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SHOCK WAVE THERAPY FOR THE TREATMENT OF THE PATELLAR TENDINOPATHY: A SYSTEMATIC REVIEW

¹Danyelle Leão Guimarães and ²Thiago Vilela Lemos

¹Physiotherapist, from Salgado de Oliveira University. Specialist in Cardiovascular and Respiratory Physiotherapy, from the State University of Goiás (UEG), Specialist in Osteopathy, from the Physiotherapy Manipulative Brazilian School (Ebrafim)

²Physiotherapist, from Pontifical Catholic University of Goiás (PUC GO), PhD in Sciences and Technologies in Health, from University of Brasilia (UnB)

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ABSTRACT

Objective: To identify the benefits of shock wave therapy in the treatment of patellar tendinopathy through a systematic review. **Materials and methods:** A systematic review study, carried out from October to November 2018. In this article, it was included randomized clinical trials with adults of both sexes who have patellar tendinopathy; studies in which the main treatment was based on shock wave therapy compared to no, minimal or other interventions and studies published in scientific journals between 2013 and 2018 without language restriction. The searches were performed in the electronic databases MEDLINE, PEDro, SciELO, LILACS and BINACIS. "shock wave therapy"; "patellar tendinopathy"; "tendinopatiapatelar"; "terapiaporonda de choque"; "tendinopathy"; "tendinopathy of the lower limb" were used as search terms. The data were transcribed to a spreadsheet on the software Microsoft Excel 2016 and expressed as a table and for the evaluation of the methodological quality of the studies, the PEDro quality scale was used. **Results and discussion:** The search for the articles resulted in a total of 57, and 48 out of them were excluded, nine were included for full reading. Then, five of them were excluded, one because they were non-randomized studies and two of them with elderly patients belonging to the sample, resulting in two studies for the analysis. One of these shows that, among the therapeutic extracorporeal modalities, the shock wave therapy is more effective, it reduces the pain, it increases the strength and range of the motion of athletes with patellar tendinopathy; the other article points out that invasive therapies are more effective than shock wave therapy in the treatment of tendinopathy. **Conclusion:** Shock wave therapy presents positive results in the treatment of patellar tendinopathy, when compared to other therapeutic extracorporeal modalities. However, the invasive therapies present better results in a short and long term. It should be observed that there is little scientific evidence on the use of shock wave therapy in biological tissue, and that most of the studies present methodological limitations.

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INTRODUCTION

Patellar tendinopathy injures about 14% of young athletes, and around 60 to 70% of the tendinopathies occur in the distal portion of the patellar tendon. It is considered as the most common one among the tendinopathies due to repetitive overloads (Horstmann *et al.*, 2017).

*Corresponding author: Danyelle Leão Guimarães

Physiotherapist, from Salgado de Oliveira University. Specialist in Cardiovascular and Respiratory Physiotherapy, from the State University of Goiás (UEG). Specialist in Osteopathy, from the Physiotherapy Manipulative Brazilian School (Ebrafim)

Clinically, the patellar tendinopathy is an overuse and frequent condition that presents an unknown pathogenesis and etiology marked by a past medical history of knee pain, and it is, typically, manifested in the lower patella. In some literatures, it is defined as "jumper's knee" since it is particularly common among jumping athletes such as the basketball and volleyball players. Due to its common refractory response to the conservative treatment, a bunch of new treatments have recently emerged, including dry sclerosis injections, platelet-rich plasma therapy, arthroscopic surgical procedures, surgical resection of the lower patella, thermotherapy with

hyperthermia, and shock wave treatment (Christian *et al.*, 2014). For the patellar tendinopathy treatment, shock waves have been widely recognized in the literature due to their potential as a biological regulator; as it promotes changes in the mesenchymal cells of the bone, muscle, ligament and tendinous tissues. Although the mechanism of its therapeutic effects is still unknown, results point out the positive and beneficial effects of the use of shock waves as a treatment for musculoskeletal disorders, with a success rate ranging from 65% to 91%, while the complications are low and / or insignificant (Saggini *et al.*, 2015). The shockwave therapy has been used in the treatment of plenty of musculoskeletal disorders since the late 80s and it has also shown significant results when compared to other therapies for pain relief and other symptoms of tendinopathy, because, besides that, it provides a function improvement. However, few studies on the effective testing of shock wave therapy in the treatment of patellar tendinopathy have been published (Maffulli *et al.*, 2014). The aim of this study is to identify the benefits of shock wave therapy in the treatment of patellar tendinopathy by means of a systematic review.

MATERIALS AND METHODS

Type of Study: A study about systematic review of primary studies, with randomization of the sample. It was performed from October to November in 2018.

Inclusion criteria: Randomized clinical trials with adults, of both sexes and presenting patellar tendinopathy were included in this article; studies in which the main treatment was based on shock wave therapy compared to no, minimal or other interventions; studies published in scientific journals between 2013 and 2018 and without any language restriction.

Search strategy: The searches were run in the electronic databases such as MEDLINE (*Medical Literature Analysis and Retrieval System Online*), PEDro (*Physiotherapy Evidence Database*), SciELO (*Scientific Electronic Library Online*), LILACS (*Literatura Latino-Americana e do Caribe em Ciências da Saúde*) and BINACIS (*Bibliografía Nacional en Ciencias de la Salud*). The terms for the searches were "shock wave therapy"; "patellar tendinopathy"; "tendinopatiapatelar"; "terapiaporondas de choque"; "tendinopathy"; "tendinopathy of the lower limb".

Extraction of data: For the studies' analysis, it was collected the data related to the type of study used in the research, allocation of the groups and the evaluation instruments used; data regarding the participants, the intervention, the duration and frequency of treatment sessions based on shock wave therapy and the control group (no, minimal and other types of interventions), results and conclusion. The data were transcribed to a spreadsheet on the software Microsoft Excel 2016 and they were expressed as a table. The selection process of the articles, which were included in the analysis, was through the flowchart of *Preferred Reporting Items for Systematic Reviews and Meta-Analysis* (PRISMA) (Moher *et al.*, 2019).

Evaluation of the methodological quality of the studies: For the evaluation of the methodological quality of the studies, the PEDro quality scale was used, and it evaluates the methodological and statistical quality of the articles included in the analysis. The PEDro quality score varies from 0 to 10

points, since item 1 is not used to calculate the PEDro score (Table 1) (Shiwa *et al.*, 2011).

Table 1. PEDroqualityscale

PEDroQualityScale	
1.	Have the eligibility criteria been specified?
2.	Were the participants randomly split up in groups?
3.	Was the participants' allocation regarded as confidential?
4.	Were the groups initially similar to the most important prognostic indicators?
5.	Was it a blind experiment for all the participants?
6.	Did all the therapists run a blind therapy?
7.	Did all the evaluators, who measured, at least, one key outcome, do it blindly?
8.	Were measurements of, at least, one key outcome, obtained in more than 85% of the participants who were initially split up in the groups?
9.	Did all the participants, that presented measurements results, receive the treatment or the control condition according to the allocation or, when this was not the case, was the data analysis done for at least one of the key outcome for "treatment intention"?
10.	Were the results of the intergroup statistical comparisons described for at least one key outcome?
11.	Does the study present both precision and variability measures for at least one key outcome?

RESULTS AND DISCUSSION

According to the inclusion criteria, the search for the articles resulted in a total of 57, and 48 out of them were excluded, nine were included for full reading. Then, five of them were excluded, one because they were non-randomized studies and two of them with elderly patients belonging to the sample, resulting in two studies for the analysis (Figure 1).

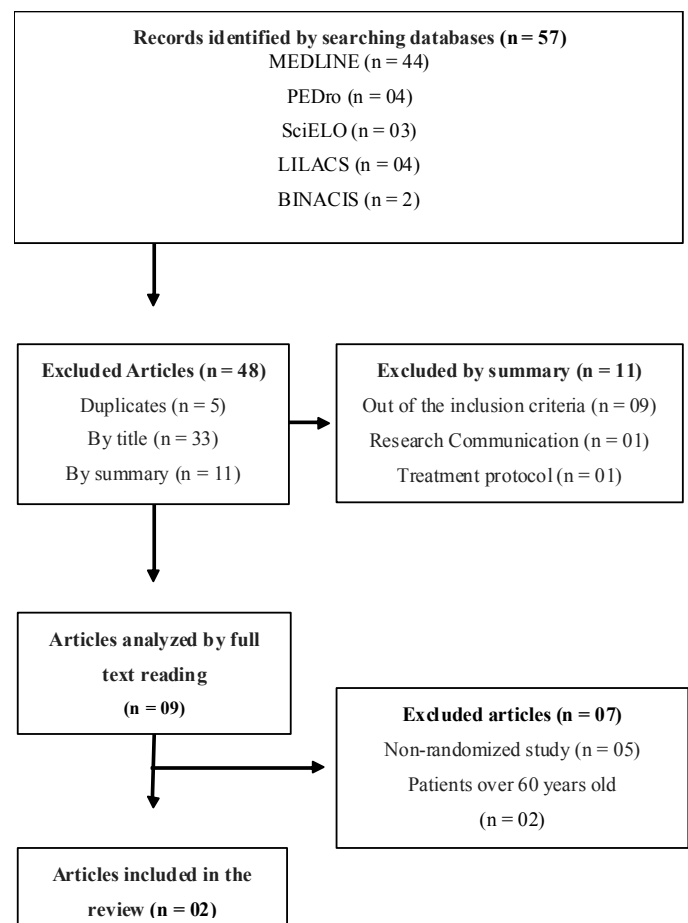


Figure 1. Selection process of the articles included in the analysis according to the PRISMA 2009 flowchart

Table 1. Details of the data extraction from the studies

Author and year	Type of study	Evaluation instruments	Participants	Intervention	Results	Conclusion
Cheng et al., 2018.	Randomized clinical trial	-Visual Analogue Scale (VAS). -Peak torques of the knee joint at 60 ° and 240 °. -Knee extensors resistance.	Athletes with patellar tendinopathy were matched according to their age, height and body weight; they were randomly split up in an: Experimental group (n = 26) and in a control group (n = 25).	The participants in the experimental group were treated once a week for 16 weeks; shock wave therapy sessions were performed (2,000 single shocks, strength, 1.5 to 3.0, shock frequency, 9 to 12 Hz). The participants in the control group performed random sessions based on acupuncture, ultrasound waves, and microwave therapy for the same number of weeks.	After 16 weeks, the VAS score in the experimental group was reduced by 69.4% (p < 0.01). The peak torques of the knee joint at 60 ° and 240 ° increased 17.2% (p < 0.01) and 7.2% (p < 0.05), respectively, and the resistance of the extensor in 17 , 4% (P < 0.05). When the groups are compared, the VAS score in the experimental group was reduced by 62.7% (p < 0.01); while the peak torques of the knee joint at 60° and 240 ° increased by 8.8% and 5.8%, respectively, and the extensor resistance increased by 12.5% (p < 0.05).	The shock wave therapy has a positive effect on patellar tendinopathy in athletes. It can be used to relieve the pain and improve the strength and endurance of the knee joint extensors, consequently enhancing the athlete's functionality and performance.
Smith and Sellon, 2014.	Controlled randomized clinical trial.	-Italian version of the Victorian Institute of Sport Assessment questionnaire - Patella (VISA-P), that measures the severity of the symptoms, the function and the capacity to practice sports. -Visual Analogue Scale (VAS) was used to assess the pain while doing 5 squats. - Blazina Scale (from excellent to bad).	The study was composed of 46 athletes diagnosed with patellar tendinopathy and they were randomly divided into two groups: The patients treated with platelet-rich plasma injections (PRP) (n = 23). The patients in the shock wave therapy group (n = 23).	The patients in the platelet-rich plasma (PRP) injection group (n = 23) received 2 Ultrasound-guided injections directed at the affected tendon portion. Each injection consisted of 2 mL of non-activated autologous PRP extracted from a single 10mL centrifugation of blood and a trained physician performed it using a 22-gauge needle. The patients in the shock wave therapy group (n = 23) received 3 sessions (2400 pulses at 0, 17-0,25mJ / mm per session) ranging from 48 to 72 hours. One week later, the two groups began a conventional stretching and strengthening program. The study lasted 12 months.	The VISA-P scores of both groups improved significantly from the beginning of the treatment (55.3 for PRP, 56.1 for shock wave therapy), however, the PRP group had the greatest improvement at 6 months (86.7 vs 73.7, p = 0.014) and at 12 months (91.3 vs 77.6, p = 0.026). The scores related to the pain when doing five squats demonstrated similar results. At 12 months, a higher proportion of the patients from the PRP group rated their response to treatment as good or excellent (PRP, 91.3% vs. shock wave therapy, 60.8%, p = 0.035).	When the shock wave therapy is compared with the application of platelet-rich plasma injections, the injections present more positive results than by shock wave therapy.

Table 2. Evaluation of the methodological quality according to the PEDro quality scale

Criteria	Cheng et al., 2018.	Smith and Sellon, 2014.
1. Have the eligibility criteria been specified?	Yes	Yes
2. Were the participants randomly split up in groups?	Yes	Yes
3. Was the participants' allocation regarded as confidential?	Yes	Yes
4. Were the groups initially similar to the most important prognostic indicators?	Yes	Yes
5. Was it a blind experiment for all the participants?	No	No
6. Did all the therapists run a blind therapy?	No	No
7. Did all the evaluators, who measured, at least, one key outcome, do it blindly?	No	No
8. Were measurements of, at least, one key outcome, obtained in more than 85% of the participants who were initially split up in the groups?	Yes	Yes
9. Did all the participants, that presented measurements results, receive the treatment or the control condition according to the allocation or, when this was not the case, was the data analysis done for at least one of the key outcome for "treatment intention"?	Yes	Yes
10. Were the results of the intergroup statistical comparisons described for at least one key outcome?	Yes	Yes
11. Does the study present both precision and variability measures for at least one key outcome?	Yes	Yes
Score 0/10	8	8

As it is found in the literature, shock wave therapy has been strongly used in the treatment of tendinitis in several anatomical locations, and among them, the patellar tendinopathy stands out, which is, preferentially, diagnosed in athletes, due to repetitive and impact movements. The application of the shock wave therapy in the treatment of patellar tendinopathy presents positive responses regarding the reduction of the pain. It occurs due to a decrease in the inflammatory process; as a consequence an improvement in the muscle strength and range of the motion and due to the improvement of the symptoms, it guarantees the athlete an improvement in their functional performance, as well as what Cheng *et al* (2018) points out in Table 01. When compared to other extracorporeal therapies such as acupuncture, ultrasound waves and microwave therapy, the shock wave

therapy shows more significant results than the others do. It also presents a faster and more effective biological response due to the technique's ability to reach deeper layers of the body besides stimulating the mesenchymal cells of the tissues (Table 1) (Cheng *et al.*, 2018). The application of shock wave therapy is extracorporeal, and its effects are beneficial for the treatment of tendinitis especially the patellar tendinopathy. However, when the invasive procedures effects are compared to the extracorporeal ones, the injections of platelet-rich plasma present better results than shock wave therapy, a factor that can be attributed to the body's faster ability to act in the organism. Nevertheless, it is possible to verify that for patellar tendinopathy both shock wave therapy and platelet-rich plasma injections should be associated with kinesiotherapy in order to guarantee more positive and satisfactory results (Table 1) (Smith and Sellon 2014).

Similar results to Smith and Sellon (2014) were identified in the literature review by Horstmann *et al* (2017), who verified that injections of platelet-rich plasma, surgical treatment, sclerotherapy and corticosteroid injections, and non-steroidal anti-inflammatory drugs (AINE), are more effective than shock wave therapy for the treatment of patellar tendinopathy. Although there are few findings on the action of shock wave therapy on the biological tissue, Waugh *et al.* (2015) points out that the therapy can aid in the remodeling of the tendon, which promotes the improvement of the inflammatory and catabolic processes that are associated with the removal of constituents of the matrix. It significantly reflects on the improvement of the symptoms. Given the search of the articles, it was possible to verify that there are still few studies on the use of shock wave therapy in the treatment of patellar tendinopathy; because among all the studies that were found, only two reported a clinical trial, which guarantee a lower probability of bias in the researches. They corroborate with the ones found by Mani-Babu *et al* (2015). In his systematic review article, the limitation of the evidences found is pointed out, it emphasizes that the studies involving the treatment of patellar tendinopathy with shock wave therapies show a bunch of methodological weaknesses, as in the process of randomization of patients, as well as those perceived in the search carried out in the present research. It is possible to verify that there are still few scientific evidences of the effects of shock wave therapy in the treatment of patellar tendinopathy. It gets hard to reach a consensus on the real action of the therapy on the biological tissue and patellar tendinopathy, and also which patterns of modulation are more acceptable so as to have repercussions in the professional clinical practice. However, according to Cheng *et al.* (2018) and to Fúria *et al.* (2013), shock wave therapy is the most effective therapy for the treatment of patellar tendinopathy among extracorporeal therapies. The PEDro scale was used in the evaluation of the methodological quality of the articles. The score was 8 points on a scale from 0 to 10. All the studies lost points on items related to the fact that the patient, therapist, and the evaluators went through a blind experiment (Table 02).

Conclusion

Through this systematic review, it was possible to conclude that shock wave therapy presents positive results in the treatment of patellar tendinopathy when compared to other therapeutic extracorporeal modalities. However, the invasive therapies present better results in a short and long term. It is also worth it emphasizing that there is little scientific evidence on the use of shock wave therapy in the biological tissue. Most of the studies present methodological limitations, and most of the times, it does not apply randomization of the sample.

Therefore, in order to support the confirmation of the effects of therapy in the treatment of patellar tendinopathy, it is of fundamental importance to perform new clinical trials over the topic.

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