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Mulligan mobilization versus traction in lumbar facet joint syndrome: randomized controlled trial

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ABSTRACT

The aim of this study was to investigate and compare the effect of Mulligan mobilization, lumbar traction and their combination on pain, functional disability and facet tropism in patients with facet joint syndrome. Sixty patients with facet joint syndrome from both sexes and aged 30 to 50 years participated in the randomized controlled trial design. They were referred from orthopedic and neurological clinics and divided into four groups as follows: group A received Mulligan mobilization and conventional treatment, group B received lumbar traction and conventional treatment, group C received Mulligan mobilization in combination with lumbar traction in addition to conventional treatment, while group D (control group) received the conventional treatment only. All participants received 3 treatment sessions per week for one month. The assessments were done before and after one month of treatment using Visual Analogue Scale (VAS) for pain, Oswestry Disability Index (ODI) for functional disability, and magnetic resonance image (MRI) for facet joint tropism. Statistically significant improvement was found in pain and functional disability in all four groups post-treatment ($p<0.05$), compared to pre-treatment, with the study groups (A, B and C) having a higher improvement than the control group (D). The improvement in group C was significantly higher than in groups A and B ($p<0.05$), and the improvement in group A was significantly higher than in group B ($p<0.05$). Regarding the facet joint tropism, there was a statistically significant improvement in the four groups post-treatment ($p<0.05$) compared with pre-treatment, with higher significant improvements in the study groups (A, B, C) in comparison with the control group (D).

There was no statistically significant difference in tropism between groups A, B and C. The combination of Mulligan mobilization and lumbar traction (group C) was the most effective treatment for relieving pain and functional disability in patients with facet joint syndrome. Regarding facet tropism, there was a statistically significant improvement with all the treatments, but the conventional treatment produced the lowest improvement.

KEYWORDS

Mulligan mobilization; Lumbar traction; Facet joint syndrome

1. INTRODUCTION

In fifteen to forty percent of people suffering from persistent low back pain, facet joint of the lumbosacral spine is considered to be the cause of pain (LBP). Goldthwait (1911) was the first to mention that LBP was caused by the facet joint. Since that time, "facetogenic back pain" has become commonly recognized; however, the entity in radiological and orthopedic literature is still debatable (Manchikanti & Pampati, 2002). Investigations showing successful alleviation of back discomfort after intraarticular or periarticular injections provide the best circumstantial basis (Manchikanti et al., 2003; Bogduk & McGuirk, 2002). In 1933, Ghormley coined the term “facet syndrome”, implying that lumbar nerve root entrapment caused by hypertrophic alterations subsequent to osteoarthritis of the zygapophyseal processes resulted in LBP (Ghormley, 1933).

With weight bearing, facet orientation influences the degree of rotation in multiple body planes and offers rotational coupling in the lumbar spine (van Schaik et al., 1997). Tropism is an abnormality of facet joint orientation that has been linked to a number of spinal illnesses that cause back discomfort, including degenerative disc disease (DDD) (Boden et al., 1996), facet joint osteoarthritis (Kalichman et al., 2009) and spondylolysis (Chung et al., 2012).

Through the stimulation of joint mechanoreceptors, joint mobilization procedures are hypothesized to help patients with lumbar mechanical dysfunction. These receptors are thought to affect the pain-spasm cycle by inhibiting hypertonic muscles and presynaptic regulation of nociceptive fibres in related regions, which improves functional outcomes (Solomonow et al., 1998).

Mulligan introduced a relatively novel approach to manual therapy that included mobilizations with movement or sustained natural apophyseal glides. When it comes to the lumbar spine, during active motions, accessory glide is performed along the plane of the zygapophyseal (facet) joint in the weight-bearing posture. These spinal procedures, according to Mulligan, relieve symptoms by aiding the limited mobility of the facet joint while also affecting the intervertebral joints mobility. The therapeutic appropriateness and success of these procedures is determined by their ability to produce immediate improvements in pain perception and spinal mobility in a pain-free way (Ghai & Ghai, 2014).

Traction is one of the most well-known therapies for low back pain (LBP). Since Hippocrates, lumbar traction has been utilized in various forms, and it is still employed in today's therapeutic context (Cyriax, 1981). Lumbar traction is used to treat degenerative disc disease, disc bulge (herniation), sciatica and facet joint syndrome (Anwar et al., 2016).

Spinal traction is a conservative treatment option for a variety of neck and back problems. The therapeutic effects of traction have been linked to a number of processes. Axial traction helps to relieve pain by increasing circulation and reducing adhesions and contractures in the spine (Hattori et al., 2002; Ozturk et al., 2006). Spinal traction may increase the intervertebral disc space, causing the posterior longitudinal ligaments to stretch, and this condition may be linked to the suction impact of the negative intradiscal pressure and the pushing action of the posterior longitudinal ligaments (Lee & Evans, 2001).

Although various researches have examined the traction effects (measured by clinical pain and disability scores, or evidence of neurological abnormalities), the underlying alterations in spinal structures must be addressed for more understanding of the possible therapeutic effects (Moeti & Marchetti, 2001).

There is a gap in the available literature concerning the effect of Mulligan mobilization and lumbar traction on facet tropism in patient with facet joint syndrome. So, this study was conducted to analyze that effect. Also, this study may add information about the management of facet joint syndrome and this may be helpful for the physiotherapists in the public hospitals and the private clinics.

2. METHODS

2.1. Study Design and Participants

Individuals aged 30-50 years old with facet joint syndrome were enrolled in this randomized controlled clinical study. Patients who had facet joint syndrome were included in the study, while patients with spinal surgery and spinal trauma, patients who had manipulation under anesthesia (MUA), patients with metabolic disorders, osteoporosis, spinal tumors and pregnant women were excluded from the study. Patients diagnosed with the facial joint syndrome were referred by an orthopedist or neurosurgeon for physical therapy at Cairo University's Faculty of Physical Therapy's outpatient clinic between January 2019 to March 2021. All participants signed written informed consent to be part of research. Collaboration with human participants in this research has been approved by the authors institutional review board at the Faculty of Physical Therapy, Cairo University, with Approval Date: 10/9/2017 and Approval Number: P.T.REC/012/001697.

2.2. Intervention

All groups received conventional treatment for facet syndrome that included ultrasound therapy (continuous 1MHz, 2.0 W/cm2, 10 min) (Anap et al., 2014). For the hamstrings, iliopsoas, and back extensors, manual passive stretching techniques were utilized (Kisner & Colby, 2012; McAtee, 2013) as well as progressive abdominal and back extensor strengthening exercises (Hussien et al., 2017). Subjects in group A received Mulligan Sustained Natural Apophyseal Glides (SNAG) in addition to the conventional treatment. Therapists performed “SNAG" on the affected lumbar level. Participants completed an active flexion 6 times while the therapist performed SNAG from a comfortable sitting position on a plinth. A belt was used and force was applied to the lumbar facet joints in a parallel direction, via the therapist's ulnar styloid process to the skin over the appropriate spinal level, after palpation of the spinous process (to be mobilized). Mulligan's rule of three was followed for three sets of mobilization, with a one-minute break between sets (Deepak et al., 2014). For each level, the SNAG dosage was three sets of six repetitions three times per week for one month (Moutzouri et al., 2012; Hing et al., 2015). Subjects in group B, received lumbar traction in addition to conventional treatment. Lumbar traction was performed three times per week for one month and every session lasted for 20 minutes with patients in a semi fowler position on the traction table. After releasing the sliding table top, the canvas bracing were wrapped over the iliac crest and lower thoracic region. The physiotherapist gradually increased the traction force until it reached a maximum of 50% of the body weight. The same traction device was used to treat all the patients (Chattanooga) (Borman et al., 2003). Subjects in group C received Mulligan mobilization, lumbar traction and the conventional treatment, while subjects in group D received conventional treatment only.

2.3. Outcome measures

The participants' demographic and descriptive data including age, gender, height, weight and body mass index (BMI) were collected. All measurements were done pre and post treatment. The pain intensity was measured by the visual analogue scale (VAS), which utilizes a horizontal line of 10 cm that is graded from zero to ten. Zero indicates no pain and ten indicates the most severe pain. The patients were given instructions to make a mark along the line at the place that corresponded to their pain level. Valid data for chronic pain can be obtained using a visual analogue scale (Scrimshaw & Maher, 2001). Functional impairment was measured by the Oswestry Low Back Pain Disability Questionnaire, which includes ten sections covering various areas of function. Each section is given a score ranging from zero to five. The total score was converted to a percentage, with lower scores indicating less impairment (Fair bank et al., 1980). Facet joint angles were measured on axial images of MRI according to Gobbler's method. The procedure was as follows: a line was drawn to join two points determined in the most posterior part of the vertebral body. Then two anterior and posterior points on the inner surface of the facet joint were determined and the joining line was withdrawn to the former coronal line and the angle was measured (Grobler et al., 1993; Naderi et al., 1997).

2.4. Sample Size

G*Power was utilized to establish the size of the sample a priori (version 3.1.9.2). The effect size 0.54 of the primary outcome variable (facet tropism) was derived from a pilot research done on 5 participants in each group and the type I error rate was set at 5% (alpha-level 0.05). The type II error rate was set at 80 percent power. A minimum sample size of 32 participants was appropriate for this study.

2.5. Statistical Analyses

Prior to analysis, Shapiro-Wilk test was used to check the normality of the data. To determine group homogeneity, Levene's test for homogeneity of variances was used. Data were normally distributed and there was a homogeneity of variance. To compare subject characteristics between groups, descriptive statistics and the ANOVA test were used. The sex distribution between groups was compared using the Chi Square test. Mixed MANOVA was used to compare the effect of time (pre vs post) and the effect of treatment (between groups), as well as the interaction between time and treatment on mean values of VAS, ODI (Oswestry Disability Index) and tropism. For subsequent multiple comparisons, post-hoc test using the Bonferroni correction were used. For all statistical tests, a p-value of <0.05 was considered statistically significant. The statistical analysis was carried out using the Statistical Package for Social Sciences (SPSS) version 25.

3. RESULTS

3.1. Subject characteristics

The subject characteristics of groups A, B, C, and D are shown in Table 1. There was no statistically significant difference between groups in age, weight, height and BMI (p>0.05). In addition, sex distribution between groups had no statistically significant difference (p>0.05).

Table 1. Basic characteristics of participants

	Group A	Group B	Group C	Group D	p-value
	Mean ± SD	**Mean ± SD**	**Mean ± SD**	**Mean ± SD**	
Age (years)	40.13 ± 5.27	37.46± 7.97	38.53 ± 6.68	39.2 ± 6.18	0.73
Weight (kg)	64.2 ± 6.16	65 ± 7.69	65 ± 7.88	67.26 ± 6.78	0.67
Height (cm)	167.66 ± 4.51	167.33 ± 6.55	168.73± 6.52	171.06± 5.73	0.3
BMI (kg/m²)	22.78 ± 1.2	23.13 ± 1.36	22.74± 1.42	22.93± 1.22	0.84
Sex, n (%)					
Females	5 (33%)	6 (40%)	7 (47%)	5 (33%)	0.85
Males	10 (67%)	9 (60%)	8 (53%)	10 (67%)	

**NOTE: SD (standard deviation); p-value (level of significance)*

3.2. Effect of treatment on VAS, ODI and tropism

A statistically significant interaction of treatment and time was detected using mixed MANOVA (Wilks' Lambda = 0.15; F = 16.81, p = 0.001, = 0.46). There was a statistically significant main effect of time (Wilks' Lambda = 0.01; F = 1232.17, p = 0.001, η^2 = 0.98), also a statistically significant main effect of treatment (Wilks' Lambda = 0.4; F = 6.64, p = 0.001, η^2 = 0.26).

3.3. Within groups comparison

There was a statistically significant reduction in VAS, ODI and tropism after treatment compared to the pre-treatment condition of group A (p> 0.001), group B (p <0.001), group C (p <0.001) and group D (p <0.01) (Table 2).

3.4. Between groups comparison

There was no statistically significant difference between groups in all pre-treatment parameters ($p>0.05$). The VAS and ODI of groups A, B, and C were significantly lower than those of group D ($p=0.0001$). The VAS and ODI of group C were significantly lower than those of groups A ($p=0.01$) and B ($p=0.001$). The VAS and ODI of group A were significantly lower than those of group B ($p=0.05$). Also the tropism of groups A, B, and C was significantly lower than tropism of group D ($p=0.0001$). There was no statistically significant difference in tropism between groups A & B, A & C, and B & C ($p>0.05$) (Table 3).

Table 2. Pre and post-treatment mean values of VAS, ODI and tropism of group A, B, C and D.

	Group A Mean ± SD	**Group B** Mean ± SD	**Group C** Mean ± SD	**Group D** Mean ± SD
VAS				
Pre	8.33 ± 0.61	8.2 ± 0.56	8.53 ± 0.63	8.46 ± 0.74
Post	3.13 ± 0.74	4.06 ± 0.7	2.13 ± 0.51	5.33 ± 0.81
MD (95% CI)	5.2 (4.82: 5.57)	4.14 (3.75: 4.5)	6.4 (6.02: 6.77)	3.13 (2.75: 3.5)
	p = 0.001	***p = 0.001***	***p = 0.001***	***p = 0.001***
ODI (%)				
Pre	67.4 ± 8.09	65.4 ± 7.21	66.6 ± 6.05	69.86 ± 6.6
Post	26.16 ± 4.9	32.28 ± 6.89	17.37 ± 4.38	43.84 ± 7.06
MD (95% CI)	41.24 (37.83: 44.65)	33.12 (29.71: 36.52)	49.23 (45.81: 52.63)	26.02 (22.61: 29.42)
	p = 0.001	***p = 0.001***	***p = 0.001***	***p = 0.001***
Tropism (degrees)				
Pre	7.62 ± 2.86	8.9 ± 4.09	8.12 ± 1.24	8.46 ± 1.85
Post	3.25 ± 1.65	4.13 ± 1.13	3.02 ± 0.97	7.08 ± 1.6
MD (95% CI)	4.37 (3.35: 5.39)	4.77 (3.75: 5.79)	5.1 (4.08: 6.11)	1.38 (0.36: 2.4)
	p = 0.001	***p = 0.001***	***p = 0.001***	***p = 0.009***

** Note: SD (Standard deviation); MD (Mean difference); CI (Confidence interval); p-value (level of significance); VAS (Visual Analogue Scale); ODI (Oswestry Disability Index)*

Table 3. Comparison of pre and post-treatment mean values of VAS, ODI and tropism between groups A, B, C and D.

	VAS		ODI		Tropism	
	Pre	**Post**	**Pre**	**Post**	**Pre**	**Post**
	P value	**P value**	**P value**	**P value**	**P value**	**P value**
Group A vs Group B	1	0.004	1	0.03	1	0.5
Group A vs Group C	1	0.002	1	0.001	1	1
Group A vs Group D	1	0.001	1	0.001	1	0.001
Group B vs Group C	0.97	0.001	1	0.001	1	0.18
Group B vs Group D	1	0.001	0.52	0.001	1	0.001
Group C vs Group D	1	0.001	1	0.001	1	0.001

**NOTE: p-value (level of significance); VAS (Visual Analogue Scale); ODI (Oswestry Disability Index)*

4. DISCUSSION AND CONCLUSIONS

The main findings of our study revealed that combination of Mulligan mobilization and lumbar traction in group C was more effective than the treatments of the other groups (A, B, C) in reducing pain and functional impairment in patients with facet joint syndrome. Between the study groups (A, B, C), there was no statistically significant difference in the improvement of facet tropism but the three study groups had a statistical significant effect higher than the control group (D) in patients with facet joint syndrome.

When comparing the current study's findings to those of prior research about the efficacy of Mulligan methods, the majority of them focused on the efficacy of Mulligan mobilization on peripheral joints (Amro et al., 2010; Teys et al., 2008) and the cervical spine (Pérez et al., 2014; Reid et al., 2008) but just a few of them have focused on the lumbar spine. The mechanism of action of lumbar SNAGs has been hypothesized using biomechanical and neurophysiologic processes. There is certain biomechanical similarity between prone lying posteroanterior mobilization and a SNAG. A posteroanterior mobilization on the L5 vertebra spinous process caused anterior translation of the L5 and bending at the L5-S1 level. The cranial direction of the glide, along the facet joint plane with active trunk movement, may improve the lumbar SNAG's biomechanical effects (Lee & Evans, 1997). Mulligan theorized that a reduction of proper facet joint gliding in flexion might cause the disc to deform and cause discomfort. As a result, increasing facet gliding may help to normalize disc forces and relieve discomfort (Mulligan, 2004). The theories of habituation and extinction might also be an available explanation. Based on this theory, people who regularly suffer from discomfort during flexion have a conditioned fear of engaging in any activity that involves such movement. Patients were gradually exposed to this frightening movement during SNAG mobilization, which resulted in no discomfort or even immediate improvement. The unpleasant memory (painful trunk flexion) is habituated and extinction occurs after successful repetition of the flexion exercise (Hidalgo et al., 2015). According to Vicenzino, the non-opioid endogenous pain inhibition pathways may be responsible for the immediate pain reduction provided by SNAGs (Vicenzino et al., 2011). SNAGs have certain psychological consequences. Self-efficacy was shown to be strongly linked to distress and pain intensity in a meta-analysis (Jackson et al., 2014). Fear avoidance may be reduced as a result of SNAGs; hence, functional improvement is obtained through increased activity.

Concerning pain and functional disability, our findings are in agreement with a previous study that concluded that, in terms of pain relief and physical disability improvement in chronic low back pain patients, the treatment benefits of SNAG' with LLLT and SNAG groups may both be clinically important and statistically significant (Seo et al., 2020). According to Seo et al. (2020) study, physical disability improvement can be attributed to a variety of factors. Firstly, SNAGs have the potential to block nociceptors. The improvement in physical impairment may be attributed to the correction of the lumbar facet joint's positional fault, which results in normal function and the relaxation of muscle guarding surrounding the joint. Secondly, SNAGs may have psychological impacts as a result of the reduced fear. Repeated experiences of painful movement without discomfort may have decreased the strength of conditioned reaction through extinction; thus, the impairment is decreased (Mulligan, 2004).

Another study found that lumbar spine SNAGs had a short-term positive effect on pain and function in those with nonspecific low back pain (Hidalgo et al., 2015). Heggannavar & Kale (2015) reported that modified lumbar SNAG demonstrated an immediate impact on pain and Back Performance Scale score in non-specific chronic low back patients. Also, Hussien et al. (2017), in a previous study that was conducted to examine the effects of incorporating SNAG mobilization into a standard treatment regimen for chronic nonspecific low back pain patients, reported that combination between SNAG mobilization and standard treatment regimen may lead to improving the repositioning error, pain intensity and function level. In addition, Anap et al. (2014) reported that in lumbar facet syndrome, sustained natural apophyseal glide significantly reduces pain, reduces disability and increases back muscular endurance.

In contrast with the current study, Konstantinou et al. (2007) reported that, after lumbar SNAGs were applied to individuals with LBP, there was a significant improvement in the trunk flexion movement without significant improvement in discomfort. This may be because in this study, extension and pain were measured immediately before and after each session but in our study the measurements were after 12 sessions, so future research should focus on the long-term impact of lumbar SNAGs.

Similarly, the current study findings reported that lumbar traction was effective to improve pain and functional disability and these findings are due to the various physiological and mechanical effects that include vertebral bodies separation, facet joints distraction and gliding, intervertebral foramen widening, ligamentous structures tensing, spinal curves straightening and spinal musculature stretching (Olivero & Dulebohn, 2002). Traction has also been shown to help with pain relief by relaxing muscles, stimulating mechanoreceptors, and inhibiting reflex muscle guarding (Graham et al., 2006). These results are in agreement with Fritz et al. (2007) study, which was conducted to compare the effects of an extension-oriented intervention with or without mechanical traction during the first two weeks. Fritz et al. (2007) reported that, after 2 weeks, patients undergoing traction showed larger decreases in impairment and fear-avoidance attitudes with no differences after 6 weeks. Also, the current study results are in agreement with a systemic review done by Cheng et al. (2020) that was aimed to assess the efficacy of lumbar traction on low back pain, functional abilities and disc morphology in patients with intervertebral disc herniations, and found that lumbar traction resulted in considerably greater pain reduction and functional improvement. In addition, another research conducted by Anwar et al. (2016), which investigated the effects of Lumbar Decompression therapy in patients with low back pain (measured with the Oswestry pain scale questionnaire), concluded that lumbar decompression therapy is very effective in treating low back pain. Kamanli et al. (2010) investigated the outcome of conservative physical therapy (hot packs, ultrasound and TENS) with traction (intermittent) in patients with low back pain caused from herniated lumbar disc utilizing magnetic resonance imaging and clinical features. Physical examination of the lumbar spine, severity of pain, sleep disorders, patient and physician global assessment with VAS, functional impairment by HAQ, Roland Disability Questionnaire, and Modified Oswestry Disability Questionnaire were assessed. Conservative physical treatments with lumbar traction were shown to be beneficial in dealing with patients suffering from subacute herniated lumbar disc in this research.

Unlike the outcomes gained in the current research for traction group, Borman et al. (2003) examined the effect of traction on individuals suffering from persistent non-specific low back pain and concluded that there is no effect of adding lumbar traction to standard physical therapy programs in terms of pain and functional disability. A study by Schimmel et al. (2009) investigated the impact of IDD Therapy (intermittent traction) when added to a regular graded activity programme for chronic LBP patients, and they found that adding axial, intermittent and mechanical traction to a regular graded activity programme was not helpful.

Also, the results are not in agreement with Beurskens et al. (1995) study, which was conducted to compare the efficacy of continuous motorized lumbar traction and sham traction on the degree of improvement in individuals having persistent non-specific low back discomfort, and concluded that high dose traction was not effective for individuals suffering persistent non-specific low back discomfort. Differences between the findings of the current and the previous studies could be due to the differences in LBP diagnostic categories, the traction device used, the mode of traction and the frequency of traction sessions.

In the available literature there were no previous studies that investigated the effect of Mulligan mobilization or lumbar traction on facet joint tropism, while there were studies about the efficacy of combination between spinal manipulation and physical therapy programme on pain severity, physical disability and asymmetry of facet angles of lumbar spine in patients with herniated lumbar disc, which reported that spinal manipulation coupled with a suitable physiotherapy programme has beneficial effect on pain severity, physical disability, and asymmetry of facet angles of lumbar spine in patients with LDH.

This study is considered critical because it was a comprehensive study that investigated and compared the effects of Mulligan mobilization and lumbar traction in patients with facet joint syndrome. Our findings suggested that the combination of Mulligan mobilization and lumbar traction (group C) was more effective than the treatments of the other groups (A, B, C) in relieving pain and functional disability in patients with facet joint syndrome. There was no statistically significant difference between the study groups (A, B, C) in the improvement of facet tropism, but the three study groups had a statistically significant effect higher than the control group (D) in patients with facet joint syndrome.

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CONFLICTS OF INTEREST

The authors declare no conflict of interest.

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