Return to play guidelines after anterior cruciate ligament surgery

G Myklebust, R Bahr

Doctors should question whether return to high level pivoting sports is in the athlete’s best interest after ACL reconstruction

When can I play again, Doc?’ is the emotionally charged, quintessential question asked by nearly every athlete after anterior cruciate ligament (ACL) injury. Invariably, the same question is one of the first asked by parents, team mates, coaches, and—in the case of the high profile athlete—the media. This implies that, to meet the expectations of the athlete and his/her surroundings, swift surgical intervention and accelerated rehabilitation becomes a priority. Therefore it is not surprising if the time to return to play is the standard by which orthopaedic surgeons measure themselves and are measured in sports circles.

Measured by this standard, sports medicine has made giant advances in ACL treatment programmes during the previous decades. We have progressed from open surgery to arthroscopic surgery, from extended casting to short term bracing, from conservative to accelerated rehabilitation programmes, and from long hospital stays to outpatient surgery. When an athlete is injured today, it is expected that arthroscopic surgery will take place a few weeks after injury, that rehabilitation is started immediately, and that the patient is able to return to sport in four to nine months. The “best” surgeons and physiotherapists are rumoured to return players even sooner.

“Are there other criteria whereby we should measure treatment outcome than the time to return to sport?”

Lost in the need to succeed and with the fear of defeat deeply embedded in our decision making processes, it is no wonder that we rarely ask: “Is it time to quit? Is it safe to return patients to pivoting sports? What are the long term results of our treatment programmes? Are there other criteria whereby we should measure treatment outcome than the time to return to sport?” Should we not consider the risks of a graft rupture or additional knee lesions and the likelihood of the development of early osteoarthritis (OA) when advising the athlete after the initial injury.

To better address these issues, we have searched the literature for follow up studies after ACL injury examining the rate of return to sport, the reinjury risk, and/or the prevalence of OA (see table 1 for details on search terms and procedures). We have included studies of patients treated non-operatively or with reconstructive surgery who have been followed from 4 to 14 years after the initial injury.

RETURN TO SPORT AFTER ACL INJURY

For athletes who wish to return to pivoting sports, the typical advice is an ACL reconstruction after 4-8 weeks when full range of motion is established and there is no joint swelling. The purpose of an ACL reconstruction is to give the athlete a mechanically stable knee and to reduce the risk of subsequent injury to the meniscus and cartilage by reducing anteroposterior joint motion. A number of short term studies have shown good to excellent knee function after reconstruction, whether hamstrings or patellar tendon grafts are used. The same studies also confirm that most patients (65–88%) are able to return to sport within the first year. Thus it is fair to state that surgery is effective in allowing injured athletes to resume their sports career.

Also, some athletes are able to return to high level pivoting sports without surgery. Among patients treated non-operatively, the return rate ranges from 19% to 82% (table 1). The athletes who successfully return to sport after non-operative treatment probably represent a selected group with functionally stable knees and a strong motivation to continue pivoting sport despite their injury.

If athletes can return to sport with or without ACL reconstruction, how long are they able to keep playing after the initial injury? Most studies deal with ACL reconstructed patients, and the results vary between studies with a range from 8% to 82% (table 1). However, it is not always clear whether the authors are reporting an initial return rate or the proportion still playing at the time of follow up.

Nevertheless, a few studies may be of particular interest, because they follow sports specific patient populations and report data on patients treated with and without surgery. Also, these studies mainly include elite athletes who can be assumed to be well motivated to continue their sports career. Thus the data may provide a realistic estimate of what to expect after returning to sport after injury. Myklebust et al found in a 6–11 year follow up of ACL injured team handball players that 58% of the reconstructed players and 82% of the conservatively treated patients were able to return to their preinjury level.

In the 10–13 year follow up study with a mixed sport population, Fink et al found a 44% reduction in high risk sports participation in the surgically treated group compared with a 70% reduction among the conservatively treated. In the longest follow up to date, von Porat et al showed that, after 14 years, 6% in the operatively treated group and 1% in the conservatively treated group were still playing soccer. However, from these studies it is not possible to determine whether the players retired because of the injury or whether the retirement rate was higher than can be expected. Clearly, athletes may quit for reasons unrelated to their knee injury.

In the only study in which the reduction in sport participation can be related to a control group, Roos et al reported on elite soccer players three to seven years after the ACL injury. They found that 30% were active in soccer after three years compared with 80% in an uninjured control population. In addition, they showed that, after seven years, none of the injured elite players were active regardless of the type of treatment. It seems fair to conclude that, although the initial return rate is high, regardless of treatment, previously injured athletes retire at a higher rate than athletes without previous ACL injuries. The reason for this may be that many of the athletes who return to sport experience significant knee problems, such as instability, reduced range of motion, and/or pain.

REINJURY RATE AFTER SURGERY

One of the potential concerns with returning to sport is that the reinjury rate to the reconstructed ACL or to other structures (menisci, cartilage, or other ligaments) may be unacceptably high. Only few studies have examined
Follow up studies on the rate of return to sport, risk of re-rupture, and the prevalence of radiological osteoarthritis after an initial anterior cruciate ligament (ACL) injury

<table>
<thead>
<tr>
<th>Study</th>
<th>Material</th>
<th>Operative/Non-operative</th>
<th>Return to sport</th>
<th>Follow up (years)</th>
<th>Re-rupture</th>
<th>Osteoarthrosis</th>
<th>Remarks</th>
</tr>
</thead>
<tbody>
<tr>
<td>Van Porst et al</td>
<td>N = 205; age, 38 (30–56) Soccer male</td>
<td>89/65*</td>
<td>7.8% (9 op &amp; 3 non-op)</td>
<td>14</td>
<td>–</td>
<td>78%**</td>
<td>*154 answered questionnaire</td>
</tr>
<tr>
<td>McDaniel &amp; Dameron et al</td>
<td>N = 50 (53 knees)</td>
<td>Non-operative</td>
<td>74%*</td>
<td>14</td>
<td>–</td>
<td>86%</td>
<td>**122 players with radiological exam</td>
</tr>
<tr>
<td>Fink et al</td>
<td>N = 71 (84%) in sports activity</td>
<td>46/25</td>
<td>44% reduction in op/70% reduction in non-op*</td>
<td>10–13</td>
<td>0</td>
<td>78%/83%</td>
<td>*Returned to strenuous sport</td>
</tr>
<tr>
<td>Myklebust et al</td>
<td>N = 79 (r: 29; q: 50) Team handball</td>
<td>57/22</td>
<td>58%/82%</td>
<td>6–11</td>
<td>13%*</td>
<td>42%/46%**</td>
<td>*BPTB reconstructed</td>
</tr>
<tr>
<td>Dragset &amp; Grantvedt</td>
<td>N = 100 (r: 45; q: 55) Different sports activities</td>
<td>Reconstruction with LAD (n = 49) Without LAD (n = 51)</td>
<td>–</td>
<td>8</td>
<td>12%*</td>
<td>50%</td>
<td>**Radiological exam of 50 players</td>
</tr>
<tr>
<td>Roos et al</td>
<td>N = 310 (r: 213; q: 97)</td>
<td>157/153</td>
<td>22%/19%*</td>
<td>7</td>
<td>–</td>
<td>Not examined</td>
<td>*All occurred in pivoting activities</td>
</tr>
<tr>
<td>Ruiz et al</td>
<td>N = 30 (r: 21; q: 9) Football: 11 Rugby: 12 Other: 7</td>
<td>Reconstruction</td>
<td>12 patients changed first choice sport*</td>
<td>7 (5–9)</td>
<td>3.3%</td>
<td>50%</td>
<td>None of the players played at the same level as before injury</td>
</tr>
<tr>
<td>Johma et al</td>
<td>N = 59</td>
<td>BPTB: 26</td>
<td>BPTB</td>
<td>7</td>
<td>10%</td>
<td>Not examined</td>
<td></td>
</tr>
<tr>
<td>Savernick et al</td>
<td>N = 33 (r: 20; q: 13) Mostly soccer, handball, alpine skiing</td>
<td>BPTB</td>
<td>–</td>
<td>7</td>
<td>–</td>
<td>57%</td>
<td></td>
</tr>
<tr>
<td>Jennings et al</td>
<td>N = 50 (r: 32; q: 18)</td>
<td>BPTB</td>
<td>–</td>
<td>5.2</td>
<td>–</td>
<td>Not examined</td>
<td></td>
</tr>
<tr>
<td>Brandston et al</td>
<td>N = 102 (r: 74; q: 38)</td>
<td>BPTB</td>
<td>–</td>
<td>4–7</td>
<td>2.9%</td>
<td>Not examined</td>
<td></td>
</tr>
<tr>
<td>Howe et al</td>
<td>N = 83</td>
<td>BPTB</td>
<td>–</td>
<td>5</td>
<td>–</td>
<td>37%*</td>
<td></td>
</tr>
<tr>
<td>Pinczewski et al</td>
<td>N = 180 (r: 95; q: 85)</td>
<td>BPTB: N = 90</td>
<td>–</td>
<td>5</td>
<td>BPTB: 3%</td>
<td>12%**</td>
<td>*No information on sports participation. *BPTB: 18%</td>
</tr>
<tr>
<td>Otto et al</td>
<td>N = 68 (r: 49; q: 19)</td>
<td>Hamstrings: N = 90 BPTB</td>
<td>38% preinjury level, 15% higher level</td>
<td>5</td>
<td>4.4%</td>
<td>24%</td>
<td>Hamstrings: 8%</td>
</tr>
<tr>
<td>Sandberg &amp; Balkdorfs</td>
<td>N = 112 (r: 75; q: 37) Different sports, soccer:72%</td>
<td>BPTB</td>
<td>35% returned to same level (soccer)</td>
<td>5</td>
<td>9.8%</td>
<td>Not examined</td>
<td>*No description of type of sports</td>
</tr>
<tr>
<td>Ferretti et al</td>
<td>N = 114</td>
<td>Hamstrings</td>
<td>67% same level</td>
<td>5</td>
<td>–</td>
<td>25.4%</td>
<td></td>
</tr>
<tr>
<td>Cooley et al</td>
<td>N = 33</td>
<td>Hamstrings</td>
<td>45% maintained activity level 55% reduced activity level*</td>
<td>5</td>
<td>3%**</td>
<td>5%</td>
<td></td>
</tr>
<tr>
<td>Patel et al</td>
<td>N = 32 (r: 8; q: 24) 88% from “sporting activities”</td>
<td>BPTB</td>
<td>41%</td>
<td>5</td>
<td>9%</td>
<td>28%</td>
<td>*Not due to knee limitations **Was excluded from follow up together with patient with meniscectomy</td>
</tr>
<tr>
<td>Wang et al</td>
<td>N = 44 (r: 32; q: 12)</td>
<td>BPTB</td>
<td>–</td>
<td>4.8</td>
<td>–</td>
<td>61%</td>
<td></td>
</tr>
<tr>
<td>Bak et al</td>
<td>N = 132 (r: 117; q: 15)</td>
<td>Hamstrings</td>
<td>68% same level 29% lower level</td>
<td>4</td>
<td>3%*</td>
<td>Not examined</td>
<td>*20% among females</td>
</tr>
<tr>
<td></td>
<td>Soccer</td>
<td>Hamstrings includes semitendinosus, gracilis and iliotibial grafts, LAD, Kennedy ligament augmentation device</td>
<td></td>
<td></td>
<td></td>
<td></td>
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</tr>
</tbody>
</table>

A total of 540 papers were identified through a Medline search using the following key words: “Anterior Cruciate Ligament/Injuries” AND “Follow-Up Studies”. Abstracts were reviewed to identify studies reporting on the return rate to sport, the reinjury rate, and/or the prevalence of osteoarthritis with a mean follow up period of at least four years. In addition, reference lists of selected papers were reviewed to identify additional studies. Follow up studies describing partial ACL ruptures or reconstructive surgery with sutures only were excluded. A single or double asterisk is used to indicate which piece of information the remark in the Remarks column is referring.
reinjury risk, and they report a wide range of rupture rates ranging from 2.3% to 13% (table 1).\textsuperscript{18–20} The highest ACL rupture risk (13%) was found by Myklebust \textit{et al}\textsuperscript{22} in their study of team handball players. However, one reason for the high risk seen in this study may be that team handball in itself is a high risk sport. Six of the 50 players who returned to team handball (9%) experienced an ACL tear in their contralateral, previously uninjured knee during the observation period.\textsuperscript{9} A similar reinjury rate was reported by Drogset and Grøntvedt,\textsuperscript{23} who found that 12% of their patients suffered a reinjury during an eight year follow up period, all during pivoting sports.

However, these results, as well as studies reporting lower rupture rates, must be interpreted with caution. Firstly, the population at risk is not known, because it clearly depends on the proportion returning to sport and the number of years they continued to play. Secondly, bias must be considered when there is a significant loss to follow up as is evident in most of the studies. Thus, we do not know if there is an increased risk of reinjury to the reconstructed ACL compared with a healthy knee, nor do we know the rate of meniscus or cartilage injury associated with return to sport. Nevertheless, it is clear that nearly all of the reruptures reported in the papers shown in table 1 occurred while pivoting sports were being played.

"Returning to pivoting sport without a reconstruction results in considerable risk of injury to the menisci and cartilage"

Further damage to the knee with continued sports participation is of course also a concern in non-operatively treated patients. Myklebust \textit{et al}\textsuperscript{22} showed that 22% of the non-operatively treated players who returned to sport underwent additional surgery for an injured meniscus compared with 12% in the operatively treated players. Returning to pivoting sport without a reconstruction results in considerable risk of injury to the menisci and cartilage.

FIGURE 1 Anterior cruciate ligament (ACL) follow up studies and osteoarthritis (OA) prevalence. OA risk after both reconstructive surgery with bone-patella-tendon-bone graft or hamstring graft and non-operative treatment is shown. The dashed line indicates the forced regression ($y = 6.0 t$; $r = 0.85$) between time ($t$) and OA prevalence ($y$), with the 95% confidence intervals shown by thin solid lines. Follow up studies describing partial ACL ruptures or reconstructive surgery with sutures only are omitted.

Figure 1 shows the risk of developing radiological signs of OA with time after an ACL injury. After 10 years, approximately half of the patients display signs of OA. An extrapolation of these results indicates that nearly all patients will have OA after 15–20 years. A recent study showed that all athletes undergoing revision ACL surgery had OA when they were re-examined 37 (12–58) months after the reoperation\textsuperscript{10} (because this study includes patients with two or more ACL injuries, it could not be included in fig 1 or table 1). It seems that a high frequency of radiographic changes is the rule rather than the exception after ACL injury.

These findings raise two important questions. Firstly, is there a difference in the risk of OA between surgically treated and non-operatively treated patients? Unfortunately, there are no prospective trials in which patients have been randomised to a reconstruction or non-operative treatment. In the three follow up studies that include surgically and non-operatively treated patients there may be a selection bias, which makes it difficult to interpret the results. Nevertheless, as shown in fig 1, the prevalence of OA does not seem to depend on whether an ACL reconstruction was performed or not. von Porat \textit{et al}\textsuperscript{14} reported 78% OA prevalence in both groups after 14 years, Fink \textit{et al}\textsuperscript{13} 78% v 83% after 10–13 years, and Myklebust \textit{et al}\textsuperscript{42} 42% v 46% after 6–11 years. Thus there is no evidence to suggest that ligament reconstruction prevents future OA.

The second question is: is there an increased risk of OA in athletes who return to sports compared with those
who choose to retire? For obvious reasons, there is no study in which athletes have been randomised to continued sports participation or early retirement. Furthermore, although it would have been interesting to compare OA prevalence between athletes who chose to retire and those who continued to play, these data have not been reported in the available studies. Therefore there is an urgent need to establish large prospective studies to follow cohorts of athletes with ACL injuries using a multivariate approach, it will then be possible to assess the independent effects of treatment methods, associated injuries to the menisci and cartilage at the time of injury, graft choice, reinjuries, and continued sports participation, to mention a few factors that could be important for the development of early OA.

The answer to the question “When can I play again, Doc?” is straightforward and can be comfortably stated by most doctors: “Probably within 1 to 9 months depending on the treatment that is best for you…” BUT let us take a moment to talk about the more difficult question I am going to ask you: “Should you return to sport?”

References


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