**Snoeker BA, Bakker EW, et al. Risk factors for meniscal tears: a systematic review including meta-analysis .J Orthop Sports Phys Ther. 2013 Jun;43(6):352-67.**

Design: Systematic review and meta-analysis of randomized trials, cohort studies ,and case-control studies

Research question: What are the factors that increase the risk for meniscal tears?

PICOS:

- Population: subjects over the age of 16 with knee disorders
- Intervention/exposure/potential risk factor for degenerative meniscal tears:
    - BMI
    - Age
    - Gender
    - Work-related kneeling or squatting
    - Sitting more than two hours per day
    - Driving more than 4 hours per day
    - Standing or walking more than 2 hours per day
    - Walking more than 2 miles per day
    - Climbing stairs more than 30 flights per day
    - Lifting or carrying weights more than 10 kg more than 10 times per week
    - Lifting or carrying weights more than 25 kg more than 10 times per week
    - Lifting or carrying weights more than 50 kg more than 10 times per week
    - Smoking
    - Alcohol use
- Intervention/exposure/potential risk factor for traumatic meniscal tears:
    - Weight bearing during trauma
    - Sports: soccer, rugby, running, swimming, other sports
- Intervention/exposure/potential risk factor for meniscal tears associated with knee laxity
    - Time from ACL injury to ACL surgery for medial meniscal tears
    - Time from ACL injury to ACL surgery for lateral meniscal tears
    - Joint laxity measured by hypermobility scores
- Outcomes: meniscal tears as defined by the authors of each included study
- Study types: Randomized trials, cohort studies, or case-control studies in any language
    - Studies which included subjects with previous meniscal injury or surgery were excluded

Study selection:

- Databases were MEDLINE, EMBASE, and the Cochrane Database of Systematic Reviews from 1950 through January 2012, and the reference lists of included articles were hand searched
- Two authors independently applied selection criteria to potentially relevant studies from titles and abstracts only; after the first selection, the criteria were applied to full-text articles
- Disagreements were resolved through consensus or through consultation with a third author
- Methodological quality was assessed using the Cochrane Collaboration's tool for assessing risk of bias
    - "Selection bias" was rated positive if there were systematic differences at baseline in the groups being compared
    - "Information bias" was rated positive if there were systematic differences between groups being compared
    - "Attrition bias" was rated positive if there were systematic differences between groups in withdrawals from a study
    - "Confounding bias' was rated positive if there were no adjustment made in the analysis for possible confounders
- In the data synthesis, an odds ratio of 2 or greater for any risk factor was considered to be "strong evidence," with an odds ratio between 1.5 and 2 considered to be "moderate evidence"
    - For a protective effect, an odds ratio of 0.8 or less was considered to be "strong"

Results:

- The initial search yielded 1709 studies; 52 full-text articles were assessed for eligibility, and 11 full-text articles were included for analysis; 10 of these were included in quantitative synthesis (meta-analysis)
    - There were 6 retrospective cohort studies, 3 prospective cohort studies, and 2 case-control studies in the analysis
- The risk factors with an odds ratio greater than 2 or less than 0.8 are reported below:
- For BMI, the results of 2 studies was too heterogeneous to combine into a single estimate of the effect of that risk factor, but both studies did report that a BMI over 25 was an important risk factor for degenerative meniscal tears
- For age, pooled analysis from 2 articles revealed that individuals over 60 had an odds ratio of 2.32 for degenerative meniscal tears compared to individuals under 60
- For gender, men had an odds ratio of 2.98 for degenerative meniscal tears compared to women in data pooled from 3 studies

- Work-related kneeling and squatting more than one hour per day was reported in 3 studies, whose pooled odds ratio for degenerative meniscal tears was 2.69 compared to no kneeling or squatting
- Sitting more than 2 hours, reported in 2 studies, reduced the risk for degenerative meniscal tears; the odds ratio for those who sat more than 2 hours was 0.68 compared to those who sat less than 2 hours per day
- Climbing more than 30 flights of stairs per day for at least 12 months had an odds ratio for degenerative meniscal tears of 2.28 compared to less than 30 flights per day
- Lifting or carrying weights greater than 50 kg more than 10 times per week for 12 months was reported in one study to have an odds ratio for degenerative meniscal tears of 3.0 compared to less than 50 kg
- Weight bearing during trauma was reported in one study with an odds ratio of 4.5 for acute meniscal tears compared to no weight bearing during trauma
- For two sports, an odds ratio greater than 2 was reported as a risk factor for acute meniscal tears
    - For soccer, the odds ratio was 3.58 in 2 articles
    - For rugby, the odds ratio in one study was 2.84
- The effect of joint laxity was estimated for both medial and lateral meniscal tears, using time from ACL injury to ACL surgery as an estimator of joint laxity; if ACL reconstruction was done 12 months or less from the time of injury, the case was classified as early surgery; if it was done more than 12 months after injury, the case was delayed surgery
    - For lateral meniscal tears, data pooled from four studies did not have an overall significantly increased risk with delayed compared to early surgery
    - For medial meniscal tears, data were pooled from four studies with an overall odds ratio of 3.50 (95% confidence interval from 2.09 to 5.88) when surgery was delayed compared to when it was done early

Authors' conclusions:

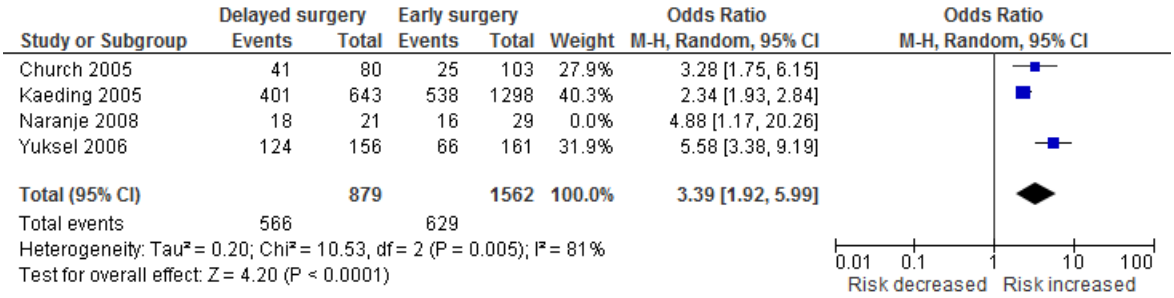
- Age, male gender, work-related kneeling and squatting, and climbing more than 30 flights of stairs are risk factors for degenerative meniscal tears (at least doubling the risk), and BMI over 25 is also a likely risk factor
- For acute meniscal tears, playing soccer and rugby at least double the risk
- Waiting longer than 12 months more than doubles the risk of a later medial meniscal tear, but does not significantly increase the risk of a lateral meniscal tear
    - This may be related to the fact that the lateral meniscus is not as firmly attached to the joint capsule as the medial meniscus, making it more mobile
- All findings are limited by the small number of studies available for the analyses undertaken

Comments:

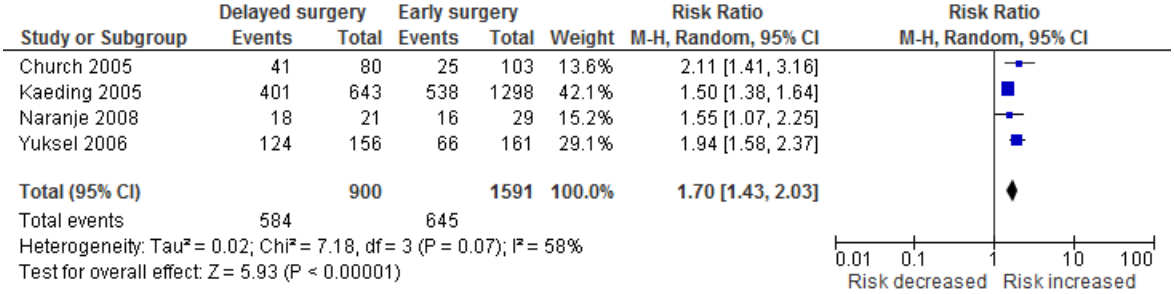
- For most of the identified risk factors with a doubling of the odds ratio, there are reasonably plausible mechanisms of injury
- The figures in the meta-analysis section are labeled “cases” and “controls” even though most of the studies are cohort studies and several figures could better be labeled “exposed” and “unexposed”
- An odds ratio of more than 2 was required for a risk factor to be strong, but an odds ratio less than 0.8 was the threshold for a factor to be strongly protective
    - This is problematic, since the reciprocal of 0.8 is 1.25, which would give the presence of the factor an odds ratio of 1.25 increasing the risk of a meniscal tear
    - To be compatible with an odds ratio of 2 or more for increased risk, a protective factor would have to have an odds ratio of 0.5 or less
    - Few “protective” factors were identified, none with an odds ratio less than 0.5, so this discrepancy may not invalidate the results of the analyses
- The four studies in the analysis of early versus delayed ACL surgery differed in population and in the purpose of the studies
    - Naranje 2008 probably should have been omitted from the analysis, since it was primarily about the predictive value of MRI for arthroscopic findings, and did not divide meniscal lesions into time periods of 12 months or less versus 12 months or more from injury
        - The authors may have extrapolated from Naranje’s table 1, which divides the time periods into 10 months intervals
    - The four studies report on patients who had ACL surgery at various times, but not on patients who had ACL tears managed conservatively
        - It would be possible to follow non-operatively treated patients with MRI and symptom reporting to estimate the presence of medial meniscal injury
    - The reasons for delayed surgery was not always clear
        - Church 2005 reported on 183 patients who had surgery and the Edinburgh Royal Infirmary between 1996 and 2002; some had surgery within 12 months and others had it later, but there is no description of the factors that led to delay
        - Kaeding 2005 also only reported that some operations were done earlh and others done later (after one year)
            - Although Kaeding reported on multiligamentous tears, the meta-analysis only used the data on those with isolated ACL tears in order to maintain comparability between studies
        - Yuksel et al did report on the reasons for delayed surgery
            - The setting was a military population in Turkey; the delayed surgery group had been recommended for earlier surgery but

chose not to undergo the operation and not to alter their daily activities

- All four studies of the timing of ACL surgery did report an increased risk of medial meniscal tears when surgery was done after 12 months versus when it was done earlier
- A potential unmeasured confounder could be injury severity; however, it is expected that the more severe knee injuries would fall into the early surgery groups, meaning that the direction of unmeasured confounding would not undermine the association between delayed surgery and meniscal tears
- When the Naranje 2008 study is omitted from the meta-analysis because the focus of the study made its suitability dubious (and the data appear to have been extrapolated by Snoeker ) the forest plot does not appreciably differ from that in Snoeker's Figure 8; the pooled odds ratio is 3.39 instead of 3.50




- In a separate systematic review of operated versus nonoperated ACL tears, Chalmers 2014 reported increased meniscal surgery in nonoperated versus operated knees
- Odds ratios tend to inflate relative risks when the prevalence of the outcome of interest is very common; if the meta-analysis is done on relative risks rather than odds ratios, the magnitude of the effect changes from 3.50 to 1.70




- The association between delayed ACL surgery and later development of osteoarthritis cannot be inferred from the available data, but the association with medial meniscal tears appears to be fairly robust

Assessment: Adequate meta-analysis of observational studies providing good evidence for an increased risk of degenerative meniscal tears with age over 60, BMI over 25, male gender, work-related kneeling and squatting, and climbing greater than 30 flights of stairs, and for an increased

risk of acute tears with soccer and rugby. Adequate for good evidence that medial meniscal tears are more commonly present when ACL reconstruction is done more than 12 months after injury than when it is done within 12 months of injury

References:

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