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MESTRADO INTEGRADO EM MEDICINA

Patient reported outcome in ACL reconstruction

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RESUMO

Introdução e objetivos: A rutura do ligamento cruzado anterior é uma das lesões mais comuns do joelho. Após tratamento cirúrgico, não é frequente verificarem-se complicações. Contudo, estas quando presentes podem causar morbilidade relevante. Com o presente trabalho pretendemos documentar os resultados obtidos nos doentes submetidos a este tipo de intervenções cirúrgicas no CHUP, assim como aspiramos a identificar determinantes que possam influenciar os mesmos resultados.

Métodos: Foi realizado um estudo de coorte retrospetivo, com dados colhidos prospectivamente, de um total de 81 doente submetidos a tratamento cirúrgico entre os anos de 2010 e 2017. Aos doentes foi solicitado que completassem as cinco subescalas do KOOS e o OKS. Os dados referentes ao WOMAC foram extrapolados das respostas obtidas no KOOS. Foram ainda recolhidos dados demográficos, relacionados com os hábitos desportivos dos doentes, relativos ao procedimento cirúrgico em si e ainda foram avaliadas as queixas sintomáticas dos doentes após um ano de seguimento.

Resultados: Esta amostra apresentou uma média de idades no momento da cirurgia de 28,14 anos, sendo 82,7% homens. O joelho direito foi o mais frequentemente lesionado (61,7%), 54,3% dos doentes tiveram lesão concomitante do menisco e 9,9% tiveram outras lesões articulares do joelho. Doente que relataram dor no seguimento pós-operatório apresentaram piores resultados médios nas subescalas de dor, AVDs, desporto e QdV do KOOS; dor, rigidez e função do WOMAC; e no OKS (p<0.05). Doentes com outras lesões articulares do. joelho também foram associados com piores resultados nas subescalas de dor, AVDs, desporto, e QdV do KOOS; dor e função do WOMAC; e no OKS (p<0.05). Classificações ASA mais altas mostraram piores resultados nas subescalas de AVDs do KOOS e de função do WOMAC (p<0.05). O retorno à prática desportiva demonstrou estar associado a melhores resultados em todas as ferramentas usadas (p<0.05). Todos os resultados descritos foram obtidos em análises univariadas e multivariadas, sendo sobreponíveis relativamente a todos os parâmetros testados.

Conclusões: Retomar atividade desportiva demonstrou ter impacto positivo na satisfação dos doentes, em todas as escalas utilizadas. Contrariamente, doentes que relatam sintomas durante o seguimento, principalmente dor, demonstraram ter piores resultados nas PROMs utilizadas. Lesões multiligamentares foram associadas a piores resultados nas medidas utilizadas. Por último, classificações ASA mais elevadas foram associadas a piores resultados nas subescalas do KOOS referente a AVDs e WOMAC relativas à função.

Palavras-chave: Joelho, Lesão do joelho, Ligamento cruzado anterior, Reconstrução do ligamento cruzado anterior, Medidas de resultados informados pelos doentes.

ABSTRACT

Background and objectives: The rupture of the ACL is one of the most common knee injuries. When treatment is surgical reconstruction, complications are not usual, but if present can cause relevant morbidity. We aim to investigate the results obtained in surgical reconstruction of this ligament in CHUP. We also aspire to identify determinants that influence patient reported outcome measures and there for patient satisfaction.

Methods: Retrospective cohort study with prospective collected data of 81 one patients, undergoing surgical treatment between the years 2010 and 2017. Patients were asked to complete the five subscales the KOOS and the OKS. The WOMAC data were extrapolated from responses obtained in KOOS. Several demographic variables, sports practice related variables, surgical variables and subjective variables related to symptoms at one-year follow-up described in medical records were assessed.

Results: The population presented a mean age at surgery of 28.14 years and 82.7% were. male. Right sided injuries were more frequent (61.7%), 54.3% of patients had a concomitant meniscus tear and 9.9% had other knee injuries. Patients reporting pain showed worst mean results in KOOS pain, ADL, sports and recreation and QoL subscales; WOMAC pain, stiffness and function, subscales and in OKS (p<0.05). Other knee injuries were also associated with worst results in KOOS pain, ADL, sports and recreation and QoL subscales; WOMAC pain and function, subscales and in OKS (p<0.05). Higher ASA classification reported significantly worst KOOS ADL and WOMAC function subscales (p<0.05). Resuming sports practice was associated with better outcomes in all KOOS and WOMAC subscales, and in OKS (p<0.05). All the described results were obtained in univariate and multivariate analysis and the results overlap in all the tested parameters.

Conclusions: Resuming sports activities showed a big impact in patient satisfaction after ACL reconstruction in all the used tools and subscales. Contrariwise, patients reporting symptoms at follow up, specifically pain, are associated with worst PROMs results. Other knee injuries also were also associated with worst results in the utilized measures. Higher ASA classification was associated with worst KOOS ADL and WOMAC function subscales.

Key words: Knee, Knee injury, Anterior cruciate ligament, Anterior cruciate ligament reconstruction, Patient reported outcome measures.

ABBREVIATIONS

ACL, Anterior Cruciate Ligament

ADL, Activities of daily living

ASA, American society of Anesthesiologists

BMI, Body Mass Index

CI, Confidence Intervals

ICBAS-UP, Instituto de Ciências Biomédicas Abel Salazar of the University of Porto

KOOS, Knee injury and Osteoarthritis Outcome Score

LM, Lateral meniscus

MM, Medial meniscus

OA, Osteoarthritis

OKS, Oxford Knee Score

PASS, Patient accepted symptom state

PROMs, Patient reported outcome measures

QoL, Quality of life

SD, Standard deviation

WOMAC, Western Ontario and McMaster Universities Osteoarthritis Index

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INTRODUCTION

Rupture of the Anterior Cruciate Ligament (ACL) is one of the most common knee injuries and frequently requires surgical reconstruction [1]. The knee after being submitted to ACL reconstruction, still has an high risk of premature osteoarthritic changes [2], despite the stabilizing effects of ACL repair [3], especially when meniscectomy is performed [4]. Up to one quarter of all patients with osteoarthritis (OA) have ACL rupture history [5]. ACL ruptures are more common in athletes and trauma victims [1].

The outcomes of this interventions can be reported by functional assessments, post-operative complications and patient reported outcome measures (PROMs) [6]. Like all surgical interventions, surgeon's skills, patients' motivation and perception of the injury will influence the outcomes measured and the ACL-related studies [7]. Organized rehabilitation programs have also a key role in future outcomes in this type of injuries.

A change in a PROM may not be associated with an improvement in patient's condition. Some patients can be in a state that they accepted their condition as normal despite all the morbidity they have. This is called patient accepted symptom state (PASS) [8].

One of the most popular knee specific PROM is the Knee injury and Osteoarthritis Outcome Score (KOOS) [9], which is frequently used in studies related with ACL injury and reconstruction [8]. It is an extension of The Western Ontario and McMaster Universities Osteoarthritis Index (WOMAC) [10]. In the clinic, KOOS is utilized to monitor groups and individuals over time.

The Oxford Knee Score (OKS) is a widely used PROM as well. It was originally developed for assessment in knee replacement surgery, but nowadays it is used in other contexts as ACL reconstruction.

Both OKS and KOOS have been adapted and validated in Portuguese versions in previous studies. [11, 12]

Complications are not common in ACl surgery, but they have potential to cause short and long term morbidity [13]. The purpose of this study was to evaluate the results obtained after ACL reconstruction in Centro Hospitalar Universitário do Porto and to identify the determinants associated with worst, or best, outcomes and with patient satisfaction.

METHODS

Study design and sample

We did a retrospective cohort study with prospective collected data. Patients were retrospectively identified from a computerized database. Between January 2010 and December 2017, 209 ACL reconstructions were performed in this institution. These surgeries were performed by one of two surgeons, using the same technic: isquiotibial graft, with ligament suspension on the femoral tunnel, made in an inside-out technic, and fixation in the tibial tunnel, made by outside-in drilling, using an interference screw. As published before, there was not significant difference between these surgeons in tunnel placement [14].

Of the initial 209 patients, we were able to contact telephonically 112 and 109 agreed to participate. Of this 109, 82.6% were males with a mean age at contact of 32.42 (SD 9.23) years and an average of 4.40 (SD 2.13) years after ACL reconstruction. To all 109 patients, data was collected via electronic mail.

A total of 90 patients replied correctly to the email. It was defined a minimum time of follow up from surgery date of one year. We defined as exclusion criteria: major knee surgery after ACL reconstruction, surgery performed after 2017, rare surgery related complications like infection [15] or postoperative venous thromboembolism [16] and less than one-year post surgery follow-up. There were 9 patients excluded: 5 lacked one-year minimum follow-up post-surgery data; 3 for being submitted to new knee surgery in less than a year; and 1 was submitted to total knee replacement posteriorly to ACL rupture. Other lesions and previous ALC reconstruction or meniscus tear were included and registered. A total of 81 patients met all inclusion criteria and enrolled the study. A detailed flow diagram is included in Figure 1.

KOOS

The KOOS consists in 42-item self-administered self-explanatory questionnaire subdivided into five subscales: pain (9 items), other disease specific symptoms (7 items), activities of daily living (ADL) function (17 items), sports and recreation function (5 items) and knee-related quality of life (QoL) (4 items). Each question is assigned a score from 0 (no problems) to 4 (extreme problems) and a normalized score is calculated for each subscale (0 is the worst possible score, 100 is the best possible score) [9].

WOMAC

The WOMAC is a popular PROM used for knee and hip osteoarthritis evaluation. In its present form it consists in 24 items, of 48 KOOS items, divided into 3 subscales: pain (5 items), which corresponds to KOOS pain subscale first 5 items; stiffness (2 items), which corresponds to KOOS symptoms subscale first two questions; and physical function (17 items), which corresponds to KOOS ADL subscale 17 items. The items are also scored from 0 to 4 and are summed up making the pain subscale ranging from 0-20, stiffness from 0-8 and physical function from 0-68. A sum of the scores for all three subscales can be performed and gives a total WOMAC score, which wasn't used in the present study [17].

OKS

The OKS is composed by 12 questions regarding activities of daily living that cover function and pain [18]. The answers are classified from 0 to 4, and then the results from each question are added so that the overall figure lies between 0 and 48 (0 is worst possible score, 48 is the best possible score) [19].

Data collection and variable definition

After obtaining approval from respective institutional review board and ethics committee we started contacting patients telephonically. After informed consent was obtained, data on patients was collected by application of the five subscales of KOOS and the OKS questionnaires. WOMAC data was extrapolated from KOOS questionnaire responses. KOOS, WOMAC and OKS validity, reliability and minimal clinical meaningful differences have been previously documented [20].

Patients received by email both questionnaires, and after completion, sent them back to the research team by the same means.

Afterwards, patient related data was harvest from the institution patient database. Demographic data included age at surgery; patient sex; present height, weight and body mass index (BMI); present smoking habits; sports participation level previous to ACL rupture and after ACL reconstruction. We defined under-weight as a BMI of <18.5 Kg/m^2, normal weight as 18.5–24.9 Kg/m^2, overweight as 25–29.9 Kg/m^2, obese as 30-34.9 Kg/m^2 and severely obese as 35 Kg/m^2 or greater [21]. ACL rupture specific data included side of injury; concomitant meniscus tear; time from presumed date of injury to operative intervention; other knee injuries, apart from ACL and meniscal tear, such as posterior cruciate ligament tear, collateral ligament tears (medial or lateral); surgery duration; and American society of

Anesthesiologists (ASA) classification [22]. We defined acute ACL reconstruction as <91 days (or approximately 3 months), chronic as >180 days (or approximately 6 months) and sub-acute as in between (3 to 6 months) [23]. Previous to the present episode knee surgical history data included side of injury; history of previous ACL reconstruction and previous meniscus tear reconstruction. Records from follow-up visits, at least one-year after surgical reconstruction, were consulted in order to access symptoms reported by patients. Those included pain, joint effusion, stiffness and joint effusion.

Ethics

This study was approved by Ethics Committee of Centro Hospitalar Universitário do Porto, E.P.E, Porto – Portugal, and Instituto de Ciências Biomédicas Abel Salazar of the University of Porto (ICBAS-UP). Written informed consent from participants was obtained. Project was identified by nº 2018-293 (249-DEFI/252-CES).

Statistical analysis

The values were presented as mean and standard deviation (SD), median and interquartile range or number and percentage, as appropriate. Independent-Samples t-test or chi-square test were used to analyse continuous or categorical variables, as appropriate. Multivariate linear regression models were constructed in order to evaluate the impact of several predictive factors in OKS, KOOS and WOMAC components scores. Linear regression coefficients and 95% confidence intervals (CI) are presented. Results were considered statistically significant if $p<0.05$. Statistical analysis was performed using IBM® SPSS® Statistics 25.0.

RESULTS

A total of 81 participants were included (82.7% male) with a mean (SD) age at surgery of 28.14 (8.77) years. Previously to injury 96.3% played sports, being 76.5% a contact sport, and after the ALC reconstruction 55.6% resumed sports activities, 21% in a contact modality. Relatively to the knee injury, 61.7% had a right sided injury, 54.3% had a concomitant meniscus tear, 9.9% had other knee injuries. In this sample 66.7% of the patients were ASA I and 33.3% ASA II, we did not find any other classes in this sample. The mean time from injury to surgery was 235 days, 59.3% being chronic injuries and 9.9% of patients had previous knee surgery history. At one-year follow-up 46.9% reported pain, 42% instability, 30.9% stiffness and 12.3% referred joint effusion. General characteristics of study sample and more surgery related data are presented in Table I.

No association was found between one-year follow-up symptoms. Patients with meniscus tear are associated with pain (p=0.042) and stiffness (p=0.028). No association was found between ASA classification, previous knee surgery and sports habits, previous or after surgery (data not shown). Some of the relations between categorical variables are presented in Table II with further details.

Patients presenting pain reported significantly worst KOOS results in the subscales of pain (76.02±3.93 vs. 89.28±14.30, p=0.005), ADL (83.39±23.14 vs. 94.63±9.48, p=0.004), sports and recreation (55.53±31.77 vs. 74.45±22.85, p=0.003) and QoL (47.75±28.00 vs. 65.84±26.18, p=0.003); higher WOMAC pain (4.61±4.87 vs. 2.12±2.95, p=0.008), stiffness (2.42±2.06 vs. 1.23±1.78, p=0.007) and function (11.97±15.74 vs. 3.65±6.45, p=0.004) subscales and lower OKS (36.68±12.21 vs. 43.16±4.98, p=0.004). Patients referring knee instability showed significantly lower KOOS ADL function subscale (57.80±15.26 vs. 93.02±10.96, p=0.016) and higher WOMAC stiffness (2.38±2.22 vs. 1.36±1.73, p=0.022) and function (11.44±16.39 vs. 4.74±7.46, p=0.032) subscales. When stiffness was present, lower KOOS pain (74.00±27.57 vs. 87.10±15.18, p=0.033), QoL (43.83±31.56 vs. 63.39±24.81, p=0.004) subscales and, higher WOMAC pain subscale (5.00±5.40 vs. 2.52±3.20, p=0.040) were reported. There weren't significant differences in the indexes used between patients presenting joint effusion from those who did not. The relation between symptoms presented in one-year follow-up consultation records and the PROMs results are shown in Table III.

Comparing the individuals who practiced sports previously to ACL tear and those who did not, there aren't significant differences between groups. Patients who resumed sports activities reported significantly higher KOOS pain (89.07±12.94 vs. 75.54±25.55, *p*=0.006), symptoms (63.89±14.57 vs. 57.14±13.34, *p*=0.035), ADL (95.23±7.66 vs. 80.96±23.88, *p*=0.001), sports and recreation (71.69±23.15 vs. 57.92±33.43, *p*=0.032), QoL (65.74±24.88 vs. 65.74±24.88, *p*=0.002) subscales; lower WOMAC pain (2.13±2.63 vs. 4.72±5.15, *p*=0.008), stiffness (1.20±1.65 vs. 2.53±2.17, *p*=0.003) and function (3.24±5.21 vs. 12.94±16.24, *p*=0.001) subscales; and higher OKS (42.58 ± 5.74 vs. 37.06 ± 12.35, *p*=0.017). The detailed description of sports practice relation with the obtained indexes are depicted in Table IV.

Patients with other knee injuries apart from ACL rupture and meniscus tear present with lower KOOS pain (67.01±24.69 vs. 84.82±19.48, *p*=0.019), ADL (71.51±25.05 vs. 90.79±16.47, *p*=0.004), sports and recreation (31.88±33.27 vs. 69.26±26.00, *p*<0.001), QoL (37.50±30.98 vs. 59.53±27.43, *p*=0.036) subscales; lower OKS (30.00±13.73 vs. 41.23±8.48, *p*=0.001); and with higher WOMAC pain (6.25±5.29 vs. 2.96±3.90, *p*=0.032), and function (19.38±17.04 vs. 6.26±11.20, *p*=0.004) subscales. Patients with class II from ASA classification presented with lower KOOS ADL subscale (92.21±11.32 vs. 82.24±26.33, *p*=0.019) and with higher WOMAC function subscale (5.30±7.70 vs.12.07±17.91, *p*=0.019). No association was observed between the PROMs and the presence of concomitant meniscus tear. More information is described in Table V.

No relation was found between time from injury to surgery and the demographic data, sports habits information, injury related data or the PROMs. BMI subscales, smoking habits, patient sex, side of injury, previous knee surgery and time elapsed since surgery also had no significant association with the PROMs studied (data not shown).

In multivariate linear regression models adjusted for pain, instability, joint effusion and stiffness (Tables VI and VII), the group of patients with pain presented a mean lower KOOS pain by -11.3 (95% CI [-19.8; -2.7], *p*=0.010), ADL by -10.4 (95% CI [-17.8; -2.9], *p*=0.007), sports and recreation by -16.6 (95% CI [-28.8; -4.5], *p*=0.008), QoL by -15.1 (95% CI [-26.8; -3.5], *p*=0.012) subscales; a mean higher WOMAC pain by 2.1 (95% CI [0.4; 3.9], *p*=0.018), stiffness by 1.1 (95% CI [0.2; 1.9], *p*= 0.016), function by 7.0 (95% CI [2.0; 12.1], p=0.007) subscales; and a mean lower OKS by -5.7 (95% CI [-9.8; -1.7], *p*=0.006). The group of patients with instability presented with a mean lower KOOS ADL subscale by -7.8 (95% CI [-15.3; -0.2], *p*=0.044) and a mean higher WOMAC function subscale by 5.3 (95% CI [0.2; 10.4], *p*=0.044). The group of patients with stiffness presented with a mean lower KOOS pain by -10.4 (95% CI [-19.8; -1.1], *p*=0.029) and QoL by -15.8 (95% CI [-28.5; -3.0], *p*=0.016) subscales and a mean higher WOMAC pain subscale by 2.0 (95% CI [0.1; 3.9], *p*=0.041).

When multivariate linear regression models were adjusted for meniscus tear, side of injury and other concomitant knee injuries (Tables VIII and IX), the group of patients with other concomitant knee injuries presented with a mean lower KOOS pain by -17.1 (95% CI [-32.2; -2.0], *p*=0.027), ADL by -17.1 (95% CI [-30.3; -3.9], *p*=0.012), sports and recreation by. -39.8 (95% CI [-60.0; -19,7], *p*<0.001) and QoL by -22.6 (95% CI [-43.6, -1.6], *p*=0.035) subscales, a mean higher WOMAC pain by 3.3 (95% CI [0.2; 6.3], *p*=0.036) and function by 11.6 (95% CI [2.7; 20.6], *p*=0.012) subscales and a mean lower OKS by -10.6 (95% CI [-17.5; -3.7], *p*=0.003).

In multivariate linear regression models adjusted for sports practice previous to ACL reconstruction, sports practice after ACL reconstruction, ASA classification and patient gender (Tables X and XI), the group of patients that resumed sports activities after surgery presented with a mean increased KOOS pain by 13.6 (95% CI [4.7; 22.5], *p*=0.003), symptoms by 6.6 (95% CI [0.2;13.0], *p*=0.044), ADL by 14.7 (95% CI [7.3; 22.2], *p*<0.001), sports and recreation by 14.4 (95% CI [1.5; 27.2], *p*=0.004) and QoL by 18.4 (95% CI [6.0; 30.7], *p*=0.004) subscales; a mean decreased WOMAC pain by -2.6 (95% CI [-4.4; -0.8], *p*=0.005), stiffness by -1.3 (95% CI [-2.1; -0.4], *p*=0.005) and function by -10.0 (95% CI [-15.1; -5.0], *p*<0.001) subscales; and a mean OKS increased by 5.7 (95% CI [1.5; 9.8], *p*=0.009). Also, patients with a higher ASA classification presented with mean reduced KOOS ADL subscale by -10.0 (95% CI [-17.9; -2.1], *p*=0.013) and increased WOMAC function subscale by 6.8 (95% CI [1.5; 12.2], *p*=0.013).

DISCUSSION AND CONCLUSIONS

The major findings of this study indicate that pain reported by patients at one-year follow-up is a possible predictor of poorer PROMs results in the subsequent evaluations. In contrast, resuming sports activities after ACL reconstruction is strong indicator of excellent results in the same type of subjective outcome evaluation tools. Stiffness and instability might also be good predictors of worst results in certain subscales of the PROMs measured. In our sample, there was not significant differences in the PROMs obtained and any demographic data, such as age, smoking habits, gender and BMI. Also, patients with concomitant meniscus tear or previous history of ACL rupture didn't presented worst results. On other hand, patients with other knee structures injured showed worst results in the majority of the used PROMs subscales. Higher ASA classification was related with worst KOOS ADL and WOMAC function subscales.

We compare our KOOS results with those described by J Kvist et al, which were accessed in a population with 7652 patients, two years after being submitted to primary ACL reconstruction surgery. They reported the following mean KOOS subscales: symptoms 79, pain 85, ADL function 92, sports and recreation 67 and QoL 62 [24]. In this population, the mean KOOS symptoms subscale was 61. The remaining subscales are overlapping with those described in the referred article. Comparison between mean KOOS values obtained and previously described in literature is illustrated in Figure 2.

As referred, in our sample patient age was not associated significantly with differences in PROMs obtained. In adults, literature is inconsistent regarding the effect of age in ACL reconstruction subjective outcomes. Some studies suggest that patient satisfaction do not seem to be affected by age [25, 26] and some show that several of the most commonly used clinical scores are better in younger patients [27].

The harmful effects of smoking after ligament and cartilage surgery in the knee are previously documented [28] and suggest an influence in both objective and subjective clinical outcomes [29]. After ACL reconstruction, smoking was correlated with a longer return to sports function and worst knee-quality of life outcomes across several measures, being KOOS one of them [30]. In the present study, patients who smoke did not presented significant differences in the PROMs accessed.

There is lack of consensual evidence about the effects of an increased BMI in clinical scores levels after ACL reconstruction or arthroscopic meniscectomy: some studies affirm that an increased BMI have a negative influence in clinical scores [28, 31] , and others affirm that BMI does not adversely affect functional outcomes, such as KOOS [32, 33]. In our findings, an increased BMI did not have significant influence in PROMs, more specifically KOOS, WOMAC and OKS.

In order to evaluate how symptoms at one-year follow-up might influence the PROMs results obtained, we did a univariate analysis of the groups and an analysis with a multivariate adjusted model with pain, stiffness, joint effusion and instability. These four symptoms are described in literature as associated with higher patient dissatisfaction and worst PROM's after ACL reconstruction surgery [26]. The results obtained in the univariate and multivariate analyses overlap.

We found that patients presenting with pain at one-year follow-up were associated with significantly worst PROMs mean results in the univariate analysis for KOOS pain, ADL, sports and recreation, and QoL subscales; pain, stiffness and function in WOMAC subscales and in the OKS and in the adjusted multivariate model were also significantly associated with reduced PROMs for the same subscales. These findings might indicate that pain at one-year follow-up might be a good indicator for a poorer subjective result after surgical reconstruction. Knee instability was associated, in our population, with worst KOOS ADL and WOMAC function subscales in both univariate and multivariate analysis. The perception of knee instability might be perceived by the patient like a worst knee related function and associated with repercussions in the ADL. Patients who presented stiffness had worst outcomes in the KOOS pain and QoL subscales, and in WOMAC pain subscale in the univariate and in the multivariate model. We thought that stiffness could be associated with the presence of pain since stiffness is related with worst KOOS pain subscale. However, the two symptoms were not related in our population. In this study, patients with stiffness were the ones who presented with lower means in the univariate analysis and bigger reductions in the multivariate model for the KOOS QoL subscale. This possibly indicates that stiffness is strongly associated with reduced knee-related QoL. We did not find any significant association between joint effusion and the PROMs obtained. It was also interesting to notice that no significant relation was found in both the univariate and multivariate analysis between the KOOS other disease specific symptoms subscale and the symptoms reported at follow-up.

In this population, concomitant meniscus tear had a prevalence of 54.3%, which is similar to what is previously described in other studies (prevalence of 55-65%) [34-36]. Meniscus rupture is associated, in this study, with pain and stiffness at one-year follow-up. Stiffness is a common criteria for clinical diagnosis of knee OA [37]. On other hand, pain is not an accurate method of identifying knee OA, given the high number of possible disorders causing it [38, 39]. As already mentioned, patients with ACL rupture are in increased risk of developing knee OA [2, 40], especially when meniscal tear is associated [4, 41] and, there for, patients with concomitant meniscus tear may present more frequently pain and stiffness because they're more prone to develop osteoarthritic changes in the injured knee. KOOS, WOMAC and OKS are commonly used tools to access the presence of knee OA [42]. We initially believed that patients with concomitant meniscus tear might present worst subjective outcomes than those without concomitant lesion, but we did not find significant differences in our population. A study with a 2-year follow-up of 4691 patients from the Norwegian knee ligament registry showed that patients treated with a lateral meniscus (LM) repair, medial meniscus (MM) resection, or LM resection were not significantly different from an isolated ACL reconstruction for any of the 5 KOOS subscales. Despite that, patients treated with MM repair in addition to ACL reconstruction had significantly lower scores in the KOOS symptoms and QoL subscales compared with isolated ACL reconstruction [43]. We did not access what type of meniscal procedure was made to treat meniscal rupture in our patients and, there for, we cannot fully compare our results to those in the referred study.

Patients with concomitant other knee injuries presented with significantly worst mean results in an univariable analyses, and with significantly mean reduce PROMs in the multivariate adjusted model with meniscal tear and the side of the injury, for KOOS pain, ADL, sports and recreation, and QoL subscales; pain and function in WOMAC subscales and in the OKS. In this category we included patients with ACL rupture, with or without meniscus tear, and another knee ligamentous structure injured. The multiple-ligament injured knee is a complex problem that require extremity vascular status assessment because of the possibility of arterial or venous compromise and, there for, may lead to a worse prognosis [44]. We did not find a study that showed PROMs comparison between groups with multiple-ligament lesions of the knee and single ones but, as expected, multiple-ligament injured knee patients had, in our population, a worst PROMs result. It would've been interesting to evaluate in more detail, if we had a bigger population, which of the considered concomitant knee injuries is associated with worst ACL PROMs results obtained.

There are limited published data concerning subjective outcomes after revision of ACL reconstruction. However, clinical outcome after ACL revision based on subjective outcome scores is less favorable than after primary ACL reconstruction [45]. In our evaluation, no significant difference was found between primary ACL reconstructions and ACL reconstructions in patients with previous knee surgery. In this population, 9.9% of our patients already had a previous knee surgery, and revision ACL reconstruction rate was

8.6%. These values are higher than those described in literature: revision of ACL reconstruction rate is described to be around 4% [45].

To access the influence of gender, sports activity, previous or after the injury and physical status at surgery time, which was deduced by ASA classification, on the results obtained in the PROMs we used a univariate analysis of these groups, and then a multivariate regression model with the referred variables: patient gender, ASA classification and previous to injury and after injury sports habits. Once again, the results obtained in the univariate and multivariate analyses overlap.

Previously to ACL rupture, 96.3% of patients practiced sports but at least one year after ACL reconstruction only 55.6% resumed sports activities of any kind. This number is inferior to what's described: on average 81% of people returned to any sport after ACL reconstruction surgery [46]. On other hand, patients that resumed physical activity after ACL reconstruction have significantly better PROMs in all questionnaires and subscales. In our findings, resuming sports activities is associated with significantly better PROMs mean results in an univariable analysis and with a significant increase in the referred adjusted model for all the PROMs, in all subscales used in this study. This supports previous findings in literature which state that resuming physical activity is linked to better objective functional measures as well as validated PROMs [27]. This may be related to higher motivational levels for the rehabilitation process, different types of physical rehabilitation programs or simply because patients who didn't resumed physical activities were going to become less active and more sedentary individuals due to age resulting lifestyle changes with or without ACL reconstruction surgery and, there for, weren't as committed in the rehabilitation process as others. Returning or not to preinjury sports level after ACL reconstruction is a complex and multifactorial process. Psychological factors probably contribute to inferior return to sport outcomes [47]. Fear of reinjury is one of the most frequently cited reasons by athletes for not returning to their preinjury level of sports, and might have an influence in the number of patients which decided not to resume their sporting activities [48].

Regarding to gender, there is evidence favoring worst KOOS scores in women postoperatively than in men [27, 49]. In the present study, PROMs did not differ based on gender. However, our sample is composed by 82.7% men, which may have influenced the referred results.

Patients in class II of the ASA classification presented with a worst ADL KOOS subscale and a worst WOMAC function subscale than those in class I in both univariate and multivariate analysis. These two subscales are based on exactly the same questions and, as expected, the results are concordant. ASA classification did not influence any of the other subjective outcomes obtained, in this research. Our population was composed by young individuals, with a mean age of 28.14 year at surgery date and we did not find any participant with an ASA classification higher than class II. We found that 66.7% of our patients were ASA I, which is similar to what is previously described (71%) [50]. Given the small prevalence of comorbidities in younger populations, like those that typically compose candidates to ACL reconstruction surgery, this is, perhaps, not surprising and may explain why we did not find any more relations between the referred variables. We did not find literature relating ASA classification and knee related PROMs, being this, probably, the first time the association between these subscales and ASA classification has been described. That said, we find it curious that the altered subscales have been those that relate to ordinary activities of patients' lives. When we assay the items included in the subscales in question, we noticed that these may be affected by other comorbidities that worsen knee condition or the perception of it, such as obesity. However, in this present study we did not find a relationship between the ASA classification with any of the other variables analyzed, including BMI.

One of the major limitations to our study is the absence of an objective assessment of knee function. Although having a small population, from those patients we were able to contact, we managed to have an 80,3% response rate, indicating patients are supportive and willingly to collaborate on similar initiatives in the future. There for, it would be interesting to do, in the future, further investigation with this population asking the same patients to be submitted to an objective evaluation such as the hop test or by a KT1000, for example, and compare the results with those obtained in this investigation. Another limitation we encounter was the impossibility to evaluate the differences between the rehabilitation programs to which the patients were submitted, and how these differences might impact knee outcomes. Lastly, we had a higher number of participants enrolled primarily into this study, but we were not able to contact them all, which can lead to selection bias.

In the future, it would be interesting to carry out a study in which participants are asked to complete the PROMs’ questionnaires used before ACL reconstruction, and afterwards, similarly to performed here, to measure the impact of surgical reconstruction on patients' PROMs. It would be also interesting to qualify in greater detailed physical activity and sports practice levels previously and after surgical intervention.

In conclusion, our study supports the importance of resuming sports activities has in patient satisfaction after ACL reconstruction, in all the used tools and subscales. Contrariwise, patients reporting symptoms at follow up, specifically pain, are associated with worst PROMs results. Other knee injuries also were also associated with worst results in the utilized measures. Higher ASA classification might be associated with worst outcomes in KOOS ADL and WOMAC function subscales.

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Table I: General characteristics of the study sample.

	All n = 81
Demographic data	
Age at surgery (years)	28.14 ± 8.77 (14 to 53)
Gender (male sex)	67 (82.7%)
Smokers	26 (32.1%)
Height (m)	1.74 ± 0.08
Weight (Kg)	78.02 ± 14.31
BMI (Kg/m^2)	25.74 ± 3.87
Under-weight	2 (2.5%)
Normal weight	33 (40.7%)
Overweight	38 (46.9%)
Obese	5 (6.2%)
Severely obese	3 (3.7%)
Sport practice	
Pre injury	78 (96.3%)
Contact sport	62 (76.5%)
Post injury	45 (55.6%)
Contact sport	17 (21%)
Injury data	
Side of injury (right)	50 (61.7%)
Meniscus tear	44 (54.3%)
Other knee injuries	8 (9.9%)
Time from injury to surgery (days)	235 (110.05; 379.50)
Acute	15 (18.5%)
Sub-acute	18 (22.2%)
Chronic	48 (59.3%)
Duration of surgery (minutes)	99.59 ± 24.79
Time after surgery (years)	4.40 ± 2.13
ASA classification	
I	54 (66.7%)
II	27 (33.3%)
Previous knee surgery	8 (9.9%)
Homolateral lesion	5 (62.5%)
ACL lesion	7 (87.5%)
Meniscus tear	3 (37.5%)
Follow-up	
Pain	38 (46.9%)
Instability	34 (42.0%)
Joint effusion	10 (12.3%)
Stiffness	25 (30.9%)

The values presented are mean ± standard deviation, mean ± standard deviation (range), n (%) or median (25th percentile to 75th percentile), as appropriate.

ACL, anterior cruciate ligament; ASA, American society of anesthesiologists; BMI, body mass index.

Table II: Association between symptoms at one-year follow-up with sports habits, patient gender, knee injury related data and between each other.

	Pain		**Instability**		**Joint effusion**		**Stiffness**	
		p		*p*		*p*		*p*
Pain			18 (47.4%)	.242	6 (15.6%)	.292	14 (36.8%)	.197
Instability	18 (52.9%)	.242			5 (14.7%)	.413	13 (38.2%)	.164
Joint effusion	6 (60.0%)	.292	5 (50.0%)	.413			5 (50.0%)	.151
Stiffness	14 (56.0%)	.197	13 (52.0%)	.164	5 (20.0%)	.151		
Sport practice								
Pre injury	36 (46.2%)	.453	33 (42.3%)	.621	10 (12.8%)	.670	24 (30.8%)	.675
Post injury	21 (46.7%)	.569	16 (35.6%)	.140	4 (8.9%)	.236	14 (31.1%)	.576
Other Variables								
Gender (male)	31 (46.3%)	.514	29 (43.3%)	.416	9 (13.4%)	.451	20 (29.9%)	.444
Side of injury (right)	25 (50.0%)	.317	19 (38.0%)	.245	6 (12.0%)	.581	15 (30.0%)	.510
Meniscus tear	25 (56.8%)	**.042**	22 (50.0%)	.085	7 (15.9%)	.237	18 (40.9%)	**.028**
Other knee injuries	5 (62.5%)	.288	3 (37.5%)	.549	2 (25.0%)	.256	4 (50.0%)	.200
Previous surgery	5 (62.5%)	.288	6 (75.0%)	.054	0 (0.0%)	.331	2 (25.0%)	.527

The values presented are n (%).

Table III: The relation between symptoms at one-year follow-up and the five subscales of KOOS, the three subscales of WOMAC and OKS.

		Pain			Instability			Joint effusion			Stiffness		
	All n = 81	**Present** n = 38	**Absent** n = 43	***p***	**Present** n = 25	**Absent** n = 56	***p***	**Present** n = 71	**Absent** n = 10	***p***	**Present** n = 71	**Absent** n = 10	***p***
KOOS													
Pain	83.06 ± 20.58	76.02 ± 3.93	89.28 ± 14.30	**.005**	78.68 ± 25.59	86.23 ± 15.56	.133	78.28 ± 27.64	84.15 ± 19.39	.204	74.00 ± 27.57	87.10 ± 15.18	**.033**
Symptoms	60.89 ± 14.35	57.80 ± 15.26	63.62 ± 13.07	.068	61.13 ± 14.31	60.71 ± 14.54	.897	65.00 ± 17.72	60.31 ± 13.87	.337	59.14 ± 14.84	61.67 ± 14.20	.467
ADL	88.89 ± 18.24	83.39 ± 23.14	94.63 ± 9.48	**.004**	57.80 ± 15.26	93.02 ± 10.96	**.016**	79.26 ± 24.80	90.24 ± 16.91	.204	82.88 ± 25.74	91.57 ± 13.08	.121
Sports and recreation	65.57 ± 28.83	55.53 ± 31.77	74.45 ± 22.85	**.003**	58.86 ± 29.05	70.43 ± 27.97	.075	54.50 ± 39.05	67.13 ± 27.10	.345	56.80 ± 32.14	69.49 ± 26.60	.067
QoL	57.56 ± 28.37	47.75 ± 28.00	65.84 ± 26.18	**.003**	50.25 ± 29.05	62.50 ± 26.96	.054	47.08 ± 32.16	58.80 ± 27.74	.223	43.83 ± 31.56	63.39 ± 24.81	**.004**
WOMAC													
Pain	3.28 ± 4.13	4.61 ± 4.87	2.12 ± 2.95	**.008**	4.24 ± 5.11	2.60 ± 3.13	.103	4.50 ± 5.50	3.11 ± 3.92	.461	5.00 ± 5.40	2.52 ± 3.20	**.040**
Stiffness	1.79 ± 2.00	2.42 ± 2.06	1.23 ± 1.78	**.007**	2.38 ± 2.22	1.36 ± 1.73	**.022**	2.00 ± 2.20	1.76 ± 1.98	.725	2.28 ± 2.23	1.57 ± 1.87	.141
Function	7.56 ± 12.40	11.97 ± 15.74	3.65 ± 6.45	**.004**	11.44 ± 16.39	4.74 ± 7.46	**.032**	14.10 ± 16.86	6.63 ± 11.50	.074	11.64 ± 17.50	5.73 ± 8.89	.121
OKS	40.12 ± 9.62	36.68 ± 12.21	43.16 ± 4.98	**.004**	38.38 ± 11.95	41.38 ± 7.39	.201	37.10 ± 13.14	40.55 ± 9.06	.291	36.44 ± 13.29	41.77 ± 6.97	.068

The values presented are mean ± standard deviation.

ADL, activities of daily living; KOOS, Knee injury and Osteoarthritis Outcome Score; OKS, Oxford Knee Score; QoL, quality of life; WOMAC, The Western Ontario and McMaster Universities Osteoarthritis Index.

Table IV: Relation between sports practice, previous and after ACL injury, and the five subscales of KOOS, the three subscales of WOMAC and OKS.

		Sports Practice					
		Previous to injury			After injury		
	All n = 81	**Present** n = 62	**Absent** n = 19	***p***	**Present** n = 45	**Absent** n = 36	***p***
KOOS							
Pain	83.06 ± 20.58	82.84 ± 20.50	83.77 ± 21.40	.864	89.07 ± 12.94	75.54 ± 25.55	**.006**
Symptoms	60.89 ± 14.35	60.77 ± 14.31	61.28 ± 14.88	.894	63.89 ± 14.57	57.14 ± 13.34	**.035**
ADL	88.89 ± 18.24	88.88 ± 18.83	88.93 ± 16.62	.991	95.23 ± 7.66	80.96 ± 23.88	**.001**
Sports and recreation	65.57 ± 28.83	65.67 ± 28.39	65.26 ± 31.02	.958	71.69 ± 23.15	57.92 ± 33.43	**.032**
QoL	57.56 ± 28.37	55.48 ± 27.99	63.49 ± 29.48	.284	65.74 ± 24.88	65.74 ± 24.88	**.002**
WOMAC							
Pain	3.28 ± 4.13	3.19 ± 4.03	3.58 ± 4.55	.725	2.13 ± 2.63	4.72 ± 5.15	**.008**
Stiffness	1.79 ± 2.00	1.77 ± 2.05	1.84 ± 1.86	.898	1.20 ± 1.65	2.53 ± 2.17	**.003**
Function	7.56 ± 12.40	7.56 ± 12.80	7.53 ± 11.30	.991	3.24 ± 5.21	12.94 ± 16.24	**.001**
OKS	40.12 ± 9.62	39.90 ± 9.35	40.84 ± 10.70	.712	42.58 ± 5.74	37.06 ± 12.35	**.017**

The values presented are mean ± standard deviation.

ADL, activities of daily living; KOOS, Knee injury and Osteoarthritis Outcome Score; OKS, Oxford Knee Score; QoL, quality of life; WOMAC, The Western Ontario and McMaster Universities Osteoarthritis Index.

Table V: Relation between ASA classification, meniscus tear, other knee injuries and the five subscales of KOOS, the three subscales of WOMAC and OKS.

		ASA classification			**Meniscus tear**			**Other knee injuries**		
	All n = 81	**I** n = 54	**II** n = 27	***p***	**Present** n = 44	**Absent** n = 37	***p***	**Present** n = 8	**Absent** n = 73	***p***
KOOS										
Pain	83.06 ± 20.58	85.0 ± 15.90	79.01 ± 27.61	.297	79.23 ± 23.76	87.61 ± 15.08	.058	67.01 ± 24.69	84.82 ± 19.48	**.019**
Symptoms	60.89 ± 14.35	59.99 ± 14.02	62.70 ± 15.10	.426	61.78 ± 15.63	61.28 ± 14.88	.614	57.14 ± 18.61	61.30 ± 13.91	.440
ADL	88.89 ± 18.24	92.21 ± 11.32	82.24 ± 26.33	**.019**	85.56 ± 21.79	92.85 ± 12.82	.061	71.51 ± 25.05	90.79 ± 16.47	**.004**
Sports and recreation	65.57 ± 28.83	67.71 ± 26.98	61.30 ± 32.33	.349	62.87 ± 28.58	68.78 ± 29.19	.361	31.88 ± 33.27	69.26 ± 26.00	**.000**
QoL	57.56 ± 28.37	57.91 ± 27.13	56.25 ± 31.20	.806	53.17 ± 29.44	62.33 ± 26.58	.149	37.50 ± 30.98	59.53 ± 27.43	**.036**
WOMAC										
Pain	3.28 ± 4.13	3.19 ± 4.03	3.58 ± 4.55	.405	3.93 ± 4.73	2.51 ± 3.19	.113	6.25 ± 5.29	2.96 ± 3.90	**.032**
Stiffness	1.79 ± 2.00	1.77 ± 2.05	1.84 ± 1.86	.369	2.16 ± 2.07	1.35 ± 1.84	.067	2.25 ± 2.44	1.74 ± 1.96	.496
Function	7.56 ± 12.40	5.30 ± 7.70	12.07 ± 17.91	**.019**	9.82 ± 14.82	4.86 ± 8.11	.061	19.38 ± 17.04	6.26 ± 11.20	**.004**
OKS	40.12 ± 9.62	39.90 ± 9.35	40.84 ± 10.70	.223	38.52 ± 11.63	42.03 ± 6.09	.087	30.00 ± 13.73	41.23 ± 8.48	**.001**

The values presented are mean ± standard deviation.

ADL, activities of daily living; ASA, American society of anesthesiologists; KOOS, Knee injury and Osteoarthritis Outcome Score; OKS, Oxford Knee Score; QoL, quality of life; WOMAC, The Western Ontario and McMaster Universities Osteoarthritis Index.

Table VI: Multivariate linear regression models for pain, instability, joint effusion and stiffness in the five KOOS subscales.

	KOOS									
	Pain		Symptoms		ADL		Sports and recreation		QoL	
	β (95%CI)	*p*	β (95%CI)	*p*	β (95%CI)	*p*	β (95%CI)	*p*	β (95%CI)	*p*
Pain	-11.3 (-19.8; -2.7)	**.010**	-6.0 (-12.4; 0.4)	.064	-10.4 (-17.8; -2.9)	**.007**	-16.6 (-28.8; -4.5)	**.008**	-15.1 (-26.8; -3.5)	**.012**
Instability	-4.9 (-13.5; 3.8)	.265	1.1 (-5.3; 7.6)	.729	-7.8 (-15.3; -0.2)	**.044**	-8.5 (-20.7; 3.8)	.174	-8.5 (-20.2; 3.3)	.156
Joint effusion	-4.5 (-17.5; 8.5)	.495	6.0 (-3.7; 15.8)	.220	-7.6 (-18.9; 3.8)	.190	-7.5 (-26.0; 10.9)	.419	-5.2 (-22.9; 12.5)	.557
Stiffness	-10.4 (-19.8; -1.1)	**.029**	-2.6 (-9.6; 4.4)	.467	-5.4 (-13.5; 2.8)	.195	-8.4 (-21.7; 4.8)	.209	-15.8 (-28.5; -3.0)	**.016**

The values presented are linear regression coefficients (β) and 95% confidence intervals, estimated by linear regression.

ADL, activities of daily living; CI, confidence intervals; KOOS, Knee injury and Osteoarthritis Outcome Score; QoL, quality of life.

Table VII: Multivariate linear regression models for pain, instability, joint effusion and stiffness in the three WOMAC subscales and OKS

	WOMAC						OKS	
	Pain		Stiffness		Function			
	β (95%CI)	*p*	β (95%CI)	*p*	β (95%CI)	*p*	β (95%CI)	*p*
Pain	2.1 (0.4; 3.9)	**.018**	1.1 (0.2; 1.9)	**.016**	7.0 (2.0; 12.1)	**.007**	-5.7 (-9.8; -1.7)	**.006**
Instability	1.1 (-0.6; 2.9)	.197	0.9 (0.0; 1.7)	.051	5.3 (0.2; 10.4)	**.044**	-1.8 (-5.9; 2.3)	.378
Joint effusion	0.5 (-2.1; 3.2)	.688	-0.1 (-1.4; 1.2)	.882	5.1 (-2.6; 12.9)	.190	-1.5 (-7.7; 4.6)	.622
Stiffness	2.0 (0.1; 3.9)	**.041**	0.5 (-0.5; 1.4)	.331	3.6 (-1.9; 9.2)	.145	-4.1 (-8.6; 0.3)	.065

The values presented are linear regression coefficients (β) and 95% confidence intervals, estimated by linear regression.

CI, confidence intervals; OKS, Oxford Knee Score; WOMAC, Western Ontario and McMaster Universities Osteoarthritis Index.

Table VIII: Multivariate linear regression models for meniscus tear, injury side and other concomitant knee injuries in the five KOOS subscales.

	KOOS									
	Pain		Symptoms		ADL		Sports and recreation		QoL	
	β (95%CI)	*p*	β (95%CI)	*p*	β (95%CI)	*p*	β (95%CI)	*p*	β (95%CI)	*p*
Other knee injuries	-17.1 (-32.2; -2.0)	**.027**	-4.8 (-15.8; 6.2)	.388	-17.1 (-30.3; -3.9)	**.012**	-39.8 (-60.0; -19.7)	**.000**	-22.6 (-43.6; -1.6)	**.035**
Meniscus tear	-6.9 (-15.9; 2.0)	.125	-1.2 (-7.7; 5.3)	.712	-5.9 (-13.7; 1.9)	.134	-2.6 (-14.4; 9.3)	.671	-7.2 (-19.6; 5.1)	.248
Injury side (right)	3.1 (-6.1; 12.3)	.507	3.2 (-3.5; 9.9)	.957	-3.0 (-11.0; 5.0)	.459	-10.6 (-1.7; 22.9)	.089	-7.8 (-5.0; 20.5)	.230

The values presented are linear regression coefficients (β) and 95% confidence intervals, estimated by linear regression.

ADL, activities of daily living; CI, confidence intervals; KOOS, Knee injury and Osteoarthritis Outcome Score; QoL, quality of life.

Table IX: Multivariate linear regression models for meniscus tear, injury side and other concomitant knee injuries in the three WOMAC subscales and OKS.

	WOMAC						OKS	
	Pain		Stiffness		Function			
	β (95%CI)	*p*	β (95%CI)	*p*	β (95%CI)	*p*	β (95%CI)	*p*
Other knee injuries	3.3 (0.2; 6.3)	**.036**	0.2 (-1.3; 1.7)	.818	11.6 (2.7; 20.6)	**.012**	-10.6 (-17.5; -3.7)	**.003**
Meniscus tear	1.1 (-0.7; 2.9)	.212	0.8 (-0.1; 1.7)	.077	4.0 (-1.3; 9.3)	.134	-2.6 (-6.7; 1.4)	.203
Injury side (right)	-0.9 (-2.7; 1.0)	.351	0.5 (-0.4; 1.5)	.246	2.0 (-3.4; 7.5)	.459	-0.0 (-4.2; 4.1)	.986

The values presented are linear regression coefficients (β) and 95% confidence intervals, estimated by linear regression.

CI, confidence intervals; OKS, Oxford Knee Score; WOMAC, The Western Ontario and McMaster Universities Osteoarthritis Index.

Table X: Multivariate linear regression models for sports practice after injury, sports practice previous to injury, ASA classification and gender in the five KOOS subscales.

	KOOS									
	Pain		Symptoms		ADL		Sports and recreation		QoL	
	β (95%CI)	*p*	β (95%CI)	*p*	β (95%CI)	*p*	β (95%CI)	*p*	β (95%CI)	*p*
Sports Practice										
After injury	13.6 (4.7; 22.5)	**.003**	6.6 (0.2; 13.0)	**.044**	14.7 (7.3; 22.2)	**.000**	14.4 (1.5; 27.2)	**.004**	18.4 (6.0; 30.7)	**.004**
Previous to injury	-2.4 (-25.9; 21.2)	.843	9.3 (-7.6; 26.2)	.275	-4.3 (-24.0; 15.3)	.662	-12.5 (-46.5; 21.4)	.464	5.7 (-27.0; 38.4)	.731
ASA classification	-5.9 (-15.4; 3.5)	.214	3.2 (-3.5; 9.9)	.542	-10.0 (-17.9; -2.1)	**.013**	-5.9 (-19.5; 7.7)	.393	-7.8 (-5.0; 20.5)	.794
Gender	-0.1 (-11.9; 11.7)	.988	1.3 (-7.2; 9.7)	.303	3.0 (-6.9; 12.8)	.551	1.6 (-15.4; 18.6)	.855	-2.7 (-19.1; 13.7)	.741

The values presented are linear regression coefficients (β) and 95% confidence intervals, estimated by linear regression.

ADL, activities of daily living; ASA, American society of anesthesiologists; CI, confidence intervals; KOOS, Knee injury and Osteoarthritis Outcome Score; QoL, quality of life.

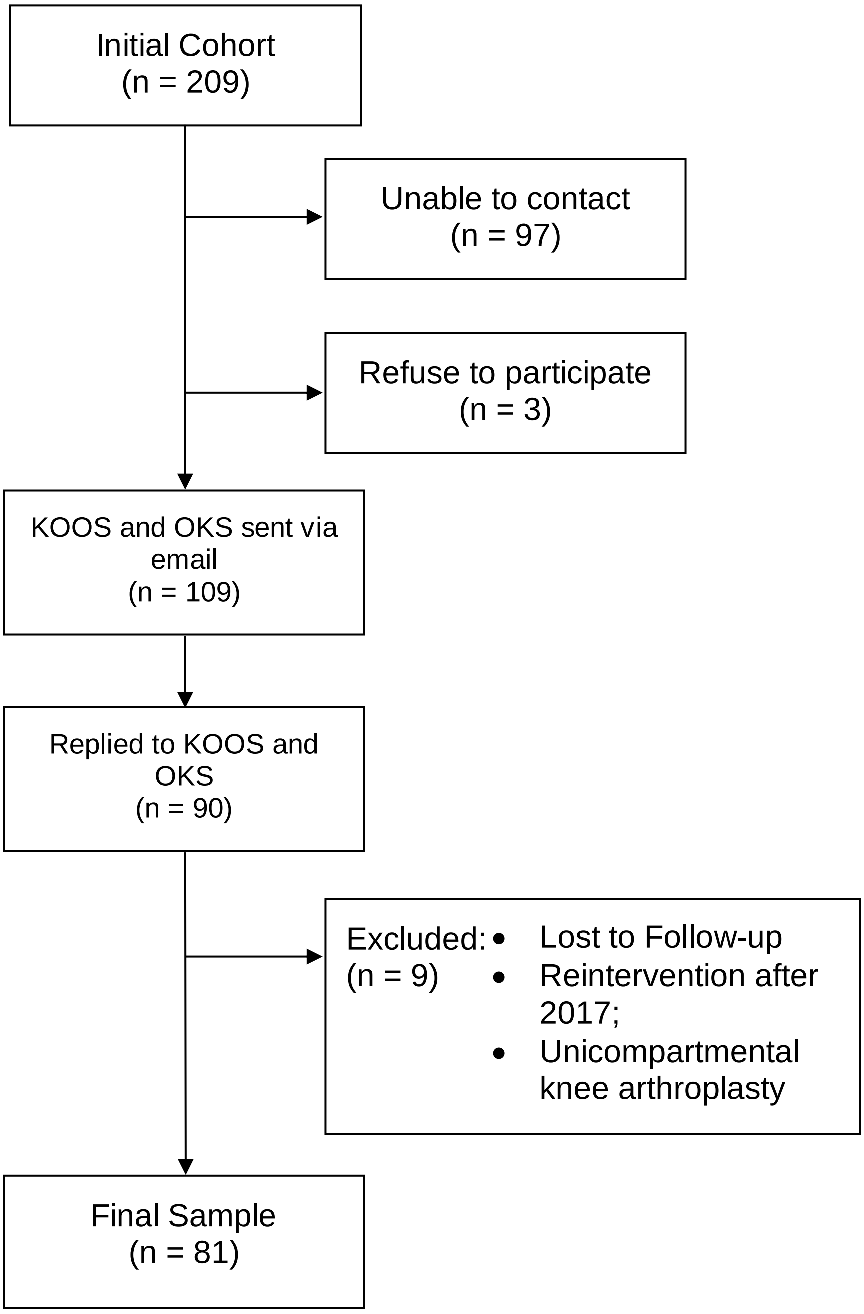
Table XI: Multivariate linear regression models for sports practice after injury, sports practice previous to injury, ASA classification and gender in the three WOMAC subscales and OKS.

	WOMAC						**OKS**	
	Pain		Stiffness		Function			
	β (95%CI)	*p*	β (95%CI)	*p*	β (95%CI)	*p*	β (95%CI)	*p*
Sports Practice								
After injury	-2.6 (-4.4; -0.8)	**.005**	-1.3 (-2.1; -0.4)	**.005**	-10.0 (-15.1; -5.0)	**.000**	5.7 (1.5; 9.8)	**.009**
Previous to injury	-0.2 (-5.0; 4.6)	.941	-0.7 (-3.0; 1.6)	.550	2.9 (-10.4; 16.3)	.662	-3.5 (-14.5; 7.6)	.534
ASA classification	0.9 (-0.9; 2.9)	.304	0.4 (-0.5; 1.3)	.360	6.8 (1.5; 12.2)	**.013**	-3.3 (-7.7; 1.2)	.144
Gender	-0.2 (-2.6; 2.2)	.854	0.5 (-0.7; 1.6)	.435	-2.0 (-8.7; 4.7)	.551	0.2 (-5.4; 5.7)	.951

The values presented are linear regression coefficients (β) and 95% confidence intervals, estimated by linear regression.

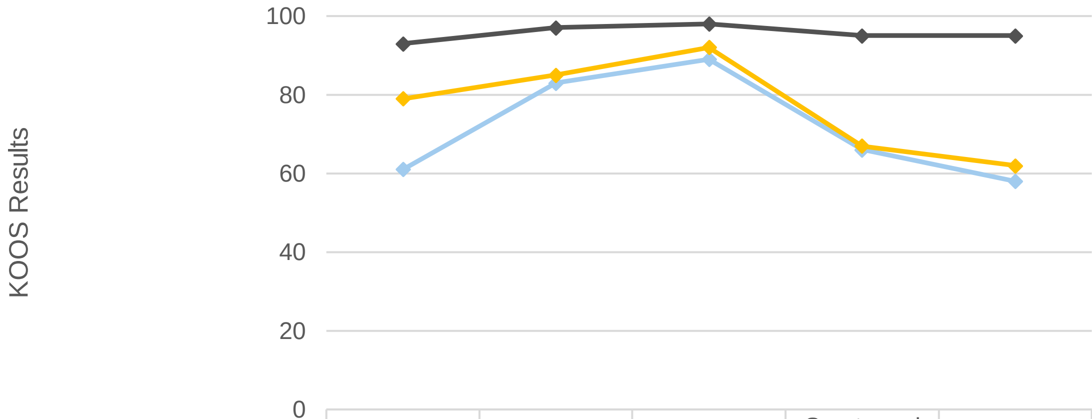
ASA, American society of anesthesiologists; CI, confidence intervals; OKS, Oxford Knee Score; WOMAC, Western Ontario and McMaster Universities Osteoarthritis Index.

Figure 1: Flow diagram outlining patient selection.



KOOS, Knee injury and Osteoarthritis Outcome Score; OKS, Oxford Knee Score.

Figure 2: Comparison between mean KOOS values obtained and previously described in literature.



	Symptoms	Pain	ADL	Sports and Recreation	QoL
Present study	61	83	89	66	58
Swedish ACL Register	79	85	92	67	62
Reference	93	97	98	95	95

The values presented are mean. Swedish ACL register values are from 7652 patients, two years after primary ACL reconstruction [24]. Reference values are from 118 soccer players with healthy knees and no history of knee injury [51].

ACL, Anterior Cruciate Ligament; ADL, activities of daily living; KOOS, Knee injury and Osteoarthritis Outcome Score; QoL, quality of life.