Author's response to reviews

Title: Measurements of Knee Rotation - Reliability of an External Device in Vivo

Authors:

Per O Almquist (per.almquist@amadeushk.se)
Charlotte Ekdahl (Charlotte.Ekdahl@ed.lu.se)
Per-Erik Isberg (Per-Erik.Isberg@stat.lu.se)
Thomas Fridén (thomas.friden@socialstyrelsen.se)

Version: 2 Date: 21 November 2011

Author's response to reviews: see over
Dear Madame/Sir!

Thank you for your wisely and thoughtful comments about our study. We have tried to make changes and answer’s to the questions and comments according to BMC’s and the referees recommendations regarding the submitted manuscript ”Measurements of knee rotation - Reliability of an external device in vivo” (4829750535791745). We have also engaged a professional editing service to correct the English language of the manuscript. We believe that the manuscript has reached a higher level due to these changes. It is our hope that you find these answers and changes satisfactory.

Yours sincerely

Per Almquist, Charlotte Ekdahl, Per-Erik Isberg and Thomas Fridén

Answers and changes:

Referee 1 (Thomas Linding Jakobsen)

Methods - paragraph 1

We agree that it’s unclear in this paragraph how the repeated measurements were performed. It is the mean of three repeated measurements of internal and external rotation that were recorded at each torque at each flexion angle. That has been added in the Method section page 5, line 15-16.

We strongly agree that the divided internal- and external knee rotation may be of great interest. However, the validity concerning isolated internal- and external knee rotation was poor (Almquist P O, Arnbjörnsson A, Zätterström R, Ryd L, Ekdahl C, Fridén T: Evaluation of an external device measuring Knee Joint Rotation - An in vivo study with simultaneous Roentgen Stereometric Analysis. J Orthop Res 2002, 20: 427-432), and was therefore excluded from the present study.

During repeated non published pilot studies made before the present investigation, we discovered a large individual variation in starting resting “zero” position of knee rotation between different subjects. The “zero” neutral position could also vary between different flexion angles within the subjects (this have been added to the Discussion section, page 10, line 1-6). The total range of knee rotation in the same subjects did however not change between different measurement occasions. This phenomenon made it hard to standardize the starting “zero” position, in spite of all efforts to standardize the subjects position and fixation to the Rottometer. Since the divided internal- and external rotations were excluded from the study, we believed that the changes of starting “zero position” didn’t affect the result of the total rotation. By defining the individual resting position as “zero position”, it may be possible to calculate the distribution of internal- and external rotation in percentage in measurements of total knee rotation. This topic is investigated further in a larger population in an ongoing study.
Methods - paragraph 2

The measurements were not randomized or blinded due to practical and technical reasons. However, we agree that it might have influenced the reliability. That has been added in the Discussion, page 10, line 16 and 19-21

The examiners were physical therapists, and were instructed and trained in using the measurement device before the study. These examiners/physiotherapists were assigned to the study by their department, based on availability at the time. The examiners/physiotherapists were in this point of view not actively handpicked, neither were they randomly selected. We were advised by statistical experts that ICC$^{2.1}$ would be the most appropriate statistical alternative to choose in this situation.

Methods - paragraph 3

The reliability terms has been changed to within-day intratester-, one week-apart intratester- and intertester reliability.

The orders of the testers were randomized. That has been added in the Intertester reliability paragraph, page 6, line 2.

The two examinations in the intertester reliability test were estimated to approximately 2 hours. Due to respect of the test subjects, the break between the two examinations was only 10 minutes long. The subjects left the set-up during the break between the examinations. We agree that this short break could have been a possible source of error due to soft tissue stretch effect. That has been added in the Discussion, page 10, line 13-15.

Methods – Paragraph 5

A power calculation in the present study was difficult to make, since there are no earlier reference values regarding normal range of knee rotation. It’s commonly accepted in clinical works in Sweden that a general standard deviation of $\pm 5^\circ$ is expected between test trials and examiners during goniometer measurements of joint motions. That standard deviation of $\pm 5^\circ$ was used in a non precise power calculation, and due to that calculation we needed a sample size of 15 observations in the present study. However, that standard deviation has no scientific references, and is probably not very useful in measurements of knee rotation since there are large individual differences between subjects in range of knee rotation. We decided, based on this knowledge, not to provide any further power calculation.

We decided to consider each knee as one unit, since the present study is evaluating the reliability of the Rottometer, and not the subject’s range of knee rotation or differences between the left and right knees. However, we agree that using both knees at each subject could be a source of error. This has been added in the Discussion, page 10, line 17-18.

An evaluation of normal healthy knee rotation reference values, differences between left and right knees within subjects and differences due to age and gender, is an ongoing study. We needed to address the reliability of the Rottometer before that study begun. Since that on-
going study is made on knee healthy subjects, we believed that it was appropriate to evaluate the reliability at healthy, and not ACL injured subjects.

Methods – paragraph 6

There is a lack of consensus regarding which statistical tests are the most appropriate for use in reliability studies (Atkinson G, Nevill AM. Statistical methods for assessing measurement error (reliability) in variables relevant to sports medicine. Sports med 1998;26:217-238, and Rankin G, Stokes M. Reliability of assessment tools in rehabilitation: an illustration of appropriate statistical analyses. Clin Rehabil 1198:12:187-1999). Different journals and different statistical experts are recommending different methods. The different methods have advantages as well as disadvantages. We were advised by statistical experts that several methods may provide us with sufficient information about the reliability of the assessment tool. However, we agree that several different statistical methods’ can be confusing to the reader, and have excluded LOA\textsubscript{ratio} from this paper.

‘The 95% CI is calculated between measurement occasion 1 and 2 at the within day and one week apart reliability tests, and between examiner 1 and 2 in the intertester reliability test, and are made to calculate the systemic bias between test trials and examiners.

The 95% CI of ICC has also been added to this manuscript.

Results – Paragraph 1

The highest ICC has been changed to 0.84.

Results – Paragraph 3

The paragraph has been rewritten.

Results Paragraph 5

During repeated earlier pilot studies with the Rottometer, made in subjects with different categories of knee injuries, we discovered that pain occurred at measurements made with 9 Nm and end-feel in some of the injured subjects. With pain present, these subjects had a hard time to relax their muscles during the examination, which in turn affected the measurements negatively. In the present study, all subjects were told before the study commenced to interrupt the examination as soon as any pain or discomfort during the measurements was felt. However, pain and/or discomfort were not reported at any time during the examinations by any of the subjects participating in this study. That has been added in the Discussion, page 9, line 15-16.

Discussion – Paragraph 4 and 6

ICC has been recommended for use in reliability studies, but has disadvantages (Atkinson G, Nevill AM. Statistical methods for assessing measurement error (reliability) in variables
relevant to sports medicine. Sports med 1998:26:217-238), for example, ICC provides values between 0 and 1, which is difficult to interpret clinically. However, according to recommendations of Fleiss (Fleiss J. Reliability of measurements. In: The design and analysis of clinical experiments. New York, John Wiley & Sons 1986, 2-31), ICC values above 0.75 represent excellent reliability, while values between 0.4 and 0.75 represent good reliability. These recommendations have now been used, and are added in the Discussion, page 8, line 1-2.

Table

The table has been divided into three tables.

Referee 2 (Defne Kaya)

As you noticed, the knee rotations in the present study are made in a non-weight bearing position. The reason for this is that the compression of the joint during weight bearing makes it very difficult to measure the total envelope of knee rotation. We also think that the knee rotation is going to be more influenced of movements in adjacent joints in weight bearing positions. These are the two of the major reasons why the measurements were made in non weight bearing positions.

The subjects included in the present study, were neither allowed to have undergone any knee-, hip- or foot surgery, nor to have any documentation or history of prior major knee injuries (ligaments, fractures, and meniscus). That has been added at page 6, line 4-6 in the Methods section - Subjects paragraph.

We agree indeed that proprioceptive stimuli related to knee rotation are very interesting and an important issue. The proprioceptive functions of the knees were not evaluated in the present study. However, we believe that it would be of great interest to evaluate the proprioceptive input related to the range of knee rotation in different knee injuries in future studies. In order to do that, we believe that we first need to evaluate the Rottometer in regard to knee rotation reliability, and establish normal reference values regarding range of knee rotation.

The thigh was strapped firmly to the device with a dual-locking clamp. When the knee was positioned properly, the dual-locking clamp was tightened into place, to keep the femur and hip from moving in the frontal and sagittal plane. The subjects foot was secured with six soft nosed screws, with the calcaneus held in the lateral-medial direction by two screws, and the medial and lateral malleolus in the anterioposterior direction by four screws. The purpose of this construction was to prevent movements of soft tissue and of the subtalar and ankle joints. The stabilization and fixation of the subjects to the Rottometer has earlier been described in details (Almquist P O, Arnbjörnsson A, Zätterström R, Ryd L, Ekdahl C, Fridén T: Evaluation of an external device measuring Knee Joint Rotation - An in vivo study with simultaneous Roentgen Stereometric Analysis. J Orthop Res 2002, 20: 427-432), and we direct to that reference in the Methods section, page 5, line 3.

A paragraph to improve the Discussion section, concerning comparison of the results from other earlier studies measuring range of knee rotation, has been added at page 8, line 10-19.