

## Correspondence

# A scientific approach to optimal treatment of cruciate ligament injuries

*Sir*—Which is the most effective treatment strategy for injuries to the anterior cruciate ligament (ACL) of the knee? This is the topic of an editorial in *Acta Orthopaedica* in which Aspenberg (2010) reflects on a study by Frobell and colleagues (2010). The editorial headlines that ACL injuries are surgically over-treated. We think that this cannot be concluded, as there are severe problems with the measurement properties of the score systems that are used by Frobell et al.

Frobell et al. found no significant difference between ACL deficient patients randomized to a rehabilitation regimen with early ACL reconstruction and patients randomized to rehabilitation with delayed ACL reconstruction “when needed”. The outcome score was a modified version (KOOS-4) of the Knee Injury and Osteoarthritis Outcome Score (KOOS).

We have shown that only 2 of the 5 subscales in the original version of KOOS fulfill the criteria of a unidimensional measurement scale when applied to ACL reconstructed patients (Comins et al. 2008). KOOS-4 differs from KOOS in that the domain to assess daily function (ADL) has been removed, and consists of 25 items distributed across 4 domains. The scores from each domain are added and divided by 4 to equally weight them. This summed and weighted total score is compared across groups (Frobell et al. 2010). But summing the scores from the separate subscales in KOOS is not justifiable (Comins et al. 2008). Among other problems we found ceiling effects in many items, and we concluded that KOOS is insufficient as a tool to evaluate function in ACL reconstructed patients 20 weeks after operation. There is no evidence to support the use of KOOS-4 to measure and compare outcome scores for these patients.

Tegner Activity Score and SF-36, which were also used in the study of Frobell et al. may have the same type of problems as KOOS regarding measurement properties (Hobart et al. 2002, Baron et al. 2006, Hagell et al. 2008).

In-depth interviews of 22 of the patients randomized in Frobells study to rehabilitation and optional reconstruction showed that many had joined the study to bypass the waiting list for surgery (Thorstensson et al. 2009). Patients who had different access to surgical treatment and who wanted early reconstruction would most likely not participate in this study. Of the patients who declined participation in the randomised study, the most common reason was unwillingness to undergo surgery (Frobell et al. 2007). Patients with the most and least

severe injuries might be included less frequently in the study compared to patients with moderate injuries and this could skew results.

Whichever treatment is performed, an ACL lesion has significant consequences. In a 20- year follow-up of 19 Olympic athletes who sustained an ACL injury between 1963 and 65 and were treated non-operatively due to a protocol in the former East Germany, 18 had meniscal resection performed and 13 had grade IV chondral lesions at arthroscopy. By the end of 2000, 10 of the athletes had a knee replacement (Nebelung and Wuschech 2005). In 100 patients with an acute ACL injury, 22 were reconstructed, and of 67 patients followed for 15 years, 21% had a poor or fair result, and generally there was a significant decrease in Tegner and Lysholm scores between 3 and 15 years post-injury (Kostogiannis et al. 2007). Despite ACL-reconstruction, more than 50% have not returned to preinjury activity levels after 12 months (Ardern et al. 2010). The effect of non-operative treatment after ACL injury has been reported in several studies. Dependent on the selection of patients, up to 2/3 are treated later with an ACL-reconstruction (Strehl and Egli 2007). Early ACL reconstruction is followed by better functional results compared to delayed reconstruction (Ahlén and Lidén 2010). Operated patients have better subjective and objective stability and a higher chance of returning to preinjury level of sports (Hinterwimmer et al. 2003), however a Cochrane review (Linko et al. 2005) concluded, that there is not enough evidence to recommend operative or non-operative treatment.

It is not clear what non-operative treatment should consist of. After ACL-reconstruction a home-based program is as good as a treatment program in a physical therapy clinic to restore knee function (Grant et al. 2010). In a randomized study between self-monitored training in a clinic and supervised training by a physical therapist after ACL injury, a large number of patients were transferred to the supervised group before follow-up, so the study results are difficult to interpret (Zätterström et al. 2000). No study has compared non-treatment with physical therapy. The non-operative treatment strategy of rehabilitation first and ACL reconstruction when deemed necessary is time consuming for the patients who choose reconstruction, as they must participate in rehabilitation twice (Thorstensson et al. 2009).

In patients with ACL rupture meniscal injury is the most

important risk factor for osteoarthritis (Öiestad et al. 2009). Stabilization of the knee through ACL reconstruction could reduce the risk of meniscus injury.

We believe that the literature, including Frobell's recent study, does not provide a basis to conclude that there is surgical overtreatment of cruciate ligament injuries. At present there is no documented best treatment of acute ACL injuries.

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*Sir*—I thank Dr. Krogsgaard and colleagues for their interest in my Editorial on anterior cruciate ligament (ACL) injuries.

I have asked Drs Lohmander and Frobell to comment on the critique of their methods. I note that both Krogsgaard et al. and Lohmander et al. agree with the Cochrane review conclusion that there is no documented best treatment of acute ACL injuries. Considering this lack of evidence, I believe it justified to state that surgery in many cases might represent overtreatment.

### **Per Aspenberg**

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*Sir*—We thank Dr. Krogsgaard and colleagues for their continued interest in our study on anterior cruciate ligament (ACL) injuries.

At 2 years of follow-up our randomized controlled trial showed no advantage of early ACL reconstructive surgery with structured rehabilitation over that of structured rehabilitation with optional reconstruction 'as needed', as monitored by the pre-specified primary outcome: change from baseline to 2 years in the average score of 4 of the 5 KOOS subscales, covering pain, symptoms, difficulty in sports and recreational activities, and knee-related quality of life (KOOS-4, equal weight for all subscales) (Frobell et al. 2010).

Further, we found no difference at 2 years for any of the pre-specified secondary outcomes: each of the 5 individual KOOS subscales (the fifth scale being activities of daily living), the scores on the SF-36 physical and mental components, the

Tegner activity scale, the area under the curve for the development of absolute KOOS4 scores from baseline to 2 years, and the percentage of subjects with a KOOS quality-of-life score below 44 (a pre-specified cutoff value consistent with a report of more than moderately decreased knee-related quality of life) between 6 months and 2 years. Neither was there any difference between the groups in the number of meniscal surgeries during the 2-year follow-up. As expected, subjects assigned to rehabilitation plus early ACL reconstruction had greater knee stability at 2 years shown by the exploratory outcomes Lachman test, pivot shift test, and KT1000 arthrometry. Our post hoc as-treated analysis identified no significant differences in self-reported outcomes at 2 years among the subjects treated with rehabilitation plus early ACL reconstruction, those treated with rehabilitation plus delayed ACL reconstruction, and those treated with rehabilitation alone.

Krogsgaard and colleagues discuss several different issues in their letter. Firstly, they question the validity of the KOOS questionnaire, the SF-36 and the Tegner activity scale to measure and compare outcomes of patients with ACL injuries.

As noted in our previous response to this question (Comins et al. 2010), we agree that the KOOS subscale for "function in daily living" has poor content validity in patients with acute ACL injury, and thus did not include it in our pre-specified primary outcome of this trial. We emphasize that the analyses of each of the individual KOOS subscales failed to show a difference between the study groups, consistent with the primary outcome. The finding of large ceiling effects of the KOOS subscales reported by Comins and colleagues is not consistent across populations and was not replicated in a recent validation study of ACL reconstructed subjects (Salavati et al. 2011). In contrast to the Tegner Activity Scale, the KOOS does not require adjustment for age and sex in amateur soccer players (Frobell et al. 2008), or for different cultures (Magnussen et al. 2010). Finally, usage of the KOOS in large scale databases such as the Scandinavian ACL registries (Granán et al. 2009) and in the US MOON database (Dunn et al. 2010) enables not only cross cultural comparisons but also provides reference data (Ageberg et al. 2010). Consequently, a recent meta-analysis recommends the KOOS for monitoring outcome following ACL surgery (Wang et al. 2010).

The SF-36 is a widely used generic instrument to assess health-related quality of life. We have previously shown SF-36 to be responsive in groups having orthopedic surgery interventions, including ACL reconstruction, but caution against use in individual patients due to a large proportion of individuals being affected by floor and ceiling effects and low individual sensitivity to change (Busija et al. 2008).

While the measurement properties of the Tegner activity scale may be less than perfect, it is widely used to report physical activity following knee injuries; a PubMed search identifies more than 100 studies relevant to this discussion.

Secondly, Krogsgaard and colleagues suggest the presence of bias in the patient screening and inclusion in our study.

During the inclusion period, we screened all patients with acute rotational trauma to the knee. All patients fulfilling the predefined inclusion and exclusion criteria were examined by an experienced clinician for the presence of antero-posterior laxity (i.e. positive Lachman test) and an ACL tear visualized on MRI confirmed the diagnosis (Frobell et al. 2010). Out of 196 eligible patients thus identified, 55 declined to participate: 30 were not willing to risk undergoing ACL reconstruction, 10 not willing to undergo non-surgical treatment, and 15 unwilling to participate in the trial. As reported, the characteristics of those who declined participation (for any reason) were similar to those who accepted (Frobell et al. 2010). The overall KOOS results at 2 years were similar to those in other ACL reconstruction studies (Nau et al. 2002, Aglietti et al. 2004, Beynnon et al. 2005, Granan et al. 2008, Lind et al. 2009) and to KOOS-4 results 2 years after surgery for patients of similar age included in the Swedish National ACL Register (Ageberg et al. 2010, Ageberg E: personal communication). The median Tegner activity scores 2 years after ACL reconstruction in our study were also similar to those reported by other investigators (Eriksson et al. 2001, Ejerhed et al. 2003, Jansson et al. 2003, Laxdahl et al. 2005). These similarities in outcomes between our study and those reported by other investigators suggest that our findings are generalizable.

With regard to the risk of meniscus lesions and other knee re-injury in reconstructed and non-reconstructed knees, we refer to our previous response in Acta to the letter of Løken et al. (2011). Observational studies suffer from confounding by indication, and the only randomized controlled trial showed no difference at 2 years (Frobell et al. 2010). More evidence is needed to draw any conclusions on the benefit of one or the other treatment in this respect.

Consistent with our publication record, we fully agree with Krogsgaard and colleagues on the often serious long-term consequences of an injury to the ACL, in particular the development of osteoarthritis (Lohmander and Roos 1994, Roos et al. 1995a, b, Lohmander et al. 2004, 2007, von Porat et al. 2004, Neuman et al. 2008). We are pleased to note the increasing attention to this problem, as compared to the frequent use of short-term consequences of “return to play” or “pre-injury activity” level as outcomes in studies of ACL injury. However, there is insufficient evidence to show whether ACL reconstruction is associated with less or more post-injury osteoarthritis compared with non-surgical management (Lohmander et al. 2007, Meuffels et al. 2009).

We agree with the conclusion of the Cochrane systematic review of Linko et al. (2005): “There is insufficient evidence from randomised trials to determine whether surgery or conservative management was best for ACL injury in the 1980s, and no evidence to inform current practice. Good quality randomised trials are required to remedy this situation”. We have now published one such trial, showing no advantage at 2 years of the addition of ACL reconstruction to structured rehabilitation. More long-term trials are needed to confirm or refute

these results in other populations. We continue to monitor our patients, and will report on longer-term outcomes.

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