Proceedings of the 4th International Conference on Biological Engineering and Medical Science
DOI: 10.54254/2753-8818/66/2024.18045

The efficacy of physical therapy in managing early meniscus lesions in hip-hop dancers

Yue Yu

d'Overbroecks College Oxford, Oxford, UK

lelia@ldy.edu.rs

Abstract. Hip-hop dance has emerged as a popular and increasingly competitive form of artistic expression. As practitioners strive for professionalism, the demands of intensive training and competition have led to a rise in injury rates, with knee injuries, particularly meniscus lesions, being prevalent. This review critically examines the efficacy of physical therapy in treating early meniscus lesions among hip-hop dancers, comparing it with various surgical approaches from both clinical and socioeconomic perspectives. By synthesizing data from recent clinical studies, this review aims to provide comprehensive insights into the management of early meniscus injuries. The analysis reveals that physical therapy demonstrates comparable clinical outcomes to surgical interventions, often with more favorable cost-effectiveness. This finding has significant implications for dancers' quality of life and career longevity. The review also highlights current research gaps, emphasizing the need for targeted studies on hip-hop dancers across different age groups and proficiency levels. It calls for the development of tailored exercise protocols and underscores the importance of patient education in injury prevention. By addressing these aspects, this review seeks to contribute to the advancement of injury management strategies in the hip-hop dance community, potentially extending dancers' active participation and enhancing their overall well-being.

Keywords: Hip-hop dance injuries, Meniscus lesions, Physical therapy.

1. Introduction

Hip-hop dance is a street dance form that involves a series of movements performed primarily to hip-hop music. Originating in New York during the 1970s, it has evolved into an international phenomenon, both as a competitive and recreational art form. The rapid global popularity of hip-hop dance has led to a proliferation of diverse styles in a relatively short period. This increased popularity and competition have elevated the physical demands placed on dancers, necessitating more complex choreography and riskier tricks, particularly during freestyle battles. As a result, higher levels of physical strength, agility, and coordination are required, which simultaneously increases the risk of injury [1].

Research indicated that knee injuries are the most prevalent among street dance injuries, accounting for 42.6% of all such injuries [1]. The dynamic and intense nature of hip-hop dance, characterized by high-impact and intricate movements, places considerable stress on the knee joint. Key movements such as rapid flexion and extension, powerful landings, and rotational twists subject the knee to higher possibilities of repetitive and acute strains. These stresses can overwhelm the knee's structural integrity, particularly affecting the menisci, which are crucial for load distribution and joint stability.

DOI: 10.54254/2753-8818/66/2024.18045

Meniscal lesions encompass tears and ruptures. In hip-hop dance, common moves such as bouncing—where the dancer frequently bends and straightens the knee—can cause micro-trauma to the menisci, potentially leading to chronic degeneration. Moves like side-skating, which involve twisting the weight-bearing knee while the joint is semi-flexed, can result in acute meniscal tears. Ruptures often occur from movements such as sudden squats on one leg followed by a jump and twist in the air, which is a popular technique in competitive dance battle scenarios.

Given the high rates of participation and injury incidence, there is a growing need for effective injury management strategies in hip-hop dance. Enhancing knee joint health could extend the active participation of both professional and amateur dancers. Physical therapy is a conservative treatment approach for meniscal lesions, involving a rehabilitation program with progressive strength, balance, and flexibility training exercises.

However, there is limited research specifically addressing injury management in hip-hop dance. This review aims to compare data from studies on sports with similar injury mechanisms to evaluate the effectiveness of physical therapy for different types of meniscal lesions and to propose directions for future research in this area.

2. Anatomy

The medial and lateral menisci are crescent-shaped, fibrocartilaginous structures located within the knee joint between the femur and the tibia. These wedge-shaped components play crucial roles in deepening the tibial plateau, transferring axial weight through the joint, absorbing shock, and enhancing knee joint stability [2].

The menisci's stability is reinforced by their attachments to surrounding structures, including the medial collateral ligament, the transverse ligament, and the meniscofemoral ligaments. Despite their importance, menisci are generally considered avascular tissues, with blood supply limited to only 10-25% of their peripheral region, known as the red-red zone. The remaining central portion, termed the white-white zone, lacks direct blood supply [2].

This limited vascularization has significant implications for the healing potential of meniscal tears. Injuries in the peripheral, vascularized areas have a higher likelihood of healing naturally. However, tears in the central, avascular portion face challenges in spontaneous repair due to the absence of blood supply. Consequently, the nature and location of meniscal lesions play a crucial role in determining appropriate treatment approaches [2].

3. Injures and treatment methods

Physical therapy, a non-operative conservative treatment approach, is often employed as a first-line intervention for non-complex and relatively minor meniscus tears in both acute and chronic settings [3]. The primary objectives of physical therapy include reducing symptoms such as pain and swelling, enhancing functional muscle strength (particularly the quadriceps), and improving overall physical ability [4].

Treatment typically occurs over an extended period, with patients receiving multiple sessions of combined therapies. Exercise therapy, with a focus on quadriceps strength training, forms the cornerstone of most physical therapy programs. Patients are usually provided with a simple exercise training protocol to perform at home between sessions. Additional therapies, such as osteopathic manual therapy (OMT), may be combined with exercise therapy to alleviate symptoms and promote tissue healing [5].

It is generally accepted that physical therapy may be more suitable for treating degenerative meniscus tears. However, in cases of severe lesions, such as complete meniscus ruptures, surgery is typically considered as the primary intervention. If symptoms persist after 4-6 weeks of physical therapy [6], a delayed meniscectomy may be recommended as part of the treatment plan.

Surgical interventions vary depending on the severity and complexity of the injury. Options include meniscectomy, meniscal repair, meniscal reconstruction, and cell-based tissue engineering [6]. Among these, meniscectomy (meniscal resection) is the most frequently performed procedure. It typically

DOI: 10.54254/2753-8818/66/2024.18045

involves an arthroscopic partial approach [7], creating three micro-invasive incisions to remove the damaged areas of the meniscus while leaving a smooth edge on the remaining tissue.

3.1. Traumatic meniscus tear

Traumatic meniscus tears are defined by two criteria: 1) the presence of a knee injury, such as a sprain or forced movement, and 2) the presence of healthy meniscal tissue with a normal macroscopic appearance. These tears are commonly described as acute, resulting from excessive force exerted on a healthy meniscus, often presenting as longitudinal or vertical tears [8].

Common mechanisms of injury during hip-hop dance include:

1) The "load-and-shear" mechanism: This occurs when rotational or shearing forces are applied across the knee joint under increased axial load. Such situations arise when the ipsilateral foot is grounded while the individual twists or pivots the knee [9]. Many hip-hop dance steps involve knee twisting (e.g., the butterfly), but most require the feet to move in tandem with the knee. Risk of traumatic meniscus tear increases when dancers attempt these steps with their feet in a fixed position.

2) Increased knee flexion: Deep knee bends, such as those seen in floorwork variations (e.g., happy feet, which involves deep squats between split jumps in various directions), can lead to meniscus tears [9]. The risk is particularly high in competitive scenarios where dancers perform tricks or risky techniques involving single-leg squats.

3) Rapid acceleration/deceleration and jumping: Sudden changes in movement speed, often dictated by music tempo changes, can potentially cause meniscus tears, especially when the lower extremities are the focus of the movement [9].

Extensive studies have been comparing physical therapy (primarily exercise therapy) with various surgical methodologies to evaluate its effectiveness. Damsted et al. conducted a randomised controlled trial to compare the effect of exercise and education on self-care against surgery among 121 young adult patients with both traumatic and non-traumatic meniscus tears [10]. In this study, 73.3% of the individuals were categorised as having traumatic tears. The researchers used Knee injury and Osteoarthritis Outcome Score (KOOS) subscales to measure the pain, function and quality of life of the patients. The results demonstrated no significant mean difference in the scores reported by patients (both with traumatic and non-traumatic tears) from the surgery group and the exercise therapy group after 12 months of simultaneous treatments. This indicated that the effectiveness of surgery doesn't necessarily outcompete physical therapy in managing either traumatic or non-traumatic meniscus tears.

A case study conducted by Feehan et al. in 2017 demonstrated the efficacy of exercise rehabilitation in treating traumatic meniscus injury in a male football athlete [5]. The study focused on a 20-year-old male individual diagnosed with an acute left medial meniscus injury. This injury resulted from landing on a fully extended unilateral knee (the left knee) while simultaneously receiving strong contact from another player during an Australian Rules Football match. The twist on the hyperextended knee caused a tear to occur. The individual received an 8-week conservative intervention combining osteopathic manual therapy (OMT) and exercise rehabilitation during each session. The researchers monitored the recovery using the KOOS and the Lower Extremity Functional Scale (LEFS). After the 8-week treatment period, the patient reported significant improvement in the functioning of the injured knee, as evidenced by the scores displayed on both scales during the reevaluation in the final session. The patient regained complete range of motion and was able to perform movements such as running and jumping without discomfort. This case report illustrated that management of acute traumatic meniscus injury could effectively utilize physical therapy in the form of a combination of OMT and exercise rehabilitation. Therefore, it provides supporting evidence for the effectiveness of physical therapy in treating meniscus injuries.

3.2. Degenerative meniscus tear

Degenerative meniscus tears typically occur without the presence of a specific trauma. These tears result from normal-range forces applied to a degenerated meniscus and are often characterized as chronic tears. The mechanism is usually unitary, involving minimal yet repetitive trauma that gradually increases

DOI: 10.54254/2753-8818/66/2024.18045

stress on the meniscus. This process can occur either over an extended period or under high-frequency repetition of movements causing micro-traumata. In hip-hop dance, this phenomenon is particularly common. Many hip-hop movements are built upon the foundation of bouncing, a relatively low-energy movement that can be directed either upwards or downwards depending on the music's timing. Both directions inevitably involve the continuous process of flexing and extending the knee joint. This repetitive movement accumulates stress on the menisci, potentially resulting in gradual degeneration of the tissue.

Van de Graaf et al. [11] compared the effectiveness of physical therapy with arthroscopic partial meniscectomy (APM) in patients with nonobstructive meniscus tears using a noninferiority randomised controlled trial. This study recruited a sample consisted of 321 patients aged from 45 to 70 years old (due to the age group being elderly, all the tears were considered in relation to degenerative changes in the meniscus). Patients randomly assigned to the physical therapy group received an 8-week exercise therapy that aimed to improve coordination and strength (by using closed kinetic chain strength exercises). They used a self-administered questionnaire to assess the patients' self-reported knee functioning, and the results demonstrated non-inferiority of physical therapy in comparison to APM. A 5-year follow-up study was done in 2022 [12] after the main study was published. The International Knee Documentation Committee Subjective Knee Form noted the results of the trial. The results of this trial provide credence to the suggestion that for degenerative meniscal tears, exercise-based physical therapy should be the preferred option over surgery [12].

Stensrud et al. also compared the effectiveness of exercise therapy with APM using a randomised controlled trial, with the criteria focusing on knee muscle strength and functional performance [13]. 89 middle-aged patients were randomly assigned to either receive either a 12-week exercise therapy program or APM, and the outcomes of the treatments were measure three months after the interventions were executed. Isokinetic knee extension peak torque was used as the primary measure, followed by lower extremity performance and self-reported global rating of change. In the results, patients in the exercise therapy group demonstrated a statistically significant improvement in the isokinetic knee extension peak torque and all the other measurements, favouring the hypothesis that exercise therapy increases knee muscle strength. This is a positive indication that the menisci would be presumptively more resistant to re-injury in the future.

Contrasting evidence was presented by a systematic review and meta-analysis done by Li et al. [14]. By analyzing 6 randomized controlled trial studies comparing APM with physical therapy in over 1000 patients with degenerative meniscus tears, they found that the APM groups had a slightly better functional performance than the physical therapy group. However, after the 12 months and 24 months follow-up points, there was no significant difference between the pain and functional outcomes between two groups.

3.3. Health-economic evaluation

When clinical data indicate no significant differences in the effectiveness of treatments, health-economic evaluation becomes a crucial factor to consider. This aspect closely relates to the socioeconomic considerations patients must make when choosing between different treatment options. Several studies mentioned in previous sections have highlighted this sociological issue. For instance, in the case report by Feehan et al., the patient opted for physical therapy instead of surgery due to limited financial means [5]. Health-economic evaluations appear to have a greater influence on treatment decision-making, especially among younger individuals who may perceive surgical treatments as an increased socioeconomic burden [15]. This consideration is particularly relevant for young professional hip-hop dancers who may not yet have established a stable monthly income.

A systematic review conducted by Deviandri et al. aimed to evaluate the evidence of the existent health-economic evaluation studies on meniscus tear treatments [16]. They included sixteen studies in total in this review. Before analyzing the results of each of the studies, they categorized the studies by the methods they used to evaluate the health-economic relation into four groups: partial economic evaluation, cost-effectiveness analysis, cost-benefit analysis and cost-utility analysis. A qualitative and

DOI: 10.54254/2753-8818/66/2024.18045

descriptive analysis was implemented, and results were grouped into 6 outcomes (this paper will only discuss ones that are relevant). The study found that for degenerative meniscus tear, physical therapy is less costly in comparison to meniscectomy; and physical therapy with delayed meniscectomy is superior to early meniscectomy in its cost-effectiveness in treating patients with meniscus tear along with knee osteoarthritis [10]. Traumatic meniscus tear is not exclusively mentioned as a distinct type of meniscus lesion in the study. This suggests that in treating certain types of meniscus tears, physical therapy should be considered as the most economical first-line treatment. However, if symptoms preserve, the patients should consider receiving delayed meniscectomy. Yet, both treatment approaches can ensure the health-economic effectiveness remained at the maximum level.

The cost-effectiveness of treatments for traumatic meniscus tears specifically was compared and analyzed in the study done by van der Graaff et al. in November 2023[, after the previous systematic review was published 15]. They mainly focus on the comparison between physical therapy (with optional delayed APM) and early APM particularly in young patients who were under 45 years. Data analysis suggested that physical therapy is more cost-effective than APM, since it reduces the cost while leading to a similar quality of life as APM. They estimated a €17 million annual save in the Netherlands (where the study was conducted in) by assuming more physical therapy is received by patients.

3.4. Discussion

The studies included in this review have certain inherent limitations. Most recruited patients from elderly age groups (especially for degenerative meniscus tears) who were not active athletes. This makes the sample less relevant to the target population of this review, even though the symptoms could be very similar. Given that most active hip-hop dancers are young individuals (children, adolescents, young adults), further investigations are required to assess the efficacy of treatments in these age groups.

Another issue is the small sample size in almost all the randomized controlled trial studies. Outcomes from a small group of patients may not accurately reflect the actual effectiveness of treatments due to the potential influence of extraneous variables. This also decreases the validity of the results collected.

Clinical research often inevitably encounters the confounding variable of individual variability. Treatment outcomes are usually determined by multiple factors beyond the clinician's chosen treatment method. The patient's level of participation in the treatment process and their willingness to collaborate with the clinician can significantly impact recovery speed and quality. This is especially crucial in physical therapy scenarios where the clinician educates patients about self-care and assigns daily home exercises. Depending on the patients' psychological, physiological, and sociological readiness, they may or may not complete the tasks without supervision from clinicians. This variation is often not considered when collecting data, potentially deviating results from predicted outcomes that typically assume uniform patient collaboration.

4. Conclusion

Physical therapy emerges as the most cost-effective treatment approach for common meniscus lesions in hip-hop dance, encompassing both early traumatic and non-traumatic meniscus tears. When compared to surgical approaches, particularly APM, physical therapy demonstrates comparable clinical outcomes. Economic evaluations, however, indicate significantly lower costs associated with both standalone physical therapy and physical therapy followed by delayed APM. Consequently, studies suggest that physical therapy should be the preferred initial approach over immediate surgical intervention.

Further research is imperative. There is a need to collect epidemiological data on injury rates among hip-hop dancers across different regions. Clinical studies should be conducted to analyze and evaluate the direct effects of physical therapy on injured hip-hop dancers, taking into account various age groups and levels of dance proficiency. Exercise protocols should be tailored based on injury severity, individual dancing habits, and lifestyle factors to achieve personalized treatment designs. Additionally, educating patients about self-care practices is crucial for preventing re-injury.

References

[1] Ursej, E., Sekulic, D., Prus, D., Gabrilo, G., & Zaletel, P. (2019). Investigating the Prevalence and Predictors of Injury Occurrence in Competitive Hip Hop Dancers: Prospective Analysis. *International journal of environmental research and public health*, *16*(17), 3214. https://doi.org/10.3390/ijerph16173214

[2] Mameri, E. S., Dasari, S. P., Fortier, L. M., Verdejo, F. G., Gursoy, S., Yanke, A. B., & Chahla, J. (2022). Review of Meniscus Anatomy and Biomechanics. *Current reviews in musculoskeletal medicine, 15*(5), 323–335. https://doi.org/10.1007/s12178-022-09768-1

[3] Chirichella, P. S., Jow, S., Iacono, S., Wey, H. E., & Malanga, G. A. (2019). Treatment of *Knee Meniscus Pathology: Rehabilitation, Surgery, and Orthobiologics. PM & R, 11*(3), 292–308. https://doi.org/10.1016/j.pmrj.2018.08.384

[4] Vervest, A. M., Maurer, C. A., Schambergen, T. G., de Bie, R. A., & Bulstra, S. K. (1999). Effectiveness of physiotherapy after meniscectomy. *Knee surgery, sports traumatology, arthroscopy, 7*(6), 360–364. https://doi.org/10.1007/s001670050181

[5] Feehan, J., Macfarlane, C., & Vaughan, B. (2017). Conservative management of a traumatic meniscal injury utilising osteopathy and exercise rehabilitation: A case report. *Complementary therapies in medicine, 33*, 27–31. https://doi.org/10.1016/j.ctim.2017.05.007

[6] Luvsannyam, E., Jain, M. S., Leitao, A. R., Maikawa, N., & Leitao, A. E. (2022). Meniscus Tear: Pathology, Incidence, and Management. *Cureus, 14*(5), e25121. https://doi.org/10.7759/cureus.25121

[7] Beaufils, P., & Pujol, N. (2017). Management of traumatic meniscal tear and degenerative meniscal lesions. Save the meniscus. *Orthopaedics & Traumatology: Surgery & Research, 103*(8), S237–S244. https://doi.org/10.1016/j.otsr.2017.08.003

[8] Denti, M., Espregueira-Mendes, J., Pereira, H., Raoulis, V., & Hantes, M. (2016). Traumatic Meniscal Injuries. Surgery of the Meniscus, 67–78. doi:10.1007/978-3-662-49188-1_7

[9] Popper, H. R., Fliegel, B. E., Elliott, D. M., & Su, A. W. (2023). Surgical Management of Traumatic Meniscus Injuries. *Pathophysiology, 30*(4), 618 – 629. https://doi.org/10.3390/pathophysiology30040044

[10] Damsted, C., Skou, S. T., Hölmich, P., Lind, M., Varnum, C., Jensen, H. P., Hansen, M. S., & Thorlund, J. B. (2024). Early Surgery Versus Exercise Therapy and Patient Education for Traumatic and Nontraumatic Meniscal Tears in Young Adults-An Exploratory Analysis From the DREAM Trial. *The Journal of orthopaedic and sports physical therapy, 54*(5), 340–349. https://doi.org/10.2519/jospt.2024.12245

[11] van de Graaf, V. A., Noorduyn, J. C. A., Willigenburg, N. W., Butter, I. K., de Gast, A., Mol, B. W., Saris, D. B. F., Twisk, J. W. R., Poolman, R. W., & ESCAPE Research Group (2018). Effect of Early Surgery vs Physical Therapy on Knee Function Among Patients With Nonobstructive Meniscal Tears: The ESCAPE Randomized Clinical Trial. *JAMA, 320*(13), 1328–1337. https://doi.org/10.1001/jama.2018.13308

[12] Noorduyn, J. C. A., van de Graaf, V. A., Willigenburg, N. W., Scholten-Peeters, G. G. M., Kret, E. J., van Dijk, R. A., Buchbinder, R., Hawker, G. A., Coppieters, M. W., Poolman, R. W., & ESCAPE Research Group (2022). Effect of Physical Therapy vs Arthroscopic Partial Meniscectomy in People With Degenerative Meniscal Tears: Five-Year Follow-up of the ESCAPE Randomized Clinical Trial. *JAMA network open, 5*(7), e2220394. https://doi.org/10.1001/jamanetworkopen.2022.20394

[13] Stensrud, S., Risberg, M. A., & Roos, E. M. (2015). Effect of exercise therapy compared with arthroscopic surgery on knee muscle strength and functional performance in middle-aged patients with degenerative meniscus tears: a 3-mo follow-up of a randomized controlled trial. *American journal of physical medicine & rehabilitation, 94*(6), 460–473. https://doi.org/10.1097/PHM.0000000000000209

[14] Li, J., Zhu, W., Gao, X., & Li, X. (2020). Comparison of Arthroscopic Partial Meniscectomy to Physical Therapy following Degenerative Meniscus Tears: A Systematic Review and Meta-analysis. *BioMed research international, 2020*, 1709415. https://doi.org/10.1155/2020/1709415

[15] van der Graaff, S. J. A., Reijman, M., Meuffels, D. E., & Koopmanschap, M. A. (2023). Cost-effectiveness of arthroscopic partial meniscectomy versus physical therapy for traumatic meniscal tears in patients aged under 45 years. *The Bone & Joint Journal, 105-B*(11), 1177-1183. https://doi.org/10.1302/0301-620X.105B11.BJJ-2023-0107.R1

[16] Deviandri, R., Daulay, M. C., Iskandar, D., Kautsar, A. P., Lubis, A. M. T., & Postma, M. J. (2023). Health-economic evaluation of meniscus tear treatments: a systematic review. *Knee surgery, sports traumatology, arthroscopy, 31*(9), 3582 – 3593. https://doi.org/10.1007/s00167-022-07278-8