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The Effect of Mulligan's Mobilization with Movement versus Dry Needling on Pain, Function, and Range of Motion among Athletes with Hip Adductor Related Groin Pain and Dysfunction.

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Thesis Approval

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Jerusalem- Palestine

1443 \2021

Dedication

I dedicate this thesis to my parents and beloved wife and daughters who have been very supportive throughout my entire time of life.

Declaration

This thesis is submitted in partial fulfillment of the requirement for the master's degree in Physiotherapy and Rehabilitation.

I declare that the content of this thesis (or any part of the same) has not been submitted for a higher degree to any other University or institution. and that it is my original research work, and where ever I have used any section from any other research, credit and incitation were made in the proper accepted manner.

Name: Ayman khader Saleem Salem

Signed : *Ayman Salem*

Date: 17/08/2021

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Firstly, foremost, praise and thanks to God, the Almighty, for His showers of blessings throughout my research work to complete the research.

At the end of this study, I would like to express my heartfelt thanks to my thesis supervisor,

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Abstract

Background

Injuries are considered a common challenge in the sports field, 31% of the injuries are muscular, especially in the lower extremities. Injuries in the groin area are a major and serious problem because they are common, lead to prolonged symptoms, and had a high recurrence rate.

Study objective

This study aims to highlight and investigate the effectiveness of two common management practices in physiotherapy, dry needling **DN** intervention as a soft tissue technique and Mulligan mobilization with movements **MWM** as a joint technique.

Methods

A convenience sampling of thirty *football players* who were diagnosed with hip adductor-related groin pain and dysfunction were recruited from different cities in the west bank who participated in this randomized clinical trial, the participants were randomly divided into two groups, the dry needling group (15), and dry needling combined with Mulligan mobilization MWM (15).

Numiric Pain Rating Scale (NPRS), Five-Second Copenhagen Squeeze test, Hip Abduction Range of Motion, Adductor Squeeze Test, Flexion Abduction External Rotation Test (FABER), Y Balance Test, and The Copenhagen Hip and Groin Outcome Score (HAGOS) were used as outcome measures (NPRS and 5-second squeeze test performed each session for the two groups).

Results

There was a significant improvement in NPRS, ROM, adductor squeeze test, 5 seconds squeeze test, Y balance test, FABER test, and HAGOS score on both groups between the pre, mid, and post-treatment ($p < 0.05$), at the same time, both DN and DN&MWM were equally effective and there was no significant differences in the effect between both interventions.

Conclusion

Both DN and DN&MWM were equally effective in improving the above-mentioned clinical variables and can be considered as an effective method in the treatment and management of hip adductor-related groin pain and dysfunction.

For further similar research comparing mulligan mobilization only versus dry needling or conventional treatment and considering the effect of using a parallel technique like a physical agent in augmentation the aimed results are recommended. also testing the effect of both interventions on add muscle like the EMG. Also, the researcher recommended the call for a unified protocol and guidelines for adductors-related groin pain assessment and management protocol.

الملخص

تأثير العلاج اليدوي بطريقة موليغان مقارنة بالإبر الجافة على الألم والوظيفة والمدى الحركي لدى الرياضيين المصابين باضطرابات المنطقة المغبنية والعضلة الضامة للفخذ

الاسم: أيمن خضر سليم سالم.

إشراف: د.أكرم عمرو

المقدمة: تعتبر الإصابات تحدياً شائعاً في المجال الرياضي، وان ما نسبته ٣١٪ من الإصابات تحدث بالجهاز العضلي وخاصة في الأطراف السفلية. وتعد الإصابات في منطقة الفخذ مشكلة كبيرة ومعقدة لأنها شائعة بين الرياضيين وتحتاج فترة استشفاء طويلة، وأيضا لها معدل تكرار مرتفع.

أهداف الدراسة: تهدف هذه الدراسة إلى تسليط الضوء ومقارنة فعالية استخدام اثنين من الأساليب العلاجية الشائعة في العلاج الطبيعي، العلاج بالإبرة الجافة كتقنية علاج للأنسجة وكذلك أسلوب موليغان للتحريك اليدوي كتقنية علاج للمفصل.

منهج الدراسة: شارك في هذه التجربة السريرية العشوائية ثلاثون رياضيا ملائمين للدراسة وتم تشخيصهم على أنهم ألم في الفخذ والمنطقة المغبنية والعضلة الضامة، من مختلف مدن الضفة الغربية، وتم تقسيم المشاركين عشوائيا إلى مجموعتين، مجموعة الإبر الجافة (١٥)، والإبرة الجافة جنبا إلى جنب مع موليغان (١٥).

تم استخدام اختبار درجة الالم الرقمي، واختبار ضغط كوبنهاغن لمدة خمس ثوان، المدى الحركي لمفصل الفخذ، واختبار ضغط وتقريب الفخذ، واختبار فابر، واختبار التوازن واي، وكذلك استبيان هاجوس كمقاييس للنتائج (تم إجراء اختبار الالم الرقمي واختبار ضغط كوبنهاغن لمدة خمس ثوان في كل جلسة للمجموعتين).

نتائج الدراسة: كان هناك تحسن كبير في اختبار الالم الرقمي، مستوى الحركة، اختبار ضغط وتقريب الفخذ، اختبار الضغط لمدة ٥ ثوان، اختبار توازن واي، اختبار فابر ومقياس استبيان هاجوس في كلا المجموعتين بين قبل العلاج وخلال العلاج وبعد العلاج ($p < 0.05$) ولم يكن هناك اختلاف بين تأثير العلاجين لهذه الإصابة.

الاستنتاجات: تشابه تأثير العلاج بالإبر الجافة والعلاج بالتحريك المفصلي موليغان في تحسين المتغيرات السريرية المذكورة أعلاه ويمكن اعتبارهما وسائل فعالةٍ في علاج وإدارة آلام العضلة الضامة للفخذ والخلل الوظيفي.

التوصيات: يوصى بإجراء أبحاث مماثلة لمقارنة أسلوب موليغان فقط مقابل الإبرة الجافة أو العلاج التقليدي مع الأخذ بعين الاعتبار مدى تأثير الوسائل الفيزيائية على النتائج، أيضًا اختبار تأثير كلاً التدخلين على العضلات مع إضافة التخطيط الكهربائي للعضلة، وكذلك اعتماد بروتكول موحد لتشخيص وعلاج العضلة الضامة لدى الرياضيين.

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List of abbreviations

DN:	Dry Needling
MWM:	Mobilization with Movements
NPRS:	Numeric Pain Rating Scale
ROM	Range of Motion
YBT	Y Balance Test
HAGOS	Hip and Groin Outcome Score

Chapter 1:

1.1 Intorodution

1.2 research problem

1.3 The rational of the study

1.4 Study objectives

1.5 Study questions

1.6 Hypothesis

1.1 Introduction

The muscle injuries are considered as a serious problem in the sports field for the players and their clubs, 31% of the injuries are muscular, especially in the lower extremities where the hamstrings (37%), adductors (23%), quadriceps (19%), and calf muscles (13%) from these injuries, besides (16%) of the muscles were reinjured (1).

The groin is known to be the inguinal region at the junction of the abdomen and thigh. Among athletes, pain and injury concerning the groin generally occur in multidirectional sports like football, ice hockey, and rugby. Injuries in the groin are a major problem in sport because they are common and lead to prolonged symptoms and a high recurrence rate. Hip adductor-related groin pain and dysfunction is the most common clinical manifestation of groin injuries, and also the cause of long-term injuries(2).

According to the Doha agreement 2014, groin pain is categorized into three fundamental groups, the first group defined clinical entities (adductor-related, iliopsoas-related, inguinal-related, and pubic-related groin pain). The second is hip-related pain while the third is a pathology that caused pain in the groin area (3). Hip adductor-related groin pain and dysfunction between footballers about 23% of muscle injuries, with prolonged time to return to sport and high recurrence injury (1).

Hip adductor-related groin pain and dysfunction are an overstretch, tear or rupture to any of the adductor muscles on the inside of the thigh. The adductor area includes three main muscles (Longus, Magnus, and Brevis) and three other muscles, Gracilis, Pectineus, and Obturator Externusr, of which the adductor Longus is the most frequently injured. They all provide adduction of the thigh. The Longus provide some internal rotation. The adductor Magnus also has an attachment to the ischial tuberosity, which involves in hip extension. The main function during open chain activation is hip adduction, in closed chain helps to stabilize the pelvis and lower extremities when walking. It also has secondary roles such as hip flexion and rotation. The Gracilis muscle is also involved in internal rotation and flexion of the hip joint. The Obturator Externus can also externally rotate the hip and pectineus, which further assist in hip flexion(4).

Most of the hip adductor-related groin pain and dysfunction occurs when the muscles contract concentrically while stretching. When the leg is externally rotated and abducted, the greatest eccentric stress is applied to the adductor complex. As a result, the muscles contract to produce both eccentric and concentric opposing forces (5).

Hip adductor-related groin pain and dysfunction can be graded I-III based upon its severity. Grade I involve a mild strain, pain without loss of ROM or strength, no significant fiber disruption. Grade II injury pain with limited ROM and decrease strength, also damage to the muscle-tendon fibers but the overall integrity of the muscle-tendon unit is preserved. A grade III injury involves disruption leading to a loss of overall tendon integrity and loss of strength (4). Most hip adductor-related groin pain and dysfunction are grades I or II. The most common symptom is an abrupt pain in the inner thigh. However, the pain varies from moderate trifling pain to very intense muscle tears that cannot be tolerated.

In terms of physiotherapy management, the hip adductor-related groin pain and dysfunction treatment comes in several physiotherapy options, manual therapy technique, soft tissue dry needling for injured muscles, heat, manual massage, stretching exercises, strengthening exercises, ultrasound, and electrical stimulation.

Mobilization with Movement MWM is a manual therapy technique advocated by Brian Mulligan for treating joint pain, stiffness, and dysfunction. The MWM includes a sustained glide to the joint with concurrent physiological movement. This mobilization technique is often used to correct the faulty position of the joint" (6). Furthermore, it aims to retrieve a painless and full range of motion in the joint. The physiotherapist applies a constant glide parallel or vertical to the joint while the patient conducts the painful movement vigorously. Although the MWM effect on groin pain hasn't been documented yet, the treatments have proved to increase progress in terms of pain and functions.

Dry needling DN is a technique that manages pain and dysfunction after the muscles are fatigued. However, there isn't much-published literature about its effect on rehabilitation or reoccurrence of injury. DN is used by healthcare providers worldwide in the management of musculoskeletal pain and injury to improve function in specific. It is used in the treatment of athletes with chronic and acute musculoskeletal injury and has recently been described for the treatment of several neuromuscular conditions. DN mainly

focuses on restoring and normalizing the range of motion. It mechanically obstructs taut bands of the muscle tissues where the muscles have dysfunction. DN of trigger points MTrPs is related to reduced local and referred pain, improved range of motion, and decreased MTrP irritability both locally and remotely(7).

1.2 Research Problem

Both restricted joints could lead to tight adductors and tight adductors affect the joint movement, and in both cases, athletes are subjected to higher risks of hip adductor-related groin pain and dysfunction

There is limited evidence about the effectiveness of either the DN or MWM on the prognosis of athletes with hip adductor-related groin pain and dysfunction, and at the same time, there is a lack of evidence regarding the superiority of either technique on the other.

The study aims to investigate the effectiveness of both techniques in the management of hip adductors related groin pain and dysfunction and compare their superiority in the management of this common sports injury.

1.3 The Rationale of the Study

The results of this study will highlight the effectiveness of two common practices in physiotherapy, which will show their effectiveness in terms of outcome represented in short duration athletes out of the playground, and at the same time will contribute to the decrease in the cost of management of hip adductor-related groin pain and dysfunction.

At the same time, the results of this study will help therapists to understand the efficiency of both practices on the outcome, which will help in adopting both the most efficient and effective techniques in the management of the common dysfunction in athletes.

Earlier healing of athlete's dysfunction will contribute to faster return of athletes to the playground, which will decrease the financial burden of injury on sports clubs, taking into consideration the high cost of treatment and the high salary of the professional athlete.

1.4 Objectives

- To study the effect of DN on hip adductor-related groin pain and dysfunction rehabilitation outcome
- To investigate the effect of DN & MWM combination of the hip joint, on hip adductor-related groin pain and dysfunction rehabilitation outcome.
- To investigate the difference in the outcome of MWM of the hip compared to DN in the management of hip adductor-related groin pain and dysfunction rehabilitation outcome.

1.5 Research Questions

1. What is the effect of dry needling on pain, function, and ROM of the hip in hip adductor-related groin pain and dysfunction athletes?
2. What is the effect of mulligan mobilization & dry needling combination on pain, function, and ROM of the hip adductor-related groin pain and dysfunction?
3. Is mulligan mobilization combination with dry needling more effective in the management of hip adductor-related groin pain and dysfunction?

1.6 Hypothesis

- There is a significant effect of DN on hip adductor-related groin pain and dysfunction rehabilitation outcome
- There is a significant effect of DN & MWM combination on the hip adductor-related groin pain and dysfunction rehabilitation outcome
- DN & MWM combination of the hip is more effective than DN in the management of hip adductor-related groin pain and dysfunction rehabilitation outcomes.

Chapter 2:

Literature review

2.1 back ground and theoretical background

2.2 Literture review

2.1 Background and theoretical framework

2.1.1 Definition of groin pain

The varied classification and definition of groin pain add confusion to this complicated area, there was no agreement on a standard terminology, along with accompanying the groin pain definitions(3). Hip adductor-related groin pain and dysfunction is a soft tissue injury to the anterior hip or thigh including the proximal adductor area and lower abdominal muscle bellies, overstretch, tear or rupture to any of the adductor muscles on the inside of the thigh occurring while playing or participating in comprehensive training or competitions leading to unable to participate in activities. Categorized into three fundamental groups, the first group defined clinical entities (adductor-related, iliopsoas-related, inguinal-related, and pubic-related groin pain), the second is hip-related pain while the third is a pathology that caused pain in the groin area (8)(3).

2.1.2 Signs and symptoms

Athletes with adductor-related groin pain usually complain of pain in the groin area, within the proximal adductor muscle region, may it extend across the pubic region and into the lower abdomen, also it can spread to the adductor region in the opposite leg, beside a decreased range of motion in the hip joint. Pain may be experienced when changing the direction, walking, standing on the affected leg, and sneezing or coughing, and leads to time away from training and competition, and may result in career-ending injury(4)(9)(10).

2.1.3 Classification of groin

The groin pain and dysfunction are classified upon terminologies and definitions stated by the Doha consensus meeting for athletes, 24 international exports in groin dysfunction from 14 countries in a one-day meeting, performed a systematic review concerning the evidence on groin pain in athletes. The categorization system includes three fundamental subtitles; “defined clinical entities for groin pain

(adductor-related, iliopsoas-related, inguinal-related, and pubic-related groin pain), hip-related groin pain", as well as other causes related to groin pain in athletes (3).

2.1.4 Risk factors and epidemiology of Groin injuries

In 2018, the clinical journal of sports medicine has published a descriptive epidemiological study done by Taylor Rachel, which assessed and consulted 100 athletes with groin pain in 2014, who participated in multidirectional sports. Using the Doha agreement, 98% of participants were male, 60% football players. There was a high prevalence of hip adductor-related groin pain and dysfunction among the athletes 61%, as a cause of groin pain (11).

Previous adductors muscle injury, weak muscles, muscle fatigue, decreased hip ROM, age, and inadequate stretch of adductor muscles, are considered risk factors for adductor strain. Also, leg length discrepancy and biomechanical abnormalities such as leg pronation can contribute (4). Anders Hauge Engebretsen and others in their cohort study conducted in 2010 to identify the risk factors for hip and groin pain, mentioned that weak adductor muscles and a history of acute adductor strain are significant risk factors for groin pain (12).

There were several risk factors for hip and groin injuries, Julianne Ryan et al in the systematic review conducted in 2014, they divided the hip and groin pain risk factor to modifiable risk factors and none modifiable factors, they found that the previous groin/hip injury was the most prominent risk factor, also older age, weak adductor muscles, early maturing players, smaller dominant femur diameter, increased/decreased body mass weight, decreased hip abduction & hip rotation ROM and strength ratio of hip muscle groups(13).

Paulina M. Kloskowska and others in 2016 conducted a systematic review with meta-analysis, studied the biomechanical factors associated with adductor-related groin pain and, investigating the muscle activation and movement patterns associated with adductor-related groin pain in both professional and amateur athletes. They found that many studies with moderate evidence mentioned that

decreased hip range of motion and adductor muscle weakness are strongly considered risk factors for adductor-related groin pain (14).

Also, Igor Tak and his colleagues in their cross-sectional study concluded that the decreased range of motion of the hip was associated with adductor-related groin pain in several situations. The study was conducted in 2015 to study the relations between the adductor strain in a professional football player and hip range of motion (15).

2.1.5 Assessment of groin pain

Andrea B Mosler and his colleagues conduct a systematic review with meta-analysis to differentiate athletes with hip groin pain from those without, they found that pain level, decreased range of motion, decreased muscle strength and self-reported questionnaire are the best outcome measure to identify adductor-related groin pain (16).

2.1.6 Treatment of groin pain

The treatment of adductor-related groin pain is varied, most cases treated conservatively, injections or surgical procedures. Regarding the conservative method of treatments, most of the studies focused on the effectiveness of exercise therapy and strengthening of the muscles caring for and treatment of athletes with adductor-related groin pain, less studies investigate the role of physiotherapy intervention with these cases (17).

Zuzana Machotka and et al 2009 conducted a systematic review was to evaluate the available evidence on the effectiveness of exercise therapy for groin pain in athletes and to identify the key features of exercise interventions used in the management of groin pain in an athletic population. They identified 468 studies, 12 of which were potentially relevant. 5 were included in the study. They found that the best available evidence continues to support the use of exercise therapy as a key component of the rehabilitation of athletes with groin pain, especially hip, and abdominal muscle strengthening exercise may be an effective intervention for athletes with groin pain. Due to the lack of reports in the main literature, there is no clear evidence on the most effective exercise intensity and frequency(18).

2.2 Similar studies in Management of groin pain

Gian Nicola Bisciotti, Karim Chamari, and others in a critical and systematic review conducted in 2020, found after reviewing many studies that conservative treatment is the first choice of intervention for athletes with adductor-related groin pain. Different modalities of conservative treatment were described. Compression clothing therapy, manual therapy together with strengthening exercise and physiotherapy intervention based on friction massage and stretching of adductor muscle, complemented by laser therapy and transcutaneous electrical stimulation, which showed both the greatest level of strength of evidence. Based on their systematic review, the authors concluded that a program based on active training is more effective than a program based on manual therapy and physiotherapy (17).

Returning to the normal performance for athletes with adductor-related groin pain can be achieved after using manual therapy for the adductor muscles. It is mentioned in the study done by Igor Tak and his team published in 2018 (19).

The hip adductors-related dysfunction treatment comes in several physiotherapy options, manual therapy technique, soft tissue Myofascial release, thermotherapy, manual massage, stretching exercises, strengthening exercises, ultrasound, and electrical stimulation.

Deborah A. Sutton and colleagues in the systematic review conducted in 2016, concluded that an intensive, clinic-based, group exercise program strengthening, stretching is more effective than multimodal care, laser, transverse friction massage, transcutaneous electrical nerve stimulation, stretching exercise for the adductor-related groin pain in male athletes (20).

In clinical practice, the treatment strategies used by physical therapists for muscular pain include stretching, soft-tissue mobilization, thermotherapy, laser, ultrasound, TENS, and biofeedback. In recent years, Dry Needling (DN) has become a popular tool used by physical therapists to treat muscular pain, however,

its effectiveness is in relieving pain, improving range of motion, and improving performance(21).

Sudarshan Anandkumar et al conducted a study in 2017 to investigate the effectiveness of dry needling on the myofascial syndrome of the quadriceps and they concluded that there were immediate improvements in all the outcome measures especially in pain after the first treatment(21).

Dry needling is rarely a standalone intervention and it's a part of a comprehensive manual physiotherapy approach. It's usually combined with other manual therapy procedures and should be considered as an assisted instrument in manual therapy techniques. Dry needling does not replace other manual physical therapy techniques but may be useful in facilitating a rapid reduction of pain and a return to function (22).

According to our knowledge, there is a lack of research investigating the effect of Mulligan mobilization with movements on a soft tissue dysfunction,

According to the effect of dry needling on myofascial pain, Sudarshan Anandkumar et al conducted a study to investigate the effect of DN on quadriceps femoris in 2017, the researcher noted that a significant improvement in NPRS and functional activity for the patient after the first session of DN intervention, and concluded that the DN is successful management for myofascial pain(21).

only one study was conducted by Seveka Bali, Karthikeyan Guru 2020 investigated the effectiveness of Mulligan stretching on hip adductor flexibility comparing with static stretch in footballers. 42 athletes participated in this study, divided into two groups, 1st group received Mulligan's adductor stretching while the 2nd received static stretching of hip adductors for 3 alternative days, hip abduction range of motion was documented. There was a significant improvement in both groups with no superiority for any techniques(23).

Chapter 3:

Methodology

3.1 study methodology

3.2 study sample and population

3.3 tools of data collection

3.4 data collection procedure

3.5 intervention

3.6 statistcal analysis

3.7 ethical consideration

3.1 Methodology of the study:

3.1.1 Design

This researcher used a randomized controlled trial (RCT), which is the golden reference standard for studying causal relationships between interventions and outcomes as randomization eliminates much of the bias inherent with other study designs, while expensive and time-consuming, RCT most reliable method available for testing new treatments. in this study we investigated the effects of Mulligan Mobilization with Movement (MWM) combined with dry needling (DN) versus dry needling DN for patients complaining of hip adductor-related groin pain and dysfunction

3.2 Study sample and population

3.2.1 Sampling method

A convenient sampling method was used, which is a type of nonprobability or nonrandom sampling, where members of the target population that meet certain practical criteria, such as easy accessibility, geographical proximity, availability at a given time, or the willingness to participate are included for the study(24). All athletes **are football players**, recruited from west bank cities of Palestine, seen in Al Manara medical center in Ramallah and Mount of olives medical center-Jerusalem. All subjects had a diagnosis of adductor-related groin pain or adductor strain

3.2.2 Sample size

Thirty participants (15 football players in each group) were recruited from different clinics and clubs. The allocation to either group based on the order of coming to the clinic, where at the beginning of the research the allocation of the order to either of the groups was based on a random selection of the orders 1st and 2nd patients, then the following patients distributed systematically, so if the 1st patient was supposed to in the A group, then so the 3rd and 5th and so on. The same for the other groups based on the random selection of the 2nd, 4^{th,} and 6th patients who came to the clinic.

3.2.3 Inclusion and Exclusion Criteria

3.2.3.1 The inclusion criteria:

1. Athletes suffered from unilateral adductor-related groin pain, grades 1 and 2.
2. Acute, subacute, or chronic athletes with hip adductor-related groin pain and dysfunction.
3. Groin pain during or after activities.
4. Pain at palpation of the adductors and their origin.
5. Pain on resistance against adduction.
6. **Aged 15- 35 years old.**

3.2.3.2 Exclusion criteria

Patients with other causes of groin pain such as:

1. Lymphadenitis.
2. Prostatitis, Urinary infections, Malignancy.
3. Spinal pathology.
4. Hip joint osteoarthritis.
5. Inguinal-related or Iliopsoas-related groin pain.
6. Femoral or Inguinal hernia.
7. Referral pain and adductor strain grade 3.
8. Current use of medication.

3.3 Tools of Data Collection

The main outcome measures used in this study were:

1. **Sheet of Demographic Data**

   Demographic, personal data, and injury history were obtained at baseline from the patient interview and recorded on a data collection sheet. **Appendix 1**

2. **Numeric Pain Rating Scale NPRS**

   The Numeric Pain Rating Scale (NPRS) is valid and reliable, a self-assessing questionnaire (25) used to assess the severity of pain. 0- 10 scale where 0 represents “no pain” and 10 representing “unbearable pain.” Each participant was asked to indicate the pain level before and after treatment. **Appendix 2**

3. **Five Seconds Copenhagen Squeeze Test**. It is a reliable, valid indicator for hip and groin dysfunction. (20), The therapist placed his arms between the athlete’s knees and asked the athlete to squeeze the legs as hard as possible for five seconds,

then, scored any pain in the groin area on a scale of 0 to 10 NPRS Scale. **Appendix 2**

4. **Hip Adductor Squeeze Test**

This test is a popular screening tool used in many sports to reduce the risk of hip injuries due to its simplicity, low cost, reliability, and ability to identify multiple types(26). It's a test for the measurement of maximal isometric hip adductor strength, the participant's hips will be in 45° flexion with knees flexed to 90°, and hips in neutral rotation, a sphygmomanometer pre-inflated to 20 mmHg and placed between the participant's knees. Participants will perform two maximal practice trials to familiarize themselves with the protocol and then perform three experimental trials. For the formal test, participants will be instructed to squeeze their knees as possible. The maximum pressure displayed on the monitor screen for each of the three tests is used for statistical testing using the average of these tests. Pain during the adductor squeeze test was also documented using NPRS(27). **Appendix 2**

5. **Range of Motion Test**. The hip abduction was measured actively while the patient is supine, with hip and knees in a neutral position, using the universal goniometer which is considered a valid and reliable instrument for measuring the joint range of motion (28), the goniometer placement, the axis location on the ASIS on the measured side, the stationary arm directed to the opposite ASIS and the movement arm parallel to femur directed to the center of the patella. **Appendix 2**

6. **FABER Test**. To assess the adductor muscle tightness and shortening due to injury.

   FABER test is used as a provocation special test but has also been used as a measurement of combined hip range of motion, also useful tools for the hip examination, particularly for anterior hip or groin pain (29). The patient lies supine on the examination table. The hip and knee of the tested leg are flexed, abducted, and externally rotated, as the foot of the tested leg is placed on the contralateral thigh just proximal to the knee. While stabilizing the pelvis on the contralateral side, gentle pressure is applied downwards on the knee of the tested leg, also

measuring the distance from the lateral condyle of the knee to the surface of the examination table for both affected and none affected knees. **Appendix 2**

7. **Y-Balance Test YBT**: It is a portion of the Functional Movement Systems screen used to evaluate dynamic balance and functional symmetry to determine a person's risk for injury or return to sport readiness. This test had a good interrater test-retest reliability with an acceptable level of measurement error among multiple raters screening(30)(31). The Y balance test was developed from the star excursion balance test (SEBT) and assesses performance during single-leg balance with reaching in the 3 directions: anterior, posteromedial, and posterolateral. the patient stands on one leg while reaching out in 3 different directions with the other lower extremity. **Appendix 2**
8. **Hip and Groin Outcome Score (HAGOS).** The Copenhagen Hip and Groin Outcome Score (HAGOS) is a valid, reliable, and responsive instrument that can be used both for research and in the clinical setting at individual and group levels (32). Consists of six separate subscales assessing Pain, Symptoms, Physical function in daily living, Physical function in Sport and Recreation, Participation in Physical Activities, and hip and/or groin-related Quality of Life (QOL)(33). **Appendix 3**

3.4 Data Collection Procedure

Ethical approval was granted from Al-Quds university's ethical committee, then letters for sports clubs were sent to recruit participants with the inclusion criteria. Each participant was screened for inclusion/exclusion criteria, then relevant participants were asked singe a consent form after they have been given written information about the research

at baseline all the assessment tools were applied, the NPRS and the five seconds squeeze test were measured in every session, however, the other outcomes, the hip adductor squeeze test, hip range of motion, FABER test, Y Balance Test, and HAGOS, were measured at the first session and on the 6th on discharge.

3.5 Intervention

The experimental group **A** was treated using Dry Needling (DN) for soft tissue trigger points, (N=15), and the experimental group **B** was treated using Mulligan Mobilization with Movements and Dry Needling (DN&MWM) for soft tissue trigger points, (N=15).

The treatment duration was 6 sessions for each group, 3 sessions per week (day after day).

All groups reserved three home program exercises, two of them for stretching the adductor muscles and the other one for isometric strengthening of the muscles.

3.5.1.A Hip internal and external rotation MWM

- The patient lies supine at the edge of the treatment table nearest the therapist with hip 90 flexion, knee 90 flexion, and neutral hip rotation.
- The pelvis is stabilized by the therapist's hand on the ilium inside the belt, and the distal femur by the therapist's sternum, while the leg is supported by the therapist's distal hand around the ankle.
- Belt loops around the proximal end of the patient's thigh and therapist's pelvis.
- The lateral distraction force is sustained, the patient actively rotates the hip with therapist assistance, if necessary, through the distal leg acting as a lever. Over-pressure is applied and then return to the starting position.
- Apply 6-10 repetitions in a set, with 3-5 sets in the treatment session, but only if there is a substantial increase in the range of hip pain-free external rotation.

Figure 3. 1. Hip abduction MWM (starting position)

Figure 3. 2 Hip abduction MWM (technique procedure)

3.5.1. B Hip Abduction

Position: Patient standing on the affected leg, opposite leg on a chair positioned at side, the therapist behind the patient.

- Technique: Stabilize the ilium, the therapist's elbow tucked into the lower abdomen, arm inside the belt.
- Glide: Posterior glide of the femur with belt high in the patient groin as patient lunges onto the chair.
- Apply 6-10 repetitions in a set, with 3-5 sets in the treatment session.

3.5.2 Dry needling protocol for hip adductor muscles

- Dry needling special informed, written consent was obtained for each participant before applying the technique.
- Palpation: the adductors are located in the internal musculature of the hip.
- Reference pattern of the pain: pain confined to the hip and leg with the adductor Longus and adductor Brevis referring pain into the groin and down towards the knee and shin.

- Needling technique: the patient lies on his back; the affected limb is slightly bent and externally rotate. The therapist can use his leg or pillows to support the patient's legs. Insert the needle into desired adductor muscle in anterio- posterior direction.
- **Clinical implications:** Avoid piercing the femoral triangle formed by the inguinal ligament, Sartorius, and adductor Longus. Many neurovascular structures pass through this area and it must be avoided.

3.5.3 Home-Based Exercises

Since stretching considered as a part of the intervention following the dry needling procedure for releasing the muscles, both groups performed home exercises based on stretching the adductors, in addition to the isometric strengthening exercises for the adductors.

- Standing Bent-Knee Hip Adductor Stretch:

Stand up straight, legs wider than shoulder-width apart, and affected leg outward. Lower your body (hips) to a semi-squat position, bend your right knee and slide your left foot to the left to keep your left knee straight. When descending, place your hands above your right knee for support and balance (or grasp objects to maintain balance).

Figure 3. 3 Standing Bent-Knee Hip Adductor Stretch

- Seated Hip Adductor Stretch (FABER Position stretch)

  Sit on the floor in a lotus pose (knees bent, feet together, soles on the ground) heels as close as possible to the buttocks (distance depends on flexibility) keep your feet or just above the ankles, extend the elbows to the sides and touch the knees the lower leg. Bend your torso toward your feet and use your elbows to press down on the lower thighs and knees as you stretch.

Athletes were advised to stretch the adductors three times daily, 3 series of 30 seconds.

Figure 3. 4 Seated Hip Adductor Stretch (FABER Position stretch)

- Adductor squeeze exercise:

  This exercise is performed by lying supine on the floor with bilateral knee flexion, placing a ball or a rolled towel in between the knees, and gradually squeeze the ball or rolled towel in between the knees to tighten the adductors. Hold the position for about five seconds and release.

  Athletes were advised to perform 10 repetitions, three times per day after the 2nd session if the athletes reported that there was a visual decrease of NPRS after the intervention.

Figure 3. 5 Adductor squeeze exercise

3.6 Statistical analysis

SPSS version 20 is used for data analysis. Descriptive statistics (frequencies, percentages, means, standard deviations) were used to describe the demographic variables of the study sample. The following tests and methods were used to analyze the results and to test the study hypotheses assuming that the P-Value ≤ 0.05 is significant:

1. Kolmogorov-Smirnov test to test the normality of study variables.
2. One Way Repeated-Measures Analysis of Variance (ANOVA) to test within-subjects effects for study variables pre of treatment, in the mid of treatment in some scales, and the post of treatment, and the test of between-subjects effects according to the type of treatment groups (DN, DN&MWM).
3. Independent Samples T-test to examine the differences in the levels of study variables between both study groups in each treatment stage.

3.7 Ethical consideration

The research ethics committee of the Al-Quds University of Palestine granted ethical approval. Before collecting data, each participant signed written informed consent. Ensure the personal data and privacy of each subject. Each participant received an information sheet explaining all aspects of the research and fatigue risk and clearly stated that they have the right to withdraw from the research at any stage to harm their interests and the safety of the participant. Anonymity and confidentiality are guaranteed by the researcher.

Chapter 4:

Results presentation

4.1 discribtive statistics

4.2 normalit tests

4.3 inferentioal and applies describtive statistics

4.1 Descriptive statistics

4.1.1 Demographic data

As shown in the table below 4.1 the sample of the study was divided into two groups, dry needling group DN and dry needling with mobilization of movement DN&MWM, each with 15 participants, all of them are males football players. The DN group was with an age average of 27 (± 6) years, while the average age of the DN&MWM group was 24(±5) years.

In the study sample 26.7% of participants having slight physical job demand in the DN group and 20% in the DN&MWM group, also 40% of participants having moderate physical job demand in the DN group, and 20% in the DN&MWM group, while 3.33% of participants having no job in the DN group and 60% in the DN&MWM group.

Table 4. 1 Participant demographics data

Demographic Variable	**Category**	**Type of Treatment Group**	
		DN N (%)	DN&MWM N (%)
Gender	Male	15(100%)	15(100%)
Job physical demand	slight	4(26.7%)	3(20%)
	Moderate	6(40%)	3(20%)
	None	5(33.3%)	9(60%)
Sport type	football	15(100%)	15(100%)
Age		Mean ± S.D	Mean ± S.D
		27 ± 6	24 ± 5

4.1.2 Descriptive statistics of the injury

As presented in table 4.2 below most of our patients were subacute and chronic patients, about 93% in DN and 90% in the DN&MWM group, where 40% of the DN group and 46,7% of the DN&MWM group with a right-side injury.

Also, in table 4.2 below 20% of participants had injured during the training activity in the DN group and 53.3% in the DN&MWM group likewise, 80% of the participants were injured during the competition in the DN group, and 40% in the DN&MWM group, only 6.7% of athletes injured during another event in the DN&MWM group.

Table 4. 2 Descriptive statistics of injury

Demographic Variable	**Category**	**Type of Treatment Group**	**Demographic Variable**
		DN	DN& MWM
Injury Type	Acute (0-4 days)	1(6.7%)	0(0%)
	sub-acute (5 d - 3 w)	5(33.3%)	5(33.3%)
	Chronic (> 3 weeks)	9(60%)	10(66.7%)
Injury side	right	6(40%)	7(46.7%)
	Left	9(60%)	8(53.3%)
Activity at the time of injury	Training	3(20%)	8(53.3%)
	Competition	12(80%)	6(40%)
	Another event	0(0%)	1(6.7%)

4.1.3 Injury associated factors

As presented in table 4.3 below 53.3% of participants presented in the clinic because of a new injury in both groups, while 40% of participants had an aggravated injury, and only one 6.7% participant having recurrent injury as a reason of presentation in both DN and DN&MWM groups.

Regarding the weekly training regime 33.3% of the participants having 2 training days per week in the DN group and 20% in the DN&MWM group, also 20% of participants had 3 training days per week in the DN group, 40% in the DN&MWM group, as well 26.7% of them had 4 training days weekly in the DN group and 13.3% in the DN&MWM group, also 20% of participants had 5 training days per week in the DN group, 20% in the DN&MWM group likewise, no one of the participants had 7 training days weekly in the DN group while only 6.7% in the DN&MWM group.

Concerning the cause of the injuries, overstretching the muscles were the most common reason for the injury in both groups 46.7% in the DN, 33.3% in the DN&MWM group, also 6.7% of the participants in the two groups DN and DN&MWM collided with a fixed object, 13.3% of participants collided with another player in the DN group, 26.7% in the DN&MWM group. None of the participants in the DN group had a fall or awkward landing while only 6.7% in the DN&MWM group, 33.3% of the participants in the DN group had injured when kicking the ball, and only 6.7% of the participants in the DN&MWM group kicked the ball and injured, as well 20% of the participant in the group DN&MWM overused the muscle.

Relating to the contributing factors of the injury, 6.7% of participants having unsuitable footwear in the DN group and no one in the DN&MWM group, 13.3% of participants having a playing surface as a contributing factor in the DN, 6.7% in the DN&MWM, however, 6.7% of participants having the used equipment as a contributing factor in the DN and no one in the DN&MWM group, most of the participants 73.3% had other contributing factors to the incidence in the DN and 93.3% in the DN&MWM group.

Table 4. 3 Contribution and associated factors of the injury

Demographic Variable	Category	Type of Treatment Group	
		DN	DN&MWM
Weekly Training Regime	2	5(33.3%)	3(20%)
	3	3(20%)	6(40%)
	4	4(26.7%)	2(13.3%)
	5	3(20%)	3(20%)
	7	0(0%)	1(6.7%)
Reason of presentation	New Injury	8(53.3%)	8(53.3%)
	Aggravated injury	6(40%)	6(40%)
	Recurrent Injury	1(6.7%)	1(6.7%)
Cause of injury	Collision with a fixed object	1(6.7%)	1(6.7%)
	Collision with another player	2(13.3%)	4(26.6%)
	Fall or awkward landing	0(0%)	1(6.7%)
	Kicking the ball	5(33.3%)	1(6.7%)
	Overstretched the muscles	7(46.7%)	5(33.3%)
	Overuse	0(0%)	3(20%)
Contributing factors to the incidence	Unsuitable foot wear	1(6.7%)	0(0%)
	Playing surface	2(13.3%)	1(6.7%)
	Equipment	1(6.7%)	0(0%)
	Other	11(73.3%)	14(93.3%)

4.1.4 Action after injury

As shown in Table 4.4 below, the athletes taken action after the injury, RICE method was the most common intervention used by athletes, 73.3% of participants applied RICE in the DN group and 40% in the DN&MWM group. While 6.7% of the participants had no action taken in the DN group and 33.3% in the DN&MWM group, however, 20% of participants taken medication in the DN group and 26.7% in the DN&MWM group.

Regarding the athlete's decision to return to the activity, 46.7% of participants were un-enabled to return to sport in the DN group and 46.7% in the DN&MWM. While 33.3% of

them return to play with restriction in the DN group and 20% in the DN&MWM, also 20% of participants immediately returned to activity in the DN group and 33.3% in the DN&MWM group.

When asking the athletes about the intervention, 73.3% of participants have some kind of medication in the DN group and 53.3% in the DN&MWM group, no one of participants having physiotherapy in the DN group, and only 20% in the DN&MWM group, however, 6.7% participant having massage therapy in the DN group and 6.7% in the DN&MWM group, relating to active training as a type of intervention 6.7% of the participants having active training in the DN and 13.3% in the DN&MWM group, also 13.3% of the participants having other interventions in the DN group and 6.7% in the DN&MWM group.

Table 4. 4 The intervention and decision have taken immediately after the injury

Demographic Variable	**Category**	**Type of Treatment Group**	
		DN	DN&MWM
Action Taken	None	1(6.7%)	5(33.3%)
	RICE	11(73.3%)	6(40%)
	Medication	3(20%)	4(26.7%)
Return to activity decision Taken	Immediate return to activity	3(20%)	5(33.3%)
	Return to play with restriction	5(33.3%)	3(20%)
	Unable to return	7(46.7%)	7(46.7%)
Intervention	Medication	11(73.3%)	8(53.3%)
	Physiotherapy	0(0%)	3(20%)
	Massage	1(6.7%)	1(6.7%)
	Active Training	1(6.7%)	2(13.3%)
	Other	2(13.3%)	1(6.7%)

Figure 4.1 below shows that 60% of the athletes in the DN&MWM had 3 and less training days per week, while 53% of DN group athletes also had 3 training days and less per week.

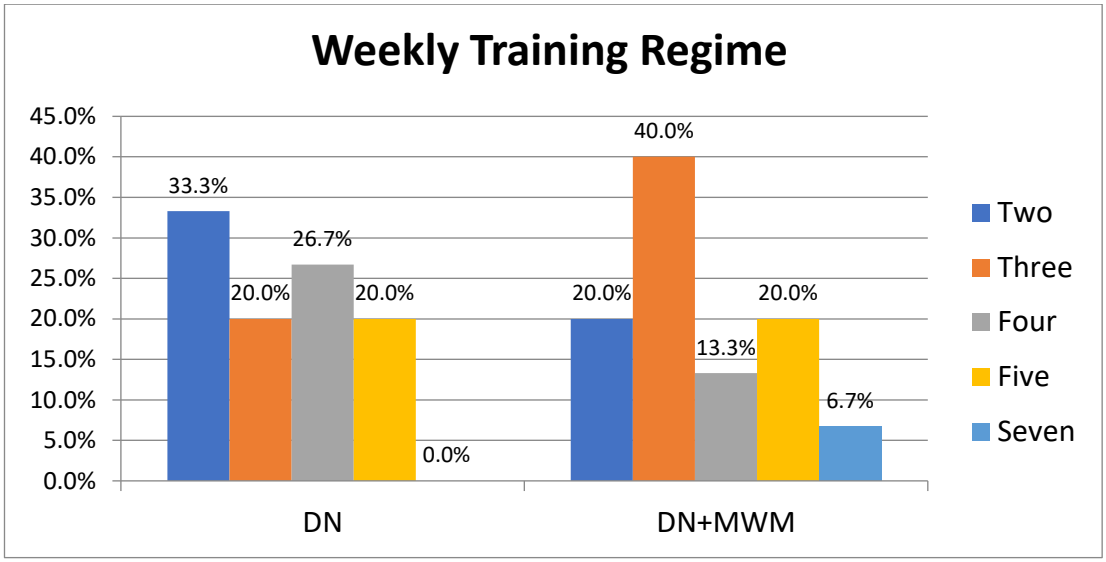

Figure 4. 1 Weekly Training Regime

Most of the athletes in both groups complained of chronic hip adductor-related groin pain and dysfunction (DN=66%, DN&MWM=66.7%), this shown in figure 4.2 below

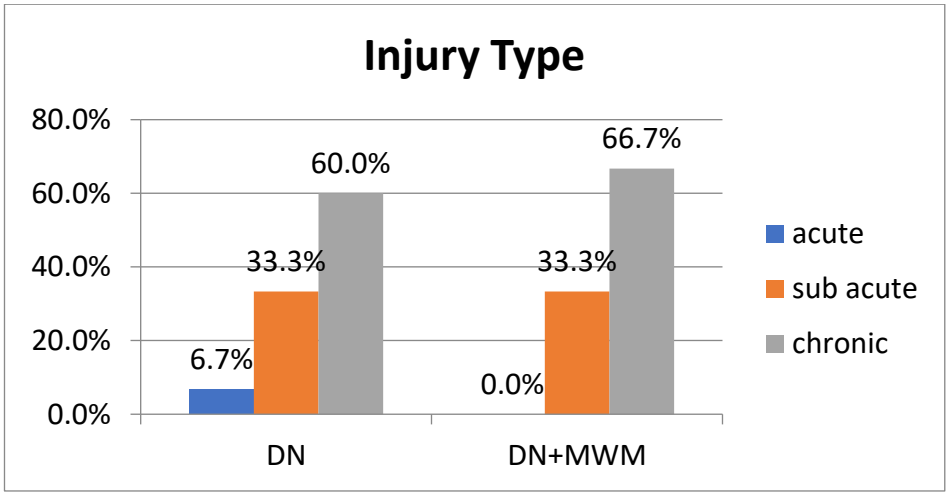

Figure 4. 2 Type of Injury

Figure 4.3 below showed that 80% of participants in the DN group were injured during competitions, 40% in the DN&MWM, while 20% in the DN group during the training time, 53.3% in the DN&MWM group.

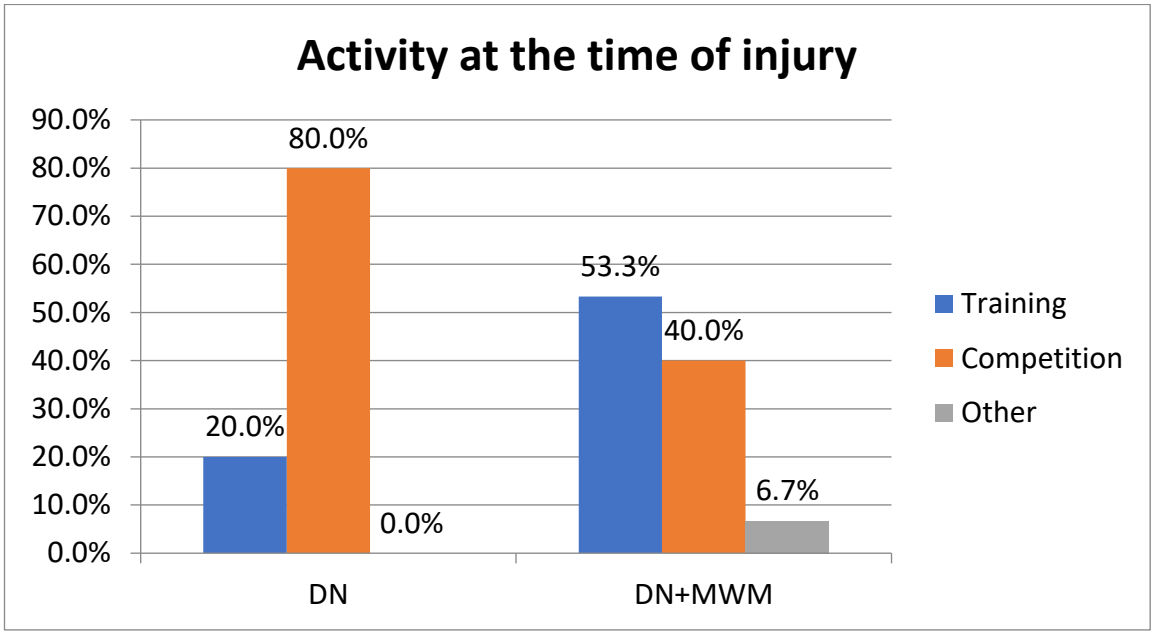

Figure 4. 3 Type of activity at the time of injury

In figure 4.4 below 53.3% of the athletes came with a new injury, while 40% of them complained of aggravated injury in both groups.

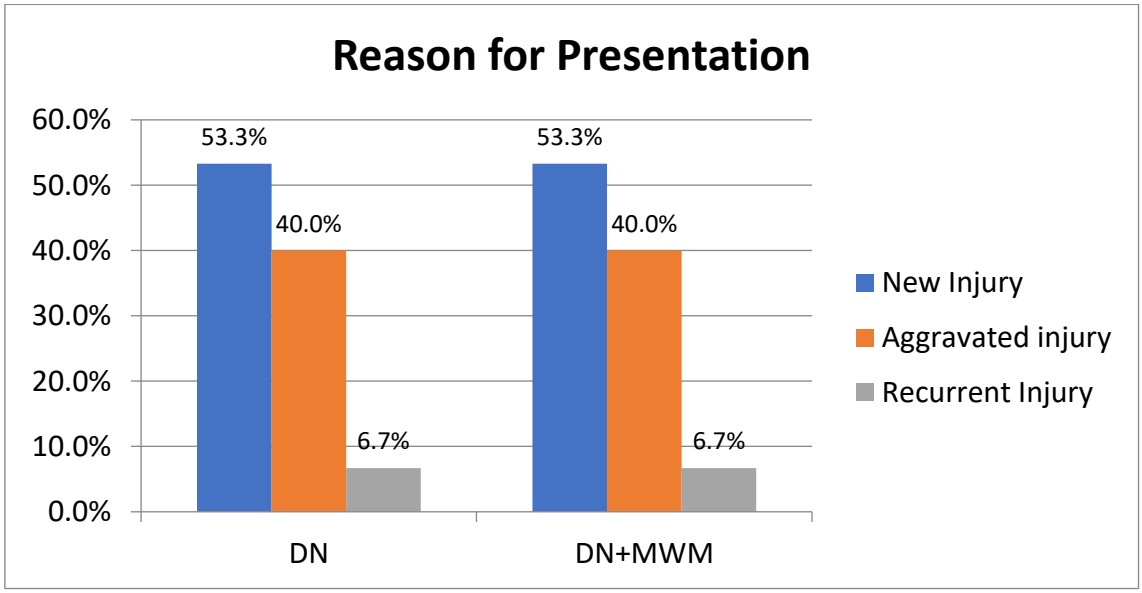

Figure 4. 4 Reason for Presentation

Overstretching the muscles, collision with fixed object or player, and kicking the ball was the most cause of injury for the athletes with hip adductor-related groin pain and dysfunction in both groups as shown in figure 4.5 below.

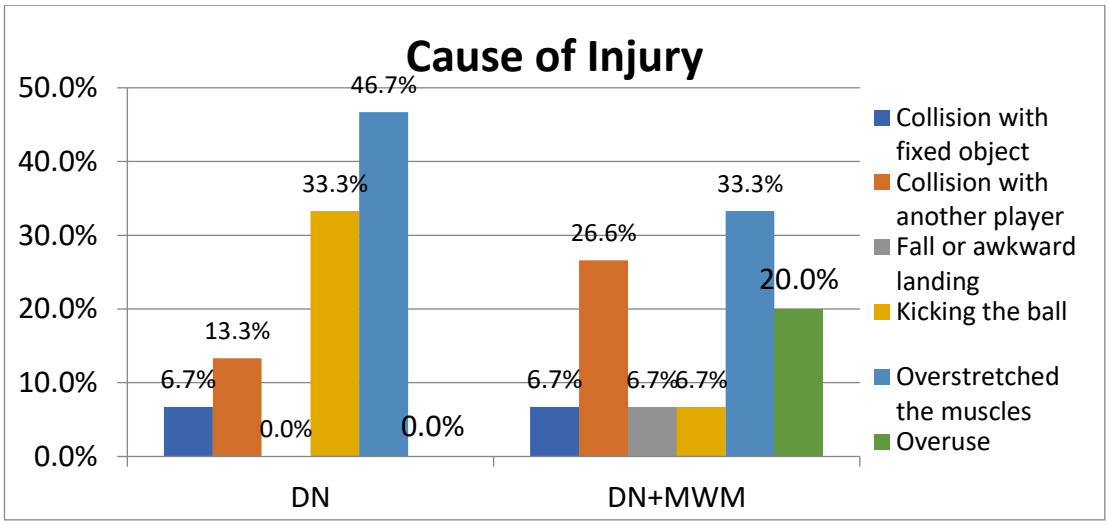

Figure 4. 5 Cause of Injury

In figure 4.6 below 46.7% of the athletes were unable to return to the normal activity in the two groups, while 33.5% in the DN group and 20% in the DN&MWM group return to activity with restriction.

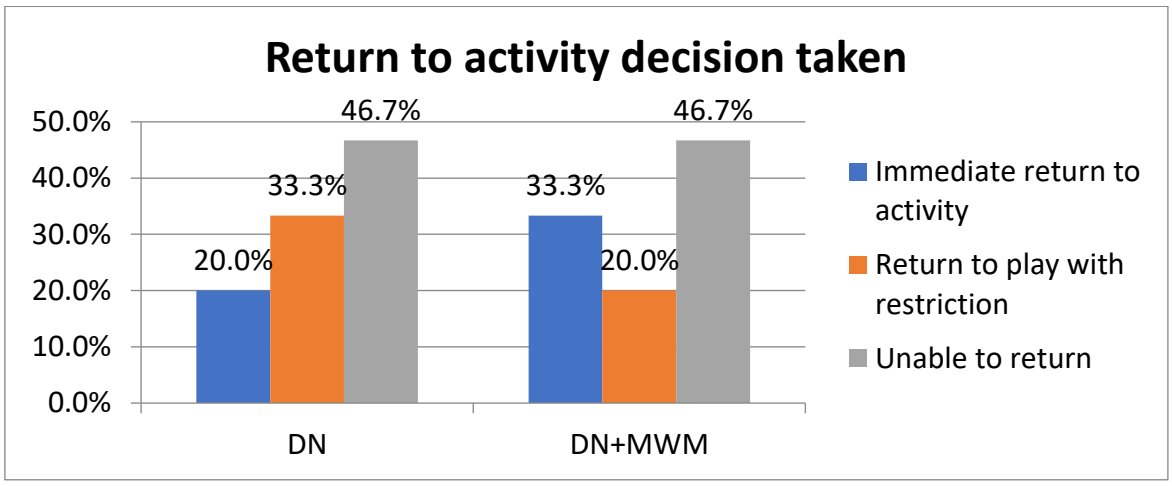

Figure 4. 6 Return to activity decision taken

As presented in figure 4.7 below both groups used medication as the first choice of intervention, while the physiotherapy intervention only 20% of the DN&MWM athletes were treated.

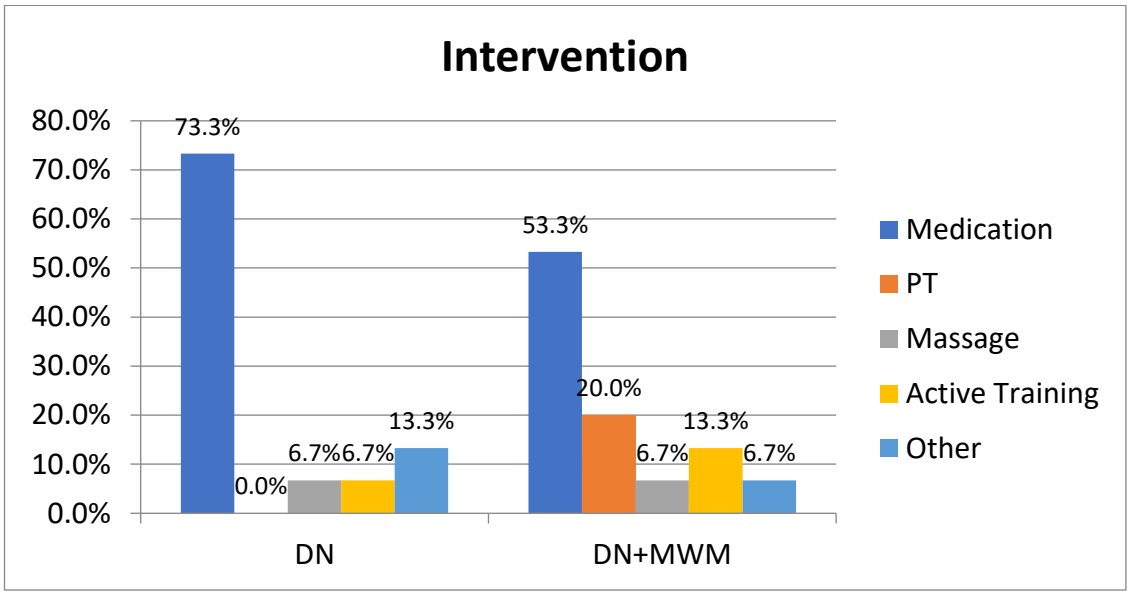

Figure 4. 7 Intervention

4.2 Normality Test:

It is important to test the normality of study variables among the study groups (DN, DN&MWM) before using parametric methods such as analysis of variance (ANOVA) for testing the study hypotheses. The test of Kolmogorov-Smirnov Z is usually used for this purpose, and the following table shows the results of this test:

Table 4. 5 The results of Kolmogorov-Smirnov Normality Test

Study Variables	**DN Group**		**DN&MWM Group**	
	Z	P-value	Z	P-value
NPRS in the 1 session	0.917	0.370	0.880	0.421
NPRS in the 3 session	1.065	0.207	0.923	0.362
NPRS in the 6 session	1.992	0.001	1.992	0.001

Five Second Copenhagen Squeeze Test 1st session	0.997	0.273	1.103	0.175
Five Second Copenhagen Squeeze Test 3rd session	0.929	0.353	0.917	0.370
Five Second Copenhagen Squeeze Test 6th session	1.357	0.050	1.880	0.002
Squeeze Test Pre Average	0.716	0.684	0.503	0.962
Squeeze Test Post Average	0.572	0.899	0.456	0.985
NPRS during Squeeze Test Pre	0.820	0.511	0.801	0.543
NPRS during Squeeze Test Post	1.880	0.002	2.073	0.000
Abduction Pre Affected side ROM	0.633	0.817	0.618	0.840
Abduction Post Affected side ROM	0.855	0.458	0.582	0.887
Abduction Pre none Affected ROM	0.810	0.528	0.897	0.398
Abduction Post none Affected ROM	0.898	0.395	1.496	0.023
Faber Test Pre Affected	0.602	0.862	0.763	0.605
Faber Test Post Affected	0.381	0.999	0.973	0.300
Faber Test Pre none Affected	0.718	0.682	0.680	0.744
Faber Test Post none Affected	0.535	0.937	0.978	0.294
Composite Score YBT Affected side Pre	0.549	0.924	0.717	0.682
Composite Score YBT Affected side Post	0.493	0.968	0.539	0.933
Composite Score YBT none Affected side Pre	0.60	0.860	0.683	0.739

	4			
Composite Score YBT none Affected side Post	0.581	0.888	0.734	0.655
HAGOS general score Pre	0.361	0.999	0.942	0.337
HAGOS general score Post	0.810	0.528	0.768	0.597
HAGOS Symptoms Subscale Pre	0.681	0.742	0.615	0.844
HAGOS Symptoms Subscale Post	-----	-----	-----	-----
HAGOS Pain Subscale Pre	0.839	0.482	0.741	0.642
HAGOS Pain Subscale Post				
HAGOS ADL Subscale Pre	0.602	0.862	0.834	0.491
HAGOS ADL Subscale Post	-----	-----	-----	-----
HAGOS Sport and Recreation Subscale Pre	0.559	0.914	0.725	0.669
HAGOS Sport and Recreation Subscale Post	1.558	0.016	1.831	0.002
HAGOS Participation Subscale Pre	0.830	0.496	1.382	0.044
HAGOS Participation Subscale Post	1.992	0.001	1.755	0.004
HAGOS QOL Subscale Pre	0.986	0.285	0.572	0.899
HAGOS QOL Subscale Post	0.797	0.550	0.904	0.388

The results of the normality test in table 4.5 above show that all study variables among the study groups are normally distributed since the P-values of the Kolmogorov-Smirnov Z test are higher than 0.05 except in (Numeric Pain Rating Scale of in the 6 sessions, Five-second Copenhagen squeeze test 6 session, NRS during Squeeze Test Post, Adduction Post None affected ROM, Abduction Post None affected ROM, HAGOS Participation Subscale

Post, HAGOS Participation Subscale Pre, HAGOS Sport, and Recreation Subscale Post). So, the results ensure that the normality condition of study variables is satisfied and it's allowed to use parametric statistical methods in this research.

4.3 Inferential and applied descriptive statistics

In order to test the study hypotheses, one way repeated measures analysis of variance (ANOVA) was used since there were two or three readings for each patient (subject), these readings were assumed as the levels of the dependent variable through time, and the independent variable was the type of treatment or group variable which consist of two categories DN and DN&MWM.

4.3.1 Numeric Pain Rating Scale NPRS:

In what follow, the results of one way repeated measures analysis of variance (ANOVA) that consists of within-subjects effects for NPRS pre of treatment, in the mid of treatment, and post of treatment, Pairwise Comparisons tests between means of NPRS at the three measurements, and the tests of between-subjects effects according to group DN and DN&MWM.

4.3.1.1. Descriptive statistics of NPRS at three assessment points

The results in table 4.6 and figure 4.8 below show that there are visual differences in the numeric pain rating scale NPRS between means at baseline, in the mid of treatment, and post of treatment within and between study groups, the tests of within and between subject's effects for NPRS will be followed to check these visual differences.

Table 4. 6 Descriptive statistics of NPRS

Group	N	Treatment Time			E.Mean(S.E)*
		At baseline	Mid of treatment	Post of treatment	
		Mean ± S.D	Mean ± S.D	Mean ± S.D	
DN	15	7.2 ± 1.08	2.4 ± 1.45	0.13 ± 0.35	3.24(٠,١٩)
DN&MWM	15	6.73 ± 1.75	1.53 ± 0.99	0.13 ± 0.35	٢,٨(٠,١٩)
All the group	30	6.97 ± 1.45	1.97 ± 1.3	0.13 ± 0.35	3.02(0.14)

* E.Mean: Estimated Mean, S.E: Standard Error. Needed for Between- Subjects Effects analysis.

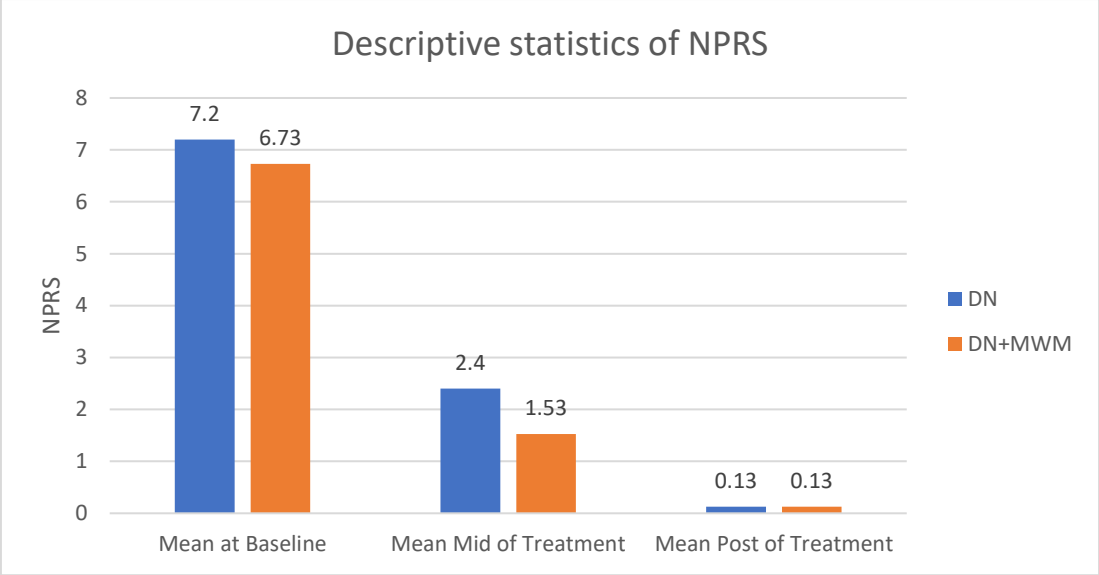

Figure 4. 8 Descriptive statistics of NPRS

4.3.1.2 Inferential statistics of difference of NPRS in between the three assessment points

The results of factor within-subjects effects in the table below table 4.7 show that there is a significant effect of the time on the dependent variable NPRS, this means that there are significant differences at 0.05 level in NPRS when measured pre of treatment, in the mid of treatment, and the post of treatment (P-value < 0.05).

Table 4. 7 Tests of Within-Subjects Effects for NPRS at Baseline, Mid, Post of Treatment, and Between-Subjects Effects according to study Groups

Source of variation		**Sum of Squares**	**df**	**Mean Square**	**F**	**P-value**
Within-Subjects Effects	Factor	750.556	2	375.278	354.460	0.000
	Factor x Group	2.822	2	1.411	1.333	0.272
Between-Subjects Effects	Groups	4.444	1	4.444	2.657	0.114

Follow up pairwise comparisons in table 4.8 below indicated that each pairwise difference was significant (all P-values<0.05), the results show that the mean of NPRS in the post of treatment (0.13) is significantly **less** than the mean of NPRS in the mid of treatment (1.97) which is significantly **less** than the mean of NPRS pre of treatment (6.97).

So, it is concluded that there is a significant **decrease** in the mean of NPRS over time, suggesting a significant time effect.

Table 4. 8 Pairwise Comparisons Tests between means of NPRS in Pre, Mid and the Post of Treatment*

(I) NPRS	(J)NPRS	Mean Differences (I-J)	P-Value
Pre	Mid	5.000	0.000
Pre	Post	6.833	0.000
Mid	Post	1.833	0.000

*Adjustment for multiple comparisons: Bonferroni.

The results of (Factor x Group) Table 4. 7 within-subjects and between groups effects exhibit no significant interaction between NPRS and treatment type, meaning that the treatments applied in DN and DN&MWM groups had no significant effect on the NPRS over time. These results show that there are no significant differences at 0.05 level in NPRS when measured in pre, mid, and post of treatment within each group (P-value=0.272 > 0.05), indicating that both (DN) and (DN&MWM) groups have the same effect on NPRS over time, since the differences within each group are not significant.

The results show that in the DN group, the mean of NPRS pre of treatment was (7.2) decreased to (2.4) in the mid of treatment, to become (0.13) in the post of treatment. By the same effect, in the DN&MWM group, the mean of NPRS pre of treatment was (6.73) decreased to (1.53) in the mid of treatment, to become (0.13) in the post of treatment.

The results of between-subjects effects in the table above show that there are no significant differences at 0.05 level in NPRS between the DN and the DN&MWM groups (P-value=0.114 > 0.05), this result indicates that the main effect of the group on the average of the three-time intervals of the NPRS is not significant and the DN technique (Estimated Mean=3.24) is not more effective than DN&MWM technique (Estimated Mean=2.8) in NPRS.

4.3.2 Five Second Copenhagen Squeeze Test:

In what follow, the results of one way repeated measures analysis of variance (ANOVA) that consists of within-subjects effects for the Five Second Copenhagen Squeeze Test pre of treatment, mid, and in the post of treatment, Pairwise Comparisons Tests between means of Five Second Copenhagen Squeeze Test at the three measurements, and the tests of between-subjects effects according to DN group and DN&MWM group.

4.3.2.1 Descriptive statistics of Five Second Copenhagen Squeeze Test

The results in table 4.10 and figure 4.9 below show that there are visual differences in the Five Second Copenhagen Squeeze Test between means at baseline, mid and post of treatment within and between study groups, the tests of within and between subject's effects for Five Second Copenhagen Squeeze Test will be followed to check these visual differences.

Table 4. 9 Descriptive statistics of Five second Copenhagen Squeeze test at three assessment points

Group	N	Treatment Time			E.Mean(S.E)*
		At baseline	Mid of treatment	Post of treatment	
		Mean ± S.D	Mean ± S.D	Mean ± S.D	
DN	15	7.13 ± 1.25	2.47 ± 1.3	0.53 ± 0.52	3.38(0.22)
DN&MWM	15	7.07 ± 1.75	1.8 ± 1.08	0.2 ± 0.41	3.02(0.22)
all groups	30	7.1 ± 1.49	2.13 ± 1.22	0.37 ± 0.49	3.2(0.16)

* E.Mean: Estimated Mean, S.E: Standard Error. Needed for Between- Subjects Effects analysis.

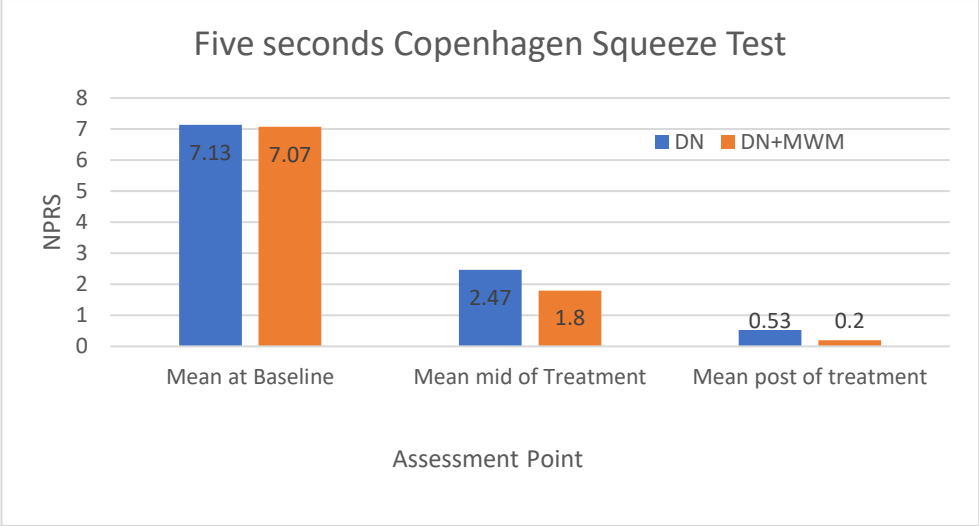

Figure 4. 9 Descriptive statistics of Five second Copenhagen squeeze test

Using the traffic light analog, relating to the results in Five Second Copenhagen Squeeze Test which divided the participants into three groups based on NPRS during the test (0-2 green which considered save group to return to sport, 3-5 yellow which considers acceptable group and 6-10 red which consider high-risk group).

4.3.2.2 Inferential statistics of the Five Seconds Copenhagen Squeeze Test

The results of factor within-subjects effects in Table 4.11 below show that there is a significant effect of the time on the dependent variable Five Second Copenhagen Squeeze Test, this means that there are significant differences at 0.05 level in Five Second Copenhagen Squeeze Test when measured pre of treatment, in the mid of treatment, and the post of treatment (P-value < 0.05).

Table 4. 10 Tests of Within-Subjects Effects for Five-Second Copenhagen Squeeze Test Pre, Mid, Post of Treatment, and Between-Subjects Effects according to Group

Source of variation		Sum of Squares	df	Mean Square	F	P-value
Within-Subjects Effects	Factor	731.267	2	365.633	403.767	0.000
	Factor x Group	1.356	2	0.678	0.748	0.478
Between-Subjects Effects	Group	2.844	1	2.844	1.323	0.260

Follow up pairwise comparisons in table 4.12 below indicated that each pairwise difference was significant (all P-values<0.05), the results show that the mean of Five Second Copenhagen Squeeze Test in the post of treatment (0.37) is significantly lower than the mean of Five Second Copenhagen Squeeze Test in the mid of treatment (2.13) which is significantly lower than the mean in the pre of treatment (7.1).

So, it is concluded that there is a significant increase in the mean of the Five Second Copenhagen Squeeze Test over time, suggesting a significant time effect.

Table 4. 11 Pairwise Comparisons Tests between means of Five second Copenhagen squeeze test Pre of Treatment, in the Mid of Treatment, and the Post of Treatment. *

(I) FiveSSquz	(J) FiveSSquz	Mean Difference (I-J)	P-value
Pre	Mid	4.967	0.000
Pre	Post	6.733	0.000
Mid	Post	1.767	0.000

*Adjustment for multiple comparisons: Bonferroni.

The results of (Factor x Group) within-subjects effects exhibit no significant interaction between the Five Second Copenhagen Squeeze Test and treatment type, meaning that the treatments applied in DN and DN&MWM groups had no significant effect on the Five Second Copenhagen Squeeze Test over time. These results show that there are no significant differences at 0.05 level in Five Second Copenhagen Squeeze Test when measured pre of treatment, in the mid of treatment, and the post of treatment within each group (P-value=0.478 > 0.05), indicating that both DN and DN&MWM groups have the same effect on Five Second Copenhagen Squeeze Test over time since the differences within each group are not significant.

The results show that in the DN group, the mean of Five Second Copenhagen Squeeze Test pre of treatment was (7.13) decreased to (2.47) in the mid of treatment, to become (0.53) in the post of treatment. By the same effect, in the DN&MWM group, the mean of the Five Second Copenhagen squeeze test pre of treatment was (7.07) decreased to (1.8) in the mid of treatment, to become (0.2) in the post of treatment.

The results of between-subjects effects in the table above show that there are no significant differences at 0.05 level in the Five Second Copenhagen Squeeze Test between DN and

DN&MWM groups (P-value=0.260 > 0.05), this result indicates that the main effect of the group on the average of the three-time intervals of the Five Second Copenhagen Squeeze Test is not significant and the DN technique (Estimated Mean=3.38) is not more effective than DN&MWM technique (Estimated Mean=3.02) in the Five Second Copenhagen Squeeze Test.

4.3.3 Squeeze Test Score

In what follow, the results of one-way repeated-measures analysis of variance (ANOVA) that consists of within-subjects effects for Squeeze Test Scores pre and post of treatment, and the tests of between-subjects effects according to the type of treatment DN and DN&MWM.

4.3.3.1 Descriptive statistics

The results in Table 4.14 and Figure 4.10 below show that there are visual differences in squeeze test score between pre of treatment mean and post of treatment mean within study groups while no visual differences between study groups, the tests of within and between subject's effects for squeeze test will be followed to check these visual differences.

Table 4. 12 Deceptive Statistics of Squeeze Test Score

Squeeze Test Score	Group	N	Treatment Time		E.Mean(S.E)*
			Pre of Treatment	Post of Treatment	
			Mean ± S.D	Mean ± S.D	
Squeeze Test (mmHg)	DN	15	125.18 ± 25.57	149.91 ± 15.94	137.54(4.67)
	DN&MWM	15	124.49 ± 18.38	148.2 ± 14.99	136.34(4.67)
	all	30	124.83 ± 21.88	149.06 ± 15.23	136.94(3.3)
NPRS during Squeeze Test	DN	15	3.53 ± 2.33	0.2 ± 0.41	1.87(0.31)
	DN&MWM	15	2.87 ± 2	0.07 ± 0.26	1.47(0.31)
	All	30	3.2 ± 2.16	0.13 ± 0.35	1.67(0.22)

* E.Mean: Estimated Mean, S.E: Standard Error. Needed for Between- Subjects Effects analysis.

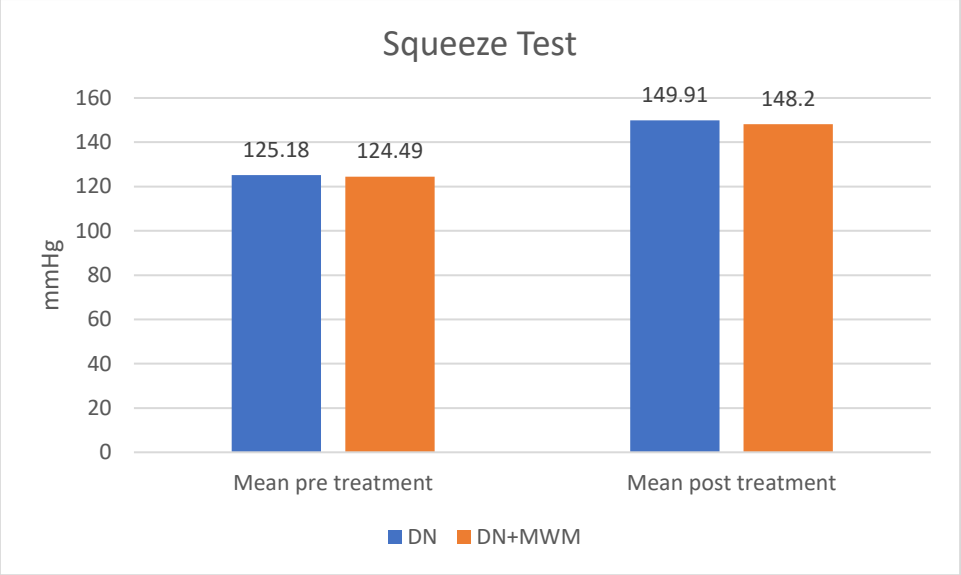

Figure 4. 10 Descriptive statistics of Squeeze Test Score

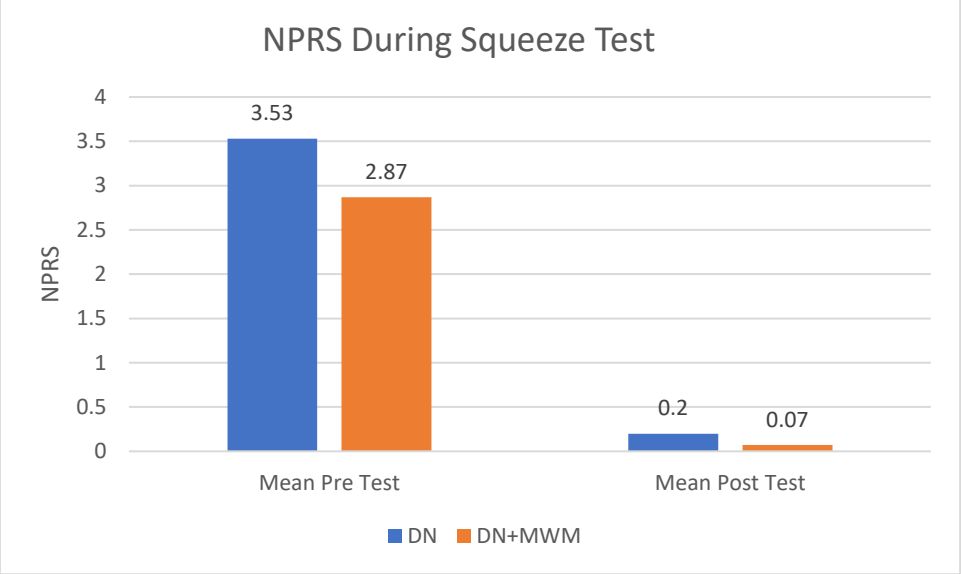

Figure 4. 11 Descriptive statistics of NPRS During Squeeze Test Score

4.3.3.2 Inferential statistics of the squeeze test

From the general point of view, the results of factor within-subjects effects in the table below 4.15 show that there is a significant effect of the time on both squeeze test and NPRS during the test, this means that there is a significant difference at 0.05 level in these scales between pre and post of treatment (both P-values< 0.05), the scores increased significantly from 124.83 mmHg pre of treatment to 149.06 mmHg post of treatment. So,

it is concluded that there is a significant increase in the mean of the squeeze test over time, suggesting a significant time effect.

Relating to the NPRS during the test, the results in table 4.15 below show that there is a significant effect of the time on the dependent variable (NPRS during Squeeze test), this means that there are significant differences at 0.05 level in NPRS during the squeeze test between pre and post of treatment (P-value< 0.05), the scores decreased significantly from 3.2 pre of treatment to 0.13 post of treatment. So, it is concluded that there is a significant decrease in the mean of NPRS during the squeeze test over time, suggesting a significant time effect.

Table 4. 13 Tests of Within-Subjects Effects for the Squeeze Test Scores Pre and Post of Treatment, and Between-Subjects Effects according to the type of treatment.

Squeeze Test Scales	Source of variation		Sum of Squares	df	Mean Square	F	P-value
Squeeze Test	Within-Subjects Effects	Factor	8800.741	1	8800.741	107.565	<0.001
		Factor x Group	3.919	1	3.919	0.048	0.828
	Between-Subjects Effects	Group	21.600	1	21.600	0.033	0.857
NPRS during Squeeze Test	Within-Subjects Effects	Factor	141.067	1	141.067	71.990	<0.001
		Factor x Group	1.067	1	1.067	0.544	0.467
	Between-Subjects Effects	Group	2.400	1	2.400	0.841	0.367

Generally, the results of (Factor x Group) within-subjects effects in table 4.15 above exhibit insignificant interaction between both squeeze test and NPRS during the test and type of treatment, meaning that the type of treatment has no significant effect on the squeeze test and NPRS during the test scores over time, these results show that the change from pre to post scores don't differ within each type of treatment (all P-values > 0.05), indicating that both the DN intervention and the DN&MWM intervention have the same effect on changing squeeze test and NPRS during squeeze test from pre to post scores.

The results of between-subjects effects in table 4.15 above show that there are no significant differences at 0.05 level in both squeeze test and NPRS during squeeze test between DN and DN&MWM types of treatment (all P-values > 0.05), the results indicate that the main effect of the type of treatment on the average of squeeze test scores and NPRS during squeeze test scores (pre and post) is not significant, and the DN is not more effective than the DN&MWM for squeeze test score and NPRS during the test.

4.3.4 Range of Motion

In what follow, the results of one-way repeated-measures analysis of variance (ANOVA) that consists of within-subjects effects for a range of motion ROM scores pre and post of treatment, and the tests of between-subjects effects according to the type of treatment DN and DN&MWM.

4.3.4.1 Descriptive Statistics of Range of Motion

The results in table 4.17 below show that there are visual differences in abduction ROM scores between pre of treatment mean and post of treatment mean within study groups while no visual differences between study groups, the tests of within and between subject's effects for abduction ROM scores will be followed to check these visual differences.

Table 4. 14 Descriptive Statistics of Abduction Range of Motion

Range of Motion	Group	N	Treatment Time		E.Mean(S.E)*
			Pre of Treatment	**Post of Treatment**	
			Mean ± S.D	**Mean ± S.D**	
Abduction Affected side	DN	15	32.27 ± 8.22	40.6 ± 5.72	36.43(1.34)
	DN&MWM	15	31.33 ± 6.11	43.6 ± 1.55	37.47(1.34)
	All	30	31.8 ± 7.14	42.1 ± 4.39	36.95(0.95)
Abduction None affected	DN	15	40.33 ± 5.5	40.93 ± 5.44	40.63(1.07)
	DN&MWM	15	41.6 ± 3.54	44.53 ± 1.19	43.07(1.07)
	All	30	40.97 ± 4.59	42.73 ± 4.28	41.85(0.76)

* E.Mean: Estimated Mean, S.E: Standard Error. Needed for Between- Subjects Effects analysis.

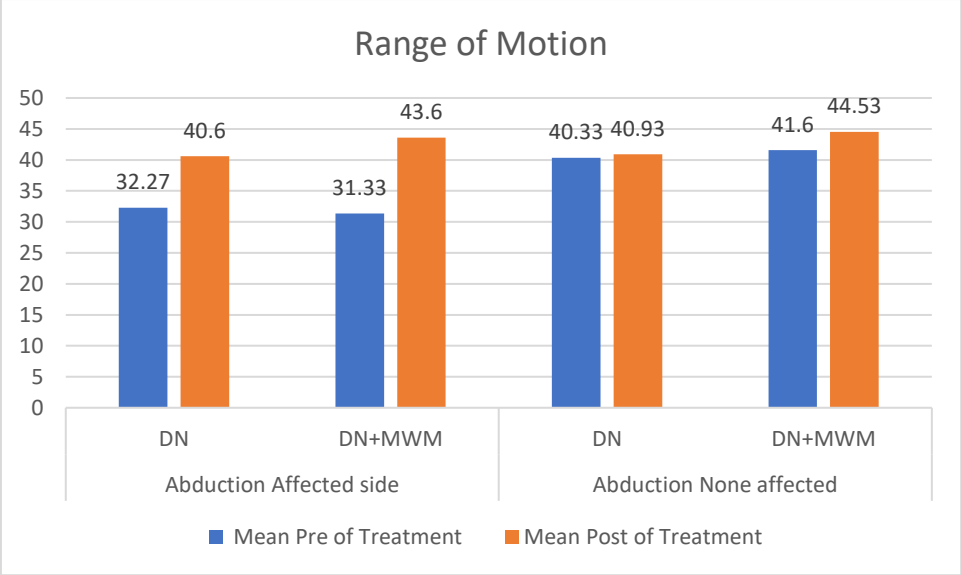

Figure 4. 12 Descriptive Statistics of Range of Motion

4.3.4.2 Inferential statistics of Range of Motion

From the general point of view, the results of factor within-subjects effects in table 4.18 below show that there is a significant effect of the time on all the dependent variables ROM scores, this means that there are significant differences at 0.05 level in ROM scores between pre and post of treatment (P-value< 0.05), all the scores increased significantly from pre of treatment to post of treatment.

The results in table 4.18 below show that there is a significant effect of the time on the dependent variable abduction affected side ROM score, this means that there is a significant difference at 0.05 level in abduction affected side ROM scores between pre and post of treatment (P-value< 0.05), the scores increased significantly from 31.8 pre of treatment to 42.1 posts of treatment.

Also, the results show that there is a significant effect of the time on the dependent variable abduction none affected ROM score, where there are significant differences at 0.05 level in abduction none affected ROM scores between pre and post of treatment (P-value< 0.05), the scores increased significantly from 40.97 pre of treatment to 42.73 posts of treatment. So, it is concluded that there is a significant increase in the mean of abduction affected and none affected ROM scores over time, suggesting a significant time effect.

Table 4. 15 Tests of Within-Subjects Effects for the Range of Motion Scores Pre and Post of Treatment, and Between-Subjects Effects according to the type of treatment

ROM	Source of variation		Sum of Squares	df	Mean Square	F	P-value
Abduction Affected	**Within-Subjects Effects**	**Factor**	1591.350	1	1591.350	99.430	0.001
		Factor x Group	58.017	1	58.017	3.625	0.067
	Between-Subjects Effects	**Group**	16.017	1	16.017	0.296	0.590
Abduction None affected	**Within-Subjects Effects**	**Factor**	46.817	1	46.817	18.394	0.001
		Factor x Group	20.417	1	20.417	8.022	0.008
	Between-Subjects Effects	**Group**	88.817	1	88.817	2.584	0.119

Generally, the results of (Factor x Group) within-subjects effects in the table 4.18 above exhibit insignificant interaction between affected side Abduction score and type of treatment, and significant interaction between none affected side abduction score and type of treatment, meaning that the type of treatment has no significant effect on the affected side abduction over time while it has significant effect on the none affected side abduction scores, these results show that the change from pre to post scores of the affected side abduction scores don't differ within each type of treatment (P-values > 0.05), while the change from pre to post scores of the none affected side abduction scores is different within each type of treatment (P-values < 0.05), indicating that both the DN intervention and the DN&MWM intervention have the same effect on changing affected side abduction from pre to post scores while the DN intervention has lower effect than the DN&MWM intervention on changing none affected side abduction from pre to post scores. It is clear from the results that regarding affected side abduction scores, the mean scores increased in the DN intervention group, and these increases are not significantly different from the corresponding increases in the mean scores in the DN&MWM intervention group, but regarding none affected side ROM scores, the mean scores increased in (DN) intervention group, and these increases are significantly lower than the corresponding increases in the mean scores in DN&MWM intervention group.

The results of between-subjects effects in table 4.18 above show that there are no significant differences at 0.05 level in abduction scores between the DN and the

DN&MWM types of treatment (all P-values > 0.05), these results indicate that the main effect of the type of treatment on the average of the abduction scores (pre and post) is not significant and the DN type of treatment is not more effective than the DN&MWM type of treatment in changing the abduction scores.

4.3.5 FABER Test Scores

In what follow, the results of one-way repeated measures analysis of variance (ANOVA) that consists of within-subjects effects for FABER test scores pre and post of treatment, and the tests of between-subjects effects according to the type of treatment DN, DN&MWM.

4.3.5.1 Descriptive statistics of FABER test

The results in table 4.20 below show that there are no visual differences in FABER test scores between pre of treatment mean and post of treatment mean within and between study groups, the tests of within and between subject's effects for FABER test scores will be followed to check these visual differences.

Table 4. 16 Descriptive statistics of FABER test

FABER Test Scores	**Group**	**N**	**Treatment Time**		**E.Mean(S.E)***
			Pre of Treatment	Post of Treatment	
			Mean ± S.D	Mean ± S.D	
FABER Test Affected	DN	15	26.67 ± 5.98	22.13 ± 4.03	24.4(1.16)
	DN&MWM	15	23.4 ± 5.23	18.6 ± 3.27	21(1.16)
	All	30	25.03 ± 5.77	20.37 ± 4.03	22.7(0.82)
FABER Test None Affected	DN	15	22.33 ± 5.97	21 ± 3.76	21.67(1.09)*
	DN&MWM	15	20.8 ± 5.09	17.67 ± 2.79	19.23(1.09)*
	All	30	21.57 ± 5.51	19.33 ± 3.67	20.45(0.77)

* E.Mean: Estimated Mean, S.E: Standard Error. Needed for Between- Subjects Effects analysis.

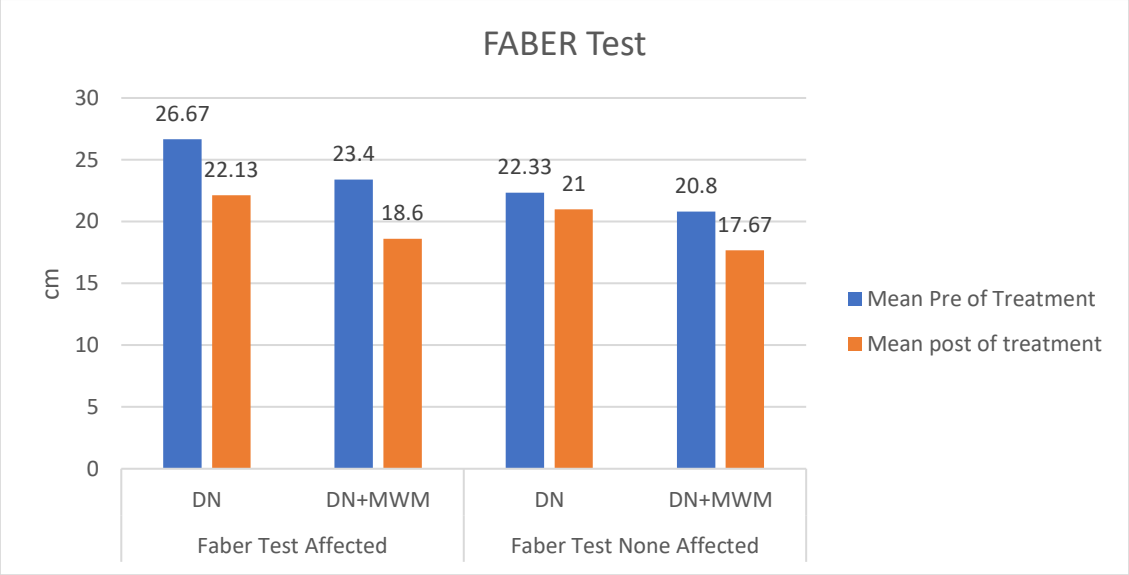

Figure 4. 13 Descriptive statistics of FABER test

4.3.5.2 Inferential statistics of the FABER test

As shown in Table 4.21 below, the results of factor within-subjects effects had a significant effect of the time on both FABER test affected and none affected the score, this means that there is a significant difference at 0.05 level in these scores between pre and post of treatment (both P-values< 0.05), the scores in this scale decreased significantly from pre of treatment to post of treatment.

The results in the table below show that there is a significant effect of the time on the dependent variable Faber test affected at 0.05 level between pre and post of treatment (P-value< 0.05), the scores decreased significantly from 25.03 pre of treatment to 20.37 post of treatment.

Related to the FABER test none affected side, there is a significant difference at 0.05 level between pre and post of treatment (P-value< 0.05), the scores decreased significantly from 21.57 pre of treatment to 19.33 post of treatment. So, it is concluded that there is a significant decrease in the mean of FABER test affected and none affected over time, suggesting a significant time effect.

Table 4. 17 Tests of Within-Subjects Effects for the FABER Test Scores Pre and Post of Treatment, and Between-Subjects Effects according to the type of treatment

FABER Test Scores	Source of variation		Sum of Squares	df	Mean Square	F	P-value
FABER Test Affected	Within-Subjects Effects	Factor	326.667	1	326.667	71.421	0.001
		Factor x Group	0.267	1	0.267	0.058	0.811
	Between-Subjects Effects	Group	173.4	1	173.4	4.281	0.048
FABER Test None Affected	Within-Subjects Effects	Factor	74.817	1	74.817	12.889	0.001
		Factor x Group	12.15	1	12.15	2.093	0.159
	Between-Subjects Effects	Group	88.817	1	88.817	2.471	0.127

Generally, the results of (Factor x Group) within-subjects effects in table 4.21 above exhibit insignificant interaction between both FABER test score and type of treatment, meaning that the type of treatment has no significant effect on the FABER test scores over time, these results show that the change from pre to post scores of the FABER test scores don't differ within each type of treatment (all P-values > 0.05), indicating that both the DN intervention and the DN&MWM intervention have the same effect on changing FABER test scores from pre to post scores.

The results of between-subjects effects in the table above show that there are significant differences at 0.05 level only in FABER test affected scores between DN and DN&MWM types of treatment (P-value < 0.05), the results indicate that the main effect of the type of treatment on the average of FABER test affected scores (pre and post) is significant, and the DN type of treatment is more effective than the DN&MWM type of treatment for only the FABER test affected scores.

Related to the FABER test score none affected, the results of within-subjects effects in table 4.21 above exhibit insignificant interaction between and type of treatment, meaning that the type of treatment has no significant effect on the FABER test none affected over time, these results show that the change from pre to post scores of the FABER test none affected do not differ within each type of treatment (P-value=0.159 >

0.05), indicating that both the (DN) intervention and the (DN&MWM) intervention have the same effect on changing FABER test none affected from pre to post scores. It is clear from the results that the mean scores decreased from (22.33) to (21) in the DN intervention group, and this decrease is not significantly different from the decrease in the mean scores in the DN&MWM intervention group from (20.8) to (17.67).

The results of between-subjects effects in table 4.21 above show that there are no significant differences at 0.05 level in the FABER test none affected between DN and DN&MWM types of treatment (P-value=0.127 > 0.05), this result indicates that the main effect of the treatment on the average of the FABER test none affected (pre and post) is not significant and the DN type of treatment (Estimated Mean=21.67) is not more effective than the DN&MWM intervention (Estimated Mean=19.23) for the FABER test none affected.

4.3.6 Y Balance Test Composite Scores:

In what follow, the results of one-way repeated measures analysis of variance (ANOVA) that consists of within-subjects effects for composite YBT scores pre and post of treatment, and the tests of between-subjects effects according to the type of treatment DN and DN&MWM.

4.3.7.1 Descriptive statistics of Y Balance Test composite score

The results in table 4.23 below show that there are no visual differences in YBT composite scores between pre of treatment mean and post of treatment mean within and between study groups, the tests of within and between subject's effects for YBT composite scores will be followed to check these visual differences.

Table 4. 18 Descriptive statistics of Y Balance test composite score

Composite YBT	Group	N	Treatment Time	E.Mean(S.E)*

Scores			Pre of Treatment	Post of Treatment	
			Mean ± S.D	Mean ± S.D	
Composite Score YBT Affected Side	DN	15	81.28 ± 7.13	83.99 ± 6.39	82.64(1.61)*
	DN&MWM	15	79.34 ± 8.01	81.75 ± 5.47	80.55(1.61)*
	All	30	80.31 ± 7.52	82.87 ± 5.95	81.59(١،١٤)
Composite Score YBT None Affected Side	DN	15	81.8 ± 6.35	82.86 ± 7.19	82.33(1.63)*
	DN&MWM	15	81.64 ± 6.43	82.15 ± 5.77	81.89(1.63)*
	All	30	81.72 ± 6.28	82.51 ± 6.42	82.11(١،١٥)

* E.Mean: Estimated Mean, S.E: Standard Error. Needed for Between- Subjects Effects analysis.

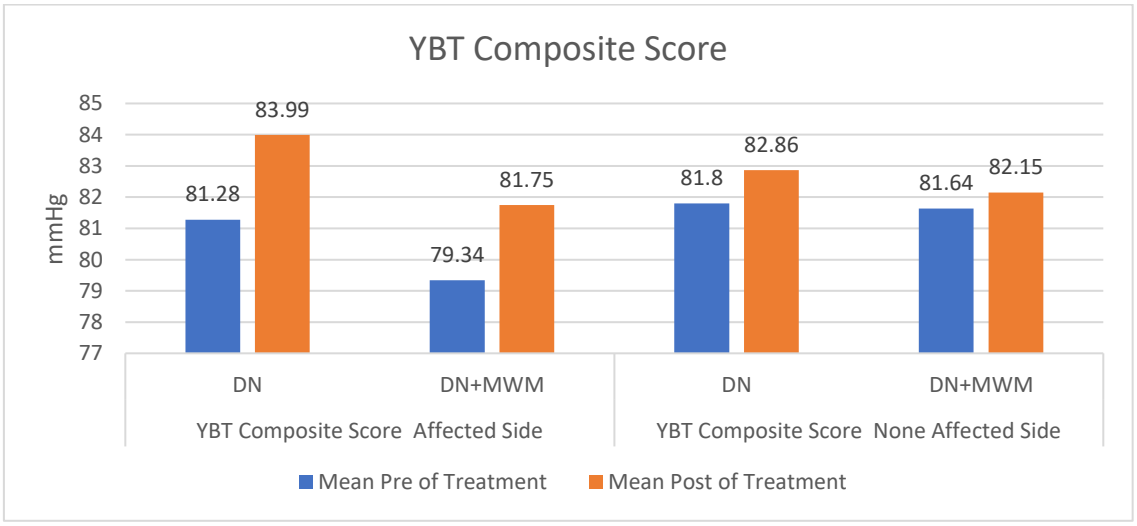

Figure 4. 14 Descriptive statistics of Y Balance test composite score

4.3.7.2 Inferential statistics of Y balance test composite score

From the general point of view, the results of factor within-subjects effects in table 4.24 below show that there is a significant effect of the time on YBT composite score affected side only, the results show that there is a significant effect of the time on the dependent variable YBT composite score affected side, this means that there are significant differences at 0.05 level in YBT composite score affected sides between pre and post of treatment (P-value=0.017< 0.05), the scores increased significantly from ٨٠,٣١ pre of treatment to ٨٢,٨٧ posts of treatment.

From the other hand, the results show that there is no significant effect of the time on the dependent variable YBT composite score none affected side, this means that there are no significant differences at 0.05 level in between pre and post of treatment (P-value=0.111>0.05), the scores increased slightly from ٨١,٧٢ pre of treatment to ٨٢,٥١ post of treatment.

Table 4. 19 Tests of Within-Subjects Effects for the Composite YBT Scores Pre and Post of Treatment, and Between-Subjects Effects according to the type of treatment

Composite YBT Scores	Source of variation		Sum of Squares	Df	Mean Square	F	P-value
Composite Score YBT Affected Side	Within-Subjects Effects	Factor	98.498	1	98.498	6.441	0.017
		Factor x Group	0.313	1	0.313	0.02	0.887
	Between-Subjects Effects	Group	65.485	1	65.485	0.844	0.366
Composite Score YBT None Affected Side	Within-Subjects Effects	Factor	9.302	1	9.302	2.714	0.111
		Factor x Group	1.168	1	1.168	0.341	0.564
	Between-Subjects Effects	Group	2.857	1	2.857	0.036	0.851

The results of (Factor x Group) within-subjects effects in the table above exhibit insignificant interaction between both YBT composite scores and type of treatment, meaning that the type of treatment has no significant effect on the YBT composite scores over time, these results show that the change from pre to post scores don't differ within each type of treatment (P-value=0.887 > 0.05) affected side, indicating that both the DN and the DN&MWM have the same effect on changing YBT composite scores from pre to

post scores. It is clear from the results for the affected side that the mean scores increased from (81.28) to (83.99) in the DN intervention group, and this increase is not significantly different from the increase in the mean scores in the DN&MWM intervention group from (79.34) to (٨١,٧٥).

Also, the YBT composite score with none affected side does not differ within each type of treatment (P-value=0.564 > 0.05), indicating that both the DN intervention and the DN&MWM intervention have the same effect on changing YBT composite score none affected side from pre to post scores. It is clear from the results that the mean scores increased from (81.8) to (82.86) in the DN intervention group, and this increase is not significantly different from the increase in the mean scores in the DN&MWM intervention group from (81.64) to (82.15).

The results of between-subjects effects show that there are no significant differences at 0.05 level in the YBT composite score none affected side between DN and DN&MWM (P-value=0.851 > 0.05), this result indicates that the main effect of the type of treatment on the average of the YBT composite score none affected Side (pre and post) is not significant and the DN type of treatment (Estimated Mean=82.33) is not more effective than the DN&MWM type of treatment (Estimated Mean=81.89) for the Composite score YBT none affected side.

4.3.7 Hip and Groin Outcome Score, HAGOS Scales

4.3.8.1 Descriptive Statistics of HAGOS Scale

In what follow, the results of one-way repeated measures analysis of variance (ANOVA) that consists of within-subjects effects for HAGOS scores pre and post of treatment, and the tests of between-subjects effects according to the type of treatment DN, DN&MWM.

The results in table 4.26 below show that there are visual differences in HAGOS scores between pre of treatment mean and post of treatment mean within study groups while no visual differences between study groups, the tests of within and between subject's effects for HAGOS scores will be followed to check these visual differences.

Table 4. 20 Descriptive Statistics of HAGOS Scale

HAGOS Scores	Group	N	Pre of Treatment	Post of Treatment	E.Mean(S.E)*
			Mean ± S.D	Mean ± S.D	
HAGOS general score	DN	15	51.67 ± 11.07	97.54 ± 1.96	74.61(1.47)
	DN&MWM	15	49.09 ± 10.48	96.87 ± 1.74	72.98(1.47)
	All	30	50.38 ± 10.67	97.21 ± 1.85	73.79(1.04)
HAGOS Symptoms Subscale	DN	15	55.94 ± 12.58	100 ± 0	77.97(1.64)
	DN&MWM	15	56.43 ± 12.81	100 ± 0	78.22(1.64)
	All	30	56.19 ± 12.48	100 ± 0	78.09(1.16)
HAGOS Pain Subscale	DN	15	68.83 ± 12.85	100 ± 0	84.42(1.43)
	DN&MWM	15	73.67 ± 9.01	100 ± 0	86.83(1.43)
	All	30	71.25 ± 11.18	100 ± 0	85.63(1.01)
HAGOS ADL Subscale	DN	15	73.33 ± 16.87	100 ± 0	86.67(1.98)
	DN&MWM	15	71 ± 13.65	100 ± 0	85.5(1.98)
	All	30	72.17 ± 15.12	100 ± 0	86.08(1.4)
HAGOS Sport and	DN	15	47.71 ± 15.55	98.52 ± 2.35	73.11(1.96)

Recreation Subscale	DN&MWM	15	48.33 ± 14.46	99.17 ± 1.86	73.75(1.96)
	All	30	48.02 ± 14.75	98.84 ± 2.11	73.43(1.38)
HAGOS Participation Subscale	DN	15	26.67 ± 22.59	98.33 ± 4.4	62.5(3.08)
	DN&MWM	15	10 ± 20.16	96.67 ± 5.72	53.33(3.08)
	All	30	18.33 ± 22.68	97.5 ± 5.09	57.92(2.18)
HAGOS QOL Subscale	DN	15	36.67 ± 14.6	84.33 ± 9.61	60.5(2.17)
	DN&MWM	15	35 ± 11.18	85 ± 8.02	60(2.17)
	All	30	35.83 ± 12.8	84.67 ± 8.7	60.25(1.53)

* E.Mean: Estimated Mean, S.E: Standard Error. Needed for Between- Subjects Effects analysis.

4.3.8.2 Inferential Statistics of HAGOS Scale

From the general point of view, the results of factor within-subjects effects in table 4.27 below show that there is a significant effect of the time on the HAGOS general score and all its subscales, this means that there is a significant difference at 0.05 level in all these scales between pre and post of treatment (all P-values< 0.05), the scores in these tests increased significantly from pre of treatment to post of treatment. So, it is concluded that there are significant increases in the mean of HAGOS general score and HAGOS Subscale over time, suggesting a significant time effect on all these scales.

Generally, the results of (Factor x Group) within-subjects effects in table 4.27 below exhibit insignificant interaction between all HAGOS scores and type of treatment except HAGOS participation subscale, meaning that the type of treatment has no significant effect on the HAGOS scores over time except regarding HAGOS Participation subscale, these results show that the change from pre to post scores of the HAGOS scores don't differ within each type of treatment (all P-values > 0.05) except regarding HAGOS Participation subscale, indicating that both the DN intervention and the DN&MWM intervention have the same effect on changing HAGOS scores from pre to post scores while regarding HAGOS Participation Subscale, the DN intervention has a different effect from the DN&MWM intervention on changing HAGOS scores from pre to post scores.

The results of between-subjects effects in table 4.27 show that there are no significant differences at 0.05 level in all HAGOS scores between the DN and the DN&MWM types of treatment (all P-values > 0.05) except in the HAGOS Participation subscale, the results indicate that the main effect of the type of treatment on the average of HAGOS scores pre and post is not significant except in HAGOS Participation subscale, and the DN type of treatment is not more effective than the DN&MWM type of treatment in changing all HAGOS scores except regarding HAGOS Participation subscale.

Table 4. 21 Tests of Within-Subjects Effects for the HAGOS Scale Pre and Post of Treatment, and Between-Subjects Effects according to the type of treatment.

HAGOS Scores	Source of variation		Sum of Squares	DF	Mean Square	F	P-value
HAGOS general score	Within-Subjects Effects	Factor	32886.836	1	32886.836	604.336	<0.001
		Factor x Group	13.719	1	13.719	0.252	0.62
	Between-Subjects Effects	Group	39.512	1	39.512	0.607	0.442
HAGOS Symptoms Subscale	Within-Subjects Effects	Factor	28794.561	1	28794.561	357.258	<0.001
		Factor x Group	0.915	1	0.915	0.011	0.916
	Between-Subjects Effects	Group	0.915	1	0.915	0.011	0.916
HAGOS Pain Subscale	Within-Subjects Effects	Factor	12398.438	1	12398.438	201.445	<0.001
		Factor x Group	87.604	1	87.604	1.423	0.243
	Between-Subjects Effects	Group	87.604	1	87.604	1.423	0.243
HAGOS ADL Subscale	Within-Subjects Effects	Factor	11620.417	1	11620.417	98.697	<0.001
		Factor x Group	20.417	1	20.417	0.173	0.68
	Between-Subjects Effects	Group	20.417	1	20.417	0.173	0.68
HAGOS Sport and Recreation Subscale	Within-Subjects Effects	Factor	38750.251	1	38750.251	336.521	<0.001
		Factor x Group	0.003	1	0.003	0	0.996
	Between-Subjects Effects	Group	6.017	1	6.017	0.052	0.821
HAGOS Participation Subscale	Within-Subjects Effects	Factor	94010.417	1	94010.417	468.831	<0.001
		Factor x Group	843.75	1	843.75	4.208	0.049
	Between-Subjects Effects	Group	1260.417	1	1260.417	4.44	0.044
HAGOS QOL Subscale	Within-Subjects Effects	Factor	35770.417	1	35770.417	337.04	<0.001
		Factor x Group	20.417	1	20.417	0.192	0.664
	Between-Subjects Effects	Group	3.75	1	3.75	0.027	0.872

4.4 Result's summary

The results showed that there are a significant effect of the time on all dependents variables Numeric Pain Rating Scale (NPRS), five-second Copenhagen squeeze test (Pre- Mid- Post), and hip abduction range of motion, adductor squeeze test, Flexion Abduction External Rotation Test (FABER) test, Y balance test, and The Copenhagen Hip and Groin Outcome Score (HAGOS) in Pre- Post, which means that there are significant differences in all tests when measured pre, mid, post and pre-post in some variables in both groups DN and DN&MWM.

Also, the results showed no significant interaction between all dependents variables and treatment groups, meaning that there was no significant difference between the treatments applied in the DN and the DN&MWM groups in all dependent variables.

4.5 Discussion

This RCT focused on one of the most prevalent sports injuries for athletes and their clubs, hip adductor-related groin pain and dysfunction because they are common injuries and lead to prolonged symptoms, discontinue athlete's participation, and a high recurrence rate.

There is a lack of studies concerning the use of a combination of dry needling and mulligan mobilization with movements for hip adductor-related groin pain and dysfunction, according to our knowledge; this is the first study that compares the soft tissue release technique and the joint mobilization technique for athletes with hip adductor-related groin pain and dysfunction.

Thirty participants (15 in each group) were male football players, age averaged 27 in the dry needling group and 24 for the DN&MWM group, which means that the participants in both groups were young, which compares well with other studies in the same injury history (34)(35), and these age players are still pliable, and generally show no degenerative dysfunctions that may be associated with such injuries. Most of them around 60% had either no or slight physical activity demand in their job, which may indicate possibilities of ergonomic risk that may affect their risk of injury in the game.

In terms of the training regime in both groups, they had more than half of the participants who had either 2 or 3 training per week, with reflects a low frequency of training that may affect their possibility to maneuver in range and length, which may have some relation with the injury itself, the nature of the range that they receive was beyond this study which may be investigated in further research. Eyal Eliakim el ta conducted a study in 2018 to investigate the relation and effectiveness of pre-session fitness on the injury rate, they concluded that less improvement in aerobic fitness indicates that insufficient pre-season training time is associated with a higher incidence of injuries during the competitive football season(36).

Most of the athletes in both groups complained of chronic hip adductor-related groin pain and dysfunction (DN=66%, DN&MWM=66.7%). Which mean that either they have sustained injuries that they were not relieved from earlier, or they have some risk factors that keep this dysfunction affecting their performance, in both cases those participants

participating in this study, due to new injury, which may be aggravated or facilitated by a previous adductors dysfunction 53.3% of the athletes came with a new injury, while 40% of them complained of aggravated injury in both groups.

Most of the participants (80% in the DN group, 40% in the DN&MWM) were injured during competitions, which shows that they were not injured with the less demanding training and that the injury happened while the players were trying to give their maximum potential, which in many cases represents a gap of effort between training and competition, which reflects a question about not just the frequency but also the intensity required at the training. Eyal Eliakim el ta also reported in their study that the improvement of VO2 max during pre-season training, among injured athletes was significantly lower than that of uninjured (36).

As was seen earlier 73% of the participants adopted the RICE as an immediate reaction to the injury, even though it was recommended in many previous studies(37). The current recommendations point to the importance of early mobility, however, the early motility accelerates capillary ingrowth and regenerates muscle fibers, prolonged inactivity can lead to atrophy of the healthy muscle, excessive build-up of connective tissue in the muscles, and significant delay in strength recovery due to damaged skeletal muscle (37).
Early mobility in many studies related to an ankle sprain and other sports injuries promotes law amplitude scale movement as an element associated with better improvement, and medications especially pain one, are associated with less possibility of development of hypersensitization at the site of injury. And in our case, only 20% reported the use of medication, which is less than expected. This use of medications and the RICE strategy adoption was also reflected in the return to activity response, where 46% were unable to return to activity at the time of injury, it was not clear in this study if there was a common criteria for recommending decision for return to play as it is in the traffic light approach, which developed relating to NPRS (0-10) during the Copenhagen five-second squeeze test, where a red light (6-10) means STOP, indicates that the player should stop current activities and should seek a clinical examination by a healthcare professional. A yellow light (3-5) means ATTENTION, must be careful before determining the level of activity and participation; players must be clinically examined by a health professional. The green light (0-2) means GO to activity and participation, but concerning return-to-activity still

needs a clinical review by a health professional before deciding on the actual participation level(38).

In terms of pain, there was a significant improvement in both groups in NPRS clearly between pre and mid tests, (NPRS mid-post less than pre-mid) as shown in the results above with no differential effect of treatment type dry needling or dry needling with mulligan mobilization. One of the unique characteristics of the intended intervention in this trial, that it incorporated both soft tissue techniques dry needling and a joint technique MWM, which is a novel approach targeting possible joint involvement in terms of range as a risk factor of challenges in muscle performance, and also as a complication of range as a result of muscle or myofascial dysfunction, in either way this intervention has considered the joint as part of the treatment. While in the DN group, the muscle was and myofascial component was targeted by a well-documented myofascial intervention as the DN. The result of this study supports the finding of the study conducted in 2020 by Igor Tak and others to study the effect of manual therapy on adductor-related groin pain, where they conclude that the soft tissue release technique is considered a very effective tool to decrease pain for athletes with hip adductor-related groin pain and dysfunction and early return to sport(34).

After treatments in this study, athletes felt that the tension in the groin area was relieved and that the range of motion was improved. dry needling may help normalize muscle tone by restoring inhibition and re-regulation of muscle activity (39), or maintaining a normal range of motion using mobilization with movement can help the muscle to back to normal function and activity(40).

Recently, hyperalgesia in the adductor tendon area has been observed in athletes with groin pain, which may be considered to be a sign of central sensitization, especially as mentioned before that a significant percentage of the participants had reported chronic adductors related groin pain (around 60%). both interventions used in this study may improve the tenderness and pain threshold by facilitating the descending inhibitory pathway, which means that if this was relevant, this is still a valid contribution to the improvement in both chronic and acute cases, which may justify the improvement in both groups, moreover, the relation in between muscle and joint dysfunction had been well documented as interrelated(41)(42), and this could explain that there was no significant difference in outcome in between the two groups of intervention.

Comparing the results of this study with the results of Igor Tak (2020) who used stretching as an intervention, shows that patients in their study were still experiencing pain after two weeks, which was not relevant to our study. And this reflects on the myths in physiotherapy in sport, where stretching was prescribed after any muscle injury, assuming that possible shortening of the muscle could have contributed to the injury, while neglection of other important variables, like joint alignment, the trajectory of the movement, muscle balance, and imbalance in terms of recruitment and strength. This argument is not taking the stretching out, but on the contrary, we think that any intervention including the stretching should be applied only when we find evidence in objective assessment indicates the need for such intervention

The range of motion in both groups had significantly improved, yet there was no statistically significant difference in the improvement between the 2 groups. While ROM is a summation of movement taking place at a joint, both the muscle length, pain at the joint or the muscle, are well-documented sources of motion restriction(42), so the argument that muscle injury leading to muscle spasm could be an indicator for decreased ROM, also pain-spasm pain cycle inducing muscle spasm that may change the movement translation in the joint, could contribute to decreased range in both cases. In the DN group, the muscle challenge was targeted, while in the DN and MWM group both the muscle and the joint were dealt with in this combination of management, even though that the other factors leading to joint restriction like in the case of joint stiffness, in this case, it is not relevant as there was not sufficient time for the development of such restriction, and any joint dysfunction could be an acute manifestation of the injury itself, especially that, the restriction due to the muscle, may not be differentiated if it was due to pain, or injury pain associated with the spasm post the injury. ROM in this study has been tested in abduction, since it is the main movement that may be restricted after adductors injury (in addition to adduction), and all ROM results are based on abduction testing.

Flexibility during exercise is an important aspect of fitness and normal biomechanical function. In our study, results showed that there is a significant effect of the time on the hip abduction range of motion in both affected and none affected sides between pre and post of treatment for DN and DN&MWM interventions. Normal joints which include the shape of the articular surface, the thickness of cartilage, the direction of the joint, the fibers of ligaments and capsules, the direction of pull muscles, and tendons, all facilitate free but

controlled movement while minimizing the compression force generated by the movement. Mulligan pointed out that any injury or sprain may lead to a minor positional fault of the joints, causing restrictions in physiological movement(43), this is why we adopted the mulligan mobilization as an additional technique in combination with soft tissue intervention, in a potential common soft tissue injury like the adductors related groin dysfunction

Any changes in these factors can change the position of the joints during exercise and provoke symptoms of pain, stiffness, or weakness in the affected area. This is why it is recommended that therapists should give some effort to re-align the joint surface at a joint that may suffer from a soft tissue-related positional fault while targeting the soft tissue with interventions that may decrease the inflammation or the spasm that may be associated with an acute injury.

The results of this study confirm the findings of the experimental study conducted by Seveka Bali and Karthikeyan Guru (2020) who compared the effectiveness of two stretching techniques (Mulligan adductor stretching and static stretching) on tight hip adductor muscles, they found that a highly significant difference in both the groups between 1st, second and third session, but both techniques equally effective in improving the hip abduction(23).

The improvement in the range was also evident and reflected in the improvement of FABER test length (distance between knee and the bed in the Faber testing position). As it is a product of health SIJ, plus health adductors length that will allow for the muscular components of the testing position to be represented in health length of internal rotators and adductors, allowing for the abduction and external rotation at the ultimate range of Faber test position.

As another indicator of a decrease in pain with the function squeeze test was tested before and after, and it showed a significant difference in strength in both groups with no difference in between interventions. Strength reflects the maximum potential of a muscle function that may be hindered or miss evaluated due to pain while the muscle is contracting indicating a pseudo weakness, originating from pain rather than a decreased ability to perform better contraction. This argument is supported by the improvement in 5 seconds Copenhagen squeeze test. where The results showed that the mean of Five second

Copenhagen squeeze test in the post of treatment was significantly lower than the mean in the mid of treatment which is significantly lower than the mean pre of treatment as tested by numeric pain rating scale, which wells support the previous discussion of improvement of strength that may be associated and linked to the decrease of pain.

Improvement in pain that may have contributed to better strength, as tested by the squeeze test, may not be justified by any of the interventions unless we are assuming better motor unit's recruitment after the intervention since we did not include a strengthening exercise or intervention in this study, the nature and mechanism of improvement of strength may be highly be attributed to the change in pain and potential improvement of muscle recruitment The results of strength in this study show that adductors strength of participants were less than strength reported in other studies on a patients with adductors related groin pain (44) as in the study conducted in 2013 by Fiona Nevin, Eamonn Delahunt to compare the differences on adductor squeeze test and ROM for athletes with or without adductor-related groin pain, the study average-strength (202 mmHg for injured and 269 non injured athletes), while in our study it was with average of 149 mmHg, which reflects a relative weakness indicating potential neglect of the strength of the adductor in the training program of Palestinian athletes, where it is from the experience of the researchers seems to be concentrating on adductors length rather than strength, which might cause overstretching of the adductors that is well known to contribute to the weakness of the over elongated muscle, further research is recommended to investigate the association of adductor muscle strength in with incidence of the adductors related groin pain, in a case-control study, investigating this potential association in Palestine

In terms of balance as tested by the Y balance test (composite score), there was no significant effect of the time on Composite score YBT in none affected, since there was no change in terms of pathology, and no intervention was carried out there, while at the same time there was a statistically significant difference in between baseline and posttest results in the Y balance score in the affected leg in both groups. The improvement in balance again took place without balance training intervention, the reason behind this improvement reflects the fact that balance is a byproduct of different systems, including a healthy muscular system that responds to the balance challenges in different positions, and as a reflection of improvement in pain, and later on, in strength, it seems that the ultimate

outcome was a better balance abilities product represented in a higher Y test composite score.

Benjamin R. Wilson et al supported the researcher point of view in their study on 2021 to understand the relation between the Y balance test and hip strength, they found a strong relationship between the hip abductors strength and Y Balance test, and we must give attention to the hip abductor muscles when athletes suffer from Y balance test deficit (45).

As athletes and competitive players, previous records of Y balance test could be beneficial in evaluating the effect of the injury to the pre-injury Y balance test, and further on, could be used as an indicator of reaching pre-injury balance status, and even investigating more other factors that could have been associated with such a decrease in this important score and domain for maneuvering during the game, that could be an indicator and important element on level of achievement in the playground

The Hip and Groin Outcome Score (HAGOS) was used to monitor hip and groin-related pain and symptoms, a significant main effect over time was found for all HAGOS subscales (Symptoms, Pain, ADL, Sport &Recreation, Participation, and QOL), (all $p < 0.05$) in both groups. The results showed improvements on all HAGOS subscales from baseline to post of treatment, also there were no significant differences between both intervention groups except in the participation subscale. As mentioned previously the kind of intervention in both groups is interrelated in terms of joint and muscle, and their effect on each other, and to have no difference in HAGOS is expected based on the pain results between the two groups, while the difference was seen in participation, actually reflects that fact that participation activities and outcome of improvement in the other variables like pain, achievement of the fulfillment of ADL, and quality of life, where participants start to use their abilities to participate in their communities, the superiority of the DN and MWM group in this variable, may be related to the fact the for longer distances walked that requires proper joint alignment together with forgiving Myofascial components of the movement, for participation activities, but still, this is one variable between much more different variables that are dictating the participation level in the community.

Our results are better than the study conducted by Igor Tak et al (2020) investigating the effect of stretching exercises on HAGOS (19), in terms of the results at 2 weeks of the intervention, comparing the results, showed remarkable improvements in the HAGOS subscales in the pre-and post-treatment, overtime was in all HAGOS subscales in both

studies. While HAGOS data in Igor Tak study, shows that after two weeks of treatment, a large number of challenges related to the hip and groin was still existing like in the score of pain, symptoms, quality of life, ADL sport, and recreation &participation level, meanwhile the results in our study indicated higher scores for all subscales in both groups DN and DN& MWM, which means that the interventions used in our study were more effective, less treatment time and faster return to activity level pre-injury.

4.6 Limitations

This study could have been better, due to the following limitations faced during the implementation of the study, the 1st and most limiting factor was the spread of CVID19, which has elongated the start of this study for several months waiting for the restriction s ease, to be able to recruit participants, in addition to the limited number of the participants that were hardly recruited in this time frame and epidemic circumstances, at the same time this limited number of participants had led the implementation with 2 groups only, where in different circumstances the third group with conventional therapy (neither dry needling nor mulligan) could have been considered for this study. One major limitation of this study is represented in the lack of follow-up for an important variable represented in Return to play, which is considered the maximum level of proper rehabilitation. The research was not blind to the intervention given, which is an ideal RCT, which could decrease bias. The researcher was committed to the protocol, even though that patient improved before, so in other studies, the searcher recommends that tests should be repeated at each session, and to stop the protocol if there is no pain.

Chapter 5:

Conclusions and Recommendations

5.1 conclusion

5.2 recommendations

5.1 Conclusions

1. The pain was significantly improved, as there was a significant change in NPRS and the Five-second squeeze test on both groups between the pre, mid, and post-treatment.
2. The ROM was significantly improved, as there was a significant change in abduction range of motion score and FABER test on both groups between the pre-and post-treatment.
3. The balance was significantly improved, as there was a significant change in the Y balance composite score on both groups between the pre-and post-treatment.
4. The strength was significantly improved, as there was a significant change in the adductor squeeze test on both groups between the pre-and post-treatment.
5. The function was significantly improved, as there was a significant change in HAGOS score on both groups between the pre-and post-treatment.
6. Both DN and DN&MWM were equally effective in improving the above mention clinical variables.

5.2 Recommendations

Based on the conclusion and discussion of this study, the researcher recommends the following

1. Considering both DN and DN&MWM management of hip adductor-related groin pain and dysfunction.
2. The discontinuation of the management plan upon the end of the symptoms, rather than a fixed number of sessions.
3. The call for a unified protocol and guidelines for adductors related groin pain assessment and management protocol
4. For further similar the researcher recommends the following:
    a. Comparing mulligan group only versus dry needling or conventional treatment
    b. Considering the effect of using a parallel technique like a physical agent in augmentation the aimed results.
    c. Testing the effect of both interventions on add muscle like the EMG.
    d. Adding the number of sessions where we get 0 pain symptoms as a variable, rather than a unified number of sessions for all the players

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Appendixes

Appendix 1 Data collection sheet

Al- Quds University

Faculty of Health Profession

Physiotherapy & Rehabilitation Department

Jerusalem – Abu Dies

The effect of Mulligan's Mobilization with Movement versus Dry Needling on Pain, Function and Range of Motion among Athletes with hip adductor related groin pain and dysfunction.

Participant Code: | |

Date of Signature: | |

Section I: Personal Data

Name: Age:

Address: Gender: ■ *Female* ■ *Male*

Phone: Email:

Occupation: work hours:

Physical demands of job: ■ *Slight* ■ *Moderate* ■ *Huge*

Sport: Team:

Training Regime per week: 1 2 3 4 5 6 7

Section II: Medical History

1. Diagnosis:
2. Referring Doctor:
3. Date of Injury:
4. Injury type: Acute Subacute chronic
5. Injury side: Right Left Both sides
6. Type of activity at time of injury:
    a. Training
    b. Warm-up
    c. Competition
    d. Cool-down
    e. Other

7. Reason for presentation:
    a. New injury
    b. Aggravated injury
    c. Recurrent injury
8. Cause of Injury:
    a. Collision with fixed object

b. Collision with another player
c. Fall or awkward landing
d. Kicking the ball
e. Overstretched the muscles
f. Overuse

9. Where there any contributing factors to the incidence
    a. Unsuitable foot wear
    b. Playing surface
    c. Equipment
10. Action taken:
    a. None
    b. Immobilization
    c. RICE
    d. Strapping / taping
    e. Stretch / exercise
    f. medication
11. Decision taken:
    a. Immediate return to activity
    b. Return to play with restriction
    c. Unable to return
12. Intervention:
    a. Medication
    b. Physiotherapy
    c. Massage
    d. Active training

Appendix 2 Outcome Measures

1. NPRS Scale:

Pretest		Mid test		Post test	
1st session	2nd session	3rd session	4th session	5th session	6th session

2. Five Second Copenhagen Squeeze Test

Pre test		Mid test		Post test	
1st session	2nd session	3rd session	4th session	5th session	6th session

3. Hip adductor squeeze test

Pre test				Post test	
mmHg		NPRS		mmHg	NPRS
1st					
2nd					
3d					
average					

4. FABER Test

Pre test			Post test	
	NPRS	High	NPRS	High
RT				
LT				

5. Hip Range of Motion Chart

Motion	Primary Muscles	RO		**Pre**		**Post**
Flexion with extended knee	Psoas, iliacus Rectus femoris Sartorius TFL	90	Date			
			Examiner			
			Right			
			Left			
Notes:						
Flexion Knee flexed	Psoas, iliacus Rectus femoris Sartorius TFL	120	Date			
			Examiner			
			Right			
			Left			
Notes:						
Extension	Biceps femoris Glut Max Semimembranosus Semitendinosus	35-45	Date			
			Examiner			
			Right			
			Left			
Notes:						
IR	Add. Brevis, longus & Magnus Glut Med, min TFL	35-45	Date			
			Examiner			
			Right			
			Left			
Notes:						
ER	Gemellus inferior, superior Glut Max Obturator externus, internus Piriformis, Quadratus fomoris	60	Date			
			Examiner			
			Right			
			Left			
Notes:						

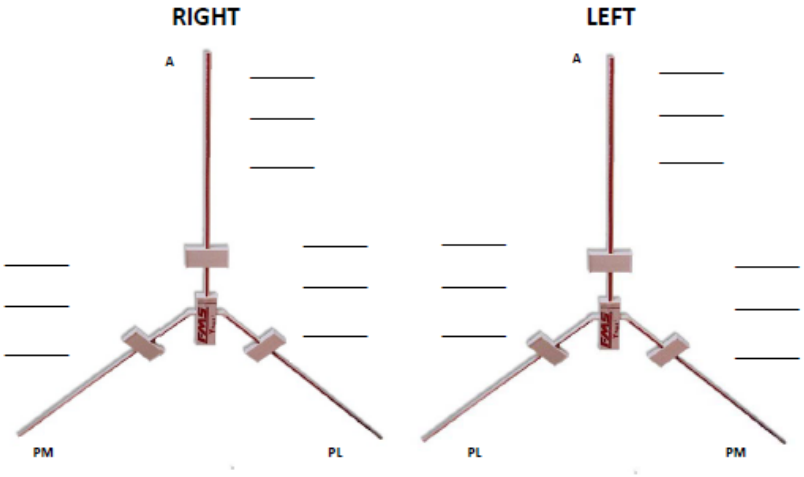
Adduction	Add. Brevis, Longus, Magnus Gracilis Pectineus	30	Date			
			Examiner			
			Right			
			Left			
Notes:						
Abduction	Glut Max, Min, Med Sartorius TFL	45	Date			
			Examiner			
			Right			
			Left			
Notes:						

6. Y Balance Test

Y-Balance Test – Score Sheet

St Luke's Sports Medicine

Right limb length in centimeters: _____
(Measure from right ASIS to right medial malleolus in supine after performing bilateral bridge)



Greatest Successful Reach

	Right	Left	Difference
Anterior (A)			
Posteromedial (PM)			
Posterolateral (PL)			

Composite Score

Right	
Left	

$$\frac{\text{(Anterior + Posteromedial + Posterolateral)}}{\text{3 x Right Limb Length}} \times 100$$

Appendix 3 HAGOS Scale

HAGOS

Questionnaire concerning hip and/or groin problems

Today's date: _____/_____/_____ Date of birth: _____/_____/_____

Name: _____

INSTRUCTIONS: This questionnaire asks for your view about your hip and/or groin problem. The questions should be answered considering your hip and/or groin function during the **past week**.This information will help us keep track of how you feel, and how well you are able to do your usual activities.

Answer **every** question by ticking the appropriate box. Tick only one box for each question. If a question does not pertain to you or you have not experienced it in the past week please make your "best guess" as to which response would be the most accurate.

Symptoms

These questions should be answered considering your hip and/or groin **symptoms** and difficulties during the **past week**.

S1 Do you feel discomfort in your hip and/or groin?

Never	Rarely	Sometimes	Often	Always
☐	☐	☐	☐	☐

S2 Do you hear clicking or any other type of noise from your hip and/or groin?

Never	Rarely	Sometimes	Often	All the time
☐	☐	☐	☐	☐

S3 Do you have difficulties stretching your legs far out to the side?

None	Mild	Moderate	Severe	Extreme
☐	☐	☐	☐	☐

S4 Do you have difficulties taking full strides when you walk?

None	Mild	Moderate	Severe	Extreme
☐	☐	☐	☐	☐

S5 Do you experience sudden twinging/stabbing sensations in your hip and/or groin?

Never	Rarely	Sometimes	Often	All the time
☐	☐	☐	☐	☐

Stiffness

The following questions concern the amount of stiffness you have experienced during the **past week** in your hip and/or groin. Stiffness is a sensation of restriction or slowness in the ease with which you move your hip and/or groin.

S6 How severe is your hip and/or groin stiffness after first awakening in the morning?

None	Mild	Moderate	Severe	Extreme
☐	☐	☐	☐	☐

S7 How severe is your hip and/or groin stiffness after sitting, lying or resting **later in the day**?

None	Mild	Moderate	Severe	Extreme
☐	☐	☐	☐	☐

Pain

P1 How often is your hip and/or groin painful?

Never	Monthly	Weekly	Daily	Always
☐	☐	☐	☐	☐

P2 How often do you have pain in areas other than your hip and/or groin that you think may be related to your hip and/or groin problem?

Never	Monthly	Weekly	Daily	Always
☐	☐	☐	☐	☐

The following questions concern the amount of pain you have experienced during the **past week** in your hip and/or groin. **What amount of hip and/or groin pain have you experienced during the following activities?**

P3 Straightening your hip fully

None	Mild	Moderate	Severe	Extreme
☐	☐	☐	☐	☐

P4 Bending your hip fully

None	Mild	Moderate	Severe	Extreme
☐	☐	☐	☐	☐

P5 Walking up or down stairs

None	Mild	Moderate	Severe	Extreme
☐	☐	☐	☐	☐

P6 At night while in bed (pain that disturbs your sleep)

None	Mild	Moderate	Severe	Extreme
☐	☐	☐	☐	☐

P7 Sitting or lying

None	Mild	Moderate	Severe	Extreme
☐	☐	☐	☐	☐

The following questions concern the amount of pain you have experienced during the **past week** in your hip and/or groin. **What amount of hip and/or groin pain have you experienced during the following activities?**

P8 Standing upright

None	Mild	Moderate	Severe	Extreme
☐	☐	☐	☐	☐

P9 Walking on a hard surface (asphalt, concrete, etc.)

None	Mild	Moderate	Severe	Extreme
☐	☐	☐	☐	☐

P10 Walking on an uneven surface

None	Mild	Moderate	Severe	Extreme
☐	☐	☐	☐	☐

Physical function, daily living

The following questions concern your physical function. **For each of the following activities please indicate the degree of difficulty you have experienced in the past week due to your hip and/or groin problem.**

A1 Walking up stairs

None	Mild	Moderate	Severe	Extreme
☐	☐	☐	☐	☐

A2 Bending down, e.g. to pick something up from the floor

None	Mild	Moderate	Severe	Extreme
☐	☐	☐	☐	☐

A3 Getting in/out of car

None	Mild	Moderate	Severe	Extreme
☐	☐	☐	☐	☐

A4 Lying in bed (turning over or maintaining the same hip position for a long time)

None	Mild	Moderate	Severe	Extreme
☐	☐	☐	☐	☐

A5 Heavy domestic duties (scrubbing floors, vacuuming, moving heavy boxes etc)

None	Mild	Moderate	Severe	Extreme
☐	☐	☐	☐	☐

Function, sports and recreational activities

The following questions concern your physical function when participating in higher-level activities. Answer **every** question by ticking the appropriate box. If a question does not pertain to you or you have not experienced it in the past week please make your "best guess" as to which response would be the most accurate. **The questions should be answered considering what degree of difficulty you have experienced during the following activities in the past week due to problems with your hip and/or groin.**

SP1 Squatting

None	Mild	Moderate	Severe	Extreme
☐	☐	☐	☐	☐

SP2 Running

None	Mild	Moderate	Severe	Extreme
☐	☐	☐	☐	☐

SP3 Twisting/pivoting on a weight bearing leg

None	Mild	Moderate	Severe	Extreme
☐	☐	☐	☐	☐

SP4 Walking on an uneven surface

None	Mild	Moderate	Severe	Extreme
☐	☐	☐	☐	☐

SP5 Running as fast as you can

None	Mild	Moderate	Severe	Extreme
☐	☐	☐	☐	☐

SP6 Bringing the leg forcefully forward and/or out to the side, such as in kicking, skating etc.

None	Mild	Moderate	Severe	Extreme
☐	☐	☐	☐	☐

SP7 Sudden explosive movements that involve quick footwork, such as accelerations, decelerations, change of directions etc.

None	Mild	Moderate	Severe	Extreme
☐	☐	☐	☐	☐☐

SP8 Situations where the leg is stretched into an outer position (such as when the leg is placed as far away from the body as possible)

None	Mild	Moderate	Severe	Extreme
☐	☐	☐	☐	☐

Participation in physical activities

The following questions are about your ability to participate in your preferred physical activities. Physical activities include sporting activities as well as all other forms of activity where you become slightly out of breath. **When you answer these questions consider to what degree your ability to participate in physical activities during the past week has been affected by your hip and/or groin problem.**

PA1 Are you able to participate in your preferred physical activities for as long as you would like?

Always	Often	Sometimes	Rarely	Never
☐	☐	☐	☐	☐

PA2 Are you able to participate in your preferred physical activities at your normal performance level?

Always	Often	Sometimes	Rarely	Never
☐	☐	☐	☐	☐

Quality of Life

Q1 How often are you aware of your hip and/or groin problem?

Never	Monthly	Weekly	Daily	Constantly
☐	☐	☐	☐	☐

Q2 Have you modified your life style to avoid activities potentially damaging to your hip and/or groin?

Not at all	Mildly	Moderately	Severely	Totally
☐	☐	☐	☐	☐

Q3 In general, how much difficulty do you have with your hip and/or groin?

None	Mild	Moderate	Severe	Extreme
☐	☐	☐	☐	☐

Q4 Does your hip and/or groin problem affect your mood in a negative way?

Not at all	Rarely	Sometimes	Often	All the time
☐	☐	☐	☐	☐

Q5 Do you feel restricted due to your hip and/or groin problem?

Not at all	Rarely	Sometimes	Often	All the time
☐	☐	☐	☐	☐

Thank you very much for completing all the questions in this questionnaire.

Appendix 4 Research information sheet

نموذج تعريف ببحث

اسم البحث :**تأثير العلاج اليدوي بطريقة موليغان مقارنة بالإبر الجافة على الألم والوظيفة والمدى الحركي لدى الرياضيين المصابين بالاضطرابات المتعلقة بالعضلة الفخذية الضامة**

يهديكم الباحث في هذه الدراسة أ. ايمن خضر دراغمه اطيب التمنيات و يشكر لكم استعدادكم للمشاركة بهذا البحث, الذي هو جزء من دراسة الماجستير في العلاج الطبيعي من جامعة القدس .

هذا البحث يهدف الى التعرف على مدى تأثير العلاج اليدوي موليغان والوخز بالابر الجافة على الألم ,الوظيفة والمدى الحركي لدى الرياضيين الذين يعانون من إصابة العضلة الضامة للفخذ.

- طبيعة الفحصوصات التي سوف تستخدم في هذا البحث هي فحوصات امنه ولا يوجد منها اي ضرر على المريض, حيث تتضمن فحوصات لقوة العضلة الضامة ومدى الحركة لمفصل الفخذ والاداء الوظيفي للاعب .
- سيكون هناك فحص قبل التدخل العلاجي و بعده.
- سيتكون العلاج من نشاطات يومية على شكل تمارين.

ان اشتراككم في هذا البحث هو طوعي و مرتبط بتوقيعكم على نموذج موافقة بالمشاركة وتصريح بفهمكم لطبيعة البحث , فحوصاته, و التدخل العلاجي فيه . و في حال وجود اي استفسار عن البحث او اي شيئ متعلق بهذه الدراسة, يرجى التواصل مباشرة مع الباحث (أ. أيمن دراغمه) على الارقام التالية ٠٥٩٧٣٧٤٦٠٠ و ٠٥٤٢٣٠٧٠٨٣

شاكرين لكم حسن تعاونكم

أ. ايمن دراغمه

بكالوريوس علاج طبيعي

طالب ماجستير علاج طبيعي

جامعة القدس

Appendix 5 Consent form

Al- Quds University

Faculty of Health Profession

Physiotherapy & Rehabilitation Department

Jerusalem – Abu Dies

نموذج موافقة للاشتراك في بحث

عزيزي المشارك /المشاركة

توقيعك ادناه على نموذج الموافقه هذا هو بموجب موافقة مكتوبة و موقعة على المشاركة في دراسة بحثية. في الدراسة التي يقوم بها الباحث أ. أيمن دراغمه بعنوان:

مدى تأثير العلاج اليدوي موليغان والوخز بالابر الجافة على الألم , الوظيفة والمدى الحركي لدى الرياضيين الذين يعانون من إصابة العضلة الضامة للفخذ.

والل١ي يتضمن العلاج بالحركة وهو اقرار بانه قد تم شرح اهداف البحث و طريقة الفحص و التدخل العلاجي للبحث و العلاج بالابر الجافة و هي طريقة علاج امنه و تتضمن شعور بوخزة اعتياجية من ابره تصل صغرها الى عشر الابر العادية. , و انه قد نم شرح حقوقك المتضمنة :

- سرية المعلومات التي تصرح بها وعدم اطلاع اي شخص عليها و تخزينها في مكان امن لا يصل اليه سوى الباحث
- اخفاء هوية المشارك في تحليل البحث والنتائج
- استخدام المعلومات للاغراض العلمية فقط
- حرية انسحابك في اي وقت من الدراسة و من دون الحاجة لابداء الاسباب و دون اية عواقب شخصية او مالية
- حقك في الاتطلاع على نتيجة فحوصاتك و نتائج البحث النهائية

وأنه في في حال كان لديك اسئلة حول الدراسة او حول اي معلومة متعلقة بها, يرجى الاتصال بالباحث ايمن خضر دراغمه على *رقم التلفون:* ٠٥٤٢٣٠٧٠٨٣ / ٠٥٩٧٣٧٤٦٠٠

موافقة المشارك

لقد تم وصف الدراسة البحثية لي شفهيا, وبما فيه المعلومات المدرجة اعلاه, واوافق على المشاركة بهذه الدراسة البحثية. سوف احصل على نسخة موقعة من هذا النموذج للاحتفاظ بها في سجلاتي , اوافق على المشاركة بهذة الدراسة.

اسم المشارك الرباعي: _____

توقيع المشارك:_____ التاريخ:_____

توقيع الشاهد:_____التاريخ_____.

Appendix 6 Special information sheet and consent for use of dry needling

Al- Quds University

Faculty of Health Profession

Physiotherapy & Rehabilitation Department

Jerusalem – Abu Dies

معلومات عن الإبر الجافة

يعرض أخصائي العلاج الطبيعي علاجك باستخدام تقنية تسمى "الإبرة الجافة" وهذا شرح نشرة المعلومات عن هذه التقنية.

هو علاج طبي ناجح للغاية ، يستخدم إبر رفيعة جدًا دون أي دواء (إبرة جافة) لتحقيق هدفه. يستخدم الإبرة الجافة لعلاج الألم والخلل الناجم عن مشاكل العضلات والصداع وبعض مشاكل الأعصاب.

تعمل الإبرة الجافة عن طريق تغيير الطريقة التي يستشعر بها جسمك الألم (التأثيرات العصبية) ، ومساعدة الجسم على التئام تشنج العضلات العنيد المرتبط بنقاط الزناد (التأثيرات الليفي العضلي). هناك تغييرات كهربائية وكيميائية إضافية مرتبطة بالمعالجة بالإبر الجافة ، والتي تساعد في عملية الشفاء. من المهم أن ترى الإبر مجرد جزء واحد من العلاج التأهيلي الشامل. الوخز بالإبر الجاف ليس علاجًا معجزة – إنه جزء طبيعي من العلاج الطبيعي. ومن المهم أن تقوم بالتمارين وأن تتبع النصيحة التي يمنحك إياها المعالج الخاص بك بالاقتران مع الوخز من أجل الشفاء الأمثل.

تم تدريب المعالج الخاص بك على وجه التحديد في مختلف تقنيات الوخز بالإبر. وسيقوم المعالج باختيار طول وسمك الإبرة المناسبة لحالتك وحجم جسمك ، ثم إدخاله عبر الجلد في المكان المناسب. اعتمادًا على نوع تقنية الإبرة التي اختارها الطبيب المعالج ، قد تشعر أيضًا بألم في العضلات ونشل في العضلات. هذه كلها أحاسيس طبيعية وجيدة ، وتعني أنك ستعاني من أعراض جيدة.

بشكل عام ، هناك القليل جدًا من المخاطر المرتبطة بهذه التقنية إذا تم تنفيذها بشكل صحيح من قبل أخصائي العلاج الطبيعي المدربين. قد تعاني من بعض الكدمات حول موقع الإبرة ، تمامًا كما تفعل مع أي حقنة. في حالات نادرة ، قد يشعر الناس بالسعادة أو البكاء أو التعرق أو البرودة. كل هذه الأعراض تتلاشى بسرعة.

لا توجد آثار مرضية دائمة لهذه الآثار الجانبية.

إذا كنت سعيدًا بمتابعة العلاج على النحو الذي اقترحه معالجك ، وقد طرحت أي أسئلة قد ترغب فيها ، فيرجى التوقيع على نموذج الموافقة المرفق بهذه الصفحة وتسليمها إلى أخصائي العلاج الطبيعي. والاحتفاظ بها بسجلاتك الخاصة.

الموافقة على العلاج بالإبر الجافة

يجب قراءة هذه الوثيقة بالاقتران مع ورقة المعلومات بعنوان "معلومات عن تقنيه العلاج بالإبر الجافة"

١. اسم المريض بالكامل ----------

٢. اسم المعالج ----------

٣. اسم المركز الذي تتلقى فيه العلاج----------

٤. أفهم أنه يمكنني سحب موافقتي في أي وقت

٥. أنا أفهم أن المعالج مؤهل بشكل مناسب ومدرب على أداء العلاج المطلوب.

٦. مناطق الجسم التي أوافق على تلقي العلاج فيها هي:

.....

.....

٧. أنا مقتنع بأن هذه التقنية قد أوضحت لي تمامًا ، وأن مخاوفي قد تمت معالجتها وأن أسئلتي قد تمت الإجابة عليها بما يرضي. لقد قرأت ورقة المعلومات المرفقة المسماة "معلومات الإبرة الجافة" ، وأنا في وضع مرضٍ لموازنة مخاطر وقيود هذه التقنية فيما يتعلق بالآثار الجانبية المعروفة.

٨. أفهم أن هذه التقنية يتم تنفيذها في إطار إعادة التأهيل وأنه يجب علي اتباع الإرشادات كما هو موضح من قبل أخصائي العلاج الطبيعي.

التـــــــــــاريخ: ..... الوقـــــــــــت: ..... المكـــــــــــان:

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Appendix 7 Ethical Approval

Al-Quds University
Jerusalem
Deanship of Scientific Research

بسم الله الرحمن الرحيم

جامعة القدس
القدس
عمادة البحث العلمي

Research Ethics Committee
Committee's Decision Letter

Date: 28 March 2020
Ref No: 118/REC/2020

Dears Dr. Akram Amro and Mr. Ayman Khader Salem Daragmeh

Thank you for submitting your application for research ethics approval. After reviewing your application entitled **"The effect of Mulligan's Mobilization with Movement versus Dry Needling on Pain, Function and Range of Motion among Athletes with hip adductors related dysfunction"**. The Research Ethics Committee confirms that your application is in accordance with the research ethics guidelines at Al-Quds University.

We would appreciate receiving a copy of your final research report/ publication. Thank you again and wish you a productive research that serves the best interests of your subjects.

PS: This letter will be valid for two years.

Nuha El Sharif, PhD
Research Ethics Committee Chair

Cc. Prof. Imad Abu Kishek - President
Cc. Members of the committee
Cc. file

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