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Variations in common operations in athletes and non-Athletes

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ABSTRACT

Background: Achieving pre-injury activity level after an injury is the fundamental goal of any orthopedic treatment for an athlete. Unfortunately, pre-injury activity levels differ significantly in different patient categories, especially in athletes and non-athlete. Hence, an outcome suitable to a non-athlete may not be adequate for an athlete. This has led to variations in the surgical approach to the same injury in an athlete and non-athlete. There is plenty of literature published comparing the outcome in athletes and non-athletes after a particular surgery. Scattered discussion about variations in these surgeries based on functional demand was done in many publications. But there was a lack of a comprehensive narrative review summarizing variations in common operations among athletes and non-athletes.

Aim: This review attempted to summarize variations in common sports operations between high functional demand patients and low demand patients and discuss the variations from the author's perspective.

Methods: A review of all the relevant papers were conducted focusing on athletes and non-athletes. Most commonly performed sports surgeries were ACL reconstruction, Meniscal repair, PCL reconstruction, and Shoulder instability surgery. A literature search was done for each commonly performed surgery using relevant keywords in PubMed and Google Scholars. Summary of papers pertinent to athletes and non-athletes were compiled to prepare this narrative review.

Results: There is a lack of papers directly comparing results in athletes and non-athletes. However, many research papers discussed surgical variations in athletes (high demand) and non-athletes (low demand) patients. There are controversies in all commonly performed surgeries, and none of the papers gives a definitive guideline on the approach to athletes and non-athlete.

Conclusion: Rather than a common suggestion on surgical variation, an individualized approach would be appropriate to decide on variation in particular surgery in both athletes and non-athletes.

1. Introduction

Traditionally, the choice of treatment for orthopedic ailments depends on various factors like severity of the injury, patient age, functional demand of the patient, and many more. Among these factors, the functional demand of patients is considered the most important factor to alter the treatment choice. Although the functional demand of a particular body part varies in various professions, athletes are deemed to have higher functional demand compared to non-athletes.

Sports injuries have become more common, not only among athletes but also among non-athletes in the past few decades. On the other hand, the functional demand of non-athletes has also increased, creating confusion in decision-making. It is generally expected to have some difference in treatment options in athletes compared to non-athlete, but there is a lack of literature explicitly describing these variations.

This narrative review aimed to summarize and critically evaluate the treatment options for common sports injuries in athletes and non-athletes.

2. Who are athletes and non-athletes?

As society is changing from a sedentary lifestyle to a more active lifestyle, non-athletes are now exercising more than athletes. Hence defining athletes and non-athletes is very important. Various terminologies are interchangeably used to describe athletes, such as sportsmen, elite sportsmen, professional players, spare time sportsmen, weekend warriors, exercisers, and many more.[1,2] There are several attempts to define athletes and non-athletes based upon exercise pattern,[3] body

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composition,[1] and many complex metabolic parameters.[4]

According to the American heart association, an athlete is a person who participates in a team or individual sport that demands regular competition against others or needs organized training.[5] European Society of Cardiology defines an athlete as a person who engages in physical activity regularly and competes in tournaments.[3] Arajo and Scharhag introduced a new term, "exercisers," to define non-athletes involved in physical exercises.[2] According to them, non-athletes are those exercisers who are engaged in sports, sporting, or physical activity to improve fitness, health, physique. Spare-time sportsmen and weekend warriors also fall in this group.[2] Ironically, there will be exercisers (non-athletes) who do more hours of physical exercise than the athletes and are still categorized as non-athletes.[6] McKinney et al. suggested defining athletes by the "volume of exercise" done per week.[7] According to them, athletes who exercise for more than 10 h a week are considered "elite" athletes. Competitive athletes exercise more than 6 h per week, and recreational athletes exercise more than 4 h per week. An exerciser performs exercise at least 2.5 h a week to maintain fitness.[7]

For our practical use, players who regularly participate in professional competitions are considered athletes, and those who do physical activities to maintain health and fitness are categorized as non-athletes.

3. Do indications for surgery differs between athlete and non-athlete?

The straightforward answer to this question based on recent literature is "yes." Many would agree that not only indications for surgery but also the type of surgery and choice of fixation devices also may vary between athletes and non-athletes. The primary reason to undergo surgery after any injuries is to achieve a pre-injury activity level, which applies to both sportsmen and non-sportsmen. But the functional demand out of the injured area is significantly higher in athletes than in non-athletes, which may be the reason for a higher rate of recurrent injuries and secondary injuries in athletes.[8] Hence, traditionally, Rehabilitation was considered the primary treatment modality for sports injuries. And surgery was indicated only if rehabilitation has failed and the athlete is still willing to return to sports.[9,10] Of late, advancements in surgical technique and availability of specific devices have increased the return to sports rate above 83% after surgical interventions.[11,12] Higher rate of RTS has led many surgeons to incline toward a surgery first approach rather than a rehabilitation first approach.

However, the decision for rehabilitation or surgery first depends on various factors. One of the obvious reasons for treatment selection bias was either the attending clinician is an orthopedic surgeon or rehabilitation expert. Rehabilitation experts are seen to be inclined towards rehabilitation first, and surgeons are inclined towards surgery first approach.[13] However, both the orthopedic and physical therapist have agreed that if the patient has high functional demand and wishes to return to preinjury level of sports, the surgical first option was considered as the choice of treatment by both.[13]

Type of sports, the position of a player, in-season or off-season injury, and many other factors are considered in treatment decision-making. In this narrative review, we have tried to summarize common sports injuries (ACL tear, PCL tear, Meniscal tear, and Shoulder dislocation) and how their treatment differs if the patient is an athlete or non-athletes.

4. Decision making in ACL tear

Anterior cruciate ligament reconstruction (ACLR) is one of the most commonly performed surgery worldwide. Over the past few years, ACLR has increased in both athletes and non-athletes.[14]

Some suggest surgery followed by rehabilitation, whereas many suggest rehabilitation first and if needed, surgery at later dates. To date, there is no conclusive evidence about the best approach after an ACL tear. ACL injury treatment guidelines advised considering surgery when a patient has symptomatic knee instability or has higher functional demands like in athletes. When activity demands are low, like in non-athletes, a period of rehabilitation is advised before deciding on operative intervention.[15,16]

The University of Delaware developed a decision-making tool to assist in deciding whether surgical intervention or rehabilitation treatment would be suitable for a particular patient after an ACL tear. This tool was later found to be ineffective, as 70% of patients categorized as candidates for surgery had satisfactory outcomes with rehabilitation alone and were able to resume their pre-injury activity level at one-year follow-up.[17]

A study by Grevnerts TH et al. found that the reason to choose surgery or rehabilitation first varies based on the patient's presentation time. In acute Injuries, high activity demands were the main reason to choose ACL reconstruction. Instability and giving way were the main reason to suggest ACL reconstruction for chronic ACL injuries.[13]

In another study by Grevnerts TH et al., The three most essential characteristics that orthopedic surgeons and physical therapists agreed upon when recommending ACLR were: 1) desire to return to sports, 2) instability while playing sports, and 3) instability in activities of daily living despite rehabilitation of more than three months.[18] Physically demanding occupation was considered the most important factor for recommending surgery by orthopedic surgeons. Whereas physical therapists considered instability and failure of rehabilitation to be the most important factor for recommending surgery.[18]

ACL study group survey revealed that the choice of operative and non-operative treatment depends on the level of athletic involvement. Among all the respondents, 92% agreed that there is no role for rehabilitation treatment for elite athletes. The agreement was different for moderate-level athletes, and 92% of respondents considered a non-operative treatment of ACL injuries in patients with lower impact athletes.[19] A 35-year follow-up study of ACL deficient knee in high-level athletes concluded that there is a 95% chance of meniscal and cartilage injury and 50% risk of total joint replacement after 35 years. Hence concluded that ACLR should be the recommended treatment for a high-level athlete.[20]

Table 1 summarizes factors taken into consideration to decide on ACL reconstruction by surgeons and physiotherapists.

Literature is still divided into surgery or rehabilitation first when deciding on treatment for an ACL tear. There is enough literature evidence to debate on either aspect of treatment. However, there is an inclination to recommend a surgical option to athletes, and non-athletes are offered a phase of rehabilitation. Surgery is recommended if instability persists in their activities of daily living. We recommend ACL reconstruction in all athletes and non-athletes if they want to return to the same activity level which has caused the injury.

5. Graft choice in ACL reconstruction

Graft selection is one of the most crucial steps of pre-operative planning for any ACL reconstruction. The most commonly used graft for ACL reconstruction is hamstring tendon (HT), bone-patellar tendon-bone (BPTB), and quadriceps tendon (QT) autografts, along with a variety of allograft options. However, the ideal graft source remains

Table 1
Factor considered for surgery after ACL tear by surgeons and physiotherapists to decide on surgical reconstruction.

Factors	Surgeons	Physiotherapists
Episodes of Instability during activities (sports or non-sports)	Yes	Yes
High Functional demand	Yes	No
Athletes	Yes	To some extend
Desire to return to sports	Yes	To some extend
Time after injury		
Early (with instability symptoms)	Yes	No
Late (with instability symptoms)	Yes	Yes

controversial. Multiple factors influence graft selection, including patient factors, graft qualities, and surgeon preference.[21]

5.1. Autograft options

Because of its simplicity of harvest, the possibility of bone to bone healing, and biomechanical advantages, BPTB autograft was once thought to be the gold standard.[22] However, because of low donor site morbidity and studies reporting similar clinical outcomes, the use of hamstring autograft is increasing.[23]

Randomized comparative studies comparing outcomes between BPTB and hamstring autograft for ACL reconstruction,[24,25] showed similar results with respect to patient-reported outcome, graft failure, and return to sport. In contrast, a Norwegian ligament registry data of more than 12000 patients revealed that patients with hamstring grafts had double the risk of revision compared with patients with BPTB grafts.[26] According to this study, BPTB autografts are a better choice for athletes of any age.

In a meta-analysis of BPTB and quadruple hamstring grafts, BPTB autografts were better in achieving rotational stability of the knee and allowing patients to return to the pre-injury status early compared to quadruple hamstring autografts. Whereas postoperative complications were lower for hamstring autografts than for BPTB autografts.[27]

Although quadriceps tendon graft is also gaining popularity for primary ACL reconstruction, BPTB and Hamstring grafts are the most popular graft. The literature favors the BPTB graft for athletes and the quadrupled hamstring graft for non-athletes. Our preferred graft for athletes is also BPTB, and for non-athletes, we prefer hamstring graft.

5.2. Allograft options

Compared to the Indian subcontinent, allografts have been used more frequently in Europe and America for both primary and revision ACL surgery. Allografts provide several benefits like reduced surgical time, adequate graft sizes, no donor site morbidity, and equivalent strength. However, there are significant disadvantages as well. Higher time required for graft incorporation, decreased mechanical strength after irradiation, risk of transferring diseases, the higher failure rate in younger patients, and, more importantly, high costs are some of the factors causing limitations of its use.[28–30] In a community-based US registry analyzing 16,192 ACL reconstructions, allografts were frequently used for revision surgeries. In 78.8% of revision surgeries, allograft was used compared to only 42% allografts in primary surgery.[31]

Similar clinical outcomes were reported by several authors while comparing autograft and allograft for ACL reconstructions. On the other hand, many researchers emphasized the inferior outcome of allograft ACL reconstruction in younger individuals. Hence allografts are not considered an ideal choice for athletes and individuals below 25 years of age.[32]

We do not use allograft in our primary ACL reconstructions; it is reserved for revision ACL only.

6. Meniscal procedures

Meniscal tears are common in both athletes and non-athletes. The paradigm change in meniscal tear treatment has shifted totally in favor of meniscus preservation in all recommended cases. Most traumatic meniscus tears are now repaired using various meniscal repair techniques.

In an eight-year follow-up period study, arthritic changes were seen in 60% of meniscectomy patients. In contrast, features of arthritis were present only in 20% of patients in the meniscal repair group. The benefit was significantly apparent for the younger age group. Although the functional score was not different in both the meniscectomy and meniscal repair group, 92% returned to the pre-injury level of sports after meniscal repair. In contrast, only 50% could return to the pre-injury activity level after meniscectomy. Athletes who underwent meniscal repair had a higher activity resumption rate than meniscectomy.[33]

Lee et al. in their systematic review, found that patients with meniscectomy returned to sports earlier than patients with meniscal repair. After meniscectomy, patients returned to sports after 7–9 weeks. In contrast, patients who underwent meniscal repair required 5.6 months to return to sports.[12]

With the increasing understanding of the meniscal function and its role in the stability of the knee, there is a trend to preserve the meniscus, and it is more important in young athletes than non-athletes. There is strong evidence to conclude meniscal preservation reduces the rate of osteoarthritis; however, return to sports and reoperation rates are higher in the meniscal repair group compared to the meniscectomy group. A thorough counseling and treatment plan has to be discussed with the athlete, and treatment should be tailored based on their demand. We repair all repairable meniscal tears irrespective of the patient is an athlete or non-athlete.

7. PCL reconstruction

7.1. Surgical versus nonsurgical approach

Management of grade III isolated posterior cruciate ligament (PCL) tears is controversial as many believe that PCL has the potential to heal.[34] Hence many authors advocate conservative treatment for isolated high-grade PCL tears. On the other hand, many surgeons argue that, even if the PCL heals, it heals in an elongated position because of posterior pull by the hamstring, and hence is non-functional, which may lead to persistent sag.[35] This persistent sag further may lead to increased patellofemoral forces causing patellofemoral arthritis and symptoms.[35]

Agolley et al. successfully treated acute grade III PCL injuries non-operatively, even in high-level athletes, and concluded that most patients returned to the pre-injury level of the sport.[36] In contrast, Boynton and Tietjens have observed deterioration in outcomes despite good early outcomes after non-operative treatment. On plain radiographs, most patients' articular cartilage degradation increased over time in their study.[37]

The understanding of the diagnosis and treatment options for posterior cruciate ligament (PCL) injuries has advanced significantly over the last few years, leading to more surgical procedures and improved clinical outcomes. Various surgical techniques and fixation devices have evolved to meet the criteria of anatomical PCL reconstruction. As a result of these discoveries and improved clinical outcomes, most surgeons agree that surgical reconstruction is the best treatment for isolated grade III PCL injuries with symptomatic instability, especially in high-demand patients.[38] Since isolated PCL injuries are not very common, there is scanty literature comparing the outcome in athletes and non-athletes. But many surgeons agree on a more aggressive approach and early treatment of grade III PCL injuries in athletes.[39] We also practice an early surgical approach for athletes. A period of bracing and rehabilitation is preferred for non-athletes. Surgery is suggested only if there are features of instability in non-athlete patients.

7.1.1. Single versus double-bundle reconstruction

Understanding of the anatomy and biomechanics of PCL has led to a surge in interest to perform a double-bundle PCL (DBPCL) reconstruction. Although there are several theoretical advantages of DBPCL, the same benefits were not evident in functional outcomes.

Several papers evaluated biomechanics of single bundle and DBPCL reconstruction and reported a superiority in knee stability after DBPCL reconstruction. However, the functional outcome was similar in the single bundle and double-bundle groups.[40,41] Considering the higher functional demand in athletes, our technique of choice is double-bundle PCL reconstruction, and we prefer single-bundle PCL reconstruction for

non-athletes and low-demand patients.

7.2. Recurrent shoulder dislocation

The shoulder joint is one of the most frequently dislocated joints because of its inherent unstable anatomy. Anterior shoulder dislocation is the most common type, accounting for 90% of cases.[42]

Recurrent dislocation after the first episode is common. Numerous variables affect the recurrence rate; the most important are age, occupation, functional demands, type of sports, physical characteristics, and familial factors.[43] Males in their early twenties who participate in contact sports have the highest recurrence rate. According to several authors, the recurrence rate varies from as low as 17% to as high as 100%.[43]According to the most recent literature, recurrent instability occurs in approximately 75%–80% of patients between the ages of 13 and 20 years. The recurrence rate is only 50% in patients between 20 and 30 years of age. As the age increases, the recurrence rates are shown to decrease.[43,44] In general, athletes tend to have a higher recurrence rate than non-athletes. Contact athletes have an even higher recurrence than non-contact athletes.[45]

Considering all these facts, we presume that a young athlete participating in contact sports will have a very high chance of recurrence.

7.2.1. Bankart versus Latarjet debate

Bankart repair and the Latarjet operation are the two most commonly performed surgeries for recurrent shoulder dislocation. However, there are ongoing debates about which surgery is preferable for athletes and non-athletes. Bankart repairs in athletes have a higher postoperative failure rate than in non-athletes.[46] A systematic review and meta-analysis comparing return to play demonstrated no statistically significant difference following arthroscopic Bankart repair, Latarjet procedure, and open stabilization.[47] Some studies have reported excellent outcomes with a 90–94% rate of return to play at all levels of sports following arthroscopy Bankart repair.[48]

A better understanding of capsular quality and recent advances in anchors have made arthroscopic Bankart repair the most popular surgery with increasingly good results. However, a failure rate of up to 70% with an arthroscopic Bankart repair was reported in the setting of significant glenoid bone loss (>25%) or engaging Hill-Sachs lesions. In these situations, the Latarjet procedure was recommended.[49]

A systematic review conducted by Hurley et al. to evaluate return to play after the Latarjet procedure found that the overall rate of return to play was 88.8%, with 72.6% of athletes returning to the same level of play. The overall rate of return to play among collision athletes was 88.2%, but only 69.5% returned to the same level of performance. Even with overhead athletes, 90.3% returned to play, with 80.6% returning to the same level of play was reported by them.[50] They emphasized that the rate of return to play is high even after the Latarjet procedure.

Although literature seems divided in recommending Bankart or Latarjet, there is consensus that a glenoid bone loss (critical bone loss) of more than 20% is the cut-off mark for decision-making. Most literature agrees that if there is bone loss of more than 20%, Latarjet procedures should be the choice of surgery. In cases of glenoid bone loss of less than 20%, Bankart repair is a suitable choice.[51] Although various authors have suggested different thresholds of critical bone loss, there is consensus in the literature about 20% critical bone loss.[52]

Critical bone loss is the major determinant in deciding Bankart or Latarjet in both athletes and non-athlete. Our first choice of surgery for both athletes and non-athletes with less than 20% bone loss would be Bankart repair. And if bone loss is more than 20%, the Latarjet procedure was recommended to them. However, the decision on the type of surgery depends not only on bone loss but various other factors like the type of sports, the need for full external rotation, and many more. Blag et al. proposed an injury severity index score (ISIS) to decide on Bankart or Latarjet for recurrent dislocation, which considered several factors to make the decision. Among the factors considered, degree of sports participation and type of sports were given emphasis, indicating their inclination towards Latarjet procedure in contact and overhead athletes.[53]

7.2.2. Surgery after the first dislocation?

Because of the high recurrence rate in young athletes, there are now suggestions for surgical stabilization even after the first dislocation. The points laid down in favor of early surgery were: deterioration of capsule quality and increased glenoid bone loss after a recurrent dislocation. Hence, if Bankart repair is performed after the first dislocation, the chance of failure of Bankart repair will be low.[54]

In a randomized control trial evaluating long-term results after surgery versus operative treatment of first-time dislocation, Jakobsen et al. showed a considerably higher frequency of recurrent instability in the conservatively treated group than in the surgical group. A total of 54% of the conservatively treated patients had recurrent instability, compared to 3% after open surgical repair at two years follows up. They also mentioned that 74% of patients in the non-operatively treated group had an unsatisfactory outcome, and 72% of operatively treated patients had a good or excellent result after ten years. Since primary stabilization yields superior results to conservative treatment, some authors recommend surgery on active patients to reduce the risk of recurrence.[55]

Plenty of research for and against surgery in first-time dislocation is pouring in. However, a consensus is yet to achieve. Our indication for surgery after the first dislocation is a bony Bankart. For all other patients, our first choice of treatment for first-time dislocation is non-operative.

8. Conclusion

Athletes have higher functional demands compared to non-athletes. Hence, surgery has to be tailored based on their functional demand. There are individual variations in the type of sports and degree of sports participation even between athletes, which also must be considered in decision making. Although there is plenty of literature published over the last two decades evaluating various aspects of athletes, there is no consensus in any of the reviewed topics about what variation is best for athletes. From this review, we can conclude that, rather than a common suggestion on surgical variation, an individualized approach would be appropriate to decide on variation in particular surgery in both athletes and non-athletes.

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Author statement

Amit Joshi: Conceptualization, Methodology, Original draft preparation, Software, Project administration, **Bibek Basukala:** Conceptualization, Resources, Writing review & editing, **Nagmani Singh:** Conceptualization, Resources, Writing review & editing, **Sunil Panta:** Conceptualization, Resources, Writing review & editing, **Rajiv Sharma** Conceptualization, Resources, Writing review & editing, **Ishor**

Pradhan: Conceptualization, Supervision.

Declaration of competing interest

None.

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