



# Wide Variability in Return-to-Sport Criteria used by Team Physicians After Anterior Cruciate Ligament Reconstruction in Elite Athletes—A Qualitative Study

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**Purpose:** The purpose of this study is to explore currently used readiness to return to sport (RTS) criteria after anterior cruciate ligament reconstruction (ACLR) used in elite athletes to gain novel insights into the RTS decision-making process of professional team physicians. **Methods:** Eighteen qualitative semistructured interviews with professional team physicians were conducted by a single trained interviewer. The interviews were used to identify team physician concepts and themes regarding the criteria used to determine RTS after ACLR. General inductive analysis and a coding process were used to identify themes and subthemes arising from the data. A hierarchical approach in coding helped to link themes. **Results:** The most important RTS criteria included muscle strength, followed by satisfactory functional testing including hop tests, a satisfactory clinical examination, joint stability, psychological readiness, time since the ACLR surgery, absence of joint effusion, subjective feeling of knee stability, pain-free return to sporting movements, completion of a sport-specific rehabilitation, and at last allied team support. **Conclusions:** This study identified 4 main themes, including (1) objective findings, (2) informative feedback of the team members, (3) subjective findings, and (4) type of sport and time to surgery as having the most influence on RTS decision after ACLR. However, interviews showed that even among professional team physicians, the main criteria to RTS in these categories were inconsistent. A definitive set of conclusive guidelines could not be established and would be a fruitful and useful area for future research through further quantitative studies and international consensus meetings along the foundation of the presenting study. **Level of Evidence:** V, evidence-based practices, qualitative study.

**A**nterior cruciate ligament (ACL) injuries in elite athletes are among the most debilitating orthopaedic injuries in terms of performance, sporting

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participation, and career length, and they often require a significant commitment to a lengthy period of rehabilitation.<sup>1,2</sup> ACL tears frequently occur in athletes, and the risk of injury depends heavily on the type of sports, level of sports participation and gender.<sup>2,3</sup> In 2018, Longstaffe et al.<sup>4</sup> reported an overall incidence of ACL injuries of 0.42/1000 player game hours or 0.20/1000 player game exposures in professional ice hockey players. In elite athletes, an ACL reconstruction (ACLR) is recommended for regaining knee stability and function, as well as returning to the preinjury activity level.<sup>5</sup> For months after ACLR deficits exist in proprioception, balance, neuromuscular control, and muscle strength in the reconstructed knee.<sup>6</sup> Furthermore, up to 30% of athletes aged 10 to 25 years old involved in a pivoting or cutting sport and with a participation level of at least 50 hours/year, who return to sports after an ACLR sustain an ACL reinjury, of which almost 50% of graft ruptures occur within the first 2 months of returning to sports.<sup>7</sup>

The big question in ACL surgery up today is “When can elite athletes safely return to sport after ACLR

within the shortest possible time and an acceptably low reinjury risk?"<sup>8,9</sup> Based on these requisitions, return to sport (RTS) assessments have been developed in determining readiness to RTS after ACLR. The quantitative measures of RTS often include lower extremity strength and functional knee tests.<sup>10</sup> However, there still exist many open questions and a lack of consensus regarding the appropriate criteria to release athletes to unrestricted sports participation after ACLR.<sup>5</sup>

Team physicians treat professional athletes who compete at the highest level, and therefore they are usually equipped with the best resources and equipment to treat their patients. After an injury, such as an ACL tear, the timing of RTS after ACLR is crucial, and there is a lot of interest and pressure not only from the athletes, but also from coaches, managers, and family. So far quantitative studies have been unable to establish clear guidelines and recommendations that can predict successful RTS after ACLR. Semistructured interviews in qualitative research can be used to identify current concepts, themes, and outcomes measures in the assessment of RTS after ACLR in professional athletes.<sup>11</sup> The qualitative approach can be helpful to further improve the understanding of the choice of RTS criteria,<sup>12</sup> and such information would be impossible to obtain quantitatively through, for example, questionnaires. The purpose of our qualitative study was to explore currently used readiness to RTS criteria after ACLR used by professional team physicians in elite athletes. We hypothesized that even among this group of specialized physicians there would be no definitive measures or criteria used to determine RTS after ACLR.

## Material and Methods

### Participants

From February to March 2020, a total of 23 professional or collegiate-level team physicians from the United States and Canada were sent an email invitation to participate in a telephone interview. A total of 18 physicians agreed to take part in this study. To ensure an appropriate sample size, recruitment of participants was stopped when no new themes emerged over 2 consecutive interviews.

### Design

We used a qualitative method of phenomenology to identify criteria currently used by elite team physicians to determine readiness to RTS after ACLR in professional and collegiate athletes. Qualitative investigations allow an examination of topics in great detail and depth because the interviews are not limited to specific research questions and can easily be guided by the researcher. Research ethics board approval (REB no. 2020-0020-E) was obtained before

the start of the study. All participating team physicians gave their verbal consent before data collection began. The study protocol was created in accordance with the Consolidated Criteria for Reporting Qualitative Studies.<sup>13</sup>

### Semistructured Interview

A total of 2 pilot interviews were performed to refine the themes and structural order of the interview. All semistructured telephone interviews were conducted by a single trained interviewer (M.B.). The interviews were transcribed by a transcriptionist, transcripts were deidentified, and an alias was assigned to each participant.

The semistructured interviews were used to identify team physician themes regarding the criteria used to determine RTS after ACLR. The interviewer used a method of active passivity, which means that he did not interrupt the participants unless the discussion deviated significantly from the overall aim of the interview.<sup>14</sup>

### Data Analysis

First, we analyzed the data using general inductive analysis, which included multiple readings, reviewing and data interpretation in order to identify themes arising from the data.<sup>15</sup> The coding process was supported by a commercial software (MAXQDA Software; Verbi Software, Berlin, Germany) and led to the identification of key themes and subthemes. Throughout the analysis process, the coding was revised and refined to reduce data redundancy, to identify new subcategories, and to include novel themes and ideas. We then used a hierarchical approach in coding, which helped to link themes with a commonality or causal relationship to assist with the pattern recognition.<sup>16</sup> A minimum of 2 rounds of coding and analysis were done by 2 investigators (M.B. and J.C.). If possible, conceptual maps were developed to assist with data interpretation and provide potential explanations for key themes. Quantitative parameters were presented as mean values with ranges.

## Results

The mean age (standard deviation) of the 18 participating professional team physicians was  $52.6 \pm 8.4$  years, with the majority (94%) being male (Table 1). All interviewees were fellowship-trained orthopaedic surgeons in orthopaedic sports medicine, while 4 surgeons were additionally trained in orthopaedic trauma and 1 in upper extremity reconstruction. The majority of team physicians mainly treated athletes from the National Hockey League (50%), followed by the National Basketball Association (11%), National Football League (11%), Major League Baseball (11%), and the Major League Soccer (6%). Eleven percent of the included team physicians focused their care on

**Table 1.** Demographic Data, Years in Practice, and Years Performing ACLR of Team Physicians Who Were Interviewed for This Study

Demographic Data	N=18
Age, mean (SD)	52.6 (8.4)
Sex	
Female	1/18
Male	17/18
Years in practice, mean (SD)	19.1 (10)
Years performing ACLR, mean (SD)	18.3 (10)

ACLR, anterior cruciate ligament reconstruction; SD, standard deviation.

collegiate-level athletes. Two of the team physicians were exclusively involved in the treatment and care of collegiate-level athletes. The performed interviews lasted on average 19 minutes and 13 seconds.

### Development of Key Themes

We identified 4 primary major key themes from the interviews that influence the RTS decision: subjective findings, objective findings, informative feedback from team members, as well as timeframe and type of sport. Within each major theme, several minor themes were included. These themes and related subthemes are described with supporting quotes from the interviews in the following sections. A breakdown of the identified themes can be found in the schematic representation of [Figure 1](#).

### Informative feedback

#### Interdisciplinary decision-making

Participants emphasized on the importance of the multi-professional approach in the RTS decision, especially the cooperation with the players' athletic trainers, physiotherapists, and strength/conditioning trainers for their assessment on how the players perform in real-time on the field.

*"I always like to get a report from the physiotherapist who has been working with them for the past months to say are they having any pain when they report to sport, do they subjectively complain of any symptoms while they're being active, and so the physiotherapist's final assessment is key too. [...] the physiotherapist is able to capture some of the pain and symptoms they don't always mention."* (P #7)

*"Talking to (strength and conditioning) trainers, you would get to understand how they are adapting to training loads, how are they progressing in terms of what they can and cannot do."* (P #8)

Another key role was given by the participants to the sports psychologists whose input on the mental readiness of the players and the presence of any anxiety is essential for the RTS decision.

*"Then, the sports psychologist is key to determine if they are mentally ready to go back."* (P #7)

*"So, I work with sports psychologists and sports scientists—we do get an assessment for anxiety and readiness to return to play."* (P #10)

### Team influence

Upon being asked about external pressures affecting RTS, most of the interviewed participants reported that the final RTS decision is only their own to make; however, a certain pressure from other parties such as the general management and the coaching staff to influence the decision was confirmed. Participants additionally mentioned that pressure may also come from other unexpected parties like the parents of the players, their families, teammates, agents, or the player her/himself. This depends immensely on external aspects such as the financial situation of the players, stage of their career, stage of the season, and team's standing in the league.

*"I obviously am naïve if I don't think that is not influenced by coaches, teammates, family, financial pressures, stage of their career, stage of the season, etc., etc. There's a whole host of factors that can affect that, but I try to leave it."* (P #13)

### Objective findings

#### Clinical signs and tests

Concerning clinical signs and tests considered in the RTS decision-making, the interviewed participants emphasized on muscle girth, the absence of knee joint effusion, knee range of motion, and knee stability. Lachman test and pivot-shift test were considered as key tests in the evaluation of knee stability after ACLR and a prerequisite for the RTS decision.

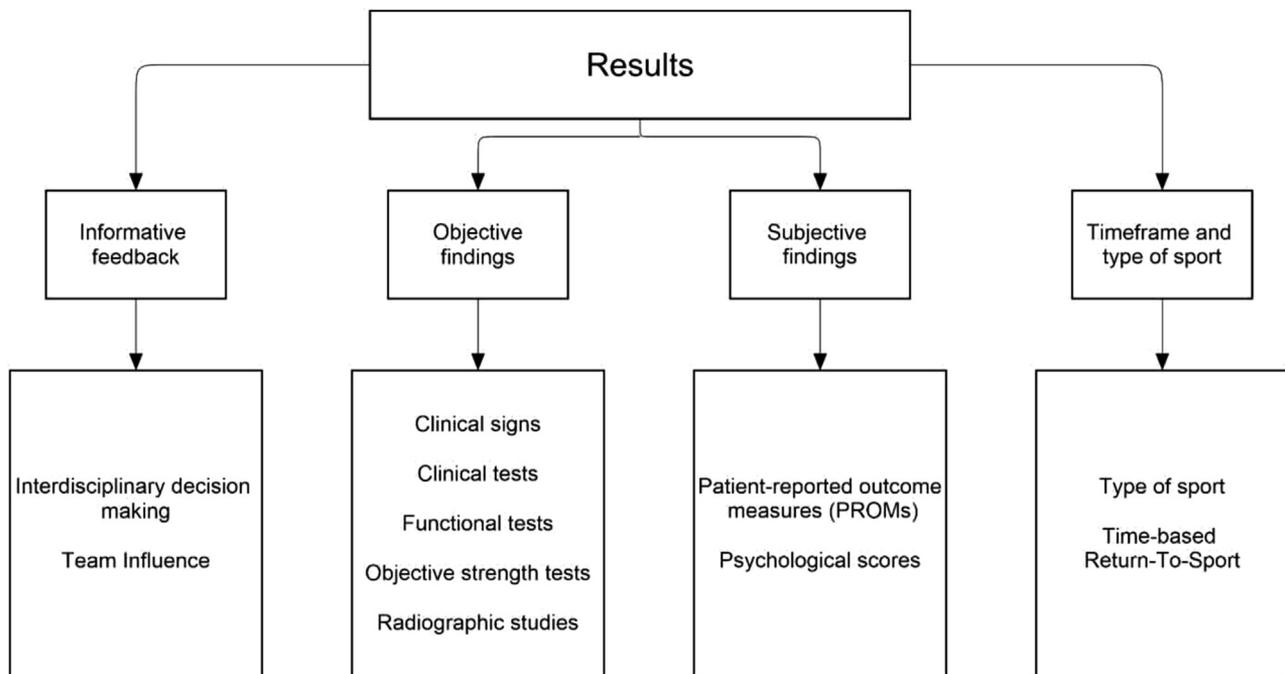
*"And I look at the presence of an effusion. I look at quadriceps strength and restoration of quadriceps bulk."* (P #3)

*"The usual absence of anterior drawer, Lachman and pivot shift is crucial, so they have to have a stable knee, of course. No effusion and a full range of motion."* (P #18)

### Functional tests

In terms of specific functional testing, the interviewed participants reported a variety in the choice of tests used after ACLR to assess RTS. A standardized set of tests could not be identified; however, frequently mentioned were the single leg hop and the triple hop tests.

*"We do a full functional test including single hop test, triple hop tests, so, the whole ACL protocol and the*



**Fig 1.** Schematic representation of the key themes derived from the interviews.

*player would have to be able to meet the side-to-side difference of less than 20%.” (P #4)*

### Objective strength tests

Regarding strength testing, the statements of the participants were inconsistent. The use and importance of objective computerized testing such as Biodex (Biodex Medical Systems, Shirley, NY) or Cybex (Cybex, division of Lumex, Inc., Ronkonkoma, NY) dynamometer systems were highlighted. On the other hand, other participants reported favorizing functional testing, clinical muscle strength evaluation, muscle girth, and comparison with the opposite side, as well as subjective readiness.

*“So, I usually send them, if they’re elite athletes, we’ll send them for a full battery of Biodex testing which usually gives you isometric strength and peak torque” (P #5)*

*“So, we have actually kind of moved away from that. We’ve gone to substituting a Biodex with functional testing.” (P #1)*

### Radiographic studies

Most participants confirmed that they do not use postoperative radiographic studies regularly to make their RTS decision. And when they do, such as in cases of repeated injury or slow progression, they tend to get an x-ray film of the joint to assess tunnel positions, for example, or static joint subluxation. Only few

participants opted for magnetic resonance imaging (MRI) routinely. The participants reported the MRI served as a baseline before RTS or was performed upon request of the player or the agent, while stating that it does not affect their RTS decision.

Independently from the imaging modality, the timing of imaging after ACLR was not always defined and ranged from directly after surgery to a year or more after the surgery.

*Interviewer: “Do u use additional imaging to determine return to sports”. Participant: “Not at all” (P #7)*

*“Well, my standard of practice is getting an x-ray done postop. And I also always get one year out” (P #2)*

*“Okay. So, after an ACL in a professional athlete before return to sport, I would do an MRI. As a baseline before return to sport.” (P #4)*

### Subjective findings

#### Patient-reported outcome measures (PROMs)

The interviews of the participants reported PROMs to be of limited value in the RTS decision-making. Only a few of the participants used such scores such as the International Knee Documentation Committee (IKDC) score and the Single Assessment Numerical Evaluation score. This use was partly for scientific purposes.

*“I do collect patient-reported outcomes. Don’t use them so much to make a return to play decision” (P #1)*

**Table 2.** Main Criteria for RTS After ACL Reconstruction Based on Interviews and Number of Participants Mentioning Each Criterion

Main Criteria	Number of participants
1. Muscle strength	10/18
2. Satisfactory functional tests	8/18
3. Satisfactory physical exam	8/18
4. Clinical joint stability	7/18
5. Psychological readiness	6/18
6. Time since surgery	5/18
7. Absence of joint effusion	3/18
8. Subjective feeling of knee stability	3/18
9. Pain free return to sporting movements	2/18
10. Completion of a sport-specific rehabilitation	2/18
11. Allied team support (trainer, physiotherapist, etc...)	1/18

ACL, anterior cruciate ligament; RTS, return to sport.

*"Yeah, so IKDC. It's more of scientific interest for us." (P #6)*

**Psychological scores**

Participants mentioned that they do not regularly use psychological scores to decide RTS. However, they tend to ask screening questions about the mental readiness of the players, and, if concerns were raised, they would opt for a sport-specific psychologist to resolve the issue. Few would screen the players using the Tampa Scale of Kinesophobia or the ACL-Return to Sport Injury Scale.

*"Intermittently, so I will do some screening questions whether they feel they're ready to go back to sports. Whether they have any concerns and if they do, then I will use something like the ACL RSI to get an objective measure of that and then if it indicates there's a problem, I'll use that as an opportunity to engage a sports psychologist and such to help deal with those concerns." (P #13)*

*"I do not currently employ any psychological testing." (P #3)*

*"I use the Tampa Kinesophobia Score." (P #6)*

**Timeframe and type of sport**

**Type of sport**

One of the main factors influencing RTS decision and cited by the participants was the type of sport the players are involved in. According to the type of sport the time frame until RTS chosen by the participants varied from as little as 3 to 4 months in cyclists and swimmers to up to 12 months and even longer in cutting and pivoting sports.

*"Depending on the position, of course, but I think a lineman could probably go back without an ACL but*

*anybody who is a safety or a wide receiver or is playing in the back field, stuff like that, doing a lot of jumping, running, single-legged landing, cutting, those cases, I think, are higher risk." (P #5)*

**Time-based Return-to-Sport**

Some of the interviewed participants reported that their RTS decision is completely time based and is directly related to the time of surgery, independently from the type of sport the players perform. The time frames reported by the participants ranged from 6 to 12 months after surgery. Additional considerations were the type of surgery including the type of graft used, as well as the professional level of the player. Participants tend to wait longer in players with allografts and in amateur players before allowing RTS.

*"Six months for anterior cruciate ligament surgery. [...] Yes. I will wait longer if I utilize an allograft. Usually nine months." (P #3)*

*"And then I usually give them a month minimum where they are scrimmaging, so not actually playing a game but playing the sport with their team so to speak." (P #6)*

**Most important RTS criteria**

According to the interviewed participants, the most important criterion for RTS was the clinical evaluation in all its aspects. An overview of the most-mentioned

**Table 3.** Main Criteria for RTS After ACL Reconstruction Based on Interviews According to Their Priority

First priority	
Functional tests	4/18
Muscle strength	3/18
Satisfactory physical examination result	3/18
Absence of effusion	2/18
Psychological readiness	2/18
Time since surgery	2/18
Pain-free return to sporting movements	1/18
Clinical joint stability	1/18
Second priority	
Muscle strength	5/18
Functional tests	3/18
Time since surgery	3/18
Clinical joint stability	2/18
Completion of a sport-specific rehabilitation	1/18
Subjective feeling of knee stability	1/18
Pain-free return to sporting movements	1/18
Third priority	
Satisfactory physical examination result	3/18
Muscle strength	2/18
Functional tests	2/18
Psychological readiness	2/18
Pain-free return to sporting movements	2/18
Subjective feeling of knee stability	1/18

ACL, anterior cruciate ligament; RTS, return to sport.

criteria for RTS are to be found in [Table 2](#). The most prioritized RTS criteria were functional tests, muscle strength, satisfactory physical examination result, and absence of joint effusion followed by psychological readiness and time since surgery. An overview of the prioritized criteria can be found in [Table 3](#).

## Discussion

The results of the current study show that professional team physicians consider subjective and objective findings, informative feedback from team members, as well as the time since surgery and type of sport as the main determinants of RTS. However, specific tools, tests, or statements to define each of these parameters could not be identified.

Definite and conclusive guidelines to RTS especially return to unrestricted sport after ACLR are still missing.<sup>17</sup> Applying qualitative techniques may improve our understanding of the RTS assessment and may also help create novel guidelines for amateur athletes using the professional team physicians' perspective and experience.<sup>18</sup> The purpose of this qualitative study was to explore currently used RTS criteria after ACLR used by professional team physicians in elite athletes. Professional team physicians practice mainly in large institutions with great financial capacities that give them almost unlimited resources and access to all kinds of medical personnel, specialized experts, facilities, and equipment, and so their perspective is of great interest.

The authors hypothesized that even among this group of physicians and despite having all these resources there still exists a great range of inconsistency regarding RTS criteria after ACLR. The hypotheses of our study were confirmed.

Participants frequently mentioned muscle strength as being the most important RTS criterion. Most participants opted for a clinical measurement of muscle strength, and few preferred isokinetic and isometric testing measures. This was confirmed by the results of Burgi et al.,<sup>19</sup> who also reported muscle strength as an RTS criterion after primary ACLR in 86 of the 209 studies included in their review. They also reported that only 2 studies involving athletes of mixed levels of play used isokinetic testing measures. Our study shows that this discrepancy in the choice of evaluation method may be affected by the level of play of the tested athletes. Data in the literature show that the sensitivity of manual muscle strength testing to detect differences in comparison to the opposite side or in comparison to normal reference values do not exceed 75%.<sup>20</sup> At the same time, some authors consider that isokinetic strength does not reflect the "real" strength and does not correlate with functional assessment.<sup>21</sup>

Physical examination was repeatedly reported as being one of the most important RTS criteria. Participants

regarded satisfactory functional tests as the main marker in this category, as well as the clinical knee stability and the absence of knee joint effusion. In the literature, functional testing is often considered as a main determinant of RTS.<sup>22</sup> With regard to joint effusion, Rambaud et al.<sup>23</sup> reported that of all the 201 studies included in their review using clinical criteria to decide return to running, 50% regarded joint effusion as an important criterion. The participants were not consistent in their choice of the most appropriate functional test; however, the single leg hop and the triple hop tests were the most often mentioned functional tests. This correlates with the results of Harris et al.,<sup>17</sup> who reported in their review that except for the single leg hop test used in 31% of the 49 studies included, no other functional test was consistently used in more than 3 studies.

Inconsistency was also seen when the participants were asked about their choice of the most reliable test for evaluating clinical knee stability. The Lachman test and the pivot-shift test were the most used tests. This goes in line with the results of Grassi et al.,<sup>24</sup> who reported the Lachman test and the pivot-shift test each as an objective RTS criterion by 65% of the 123 physicians of the Italian Society of Knee, Arthroscopy, Sport, Cartilage and Orthopedic Technologies included in their survey.

Both physical and psychological readiness are essential to reach RTS.<sup>25</sup> The correlation between these 2 parameters is, however, not obvious.<sup>26</sup> In comparison to traditional tests including objective measurements, Faleide et al.<sup>27</sup> confirmed that along with age, psychological readiness was the only other factor showing predictive ability in the determination of return to preinjury sport level.

In fact, several authors report very little correlation between psychological readiness and objective parameters.<sup>25,28,29</sup> Betsch et al.<sup>29</sup> reported a correlation between higher pain levels at 1 year after ACLR measured with the knee injury and osteoarthritis outcome score and lower psychological readiness. In their study, no association between single-legged hop test pass and psychological readiness to RTS was found. For that reason, in addition to the traditional knee outcome scores, several studies created new scores or modifications of preexisting scores to assess the psychological aspects after injury and reconstruction such as the Tampa Scale for Kinesophobia, Emotional Responses of Athletes to Injury Questionnaire, Profile of Mood States, and ACL-Return to Sport Injury Scale.<sup>26,30</sup>

Patient-reported psychological readiness, subjective feeling of knee stability, and pain-free return to sporting movements were considered by some participants as some of the most important RTS criteria. The current study revealed that even when the participants considered that these subjective factors play an essential role, most of them did not use PROMs or a specific score to assess psychological factors in the RTS decision

making. Instead, under the slightest suspicion of a mental issue affecting the player's subjective RTS readiness, a sport-specific psychologist was engaged. The lack of utility of PROMs in RTS decision making observed in the current study may be supported by some authors, who report a limited association between patient reports and psychological readiness, for example, when comparing patients of different sexes.<sup>31</sup>

Another important RTS criterion referred to by the team physicians was time since the ACLR surgery. Burgi et al.<sup>19</sup> reported that 178 (85%) of the 209 studies included in their review used time as an RTS criterion after primary ACLR. However, only 3 of the reviewed studies involved professional athletes. Further analysis of the participants' interviews showed, however, that the time-based RTS was not a strict concept but more of a minimum requirement to reach RTS. These time frames were inconsistent and ranged from 6 to 12 months after surgery, although participants reported that a certain minimum time after surgery is necessary before reaching RTS.

This unclear definition of time-based RTS is confirmed by the literature, especially when it comes to professional athletes, where a range from 186 to 310 days until RTS mainly in soccer players and 258 to 424 days in patients with shoulder instability playing in the National Hockey League, National Football League, Major League Baseball, and National Basketball Association is described.<sup>32,33</sup> Also, within the same sport, the player's position could also have an effect on injury rates; Bloomfield et al.<sup>34</sup> reported that attackers of the English Football Association Premier League perform the most intense activity on the field compared to midfielders and defenders, which clearly makes them more exposed to injury. Accordingly, in their analysis of RTS times and player performance after ACLR in elite UEFA professional soccer players, Forsythe et al.<sup>35</sup> included 51 players in their study with a complete ACL tear: 37.3% of the included players were attackers (highest proportion) versus 27.5% and 31.4% midfielders and defenders, respectively.

Regarding radiographic studies, most participants reported that they do not perform postoperative radiography or MRI routinely as a decision tool for RTS. The poor association between imaging parameters and functional outcome is already described in the literature. Biercevicz et al.<sup>36</sup> examined the graft signal intensity in MRI and clinical outcome 3 years after ACLR and found no correlation using traditional knee scores for patients with both hamstring tendon and bone patellar tendon bone autografts.

### Limitations

This study has some limitations that should be mentioned here. Because of the nature of the interview setting, some participants may have been hesitant in

sharing their opinions, especially regarding delicate topics such as influence of other team members on RTS and pressure from general management and coaching teams. Another limitation was the fact that a comparison of the findings of the current study with similar studies in the literature was not always possible because data on RTS involving professional team physicians and professional athletes is scarce. An additional limitation was the relatively small number of team physicians for each sport, because many different types of sport were included. A last limitation is the small proportion of female physicians included and the missing categorization of RTS criteria between male and female athletes.

### Conclusion

This study identified 4 main themes including (1) objective findings, (2) informative feedback of the team members, (3) subjective findings, and (4) type of sport and time to surgery as having the most influence on the RTS decision after ACLR in professional athletes. However, interviews showed that even among professional team physicians, the main criteria to RTS in these categories were inconsistent. A definitive set of conclusive guidelines could not be established and would be a fruitful and useful area for future research through further quantitative studies and international consensus meetings along the foundation of the presenting study.

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