Inside-Out or Outside-In Suturing Should Not Be Considered the Standard Repair Method for Radial Tears of the Midbody of the Lateral Meniscus: A Systematic Review and Meta-Analysis of Biomechanical Studies

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Abstract

The purpose was to evaluate which meniscal repair technique for radial tears of the midbody of the lateral meniscus demonstrates the best biomechanical properties. An electronic literature search was conducted using PubMed, EMBASE, CINAHL, and ScienceDirect databases. Biomechanical studies investigating the repair characteristics of radial tears in the midbody of the lateral meniscus were included. After appropriate screening, a total of 54 studies were reviewed in detail (full text), and 6 met inclusion criteria. The most common cause of exclusion was the investigation of longitudinal tears. Only two studies could be meta-analyzed. Stiffness was significantly higher for all-inside compared with inside-out repair techniques ($p = 0.0009$). No significant differences were observed between both suture methods for load to failure ($p = 0.45$). However, both studies used different all-inside devices and suture constructs. No clear conclusions can be drawn from the comparison of both types of repairs for displacement, site of failure, or contact pressure changes. Overall, there are no conclusive data to suggest that inside-out or outside-in suture repair has better load to failure or stiffness, less displacement, or different site of failure compared with all-inside repair. According to biomechanical data, it is under surgeon's preference to elect one repair technique over the other.

Keywords
- lateral meniscus
- meniscal repair
- radial tear
- biomechanics

Meniscal tears are common knee injuries in young and active individuals. While meniscectomy has been advocated as the treatment of choice for many years, the management of meniscal tears has more recently trended toward meniscal preservation.[1] It has been observed that removing meniscal tissue is a precursor to mid- and long-term morbidities, including early onset of knee osteoarthritis.[2,3] This undesired consequence of meniscectomy is explained by the fact that complete radial tears and total meniscectomy of the lateral meniscus cause a significant increase in mean contact pressure and decrease in contact area.[4] It has been observed that these changes are more pronounced after lateral meniscectomy as compared with medial meniscectomy.[5] Postmeniscectomy early-onset knee osteoarthritis is especially concerning considering that most of the acute, reparable meniscal tears occur in young and active patients. In addition,

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meniscal repair has overall demonstrated better long-term functional and radiographic outcomes compared with meniscectomy.[6–8] Therefore, meniscal repair should be attempted whenever possible, especially in cases of injury to the lateral meniscus.

The investigation of biomechanical properties of meniscal repairs has significantly increased in the past 15 years.[9] Several studies have compared different repair methods, types of devices, and suture constructs.[9] A general conclusion has been that suture repair through inside-out or outside-in technique is the standard method for meniscal repair, and that the load to failure of a vertically oriented suture configuration is higher as compared with a horizontal configuration.[9] However, the vast majority of studies have included repair of longitudinal body-posterior horn tears, bucket-handle tears, or medial meniscus repairs. Therefore, it is pertinent to investigate if suture repair (inside-out or outside-in) should be considered the standard for repair of radial tears of the lateral meniscus.

The principal purpose of this systematic review and meta-analysis was to evaluate which meniscal repair technique for radial tears of the body of the lateral meniscus demonstrates the best biomechanical properties. We hypothesized that inside-out or outside-in suture repair was not associated with better biomechanical properties compared with all-inside repair devices for radial tears of the lateral meniscus.

Methods

The methodology of this study was reported following the PRISMA Statement for systematic reviews and meta-analyses.[10]

Eligibility Criteria

All studies investigating the biomechanical characteristics of repair involving radial tears of the lateral meniscus were evaluated for eligibility. Studies were included if they were: controlled laboratory biomechanical studies, written in English language, involving either human or animal specimens, involved a radial tear of the body of the lateral meniscus, and contained information on the biomechanical characteristics of any kind of repair. Studies involving the repair of radial tears of both menisci were only included if they provided enough information on biomechanical characteristics of the lateral meniscus. Clinical therapeutic, prognostic, or diagnostic studies were not included in this systematic review. Related review articles, systematic reviews, and meta-analyses were not included, but reference lists were examined to ensure completeness of relevant studies.

Information Sources and Search

A systematic electronic literature search was conducted in December 2014 using the PubMed (MEDLINE), EMBASE, CINAHL, and ScienceDirect databases. This was performed by one of the authors with experience on comprehensive, multiple database–based, electronic literature searches. The search strategy was aimed to provide a broad output. The terms employed in this study were: (meniscus OR meniscal OR menisci) AND (repair OR suture) for title, abstract, and keywords without limits on publication year or type of study. The reference lists of all included articles and review articles were reviewed to search for potential studies not previously identified.

Data Selection

The selection of studies was conducted through a two-phase process. All titles and abstracts were read (first phase) and articles of potential interest were reviewed in detail (full text; second phase) by one of the authors to decide on inclusion or exclusion from this systematic review. The study selection was then verified by another author. The study selection process and studies finally included in this study were reviewed and discussed with a third author to ensure adequacy of methodology and appropriateness for the present systematic review. In cases when relevant information was missing from the studies for determination on the inclusion or exclusion from this study, we requested information directly from the studies' authors.

Data Collection

For all included studies, the following information was collected in a summary table: reference, characteristics of the specimens (species, total number of specimens used, mean age in human specimens only), repair methods (all-inside, inside-out, outside-in, type of suture used, shape of the repair construct), assessment method, biomechanical outcomes, and key findings.

Data Analysis

Descriptive statistics were used to summarize the biomechanical outcomes of the included studies. A meta-analysis for studies comparing the all-inside and inside-out meniscal sutures was conducted for load to failure (N) and stiffness (N/m). The I^2 heterogeneity index was used to determine the meta-analysis model for continuous variables (load to failure and stiffness): for I^2 between 0 and 40%, the fixed-effects model was used; for I^2 between 40 and 60%, the random-effects model was used.[11,12] In both cases, the inverse variance statistical method was employed, with standard mean difference (95% confidence interval) as the effect measure. In cases of I^2 greater than 60%, the meta-analysis was not conducted if it only involved less than three studies.[11,12] A forest plot was used to represent the meta-analysis. The statistical analysis was conducted with RevMan 5.3 (Copenhagen: The Nordic Cochrane Centre, The Cochrane Collaboration, 2014).

Results

Study Selection

The literature search using the four databases elicited a total of 5,640 references. After title/abstract screening, 5,586 references were excluded (►**Fig. 1**). A total of 54 studies were reviewed in detail (full text), and 6 met inclusion criteria (►**Fig. 1**).[4,13–17] The most common cause of exclusion was the investigation of longitudinal meniscal tears.

Characteristics of the Studies

Of the six studies, three were human specimens (one fresh and two fresh-frozen)[4,16,17] and three porcine fresh-frozen specimens.[13–15] The types of meniscal repair were summarized in four items: (1) type of device-suture repair used (all-inside or inside-out/outside-in); (2) direction of the suture from entry point in the meniscus to the suture anchorage with respect to the meniscal tear (perpendicular, oblique, or parallel); (3) orientation in a cross-section of the meniscus (vertical or horizontal); and (4) appearance from an intra-articular view (negative-sign [for one stitch] or equal-sign [for two stitches] shaped, z-shaped, or x-shaped). The types of constructs that have been biomechanically tested have been summarized in ►**Fig. 2**. Four studies reported the outcomes as load to failure, stiffness, displacement, and site of failure,[13–16] whereas the other two reported the outcomes as contact pressure and contact area.[4,17]

All six studies were included in the qualitative analysis. ►**Table 1** summarizes the characteristics and principal findings of the included studies. Only two studies could be meta-analyzed, corresponding to the comparison between all-inside and inside-out suture repairs.[13,15] No study could

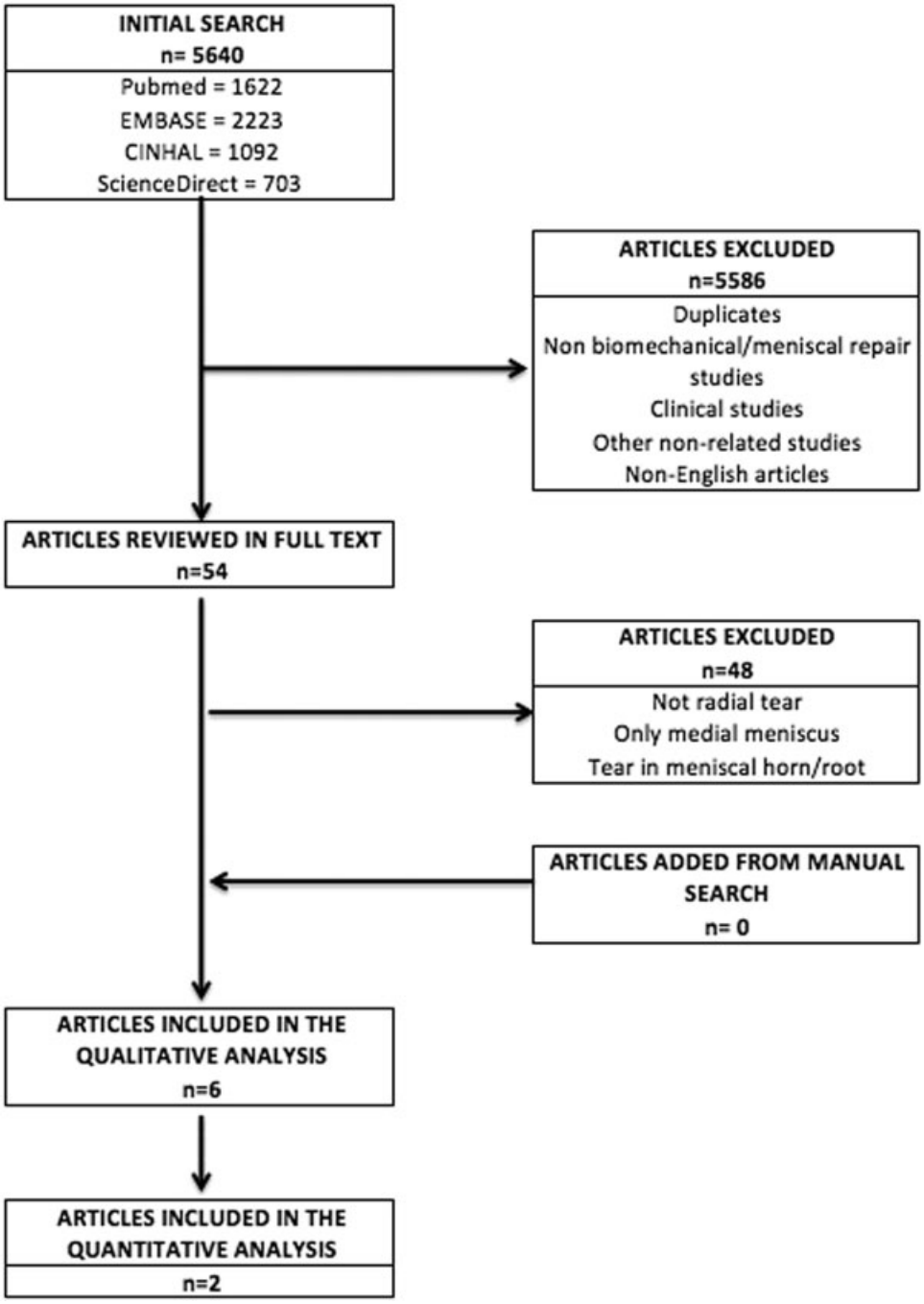

Fig. 1 Flow chart of the study selection process.

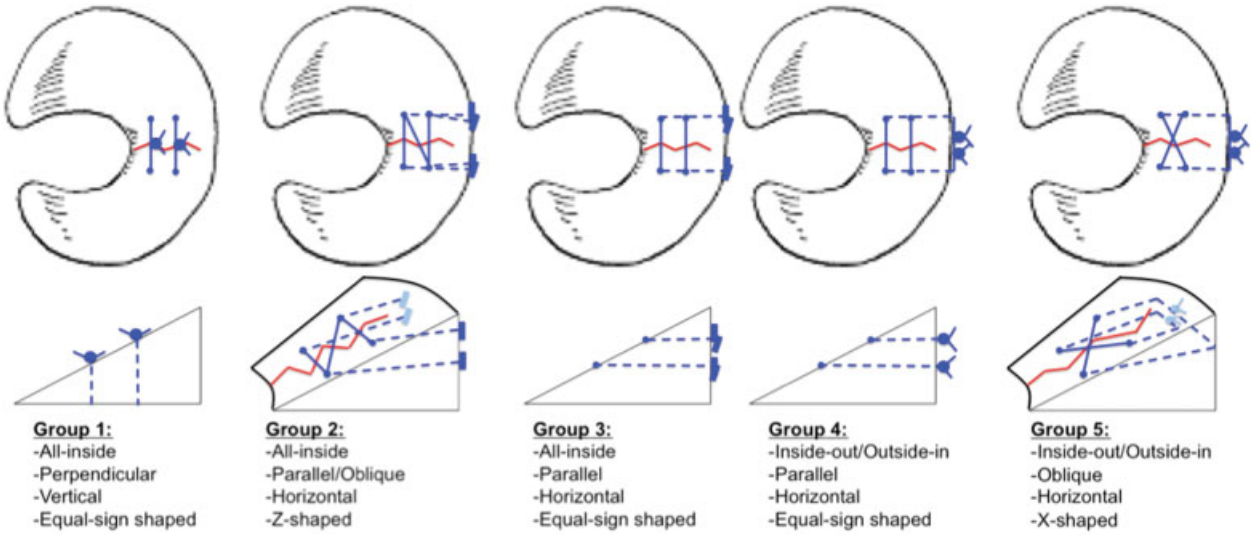

Fig. 2 Summary of repair methods and constructs employed in the included studies.

be meta-analyzed for different types of constructs because no more than one study compared the same constructs (►**Table 1**). The meta-analysis could only be conducted for two of the parameters: load to failure and stiffness. The heterogeneity index (I^2) for displacement and suture failure was 88 and 92%, respectively. ►**Figs. 3** and **4** demonstrate the meta-analysis for load to failure and stiffness for the two studies comparing all-inside and inside-out meniscal repairs. Pooled together, it was observed that the stiffness was significantly higher for all-inside compared with inside-out constructs ($p = 0.0009$; ►**Fig. 4**). No differences were observed between both suture methods for load to failure ($p = 0.45$; ►**Fig. 3**). However, although both studies involved radial tears of the lateral meniscus in porcine (fresh-frozen specimens), they used different all-inside devices and different suture constructs (►**Table 1** and ►**Fig. 2**). ►**Table 1** summarizes the principal findings regarding contact area and contact pressure changes after meniscal repair of radial tears.

Discussion

The purpose of this study was to evaluate which meniscal repair technique for radial tears of the lateral meniscus demonstrated the best biomechanical properties. This purpose could only be partially accomplished due to the limited number of biomechanical studies evaluating this specific tear pattern. However, this study clearly demonstrates that there is no evidence to suggest that inside-out or outside-in is the standard method for repair of radial tears of the lateral meniscus from a biomechanical standpoint. In the studies available for meta-analysis, the all-inside repair demonstrated significantly higher stiffness compared with inside-out repair method. However, both studies used different all-inside devices and suture constructs. Overall, there are no conclusive data to suggest that inside-out or outside-in suture repair has better load to failure or stiffness, less displacement, or different site of failure compared with all-inside repair.

Radial tears of the lateral meniscus represent a small proportion of all meniscal tears, but lateral meniscus tears have been found to have worse clinical implications compared with medial meniscus tears.[5] Additionally, a partial meniscectomy of a radial tear extending into zone 1 or 2 implies the removal of ≥50% of the meniscus to leave the native meniscus free of sharp corners.[18] Potential undesired consequences affecting the articular cartilage from radial tears are especially relevant when dealing with complete tears that extend to zone 0 (capsule).[17] Thus, the investigation of repair techniques for radial tears of the lateral meniscus is warranted.

A recent meta-analysis on biomechanical properties of meniscus repairs was conducted involving 41 studies.[9] In general, it was observed that suture repair (inside-out and outside-in) had better biomechanical properties compared with all-inside meniscal repair devices.[9] In addition, it was found that vertically oriented constructs had higher load to failure compared with horizontal configuration.[9] The conclusion was made that suture repair (instead of all-inside repair with devices) remains the gold standard for meniscal repair. However, these conclusions are not applicable to radial tears, as all but one of the included studies involved longitudinal tears.[9,17] Results of biomechanical properties of meniscal repair involving longitudinal tears do not necessarily apply to radial tears for two reasons. First, the different orientation of the tear in longitudinal compared with radial tears may influence the forces that the repair has to resist. In the case of radial tears, compressive forces on the joint are converted into circumferential or hoop stress forces on the meniscus that may separate meniscal edges,[19,20] whereas in the case of longitudinal tears, compressive forces may bring the edges together.[21] Second, for radial tears, any type of meniscal repair with attachment to the capsule creates a force parallel to the tear when the suture is tightened (►**Fig. 2**). In contrast, the same type of suture applied to a longitudinal tear will create a force perpendicular to the tear when the suture is tightened, which should function to bring both edges of the

Table 1 Comparison of studies investigating meniscal suture biomechanics in radial tears of the lateral meniscus

Reference	Specimen	Suture type	Outcomes	Assessment tool/protocol	Key findings
Beamer et al[13]	Porcine, fresh-frozen	– Group 1 ($n = 18$) with one NovoStitch (Ceterix) suture vs. group 4 ($n = 18$) with one suture – Both groups 2–0 Force Fiber UHMWPE suture (Teleflex Medical) – Included both menisci	– Load to failure, N – Stiffness, N/mm – Displacement (mm) after 1, 100, 300, and 500 cycles – Site of failure (suture, tissue, or knot)	– Mechanical testing system – After 2-N preload, cyclic loading was performed between 5 and 20 N at a frequency of 1 Hz – Displacement measured as distance between dots at each site of tear marked with Indian ink, using a calibrated high-resolution digital camera – Load to failure testing performed at a rate of 3.15 mm/s – Stiffness: slope of load–displacement curve between 20 and 60% of yield load	– All-inside: significantly lower displacement and greater load to failure and stiffness compared with inside-out – All-inside had suture failure – Inside-out had tissue failure
Lee et al[15]	Porcine, fresh-frozen	– Group 2 ($n = 8$) with Sequent (ConMed, Linvatec) continuous stitching device vs. group 4 ($n = 8$) – Both group 2–0 Polyester braided sutures	– Load to failure, N – Displacement (mm) at load to failure and at 1, 100, 500, and 1,000 cycles. – Stiffness, N/mm – Site of failure (suture rupture or implant dislodgement)	– Universal testing machine – Tensile load applied perpendicular to the tear – After applying a 2-N load, specimens cycled from 5 to 20 N (0.1 Hz) to remove system slack – Specimens then underwent 1,000 submaximal loading cycles from 5 to 20 N (0.5 Hz). Pause provided for 40 s at 100, 500, and 1,000 cycles – After cycling loading, specimens underwent load-to-failure testing (12.5 mm/s) – Gapping measurements: digital camera with lens at 76.2 cm from clamped specimen used. Metric ruler included in the picture	– No between-group differences in all parameters – All-inside: failed by implant dislodgement from periphery – Inside-out: failed by suture rupture
Herbort et al[14]	Porcine, fresh-frozen	– All group 4 but compared between different distances from the meniscal rim: groups A, B, C ($n = 11$ each) using one suture, group D ($n = 11$) using two sutures, compared with a control group with longitudinal tear ($n = 11$) – All groups used 2–0 Ethibond (Ethicon)	– Load to failure (N) – Yield load (N) – Stiffness (N/mm) – Displacement (mm) – Failure mode (suture or tissue)	– Specimens thawed at room temperature 5 h before testing and moistened during testing with saline solution – Tensile testing: using uniaxial testing frame. Menisci clamped with custom-made tissue clamps – Preload 2 N, then cyclically preconditioned between 5 and 20 N at a crosshead speed of 12.5 mm/s – 1,000 cycles applied – Outcomes after 1,000 cycles, and load to failure at 12.5 mm/s	– Double-loop technique (true group 3 using two sutures) had higher maximum load and yield load and lower displacement after 1,000 cycles compared with single-loop techniques – Different distances from tear edges have no influence on structural properties

(*Continued*)

Table 1 (*Continued*)

Reference	Specimen	Suture type	Outcomes	Assessment tool/protocol	Key findings
Matsubara et al[16]	Human, fresh	– Group 4 ($n = 20$) with age range 68–84 y vs. group 5 ($n = 20$) with age range 70–84 y – Both groups repaired with 2–0 Prolene, Ethicon Inc – Only lateral meniscus	– Load to failure, N – Stiffness, N/mm – Displacement (mm) after 500 cycles and after load to failure – Site of failure (suture, tissue, or knot)	– Universal testing machine with peripheral parts of menisci clamped with custom-made tissue clamps – Preconditioning of specimens: 5 and 30 N at 1 Hz for 500 cycles at a displacement rate of 5 mm/min – Displacement defined as the distance between the two tissue clamps – Stiffness: linear region of the load–displacement curve during load to failure	– Group 4 had significantly higher ultimate load to failure, stiffness, and significantly lower displacement after 500-cycle loading protocol (not after load to failure) compared with group 3 – No differences in site of failure (most tissue failure)
Bedi et al[17]	Human, fresh-frozen	– All group 4 ($n = 6$). – Comparison between intact meniscus, 30% radial tear, 60% radial tear, 90% radial tear, repair, partial meniscectomy	– Peak contact pressure, MPa – Location of contact pressure: quadrants anteroperipheral, anterocentral, posteroperipheral, and posterocentral – Contact area, mm^2	– Femur and tibia transected at 10 cm from joint line. All tissue resected except capsule, menisci, and ligaments – Sensors placed under lateral meniscus: piezoelectric pressure-sensing elements contained within a thin sealed sheet of plastic – Each sensor placed between two layers of adhesive dressing – Sensor attached with figure-of-eight 3–0 Ethibond sutures (Ethicon) – Sensor programmed to record data at 9.5 Hz – Simulator applied 20 gait cycles at a frequency of 0.5 Hz – Data extracted at 14 and 45% of gait cycle, as an average for the last eight gait cycles	– Radial tears < 90% thickness had no effects on knee mechanics – 90% radial tears significantly increased peak pressure (in posteroperipheral quadrant) and reduced contact area compared with intact – Repair resulted in significant decreased in peak pressure relative to 90% tear, but no changes in contact area – Similar mechanics in meniscectomy and 90% radial tears
Ode et al[4]	Human, fresh-frozen	– Group 3 ($n = 5$) using Meniscal Cinch (Arthrex) vs. group 4 ($n = 5$) with 2–0 Fiber-Wire (Arthrex) – Conditions evaluated: intact, 50% radial tear, 75% radial tear, 100% radial tear, meniscal repair, total meniscectomy	– Normalized contact pressure (pressure assessed in kg/cm^2) – Peak contact force – Normalized contact area	– All specimens tested under axial compression (800 N) at 0 and 60 degrees of knee flexion – Tibia and femur transected at 13 cm from joint line. All removed except capsule, menisci, ligaments, extensor mechanism, and popliteus muscle and tendon – Sensors inserted below menisci using 0.1-mm-thick dynamic pressure-	– Complete tear significantly increased mean contact pressure and decreased contact area compared with intact (effect worst in total meniscectomy) – Lesser degrees of radial tear not significantly different from intact knee – No differences in mean contact pressure between repair and intact, or between both repair techniques

Table 1 (*Continued*)

Reference	Specimen	Suture type	Outcomes	Assessment tool/protocol	Key findings
		– Mean age 65, range 50–82 y		sensitive film – Before testing, specimens mounted in testing machine with femur fixed in extension and tibia fixed to a spatial frame dynamic external fixator – Preload of 20 N for 2 min. Loaded at a rate of 13 N/s until maximum of 800 N. Two-minute tissue recover allowed after testing loads	– Repair did not improve contact area compared with intact

tear together. Therefore, most suture constructs do not apply a force directly perpendicular to the direction of the radial tear (►**Fig. 2**). Group 1 of the present study (►**Fig. 2**) was the only one in which the suture forces were applied perpendicular to the tear.[13]

This systematic review only found six studies specifically investigating biomechanical characteristics of radial tears of the lateral meniscus. The biomechanical outcomes evaluated in two studies were different than the rest of studies.[4,17] The remaining four studies evaluated the same outcomes using different repair comparisons (►**Fig. 2**).[13–16] Therefore, only two studies could be meta-analyzed regarding the biomechanical properties of all-inside devices compared with inside-out suture repair.[13,15] The reason for performing a meta-analysis including only two studies is to try to pool both results together. Although this is not an ideal scenario, a meta-analysis including two studies is accepted if the studies can be meaningfully pooled and have low (or moderate if a random-effects model is used) heterogeneity.[11,12] Beamer et al observed significantly higher load to failure and stiffness and significantly lower displacement in the all-inside repair compared with the inside-out suture repair.[13] In contrast, Lee et al observed no significant differences in the same parameters between the all-inside and the inside-out suture repairs.[15] It is hypothesized that the disparity in the results observed between both studies may be explained, in part, by the differences in the repair construct. In the all-inside repair used in the study by Lee et al,[15] the suture anchorage is at the capsule (►**Fig. 2**), which does not create a force purely perpendicular to the radial tear as it does in the all-inside repair construct employed by Beamer et al.[13] Interestingly, the results of both studies pooled together demonstrated that the stiffness is significantly higher in the all-inside compared with the inside-out repairs (►**Fig. 4**), whereas no significant differences were observed for load to failure. The displacement was significantly lower in the all-inside group compared with the inside-out group in the study by Beamer et al,[13] whereas the all-inside group in the study by Lee et al had an increased (nonsignificant) displacement compared with the inside-out group.[15] Displacement and site of failure could not be meta-analyzed because the heterogeneity index (I^2) was too high.[11]

A general conclusion regarding the suture construct is that the use of two sutures provides better biomechanical properties compared with one suture.[14] It has been observed that the use of two sutures in an "X" configuration (group 5; ►**Fig. 2**) demonstrates higher load to failure and stiffness, and lower displacement compared with the "equal-sign" construct (group 4; ►**Fig. 2**). Due to the variety of suture constructs used among studies, it was not possible to perform a pooled analysis. The comparison between subgroups with similar constructs from different studies would not provide reliable conclusions. Conclusions made for longitudinal tears regarding better biomechanical properties of vertical compared with horizontal sutures cannot be established for radial tears nor extrapolated from longitudinal tears.

Biomechanical characteristics of meniscal repair do not necessarily correlate with clinical outcomes. In other words, a

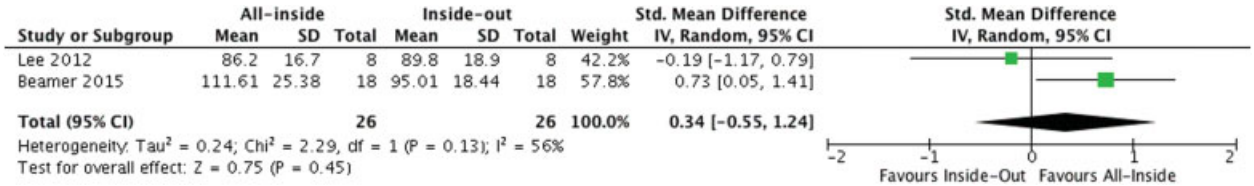

Fig. 3 Load to failure (N) depending on the repair technique in the included studies.

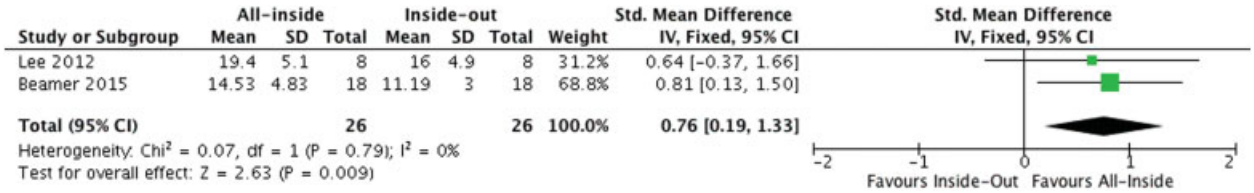

Fig. 4 Stiffness (N/mm) depending on the repair technique in the included studies.

biomechanically stronger construct does not guarantee healing of the radial tear. However, some studies have reported very good healing rates with some of the repair techniques reviewed in this study for radial meniscal tears.[22–25] These studies have used the types of repair classified as group 1[22,25] and group 4.[23,24] In a case series involving 14 radial tears of the midbody of the lateral meniscus repaired through the group 1 technique (►**Fig. 2**), Choi et al found 100% absence of joint line tenderness, mean 138-degree knee range of motion, postop Lysholm score of 94.7 points, and postop Tegner activity level of 5.7 at a mean follow-up of 36 months.[22] Thirty-five percent of patients had complete and 57.1% had partial magnetic resonance imaging (MRI)–based healing.[22] The three cases of complete radial tears of the lateral meniscus reported by Yoo et al and repaired through the same technique (group 1; ►**Fig. 2**) demonstrated complete healing after second-look arthroscopy.[25] Using the inside-out repair technique classified as group 4 with the addition of fibrin clot, Ra et al observed an MRI-based complete healing rate of 91%.[23] Six of seven patients who had a second-look arthroscopy showed complete healing as well.[23] At a mean of 30-month follow-up, the patients demonstrated improvements of Lysholm and International Knee Documentation Committee subjective knee score from 65 and 57 to 94 and 92, respectively.[23] Using an outside-in technique with the parallel, horizontal construct with the addition of a fibrin clot, van Trommel et al found that all five patients returned to preinjury sports activity level after repair of complete radial tears of the lateral meniscus.[24] All patients available for follow-up (three patients) demonstrated an MRI-based complete healing.[24] In summary, very good healing rates and clinical and functional outcomes have been reported with repair of radial tears of the lateral meniscus using either inside-out (and outside-in), parallel, horizontal sutures (group 4) with addition of fibrin clot, or using all-inside, perpendicular, vertical (group 1) techniques.

Biomechanical and clinical evidence supports the attempt to repair radial tears of the lateral meniscus. Even if the healing rate is not 100%, the attempt is justified by the fact that complete radial tears create a significant increase in peak contact pressure and decrease in contact area equal to partial meniscectomy,[4,17] which would have mid- and long-term consequences on articular cartilage integrity. Nonetheless, the effects of repair of radial tears of the lateral meniscus on the modification of contact area are controversial. While significant decrease in peak pressure with meniscal repair compared with complete tears has been reported,[17] the role of meniscus repair in increasing contact area is not clear.[4,17] Given that biomechanical studies on pressure changes were controlled laboratory studies, it would be interesting to investigate pressure changes in an in-vivo animal model after repair and eventual healing. Biomechanical and clinical evidence supports that the best construct for radial tears is vertical and perpendicular sutures (►**Fig. 2**),[13,22] which for technical reasons may be better achieved through an all-inside technique. Given the low number of studies supporting this conclusion, further research is needed in this area before strong conclusions can be drawn regarding the best construct from a biomechanical and clinical standpoint.

This study has some limitations. As in any systematic review and meta-analysis, there are several potential shortcomings: risk of missing related studies, validity of results depending on validity of studies included, potential heterogeneity among studies, or publication bias. Two specific limitations of this study are the low number of studies included and the fact that only two of them could be meta-analyzed. While having strict inclusion criteria and a limited number of studies included is not necessarily a weakness of a systematic review,[11] a meta-analysis with only two studies can lead to wrong conclusions if not appropriately conducted. Heterogeneity among studies has to be strongly considered and nonsignificant differences interpreted with caution. It might be possible that an increase in the number of studies meta-analyzed would have elicited significant differences. However, we believe that based on the present findings, the inside-out or outside-in meniscal suture should not be considered the standard method for repair of radial tears. Finally, two studies included the body-posterior horn junction of the

lateral meniscus.[4,17] However, these studies did not include information on the main outcomes evaluated (load to failure, stiffness, displacement, and site of failure), and hence the principal conclusions are not affected. The conclusions from this study cannot be applied to tears of the anterior or posterior horn of the lateral meniscus.

Conclusion

There is no evidence to suggest that an inside-out or outside-in technique is the standard method for repair of radial tears of the body of the lateral meniscus from a biomechanical standpoint. Overall, there are no conclusive data to suggest that inside-out or outside-in suture repair has better load to failure or stiffness, less displacement, or different site of failure compared with all-inside repair. Repair of radial meniscal tears should be attempted given the good healing and clinical and functional outcomes reported, but according to biomechanical data it is under surgeon's preference to elect one repair technique over the other.

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