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Joint line obliquity can increase meniscus root tension

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Disclosure Information

- Nothing to disclosure



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Introduction

There is no consensus on the limits of joint line obliquity (JLO) following high tibial osteotomy (HTO), beyond which double-level osteotomy may be indicated.

JLO causes medial-lateral tibiofemoral subluxation that may be resisted by the menisci, but that role has never been studied.

The objective was to measure meniscus posterior root tension, tibiofemoral medial-lateral subluxation and changes of peak articular pressure, and how they are affected by JLO.

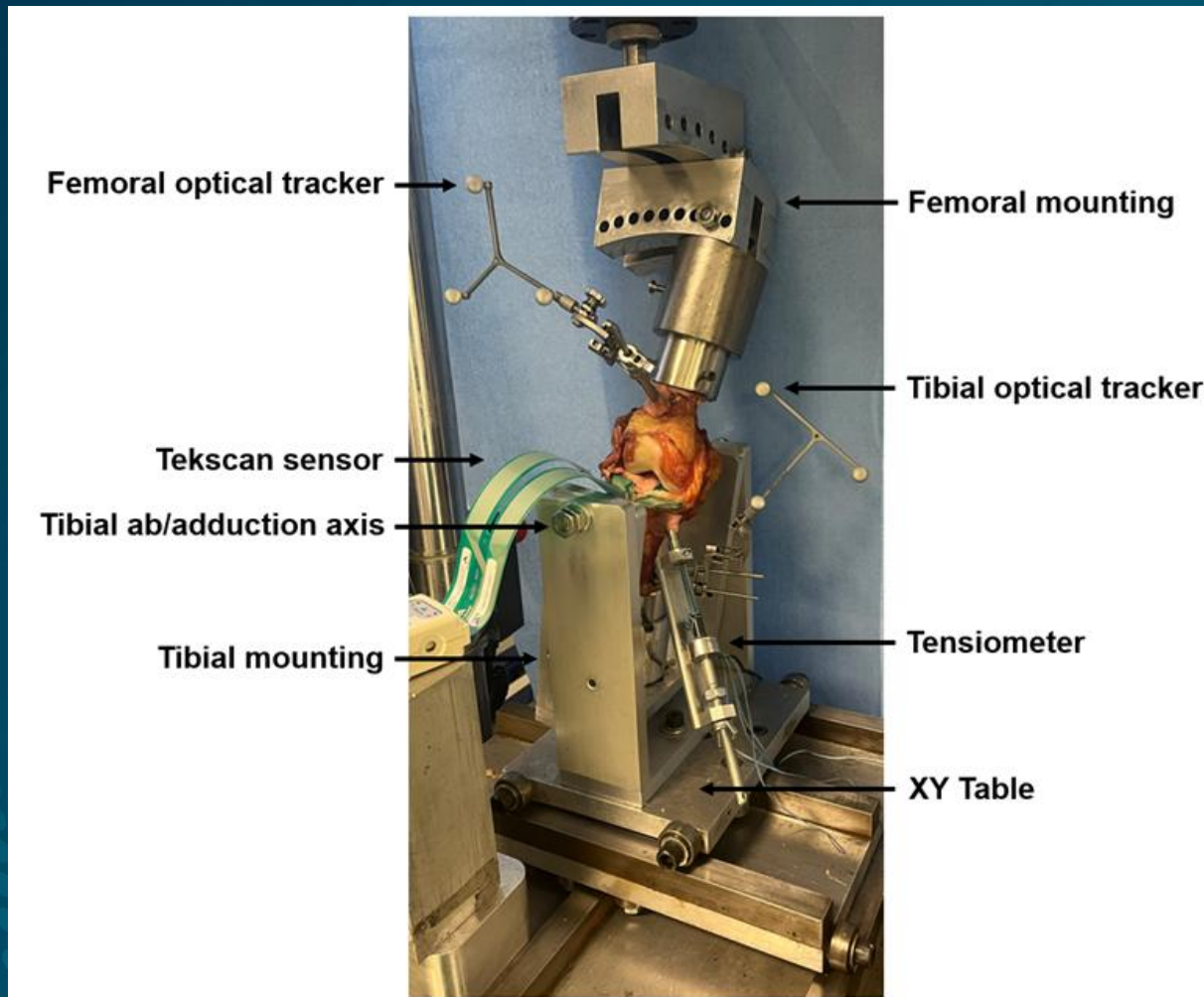


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Experimental setup of a right knee



Eight knee specimens were mounted in a custom-built fixture in a compression loading machine with the native 4° medial downslope. A range of JLO from 12° medial (varus) to 16° lateral (valgus) downslope were created by tilting the load axis.

Mediolateral subluxation was measured optically. Peak articular contact pressures were measured using Tekscan sensors inserted sub-meniscally.

The posterior medial or lateral meniscus root was transected and repaired using suture tapes through a transosseous tunnel then attached to a tensiometer mounted at the tunnel entrance.

The repair was tensed 30N with the knee preloaded 100N, then the tension with 2xBW was measured. This was repeated for both medial and lateral downslopes and both menisci, at both 0 and 20° flexion. Data were analyzed using Shapiro-Wilk tests, 2-way RM-ANOVA and RM-t post-tests.

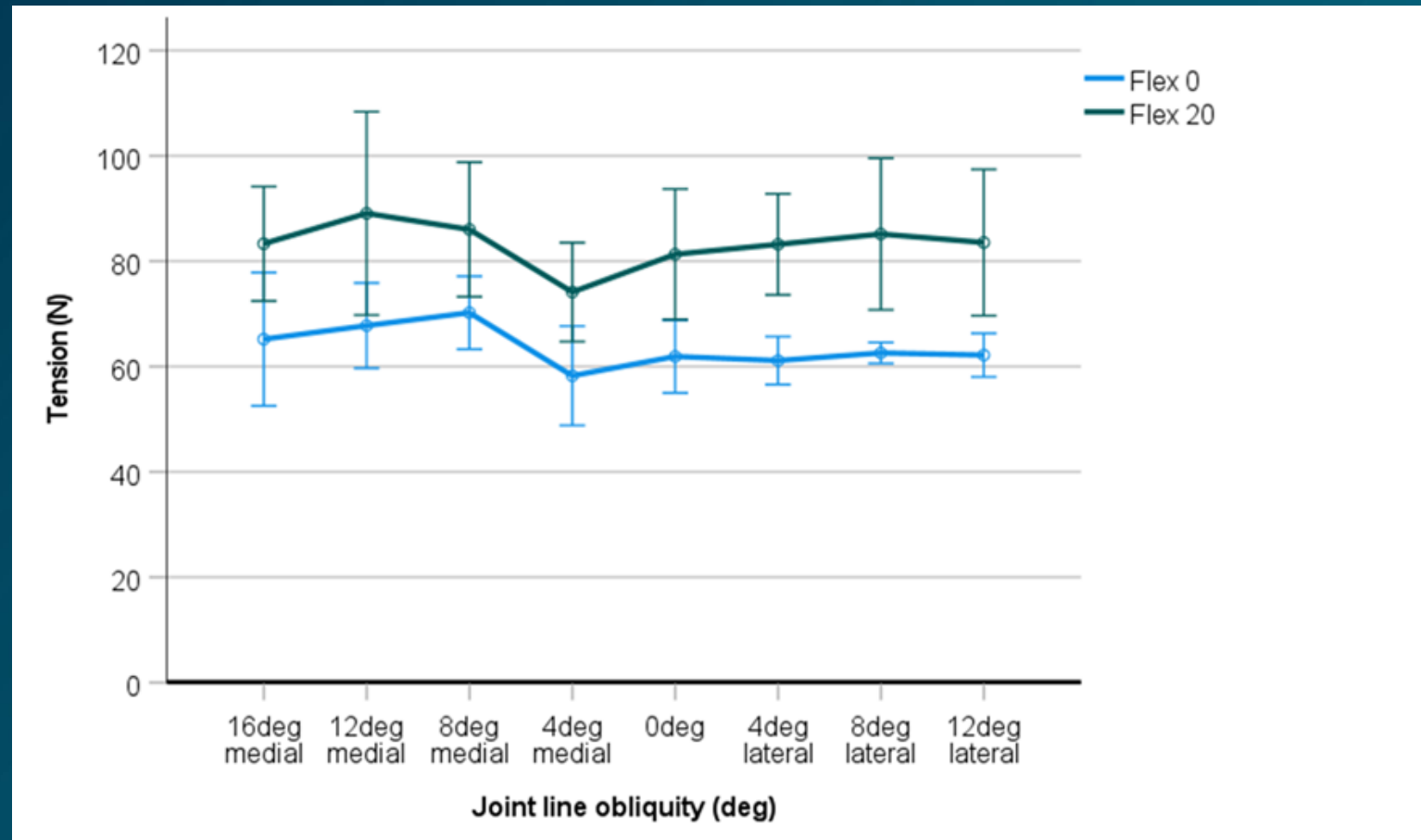


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Tension of the sutures securing the posterior horn of the medial meniscus



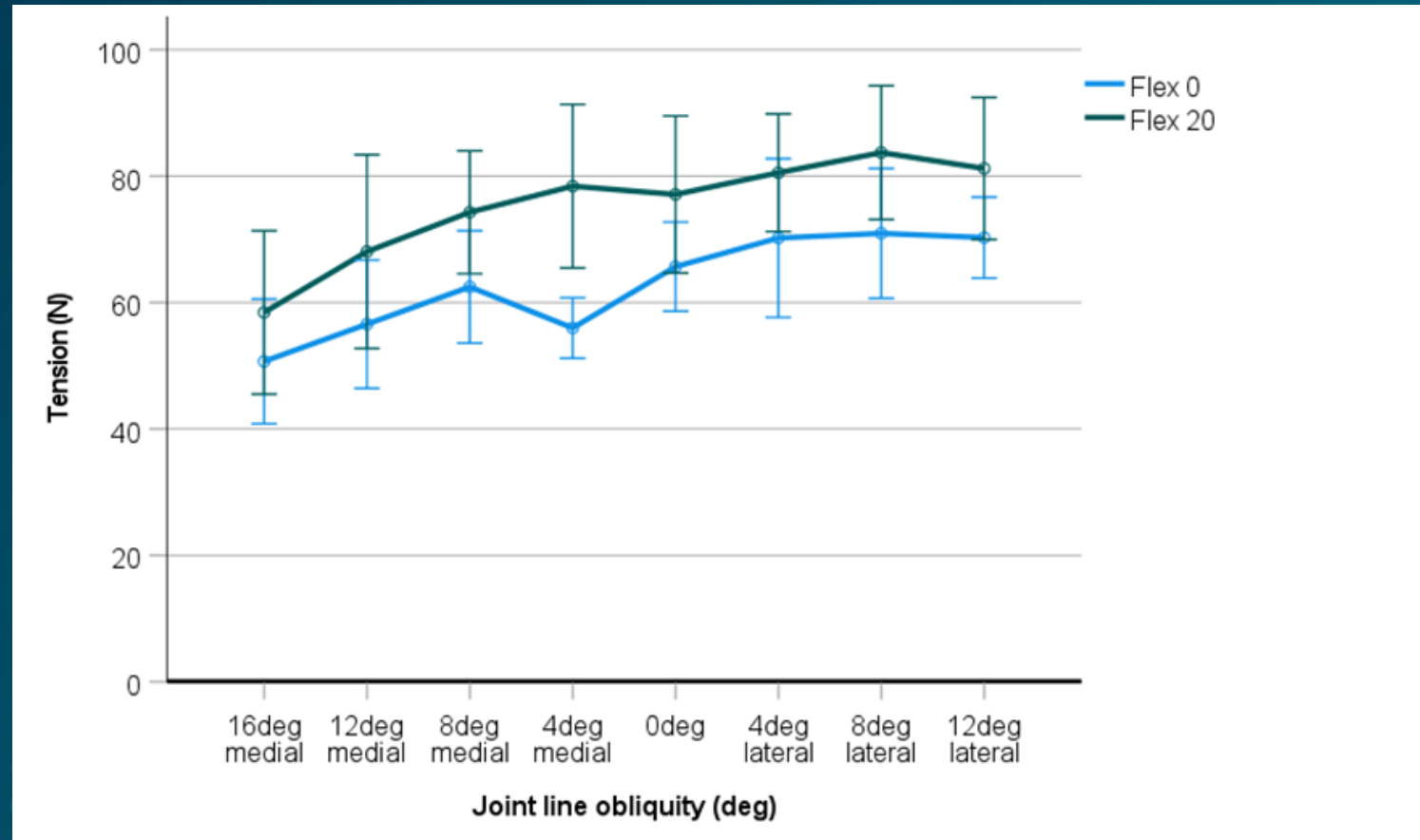
There was no interaction between knee flexion angle and JLO ($P = 0.65$), that is: the suture tension varied the same way at both 0° and 20° flexion.

The tension at 20° flexion was higher than in full extension for all JLO: MM: 64 ± 9 (43 – 82) N at 0° flexion, versus 83 ± 15 (54 – 134) N at 20° flexion ($P < 0.001$).

Although there were significant effects on suture tension as JLO varied, it did not have a large overall effect on tension in the MM sutures, which at 20° flexion was 83 ± 11 N at 16° medial JLO and 84 ± 14 N at 12° lateral JLO.



Tension of the sutures securing the posterior horn of the lateral meniscus



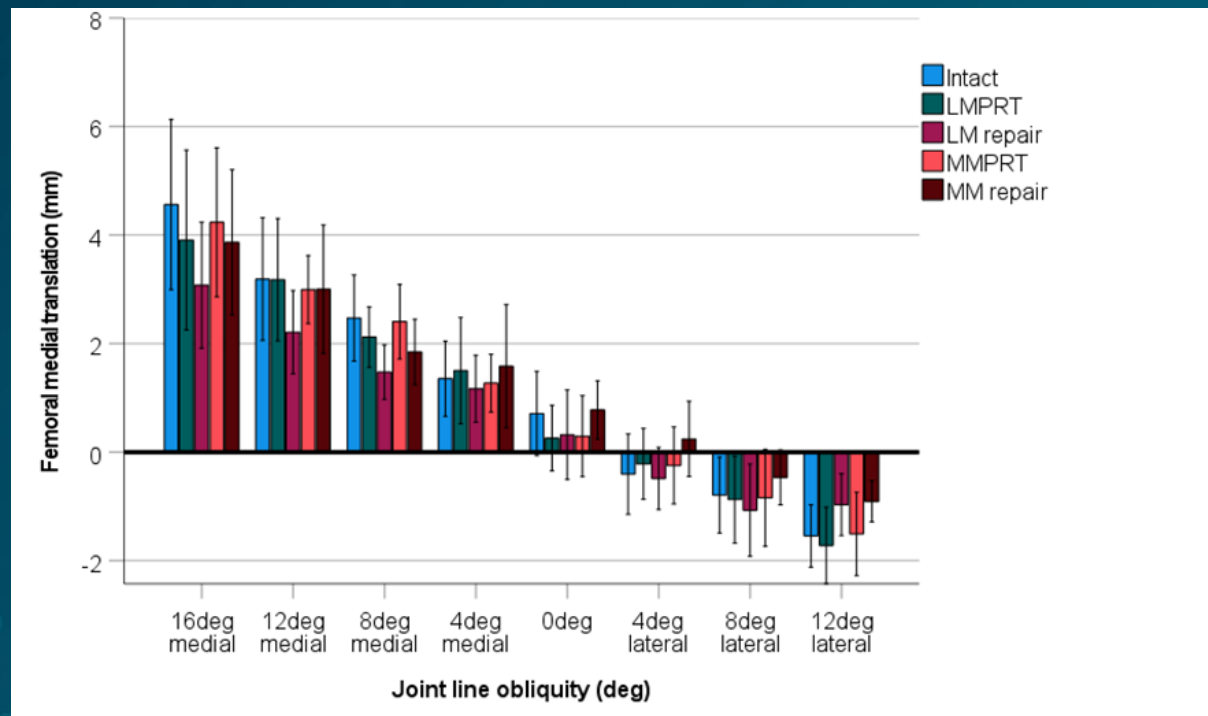
There was no interaction between knee flexion angle and JLO for the lateral meniscus ($P = 0.15$).

The LM suture tension at 20° flexion was higher than in full extension: 63 ± 13 (39 – 101) N for all JLO at 0° flexion, versus 75 ± 16 (40 – 100) N at 20° flexion ($P=0.006$).

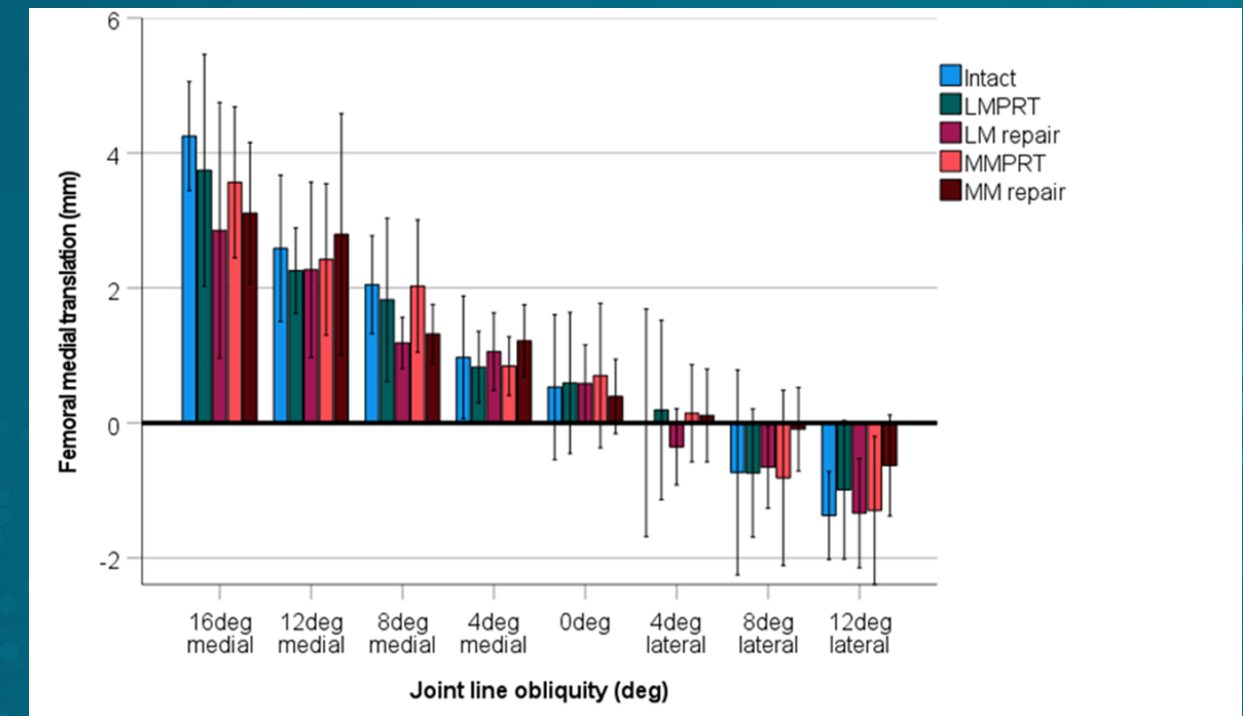
The LM suture tension reduced with a medial downslope and increased with a lateral downslope: 55 ± 14 N at 16° medial JLO versus 76 ± 12 N at 12° lateral JLO ($P=0.016$), with other significant differences among the intermediate JLO. Changing from the native state (4° medial slope) to 12° lateral slope caused the suture tension to rise from 67 ± 16 N to 76 ± 12 N ($P=0.005$).

Medial-lateral translation of the femur relative to the tibia in each meniscus status

Full extension



20° flexion



The application of joint load caused the femur to translate laterally across the tibial plateau in the presence of a lateral downslope JLO, and vice-versa. The presence or absence of a meniscus root transection had no effect on tibiofemoral ML translation.



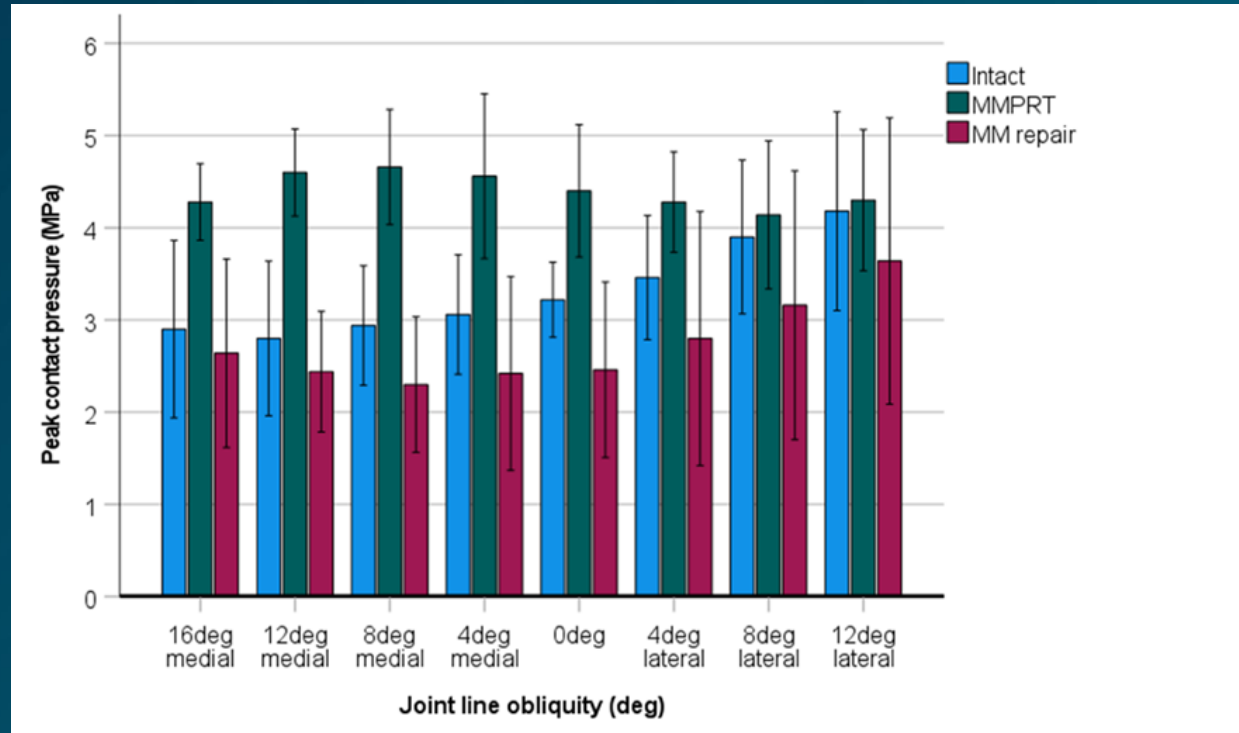
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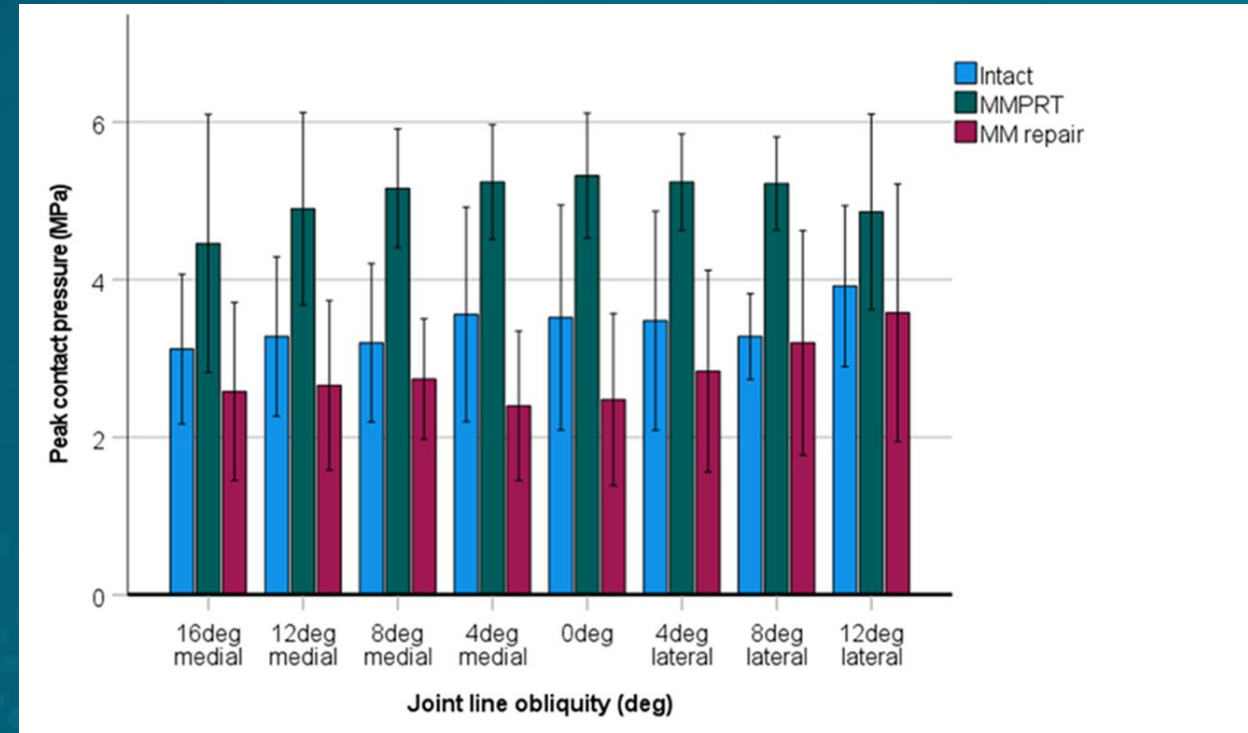
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Peak contact pressure in medial compartment

Full extension



20° flexion



In the medial compartment at 0° and 20° flexion, there was no difference in PCP amongst the JLOs. The PCP was higher post MMPRT compared to intact. The PCP was reduced post MM root repair.



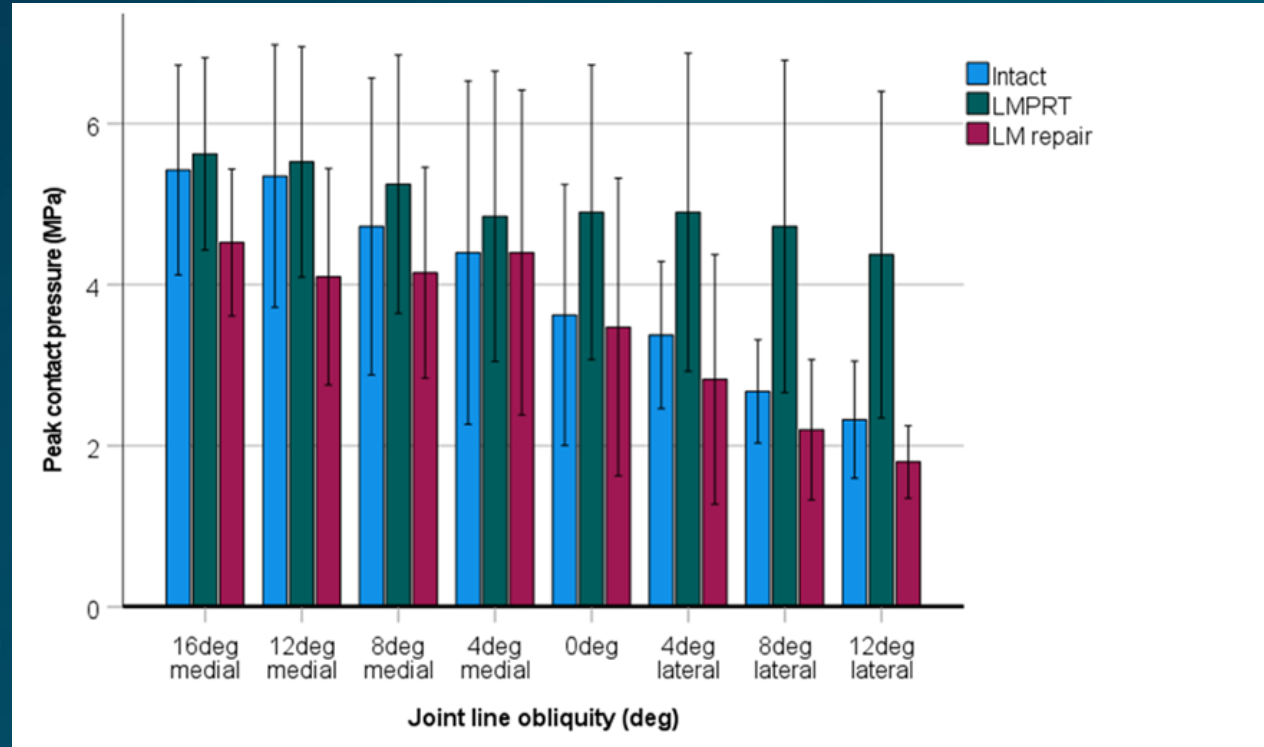
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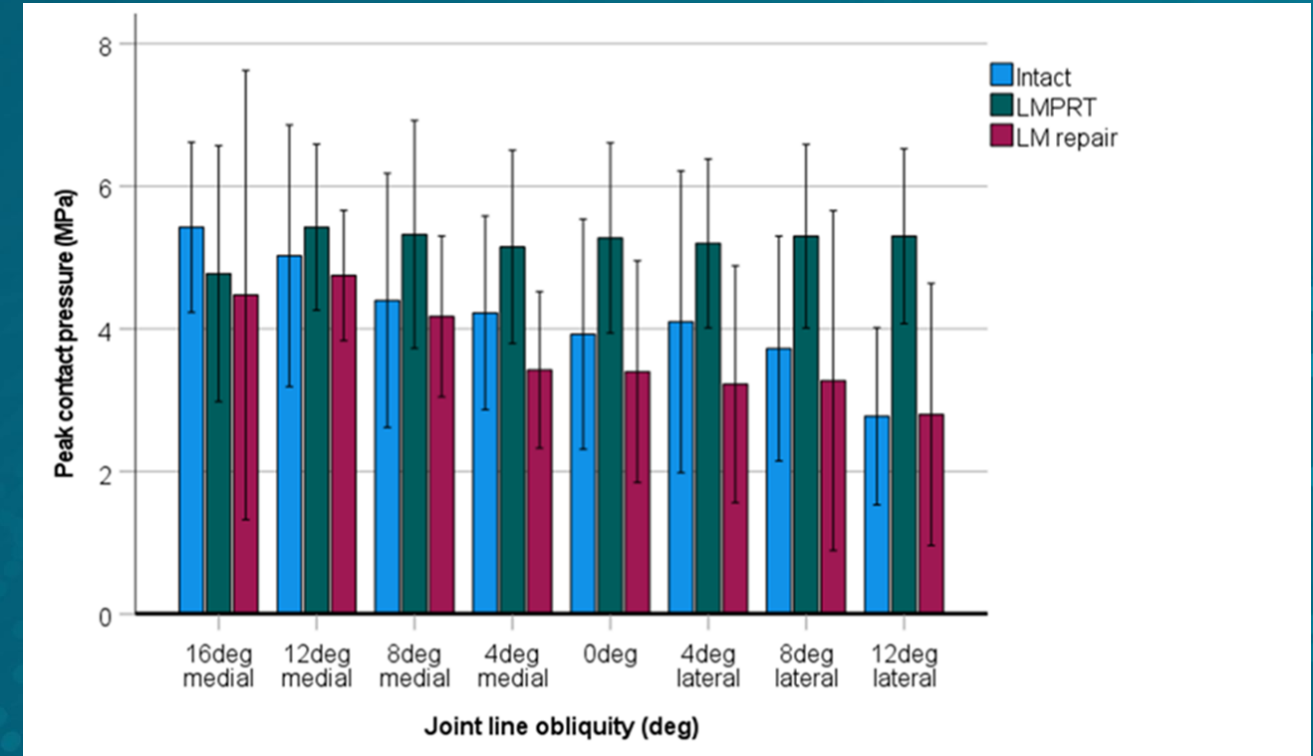
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Peak contact pressure in lateral compartment

Full extension



20° flexion



In the native lateral compartment, the PCP reduced progressively as the JLO varied from 16 medial to 12° lateral. The LMPRT had little effect on PCP with a medial JLO. The LM root repair reduced the PCP.



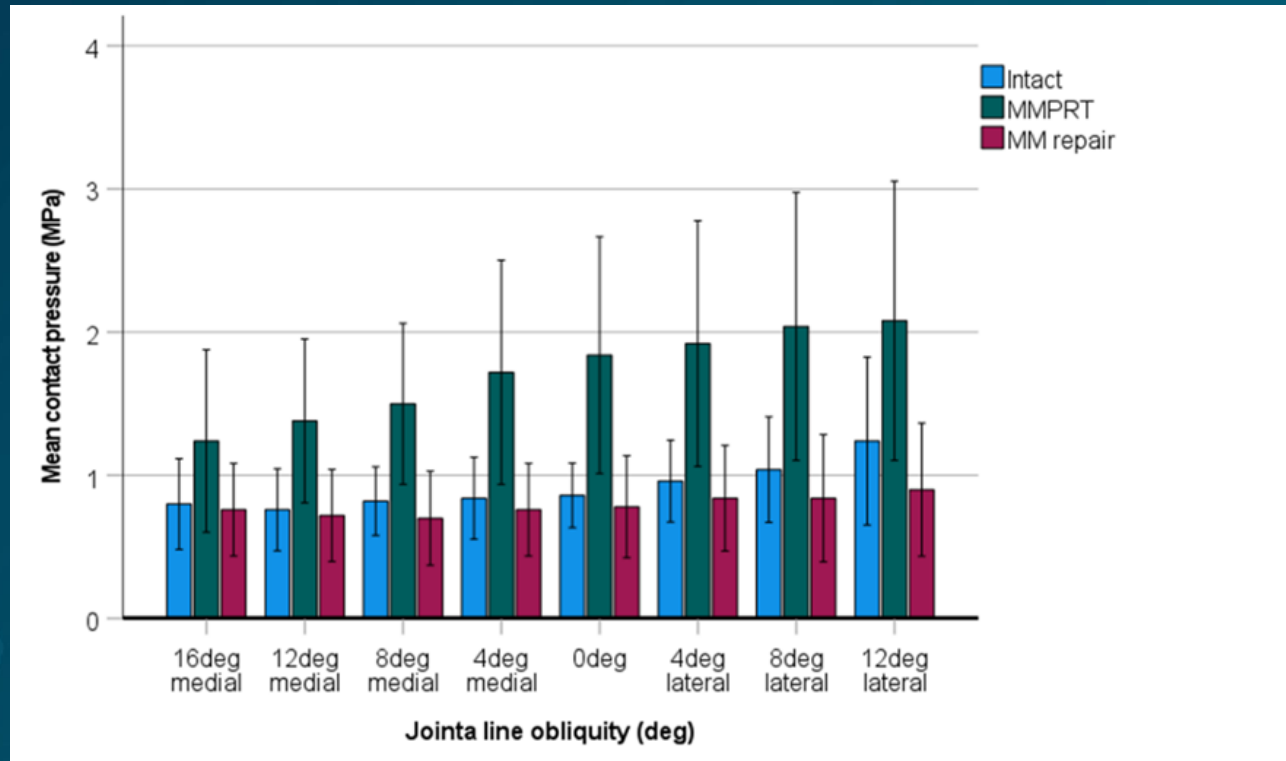
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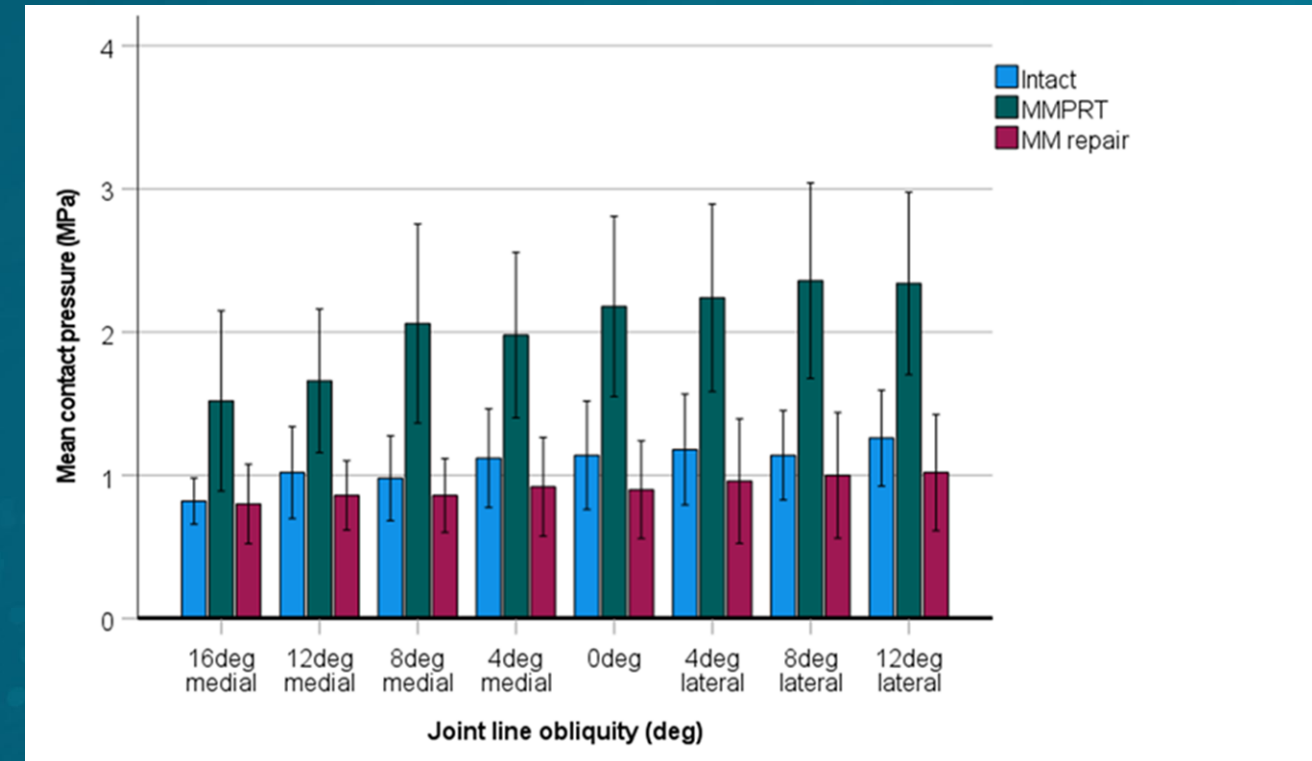
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Mean contact pressure in medial compartment

Full extension



20° flexion



For the medial compartment, there was little variation in mean contact pressure (MCP) with changes of JLO for each meniscus status.



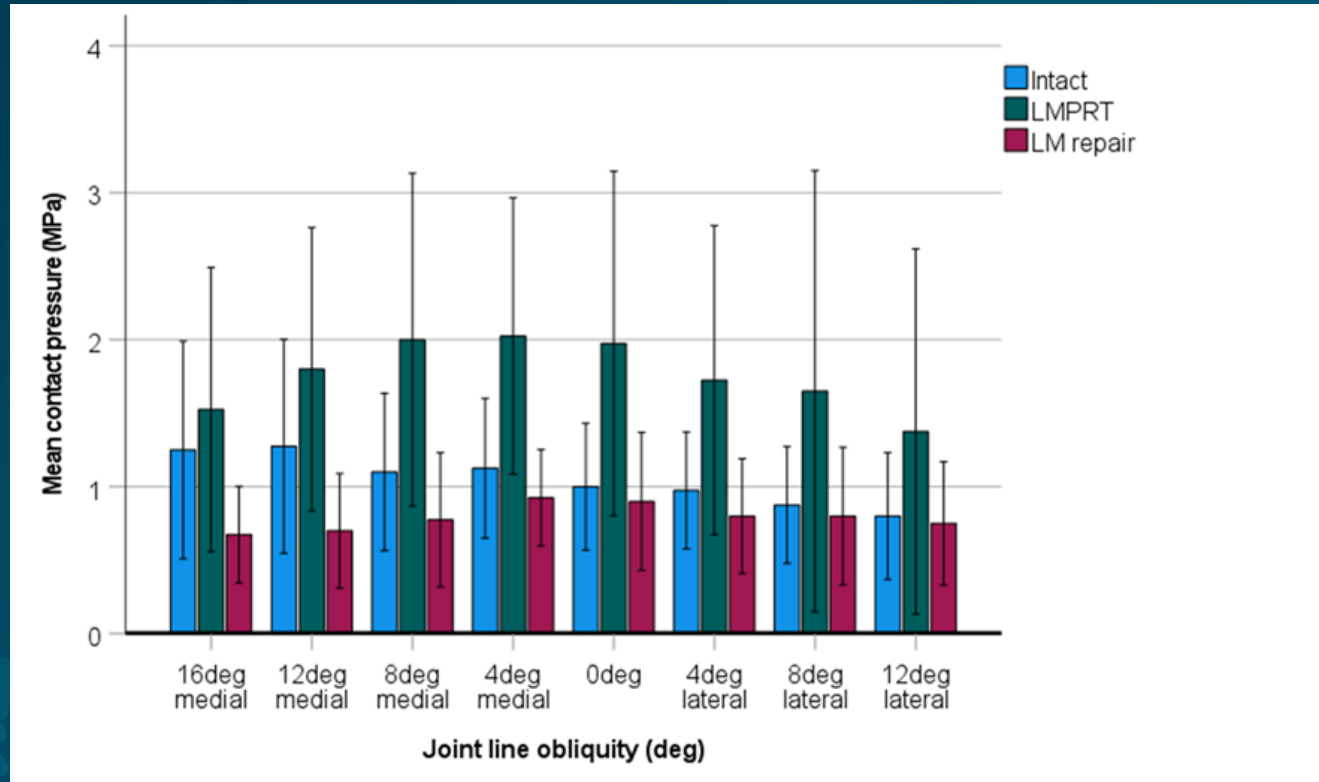
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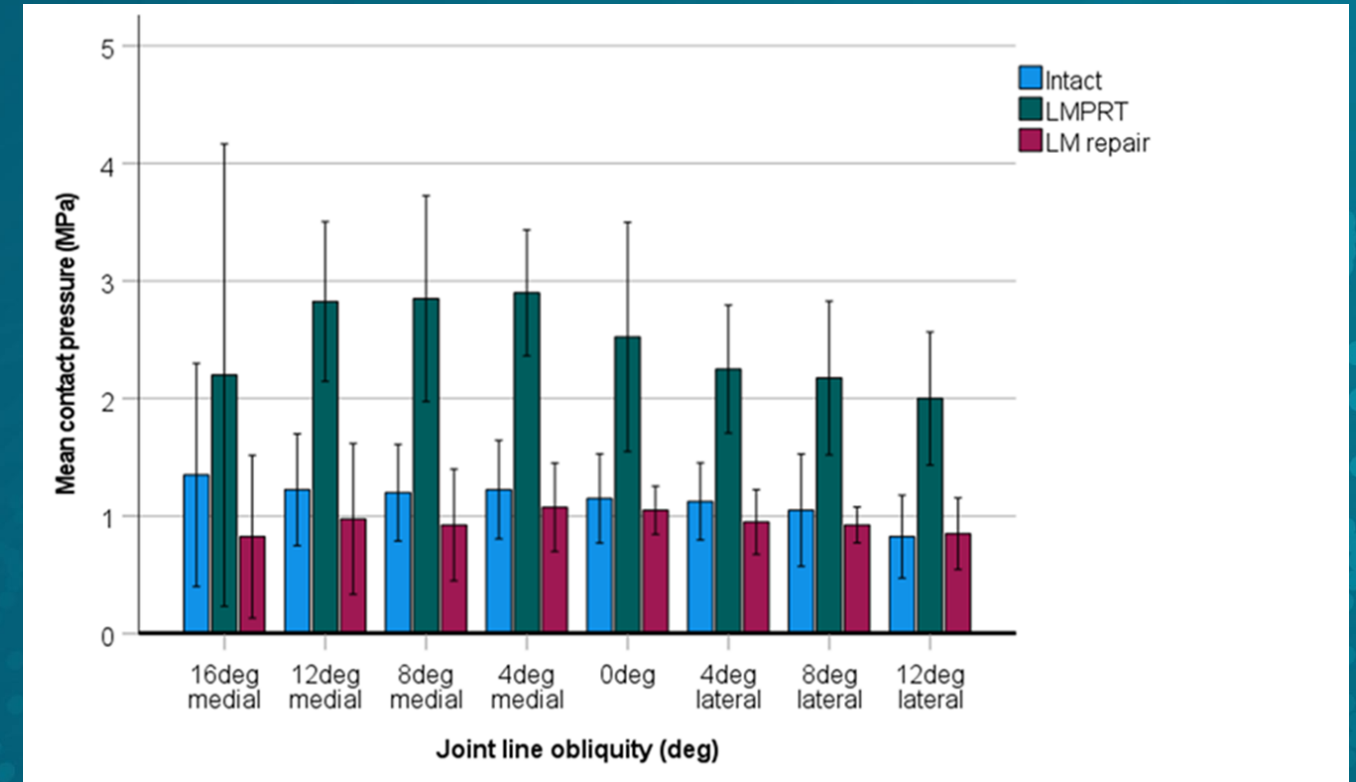
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Mean contact pressure in lateral compartment

Full extension



20° flexion



In the lateral compartment at both full extension and 20° of flexion, there were no differences of MCP across the range of JLO examined and for each meniscus status.



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Discussion

A 12° lateral JLO caused a significant increase in suture tension in the LM versus the native 4 °medial JLO. Conversely, JLO did not have a large overall effect on tension in the MM sutures across the range examined.

The femur translated laterally across the tibial plateau in the presence of a lateral downslope JLO, and vice-versa

In both the medial and lateral compartments at 0° and 20° flexion and at all JLO tested both the mean and peak contact pressures increased with MMPRT and were consistently restored to slightly below native values post root repair.

Overall, changing the JLO did not have a significant effect on the PCP in the medial compartment. The PCP in the intact lateral compartment decreased with lateral JLO, and vice-versa with medial JLO.



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Conclusion

Articular contact stresses were affected significantly by changes of JLO, those changes were smaller than those following meniscal root transection.

Beyond 8° lateral JLO, the contact stress was significantly above that with native 4° medial downslope.

Root repairs reversed contact pressure increases following root transection at all JLO tested.

I'm happy to discuss my work face to face, or please contact me.

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