The knee function of the soccer players after ACLR is comparable with non-injured controls: A case-control study

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Abstract

Purpose: Many studies report a high primary success rate of ACL reconstruction (ACLR), with an increased risk of decline in knee performance correlating with the time passed since surgery. Only one study has compared male soccer players after ACLR to a matched control group of uninjured players in terms of their return to sport and performance. The purpose of this cross-sectional case-control study was to determine the knee performance between soccer players after ACLR and control group matched by age, sex, and professional experience. Methods: All the male professional soccer players aged 18–36 years at the time of injury, who sustained an ACL tear while playing league soccer in Poland between January 2008 and December 2011 were contacted and compared with age and experience-matched healthy control group selected from professional football players. KOOS, IKDC-2000, Lysholm and SF-36 scales were used for comparison. Results: The average follow-up was 7.9 years (range 6–9 years). The ACL-injured soccer players scored significantly lower in IKDC and Lysholm scores compared with the reference group but still were classified as normal knee function in both scales. In all five dimensions of the KOOS and subscales of SF-36 no apparent differences were noted. In all scales in the study group, no correlation was observed between the player’s age and follow-up time after ACLR. Conclusion: After ACL reconstruction and successful return to professional sport, knee function is as good as uninjured team members in the midterm follow-up. Level of evidence: III

Keywords

ACL, ACL reconstruction, return to sport, soccer, stay in sport

Introduction

Soccer is the most popular sports activity worldwide, with 24 million regular players1. It is inevitably related to the high occurrence of injuries, that in adult male players is estimated to be between 10 and 35 per every 1000 h played.1 The reported rate of injury becomes even higher in younger, less skilled athletes.2 Amongst all of the injuries, soccer is more often than other sports, accompanied by serious knee injuries. Anterior cruciate ligament (ACL) in particular,3–6 which represents 40% of all post-traumatic knee dysfunctions in this sport.7 The total ACL injury incidence rates for amateur athletes are expected to be lower than 0.19 per 1000 h of game exposure.8 In a professional soccer team the frequency of ACL injury is expected to be 0.4 per team and season.9

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Many studies report a high primary success rate of ACL reconstruction (ACLR), with an increased risk of decline in knee performance correlating with the time passed since surgery. Only one study has compared male soccer players after ACLR to a matched control group of uninjured players in terms of their return to sport and the knee function. No studies compared short term clinical outcomes after ACLR taking into account the same study design.

The primary purpose of this investigation is to determine the knee performance after ACLR, and the differences in performance between soccer players who sustained an ACL rupture and control group matched by age, sex, and professional experience. The study hypothesis was that soccer players who underwent successful ACL reconstruction and return to sport would display no difference in the knee function if compared to the control group.

Materials and methods

All male professional soccer players (Division 1–3) 18–36 years of age at the time of injury, who sustained an ACL tear while playing league soccer in Poland between January 2008 and December 2011 were retrospectively reviewed. All of the individuals were identified through the data from the Medical Committee of the Polish Football Association. During this period in time, the medical staff of each football club needed to report all injuries happening to League Medical Authorities.

Inclusion criteria for the study group were: ACL injury while playing football, ACL injury with no concomitant ligamentous or cartilaginous injuries, ACL reconstruction with a successful return to professional sport within 12 months, no re-injury in the index knee during follow-up and keeping Professional Footballer status at the time of the study. In 2015, 87 players with an ACL tear who fulfilled inclusion criteria were identified and contacted by mail. Six players left to go abroad and could not be located.

A healthy control group was selected from professional football players from six clubs (one Division 1, three Division 2, and two Division 3) located in southern Poland where one of the authors (F.P.) conducted therapeutic and physical preparation supervision. It was up to the player to decide which knee would be taken into consideration for the study. Inclusion criteria for the control group were: no reported injury of the studied knee during the career, a minimum of 6 years in professional football, and professional status at the time of the study. To attain average age at the same level between the study and control group only players above 24 years of age were invited to the control group.

Clinical scales

*Knee Injury and Osteoarthritis Outcome Score (KOOS).* The KOOS is a self-administered knee-specific questionnaire containing 5-item scales. The KOOS covers five patient-relevant dimensions: pain, other symptoms, activities of daily living (ADL), function in sports and recreation (Sports/Rec), and knee-related quality of life (QOL). The validated Polish version of the KOOS was used.

*IKDC-2000 (International Knee Documentation Committee).* The Subjective Knee Evaluation Form consists of questions about the patient’s activity and subjective symptoms of the knee joint. The validated Polish version of the IKDC-2000 Subjective Evaluation Form was used.

*Lysholm Knee Scale.* The Lysholm scale is a form containing eight questions, concerning: limping, the use of crutches, the feeling of clicking and blocking in he knee, joint instability, pain, the presence of an effusion, ability to walk the stairs and to make squats. The validated Polish version of the Lysholm Knee Scale was used.

*Short Form 36-item (SF-36) health survey.* The SF-36 is a widely used generic measure of health status, comprising eight subscales: physical functioning, role-physical, bodily pain, general health, vitality, social functioning, role emotional, and mental health. The SF-36 has been used in subjects with ACL injury. The validated Polish SF-36 v.2 was applied in this study. According to the Polish version of the questionnaire, the highest value of points signifies the lowest quality of life, while the minimal value of points represents the highest level of quality of life.

The subjects in the study group answered additional questions about their career after the reconstruction of the anterior cruciate ligament, studied individuals were asked about: what was their perception of the medical care provided by the club, did they return to the same level of professional sport (first team), to the same club, or whether they were discriminated against because of how their injury was perceived by coaches, club authorities or colleagues.

Approval from the Ethical Board at our local University was obtained for the study design, and to acquire data from medical records for this study and informed consent was obtained from all participants.

Statistical methods

For statistical analyses and to thoroughly describe our study population, means and dispersion values were calculated for all soccer players’ characteristics. Shapiro – Wilk goodness-of-fit tests for Gaussian data distribution was performed and confirmed the normality of all data. Single-variable analyses for all continuous variables (clinical scales) between the ACL-reconstructed soccer players and their uninjured peers were performed using U –Mann Whitney tests. The significance of the correlation between variables was assessed using Spearman correlation. All statistical analyses were performed using Statistica 10 PL (Statsoft, Poland). The level of significance was set at \( p = 0.05 \) throughout. The sample size calculation showed
that with a power of 80% (two-sided testing at a significance level of 0.05) a sample size of 126 participants was needed to show a clinical difference between operated and non-operated players.

**Results**

We managed to contact 81 professional soccer players who underwent ACLR out of which group we excluded two players who already had finished their careers and four athletes who reported re-injury of the reconstructed ACL. Assuredly 75 athletes met the inclusion criteria in the study group and 106 players in the control group. Sixty players (76%) in the study group and 84 players (79%) in the control group accepted the invitation, responded to mail, and filled all the questionnaires. The demographics of both groups are presented in Table 1. The average follow-up in the study group was 5.9 ± 0.87 years (range 4–7 years). There were no side nor leg-domination differences between groups.

Forty-four ACLR was performed using hamstring tendons as a graft and 16 reconstructions using a patellar bone graft. There were 15 tears of the medial meniscus and 3 tears of the lateral meniscus treated by partial meniscectomy.

**Questionnaires**

The ACL-injured soccer players scored significantly lower in IKDC and Lysholm scores compared with the reference group but still were classified as normal knee function in both scales (Table 2). In all five dimensions of the KOOS and two subscales of SF-36 no apparent differences were noted.

The type of graft used for reconstruction did not influence the results of the questionnaires.

In all scales in the study group, no correlation was observed between the player’s age at the time of research and follow-up time after ACLR (Table 3).

**Discussion**

The most important findings of your current study was that after successful, on time return to professional sport after ACL reconstruction knee function measured by clinical
scales was comparable with uninjured players in the midterm. All players who came back to the field within 12 months after ACL injury were able to resume their careers at the same level in the professional teams. Performance after ACLR during follow-up was not considerably different between cases and age-, and professional experience-matched controls.

There were only two performance measures: IKDC and Lysholm scores, that were statistically different between cases and controls, but scores were located in within very good and good outcomes giving no clinically important differences.

In our study group the average IKDC score reached almost 92 points, which is considered a very good result,

Table 3. Correlation between clinical scales and the player’s age at the time of research and follow-up time after ACLR in the study group.

| Age FU after ACLR | N | R | p |
|------------------|---|---|---|
| KOOS Symptoms    | 60| 0.16| 0.2325 | 60| 0.18| 0.1575 |
| KOOS Pain        | 60| 0.07| 0.6193 | 60| 0.09| 0.4846 |
| KOOS ADL         | 60| 0.09| 0.4763 | 60| 0.08| 0.5366 |
| KOOS Sport/Rec   | 60| 0.07| 0.6125 | 60| 0.16| 0.2271 |
| KOOS QoL         | 60| 0.09| 0.5170 | 60| 0.21| 0.1131 |
| IKDC 2000        | 60| 0.07| 0.5723 | 60| 0.17| 0.1925 |
| SF.36. Physical Health | 60| -0.11| 0.4089 | 60| -0.12| 0.3637 |
| SF.36. Mental health | 60| -0.09| 0.4824 | 60| -0.11| 0.4216 |
| SF.36. Global Score | 60| -0.24| 0.0616 | 60| -0.14| 0.2813 |
| Lysholm Knee Scale | 60| -0.03| 0.8370 | 60| -0.04| 0.7710 |

Table 3. Correlation between clinical scales and the player’s age at the time of research and follow-up time after ACLR in the study group.

ACL, anterior cruciate ligament reconstruction; ADL, activities of daily living; FU, follow-up; IKDC, International Knee Documentation Committee; KOOS, Knee Injury and Osteoarthritis Outcome Score; N, number of cases; P, p-value of Spearman correlation significance marked with *; PA, participation in physical activity; QoL, quality of living; R, the value of the correlation coefficient R Spearman; Sport/Rec, sport and recreational activities.

and was only 3 points below control group. These IKDC results are comparable with meniscal transplants\textsuperscript{26} and meniscal sutures\textsuperscript{27} scores reported in soccer players with similar follow-up.

Even though the Lysholm score after ACLR was also lower than in control group by 3.5 point o average, the results were still classified as good with median of 93 points. Lysholm score was not reported in professional soccer players after ACLR, but our results are similar with those presented for general population with similar or longer follow-up.\textsuperscript{28–30}

Our results revealed no differences between groups in all subscales of the KOOS questionnaire. In analogy to the other studies, the highest scores were observed in activities of daily living subscale (Figure 1).\textsuperscript{16,29,31–33} It has been suggested that a change of 8–10 KOOS points constitutes a clinically relevant difference.\textsuperscript{18} With the use of these criteria, our results in comparison with other reported scores differ in three subscales: pain, symptoms, and quality of life.\textsuperscript{16,31–33} In the general population the lowest values after ACL reconstruction in Pain, Sport/Rec and QoL subscales were obtained in the studies of Kvist et al.\textsuperscript{32} (age 27.5; 3–4 years FU) and Oiestad et al.\textsuperscript{33} (age 39; 10–15 years FU), and the highest values in Möller et al.\textsuperscript{33} study conducted within 11.5 years after ACL reconstruction.

Soccer population obtained comparable KOOS scores in all but one subscale if compared to the studies of Arliani et al.\textsuperscript{31,34} In this study that looked at retired soccer players, the quality of life subscale was reduced by 9 points compared to our results.\textsuperscript{31} Pain Symptoms and QoL subscales were significantly lower than the age-matched control group in his study.\textsuperscript{31} The worst KOOS results in the male soccer population with high prevalence was proven in radiographic knee examinations where signs of osteoarthritis were reported 14 years after ACLR by von Porat et al.\textsuperscript{16} This
study however described players treated by ACL reconstruction in 1986, and the knee dependant reduction in quality of middle-aged retired athletes may be related to surgical approach and ACLR technique.16

We could not find any differences between groups in terms of health-related quality of life, as measured by the short form–36 version 2 questionnaire. A similar study that compared the quality of life at a long-term follow-up after ACL reconstruction in the general population to an age-matched healthy Swedish population showed higher scores for General Health (GH), Social Function (SF), Role Emotional (RE) and Mental Health (MH) of the patient population, and higher scores for Physical Function (PF) in the control group.25 Möller et al.29 also use the Swedish population as a reference group and no significant differences were found in SF-36 in comparison with the ACLR group at 11.5 years follow-up. Barenius et al.28 reported good overall SF-36 results after ACLR with 8 years follow-up in the general population. They presented better health-related quality of life regarding physical functioning, bodily pain, and social functioning subscales of SF-36 for the early-reconstructed patients, which is commonly used in professional players. Some authors hypothesized that playing soccer may reduce the quality of life with time21,34,36 Arlani et al.34 revealed a significant difference only in one subscale of SF-36: the former Division 1 player (age 30–50) with minimum 5 years of experience had lower scores in the physical aspects of the scale than the age-matched control group. In his follow-up study, he found lower scores among former players on role-physical and vitality subscales of the SF-36. de Albuquerque et al.36 observed a strong association between psychological and physical changes in the SF-36 questionnaire among soccer players after lower limb injuries. The results of these studies indicate probable specific adverse effects associated with playing professional soccer. However, this observation was not confirmed in our study.

There was no correlation between the results of the questionnaires and the age of the players at the time of reconstruction nor the length of a soccer career. The average age in the study group was 29 years of age which is far below average age in other studies of the soccer population.16,31,34 In the future, age and follow-up time may possibly influence the results in our cohort, especially when it comes to the quality of life measures.

The present study has some limitations: a drop-out rate of 31% may have biased the results, but we believe it is still within an acceptable range for modern studies. We contacted the players by e-mail only, so no radiographic examination was available in this study. It would be interesting to compare the signs of osteoarthritis between studied groups.

This study demonstrates that after ACL reconstruction and successful return to professional soccer, knee function is as good as uninjured team members. Taking into account that the players were compared based on age, professional experience, clinical outcomes, and quality of life, this study concludes that there is no considerable difference in professional performance when matched with the control group in the midterm. Majority of previous studies compared soccer players after ACLR with general population or recreational players, showing decline in knee function correlating with the time passed since surgery. Our comparison showed that potential worsening of the knee function due to ACLR was not significantly bigger than deterioration due to participation in the professional soccer.

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