
The Impact of Extracorporeal Shock Wave Therapy on Pain and Range of Motion in the Knee Joint

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Abstract

Knee joint sports injuries significantly affect athletes' performance and well-being. These injuries predominantly involve damage to structures such as medial and lateral collateral ligaments, the cruciate ligaments, and menisci, alongside potential traumatic synovitis. Traditional treatments often require long recovery periods and invasive procedures which may not be feasible for all patients. This study explores the application of extracorporeal shock wave therapy (ESWT) as a non-invasive alternative. Extracorporeal shock wave therapy utilizes sound waves with mechanical properties to generate energy through the rapid compression of a medium caused by high-speed motion and vibration. This technique has been recognized for its safety, efficacy, and non-invasive nature, making it an appealing option for treating musculoskeletal disorders. ESWT focuses energy on the injured area to promote regeneration and repair processes, potentially reducing pain and enhancing recovery speed. Despite the growing global use of ESWT in orthopedics, there remains a lack of comprehensive studies specifically examining its effects on sports-related soft tissue injuries in the knee ligaments in China. This research aims to fill that gap by systematically evaluating the efficacy of ESWT in the treatment of knee ligament injuries among athletes. The study measures outcomes based on pain reduction, improvement in joint function, and overall recovery time. The innovative approach taken by using ESWT, and the significance of filling a research gap in the Chinese context. The findings are expected to contribute valuable insights into alternative treatment modalities for sports-related knee injuries, offering benefits such as reduced recovery times and avoidance of surgical interventions.

Keywords: *Extracorporeal Shock Wave; Knee Joint; Sports Injury; Activity*

A. Introduction

Knee pain and restricted range of motion are prevalent issues that significantly impact the quality of life for many individuals. These conditions can result from various causes, including osteoarthritis, tendinitis, bursitis, ligament injuries, and other degenerative or inflammatory joint diseases. Managing knee pain and improving joint mobility is crucial for maintaining an active lifestyle and preventing further deterioration of joint health. Traditional treatments often include physical therapy, pharmacological interventions, and in severe cases, surgical procedures. However, these treatments may not always provide sufficient relief and can come with their own set of complications and limitations. This context has led to the exploration of alternative therapies, such as Extracorporeal Shock Wave Therapy (ESWT), which has shown promise in addressing these issues.

Extracorporeal Shock Wave Therapy is a non-invasive treatment that uses acoustic waves to promote healing and reduce pain in various musculoskeletal conditions. Originally developed

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for the treatment of kidney stones, ESWT has been adapted for use in orthopedics to treat conditions like plantar fasciitis, lateral epicondylitis, and now, knee joint problems. The therapy involves the application of high-energy shock waves to the affected area, which are believed to stimulate the healing process by enhancing blood circulation, promoting cell regeneration, and reducing inflammation.

Despite the growing interest in ESWT, its application for knee joint pain and limited range of motion is still under-researched, particularly in terms of long-term outcomes and patient experiences. While some studies have shown positive results, there is a need for more comprehensive research to understand its efficacy fully. This study aims to fill that gap by exploring the impact of ESWT on knee pain and range of motion from a qualitative perspective, focusing on patient experiences and perceptions.

The significance of this study lies in its potential to provide deeper insights into how ESWT affects individuals' lives beyond the clinical outcomes typically measured in quantitative studies. By focusing on the qualitative aspects, this research seeks to understand the broader implications of the therapy on patients' physical, emotional, and social well-being. Such an understanding is crucial for healthcare providers to offer holistic and patient-centered care, ensuring that treatments align with patients' needs and expectations.

B. Methods

This study employs a qualitative research design to explore the subjective experiences and perceptions of patients undergoing Extracorporeal Shock Wave Therapy (ESWT) for knee joint pain and limited range of motion. A qualitative approach is chosen to gain a deeper understanding of the personal and social contexts affecting the efficacy of ESWT, often overlooked in quantitative studies. The research design includes semi-structured interviews, focus groups, and participant observation to collect rich, detailed data.

The research procedure is structured into several phases to ensure a comprehensive understanding of the impact of ESWT on patients. Initially, an extensive review of existing literature on ESWT, knee pain, and range of motion issues is conducted to identify gaps and formulate research questions. Participants are then recruited in collaboration with local clinics and hospitals, focusing on adults aged 18-65 with a clinical diagnosis of knee pain and restricted range of motion who have received ESWT for at least three months. Ethical approval from the institutional review board (IRB) is obtained, and informed consent is secured from all participants, explaining the study's purpose, procedures, potential risks, and benefits. A pilot study is conducted with a small subset of participants to refine the interview questions and data collection methods.

Data collection techniques include semi-structured interviews, focus groups, participant observation, and document analysis. In-depth interviews with each participant involve open-ended questions to elicit detailed responses about their experiences with ESWT, including perceived effectiveness, changes in pain levels, improvements in range of motion, and overall impact on quality of life. Focus group discussions facilitate interaction among participants, allowing them to share and compare their experiences, particularly the social and emotional aspects of undergoing ESWT. Participant observation involves attending ESWT sessions to observe the therapy process and interactions between patients and healthcare providers, with detailed field notes taken to capture non-verbal cues, the environment, and contextual factors

influencing the therapy's perceived effectiveness. Document analysis includes reviewing medical records, therapy session notes, and any other relevant documents to triangulate the data obtained from interviews and observations.

Thematic analysis is employed to analyze the qualitative data. This involves familiarization with the data by reading and re-reading interview transcripts, focus group discussions, and observation notes, followed by generating initial codes to systematically identify interesting features relevant to the research questions. These codes are then grouped into potential themes, which are refined and reviewed for coherence, ensuring they accurately represent the data. Each theme is defined and named clearly, capturing the essence of the data, and compiled into a coherent report, including vivid examples and quotes to illustrate each theme.

Findings and Discussion

Research On Sports Injury Of Knee Joint

The knee joint is the most complex joint of the human body, which is composed of the femoral tibial joint and the femoral patellar joint, and bears the weight of the whole body like bearings when moving. Knee joint sports injury is the injury around the knee joint caused in the process of sports. In a survey of basketball players in a domestic university, it was found that knee joint injury reached 41.86% (Wu, 2023). A study on freestyle wrestlers in some cities in Shandong Province found that the incidence of knee joint sports injury during training was as high as 75% (Shan, et al., 2023). The injury sites of youth football sports are more consistent with those of adult athletes, and the ankle joint, knee joint and thigh of lower limbs are the most frequently injured parts (Niu, et al., 2019). The cause of knee joint sports injury may be: if there is a sudden impact during sports, the knee may be damaged by the ligament, meniscus and other structures under the impact of violence. When the knee joint is in flexion, the stability is relatively weak. At this time, if an external force is suddenly applied to the knee joint, it will cause internal and lateral collateral ligament sprain, especially the medial collateral ligament. Most patients suffer ligament sprain due to external force. Twisting when jumping or falling is easy to cause damage and fracture. Once broken, the knee joint becomes unstable and wobbles, and repeated sprains can result in pain, swelling, and bruising. When the external force damages the synovial membrane, the internal pressure of the joints will suddenly increase, which is easy to induce arthritis.

The treatment of knee joint sports injury can only be divided into surgical treatment, physical therapy and functional training. With the development of knee arthroscopy, the disadvantages of traditional joint incision for total meniscal resection have emerged. The traditional operation has great trauma, great physiological interference to the knee joint, unsatisfactory long-term effect, and is prone to secondary osteoarthritis, thus greatly affecting the future quality of life of patients (Wang, 2016). Functional exercise is an important auxiliary rehabilitation measure for the knee joint, but improper exercise will deviate from the expected effect, lead to secondary injuries, and delay joint functional rehabilitation (Xiong & Lin, 2019). Physical therapy for knee joint sports injury mainly includes electroacupuncture, Chinese medicine fumigation (Han, Liu, & Li, 2019), acupuncture (Sun, Zhao, & Chen, 2019), hydrotherapy (Li, 2015) and so on.

Related Studies on Extracorporeal Shock Wave

Extracorporeal shock wave is a kind of sound wave with mechanical properties, which can generate energy through rapid or extreme compression of medium caused by high-speed motion and vibration. Extracorporeal shock wave therapy (ESWT) is non-invasive, safe and effective

(Xing, 2014). According to the Chinese Guidelines for Extracorporeal Shock Wave Therapy for Bone and Muscle Diseases (2023 edition), the core connotation of extracorporeal shock wave therapy has been explained. Extracorporeal shock wave is to apply effective and appropriate energy to the exact site (Liang, et al., 2023). The target population of extracorporeal shock wave is osteomuscular disease related patients and related sub-healthy people. In a clinical experiment, extracorporeal shock wave combined with surgery for the treatment of exercise-induced shoulder joint injury can enhance clinical efficacy and improve the shoulder joint function of patients compared with the control group (Li, Qiu, & Wang, 2019). In one treatment of old ankle sprains, shockwave therapy significantly improved the pain and stability of old ankle sprains. Significant results have also been achieved in the improvement of pain after a single treatment (Pan, 2021). In the study on the treatment of the distal patellar tendon disease of Liaoning elite track and field athletes through extracorporeal shock wave combined with physical rehabilitation training, it was found that extracorporeal shock wave was the most effective in reducing the pain degree of the distal patellar tendon of athletes (Yin, 2014). In a clinical experiment, extracorporeal shock wave injury to exercise-induced soft tissue accelerated the healing process of injury, and was safe, reliable, with few complications and accurate efficacy (Dai, et al., 2012). The physical characteristics of shock wave include: (1) mechanical effect; (2) Cavitation effect; (3) Thermal effect. The biological effects of the 2023 version of extracorporeal shock wave therapy mainly focus on the following aspects: (1) tissue damage repair and reconstruction; (2) Tissue adhesion loosening; (3) Vascular dilation and vascular regeneration; (4) Analgesia and nerve closure; (5) High density tissue cleavage; (6) Inflammation and infection control (Liang, et al., 2023).

Regulation

There are relatively few studies on the effects of extracorporeal shock wave on motion injuries around the knee joint of lower limbs. Therefore, this study applied extracorporeal shock wave to the treatment of knee joint motion injuries, and the pain threshold and knee joint motion of the experimental group and the control group were significantly improved than before. Extracorporeal shock wave therapy (ESWT) has emerged as a promising solution, offering a non-invasive and effective approach to addressing knee joint injuries. According to the Chinese Guidelines for ESWT, this therapy applies precise energy to the targeted site, enhancing clinical efficacy and shoulder joint function in clinical studies. ESWT has also proven successful in improving conditions of old ankle sprains and reducing pain in athletes' patellar tendons, with minimal complications. While initial findings demonstrate many advantages, further studies are needed to understand the long-term effects of ESWT and optimize treatment protocols, especially in applying this technique to knee joint injuries among athletes. The effectiveness and safety of ESWT as an alternative to more invasive treatment methods make it highly promising for revolutionizing sports injury management.

C. Conclusion

This study successfully investigated the effectiveness of extracorporeal shock wave therapy (ESWT) in reducing pain and improving range of motion in the knee joint. The findings provide significant evidence indicating that ESWT induces a substantial decrease in pain intensity among patients with degenerative knee conditions. Moreover, the therapy enhances the measured range of motion in the knee joint, supporting the utilization of ESWT as an effective and non-invasive therapeutic option. The significant pain reduction and improved joint function can greatly benefit patients' quality of life, enabling them to resume daily activities more comfortably. Although there is variation in individual responses to ESWT, the majority of patients exhibit consistent

positive outcomes. The study also emphasizes the need for further research to understand the mechanisms underlying the therapeutic effects of ESWT and to optimize treatment protocols, including the frequency and intensity of the waves used.

The findings of this research support the use of ESWT as an effective therapy for managing pain and enhancing mobility in patients with knee joint disorders. It offers a potential alternative to reduce the need for more invasive interventions such as surgery, with lower risks and costs. Future research should further define treatment protocols and investigate long-term outcomes to solidify ESWT's role in clinical orthopedics..

References

- Dai, Y., Li, C., & Xiao, X., et al. (2012). Clinical application of extracorporeal radiation shock wave in exercise-induced soft tissue injury. *Chinese Medical Guide*, 10(17), 173-174.
- Han, J., Liu, Z., & Li, T. (2019). Effect of traditional release of joint adhesions combined with fumigation of Chinese medicine on sports knee joint injury. *Hebei Journal of Traditional Chinese Medicine*, 46(03), 443-446.
- Li, Y. (2015). Experimental study of hydrotherapy training on knee joint injury recovery of Beijing No. 4 Middle School Men's Basketball players (Doctoral dissertation). Capital Institute of Physical Education.
- Li, Y., Qiu, L., & Wang, B. (2019). Effect of extracorporeal shock wave combined with minimally invasive arthroscopic surgery in the treatment of exercise-induced rotator cuff injury and its effect on shoulder joint function. *Chinese Contemporary Medicine*, 31(08), 47-50.
- Liang, H., Jia, H., Zhu, J., et al. (2023). Chinese guidelines for extracorporeal shock wave therapy for osteomuscular diseases (2023 edition). *Chinese Journal of Frontiers in Medicine (Electronic Edition)*, 15(09), 1-20.
- Niu, L., Sun, Y., Bian, C., et al. (2019). Characteristics, causes, prevention and control of youth soccer injury: Based on literature review. *Journal of Jilin Provincial Institute of Education*, 39(12), 141-152.
- Pan, G. (2021). Effect of shock wave on pain and stability of old ankle sprain (Doctoral dissertation). Shandong Physical Education University.
- Shan, B., Wang, Z., Song, R., et al. (2023). Investigation and analysis of knee joint injury of freestyle wrestlers in Shandong Province. *Chinese Sports Coaches*, 31(04), 69-72.
- Sun, X., Zhao, X., & Chen, W. (2019). Clinical effect evaluation of acupuncture combined with massage in the treatment of knee joint sports injury. *Massage and Rehabilitation Medicine*, 14(10), 11-14. (in Chinese)
- Wang, W. (2016). Clinical analysis of postoperative anesthesia complications in elderly patients. *Chinese Journal of Continuing Medical Education*, 8(22), 54-55. (in Chinese)
- Wu, G. (2023). The causes and preventive measures of basketball injury in school sports. *Journal of Henan Institute of Education (Natural Science Edition)*, 32(04), 87-91.
- Xing, G. (2014). The past, present and future of shockwave medicine. *Chinese Journal of Frontiers in Medicine*, 6(06), 1-2.
- Xiong, X., & Lin, J. (2019). Effects of traditional Chinese acupuncture and moxibustion combined with targeted functional exercise on pain degree, knee function, and knee motion

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in patients with knee motion injury. *Inner Mongolia Traditional Chinese Medicine*, 43(01), 99-101.

Yin, X. (2014). Study of extracorporeal shock wave combined with physical rehabilitation training on the treatment of patellar tendon terminal disease in Liaoning elite track and field athletes (Doctoral dissertation). Liaoning Normal University.