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LETTER TO THE EDITOR

Response letter to "Higher re-rupture rate in quadriceps tendon ACL reconstruction surgeries performed in Denmark: let's return to the mean" by Matthieu Ollivier (Knee Surg Sports Traumatol Arthrosc. doi: 10.1007/s00167-019-05751-5)

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We would like to thank Ollivier et al. for their excellent editorial on issues about our results from a national registry study investigating revision rates after ACL reconstruction with different graft types. The study found a higher revision rate for quadriceps tendon (QT) graft compared to hamstring and patella tendon grafts. The authors suggest several issues that could explain the very surprising finding that the quadriceps tendon was found to have two-times higher revision rate than hamstring tendon and three times higher revision rate than patella tendon.

The first issue is the statistical issue of the "return to (or toward) the mean" This issue may be in play with surgical outcomes if a small group is compared to a bigger one, for example 531 QT vs 14213 HT ACL.

It is correct, that when we compare mean revision rates which have a relatively low incidence (< 10%), then limited group sizes such as the 531 QT graft patients might not represent the true mean value as if 10.000 QT patients had been available. However, our purpose of the study was to present the first registry revision outcome data for the use of QT graft for ACL reconstruction. And we had been waiting for more 500 QT surgeries to be included in the registry before conducting the presented study to have a feasible and reasonably representable QT cohort for the study.

Another suggested issue is selection bias may have occurred in this study due to the QT having a lower age and more meniscus and cartilage injuries that the other graft type cohorts.

In the study, QT patients had a 2–3-year lower age than the hamstring and patella tendon patients so a minor but not substantial selections bias due to age differences might have occurred and that meniscus and cartilage injuries were seen 6 and 10% more frequently in QT patients than in hamstring and patella tendon patients. But in our comparison of revision rates we corrected for age and for meniscus and cartilage injuries, so our results are to some degree corrected for these potentially predictive factors.

A third suggested issue is that a learning curve of surgeons participating in the Danish ACL reconstruction registry which was associated with a graft that has not been used on a routine basis previously may have affected the results negatively.

It is correct that QT graft was primarily introduced in the last 7–8 years of the total 14 years of registry data included in the study. And learning curve could therefore influence the results for QT graft usage compare to the more established graft types. To account for this, we did perform a subgroup analysis with the purpose of correcting for a learning curve effect. This was done by removing the first one-third of all surgeries for each graft type. The finding of this subgroup analysis demonstrated that QT graft still had higher revision rates despite the learning curve correction. However, one can speculate if there is a potential continuous learning curve in the remaining QT group due to the growing interest in the utilization of the QT graft for ACLR.

A fourth issue was a critique of the statistics used to compare the revision rates. It is suggested to use propensity score to decrease the effect of uncontrolled bias.

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The study did not use the suggested propensity score statisticsp; the study did statistically correct for a number of potential revision predictor factors in the hazard ratio analyses and comparisons. These correction factors were: gender, age (≤ 20 and > 20 years of age), cartilage damage > 1 cm^2 present (no/yes or missing data), surgical treatment of meniscal injury either resection or repair (yes/no or missing data). There might be other bias factors that could have influenced the revision rates for which we have not corrected such as tunnel positioning and graft size.

As a final comment the authors of the study were as surprised as the authors of editorial about the study findings. Our research group have therefore continued to pursue explanations for the surprising findings of the high revision rates for QT grafts. New unpublished data from analysis of single clinic revision rates have revealed that clinics which had a high volume of QT graft procedures (> 100) have excellent revision rates of 0.8–2.0%. This suggests that low volume clinics have contributed to the majority of the revision cases. But this issue is presently being investigated further.