

CASE SERIES

AN ALTERNATIVE APPROACH TO THE TREATMENT OF MENISCAL PATHOLOGIES: A CASE SERIES ANALYSIS OF THE MULLIGAN CONCEPT “SQUEEZE” TECHNIQUE

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ABSTRACT

Background: Partial meniscectomy does not consistently produce the desired positive outcomes intended for meniscal tears lesions; therefore, a need exists for research into alternatives for treating symptoms of meniscal tears. The purpose of this case series was to examine the effect of the Mulligan Concept (MC) “Squeeze” technique in physically active participants who presented with clinical symptoms of meniscal tears.

Description of Cases: The MC “Squeeze” technique was applied in five cases of clinically diagnosed meniscal tears in a physically active population. The Numeric Pain Rating Scale (NRS), the Patient Specific Functional Scale (PSFS), the Disability in the Physically Active (DPA) Scale, and the Knee injury and Osteoarthritis Outcomes Score (KOOS) were administered to assess participant pain level and function.

Outcomes: Statistically significant improvements were found on cumulative NRS ($p \leq 0.001$), current NRS ($p \leq 0.002$), PSFS ($p \leq 0.003$), DPA ($p \leq 0.019$), and KOOS ($p \leq 0.002$) scores across all five participants. All participants exceeded the minimal clinically important difference (MCID) on the first treatment and reported an NRS score and current pain score of one point or less at discharge. The MC “Squeeze” technique produced statistically and clinically significant changes across all outcome measures in all five participants.

Discussion: The use of the MC “Squeeze” technique in this case series indicated positive outcomes in five participants who presented with meniscal tear symptoms. Of importance to the athletic population, each of the participants continued to engage in sport activity as tolerated unless otherwise required during the treatment period. The outcomes reported in this case series exceed those reported when using traditional conservative therapy and the return to play timelines for meniscal tears treated with partial meniscectomies.

Levels of Evidence: Level 4

Key Words: Knee pain, meniscus, mobilization with movement

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BACKGROUND AND PURPOSE

Meniscal tears are the second most common knee injury in sport,¹ contributing to significant time loss for athletes.^{2,3} Common symptoms of meniscal tears include: clicking, catching or locking, joint line tenderness, a feeling of “giving out” or instability, pain with squatting or pivoting motions, pain at end range of flexion and/or extension, and a loss of range of motion.^{4,5} Sustaining a meniscal tear is thought to lead to knee joint space narrowing and altered joint biomechanics,⁶ which if not addressed, may lead to osteoarthritis (OA).⁷

Arthroscopic surgery is the “gold standard” for diagnosing meniscal tears,⁸ but the most frequently used advanced diagnostic tool is magnetic resonance imaging (MRI);⁹ MRI has been found to have a specificity of 76%, sensitivity of 96%, and a diagnostic accuracy of 88%.¹⁰ Meniscal tears are also commonly diagnosed clinically using a battery of special tests. McMurray's (specificity 95%, Sensitivity 21%),¹¹ Apley's (Specificity 90%, Sensitivity 13%)¹² and Thessaly's test (Specificity 97.7%, Sensitivity 90.3%)¹³ are the most commonly used special tests for clinical diagnosis,¹⁴ with Thessaly's test having the highest diagnostic accuracy (94-96%) when performed at 20 degrees of knee flexion.¹⁵ Clinicians can also expect high diagnostic accuracies (>88%) from McMurray's and Apley's tests; when used as a testing battery, McMurray's and Apley's tests are comparable to MRI findings alone.¹⁶⁻¹⁸

One method for improving the accuracy of the clinical exam is to create a more detailed clinical testing battery. Lowery et al.¹¹ identified five components of a standard clinical examination which, when used as a battery, yielded a clinical composite score (CCS) superior to the accuracy of MRI for the detection of meniscal tears. The battery included: a history of catching or locking in the knee, pain with passive terminal knee flexion, pain with passive terminal knee extension, joint line tenderness and a positive McMurray's test. When all five signs were present in patients, a positive predictive value (PPV) of 92.3%, a specificity of 99% and a sensitivity of 11.2% were identified for the detection of meniscal tears (Table 1).¹¹ The PPV and specificity decreased to 81.8% and 96.1% respectively, while sensitivity increased to 17% in the presence of four signs.¹¹ When three

of the five signs were present, the PPV was 76.7%, specificity 90.2%, and sensitivity 30.8%; even with only three signs present, accuracy remained comparable to that of MRI findings.¹¹ Despite the frequent use of MRI for diagnosing meniscal tears, a detailed patient history combined with a battery of reliable special tests can produce a diagnostic accuracy of 90%,¹⁸ slightly superior to the diagnostic accuracy of MRI alone.^{11,18} Accurate diagnosis of meniscal tears is the gateway to producing quality outcomes in patients with meniscal tear symptoms. However, following up an accurate diagnosis with the proper course of treatment should be the primary focus of any experienced practitioner.

The standard of care for partial tears in the non-vascular portion of the meniscus is arthroscopic partial meniscectomy;¹⁹ this surgical procedure accounts for as many as 50% of all orthopedic surgeries in the United States.²⁰ Partial meniscectomy is said to provide symptom relief, correct biomechanical dysfunction that occurs as a result of the injury,²¹ and delay the onset of OA.^{5,22} However, partial meniscectomies do not correct biomechanical dysfunction, and have actually been identified as the leading cause of OA in the knee.²¹⁻²⁴ Furthermore, post-surgical outcomes have only reported limited success in radial tears of the posterior medial horn.²⁵ Despite its prevalent use, partial meniscectomy patient outcomes have been found to be no different to those of patients who receive a sham surgery.²⁶ Patient-reported symptoms 12-months after surgery and the number of patients requiring follow-up surgery were not significantly different between the two groups.²⁶

When indicated, meniscal repair surgery is a preferred alternative to partial meniscectomy due to the preservation of the meniscus, which is thought to enhanced joint stability.²⁷ However, reported failure rates for meniscal repair procedures can range from 8.9%²⁵ up to 42%,⁵ and depending on the location of the tear, a repair may not be indicated in patients without a concomitant anterior cruciate ligament (ACL) tear.¹⁹ Additionally, the risk for follow-up surgery is higher for meniscal repair, 20.7%, than meniscectomy, 3.9%.²⁸ In light of the evidence, it is important for clinicians to exhaust conservative treatment options prior to surgery in the management of meniscal tears.

Table 1. <i>Clinical composite score findings for the detection of meniscal tears. (Lowery et al., 2006)</i>			
	5 tests	≥ 4 tests	≥ 3 tests
% Sensitivity	11.2	16.86	30.8
% Specificity	99	96.1	90.2
PLR	11.45	4.29	3.15
% PPV	92.3	81.8	76.7
PLR=Positive Likelihood Ratio; PPV= Positive Predictive Value Clinical Composite Tests = history of clicking and popping, joint line pain, pain with terminal knee flexion, pain with terminal knee extension, and a positive McMurray's test			

The Mulligan Concept (MC) “Squeeze” technique is a manual therapy intervention designed to treat limited range of motion and localized joint line pain,²⁹ which are symptoms often found in the presence of meniscal tears.^{4,5,11} Despite the theorized benefit of this technique in patients with meniscal tears symptoms, limited formal investigations of the efficacy of this treatment exist and the mechanism of action is unknown.³⁰ Therefore, the purpose of this case series was to examine the effect of the MC “Squeeze” technique in symptomatic, physically active patients who met the criteria for a clinical diagnosis of a meniscal tear.

CASE SERIES DESCRIPTION

A multi-site a priori study was designed by four clinicians (mean clinical experience = 6 years $\pm$ 2.94 SD) to treat patients presenting with meniscal tear symptoms. Five participants (age = 19.6 $\pm$ 3.2, four males and one female) actively competing in a variety of sports at either high school or collegiate levels

(Table 2) presented with clinical symptoms of meniscal tears. All participants were treated with the MC “Squeeze” technique until they reached discharge criteria; outcome measures were collected throughout the course of treatment. No other treatment intervention was applied and participant activity-level was not modified during the course of treatment. The Institutional Review Boards at all four data collection sites approved the collection of medical information from the participants in this study. Participants signed written informed consent acknowledging possible publication of their outcomes.

CLINICAL IMPRESSION #1

Participants were included in the case series if they presented with at least three of the following: positive McMurray's test, pain with terminal knee flexion, pain with terminal knee extension, joint line tenderness, and a history of clicking and/or popping; yielding a high CCS.¹¹ Participants were excluded if they

Table 2. <i>Demographic data for participants</i>				
Participant	Age	Sex	Sport	Onset of Symptoms
1	15	Male	Football	Acute
2	20	Male	Track	Acute
3	20	Female	Lacrosse	Acute
4	24	Male	Basketball	Acute
5	19	Male	Football	Acute

had a potential ACL injury, indicated by a positive Lachman's test, because ACL tears have been found to reduce the diagnostic accuracy of the meniscal clinical composite score.¹¹ In addition to the CCS, two tests involving a rotational force, Thessaly's at 20 degrees and Apley's compression and distraction test, were used because they have been identified to accurately assist in the clinical diagnosis of meniscal tears.¹² Participants were required to present with a positive finding in at least one of these rotational special tests. Participants were also excluded if they presented with the following conditions during the initial exam: knee contusions, fractures, knee dislocations, increased pain with manual therapy, knee ligament instability, and non-mechanical causes of

pain (e.g., hyperalgesia). The co-morbidities were considered precautions to manual therapy for the purpose of this study.

EXAMINATION

Examination included a thorough history and a comprehensive clinical exam relating to the chief complaint. The participants reported the following signs that met the inclusion criteria of: history of clicking and popping (n=2), joint line pain (n=5), pain with terminal knee flexion (n=5), pain with terminal knee extension (n=4), positive McMurray's test (n=4), positive. Thessaly's test at 20 degrees of knee flexion (n=4), and/or positive Apley's compression/distraction test (n=3; Table 3). Based on the evidence

Table 3. <i>Inclusion criteria for all participants with descriptions of positive special tests on clinical exam</i>					
Sign/Symptom	Participant 1	Participant 2	Participant 3	Participant 4	Participant 5
History of Popping or Clicking	Positive	Positive	Negative	Negative	Negative
Joint Line Tenderness	Positive	Positive	Positive	Positive	Positive
Terminal Knee Extension	Positive	Negative	Positive	Positive	Positive
Terminal Knee Flexion	Positive	Positive	Positive	Positive	Positive
McMurray's Test	Positive	Positive	Positive	Positive	Positive
Thessaly's Test (@ 20°)	Not Performed	Positive	Positive	Positive	Positive
Apley's Compression Test	Positive	Negative	Positive	Positive	Positive
Other Initial Exam Symptoms	Edema, ROM Restriction, unable to weight bear	Edema and ROM Restriction	ROM Restriction	Edema and ROM Restriction	ROM Restriction

supporting the diagnostic accuracy of Thessaly's test¹⁵ and a battery of special tests,¹⁶⁻¹⁹ participants who met the inclusion criteria were provisionally diagnosed with meniscal tears.

CLINICAL IMPRESSION #2

Once participants were included in the study based on the clinical exam (Table 3), all five were treated with the MC "Squeeze" technique. The number of treatments (mean = 5 ± 1.73) and the duration of treatment in days (mean = 14.2 ± 5.68 days) were not standardized. Participants were treated until they reported a Patient Specific Functional Scale (PSFS) score of 10, a Numeric Pain Rating Scale (NRS) score of one or less, and a DPA scale score below 23 (Table 4). Participants were also progressively released to participate in physical activity as tolerated based on the clinician's individual sport-specific return to play criteria, which did not necessarily correlate to being discharged from the study. The participant could remain in the study after returning to sport activity until they reached the standardized discharge criteria.

OUTCOME MEASURES

The following outcomes were collected at intake: Numeric Pain Rating Scale (NRS), the Patient Specific Functional Scale (PSFS), the Disablement in the Physically Active Scale (DPA), and the Knee injury and Osteoarthritis Outcomes Score (KOOS). The NRS and PSFS were collected pre- and post- each treatment, while the DPA and KOOS were only collected at intake and discharge. All outcomes scales were

found to be internally and externally valid, as well as reliable.³¹⁻³⁶

The NRS was used to quantify participant reported pain. The NRS score was conducted verbally and documented as an average (cumulative NRS) of current pain, best pain within 24 hours, and worst pain within 24 hours at intake, pre-treatment, and discharge.³¹ Immediate post-treatment pain changes (current NRS) were recorded using participant reported current pain post-treatment. The NRS scale was scored on an 11-point scale, with 0 representing no pain and 10 representing severe pain.³¹ The reported minimal clinically important difference (MCID) for the NRS is a decrease of 2 points or 33%.³²

The PSFS was used to quantify functional ability. The PSFS score was documented during intake, pre- and post-treatment, and after discharge. The participant was asked to identify a single activity to perform in the clinic that was limited due to injury. After identifying the activity, the participant verbally rated the severity of the limitation on an 11-point scale, with 0 representing being unable to perform the activity and 10 representing being able to perform the activity at the level before injury.³² The reported minimal detectable change (MDC) is a change in 2.5 points when using an individual activity in patients with a lower limb injury.³⁴

The DPA scale was used to quantify disablement across impairment, functional limitation, disability, and health-related quality of life.³⁵ The DPA was collected at intake and discharge. Responses on the DPA are based on a scale ranging from 1 (no problem) to 5 (severe

Table 4. Treatment data for duration of treatment from intake to discharge including when participants achieved MCIDs

Participant	Total Treatments	Days to Discharge	Average NRS		Current NRS		PSFS		DPA		KOOS	
			Intake	Discharge	Intake	Discharge	Intake	Discharge	Intake	Discharge	Intake	Discharge
1	5	21	3	0*	2	0*	0	10**	35	4**	43.29	86.60**
2	6	18	5.33	0*	5	0*	6	10**	11***	3	66.69	87.54**
3	6	9	4	0*	4	0*	4	10**	42	16**	47.81	74.99**
4	6	21	5.33	0.33*	5	1*	3	10**	19***	0**	63.31	91.03**
5	2	2	4.33	0*	5	0*	4	10**	21***	14	65.85	89.60**

Average Numeric Pain Rating Scale (NRS)= the patients average score of current, best and worst pain over 24 hours;
 Current NRS=patients reported pain at time of treatment; PSFS= Patient Specific Functional Scale; DPA= Disability in the Physically Active Scale; KOOS= Knee injury and Osteoarthritis Outcomes Score
 *= MCID Achieved in first treatment
 **= MCID Achieved by discharge
 ***= Normal range prior to treatment

problem) across 16 items; total possible scores range from 0 to 64 points.³⁵ A normal, healthy score is less than or equal to 34.³⁵ An MCID is a decrease of 9 points for an acute injury and 6 points for a chronic injury.³⁵

The KOOS, was used to assess five dimensions: pain, symptoms, activities of daily living, sport and recreational function, and knee-related quality of life.³⁶ The KOOS was collected at intake and discharge. Responses within each dimension of the KOOS are based on a scale ranging from 0 to 4; a total score of 100 indicates no symptoms present. Each dimension of the KOOS was scored separately and a composite score of the average of all 5 categories (KOOS₅) was used in the analysis of the data presented in this case series.³⁶ An MCID for each subsection is a change of 8-10 points,³⁶ however, an MCID value has not been established for the KOOS₅ composite score.

INTERVENTION

The MC “Squeeze” technique was administered according to Mulligan Concept principles.²⁹ All treatment started with the participant supine and the involved knee in 90 degrees of flexion, or flexed to the participant’s pain-free limit, for better access to the joint line. The clinician placed the medial border of one thumb over the site of maximum joint line pain and swelling, and with the other thumb reinforced the first to create an overlap grip position (Figure 1).²⁹ Next, the participant extended their knee to their maximal pain-free range, while the clinician

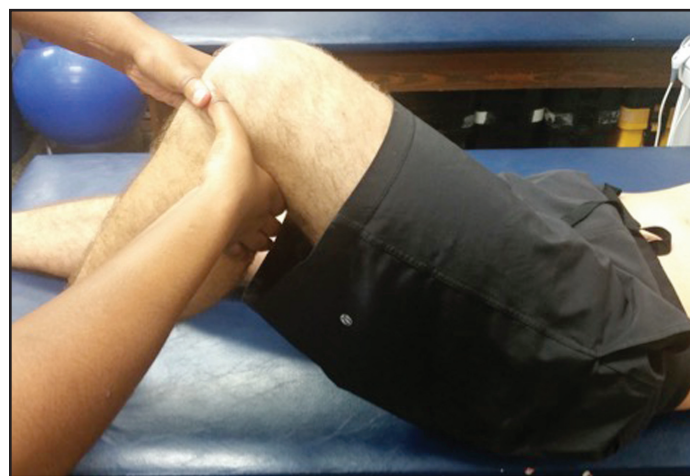


Figure 1. Clinician hand placement as the participant moves through active knee extension. Note: The pressure from the mobilizing thumb is released when the joint space closes, and reapplied when it opens with knee flexion.

maintained hand position, releasing the grip force on the joint line as the joint space closed (Figure 2). After maximal knee extension was reached, the participant actively returned their knee towards full flexion as the clinician increased the force with the overlapping thumb towards the center of the joint.²⁹ The clinician continued to hold the pressure at the joint line for two seconds as the participant applied overpressure by pulling the tibia with both hands to their end range of knee flexion (Figure 3).²⁹

The participants were allowed to experience localized discomfort from the overlap grip to tolerance, but the localized discomfort was not to be exacerbated with movement.²⁹ Each treatment consisted of three sets of ten repetitions of the MC “Squeeze” technique. All participants were treated until discharged. The discharge criteria consisted of a PSFS score of 10, an NRS score of

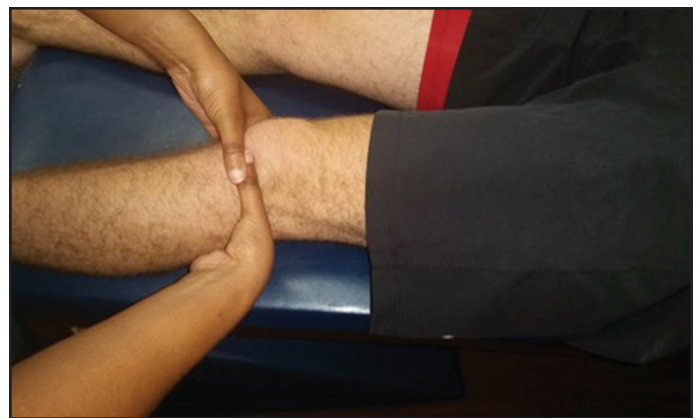


Figure 2. Starting hand placement for the MC “Squeeze” Technique with the participant’s knee at approximately 90 degrees of flexion. Note: Hand placement was found in a pain-free range of motion.



Figure 3. Clinician providing the compression on the tender portion of the joint line as the participant performs active knee flexion with overpressure.

one or less, and a DPA scale score below 23. No additional care was provided beyond the MC “Squeeze” technique. Participants were not restricted from any activities of daily living, and those deemed able by the clinician (based on clinical presentation) were allowed to participate as tolerated in their specific sport activity.

OUTCOMES

DATA ANALYSIS

Paired t-tests were performed on the cumulative NRS score, current NRS pain score, PSFS, DPA Scale, each dimension of the KOOS, and KOOS₅ (an average of all dimension scores) to determine the effect of the interventions from initial exam to discharge. Mean differences from the initial visit scores and 95% confidence intervals (CIs) were calculated for all outcomes measures. Cohen's *d* was calculated to determine the effect size, or maximum likelihood, of each outcome measure. For Cohen's *d*, an effect size of 0.2 to 0.3 was considered a “small” effect, 0.5 a “medium” effect, and 0.8 to infinity a “large” effect.³⁷ All data was analyzed using SPSS version 23.0 (SPSS Inc., Chicago, IL, USA).

NRS

The use of the MC “Squeeze” technique produced a statistically significant improvement in cumulative NRS scores ($t(4) = 10.796$, $p \leq .001$, 95% CI: 3.21 to 5.43, Cohen's *d* = 4.39) from initial exam to discharge. A statistically significant improvement in current NRS pain scores ($t(4) = 7.303$, $p \leq .002$, 95% CI = 2.48 to 5.52, Cohen's *d* = 3.07) was also found from initial exam to discharge, 14.2 ± 5.68 days after

initial exam (Table 5). The Cohen's *d* values resulted in a large effect size,³⁷ indicating the change in NRS scores can very likely be attributed to the treatment intervention. All five participants reported a decrease in pain immediately after a single treatment; four participants met or exceeded the MCID (decrease of 2 points or 50%)³² on the NRS after the first treatment (mean change = 3.75 ± 1.89). All participants also reported a cumulative NRS score of less than 1 by discharge. Four participants reported cumulative NRS scores of 0, while one participant reported a cumulative score of 0.33 at discharge.

PSFS

The use of the MC “Squeeze” technique produced a statistically significant positive change in PSFS scores ($t(4) = -6.74$, $p \leq .003$ 95% CI = -9.32 to -3.88, Cohen's *d* = 3.01) from initial exam to discharge 14.2 ± 5.68 days after initial exam (Table 5). The Cohen's *d* value resulted in a large effect size,³⁷ indicating the change in PSFS scores can likely be attributed to the treatment intervention. Of particular importance, all participants reported an increase of at least 3-points by discharge, meeting the MDC for PSFS.³⁴ All participants reported a PSFS score of 10 by discharge, indicating a complete restoration of function (Table 4).

DPA SCALE

The use of the MC “Squeeze” technique produced a statistically significant improvement in DPA Scale scores ($t(4) = 3.817$, $p \leq 0.019$, 95% CI = 4.96 to 31.44, Cohen's *d* = 1.44) from initial exam to discharge,

Table 5. Statistical and clinical significance for pain, function, and disability scales

Outcomes Scales	Mean Change	<i>p</i> -value	95% Confidence Interval	Cohen's <i>d</i>
NRS- Average	4.32	0.00*	3.21 to 5.43	4.39
NRS-Current	4	0.002*	2.48 to 5.52	3.07
PSFS	6.6	0.003*	-9.32 to -3.88	3.01
DPA	18.2	0.019*	4.96 to 31.44	1.44
Average Numeric Pain Rating Scale (NRS)= the patients average score of current, best and worst pain over 24 hours; Current NRS=patients rating of pain at time of treatment; PSFS= Patient Specific Functional Scale; DPA=Disability in the Physically Active Scale *= Statistically significant difference				

Table 6. Statistical and clinical significance for all subsections of the KOOS

KOOS Sub-Scale	Mean Change	Significance (<i>p</i>)	95% Confidence Interval	Cohen's <i>d</i>
Symptoms	27.06	0.036*	-51.98 to -2.93	2.89
Pain	32.22	0.013*	-53.06 to -11.39	1.89
ADL's	23.22	0.014*	-38.94 to -7.72	1.93
Sports	49	0.014*	-81.38 to -16.62	1.77
QOL	11.2	0.037*	-21.31 to -1.09	0.79
Composite	28.56	0.002*	-39.36 to -17.76	1.36

KOOS= Knee injury and Osteoarthritis Outcomes Score; ADL= Activities of Daily Living; QOL= Quality of Life
*= Statistically significant difference

14.2 $\pm$ 5.68 days after initial exam (Table 5). While only three participants reported a score that met the MCID for acute injuries (9 points),³⁵ the other two participants began with scores below 23, which is within the normal range. The two participants who did not meet the MCID still improved by 7 and 8 points respectively. All participants' scores on the DPA Scale were below 23 at discharge, which indicated that their perception of disability had likely returned to their pre-injury state (mean change = 18.2 $\pm$ 10.66; Table 4).

KOOS

The use of the MC "Squeeze" technique produced statistically significant improvement in KOOS₅ ($t(4) = -7.342$, $p \leq 0.002$, 95% CI = -39.36 to -17.62, Cohen's $d = 1.36$) scores in each of the five dimensions, along with large effect sizes, from initial exam to discharge 14.2 $\pm$ 5.68 days after initial exam (Table 6). Of particular importance, all participants reported a minimum of 8-10 point increase on each of the five dimensions of the KOOS, meeting the MCID³⁶. There is currently no published MCID values for the KOOS₅, but the mean change was a total increase of 28.56 $\pm$ 8.7 points for each participant on the KOOS₅ from initial exam to discharge.

DISCUSSION

The results of this case series indicate improved patient outcomes when utilizing the MC "Squeeze" technique in participants who were classified as having

a meniscal tear based on the meniscal pathology clinical composite score.¹¹ Meniscal tear diagnosis was determined by a clinical evaluation consisting of a thorough history and a comprehensive clinical assessment relating to the chief complaint. The criteria for clinical diagnosis was determined to be accurate based on the evidence supporting the diagnostic accuracy of Thessaly's test¹⁵ and a battery of special tests.¹⁶⁻¹⁹ A clinical examination has been determined to have a similar, and in some cases better, diagnostic accuracy than MRI alone, concluding that MRI is only necessary in cases lacking a definitive clinical diagnosis.^{11,18,38-40}

The treatment timelines in this case series varied due to each participant's availability, however, all participants were discharged within six treatments (Table 4) delivered over an average of 14.2 days ($\pm$ 5.68 SD). Additionally, the improvements reported by each participant were found to be statistically and clinically significant across all outcomes measures used in this case series. The use of the MC "Squeeze" technique also produced immediate benefits for the participants, as four of the five participants reported experiencing clinically significant improvements in pain after the first treatment (Table 4). Of particular importance to the athletic population, each of the participants continued to engage in sport activity as tolerated during the treatment period. Participants #1 and #4 returned from non-weight bearing status to limited activity after just one treatment and returned to full activity by the third treatment.

Participant #2 returned to full activity after two treatments. Participants #3 and #5 maintained full activity for the duration of treatment.

The outcomes reported in this case series exceed those reported in the use of traditional conservative therapy. The use of progressive resistive exercises (PREs) and non-steroidal anti-inflammatory drugs for treating meniscal pathology typically require more treatment sessions over a longer period of time (i.e., 12 weeks).⁴⁰ The outcomes of this case series also surpass the return-to-play timelines for meniscal tears treated with partial meniscectomies. In a previous study, only 80% of participants who underwent partial meniscectomy returned to full sport activity after six months of rehabilitation.⁴⁰ Despite less than desirable outcomes in many cases, the “gold standard” of care continues to be partial meniscectomy,^{5,14,25-26,28,42-45} however, there are also recommendations to exhaust conservative treatment options prior to considering surgery.^{25,43-45} While more research is still needed, the positive results reported in this case series provide support for the MC “Squeeze” technique as an alternative non-operative treatment option for patients with presenting with meniscal pathology.

Several limitations exist in this case series, beginning with not controlling for each participants' activity during the course of treatment and the lack of arthroscopy for the confirmation of meniscal tears; however, given that most diagnoses are not made with arthroscopy and rely on clinical diagnosis, it is important to study the treatment of meniscal pathology patients who are classified through a clinical exam. Other limitations include the lack of a control or comparison treatment group and the collection of long-term (e.g., 6-months post-discharge) outcome measures. Additionally, according to the Mulligan Concept, it is common to first apply an internal rotation accessory glide of the tibia when treating patients with general knee pain, and to progress to medial/lateral glides of the tibia, to provide the greatest reduction in symptoms.²⁹ Thus, the patient outcomes reported in this case series may have been further improved by determining which MC technique was best for each individual participant. However, as the MC “Squeeze” technique is recommended for the management of meniscal tear symptoms.²⁹ Finally, while the out-

comes using the MC “Squeeze” technique were positive, the application of the technique was provided by clinicians who were novices in utilizing this specific technique. Expert MC practitioners could have possibly exceeded the clinical outcomes produced in this study; the impressive results produced by novices, however, provides evidence for the potential efficacy of using this technique. Future research is needed to compare the MC “Squeeze” technique to other interventions for short- and long-term benefit. If the technique is found to be beneficial, investigation would also be needed to better understand the underlying physiological mechanism of the treatment.

CONCLUSION

Meniscectomy and meniscal repair surgery are currently common practice;²⁴ however in this case series, use of the Mulligan Concept “Squeeze” technique produced statistically and clinically significant improvements in participants who were clinically diagnosed with a meniscal tear. The MC “Squeeze” technique may produce positive results in an athletic population seeking conservative treatment of meniscal pathology. The use of this manual therapy technique may also satisfy recommendations to exhaust conservative treatment interventions before seeking surgical intervention. Further research is needed to determine physiological mechanism and long-term effect of the treatment.

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