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Exercise Therapy for the Treatment of Knee Pain in Breaststroke Swimmers

Wengyue Liu*

School of Physical Education, China University of Mining and Technology (CUMT), Xuzhou, Jiangsu, 221116, China

**Corresponding author: Wengyue Liu.*

Abstract

Breaststroker's knee is a common overuse injury in competitive swimmers who practice breaststroke, usually marked by medial knee pain that greatly affects the quality of training and the life of an athlete. It is not caused by a single cause but instead, poor kick technique, imbalance between the muscles of the lower limbs, and repeated mechanical loading at high intensity are the main etiological factors. Conventional physical therapy and pharmacological treatment are likely to offer temporary relief of pain, but they do not tend to be effective in treating the causes of the pain, and have a high rate of recurrence. As evidenced by recent studies, through two types of exercise therapies—technical correction and muscle strength balance training can help meet various therapeutic goals, such as pain reduction, optimization of movement patterns, and functional recovery. This paper is a systematic review of the intervention programs and the available evidence of such exercise therapy and examines the shortcomings of existing studies to give them a theoretical framework in order to rehabilitate, prevent, and then conduct further experimental research on breaststroker's knee injuries.

Keywords

breaststroke swimmers, breaststroker's knee strain, exercise therapy, technique correction, muscle strength balance

1. Introduction

Breaststroke is one of the popular competitive swimming strokes with the greatest level of practice and general use, in which the kick acts as the central propelling stage and provides the greatest proportion of forward thrust. Nevertheless, due to repeated exposure to both valgus and external tibial rotation forces at the knee joint in this movement cycle, there is a tendency to have repeated microtrauma to structures such as the medial collateral ligament, medial synovial plica, and pes anserinus tendons, causing knee pain in exercise - the so-called breaststroker's knee. It is a usual chronic overuse sports injury. The study conducted by Zhang Peng concluded that the breaststroker's knee is one of the frequent lower limb sports injuries in swimmers and has a rate of occurrence of around 75 percent among swimmers who engage in the breaststroke style, which means that the frequency of this injury is dangerously high [1]. In the course of prolonged specialized breaststroke training, the mechanical load on the medial collateral ligament can be greatly increased by the presence of chronic technical flaws in the kick. At the end of knee extension and the kick, the ligament is stretched by passivee tension, and combined with uneven lower limb muscle strength development, overall knee stability decreases over time. Repeated training stress causes continuous accumulation of microtrauma in

the medial soft tissues of the knee, resulting in overuse-related pain. Its negative effects are significant: in the near future, it directly decreases the propulsive power of the kick and disrupts the quality of training; in case of chronicity and resistance to treatment, it not only limits the improvement of athletic performance but can also shorten the career of an athlete and even lead to long-term inability to perform activities of daily life.

Since the advancement of modern medical technologies, there has been a wide variety of treatments available to relieve knee pain, but medical intervention alone has very poor effectiveness in addressing knee injuries caused by training. Zhang Huiwu, Liu Bei, Zhao Daren, et al. treated 39 patients with pharmacological and physical therapy, and the findings showed that these interventions can actually reduce local pain and lessen inflammatory responses [2]. However, this method can merely offer a temporary solution to the pain and does not really solve the root causes of the pain, and the recurrence rate of the injury is also quite high. In more recent years, studies have slowly moved towards non-pharmacological intervention pathways, indicating that exercise therapy through mechanisms of sports injury, which integrates technique correction and muscle strength balance training, is more aligned with the training rhythms and athletic demands of athletes. A 2022 randomized controlled trial conducted by Zhao Rongting and Sheng Lei with 30 patients with knee pain revealed that aquatic rehabilitation exercise therapy could decrease the duration of rehabilitation in patients with knee pain [3]. The rehabilitation programme involves no pharmacological treatment and does not have any side effects. It may be utilized as an intervention to treat pain and repair tissue at the beginning of the injury and also as part of daily training during the preparation for competition. It assists in reducing the risks of injury recurrence drastically and shows promising perspectives and long-term benefits in the rehabilitation of knee strain among breaststrokers.

The current paper mainly uses the literature review approach because it allows summarizing the clinical features and causative agents of breaststroker’s knee in a systematic manner, as it will define the internal logic under which technical errors lead to pain, and muscle strength imbalance leads to increased overuse injuries, and it will discuss intervention approaches focused on technique correction and muscle strength balance training. The current research findings are used to summarize the advantages and disadvantages of this approach, which gives an insight into the practical rehabilitation and clinical care of breaststroker knee injuries and provides guidelines to prevent injuries among athletes on a daily basis.

2. Characteristics of Breaststroker’s Knee

The knee injury commonly known as breaststroker’s knee is an overuse injury, with nearly 70-80 percent of the cases affecting the medial side of the knee, which tends to show up as a strain of the medial collateral ligament and pes anserine bursitis, whereas the rest are patellofemoral pain syndrome and meniscal impingement injury. In a study by Rovere G. D. and Nichols A. W. of 36 breaststroke swimmers, it was reported that medial synovial plica syndrome might be a source of breaststroker's knee pain, and of the athletes evaluated, 47% of them had medial synovial thickening and tenderness on weekly assessments of knee pain. It was also observed that there was a significant correlation of knee pain with age, training years, breaststroke-specific swimming distance, and poor warm-up [4]. This result was later verified by experiments by Vizsolyi P, Taunton J, Robertson G, et al. [5]. All ages may be affected, including adolescent and adult competitive swimmers. Strength testing of 78 adolescent swimmers revealed that the differences between male and female athletes were insignificant prior to puberty, but after puberty, the female athletes, because of hormonal effects, did not develop sufficient hamstring muscles, and consequently, they have a relatively increased risk of muscle strength imbalance [6]. As a result, the incidence rate of breaststroker s knee is higher in women.

3. Causes of Knee Pain in Breaststroker’s Knee

3.1 Technical Deficiencies

The breaststroke leg cycle involves four stages: the leg recovery, foot external rotation, the propulsive kick, and gliding. Technical errors may lead to the overloading of the knee joint. The study conducted by Man Minghui shows that leg recovery and the propulsive kick are the two steps that are the most vulnerable to issues. The thighs are excessively moved in a downward and forward direction to cause excessive hip flexion, excessive abduction of the knees, and the feet to move much farther apart than the distance between the knees. In the propulsive kick, wrong force generation source leads to significant knee valgus moment as the kick is

powered by the knee but not controlled by the hip, causing the medial collateral ligament to experience prolonged tension [7]. Knee joint stress can also be increased with improper hip abduction angles. Earlier research has established that the peak knee abduction and internal rotation moments take place in the propulsive part of the kick, making it a highly risky time for soft tissue microtrauma. With limited range of motion in hip rotation, athletes tend to counteract it with increased rotation of the knee, transferring the load of the movement which would normally be supported by the hip to the knee and speeding the process of injury accumulation.

3.2 Muscle Strength Imbalance

The athletes with breaststroker's knee usually demonstrate inadequate activation of the muscles of the hip and knee. In particular, the gluteus medius, gluteus maximus, deep external rotators, and adductors cannot produce sufficient force during the kick. At the same time, the iliopsoas, lateral hamstrings, and adductor muscles of the thigh become overly taut, so that there is a reduction in core stability. Since the hip musculature is weak, the hip joint is not stabilized and it does not work well, the hip control is easily lost during the kick, and the knee has to compensate and increase the valgus and rotational loads. Along with bony structure factors, a significant fraction of cases of knee varus is related to an imbalance in the lower extremity muscle strength. The research by Zhang Yanan, Zhao Xiangyu, and Sun Xugui supports this point of view, which states that knee varus occurs due to high tension of the hip adductors and low tension of the knee flexors, which in turn leads to increased pressure on the medial side of the knee and then causes pain in the middle part of the knee and damage to the cartilage [8]. This imbalance also lowers the dynamic stability of the knee joint even more.

4. Current Status of Research on Exercise Therapy Interventions

4.1 Current Status of Research on Technique Correction Interventions

The essence of technique correction involves assisting athletes to rebuild a sensible kick pattern, directing them towards finding the proper origin of the force creation, and eliminating non-essential valgus and rotational loads on the knee joint, which would ease the burden on the soft tissues of the knee. Presently, there are two major corrective techniques, namely, underwater video feedback correction and sport-specific technical correction exercises. Yang Honghui, Yu Weidong, Sun Jiawei, et al. have used underwater videography to compare standard movements with those made by athletes at the same time, allowing visualisation of problems like excess knee abduction and improper timing of foot outward rotation, thus, giving an opportunity to provide kinematic proof of technical diagnosis [9]. Sport specific technical exercises are divided into land-based and water-based exercises. In a 2025 focused simulation experiment, Chen Jiacheng utilized a self-designed prone breaststroke kick auxiliary training apparatus to help athletes in performing land-based technical correction exercises. As they were simulating sport specific movement, the device restricted the trunk movement and minimized the angle of knee abduction angle allowing athletes to standardize their kick rhythm [10]. Water based activities consist of narrow breaststroke kicks, restricting the range of kick with a kickboard and the use of short fins to promote the development of proprioception of the outward rotation of the feet. These two intervention modalities combined are more effective in addressing breaststroker's knee. Nevertheless, several clinical controlled studies have shown that technique correction alone offers slight relief to mild breaststroker's knee pain, but in case of athletes with serious muscle weakness or strength imbalance, the benefit of pain reduction attained purely through technical changes is minimal and the recurrence rate is high. Hence, even with only the correction of technical movement, there are still significant limitations.

4.2 Current Status of Research on Muscle Strength Balance Training Interventions

Balance training of the core muscles does not necessarily only involve developing absolute strength but instead focuses on maximizing the synergistic ability of the hip and knee muscles. It requires not only building up the strength of the gluteus maximus, gluteus medius, hip external rotators, and adductors, but also balancing the strength of the quadriceps and hamstrings, as well as enhancing the range of motion of the hip joint so that the dynamic stability of the lower extremities can be improved. Yang Man, Liu Qiang, Xiong Xiaoyun, et al. have applied isometric contraction training to the quadriceps and hamstrings to engage the motor units and prevent muscle atrophy and applied an isokinetic dynamometer to conduct controlled resisted flexion-extension training in a small range of motion, which stimulated the quadriceps and hamstrings at various angles

and enhanced neuromuscular control and thus muscle strength [11]. He Xiaohao, He Jiangyan, Ji Qiaoping, et al. were concerned with functional reinforcement of the hip and knee muscle groups, using elastic bands as a source of low-load resistance training to muscle strength of the knee [12]. In 2023, Ma Shengnan, Ke Jingyue, et al. performed practical studies on the relationship between core stability training and local knee muscle strength improvement. At the same time, the training was employed to develop the hip musculature to fix the pelvic girdle and align the lower extremity in the frontal plane to minimize the overloading of the medial side of the knee and enhance the function of the knee joint [13]. Nevertheless, when land-based training is separated from water proprioception and just increases muscle strength, then it is hard to efficiently relieve pain in actual swimming.

5. Summary

The current research validates the fact that breaststroker's knee is actually a result of prolonged high-intensity sport-specific training with the presence of technical faults and imbalance in muscle strength. The proper technique correction results in substantial changes in the movement patterns of athletes, and further muscle strength balance training will also enhance a number of weaker muscle groups; these two forms of intervention do actually help to reduce knee pain to some degree. Nonetheless, even the unimodal approach of technique correction or muscle strength training does have severe shortcomings and cannot be used to break the vicious cycle of injury.

Suggestions to consider during future research include the adoption of exercise therapy that involves technical movement correction with muscle strength balance training; conducting large-sample randomized controlled trials; creating standardized combined intervention protocols to treat breaststroker's knee of different severity levels; increasing long-term follow-up; and identifying the main factors that lead to recurrence. Simultaneously, both aquatic and land-based methods should be used in combination, particularly on the loading of the lower extremity biomechanics to minimize the excess excitation of the medial soft tissues of the knee. Foam rolling could be used more often either before or after training workouts, to release tight muscles like the iliopsoas and hamstrings, and also along with flexibility exercises to elongate the ligaments. Such method may alleviate pain and recover the function and at the same time maintain sports-specific competitive level, which is a preferred way of treatment and prevention of breaststroker knee. This exercise therapy should be advocated in the rehabilitation process of domestic swimming leagues.

References

[1] Peng Zhang. (2011). Preventive training methods for breaststroke knee. Chinese sports coach,19 (3) : 38-39.

[2] Huiwu Zhang, Bei Liu, Daren Zhao, et al. (2020). Clinical observation on the therapeutic effect of external application of traditional Chinese medicine combined with exercise therapy in the treatment of medial collateral ligament injury of the knee joint. Chinese Journal of Sports Medicine, 30 (7) : 531-534.

[3] Rongting Zhao, Lei Sheng. (2022). The effect of aquatic exercise rehabilitation on functional recovery in patients with knee joint injuries. Nanjing Sport Institute.

[4] Rovere G. D., Nichols A. W. (1985). Frequency, associated factors, and treatment of breaststroker's knee in competitive swimmers. Am J Sports Med,13 (2): 99-104.

[5] Vizsolyi P, Taunton J, Robertson G, et al. (1987). Breaststroker's knee: An analysis of epidemiological and biomechanical factors. Am J Sports Med,15 (1): 6371.

[6] Amado B. L., De Lira C. A. B., Vancini R. L., et al. (2023). Comparison of Knee Muscular Strength Balance among Pre-and-Post-Puberty Adolescent Swimmers: A Cross-Sectional Pilot Study. Healthcare, 11 (5): 744.

[7] Minghui Man. (2008). Analysis of Common Mistakes in Breaststroke Leg Movements in College Swimming Instruction. Hubei Sports Science and Technology, 27 (4): 466-467.

[8] Yanan Zhang, Xiangyu Zhao, Xugui Sun. (2020). Rehabilitation Study on Elastic Band Resistance Exercise Training for Correcting Knee Varus Caused by Muscle Strength Imbalance. Mudanjiang Normal University Journal (Natural Science Edition), 46 (1) : 62-65.

[9] Honghui Yang, Weidong Yu, Jiawei Sun, et al. (2005). Underwater Kinematics Analysis of Men's Wavy Breaststroke Technique. Sports science research, 26 (4): 53-56.

[10] Jiacheng Chen. (2022). Research on the Application of Land based Auxiliary Practice Equipment in Improving Leg Techniques of breaststroke: A Case Study of the Swimming Specialization Class at Harbin Institute of Sports. Harbin Institute of Physical Education.

[11] Man Yang, Qiang Liu, Xiaoyun Xiong, et al. (2023). The effect of rehabilitation therapy combined with isokinetic muscle strength training on knee joint function in patients after total knee arthroplasty. Journal of Xinxiang Medical University ,40 (3): 230-233.

[12] Xiaohao He,Jiangyan He, Qiaoping Ji. (2025). The effect of hip-knee-ankle periarticular muscle strength training combined with three-dimensional gait analysis system training on pain level and knee joint function in patients after anterior cruciate ligament reconstruction. Reflexology and Rehabilitation Medicine, 6 (4):106-109.

[13] Shengnan Ma, Jingyue Ke, Hongming Dong, et al. (2023). Core stability training intervention on dynamic balance and surface electromyography after anterior cruciate ligament reconstruction surgery. China Rehabilitation Theory and Practice, 29 (8): 882-889.-889.

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Conflicts of Interest

The authors declare no conflict of interest.

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