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Editorial

Where are we with return-to-sport testing following ACL reconstruction?

Most anterior cruciate ligament (ACL) injuries occur during sports participation and it is therefore not unexpected that most patients who undergo ACL reconstruction do so with the goal of returning to sport. Whatever surgical technique is used and whatever rehabilitation protocol is followed, when it comes to advising a patient when it is appropriate to return to sport, the clinician is effectively addressing two separate questions; is it safe for the patient to return to sport, and is the patient capable of returning to a specific sporting activity, preferably at or better than their pre-injury level? It is in this context that so-called return-to-sport (RTS) testing is frequently used.

The questions of safety and capability cannot necessarily be addressed in the same way. In general, most RTS testing is done with the aim of assessing the safety of the patient making a return to sport without suffering a further ACL injury, either to the operated knee or to the contralateral knee. However, the same or similar measurements are also used as assessments of how much of their functional capacity a patient has regained and the likelihood of making a return to sport. For instance, Naswareh et al. [1] showed that meeting RTS criteria at 6 months postoperatively was associated with higher rates of return to pre-injury activity level at 12 and 24 months. For the sake of clarity, this editorial will focus on RTS testing to assess the safety of returning to sport.

Despite the myriad of information and discussions about RTS testing following ACL reconstruction, the evidence surrounding it is relatively limited, and the evidence that is available is somewhat conflicting. However, one common theme predominates and that is that a surprisingly small number of patients actually meet the RTS thresholds and criteria. This has been highlighted in a recent systematic review that included 18 studies, with an overall rate of 23% of patients "passing" return to sport test batteries, both prior to returning to sport and after returning to strenuous sports [2]. Despite this, many if not most athletes do return to sport and do so safely.

The same study [2], together with a similar systematic review [3], highlighted the conflicting findings reported in the literature. Both reported that passing a RTS test battery was associated with what can at best be regarded as a modest decrease, 9% and 7% respectively, in the risk of graft rupture in those who pass RTS testing compared to those who do not. On the other hand, meeting RTS criteria was also shown to be associated with an increased risk of a contralateral ACL injury; 8 and 4% respectively. It is worth noting that when the same comparisons are presented as risk ratios rather than risk differences, the numbers are much larger and therefore eye-catching (i.e. 53–60% decrease in risk for graft rupture and 176–235% increased risk for contralateral ACL injury in those that pass RTS testing), so close attention needs to be paid to the unit of measurement when interpreting such results.

It also is important to understand exactly what outcomes authors are reporting. For instance, two frequently cited studies [4,5] included in one of the systematic reviews examined the risk of all subsequent knee injuries, rather than ACL injuries specifically. Meta-analysis of the two studies showed that although there was a trend for reduced risk of any knee injury when RTS criteria were met, this was not a significant finding due to small sample sizes in both studies [2]. Thus, findings such as that of Grindem et al. [5] that meeting RTS criteria and waiting until at least 9 months to return to sport was associated with significant risk reduction of all knee injuries, need to be seen in the appropriate context.

It is fundamentally difficult to undertake the ideal study to assess the value of RTS testing in large numbers of patients. For a test or battery of tests to be considered useful in predicting relative safety for the athlete in their return to sport, we need prospectively collected data showing that those who meet the required thresholds return to sport more safely than those who return to sport, despite not meeting the same thresholds. This creates a conundrum for researchers and clinicians; if an individual has not met the required thresholds, is it responsible to allow them to return to sport? From a practical point of view, it is ultimately the athlete's decision, but it does create ethical issues when designing a research protocol.

Another difficulty in assessing the data about relative re-injury rates between those who meet certain thresholds compared to those who do not, is that the actual return to sport rates of both groups, as well as the nature of the sport and level of participation, need to be taken into account. If the two patient groups are not returning to comparable levels of activity or sport, then it is difficult to draw conclusions about the benefit of meeting the RTS criteria. Unfortunately relatively few studies report the return to sport rates along with the re-injury rates, and even when they do, the definition of return to sport varies from one study to another.

We also know that younger patients [6] are at a higher risk of further ACL injury, but perform better on functional tests commonly used in RTS test batteries and have higher rates of return to strenuous sport [7]. Determining the role of RTS testing must therefore take into account the effect of such confounding variables. It may be that different thresholds or tests should be used, depending on the age and sex of the patient, and potentially on graft type and

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the type of sport as well. For example, a patient who has had a hamstring graft harvested can be expected to show reduced hamstring strength compared to a patient who has had a patellar tendon graft harvested, and "pass" thresholds may need to be adjusted to account for this.

Of course, it can never be completely safe to return sport, particularly level 1 sports, following ACL reconstruction. Rehabilitation and return to sport testing can only aim to reduce the risk of further ACL injury. As such, injury reduction may be better term than injury prevention, and may put things into a more appropriate perspective for the athlete. Just because someone meets all return to sport criteria clearly does not mean they will not suffer a further ACL injury when they return to sport. Percentages quantifying the risk may mean little to the individual, particularly if they are unlucky enough to have a further ACL injury. For such athletes the risk may seem like 100%!

So how can we use RTS testing? It can clearly identify deficits and provide feedback to the patient and practitioner on how to tailor further rehabilitation and this may in fact be a better way to use the information gained. Taking this one step further, it has been suggested that once a particular component has been passed, then it may not need to be re-tested and that the focus should be on tests that were not passed or are subsequently introduced in a sequential manner [2]. Re-testing is however potentially subject to a learning effect, but whether this reduces the value of a test result is unknown.

How extensive should a test battery be? Is more actually better or just more time-consuming? Do we need tests that require expensive equipment such as isokinetic dynamometers, which is beyond the reach of most facilities? A recent systematic review has suggested that a maximum of only 5 variables should be used to develop a risk profile based on five domains: anthropometrics, strength, movement biomechanics, kinaesthesia and balance, and psychological factors [8]. Even then, individual components of a battery may be more important than others.

Thus, based on the varied and sometimes conflicting evidence available, caution should be exercised in using the information gained from current RTS testing to advise individual patients about their risk for further injury, if and when they return to sport.

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