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REVIEW ARTICLE

The Analysis of Injuries or Pain among Fencing Athletes and Recovery Methods Based on the Distribution of the Cutaneous Nerve: Literature Review

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Fencing,
Musculoskeletal Pain,
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ABSTRACT

Background. Pain is transmitted to the brain via sensory nerves, and in the musculoskeletal system, pain is often well-perceived due to the abundant distribution of cutaneous nerves in the subcutaneous fat. **Objectives.** This study aims to analyze the causes of musculoskeletal pain associated with the repetitive daily training movements of fencers and propose initial recovery methods to maximize athletic performance. **Methods.** This study comprehensively searched the scientific literature about fencing, pain, or treatment. **Results.** Most injuries and pain experienced by fencers were concentrated in the lower extremities, followed by the upper extremities, and then the trunk and head, including neck regions. **Conclusion.** When pain occurs in specific areas, it is advisable to assess and address the condition of the structures that affect the course of the corresponding cutaneous nerves, as these may serve as key treatment points. This study hopes that the results can be applied in clinical practice to facilitate early treatment.

INTRODUCTION

Fencing is a specialized combat sport characterized by using weapons to score points through touches on the opponent without physical contact. The sport is segmented into three distinct disciplines: foil, sabre, and epee, each with its own rules and target areas on the body (1). In competitive fencing, participants don specific protective attire, including fencing masks, jackets, and gloves, and engage on a piste—a strip measuring 14 meters in length and between 1.5 and 2 meters in width (2). Given the inherently asymmetrical nature of fencing, which demands coordination, explosive power, speed, and precision, and the rapid, unpredictable movements of the opponent, the ability to effectively convert visual stimuli into appropriate motor responses is of paramount importance (3).

Most injuries arise from unforeseen accidents, underscoring the need to focus on preventing unnecessary injuries. Consequently, injury prevention is a critical consideration for fencing athletes. Specifically, preventing musculoskeletal injuries holds significant importance for athletes, as such injuries often result from the musculoskeletal system being subjected to excessive load without adequate recovery or adaptation. Thus, it is essential to implement effective training strategies to avert these injuries (4). Therefore, sports professionals and coaches should integrate muscle-strengthening exercises, nutritional advice, and comprehensive guidance into their injury prevention protocols. Moreover, enhancing athletic performance through scientifically grounded training is particularly crucial (5). The training regimen must address the multifaceted requirements associated with various skills to ensure both practical training and injury prevention.

In fencing, the unilateral nature of the sport contributes to a high incidence of lower extremity injuries. Research involving the U.S. national fencing team indicates that 69% of fencers have sustained at least one injury to their dominant knee, while 31% have experienced at least one injury involving the hip joint. Muscle strains are predominantly observed in the dominant hip, whereas muscle and labral tears are more frequently reported in the nondominant hip (5). Given the impact of injuries on athletic performance, it is crucial to explore preventive measures. Specifically, factors such as inadequate warm-ups, suboptimal fencing techniques, hazardous tactics, insufficient general conditioning, fatigue, overtraining, and repetitive movements can lead to overuse injuries, which may result in more severe and enduring damage (6). Such injuries or musculoskeletal pain also have a significant impact on fencing performance.

Both athletes and the general population should recognize that early treatment is crucial for all conditions, and accurate initial diagnosis may vary depending on the perspective from which the body is examined. Pain is transmitted to the brain via sensory nerves, and in the musculoskeletal system, pain is often well-perceived due to the abundant distribution of cutaneous nerves in the subcutaneous fat. Although simple muscle soreness is also considered pain, entrapment of nerves or blood vessels within muscles or other connective tissues can significantly increase pain. In such cases, it is advisable to identify the nerve pathway responsible for the painful region and determine whether entrapment has occurred along this pathway. This approach can help effectively target the structural treatment points (7).

This study aims to analyze the causes of musculoskeletal pain associated with the repetitive daily training movements of fencers and propose initial recovery methods to maximize athletic performance.

MATERIALS AND METHODS

Study Design. This study researched the scientific literature published between 2000 and 2024 using PubMed Central. Indexed terms and keywords such as "fencer", "fencing", "athlete injury", "musculoskeletal pain", "treatment", "recovery" and "performance" were utilized. Subsequently, the reference lists of all relevant studies were examined. In this study, only research papers specifically addressing fencing athletes, including those that mention accurate diagnoses of injuries, pain regions, recovery methods, and performance-related aspects, were considered for inclusion. Studies focused on other sports were excluded. Additionally, studies published prior to the year 2000 were also excluded. For each identified study, information regarding injuries, pain, and recovery methods was systematically organized into tables and analyzed (Figure 1).

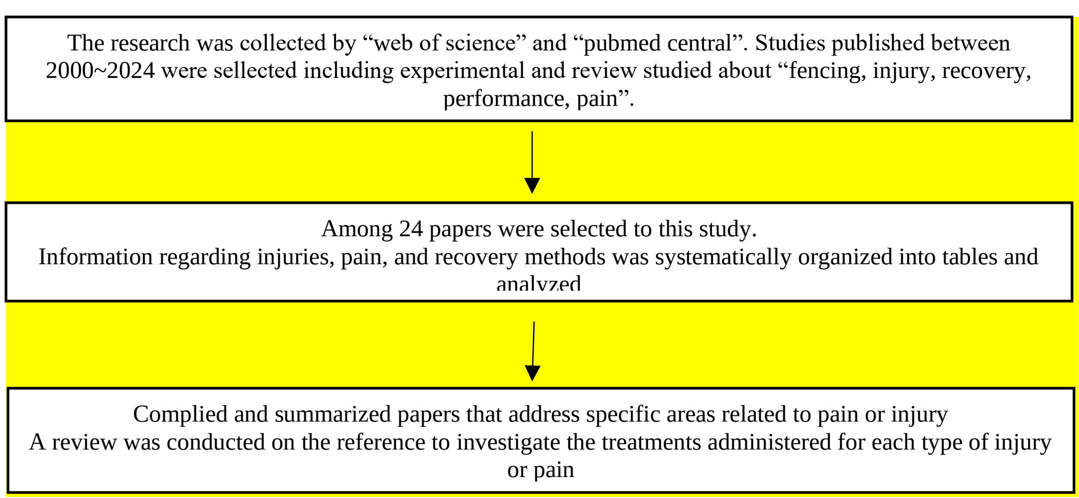

Figure 1. The processing of this study.

RESULTS

According to the research in Italy in 1992, the intravascular papillary endothelial hyperplasia was reported to the female fencer. Research conducted on American athletes in 1996, 2012, and 2022 reported a high incidence of pneumothorax, as well as hip and knee pain. Data reported from Germany in 2004 and 2008 indicated a prevalence of injuries to the anterior tibial tendon and stress-related injuries. Additionally, reports of stress-related injuries were observed in Spanish fencers in 2011. Studies conducted on Korean fencers in 2016 and 2020 indicated that the most common sites of pain or injury were the lower extremities, followed by the upper extremity, trunk, head, and neck. A study from Singapore in 2021 reported finger pain, while research from China in 2022 identified foot pain, and studies from the United States and Canada highlighted hip and knee pain, as well as femoroacetabular impingement, respectively. Additionally, a study from France in 2023 reported wrist pain (Table 1).

Table 1. The musculoskeletal pain and injury of fencer.

Population	Year	Pain or diagnosis	Injury
Italy (8)	1992	Intravascular papillary endothelial hyperplasia	
American (9)	1996	pneumothorax	
Germany (10)	2004	Rupture of tibialis anterior tendon	
Germany (11)	2008		Stress injury
Spain (12)	2011		Stress fracture of metatarsal
American (13)	2012	Right hip pain	
Italy (14)	2013	Achilles, quadriceps, patella tendon	
Korea (15)	2016		Lower limb (47.2%) Upper limb (26.4%) Trunk (21.4%) head & neck (5%)
Korea (16)	2020		Ankle
Singapore (17)	2021	Finger pain	
China (18)	2022	Metatarsophalangeal joint	
American (19)	2022	Hip and knee pain	
Canada (20)	2022	Femoroacetabular impingement	
France (21)	2023	wrist	

DISCUSSION

The intravascular papillary endothelial hyperplasia study reported in Italy (8) in 1992 primarily addresses cellular hyperplasia. Since this research aims to analyze pain related to postural imbalances, excessive muscle use, or external entrapment, it would be prudent to exclude cellular hyperplasia considerations from this study's scope.

In 1996 (9), a case of pneumothorax was reported in a fencer, and a similar occurrence was documented in an athlete in 1997 (22). However, there is a paucity of studies focusing on the incidence of pneumothorax by sport or athlete gender. This suggests that the condition may be attributed to individual-specific factors rather than being influenced by the type of sport or gender. Predisposing factors for primary spontaneous pneumothorax include smoking, a family history of the condition, Marfan syndrome, homocystinuria, and thoracic endometriosis. Additionally, an increased risk of recurrence has been associated with female gender, tall and slender physique in males, low body weight, anorexia nervosa, and ongoing smoking (23).

A comprehensive review of the references examined in this study reveals that injuries and pain predominantly occur in the lower extremities (Table 1). In fencing, the tibialis anterior muscle, which plays a primary role in the fente movement, is located in the anterior compartment of the leg. It is responsible for the dorsiflexion of the ankle joint. Additionally, the extensor hallucis longus and extensor digitorum longus muscles, which function in conjunction with the tibialis anterior, are also part of the anterior compartment of the calf. Therefore, these muscles should be adequately addressed in recovery training to ensure sufficient rehabilitation. During fencing training, the anterior compartment muscles of the leg undergo rapid contraction when advancing. To mitigate the risk of stress fractures or tendon ruptures, it is crucial to thoroughly address these muscles during recovery to facilitate adequate relaxation and rehabilitation. As reported in other studies (24), there is considerable focus on the knee joint during the fente movement. However, the ankle joint also plays a crucial role in performance. Therefore, it is essential to give attention to the fatigue experienced by the anterior compartment muscles of the leg, as they significantly impact athletic performance. The anterior compartment muscles of the leg, including the tibialis anterior, have their muscle belly located in the upper part of the leg, adjacent to the lateral zone of the anterior border of the tibia (Figure 1). recovery can be facilitated by applying pressure to this region while stretching the muscle, which can be effectively achieved through ankle joint plantar flexion. This approach aids in elongating the muscle and enhancing recovery. It is anticipated that recovery of the tibialis anterior muscle, which is extensively utilized in fencing training, will positively prevent damage or pain in the ankle and foot regions.

Additionally, tightness in the anterior compartment muscles of the leg may lead to entrapment of the deep peroneal nerve. This nerve innervates the sensory region between the first and second toes, and any entrapment can result in altered sensory perception in this area. Initial symptoms of sensory abnormal sensations should be promptly assessed through sensory testing. For athletes exhibiting such symptoms, a beneficial recovery approach would be to implement relaxation techniques for anterior compartment muscles to alleviate pressure on the nerve (Figure 2). Table 1 indicates the presence of various injuries or pain, including metatarsal stress fractures, Achilles tendinitis, ankle, patellar issues, and hip joint pain. Should recovery be adequately achieved through daily exercise from a dermatoneurological perspective, it would be pertinent to investigate the potential relationships between these injuries or pain and the recovery process in future research. The superficial peroneal nerve innervates the muscles in the lateral compartment of the leg and is responsible for sensory innervation of the anterior aspect of the ankle joint. In athletes with ankle pain, the cutaneous branches of the superficial peroneal nerve in this region should be evaluated. Therefore, assessing the condition of the peroneus longus and brevis muscles and addressing these areas as potential treatment targets may be a practical approach (Figure 2).

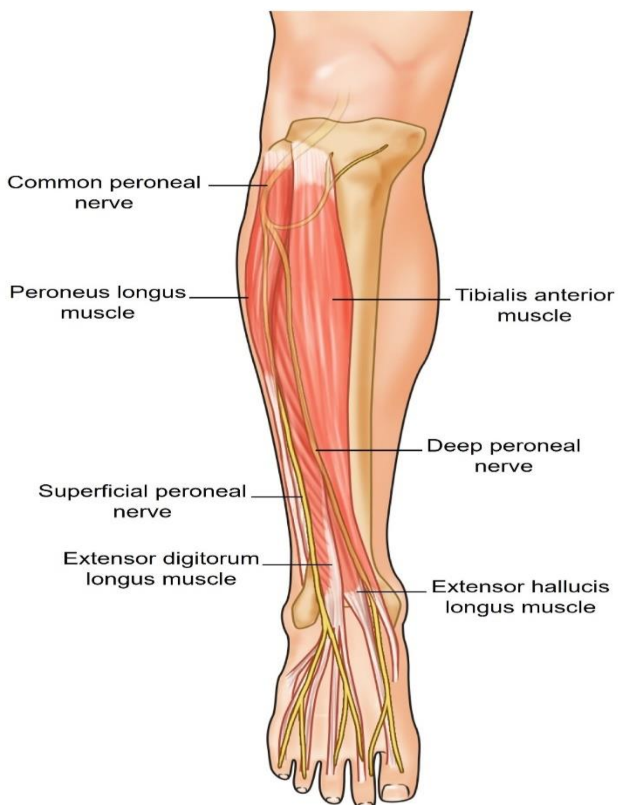

Figure 2. Illustration of the structure in the anterior compartment of the leg.

In cases of hip-related pain, the specific location of the discomfort can provide insights into potential underlying causes. For instance, the inguinal ligament is a reference point for several key nerves. The lateral femoral cutaneous nerve (LFCN), emerging lateral to the inguinal ligament, is responsible for the cutaneous innervation of the lateral aspect of the thigh. The medial femoral cutaneous nerve (MFCN), a branch of the femoral nerve, supplies sensation to the medial portion of the thigh. Additionally, the intermediate femoral cutaneous nerve (IFCN), also derived from the femoral nerve, innervates the anterior aspect of the thigh. The MFCN and IFCN traverse the apex of the femoral triangle (Figure 3). Therefore, if there is increased tension in the structures that define the triangle's boundaries, sensory abnormalities may arise in the areas innervated by these two nerves. In such cases, employing methods to relax the structures forming the triangle's boundaries is advisable. Since these branches run beneath the iliopsoas muscle, relaxing this muscle may be a practical approach for managing and alleviating such pain (Figure 4).

Pain radiating to the medial knee region and leg may be alleviated by addressing the muscle tension defining the boundaries of the femoral triangle. The saphenous nerve, which traverses the apex of the femoral triangle, descends along the medial aspect of the knee and further down into the leg. At the medial knee, it branches into the infrapatellar branch, which provides sensation to a portion of the medial knee. The main saphenous nerve continues its course medially in the leg and towards the ankle (Figure 3). Palpating the muscles at the boundaries through which these nerves traverse is an important approach from the perspective of initial recovery.

A limitation of this study is that it does not explicitly investigate the therapeutic effects focused on the distribution of the cutaneous nerve. Further research, scientifically analyzing the treatment effects, is necessary and should be pursued based on the findings of this study.

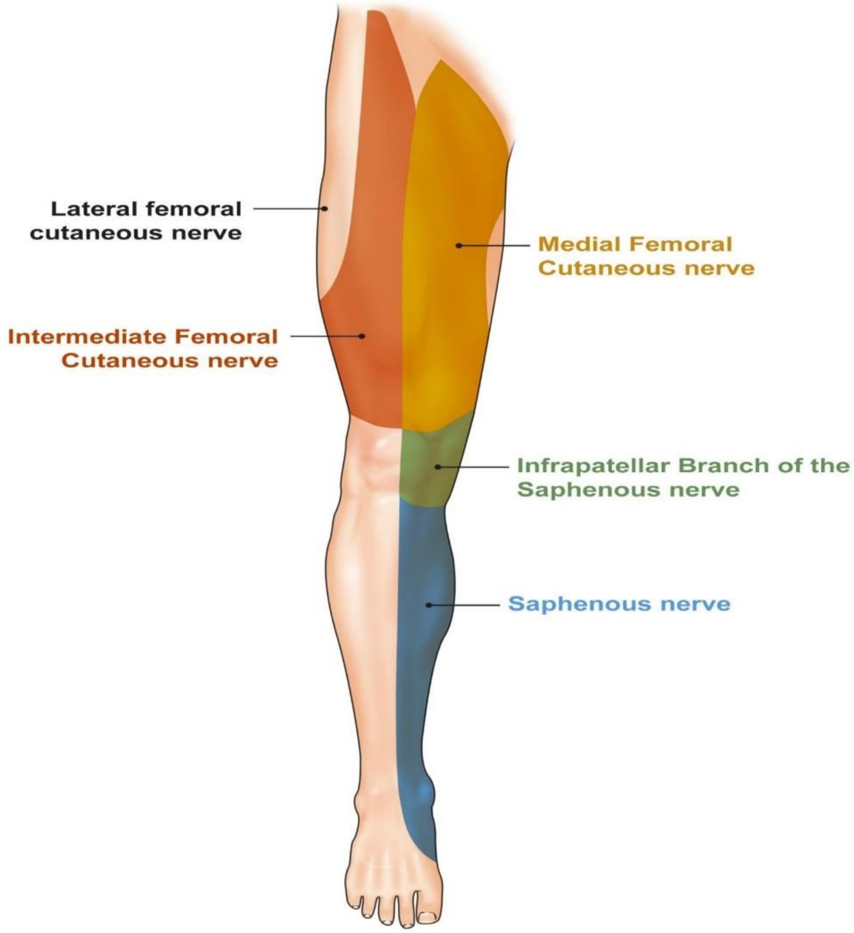

Figure 3. Illustration of the cutaneous nerves corresponding to each region of the lower extremity.

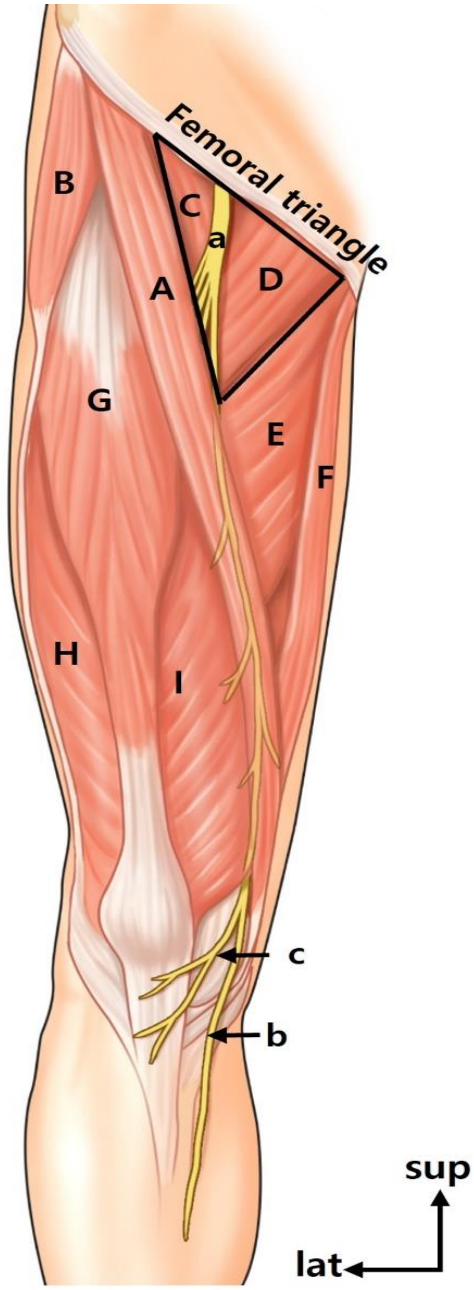

Figure 4. The illustration depicting the boundaries of the femoral triangle and its positional relationship with the femoral nerve. A: sartorius, B: tensor fascia lata, C: iliopsoas, D: pectineus, E: adductor longus, F: gracilis, G: rectus femoris, H: vastus lateralis, I: vastus medialis, a: femoral nerve, b: saphenous nerve, c: infrapatellar branch, sup: superior, lat: lateral.

CONCLUSION

When pain occurs in specific areas, it is advisable to assess and address the condition of the structures that affect the course of the corresponding dermatome nerves, as these may serve as key treatment points. The abnormal condition of muscles has limited movement, so intentionally applying pressure can effectively relieve tension and reduce associated pain.

APPLICABLE REMARKS

- Since the nerves responsible for pain travel through muscles, when any pain occurs, intentional stimulation of the boundary muscle according to each pain region helps relieve pain.

AUTHORS' CONTRIBUTIONS

Study concept and design: Junghwan Kim, Je-Hun Lee. Acquisition of data: Junghwan Kim, Hyejung Oh, Je-Hun Lee. Analysis and interpretation of data: Je-Hun Lee. Drafting the manuscript: Junghwan Kim, Hyejung Oh, Je-Hun Lee. Critical revision of the manuscript for important intellectual content: Junghwan Kim, Hyejung Oh. Statistical analysis: Hyejung Oh. Administrative, technical, and material support: Junghwan Kim, Hyejung Oh, Je-Hun Lee. Study supervision: Je-Hun Lee.

CONFLICT OF INTEREST

The authors declare no conflict of interest.

FINANCIAL DISCLOSURE

This study has no financial interests related to the material in the manuscript.

FUNDING/SUPPORT

This study has no funding or support for the manuscript.

ETHICAL CONSIDERATION

This study protocol conforms to the ethical guidelines of the 1975 Declaration of Helsinki.

ROLE OF THE SPONSOR

The funding organizations are public institutions and had no role in the design and conduct of the study.

ARTIFICIAL INTELLIGENCE (AI) USE

It did not use AI or AI-assisted tools in this study.

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