




# Treatment of Anterior Cruciate Ligament Injuries in Professional Soccer Players by Orthopedic Surgeons\*

## *Tratamento das lesões do ligamento cruzado anterior em jogadores profissionais de futebol por cirurgiões ortopedistas*

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### Abstract

**Objective** To describe the treatment provided by specialists for ACL lesions in professional soccer players.

**Methods** A cross-sectional study in which orthopedic surgeons affiliated to soccer teams competing in the Brazilian Soccer Championship answered a questionnaire about the treatment of ACL injuries in professional soccer players.

**Results** The specialists wait between one to four weeks after the ACL injury to perform the surgical treatment. They use a single incision and single-bundle reconstruction, assisted by arthroscopy, femoral tunnel drilling by an accessory medial portal, and quadruple flexor tendon autografts or patellar tendon autografts. After three to four months, the players are allowed to run in a straight line; after four to six months, they begin to practice exercises with the ball without contact with other athletes; and, after six to eight months, they return to play. The main parameter used to determine the return to play is the isokinetic strength test. The specialists estimate that more than 90% of elite soccer players return to playing professionally after an ACL reconstruction, and 60 to 90% return to play at their prior or at a greater level of performance.

**Conclusion** The present article successfully describes the main surgical practices and post-surgery management adopted by specialists in this highly-specific population of patients.

### Keywords

- anterior cruciate ligament
- knee/surgery
- soccer
- rehabilitation

### Resumo

**Objetivo** Descrever o tratamento realizado por especialistas das lesões do ligamento cruzado anterior (LCA) em jogadores profissionais de futebol.

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**Palavras-chave**

- ▶ ligamento cruzado anterior
- ▶ joelho/cirurgia
- ▶ futebol
- ▶ reabilitação

**Métodos** Estudo transversal, no qual ortopedistas vinculados a clubes participantes do Campeonato Brasileiro de Futebol responderam a um questionário sobre o tratamento das lesões do LCA em jogadores profissionais de futebol.

**Resultados** Os especialistas aguardam entre uma e quatro semanas após a lesão do LCA para realizar o tratamento cirúrgico. Utilizam técnica com incisão e banda únicas auxiliada por artroscopia, perfuração do túnel femoral via portal acessório medial, e autoenxerto quádruplo de tendões flexores ou autoenxerto de tendão patelar. Os jogadores são liberados para correr em linha reta após três a quatro meses; para exercícios com bola sem contato com outros atletas, após quatro a seis meses; e o retorno ao esporte ocorre após seis a oito meses. O principal parâmetro usado para o retorno ao esporte é o teste de força isocinético. Os especialistas estimam que mais de 90% dos jogadores operados por lesão do LCA retornam ao esporte profissional, e entre 60% e 90% retornam com o mesmo nível ou com um nível melhor de desempenho.

**Conclusão** Este estudo descreve de forma satisfatória as principais práticas cirúrgicas e pós-operatórias adotadas pelos especialistas nessa população altamente específica de pacientes.

## Introduction

Soccer (also known as football in the United Kingdom), is the most popular sport in the world, with over 265 million active players worldwide.<sup>1</sup> It is the main cause of sports injuries.<sup>2</sup> One of the most common knee injuries is the rupture of the anterior cruciate ligament (ACL),<sup>3-6</sup> a serious injury that predominantly requires surgical treatment.<sup>7,8</sup> Although the risk of this injury is low in the general population, it is considerably higher among team sports athletes.<sup>9</sup>

In professional football, this injury has important economic consequences: the absence from training and competitions for months, associated with issues such as compliance with contracts, schedules, advertising engagements and other engagements often entails enormous pressure for a quick return to sport.

The primary goal of ligament reconstruction in these patients is to restore the physiological function of the injured knee, to enable the athlete to return to play soccer as soon as possible, with the same proficiency level as before the injury, and to help prevent the degenerative processes that could take place.<sup>10,11</sup> There is no consensus regarding the best treatment, nor regarding the time required for rehabilitation and safe return to competitive activities.<sup>9,10,12</sup> Given the lack of solid evidence, the experience of experts is an important factor in the management of these cases. Our goal is to describe the treatment of ACL injuries in professional soccer athletes performed by orthopedists affiliated to soccer teams competing in the Brazilian Soccer Championship.

## Materials and Methods

This cross-sectional study was approved by the Ethics in Research Committee of Universidade Federal de São Paulo, under opinion number 2.221.990. It was developed based on interviews with 61 orthopedists affiliated to Brazilian profes-

sional soccer teams, mainly those that compete in the Brazilian Soccer Championship. The experts were approached individually by the research team members by telephone or via email. After signing the informed consent form, a multiple choice questionnaire containing 17 questions was applied to every orthopedist. The questionnaire was based on models used in international research, and it was adapted by the authors and approved by a committee of medical specialists in the field.

The questions were developed in order to obtain data about the interviewees' profile and their experience, treatment methods, surgical techniques and postoperative practices.

In the research, the following software were used: the Statistical Package for the Social Sciences (SPSS, IBM Corp., Armonk, NY, US), version 20.0, Minitab (Minitab, LLC, State College, PA, US), version 16, and Excel Office 2010 (Microsoft Corp., Redmond, WA, US). For the quantitative variables, a complete descriptive analysis was performed. We obtained low variability in the responses (coefficient of variance [CV] < 50%), which demonstrates the homogeneity of the data. The qualitative variables were analyzed through the calculation of absolute and relative frequencies, tests of equality of proportions, analysis of the statistical 95% confidence intervals (95% CIs) and *p*-values (statistical error allowed)  $\leq 0.05$ . The data obtained were compared to those found in the literature. The results that differed from the established parameters were detailed.

## Results

From a total of 61 participating specialists, 31 (50.8%) were affiliated to teams that form what is called in Portuguese "Série A" (the major league, or first division), which compete in the Brazilian Soccer Championship; 21 (34.4%) respondents were affiliated to teams from "Série B" (the second division); and 9 (14.8%) were affiliated to teams from "Série C" or "D" (the third and fourth divisions), which compete in regional soccer

**Table 1** Complete descriptive analysis of the quantitative variables of questions 1, 2 and 3

Descriptor	Mean	Median	Standard deviation	CV	Q1	Q3	Min.	Max.	N	CI
Age (years)	47.43	46	8.63	18%	42	53	30	65	61	2.17
Time after graduation (years)	23.64	24	8.56	36%	18	30	6	41	61	2.15
Career in orthopedics (years)	20.33	19	8.89	44%	15	27	1	36	61	2.23

Abbreviations: CI, confidence interval; CV, coefficient of variance; Max., maximum; Min., minimum; N, number; Q, question.

championships. ► **Table 1** describes the information obtained from the first three questions.

Regarding the definitive surgery after ACL injury, 45.9% of the respondents wait between 1 and 2 weeks to perform it after an acute and isolated ACL injury; 34.4% wait 2 to 3 weeks; 16.4% perform immediate surgery; and only 3.3% wait 4 to 6 weeks for the definitive approach. Statistically, there was no difference between the waiting periods of 1 to 2 weeks and 2 to 3 weeks ( $p = 0.196$ ).

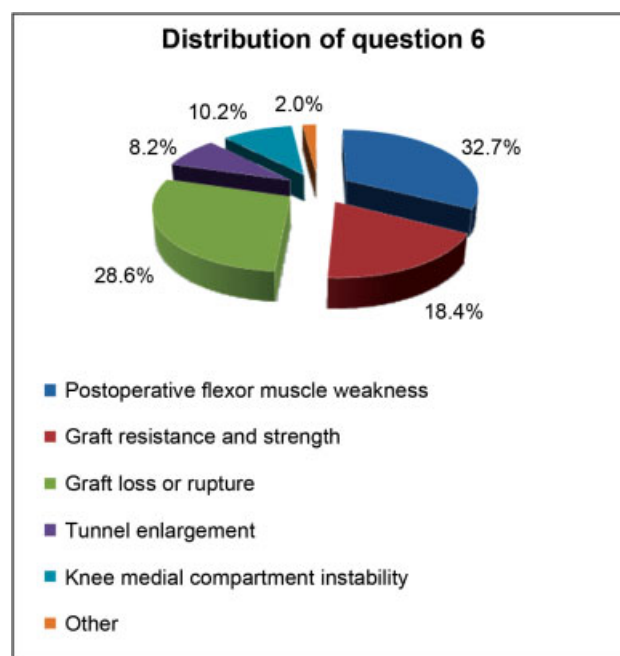
The preferred surgical technique was single incision and arthroscopically-assisted single-bundle for 78.7% of the respondents, followed by double incision and arthroscopically-assisted single-bundle for 16.4%; and by single incision and arthroscopically-assisted double-bundle for 4.9%. No respondents opted for other alternatives.

Perforation of the femoral tunnel via the medial accessory portal (transportal) was the choice for 50.8% of the respondents; 24.6% opted for the outside-in technique; 23%, for the transtibial technique; and only 1.6%, for the double incision.

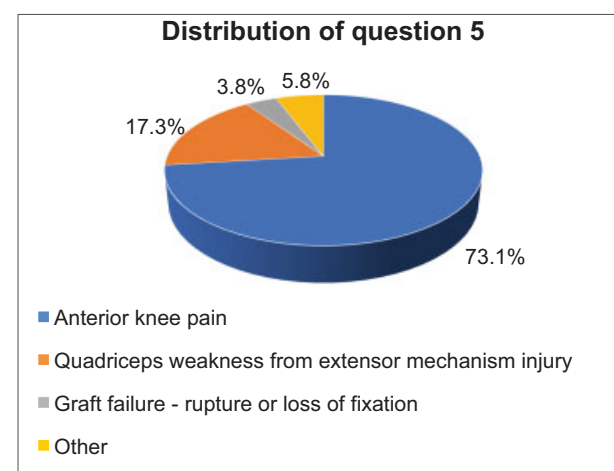
The most commonly used autograft were quadruple flexor tendons for 49.2% of the respondents, followed by patellar tendon autograft for 34.4%. In third place, the fivefold or sixfold flexor tendon autograft for 13.1%, followed by the quadriceps tendon autograft for 3.3%. It cannot be said that there is a difference between the two most widely adopted options ( $p = 0.099$ ). ► **Figures 1** and **2** describe the main concerns mentioned by the respondents according to the chosen autograft.

Continuous passive motion (CPM) is used in rehabilitation after ACL reconstruction by 67.2% of orthopedists. Running in a straight line was allowed after 3 to 4 months by 68.9% of the respondents, after 4 to 6 months by 21.3%, and after less than 2 months by 9.8%. Exercises with a ball but with no contact with other athletes were allowed after 4 to 6 months by 72.1% of physicians; 16.4% opted for allowing it after 6 to 8 months; 9.8%, after 2 to 4 months; and only 1.6%, after 8 to 10 months. No one has opted for more than ten months of restriction.

Unrestricted return to sport was allowed by 65.6% of the respondents after 6 to 8 months postoperatively; 24.6% allowed the return after 8 to 10 months; 8.2%, after 4 to 6 months; and only 1.6%, after more than 10 months. No respondents opted for the release in less than 4 months. The main parameter used was the isokinetic strength test (49.2%). The second most used criterion was rehabilitation and postoperative time longer than 6 months (23%), followed by normal and painless physical examination (13.1%), the hop test (9.8%), physiotherapy assessment (8.2%), and other parameters (8.2%), among them the combination of the previously mentioned parameters with kinematics and force



**Fig. 1** Distribution of the answers obtained from question 6. Statistically, there was no difference between the most recurrent response ("postoperative flexor muscle weakness") and the responses "graft loss or rupture" ( $p = 0.661$ ) and "graft resistance and strength" ( $p = 0.105$ ).



**Fig. 2** Distribution of the answers obtained from question 5. The major concern was anterior knee pain. Other conditions mentioned by 5.8% of the respondents included knee extension block and absence of concern.

platform, comparative contralateral functional tests, and the application of the "Functional Movement Screen".

The use of functional orthoses was only recommended by 9.8% of the specialists. Among those who recommended it,

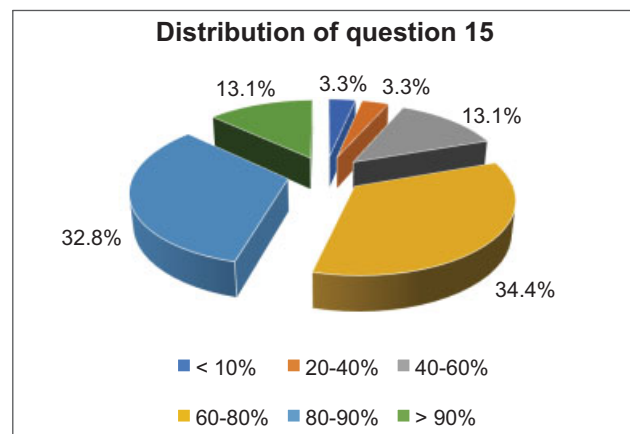
83.3% maintain orthoses for 2 weeks after surgery, while 16.7% maintain them for 3 weeks.

Regarding the percentage of professional soccer athletes who return to play professionally after ACL reconstruction, 73.8% of physicians believe that over 90% return to the previous professional level, 18% believe that about 80-90% return to the professional level, and 8.2% believe that 60-80% return to professional soccer. ►Figure 3 describes the responses obtained regarding the return to the previous (or higher) level of performance when compared to the pre-injury level.

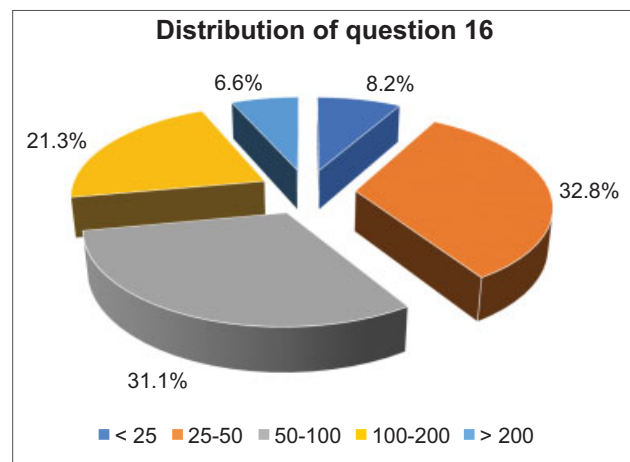
►Figure 4 describes the distribution of the responses regarding the average number of ACL reconstructions performed per year by the experts, while ►Figure 5 describes the results related to the average ACL reconstructions performed per year specifically on soccer players of all levels.

## Discussion

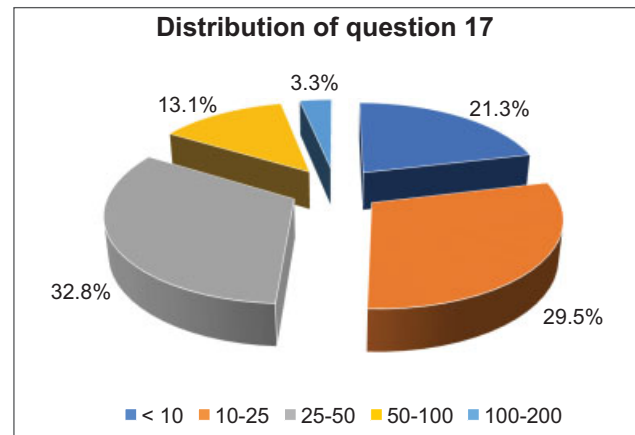
The divisions system of the Brazilian Soccer Championship is based on the technical quality of the teams and their perfor-



**Fig. 3** Distribution of answers obtained from question 15. There was no statistical difference between the “80-90%” (more frequent) and “60-80%” ( $p = 0.848$ ) options.



**Fig. 4** Average number of reconstructions. The responses involving the values “25-50”, “50-100” and “100-200” were statistically equal ( $p = 0.846$  and  $p = 0.154$ ).



**Fig. 5** Average number of ACL reconstructions performed per year specifically among soccer players. Statistically, the responses “25-50”, “10-25” and “< 10” did not show differences ( $p = 0.696$  e  $p = 0.154$ ).

mance in the previous year. The first division is comprised of the teams with the best performances; then come the other divisions. Regarding the present study, most respondents are affiliated to first-division teams, and even though there were professionals affiliated to clubs from every division in the study, it predominantly involved orthopedists who perform surgeries in athletes of the highest national technical level. To the best of our knowledge, there are no other similar studies in the Brazilian literature involving this many orthopedists and traumatologists specializing in the field, and when reviewing the literature, we found only three similar studies.<sup>4,13,14</sup>

The respondents were predominantly middle-aged doctors, long-time graduates with extensive orthopedic and football experience. Most choose to wait one to four weeks for the definitive surgical treatment after an ACL injury. Late ACL reconstruction was believed to lead to lower risk of knee stiffness and arthrofibrosis.<sup>15,16</sup> However, more recent studies report that the acute reconstruction of these injuries is safe, and does not increase the risk of knee stiffness.<sup>15</sup> According to Marcacci et al,<sup>17</sup> patients with acute ACL reconstruction returned to sports faster and with better clinical results.

The respondents showed preference for the arthroscopic single-bundle ACL reconstruction technique. This is a controversial topic, even though in the literature there are no significant differences in multiple systematic reviews and meta-analysis in the postoperative evaluation of patients who underwent both techniques.<sup>18-20</sup>

No respondents opted for the use of allografts for ACL reconstruction. The lack of availability and the small number of biobanks in Brazil make this finding predictable, and it is in agreement with foreign studies. Farber et al<sup>4</sup> reported that allografts were not the first choice of any of the surgeons, and most orthopedists believe that allografts have a higher chance of failure. In fact, the rate of new ACL injuries after allograft reconstruction is four to eight times higher than that of autograft reconstruction in athletes and those who serve in the military.<sup>3,4</sup> There are no differences between allografts or autografts regarding the quality of ACL injury repair.<sup>21</sup>



The preferred method for perforation of the femoral tunnel was the medial accessory portal, followed by the outside-in technique and the transtibial technique. It is known that this is another controversial topic in the literature, as illustrated by Luzo et al.<sup>22</sup> and Farber et al.<sup>4</sup> It has been shown in multiple biomechanical studies<sup>23,24</sup> that the femoral tunnel performed via the medial accessory portal covers more of the ACL footprint in the femur than the transtibial tunnel. However, there is a lack of significant and clinically relevant outcomes.<sup>7,25</sup>

The patellar tendon is considered an ideal graft choice, although problems such as loss of sensation, patellar fracture, inferior patellar contracture, and loss of extension torque have been reported after graft removal. The main concern associated with patellar tendon autograft was anterior knee pain, a common and limiting complaint associated with this surgical technique.<sup>26</sup> The use of flexor tendon autografts has been growing in popularity because many reports suggest that their use leads to fewer local complications. Postoperative flexor muscle weakness, graft strength and resistance, and graft loss or rupture were the most mentioned concerns, also according to the findings in the literature.<sup>15,26</sup>

The rates of return to sport and recovery of knee function are not significantly different between the two most commonly used graft groups,<sup>27</sup> although there are few well-designed and randomized studies comparing the methods.<sup>26</sup> Return to competition was allowed after six to eight months, predominantly without the use of orthoses, as reported in other studies.<sup>4,7,15</sup> Although the isokinetic strength test was the main parameter used to allow the return to sports, it is noteworthy that the questionnaire did not detail which device was used or which protocol was applied, and we believe that this is an important topic for future studies.

Most orthopedists believe that soccer players successfully return to sport and pre-injury performance levels. A systematic review by Mohtadi et al.<sup>28</sup> demonstrated a rate of return to sport from 63 to 97% for highly-competitive athletes, a value consistent with the findings of Zaffagnini et al.<sup>12</sup> (62% to 95%). The return to sport in European professional football (soccer) is quite high, with 97% of the Union of European Football Associations (UEFA) Champions League athletes returning to the same levels prior to injury after ACL reconstruction. However, only 65% of these athletes continue to play at the same level after three years.<sup>29</sup>

Although this is a study with level V of evidence, the opinion of multiple experts with varying surgical volume and more than 200 ACL reconstructions per year revealed important information. We must, however, remember the biases inherent to the use of questionnaires in scientific studies. Other factors to consider are the predominance of men in sports in Brazil, the disregard concerning injuries or associated diseases, and the lack of details of other surgical technical aspects, such as the graft fixation method, instrumentation, use of adjuvants, among other factors.

## Conclusion

Orthopedic and traumatology specialists associated with major-league soccer teams in Brazil tend to wait one to

four weeks after ACL injury to perform the surgical treatment. They preferably use the arthroscopically-assisted single incision and single-bundle technique, femoral tunnel perforation through the medial accessory portal, and the quadruple flexor tendon autograft or the patellar tendon autograft.

The players are allowed unrestricted return to sport after six to eight months of surgery. The parameter used for allowing the athletes to return to sport is the isokinetic strength test, and they do not use postoperative functional orthoses.

According to the respondents, more than 90% of players operated for ACL injuries return to professional sports, with 60 to 90% returning to the same or better level of performance.

Therefore, the present article successfully describes the main surgical practices and post-surgery management adopted by specialists in this highly-specific population of patients.

## Conflicts of Interest

The authors have none to declare.

## References

- 1 Fédération Internationale de Football Association. FIFA Big Count 2006. Disponível em: [http://www.fifa.com/mm/document/fifafacts/bcoffsurv/bigcount.statspackage\\_7024.pdf](http://www.fifa.com/mm/document/fifafacts/bcoffsurv/bigcount.statspackage_7024.pdf)
- 2 Astur DC, Xerez M, Rozas J, Debieux PV, Franciozi CE, Cohen M. Lesões do ligamento cruzado anterior e do menisco no esporte: incidência, tempo de prática até a lesão e limitações causadas pelo trauma. *Rev Bras Ortop* 2016;51(06):652–656
- 3 Inklaar H. Soccer injuries. I: Incidence and severity. *Sports Med* 1994;18(01):55–73
- 4 Farber J, Harris JD, Kolstad K, McCulloch PC. Treatment of Anterior Cruciate Ligament Injuries by Major League Soccer Team Physicians. *Orthop J Sports Med* 2014;2(11):2325967114559892. Doi: 10.1177/2325967114559892
- 5 Brito J, Soares J, Rebelo AN. Prevenção de lesões do ligamento cruzado anterior em futebolistas. *Rev Bras Med Esporte* 2009;15(08):62–69
- 6 Waldén M, Häggglund M, Magnusson H, Ekstrand J. Anterior cruciate ligament injury in elite football: a prospective three-cohort study. *Knee Surg Sports Traumatol Arthrosc* 2011;19(01):11–19
- 7 Arliani GG, Astur DC, Kanas M, Kaleka CC, Cohen M. Lesão do ligamento cruzado anterior: tratamento e reabilitação. *Perspectivas e tendências atuais. Rev Bras Ortop* 2012;47(02):191–196
- 8 Gali JC, Mod MSB, Mimura HM, Kushiya W. Reconstrução anatômica do ligamento cruzado anterior com dupla banda: estudo prospectivo com seguimento de dois anos. *Rev Bras Ortop* 2011;46(01):31–36
- 9 Waldén M, Häggglund M, Werner J, Ekstrand J. The epidemiology of anterior cruciate ligament injury in football (soccer): a review of the literature from a gender-related perspective. *Knee Surg Sports Traumatol Arthrosc* 2011;19(01):3–10
- 10 Roi G, Nanni G, Tencone F. Time to return to professional soccer matches after ACL reconstruction. *Sport Sci Health* 2006;1(04):142–145
- 11 Shelbourne KD, Gray T. Anterior cruciate ligament reconstruction with autogenous patellar tendon graft followed by accelerated rehabilitation. A two- to nine-year followup. *Am J Sports Med* 1997;25(06):786–795
- 12 Zaffagnini S, Grassi A, Marcheggiani Muccioli GM, et al. Return to sport after anterior cruciate ligament reconstruction in professional soccer players. *Knee* 2014;21(03):731–735

- 13 Erickson BJ, Harris JD, Fillingham YA, et al. Anterior cruciate ligament reconstruction practice patterns by NFL and NCAA football team physicians. *Arthroscopy* 2014;30(06):731–738
- 14 Bradley JP, Klimkiewicz JJ, Rytel MJ, Powell JW. Anterior cruciate ligament injuries in the National Football League: epidemiology and current treatment trends among team physicians. *Arthroscopy* 2002;18(05):502–509
- 15 Marder RA, Raskind JR, Carroll M. Prospective evaluation of arthroscopically assisted anterior cruciate ligament reconstruction. Patellar tendon versus semitendinosus and gracilis tendons. *Am J Sports Med* 1991;19(05):478–484
- 16 Shelbourne KD, Wilckens JH, Mollabashy A, DeCarlo M. Arthrofibrosis in acute anterior cruciate ligament reconstruction. The effect of timing of reconstruction and rehabilitation. *Am J Sports Med* 1991;19(04):332–336
- 17 Marcacci M, Zaffagnini S, Iacono F, Neri MP, Petitto A. Early versus late reconstruction for anterior cruciate ligament rupture. Results after five years of followup. *Am J Sports Med* 1995;23(06):690–693
- 18 Desai N, Björnsson H, Musahl V, et al. Anatomic single- versus double-bundle ACL reconstruction: a meta-analysis. *Knee Surg Sports Traumatol Arthrosc* 2014;22(05):1009–1023
- 19 Tiamklang T, Sumanont S, Foocharoen T, Laopaiboon M. Double-bundle versus single-bundle reconstruction for anterior cruciate ligament rupture in adults. *Cochrane Database Syst Rev* 2012;11:CD008413
- 20 Xu M, Gao S, Zeng C, et al. Outcomes of anterior cruciate ligament reconstruction using single-bundle versus double-bundle technique: meta-analysis of 19 randomized controlled trials. *Arthroscopy* 2013;29(02):357–365
- 21 Jia YH, Sun PF. Comparison of Clinical Outcome of Autograft and Allograft Reconstruction for Anterior Cruciate Ligament Tears. *Chin Med J (Engl)* 2015;128(23):3163–3166
- 22 Luzo MVM, Franciozi CE, Rezende FC, Gracitelli GC, Debieux PV, Cohen M. Ligamento cruzado anterior. *Rev Brasil Ortop* 2016;51(04):385–395
- 23 Gadikota HR, Sim JA, Hosseini A, Gill TJ, Li G. The relationship between femoral tunnels created by the transtibial, anteromedial portal, and outside-in techniques and the anterior cruciate ligament footprint. *Am J Sports Med* 2012;40(04):882–888
- 24 Robert HE, Bouguennec N, Vogeli D, Berton E, Bowen M. Coverage of the anterior cruciate ligament femoral footprint using 3 different approaches in single-bundle reconstruction: a cadaveric study analyzed by 3-dimensional computed tomography. *Am J Sports Med* 2013;41(10):2375–2383
- 25 Chalmers PN, Mall NA, Cole BJ, Verma NN, Bush-Joseph CA, Bach BR Jr. Anteromedial versus transtibial tunnel drilling in anterior cruciate ligament reconstructions: a systematic review. *Arthroscopy* 2013;29(07):1235–1242
- 26 Aune AK, Holm I, Risberg MA, Jensen HK, Steen H. Four-strand hamstring tendon autograft compared with patellar tendon-bone autograft for anterior cruciate ligament reconstruction. A randomized study with two-year follow-up. *Am J Sports Med* 2001;29(06):722–728
- 27 Cohen M, Ferretti M, Amaro JT. Reconstrução do ligamento cruzado anterior: escolha do enxerto. Projeto Diretrizes. São Paulo: Associação Médica Brasileira; Conselho Federal de Medicina, Sociedade Brasileira de Ortopedia e Traumatologia, São Paulo; 2007
- 28 Mohtadi NG, Chan DS. Return to Sport-Specific Performance After Primary Anterior Cruciate Ligament Reconstruction: A Systematic Review. *Am J Sports Med* 2017;•••:363546517732541
- 29 Arundale AJH, Silvers-Granelli HJ, Snyder-Mackler L. Career length and injury incidence after anterior cruciate ligament reconstruction in major league soccer players. *Orthop J Sports Med* 2018;6(01):2325967117750825