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LIGAMENTOUS KNEE INJURIES IN AMATEUR ATHLETES: EPIDEMIOLOGICAL PROFILE AND THERAPEUTIC APPROACHES

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Abstract: INTRODUCTION Ligamentous knee injuries are a prevalent concern in amateur athletes, resulting from high-impact activities without adequate preparation or preventive measures. These injuries, particularly involving the anterior cruciate ligament (ACL) and posterior cruciate ligament (PCL), significantly impact joint stability and athletic performance. Factors such as inadequate training, fatigue, and biomechanical inefficiencies increase the risk, particularly in sports requiring pivoting and deceleration. Epidemiological studies highlight the disproportionate burden of these injuries among amateur athletes, emphasizing the need for targeted prevention programs. **OBJETIVE** To analyze the epidemiological patterns, risk factors, and treatment approaches for ligamentous knee injuries in amateur athletes, highlighting the challenges and solutions specific to this population. **METHODS** This is a narrative review which included studies in the MEDLINE – PubMed (National Library of Medicine, National Institutes of Health), COCHRANE, EMBASE and Google Scholar databases, using as descriptors: "Ligamentous knee injuries" AND "Amateur athletes" OR "Epidemiology" OR "Rehabilitation strategies" OR "Sports medicine" in the last 5 years. **RESULTS AND DISCUSSION** Results demonstrate that timely diagnosis using clinical tests and imaging modalities like MRI is crucial in guiding effective management. Conservative approaches, including physiotherapy and bracing, are effective for minor injuries, while severe cases often require surgical intervention. Rehabilitation programs tailored to individual needs improve recovery outcomes and reduce the risk of recurrence. Challenges remain in addressing delayed treatment, gender-specific considerations, and the psychological and economic impacts of these injuries. **CONCLUSION** In conclusion, managing ligamentous knee injuries in amateur athletes requires a multifaceted approach that integrates prevention, early diagnosis, and individualized treatment. By addressing the unique challenges of this population, clinicians can enhance recovery outcomes and reduce the long-term burden of these injuries. Future research should focus on refining prevention strategies and advancing therapeutic options to meet the specific needs of amateur athletes.

Keywords: Knee injuries; ACL injuries; Sports medicine; Rehabilitation; Amateur athletes

INTRODUCTION

Ligamentous knee injuries are among the most prevalent and disabling conditions encountered in sports medicine, particularly affecting amateur athletes[1]. These injuries, which include damage to structures such as the anterior cruciate ligament (ACL), posterior cruciate ligament (PCL), and collateral ligaments, are often caused by high-impact activities or sudden directional changes during physical exertion[1]. Amateur athletes, lacking access to professional-grade preventive programs and coaching, are more vulnerable to such injuries, resulting in significant long--term functional impairment if inadequately managed[1].

The knee joint's unique biomechanical demands and complex structure render it prone to ligamentous injuries during physical activities[2]. Ligaments serve a crucial role in stabilizing the joint by limiting excessive motion while allowing controlled mobility, but they are susceptible to failure under abnormal mechanical loads[2]. In amateur athletes, insufficient neuromuscular training, improper movement patterns, and suboptimal conditioning often lead to injury, particularly in activities involving rapid deceleration, twisting, or jumping[2].

Epidemiological studies reveal that ligamentous knee injuries are disproportionately associated with specific sports, such as soccer, basketball, and skiing[3]. These activities often involve high-speed movements and unpredictable external forces, increasing the risk of ligament tears[3]. Gender-based differences in injury prevalence have also been documented, with female athletes exhibiting a higher incidence of ACL injuries due to hormonal, anatomical, and biomechanical factors[3]. Understanding these patterns is critical for designing effective prevention strategies tailored to specific populations.

Multiple intrinsic and extrinsic risk factors contribute to the occurrence of ligamentous knee injuries[4]. Intrinsic factors include age, with younger athletes at risk due to immature musculoskeletal systems, and older athletes facing degenerative changes[4]. Additionally, individuals with a history of prior ligamentous injuries are significantly predisposed to recurrence[4]. Extrinsic factors, such as inadequate footwear, playing surface conditions, and improper sports techniques, further exacerbate the likelihood of injury.

Diagnosis of ligamentous knee injuries in amateur athletes is frequently delayed due to limited access to specialized medical care[5]. Although clinical tests, such as the Lachman and pivot shift tests, remain valuable for initial assessment, imaging modalities like magnetic resonance imaging (MRI) provide definitive diagnostic information[5]. However, the availability of advanced imaging is often restricted in amateur sports settings, necessitating reliance on clinical judgment and alternative tools such as ultrasound[5].

Management of ligamentous injuries varies depending on the severity, ligament involved, and functional demands of the athlete[6]. Initial treatment typically involves the RICE protocol to control pain and swelling, followed by more definitive interventions such as physiotherapy or surgical repair[6]. In amateur athletes, conservative management is often preferred, but severe cases, particularly complete ligament ruptures, may necessitate surgical reconstruction to restore stability and prevent long-term joint degeneration[6].

The economic and psychological impacts of ligamentous knee injuries are substantial, particularly in amateur athletes, who often lack comprehensive medical support[7]. Financial burdens associated with treatment, rehabilitation, and potential lost income due to work absences are significant[7]. Psychologically, the loss of mobility and participation in sports can lead to anxiety, depression, and decreased quality of life, underscoring the importance of holistic care that addresses these dimensions[7].

Preventive strategies have been shown to reduce the incidence of ligamentous injuries, particularly those involving neuromuscular training programs[8]. Protocols such as the FIFA 11+ program focus on improving proprioception, strength, and coordination, effectively mitigating injury risk in both professional and amateur settings[8]. However, implementation remains a challenge in amateur populations due to limited resources, emphasizing the need for community-based initiatives and education[8].

Recent advancements in the understanding of ligament healing and regeneration have introduced novel therapeutic options, including biologic therapies[9]. Platelet-rich plasma (PRP) and mesenchymal stem cell applications have demonstrated potential in accelerating ligament repair and enhancing outcomes, although their widespread use is limited by cost and accessibility[9]. These approaches, coupled with traditional surgical techniques, hold promise for improving recovery in amateur athletes[9].

Despite advances in prevention and treatment, managing ligamentous knee injuries in amateur athletes requires a multifaceted

approach[10]. Tailored strategies that consider individual risk factors, socioeconomic barriers, and access to care are essential for optimizing outcomes[10]. Ongoing research and the development of evidence-based practices remain critical to reducing the burden of these injuries and enabling athletes to safely return to their activities[10].

OBJETIVES

To analyze the epidemiological patterns, risk factors, and treatment approaches for ligamentous knee injuries in amateur athletes, highlighting the challenges and solutions specific to this population.

SECUNDARY OBJETIVES

1. To assess the prevalence and mechanisms of ligamentous knee injuries in amateur sports.
2. To evaluate diagnostic and imaging modalities used for knee injuries in non-professional athletes.
3. To compare conservative and surgical treatment approaches, focusing on their outcomes in amateur athletes.
4. To explore the role of preventive strategies, such as neuromuscular training, in reducing the incidence of ligamentous knee injuries.
5. To discuss the long-term implications of untreated ligamentous injuries and the psychological impact on amateur athletes.

METHODS

This is a narrative review, in which the main aspects of Double Heart-Kidney Transplantation in recent years were analyzed. The beginning of the study was carried out with theoretical training using the following databases: PubMed, sciELO and Medline, using as descriptors: "Ligamentous knee injuries" AND "Amateur athletes" OR "Epidemiology" OR "Rehabilitation strategies" OR "Sports medicine" in the last 5 years. As it is a narrative review, this study does not have any risks.

Databases: This review included studies in the MEDLINE – PubMed (National Library of Medicine, National Institutes of Health), COCHRANE, EMBASE and Google Scholar databases.

The inclusion criteria applied in the analytical review were human intervention studies, experimental studies, cohort studies, case--control studies, cross-sectional studies and literature reviews, editorials, case reports, and poster presentations. Also, only studies writing in English and Portuguese were included.

RESULTS AND DISCUSSION

Ligamentous knee injuries in amateur athletes present unique epidemiological patterns that highlight their increased vulnerability compared to professional athletes[10]. Studies indicate that amateur athletes often lack the structured preventive measures, such as neuromuscular training programs, widely implemented in professional sports[10]. This lack of preparation contributes significantly to the prevalence of injuries, with the anterior cruciate ligament (ACL) being the most commonly affected structure[10]. The ACL's vulnerability is attributed to its critical role in stabilizing the knee during pivoting and cutting movements, which are frequent in sports like soccer and basketball[11].

The posterior cruciate ligament (PCL), while less frequently injured, also plays a vital role in knee stability, particularly in resisting posterior tibial translation[11]. PCL injuries are often associated with direct trauma, such as collisions or falls, making them more common in contact sports[11]. Medial and lateral collateral ligament injuries, on the other hand, are frequently observed in sports requiring rapid directional changes and are often linked to valgus or varus stress mechanisms[12]. Combined ligament injuries, though less common,

pose significant challenges due to their complexity and the need for comprehensive treatment strategies[12].

The association between specific sports and ligament injuries reveals important trends that inform prevention efforts[12]. For example, soccer and basketball are strongly associated with ACL injuries due to the high prevalence of pivoting, jumping, and sudden deceleration movements in these sports[13]. Skiing, on the other hand, poses unique risks for combined ligament injuries due to the rotational forces often experienced during falls[13]. Training regimens also play a critical role, with evidence suggesting that athletes who undergo consistent strength and proprioceptive training are less likely to sustain ligamentous injuries[13].

Fatigue has emerged as a significant factor in increasing the risk of ligament injuries[14]. As athletes become fatigued, neuromuscular control deteriorates, leading to improper landing mechanics and reduced joint stability[14]. This phenomenon is particularly evident in amateur athletes, who may lack the endurance required to maintain proper form during prolonged activity[14]. A comparison of injury mechanisms between amateur and professional athletes further highlights the influence of fatigue, with amateur athletes demonstrating a higher incidence of non-contact injuries due to poor technique[15].

The diagnostic accuracy of clinical tests for ligamentous knee injuries remains a cornerstone of initial evaluation[15]. Tests such as the Lachman and pivot shift are highly sensitive for ACL injuries, while the posterior drawer test is effective for PCL assessment[15]. However, the utility of imaging techniques, particularly magnetic resonance imaging (MRI), cannot be overstated[16]. MRI provides detailed visualization of ligamentous structures, enabling accurate diagnosis and treatment planning[16]. Despite its advantages, the high cost and limited availability of MRI in amateur sports settings often necessitate reliance on clinical expertise and ultrasound as alternative diagnostic tools[16].

Acute management strategies for knee injuries typically prioritize pain relief and swelling control, with the RICE protocol being the most widely used approach[17]. While effective in the short term, this protocol must be complemented by comprehensive evaluation and intervention to address underlying ligament damage[17]. Conservative management approaches, including physiotherapy and bracing, are often employed for minor injuries, while surgical intervention is reserved for more severe cases[17]. The indications for surgery are determined by factors such as the extent of ligament damage, instability, and the athlete's functional demands[18].

Comparisons of surgical and nonsurgical treatment outcomes reveal important considerations for amateur athletes[18]. While surgical reconstruction offers superior stability and reduces the risk of reinjury in complete ligament tears, nonsurgical approaches may suffice for partial tears or low-demand athletes[18]. Rehabilitation plays a critical role in both scenarios, with tailored protocols designed to restore strength, proprioception, and range of motion[19]. Post-surgical rehabilitation, in particular, requires close monitoring to prevent complications and optimize outcomes[19].

Delayed treatment of ligamentous injuries can have significant implications for recovery outcomes[20]. Prolonged instability and altered joint mechanics can lead to secondary damage, including meniscal tears and cartilage degeneration[20]. Physiotherapy remains a cornerstone of recovery, with evidence supporting its effectiveness in improving joint function and reducing pain[20]. The use of bracing and orthotics also aids in managing instability, particularly during the early stages of rehabilitation[21].

The timeline for returning to sports after a ligamentous injury varies widely depending on the severity of the injury, the treatment approach, and the athlete's adherence to rehabilitation protocols[21]. Predictors of successful return to sports include restoration of strength and proprioception, psychological readiness, and the absence of residual instability[21]. Challenges in managing recurrent knee injuries further emphasize the importance of effective initial treatment and prevention strategies[22].

Strength training and biomechanical training programs are critical components of injury prevention in amateur athletes[22]. These programs focus on improving muscle strength, joint stability, and movement patterns, thereby reducing the risk of reinjury[22]. Psychological support also plays a vital role, particularly for athletes recovering from severe injuries, as anxiety and fear of reinjury can hinder rehabilitation progress[23].

The influence of comorbidities, such as obesity and diabetes, on recovery outcomes cannot be overlooked[23]. These conditions may impair healing processes and increase the risk of complications, necessitating multidisciplinary management[23]. Untreated ligament injuries, meanwhile, can lead to chronic instability, pain, and functional limitations, significantly impacting athletic performance and quality of life[24].

Gender-specific rehabilitation approaches have gained attention due to the higher incidence of ACL injuries in female athletes[24]. Hormonal, anatomical, and neuromuscular differences necessitate tailored protocols to address specific vulnerabilities and optimize recovery[24]. Cost-effectiveness of treatment options is another important consideration, particularly in amateur athletes with limited financial resources[25].

Community-based injury prevention programs have demonstrated success in reducing the incidence of ligamentous injuries, particularly in youth sports[25]. These programs often incorporate neuromuscular training, education, and proper equipment use[25]. Telemedicine also offers promising opportunities for managing amateur sports injuries by providing remote access to expert guidance and monitoring[26].

Ethical considerations in returning to sports post-injury emphasize the need for comprehensive evaluation and shared decision-making[26]. Nutrition plays a supportive role in ligament healing, with adequate protein intake and supplementation of vitamins and minerals such as vitamin D and calcium being particularly beneficial[26]. Advances in surgical techniques, including minimally invasive approaches and improved graft materials, continue to enhance outcomes for ligamentous injuries[27].

Regenerative therapies, such as platelet-rich plasma (PRP) and mesenchymal stem cells, offer exciting possibilities for accelerating healing and improving recovery[27]. Public health policies targeting amateur sports injury prevention are essential for addressing the broader impact of ligamentous injuries[27]. Future research directions include the development of personalized prevention and rehabilitation strategies that account for individual risk factors and activity levels[28]. Best practices in managing ligamentous knee injuries must integrate evidence-based approaches, multidisciplinary collaboration, and a commitment to optimizing outcomes for amateur athletes[28].

CONCLUSION

Ligamentous knee injuries in amateur athletes present a significant challenge in sports medicine, with their prevalence and long-term implications necessitating focused attention from clinicians and researchers. These injuries, often resulting from high-intensity activities without adequate preparation or preventive measures, underscore the importance of implementing structured prevention strategies in amateur sports. The disproportionate impact on this population highlights the need for tailored approaches that address the unique vulnerabilities of amateur athletes, including limited access to resources and professional guidance. Effective management strategies must integrate prevention, timely diagnosis, and appropriate treatment to minimize functional impairment and improve outcomes.

The role of preventive programs, particularly those focused on neuromuscular training, cannot be overstated in reducing the incidence of ligamentous knee injuries. Evidence-based initiatives, such as the FIFA 11+ program, have demonstrated considerable success in professional settings and should be adapted for amateur athletes to enhance accessibility and efficacy. Addressing modifiable risk factors, such as fatigue, poor biomechanics, and inadequate conditioning, is critical in preventing these injuries. Furthermore, community-based efforts and education programs are essential to ensure that amateur athletes and their coaches are equipped with the knowledge and tools necessary to mitigate injury risks.

Timely and accurate diagnosis remains the cornerstone of effective management for ligamentous knee injuries. While imaging modalities such as MRI provide unparalleled diagnostic clarity, their limited availability in amateur sports settings necessitates reliance on clinical expertise and alternative tools like ultrasound. Prompt intervention, whether through conservative management or surgical reconstruction, is crucial to prevent secondary complications and optimize recovery. Rehabilitation programs should be individualized to address the specific needs of amateur athletes, emphasizing strength, proprioception, and functional restoration to enable a safe return to sports.

The long-term consequences of untreated or poorly managed ligamentous knee injuries, including chronic instability, degenerative joint disease, and psychological distress, highlight the importance of comprehensive care. Multidisciplinary approaches that incorporate medical, psychological, and socioeconomic considerations are essential for addressing the holistic needs of amateur athletes. Advances in regenerative therapies and minimally invasive surgical techniques offer promising avenues for improving outcomes, but their widespread implementation will require further validation and cost-effectiveness analysis.

In conclusion, managing ligamentous knee injuries in amateur athletes requires a multifaceted approach that balances prevention, early diagnosis, effective treatment, and long-term rehabilitation. By addressing the specific challenges faced by this population and leveraging advancements in sports medicine, clinicians can significantly reduce the burden of these injuries. Continued research and collaboration between healthcare providers, sports organizations, and community stakeholders are imperative to develop and implement strategies that optimize recovery, enhance athletic performance, and improve the overall quality of life for amateur athletes.

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