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EFFECTS OF OSTEOPATHIC MANIPULATIVE TECHNIQUE WITH AND WITHOUT HIGH POWER LASER THERAPY ON PAIN AND FUNCTIONAL DISABILITY IN PATIENTS WITH PATELLOFEMORAL PAIN SYNDROME: A RANDOMIZED CONTROLLED TRIAL

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ABSTRACT

Background: Patellofemoral pain syndrome also known as chondromalacia patella is a very common musculoskeletal disorder in young adults and athletes. The basic cause of PFPS is not known, but some medical professionals believe that pain in the knee area is due to some muscular, soft tissues, and biomechanical abnormalities. If PFPS is not treated in a manageable way, then it may cause weakness of quadriceps muscles. PFPS affects both adults and adolescents having a prevalence rate of 23% in the general population. The prevalence of PFPS is more in females as compared to males. Usually, the diagnosis of PFPS is slow because there is a cluster of signs and symptoms.

Objective: To determine the effects of Osteopathic manipulative techniques (OMTh) with and without high power laser therapy on pain and functional disability in patients with patellofemoral pain syndrome.

Methodology: It is a RCT (randomized controlled trial). There were two groups i.e. Group A (Routine physiotherapy + High power laser therapy) and Group B (Routine physiotherapy + Osteopathic manipulative techniques (OMTh) + Hi power laser therapy) with 33 patients in each group (total of 66 participants of study). VAS and Kujala scoring were used to interpret the data. The data was analyzed statistically and then was compared to study the difference between two groups.

Results: The data was statistically analyzed and showed the difference between two groups of the study. The value of P is less than 0.05 which was considered significant.

Conclusion: It is concluded that the patients who receive HPLT (high power laser therapy) along with Osteopathic manipulative techniques (OMTh) and routine physiotherapy showed better results and progress in pain and functional disability than those who only receive routine physiotherapy and HPLT(high power laser therapy) treatment.

Key words: High Power Laser therapy, Patellofemoral Pain Syndrome, Functional Disability, Osteopathic manipulative techniques.

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1. Introduction

Patellofemoral pain syndrome also known as chondromalacia patella is a very common musculoskeletal disorder in young adults and athletes. When pain exists in the posterior patella or anterior knee without any other knee disease, it is termed PFPS (Patellofemoral Pain Syndrome). The basic cause of PFPS is not known, but some medical professionals believe that pain in the knee area is due to some muscular, soft tissues, and biomechanical abnormalities. If PFPS is not treated in a manageable way, then it may cause weakness of quadriceps muscles.[1]PFPS can affect the knee, hip, and ankle as the whole lower limbs work in collaboration to produce functional movements. [2]

PFPS affects both adults and adolescents having a prevalence rate of 23% in the general population. The prevalence of PFPS is more in females as compared to males. Usually, the diagnosis of PFPS is slow because there is a cluster of signs and symptoms. According to an estimate, it has been reported that high prevalence is found in elite athletes as 35.7%, adolescents as 28.9%, and military as 13.5%.[1-3]

The typical clinical symptom of PFPS include is commonly pain around the patella region which increases with physical activities particularly during running, that is why it is called runner's knee. In sports medicine health units, PFPS is very common, especially in Europe and USA.[2]

High-intensity laser therapy (HILT) has been used more recently in the therapeutic protocols of pain managements. Adding therapeutic interventions to laser therapy is usual in clinical practice. This study aimed to evaluate the efficacy of HILT and beneficial effects of adding cointerventions to HILT in musculoskeletal pain management.[4]

There are many risk factors associated with PFPS including greater hip adduction during running, increased navicular drop in military recruits, and increased forces at the level of the foot during both running and walking.[5]

The basic reasons behind PFPS are genu valgum, degenerative changes in the joint region, an increase in Q angle specifically during weight-bearing position, and weakness of gluteus maximus and medius.There are various ways and tests of assessing PFPS like the FSD (Forward Step Down) test which is positive in the case of patellofemoral joint dysfunction and ACL (Anterior Cruciate Ligament) injury and this test indicates high intra-rater

reliability. Other ways include assessing the ROM and strength of gluteus muscles. The most important thing in assessment is a physical examination of the joint.[6]

The more specific way for assessing patellofemoral pain syndrome is to examine the J sign which is usually not aligned and the patella is pulled laterally. Further, the medial patella glide should also be examined by the physiotherapist and the finding is positive if the health professional cannot move the patella in the medial direction, which may indicate the shortening of (lateral) reticulum.[7]

Non-operative or conservative treatment for managing this syndrome is considered first-line treatment. Among conservative management, there are many ways such as bracing and taping, which are non-invasive and easy to use.[6]Physical therapy is very important in managing and treating musculoskeletal disorders like osteoarthritis, carpal tunnel syndrome (CTS), and patellofemoral pain syndrome. Low power laser therapy and high power laser therapy, both are very effective in treating PFPS. LASER stands for Light Amplification by Stimulated Emission of Radiation and it is a physical source that is used to promote the healing process by repairing the injured tissues. High power laser therapy is the latest physical therapy treatment strategy for managing pain in the case of musculoskeletal disorders.[8]

Low power laser therapy is very beneficial than conventional physiotherapy as it improves functional outcomes in patients with PFPS.[9] However, high power laser therapy proved to be very helpful in decreasing pain produced as a result of PFPS. High power laser therapy combined with exercise proved to be very useful and improved pain in patients with PFPS. The pain relieved by high power laser therapy is generally due to the biological effects of laser on tissue function producing thermal, endogen opium, and anti-inflammatory effects, generating better results than low power laser therapy.[1]

Laser therapy is also known as phototherapy which in turn activates the muscle bioenergy and in this way, it can affect the biomechanical function of the tissues. High power laser therapy stimulates deeper and larger surfaces in a very short time. It has been observed that HPL (High Power Laser) therapy enhanced the functioning of quadriceps muscles. The HPL shows immediate effects and researchers have described that only one session or application of HPL significantly improves the functioning of quadriceps muscles.[10]

The efficacy of high power (12W) laser therapy has been tested in a study and the findings of a study have shown promising results indicating positive impacts of HPLT. It has been seen that high-power laser therapy with a proper exercise regime proved to be very helpful. Less pain has been recorded on VAS (Visual Analogue Scale) as an outcome measure.[1, 2]

In past, HPLT was used to target only destroyed tissues, but in recent times, it is now being applied by physiotherapists for treating joint pain. It is more preferred by health professionals as it has a larger emission interval and a short emission time. Therefore, this new feature of High-Intensity Laser Therapy (HILT) has shown more positive impacts on reducing discomfort and pain in patients with patellofemoral pain syndrome. Joint pain causes stiffness and mobility limitations in patients with PFPS.[11]

Patellofemoral pain syndrome (PFPS) is a common knee disorder that causes pain in inactive teens and is more common in athletes. One of the main symptoms of this disorder is the onset of vague pain that gradually rises in the anterior region of the knee and posterior surface of the patella. This research was conducted for the improvement in hip extensor and to strengthen the external rotator muscles.[12]

The trigger point is one of the main and common problems of musculoskeletal disorders. The causes for this syndrome have been reported high and this literature study was designed to analyze and investigate the effects of dry needling and Kinesio tape on a trigger point in the muscle of vastuslateralis.[13]

Many other physiotherapy techniques have been applied for managing PFPS including kinesiotaping, post-isometric relaxation, and mobilization of the patella.[7] All these management techniques proved to be very helpful for treating PFPS. This study will throw light on the significance of Osteopathic manipulative techniques (OMTh) with high-power laser therapy.

Because of the complex pathophysiology of patellofemoral joint, more frequent and longer duration treatment protocols will be helpful in treating knee pain and reducing functional disability.OMTh alone or in combination is effective in reducing pain and disability and with high power laser therapy is effective in gaining functional mobility and increasing Q angle.[14-16]

In low back pain vOMTh techniques were very effective in reducing pain and gaining mobility as comared to gOMTh techniques because of the anatomical anf fascial connection relative to viscera-somatic reflexes.[16-18]

The 4 main principles of osteopathy are that the body is a unit and the person is a unit of body, mind, and spirit; the body is capable of selfregulation, self-healing, and health maintenance; structure and function are reciprocally interrelated; and rational treatment is based on an understanding of the basic principles of body unity, self-regulation, and the interrelationship of structure and function. [19-21]

Previous studies[21, 22]have supported the use of manipulative therapy, including the use of osteopathic manipulative techniques OMTh, such as osteopathic manipulative therapy.([23]

In Azerbaijan, laser therapy with osteopathic manipulative techniques OMTh is not used as commonly as other electrotherapy modalities so only a few studies have been done on the effects of this modality in Azerbaijan. High Power Laser Therapy (HPLT) with osteopathic manipulative techniques (OMTh) has proved its effects in the pain management of different musculoskeletal conditions but despite its confirmed therapeutic effects, the studies investigating the efficacy of HPLT with Osteopathic manipulative techniques (OMTh) in alleviating pain and functional limitations in the population of Patellofemoral Pain Syndrome (PFPS) is much limited.

By this study, the researcher wants to highlight the use and effects of high-power laser therapy with Osteopathic manipulative techniques (OMTh) in the treatment of patellofemoral pain syndrome in Azerbaijan.

The basic objective for carrying out this research is to evaluate the effect of high-power laser therapy with and without Osteopathic manipulative techniques (OMTh) on pain and functional disability in patients with patellofemoral pain syndrome. Past studies have been performed just in studying the effect of low-power laser therapy and explained how it proved useful in decreasing pain. This study will be very useful for future researchers as well as in filling the literature gap by elucidating the importance of high-power laser therapy with Osteopathic manipulative techniques (OMTh) for a long interval of time. Running, jumping and overuse are the main reasons for PFPS which cause pain and functional disability. The technique used in this research will prove very helpful in decreasing pain in patients with patellofemoral pain syndrome. In this study, the effects of

HPLT with Osteopathic manipulative techniques (OMTh) in combination with routine physiotherapy are being compared with routine physiotherapy and HPLT alone.

2. Literature Review

A recent study by Kuwabara et al (2022) explicated that there are many treatment options for managing this musculoskeletal disorder and its related pain and functional disability. Physical therapy, cold therapy, orthotics, bracing, and taping are some of the non-pharmacological treatment options for treating this syndrome. [24]

Chen et al. (2022) conducted a review to identify the role of laser therapies and ultrasound for chronic pain. The purpose of this review was to summarize the current literature regarding laser radiation and ultrasound therapy used for managing chronic pain syndromes. There is stronger evidence supporting the usage of laser therapy for managing chronic pain states compared to low-intensity ultrasound therapies. As a monotherapy, laser therapy has proven to be beneficial in managing chronic pain in patients with a variety of pain syndromes. On the other hand, LIUS has less clear benefits as a monotherapy with an uncertain, optimal delivery method. They concluded that both laser therapy and low-intensity ultrasound have proven beneficial in managing various pain syndromes and can be effective interventions, in particular, when utilized in combination therapy.[25]

Ammendolia et al in 2021 explained the efficacy of High Laser Therapy for managing knee osteoarthritis. The researchers have combined the HILT with Glucosamine Sulfate and the outcomes were amazing. 6 months treatment protocol was given to the patients. A significant reduction in pain has been reported on VAS. [26]

A single-blind and randomized controlled trial was conducted for assessing the effectiveness of high-power laser therapy up to 12 W on patients having patellofemoral pain syndrome (PFPS). The experiments were carried out on forty-four patients with the help of MATLAB software based on the even and odd numbers being attributed to sham and actual laser groups. Two main analyses were performed: within the group and between groups. The main kinds of exercises that were conducted include isometric knee exercises for 3 sets each day and to perform 10 times in each set for 10 seconds per time. The second exercise includes raising the straight leg for 15 seconds almost 10 times each day. The

results of this study show significant improvement and development concerning all the measurements of pre-therapy and post-therapy and the short-term HPLT with proper exercise reduced the pain in patients. But at the same time, it was not recommended for functional improvement. Hence it was a safe modality for a short-term study.[1]

The purpose of this study is to analyze and compare different effects of extracorporeal shock wave therapy and high-intensity laser therapy on patients having knee osteoarthritis (KOA). The whole experiment was carried out on 40 individuals having stage II KOA. Patients with more than 3rd grade pain in the visual analog scale have a weight index of less than 30 and have no history of any knee surgery, fracture, cancer, or any other type of musculoskeletal disease that may affect the results of the research study. The population in the study was divided into two groups and both had strong therapeutic effects. Disability was assessed before and after 4 weeks of intervention with the help of VAS 6 min mobility assessment. The results showed significant progress on both sides. There were also results in favor of HILT groups compared to other ESWT groups.[27]

In this study focus on the effects of OMT versus EP on knee pain functionality, plantar pressure in middle foot (PPMF), posterior thigh flexibility (PTF), and range of motion of hip extension in runners with PFPS. OMT group showed increased functionality, decreased PPMF, and increased PTF. The range of motion for hip extension increased only in the EP group. Both OMT and EP are effective in treating runners with PFPS.[28]

Whole-body vibration (WBV) and hip-knee muscle strengthening have been investigated and are very efficient for relieving pain and improving the function that strengthens and helps to strengthen the knee. The study population for this research was 36 participants having patellofemoral pain syndrome (PFPS). All the participants had to attend 18 sessions of physiotherapy having 3 sessions per week with 40 minutes per session over 6 weeks. The VAS score shows that the WHK group has greater pain relief than of HK group. The results of this study indicated that 6 weeks of physical therapies improve the vast medialis performance and also help to maintain the long-term relief to a greater extent.[29]

Moretti et al in 2021 elucidated two physiotherapy techniques for treating the pain associated with joint generative diseases in athletes. ESWT (Extracorporeal Shock Wave Therapy) and PEMFs (Pulsed Electromagnetic Fields) techniques were studied and reviewed by the authors. Biophysical stimulation by using these modalities has a major

role in treating degenerative disorders of joints. Recently, biophysics has been evolved as an important medical branch that explores the relationship between the human body and some non-ionizing physical energy. ESWT and PEMFs have strong evidence for preventing and treating various joint-related issues in athletes. PEMF has shown positive effects on subchondral bone, articular cartilage, and synovia. ESWT has been used for about 25 years in managing bone-related MSK (Musculoskeletal) and soft tissue issues. Thus, biophysical stimulation in degenerative joints with the help of ESWT and PEMF can act to increase functions of joints and can also improve the symptoms. This research work is very helpful for athletes having some MSK issues and can easily return to sport by using these therapies.[30]

During the past few decades, much research has been done in the medical field for finding some non-surgical approaches for various medical pathologies. The concept of the laser was introduced in 1960. In the modern era, laser technology has been used from skin treatment to different surgical procedures. In current times, all medical and health professionals are using laser technology for treating diseases particularly bone and joint-related disorders for providing comfort to the patients. Afzal and Ramlee in 2021 studied the efficacy of low-level laser therapy for treating knee osteoarthritis (OA). The results of this review article greatly favored that laser therapy is very helpful and has remarkable advantageous effects on various MSK conditions. Laser is a non-invasive approach and can easily be applied directly over the degenerative joint or tissue. Further, it has been studied by the researchers that laser is the best alternative to medicines and anti-oxidative property makes it more useful. Hence, it can be deduced from this paper that low-level laser therapy is a good means for treating bone and joint-related diseases.[31]

The research was conducted by Cabello et al in 2020 described the efficacy of diathermy in managing pain and functional disability in patients with patellofemoral pain syndrome. A single-blind RCT (Randomized Control Trial) was performed on eighty-four participants that were divided into two groups named a control group and an experimental group. Both groups received conventional physiotherapy, but the experimental group was also given mono-polar dielectric diathermy. All eight-four study participants were given 3 weeks session with 10 min of daily exercise regime. Range of Motion, Visual Analogue Scale, Kujala Scale, Lower Extremity Functionality Scale, and DN4 questionnaire were the variables that were measured. The results were significantly favored the experimental

group as their pain intensity decreased to a maximum level as compared to the control group. The functionality was also improved in the experimental group. Hence, this study has shown that diathermy by emission of radio-frequency is a good option that should be applied on large scale for treating other musculoskeletal issues as well.[32]

Payne, K., et al. (2020) tried to determine if the thickness or activation of the gluteus medius muscle varied between the left and right sides and was correlated with pain or intensity of patellofemoral pain in patients. Participants (males and females) were recruited and tested for inclusion in the control group or patellofemoral pain syndrome group by a physiotherapist and they completed the VAS and anterior knee pain scale. Using ultrasound, bilateral Q angles and gluteus medius muscle thickness were measured at rest and on contraction in standing with hip externally rotated. Muscle activation is measured as a percentage of changes in muscle strength in contraction and at rest. The findings showed a high association between the activation of gluteus medius muscle asymmetry and patellofemoral pain syndrome and the severity of pain.[33]

Yang, J.-s., et al. (2020) needed to determine the proportion of mal-aligned and non-malaligned Patellofemoral pain and instability among anterior knee pain patients. The study was performed in Multan and Lahore clinical settings, and the Kujala disability score questionnaire was used to collect data from different patients on age, limp, walking, stairs climbing, squatting, running, jumping, prolonged knee-flexed sitting, discomfort, swelling, irregular painful knee movements, thigh atrophy, and deficit of flexion. The scores and disability were inversely proportional which resulted in higher scores indicating less disability. It was therefore concluded that it is not solely due to any issues with malalignment and instability, but due to some other causes that contribute to anterior knee pain.[34]

A pilot study was conducted with 2 months of follow up. A visual analogue scale (VAS) was used to assess general knee pain, peripatellar pain, pain after prolonged sitting, pain during the patellar compression test, and pain during stair ascent and descent. The VAS score was significantly reduced and clinically relevant in the OMTh group after each treatment and after 2 months of follow-up.[35]

Lee, J. H., et al. (2020) studied the impacts of static and dynamic hamstring stretching in PFP patients inflexible hamstrings. A total of 46 patients participated and were evaluated

with visual analogue scale (VAS) for pain and the anterior knee pain scale (AKPS). During active knee extension, hamstring flexibility was tested in conjunction with the popliteal angle. Using an isokinetic unit, muscle strength and muscle activation time was calculated. The findings showed that dynamic hamstring stretching with strengthening exercises was superior compared to static hamstring stretching with strengthening exercises to increase muscle activation time and clinical outcomes.[36]

Ezzati et al. (2020) conducted a systematic review to identify The Beneficial Effects of High-Intensity Laser Therapy and Co-Interventions on Musculoskeletal Pain Management. The following databases were searched up to August 2018: Medline, PubMed, EMBASE, Cochrane, Google Scholar, Springer and ISI. The keywords of pain, HILT, high power laser therapy, laser therapy, photobiomodulation, physical therapy and rehabilitation were searched. The primary measure was pain severity expected to be reported in all studies. Effect size was calculated as standardized mean differences divided by the standard deviation of either the treatment or other group. Approximately, 94% of included articles (n=18) revealed positive effects of HILT on pain. The effect sizes for HILT and placebo/comparator groups were 0.9-9.11 and 0.21-11.22 respectively. Also, the differences of effect size between two groups were between 0.03 to 5.85. They concluded that it is early to determine that HILT may be an effective non-invasive agent in the management of musculoskeletal pain, as few studies have shown its clinical efficacy. Adding related co-interventions to HILT may enhance the beneficial effects of laser therapy. The variability of the study methods and outcomes suggests that further long-term follow-up, randomized controlled clinical trials with appropriate methodological design are needed regarding the effectiveness of HILT on pain.[4]

Macri, E. M., et al. (2020) conducted a systematic review of medical interventions (pharmaceutical, nutraceutical, and surgical) for patellofemoral pain syndrome and patellofemoral osteoarthritis informing decision making for primary care. Seven databases for randomized clinical trials were searched and the risk of bias was minimized while the primary outcome was pain. For oral nonsteroidal anti-inflammatory drugs or arthroscopic surgery, no effectiveness has been identified. With little supporting evidence, pharmaceutical and nutraceutical prescriptions and surgical referrals are currently being made, with some treatments showing minimal efficacy. This should be viewed as a core

treatment for PFP and PFOA within the wider sense of evidence supporting exercise therapy.[37]

Motealleh et al, in 2019 presented the effects of core neuromuscular training on different determinants like pain, balance, and performance in women having PFPS. This randomized trial was based on a convenience sample of 28 women based on unilateral PFPS. All the participants were assigned random numbers with intervention and control groups based on block randomized algorithms. All the participants were given physical therapy exercises for PFPS. The measures that were taken included pain intensity, function, and balance. After calculating results, pain score was measured and was significantly lowered. 4 weeks of core neuromuscular training were assigned with routine physical therapy and this was more effective than the routine physical exercise and it was proved very useful for improvement in pain, balance, and functional performance.[38]

Aceituno-Gomez et al. (2019) conducted a Clinical controlled trial with alternate allocation. The purpose of the study was to evaluate the effectiveness of high-intensity laser therapy on shoulder pain and function in subacromial impingement syndrome. Participants were allocated to an intervention group (high-intensity laser therapy + exercise therapy) and control group (sham-laser + exercise therapy) and received 15 sessions (five days a week during three weeks). Patients were evaluated at baseline, after 15 sessions, and at one month and at three months after completing the intervention. The main outcome variables were pain and functionality as measured by visual analogue scale; pressure pain threshold; Shoulder Pain and Disability Index; Constant-Murley Score; and Quick DASH. Secondary outcomes were number of sessions at discharge and drug use. A total of 21 patients in high-intensity laser therapy group and 22 patients in sham-laser group concluded the study. No differences were found between groups ($P > 0.05$). They concluded that the effect of high-intensity laser therapy plus exercise is not higher than exercise alone to reduce pain and improve functionality in patients with subacromial syndrome.[39]

Azizi, S., et al. (2019) decided to investigate the normal increase in the progressive onset of vague pain in the anterior region of the knee while the posterior surface of the patella was examined following the strengthening exercises of the hip extensor and external rotator muscles. 40 patients (mean age group -26) with PFPS were randomly divided into 2 groups

which followed the strengthening exercise program for 8 weeks. At the beginning and end of the study, knee pain was reported during rest, running, climbing stairs, and during Scott's exercise. The results proved these strengthening exercises to be highly recommended for any sort of knee pain issues.[40]

Nazari et al. (2019) conducted a RCT. The purpose of the study was to compare the effects of high-intensity laser therapy (HILT), conventional physical therapy (CPT), and exercise therapy (ET) on pain and function in patients with knee osteoarthritis (KOA). The study was designed as an assessor-blind randomized controlled trial. Ninety-three patients (aged between 50 and 75 years) with proved KOA were included and randomly allocated into three groups, and received 12 sessions of HILT, CPT, or ET. The outcomes were pain intensity measured by visual analog scale (VAS), knee flexion range of motion (FROM), timed up and go test (TUG), 6-min walk test (6MWT), and functionality of knee measured by the Western Ontario and McMaster Universities Osteoarthritis (WOMAC) questionnaire. Statistical analyses were done to compare the amounts at the baseline, immediately after treatment and after 12 weeks. They concluded that HILT was significantly more effective than the other groups in decreasing the VAS, increasing FROM and improving the scores of WOMAC (total and function subscale) both after treatment and after 12 weeks. The effect of HILT and CPT on the TUG, 6MWT, and WOMAC pain subscale was not significantly different after treatment, and both were better than ET. HILT was significantly better than the others after follow-up, particularly more effective on the stiffness subscale of WOMAC. HILT combined with exercise therapy, as a useful therapeutic approach, could have positive influences on KOA patients.[41]

Many studies were conducted for evaluating the clinical practices and to put forward the guidelines for physical therapist management of patellofemoral pain syndrome. This study has collected data from the five electronic databases including CINAHL, Embase, Medline, Psychinfo, and other journals from 2013 to 2019. The data was extracted from different websites that publish clinical practices and recommendations for other physical therapists. The results guide clinicians to provide high-value physical therapists management.[42]

De la Corte-Rodriguez, H. and J. M. Roman-Belmonte (2019) did this research to highlight the non-operative methods of dealing with patellofemoral pain syndrome. He emphasized on first proper clinical and functional evaluation of patients and then prescribing the

combination of physical exercise (strengthening, flexibilization, proprioceptive, gait retraining) with other therapies of both knee and hip. The best clinical results were obtained when close kinetic chain and open kinetic chain exercises were combined with weight-bearing exercises and strengthening exercises with blood flow restriction. There were numerous treatment options being adjunct to therapeutic exercise, were magneto-therapy, manual medicine, shoe insoles, and patellar taping.[43]

Syed, S., et al. (2018) analyzed the efficacy of patellar glides and distraction in the patients with patellofemoral pain syndrome (PFPS). This longitudinal comparative research was conducted from September 2015 to March 2016 at the Department of Physiotherapy, Republican Diagnostic Center, Baku Azerbaijan. There were 70 patients divided into 2 groups and were given the therapy along with distraction in one group and glides in another. VAS and Knee injury and osteoarthritis outcome score (KOOS) scales were used to determine the results which proved both techniques to be equally effective, but glides being superior in minimizing the pain.[44]

Ustarbowska and Trybulec in 2018 carried out research to study different physiotherapy approaches for managing patellofemoral pain syndrome. The writer studies a case report of a 23 years old woman having PFPS which developed secondary to a knee sprain. Various proactive and functional tests were performed for assessing pain and range of motion. Three different physiotherapy techniques like kinesiotaping, mobilization, and post-isometric relaxation techniques were applied for 5 sessions. Each session was last for 35 to 40 minutes and was performed in a 3 day internal. Pain intensity was recorded on VAS (Visual Analogue Scale) and after the first session, the patient reported a maximum decrease in pain. Muscle strengthening and taping techniques have shown greater results, thus decreasing pain and increasing range of motion at the knee joint.[7]

Fekri et al. (2018) conducted a comparative evaluation of the effect of high-power and low power laser therapy on the pain, tenderness and grip force of the patients with tennis elbow. Thirty individuals previously diagnosed with tennis elbow disorder participated in the study after being subjected to the study inclusion and exclusion criteria. The variables studied here were the pain intensity, tenderness and the grip force of the participants. The study subjects were randomly assigned to two treatment groups: 1) group one, which was subjected to the high-power laser therapy and common treatments (n=15) and 2); group

two, which was subjected to low-power laser therapy and common treatments. To determine the changes in the variables in both of the treatment groups after the termination of the treatment sessions, paired t-test was used, and independent t-test was applied to compare the two foresaid methods. The results of the study indicated that the effect of the high-power laser therapy along with the common treatments were statistically significant in the reduction of pain, tenderness and the increase in the grip force of the patients. A comparison of the two treatment groups was not suggestive of any significant differences between them in terms of any of the variables. They concluded that Both types of low-power and high-power laser therapy along with common physiotherapy treatments were effective on the reduction of pain and tenderness and the increase in the grip force of the patients with tennis elbow; and they did not show any significant differences[45]

Wysznska and Bochenska in 2018 elaborated on the impact of high-intensity laser therapy on patients with knee OA. For this purpose, a systematic review had been carried out to analyze the efficacy of HILT in managing knee OA. Various randomized control trials had been studied and included in the study. Different databases were searched for this review article. All articles were selected according to the CONSORT statement's guidelines. For this study, six studies were included for exploring the effect of high-intensity laser therapy. The laser ranged from 0.51 J/cm^2 to 120 J/cm^2 for one treatment session. The energy transferred was ranged from 1250 to 3000 J during one therapy session. All six studies explicated that HILT is very useful in treating knee OA. Hence, the results of this study have investigated that high-intensity laser therapy is very practical to apply for improving functional limitations and pain in OA patients.[46]

Alayat et al in 2017 elucidated the importance of using laser therapy in treating patients with knee osteoarthritis. During the treatment session, the researchers also examined the changes in knee function such as cartilage thickness (CT), synovial thickness (ST), pain intensity, and femoral cartilage thickness (FCT). 67 males were included in the study and were divided into three groups. Group 1 received high-intensity laser therapy, exercises, and glucosamine or chondroitin sulfate, while group 2 was treated with exercises and glucosamine or chondroitin sulfate (GCS), and group 3 received exercise and placebo laser therapy (PLT). Functional disability and pain intensity were measured using WOMAC (Western Ontario and McMaster Universities Osteoarthritis Index) and VAS respectively. Further femoral cartilage thickness and synovial thickness were measured by US

(Ultrasound) examination. It had been seen that overall pain and functional disability decreased in all three groups. However, group 1 had shown remarkable differences as compared to other groups, as a significant decrease in synovial thickness had been recorded in those study participants who had received high-intensity laser therapy along with exercise and GCS. Thus, this research has shown that laser therapy is very effective in treating joint disorders than alone exercise and GCS.[47]

Canning in 2017 researched exploring therapeutic approaches which can be applied to patients with PFPS. Concerning this, a non-random quasi-experimental study was conducted for evaluating the best therapeutic therapy for PFPS patients. A medial taping technique named McConnell medial taping technique was used by the researcher for assessing the pain in the knee joint and patellar alignment in individuals with PFPS. Participants were split into control and experimental group. The Control group was treated with a standard exercise program for 4 weeks and the experimental group received the same exercise protocol along with McConnell medial taping technique. Two outcomes were measured by the researcher, pain and alignment. Although the results were very surprising and there were no remarkable differences plotted between the two groups. The findings further had elucidated that the additional McConnell taping technique had shown no further improvement in the experimental group. Moreover, in some patients, patellar alignment was found to be correct with McConnell taping technique. From this study, it is concluded that the knee taping technique has some mechanical effect on the alignment of patella bone. It can be speculated from this research article that alterations in PFJ (Patellofemoral Joint) contact area may be the basic reason which caused a decrease in pain intensity in PFPS patients.[48]

Patellofemoral pain syndrome (PFPS) is the most common cause of knee pain especially seen in outpatient settings in people having age greater than 60 years. The percentage of this PFPS in adolescents and adults is 3 % and 6%. The main feature of this PFPS is pain around the anterior knee and the pain gets intensity during knee flexing in weight-bearing activities. The intensity of the pain gets higher when patients sit for a long time or during descending stairs. During the physical examination of these patients, it was found that squatting causes more severe pain. More causes can be found by examining the patient's gait, posture, and footwear. If the consecutive treatment doesn't work on such patients then

plain radiography is usually recommended. The main treatment for this kind of pain syndrome includes strengthening of hip flexor, knee muscles groups, and trunk.[49]

There are so many factors being responsible for the patellofemoral pain, it is very difficult to locate the actual reason for this PFPS. The demographic factors also affect the patients and this study was discussing various kinds of factors like height, weight, sex body mass index, and age between different groups of people and differences in PF kinematics. 41 skeletally mature patients and 79 healthy were taken as the study participants. With the help of multiple regressions, results indicated that PF kinematics was influenced by the demographic features. Weight is the most important and significant factor that affects both patellar shift and flexion and thus this demographic factor has a great contribution to future clinical practices and research work.[50]

A systematic review was conducted by Diego Rabello et al in 2020 to campare different therapies used in patellofemoral pain syndrome.The specific purpose of this study was to compare the data obtained from the collected articles and to try to measure the effectiveness of the treatments and to identify potential conflicts of interest in the literature.Integrated reviews were conducted on the following websites: SciELO, BVS Sauld, PUBMED and google education. The selection of articles was made by two researchers, each leading to the last 49 topics from which data was extracted and discussion.[51]

Behrangrad et al. (2017) conducted a double blind randomized controlled trial to compare the effectiveness of ischemic compression (IC) directly to the vastusmedialis obliquus (VMO) versus lumbo pelvic manipulation (LPM) in improving pain, functional status and sensitivity to mechanical stimulation of the VMO trigger point in patients with patellofemoral pain syndrome (PFPS). Patients in both groups were treated in three sessions per week. IC consisted of three sets of continuous pressure applied on the myofascial trigger point (MTrP) of VMO. LPM consisted of supine rotational glide manipulation of the ipsilateral lumbo pelvic region of the involved knee. Numeric pain rating scale (VAS) for pain intensity, Kujala questionnaire for functional status, and pressure pain threshold (PPT) for sensitivity to mechanical stimulation were used. All three were recorded before treatment, after 1 week, 1 month and 3 months after the last session. Both groups showed significant improvement in pain, functional status and PPT values. However, the IC group showed greater improvements, and outcome measures remained

significantly better than in the LPM group during post-intervention follow-up. They concluded that the IC showed better short-term and long-term effectiveness than LPM for treating PFPS.[52]

Espí-López, G. V., et al. (2017) performed a systematic review in order to assess the treatment efficacy of the combination of manual therapy (MT) with other physical therapy methods. The following terms were used: "patellofemoral pain syndrome," "physical therapy," "manual therapy," and "manipulation. They included RCTs that examined adults diagnosed with patellofemoral pain syndrome (PFPS) treated by manual therapy and physical therapy approaches. The Jadad Scale evaluated the quality of the studies. The findings indicated that it would help to improve the symptoms further by giving more focus to proximal stabilization and full kinetic chain treatments in PFPS.[53]

There are large effects of Kinesio taping and strengthening exercises in the individuals having PF. Plantar fasciitis can affect the activities based on weight-bearing among individuals. This research study had taken thirty patients randomly with PF that were divided into three groups. All of them have received kinesiotaping and stretching exercises. After the first treatment, pain intensity and foot disability were measured at the margin of one week. The results of this treatment show significant changes in heeling and pain intensity. Hence, the exercises show great results in reducing the pain among all the groups. The improvement in foot function was seen in those individuals who received combined treatment. For further improvement, larger samples are required for establishing superiority over kinesiotaping and strengthening.[54]

Erden A et al in 2020 explain that there is a large contribution of instruments and physical therapy based on soft tissue mobilization. 22 participants had taken having the pain syndrome. The patients have applied the traditional physiotherapy without any manual program. The methods that were used for the collection of data include visual pain scale, neck, and shoulder joint range, pain pressure threshold, neck pain, and the beck depression inventory. The results of this research show that myofascial pain syndrome based on soft tissue mobilization is a very effective treatment for enhancing the quality of life, emotional status, and range of motion.[55]

Clinical trial was carried out on 40 patients having this PFPS syndrome. All the participants took part in a therapeutic strengthening exercise program for 8 weeks. The results were

calculated and measured at the beginning and end session of exercise programs including the knee pain at rest, during the running condition, stairs climbing, and Scott exercises. The number of participants for this research study was 40 having mean age between 24 to 28 years. The results of this research concluded that therapists can recommend these exercises not only for strengthening and training programs but also for the treatment of various other knee disorders.[12]

A randomized control design was conducted for evaluating dry needling and Kinesio taping for the treatment of knee disability and reducing the pain intensity based on the session's treatments on triggers points. 30 participants have been taken having these knee issues and pain disability. The statistical analysis shows significant improvement and changes based on the activities and KOOS scores after three treatment sessions. But the variables show no changes and improvement after this intervention. Hence, it can be concluded from this analysis that pain intensity and knee disability are improved due to DN and KT.[13]

In outpatients, PFPS is one of the main causes of pain in the knee. A few literature studies have shown different effects of radiofrequency on knee pain. This study wasanalyzing and evaluates the effects of applications of dynamic monopolar dielectric diathermy by emission of radiofrequency on outpatients having the PFPS. The experimental setup was conducted with 27 patients having this pain syndrome disease. All of them were treated with 10 sessions of MDR-based dynamic applications. The results of this research show statistical differences in pain improvement and also in functionality. All the results have shown great changes in reducing pain and knee flexion in patients having PFPS by following the regular exercises of 6 months.[32]

Jia et al in 2016 had carried out a study for investigating the impact of low-intensity US (Ultrasound) therapy on the health and functional status of patients having OA of the knee. 48 patients were selected for the study and were divided into two groups. Group 1 received diclofenac sodium and low-intensity US therapy, while 2nd group was treated with sham diclofenac sodium and low-intensity US. The Health and functional status of all patients were evaluated after 10 days of the treatment session. Group1 showed more improvements than the other group. The study has shown that ultrasound is very effective in managing pain caused by OA. Ultrasound is commonly preferred as it is non-invasive and cost-effective. Low-intensity pulsed ultrasound is more beneficial as compared to the ultrasound

as stated in other studies. Thus, this study has explicated that low intensity of US has positive effects in decreasing joint swelling, reducing pain, and increasing joint mobility. Joint ROM and ambulation speed are considered two main factors for functional performance. For this purpose, ultrasound proved to be very helpful in increasing the range of motion and decreasing functional disability.[56]

Youssef et al in 2016 had performed research for knowing the effect of laser therapy on chronic OA of the knee. Various non-pharmacological therapies are used for managing pain and functional disability in patients with knee OA. Laser therapy has been introduced in recent times. LLLT has become very popular and is being used by physiotherapists along with exercise programs for treating chronic conditions. Sixty old patients from age between 60 to 72 years were included in the study. Participants were split into three groups. Group 1 received a laser dose of 6 J/cm2 and group 2 was treated with a laser dose of 3 J/cm. Group 3 was assigned as a control group. The results of this study have described that laser therapy is very helpful for OA patients irrespective of the dosage used. Furthermore, the researchers have depicted that a combination of low-level laser therapy with an exercise program is very effective. A significant decrease in pain had been reported.[57]

Pekyavas and Baltaci in 2016 conducted a research.The key objective of this study was to compare the effects of KT, MT, and HILT on the pain, the range of motion (ROM), and the functioning in patients with SAIS. Seventy patients with SAIS were randomly divided into four groups based on the treatment(s) each group received. All the patients were assessed before and at the end of the treatment (15th day). The main outcome assessments included the evaluation of severity of pain by visual analogue scale (VAS) and shoulder flexion, abduction, and external rotation ROM measurements by a universal goniometry. Shoulder pain and disability index (SPADI) was used to measure pain and disability associated with shoulder pathology. Statistically significant differences were found in the treatment. When the means of ROM and 1SPADI results of three groups were compared, statistically significant differences were found between all the groups ($p < 0.05$). These differences were significant especially between the groups MT + KT + EX and KT + EX ($p < 0.05$) and HILT + MT + KT + EX and KT + EX ($p < 0.05$). HILT and MT were found to be more effective in minimizing pain and disability and increasing ROM in patients with SAIS. Further studies with follow-up periods are required to determine the advantages of these treatments conclusively.[58]

Kim et al. (2016) conducted a RCT to examine the effects of high intensity laser therapy (HILT) on pain and function in patients with knee osteoarthritis an experiment was conducted on 20 subjects who were divided into the control group, which would receive conservative physical therapy (CPT), and the experimental group, which would receive effects of high intensity laser therapy after conservative physical therapy. All patients received their respective therapies three times each week over a four-week period. The visual analogue scale was used to measure pain and the Korean Western Ontario and McMaster Universities Osteoarthritis Index was used for functional evaluations. The results showed the comparison of differences in the measurements taken before and after the experiment within each group and a statistically significant decline in both the VAS and the K-WOMAC. The comparison of the two groups showed that the high intensity laser therapy group had statistically significant lower scores in both the visual analogue scale and the Korean Western Ontario and McMaster Universities Osteoarthritis Index than the conservative physical therapy group. They concluded that High intensity laser therapy is considered an effective non-surgical intervention for reducing pain in patients with knee osteoarthritis and helping them to perform daily activities.[59]

Anwer and Ahmed in 2015 conducted a research to assess the long-term effect of pulsed high-intensity laser therapy (HILT) in the treatment of the post-mastectomy pain syndrome (PMPS). A total of 61 women participated in this study (30 in the laser group and 31 in the placebo laser group). Patients who were randomly assigned to the laser group received HILT three times per week for 4 weeks, plus a routine physical therapy program (RPTP). The placebo laser group received placebo HILT plus RPTP. The outcomes measured were pain level by visual analog scale (VAS), shoulder range of motion (ROM), and quality of life (QOL). The results showed Shoulder ROM significantly increased in the laser group after 4 weeks of treatment and after 12 weeks of follow-up compared with the placebo group. VAS results showed a significant decrease post-treatment in the laser group relative to the placebo group, and QOL results showed a significant improvement in the laser group compared with the placebo group and still improved after 12 weeks of follow-up. HILT combined with an RPTP appears to be more effective in patients with PMPS than a placebo laser procedure with RPTP.[60]

Boyraz et al. (2015) conducted a comparative research. The aim of the present study was to evaluate the efficiency of high intensity laser and ultrasound therapy in patients who

were diagnosed with lumbar disc herniation and who were capable of performing physical exercises. 65 patients diagnosed with lumbar disc were included in the study. The patients were randomly divided into three groups: Group 1 received 10 sessions of high intensity laser to the lumbar region, Group 2 received 10 sessions of ultrasound, and Group 3 received medical therapy for 10 days and isometric lumbar exercises. Comparing the changes between groups, statistically significant difference they observed in MH (mental health) parameter before treatment between Groups 1 and 2 and in MH parameter and VAS score in third month of the therapy between Groups 2 and 3. However, the evaluation of the patients after ten days of treatment did not show significant differences between the groups compared to baseline values. They found that HILT, ultrasound, and exercise were efficient therapies for lumbar discopathy but HILT and ultrasound had longer effect on some parameters.[61]

Montalvo in 2015 illustrated the impact of kinesiology taping on functional measures and pain in patients with patellofemoral pain. A total of 33 study participants out of 64 completed the study including 24 females and 9 males.14 of them presented with unilateral pain in their left knee and 19 of them with unilateral pain in their right knee. The interventions were kinesiology taping of both hip and knee along with placebo laser treatment. Three-minute laser therapy was administered to the study participants. Dynamic stability and dynamic postural control were observed after giving interventions. Kujala Questionnaire was used by the study researcher for examining the functional disability in patients with PFPS. The findings of this study have demonstrated that the placebo effect of laser therapy has shown good results. Although overall the application of kinesiology taping has given better results both in reducing pain intensity and functional disability. This research further elucidates that much work is needed on the applicability of kinesiology taping in the PFPS population.[62]

Bhatt and Khan in 2015 reviewed to explore the exercises and regimes for activation of vastusmedialis oblique (VMO) muscle. VMO has clinical significance as it is only the medial stabilizer of patella bone and this feature is considered an essential element for patella stability. Various studies had been searched by the writers for getting the best exercise therapy for VMO. Some of the articles suggest close chain, open chain, and squatting exercises for VMO activation. In PFPS, patella mal-alignment happened and therefore the strengthening of vastusmedialis oblique muscle is necessary. This review

article has explained that there are several physiotherapy treatments available that can be used for activating and strengthening the VMO muscle. Some of them are taping, retraining with bio-feedback, and quadriceps strengthening exercises. Hence, it is concluded from the article that activation of VMO is significant in early rehabilitation sessions and physiotherapists should focus on strengthening exercises as well.[63]

There are many effects of patellar taping on pain and functional disability. A double-blind randomized clinical trial was designed with 30 patients of PFPS and the study participants were divided into two groups named: intervention and control. The patients of the control group only received routine physiotherapy and in the intervention group, patellar taping was added. Each patient within these groups was given the treatment of 12 sessions for 4 weeks. This study has adopted KOOS and VAS questionnaires for evaluating and assessing the quality of life and intensity of pain. The skyline radiography method was implemented for evaluating three major components: Patellofemoral Congruence Angle (PFCA), Lateral Patellofemoral Angle (LPA), and Lateral Patellar Displacement (LPD). Hence, the results indicated that there were no significant differences between the control and intervention groups. The introduction and addition of the patellar taping with routine physical therapy show no specific improvement in pain reduction and quality of life.[64]

Different types of researches have been performed for knowing the safety and efficacy of laser therapy. A review conducted in 2014 depicted the importance of low-level laser therapy for managing musculoskeletal pain. The dosage of laser therapy is very important for managing pain in chronic conditions. In this evidence-based review paper, many systematic reviews had been studied for exploring the dosage impact of LLLT. Among all studies reviewed, six of them had given strong evidence about the dose of low-level laser therapy. According to these studies, laser therapy is administered in a dose-dependent way. Patellofemoral pain syndrome is a joint disorder and dose-dependent LLLT is very useful in managing its pain.[65]

Stuhlmann in 2014 performed research to understand the flexibility and strength of the ankle, knee, and hip. For this research, a case-control study was conducted and a comparison was drawn for this purpose. An asymptomatic control group was compared with symptomatic case group. Ten symptomatic "cases" and ten asymptomatic "controls" were recruited. Patients between the ages of 18 and 60 and with crepitus patellofemoral

joint included in this study.In this study, many significant changes have been seen. Isometric hip external and internal rotation was found to be different between the case and control groups. RPAQ (Recent Physical Activity Questionnaire) was used by the researcher for assessing the health and functional status of the participants. Hence, this study has illustrated that strength measures had shown weakness in cases, while the range of motion was the same between the two groups.[66]

The taping technique is also very useful for treating patients with patellofemoral pain syndrome. A study conducted by Hussein in 2012 elaborated two taping techniques for managing PFPS patients. As there is excessive lateral tilt or lateral tracking of the patella in this pain syndrome and thus, the patient complains of functional limitation at the knee joint and increased pain intensity. Vastuslateralis inhibitory taping technique and medial patellar taping technique were used by the researcher for evaluating the pain intensity by using VAS. For this purpose, thirty participants were assigned for these researches which were divided into two experimental groups. Muscle activity was recorded by using EMG (Electromyograph). Both techniques had given the same results and this study had shown that any taping technique either inhibitory taping technique or medial patellar taping technique was applied, the results were the same. The patients in both groups reported the same findings including decreased pain and functional disability.[67]

Sifta and Danilov explained the productiveness of HILT on joint disorders. The study aimed to find out the efficacy of high-intensity laser therapy guided by high-power Nd: YAG laser. The basic purpose was to increase ROM and alleviate pain in OA patients. The treatment plan was divided into three phases. The first phase involves quick scanning, the second includes the treatment of trigger points, and the last phase involves slow scanning. Figure 1 indicates the phases of interventions and parameters used in this study.

Parameters of treatment			
Phase	Intensity (mJ/cm²)	Frequency (Hz)	Scanning speed
First	360 mJ/cm²	10Hz	Higher
Second	810 mJ/cm²	25Hz	Static treatment
Third	1780 mJ/cm²	30Hz	Slow

Figure 1*: Parameters of Treatment*

The data obtained as a result of this study has clearly stated that HILT has good and productive results on OA patients. Furthermore, the study has also defined laser therapy as a very easy, simple, and cheap way of treating patients with joint disease.[68]

Magalhaes et al in 2010 had conducted a study comparing the hip strength between inactive females without and with PFPS. Fifty females of age between 15 and 40 years were included in the study. The study participants were divided into control groups (without PFPS), females with unilateral PFPS, and women with bilateral PFPS. Firstly, the strength of muscles was measured and then their data was collected. The muscle strength of hip lateral rotators, hip flexors, and hip abductors were measured. The outcomes of this study have described that no difference of strength among muscle groups had been reported in the bilateral PFPS group. The females with unilateral PFPS had outlined the weakness of hip abductors only. Hence, muscle weakness has been observed in females with PFPS. The findings of this study have narrated that a sedentary lifestyle has no direct relationship with the development of PFPS. The study has further demonstrated that ladies with bilateral PFPS had weakness of all 6 major (hip lateral rotators, medial rotators, flexors, extensors, adductors, and abductors) muscle groups.[69]

Bjordal et al in 2003 reviewed studying the effects of low-level laser therapy on pain intensity in the case of several chronic joint disorders. A total of 14 trials out of 20 were

conducted on 695 patients, 6 trials were excluded because those experiments had not fulfilled the inclusion criteria. A four-step sequential procedure was performed by the researchers to know about the efficacy of low-level laser therapy. These steps include predetermining optimal dose, performing sensitive literature, pre-specified exclusion, and inclusion criteria, and testing the differences between experimental without and with optimal dose. The exact range of dose was derived from laboratory experiments before starting the literature search. For measuring pain, Visual Analogue Scale was selected for recording the intensity of pain as the outcome variable. The second outcome measure was global health status. The findings of this review have shown that low-level laser therapy is effective in the case of chronic joint disease. Further, overall health status was also improved among patients who received low-level laser therapy. However, some heterogeneity had been observed in this review article which depicted that more research is required for determining the optimal procedure for LLLT along with other physiotherapy treatment plans.[70]

It was a Retrospective review of the medical records of patients with high-frequency migraine who were treated with OMTh at the Headache Istituto di Ricovero e Cura a Carattere Scientifico Fondazione Santa Lucia from 2011 to 2015. Clinical assessments were made using the Headache Disability Inventory (HDI), the Headache Impact Test (HIT-6), the Hamilton Depression Rating Scale (HDRS), and the State-Trait Anxiety Inventory (STAI) forms X-1 and X-2.[71]

It was a randomized controlled trial with total of 100 patients with Stage II-III bilateral knee OA enrolled to the study and randomized into two groups. Group 1 performed exercise and received OMT and Group 2 performed exercise alone. We assessed the clinical parameters with Western Ontario MacMaster Questionnaire (WOMAC) pain score, WOMAC joint stiffness score, WOMAC physical function score, Visual Analog Scale (VAS) and 50-m walking time. All patients were assessed at the beginning of the study, just after the treatment, and four weeks after the treatment.

There was no significant difference between groups in terms of physical examination and clinical assessment parameters before treatment. Functional improvement ($p<0.05$) and

pain relief ($p<0.05$) were significantly higher in the exercise + OMT group.OMT is a particular treatment used by osteopathic physicians to complement conventional treatment of OA of the knee. In addition to the conservative treatment, OMT can be used.[72]

Angelova and Ilieva conducted a pilot, randomized clinical study about the effect of high intensity laser therapy in patients with osteoarthritis of the knee. 72 patients (aged between 39 and 83 years) with (clinically and radiographically proved) OA of the knee were included in the study. They were randomized in two groups: therapeutic (test) old; patients were treated with HILT and control group both groups had seven sessions of treatment. VAS and dolorimetry were used for assessment of pain before and after the therapy. Pedobarometric analysis (static and dynamic) was used to assess comparatively the contact surface area and maximum pressure under the heel. Results showed Pain levels measured by VAS and dolorimetry decreased significantly in the therapeutic group after seven days of treatment. They concluded that the results after seven days of treatment show more intensive and cumulative effect after the application of high intensity laser therapy in comparison to sham laser. This is the reason why HILT can be a method of choice in the treatment of gonarthrosis.[73]

It was a systematic review that included 65 RCTs. Four interventions demonstrated short-term primary efficacy: knee-targeted exercise therapy for pain and function combined interventions for pain and function, foot orthoses for global rating of change, and lower-quadrant manual therapy for pain. Two interventions demonstrated short-term secondary efficacy compared to knee-targeted exercise therapy: hip-and-knee-targeted exercise therapy for pain and function, and knee-targeted exercise therapy and perineural dextrose injection for pain and function.it was concluded that Six interventions had positive effects at three-months for people with PFP, with no intervention adequately tested beyond this timepoint.[74]

Andras in 2003 studied the roles of biomechanical risk factors and sporting activity in patellofemoral pain syndrome patients. The cross-sectional screening was performed by the researcher on the school-aged group. Visual Analogue Scale was used for recording the pain level during running, at rest, while climbing on stairs, with the knee flexed, and after sitting. Further, dynamic walk analysis and leg tests were also performed and anthropometric measurements were also taken. A total of 586 students were examined with

a ratio of 294 boys and 292 girls. Greater levels of pain intensity were recorded while climbing stairs. Instability of patella was found in 26 cases. Q angles were also reported to be higher in PFPS patients.[75]

Crossley et al. (2002) conducted a double blind RCT seventy-one subjects, 40 years of age or younger with patellofemoral pain of 1 month or longer, were randomly allocated to a physical therapy or placebo group. A standardized treatment program consisted of six treatment sessions, once weekly. Physical therapy included quadriceps muscle retraining, patellofemoral joint mobilization, and patellar taping, and daily home exercises. The placebo treatment consisted of sham ultrasound, light application of a nontherapeutic gel, and placebo taping.Sixty-seven participants completed the trial. The physical therapy group (N = 33) demonstrated significantly greater reduction in the scores for average pain, worst pain, and disability than did the placebo group (N = 34). They concluded that a six-treatment, 6-week physical therapy regimen is efficacious for alleviation of patellofemoral pain.[76]

3. OBJECTIVES

- To determine the effects of osteopathic manipulative techniques (OMTh) in addition

with high power laser therapy and routine physical therapy on pain and functional disability in patients with patellofemoral pain syndrome.

4. HYPOTHESIS

4.1. NULL HYPOTHESIS:

There was no significant difference in pain and functional disability in experimental and control group following high power laser therapy along with osteopathic manipulative techniques (OMTh) and routine physical therapy and high power laser therapy with routine physical therapy alone.

4.2. ALTERNATE HYPOTHESIS:

There was significant difference in pain and functional disability in experimental and control group following high power laser therapy along with osteopathic manipulative techniques (OMTh) and routine physical therapy and high power laser therapy with routine physical therapy alone.

5. OPERATIONAL DEFINITIONS

5.1. PATELLOFEMORAL PAIN SYNDROME:

Patellofemoral pain syndrome is characterized by vague anterior knee pain, crackling sound especially on knee movements and loss of functional abilities in activities of daily living like walking, running, jumping, squatting, cycling, climbing stairs or any activity that requires knee flexion movement. This problem arises due to overtraining in sportsmen or athletes, faulty biomechanics, improper footwear, over-activity placing extra stress on the joint, asymmetrical forces acting on the knee joint, misalignment of patella, weakness of surrounding muscles especially quadriceps, any trauma etc. [77, 78]

5.2. OSTEOPATHY :

Osteopathy is a way of detecting, treating and preventing health problems by moving, stretching and massaging a person's muscles and joints**.**

- Osteopathic techniques including joint articulation/mobilization and muscle techniques may help promote blood and lymphatic flow, helping reduce pain and inflammation.
- Osteopathy may help reduce muscle tension around the knee and hip joints which can help improve range of movement.
- Our osteopaths will treat/release the structures around the hip, knee and ankle joints to help overall lower limb biomechanics.[71]

5.3. HIGH POWER LASER THERAPY:

Laser is created by specific process within the laser device which enables the controlled emission of radiation in the form of light. LASER having an output power greater than 500mW or 0.5W is termed as High Power Laser Therapy (HPLT). It can be used in two modes i-e continuous or pulsed. In pulsed mode, the laser is turned on and off with high frequency and is used for analgesic effects while in continuous mode, laser is kept on during the therapy session and is used to promote biostimulation, healing and recovery. The source of laser beam in HPLT is usually a semi-conductor diode which is capable of

producing light of one specific wavelength e.g 1064nm. Due to their higher power density, HPLT creates heat on the surface of the skin. Unlike the Low Level Laser Therapy (LLLT), HPLT allows deeper tissue stimulation and significantly speeds up the healing and tissue regeneration. It provides a powerful form of acute pain management especially in sports injuries.[79]

5.4. PAIN:

The Visual Analogue Scale (VAS) is a unidimensional measure of pain intensity which is widely used in adult population. A horizontal line is drawn which is then marked from 0-10 and the amount of pain felt by patient ranges across a continuum from none to extreme amount of pain in which"0" represents "no pain" while "10" represents "worst pain possible". The patient is then asked to mark either number on the scale which describes the intensity of his/her pain. [80]

5.5. FUNCTIONAL DISABILITY:

The Kujala Anterior Knee Pain Scale (AKPS) is a 13 item questionnaire for the assessment of functional limitations associated with anterior knee pain. The score was originally introduced for patients with patellofemoral pain syndrome. This score asks about the ability to do several activities of daily living like squatting, stair climbing, running and also the presence of symptoms or disabilities like limping, swelling, thigh atrophy etc. The patient is asked to mark each option according to his/ her condition and then the items are summed up to give a total score ranging from 0 – 100. The high scores indicate good outcomes.

The Kujala score is the most frequently used patient reported outcome measurement in patients with patellofemoral disorders with high validity and reliability. [81]

6. MATERIAL AND METHODS

Study Design: Randomized Controlled Trial.

Study Setting: Republican Diagnostic Centre, Baku

Duration of Study: The study has been completed in 8 months after the approval of synopsis.

Sample Size: The calculated sample size using Kujala as outcome measure is 32 in each group after adding 20% dropout the sample size was 33+6=39 in each group. [82]

Sample Size For Comparing Two Means

Input Data

Confidence Interval (2-sided)	95%
Power	80%
Ratio of sample size (Group 2/Group 1)	1

	Group 1	Group 2	Difference*
Mean	88.64	82.9	5.74
Standard deviation	6.18	9.82	
Variance	38.1924	96.4324	

Sample size of Group 1	33
Sample size of Group 2	33
Total sample size	66

$$n = \frac{2\sigma^2 (z_{1-\alpha/2} + z_{1-\beta})^2}{(\mu_1 - \mu_2)^2}$$

Figure 2*: Sample Size*

$Z_{1-\alpha/2}$ Level of significance=95%

μ_1 Expected mean change in Kujala in Group-A= 82.9

μ_2 Expected mean change in Cobb angels in Group-B= 88.64

δ_1Expected standard deviation in Control group=6.18

δ_2Expected standard deviation in Experimental group=9.82

$Z_{1-\beta}$ power of the study= 80%

n Expected sample size in a group= 33

After adding 20% drop out 33+6=39 in each group. [82]

Sampling Technique: Purposive Sampling Technique

Sample Selection:

Inclusion Criteria:

- Both male and female
- Age group: 15 – 40 years. [3]
- Anterior, retro-patellar or peri-patellar knee pain for more than 3 months.
- Insidious or gradual onset of symptoms
- Pain relieved by rest.
- Pain aggravated by prolonged sitting, stair climbing, running, squatting, kneeling, hopping\jumping, overuse activities
- Presence of pain on palpation of patellar facets, on step down from a 25 cm step, or during a double legged squat.

Exclusion Criteria:

- Osteoarthritis, meniscal injury, joint effusion, autoimmune diseases.
- Conditions like patellar subluxation/dislocation, intraarticular derangement and pathology, bursitis, patellar tendonitis etc.
- Recent trauma or surgery
- Neurologic disorders that can influence gait and similar disorders.
- Patients who have had previous physical therapy, chiropractic treatment or massage therapy in the last 3 months.

Outcome Measures:

Visual Analogue Scale,Kujala Anterior Knee Pain Scale (AKPS)

Equipment:

High Power Laser Therapy machine.

7. ETHICAL CONSIDERATIONS

- The rules and regulations set by the ethical committee of The National University of Medical Science, Spain were followed while conducting the research and the rights of the research participants were respected.
- Written informed consent attached was taken from all the participants
- .All information and data collection was kept confidential.
- Participants were remained anonymous throughout the study.
- The subjects were informed that there are no disadvantages or risk on the procedure of the study.
- The participants were also informed that they would be free to withdraw at any time during the process of the study.
- Data was kept in under key and lock while keeping the keys with the researcher. In laptop it was kept under password set by the researcher.

8. DATA COLLECTION PROCEDURE

The data was collected in following ways:

Screening: The patients who met the inclusion criteria were included in the study. Consent forms were filled by every participant. After that each participant was randomly allocated to each group i-e control group and experimental group.

Randomization: The participants were randomly divided into two groups i-e control group and experimental group by using the lottery method of randomization in which a number was assigned to each participant and then they were randomly allocated to each group.

Blinding: The study was single blinded. The assessor was unaware of the treatment that was given to both groups.

Assessment: Before giving either treatment to each group, baseline data was collected from each participant and then after 4^{th} week of treatment. Follow-up assessments were also done after 8^{th} week of treatment and all the results were then compared before and after the treatment.

8.1. INTERVENTIONS

Group A (RPT+ HPLT): This group received routine physical therapy regime as a treatment for patellofemoral pain syndrome 40-45 minutes per session 4-5 sessions per week for four weeks. Following techniques were applied:

- Prone quadriceps stretch: 30 seconds hold with 5 repetitions
- IT Band Stretch: 30 seconds hold with 5 repetitions
- Calf stretch: 30 seconds hold with 5 repetitions.
- Patellar mobilizations: lateral, medial, superior, inferior

- Quadriceps Strengthening: Keep knee in extension, tighten the muscles of thigh and hold for 5 seconds or ask the patient to press the foam\towel underneath the knee and hold for 5 seconds with 10 repetitions.
- Straight leg raise: Patient lying supine with knee in extension and feet at 45 degrees from the ground. Ask the patient to perform SLR with 5 repetitions.
- Hip Abduction Exercise: Patient is in side lying and is asked to raise the involved limb on the upper side approx. 18 inches with 5 repetitions.
- Hip Adduction: The patient is in side lying on the involved side. Bring the uninvolved leg back behind the involved leg. Raise the involved across the body with 5 repetitions.
- Hamstrings Strengthening: While standing, with arms supported on a wall, the patient will be asked to perform knee flexion to 90 degrees with 2 seconds hold and 10 repetitions.
- Dumbbell squats and wall squats with 5 – 10 repetitions.

In addition they also received high intensity laser therapy (HPLT) for 8 consecutive sessions with an interval of 3 days. Each participant of this group was exposed to 120 seconds of 10W- laser with 120J/cm2 per therapy.

The patients were in supine position with knee in extension placing the patella in its resting position. Pulsed laser on patellar margins was used in circulatory movements. The distance of the applicator from the skin was 2 cm and the spot size was 0.8 cm2.

Group B (RPT + HPLT + Osteopathy Manipulative Techniques OMTh): This group also receives routine physical therapy as a treatment of patellofemoral pain syndrome. In addition they also received

Muscle energy technique.

Place bone or joint into barrier and apply isometric resistance against patient's active contraction of muscle for 3-5 sec; repeat 3-5 times.

8.2. Counterstrain

Position joint to shorten muscle until pain is relieved/ mobile point is reached.hold positioning for 90 seconds to allow for reduction in proprioceptive firing return jointslowly to neutral to prevent limitation of inappropriate fringe.

High intensity laser therapy (HPLT) for 8 consecutive sessions with an interval of 3 days. Each participant of this group was exposed to 120 seconds of 10W- laser with 120J/cm2 per therapy.

The patients were in supine position with knee in extension placing the patella in its resting position. Pulsed laser on patellar margins was used in circulatory movements. The distance of the applicator from the skin was 2 cm and the spot size was 0.8 cm2.

Data Collection Tools:

Visual Analogue Scale,Kujala Anterior Knee Pain Scale (AKPS)

Outcome measurements:

- Posture Stability
- Pain reduction
- Functional Activity

Dependent variables:

- pain
- functional disability

Independent variable:

- High Power Laser Therapy
- Osteopathy Techniques

9. DATA ANALYSIS PROCEDURE

Data was analyzed using SPSS version 26.The quantitative variables were presented in the form of mean ±SD and qualitative variables like pain and functional disability were presented in the form of frequency and percentage. Kolmogorov – Smirnova and Shapiro –wilk test were performed as the data was non-parametric. Comparative difference analyzed with Mann Whitney U Test for vas and Kujala score. The within group difference for the VAS score and Kujala score was analyzed by applying Wilcoxon Rank Test.

Pie Charts and Bar Graphs are used to show the data division.

GANTT CHART

Activity	Months			
	02	04	02	01
Synopsis Submission				
Data collection				
Data analysis and interpretation				
Thesis compilation				
Thesis presentation and submission				

10. Results

The mean age of the patientsin group A was 27.96± 6.47 and ofgroup B was28.18± 6.25 years.Table-1. The results regarding gender of patients showed that there were 31(62%) male and 19(38%) females in Group A and 25(50%) males and 25(50%) female in group B.Table-2. Descriptive statistics of group A (Laser +routine physiotherapy) Baseline VAS mean value was7.82 with standard deviation was 0.8 and maximum, minimum value was 6 and 9. 2nd week VAS mean, standard deviation, maximum and minimum values were 6.42, 0.78,5 and 8 respectively. 4th week NPRS mean, standard deviation, maximum and minimum values were5.14, 0.85, 4 and 7 respectively.8th week VAS mean, standard deviation, maximum and minimum value 2.80, 0.63,2 and 4 respectively.

In group B (Osteopathy+ routine Physiotherpy + Laser therapy) Baseline VAS mean value7.82 with standard deviation 0.96 and maximum, minimum value was 9,6. 2nd week VAS mean, standard deviation, maximum and minimum value was 6.40, 0.83,5 and 8 respectively. 4th week VAS mean, standard deviation, maximum and minimum value was 4.40, 1.125, 3 and70 respectively.8th week VAS mean, standard deviation, maximum and minimum value 0.96, 1.38, 6 and 0.respectively. Table-3Descriptive statistics of group A (Laser +routine physiotherapy) Baseline Kujala score mean value was42.44 with standard deviation 6.33. and maximum, minimum valueswere30 and 57. 2nd week Kujala score mean, standard deviation, maximum and minimum values were 45.58, 6.62, 32 and 59 respectively. 4th week Kujala score mean, standard deviation, maximum and minimum values were49.30, 5.86, 40 and 63 respectively.8th week Kujala score mean, standard deviation, maximum and minimum v alue 53.28, 6.99,40 and 69 respectively.

In group B (Osteopathy+ routine Physiotherpy + Laser therapy) Baseline Kujala score mean value42.82 with standard deviation 6.6 and maximum, minimum value was 35,56. 2nd week Kujala score mean, standard deviation, maximum and minimum value was 54.56, 6.81,69 and 46 respectively. 4th week Kujala score mean, standard deviation, maximum and minimum value was 67.88, 6.57, 91 and 69 respectively.8th week Kujala score mean, standard deviation, maximum and minimum value 83.02, 6.57, 91 and 69 respectively. Table-4

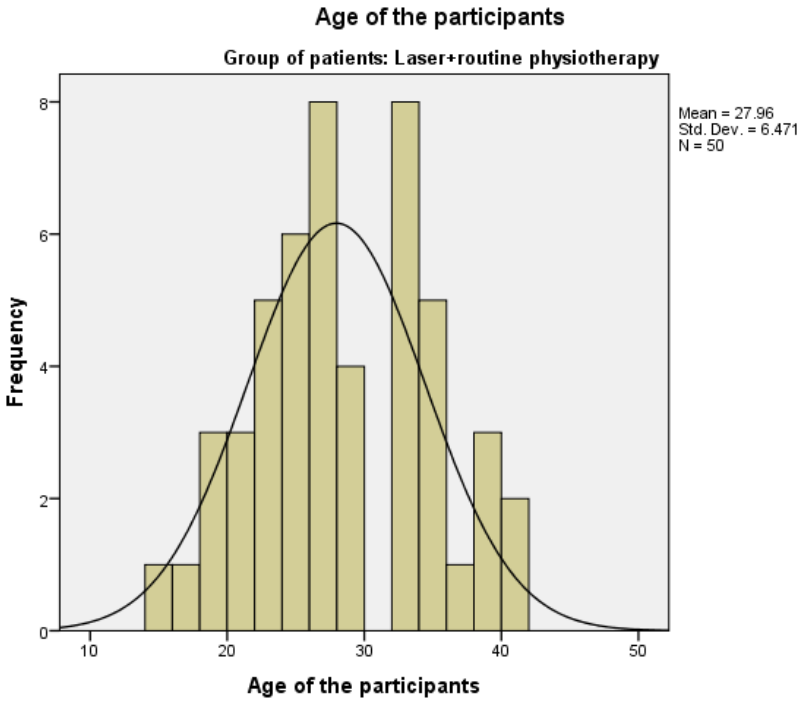
To check the normality of data Kolmogorov-Smirnov test was used and data was found to be not notrmally distributed with p value < 0.05. Table-5. Friedman testwas used for comparison within the control group based on VAS,. There was significant difference in the mean score of VAS from baseline till 8th week in both the groups i.e. group A and group B as the p-values were significant. (p-value: 0.000 and 0.000). Table-6. Friedman testwas used for comparison within the control group based on Kujala score,. There was significant difference in the mean value of Kujala score from baseline till 8th week in both the groups i.e. group A and group B as the p-values were significant. (p-value: 0.000 and 0.000). Table-7. There was no significant difference in the mean values of VAS in group A and group B at baseline and 2nd week (p-values: 0.87 and 0.70) while there was significant difference in the mean values of VAS in group A and group B at 4th week and 8th week. (p-value:0.001 and 0.000). Table-8. There was no significant difference in the mean value of VAS in group A and group B at baseline (p-values: 0.71) while there was significant difference in the mean values of VAS in group A and group B at 2nd week, 4th week and 8th week. (p-value:0.000,0.000 and 0.000). Table-9

Table 1: Age of Participants

Age of the participants		
LASER +routine physiotherapy	N	50
	Mean	27.96
	Std. Deviation	6.471
	Minimum	15
	Maximum	40
Osteopathy+ routine Physiotherpy + Laser therapy	N	50
	Mean	28.18
	Std. Deviation	6.252
	Minimum	15
	Maximum	39

The mean age of the patientsin group A was 27.96**±** 6.47 and ofgroup B was28.18**±** 6.25 years.Table-1

Figure 3-4: Descriptive statistics for Age



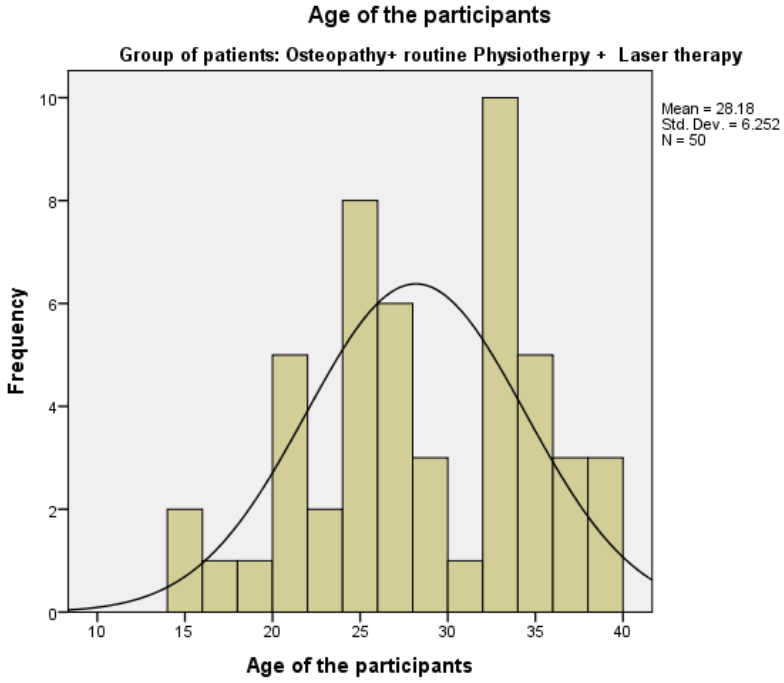
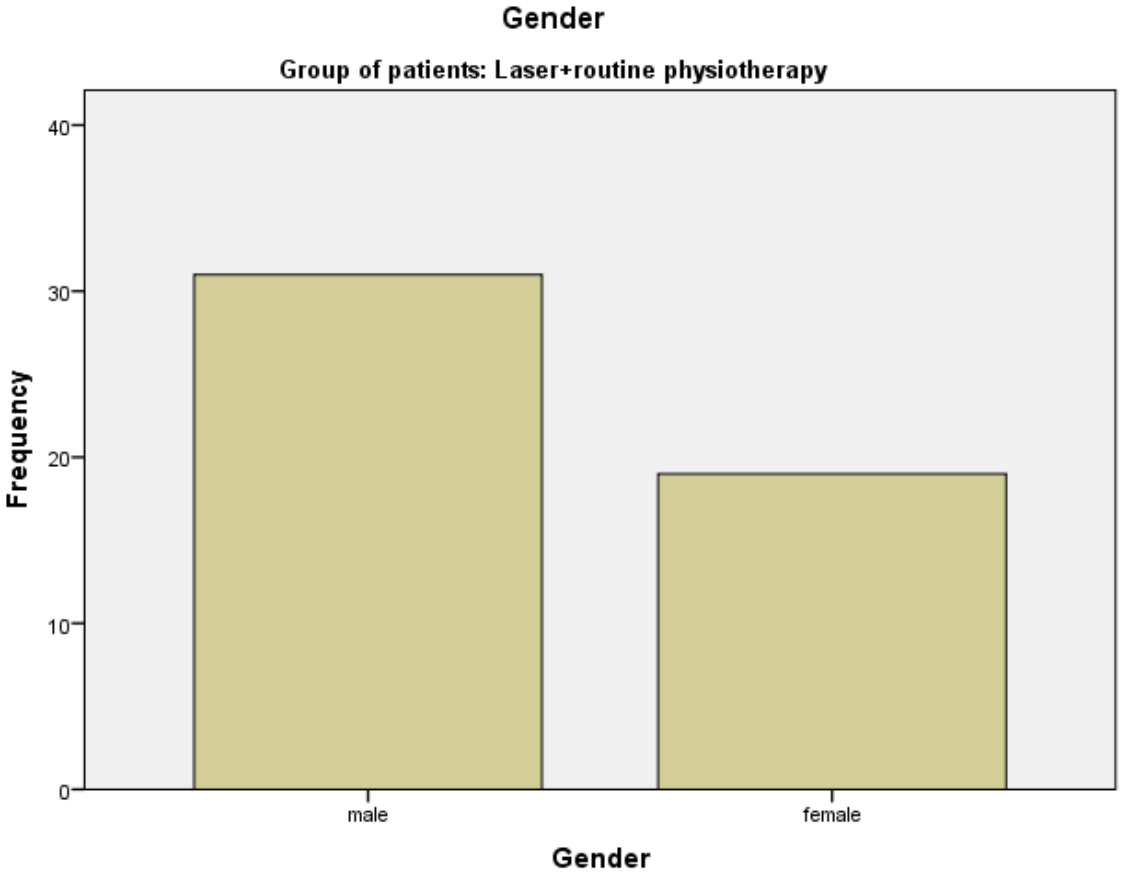


Table 2: Gender Distribution among Study Groups

Group of patients		Frequency	Percent
LASER +routine physiotherapy	male	31	62.0
	female	19	38.0
	Total	50	100.0
Osteopathy+ routine Physiotherpy + Laser therapy	male	25	50.0
	female	25	50.0
	Total	50	100.0

The results regarding gender of patients showed that there were 31(62%) male and 19(38%) females in Group A and 25(50%) males and 25(50%) female in group B.Table-2




Gender
Group of patients: Osteopathy+ routine Physiotherpy + Laser therapy
Frequency
25
20
15
10
5
0
male
female
Gender

Table 3 : Descriptive Statistics for VAS at baseline 2nd week 4th week and 8th week

Group of patients		Baseline Vas score	2nd week VAS score	4th week VAS score	8th week VAS score
LASER +routine physiotherapy	N	50	50	50	50
	Mean	7.82	6.42	5.14	2.80
	Std. Deviation	.800	.785	.857	.639
	Minimum	6	5	4	2
	Maximum	9	8	7	4
Osteopathy+ routine Physiotherpy + Laser therapy	N	50	50	50	50
	Mean	7.82	6.40	4.40	.96
	Std. Deviation	.962	.833	1.125	1.384
	Minimum	6	5	3	0
	Maximum	9	8	7	6

Descriptive statistics of group A (Laser +routine physiotherapy) Baseline VAS mean value was7.82 with standard deviation was 0.8 and maximum, minimum value was 6 and 9. 2nd week VAS mean, standard deviation, maximum and minimum values were 6.42, 0.78,5 and 8 respectively. 4th week NPRS mean, standard deviation, maximum and minimum values were5.14, 0.85, 4 and 7 respectively.8th week VAS mean, standard deviation, maximum and minimum value 2.80, 0.63,2 and 4 respectively.

In group B (Osteopathy+ routine Physiotherpy + Laser therapy) Baseline VAS mean value7.82 with standard deviation 0.96 and maximum, minimum value was 9,6. 2nd week VAS mean, standard deviation, maximum and minimum value was 6.40, 0.83,5 and 8 respectively. 4th week VAS mean, standard deviation, maximum and minimum value was 4.40, 1.125, 3 and70 respectively.8th week VAS mean, standard deviation, maximum and minimum value 0.96, 1.38, 6 and 0.respectively. Table-3

Table 4 : Descriptive Statistics for Kujala score at baseline 2nd week 4th week and 8th week

Group of patients		Baseline Kujala score	2nd Week Kujala score	4th week kujala score	8th week kujala score
LASER +routine physiotherapy	N	50	50	50	50
	Mean	42.44	45.58	49.30	53.28
	Std. Deviation	6.335	6.621	5.860	6.999
	Minimum	30	32	40	40
	Maximum	57	59	63	69
Osteopathy+ routine Physiotherpy + Laser therapy	N	50	50	50	50
	Mean	42.82	54.56	67.88	83.02
	Std. Deviation	6.608	6.819	7.275	6.570
	Minimum	35	46	51	69
	Maximum	56	69	78	91

Descriptive statistics of group A (Laser +routine physiotherapy) Baseline Kujala score mean value was 42.44 with standard deviation 6.33. and maximum, minimum values were 30 and 57. 2nd week Kujala score mean, standard deviation, maximum and minimum values were 45.58, 6.62, 32 and 59 respectively. 4th week Kujala score mean, standard deviation, maximum and minimum values were 49.30, 5.86, 40 and 63 respectively.8th week Kujala score mean, standard deviation, maximum and minimum value 53.28, 6.99,40 and 69 respectively.

In group B (Osteopathy+ routine Physiotherpy + Laser therapy) Baseline Kujala score mean value 42.82 with standard deviation 6.6 and maximum, minimum value

was 35,56. 2nd week Kujala score mean, standard deviation, maximum and minimum value was 54.56, 6.81,69 and 46 respectively. 4th week Kujala score mean, standard deviation, maximum and minimum value was 67.88, 6.57, 91 and 69 respectively.8th week Kujala score mean, standard deviation, maximum and minimum value 83.02, 6.57, 91 and 69 respectively. Table-4

Table 5: Test of Normality

Tests of Normality				
	Group of patients	Kolmogorov-Smirnov[a]		
		Statistic	df	Sig.
Baseline Vas score	LASER +routine physiotherapy	.249	50	.000
	Osteopathy+ routine Physiotherpy + Laser therapy	.214	50	.000
2nd week VAS score	LASER +routine physiotherapy	.290	50	.000
	Osteopathy+ routine Physiotherpy + Laser therapy	.264	50	.000
4th week VAS score	LASER +routine physiotherapy	.285	50	.000
	Osteopathy+ routine Physiotherpy + Laser therapy	.179	50	.000
8th week VAS score	LASER +routine physiotherapy	.303	50	.000
	Osteopathy+ routine Physiotherpy + Laser therapy	.328	50	.000
Baseline Kujala score	LASER +routine physiotherapy	.190	50	.000
	Osteopathy+ routine Physiotherpy + Laser therapy	.187	50	.000
2nd Week Kujala score	LASER +routine physiotherapy	.108	50	.198
	Osteopathy+ routine Physiotherpy + Laser therapy	.172	50	.001
4th week kujala score	LASER +routine physiotherapy	.160	50	.003
	Osteopathy+ routine Physiotherpy + Laser therapy	.128	50	.040
8th week kujala score	LASER +routine physiotherapy	.110	50	.185
	Osteopathy+ routine Physiotherpy + Laser therapy	.168	50	.001

To check the normality of data Kolmogorov-Smirnov test was used and data was found to be not notrmally distributed with p value < 0.05. Table-5

Table 6: Within group comparison for VAS

Group of patients		N	Mean	Std. Deviation	Mean Rank	P-value
LASER +routine physiotherapy	Baseline Vas score	50	7.82	.800	3.99	0.000
	2nd week VAS score	50	6.42	.785	2.95	
	4th week VAS score	50	5.14	.857	2.06	
	8th week VAS score	50	2.80	.639	1.00	
Osteopathy+ routine Physiotherpy + Laser therapy	Baseline Vas score	50	7.82	.962	4.00	0.000
	2nd week VAS score	50	6.40	.833	2.98	
	4th week VAS score	50	4.40	1.125	2.02	
	8th week VAS score	50	.96	1.384	1.00	

Friedman testwas used for comparison within the control group based on VAS,. There was significant difference in the mean score of VAS from baseline till 8th week in both the groups i.e. group A and group B as the p-values were significant. (p-value: 0.000 and 0.000). Table-6

Table 7: Within group comparison for Kujala score

Group of patients		N	Mean	Std. Deviation	Mean Rank	p-value
LASER +routine physiotherapy	Baseline Kujala score	50	42.44	6.335	1.12	0.000
	2nd Week Kujala score	50	45.58	6.621	1.99	
	4th week kujala score	50	49.30	5.860	3.01	
	8th week kujala score	50	53.28	6.999	3.88	
Osteopathy+ routine Physiotherpy + Laser therapy	Baseline Kujala score	50	42.82	6.608	1.00	0.000
	2nd Week Kujala score	50	54.56	6.819	2.00	
	4th week kujala score	50	67.88	7.275	3.00	
	8th week kujala score	50	83.02	6.570	4.00	

Friedman testwas used for comparison within the control group based on Kujala score,. There was significant difference in the mean value of Kujala score from baseline till 8th week in both the groups i.e. group A and group B as the p-values were significant. (p-value: 0.000 and 0.000). Table-7

Table 8 : Between group comparison for VAS

Ranks					p-value
	Group of patients	N	Mean Rank	Sum of Ranks	
Baseline Vas score	LASER +routine physiotherapy	50	50.07	2503.50	0.87
	Osteopathy+ routine Physiotherpy + Laser therapy	50	50.93	2546.50	
	Total	100			
2nd week VAS score	LASER +routine physiotherapy	50	51.53	2576.50	0.70
	Osteopathy+ routine Physiotherpy + Laser therapy	50	49.47	2473.50	
	Total	100			
4th week VAS score	LASER +routine physiotherapy	50	60.07	3003.50	0.001
	Osteopathy+ routine Physiotherpy + Laser therapy	50	40.93	2046.50	
	Total	100			
8th week VAS score	LASER +routine physiotherapy	50	70.98	3549.00	0.000
	Osteopathy+ routine Physiotherpy + Laser therapy	50	30.02	1501.00	
	Total	100			

There was no significant difference in the mean values of VAS in group A and group B at baseline and 2nd week (p-values: 0.87 and 0.70) while there was significant difference in the mean values of VAS in group A and group B at 4th week and 8th week. (p-value:0.001 and 0.000). Table-8

Table 9: Within group comparison for VAS

Ranks					p-value
	Group of patients	N	Mean Rank	Sum of Ranks	
Baseline Kujala score	LASER +routine physiotherapy	50	51.58	2579.00	0.71
	Osteopathy+ routine Physiotherpy + Laser therapy	50	49.42	2471.00	
	Total	100			
2nd Week Kujala score	LASER +routine physiotherapy	50	34.79	1739.50	0.000
	Osteopathy+ routine Physiotherpy + Laser therapy	50	66.21	3310.50	
	Total	100			
4th week kujala score	LASER +routine physiotherapy	50	26.88	1344.00	0.000
	Osteopathy+ routine Physiotherpy + Laser therapy	50	74.12	3706.00	
	Total	100			
8th week kujala score	LASER +routine physiotherapy	50	25.52	1276.00	0.000
	Osteopathy+ routine Physiotherpy + Laser therapy	50	75.48	3774.00	
	Total	100			

There was no significant difference in the mean value of VAS in group A and group B at baseline (p-values: 0.71) while there was significant difference in the mean values of VAS in group A and group B at 2nd week, 4th week and 8th week. (p-value:0.000,0.000 and 0.000). Table-9

11. Discussion

The purpose of this research is to explore the effects of osteopathic manipulative technique with high-power laser therapy on pain and functional disability in patients with Patellofemoral Pain Syndrome. However, there are many types of research relating to PFPS, but no strong evidence exists to favor any specific treatment. Physiotherapy is a non-surgical way of treating Patellofemoral Pain Syndrome. osteopathic manipulative technique (OMTh) with High Power Laser Therapy is a very effective way to manage pain and functional disability in PFPS patients. While having two different hypothesis in view regarding this research, it rejects the Null Hypothesis and shows that OMTh+HPLT has significant effect in treating and dealing with pain. According to this study, routine physiotherapy and osteopathic manipulative technique with High laser therapy are more effective as compared to routine physiotherapy with High power laser therapy. The pain intensity score improved on VAS and at the end of a treatment session, only 3 patients had moderate pain.

Chen et al 2022 depicted that laser therapy was found to be very useful in treating musculoskeletal conditions including patellofemoral pain syndrome. This study elaborates that routine physiotherapy alone is not very effective. The researcher has found that the addition of laser therapy decreased the pain intensity to a larger extent.Nouri et al 2019 explained that High Power Laser Therapy is a safe modality and can be used along with a proper exercise regimen for treating PFPS. This modality proved to be very effective in decreasing pain intensity.(25)

Yasir rehmen et al (2020) conducted a systematic review and searched online the databases Ovid, MEDLINE, Embase, OSTMED.DR, EMCare, Allied and Complementary Medicine Database (AMED), Physiotherapy Evidence Database (PEDro), and Cochrane Central Register of Controlled Trials (CENTRAL), as well as the bibliographic references of previous systematic review articles evaluating OMTh for pain severity, disability, QOL, or RTW outcomes. Moderate quality evidence showed that OMTh vs. standard care was significantly associated with a reduction in pain and disability , as well as improved QOL and OMTh plus exercise vs. exercise only was significantly associated with reduction in

pain severity and disability while using visceral OMTh vs. general OMTh was significantly associated with reduction in pain severity .[83]

Kim et al. (2016) conducted a RCT to examine the effects of high intensity laser therapy (HILT) on pain and function in patients with knee osteoarthritis an experiment was conducted on 20 subjects who were divided into the control group (n=10), which would receive conservative physical therapy (CPT), and the experimental group (n=10), which would receive effects of high intensity laser therapy after conservative physical therapy. All patients received their respective therapies three times each week over a four-week period.

J zago et al (2020) worked on a RCT randomized controlled trial and on OMT group he gave joint manipulation and myofacial release to decrease pain and reduction in functional disability. Results proved to be effective in treating runners with PFPS.([28]

J kostenjevec et al in 2019 conducted a case study on patient with a history of lateral knee pain and found that OMT with routine physical therapy reduced the lateral tension on the patella and resolve the lateral knee pain. This recommendation is based on the anatomical connections of patella. Proper stretching of the IT band can be easily taught to patients, who can then perform the exercises at home as needed. [84]

This study also shows that an osteopathic manipulative technique (OMTHh with high power laser therapy has good effects on patients with knee osteoarthritis. Combining physical therapy treatment with osteopathic manipulative technique (OMTh)+ HPLT shows better effects than HPLT+ Physiotherapy alone.

In this study, an 8th-week treatment session was given to patients in both groups. The routine and osteopathic manipulative technique (OMTh)+ Hi laser therapy group has shown excellent results in treating PFPS. 4 readings were taken during the study period. Firstly, baseline values were measured, then after 2, 4, and 8 weeks, scores were recorded on VAS and Kujala scales. Patients in the routine and osteopathic manipulative technique (OMTh)+ Hi laser therapy group have shown more improvements on both VAS and Kujala scales.

Increased pain and functional disability are very common in these patients. The application of routine physiotherapy and osteopathic manipulative technique (OMTHh)+Hi laser

therapy used by the researcher has given much better results. After 8 weeks, pain intensity was recorded to be very less and functional disability has also been improved in these patients.

Mostafa et al (2022) depicted that High-Intensity Laser Therapy has shown superior effects on pain intensity and functional disability in PFPS patients. This modality is also very helpful in treating Knee Osteoarthritis (KOA). Values were taken at the start of research and after the 4th week of intervention. A remarkable decrease n pain intensity has been observed in patients with PFPS.[27]

High-Intensity Laser Therapy is very useful for managing pain in these patients and making their activities of daily living easy. 23 patients had good, 6 had excellent, and 4 had fair Kujala scores, while opposite results were reported in the routine physiotherapy group. Alayat et al 2017 elucidated that Hi laser therapy along with exercise is very useful in treating PFPS patients. High-Intensity Laser Therapy is very effective in managing such disorders. [47]

Ammendolia et al in 2021 explained the efficacy of High Laser Therapy for managing knee osteoarthritis. The researchers have combined the HILT with Glucosamine Sulfate and the outcomes were amazing. 6 months treatment protocol was given to the patients. A significant reduction in pain has been reported on VAS. [26]

Azizi et al 2019 depicted the effectiveness of therapeutic exercises for treating PFPS. The strength training program proved to be very effective in managing Patellofemoral Pain Syndrome. A low pain score was recorded in the study group and the research participants after the interventions can easily run and climb stairs. Hence, The strengthening exercises of hip external rotators and hip extensors have beneficial effects in reducing pain intensity.[12]

Hence, osteopathic manipulative technique (OMTh)+ High intensity and High Power laser therapy has also shown significant results in managing the condition and decreasing the functional limitations and other associated complains. Concerning the previous data and information produced by current research, it can be considered that osteopathic manipulative technique (OMTh)+ HILT/ HPLT could give an effective treatment in managing knee pain, range of motion, and functionality. Although the complex pathophysiology of patellofemoral Pain Syndrome needs more studies to confirm whether

improved clinical benefits can be acquired by using routine physiotherapy and Hi laser therapy. Considering previous literature, many musculoskeletal disorders have been treated with only laser therapy, so we can consider this treatment protocol to be valid in the management of joint function and pain.

12. Conclusion

The study has elucidated that the combination of routine physiotherapy with osteopathic manipulative technique (OMTh) and Hi Power laser therapy has shown very excellent results and a remarkable decrease in pain intensity has been observed in patients. Functional disability has also been decreased in this group.

By keeping in view all the previous research work and this study. It has been identified through the result that osteopathic manipulative technique (OMTh) with High power laser therapy is beneficial in treating the pain in PFPs, the addition of routine physiotherapy with osteopathic manipulative technique (OMTh) and High Power laser therapy yield very impressive results for PFPS management and treatment, encouraging future researchers to follow this study approach.

13. Recommendations

There is need of further researches to identify the role of osteopathic manipulative technique (OMTh) with high power laser therapy in dealing with PFPs with Generalizability and long term effect study, to clearly define the role of osteopathic manipulative technique (OMTh)+ with High power laser therapy in identifying its effects, benefits and side effects.

14. Limitations:

The current study has some limitations.

Localization of the data reduces the generalizability of the outcomes. Secondly, study participants were asked to avoid any change in their daily activity and treatment, but this is not assured that all of them followed this. Finally, only 2 months intervention period was given to study participants, it is assumed that more treatment time should be given to patients to check the efficacy of the treatment procedure.

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16. CONSENT FORM

You are requested to participate in a research study conducted by Parvin Akbarov. The purpose of this research is to evaluate the "Effects of high intensity laser therapy in reducing pain and functional disability in patients with patellofemoral pain syndrome".

Risks and Discomforts: There are no known risks associated with these maneuvers. This treatment consists of handling patients with physical means and there is no invasive procedure.

Potential Benefits: Reduction in pain intensity and functional disability.

Protection of Confidentiality: We will do everything we can do to protect your privacy. Your identity will not be revealed to anyone and in any publication resulting from this study.

Voluntary Participation: Your participation in this study is voluntary. You may chose not to participate and you may withdraw your consent to participate any time. You will not be penalized in any way should you decide not you participate or to withdraw from this study.

CONSENT:

I have read this consent form and have been given the opportunity to ask question. I give my consent to participate in this study.

Participant's Signature _____ Date: _____

A copy of this consent form will be given to the participant also.

PERFORMA/QUESTIONNAIRE:

EFFECTIVENESS OF HIGH POWER LASER THERAPY ON PAIN AND FUNCTIONAL DISABILITY IN PATIENTS WITH PATELLOFEMORAL PAIN SYNDROME: A RANDOMIZED CONTROLLED TRIAL

Serial Number: _____

Age: _____

Gender (Male/Female): _____

Height: _____

Weight: _____

BMI: _____

Effect Side (Right/Left/ Bilateral): _____

Durations of Symptoms: _____

OUTCOME VARIABLES:

Mention your outcome variables names below (For example)

- Visual Analogue Scale
- Kujala Anterior Knee Pain Scale

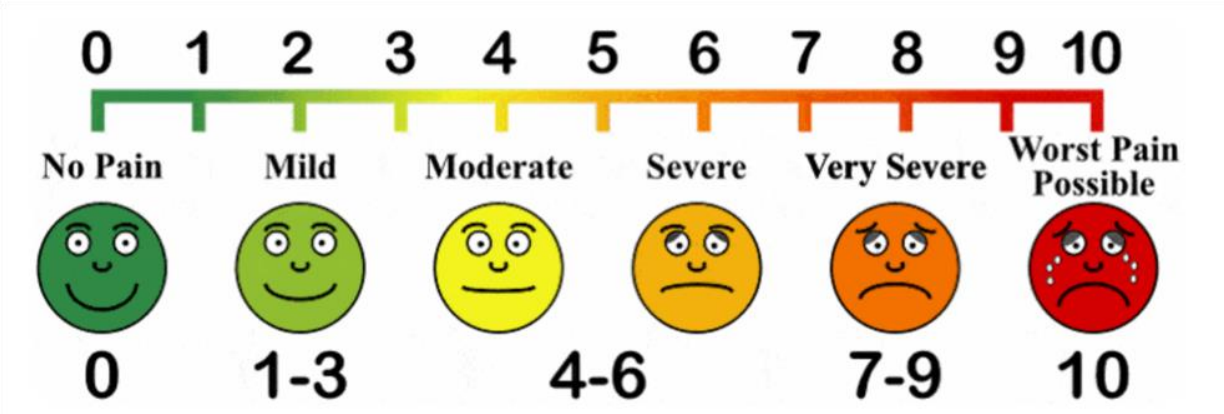
TREATMENT GROUPS

Group-A: (Routine Physiotherapy)

Group-B: (Routine Physiotherapy + High Power Laser Therapy)

Outcome Variables	***Baseline***	***2nd Week***	***4th Week***	***8th Week***
VAS				
Kujala Score				

Visual Analogue Scale:



Kujala Anterior Knee Pain Scale:

KUJALA SCORING QUESTIONNAIRE

Name: First Last Date:

Physician:

1. Limp:
- ◯ a) None
- ◯ b) Slight or periodic
- ◯ c) Constant

2. Support:
- ◯ a) Full support without pain
- ◯ b) Painful
- ◯ c) Weightbearing impossible

3. Walking:
- ◯ a) Unlimited
- ◯ b) More than 2 km
- ◯ c) 1-2 km
- ◯ d) Unable

4. Stairs:
- ◯ a) No difficulty
- ◯ b) Slight pain when descending
- ◯ c) Pain both when ascending and descending
- ◯ d) Unable

5. Squatting:
- ◯ a) No difficulty
- ◯ b) Repeated squatting painful
- ◯ c) Painful each time
- ◯ d) Possible with partial weightbearing
- ◯ e) Unable

6. Running:
- ◯ a) No difficulty
- ◯ b) Pain after more than 2 km
- ◯ c) Slight pain from the start
- ◯ d) Severe pain
- ◯ e) Unable

7. Jumping:
- ◯ a) No difficulty
- ◯ b) Slight difficulty
- ◯ c) Constant pain
- ◯ d) Unable

8. Prolonged sitting with knee flexed:
- ◯ a) No difficulty
- ◯ b) Pain after exercise
- ◯ c) Constant pain
- ◯ d) Severe pain
- ◯ e) Unable

9. Pain:
- ◯ a) None
- ◯ b) Slight and occasional
- ◯ c) Interferes with sleep
- ◯ d) Occasionally severe
- ◯ e) Constant and severe

10. Swelling:
- ◯ a) None
- ◯ b) After severe exertion
- ◯ c) After daily activities
- ◯ d) Every morning
- ◯ e) Constant

11. Abnormal painful kneecap movements:
(patellar subluxations)
- ◯ a) None
- ◯ b) Occasionally in sports activities
- ◯ c) Occasionally in daily activities
- ◯ d) At least one dislocation after surgery
- ◯ e) More than two dislocations

12. Atrophy of thigh:
- ◯ a) None
- ◯ b) Slight
- ◯ c) Severe

13. Flexion deficiency:
- ◯ a) None
- ◯ b) Slight
- ◯ c) Severe

Score

National University of Medical Sciences (Spain)

Doctor of Philosophy in Osteopathic Clinical Rehabilitation Phd (OCR)

Institutional Review Board Form

Serial No (for office use): _____ Date of submission _____

Name & Reg. No: Parvin Akbarov (S1902031)

Program: Doctor of Philosophy in Osteopathic Clinical Rehabilitation Phd (OCR)

Contact No: +994 55 222 20 03 Email: akbarovparvin@gmail.com

Name & Designation of Supervisor Dr.Farjoud Shokouhi . PhD. DPT.DO (National University Of Medical Sciences)

Type of Participants: Humans YES Animals Others (specify): _____

Category: 1): ☐ empt from review 2): ☐ Expedited Review 3): ☐ Full Review

Title of the project: EFFECTS OF HIGH POWER LASER THERAPY ON PAIN AND FUNCTIONAL DISABILITY IN PATINETS WITH PATELLOFEMORAL PAIN SYNDROME: A RANDOMIZED CONTROLLED TRIAL

Please tick the following checklist before submission:

Supervisor/Co-supervisor Acceptance Letter:	**Yes / No**
Approved by Departmental Research Committee (DRC):	**Yes / No**
Data Collection Permission Letter	**Yes / No**
Covering Letter Attached:	**Yes / No**
01 copies of proposals and all supplementary documents attached:	**Yes / No**
Consent Form Attached (English & Urdu)	**Yes / No**
Study Cost attached	**yes / No**

Candidate Signature: **Supervisor Signature and Stamp:**

For office use only

Date Received: _____ Date of discussion in IRB: _____

Remarks in meeting: _____

_____

_____

Approved: _____ Approved Conditionally: _____ (Amendments/Clarification/Documentation)

Deferred: _____ Rejected: _____

ON LETTER HEAD

Ref. No. DRC-UIPT-FAHS-157/2021 **Date:4th March,2021**

DEPARTMENTAL RESEARCH COMMITTEE (DRC) SYNOPSIS APPROVAL LETTER

Student Name: **Parvin Akbarov**
Reg. no: **FZ8803692**
Session: **2019-2021**
Degree Program: Doctor of Philosophy in Osteopathic Clinical Rehabilitation Phd (OCR)

On the behalf of all members of the Departmental Research Committee (DRC) of Faculty of Allied Health Sciences (FAHS), this is to inform you that your synopsis for **"Doctor of Philosophy in Osteopathic Clinical Rehabilitation Phd (OCR)"** (**Session 2019-2021**) presented on **12/04/2021** on topic **"Effects of high power laser therapy on pain and function disability in patients with patellofemoral pain syndrome: A randomized controlled trial"** has been duly approved and accepted by all the members of the DRC after submission of your updated draft by correcting all amendments and clarification indicated by the committee.
Now you may precede your synopsis further to Institutional Review Board (IRB) and Board of Advanced Studies & Research (BASR) of The National University Of Medical Sciences (Spain).

Member's Signatures:

1. **Convener** _____
2. **Member 1** _____
3. **Member 2** _____
4. **Member 3** _____
5. **Secretary, DRC, FAHS** _____