

Tear Features and Surgical Techniques in 1230 Children and Adolescent Meniscus Repairs: Results from a Prospective, Multicenter Registry

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Objectives: Recent literature has suggested a marked shift towards increased meniscus repair relative to meniscectomy over the last decade in younger populations. Children and adolescents are more profoundly impacted by the outcomes of meniscus preservation, in terms of long-term joint health, whose decades of subsequent high activity levels put them at the highest risk of meniscus re-injury and progression towards degenerative joint disease in the setting of meniscus deficiency. The purpose of this study was to provide a comprehensive assessment of children and adolescent meniscus tear patterns and the current spectrum of repair techniques utilized to address them to better elucidate features of this common injury and national trends in treatment.

Methods: A prospective, multi-center registry of 4 different arthroscopic surgeries—discoid meniscus surgery, non-discoid meniscus repair [medial meniscus repair (MMR), or lateral meniscus tear (LMR)], anterior cruciate ligament reconstruction (ACLR), and tibial spine repair (TSR)—performed by 32 surgeon-investigators at 20 different academic centers over 30 months, was queried for all cases of non-discoid meniscus repair, which were further categorized according to whether they were performed in isolation (I-MR), or in conjunction with ACLR or TSR. Variables collected included patient demographic features (age, sex, BMI), tear compartment (lateral meniscus tear, LMT; medial meniscus tear, MMT), tear zone (white-white, red-white, red-red), tear pattern (longitudinal/vertical, complex/degenerative, radial, oblique/parrot's beak, horizontal/cleavage), tear displacement (yes/no), location of tear (anterior, body, posterior, root), repair technique (all-inside, inside-out, outside-in, other), repair implant/construct (menisco-capsular implants/sutures, meniscal-based sutures), and number of implants/sutures. Descriptive statistics were generated, and comparisons were made between tear in isolation compared to those during ACLR or tibial spine fixation and between medial and lateral meniscus tears.

Results: Of 1374 meniscus repairs (mean 15.1 years old, range 5-19, 44% Female), 763 (55.5%) were performed for LMT and 611 (44.5%) for MMT, with 184 of all cases (15%) representing bicompartamental meniscus repair (LMR+MMR). ACLR-MR (n=817, 66.9%) was significantly more common than I-MR (n=373, 30.6%), which was significantly more common than TSR-MR (n=31, 2.5%, p=0.001). I-MR had a higher incidence of anterior horn, meniscal body tears, inside out repairs, and outside in repairs (all p<0.001). Of MMTs that underwent repair 81.2% were vertical/longitudinal, while LMTs that underwent repair were comprised of 49.6% vertical/longitudinal, 24.2% complex/degenerative, and 13.9% radial (Table 1). While the most common tear zone for repaired menisci was the red-white zone, 18% of LMR and 13.4% of MMR were in the white-white zone. The posterior horn was one of the most common location of a repairable lesion (45.1% LMT and 43.9% MMT) with 12.8% of LMT repairs and 6.2% of MMT repairs performed on the posterior root. 70% of repairs were performed with all-inside technique, which was the predominant technique for all tear patterns in both MMT and LMT. Only 14.1% of repairs were performed with inside-out technique, but 70% of these cases were for displaced tears. The average number of implants/sutures for non-displaced tears was 4.0, compared with 5.9 for

displaced tears. While a majority of repairs used meniscocapsular repair techniques, 11.1% of meniscus repairs were based on meniscal-based sutures including 20.8% of radial tear repairs. 14 different implants were used by study surgeons (Figures 1 and 2).

Conclusion: Amongst repairable tears in adolescents, LMT is more common than MMT, and the majority of cases arise in conjunction with ACLR, compared to isolated tears. The predominant tear pattern is vertical in MMTs (80%). By percentage, radial tears are seven times more common and posterior root tears are twice as common in lateral meniscus tears. While historically treated almost exclusively with meniscectomy, a substantial number of white-white zone tears are currently being treated with repair in adolescents. Given the high and increasing frequency of this injury and procedure, nationally, the variation detected in repair techniques and implants utilized represent potential opportunities for optimization of care and reduction in health care costs.

| Table 1: Medial and lateral meniscus tear types and fixation techniques used. (%) indicated percentage of repair technique type for each tear type | | | | | |
|--|------------|------------|------------|-----------|------------|
| | All-Inside | Inside Out | Outside In | Other | TOTAL |
| Medial | | | | | |
| <i>Longitudinal/vertical</i> | 438 (73.6) | 92 (15.5) | 18 (3.0) | 47 (7.9) | 595 (81.2) |
| <i>Complex/degenerative</i> | 47 (54.0) | 25 (28.7) | 3 (3.5) | 12 (13.8) | 87 (11.9) |
| <i>Oblique / parrot's beak / flap</i> | 9 (50.0) | 5 (27.8) | 1 (5.6) | 3 (16.7) | 18 (2.4) |
| <i>Radial</i> | 9 (52.9) | 1 (5.9) | 1 (5.9) | 6 (35.3) | 17 (2.3) |
| <i>Horizontal/cleavage</i> | 12 (75.0) | 2 (12.5) | 0 | 2 (12.5) | 16 (2.2) |
| TOTAL | 515 (70.3) | 125 (17.1) | 23 (3.1) | 70 (9.5) | 733 |
| Lateral | | | | | |
| <i>Longitudinal/vertical</i> | 334 (80.7) | 40 (9.6) | 19 (4.6) | 21 (5.1) | 414 (49.6) |
| <i>Complex/degenerative</i> | 144 (71.3) | 13 (6.4) | 18 (8.9) | 27 (13.4) | 202 (24.2) |
| <i>Radial</i> | 48 (41.4) | 31 (26.7) | 16 (13.8) | 21 (18.1) | 116 (13.9) |
| <i>Oblique /parrot's beak</i> | 38 (63.3) | 9 (15.0) | 1 (1.7) | 12 (20.0) | 60 (7.2) |
| <i>Horizontal/cleavage</i> | 29 (67.4) | 3 (7.0) | 7 (16.3) | 4 (9.3) | 43 (5.1) |
| TOTAL | 593 (71.0) | 96 (11.5) | 61 (7.3) | 85 (10.2) | 835 |

Figure 1. Implant Types Used in Medial Meniscal Repairs

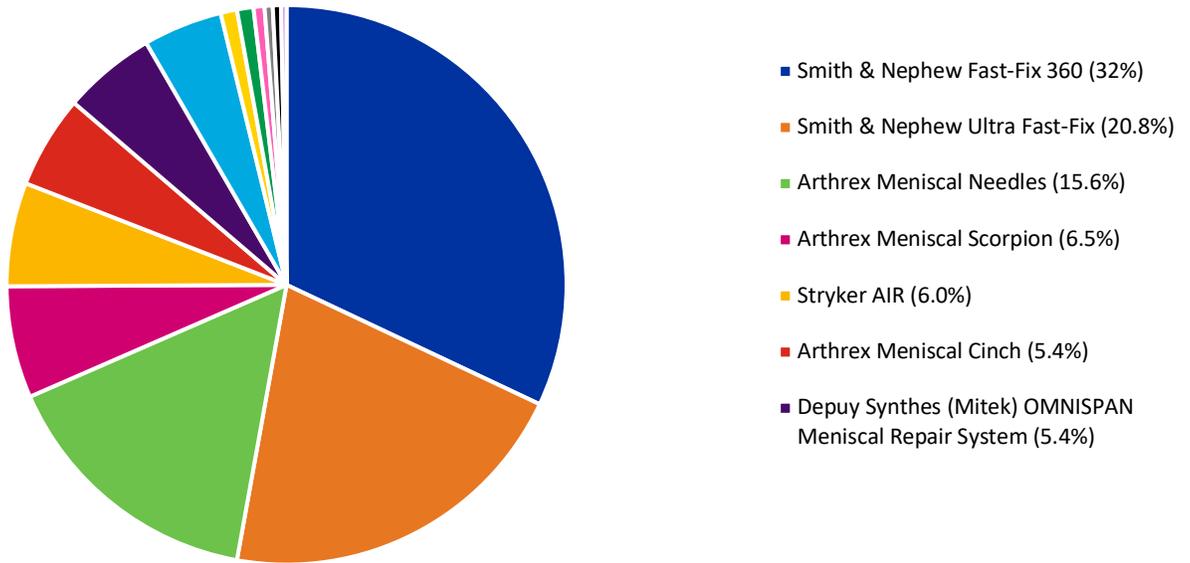


Figure 2. Implant Types Used in Lateral Meniscal Repairs

