Comparison of the measurement of the anterior knee laxity by the GNRB system and by a navigation system

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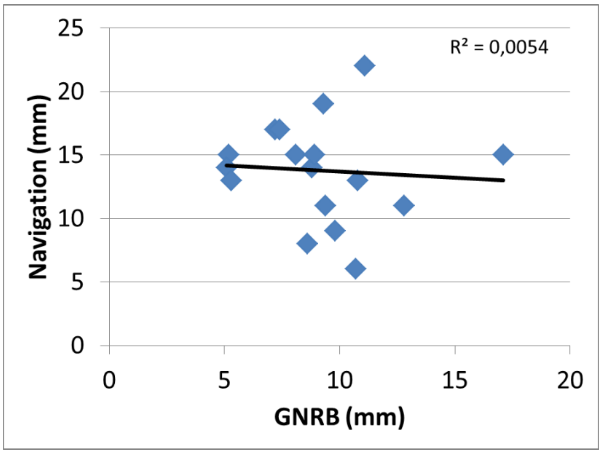
Introduction: The measurement of the anterior knee laxity allows the evaluation of anterior cruciate ligament (ACL) insufficiency. The amount of laxity is a significant parameter for surgical decision, and the control of the laxity is the major goal of any ACL reconstruction. Clinical assessment of the anterior laxity is not accurate. Instrumental techniques (stress X-rays, KT-1000 arthrometer, Rolimeter) have a suboptimal accuracy. The GNRB system might be more efficient. We tested the following hypothesis: the laxity measured by the GNRB system is different from the reference intra-operative measurement by a navigation system.

Methods: Inclusion criterion was a clinically or MRI proved ACL insufficiency requiring surgical reconstruction. There were no exclusion criteria. 20 consecutive patients operated on for an arthroscopic-assisted ACL reconstruction have been selected: 13 men and 7 men, with a mean age of 25.2 years.

The anterior laxity was measured before reconstruction, on the day of surgery but outside the operating theater and before the anesthesia, by the GNRB system with a 250 N anterior force. The anterior laxity was measured during the procedure by the navigation system with a maximal manual antero-posterior force.

The GNRB measurements and the navigated measurements have been compared with a paired Wilcoxon rest and a Spearman correlation test at a 0.05 level of significance. The agreement between the GNRB measurements and the navigated measurements has been assessed by the Bland and Altman technique. Agreement was considered satisfactory if the correlation between the mean and the difference of the paired measurements was weak ($r^2<0.4$).



There was a significant difference between the GNRB measurement and the navigated measurement of the anterior tibia translation ($p<0.01$). There was no significant correlation between the GNRB measurement and the navigated measurement of the anterior tibia translation ($r^2=0.005$). However, the agreement between the GNRB measurement and the navigated measurement of the anterior tibia translation was satisfactory ($r^2=0.27$).

Discussion: The tested hypothesis was confirmed: the laxity measured by the GNRB system is different from the reference intra-operative measurement by a navigation system.

Several reasons may explain the differences observed: 1) A variable amount of hamstring contraction may be present during the GNRB process, while the anesthesia eliminated any muscle contraction during the navigated measurement. 2) The anterior force applied during the GNRB measurement is calibrated to 250N, while the force applied during the navigated measurement was only manual and not calibrated. 3) The presence of a coupled, automatic rotation during the anterior tibia translation may be different during GNRB measurement and navigated measurement, and may substantially modify the location of the reference points and consequently the measurement of the anterior tibia translation. 4) The zero position cannot be controlled during both processes and may be different in each situation.

It has been demonstrated that the GNRB system was more accurate than other instrumented techniques. However, the precision of the system was suboptimal when compared with the intra-operative navigated reference, and these differences must be taken into consideration.

Summary: The anterior knee laxity measured by the GNRB system is different from the reference intra-operative measurement by a navigation system.