Evaluating the Impact of Graft Tensioning and Leg Positioning in Medial Patellofemoral Ligament Reconstruction on Patellofemoral Pressure Profile: A Systematic Review and Meta-analysis

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Presenter Disclosure Information

- Consultant: Arthrex

Presentation Overview

- Introduction to patellar instability and MPFL reconstruction

- Purpose and Methods

- Key findings

- Limitations

Patellar instability and MPFL reconstruction

- Patellofemoral instability is a prevalent condition, accounting for approximately 3% of all knee injuries

- The medial patellofemoral ligament (MPFL) is an essential component of the medial patellofemoral complex

- MPFL reconstruction is the mainstay of the surgical treatment of patellar instability

- Restoration of patellar kinematics is based on three factors

Patellar instability and MPFL reconstruction

- Positioning - Precise graft placement is vital for restoring normal, isometric, patellar tracking and joint mechanics. Malpositioning can lead to pain and recurrent instability

- Pre-Tension - Applying appropriate initial tension mimics the native ligament without over-constraining the joint, which could otherwise alter pressure and cause complications

- Length - The correct functional graft length, influenced by positioning and tension, is essential for stability and preventing excessive joint pressure.
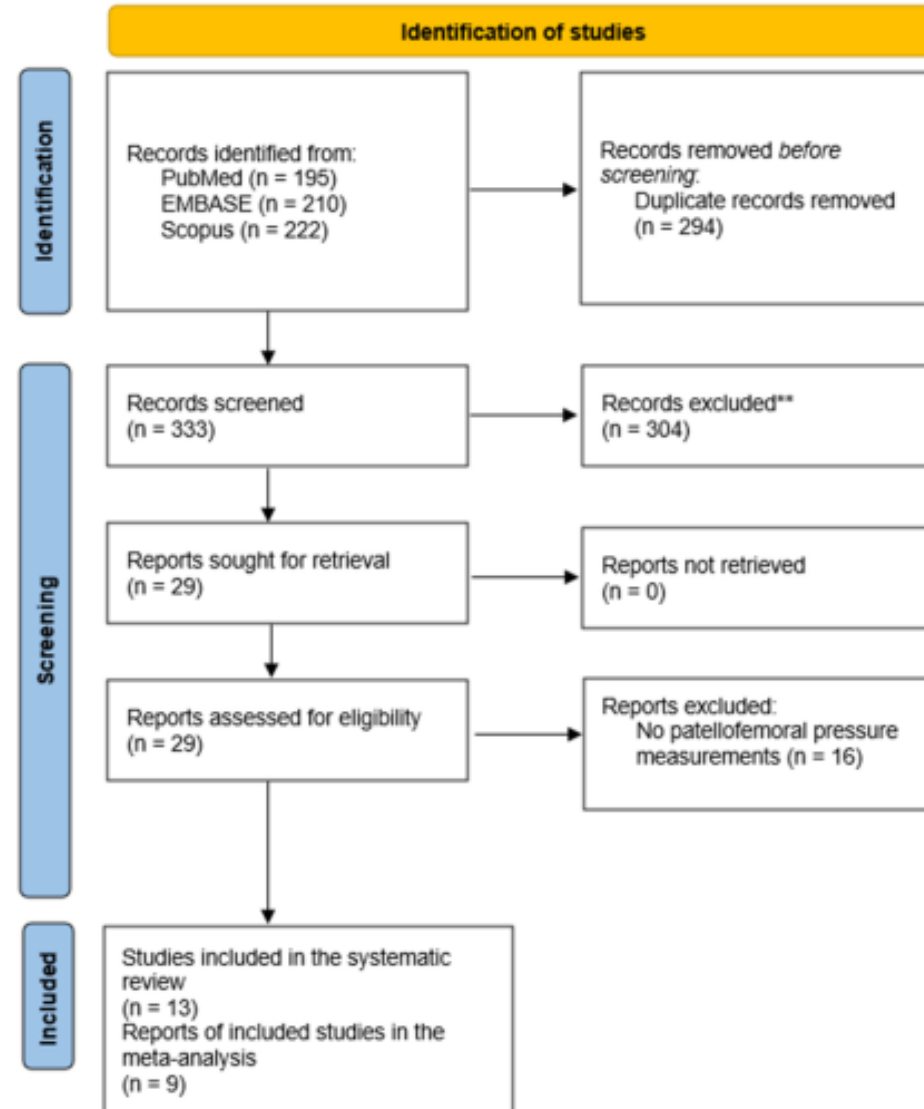
Purpose

- Primary - systematically review the effects of pretension on patellofemoral pressure distribution

- Secondary - determine which flexion angle at fixation allows for the most reliable restoration of patellofemoral kinematics and mechanics

- Hypothesis - MPFL reconstruction with lower levels of graft pretension (≤10 N) and graft fixation at moderate knee flexion angles (30°-60°) will most closely restore native patellofemoral pressure distribution

Methods

- A systematic literature review was performed based on the PRISMA statement

- Screening and data extraction were performed by two assessors, with a third author resolving discrepancies

- The methodological quality of the included articles was assessed using the Quality Appraisal for Cadaveric Studies (QUACS) scale, a validated 13-item checklist

- The data were analyzed using the latest version of OpenMeta[Analyst]. Data were divided based on the pretension applied at MPFL reconstruction: 2 N, 10 N, and 10+ N

Methods – PRISMA flow chart

Identification of studies

Identification

Records identified from:
PubMed (n = 195)
EMBASE (n = 210)
Scopus (n = 222)

Records removed *before screening*:
Duplicate records removed
(n = 294)

Screening

Records screened
(n = 333)

Records excluded**
(n = 304)

Reports sought for retrieval
(n = 29)

Reports not retrieved
(n = 0)

Reports assessed for eligibility
(n = 29)

Reports excluded:
No patellofemoral pressure measurements (n = 16)

Included

Studies included in the systematic review
(n = 13)
Reports of included studies in the meta-analysis
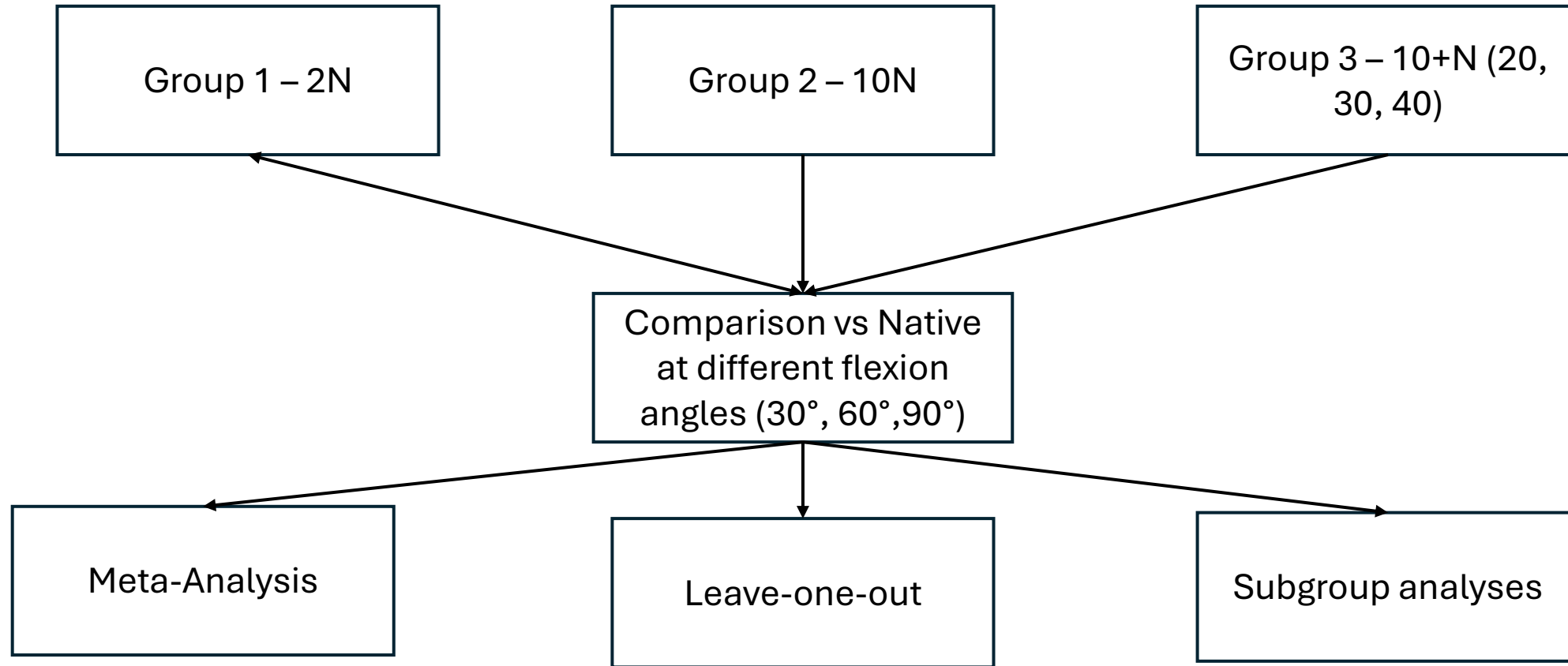(n = 9)

Methods – Data Extraction

- Data from tables were extracted directly, while WebPlotDigitizer and an R package were used for X-Y and bar graphs

- Standard deviations (SD) were extracted if available, calculated, or imputed in one case following Cochrane guidelines

Methods – Statistical Analysis

- Data were grouped by MPFL graft pretension (2N, 10N, 10+N) and compared to native knees across different flexion angles

- A meta-analysis determined the main outcomes, with leave-one-out and subgroup analyses performed to ensure the results' robustness

Methods – Statistical Analysis

84 Knees in total qualified for quantitative analysis (of 120)

Group 1 – 2N	Group 2 – 10N	Group 3 – 10+N (20, 30, 40)

Comparison vs Native at different flexion angles (30°, 60°,90°)

Meta-Analysis	Leave-one-out	Subgroup analyses

*Fixed and Random effects models were chosen by the I^2 value (50%)

**α=0.05

Key Findings

- The study found no statistically significant difference in patellofemoral pressure between native and MPFL-reconstructed knees across various flexion angles (30°, 60°, 90°) and pretension levels (2 N, 10 N, 10+ N)

- Most papers fixated the graft with leg flexed at 30° (10/11)

- While overall analysis showed no significant pressure difference at 30° and 90° flexion with 10+ N pretension, sensitivity analysis suggests a trend of higher tensions (especially 40 N) potentially increasing patellofemoral pressure, indicating a possible "dose-dependent" relationship above 10 N

- The methodological quality of the included studies was generally high, as assessed by the Quality Appraisal for Cadaveric Studies (QUACS) scale. Eleven (84.6%) of the 13 studies received a rating of "excellent" (>80%), and two were rated as "substantial" (>60%)

Limitations

- Cadaveric studies may not fully replicate in vivo conditions

- Sample sizes in some included studies were relatively small

- Data extraction from graphs using tools like WebPlotDigitizer could introduce inaccuracies

- The subjective nature of some criteria in the QUACS scale, which could lead to variability in quality ratings despite the generally high scores.

Thank you!

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