CHAPTER 5
DISCUSSION

“The only way to discover the limits of the possible is to go beyond them into the impossible.” …… Arthur C Clarke

Chapter overview.

This chapter discusses the findings of randomized control trial comparing sustained natural apophyseal glides, Maitland mobilization and conventional physiotherapy for treating lumbar facet joint syndrome. To the best of our knowledge, this study is the first RCT to scientifically quantify the effects of these treatments. The chapter begins with a summary of the main findings of the trial. It then provides a discussion of the outcomes of the trial followed by a discussion of how the results of this trial are comparable to the previous trials. At many places, the results and mechanisms have also been compared with other studies in chronic low back pain. Following this the clinical implications of the study, limitations and directions for future research are presented.

The findings of the present study highlights that both Maitland spinal mobilization and sustained natural apophyseal glides along are equally effective in reducing pain, disability and improving pressure pain threshold, however, the latter is more effective in improving spinal flexion and extension range of motion in cases with lumbar facet joint syndrome. Though back muscle endurance was improved in all three groups, difference between the groups was not statistically significant. To the author’s knowledge, this is the first registered controlled trial wherein manual therapy was used along with conventional physiotherapy as a part of the treatment protocol in participants with lumbar facet joint syndrome.

As there is a paucity of literature on the role of physiotherapy in facet joint syndrome, at many places in the discussion, mechanism of manual therapy techniques is discussed and compared with research on chronic low back pain due to evidence of similar results of manual therapy techniques when applied to the spine.

The results of our study showed significant improvement in pain (p< 0.001) at the end of 3rd week in both manual therapy groups as compared to conventional physiotherapy. Results of pain relief with Mulligan’s SNAGs technique in lumbar
facet syndrome are in agreement with the results of the case study by Exelby who reported success following a SNAGs treatment of a clinically diagnosed lumbar facet joint syndrome in 46 years old female.\textsuperscript{193} The researcher found that there was significant reduction in pain and improvement in spinal flexion range of motion. This was the only reported case study available on the role of SNAGs in lumbar facet syndrome when we planned our trial. The findings of the trial are also comparable to the case study by S. J. Horton\textsuperscript{73} on acute thoracic pain of facet origin which was treated by SNAGs technique. This case study concluded that significant reduction in pain level was observed after application of SNAGs. An unpublished study on lumbar facet dysfunction and use of Mulligan’s SNAG technique conducted by Bedard R\textsuperscript{226} also resulted in a pain free lumbar range of motion and normal function. Back pain relief in patients using SNAGs technique was also described by K. Konstantinou et al\textsuperscript{227} conducted a survey on therapist’s practicing in UK, which was aimed at investigating the use of mobilizations with movement (MWM) for LBP management in Britain. As a part of survey therapists were asked to indicate the most important potential treatment outcomes expected when using MWMs for LBP patients, 38.3\% (n = 178) reported ‘pain relief’ and 31.3\% (n = 147) reported ‘improvement in ROM’. Improvements in ROM and pain relief were reported as the most common immediate effects observed by therapists on application of Mulligan’s technique.

In a pilot study on the role of SNAGs and Maitland mobilization by Anap et al\textsuperscript{228} it was found that sustained natural apophyseal glides significantly reduces the pain originating from lumbar facet syndrome. Case series by Anap et al\textsuperscript{229} on four participants of lumbar facet syndrome in which participants were treated with SNAGs technique along with spinal exercises resulted in 49.87\% reduction in pain at the end of the treatment protocol.

Results of significant improvement in pain level in Maitland manual therapy group are in agreement to study done by Sean Hanrahan et al\textsuperscript{204} on the effects of postero-anterior Maitland’s lumbar mobilizations on pain and muscle force after an episode of acute, mechanical low back pain resulted in a 24-hour decrease in pain.

Passive joint mobilization techniques are commonly used by physiotherapists to address the problems of pain and joint stiffness, in order to allow pain free activities. A number of mechanisms have been proposed to explain how the analgesic effects of
passive joint mobilization are mediated. The significant decrease in facetal pain in manual therapy groups is attributed to the stimulation of mechanoreceptors in lumbar facet joints and its relationship to the surrounding musculature. Anatomical studies have already proved presence of four types of mechanoreceptors in lumbar facet joints which are responsible for proprioception. Stimulation of mechanoreceptors within the joint capsules of the facet, inhibits the nociceptive fibers in the area, thereby disrupting the pain spasm cycle. Sambajon et al explained that local mechanical disturbance caused by mobilization may modify the chemical environment inside the joint and thereby alter concentrations of inflammatory mediators which may lead to a reduction in the perceived pain. In addition, Wright et al hypothesized that mobilization may activate descending pain inhibitory systems, mediated supraspinally. This hypothesis was supported by animal studies showing that pressure on the facet joint (including the joint capsule) decreases activity of spinal cord dorsal horn neurons responding to nociceptive stimulation.

Role of gate mechanism in mobilization was also supported by Mangus et al. who postulated that joint mobilization controls pain through neurophysiological effects by stimulating type II mechanoreceptors while inhibiting type IV nociceptors. Passive joint mobilization provokes golgi tendon organ activity at the end of the joint mobilization and causes reflex inhibition of the muscle. Decreased muscle activity after joint mobilization decreases joint concentric activation, alleviating pain and muscle tension in periarticular tissue.

Adaption is another important mechanism explained by many authors for pain relief when manual therapy was included as important treatment component. It has been hypothesized that mobilization promotes adaptations of the nervous system with a decrease in the level of neural input from the painful site. Research also suggests that mobilizations increase the pain threshold levels - relative hypoalgesia.

The proposed mechanism(s) by which the Mulligans SNAGS technique exerts its ameliorative effects is by correcting positional faults of the facet joints that occur following injuries or strains to the joint. This hypothesized mechanism of action is based on a premise that a minor positional fault results following joint injury and that these faults are largely responsible for the pain and observed limitation of movement. Abbott in his study on role of MWM postulated that the technique may act neurophysiologically to decrease the level of contractile activity of the
muscles around affected joint. Reduction in pain levels with Mulligan’s technique could potentially decrease paraspinal muscle spasm and thus facilitate movement thereby mitigating the chance of ROM improvements. As reported by Horton, the patient may better tolerate the application of the SNAGs, since it theoretically replicates the correct physiological motion, in contrast to perpendicular posterior–anterior procedures that may produce non-physiologic motion and compression. We believe that the above explained multiple mechanisms are responsible for pain relief in facet joint syndrome when manual therapy techniques are used as part of treatment.

Zusman has described a rationale for the pain relief provided by manual therapy based on the theory of extinction and habituation. Pain may be considered as a form of aversive memory that once present could be more and more easily recalled. Behaviorally, a conditioned fear response may be reduced in intensity through extinction, a form of learning characterized by a decrease in a conditioned response when the conditioned stimulus that elicits it, is repeatedly nonreinforced such as it might occur during the SNAGs. In our study of participants with LBP of facet joint origin, trunk flexion and extension movements were the most painful. SNAG’s intervention provided exposure to the painful movement in the absence of any overt danger, which is fundamental to interventions used in the extinction of aversive memories. These proposed mechanisms of action described here might explain the significant difference observed on outcome measures in favor of manual therapy techniques as compared to conventional physiotherapy alone.

Pain relief which was seen in both the groups is also contributed by addition of therapeutic ultrasound to the treatment protocol. A randomized control trial by N.N. Ansari in which the effect of continuous ultrasound was studied in chronic low back participants showed improvement in functional ability because of a significant reduction in pain level. Dyson M explained that continuous movement of the ultrasound applicator may increase the temperature of the area under treatment and stimulates the skin receptors activating the gate control mechanism.

Nwuga studied the use of ultrasound in participants diagnosed with acute prolapsed intervertebral disc in the lumbar spine. The ultrasound treatment group demonstrated a statistically significant improvement in self rated pain, spinal range of motion, and straight leg raise range of motion over control and placebo ultrasound groups. Mirsad Muftic et al in their study on the effect of continuous ultrasound on pain caused by
degenerative diseases of the musculoskeletal system found that that application of continuous ultrasound on chronic pain, caused by degenerative changes in the musculoskeletal system, led to a significant reduction in pain.

These effects together may lead to improvement in pain, back muscle spasm and functional status in facet syndrome patients. The absorption of ultrasonic waves in the tissues is suggested to cause an oscillation within those tissues. The oscillations are believed to produce both thermal and nonthermal effects within those tissues. Williams et al.\textsuperscript{248} found that when ultrasound is applied with 1MHz frequency and intensity of 1w/cm\textasciicircum{2} the temperature increased at the rate of 0.86 °C/minute in the tissues. Morrisette et al.\textsuperscript{249} stated that the temperature elevation by ultrasound treatment with intensity either 1.5 w/cm\textasciicircum{2} or 2w/cm\textasciicircum{2} is at a level thought to be sufficient to produce the therapeutic effects proposed with an elevation in temperature, such as reduction in pain, spasm and alteration of nerve conduction velocity. It was found that 10 minutes of ultrasound given at 1.5 w/cm\textasciicircum{2} applied to an area twice the size of the transducer, produced a mean temperature increase of 1.9°C, in the region of the L4-L5 zygapophyseal joint. The deep heating treatment with ultrasound is reported to increase collagen tissue extensibility, alter blood circulation and enhance enzymatic activity within the tissues. The pain relief and thermal effect of ultrasound on tissue extensibility may also contribute to improvement in lumbar spine range of motion in the lumbar facet joint syndrome participants, when used along with sustained natural apophyseal glides and Maitland spinal mobilization techniques.

Our results showed significant improvement in pressure pain threshold (PPT) (p<0.001) at the end of 3rd week in both manual therapy techniques as compared to conventional physiotherapy. These results are in concordance with study by Elaine Willett et al.\textsuperscript{34} in which they investigated the effects of Maitland’s lumbar postero anterior mobilizations on PPT demonstrating an immediate and significant improvement in PPT measures (p=0.000) irrespective of the rate or site tested. Similar findings are also demonstrated in a study by Oliver Krouwel\textsuperscript{207} in which they explored the extent of pain reliving effects seen following Maitland’s central PA glides at different frequency of oscillations. Results demonstrated a significant increase in PPT following lumbar mobilizations (p = 0.013) at all measured sites. This study also suggested that in asymptomatic subjects a systemic hypoalgesic response is
caused by lumbar mobilization regardless of amplitude. Our results also correspond with evidence from spinal mobilization which demonstrated improvements in PPT to approximately 25% and 30% following MWM technique.\textsuperscript{250}

A study by Teys Pet al.\textsuperscript{251} Mulligan's mobilization with movement technique on shoulder pain demonstrated significant change in PPT. These studies, along with others have proposed that manual therapy may provide sufficient sensory input to activate the endogenous pain inhibitory systems leading to improvement in PPT. Improvements in PPT have also been demonstrated when MWM technique was applied to lateral epicondylalgia patients.\textsuperscript{252}

Another possible mechanisms for improvement in pressure pain threshold include both segmental and central inhibitory mechanisms. Local effects\textsuperscript{253} could result from the stimulation of large-diameter low-threshold mechanoreceptors at the spinal cord level,\textsuperscript{254} according to the gate control theory.\textsuperscript{255} Zusman\textsuperscript{237} suggested that spinal manual procedures might produce a decrease in joint afferent activity in facet area. Thus, it was shown by many researchers that spinal mobilization and peripheral mobilizations immediately reduce mechanical hyperalgesia more than the control procedure. In accordance with investigations of other measures, an improvement of more than 15% may be considered to reflect a clinically significant effect\textsuperscript{256}, which was also observed in our study.

A recent in vitro study of healthy animal fibroblasts by Sambajon et al\textsuperscript{231} suggested that movements may alter concentrations of inflammatory mediators which are known to sensitize peripheral nociceptors. Levels of prostaglandin (PGE), an inflammatory mediator strongly implicated in arthritic hyperalgesia, were assessed before and after fibroblast cells were subjected to cycles of mechanical deformation, designed to mimic mobilization effects. After mobilization these mobilized cells were found to contain nearly 70% less PGE than undisturbed cells.

Between the group analysis showed no significant (p =0.1050) improvement in back muscle endurance at the end of the 3\textsuperscript{rd} Week. These results are in contrast to the study done by Sevtap Günay\textsuperscript{215} et al in which they compared classical strengthening exercises with endurance exercises in low back pain participants. At the end of the study, they found that back muscle endurance time was significantly higher in the muscle endurance training group than that of the control group (p<0.05). These results
could be due to short duration of exercise programme i.e 3 weeks exercise programme included in our study as compared 6 weeks by Gunay et al.\textsuperscript{215}

On statistical analysis within the groups, there was significant improvement in the back muscle endurance by the end of 3\textsuperscript{rd} week in all the three groups. The reduction in pain in the manual therapy groups may be due to the gain in the endurance of the back extensor muscles following training, as it has been suggested that poor endurance of trunk muscles may induce strain on the passive structures of the lumbar spine like facet joints, leading to low back pain. These muscles help the body to maintain a natural posture and control the body while flexing and extending. Hence based on this theory, we conclude that reduction of trunk muscle endurance leads to muscle fatigue and increased pressure on the soft tissues and facet joints in the spine lead to injuries of these structures.\textsuperscript{257}

Muscular endurance is an important component of physical fitness and functional ability of the human body. In this regard, most of the researches have evaluated the role of trunk muscles in protecting the spine from harmful pressures. Also, since the muscles endurance capacity indicates the fatigue of muscles, it is believed, that people with less muscular endurance in trunk muscles, are more prone to structural pressures; it may cause inappropriate pressure on the facet joints leading to chronic low back pain.\textsuperscript{258}

Pain in itself has been reported to precipitate decreased muscle endurance resulting from increased muscle metabolite from prolonged muscle tension and spasm,\textsuperscript{259} muscle deconditioning\textsuperscript{260} and inhibition of the paraspinal muscles.\textsuperscript{260} Researches also showed that there was a significant correlation between low back pain and back muscles endurance.\textsuperscript{261} Hence, good muscular endurance and coordination of the involved muscles are the most important factors in prevention and treatment of musculoskeletal disorders such as chronic low back pain related to facet syndrome.

In the current study, we found that there was significant reduction in MODQ score in Maitland and SNAGs group (p<0.001) as compared to conventional physiotherapy. Exercise had a beneficial effect on the emotional and cognitive aspects of the pain experience. The subject’s pain perception may have influenced their perception of disability as a result of their back pain. This argument is supported by the strong positive correlation between pain and disability as measured by the MODQ. As the
pain scores decreased, the MODQ scores also decreased. The reduction of pain may have enabled the participants to carry on with their activities of daily living, and thus they reported reduced disability. So from our results we state that as the level of pain reduced after SNAGs and Maitland mobilization combined with exercises, the level disability also reduced. There are reports which indicate that endurance training of the low-back extensors can be effective to elevate fatigue threshold and improve performance, thus reduce disability\textsuperscript{262,99} and decrease work loss\textsuperscript{98}.

Spinal flexion and extension ROM was significantly improved in SNAGs group (p<0.0001) as compared to Maitland and conventional group. Our results are comparable to the study on immediate and short-term effects of lumbar Mulligan sustained natural apophyseal glides (SNAGs) on patients with nonspecific low back pain with respect to range of motion and speed as well as pain, functional disability, and kinesiophobia. This study concluded with the improvement in spinal ROM, pain and kinesiophobia\textsuperscript{199}. Another study investigated patients with LBP and showed a significant increase in trunk flexion ROM. 9 (73\%) of 26 subjects benefited from MWMs techniques in terms of range of movement in this study\textsuperscript{194}. Our results shows that lumbar SNAGs reduced pain at both rest and during active trunk flexion-extension and also increased trunk ROM. The effectiveness of SNAGs was not limited to just pain decrease and improved ROM but also to better functional ability in people with lumbar facet syndrome.

The exact mechanism of potential action for lumbar SNAGs on ROM is not known, as no studies have yet investigated this. However, there are proposed biomechanical and neurophysiologic mechanisms. Biomechanically, there are some similarities between posteroanterior mobilization undertaken in prone lying and a SNAG. Lee and Evans\textsuperscript{263} reported that a posteroanterior glide on the L5 spinous process induced anterior translation of the L5 vertebra and flexion at the L5-S1 segment. The biomechanical effects of a lumbar SNAG may be enhanced by the cranial direction of the glide along the facet joint plane, together with the active trunk movement.

According to Mulligan, another proposed mechanism for beneficial effect of SNAGs could be because of the application of the accessory glide component of a SNAG which repositions the superior facet supero-anteriorly, allowing a greater pain-free ROM\textsuperscript{264}. The accessory glide component of a SNAG could potentially facilitate pain-free motion by distracting the ipsilateral functional spinal unit (FSU). Mulligan, as
cited by Exelby,\textsuperscript{76} proposed that when an increase in pain-free ROM occurs with a SNAG it is primarily the correction of a positional fault at the zygapophyseal joint, although a SNAG also influences the entire spinal functional unit (SFU). Mulligan’s original theory for the effectiveness of an MWM is based on the concept related to a ‘positional fault’ that occur secondary to injury and lead to maltracking of the joint; resulting in symptoms such as pain, stiffness or weakness.\textsuperscript{224} The cause of positional faults has been suggested to be due to changes in the shape of articular surfaces, thickness of cartilage, orientation of fibers of ligaments and capsules, or the direction and pull of muscles and tendons. MWM’s correct this by repositioning the joint causing it to track normally and improve range of motion.\textsuperscript{75}

Combining the accessory joint glide in facetal plane with a physiological spinal movement (i.e. lumbar flexion), is argued to overcome the (biomechanical) joint problems in lumbar facet that may be the cause of symptoms.\textsuperscript{75,76} The use of MWMs in combination with other physiotherapeutic techniques in the overall management of chronic low back pain related to facet joints is in accordance with Mulligan’s\textsuperscript{224} suggestion that ‘other physiotherapy should also be given’ in addition to MWMs.

Mobilization techniques are often used with the objective to increase the range of motion of the joint through stretching of fibrous tissue.\textsuperscript{265} This stretching may cause the tissue to ‘creep’. This mechanical effect of mobilization enables an increase in range of motion at the joint. Although our study aim was not to address the specific mechanism by which pain and motion were influenced by the two interventions, it is interesting to consider what changes may have occurred during both treatment procedures. Both mechanical and neurophysiological mechanisms have been described to explain pain reduction and improved mobility following joint motion or mobilization, and it is conceivable that both mechanisms played a role in the findings of the present study. For example, passive motion has been reported to selectively stretch contracted tissues without damaging healthy adjacent tissues.\textsuperscript{266} In addition, repetitive movements are thought to distribute synovial fluid over the articular cartilage and disk, resulting in less resistance to motion.\textsuperscript{267} With less resistance to motion, subjects may have felt free to move and thus, may have experienced less pain.
The results showed, that clinically, inclusion of Mulligans mobilization with movement and Maitland spinal mobilization along with conventional physiotherapy is more beneficial than conventional physiotherapy alone in cases of Lumbar facet syndrome.

Limitations

The current study compared different methods to treat lumbar facet syndrome. All these methods have been independently shown to be effective but a comparison of these various methods was never done prior to this study. Having achieved this basic aim, long term follow up of patients was therefore not attempted.

The participants were unaware of the different interventions but the Investigator was not blinded. Although theoretically this can introduce bias, an attempt to reduce it was done by obtaining standardised response from all patients; irrespective of their subgroups.

It is possible that specific gender wise data analysis could through more light on the research topic / provide additional information about the research topic.

Need for complex interventions and investigations prevented study of cause and effect relationship.

Suggestions and Recommendations

Further research should be undertaken for long term follow up of participants.

Double blind study design can prevent the possible bias in the study.

Additional data analysis for gender and age specific groups and possibly profession specific groups would definitely add important information.

Clinical Implications

This is the first scientific study to directly compare the effectiveness of different treatment methods in patients with chronic low back pain of facetal origin.

This study proves that Maitland’s spinal mobilization and Mulligan SNAGS along with spinal exercises was found to be effective in improving symptoms of the patients. So after the patient has been examined and diagnosed, appropriate treatment
method can thus be used either singly or in combination to treat the underlying cause and relieve them of the symptoms.

Armed with this scientific information any modern physiotherapist can successfully treat the affected individuals and in fact due to the sound scientific basis of this study-it won’t be long before

**Conclusion**

Sustained natural apophyseal glides and Maitland’s spinal mobilization are equally effective in reducing pain, disability and improving pressure pain threshold but sustained natural apophyseal glide is more effective in improving flexion and extension range of motion in spine. Back muscle endurance improved in all three groups but difference was not statistically significant.