of the Patellar-Femoral Q Angle***: The determination of the patellar-femoral Q angle was performed employing a goniometer, with the participant in a supine position on an examination table. Two linear references were delineated: one connecting the midpoint of the patella to the anterior superior iliac spine, and the other spanning from the centre of the patella to the tibial tuberosity. The angular measurement between these reference lines was carried out using the goniometer (Malone, 2017).

***Assessment of Tight and Gluteal Muscle Strength***: The evaluation of muscle strength encompassed the deployment of the Lafayette Manual Muscle Testing System. During the assessment, the muscle force was recorded at the highest point of the forearm. The testing protocol encompassed the assessment of the strength of the gluteus maximus, quadriceps, vastus medialis, vastus lateralis, rectus femoris, hip adductors, and hip abductors.

***Initial Position for Assessment of the Gluteus Maximus*****:** The participant assumed a prone position on the examination table, and the Lafayette muscle strength tester was positioned superiorly to the sacrum, providing an opposing force. Following the auditory cue, the participant executed hip extension with full knee extension, concluding upon the subsequent auditory signal.

***Initial Position for Assessment of the Quadriceps:*** The participant was seated at a 90° angle on the examination table, with knees flexed. The Lafayette muscle strength tester was situated superior to the ankle, offering resistance. Upon receiving the initial auditory cue, the participant executed knee extension until the second auditory cue.

***Initial Position for Assessment of the Vastus Medialis:*** The participant was seated at a 90° angle on the examination table with the knees flexed. The Lafayette muscle strength tester was positioned superiorly to the ankle, providing resistance. The participant, upon hearing the first auditory cue, performed knee extension, concurrently externally rotating the foot to assess the strength of the vastus medialis and internally rotating the foot to evaluate the strength of the vastus lateralis. This movement was executed until the second auditory cue.

***Initial Position for Assessment of the Hip Adductors*****:** The participant stood in lateral alignment against a wall, with the Lafayette muscle strength tester located superiorly to the inner ankle, supplying resistance. The movement encompassed hip adduction, ceasing upon auditory signal reception.

***Initial Position for Assessment of the Hip Abductors*****:** The participant stood laterally against a wall, and the Lafayette muscle strength tester was positioned superiorly to the outer ankle, imparting resistance. The movement involved hip abduction, concluding upon auditory signal reception. All the muscle groups were bilaterally evaluated, and the recorded results were expressed in kilograms.

**Assessment of the knee joint range of motion** was conducted utilizing goniometry. This assessment encompassed the performance of knee joint flexion and extension movements. To appraise the range of motion of the knee joint, the participant assumed a seated position on an examination table, with her legs fully extended and knees flexed at a 90-degree angle. The axis of the goniometer coincided with the axis of the knee joint. The non-moving segment of the goniometer was positioned at the junction of the tibia and femur, while the mobile part of the goniometer moved synchronously with the tibia during knee joint motion. The results of these movements were recorded in degrees when the participant achieved her maximal knee flexion and extension amplitudes.

**Study Organization**:

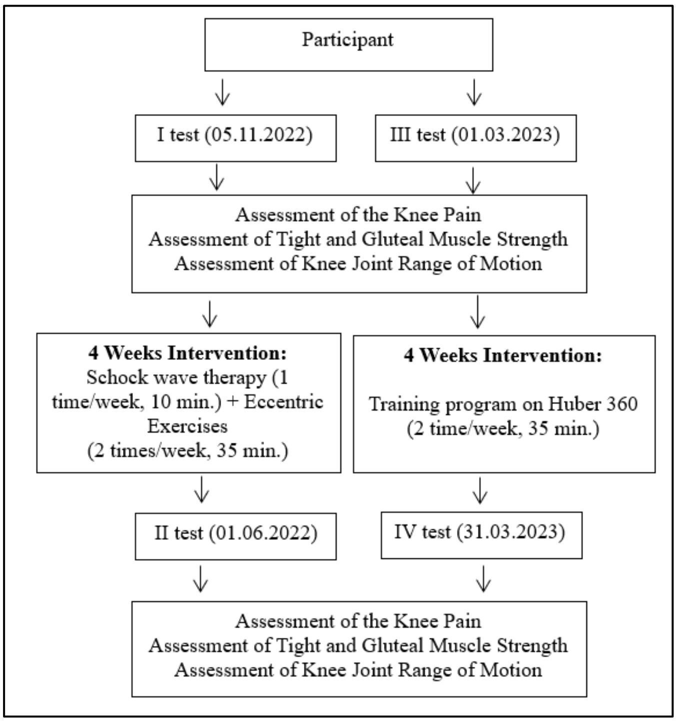
The investigation involved the application of two distinct physiotherapeutic interventions to the participant. The onset of the study, comprising physiotherapy and shockwave therapy (I test), commenced on May 11, 2022, and concluded (II test) on June 1, 2022. The commencement of training on the motorized HUBER 360 platform (III test) was initiated on March 1, 2023, with the culmination (IV test) on March 31, 2023. The period between II and III tests was 9 months. All assessments were conducted in the physiotherapy facility of Šiauliai State College. The decision to employ two divergent methodologies at discrete time intervals for the same participant was predicated on the premise that this approach affords the most uniform and objective means of assessing the effects of these interventions on measures of strength and pain in the context of patellar chondromalacia.

The testing protocol comprised a series of four evaluations (see Figure 1). Throughout the first, second, third, and fourth assessments, the following measures were undertaken: pain appraisal using the Visual Analog Scale (VAS), assessment of thigh and gluteal muscle strength employing the Lafayette system, and determination of the range of motion of the knee joint.

Shockwave therapy was administered once weekly for a duration of four weeks, with each session comprising 10 minutes and involving 2000 impulses, a frequency of 10Hz, and an energy density of 0.6 mJ/mm2. The participant was seated during the administration of shockwave therapy, and a coupling gel was utilized alongside the shockwave therapy device (Hammam et al., 2020). Thigh muscle strengthening exercises were performed three times per week (comprising a total of eight physiotherapy sessions). Each session had a duration of 35 minutes and included exercises with three sets of ten repetitions, incorporating a 6-second inter-repetition rest interval and a 1-minute rest period between sets (Hafez et al., 2012; Alarab et al., 2019; Gaitonde et al., 2019).

Training sessions on the motorized HUBER 360 platform spanned four weeks, occurring twice weekly for 30 minutes each session (Akinoglu et al., 2019). During platform-based training, exercises were executed for 10 minutes with a 5-minute intermission. The program encompassed pushing and pulling exercises involving the platform handles in various configurations: (1) Feet parallel on the platform, hands positioned at chest level, and platform movement in forward, backward, upward, downward, leftward, and rightward directions. The tasks were performed both with and without visual feedback. (2) Feet at shoulder width, hands at shoulder level, platform movement in forward, backward, upward, downward, leftward, and rightward directions. The exercises were executed with and without visual feedback. (3) Feet positioned at an angle to each other, with hands placed freely, platform movement in forward, backward, upward, downward, leftward, and rightward directions. The exercises were performed with and without visual feedback.

**Figure 1 Scheme of study design**




**Data description and comparative analysis**:

The research data underwent analysis using descriptive statistical methods facilitated by the Microsoft Excel 2010 software package. This data processing procedure encompassed the computation and comparison of parameters both before and following the interventions, specifically physiotherapy and shockwave therapy, as well as before and following training on the multidirectional motorized HUBER 360 platform. The analytical framework involved an examination of disparities concerning temporal factors (pre- and post-intervention), the influence of the injured leg condition (distinguishing between the non-injured leg and injured leg), the various interventions (comprising physiotherapy and shockwave therapy, in addition to training on the multidirectional motorized HUBER 360 platform), and physical performance results.

**Results of Pain Intensity Assessment**

Comparing the results of pain intensity (see Table 1) *before and after the interventions*, we found that the pain tended to decrease by 2 points in the injured leg after physiotherapy and shockwave therapy, and by 4 points after training exercises on the motorized HUBER 360 platform. There was no change in pain in the non-injured leg during both interventions, and it remained at 0 points.

Comparing the results of pain intensity (see Table 1) *between the interventions*, we found that the pain intensity was 1 point lower after training exercises on the motorized HUBER 360 platform intervention than after physiotherapy and shockwave therapy intervention.

Table 1

**Results of the knee pain difference between legs before and after Interventions**

| | I Test | II Test | III Test | IV Test |
|---|---|---|---|---|
| Knee pain difference between legs (points) | 5 | 3 | 6 | 2 |

**Results of Thigh and Gluteal Muscle Strength Assessment**

Comparing the gluteal muscle strength results (see Table 2) *between non-injured and injured legs*, we determined that before the physiotherapy and shockwave therapy intervention, there was no difference in gluteal muscle strength between the legs, but after the intervention, there was a 0.3 kg difference. Likewise, before the training exercises on the motorized HUBER 360 platform intervention, there was a 0.5 kg difference in gluteal muscle strength between the legs, which tended to reduce to 0.3 kg after the intervention.

Comparing the gluteal muscle strength results (see Table 2) *before and after the interventions*, we determined that gluteal muscle strength tended to increase by 2.7 kg in the injured leg after the physiotherapy and shockwave therapy intervention and by 2.2 kg after the training exercises on the motorized HUBER 360 platform intervention. In the non-injured leg, gluteal muscle strength tended to increase by 3 kg after the physiotherapy and shockwave therapy intervention and by 2 kg after the training exercises on the motorized HUBER 360 platform intervention.

Furthermore, in the comparative assessment of the gluteal muscle strength results (see Table 2) *between the interventions*, we determined that in the injured leg, gluteal muscle strength was 0.5 kg tended to be greater after the physiotherapy and shockwave therapy intervention than after the balance and muscle strength training exercises on the motorized HUBER 360 platform intervention.

Table 2

**Results of the Gluteal Muscle Strength Before and After Interventions**

| | **I Test** | | **II Test** | | **III Test** | | **IV Test** | |
|---|---|---|---|---|---|---|---|---|
| | **Non-injured leg** | **Injured leg** | **Non-injured leg** | **Injured leg** | **Non-injured leg** | **Injured leg** | **Non-injured leg** | **Injured leg** |
| Muscle stenght (kg) | 15 | 15 | 18 | 17,7 | 15 | 15,5 | 17,2 | 17,5 |

Comparing the quadriceps strength results (see Table 3) b*etween the non-injured and injured legs,* we determined that before the physiotherapy and shockwave therapy intervention, there was a difference of 1.6 kg in quadriceps strength between the legs, which tended to decrease to 0.3 kg after the intervention. Similarly, before the training exercises on the motorized HUBER 360 platform intervention, there was a 1.2 kg difference in quadriceps strength between the legs, which tended to reduce to 1.1 kg after the intervention.

Comparing the quadriceps strength results (see Table 3) *before and after the interventions*, we determined that in the injured leg, quadriceps strength tended to increase by 1.9 kg after the physiotherapy and shockwave therapy intervention and by 1.3 kg after the training exercises on the motorized HUBER 360 platform intervention. In the non-injured leg, quadriceps strength tended to increase by 0.6 kg after the physiotherapy and shockwave therapy intervention and by 1.2 kg after the training exercises on the motorized HUBER 360 platform intervention.

Furthermore, in the comparative assessment of the quadriceps strength results (see Table 3) *between the interventions*, we determined that in the injured leg, quadriceps strength was 0.6 kg tended to be greater after the physiotherapy and shockwave therapy intervention than after the training exercises on the motorized HUBER 360 platform intervention.

Table 3

**Results of Quadriceps Muscle Strength Before and After Interventions**

| | **I Test** | | **II Test** | | **III Test** | | **IV Test** | |
|---|---|---|---|---|---|---|---|---|
| | **Non-injured leg** | **Injured leg** | **Non-injured leg** | **Injured leg** | **Non-injured leg** | **Injured leg** | **Non-injured leg** | **Injured leg** |
| Muslce stenght (kg) | 19,4 | 17,8 | 20 | 19,7 | 19,2 | 18 | 20,4 | 19,3 |

Comparing the adductor muscle strength result (see Table 4) *between the non-injured and injured legs*, we determined that before the physiotherapy and shockwave therapy intervention, there was a difference of 1 kg in adductor muscle strength between the legs, which tended to decrease to 0.4 kg after the intervention. Similarly, before the training exercises on the motorized HUBER 360 platform intervention, there was a 1 kg difference in adductor muscle strength between the legs, which tended to reduce to 0.8 kg after the intervention.

Comparing the adductor muscle strength result (see Table 4) *before and after the interventions*, it was determined that in the injured leg, adductor muscle strength tended to increase by 0.8 kg after the physiotherapy and shockwave therapy intervention and by 1 kg after the training exercises on the motorized HUBER 360 platform intervention. In the non-injured leg, adductor muscle strength increased by 0.2 kg after the physiotherapy and shockwave therapy intervention and by 0.8 kg after the balance and muscle strength training exercises on the motorized HUBER 360 platform intervention.

Furthermore, in the comparative assessment of the adductor muscle strength result (see Table 4) *between the interventions*, it was determined that in the injured leg, adductor muscle strength was 0.2 kg tended to be greater after the balance and muscle strength training exercises on the motorized HUBER 360 platform intervention than after the physiotherapy and shockwave therapy intervention.

Table 4

**Results of Adductor Muscle Strength Before and After Interventions**

| | **I Test** | | **II Test** | | **III Test** | | **IV Test** | |
|---|---|---|---|---|---|---|---|---|
| | **Non-injured leg** | **Injured leg** | **Non-injured leg** | **Injured leg** | **Non-injured leg** | **Injured leg** | **Non-injured leg** | **Injured leg** |
| Muslce stenght (kg) | 17,2 | 16,2 | 17,4 | 17 | 17 | 16 | 17,8 | 17 |

Comparing the vastus medialis strength results (see Table 5) *between the non-injured and injured legs*, we determined that before the physiotherapy and shockwave therapy intervention, there was a difference of 1.1 kg in vastus medialis strength between the legs, which tended to decrease to 1 kg after the intervention. Similarly, before the training exercises on the motorized HUBER 360 platform intervention, there was a 0.8 kg difference in vastus medialis strength between the legs, and this difference remained at 0.8 kg after the intervention.

Comparing the vastus medialis strength results (see Table 5) *before and after the interventions*, it was determined that in the injured leg, vastus medialis strength tended to increase by 0.5 kg after the physiotherapy and shockwave therapy intervention and by 0.4 kg after the training exercises on the motorized HUBER 360 platform intervention. In the non-injured leg, vastus medialis strength tended to increase by 0.4 kg after the physiotherapy and shockwave therapy intervention and by 0.4 kg after the training exercises on the motorized HUBER 360 platform intervention.

Furthermore, in the comparative assessment of the external vastus medialis results (see Table 5) *between the interventions*, it was determined that in the injured leg, vastus medialis strength was 0.1 kg tended to be greater after the physiotherapy and shockwave therapy intervention than after the training exercises on the motorized HUBER 360 platform intervention.

Table 5

**Results of External Quadriceps Strength Before and After Interventions**

| | **I Test** | | **II Test** | | **III Test** | | **IV Test** | |
|---|---|---|---|---|---|---|---|---|
| | **Non-injured leg** | **Injured leg** | **Non-injured leg** | **Injured leg** | **Non-injured leg** | **Injured leg** | **Non-injured leg** | **Injured leg** |
| Muslce stenght (kg) | 18,1 | 17 | 18,5 | 17,5 | 17,8 | 17 | 18,2 | 17,4 |

Comparing the biceps femoris muscle strength results (see Table 6) *between the non-injured and injured legs*, we determined that the biceps femoris muscle strength between the legs remained at 1.4 kg before and after the physiotherapy and shockwave therapy intervention intervention. Similarly, before the training exercises on the motorized HUBER 360 platform intervention, there was a 1.5 kg difference in biceps femoris muscle strength between the legs, which tended to reduce to 0.9 kg after the intervention.

Comparing the biceps femoris muscle strength results (see Table 6) *before and after the interventions*, it was determined that in the injured leg, biceps femoris muscle strength tended to increase by 0.2 kg after the physiotherapy and shockwave therapy intervention and by 0.6 kg after the training exercises on the motorized HUBER 360 platform intervention. In the non-injured leg, biceps femoris muscle strength tended to increase by 0.2 kg after the physiotherapy and shockwave therapy intervention and by 1 kg after the training exercises on the motorized HUBER 360 platform intervention.

Furthermore, in the comparative assessment of the biceps femoris muscle strength results (see Table 6) *between the interventions*, it was determined that in the injured leg, biceps femoris muscle strength was 0.4 kg tended to be greater after the training exercises on the motorized HUBER 360 platform intervention than after the physiotherapy and shockwave therapy intervention.

Table 6

**Results of Biceps Femoris Muscle Strength Before and After Interventions**

| | **I Test** | | **II Test** | | **III Test** | | **IV Test** | |
|---|---|---|---|---|---|---|---|---|
| | **Non-injured leg** | **Injured leg** | **Non-injured leg** | **Injured leg** | **Non-injured leg** | **Injured leg** | **Non-injured leg** | **Injured leg** |
| Muslce stenght (kg) | 19 | 17,6 | 19,2 | 17,8 | 19 | 17,5 | 20 | 18,1 |

Comparing the hip adductor muscle strength results (see Table 7) *between the non-injured and injured legs*, we determined that both before and after the physiotherapy and shockwave therapy intervention, there was a 2 kg difference in hip adductor muscle strength between the legs. Similarly, both before and after the training exercises on the motorized HUBER

360 platform intervention, the difference in hip adductor muscle strength was 1 kg between the legs.

Comparing the hip adductor muscle strength results (see Table 7) *before and after the interventions*, it was determined that in the injured leg, hip adductor muscle strength tended to increase by 2 kg after the physiotherapy and shockwave therapy intervention and by 1 kg after the training exercises on the motorized HUBER 360 platform intervention. In the non-injured leg, hip adductor muscle strength tended to increase by 2 kg after the physiotherapy and shockwave therapy intervention and by 1 kg after the training exercises on the motorized HUBER 360 platform intervention.

Furthermore, in the comparative assessment of the hip adductor muscle strength results (see Table 7) *between the interventions*, it was determined that in the injured leg, hip adductor muscle strength was 1 kg tended to be greater after the physiotherapy and shockwave therapy intervention than after the training exercises on the motorized HUBER 360 platform intervention.

Table 7

**Results of Hip Adductor Muscle Strength Before and After Interventions**

| | **I Test** | | **II Test** | | **III Test** | | **IV Test** | |
|---|---|---|---|---|---|---|---|---|
| | **Non-injured leg** | **Injured leg** | **Non-injured leg** | **Injured leg** | **Non-injured leg** | **Injured leg** | **Non-injured leg** | **Injured leg** |
| Muslce stenght (kg) | 11 | 9 | 13 | 11 | 10 | 9 | 11 | 10 |

Comparing the hip abductor muscle strength results (see Table 8) *between the non-injures and injured legs*, we determined that before the physiotherapy and shockwave therapy intervention, there was a 2 kg difference in hip abductor muscle strength between the legs, which tended to decrease to 1.9 kg after the intervention. Similarly, before the training exercises on the motorized HUBER 360 platform intervention, there was a 0.6 kg difference in hip abductor muscle strength between the legs, which tended to increase to 0.8 kg after the intervention.

Comparing the hip abductor muscle strength results (see Table 8) *before and after the interventions*, it was determined that in the injured leg, hip abductor muscle strength tended to increase to 1.3 kg after the physiotherapy and shockwave therapy intervention and to 0.8 kg after the training exercises on the motorized HUBER 360 platform intervention. In the non-injured leg, hip abductor muscle strength tended to increase to 1.2 kg after the physiotherapy and shockwave therapy intervention and by 1 kg after the training exercises on the motorized HUBER 360 platform intervention.

Furthermore, in the comparative analysis of the hip abductor muscle strength results (see Table 8) *between the interventions*, it was determined that in the injured leg, hip abductor muscle strength was 0.5 kg tended to be greater than after the physiotherapy and shockwave therapy intervention than after the training exercises on the motorized HUBER 360 platform intervention.

Table 8

**Results of Hip Abductor Muscle Strength Before and After Interventions**

| | **I Test** | | **II Test** | | **III Test** | | **IV Test** | |
|---|---|---|---|---|---|---|---|---|
| | **Non-injured leg** | **Injured leg** | **Non-injured leg** | **Injured leg** | **Non-injured leg** | **Injured leg** | **Non-injured leg** | **Injured leg** |
| Muslce stenght (kg) | 13 | 11 | 14,2 | 12,3 | 12 | 11,4 | 13 | 12,2 |

**Results of Knee joint range of motion Assessment**

Comparing the knee joint flexion range of motion results (see Table 9) *between non-injured and injured legs*, we determined that before the intervention of physiotherapy and shockwave therapy, the difference in knee joint flexion range of motion between the legs was 3°, which tended to decrease to 1° after the intervention. Similarly, before the training exercises on the motorized HUBER 360 platform intervention, the difference in knee joint flexion range of motion between the legs was 3°, which became 0° after the intervention.

Comparing the knee joint flexion range of motion results (see Table 9) *before and after the interventions*, it was determined that in the injured leg, the flexion range of motion tended to increase by 2° after the physiotherapy and shockwave therapy intervention and by 3° after the training exercises on the motorized HUBER 360 platform intervention. The knee joint flexion range of motion in the non-injured leg remained unchanged after both interventions.

Furthermore, in the comparative analysis of the knee joint flexion range of motion results (see Table 9) *between the interventions*, it was determined that in the injured leg, the knee joint flexion range of motion was 1°tended to be greater after the training exercises on the motorized HUBER 360 platform intervention than after the physiotherapy and shockwave therapy intervention.

As for the evaluation results of knee joint flexion range of motion results (see Table 9), both in the healthy and affected legs, before and after the interventions, it remained unchanged and equal to 0°.

Table 9

**Results of Knee joint Range of Motion Before and After Interventions**

| Knee range of motion (°) | I Test | | II Test | | III Test | | IV Test | |
|---|---|---|---|---|---|---|---|---|
| | Non-injured leg | Injured leg | Non-injured leg | Injured leg | Non-injured leg | Injured leg | Non-injured leg | Injured leg |
| Flexion | 129 | 126 | 129 | 128 | 129 | 126 | 129 | 129 |
| Extension | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |

***Discussion of Results***

In the study "The impact of different physiotherapy methods on improving function in Grade II patellar chondromalacia: a comparative case analysis" it was determined that in individuals diagnosed with grade II patellar chondromalacia, the strength of thigh and gluteal muscles tended to increase in both legs after both interventions. Specifically, the strength of the gluteal, quadriceps, vastus medialis, thigh adductors, and abductors muscles tended to be greater after physiotherapy and shockwave therapy intervention, while the strength of the vastus medialis and quadriceps muscles was higher after training exercises on the motorized HUBER 360 platform intervention. Moreover, it was found that after muscle strength training exercises on the motorized HUBER 360 platform, there was a tendency for a greater increase in the range of motion of the affected knee joint, as well as a reduction in pain compared to the results obtained after physiotherapy and shockwave therapy.

It is well-known that individuals diagnosed with patellar chondromalacia experience pain due to friction between the patella and the femur (Ranjith et al., 2019). It was established that applying shockwave therapy once a week for four weeks tended to reduce the pain caused by patellar chondromalacia by 2 points. Kim (2017) and colleagues established that extracorporeal shockwave therapy is increasingly used to treat various musculoskeletal and orthopedic conditions. This therapy is characterized by pain reduction and overall functional improvement. In Hammam's study (2020), it was determined that after 4 weeks of shockwave therapy, knee pain on the VAS scale decreased by 2 points. In our study, knee pain also tended to decrease by 2 points on the VAS scale after shockwave therapy. Additionally, it was observed that four weeks of training exercises on the motorized HUBER 360 platform had an impact on reducing pain related to patellar chondromalacia, with pain tended to decrease by 4 points. Ghergel (2019) and colleagues established that balance and muscle strength training exercises on the multidirectional motorized HUBER 360 platform not only significantly improve proprioception and balance but also reduce knee pain. While their study did not find significant results in terms of pain reduction, our results align with their findings.

Muscle asymmetry and weakness are among the causes of patellar chondromalacia development. Research has shown that weak eccentric quadriceps, thigh adductors, abductors,

and gluteal muscle contraction strength significantly affect the development of patellar chondromalacia (Mellinger et al., 2019). In the treatment of patellar chondromalacia, it is particularly important to strengthen the thigh abductors and external thigh muscles (Chen et al., 2018). Our study results show that performing eccentric muscle strength training exercises for the thigh and gluteal muscle groups resulted in the tendency to increase the strength of the gluteal, quadriceps, internal thigh, vastus medialis, quadriceps, thigh adductors, and thigh abductors. These results contributed to pain reduction, improved functional status, and reduced intra-articular pressure (Chen et al., 2018). Hafez (2012) and colleagues observed changes in thigh and gluteal muscle strength and significant pain reduction after eccentric muscle strength training exercises. In our study, eccentric training exercises for thigh and gluteal muscles were performed as described by Hafez (2012) and colleagues, which is why changes in thigh and gluteal muscle strength were observed. Furthermore, training exercises on the motorized HUBER 360 platform also influenced the increase in the strength of the thigh and gluteal muscles. Research has shown that training exercises on the multidirectional HUBER 360 platform increase the strength of deep and superficial thigh muscles (Ghergel et al., 2019). Akinoglu (2019) and colleagues noted an increase in strength in the thigh extensors and hip flexors during balance and muscle strength training exercises on the HUBER 360 platform, which also affected indicators of dynamic stability since the exercises load muscles responsible for postural stability. As our study was conducted based on Akinoglu (2019) and colleagues, we also observed that after training exercises on the motorized HUBER 360 platform, the strength of hip extensors and thigh muscles increased.
Analysing the results of knee joint range of motion it is believed that the increased range of motion in knee flexion of the injured leg is directly related to the reduction of knee pain after physiotherapy and shockwave therapy, as well as after training exercises on the motorized HUBER 360 platform. Meibodi (2022) and colleagues argue that joint mobility is increased by performing balance exercises with and without visual feedback. Therefore, we can conclude that comparing the effects of physiotherapy and shock wave therapy, as well as muscle strength training on the knee joint function, we found that physiotherapy and shock wave therapy are more effective in developing the strength of the thigh and gluteus muscles. Muscle strength training on the motorized HUBER 360 platform was more effective in reducing pain in the hip joint and increasing the range of motion in the knee joint.

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