

Suitability of the AAOS Appropriate Use Criteria for Surgical treatment of Anterior Cruciate Ligament Injuries

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Conflict-of-interest statement: The author(s) declare(s) that there is no conflict of interest regarding the publication of this paper.

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Received: January 23, 2021

Revised: April 10, 2021

Accepted: April 12 2021

Published online: April 30, 2021

ABSTRACT

BACKGROUND: The Appropriate use criteria (AUC) was established by American Academy of Orthopedic surgeons (AAOS) to provide the appropriate treatment options to patients with anterior cruciate ligament (ACL) injuries. This study aimed to assess the appropriateness of our current practice of surgical treatment of ACL injuries in comparison with appropriate use criteria recommendations. **METHODS:** A prospective data collection and analysis of adult patients undergoing ACL reconstructions from December 2018 until April 2019. 80 out of 87 patients were undertaken in this study. Demographic data and AUC variables were collected and input into the ACL appropriate use criteria website application to check the appropriateness of our treatments. The data of age, gender, activity level, presence of arthritis, presence of repairable meniscal tear and any history of appropriate non-operative measures were collected from the patient records.

RESULTS: 80 patients were included in the study after excluding 7 patients who were consented and interviewed initially due to different reasons. Most of the patients were males 93.75% and 82.5% were aged above 25 years. Appropriate use criteria for anterior cruciate ligament injury treatment was applicable in our institution with 95% of our patients (76 patients) got appropriate treatment whilst the other 5% (4 patients) had their treatment categorized as maybe appropriate according to AAOS appropriate use criteria. No AUC rarely-appropriate treatment was encountered in our patients.

CONCLUSION: The appropriate use criteria for treatment of anterior cruciate ligament injuries is quite suitable and easy to perform clinically to guide treatment options of such injuries.

Key words: Anterior cruciate ligament; AAOS; Appropriate use criteria; ACL reconstruction

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Elmhiregh A, Fuad M, Alrawi A, Abuodeh Y, Al Mass A, Al Ateeq Aldosari M, Alhaneedi GA. Suitability of the AAOS Appropriate Use Criteria for Surgical treatment of Anterior Cruciate Ligament Injuries. *International Journal of Orthopaedics* 2021; 8(2): 1463-1466 Available from: URL: <http://www.ghrnet.org/index.php/ijo/article/view/3076>

INTRODUCTION

The anterior cruciate ligament (ACL) rupture typically results from a traumatic, sports-related contact or non-contact injuries. The annual rate of ACL injuries has been estimated to be 252,000 in USA^[1,2]. Females are two to eight times more likely to sustain ACL injuries compared to males^[2] and Patients with such injuries are at increased risk of developing knee osteoarthritis later in life^[2].

The aim of anterior cruciate ligament (ACL) treatment is essentially to restore functional stability of the knee and to allow patients to return to their desired work and activities^[2,3]. Treatment options are basically guided by several factors including occupation, age, sex, activity level of the subject, amount of time spent performing highly demanding activities, presence of coexistent knee pathology as well as the individual's co-morbidities, skeletal maturity, and/or specific

patient characteristics including obesity and work demands, and acceptance of possible posttreatment complication^[2-4].

The American academy of Orthopedic surgeons (AAOS) has developed appropriate use criteria for management of different orthopedic related health problems to standardize the best evidenced care among orthopedic surgeons. Appropriate use criteria are a scoring system based on patient related variables that can collectively guide the orthopedic surgeon towards different treatment options. It labels the strength of the treatment as appropriate, maybe appropriate or rarely appropriate based on agreement with best available scientific evidence and expert opinion on different pathologies^[5,6].

AAOS started developing different AUC for different pathologies of the knee including knee osteoarthritis and anterior cruciate ligament injuries prevention program and treatment^[7]. The criteria for anterior cruciate ligament injuries treatment was published in 2015 and based on five variables including patient maturity, activity level, presence of advanced arthritis, presence of repairable meniscal tear and trials of non-operative measures. Input of these patient's variables into the web-based AUC application will generate the appropriate treatment options that can be either operative or non-operative. 56 different anterior cruciate ligament tear patient scenarios were covered by these criteria (Figure 1). Rating of treatment appropriateness is based on a scoring system where appropriate treatment will score 7-9 while maybe appropriate treatment score 4-6 and rarely-appropriate options score 1-3.

This study was conducted at Hamad medical corporation in the state of Qatar where a high volume of daycare anterior cruciate ligament surgeries are available. A prospective patient interview and chart review was done between December 2018 and April 2019. The purpose of this study was to assess the appropriateness of our anterior cruciate ligament injuries management and to demonstrate the applicability of the AUC to guide evidence-based management on different orthopedic specialties.

METHODS

A prospective study that included patients interview and chart review of patients admitted through daycare facility for anterior cruciate ligament reconstruction surgery. After getting ethical approval, 87 patients were consented to participate in the study in the period between December 2018 and April 2019, we excluded 7 patients as 4 of them had incomplete chart data while 2 patients were admitted for ACL revision surgeries and one patient had no ACL injuries intraoperatively. Our study population included 75 males and 5 females and 82.5% aged above 25 years.

The inclusion criteria were patients who were admitted for primary anterior cruciate ligament reconstruction with available data in their charts. The exclusion criteria were revision ACL cases, multi-ligamentous knee injuries, history of periarticular fractures, incomplete chart data and patients who cannot participate in physical therapy or rehabilitation. Only 80 patients were eligible for these criteria and all of our study population underwent anterior cruciate ligament reconstruction after they were consented to participate in the study. There were no patients follow up as the study was focusing on the appropriateness of our treatment and applicability of the AUC.

The data collected from the patients included; age/maturity, activity level, presence of radiographic knee arthritis, presence of repairable meniscal tear in the operative notes and whether the patient tried optimal non-operative measures in physiotherapy or rehabilitation department. These data were entered in the AUC website application (Figure 1) and according to the entered scenario, the application will show the appropriateness of the selected treatment.

Figure 1 Web base AUC page.

Table 1 summarizes the patients Demographics

| Gender | % |
|---------------------------------------------|--------|
| · Male | 93.75% |
| · Female | 6.25% |
| Age | % |
| · Open physis | 0% |
| · Below 25 – closed/closing physis | 17.50% |
| · Above 25 | 82.50% |
| Activity level | % |
| · Participate in pivoting sport | 92.50% |
| · Doesn't participate in pivoting sport | 7.50% |
| Presence of arthritis | % |
| · Advanced arthritic changes | 0% |
| · Mild to moderate arthritic changes | 7.50% |
| · No arthritic changes | 92.50% |
| Presence of repairable meniscal tear | % |
| · Yes | 32.50% |
| · No | 67.50% |
| Trial of optimal non-operable measures | % |
| · Failed optimal non-operable measures | 65% |
| · Didn't fail optimal non-operable measures | 35% |

Table 2 summarizes the AUC treatment options

| TREATMENTS |
|-----------------------------------------------------------------------|
| Treatments Addressed Within This AUC |
| 1) Self-directed exercise program |
| 2) Supervised Rehabilitation program |
| 3) Activity Modification |
| 4) ACL Functional Knee Brace |
| The following treatments only apply to scenarios without open physes: |
| 5) ACL Reconstruction –Autograft |
| 6) ACL Reconstruction –Allograft |
| The following treatments only apply to scenarios with open physes: |
| 7) Physael sparing autograft |
| 8) Physael sparing allograft |
| 9) Transphyseal sparing autograft |
| 10) Transphyseal sparing allograft |

Table 3 Summary of appropriateness of ACL reconstructions in our sample.

| Surgical treatment | N | Appropriate | Maybe-appropriate | Agreement with AUC |
|--------------------|----|-------------|-------------------|--------------------|
| ACL Reconstruction | 80 | 76 (95%) | 4 (5%) | 80 (100%) |

Table 4 The most common patients' scenarios.

| AUC scenario | N | Age | Activity level | Presence of OA* | Repairable meniscal tear | Optimal non-op | Treatment provided | appropriateness |
|--------------|------------|-----|----------------|-----------------|--------------------------|----------------|--------------------|-----------------|
| 34 | 25(31.25%) | >25 | pivoting | No OA | No | Failed | ACLR** | Appropriate |
| 36 | 16(20%) | >25 | pivoting | No OA | Yes | Failed | ACLR | Appropriate |
| 33 | 13(16.25%) | >25 | pivoting | No OA | No | none | ACLR | Appropriate |

*Osteoarthritis, ** Anterior cruciate ligament reconstruction.

Table 5 Encountered Maybe appropriate scenarios

| AUC scenario | N | Age | Pivoting sport | Presence of OA* | Repairable meniscal tear | Optimal non-op | Treatment provided | appropriateness |
|--------------|---------|-----|----------------|-----------------|--------------------------|----------------|--------------------|-------------------|
| 45 | 2(2.5%) | >25 | No | No OA | No | None | ACLR** | Maybe Appropriate |
| 43 | 2(2.5%) | >25 | No | Mild | No | None | ACLR | Maybe Appropriate |

*Osteoarthritis, ** Anterior cruciate ligament reconstruction.

Statistical analysis

The software (IBM SPSS version 24; SPSS Inc., Chicago, IL, USA) was used for the analysis. The descriptive statistical tools like mean, mode, range and percentage were used for data demonstration.

Appropriateness of treatment was reported as appropriate, maybe appropriate or rarely-appropriate according to AUC and the agreement with our hospital treatment was described as percentage and proportion. Two authors collected the data and Pearson's intraclass correlation coefficient (ICC) >0.75 was considered to indicate excellent agreement. Post hoc power analysis showed a power of more than 80% as no pre-study sample size calculation was done because all the patients meeting inclusion criteria were included in the study.

RESULTS

Based on AUC, the ACL reconstruction was appropriate treatment in 76 patients (95%), maybe-appropriate in 4 patients (5%) and no patient had rarely-appropriate treatment. All appropriate and maybe-appropriate options were in agreement with AUC recommendations and hence 100% agreement was achieved in our patient population. There was no correlation between patients age and participation in pivoting sport or presence of repairable meniscal tear or appropriateness of treatment ($p > 0.05$).

The most encountered scenario in our population was the scenario 34 (31.25%) followed by the scenario 36 (20%) and the scenario 33 (16.25%) in the ACL treatment AUC original paper^[6]. 25 patients presented with the scenario 34 which included age above 25, the patient is participating in pivoting sport, no knee arthritic changes, no repairable meniscal tear and failure of optimal non-operative treatment. Whilst 16 patients presented with the scenario 36 that included age above 25, patient participating in pivoting sport, no knee arthritic changes, coexistent repairable meniscal tear and failure of optimal non-operative treatment, 13 patients had the scenario 33 upon presentation with age above 25, participation in pivoting sport, no knee arthritic changes, no repairable meniscal.

There were 2 scenarios in 4 patients who got their ACL reconstruction labeled as maybe-appropriate as per the AUC. All of those patients were not participating in pivoting sports, they had no repairable meniscal tear and did not had optimal non-operative measures and hence the surgical choice was maybe appropriate (Table 4). The highly scored (Appropriate) AUC treatment for those 4 patients was either self-directed exercise program or supervised rehabilitation program or Activity modification without ACL reconstruction.

DISCUSSION

Appropriate use criteria are a unique and helpful evidence-based tool to guide orthopedic surgeons towards the best available scientific treatment options. In orthopedics, treatment options for single musculoskeletal disease could vary according to geographic, scientific and experience differences between surgeons and hence appropriateness of treatment would be a concern in any discussions related to the patient care^[8-10].

The most important finding of the present study was that the treatment provided at our institute was found to be appropriate and in agreement with the AUC recommendations in the majority of patients. This finding demonstrated the consensus regarding the surgical treatment of ACL injuries at our institute with evidence-based indications. The application of the AUC made selecting an appropriate treatment for each patient relatively simple and applicable. In this study not all the AUC scenarios were observed in our patients which might be attributed to cultural and demographic variation across the world.

Nevertheless, all the maybe-appropriate treatment labelled patients in our sample aged above 25, it was clear that participating in pivoting sport or presence of repairable meniscal tear and/or failure of optimal non-operative measures were the most determinant factors for ACL reconstruction according to AUC. However, the appropriate treatment of those 4 patients was mainly conservative as per the AUC, Tsoukas et al^[11] reported better functional outcome with ACL reconstruction compared to conservative management of ACL injuries with no increased incidence of radiological arthritis with the latter option. Gföller et al^[12] in contrast, claimed patient satisfaction with conservative treatment of ACL injuries in spite of worsening knee arthritis at 20 years follow up.

Although ACL injuries are 3 times higher in female athletes than male athletes^[13,14], we reported more occurrence of ACL injuries among males in our sample. This indeed can be attributed to cultural and sport preferences among females in this part of the world. Alternatively, age is not considered a risk factor for ACL injuries^[14] and in our study we had no patient with open physis admitted for ACL reconstruction, properly due to the controversy among surgeons whether to operate in this age group^[15].

Being a risk for early knee osteoarthritis^[16], ACL treatment AUC has considered presence of knee arthritis in the scoring system as the extent of the osteoarthritis would have a significant impact on the functional outcome following ACL reconstruction; as severely arthritic ACL-deficient knees tend to be more stable and the decision of ACL reconstruction should be carefully made or combined with other modalities like osteotomies or partial arthroplasties^[17]. ACL

treatment AUC had a limitation of not addressing combined treatment of ACL tear and advanced osteoarthritis.

ACL treatment AUC provided an applicable and easy tool to guide management of ACL raptures in 56 different scenarios with 10 different treatment options, thanks to AAOS panel who worked out this criteria based on best available evidence and well established orthopedic surgeons experiences, some scenarios are yet to be cleared like (age above 40 and irreparable meniscal tear) as they will be an areas of surgical uncertainty^[18]. The use of AUC was feasible as it was easily accessible through a web-based application and thus easy evaluation of the treatment appropriateness.

While the strength of our study is that it included prospective patient interview with ACL treatment AUC based questions that would add to the precision of appropriateness of the treatment the limitations were the lack of follow ups and the limited sample size. Furthermore, incomplete documentation of the medical chart can hinder application of the AUC, patients with incomplete documentations were excluded.

CONCLUSION

This study demonstrated that the Majority of ACL injuries in our institution were treated appropriately according to AUC recommendations. The appropriate use criteria for treatment of anterior cruciate ligament injuries is quite suitable and easy to perform clinically to guide treatment options of such injuries.

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