

Using the Mulligan Mobilization with Movement and Fibular Repositioning to Treat High School Patients with a Grade One Lateral Ankle Sprain

Alexander Zettlemoyer, DAT, LAT, ATC *; Rich Patterson, DAT, LAT, ATC†; Russell Baker PhD, DAT, ATC‡; Alan Nasypany, EdD, LAT, ATC‡

*Mechanicsburg Area School District, Mechanicsburg, PA; †Clarion University, Clarion, PA; ‡ University of Idaho, Moscow, ID

ABSTRACT

Ankle injuries are common among high school athletics with the highest incidence rates in boys and girls basketball and boys football. Novel treatment paradigms like the Mulligan Mobilization with Movement (MWM) in conjunction with fibular repositioning tape have shown promising results in reducing pain, disability, and time lost due to lateral ankle sprains (LAS). However, research focusing on Mulligan treatment strategies and ankle swelling following a LAS is limited. Therefore, the purpose of this case series was to evaluate the combined effects of the MWM and fibular repositioning taping on swelling, function, and pain in high school patients with an acute grade 1 LAS. A convenience sample of seven (4 females, 3 males, 5 right ankle, 2 left ankle injuries) consecutive high school patients (15.9± 1.4 years of age; range = 14-18 years) were evaluated following an acute LAS and treated with the MWM and fibular repositioning tape. Subjective evaluation of pain, self-report function and disability were assessed throughout the treatment process utilizing PROMs. Specifically, the Numeric Pain Rating Scale, Disabling in the Physically Active scale, Foot and Ankle Ability Measure and the Foot and Ankle Ability Measure Sport Subscale were included throughout the treatment protocol along with the figure-of-eight ankle girth measurement to assess the amount of swelling following each treatment session. All seven patients returned to unrestricted participation following an average of 2.9±0.8 treatments (range 2-4 treatments) and presented an average decrease in ankle girth of 24.7±13.7mm from baseline to return to participation. Overall, the MWM and fibular repositioning tape produced an immediate change in pain, disability, function and swelling following an acute grade 1 LAS.

Key Phrases

Manual techniques, clinician-rated outcomes, patient-reported outcomes

Correspondence

Mechanicsburg Area Senior High School, 500 South Broad Street, Mechanicsburg, PA 17055

E-mail: SZettlemoyer@mbqsd.org

Twitter: @realneal35

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INTRODUCTION

With a peak ankle incident rate between the ages of ten and nineteen, high school athletes are specifically susceptible to ankle sprains, accounting for 22.6% of all sports related musculoskeletal injuries.^{1,2} The highest incidence in high school sports of ankle sprains occurs in boys basketball (7.74 per 10,000 exposures), followed by girls basketball (6.93 per 10,000 exposures) and boys' football (6.52 per 10,000 exposures).² Approximately 85% of ankle injuries occur after excessive inversion and plantarflexion of the foot combined with external rotation of the distal leg, which results in damage to the lateral ligament complex.³ Of the three lateral ligaments, the anterior talofibular ligament (ATFL) is the weakest and is more frequently involved in ankle sprains than the calcaneofibular ligament or the posterior talofibular ligament.^{3,4}

Following an acute lateral ankle sprain (LAS), ankle joint ligamentous and muscular dynamic stability are compromised to varying degrees based on the extent of the injury. One factor that may contribute to increased dysfunction associated with LAS is the anatomical position of the fibula in relation to the tibia within the ankle mortise.⁵⁻⁷ This post-injury variation was first hypothesized by Brian Mulligan, founder of the Mulligan Concept (MC), as a positional fault in which the distal fibula is displaced in the anterior, inferior and medial direction.⁸ Following LAS, the fibula may become stuck anteriorly resulting in an increase in accessory movements such as gliding and rolling of talus in the ankle mortise.⁹ These

altered arthrokinematic motions lead to abnormal physiological motions which increase ligamentous stress and when left untreated may lead to delayed healing and chronic ankle instability.¹⁰

Immediate conservative treatment of LAS commonly includes protection, optimal loading, ice, compression and elevation (POLICE)¹¹ in conjunction with early mobilization and non-steroidal anti-inflammatory medication.¹² This intervention is recommended based on the tissue-healing model that clinicians believe must occur post-LAS. However, given the previous research on the presence of positional faults post-LAS,^{5,10,13} it appears that commonly used conservative methods fail to address the position of the fibula which may lead to delayed recovery and the development of ankle instability. The early application of MC Mobilization with Movement (MWM) and the fibular repositioning taping technique, which are designed to provide an immediate and long-lasting correction of the previously mentioned positional fault, may improve patient outcomes following LAS. If a Pain-free, Immediate, and Long-Lasting (P.I.L.L) mobilization applied to the distal fibula in a posterior, superior and lateral direction while active or passive range of motion is performed with overpressure at the end-range, resolves patient-reported pain and improves range of motion, then the clinician should continue to utilize the technique as part of the treatment protocol following MC guidelines.⁸

The majority of the evidence on this technique includes description studies, but initial reports have documented positive effects of the MWM and fibular repositioning tape on pain and dysfunction in patients suffering from acute LAS.¹⁴⁻¹⁷ Studies evaluating patient outcomes for swelling or edema reduction post MWM or fibular repositioning taping application post-LAS were not identified. Thus, there is a paucity of research on the effects of MWMs in patients who have suffered acute LAS. Therefore, the purpose of this

case series was to evaluate the combined effects of the MWM and fibular repositioning taping on swelling, function, and pain in high school patients with an acute grade 1 LAS.

PATIENT POPULATION

A convenience sample of seven (4 females, 3 males, 5 right ankle, 2 left ankle injuries) consecutive high school patients (15.9 ± 1.4 years of age; range = 14-18 years) were evaluated by an Athletic Trainer following an acute inversion ankle injury. Initial examination occurred within 72 hours of the acute LAS. Prior to beginning the study, each patient agreed to complete the LAS treatment protocol, as well as the associated patient reported outcome measures (PROMs). Patients were included if they suffered an acute (i.e., must report within 72 hours of initial onset) inversion ankle sprain as well as self-reported functional limitations resulting from the injury. Patients were excluded if they had any concomitant injuries or contraindications to manual therapy such as: systemic or local infection, fracture, malignancy, acute circulatory conditions, pregnancy, or hyper joint mobility. Patient history of LAS was not controlled for during the study. All patients completed the approved consent process (i.e., minor participant assent and parental consent) prior to participation in the study. The study was approved by the high school's institutional review board.

CLINICAL EVALUATION AND INTERVENTION

Initial evaluation consisted of a standardized bilateral physical examination of the ankle, which included a detailed history, physical exam, the Ottawa Ankle Rules to rule out ankle fracture, girth measurement (figure-of-eight), and baseline PROMs. Pre- and post-intervention PROMs included the Numeric Pain Rating Scale (NPRS), the Disablement in the Physically Active (DPA) scale, Foot and Ankle Ability Measure (FAAM) and the Foot and Ankle Ability Measure Sport Subscale (FAAM-S). A second Athletic Trainer, who

was blinded to the results of the primary investigator, performed a secondary examination to confirm the original diagnosis and verify patient inclusion criteria. Diagnosis of a Grade 1 LAS was defined by mild swelling along the distal lateral malleolus, tenderness on palpation, pain along the ATFL during the anterior drawer test with the patient seated and the foot in neutral, and inversion stress testing with a firm end-feel (i.e., without ligament laxity).¹⁸

Following the initial evaluation and acknowledgment of consent, patients completed the baseline PROMs and were treated using the Mulligan distal fibular anterior-posterior (A-P) MWM followed by the fibular repositioning taping technique. This technique was carried out by placing the patient supine with the involved ankle off the end of the treatment table. The MWM technique required a pain-free sustained anterior to posterior, slightly superior and lateral glide of the distal fibular in relation to the ankle mortise (**Figure 1**), which was performed by placing the thenar eminence of the clinician on the patient's fibula just anterior to the distal, lateral malleolus. In conjunction with the sustained glide, the patient actively plantar-flexed and inverted the foot for 3 sets of 10 repetitions to the end of active range, followed by pain-free overpressure by the clinician. Immediately following the MWM, fibular repositioning tape was applied to maintain the corrected positional fault.⁸ Two-inch (5.0cm) BSN Medical Cover-Roll® was loosely applied anterior to the distal fibula and continued in a posterior-superior direction, wrapping around the distal tibia ending approximately one-inch (2.5cm) superior to the starting position along the anterior aspect of the tibia. One and one-half (3.84cm) inch Leukotape® was then applied directly to the Cover-Roll in the same direction as the glide to maintain the position of the fibula until the next scheduled treatment (**Figure 2**).⁸



Figure 1. Mulligan Technique: anterior to posterior, slightly superior and lateral glide of the distal fibular



Figure 2. MC lateral fibular repositioning taping technique

Each patient was seen for a minimum of two visits, with one day between visits. During each follow-up visit the patient was re-evaluated for change in ankle girth measurements (figure-of-eight) as described by Tatro-Adams et al¹⁹ by both clinicians which were blinded to the results followed by completion of the NPRS. The patient was again treated with the Mulligan distal fibular A-P MWM in the same method as previously described. The fibular repositioning tape remained in place for the duration of the study but was reinforced if slippage was identified. The use of standard conservative treatment such as POLICE was not controlled by the investigators. The patients were instructed to continue activities of daily living (ADLs) as tolerated but refrain from participation in sports.

Following the treatment intervention, each patient completed the DPA scale, FAAM and the FAAM-S outcome measures. Patients were monitored throughout the study for signs warranting additional medical care, but no such patient existed during the duration of the study. As a condition of discharge, each patient had to perform functional non-standardized sports-specific activities evaluated by the original clinicians. The activities were performed with the Mulligan fibular repositioning tape applied and included running, cutting/lateral movement, jumping and single-leg hop on the involved extremity.

OUTCOME MEASURES

Subjective evaluation of pain, self-report function and disability were assessed throughout the treatment process utilizing PROMs. Specifically, the NPRS, DPA scale, FAAM and the FAAM-S were included throughout the treatment protocol. Clinician oriented evidence included the figure-of-eight ankle girth measurement to assess the amount of swelling following each treatment session.

Numeric Pain Rating Scale and Disablement in the Physically Active Scale

Patient oriented evidence including pain and global disablement was collected utilizing the NPRS and DPA scale. The NPRS is an 11-point self-report pain scale ranging from 0-10, where 0 is “no pain” and 10 is the “worst pain imaginable.” The patient indicates intensity of current pain, worst pain and best pain over the last 24-hours which is averaged to identify a pain score.²⁰ The DPA scale is a 16 item, multidimensional, outcome instrument based on the disablement model which uses a 5-point Likert Scale where 0 represents “no problem” and 4 represents “severe” disability.²¹ With a scoring range of 0-64, the higher the score the higher the level of disability.²¹ The minimally clinically important difference (MCID) represents the ability

of the instrument to reflect the patient’s perception of change in the disease process over time. The MCID for the NPRS and DPA scale has been previously calculated as a 2-point change²² and 9-points in acute participants respectively.²¹ These instruments were chosen because they have demonstrated consistent validity among patients with similar musculoskeletal conditions such as acute LAS.^{21,23}

Foot and Ankle Ability Measure

The FAAM is a region-specific PROM divided into the FAAM-ADL (activities of daily living) and the FAAM-S subscales. The FAAM evaluates activity limitations and patient disability on a 5-point Likert scale (0-4, 0=no difficulty and 4=unable to do). Scores range from 0-84 (FAAM-ADL) and 0-28 (FAAM-S) which are written as a percentage with 100% representing no functional loss. The MCID for the FAAM-ADL and FAAM-S is an 8-point and 9-point change respectively.²⁴ Similarly, the FAAM-ADL and FAAM-S have shown reliability and validity for patients with a broad range of lower limb, ankle and foot dysfunctions.²⁴

Ankle Girth Measurements - Figure-of-Eight

Ankle girth was measured by applying the figure-of-eight method while each foot was maintained in a neutral position. Tatro-Adams et al¹⁹ described the figure-of-eight as the following procedure; with the ankle in a neutral dorsiflexion position, a flexible 1-centimeter tape starts midway between the tibialis anterior tendon and the lateral malleolus and is then drawn medially across the instep and placed just distal to the tuberosity of the navicular and then pulled across the arch and up just proximal to the base of the 5th metatarsal. The tape is then placed across the tibialis anterior tendon and continues around the ankle joint just distal to the distal tip of the medial malleolus, crosses the Achilles tendon, and is placed just distal to the distal tip of the lateral malleolus ending at the starting position.¹⁹ The

ICC was previously determined to be 0.99 for both inter-tester and intra-tester reliability for this method of measuring ankle swelling.¹⁹ Ankle girth measurements were in millimeters and taken three times during the initial treatment and following each subsequent treatment with the average of the three measures recorded.

RESULTS

Patient demographic data was analyzed using mean and standard deviation (**Table 1**). All seven patients were evaluated and treated for LAS and returned to unrestricted participation following an average of 2.9 ± 0.8 treatments (range 2-4 treatments). Figure-of-eight measurements were taken at baseline and following each treatment. Baseline figure-of-eight measures for the involved ankle were 587.5 ± 15.0 mm compared to the uninvolved ankle 559.9 ± 11.3 mm. Between baseline treatment and final figure-of-eight measures, patients demonstrated a decrease in ankle girth of 24.7 ± 13.7 mm (**Table 2**) and presented a final ankle girth of 562.7 ± 11.6 mm. All seven patients also reported changes across all PROM taken between baseline and final measure which met the MCID for the NPRS (2-points), DPA (9-points), FAAM (8-points) and FAAM-S (9-points) (**Table 3**).

DISCUSSION

Application of the MWM treatment protocol in combination with the fibular repositioning tape on patients presenting with an acute grade 1 LAS demonstrated improvement across all outcome instruments and a reduction in swelling as measured by the figure-of-eight girth method over approximately 3 treatments. As we hypothesized, restoring the normal relative position of the distal fibula through the MWM and fibular repositioning tape was an effective intervention for the treatment of pain and disability in high school patients with acute grade 1 LAS. All seven patients also met or exceeded the MCID on the included outcome instruments indicating clinically significant improvements from baseline to discharge for pain, measured by the NPRS, disablement measured by the DPA scale, and function which was measured by the FAAM and FAAM-S (Table 3). These meaningful improvements in PROMs are consistent with patient measures reported in previous studies.^{14-17, 25-28}

Acute LAS are frequently accompanied by swelling around the ankle joint and foot.¹² The figure-of-eight ankle girth measurement is a reliable and cost-effective method for measuring ankle swelling regardless of ankle position.^{5,29} Hubbard and Hertel⁵ found a correlation between the anterior position of the fibula and the amount of swelling in individuals with sub-acute ankle sprains using fluoroscopy. However, it should be noted that the amount of swelling does not directly

Table 1. Patient demographic information

| Patient | Days from Initial Injury to Evaluation and Treatment | Patient Age | Sex | Sport | Involved Ankle | Number of Treatments to discharge |
|---------|--|-------------|-----|-------|----------------|-----------------------------------|
| 1 | 1 | 15 | F | WBB | R | 3 |
| 2 | 1 | 17 | F | WBB | R | 4 |
| 3 | 1 | 15 | M | MBB | L | 2 |
| 4 | 3 | 18 | M | SOC | L | 3 |
| 5 | 2 | 15 | F | WP | R | 2 |
| 6 | 1 | 17 | M | SOC | R | 2 |
| 7 | 1 | 14 | F | VB | R | 4 |

* WBB= Women's Basketball, MBB= Men's Basketball, SOC= Men's Soccer, WP= Women's Water Polo, VB= Women's Volleyball

Table 2: Figure-of-eight measures

| Patient | <i>Injured</i> | | | <i>Uninjured</i> |
|----------------|------------------------|----------------------------|-------------------------|------------------------|
| | Baseline Girth (mm) | Girth at Discharge (mm) | Change in Girth (mm) | Baseline Girth (mm) |
| 1 | 581.6 | 556.2 | 25.4 | 555.2 |
| 2 | 582.8 | 546.6 | 36.2 | 544.8 |
| 3 | 595.5 | 580.3 | 15.2 | 576.7 |
| 4 | 588 | 565.7 | 22.3 | 566 |
| 5 | 564.9 | 553.2 | 11.7 | 548 |
| 6 | 585.2 | 572.1 | 13.1 | 567.4 |
| 7 | 614.3 | 565.3 | 49 | 561.3 |
| Average | 587.5 | 562.8 | 24.7 | 559.9 |
| SD (±) | 15.0 | 11.6 | 13.7 | 11.3 |

Table 3. Patient-rated outcome measure results: initial, discharge and mean change

| Patient # | 1 | 2 | 3 | 4 | 5 | 6 | 7 | Mean change and SD | MCID |
|-----------------------------|-------|-------|------|------|-------|-------|-------|-----------------------|------|
| NPRS Baseline | 6.00 | 8.00 | 4.33 | 5.00 | 4.00 | 6.33 | 5.00 | | |
| NPRS Discharge | 1.33* | 1.67* | 3.00 | 2.33 | 2.00* | 1.00* | 0.33* | 3.86±1.86 | 2 |
| FAAM Baseline | 40 | 28 | 47 | 35 | 42 | 13 | 54 | | |
| FAAM Discharge | 80* | 79* | 79* | 64* | 64* | 84* | 83* | 39.12±16.87 | 8 |
| FAAM-S Baseline | 1 | 7 | 7 | 0 | 12 | 3 | 7 | | |
| FAAM-S Discharge | 22* | 21* | 19* | 18* | 24* | 24* | 22* | 16.14±3.89 | 9 |
| DPA Baseline | 37 | 36 | 27 | 29 | 42 | 57 | 30 | | |
| DPA Discharge | 3* | 6* | 7* | 12* | 3* | 4* | 14* | 29.86±13.48 | 9 |

*Achieved MCID

correlate with the self-reported function following an ankle injury.³⁰ Therefore, measures of swelling may not represent a functional outcome but could be useful in establishing a baseline which can be tracked throughout the rehabilitation process.

While our research design does not include diagnostic testing, repositioning of the fibula and ankle mobilization did demonstrate a decrease in swelling over the short treatment duration. The reduction in ankle swelling following the intervention represents a positive effect on mechanical properties, regardless of the influence

of swelling on self-reported function suggesting that pain, rather than swelling is the limiting factor in acute LAS.³⁰

The addition and quantity of swelling during the plantarflexion/inversion mechanism for LASs may influence the relative position of the fibula on the tibia in the ankle mortise.

Hubbard and Hertel⁵ found nine of 11 patients with subacute ankle injuries to have an anterior positioned fibula and suggested that the amount of swelling was correlated with the amount of

anterior fibular displacement. These results coincide with Mavi et al¹³ and Kavanagh⁶ who both reported an anterior displacement of the distal fibula following ankle injury through radiographic imaging. Suggested treatment for the anterior fibular displacement includes mobilization and has been documented in case reports with positive outcomes in ROM, patient reported pain and function.^{15,28} Fibular repositioning taping has also been evaluated in limited fashion and reported to have no effect on static or dynamic balance³¹ but may help to prevent recurrent ankle sprains.³²

Our study demonstrated a decrease in both pain and ankle girth, but the limited number of participants makes it difficult to draw a statistical correlation. This is consistent with Collins, Teys & Vicenzino,²⁸ who evaluated the acute effects of the dorsiflexion MWM on subacute ankle sprains, and found significant improvements in ankle dorsiflexion but no change in hypoalgesic effects following a single treatment session. In contrast, our study included the MWM in conjunction with fibular repositioning tape on acute ankle patients and included multiple MWM treatments. The subtle changes in fibular position combined with active movement may have a greater influence on the mechanical response to acute injury while pain receptors are not inhibited by this technique. Additional research is warranted to clarify this potential change following the MWM and fibular repositioning taping.

The case series design (level 4) of this study presents some limitations. The lack of short-term follow-up does not give sufficient insight into the long-term consequences of the treatment. All patients returned to participation with no reported ankle complications for the remainder of the competitive season, but no additional PROMs were administered as a follow-up. This case series included a standardized treatment intervention of MWM and fibular repositioning, but the lack of a control group does not strictly prove that the

Mulligan Concept caused an improvement in the outcome measures but does indicate that an association exists. Since all subjects in the study were high school students, the generalizability of the results to various age and activity levels also has limitations. In addition, clinicians were not blinded to the results of their figure-or-eight ankle girth measurements which could result in measurement bias in subsequent applications. Future research should include a longitudinal design with larger sample size, inclusion of a control group, and a more diverse patient population.

CLINICAL APPLICATION

The results of this case series demonstrate that the inclusion of the MC fibular repositioning tape and MWM produce an immediate change in pain, disability, function and swelling following an acute grade 1 LAS. Over the course of 2-4 treatments, patients were returned to unrestricted participation with no reported ankle impairments. The application of the MC treatment intervention early in the acute phase of healing had a meaningful impact on patient and clinician evidence for patients presenting with acute grade 1 LAS. By addressing the acute positional fault early in the rehab process, the clinician may impede the inflammatory response to reduce the amount of edema following injury. The reduction of edema may lead to improved outcomes and a more efficient return to healthy participation. Based on the outcome of our study, clinicians looking to efficiently treat acute grade 1 LAS may benefit from the inclusion of the MC in their therapeutic approach.

REFERENCES

1. Waterman BR, Owens BD, Davey S, Zacchilli MA, Belmont PJ. The epidemiology of ankle sprains in the United States. *J Bone Joint Surg Am.* 2010;92(13):2279-2284. <https://doi.org/10.2106/JBJS.I.01537>.

2. Nelson AJ, Collins CL, Yard EE, Fields SK, Comstock RD. Ankle injuries among United States high school sports athletes, 2005-2006. *J Athl Train.* 2007;42(3):381-387.
3. Ferran NA, Maffulli N. Epidemiology of sprains of the lateral ankle ligament complex. *Foot Ankle Clin.* 2006;11(3):659-662.
<https://doi.org/10.1016/j.fcl.2006.07.002>.
4. Kofotolis ND, Kellis E, Vlachopoulos SP. Ankle sprain injuries and risk factors in amateur soccer players during a 2-year period. *Am J Sports Med.* 2007;35(3):458-466.
<https://doi.org/10.1177/0363546506294857>.
5. Hubbard TJ, Hertel J. Anterior positional fault of the fibula after sub-acute lateral ankle sprains. *Man Ther.* 2008;13(1):63-67.
<https://doi.org/10.1016/j.math.2006.09.008>.
6. Kavanagh J. Is there a positional fault at the inferior tibiofibular joint in patients with acute or chronic ankle sprains compared to normals? *Man Ther.* 1999;4(1):19-24.
7. Berkowitz MJ, Kim DH. Fibular position in relation to lateral ankle instability. *Foot Ankle Int.* 2004;25(5):318-321.
<https://doi.org/10.1177/107110070402500507>.
8. Mulligan B. *Manual Therapy: NAGS, SNAGS, MWMs, Etc.* 6th ed. Wellington (NZ): Plane View Services; 2010.
9. Denegar CR, Hertel J, Fonseca J. The effect of lateral ankle sprain on dorsiflexion range of motion, posterior talar glide, and joint laxity. *J Orthop Sports Phys Ther.* 2002;32(4):166-173.
<https://doi.org/10.2519/jospt.2002.32.4.166>.
10. Hubbard TJ, Hertel J, Sherbondy P. Fibular position in individuals with self-reported chronic ankle instability. *J Orthop Sports Phys Ther.* 2006;36(1):3-9.
<https://doi.org/10.2519/jospt.2006.36.1.3>.
11. Glasgow P, Phillips N, Bleakley C. Optimal loading: key variables and mechanisms. *Br J Sports Med.* 2015;49(5):278-279.
<https://doi.org/10.1136/bjsports-2014-094443>.
12. Kaminski TW, Hertel J, Amendola N, et al. National Athletic Trainers' Association position statement: conservative management and prevention of ankle sprains in athletes. *J Athl Train.* 2013;48(4):528-545.
<https://doi.org/10.4085/1062-6050-48.4.02>.
13. Mavi A, Yildirim H, Gunes H, Pestamalci T, Gumusburun E. The fibular incisura of the tibia with recurrent sprained ankle on magnetic resonance imaging. *Saudi Med J.* 2002;23(7):845-849.
14. Hudson R, Baker RT, May J, Reordan D, Nasypany A. Novel treatment of lateral ankle sprains using the Mulligan concept: an exploratory case series analysis. *J Man Manip Ther.* 2017;25(5):251-259.
<https://doi.org/10.1080/10669817.2017.1332557>.
15. Mau H, Baker RT. A modified mobilization-with-movement to treat a lateral ankle sprain. *Int J Sports Phys Ther.* 2014;9(4):540-548.
16. May JM, Nasypany A, Paolino J, Baker R, Seegmiller J. Patient outcomes utilizing the mulligan concept of mobilization with movement to treat intercollegiate patients diagnosed with lateral ankle sprain: an a priori case series. *J Sport Rehabil.* 2017;26(6):486-496.
<https://doi.org/10.1123/jsr.2015-0204>.
17. Lawson BL, Williamson JD, Baker R, May J, Larkins L, Nasypany A. Examining the effect of the mulligan concept fibular repositioning taping technique after a lateral ankle sprain. *Athletic Training & Sports Health Care.* 2018;10(1):41-45.
<https://doi.org/10.3928/19425864-20170816-02>.

18. Lynch SA. Assessment of the injured ankle in the athlete. *J Athl Train*. 2002;37(4):406-412.
19. Tatro-Adams D, McGann SF, Carbone W. Reliability of the figure-of-eight method of ankle measurement. *J Orthop Sports Phys Ther*. 1995;22(4):161-163.
<https://doi.org/10.2519/jospt.1995.22.4.161>.
20. McCaffery M, Beebe A. The numeric pain rating scale instructions. *Pain: Clinic Manual for Nursing Practice*. 1989.
21. Vela LI, Denegar CR. The Disablement in the Physically Active Scale, part II: the psychometric properties of an outcomes scale for musculoskeletal injuries. *J Athl Train*. 2010;45(6):630-641.
<https://doi.org/10.4085/1062-6050-45.6.630>.
22. Farrar JT, Young JP, LaMoreaux L, Werth JL, Poole RM. Clinical importance of changes in chronic pain intensity measured on an 11-point numerical pain rating scale. *Pain*. 2001;94(2):149-158.
[https://doi.org/10.1016/s0304-3959\(01\)00349-9](https://doi.org/10.1016/s0304-3959(01)00349-9).
23. Ferreira-Valente MA, Pais-Ribeiro JL, Jensen MP. Validity of four pain intensity rating scales. *Pain*. 2011;152(10):2399-2404.
<https://doi.org/10.1016/j.pain.2011.07.005>.
24. Martin RL, Irrgang JJ, Burdett RG, Conti SF, Van Swearingen JM. Evidence of validity for the Foot and Ankle Ability Measure (FAAM). *Foot Ankle Int*. 2005;26(11):968-983.
<https://doi.org/10.1177/107110070502601113>.
25. Bianco L, Fermin S, Oates R, May J, Cheatham SW, Nasypany A. Use of the Mulligan concept in the treatment of lateral ankle sprains in the active population: an exploratory prospective case series. *J Can Chiropr Assoc*. 2019;63(3):154-161.
26. Vicenzino B, Branjerdporn M, Teys P, Jordan K. Initial changes in posterior talar glide and dorsiflexion of the ankle after mobilization with movement in individuals with recurrent ankle sprain. *J Orthop Sports Phys Ther*. 2006;36(7):464-471.
<https://doi.org/10.2519/jospt.2006.2265>.
27. O'Brien T, Vicenzino B. A study of the effects of mulligan's mobilization with movement treatment of lateral ankle pain using a case study design. *Man Ther*. 1998;3(2):78-84.
[https://doi.org/10.1016/S1356-689X\(98\)80022-2](https://doi.org/10.1016/S1356-689X(98)80022-2).
28. Collins N, Teys P, Vicenzino B. The initial effects of a Mulligan's mobilization with movement technique on dorsiflexion and pain in subacute ankle sprains. *Man Ther*. 2004;9(2):77-82.
[https://doi.org/10.1016/S1356-689X\(03\)00101-2](https://doi.org/10.1016/S1356-689X(03)00101-2).
29. Petersen EJ, Irish SM, Lyons CL, et al. Reliability of water volumetry and the figure of eight method on subjects with ankle joint swelling. *J Orthop Sports Phys Ther*. 1999;29(10):609-615.
<https://doi.org/10.2519/jospt.1999.29.10.609>.
30. Man IOW, Morrissey MC. Relationship between ankle-foot swelling and self-assessed function after ankle sprain. *Med Sci Sports Exerc*. 2005;37(3):360-363.
<https://doi.org/10.1249/01.mss.0000155435.10686.04>.
31. Hopper D, Samsson K, Hulenik T, Ng C, Hall T, Robinson K. The influence of Mulligan ankle taping during balance performance in subjects with unilateral chronic ankle instability. *Phys Ther Sport*. 2009;10(4):125-130.
<https://doi.org/10.1016/j.ptsp.2009.07.005>.
32. Moiler K, Hall T, Robinson K. The role of fibular tape in the prevention of ankle injury in basketball: A pilot study. *J Orthop Sports Phys Ther*. 2006;36(9):661-668.
<https://doi.org/10.2519/jospt.2006.2259>.