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Early Surgery Versus Exercise Therapy and Patient Education for Traumatic and Nontraumatic Meniscal Tears in Young Adults—An Exploratory Analysis From the DREAM Trial

OBJECTIVE: To compare the effect of early meniscal surgery versus exercise and education with the option of later surgery on pain, function, and quality of life in young patients with a meniscal tear, taking symptom onset into account.

DESIGN: Randomized controlled trial.

METHODS: In a randomized controlled trial (the "Danish RCT on Exercise versus Arthroscopic Meniscal surgery for young adults" [DREAM] trial), 121 patients aged 18-40 years with a magnetic resonance imaging–verified meniscal tear were randomized to surgery or 12 weeks of supervised exercise and patient education. For this exploratory study, the analyses were stratified by symptom onset (traumatic/nontraumatic). The main outcome was the difference in change after 12 months in the mean score of 4 Knee injury and Osteoarthritis Outcome Score subscales ($KOOS_4$) covering pain, symptoms, function in sport and recreation, and quality of life.

RESULTS: Forty-two patients (69%) in the exercise therapy group and 47 (78%) in the surgery group were categorized as having a traumatic tear. We observed no difference in change in the $KOOS_4$ after 12 months between the 2 treatment groups for either traumatic tears (18.8 versus 16.0 in the surgery versus exercise therapy groups; adjusted mean difference, 4.8 [95% confidence interval, −1.7 to 11.2]) or nontraumatic tears (20.6 versus 17.3 in the surgery versus exercise therapy groups; adjusted mean difference, 7.0 [95% confidence interval, −3.7 to 17.7]).

CONCLUSION: In patients with traumatic and nontraumatic meniscus tears, early meniscal surgery did not appear superior to exercise and education in improving pain, function, and quality of life after 12 months. Further research is needed to confirm the clinical applicability of these findings.
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KEY WORDS: *knee, meniscal tears, symptom onset, traumatic, treatment*

Arthroscopic meniscal surgery has been the preferred treatment for young patients with meniscal tears,[1,18,23] despite an absence of trials comparing surgery to nonsurgical treatment. Recently, 2 randomized trials comparing meniscal surgery with exercise therapy, on average, reported no differences in patient-reported pain, function, and quality of life at 12 and 24 months between treatments for young patients with meniscal tears.[25,32] However, specific subgroups of patients who may respond better to surgical treatment may exist. One such subgroup is patients with traumatic meniscal tears.[3,10,17,23]

Traumatic meniscal tears usually occur in an otherwise healthy meniscus

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in younger (<40 years) active patients as a result of a specific event such as a sports-related trauma.[20] While nontraumatic (degenerative) meniscal tears are mostly observed in middle-aged and older people (>50 years)[7] and associated with incipient knee osteoarthritis,[6,8,19] a smaller proportion of younger patients also present with nontraumatic meniscal tears without recollection of any specific triggering event or trauma.

There are observational studies comparing outcomes between surgically treated patients with traumatic and nontraumatic tears. Two large observational studies of mostly middle-aged and older patients (18-90 years) reported no superior effect of surgery for patients with traumatic meniscal tears compared to nontraumatic tears,[11,31] while we only identified 1 small observational study (n<40) comparing outcomes for surgically treated younger patients (<40 years) with traumatic and nontraumatic tears.[13] So far, no studies have compared surgical and nonsurgical treatment strategies for traumatic and nontraumatic meniscal tears in younger patients, respectively.

In an exploratory analysis of data from our recently reported randomized controlled trial (RCT),[25] we aimed to investigate the effects of early meniscal surgery versus supervised exercise therapy and patient education with the option of later surgery on patient-reported pain, function, and quality of life for young patients with a meniscal tear stratified by traumatic or nontraumatic symptom onset.

MATERIAL AND METHODS

The study was approved by the Regional Committees on Health Research Ethics for Southern Denmark (S-20160151) and the Danish Data Protection Agency (University of Southern Denmark, 16/45314) and registered at ClinicalTrials.gov (NCT02995551). All patients provided written informed consent to participate in the study.

This study is an exploratory analysis of the "Danish RCT on Exercise versus Arthroscopic Meniscal surgery for young adults" (DREAM) trial.[25] The DREAM trial design and conduct has previously been described and reported.[25,26] In short, the DREAM trial was a pragmatic, comparative effectiveness, multicenter, parallel-group RCT (1:1 treatment allocation) where patients were randomized to 12 weeks of supervised exercise therapy and patient education, with the option of later surgery if needed or surgery (arthroscopic partial meniscectomy [APM] or meniscal repair).

Patients

We included 121 adults aged 18-40 years with knee pain; with a clinical history and symptoms consistent with a meniscal tear, verified on magnetic resonance imaging (MRI); and who were deemed eligible for meniscal surgery (APM or repair) by an orthopaedic surgeon at 1 of 7 orthopaedic departments. They all provided oral and written informed consent.

The exclusion criteria were as follows: previous knee surgery on the affected knee, displaced bucket handle tear confirmed by MRI, fracture of the affected extremity within the previous 6 months, complete rupture of 1 or more knee ligaments, and participation in supervised systematic exercise for knee problems within the last 3 months prior to recruitment. Other reasons for exclusion include the following: unable to understand Danish, mentally unable to participate, with congenital discoid meniscus, and so forth.

Interventions

Patients were randomized to 1 of 2 treatment strategies: either supervised exercise therapy and patient education (with the option of later surgery) or meniscal surgery. An in-depth description of the interventions can be found in previous publications.[25,26,29]

The supervised exercise therapy consisted of 12 weeks of supervised group-based neuromuscular and strengthening exercise therapy (two 60- to 90-minute weekly sessions), and patient education was (30-45 minutes in total) placed at the beginning and at the end of the exercise intervention. The intention of patient education was to support motivation and capability to sustain exercise and for patients to learn about long-term risks after knee injury.[26] The exercise program was developed based on evidence from other types of knee injuries and osteoarthritis,[2,9,16,27,28] and its feasibility was tested before the RCT in collaboration with patients and experienced physical therapists.[29]

Patients who were randomized to meniscal surgery underwent APM or meniscal repair following standard procedures.[23] The decision on whether to perform an APM or meniscal repair was determined by the operating surgeon during surgery, reflecting routine clinical practice. After surgery, patients undergoing APM received a standard brochure with exercises to facilitate at least a minimum level of postoperative rehabilitation. Patients undergoing meniscal repair received postoperative rehabilitation, ranging from control of range of motion and instructions in standard postoperative exercises to a supervised, knee-related exercise program based on patient needs and local procedures.

Definition of Traumatic and Nontraumatic Meniscal Tears

We defined traumatic and nontraumatic meniscal tears based on self-reported symptom onset assessed at baseline before randomization using a single item question: "How did the knee pain/problems for which you are now seeking treatment develop (choose the answer that best matches your situation)?" with 3 response options, as follows:

A. The pain/problems have slowly evolved over time.
B. As a result of a specific incident (ie, kneeling, sliding, and/or twisting of the knee or the like).
C. As a result of a violent incident (ie, during sports, a crash, a collision, or the like).

This question was developed for, and previously used in, the Knee Arthroscopy Cohort Southern Denmark, aiming at comparing patient-reported outcomes 52 weeks after surgery between patients

undergoing APM for traumatic and nontraumatic tears, respectively.[30,31]

We categorized patients as having a traumatic tear when replying "B" or "C" to this question. Patients replying "A" to this question were defined as having a nontraumatic tear.

Patient Characteristics and Patient-Reported Outcomes

Patient characteristics and patient-reported outcomes were collected using online questionnaires distributed to the patients at baseline, as well as for the patient-reported outcomes at 3, 6, and 12 months of follow-up.

The patient-reported outcomes were collected using the Knee injury and Osteoarthritis Outcome Score (KOOS)[22] and the Western Ontario Meniscal Evaluation Tool (WOMET).[15]

The KOOS is a knee-specific, valid, and reliable patient-reported outcome measure for individuals on the continuum from knee injury to knee surgery (anterior cruciate ligament reconstruction, meniscectomy, and total knee replacement) and to osteoarthritis[5,22,31] and is assessed using 5 subscales (pain, symptoms, function in daily living [activities of daily living or ADL], function in sport and recreation, and quality of life), all ranging from 0 to 100, with lower scores indicating worse pain, symptoms, function, and quality of life. We considered the between-group difference in change in the 4 KOOS subscales ($KOOS_4$) from baseline to 12 months as the main outcome of this analysis. The $KOOS_4$ is the average score of 4 of the 5 subscale scores, including for pain, symptoms, function in sport and recreation, and quality of life. In the $KOOS_4$, we excluded ADL, as this construct is not sensitive in the young population.[5] Similar to other trials,[9,16] we used the $KOOS_4$ for statistical purposes to have a single primary outcome, although the measurement properties have not been tested separately for the $KOOS_4$. We defined a difference of 10 points as being clinically relevant, as a difference of 10 points has previously been suggested for the individual KOOS subscales, although acknowledging that the minimal clinically important difference (MCID) for the different subscales of the KOOS may vary by population and context.[12,14]

The WOMET is a disease-specific tool designed to evaluate health-related quality of life in patients with meniscal pathology and is a valid, reliable, and responsive patient-reported outcome measure.[15] The WOMET has 16 items addressing 3 different subdomains: physical symptoms; disabilities due to sports, recreation, work, and lifestyle; and emotions, which are measured on 3 different subscales. The scores from each of the subscales and a total overall score merged from all 3 subscales are converted and reported as a percentage ranging from 0 to 100, with 0 corresponding to the least symptomatic situation and 100 to the most symptomatic. The MCID for the WOMET total overall score scale has been reported to be 15.5 points.[24]

Statistics

Baseline characteristics are presented as means with standard deviations or medians and interquartile ranges or as numbers with percentages as appropriate.

The between-group difference in change for both the main outcome ($KOOS_4$) and secondary outcomes (the 5 KOOS subscales and the WOMET) were analyzed using a linear mixed model, with time (baseline and 3, 6, and 12 months); treatment arm (surgery or exercise therapy); meniscal tear type (traumatic or nontraumatic); and the interaction between treatment arm, time, and meniscal tear type as fixed effects constraining the difference between the arms to 0 at baseline.[4] The model was adjusted for the randomization stratification factors (center and sex) and age. To accommodate within-person measurement dependence, a patient-specific intercept and slope were added as random effects. A 95% confidence interval excluding differences greater than 10 KOOS points[21] and 15.5 WOMET points[24] between treatment arms was interpreted as no clinical meaningful difference.

While the original RCT was powered to detect a 10-point between-group difference in change, the current study was not and should, as such, only be seen as an exploratory analysis.

To assess the assumptions of model validity, we created scatterplots of the residuals versus time and 2-dimensional scatterplots of the best linear unbiased predictions of the random effects stratified by treatment. These plots indicated distributions compatible with the assumption of normality and did not indicate the existence of outliers. In general, model checking in this context is challenging due to the limited sample size. Hence, an explicit check of the linearity of age was not performed.

Sensitivity and Per-Protocol Analyses

We performed a sensitivity analysis excluding patients with semitraumatic symptom onset responding that the pain/problems were "As a result of a specific incident (ie, kneeling, sliding, and/or twisting of the knee or the like)" (response option B) to assess the robustness of the results by comparing only patients with violent symptom onset (ie, during sports, a crash, a collision, or the like) (response option C) to patients with symptoms evolving slowly over time. In this analysis, 49 patients were excluded.

In the per-protocol analysis, patients randomized to exercise therapy were excluded if they participated in 17 or fewer of 24 exercise sessions (n = 15) or crossed over to surgery (n = 16), and the patients in the surgery group were excluded if not having surgery (n = 8).

The results are presented with 95% confidence intervals and considered statistically significant at $P<.05$. All statistical analyses were conducted using Stata/BE version 17.0 (StataCorp LLC, College Station, TX).

RESULTS

Patient Characteristics

A total of 121 patients were randomly assigned either to exercise therapy and patient education (n = 61) or to surgery (n = 60).

In the exercise therapy group, 42 patients were categorized as having a

traumatic tear, while 19 patients were categorized as having a nontraumatic tear. During follow-up, a total of 16 patients (26%) in the exercise group (8 with traumatic tears and 8 with nontraumatic tears) chose the option of receiving later surgery.

In the surgery group, 47 (28 had resection, 5 had repair, 5 had resection and repair, 2 had no meniscal resection or repair, and 7 did not receive surgery) were categorized as having a traumatic tear, and 13 (8 had resection, 1 had repair, 2

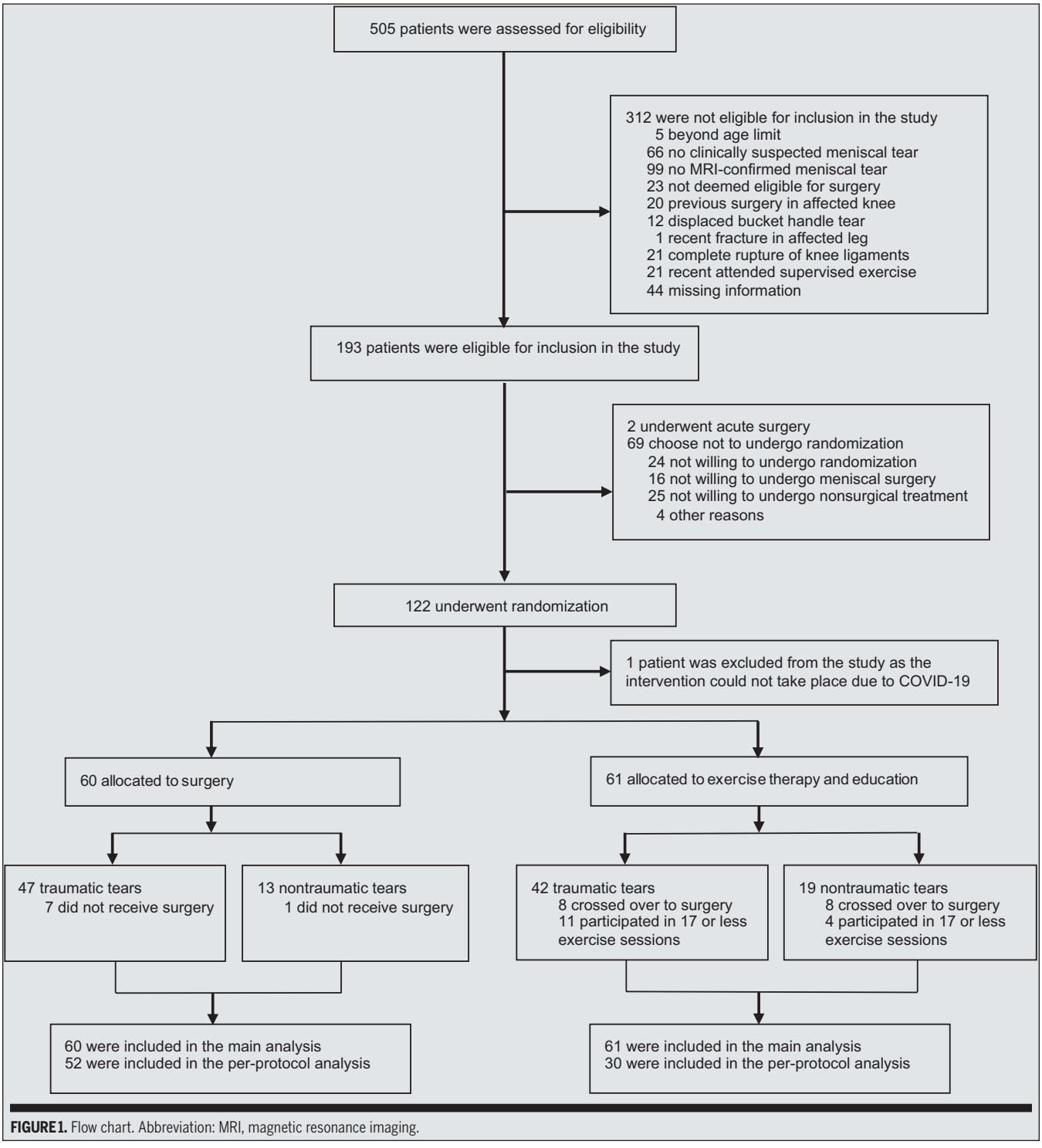

FIGURE 1. Flow chart. Abbreviation: MRI, magnetic resonance imaging.

had resection and repair, 1 had no meniscal resection or repair, and 1 did not receive surgery) were categorized as having a nontraumatic tear (**FIGURE 1**). An overview of the patient baseline characteristics stratified by symptom onset is shown in **TABLE 1**.

Treatment Effect Stratified by Traumatic or Nontraumatic Symptom Onset

We observed no difference in change in $KOOS_4$ scores from baseline to 12 months of follow-up between the 2 treatment groups for traumatic tears (18.8 versus 16.0 in the surgery versus exercise therapy groups; adjusted mean difference, 4.8 [95% confidence interval, −1.7 to 11.2]) or nontraumatic tears (20.6 versus 17.3 in the surgery versus exercise therapy groups; adjusted mean difference, 7.0 [95% confidence interval, −3.7 to 17.7]) (**FIGURE 2**). Similar to the main analysis, most secondary

TABLE 1 Baseline Characteristics of Patients Randomized to Exercise Therapy or Meniscal Surgery Stratified by Traumatic or Nontraumatic Symptom Onset

	Traumatic Tears (N = 89)		Nontraumatic Tears (N = 32)	
Variable	**Meniscal Surgery (n = 47)**	**Exercise Therapy (n = 42)**	**Meniscal Surgery (n = 13)**	**Exercise Therapy (n = 19)**
Age, mean (SD)	28.2 (6.3)	31.4 (6.7)	28.2 (7.5)	30.6 (6.2)
Females, no. (%)	12 (26)	9 (21)	6 (54)	7 (37)
BMI; kg/m², mean (SD)	25.4 (4.3)	26.2 (4.4)	25.9 (4.3)	28.0 (5.3)
Mechanical symptoms (yes/no), no. (%)[a]	27 (57)	17 (40)	6 (46)	13 (68)
Sport participation prior to injury (Tegner score), median (IQR)[b]	5 (2-6)	6 (4-7)	6 (4-7)	6 (4-7)
Duration of symptoms, no. (%)				
0-3 months	9 (19)	12 (29)	0 (0)	3 (16)
4-6 months	18 (38)	11 (26)	7 (54)	9 (47)
7-12 months	9 (19)	11 (26)	2 (15)	2 (11)
13-24 months	6 (13)	3 (7)	1 (8)	1 (5)
>24 months	5 (11)	5 (12)	3 (23)	4 (21)
KOOS scores, mean (SD)[c]				
$KOOS_4$	58.9 (16.2)	54.9 (17.2)	57.7 (10.5)	49.2 (15.4)
Pain	70.0 (16.4)	65.8 (18.1)	65.6 (10.9)	59.2 (17.8)
Symptoms	70.0 (16.8)	70.1 (17.0)	67.6 (15.7)	63.7 (17.8)
ADL	78.9 (16.5)	75.0 (20.0)	76.0 (15.4)	74.0 (19.2)
Sport/Rec	46.7 (25.8)	41.2 (25.4)	45.8 (18.9)	31.8 (18.4)
QOL	49.0 (17.8)	42.3 (17.6)	52.0 (12.8)	41.8 (20.6)
WOMET total scores, mean (SD)[d]	48.3 (20.9)	42.4 (18.7)	51.2 (19.6)	40.5 (17.4)
Tear pattern, no. (%)				
Lateral meniscus				
Horizontal tear	2 (4)	3 (7)	1 (8)	3 (16)
Radial and vertical tear	5 (11)	6 (14)	2 (15)	2 (11)
Bucket handle or complex tear	7 (15)	5 (12)	2 (15)	1 (5)
Medial meniscus				
Horizontal tear	12 (26)	12 (29)	5 (39)	7 (37)
Radial and vertical tear	2 (4)	5 (12)	1 (8)	1 (5)
Bucket handle or complex tear	21 (45)	12 (29)	2 (15)	6 (32)

All numbers are presented as means with SDs (or medians with IQRs) and as percentages as appropriate.
Abbreviations: ADL, activities of daily living; BMI, body mass index (kg/m²); IQR(s), interquartile range(s); KOOS, Knee injury and Osteoarthritis Outcome Score; QOL, quality of life; SD(s), standard deviation(s); WOMET, Western Ontario Meniscal Evaluation Tool.
[a]*Mechanical symptoms were assessed using a single item question: "Does your knee catch or hang up when moving during the last week?" from the KOOS with 5 response options ranging from "never" to "always." Patients were categorized as having mechanical symptoms unless replying "never" to this question.*
[b]*The Tegner Activity Scale ranges from 0 to 10, with 0 representing sick leave or disability pension because of knee problems and 10 representing competitive sports such as European football (national and international elite level).*
[c]*The KOOS includes subscales for pain, symptoms, function in daily living, function in sport and recreation, and quality of life, with scores ranging from 0 (worst) to 100 (best). The $KOOS_4$ is the mean score of 4 of 5 of the KOOS subscale scores (ie, pain, symptoms, function in sport and recreation, and quality of life).*
[d]*The WOMET includes subscales of physical symptoms; disabilities due to sports, recreation, work, and lifestyle; and emotions. The WOMET total score comprises the overall score for all the subscales and is converted to scores from 0 to 100, with lower scores indicating worse quality of life.*

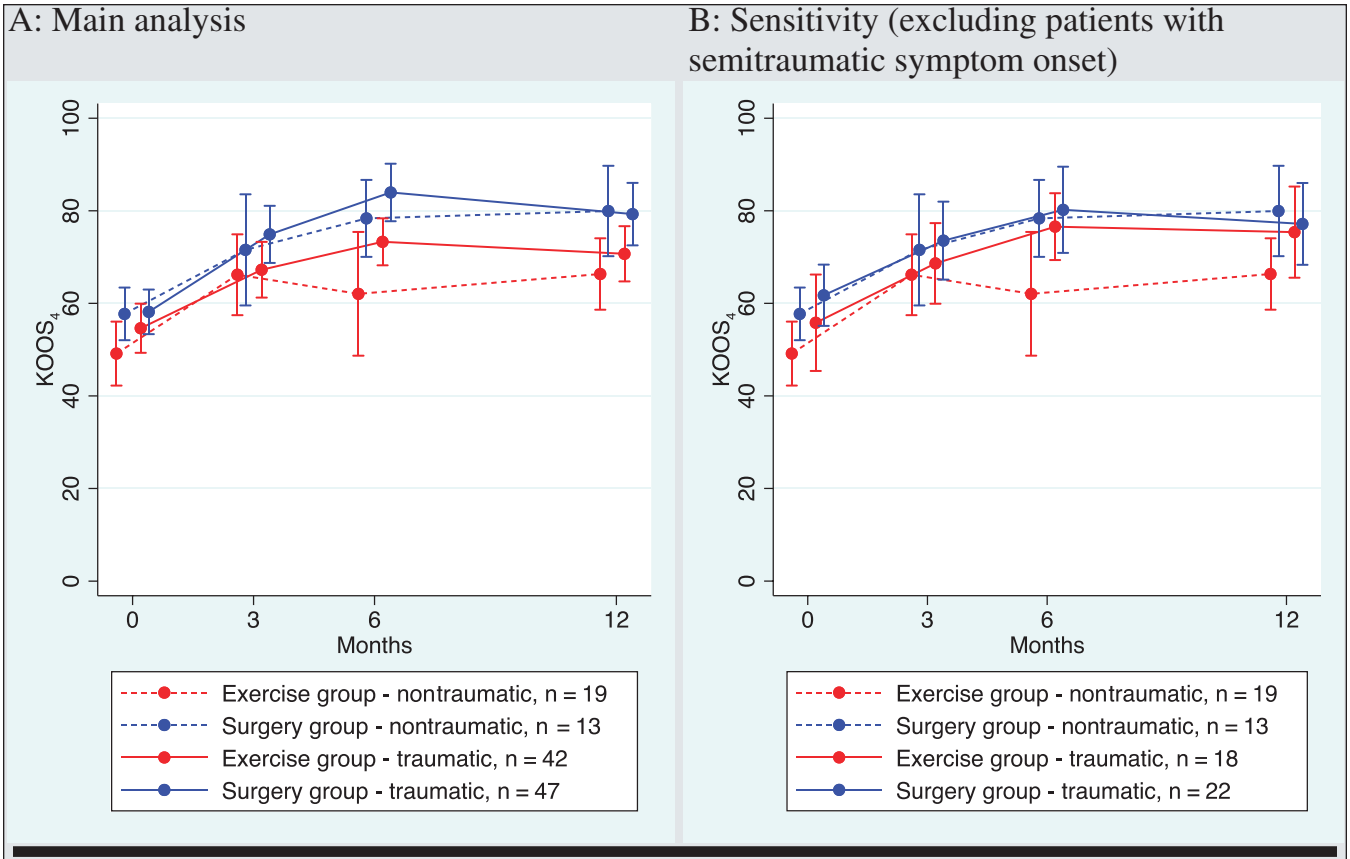

FIGURE 2. Curves for the $KOOS_4$ scores measured at 3, 6, and 12 months of follow-up for the 2 treatment groups stratified by traumatic or nontraumatic symptom onset. The Knee injury and Osteoarthritis Outcome Score (KOOS) includes subscales for pain, symptoms, function in daily living, function in sport and recreation, and quality of life, with scores ranging from 0 (worst) to 100 (best). The $KOOS_4$ is the mean score of 4 of 5 of the KOOS subscale scores (ie, pain, symptoms, function in sport and recreation, and quality of life). A & B, $KOOS_4$ scores were obtained for the groups randomly assigned to meniscal surgery or exercise therapy from the main (A) and sensitivity (B) analyses. In the sensitivity analysis, patients reporting the development of their meniscal tear as a result of a specific semitraumatic incident (ie, kneeling, sliding, and/or twisting of the knee or the like) were excluded (n = 49).

outcomes confirmed the findings of no difference between treatment strategies for both traumatic and nontraumatic tears (**TABLE 2**). However, in the adjusted analysis of the WOMET subscales *disabilities due to sports, recreation, work, and lifestyle* and *emotions*, the results suggested a clinically relevant larger effect of surgery compared with exercise for patients with a traumatic tear. For nontraumatic tears, results suggested a clinically relevant larger improvement in favor of surgery in the KOOS subscale *function in sport and recreation* (**TABLE 2**), although this did not reach statistical significance.

For both treatment groups, we observed clinically relevant within-group improvements for the majority of all outcomes from baseline to 12 months of follow-up, for both patients with traumatic and with nontraumatic meniscal tears (**TABLE 2**).

Sensitivity and Per-Protocol Analyses

Both the sensitivity analysis (excluding patients with semitraumatic symptom onset) and the per-protocol analysis (excluding patients not adhering to the treatment protocol) yielded similar results as the main analysis (see **SUPPLEMENTAL TABLE S1**, **TABLE S2**, and **FIGURE S1**).

DISCUSSION

Overall, the results from this exploratory analysis did not indicate that early meniscal surgery was superior to a strategy of exercise therapy and education with the option of later surgery in improving pain, function, and quality of life at 12 months in young adults with traumatic meniscal tears. Similarly, the results suggested no difference in change between treatment strategies in patient-reported outcomes for patients with nontraumatic tears.

Previous observational studies have reported no better effect of APM for patients with traumatic compared with nontraumatic meniscal tears.[11,13,31] To our knowledge, this is the first RCT comparing the effect of a surgical versus a nonsurgical treatment strategy for young adults, where exploratory analyses were performed stratified on traumatic and

TABLE 2 Main Analysis of Between-Group Difference in Change From Baseline to 12 Months of Supervised Exercise Therapy and Education and Meniscal Surgery Stratified by Traumatic or Nontraumatic Symptom Onset

Variable	No. of Patients: Surgery Group/Exercise Group	Mean Improvement in *Surgery* Group (95% CI)	Mean Improvement in *Exercise* Group (95% CI)	Difference in Mean Improvement (Crude)[a] (95% CI)	Difference in Mean Improvement (Adjusted[b]) (95% CI)
Traumatic tears					
$KOOS_4$[c]	39/40	**18.8** (13.3, 24.4)	**16.0** (10.4, 21.7)	**2.8** (−5.0, 10.6)	**4.8** (−1.7, 11.2)
Pain	39/41	**15.1** (9.0, 21.2)	**12.7** (7.1, 18.3)	**2.4** (−5.8, 10.5)	**5.4** (−0.8, 11.5)
Symptoms	39/41	**13.2** (7.3, 19.1)	**9.3** (4.3, 14.3)	**3.9** (−3.7, 11.4)	**4.5** (−1.0, 10.1)
ADL	40/41	**11.2** (6.6, 15.7)	**9.9** (4.9, 14.9)	**1.3** (−5.4, 7.9)	**3.1** (−1.8, 8.1)
Sport/Rec	40/40	**25.6** (17.7, 33.6)	**23.5** (14.9, 32.1)	**2.1** (−9.4, 13.7)	**4.4** (−4.7, 13.5)
QOL	39/40	**20.3** (14.0, 26.8)	**17.0** (9.3, 24.8)	**3.3** (−6.6, 13.2)	**6.8** (−1.5, 15.0)
WOMET total scores[d]	34/37	**26.3** (19.1, 33.5)	**18.8** (11.5, 26.2)	**7.4** (−2.7, 17.6)	**10.7** (2.6, 18.9)
Symptoms	34/37	**20.1** (12.3, 27.9)	**17.2** (10.0, 24.5)	**2.9** (−7.5, 13.3)	**6.2** (−1.5, 14.0)
Sport/rec/work/lifestyle	34/37	**33.5** (24.7, 42.2)	**18.7** (9.3, 28.1)	**14.8** (2.1, 27.5)	**18.8** (8.0, 29.6)
Emotions	34/37	**35.2** (24.9, 45.5)	**24.0** (14.5, 33.5)	**11.2** (−2.6, 25.0)	**16.1** (4.7, 27.5)
Nontraumatic tears					
$KOOS_4$[c]	10/18	**20.6** (9.4, 31.5)	**17.3** (9.0, 25.6)	**3.3** (−9.9, 16.4)	**7.0** (−3.7, 17.7)
Pain	10/18	**15.0** (2.6, 27.4)	**14.7** (7.5, 21.8)	**0.3** (−12.2, 12.9)	**7.0** (−3.3, 17.4)
Symptoms	10/18	**16.1** (6.0, 26.1)	**14.7** (4.7, 24.7)	**1.4** (−13.4, 16.2)	**6.1** (−3.0, 15.2)
ADL	10/18	**13.0** (3.7, 22.3)	**10.7** (3.4, 18.0)	**2.3** (−9.2, 13.7)	**7.0** (−1.2, 15.2)
Sport/Rec	10/18	**30.0** (14.6, 45.5)	**26.4** (14.2, 38.6)	**3.6** (−15.5, 22.7)	**11.1** (−3.7, 25.9)
QOL	10/18	**21.3** (6.8, 35.7)	**13.5** (3.5, 23.6)	**7.7** (−8.6, 24.1)	**6.7** (−6.5, 19.9)
WOMET total scores[d]	8/16	**14.4** (−2.3, 31.1)	**18.9** (6.5, 31.2)	**−4.5** (−24.4, 15.5)	**3.2** (−10.5, 16.9)
Symptoms	8/16	**13.5** (0.5, 26.5)	**20.4** (6.3, 34.6)	**−6.9** (−28.1, 14.3)	**5.1** (−7.9, 18.1)
Sport/rec/work/lifestyle	8/16	**10.2** (−19.1, 39.5)	**17.9** (3.3, 32.5)	**−7.7** (−34.7, 19.3)	**2.1** (−16.5, 20.6)
Emotions	8/16	**22.6** (3.0, 42.1)	**15.3** (2.5, 28.2)	**7.3** (−14.2, 28.7)	**8.3** (−11.5, 28.1)

All estimates are presented as means with corresponding 95% confidence intervals.
Abbreviations: ADL, activities of daily living; CI, confidence interval; KOOS, Knee injury and Osteoarthritis Outcome Score; QOL, quality of life; WOMET, Western Ontario Meniscal Evaluation Tool.
[a]*Negative values denote a higher improvement in favor of the exercise therapy group.*
[b]*Adjusted for the randomization stratification factors (center and sex) and age.*
[c]*The KOOS includes subscales for pain, symptoms, function in daily living, function in sport and recreation, and quality of life, with scores ranging from 0 (worst) to 100 (best). The $KOOS_4$ is the mean score of 4 of 5 of the KOOS subscale scores (ie, pain, symptoms, function in sport and recreation, and quality of life). Improvements of 10 points or more are considered clinically relevant. For the $KOOS_4$, no difference between groups was also found when comparing all 4 groups after 12 months (P = .7).*
[d]*The WOMET includes subscales of physical symptoms; disabilities due to sports, recreation, work, and lifestyle; and emotions. The WOMET total score comprises the overall score for all the subscales and is converted to scores from 0 to 100, with lower scores indicating worse quality of life. Improvements of 15.5 points or more are considered clinically relevant.*

nontraumatic meniscal tears (ie, symptom onset). We observed no clinically relevant between-group differences in change in the main outcome ($KOOS_4$) from baseline to 12 months of follow-up between surgical and nonsurgical treatment strategies in young patients with either traumatic or nontraumatic tears. In general, most secondary outcomes confirmed the finding of no clinically relevant difference in improvement between treatment strategies for traumatic and nontraumatic tears. That said, a clinically relevant larger effect of surgery compared with exercise for patients with a traumatic tear was observed in 2 of the WOMET subscales, and the KOOS subscale *function in sport and recreation* also seemed to favor surgery for nontraumatic tears, but with wide nonsignificant confidence intervals. It is therefore important to test if this clinically relevant larger effect still applies when investigated in an RCT fully powered for this purpose.

Overall, our results confirm the results from the recent "Study of Traumatic meniscal tears: Arthroscopic resection vs Rehabilitation" (STARR) trial comparing APM with exercise therapy for young adults (18-45 years) with traumatic meniscal

tears. In the STARR trial, no difference in patient-reported outcomes from baseline to 24 months was observed, although 41% of patients from the exercise therapy group opted to have surgery during the follow-up period.[32]

In patients with traumatic and nontraumatic meniscal tears, we observed clinically relevant improvements following both treatment strategies for the majority of all outcomes after 12 months of follow-up. This suggests that surgery and exercise therapy are reasonable treatment strategies for both types of meniscus tears and that symptom onset should not be the main driver of which treatment to choose. Shared decision making will guide patients and health care professionals to consider information and make a decision.

Limitations

Our exploratory analysis of the DREAM trial was not powered for the stratified analyses based on symptom onset, resulting in estimates with wide confidence intervals. Given the proportionally lower number of patients in the nontraumatic tear type group, the ability detecting a difference in change between the 2 treatment strategies is particularly affected in that subgroup. This limitation is further amplified in the per-protocol and sensitivity analyses, excluding additional patients, and should be taken into consideration when informing clinical practice.

There is no consensus on how to define traumatic and nontraumatic tears. In the DREAM trial, we defined traumatic and nontraumatic tears based on self-reported symptom onset. However, in the clinical setting, this distinction may not always be clear-cut, and likely, some overlap may exist, leading to the risk of misclassification. To test the robustness of our definition, we performed a sensitivity analysis excluding patients with semitraumatic symptom onset (ie, with symptom onset "As a result of a specific incident [ie, kneeling, sliding, and/or twisting of the knee or the like]"), thereby only comparing patients with clear traumatic onset to those with nontraumatic symptom onset (ie, slowly evolving symptoms). The analysis did not change the interpretation of the main analysis of no difference in change between treatment strategies for both patients with traumatic and with nontraumatic symptom onset.

Finally, in the surgical groups, some patients had APM whereas others had meniscal repair at the discretion of the operating surgeon. Due to the already reduced sample size of our subgroup analysis, this has not been taken into account in our analysis.

CONCLUSION

Our exploratory analysis did not support that early meniscal surgery was superior to a strategy of exercise therapy and education with the option of later surgery in improving pain, function, and quality of life at 12 months in young adults with either a traumatic or a nontraumatic meniscal tear. In total, 16 patients (26%) opted to have later surgery during the 12-month follow-up period (8 with traumatic tears and 8 with nontraumatic tears). The results should be interpreted and applied with caution due to the low sample size in the investigated subgroups, particularly for nontraumatic tears, and further research is needed to confirm these results. ◉

KEY POINTS

FINDINGS: We observed no clinically relevant between-group differences in change in the main outcome ($KOOS_4$) from baseline to 12 months of follow-up between the surgical and nonsurgical treatment strategies in young patients with either traumatic or nontraumatic tears.

IMPLICATIONS: The findings suggest that both surgery and exercise therapy are viable as treatment strategies for both types of tears and that symptom onset should be used with caution to guide selection of the best treatment strategy.

CAUTION: The results should be interpreted with caution due to the low sample size in the investigated subgroups, particularly for nontraumatic tears, and further research is needed to confirm the findings.

STUDY DETAILS

AUTHOR CONTRIBUTIONS: The authors contributed in the following areas per the CRediT (Contributor Roles Taxonomy): C.D.: Methodology, Formal analysis, Data curation, Project administration, Writing – original draft; S.T.S.: Conceptualization, Methodology, Supervision, Writing – review & editing; J.B.T.: Conceptualization, Methodology, Supervision, Writing – review & editing; P.H.: Investigation, Writing – review & editing; M.L.: Investigation, Writing – review & editing; C.V.: Investigation, Writing – review & editing; H.P.J.: Investigation, Writing – review & editing; M.S.H.: Investigation, Writing – review & editing.

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