Physiotherapy and Occupational Therapy Journal

POTJ

Editor-in-Chief
Meenakshi Singh
Amity Institute of Physiotherapy, Noida

Associate Editor
Senthil P Kumar
School of Allied Health Science and Research, Sharda university, Greater Noida

Executive Editors
H.L. Sharma, S. Sharma

Indexing information: *NLM catalogue & locator plus, USA; Index Copernicus, Poland; EBSCO Publishing's Electronic Databases, USA; Academic Search Complete*, USA; *Academic Search Research & Development, USA; ProQuest, USA; Genamics JournalSeek, OCLC World Cat.*

Corresponding address
Red Flower Publication Pvt. Ltd.
48/41-42, DSIDC, Pocket-II, Mayur Vihar, Phase-I
Delhi - 110 091 (India)
Tel: 91-11-22754205, 45796900, Fax: 91-11-22754205
E-mail: info@rfppl.co.in
Website: www.rfppl.co.in

The Physiotherapy and Occupational Therapy Journal's (pISSN: 0974–5777, eISSN: 2455-8362, Registered with Registrar of Newspapers for India: DELENG/2007/22242) on topics pertaining to physical therapy and rehabilitation. Coverage includes geriatric therapy, pain management techniques, cardiac, orthopaedic and pulmonary rehabilitation, working with stroke patients, occupational therapy techniques and much more. The editorial contents comprise research papers, treatment notes and clinical observations, case histories, professional opinion and memoirs and comments on professional issues. The Editorial Board's mission is to publish significant research which has important implications for physiotherapy and occupational therapy. Our vision is for the journal to be the pre-eminent international publication of the science and practice of physiotherapy and occupational therapy.

Readership: Physiotherapist, Occupational therapists, medical engineers, epidemiologists, family physicians, occupational health nurses etc.

Subscription Information

Individual (1 year): Contact us

Institutional (1 year): INR8500/USD850

Payment methods

Bank draft / cashier s order / check / cheque / demand draft / money order should be in the name of **Red Flower Publication Pvt. Ltd.** payable at **Delhi**.

International Bank transfer / bank wire / electronic funds transfer / money remittance / money wire / telegraphic transfer / telex

1. **Complete Bank Account No.** 604320110000467
2. **Beneficiary Name (As per Bank Pass Book):** Red Flower Publication Pvt. Ltd.
3. **Address:** 41/48, DSIDC, Pocket-II, Mayur Vihar Phase-I, Delhi – 110 091(India)
4. **Bank & Branch Name:** Bank of India; Mayur Vihar
5. **Bank Address & Phone Number:** 13/14, Sri Balaji Shop,Pocket II, Mayur Vihar Phase- I, New Delhi - 110091 (India); Tel: 22750372, 22753401. **Email:** mayurvihar.newdelhi@bankofindia.co.in
6. **MICR Code:** 110013045
7. **Branch Code:** 6043
8. **IFSC Code:** BKID0006043 (used for RTGS and NEFT transactions)
9. **Swift Code:** BKIDINBBDOS
10. **Beneficiary Contact No. & E-mail ID:** 91-11-22754205, 45796900, E-mail: info@rfppl.co.in

Online You can now renew online using our RFPPL renewal website. Visit http://rfppl.co.in/subscribe.php?mid=7 and enter the required information and than you will be able to pay online.

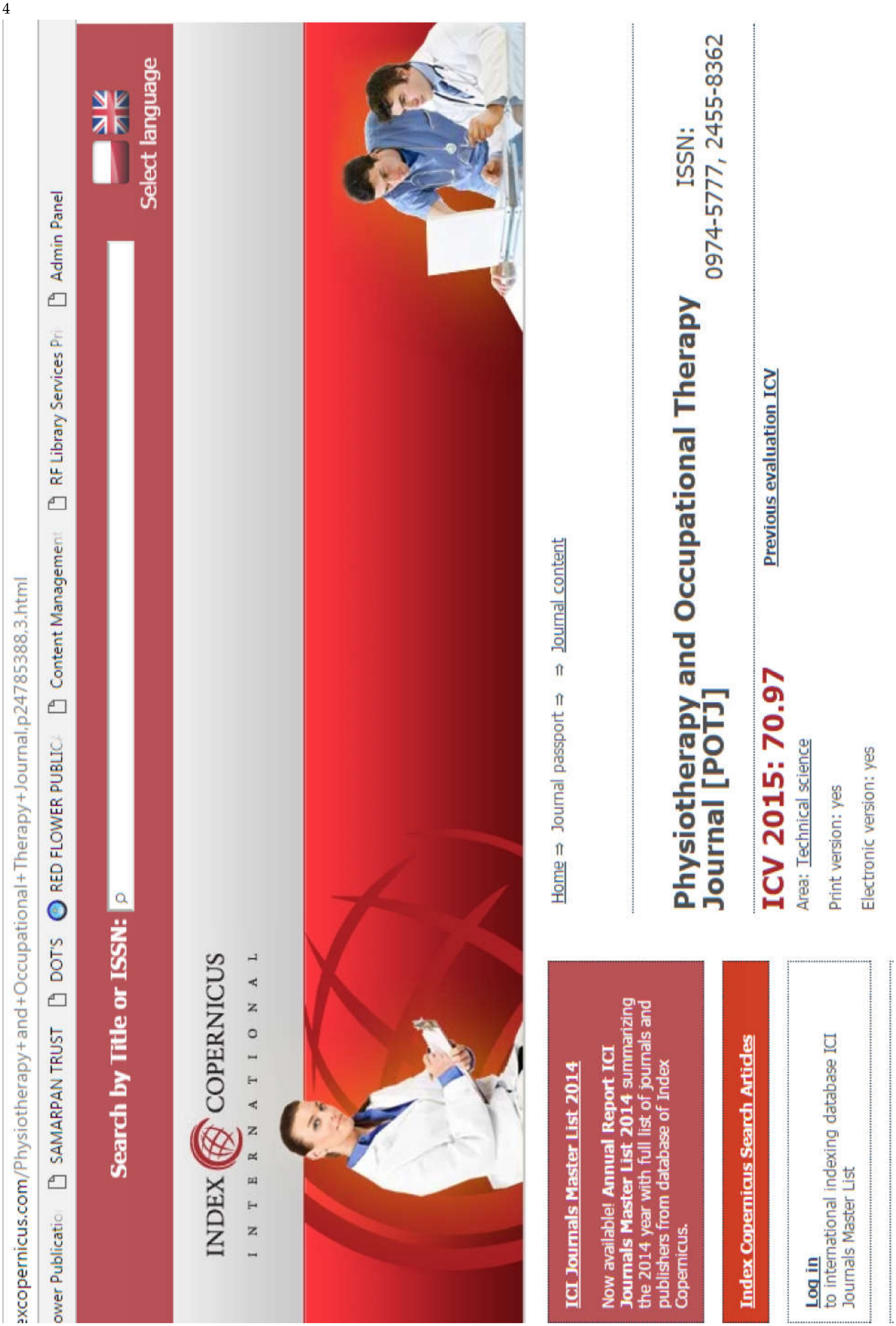
Send all Orders to: Subscription and Marketing Manager, Red Flower Publication Pvt. Ltd., 48/41-42, DSIDC, Pocket-II, Mayur Vihar Phase-I, Delhi - 110 091(India), Phone: 91-11-45796900, 22754205, 22756995, Fax: 91-11-22754205, E-mail: sales@rfppl.co.in.

Physiotherapy and
Occupational Therapy Journal

POTJ

January - March 2017
Volume 10, Number 1

Contents


excopernicus.com/Physiotherapy+and+Occupational+Therapy+Journal,p24785388,3.html
SAMARPAN TRUST
DOT'S
RED FLOWER PUBLIC
Content Management
RF Library Services Pr
Admin Panel
Search by Title or ISSN:
Select language
INDEX COPERNICUS
INTERNATIONAL
ICI Journals Master List 2014
Now available! Annual Report ICI Journals Master List 2014 summarizing the 2014 year with full list of journals and publishers from database of Index Copernicus.
Index Copernicus Search Articles
Log in
to international indexing database ICI Journals Master List
Home ⇒ Journal passport ⇒ ⇒ Journal content
Physiotherapy and Occupational Therapy Journal [POTJ]
ISSN:
0974-5777, 2455-8362
ICV 2015: 70.97
Previous evaluation ICV
Area: Technical science
Print version: yes
Electronic version: yes

Original Article

Physiotherapy and Occupational Therapy Journal
Volume 10 Number 1, January - March 2017
DOI: http://dx.doi.org/10.21088/potj.0974.5777.10117.1

The Effect of Strength Training and Strength-Agility Training on Knee Proprioception in Normal Collegiate Males

Md. Naim Akhtar*, Deepak Malhotra, Davinder Gaur*****

Abstract

The objective of this pre test post test experimental study design was to find out the effect of strength training and strength-agility training on knee joint proprioception in normal collegiate males. Fourty five study participants participated in the study. They were randomly allocated into 3 groups of 15 participants each on the basis of inclusion and exclusion criteria.i.e. group1- strength training, group2- strength-agility training and group3- control group. The training in the strength training group consisted of Leg press and Lunges exercises. In the strength-agility training group consisted of Leg press, Lunges and Change-of-direction sprints exercises. In the control group no exercise was given.The outcome measures were knee joint proprioception. The between-group comparisons at the end of the training showed that maximal proprioception gain was in group 2 (strength-agility training) specifically at an angle of 45^0. Although the gain at 15^0 was also statistically significant but it was comparatively less as compared to the gain at 45^0. The results of the study suggested that strength-agility training is more effective than strength training to improve proprioception in knee joint.

Keywords: Strength Training; Strength-Agility Training; Proprioception.

Introduction

The word proprioception is derived from Latin word "proprius" meaning "one's own", "individual" and "ception" meaning "perception", is the sense of the relative position of parts of the body and strength of effort being employed in movement [1].

Proprioception is any postural or movement information provided to central nervous system by sensoroy receptors in muscles, tendons, joints, skin which can potentially be used by the central nervous system to co-ordinate a wide range of natural movement in normal behaviours [2].

Proprioception is the sum of kinaesthesia and joint position sense. Kinaesthesia is defined as the awareness of joint movement and is dynamic. Joint position sense is restricted to the awareness of the position of a joint in space and is a static phenomenon (Grob *et al*., 2002; Lephart, 1992).

Knee joint proprioception is essential to neuro-motor control. Neuro-motor control of the knee involves the coordinated activity of surrounding muscles in particular, the quadriceps (Bennell *et al*., 2003). In recent years, increasing numbers of authors have recommended weight bearing tests of joint position or movement sense. Hsu *et al*. (2006) found that joint proprioceptive inputs play a major role in joint position sense [2].

Joint positioning and joint motion are two closely related proprioceptive sensations that are mediated by mechanoreceptors such as the Ruffini ending, the Golgi tendon organ, and the Pacinian corpuscle, which originate in the tendons, ligaments, and joint capsule. Sensory receptors in muscle and tendon are thought primarily to mediate subcortical reflexes, and as such, these receptors are not stimulated by changes in joint position. Dvir et al. concluded, however, that static position sense is the function likely to be controlled entirely by knee musculature. Barrack et al. reported that muscle and tendon receptors play a significant role in the sensation of joint motion and

Author Affiliation: *Post Graduate **Assisant Professor, Department of Rehabilitation Sciences, Hamdard University, New Delhi, India. ***Assisant Professor, Banarsidas Chandiwala Institute of Physiotherapy (BCIP), New Delhi, India.

Reprint Request: Davinder Kumar Gaur, Assisant Professor, Banarsidas Chandiwala Institute of Physiotherapy (BCIP), Maa Anandmai Marg, Kalkaji, New Delhi – 110019.
E-mail: physiodev2006@bcip.ac.in

Received on 10.01.2017, **Accepted on** 16.01.2017

position [3].

Proprioception an important component of balance and proper postural control, is perceiveing the position or movement of extremities and body segments in space. The sense of position of a joint depends on afferent signals from joint, muscle and skin receptors. Joint mechanoreceptors have the ability to detect the actual joint position and joint motion. Proprioception allows an individual to maintain joint stability during static and dynamic posture [4].

It was believed that for the most part, kinesthesia sensations are detected by Pacinian corpuscles and Ruffini endings. However, it is now clear that muscle spindles, once thought to encode exclusively individual muscle lengths, are also major contributors to the kinesthetic sense of position and movement (Clark et al. 1985) [5].

Agility is the ability to maintain or control body position while quickly changing direction during a series of movements (Twist and Benickly, 1995). Agility training is thought to be a re-enforcement of motor programming through neuromuscular conditioning and neural adaptation of muscle spindles, golgi-tendon organs, and joint proprioceptors (Barnes and Attaway, 1996; Craig, 2004, Potteiger et al., 1999) [6]. Agility is the ability to decelerate one's momentum, stop, overcome inertia and accelerate one's body mass in another direction. Clark (2001) sums it up by stating, "agility is the ability to decelerate, stabilize, accelerate and change direction quickly while maintaining proper posture and moving in the intended direction [7]. Looking at this from a physics perspective, momentum, impulse and inertia are the three critical components of agility. The ability to decelerate and stop one's momentum in a short distance/period of time requires great amounts of unilateral relative strength and power, particularly in the extensor mechanism musculature of the lower extremities. Impulse can be found in the period of time in which the switching from eccentric action (deceleration) to concentric action (acceleration) occurs.

"Any change of running direction is caused by an external impulse to the ground. The greater and quicker the direction change during desired high running speed, the greater force and shorter time of push off to the ground in the optimal direction is necessary [8]. The ability to then accelerate in a different direction also requires a great degree of unilateral relative strength and power. Often times in the beginning phases of agility training, these components are overlooked, and substituted for "drills", even if baseline strength and power levels are subpar.

According to Kurtz (2001), "agility is measured by the difficulty of coordination of assignments, precision of performance, the time between moment of change and the beginning of the response, and the time required for achieving a necessary level of precision'' [9].

With proper execution, agility skills can create various physical benefits. "Agility training enhances eccentric neuromuscular control, dynamic flexibility, dynamic postural control, functional core strength and proprioception [7] which can lead to overall increases in athletic performance. Agility can also "help to prevent injury by enhancing eccentric neuromuscular control and improving the structural integrity of the connective tissue [3]. These benefits can create an environment in which the development of other skills can be cultivated.

'Strength training' is performed with a variety of exercise machines, free weights, or even the use of gravity acting upon the athlete's body mass. Most resistance training (strength) programmes are based on a system of exercise to a repetition maximum (RM) as presented in the mid-1940s by T.L. De Lorme (De Lorme 1945) for use in physical medicine and rehabilitation [10].

Muscular strength is defined as the capacity of the muscles to exert force and is fundamental to the performance of many tasks that are encountered in daily living. Female athletes demonstrate less absolute strength than their male counterparts, suggesting a potential link between insufficient muscular strength and noncontact ACL injuries in female athletes [11].

Blackburn et al. (2000) reported that strength contributes to balance by producing muscle stiffness (resistance to muscle lengthening), which could enhance neuromuscular control by increasing proprioceptor sensitivity to stretch and reducing electromechanical delay from the muscle spindle stretch reflex [12].

There are many instances in daily life and sport where knee joint proprioception is essential for accurate modulation and activation of muscles, thus providing adequate neuromuscular control of knee joint position and joint movement, and ultimately the performance of physical tasks. Adequate proprioception is required for safe and capable movement of the body. Especially disturbed position sensation in lower limbs may lead to perturbation in daily activities such as walking, running, and may ultimately lead to injuries [4].

Methodology

Subjects

A sample consisting total of 45 individuals was selected for the study using randomized sampling .It consisted of all male participants. All the subjects were randomly assigned (Lottery system) to three different groups. i.e, Strength training (Group1), Strength-Agility training (Group2) and Control group (Group3). Each subject was tested for knee proprioception on Biodex Multi Joint system-4 before the training protocol. Each subject of the respective group was done specific training for 6 weeks except control group. After the training protocol the subjects were again be tested for proprioception on Biodex Multi Joint system-4 machine. The Subjects were recruited according to inclusion and exclusion criteria and were assigned to group 1, 2, and 3 randomly after baseline testing. Inclusion Criteria: Gender : Normal collegiate males, Age : 18 to 28 year, BMI: Normal range WHO 18.5 - 24.9 kg/m^2, Knee joint ROM= 0-120^{0}to 135^0, Poor proprioception level (Absolute error >5^0). In case if we are not able to get subject with error of greater than 5^0 than a lower error would be included (Absolute error range = 3^0-5^0) Exclusion Criteria: Recent history (past six months) of any musculoskeletal or neurological impairment in lower extremities as reported by participants, Current or recent knee injuries as reported by participants in past 6 month, Limitation in knee ROM, Inflammation or pain in the lower extremities, Subjects who are involved in any form of structured physical training involving the lower extremities, Major surgery in lower extremity-acute and sub-acute period,Any apparent biomechanical deviation for the lower extremities –revealed after clinical inspection.

Procedure

All the selected subjects were informed in detail about the type and nature of the study. The subjects were requested to sign the consent form prior to the study. pre-testing evaluation was conducted in the lab prior to the testing session.

During the pre-testing evaluation demographic information and general assessment was obtained. Leg dominance was determined at that time by asking participant which foot they would kick a ball with. The leg indicated as the dominant leg was considered as the leg for testing sessions. The decision to use the dominant leg for all testing procedure wasm ade due to reference of previous research indicate that there is no difference in proprioception between the dominant and non-dominant leg [13].

All the subjects were randomly assigned (Lottery system) to three different groups. i.e, Strength training (Group1), Strength-Agility training (Group2) and Control group (Group3). Each subject was tested for knee proprioception on Biodex Multi Joint system-4 before the training protocol. Each subject of the respective group was done specific training for 6 weeks except control group. After the training protocol the subjects were again be tested for proprioception on Biodex Multi Joint system-4 machine.

Measurement of Proprioception

Active Angle Reproduction (Biodex Multi Joint System-4): In the seated positions, the subject’s limb was passively moved to the target angles (i.e:15^0& 45^0). The leg was held there for 10sec. for the subject to memorize the position and then returned to 90^0 knee flexion. After a pause of 5sec, the subject moved the lower limb by active contraction at an angular velocity approximating 2^0/s and stopped when he perceived the target angle has been achieved. Once the angle was achieved, subjects were not be permitted to correct the angle. A total of three readings were taken for each respective angle and the difference between the perceived angle and each of the target angles noted for each trial [14,15].

Warm up

Warm up started at least 2-3 days before training.

Each subject was performed a warm-up consisting of 3 minutes of jogging and stretching of the muscles of the lower extremity [16].

Stretching Interventions [7]:

Before the static stretching interventions (either 15sec to the point of discomfort), participants undertook a 3minutes of seated recovery. Static stretching included three different stretching exercises: unilateral standing quadriceps stretch, unilateral standing hamstring stretch, unilateral standing calf stretch, executed for 15 sec for each leg and each exercise, to the point of discomfort.

For the unilateral standing quadriceps, the participants grabbed the ankle with the ipsilateral handmaking sure not to pull the leg into abduction while performing the stretch. For the unilateral standing hamstring stretch the heel of the foot is placed on an adjustable obstacle slightly below the hip level with the knee fully extended, while for the standing calf stretch the hands were placed against a wall and the foot is planted on the floor approximately 1 meter from the wall with the heel touching the ground (Alter, 1988). The subjects are then instructed to lean forward making sure that the stretched foot is flat on the floor. Participants are asked to maintain the stretching position where they felt discomfort throughout the required stretching time period. The participants are familiar with the stretching protocols, since they routinely performed these exercises in everyday training [17].

Leg press[18]:

Session	Set	Repetitions	% Of 1 Rm	Rest Time
1ST Three	4	8	30	60sec
2nd three	4	8	45	60sec
3rd three	4	6	60	50sec
4th three	3	6	75	40sec

Lunges (19,20):

Week	Forward lunge	Lateral lunge	Backward lunge
wk1	3 set x 8 rep	3 set x 8 rep	3 set x 8 rep
wk2	3 set x 10 rep	3 set x 10 rep	3 set x 10 rep
wk3	3 set x 12 rep	3 set x 12 rep	3 set x 12rep
wk4	4 set x 8rep	4set x 8rep	4 set x 8rep
wk5	4set x 10 rep	4 set x 10 rep	4set x 10 rep
wk6	4set x 12 rep	4 set x 12 rep	4set x 12 rep

Strength Training (Leg press and Lunges):

Two Session in Each Week

Lunges were performed in the forward lunge, lateral lunge, and backward lunge. All 3 lunges started with the Subjects standing with their feet near each other and hands on their hips. All lunges were performed with the dominant limb taking the step and lowering into 90^0 of hip and knee flexion while the trunk was maintained in an upright position. This prevented the knee from moving anterior to the foot, and the knee of the non-dominant limb did not touch the ground. Subjects were instructed to keep their knees over the toes for all lunges. They lunged forward, lateral and backward (toward the dominant side).

Week	Repetition number x Distance (m)	Rest between Repetitions (3minutes)	Angle of directional change $(0)^0$	No. of change direction
1	6x40	Complete	100	3
2	8x30	Complete	100	3
3	8x20	Complete	100	4
4	5x40	Complete	100	4
5	6x30	Complete	100	5
6	5x30	Complete	100	5

Agility training [21]:

Change-of-Direction Sprints

Two Session in Each Week.

Data Analysis

A pre-test post-test experimental group design was used for the study. The baseline values for dependent variable Knee joint Proprioception was taken on day 1 (pre intervention score) by using Biodex Multi joint System 4. The final reading was taken after six weeks. The data was analyzed using SPSS 16, Illinois Inc. Chicago, USA software. One way ANOVA test was applied for comparison of pre test and post test readings between all the groups. Paired t test was applied to compare the pre test and post test readings within all the groups. Post hoc test was applied for comparison of pre test and post test readings of the multiple groups. The test were applied at 95% confidence interval and p values set at 0.05.The result were taken to be significant if $p<0.05$.

Results

A total number of 45 subjects participated in the study out of which 15 participated in Strength training Group (group 1), another 15 subjects participated in Strength-Agility training (group 2) Another 15 participated in Control group (group 3). The demographic data was analyzed by comparing means of descriptive. They have their mean age to be 23.53 ± 2.06 years, 22.13 ± 2.77 years and 24.67 ± 2.52 years respectively. They have their mean height to be 169.73 ± 6.73 cm, 169.60 ± 5.30 cm and 171.40 ± 7.53 cm respectively and mean weight to be 66.20 ± 8.05 kg, 64.00 ± 8.00 kg and 63.13 ± 9.34 kg respectively. They have their mean BMI 22.73± 1.62, 22.13 ± 2.16 and 21.47± 2.16 respectively.

Table 5.1: Demographic data for three groups

	Group 1 Mean ± SD	Group 2 Mean ± SD	Group 3 Mean ± SD	P value
Age	23.53 ± 2.06	22.13 ± 2.77	24.67 ± 2.52	0.027
Height	169.73 ± 6.73	169.60 ± 5.30	171.40 ± 7.53	0.709
Weight	66.20 ± 8.05	64.00 ± 8.00	63.13 ± 9.34	0.599
BMI	22.73± 1.62	22.13 ± 2.16	21.47± 2.16	0.234

There was insignificant difference between these groups on baseline demographic characteristics including age (p value = 0.027),height(p value = 0.709),weight(p value = 0.599) and BMI (P value = 0.234). The data showed that three groups were homogeneous.

There was no statistically significant difference present in pre test baseline of Proprioception among all the three groups with the p values for mean ± SD of Proprioception pre 15p was p= 0.497. There was statistically significant difference present in pre test baseline of Proprioception among all the three groups with the p values for mean ± SD of Proprioception pre 45p was p= 0.012.

Table 5.2: Base line measurement

	Group 1 Mean ± SD	Group 2 Mean ± SD	Group 3 Mean ± SD	p value
Prop. Pre 15^0	4.91 ± 3.37	5.29 ± 3.19	4.07 ± 1.75	0.497
Prop. Pre 45^0	7.68 ± 3.72	11.73 ± 4.67	8.02 ± 3.25	0.012

The comparison of within group significance was done using Paired sample 't' test for group 1 group 2, and group 3 respectively. Pre- post measurement were compared for each outcome measures of dependent variable of subjects.

Table 5.3: Proprioception gain in group 1

	Pre test value Mean ± SD	Post. Test value Mean ± SD	Pair t test	
			t value	p value
Prop.15^0	4.91 ± 3.37	1.93 ± 1.04	2.95	0.011
Prop.45^0	7.68 ± 3.72	2.99 ± 1.24	5.41	0.000

In within group analysis, on comparing Proprioception pre 15^0 and Proprioception post 15^0, Proprioception pre 45^0 and Proprioception post 45^0. Proprioception was improved significantly in group1 with p value = 0.011 and p value = 0.000 respectively.

In within group analysis, on comparing Proprioception pre 15^0 and Proprioception post 15^0, Proprioception pre 45^0 and Proprioception post 45^0. Proprioception was improved significantly in group

Table 5.4: Proprioception gain in group 2

	Pre test value Mean ± SD	Post test value Mean ± SD	Pair t test	
			't' Value	'p' value
Prop.15	5.29 ± 3.19	1.91 ± 0.94	4	0.001
Prop.45	11.73 ± 4.67	2.01 ± 1.38	8.13	0.000

Table 5.5: Proprioception gain in group 3

	Pre test value Mean ± SD	Post test value Mean ± SD	Pair t test	
			't' Value	'p' value
Prop.15	4.07 ± 1.75	3.73 ± 1.47	1.20	0.247
Prop.45	8.02 ± 3.25	6.95 ± 3.17	2.17	0.048

2 with p value = 0.001 and p value = 0.000 respectively.

In within group analysis, on comparing Proprioception pre 15^0 and Proprioception post 15^0 was not improved significantly in group 3 with p value = 0.247. Proprioception pre 45^0 and Proprioception post 45^0. Proprioception was improved significantly in group 3 with p value = 0.048.

The comparison of between group significance was done using one way ANOVA for group 1, group 2, and group 3 respectively.

Proprioception Gain in Between Groups

In between group analysis, on comparing the mean value ± SD of Proprioception pre 15^0 and Proprioception post 15^0, Proprioception pre 45^0 and Proprioception post 45^0 for all three groups. There was no statistically significant difference present in Proprioception pre 15^0 among the three groups for mean ± SD with p value = 0.490 .There was statistically significant difference present in Proprioception post 15^0, Proprioception pre 45^0 and Proprioception post 45^0 among the three groups for mean ± SD with p value = 0.000, p value = 0.012 and p value = 0.000 respectively.

Table 5.6: Proprioception gain in between groups

	Group 1 Mean ± SD	Group 2 Mean ± SD	Group 3 Mean ± SD	'f' value	' P' value
Prop.pre 15	4.91 ± 3.37	5.29 ± 3.19	4.07 ± 1.75	0.71	0.490
Prop.post 15	1.93 ± 1.04	1.91 ± 0.94	3.73 ± 1.47	11.87	0.000
Prop.pre 45	7.68 ± 3.72	11.73 ± 4.67	8.02 ± 3.25	4.91	0.012
Prop.post 45	2.99 ± 1.24	2.01 ± 1.38	6.95 ± 3.17	22.75	0.000

Multiple Group Comparisons Result

ANOVA followed by post hoc test (tukey) was performed to do multiple comparisons between three groups to analyze the post training effect on all three groups. When multiple comparisons done in different groups, group 1 is compared to group 2, group 1 is compared to group 3 and group 2 is compared to group 3.

Proprioception Gain Difference between Group 1 and Group 2

In multiple group analysis, on comparing the mean value ± SD of Prop.pre 15p - prop.post 15p and Prop.pre 45p - prop.post 45p for group1 and group 2. There was no statistically significant difference present in Prop.pre 15p - prop. post 15p among the two groups for mean ± SD with p value = 0.930. There was statistically significant difference present in Prop. pre 45-prop.post 45 among the two groups for mean ± SD with p value = 0.001.

Table 5.7: Proprioception gain difference between Group 1 and Group 2

	Group 1 Mean ± SD	Group 2 Mean ± SD	'P' value
Prop.pre 15-prop.post 15	2.98 ± 3.92	3.38 ± 3.27	0.930
Prop.pre 45-prop.post 45	4.69 ± 3.35	9.72 ± 4.62	0.001

However, improvement in mean difference in group 1 for Prop.pre 15-prop.post 15 (2.98 ± 3.92) and Prop.pre 45p - prop.post 45p (4.69 ± 3.35) was less than improvement in mean difference for Prop.pre 15p - prop.post 15p (3.38 ± 3.27) and Prop. pre 45p -prop.post 45p (9.72 ± 4.62) of group 2. Thus Strength-Agility training improved more Proprioception than the Strength training.

Proprioception Gain Difference between Group 1 and Group 3

In multiple group analysis, on comparing the mean value ± SD of Prop.pre 15- prop.post 15 and Prop.pre 45p - prop.post 45p for group1 and group 3. There was no statistically significant difference present in Prop.pre 15p - prop.post 15p among the two groups for mean ± SD with p value = 0.053. There was statistically significant difference present in Prop.pre 45p -prop.post 45p among the two groups for mean ± SD with p value = 0.018.

Table 5.8: Proprioception gain difference between Group 1 and Group 3

	Group 1 Mean ± SD	Group 3 Mean ± SD	'P' value
Prop.pre 15-prop.post 15	2.98 ± 3.92	0.34 ± 1.09	0.053
Prop.pre 45-prop.post 45	4.69 ± 3.35	1.06 ± 1.90	0.018

However, improvement in mean difference in group 1 for Prop.pre 15p - prop.post 15p (2.98 ± 3.92) and Prop.pre 45p - prop.post 45p (4.69 ± 3.35) was more than improvement in mean difference for Prop.pre 15p - prop.post 15p(0.34 ± 1.09) and Prop.pre 45p - prop.post 45p (1.06 ± 1.90) of group 3. Thus Strength training improved more Proprioception than the control group.

Proprioception gain difference between Group 2 and Group 3

In multiple group analysis, on comparing the mean value ± SD of Prop.pre 15p - prop.post 15p and Prop.pre 45p - prop.post 45p for group 2 and group 3. There was statistically significant difference present in Prop.pre 15p - prop.post 15p and Prop.pre 45p -prop.post 45p among the two groups for mean ± SD with p value = 0.022 and p value = 0.000 .

Table 5.9: Proprioception gain difference between Group 2 and Group 3

	Group 2 Mean ± SD	Group 3 Mean ± SD	'P' value
Prop.pre 15-prop.post 15	3.38 ± 3.27	0.34 ± 1.09	0.022
Prop.pre 45-prop.post 45	9.27 ± 4.62	1.06 ± 1.90	0.000

However, improvement in mean difference for Prop.pre 15p - prop.post 15p (3.38 ± 3.27) and Prop.pre 45p - prop.post 45p (9.72 ± 4.62) of group 2 was more than Prop.pre 15p - prop.post 15p (0.34 ± 1.09) and Prop.pre 45p - prop.post 45p (1.06 ± 1.90) of group 3. Thus Strength-Agility training improved more Proprioception than the control group .

Discussion

The objective of present study was to find out the effect of strength training and strength-agility training on knee proprioception in normal collegiate males.

After providing six weeks of training it was observed that, there is a significant improvement in proprioception in group 1 (strength training) and group 2 (strength-agility training) on comparison with control group.

The result of the present study showed that maximal proprioception gain was in group 2 (strength-agility training) specifically at an angle of 45^0.Although the gain at 15^0 was also statistically significant but it was comparatively less as compared to the gain at 45^0.

Improvement in proprioception is more with Strength-agility training than with strength training alone: The reason may be strength-agility training group received both the trainings including agility (Change-of-direction sprints) and strength training (Leg press and Lunges) in comparison to strength training group which received only strength training (Leg press and Lunges).

Proprioception improve more at the angle of 45^0 in the comparison of 15^0:

The reason may be because in the middle range of knee motion (45p), the capsule, ACL, and PCL are relatively relaxed and thus the poorest proprioceptive sensory feedback should be noted [29]. Therefore there is more scope for improvement in proprioception.

Another reason may be when the knee is in relative extention position (15p), it is stable and also there is not much pressure on posterior horn of menisci. Thus other inner′ structures may take the responsibility of the proprioceptive sense other than menisci. When the knee is in flexion (45^0) there would be more pressure on the posterior horn of menisci because of the relative instability. Therefore knee flexion results in a higher firing frequency of the mechanoreceptors on meniscus, pressure stimulates the slowly adapting Ruffini and Golgi receptors, which boost proprioceptive awareness [30].

The result of the study is in agreement conducted by Pincivero et al (2001), who studied the effects of joint angle and reliability on knee proprioception, in their study they examined the reliability and effects of knee angle on the detection and subsequent response to passive knee movement. The results of their study demonstrated that at a more extended knee joint position (15p) significantly less knee movement response than in a more flexed position (30p -60p) [31].

So, during strength training and strength-agility training there is increased and repetitive flexion of the knee joint in weight bearing position. Therefore there would be more stimulation of the mechanoreceptors in the menisci which may have led to more increase in proprioception specifically at 45^0 of knee flexion

Conclusion

The result of present study showed, there is a statistically significant improvement in knee joint proprioception after six weeks of strength training and strength-agility training programs. But the strength-agility training group showed more improvement when compared to strength training alone. Therefore for maximum proprioception gain it would be advisable to add an agility component in the strength training program.

So, it may be concluded from the present study that strength-agility training is more beneficial in improvement of knee joint proprioception than strength training alone.

Acknowledgment

We express our sincere thanks to Dr. Shibili Nuhmani and Dr. Kalpana Zutshi for helping in the study process.

Conflict of interest: None

References

1. Mosby's Medical, Nursing and Allied Health Dictionary, Fourth Edition, Mosby-1994.p.1285.
2. Andersen SB, Terwilliger DM and Denegar CR. Comparisn of open versus closed kinetic chain test positions for measuring joint position sense. Journal of sport Rehabilitation. 1995; 4:165-171.
3. Michael J. Higgins and David H. Perrin, Comparison of Weight-Bearing and Non-Weight-Bearing Conditions on Knee Joint Reposition Sense, Journal of Sport Rehabilitation, 1997; 6:327-334.
4. Nursen Özdemer, Sevgi Sevi Subasi, Nihal Gelecek, Sükrü Sari, Pðlates Egzersðz Eððtðmðnðn Dðz Proprðosepsðyonu Üzerðne Etkðlerð – Randomðze Kontrollü Çalisma: The Effects of Pilates Exercise Training on Knee Proprioception – A Randomized Controlled Trial.
5. Elizabeth O. Johnson, PhD. International Encyclopedia of Rehabilitation: Copyright © 2010 by the Center for International Rehabilitation Researc Information and Exchange (CIRRIE).
6. Michael G. Miller et al. The Effects Of A 6-Week Plyometric Training Program On Agility: 21 June 2006 / Accepted: 07 August 2006 / Published (online): 01 September 2006.
7. Clark M. National Academy of Sports Medicine: Performance Enhancement Specialist Manual. Integrated Speed Training: Section Ib. NASM, Az. 2001.
8. Kraemer w., Hakkinen K. Strength Training for Sport. Blackwell Science Ltd. 2002.p.79-84.
9. Kurz T. Science of Sports Training. Island Pond, Vt. 1991.p.137-138.
10. Paavo V. Komi, Strength and power in sports,Vol-3. Second Edition Chapter15,page no 281-287.
11. Takashi et al, Knee Proprioception and Strength and Landing Kinematics During a Single-Leg Stop-Jump Task, Journal of Athletic Training. 2013; 48(1):31–38.
12. Kevin McCurdy and George Langford, The Relationship Between Maximum Unilateral Squat Strength And Balance In Young Adult Men And Women, Journal of Sports Science and Medicine. 2006; 5:282-288.
13. Barrack RL, Skinner HB, Brunet ME, Cook SD, Joint kinaesthesia in the highly trained knee. Journal of Sports Medicine.1984; 24:18-20.
14. Michael J. Callaghana, James Selfeb, Alec McHenryc, Jacqueline A. Oldhama, Effects of patellar taping on knee joint proprioception in patients with patellofemoral pain syndrome,page-3.
15. Giselle Cross, Patrick A. Costigan and Scott K. Lynn Is Lower Limb Joint Proprioception Systemic, Email: 3PAC13@post.queensu.ca,page- 485.
16. Warren B. Young, Mark H. Mcdowell, And Bentley J. Scarlett, Specificity of Sprint and Agility Training Methods. Journal of Strength and Conditioning Research, 2001; 15(3):315–319.
17. Charilaos Tsolakis and Gregory C. Bogdanis; Acute effects of two different warm-up protocols on flexibility and lower limb explosive performance in male and female high level athletes: Journal of Sports Science and Medicine. 2012; 11:669-675.
18. Rahman Rahimi, Naser Behpur: The Effects Of Plyometric, Weight And Plyometric-Weight Training On Anaerobic Power And Muscular

Strength. Facta Universitatis Series: Physical Education and Sport 2005; 3(1):81–91.

19. James Burk, CSCS. Lunge Progressions. Varner, M., et al. The lunge. Strength and Conditioning Journal. 1990; 12(4):77-81.
20. Rebecca L. Begalle, Lindsay J. DiStefano: Quadriceps and Hamstrings Coactivation During Common Therapeutic Exercises. Journal of Athletic Training 2012; 47(4):396–405.
21. Warren B. Young, Mark H. Mcdowell, And Bentley J. Scarlett: Specificity of Sprint and Agility Training Methods. Journal of Strength and Conditioning Research, 2001; 15(3):315–319.
22. Glenna Batson, P.T., D.Sc., M.A. Update on Proprioception Considerations for Dance Education.
23. Dietz V: Proprioception and locomotor disorders. Nat Rev. 2002; 3:781-9.
24. Schaffer SW, Harrison AL. Aging of the somatosensory system: a translational perspective. Phys !er. 2007; 87(2):193-207.
25. Paavo V.Komi, Strength and power in sports, Blackwell Science publication,2nd edition, 2003; 3: 229-251.
26. William E. Prentice,Rehabilitation Techniques for Sports Medicine and Athletic Training, Fourth Edition, Mc Graw-Hill Publication, 2004.p.225-238.
27. K.R.Thompson,A.E. Mikesky,R.E. Bahamonde, D.B. Burr; Effects of physical training on proprioception in older women: J Musculoskel Neuron Interact 2003; 3(3):223-231.
28. Michael G. Miller, Jeremy J. Herniman, Mark D. Ricard, Christopher C. Cheatham and Timothy J. Michael; The effects of a 6-week plyometric training program on agility: Journal of Sports Science and Medicine. 2006; 5:459-465.
29. M.R. Safran, A.A. Allen, S.M. Lephart, P.A. Borsa F.H. Fu, C.D. Harner: Proprioception in the posterior cruciate ligament deficient knee; Knee Surg, Sports Traumatol, Arthrosc. 999; 7:310–317.
30. Mustafa Karahan , Baris Kocaoglu , Cengiz Cabukoglu , Umut Akgun , Rustu Nuran: Effect of partial medial meniscectomy on the proprioceptive function of the knee; Arch Orthop Trauma Surg. 2010; 130:427–431.
31. Danny M. Pincivero, Brad Bachmeier, And Alan J. Coelho : The effects of joint angle and reliability on knee proprioception ; Med. Sci. Sports Exerc., Vol. 2001; 33(10):1708-1712.

Subscription Information
Institutional (1 year) INR8500/USD850

Here is payment instruction for your reference.

Check:
Please send the US dollar check from outside India and INR check from India made:
Payable to 'Red Flower Publication Private Limited'.
Drawn on Delhi branch

PayPal Instructions for the payment (only for transfer from outside India):
Payments can be made through our PayPal account at https://www.paypal.com. Our PayPal recipient email address is redflowerppl@gmail.com.

Credit Card:
We accept Visa or MasterCard.

Wire transfer:
Complete Bank Account No. 604320110000467
Beneficiary Name: Red Flower Publication Pvt. Ltd.
Bank & Branch Name: Bank of India; Mayur Vihar
MICR Code: 110013045
Branch Code: 6043
IFSC Code: BKID0006043 (used for RTGS and NEFT transactions)
Swift Code: BKIDINBBDOS

**Please kindly add bank charge at your side if you pay by check or wire transfer.

Payment, orders and all correspondences should be sent to;
Red Flower Publication Pvt. Ltd.
48/41-42, DSIDC, Pocket-II
Mayur Vihar Phase-I
Delhi - 110 091(India)

Original Article

Physiotherapy and Occupational Therapy Journal
Volume 10 Number 1, January - March 2017
DOI: http://dx.doi.org/10.21088/potj.0974.5777.10117.2

A Study to See the Combined Effect of Abdominal Binder and Compression Stockings on Tilt-Induced Orthostatic Hypotension in Spinal Cord Injurypatients

Vaibhav Agarwal*, Shiv Kumar Verma*, Sharda Sharma*, Preeti Patel**

Abstract

Aims and Objectives: The aim of the study is to see the combined effect of compression stockings and abdominal binder on orthostatic hypotension in spinal cord injury. *Methodology*: A sample of 30 subjects were recruited for the study. The subjects were randomly divided into three groups. Group A (compression stockings and abdominal binder) Group B (compression stockings) and Group C (abdominal binder).All subjects were dealt individually. Prior to the intervention the subject was tilted to 30^0 ,60^0 ,90^0 with the help of tilt table and the blood pressure was recorded and mean arterial pressure was calculated for the subjects of all the three groups. After that, the intervention received by Group A was (compression stockings and abdominal binder) Group B (only compression stockings) and GroupC (only abdominal binder) and again with the help of tilt table the blood pressure was recorded in different angles i.e.30^0, 60^0, 90^0 and mean arterial pressure was calculated. *Results:* Post intervention there was significant increase in the blood pressure and mean arterial pressurein group A compared to group B and group C. *Discussion:* Combined use ofcompression stockings and abdominal binder helps to reduce the symptoms of orthostatic hypotension. Compression stocking when used with an abdominal binder provide great benefit by decreasing splanchnic pooling and interstitial pressure on legs. *Conclusion:* So, this study concluded that the combined use ofcompression stockings and abdominal binder (Group A) is more effective than use of compression stockings and abdominal binder alone (Group B and Group C) in spinal cord injury patients.

Keywords: Spinal Cord Injury; Orthostatic Hypotension; Tilt Table; Abdominal Binder; Compression Stockings.

Introduction

Spinal Cord Injury is a devastating injury and is a major musculoskeletal condition, it can result in alteration of normal motor, sensory and autonomic function, and it presents a serious disease burden [1]. The incidence of spinal injury in India was estimated as 15 new cases per million per year, and global incidence of spinal cord injuries is noted as 40 to 80 cases per million population per year [2,3].

Author Affiliation: *Lecturer **PG (MPT Neurology), Department of Physiotherapy, Swami Rama Himalayan University, Dheradun, U.K.

Reprint Request: Shiv Kumar Verma, Lecturer, Department of Physiotherapy, Swami Rama Himalayan University, Jolly grant Dehradun, Uttarakhand – 248016.
E-mail: vermashiv_2005@yahoo.co.in

Received on 29.11.2016, **Accepted on** 13.12.2016

The common manifestations of spinal cord injury are autonomic dysfunctions, including abnormal cardiovascular control. Autonomic dysfunction is a vascular reflex which may occur in spinal cord injury patients with lesion above fourth thoracic vertebra (T4) or in neuromuscular disorders [4].

Orthostatic hypotension (OH) is defined as a fall in systolic blood pressure (SBP) of at least 20 mm Hg and/or diastolic blood pressure (DBP) of at least 10 mm Hg within 3 min of standing [5].

Orthostatic hypotension is a common problem after acute cervical cord injury and high thoracic spinal cord injury and following cervical cord injury the thoracolumbar or sympathetic outflow is impaired and parasympathetic tone unopposed [6].

OH is associated with an abnormality of reflexive regulation of the circulation by the sympathetic noradrenergic system. Failure of sympathetic nervous system always results in failure to tolerate upright posture because of OH. OH can be an asymptomatic sign or manifest as symptoms that range from lightheadedness to loss of consciousness, generalized weakness, dizziness, fading vision, that are relieved by lying down [7].

Numerous studies have documented the presence of OH following spinal cord injury (SCI). Standard mobilization during physiotherapy (e.g., sitting or standing) is reported to induce blood pressure decreases that are diagnostic of OH in 74% of SCI patients, and which are accompanied by OH symptoms in 59% of SCI individuals [8]. This, in turn, may have a negative impact upon the ability of SCI individuals to participate in rehabilitation.

Methodology

Thirty patients with spinal cord injury had been taken for the study from the neurosurgery ward of the Himalayan Hospital, Jolly Grant, Dehradun. The inclusion and exclusion criteria for the study were as follows:

Inclusion Criteria

Age -18 to 40 years, both male and female, Spinal cord injury (C6-T6) and Co-operative patients

Exclusion Criteria

Unstable vital parameters, Open wounds on the calf and thigh, abdominal injury, Lower limb fracture, Pre operative patient of SCI.

To achieve the study accomplishment, following instruments were used:

- Sphygmomanometer and stethoscope
- Tilt table
- Compression stockings
- Abdominal binders
- Goniometer

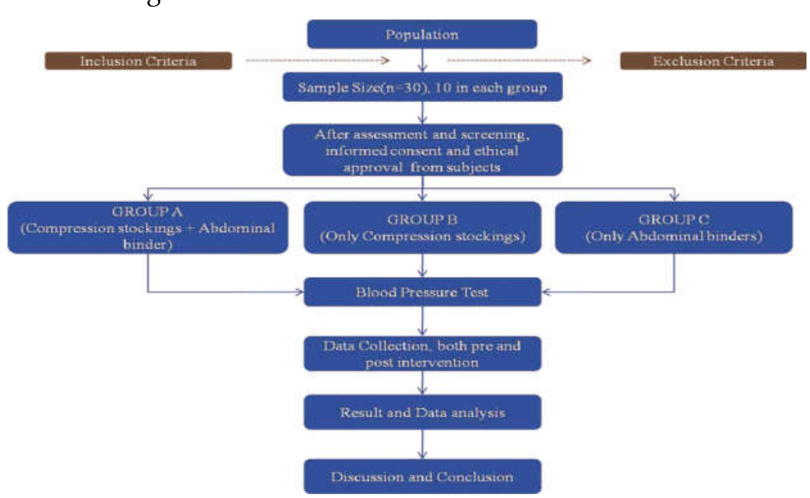
The subjects were screened who fulfill the inclusion and exclusion criteria and were randomly divided in to three groups each group having 10 subjects.

- Group A – 10 Subjects (Compression stockings and abdominal binder)
- Group B – 10 Subjects (Compression stockings)
- Group C – 10 Subjects (Abdominal binder)

The subjects were carefully shifted to the tilt table placed nearby the bed. Subject was kept supine position on the tilt table without any tilt and was fastened with straps at chest, knee and pelvic region. After that BP was recorded with the sphygmomanometer and mean arterial pressure was calculated with the equation (MAP=DBP+1/3(SBP-DBP). After 1 minute the tilt table was tilted at 30^o(which is measured with the help of Goniometer) and the BP was recorded after 3 minutes and MAP was calculated. The same procedure was repeated for 60^o and 90^o and thereafter; the tilt table was brought back to 0 degrees.

During the procedure the subjects were constantly examined for any decrease in BP i.e. systolic BP more than 20mmHg till 90mm Hg and diastolic BP more than 10 mm Hg, till 60mm Hg, and check for any symptoms of OH like decrease in pulse, syncope, sweating, dizziness, and visual disturbances ranging from blurred vision to blackouts, weakness. If such symptom occurs then the subject was immediately brought back to 0 degree.

After that different intervention was applied to the subjects of three different groups i.e. group A, group B and group C. Compression stockings on both lower limbs and abdominal binder was applied for the Flow Chart:



subjects of group A, after 20 minute of application of the compression stockings and abdominal binder again BP was measured and MAP was noted in 30°, 60°, 90° which was achieved using tilt table. For the subjects of group B only compression stockings was applied and for Group C, only abdominal binder was applied to the subject for 20 min and again after its application the BP and MAP was noted in 30°, 60°, 90° in a tilt table.

Results

All variables for three groups have been compared for both pre and post intervention. Intra-group analysis of all three groups shows significant difference in BP (systolic, diastolic and mean arterial pressure) between pre and post intervention. However, in case of Group A (combination of compression stockings and abdominal binders) the difference is most significant.

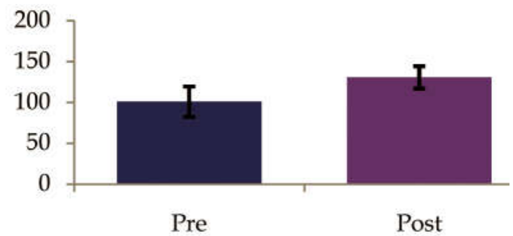


Fig. 1: Change in SBP with Combination of Stockings and Abdominal Binder

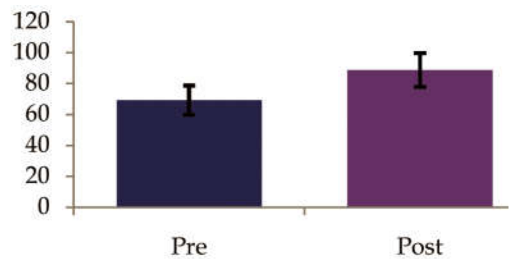


Fig. 2: Change in DBP with Combination of Stockings and Abdominal Binder

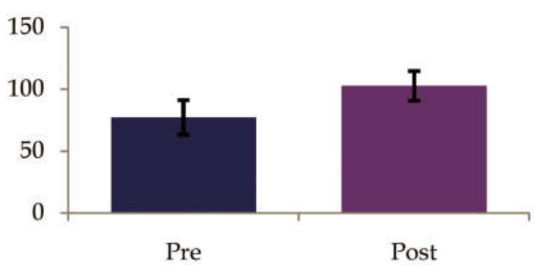


Fig. 3: Change in MAP with Combination of Stockings and Abdominal Binder

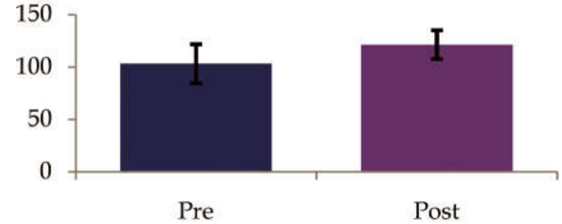


Fig. 4: Change in SBP with Compression stockings

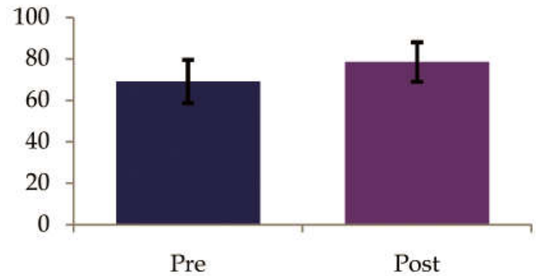


Fig. 5: Change in DBP with Compression stockings

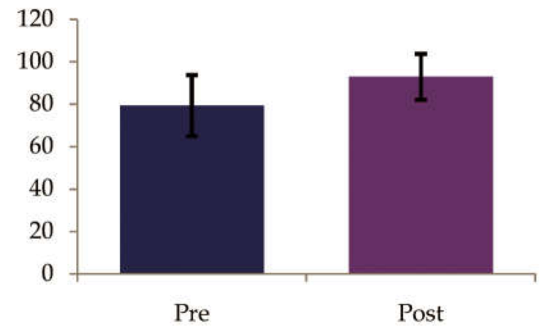


Fig. 6: Change in MAP with Compression stockings

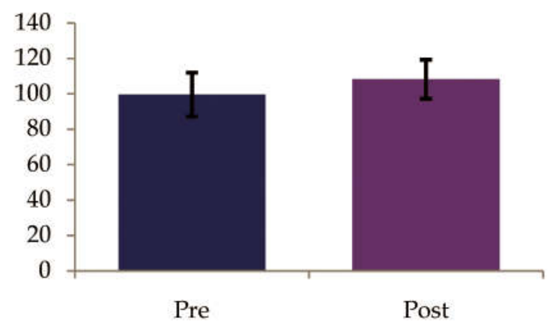


Fig. 7: Change in SBP with Abdominal Binder

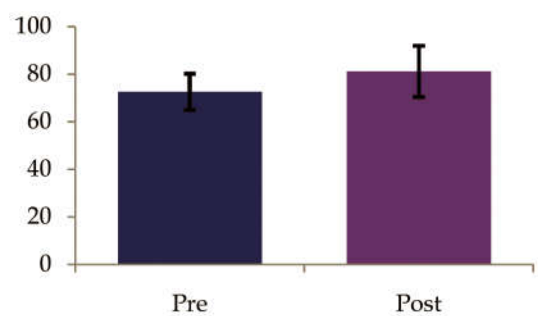


Fig. 8: Change in DBP with Abdominal Binder

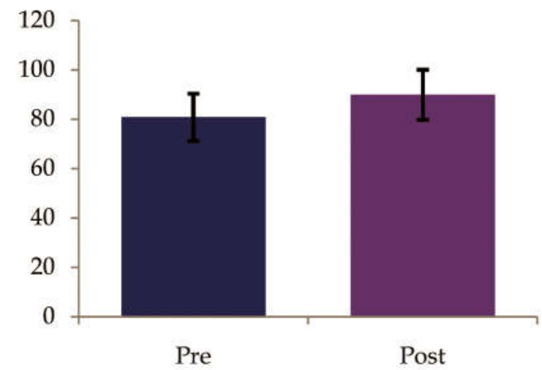


Fig. 9: Change in MAP with Abdominal Binder

Discussion

The study was performed on population affected by orthostatic hypotension that caused an inability to tolerate a standing position. OH is very common in subjects with spinal cord injury.

The result obtained from the study revealed that the combined use of compression stockings and abdominal binder (Group A) for OH in SCI shows better result than the use compression stockings and abdominal binder alone (Group B and Group C). So this study supports the experimental hypothesis that combined effect of compression stockings and abdominal binder (Group A) is better for reducing OH in SCI.

According to Jaun J Fiueroa etal, compression of capacitance beds (i.e. the legs and abdomen) improves orthostatic symptoms. The improvement is due to reduction of venous capacitance and an increase in total peripheral resistance. Compression of the legs alone is not beneficial as compression of the abdomen because the venous capacitance of the calves and thighs is relatively small compared with that of splanchnic mesenteric bed, which accounts for 20% to 30% of total blood volume.

The rationale for the use of elastic compression stockings and binder is to apply external counter pressure to the capacitance beds of the abdomen and legs to improve the venous return to the heart and prevent the occurrence of symptoms of OH.

The group B in which only compression stockings was applied had also shown a significant effect by increase in the blood pressure but it was less significant in comparison to group A but more significant compared to group C.

According to Smit etal, use of compression stockings apply pressure to the lower extremities. These stockings minimize peripheral blood pooling in the lower extremities and increase venous return and thereby increasing the cardiac output and increase in blood pressure.

The group C had shown less significant effect among the group A and group B because only use of abdominal binder was not sufficient to increase the blood pressure as its only use cannot increase the stroke volume and cardiac output because approximately 80% of blood pooled in lower limbs which also needs appropriate intervention to improve venous return to the heart and thereby reducing orthostatic hypotension.

Clinical Implication

Orthostatic Hypotension is a very common complication in patients who are bed ridden and neurological impaired. Compression stockings and abdominal binder were proved to be beneficial in preventing orthostatic hypotension in patients of spinal cord injury to prevent the occurrence of symptoms. So, this should be widely used in patients with orthostatic hypotension.

Limitation of the Study

Small sample size and short duration were limitations of the study.

Future Research

This study can be done on large sample size with longer duration and follow –up study can be done to evaluate the compliance of elastic stockings and abdominal binder. Study to see the effects of pneumatic compression device with abdominal binder on orthostatic hypotension can be done.

Acknowledgement

We are very grateful to our Deputy Dean Dr. Anuradha Kusum & Dr. R. Maheshwari who provided us valuable guidance and all facilities. We are also thankfully to all the members of paramedical ethical committee for approval our study. Last but not least also deeply thankful to our all subject participated in study.

References

1. WHO Bulletin. The Global Economic and Healthcare Burden of Musculoskeletal Disease (spinal cord injury incidence).

2. Ravi Shankar, A Study on Quality Of Life of Persons with Spinal Cord Injury 2010, Christ University Bangalore.

3. Jerome Bickenbach etal WHO Library Cataloguing-in-PublicationData International perspectives on spinal cord injury. 2013.

4. usan Edward Neurological Physiotherapy second edition; 128-129.

5. American Autonomic Society And American Academy Of Neurology, 1996; 46:1470.

6. Andrei V. Krassioukov, Ann-Katrin Karlsson, Jill M. Wecht, Lisa-Ann Wuermser, Christopher J. Mathias, Ralph J. Marino, Assessment of autonomic dysfunction following spinal cord injury: Rationale for additions to International Standards for Neurological Assessment Journal of Rehabilitation Research & Development, 2007; 44(1):103–112.

7. David S. Goldstein and Yehonatan Sharabi, Neurogenic Orthostatic Hypotension: A Pathophysiological Approach, Journal of American Heart Association. 2009; 119:139-146.

8. Andrei Krassioukov Janice J Eng, Darren,ER Warburton, Robert Teasell, A Systematic Review of the Management of Orthostatic Hypotension Following Spinal Cord Injury, Arch Phys Med Rehabilitation. 2009; 90:5:876–885.

9. Maxime Lamarre-Cliche,Jean Cusson,The fainting patient: value of the head-upright tilt-table test in adult patients with orthostatic intolerance, Canadian Medical Association. 2001; 164(3):372-376.

10. Roy Freeman, Wouter Wieling,Felicia B. Axelrod, David G.Benditt etal. Consensus statement on the definition of orthostatic hypotension, neurally mediated syncope and the postural tachycardia syndrome, Clin Auton Res. 2011; 21:69–72.

11. Diana Rimaud, Paul Calmels, Vincent Pichot, Francois Bethoux, Frederic Roche, Effects of compression stockings on sympathetic activity and heart rate variability in individuals with spinal cord injury, The journal of spinal cord medicine 2012; 35:81-8612. Humaira Fayyaz Khan, Muhammad Amjad Hameed, Umar Ali Khan, Heart rate and blood pressure responses to orthostatic stress during head-up tilt test, Pakistan journal of physiology. 2012; 8:3-6.

13. Manuela Metzler, Susanne Duerr, Roberta Granata, Florian Krismer, David Robertson Gregor K. Wenning, Neurogenic orthostatichypotension, pathophysiology, evaluation, and management, 2013; 260:2212–2219.

14. Mustapha El Bakkali, Halima Benjelloun, Hanan Rkain, Leslie Coghlan, Youssof Radjab Leila Errguig etal. A Cross-Sectional Study Evaluating Orthostatic Hypotension in Normotensive and Hypertensive Patients with Diabetes Mellitus, Journal of cardiovascular disease 2013; 1:3-7.

15. Ar Kar Aung, Susan J Corcoran, Vathy Nagalingam, Eldho Paul, Harvey H. Newham , Prevalence, Associations, and Risk Factors for Orthostatic Hypotension in Medical Surgical and Trauma Inpatients,The Ochner Journal, 2012; 12:1235-1241.

16. Rachel Swope, Aimee Adams, Prevention and Treatment of Orthostatic Hypotension in the Orthopaedic Patient Population ,Pharmacology Update 2012; 35:600-603.

17. Tarek M. Abdel Rahman ,Value of Orthostatic Hypotension as a Prognostic Bed-Side Test in Heart Failure World Journal of Cardiovascular Surgery, 2012; 2:132-140.

18. Chie Wei Fan, Cathalwalsh, Conal J. Cunningham, The effect of sleeping with the head of the bed elevated six inches on elderly patients with orthostatic hypotension: an open randomised controlled trial Oxford University Press Age and Ageing. 2011; 40:187–19.

Physiotherapy and Occupational Therapy Journal

Library Recommendation Form

If you would like to recommend this journal to your library, simply complete the form below and return it to us. Please type or print the information clearly. We will forward a sample copy to your library, along with this recommendation card.

Please send a sample copy to:

Name of Librarian

Name of Library

Address of Library

Recommended by:

Your Name/ Title

Department

Address

Dear Librarian,

I would like to recommend that your library subscribe to the **Physiotherapy and Occupational Therapy Journal**. I believe the major future uses of the journal for your library would provide:

1. useful information for members of my specialty.
2. an excellent research aid.
3. an invaluable student resource.

I have a personal subscription and understand and appreciate the value an institutional subscription would mean to our staff.

Should the journal you're reading right now be a part of your University or institution's library? To have a free sample sent to your librarian, simply fill out and mail this today!

Stock Manager

Red Flower Publication Pvt. Ltd.

48/41-42, DSIDC, Pocket-II

Mayur Vihar Phase-I

Delhi - 110 091(India)

Phone: Phone: 91-11-45796900, 22754205, 22756995, Fax: 91-11-22754205

E-mail: sales@rfppl.co.in

Original Article

Physiotherapy and Occupational Therapy Journal
Volume 10 Number 1, January - March 2017
DOI: http://dx.doi.org/10.21088/potj.0974.5777.10117.3

A Study to Compare the Effect of Intermittent Mechanical Traction and Manual Traction to Reduce Pain and Radiculopathy on Cervical Spondylosis

Danish Nouman*, Sanjai Kumar, Raj Kumar Meena***, Avikirna Pandey*, Surandar Kumar*, Kayinat Hassan***

Abstract

Objective: The purpose of study was to compare the effect of Intermittent mechanical traction and intermittent manual traction to reduce pain and radiculopathy on cervical spondylosis. *Methods:* Forty patients both male and female of cervical spondylosis with radiculopathy were randomly divided into two groups group A (n=20) was given Intermittent Mechanical traction and group B (n=20) was given manual traction Both groups were also administered a common conventional exercise protocol. The outcome measures used were Neck disability index (NDI), Visual Analogue Scale (VAS). The subjects were assessed pre-treatment test i.e. at the first day of treatment and after the 3 weeks of the treatment i.e. at the last day of the treatment. *Result:* The result showed a statistically significant improvement ($p < 0.05$) in all assessment parameters in pre to post treatment in all groups. After three weeks on comparing Group A and Group B the mean change, improvement in pain (1.8 ± .5232) vs. (2.2 ± .7678), NDI (5.05 ± 1.4681 vs. 7.25 ± 2.7697).

Keywords: Imtermittent Mechanical Traction; Manual Traction.

Introduction

Neck pain is becoming increasingly common throughout the world. The overall prevalence of neck pain in the general ranges between 0.4% to 41.5% (mean 14.4%) and 1 year prevalence ranges from 4.8 to 79.5% (mean: 25.8%) prevalence is generally higher in women higher in high – income countries compared with low and middle income countries and higher in urban areas compared with rural areas. Most studies indicates a higher incidence of neck pain among women and an increased risk of developing neck pain until the 35-49 years age group after which the risk beings to decline [1]. In cross sectional studies neck pain has been associated with self-reported poor general health status, psychological distress, and previous neck injury, in addition to other factor such as occupational tasks and obesity. Neck pain and its related disability have a huge impact on individuals and their families, communities, health – care system and business [2]. It has major economic consequence through the cost of health – care, work absenteeism, insurance and pressure health care system. The natural history is unclear. Non specific neck pain is generally caused due to wrong posture. The other causes are cervical spondylosis, whiplash, sprains, rhamatoid arthritis, ankylosis spondylosis other inflammatory disease.

Cervical spondylosis signifies progressive degeneration of the intervertibral disc leading to changes in the surrounding structures especially bones and meninges [13] its signs and symptoms include pain, limitation of neck movement, headache pain radiating to upperlimb paraesthesia, vertibro-basilar insufficiency may be present. The signs and systems can be present singly or in combination However it has been observed that in adults more than 40 years about 60% have degeneration disc disease, 20% have for foraminal stenosis, both of which may irritate nocieptors, further more, advanced spondylotic changes can narrow the vertibral and intervertebral foramina and restrict cervical mobility

Author Affiliation: *Assistant Professor **Associate. Professor ***Professor & Principal, Subharti College of Physiotherapy, Swami Vivekanand Subharti University, Meerut (U.P)

Reprint Request: Sanjai Kumar, Associate Professor, Subharti College of Physiotherapy, Swami Vivekanand Subharti University, N.H.-58, Meerut Haridwar Bye Pass, Meerut – 250005 Uttar Pradesh.
E-mail: kumarsanjai880@gmail.com

Received on 13.01.2017, **Accepted on** 20.01.2017

resulting in pain and dysfunction [13].

The physiotherapy treatment of cervical spondylosis includes patients education, posture corrections, and ergonemics, Electrotherapy, Manual therapy and Exercises. The recurrence rate of neck pain is high approximately 60% of all episodes are followed by a relapse [13] although neck pain is most frequent disorder treated by physiotherapist all over, there is no consensus about the management of this condition. Many interventions like traction, active and passive exercise, ultrasound, transcutaneous electrical nerve stimulation. Interferential therapy, patient education all these are useful generally for the treatment but the evidence of their effectiveness is lacking.

A study shows combined mechanical traction and exercise has resulted in improved patient outcomes or satisfaction level when compared to spinal manipulation or exercise alone [4]. In the other study there was no statistically significant difference between continuous and placebo traction in reducing pain or improving function for individuals with chronic neck disorder with radicular symptoms [10].

One of the commonly used treatment for cervical spondylosis is traction. Traction can be given in various forms such as manual traction, mechanical traction suspension and bed traction [10]. Out of these the most commonly used are the manual and mechanical traction, which one is more effective form of treatment is unknown. This the purpose of our study is to compare the effectiveness of intermittent mechanical traction with manual traction.

Methodology

Study Approach

The subject assessed on the basis of inclusion criteria as cervical spondylosis were requested to participate in study. The purpose of study was explained and consent form was taken from each subjects. All the subjects were assessed using a similar assessment Performa and assigned randomly to either of the group.

Inclusion Criteria

a. Age Group – 30 to 50
b. Gender - Both sex
c. Neck pain - Radiculopathy
d. Presence of sign and symptoms of Cervical Spondylosis
e. Showing x-ray changes

Exclusion Criteria

a. No other pathology
b. Age not above 50 years
c. Traumatic condition
d. Fracture around cervical
e. Vertigo dizziness

Sample Selection – Random Sampling

40 subjects were randomly allocated which were based on inclusion and exclusion criteria.

Study Design

Pre and post test comparative design with Group A and B.

Sample Size

40 subjects (20 in each) duration of the study 3 weeks.

Outcome Measures

Visual analogue scale and neck disability index.

Place of Study: Subharti College of physiotherapy & OPD of CSSH swami Vivekananda Subharti University Meerut, Uttar Pradesh (U.P) India.

Tool Used in the Study

a. Stationary
b. Hand sanitizer
c. Couch
d. Towel

Treatment Procedure

Ethical approval was obtained from the board of studies of Jyoti Rao phule Subharti College of physiothrapy, Swamivivekanand Subharti University, Meerut, (U.P) India.

GROUP (A)

Intermittent Mechanical Traction

Position of the patient is supine to obtained maximum lower posterior separation of vertebrae's the head should be flexed upto 20^0 to 30^0 and apply the halter over the chin and occiput comfortably major traction force must be against the occiput not the chin

1/10th of the total body weight applied for 10 minutes which includes 20 second hold and 5 second relaxation period during cervical traction provides better results [15], thus we have used it in the study.

Group (B)

Manual Traction : Cervical Spine

Traction techniques can be used for the purpose of stretching the muscle and the facet joint capsules and widening the intervertebral foramina. The value of manual traction is that, the angle of pull, head position and placement of the force can be controlled by the therapist, thus the force can be specifically applied with minimum stress to regions that should not be stretched. Patient is in supine lying on position table, therapist standing at the head of the treatment table, supporting the weight of the patients head in the hands of the therapist place one hand under chin and another hand on occiput, place the index fingers around the spinous process above the vertebral level to be moved. This hand placement provides a specific traction only to the vertebral segments below the level at which the fingers are placed [16]. Then apply a traction force by assuming a stable stance and leaning backward in a controlled manner. The force is usually applied intermittently with smooth and gradual building and releasing of the force. The intensity and duration are usually limited by the therapist's strength and endurance.

Result

The result showed a statistically significant improvement ($p < 0.05$) in all assessment parameters in pre to post treatment in all groups. After three weeks on comparing Group A and Group B the mean change, improvement in pain (1.8 ± .5232) vs. (2.2 ± .7678), NDI (5.05 ± 1.4681 vs. 7.25 ± 2.7697).

Table 1: Mean, standard deviation & s.e.m. for pre vas score & post vas score intermitent mechanical & manual traction

S. No.	Time Periods	Mechanical (Mean±S.D.)	S.E.M.	Manual (Mean±S.D.)	S.E.M.
1	Pre Vas Score	5.9±1.586	0.27	5.895±1.243	.3540
2	Post Vas Score	2.2±.7677	0.1168	1.7895±.5353	,1714

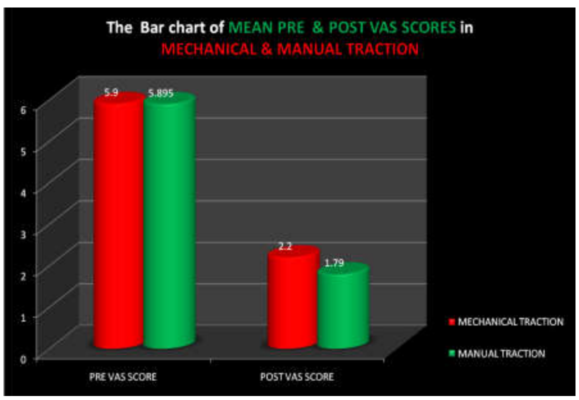


Fig. 1:

Table 2: Mean, standard deviation & s.e.m. for pre ndi score & post ndi score intermitent mechanical & manual traction

S. No.	Time Periods	Mechanical Mean±S.D.)	S.E.M.	Manual (Mean±S.D.)	S.E.M.
1	Pre NDI Score	20.15±7.3862	1.0671	21.158±4.8678	1.6487
2	Post NDI Score	7.25±2.7697	0.3277	5.1053±1.4868	.6182

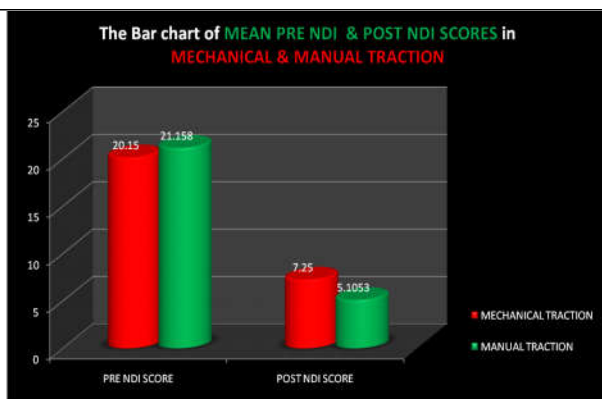


Fig. 2:

Table 3: Mean, standard deviation for the difference (pre to post) ndi score vas score intermitent mechanical & manual traction

S. No.	Time- Difference	Mechanical (Difference)	Manual (Difference)
1	(PRE- POST) VAS SCORE	3.7±1.0809	4.1053±.9366
2	(PRE- POST) NDI SCORE	12.9±5.9727	16.05±3.923

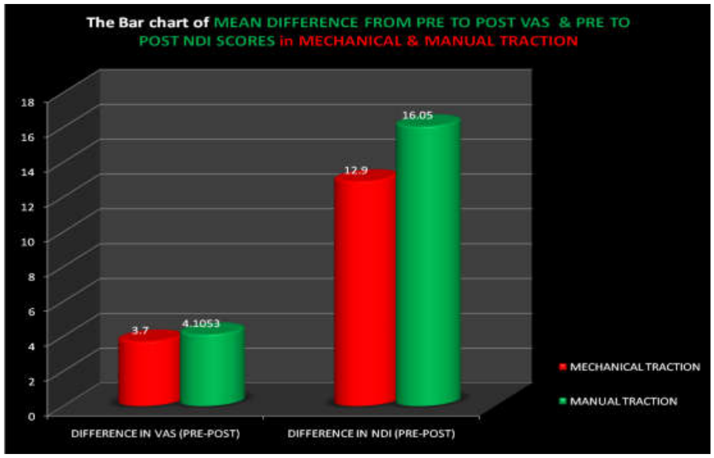


Fig. 3:

Table 4: Comparasion b/w pre to post vas score & pre to post ndi score (by paired "t" test) intermitent mechanical & manual traction

S. No.	Type of Scores	Intermitent Mechanical (P-Value)	Manual (P-Value)
1	VAS SCORE	.0000* P<.05 (SIG.)	.0000* P<.05 (SIG.)
2	NDI SCORE	.0000* P<.05 (SIG.)	.0000* P<.05 (SIG.)

*p<.05 shows a significant difference at á=.05 level of significance.

Discussion

A comparative study has been done, to see the effect of intermittent cervical mechanical traction and cervical manual traction to reduce pain and radiculopathy on cervical spondylosis patient. The study is done on 40 patients, which are equally divided into two groups (Group- A and Group-B). I have given intermittent cervical mechanical traction to Group-A patients and cervical manual traction to Group-B patients. The measurement has been taken by VAS (visual analogue scale)and NDI (neck disability index) respectively. The measurement has be taken on day one and after the last day of third week.

The result show after measuring VAS and NDI on last day of third week that in Group-A the mean VAS(5.9+-1.586 vs. 2.2+- .7677), NDI(20.15+-7.3862 vs. 7.25 +- 2.7697) at post treatment decreased (improved) significantly (p<0.05) as compared to pre treatment.

Group- B the mean VAS(5.895+-1.243 vs. 1.7895+-.5353), NDI(21.158+-4.8678 vs. 5.1053+-1.4868) at post treatment decreased (improved) significantly (p<0.05) as compared to pre treatment. After three weeks, on comparing Group-A and Group-B the mean change improved in pain (2.2+-.7677) vs. (1.7895+-.5353), Disability(7.25+-2.7697 vs.(5.1053+-1.4868) in Mechanical traction group improved significantly (p<0.05) more than the manual traction group. The study reported a reduction in pain and improved NDI in the group that received mechanical traction than either of another group. Intermittent traction improves the circulation to the tissues and reduces swelling of the tissues thus helps to relieve the inflammatory reaction of nerve roots. This approach is clinically therapeutic for two reasons. Firstly it is a form of stretching that lengthens all vertically oriented soft tissues of the neck. Secondly it decreases the weight bearing compression forces upon the joint surfaces, intervertebral discs and intervertebral foramina of the cervical spine. Some theories suggest that the stimulation of the propioceptive receptors in the vertebral ligaments and mono segmental muscle may alter or inhibit abnormal neural input from these structures. When we stretch the neck in one direction, we introduce a stretching and lengthening force into most every soft tissue of the neck. However, we also create a compression force on the opposite side of the spine. For example, if we stretch the subject's neck into right lateral flexion, we do so by moving the neck into left lateral flexion, thereby causing compression to the left side. Cervical traction achieves a desired stretch, without causing any compression.

In Mechanical traction the affected level of the spine. As the traction separates the spinous process, the intervertebral formina size increase thus relieving the compressed nerve root giving faster relief in radiation and also improves the intervertebral movement at that level. In Manual traction angle the pull is distributed over the entire cervical spine not concentrating it on a particular affected area. Thus manual traction gives a generalized treatment unlike mechanical traction which is localized on affected segment.

Conclusion

The result of the study suggest that the effect of Intermittent Mechanical traction is better than manual traction in cervical spondylosis. Thus Intermittent Mechanical traction can be considered as the treatment of choice over manual traction for cervical spondylosis with or without radiculopathy.

Reference

1. The epidemiology of neck pain – D.G. Hoyer, M. Protania, R. Dea, R. Buchbinder b 2011.
2. Peter R. Crofta, Martyn Lewisa, Ann C. Papagorgioub, Elaine Thomasa, Malcolm I.V. Jayso May 2001.
3. The Efficacy of Traction for Back and Neck pain A Systematic, Blinded Review of Randomized clinical Trial Methods, Great JMG.
4. Van der Heijden, Anna JHM Beurskens, Bart W Koes, Willem JJ Assendem, Hernica CW de Vetlex M Bouter 1995.
5. The effectiveness of Manual Physical therapy and Exercise for Mechanical Neck Pain Mechael J. Walker 2008 M. Dena Gardiner.
6. http://emedicine, medscape. com/article/324694-overview#awzaab6b4
7. Traction angle and intervertebral seperation – Alice wong et al.
8. Intermittent cervical traction for cervical radiculopathy caused by large volume herniated disc constatine constantoyannis, MD, a.b.
9. Dem atress Vonstantinou, MD, b Haruy Kourtopoulos, MD, PhD, a and Nicolas papadavis, MD, PhDbJ.
10. EMP08027 White paperupdate.
11. Mechanical traction for neck pain with or without radiculopathy – Nadine Graham et all.
12. Conservative management of Mechanical neck pain systemic critical overview and meta analysis peter D Aker, Anita R Gross, Charles M, Goldsmith, Paul Pelso.
13. The privalence of neck pain in the world population a systemiatic critical review of the literatutre – Rene' fejer Kristen ohm Kyvik Jan Hartvigsen.
14. Relative therapeutic efficacy of some vertebral mobilization techniques in the management of unilateral cervical spondylosis–a comparative study.
15. Michael Ogbonia EGWU, BMR, M.Sc., Ph.D. Cervical spondylosis and Neck, pain Allan I Binder.
16. Kisner C, Colby LA. The spine: traction procedures. In : Therapeutic exercise: foundations and techniques 3rd edn. Philiadelphia: FA Davis CO; 1996.p.575–591.

Subscription Information
Institutional (1 year) INR8500/USD850

Here is payment instruction for your reference.

Check:
Please send the US dollar check from outside India and INR check from India made:
Payable to 'Red Flower Publication Private Limited'.
Drawn on Delhi branch

PayPal Instructions for the payment (only for transfer from outside India):
Payments can be made through our PayPal account at https://www.paypal.com.
Our PayPal recipient email address is redflowerppl@gmail.com.

Credit Card:
We accept Visa or MasterCard.

Wire transfer:
Complete Bank Account No. 604320110000467
Beneficiary Name: Red Flower Publication Pvt. Ltd.
Bank & Branch Name: Bank of India; Mayur Vihar
MICR Code: 110013045
Branch Code: 6043
IFSC Code: BKID0006043 (used for RTGS and NEFT transactions)
Swift Code: BKIDINBBDOS

**Please kindly add bank charge at your side if you pay by check or wire transfer.

Payment, orders and all correspondences should be sent to;
Red Flower Publication Pvt. Ltd.
48/41-42, DSIDC, Pocket-II
Mayur Vihar Phase-I
Delhi - 110 091(India)

Original Article

Physiotherapy and Occupational Therapy Journal
Volume 10 Number 1, January - March 2017
DOI: http://dx.doi.org/10.21088/potj.0974.5777.10117.4

Neuromobilization, Exercise and Traction in Patients with Cervical Radiculopathy

Neha Gupta*, Susmita Yesentarao**

Abstract

Background: Cervical Radiculopathy (CR) involves compression of the cervical nerve roots leading to numbness, paraesthesias, muscle weakness, etc. in the upper extremity making the patient functionally disabled. There have been studies about treating the condition using Intermittent cervical traction. However, there have been controversial reviews regarding its use. The objective of the study was to find out the effectiveness of traction in patients with cervical radiculopathy, along with neuromobilization and exercises. *Methodology:* 30 patients diagnosed with CR participated in a Randomized Controlled Trial and were assigned to either - Group 1(traction group) or Group 2(no traction group). Group 1 was given neuromobilization, exercise and traction. Group 2 was given neuromobilization and exercise. The patients were treated for 10 sessions thrice a week for 3.2 weeks. The NPRS (Numeric Pain Rating Scale), NDI (Neck Disability Index), & PSFS (Patient-specific Fucntional Scale) were used to collect data on 1st, 5thand 10th sessions of treatment. *Results:* There was a significant improvement within each group. The post-mean NPRS for group 2 was 3.81(±0.54) and for Group 1 was 3.85(±0.55). The post-mean NDI for group 2 was 13.67 (±4.93) and for Group 1 was 12.73 (±4.72). The post-mean PSFS for Group 2 was 7.37(±1.04) and for Group 1 was 7.79(±0.88). However, no significant difference was found when the outcome measures were compared between the two groups. *Conclusion:* Neuromobilization along with exercise is an effective technique which can be used to treat patients of CR. But, in our study intermittent cervical traction did not have any additional significant benefit in the experimental group.

Keywords: Cervical Radiculopathy; Intermittent Cervical Traction; Neuromobilization.

Introduction

Cervical radiculopathy is a common disorder of neck. It is defined as radiating pain from cervical region because of compression of one or more cervical nerve roots. Mainly C5 to T1, are the ones usually involved. The symptoms of this condition include varying amount of pain in neck, shoulder, one or both upper extremities, near the scapular area. There is also complaint of tingling and numbness, as well as paraesthesia along the course of the affected nerve. Muscles which are supplied by the compressed nerve are also affected and hence weakness is seen. Reflexes in the upper extremity may get affected in severe compression leading to less response or may sometimes even be absent [1,2].

The nerve roots come out from the spinal cord via the intervertebral foramen. Therefore, any pathology which can lead to a decrease in the space of the foramen and thereby causing compression of the nerve can lead to radiculopathy. These pathologies are mainly spondylosis of the facet joints or herniation of the intervertebral cervical disc [1].

The annual incidence of this condition is 83 per 1,00,000 in the population marking fifth decade of life by an increase in its prevalence [2]. C6 & C7 radiculopathies are the most common [3]. After that C5 radiculopathy is common [10].

Both the younger as well as the geriatric age groups are affected by CR [4]. Acute herniation of the disc is more common in young people, and is related to sudden onset of symptoms which tends to be more severe, whereas it is the chronic herniation and degenerative changes that cause compression in

Author Affiliation: *Assistant Professor **BPT, Amity Institute of Physiotherapy, Amity University, Noida.

Reprint Request: Neha Gupta(PT), Assistant Professor, Program Leader, Amity Institute of Physiotherapy, Amity University, Sector-125, Noida - 201313 Uttar Pradesh.
E-mail: neha0628@gmail.com

Received on 18.01.2017, **Accepted on** 20.01.2017

geriatric people such as decrease in disc space, osteophytes, or spurs and symptoms develop gradually and are less severe [4,9].

Diagnosis of CR can be done both on the basis of imaging as well as by using the Clinical Prediction Rule. Frequently, history of the patient and proper clinical examination can diagnose the condition in at least 75% of the patients as effectively as imaging [10]. EMG is considered to be the mainstay for diagnosis. However, performing imaging techniques can be an expensive affair for the patient [10].

Wainner et al in 2000 came up with a clinical prediction rule (CPR) to specifically diagnose CR. This includes the Spurling's test, the Neck distraction test, Upper limb tension test, less than 60° ipsilateral cervical rotation [10]. Specificity of 94% was found when 3 out of the 4 given criteria are fulfilled [12]. CPR has been effectively used in many studies for diagnosing CR [1-3,6,12,14].

A variety of treatment options are available for treating CR.Usually, a combination of approaches or treatments are used as they have been found to have a better outcome. Many studies have shown the use of physiotherapeutic interventions to be beneficial for patients by resulting in a significant reduction in the manifestation of the symptoms [2-6,17]. These include TENS, ICT [4], Cryotherapy [5] US in electrotherapy while manipulations, soft-tissue mobilizations, neural mobilizations, exercises, etc. in manual therapy and exercise therapy [5]. Other than these, soft collars are used for the purpose of stabilizing and restricting movement of neck in acute phases and have proven to provide a better prognosis [8].

There are many types of traction which are used in clinic setups - Intermittent cervical traction(ICT), continuous traction, manual traction.Many studies are available which have tried to look into cervical traction as a definite treatment for CR [2,4,6,7]. Few of them supported its use by establishing an improvement [6,13,15,16,18]. Others could not find it as a superior treatment as compared to other approaches [2,4,7]. Vander Heijden et al found that traction cannot be taken as the most effective approach as there isn't enough clarity about its mechanism and proof regarding its contribution [15].

Till now the studies which have been done on effectiveness of traction in cervical radiculopathy patients have not been able to reach any clear conclusionand have shown varied results.

Through this study, we try to find out the effectiveness of intermittent cervical traction in patients suffering from cervical radiculopathy.

Methodology

52 patients presenting with neck pain in the physiotherapy department of Kailash Hospital and Heart Institute, Noida were assessed out of which 22 were rejected since these patients did not meet the inclusion and exclusion criteria (Table 1). The assessment was done by a chief assessor who was blinded to the study.

Table 1: Inclusion and Exclusion Criteria

Inclusion Criteria:	Exclusion Criteria: [2]
1. Both male and female between the age group of 25 to 45 years [3]	1. Any surgical history in past related to cervical and thoracic spine
2. Pain, paraesthesia, tingling or numbness in one upper-extremity [2]	2. Symptoms in both upper-extremities
3. At least 3 out of 4 Clinical Prediction Rule must be positive: [2] • Spurling test • Distraction test • Upper limb tension test [3, 7] • Ipsilateral cervical rotation less than 60degrees	3. Any signs or symptoms related to upper motor neuron disease
4. Symptoms lasting for 2 weeks or more [7]	4. Presence of "red flags" 5. Steroids injected in cervical spine in past 2-3 weeks 6. Oral steroids for CR

A Randomized Controlled Trial was conducted. Lottery method was used for randomization of the subjects.

The names of the subjects were written on chits which were randomly drawn by an assessor II who was blinded to the objective and was not involved in the study. The subjects were divided in Groups 1 and 2.

A brief explanation of the procedure to be followed was given to each patient separately by the therapist and when the patients had agreed to participate, a written informed consent form was made to be signed by the patient. Baseline data was collected through NPRS (Numeric Pain Rating Scale) for assessing the pain, NDI (Neck Disability Index) for neck disability & PSFS (Patient Specific Functional Scale) for level of functional activity for both the groupsby the chief assessor who was blinded to grouping of patients.

All patients received the treatment in sequential order that is neural mobilization, exercises, postural education, and lastly traction or no traction. The patients knew what treatment was given to them for obvious reasons however, they were blinded to whether they were in the experimental or control group. The therapist was not blinded of the groups. The same therapist gave treatment to both the groups.

The patients were treated for 10 sessions (thrice a week) for 3.2 weeks [2]. Post intervention data was again collected using the outcome measures at the end of 5th session and then at the end of 10th session by the chief assessor (Figure 1).

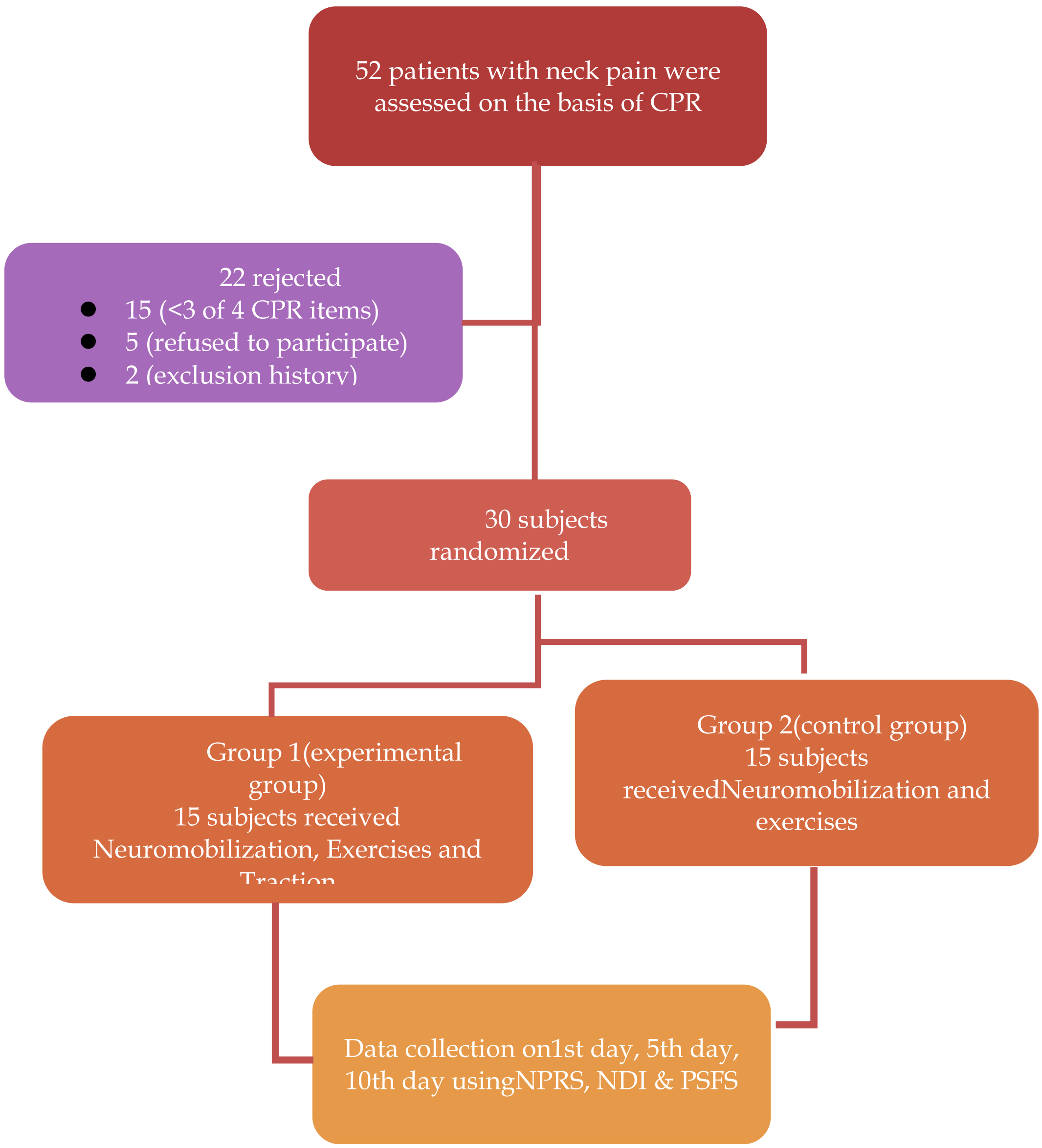


Fig. 1: Flow chart showing distribution of subjects

Results

SPSS software version 24.0.0 was used to analyse the data. Student's t-test was applied, using p value equivalent to 0.05 i.e., t value was considered at 5% significance level.Result was interpreted as significant if t-value exceeded the value of t= 2.05 as given under p=0.05 at df=28 for unpaired t-test and t= 2.15 at df=14 for paired t-test, else insignificant.

The mean age of the subjects in Group 2 was 36.80 ±5.65 having a range of 28-45 while that in Group 1 was 34.93 ±4.57 having a range of 28-43. Number of males in this study were 16 and number of females were 14.

The baseline data for group 1 & 2 under all 3 scales i.e., NPRS, NDI & PSFS showed no significant variation (Table 2).

Intra-group Analysis

The results showed a significant improvement for both the groups in all 3 scales indicating that subjects in both the groups had better outcome after 10 treatment sessions (Table 3, Table 4). Also, 5th day treatment analysis showed significant improvement for group 2 subjects with mean NPRS score of 5.14(±0.65), mean NDI score of 22.20(±4.45) and mean PSFS score of 5.35(±0.93). Similarly, 5th day analysis of group 1 subjects showed significant improvement with mean NPRS score of 4.96(±0.67), mean NDI score of 20.53(±4.62), and mean PSFS score of 5.83(±0.69).

Table 2: Baseline Data for Group 2 and 1

	Group 2	Group 1	t value
NPRS	5.94 (±0.63)	5.76 (±0.64)	0.769
NDI	29.07 (±4.21)	27.13 (±4.73)	1.18
PSFS	3.82 (±0.68)	4.02 (±0.75)	0.73

Table 3: Pre-Post Scores of Group 2

Group 2(no traction)	PRE	POST	t value
NPRS	5.94 (±0.63)	3.81 (±0.54)	44.05
NDI	29.07 (±4.21)	13.67 (±4.93)	28.43
PSFS	3.82 (±0.68)	7.37 (±1.04)	26.43

Table 4: Pre-Post Scores of Group 1

Group 1 (traction)	PRE	POST	t value
NPRS	5.76 (±0.64)	3.85 (±0.55)	29.63
NDI	27.13 (±4.73)	12.73 (±4.72)	21.12
PSFS	4.02 (±0.75)	7.79 (±0.88)	26.15

Table 5: Post scores comparison between Group 2 and 1

	Group 2	Group 1	t value
NPRS	3.81 (±0.54)	3.85 (±0.55)	0.198
NDI	13.67 (±4.93)	12.73 (±4.72)	0.52
PSFS	7.37 (±1.04)	7.79 (±0.88)	1.18

Inter-group Analysis: The results did not show any significant superiority of any one combination of treatment (Table 5).

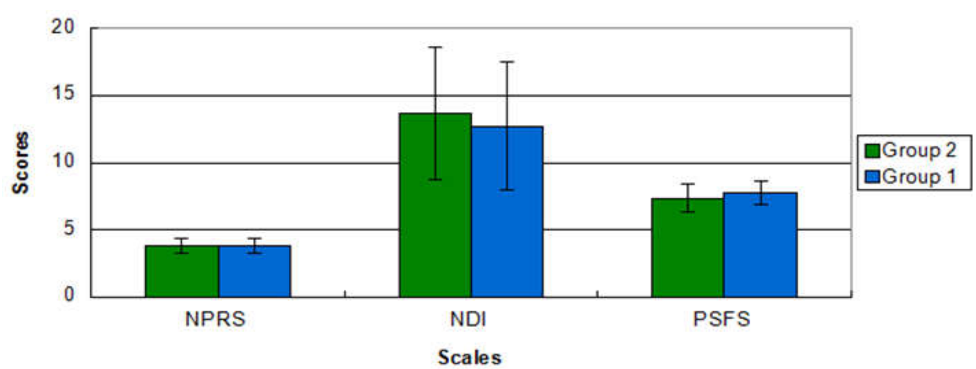


Fig. 2: Post scores comparison between Group 2 and 1

Discussion

The aim of our study was to find out the effectiveness of traction on cervical radiculopathy patients.

The results were found to be insignificant for the effect of traction when both the groups were compared as there was no significant difference between the mean post scores of both groups. However, there was a significant change in the score on last day of treatment when compared to the baseline score within both groups implying the effectiveness of the treatments given to both groups. The reason for not having found a significant effect of traction may be because of the fact that neural mobilization was given to both the groups. Neural mobilization has been used by lot of researchers and its effectiveness on cervical radiculopathy has been found as promising [3,5,7,11].

Smati Sambyal & Sandeep Kumar in their study showed that neural mobilization was more effective than traction in a group of 20 patients with CR. One group received neural mobilization along with traction while the other group was treated using only traction plus exercises [3]. Sahreen Anwar, in a group of 30 patients, performed an RCT by giving one group traction and neck exercises while in the other group same treatment plus neural mobilization was given. His study supported neural mobilization as being more beneficial in treating CR [11].

Neural mobilization consists of creating movement of specific nerves in the body whose functions have been altered due to some pathology. This method is useful in increasing the impulse conduction which helps in reducing the symptoms of numbness & tingling by resulting in a change in the flow within the nerve and blood supply [3,5,7]. In our study, the effect of neural mobilization could have prevailed over traction thereby negating its effects.

There have been a lot of studies on traction on patients with CR. It is used commonly for this condition. But still, traction studies have shown varied conclusions.Young et al, in his study including 81 patients, tried to examine the effect of traction mainly, along with manual therapy & exercises. He divided them into 2 groups, one group receiving all 3, other group receiving sham traction along with manual therapy & exercises. His study couldn't find any significant effect of ICT although patients felt improvement in their condition. The study was conducted for a period of 4 weeks; treatment sessions being given thrice a week. Young incorporated CPR for diagnosing the condition [2].

Our study was conducted for a period of about 3.2 weeks, treatment being delivered thrice a week. We utilised the technique of neural mobilization, and we created a control group which did not receive traction at all to properly examine the effects of ICT. Our diagnostic criteria were also based on positive findings from CPR.

The usage of CPR, given by Wainner et al, is 94% accurate for diagnosing the condition when at least 3 tests come out to be positive [10]. Although its use has still not been validated properly, it has been used by researchers in their studies [2,3,6,12] and continues to be an effective measure for diagnosing CR.

The position of head used for giving traction may also have been a factor that effect of traction wasn't identified in our study. There are normally 3 neck positions which can be used - flexion, neutral and extension, depending upon whether lower cervical roots, mid cervical roots or upper cervical nerve roots have been affected. Very commonly position of neck flexion is used in supine for giving ICT. Head was kept in flexion position in our study for all the patients irrespective of the nerve bias as we wanted to see what effect it would have on the symptoms of the patient. Though head flexion position did not seem to have relieved the symptoms effectively in patients whose upper and mid cervical root got affected, but also it did not have any worsening effect as well.

Exercises are widely used in CR. The main objective involves taking the spine off load by strengthening all the muscles - anterior, posterior- of neck. This helps to prevent the relapse of the condition.

Our study made use of cervical neck retraction exercises, neck extension exercises, strengthening of the deep neck flexors along with scapular muscles.

As far as studies on cervical radiculopathy are concerned, there are still varied results and conclusions regarding the worth of traction. While some studies seem to fully support it, others couldn't find its significance when compared to another technique or method.

Our study could not find the effect of traction despite having a control group. In our study, neuromobilization has proven to benefit the patients a lot. There was a siginificant change under all scales (NPRS, NDI & PSFS) in both the groups.

Future Research

The study can be replicated on a statistically suitable sample size to predict the differences more accurately. Different types of traction can also be compared along with the technique of nerve mobilization. Also, different positions of neck used for traction can be analysed in detail in accordance to nerve bias which can help to identify a more precise role of traction in CR.

Conclusion

CR can turn into an incapacitating condition, by becoming a hindrance in performing daily living activities as the upper extremities are affected leading to economical problems specially in acute condition as the patient is unable to go to work, affecting social relationships in patient's life, disturbing sleep in turn creating a psychological disturbance in patient's mind [9].

Therefore, it is of the utmost importance that proper studies be conducted in order to find the most beneficial and effective treatment approach for cervical radiculopathy patients.

Acknowledgement

We would also like to thank the staff of Physiotherapy department of Kailash Hospital and Heart Institute, Noida for their cooperation and assistance during the study.

References

1. Langevin et al.: Cervical radiculopathy: Study protocol of a randomised clinical trial evaluating the effect of mobilisations and exercises targeting the opening of intervertebral foramen [NCT01500044]. BMC Musculoskeletal Disorders 2012; 13:10.
2. Young IA, Michener LA, Cleland JA, et al. Manual therapy, exercise, and traction for patients with cervical radiculopathy: a randomized clinical trial. Phys Ther. 2009; 89:632–642.
3. SmatiSambyal, Sandeep Kumar "Comparison Between Nerve Mobilization And Conventional Physiotherapy In Patients With Cervical Radiculopathy.International Journal of Innovative Research & Development 2013; 2(8):442-445.
4. Himanshi Sharma, Nirali Patel. EEffectiveness of Tens Versus intermittent Cervical Traction In Patients With Cervical radiculopathy. Int J Physiother Res 2014; 2(6):787-792.
5. Robert Boyles, Patrick Toy, James Mellon Jr, Margaret Hayes, Bradley Hammer Effectiveness of manual physical therapy in the treatment of cervical radiculopathy: a systematic review Journal of Manual and Manipulative Therapy. 2011; 19(3):135-142.
6. Angela Tao NG et al., Effectiveness Of Cervical Traction On Pain And Disability In Cervical Radiculopathy. International Journal of Recent Scientific Research. 2015 April; 6(4):609-3611.
7. Pratik Chettri , Nikita Joshi and Bishal Bista Effectiveness of Neural Mobilisation and Intermittent Cervical Traction in Cervical Radiculopathy Patients : A Randomised Clinical Trial SMU Medical Journal, Volume – 1, No. – 1, January, 2014.P.179
8. Barbara Kuijper, Jos Th J Tans, Anita Beelen, FransNollet, Marianne de Visser,Cervical collar or physiotherapy versus wait and see policy for recent onset cervical radiculopathy: randomised trial BMJ. 2009; 339(b3883):1-7.
9. John M. Caridi, Matthias Pumberger, Alexander P. Hughes Cervical Radiculopathy: A Review HSSJ. 2011; 7:265–272.
10. Maj. Robert S. Wainner, LtCol Howard Gill Diagnosis and Nonoperative Managementof Cervical Radiculopathy Journal of Orthopaedic & Sports Physical Therapy. 2000; 30(12):728-744.
11. Sahreen Anwar, Arshad Nawaz Malik, Imran Amjad Effectiveness of neuromobilization in patients with cervical radiculopathy. Rawal Medical Journal. 2015 Jan-Mar; 40(1):34-36.
12. Mark A. Waldrop Diagnosis and Treatment of Cervical Radiculopathy Using a Clinical Prediction Rule and a Multimodal Intervention Approach: A Case Series Journal of Orthopaedic & Sports Physical Therapy. 2006 March; 36(3):152-159.
13. Joshua A. Cleland, Julie M. Whitman, Julie M. Fritz, Jessica A. Palmer, Manual Physical Therapy, Cervical Traction,and Strengthening Exercises in PatientsWith Cervical Radiculopathy: A Case Series J Orthop Sports Phys Ther December 2005; 35 (12):802-811.
14. Michael Costello Treatment of a Patient with Cervical RadiculopathyUsing Thoracic Spine Thrust Manipulation, Soft Tissue Mobilization, and Exercise. The Journal Of Manual & Manipulative Therapy. 16(3):129-135.
15. Prisca Moeti, Gregory MarchettiClinical Outcome From Mechanical Intermittent Cervical Traction for the Treatment of Cervical Radiculopathy: A Case Series Journal of Orthopaedic & Sports Physical Therapy. 2001; 31(4):207-213.
16. A. Jellad, Z. Ben Salah, S. Boudokhane, H. Migaou, I. Bahri, N. Rejeb The value of intermittent cervical traction in recent cervical radiculopathy Annals of Physical and Rehabilitation Medicine 2009; 52: 638–652.
17. Jason David Eubanks Cervical Radiculopathy: Nonoperative Managementof Neck Pain and Radicular SymptomsAmFam Physician. 2010; 81(1): 33-40. www.aafp.org/afp.
18. Ibrahim M. Moustafa , Aliaa A. DiabMultimodal Treatment Program Comparing 2Different Traction Approaches for Patients WithDiscogenic Cervical Radiculopathy: ARandomized Controlled Trial Journal of Chiropractic Medicine. 2014; 13:157–167. http://dx.doi.org/10.1016/j.jcm.2014.07.003.

Original Article

Physiotherapy and Occupational Therapy Journal
Volume 10 Number 1, January - March 2017
DOI: http://dx.doi.org/10.21088/potj.0974.5777.10117.5

Application of Posterior Pelvic Tilt Taping for the Treatment of Sacroiliac Joint Dysfunction and Increase Sacral Horizontal Angle in Post Partum3 Females

Trishna Awasthi*, Sharda Sharma, Shiv Verma***, Amit Sharma****

Abstract

Purpose: Kinesio Taping is a therapeutic method used by physical therapist and athletic trainer in combination with other treatment techniques for various musculoskeletal and neuromuscular problems. The purpose of this study was to describe the application of posterior pelvic tilt taping with kinesio tape as a treatment for Sacroiliac joint dysfunction and to reduce sacral horizontal angle and the anterior pelvic tilt angle in post partum females. *Subjects*: 5 post-partum females were taken who agreed to participate in this experiment. *Methods:* The patient was lye in a supine position .The first tape was apply to the rectus abdominus muscle for the correction of posterior pelvic tilt and for the second taping the patient position will be change patient lye in a side lying position and apply the second taping on external oblique muscle for the correction of S.I joint in post partum females. *Results*: This result show a significant (p=0.05) difference between the pre and post taping in postpartum female. *Conclusion:* There seems to be considerable improvement in post partum females with S.I joint dysfunction. In outcome majors there was a decrease in punctuation, what means improvement in symptoms. The present study stated a beneficial effect of Kinesio taping on post partum females with S.I joint dysfunction and also improvement in the daily activities.

Keywords: Posterior Pelvic Tilt Taping; Post Partum Females; S.I Joint Dysfunction; Kinesiotaping.

Introduction

Many of the physical changes during pregnancy contribute to low back pain. During pregnancy the expanding uterus stretches and weakens abdominal muscles, alter the posture putting strain on back .The extra weight and increased stress to the SI joints causing back pain. Sacroiliac (SI) joint dysfunction is a common cause of low backpain.

Many pregnant women experience low back pain or pelvic pain due to sacroiliac joint dysfunction because the SI joints can stretch and become loose during pregnancy. Also, hormone changes and the additional weight gained during pregnancy can put added stress on SI joints. Due to extreme weight. On S.I joint there will be anterior tilting of pelvis in post partum females. This condition is usually accompanied by excessive lordosis of the spine.

Taping is also used to treat low back pain.Kinesio taping is method applied over muscles to reduce pain and inflammation relax over used or tired muscles and support muscle in movement on 24 hours a day basis. The taping is non restrictive and allow for full Range of motion.

Kinesio taping is a technique based on the body's own natural healing process. This kinesio taping exhibits its efficacy through the activation of neurological and circulatory system. This method basically stems from the science of kinesiology, hence the same "kinesio" muscles are not only attributed the movements of the body but also control the circulation of venous and lymph flows body temp. etc.

This study makes an effort to find or to justify the effect of kinesiotape in treatment of decrease pelvic tilt and decrease sacral horizontal angle in post partum females.

Author Affiliation: *P.G.M.P.T (Musculoskeletal) **M.P.T Ortho ***MPT Neurology, Dept of Physiotherapy, wami Rama Himalayan University, Dehradun, U.K.

Reprint Request: Shiv Verma, Lecturer, Department of Physiotherapy, Swami Rama Himalayan University, Jolly grant Dehradun, Uttarakhand – 248016..
E-mail: vermashiv_2005@yahoo.co.in

Received on 05.12.2016, **Accepted on** 13.12.2016

Methodology

Five females will be taken according to inclusion and exclusion criteria. Consent was taken pre Oswestry questionnaires score were taken before taping. Pre x-ray was taken of Lumbar sacral region before taping post x-ray was taken of Lumbar sacral region after 1 week when Kinesio tape was applied.

Inclusion Criteria

Post-partum females with S.I joint pain.Age-20-35 years, primary gravida, post-partum females under (3 months).

Exclusion Criteria

The patient who presented any skin infection, congenital/acquired deformity, Neurological deficit, Paragravida, Recent trauma or fracture, Unco-operative patient..

Instrumentation

The instrumentation included were Kinesio tape, Scissor, Couch, Camera, Compass, and Scale.

Procedure

Five females will be taken according to inclusion and exclusion criteria. The subject should have comfortable clothing and slippers should be removed. The skin should be cleaned where we going to apply a kinesio tape. First the pelvic inclination of both sides was measured by (PALM).

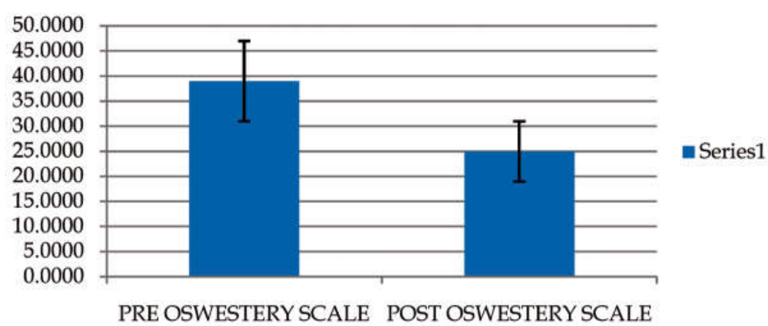
Technique

The subject may lye down in a couch in a supine position When the patient remained in the same position kinesio tape was stretched approximately 100% The first kinesio tape was applied beginning at pubic bone and ending at border of sternum the kinesio tape applies on both the sides. For the second taping technique the position of the patient will be change the patients come in side lying position The second kinesio tape was applied beginning from the crest of the Ilium and ending to the 6 and 7 ribs. After applying a tape we should ask a patient if patient have any discomfort or itching.

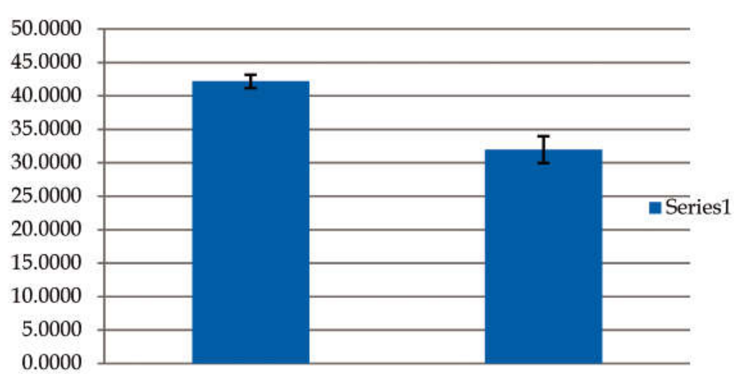
After the application of the tape the patient was allowed to follow her every day activities and give instruction to patient that if patient have any discomfort then the tape should be removed after 3 days the tape is changed we apply kinesio tape for one week.

Results

This chapter deals with the results of data analysis of pre-post reading using Paired t test.



Graph 1: Comparison of pre and post reading in Oswestry scale



Graph 2: Comparison of pre and post reading in sacral horizontal angle

The pre mean ±SD test score was found to be 39.00±8.21.After the Intervention post mean ±SD score was found to be 25.00±6.48 the difference between the pre score and post score 14 (CI=10.71-17.28) was statistically significance at 5% level of significance.

The present study also proves and supports the improvement in activity of daily living in present study it will be proof that kinesio tape will be effective to control the Low back pain and to decrease the sacral horizontal angle and to improve the tilt of pelvic inclinationment of anterior pelvic tilt.

Discussion

About 50% of women experience Low back pain during pregnancy. Back pain in pregnancy may be severe enough to cause significant pain and disability Sacroiliac joint dysfunction is a common cause of Low back pain or pelvic pain due to sacroiliac joint dysfunction. Due to extreme weight on sacroiliac joint there will be anterior tilting of pelvis in post partum females.

According to the research titled "Application of Posterior Pelvic Tilt Taping for the treatment of sacroiliac joint dysfunction and increased sacral horizontal angle on Post Partum females" this research is done by "Lee JH, Yoo WG". This research is done as a case study in two patient this data is fully supporting the availability of treatment protocol to be done in post partum females for low back pain and improve. In earlier studies it has been prove that the efficacy of kinesio tape for the immediate effect of low back pain and also the effect on pelvic tilt as stated in a research titled "The immediate effect on anterior pelvic tilt taping on pelvic inclination for the treatment of low back pain" done by Lee JH, Yoo WG, Hwang-BO-G" done in china stated that kinesio taping and effective in patients pelvic tilt inclination and in low back pain.

Conclusion

There seems to be considerable improvement in post partum females with S.I joint dysfunction. In outcome majors there was a decrease in punctuation, what means improvement in symptoms.The present study stated a beneficial effect of Kinesio taping on post partum females with S.I joint dysfunction and also improvement in the daily activities.

References

1. Application of posterior pelvic tilt taping for the treatment of chronic low back pain with sacroiliac joint dysfunction and increased sacral horizontal angle(2011-2012).
2. The mechanical effect of Anterior Pelvic Tilt Taping on Slump Sitting by Seated Workers (2010).
3. Pregnancy and low back pain Author(Jonathan N.Grauer).
4. Deyo RA rt al. Outcome measures for Low Back Pain research. A proposal for standardized use. Spine.15; 1998; 23(18):2013-13.
5. Mannion AF.et al (2007).Pain measurement in patients with Low Back Pain Nat.clin, Pract. Rheumatol. 2007; 3(11):610-618.

Subscription Form

I want to renew/subscribe international class journal **"Physiotherapy and Occupational Therapy Journal"** of Red Flower Publication Pvt. Ltd.

Subscription Rates:
• Institutional: INR8500/USD850

Name and complete address (in capitals): ______________________________

____

Payment detail:
Ch/Dd No.
Date of Ch/DD
Amount paid Rs./USD

1. Advance payment required by Demand Draft payable to Red Flower Publicaion Pvt. Ltd. payable at Delhi.
2. Cancellation not allowed except for duplicate payment.
3. Agents allowed 10% discount.
4. Claim must be made within six months from issue date.

Mail all orders to
Subscription and Marketing Manager
Red Flower Publication Pvt. Ltd.
48/41-42, DSIDC, Pocket-II
Mayur Vihar Phase-I
Delhi - 110 091(India)
Phone: 91-11-45796900, 22754205, 22756995, Fax: 91-11-22754205
E-mail: sales@rfppl.co.in

Review Article

Physiotherapy and Occupational Therapy Journal
Volume 10 Number 1, January - March 2017
DOI: http://dx.doi.org/10.21088/potj.0974.5777.10117.6

Efficacy of Neurodynamic Technique on Athletes with Lower Lumbar Radiculopathy: Narrartive Review

Rashmi Gupta*, Saurabh Sharma**

Abstract

Lumbar radiculopathy is associated with nerve root injury. It involves radiating pain below knee with neural deficit in neural distribution pattern. Neurodynamic technique has been advocated as an effective treatment for lumbar radiculopathy. The purpose of this review is to analyse the mechanism and the effectiveness of neurodynamic technique and to examine the effect of neurodynamic technique on motor nerve conduction velocity (mNCV) and surface electromyographic activity (sEMG).

Keywords: Neural Mobilisation; Lumbar Radiculopathy; NCV; sEMG.

Introduction to Lumbar Radiculopathy

Lumbar radiculopathy is defined as the radiating leg pain below knee with neurological deficits in the distribution of the nerves (BW Koes et al; 2007). The major symptoms of lumbar radiculopathy involve pain, numbness, paresthesia and loss of muscle strength. The clinical presentation of lumbar radiculopathy depends on the nerve root impinged. In this study we are including the subjects with lower lumbar radiculopathy (L4-L5 and L5-S1).

Clinical presentation of L4 radiculopathy includes pain on the medial side of the leg, paresthesia over the medial leg along the course of saphenous nerve. There may be weakness of tibialis anterior, quadriceps and hip adductors. Knee jerk may be hypo-reflexive or absent in radiculoapthy (Tarulli & Raynor, 2007).

Clinical presentation of L5 radiculopathy includes pain along the lateral thigh, lower leg and dorsum of foot. Patient may experience paresthesia over the lateral lower leg, dorsum of foot and great toe. There may be weakness of toe extensors and flexors, ankle dorsiflexors, evertors and invertors and hip abductors. Internal hamstring reflex is affected in this radiculopathy. Patient might experience foot drop (Tarulli & Raynor, 2007)

There are several causes of lumbar radiculopathy like intervertebral disc herniation, degenerative lumbar spondylosis and other conditions such as neoplasm, infection, inflammatory. Hemorrhagic areas which are considered red flags.

Diagnosis of Lumbar Radiculopathy

Physical examination: physical examination is performed using a battery of tests based on established criteria (Surie et al 2010). It includes the following test - Provocative test : straight leg raise test, crossed straight leg raise test, Motor testing: heel walk for L4, great toe extension strength for L5, Sensory testing: pin prick test on medial ankle for L4, pin prick on great toe for L5, Reflex testing : patellar reflex for L4.

Subjects with sensory deficits, absence of reflex (or diminution of reflex) and loss of muscle strength represents moderate to severe case of lumbar radiculopathy. However in this study subjects with radiating complaints in the leg below knee, pain on coughing, sneezing of straining, positive straight leg raise test, NPRS more than 4 and symptoms for at least 3 months or more will be included.

When the spinal nerves comes out of the intervertebral foramen, the arachnoid matter and the dura matter forms the inner and outer epineurium which is the outermost covering of the nerve. When the nerve is compressed, nociceptors on the outer epineurium are stimulated which results in pain.

Author Affiliation: *MPT, Jamia Millia Islamia, New Delhi. **Assistant Professor, CPRS, Jamia Millia Islamia, New Delhi 110025.

Reprint Request: Saurabh Sharma, Assistant Professor, Centre for Physiotherapy and Rehab Sciences, Jamia Millia Islamia, New delhi -110025.
E-mail: saurabh14332003@yahoo.com

Received on 21.12.2016, **Accepted on** 09.01.2017

Nerve compression leads to blockage of intraneural circulation and axoplasmic flow leading to upregulation of inflammatory mediators which leads to generation of pain (Tapp & Boyd 2006, Kobayashi et al 2004)

Lumbar Radiculopathy, Neural Mobility and Nerve Conduction

Nerve compression leads to microvascular alteration causing inflammatory mediators upregulation. Inflammation leads to adhesion formation between herniated disc and nerve root resulting in decreased nerve gliding (Kobayashi et al,2004). Nerve conduction block, mechanical sensitization, intra-neural edema and increase of sodium channel density have been reported in acute and subacute stages of nerve root compression (Chen et al 2003, Kabayashi et al 2004, Rempel et al 1999).

Neurodynamics

Shacklock gave the concept of neurodynamics in 1995. Neurodynamics is composed of mechanical physiological mechanisms. It includes interaction between mechanics and physiology of nervous system which are interdependent on each other. According to the mechanics, body acts as a container of nervous system and the musculoskeletal system is the mechanical interface (MI) of the nervous system which can be divided as Central mechanical interface and Peripheral mechanical interface. Central mechanical interface consists of cranium, spinal and radicular canals housing the neuraxis, cranial nerves, meninges and nerve roots. Peripheral mechanical interface is composed of nerve beds in the limbs and torso where the nerves are presented with bone, fascia and fibrosseous tunnels.

During daily activities, body moves resulting in changing dimensions of MI imposing force on neural structures. In order to protect against such compromise, nervous system undergo distinct mechanical events such as elongation, sliding, cross sectional changes,angulation and compression. When these mechanism fails, symptoms may occur. Joint angulation and destination of the nerves are the two features which combine to cause neuro mechanical responses.

During the early range of a tension test, nerves are wrinkeled sitting loosely in their bed. When movement exerts tension in the nerve, the nerve loose their slack (Sunderland and Bradley, 1961) and begin sliding (Breig, 1978). During the mid range of movement, nerve slides more rapidly because of sufficient tension. Towards end range, neural sliding depletes and there is a more marked increase in neural tension (Charnley, 1951).

Neural sliding does not always occur in one direction. The nerve convergence occurs towards the joint where the nerve elongation is initiated. Sequence of body movement influences the neural sliding as when dorsiflexion is added to the SLR, the nerves slides towards ankle. Neural tissues possess viscoelastic properties. With constant loading neural tissue elongate progressively given that elastic limit is not exceeded and enough time is allowed, they come back to their original length when the load is removed (Kwan et al, 1992). Peripheral nerves and nerve roots possess high risk of plastic deformation with excessive loading (Sunderland and Bradely, 1961)

Physiological responses includes intraneural blood flow, axonal transport, mechanosensivity and sympathetic activation. Excessive tension reduces intraneural microcirculation by stretching and strangulation of vessels. If the vascular capabilities are exceeded by excessive stretching, nerve damage occurs (Lundborg and Rydevik, 1873). Intracellular cytoplasmic movement is sensitive to hypoxia (Ochs and Hollingsworth, 1971; Leone andOchs, 1978). Nerve compression leads to hypoxia (Sunderland, 1976) and reduces axonal transport (Mackinon and Dellon, 1988). Axonal transport is found to be reduced at pressures as low as 30 mm Hg which can be achieved during daily activities like wrist flexion/ extension (Rydevic et al 1981; Gelberman et al 1981)

Mechanosensitivity refers to the impulse activation occuring when a neural structure comes across a mechanical stimuli such as pressure or tension. When a nerve is injured or inflamed, impulses are more readily evoked (Calvin et al 1982; Howe et al 1977). When a nerve is compressed or stretched, action potentials generate in the sympathetic nerve fibres causing increased sweating.

Changes in neural mechanics or physiology can lead to pathodynamics. Pathodynamics is a combination of pathomechanics and pathophysiology.

According to Shacklock, neural tension test should be called as neurodynamic test as they evoke both mechanical and physiological reactions which should be included in clinic thinking. The aim of using these tests in assessment is to mechanically stimulate and move neural tissues in order to determine their mobility and sensivity to mechanical stresses.

Neural Mobilization Techniques

There are two techniques according to butler and shacklock. Gliding technique – Also known as sliders. These are the manoeuvre causing sliding movements between the non neural and neural structures. These are carried out in non provocative manner (butler 2000, Shacklock 2005). Tensile loading technique – these techniques enable the neural tissue to movements which causes lengthening of nerves. These are not stretches. Tensile loading techniques are performed in an oscillatory manner gently engaging resistance during the movement(butler 2000, Shacklock 2005).

Mechanism by which Neurodynamic Technique Exerts its Effect

There are many mechanism proposed by different authors. According to a study conducted by Brown et al (2011) on the tibial nerves of cadavers, neural mobilisation increases dispersion of fluid, thereby, reducing intraneural oedema. Injured neural tissue or regenerating nerve fibres become hyperexcitable leading to the formation of abnormal impulse generating sites (AIGS) which repeatedly produces impulses (Devor & Seltzer,1999). AIGS are mechanosensitive, chemosensitive and produces spontaneous firing. Neural mobilisation causes inhibition at dorsal horn thereby reducing thermal pain (Beneciuk et al., 2009). Another study conducted by Santos et al, 2012 on animal model says that neural mobilisation leads to decrease in Nerve Growth Factor (NGF) and Glia Fibrillary Acid Protiens (GFAP) in the dorsal root ganglion and spinal cord leading to reduction in hyperalgesia and allodynia.

Effectiveness of Neurodynamic Technique

In 2008, Ellis and Hing conducted a systemic review of RCTs to analyse the therapeutic efficacy of neural mobilisation. 10 RCTs (11 articles) were included that discussed therapeutic effect of neural mobilisation. 8 of the 11 studies concluded a positive benefit from using neural mobilisation in the treatment of altered meurodynamics or neurodynamic dysfunction. However, in consideration of methodological quality, there is limited evidence to supports use of neural mobilisation. Further studies are needed in this direction.

Schaffer et al conducted a study in 2011 in which he classified patients with low back and leg pain in to four groups: Neuropathic Sensitization , Denervation, Peripheral nerve sensitization and musculoskeletal. Neural mobilisation was given for 7 sessions twice a week in all of the groups. Number of responders to neural mobilisation were greater in peripheral nerve sensitization group (55.6%) compared to other groups. Thus, patients with peripheral nerve sensitization were the appropriate candidates for neural mobilisation.

In another study conducted by Cleland and Hunt et al in 2004, effectiveness of neural mobilisation was demonstrated in a patient with lower extremity neurogenic pain. 14 physiotherapy sessions over a period of 48 days was conducted out of which 8 sessions included neural mobilisation. Visual as well as statistically significant improvement was observed following implementation of neural mobilisation technique.

Nerve Conduction Velocity (NCV)

Nerve conduction velocity is an important aspect of nerve conduction studies. It is the speed at which an electrochemical impulse propagates down a neural pathway. (National Institutes of Health, 31 October 2013).In this study, we are concerned with motor nerve conduction velocity.

Motor nerve conduction velocity can be obtained by electrically stimulating the nerve and then recording the CMAP (Compound Muscle Action Potential) from the surface electrodes placed over the muscles innervated by that nerve. Recording electrodes are placed over the target muscles using adhesive conductive pads. Reference electrode is placed over a neutral (inactive) area while the active electrode is placed above the belly of muscle. CMAP is recorded. Latency is the time from the stimulus artefact to the onset of response. To record motor nerve conduction velocity, nerve is stimulated at 2 sites- proximal point and a distal point. Proximal and distal latencies are recorded (A Mallik et al, 2016). The motor nerve conduction velocity is recorded in the following way:

mNCV= distance between distal and proximal point divided by difference between distal latency and proximal latency.

Effect of Neurodynamic Technique on MNCV

Some authors examined the effect of neural mobilisation on mNCV. According to them, improvement was observed in motor nerve conduction velocity following application of neurodynamic technique. Dongwook Han et al (2013) conducted a study in which he examined the effect of median nerve mobilisation in open as well as closed kinetic chain conditions on median motor nerve conduction velocity. 20 healthy female college students were recruited and divided in to 2 groups in this study. One group performed self CKC median nerve mobilisation while the other performed the same in OKC. A statistically significant improvement was observed in CKC group as compared to OKC group in mNCV in the wrist elbow section.

Misook HA et (2012) conducted a similar study on the similar population which compared the effect of median nerve mobilisation performed by the therapist and the effect of self median nerve mobilisation on the median motor nerve conduction velocity. It was concluded that physical therapist's application of median nerve mobilisation was more effective than self median nerve mobilisation.

Effect of Neurodynamic Technique on Surface Electromyography (SEMG)

EMG is a technique which involves the development, recording and analysis of myoelectric signals. In lumbar radiculopathy, neuromuscular imbalance is found in the lumbar region. Tobias Renkawitz et al conducted a study in 2006 analysing the association of low back pain with neuromuscular imbalance, and trunk extension strength in athletes before and after the implementation of back exercise program. They found that significant association exist between neuromuscular imbalance and LBA.

According to a study conducted by Giselle Horment Lara et al., there was a reduction in sEMG amplitude of ipsilateral and contralateral erector spinae after application of self neurodynamic sliding technique.

Conclusion and Clinical Implications

The literature search examined the effect of neural mobilisation on mNCV. According to them, improvement was observed in motor nerve conduction velocity following application of neurodynamic technique. A statistically significant improvement is observed in studies having CKC group as compared to OKC group in mNCV .

EMG is a technique which involves the development, recording and analysis of myoelectric signals. In lumbar radiculopathy, neuromuscular imbalance is found in the lumbar region. It is concluded from literature search that significant association exist between neuromuscular imbalance and LBA. The practical and clinical application of this review that since erector spinae EMG activity decreases with neural mobilisation so it gives a chance for the inner core to initiate muscular activity which was inhibited due to pain and inactivity.

References

1. Ellis, R.F., & Hing, W.A. Neural mobilization: a systematic review of randomized controlled trials with an analysis of therapeutic efficacy. Journal of manual & manipulative therapy, 2008; 16(1):8-22.
2. Schäfer, A., Hall, T., Müller, G., & Briffa, K. Outcomes differ between subgroups of patients with low back and leg pain following neural manual therapy: a prospective cohort study. European Spine Journal, 2011; 20(3):482-490.
3. Nee, R.J., & Butler, D. Management of peripheral neuropathic pain: integrating neurobiology, neurodynamics, and clinical evidence. Physical Therapy in Sport, 2006; 7(1):36-49.
4. Cleland, J., Hunt, G.C., & Palmer, J. Effectiveness of neural mobilization in the treatment of a patient with lower extremity neurogenic pain: a single-case design. Journal of Manual & Manipulative Therapy. 2013.
5. Shacklock, M. Neurodynamics. Physiotherapy, 1995; 81(1):9-16.
6. Han, D., Kim, J., Kim, H., Ha, M., Son, Y., & Lee, J. The Effects of Median Nerve Self-Mobilization in Open Kinetic Chain and Closed Kinetic Chain Conditions on Median Motor Nerve Conduction Velocity. Journal of Physical Therapy Science, 2013; 25(2):189-191.
7. Ross, M.A. Electrodiagnosis of peripheral neuropathy. Neurologic clinics, 2012; 30(2):529-549.
8. Mallik, A., & Weir, A.I. Nerve conduction studies: essentials and pitfalls in practice. Journal of Neurology, Neurosurgery & Psychiatry, 2005; 76(suppl 2):ii23-ii31.
9. Santos, F. M., Silva, J. T., Giardini, A. C., Rocha, P. A., Achermann, A. P., Alves, A. S., ... & Chacur, M. Neural mobilization reverses behavioral and cellular changes that characterize neuropathic pain in rats.Molecular pain, 2012; 8(1):1.
10. Brown, C.L., Gilbert, K.K., Brismee, J.M., Sizer, P.S., Roger James, C., & Smith, M.P. The effects of neurodynamic mobilization on fluid dispersion within the tibial nerve at the ankle: an unembalmed cadaveric study. Journal of Manual & Manipulative Therapy, 2011; 19(1):26-34.
11. Beneciuk, J. M., Bishop, M. D., & George, S. Z. Effects of upper extremity neural mobilization on thermal pain sensitivity: a sham-controlled study in asymptomatic participants. journal of orthopaedic & sports physical therapy, 2009; 39(6):428-438.
12. Alexiev, A.R. Some differences of the electromyographic erector spinae activity between normal subjects and low back pain patients during the generation of isometric trunk torque. Electromyography and clinical neurophysiology, 1994; 34(8):495-499.

13. Horment-Lara, G., Cruz-Montecinos, C., Núñez-Cortés, R., Letelier-Horta, P., & Henriquez-Fuentes, L. Onset and maximum values of electromyographic amplitude during prone hip extension after neurodynamic technique in patients with lumbosciatic pain: A pilot study. Journal of bodywork and movement therapies, 2016; 20(2): 316-323.

14. Renkawitz, T., Boluki, D., & Grifka, J. The association of low back pain, neuromuscular imbalance, and trunk extension strength in athletes. The Spine Journal, 2006; 6(6):673-683.

15. Iversen, T., Solberg, T.K., Wilsgaard, T., Waterloo, K., Brox, J.I., & Ingebrigtsen, T. Outcome prediction in chronic unilateral lumbar radiculopathy: prospective cohort study. BMC musculoskeletal disorders, 2015; 16(1).

16. Suri, P., Hunter, D.J., Katz, J.N., Li, L., & Rainville, J. Bias in the physical examination of patients with lumbar radiculopathy. BMC musculoskeletal disorders, 2010; 11(1).

17. Suri, P., Rainville, J., Katz, J.N., Jouve, C., Hartigan, C., Limke, J., & Hunter, D.J. The accuracy of the physical examination for the diagnosis of midlumbar and low lumbar nerve root impingement. Spine, 2011; 36(1):63.

18. Tarulli, A. W., & Raynor, E. M. (2007). Lumbosacral radiculopathy.Neurologic clinics, 2007; 25(2):387-405.

Instructions to Authors

Submission to the journal must comply with the Guidelines for Authors.

Non-compliant submission will be returned to the author for correction.

To access the online submission system and for the most up-to-date version of the Guide for Authors please visit:

http://www.rfppl.co.in

Technical problems or general questions on publishing with POTJ are supported by Red Flower Publication Pvt. Ltd's Author Support team (http://rfppl.co.in/article_submission_system.php?mid=5#)

Alternatively, please contact the Journal's Editorial Office for further assistance.

Editorial Manager
Red Flower Publication Pvt. Ltd.
48/41-42, DSIDC, Pocket-II
Mayur Vihar Phase-I
Delhi - 110 091(India)
Phone: 91-11-22754205, 45796900, 22756995, Fax: 91-11-22754205
E-mail: author@rfppl.co.in

Review Article

Physiotherapy and Occupational Therapy Journal
Volume 10 Number 1, January - March 2017
DOI: http://dx.doi.org/10.21088/potj.0974.5777.10117.7

Cryotherapy in Sports Physiotherapy: An Update

Saurabh Sharma

Abstract

Cryotherapy and stimulation both having post injury positive effect in treatment to reduce pain inflammation edema as well as gaining the strength via activation of inhibited muscles. There may have some tolerance issue with patient while using stimulation (NMES) which can be reduced by prior use of ice over the muscle, infact short duration of cryo application may increase the threshold to tolerate higher stimulation to produce powerful contraction. Cryotherapy and stimulation widely used after knee injury to activate quadriceps after reflex inhibition achieved due to pain, and inflammation. Studies proved that cryotherapy can used in acute condition whereas stimulation is used in chronic condition for gaining strength. Cryotherapy also used after every soft tissue injury specially in sports injuries but some studies support the use of cryotherapy for 15 min reduce dynamic postural stability after lower limb injury

Keywords: Cryotherapy; Inflamation; Cryo Stimulation**.**

Introduction

Cryotherapy has been used in physiotherapy as well as sports for several purposes. For egcryotherapy is a very useful modality to reduce inflammation , pain and swelling..

A.M Pusey gave the word cryotherapy to indicate the management of skin problems using low temperatures [Zagrobelny et al. 1999; Jezierski 2006;]. Nowdays, cryotherapy means using spectrum treatments purposed for lowering the body surface temperature without tissue destruction, while in cryosurgery diseased tissues are destroyed through freezing.

The world's first cryogenic- temperature chamber was set up in Japan, in 1978. [Zagrobelny 2003; Skrzek 2009].

There are multiple spectrum of types and methods of cold application done by the use of ice bags, silicone gel, wet cold (which is not tolerated well by many people), partial bathing in cold water or whole body bath (temperature below 10ºC). Cooling leads to heat loss, the treated body region undergoes vasoconstriction and other physiologically mediated responses [Rawecka&Rokita, 2006].

Cryotherapy is treatment modality for many of clinicians in soft tissue injury in acute condition to promote quicker recovery in many of athletes for fast return inflammation and competition. Cryo is always used as the first choice in sports injury management as well as in recovery from high intensity work out. Cryotherapyfascilitates edema reduction and produce analgesia, inflammation in inflammation by reducing muscle temperature and vasoconstriction. This is the reason why cryo is taken as first choice by sportsman off field and on field both.

Stimulation also have been used in injured tissue to activate the muscle as it is inhibited due to local pain edema swelling ect. Stimulation can produce muscle contraction which further result in activation of muscle leads to gaining strength and so functional outcomes can be seen.

In contrast many of studies also reports negative and adverse effect of cryotherapy as (*Bleakley et.al.*, 2012) reported that in his recent litrature review that cryotherapy application affects in negative manner in following outcomes; vertical jump height, agility performance and sprint time. These tasks are the

Author Affiliation: Assistant Professor, CPRS, Jamia Millia Islamia, New Delhi 110025.

Reprint Request: Saurabh Sharma, Assistant Professor, Centre for Physiotherapy and Rehab Sciences, Jamia Millia Islamia, New delhi -110025.
E-mail: saurabh14332003@yahoo.com

Received on 21.12.2016, **Accepted on** 09.01.2017

integral component of field based sports. *(Pritchard and salibaet.al***.,** 2014)said athletic performance may adversely affected as athlete return to participation immediately after cryotherapy. (*Uchioet.Al., 2003)* said that 15 minutes cryotherapy application can decreased knee joint position sense acuity and increased knee joint stiffness.

CRYO with Stimulation

First study which has been done as RCT explainsbeside all these advantages and disadvantages of only cryotherapy, cryo with stimulation is also a most effective treatment choise to activate and produce strong contraction of muscles for any inhibited muscle after injury. As neuromuscular electrical stimulation (NMES) is mainly used for rehabilitation in weak and damage muscles. NMES also used for strenthning of weak muscles after injury and following ligament repair in knee and total joint arthroplasty (*SnyderMackler L et al***.,** 2014). Many of studies supports the fact that NMES is only used after injury for strengthening of muscle and it is very uncommon to use in uninjured muscle. This is because as strength gain can achieve via any exercise program protocol too.

Sometimes cryotherapy can engaged with stimulation protocol to increase the threshold of the muscle to tolerate the stimulation discomfort and it found to be effective while using ice prior to stimulation as it lower the tissue temperature and increases muscle contraction threshold.Author conclude as if cryotherapy is engaged with stimulation to activate muscle, threshold of tolerance over stimulus pain can be improved and patient can tolerate and produce more powerful contraction over stimulus.

Effect of Tens Only on Quadriceps Activation Knee OA Subjects

A randomized control trial blinded has been done in year of 2011 in which subjects allocated in 2 groups with exercise+ tens and exercise only. Author found after follow up and treatment that group with exercise and tens has been improved faster and better than only exercise.The inability to optimallyactivate the quadriceps muscle may be modulated by both corticaland spinal reflex mechanisms. (Palmieri RM et.al.,2004) primary outcome measures,quadriceps central activation ratio, and the Western Ontario and McMaster Universities Osteoarthritis Index (WOMAC) were evaluated at baseline and at 2 weeks and 4 weeks of the intervention and concluded as improved in TENS group (Brian. G et.al., 2011) (Cheing GL et. Al., 2004).

Comparison of Stimulation VS Cryo for Activation of Muscle

Study which is RCT review supports NMES is indicated in those patients who unable to perform action or even to achieve strong voluntary contraction of the muscle which is required for muscle strengthening programms**.** These patients may limit due to pain or swelling which can inhibits voluntary muscle contraction. This unable to even generate muscle contraction is due to reflex inhibition.

NMES can help to overcome this reflex inhibition and can help to generate powerful muscle contraction. But patient may unable to tolerate electrical current that has been chose for stimulation(*Farquhar S et***.***al.,2004***).** This is the reason many researcher support the application of ice over the tissue just with stimulation. Many studies has been done as RCT to prove that TENS and cryotherapy is improving quadriceps activation in those who diagnosed with knee pathologies (*Pietrosimone B Get al*., 2014).There are sufficient evidence to prove that TENS and cryotherapy is used to improve quadriceps activation in those having knee injury and demonsrate as quadriceps failure in acrtivation. As it is known that quadriceps failure can be the result of swelling/ pain or both in the joint (*Palmieri-Smith RM et al*., 2013). Patients who under gone recent surgery for knee and having acute quads activation failure are advise to go for cryotherapy only as it decreases cell metabolism, pain in inflammatory phase and control edema formation *Merrick MA* et.al., 2004). But those having chronic pain in knee and quad activation is fail, are advise to go for TENS more than cryo unless attempting to control inflammation and swelling after exercise. As inflammation period subsidies cryo can replaced by TENS to activate quads, control pain and to fascilitate exercise further (*Levin MF et al*., 2012). Cryotherapy can be applied in those days when patients having pain so better to introduce basic simple exercise, non weight bearing as SLR ect. As patients has been showing some strength as well as reduced swelling and pain, TENS can be administered to gain strength.

Clinical Recommendation for CRYOVS Stimulation

We can conclude as TENS and cryo both are effective in case of activating muscle and improves strength mainly in knee pathology for quadriceps.But both of them their own role and time period to apply. Clinicians may wisely opt for their option according to patient condition.

Effect of Cryotherapy in Ankle Sprain

study include effect of Cryotherapy in soft tissue injuryspecially in ankle sprain and effects has been shown over functional outcomes. 43 male and female taken as subject of age 16-50 yr having acute injury in ankle. Both control and treatment group explained and cryotherapy given to treatment only and after author found treatment group came with improved functional outcomes. Even ROM has been improved, and swelling is reduced. 2 week of follow up done and functional activity as strairs climbing, weight bearing is improved with reduction of pain.

When a RCT done to see the effect of crytherapy in 2 different method, using: standard ice application (n = 46) or intermittent ice application (n = 43). The method used for cryotherapy was same across groups and consisted of melting iced water (0°C) in a standard pack. Outcome measures included Function, pain, and swelling. They found to have improvement in both the groups but , intermittent group found to be more effective in terms of pain,,edema and swelling reduction. But functional like difficulty running on uneven ground and making cutting movementsoutcome were same may due to functional instability rather than pain (*Garrick JG et al., 2006).*

Effect of Cryotherapy Over Dynamic Postural Stability

Last article which done to see the effect of cryotherapy after ankle injury on postural stability shown some negative effect as it done for 15 min application over ankle joint which can ultimately decrease cutaneous temrature on talofibular and deltoid ligament. This 15 min application of cryotherapy can negatively influence dynamic postural stability performances. Reach distance in, posterolateral, posterior, and anterolateral direction of star excursion balance test and mean velocity has been decreased after cryotherapy (karlfullam et al., 2015).

Conclusion

As many of studies done over cryotherapy along with stimulation at different differentperspective and approaches. RCT has been done to see the effect and to stabilize a evidence based practice in physiotherapy as cryotherapy had been used since last many years in sports injury. These studies make a background approach to practice in clinics and onfield with cryotherapy.Studies found and concluded as TENS can be used to increase threshold of tolerance for stimulation given to patients which is necessary to achieve activation of muscles after injury specially in quadriceps. As muscles get inhibited due to pain edema and swelling as reflex inhibition after injury. They must need to activatedwith some support tool as cryotherapy and TENS or NMES. Tens has proved as benefits in activating muscles after inhibition. Cryotherapy also used for same purpose but with different duration.

Cryotherapy is used in acute condition after injury to activate muscle and reduce pain, swelling. Cryo is only for acute when pain inflammation is high. Whereas tens can be use for chronic condition while pain subsides and weight bearing starts.

References

1. Bleakley CM, Costello JT, Glasgow PD. Should athletes return to sport after applying ice? A systematic review of the effect of local cooling on functional performance. Sports Med. 2012; 42(1): 69–87.
2. Palmieri RM, Weltman A, Edwards JE, et al. Presynaptic modulation of quadriceps arthrogenic muscle inhibition. Knee Surg Sports Traumatol Arthrosc. 2005; 13:370– 376.
3. Palmieri-Smith RM, Villwock M, Downie B, Hecht G, Zernicke R. Pain and Effusion and Quadriceps Activation and Strength. Journal of athletic training. 2013; 48(2):186-191.
4. Pietrosimone BG, Saliba SA, Hart JM, Hertel J, Kerrigan DC, Ingersoll CD. Effects of transcutaneous electrical nerve stimulation and therapeutic exercise on quadriceps activation in people with tibiofemoral osteoarthritis. J Orthop Sports PhysTher. Jan 2011; 41(1):4-12.
5. Tubach F, Ravaud P, Baron G, et al. Evaluation of clinically relevant changes in patient reportedoutcomes in knee and hip osteoarthritis: the minimal clinically important improvement. Ann RheumDis. 2005; 64:29–33.
6. Farquhar SJ, Snyder-Mackler L. Electrical stimulation of muscle: techniques and applications. In: Robinson AJ, Snyder-Mackler L. Clinical Electrophysiology, Electrotherapy and Electrophysiologic Testing. 3rd ed. Philadelphia, PA: Lippincott Williams & Wilkins; 2008.p.206-212.
7. Fitzgerald GK, Piva SR, Irrgang JJ. A modiûed neuromuscular elec- trical stimulation protocol for quadriceps strength training follow- ing anterior cruciate ligament reconstruction. J Orthop Sports PhysTher. 2003; 33(9):492-501.
8. Hart JM, Kuenze CM, Pietrosimone BG, Ingersoll

CD. Quadriceps function in anterior cruciate ligament-deficient knees exercising with transcutaneous electrical nerve stimulation and cryotherapy: a randomized controlled study. ClinRehabil. 2012 Nov; 26(11):974-981.

9. Levin MF, Hui-Chan CW. Conventional and acupuncture-like transcutaneous electrical nerve stimulation excite similar afferent fibers. Arch Phys Med Rehabil. 1993 Jan; 74(1):54-60.

10. ,Mintken PE, Carpenter KJ, Eckhoû D, Kohrt WM, Stevens JE. Early neuromuscular electrical stimulation to optimize quadriceps muscle function following total knee arthroplasty: a case report. J Orthop Sports PhysTher. 2007; 37(7):364-371.

11. Palmieri RM, Tom JA, Edwards JE, et al. Arthrogenic muscle response induced by an experimental knee joint effusion is mediated by pre and post synaptic spinal mechanism., 2004.

12. Petterson S, Snyder-Mackler L. The use of neuromuscular electrical stimulation to improve activation deûcits in a patient with chronic quadriceps strength impairments following total knee arthroplas- ty. J Orthop Sports PhysTher. 2006; 36(9):678-685.

13. Pritchard KA, Saliba SA. Should athletes return to activity after cryotherapy? J Athl Train. 2014; 49(1):95–96.

14. Snyder Mackler L, - Delitto A, Bailey SL, Stralka SW. Strength of the quadriceps femoris muscle and functional recovery after re- construction of the anterior cruciate ligament. J Bone Joint Surg. 1995; 77-A(8):1166-1173.

15. Torry MR, Decker MJ, Viola RW, O'Connor DD, Steadman JR. Intraarticularknee joint effusion induces quadriceps avoidance gait patterns. ClinBiomech (Bristol, Avon). 2000; 15:147–159.

16. Uchio Y, Ochi M, Fujihara A, Adachi N, Iwasa J, Sakai Y. Cryotherapy inûuences joint laxity and position sense of the healthy knee joint. Arch Phys Med Rehabil. 2003; 84(1):131–135.

17. Pietrosimone BG, Hart JM, Saliba SA, Hertel J, Ingersoll CD. Immediate effects of transcutaneous electrical nerve stimulation and focal knee joint cooling on quadriceps activation. Med Sci Sports Exerc. 2009 Jun; 41(6):1175-1181.

18. Merrick MA, Rankin JM, Andres FA, Hinman CL. A preliminary examination of cryotherapy and secondary injury in skeletal muscle. Med Sci Sports Exerc. 1999 Nov; 31(11):1516-1521.

19. Torry MR, Decker MJ, Viola RW, O'Connor DD, Steadman JR. Intraarticularknee joint effusioninduces quadriceps avoidance gait patterns. ClinBiomech (Bristol, Avon). 2000; 15:147-159

20. Garrick JG, Requa RK. The epidemiology of foot and ankle injuries in sports. ClinPodiatr Med Surg. 1989; 6:629–37.

Review Article

Physiotherapy and Occupational Therapy Journal
Volume 10 Number 1, January - March 2017
DOI: http://dx.doi.org/10.21088/potj.0974.5777.10117.8

Pilates Exercises in Low Back Pain Syndrome

Saurabh Sharma

Abstract

Neuromuscular system of body acts to maintain postural stability and reduce the impact of various loads on the spine. Exercises for abdominal muscles are commonly used to enhance spinal stability which further reduces the incidence of low back pain. Different exercise methods have been used to enhance spinal stability. Pilates exercises are the other form of exercises which is widely used for core stability. It is believed that Pilates exercises are effective in maintaining core stability, increasing flexibility, core strength and muscle endurance. The aim of the review is to check the effects of Pilates exercises on core muscles and its role in improving core stability.

Keywords: Pilates Exercises; Core Muscles; Low Back Pain.

Introduction

The Pilates Method is a techniquewidely used by therapists that was created by Joseph Pilates. Joseph Pilates (1880 –1967) developed an exercise method based on a combination of movement techniques such as yoga and Westernmethods of body conditioning. The Pilates method uses stretching and strengthening exercises to provide strength and flexibility to the coremuscles, exercises can be divided into 2 broad categories: mat and apparatus exercises (Bergmark et al.,1989).

Pilates method is based on six principles which include concentration, control, flowing, precision, breathing and the centering principle, and called as differential technique of method.Currently, the Pilates Method is widely used in physiotherapy for flexibility training, improvement of postural alignment and body awareness(Musculino et al.2004). The Pilates exercises increases stability of the trunk and activate the deep muscles of the lumbo-pelvic region requiring endurance of trunk muscles.(Endleman and Critchley, 2008). Core stability relates to the body region bounded by the abdominal wall, the pelvis, the lower back and the diaphragm , spinal extensor muscle and its ability to stabilize the body during movement. However, trunk muscles are classified into 2 groups; superficial muscles which are part of the global muscle system and these include the rectus abdominis muscle (RA) and the external oblique muscle (EO), and deep muscles which are part of the local muscle system and include the transverses abdominis (TrA), the multifidus and the internal oblique (IO)(Bergmark1989). Themain muscles involved in core stability are the transversus abdominis,the internal and external obliques,the quadratus lumborum and the diaphragm, erectorspinae and lumbar multifidus muscle. Core is primarily responsible for posture and static as well as dynamic stability and provide the strength in normal individuals and in athletes.

Low back pain is considered as a common musculoskeletal symptom. Low back pain (LBP) affects almost everyone(about 80%) at some time during their life(da fonseca et al). Studies indicate that there is an annual prevalence of symptoms in 50% of working age adults(van Tulder et al.,1997). It is estimated that about 90% of cases of low back pain have a nonspecific origin andis of a multifactorial and complex etiology. Core stability is essential for healthy and strong body. Impaired core stability can lead to low back pain and frequent and prolonged back pain inhibits physical activity, can lead to decrease in flexibility, range of motion, endurance and muscle strength (Adams &Roughely 2006). Sertpoyrazet al., stated there are various rehabilitation

Author Affiliation: Assistant Professor, CPRS, Jamia Millia Islamia, New Delhi 110025.

Reprint Request: Saurabh Sharma, Assistant Professor, Centre for Physiotherapy and Rehab Sciences, Jamia Millia Islamia, New delhi -110025.
E-mail: saurabh14332003@yahoo.com

Received on 23.12.2016, **Accepted on** 09.01.2017

and exercise programs which have been devel-oped to increase lower back muscle strength and correct imbal-anced muscle strength in patients with back pain.Ebenbichler et al., in 2001 reported Muscle dysfunctions, changes in motor control and inadequate recruitment of trunk muscles are the possible causes of non specific low back pain which further lead to reduced stability of the segments of the spine and altered distribution of loads .It has been re-ported that abdominal strength is important not only for the prevention and treatment of back pain, but also for improving trunk movement and stability.

It is demonstrated that coactivation of trunk muscles is the most widely used mechanism for the maintenance of spinal stability. Pilatesmethod is known to promote protection of spinal structures duringthe performance of functional activities. In order to study the function of the neuromuscular system of the low back by quantifying the activation and co activation of trunk musclegroups, electromyography has proven to be an important tool(Granata et al., 2005). In clinical practice, the largest recruitment of global muscles is reported which can be associated with an increase in spinalload that has can cause injury or may worsen pain in patients having low back pain.While focusing on the activation of local muscles, the Skilled Modern Pilates exercises are performed in a neutral position that leads to greater local muscle recruitment than global recruitment (O'Sullivan et al.,2006). These exercises can be considered functional since they require the recruitment and sensorimotor control of the trunk muscles while performing limb movements.

Literature Review

Herrington et al. in 2003 conducted a comparativestudy on 36 female subjects taken from an asymptomatic population in which they compared the effect of Pilates exercise between 3 different groups.The subjects were divided into 3 groups. One was Pilates group who attended Pilates classes for 45 minutes per week for 6 months ,second was abdominal curl group who attended resistance classes for 15 minutes, once or twice per week for 6 months and the last one was the control group who did not attended any classes. Outcome measures were TrA isolation formal test and lumbo-pelvic stability. Data was analyzed using SPSS software. It was identified that 83% subjects from the Pilates group, 33% from the abdominal curl group, and 25% from the control group passed TrA isolation formal test.

Study showed that only 14% percent of subjects out of 36 has passed the TrA isolation formal test and lumbopelvic stability test using PBU (Pressure Biofeedback Unit). PBU demonstrated that subjects who were Pilates trained were able to contract the TrA more correctly, and maintained better lumbo-pelvic control than others who performed regular abdominal curl exercises.

D.M. Rossi et al.,in 2014 conducted a cross sectional study on 12 young active female subjects. In this study they compared the percentage coactivation between local antagonist muscles (OI/ MU) and global antagonist muscles (RA/IL). EMG activity of muscles was analyzedbefore and during the exercises. Study demonstrated the mat-based Skilled Modern Pilates exercises showed differences in coactivation of the trunk muscles during five Pilatesexercises.The antagonistcoactivation of global muscles was found to be much more than local muscles in all the Pilates exercises which were performed.

Ji-Hyun Moon et al., in 2015 conducted a study on 30 females in which they compared the effect of Pilates exercises and resistanceexercises on activation of deep and superficial abdominal muscles. One control group was also taken. They used Ultrasound machine to measure thickness of muscles and EMG for recording muscle activity. Post test analysis demonstrated that MVIC of the EO(External Oblique) was higher in the Pilates group than the controls. Study demonstrated that the recruitment of surface mus-cles was not affected by pilates and resistance exercises. But ,the thickness of the deep muscles of core was significantly different.Pilates group showed marked chang-es in the thickness of TrA and IO muscle.EO muscle thickness was higher in Pilates group. The IO muscle thickness was similar between the Pilates and resistance groups.Overall, findings of the study show thatPilates and resistance exercise have a similar effect on spinal stabilization be-cause of the activation and recruitment of deep muscles.

Queiroz et al., in 2010 conducted a comparative study on 19 ballet dancers and pilates instructors who were practicing Pilates from last 6 months and joined a minimum of 1 class of Pilates per week. He studied the activation of core muscles during four Pilates exercises.Outcome measure was surface EMG (SEMG). The exercises was performed in the reformer apparatus. Surface EMG of the four core muscles before the exercises were measured. Then subjects performed exercises and SEMG is measured during exercise. The maximum activity of multifidus muscle is found in the anteverted pelvis and extended trunk exercise and also during the neutral pelvis and trunk inclined position.

While Gluteus maximus and Rectus abdominis activity was found higher retroverted pelvis and flexed trunk exercise.The study suggeststhat pelvic stability is maintained in the 4 exercise positions. The neutral pelvis position with the trunk parallel to theground was found to be increasing Multifidus, gluteus maximus, and oblique muscle activity from 8% to 28% of the MVIC.Multifidus muscle activity was also promoted in the anteverted pelvic position with extended trunk.

Tony English, et al., in 2007 conducted a single subject design study which was done on 3 young and healthy base ballpitchers. Recruitment of subjects were done during off season to avoid threat to internal validity. Pilates exercise methods are taught to the subjects and exercises are performed on mats and tables. Outcome measures wereDouble leg lowering (DLL) test, Star excursion balance test (SEBT) test and throwing speed.For each subject Double leg lowering (DLL) test, Star excursion balance test (SEBT) test and throwing speed is measured prior to intervention and intervention was continued for 10 weeks and was introduced to one subject at a time. The baseline measurements were compared with after intervention measurements. (DLL) test showed the percent change of 24.43-32.6% and (SEBT) showed change of 4.63-17.84% and throwing speed measurements ranged from 2.29-5.3% with Pilates exercises. The Pilates method of exercise implicated into an off-season baseball conditioning program have a positive effect on performance in trunk strength and stability test and on single leg balance test in all subjects who were studied. Throwing velocity was also positively improved.

Discussion

The prone lying TrA isolation test can classify subjects accurately into LBP and painless group in about 80% of subjects(Hodges et al.). Lumbo-pelvic instability can occur due to TrA dysfunction and there is increased incidence of low back pain (Richardson et al.,1992; Jull et al., 1993) Herrington et al. demonstrated that subjects trained with pilates have higher TrAactivity than abdominal curl trained and untrained people. The onset of limb load is predicatble in pilates exercises which can lead to pre setting of TrA because of anticipation of load by the body.

Study by D. M . Rossi et al., demonstrated that trunk stability during pilates exercises on mats showed high coactivation of trunk muscles especially on right side muscles. Asymmetry of load application from lower limbs during performing unilateral exercises may have generated disturbance and trunk rotation which has lead to higher coactivation of right sided muscles. Overall pilates exercises has shown to increase coactivation of global muscles of both sides.

In the study conducted by Moon.J. H. et al., comparison of surface EMG and deep muscle thickness in experienced pilates instructors and resistance instructors relative to control subjects was done. Study demonstrated that muscle activation does not depend on experience. However activity of deep muscles was similar in both groups, but TrA is most activated in pilates group. Also the thickness of TrA and IO muscle is increased both in pilates and resistance exercise group. The increase in thickness can be becausepilates and resistance exercise groups may be familiar with exercises. The increase in thickness of IO muscle with resistance exercise can be a result of hypertrophy as resistance exercises stabilize the lumbar spine as they work with global muscles against external load (Sitilertpisan et al., 2011).

The purpose of study by Queiroz et al., was to compare activation of trunk flexors, extensors and hip muscles during pilates exercises. Activation of trunk muscles found to be increased with pilates training. Exercises with trunk flexion increased external oblique and gluteus medius activity but reduced multifidus activity. Activity of rectus abdominis was much higher in trunk flexed and pelvis retroversion exercise. While multifidus activity is found to be higher during trunk extensor exercises.

In a study by Tony English, et al., 2007,there is improvement in the subjects performance after the Pilates exercises. Positive changes are seen very early in DLL test. Positive changes are also seen in subjects and throwing velocity is also found to be increased in all subjects. Although limitations are there in study because a single subject design can have a threat over external validity.

Conclusion

Various methods of exercises has been used such as, strengthening exercises, flexibility training, abdominal drawing-in maneuver for core stabilization but there is evidence which shows that Pilates exercises can also be used for core stabilization and has positive effects on core stability. Pilates training also enhance postural stability and performance in athletes.

But there were lot of limitations in the studies which were conducted. One study was single subject design which imposed the threat on external validity. In some studies they performed the protocol in single attempt with the limitation that the results can be different on other days. Some studies were performed on people who are trained in that particular exercise programme which can make them familiar with and can lead to different results. Therefore , further studies are required on these factors.

References

1. Adams MA, Roughley PJ; What is intervertebral disc degeneration and what causes it? Spine 2006; 31(18):2151-2161.
2. Bergmark A. Stability of the lumbar spine.A study in mechanical engi-neering.ActaOrthopScandSuppl 1989; 230:1-54.
3. Da Fonseca JL etal; Laboratory gait analysis in pa-tients with low back pain before and after a Pilates intervention. J Sport Rehabil 2009; 18(2): 269-182.
4. Ebenbichler, G.R etal;Sensory-motor control of the lower back implications for rehabilitation. Medicine and Science in Sports and Exercise 2001; 33(11).
5. Endleman L etal; Transversus abdominis and obliquus internus activity during pilates exercise: measurement with ultrasound scanning. Arch Phys Med Rehabil. 2008; 80(11):2205-2212.
6. English, T., & Howe, K; The Effect of Pilates Exercise on Trunk and Postural Stability and Throwing Velocity in College Baseball Pitchers: Single Subject Design. North American Journal of Sports Physical Therapy/ ; 2007; 2(1):8–21.
7. Granata,K etal;Co-contractionrecruitment and spinal load during isometric trunk flexion andextension. Clinical Biomechanics 2007; 20(10):1029-1037.
8. Herrington, L., & Davies, R; The influence of Pilates training on the ability to contract the transverses abdominis muscle in asymptomatic individuals. Journal of bodywork and movement therapies, 2005; 9(1):52-57.
9. Jull G etal; Towards a measurement of active muscle control for lumbar stabilisation. Australian Journal of Physiotherapy 1993; 39(3):187–193.
10. Moon etal; Comparison of deep and superficial abdominal muscle activity between experienced Pilates and resistance exercise instructors and controls during stabilization exercise.Journal of Exercise Rehabilitation, 2015; 11(3):161–168.
11. Muscolino, J.E., Cipriani, S.,Pilates and the powerhouse-II;Journal of Bodywork and Movement Therapies 2004; 8:122-130.
12. O'Sullivan, P etal; Effect of different upright postureson spinal-pelvic curvature and trunk muscle activation in a pain free population. Spine 2006; 31 (19):707-712.
13. Richardson, C etal;Techniques for active lumbar stabilisation for spinal protection: a pilot study. Australian Journal of Physiotherapy 1992; 38(2):105–112.
14. Sertpoyraz etal; Comparison of isokinetic exercise versus standard exercise training in patients with chronic low back pain: a randomized controlled study. Clinical Rehabilitation 2009; 23(3):238-247.
15. Rossi, D. M etal; Antagonist coactivation of trunk stabilizer muscles during Pilates exercises. Journal of bodywork and movement therapies, 2014; 18(1): 34-41.
16. Sitilertpisan P etal;. Comparison of lateral abdominal muscle thickness between weightlifters and matched controls.Physical Therapy Sport; 2011; 12(4):171-174.
17. VanTulder etal; Conservative treatment of acute and chronic non-specific low back pain. Spine 1997; 22 (18):2128–2156.
18. Queiroz, B. C etal;Muscle activation during four Pilates core stability exercises in quadruped position.Archives of physical medicine and rehabilitation, 2010; 91(1):86-92.

Review Article

Physiotherapy and Occupational Therapy Journal
Volume 10 Number 1, January - March 2017
DOI: http://dx.doi.org/10.21088/potj.0974.5777.10117.9

Efficacy of Neural Mobilisation in Hamstring Strain Injury: Current Update

Saira Ali*, Saurabh Sharma**

Abstract

The nervous system mobilization has emerged as a significant addition to the treatment of different musculoskeletal injuries. There are different techniques directed at restoring normal neural physiology andbiomechanics. There are studies suggest one of the factor of recurrent hamstring strain is altered neural tissue mobility. Studies have also shown the effectiveness of neural mobilisation technique to increase hamstring flexibility.

Keywords: Neural Mobilisation; Hamstring Strain; Stretching; Flexibility.

Flexibility is said to be essential in the maintenance and improvement of correct posture, promotion of appropriate and elegant behaviour, and promotion and development of motor skills(Ogura Y et al 2006). Limited flexibility has adverse effect on normal biodynamic balance and function and causes musculoskeletaldamage, pain due to overuse, and reduction in physical performance(Halbertsma JP et al 1996, Hartig DE et al 1999). It is one of the major factors that predisposes the hamstring muscle into strain injuries. The hamstring muscles play an important role in the performanceof daily activities such as controlled movement of the trunk, walking, running, and jumping, and it is an important muscle involved in maintaining balance and posture in standing position. The hamstrings significantly affect flexibility of the body, and reduced hamstring flexibility results in decreases in trunk stability and balance due to improper adjustment of the gluteus maximus and abdominal muscles. Hamstring strain injuries are common problem within elite and recreational sport, regularly resulting in frequent occurrence and lengthy time off sport. These injuries occurs in wide range of sports that involve high speed running like football, soccer, sprtinting, rugby (Bahr & Holme, 2003; Davis, et al 2005; Decoster,et al 2005; Malliaropoulos, et al 2004). The hamstring strain injuries are characterized by acute pain in the posterior thigh and disruption of fibres in the hamstring muscle, these are the most common injury sustained in sports (Orchard and Seward, 2010; Woods et al., 2004; Drezner et al., 2005) andre-occurrence rates are also very high (Orchard and Seward, 2010).The most significant risk factor for future injury is the combination of high rate of injury and a previous hamstring strain (Arnason et al., 2004),this proposes that our understanding of the neuromuscular maladaptations that occur following hamstring strain requires further attention.

There are various predisposing factors for hamstring injury have been suggested within the literature that includes: muscle imbalance (Croisier, 2004; Croisier, et al, 2002);insufficient warm-up (Safran, et al, 1988); neural tension (Turl& George, 1998); poor flexibility (Witvrouw, Danneels, et al 2003); and previous injuries (Bennell et al., 1998; Verrall, et al 2001). Amongst risk factors for hamstring injury, inadequate extensibility within the posterior thigh compartment seems to be one of the more commonly accepted causes (Davis et al., 2005; Decoster, et al 2004) and it has been recommended that stretching afore physical activity could increase extensibility of the stretched muscle, fascia and neural tissues, which could in turn decrease the chance for injury (Halbertsma & Eisma, 1999; Hartig & Henderson, 1999; Ross, 1999). It has also been proposedthat pain occurs due to neural tissue involvement is one factor includes in the etiology and differential diagnosis of grade I hamstring strains.

Author Affiliation: *MPT, Jamia Millia Islamia, New Delhi 110025. **Assistant professor, CPRS, Jamia Millia Islamia, New Delhi 110025.

Reprint Request: Saurabh Sharma, Assistant Professor, Centre for Physiotherapy and Rehab Sciences, Jamia Millia Islamia, New delhi -110025.
E-mail: saurabh14332003@yahoo.com

Received on 21.12.2016, **Accepted on** 09.01.2017

Adverse neural tension described as abnormal physiological and mechanical responses produced from the nervous system structures when their normal range of movement and stretch capabilities are tested (Butler DS.1989). This alteration can either be extraneural (ie., an interface problem between the nerve and the tissue that it runs through) and/or intraneural (ie., changes within the nerve). With the close proximity of the sciatic nerve to the hamstrings, adverse neural tension may provide an alternate or additional factor in the etiology of single and/or repetitive hamstring strain. It is possible that repeated injury to the hamstrings could produce inflammation and possible scarring, which could interfere with normal mobility and nutritional well-being of the sciatic nerve, producing clinical sips of adverse neural tension.The impact of strain injuries on the neural function of the involved muscle has been largely overlooked.

Nerve adhesions in the hamstring may alter neurodynamics and cause abnormal mechano sensitivity of the sciatic nerve; which could influence hamstring flexibility. Changes in mechanosensitivity of the neural tissue have been shown to limit hamstring length in normal healthy individuals (Lew and Briggs, 1997; McHugh et al. 2012) and in individuals with previous hamstring injuries(Kornberg & Lew, 1989; Turl and George, 1998). Any mechanical or physiological alterations in the nerve can result in mechanosensitivitywhich is the sensitivity of a nerve to movement (Boyd et al., 2009) and can contribute to pain during movement or sustained postures (Shacklock, 2005). Research has stated a positive slump test in 57%–76% of subjects with a grade I hamstring strain(Turl SE, George KP. 1998). Alternatively, the protective muscle contraction of the hamstring muscles found in the presence of neural mechanosensitivity(Hall T, Zusman M, Elvey R. 1998) might result in hamstrings inflexibility and thereby predispose the muscle to followingstrain injury. In fact, as neural sliding intervention can decrease neural mechanosensitivity, (Hall T, Zusman M, Elvey R. 1998) it is possible that addition of these interventions for the management of muscle tissues would be useful. Neuromeningeal mechano sensitivity presenting clinically as positive adverse neural tension signs is a probable yet only retrospectively studied possible risk factor for or potential differential diagnosis to be considered in hamstring strain injury (Gabbe BJ et al., 2005). The research evidence for stretching as mean of prevention of hamstring strain injuries is equivocal, yet stretching is used commonly for just this purpose.

Neural mobilization techniques have been shown to be effective adjunct interventions in the rehabilitation of patients with grade I hamstring injury (Kornberg C, Lew P., 1989). The principle of neural mobilization is that changes in the mechanics or the physiology of the nervous system can result in other system dysfunctions or dysfunctions of the musculoskeletal structures that receive its innervations. Nowadays *Neurodynamics* is a more recognised term referring to the integrated physiological, biomechanical, and morphological functions of the nervous system. Irrespective of the underlying construct, it is vital that the nervous system is able to adapt to mechanical loads, and it must undergo distinct mechanical events such as elongation, sliding, cross-sectional change, angulation, and compression. If these dynamic protective mechanisms fail, the nervous system is vulnerable to neural edema, ischaemia, fibrosis, and hypoxia, which may cause altered neurodynamics.

When neural mobilization is used for treatment of adverse neurodynamics, the primary theoretical objective is to attempt to restore the dynamic balance between the relative movement of neural tissues and surrounding mechanical interfaces, thereby allowing reduced intrinsic pressures on the neural tissue and thus promoting optimum physiologic function. The theorized benefits from such techniques include facilitation of nerve gliding, reduction of nerve adherence, dispersion of noxious fluids, increased neural vascularity, and improvement of axoplasmic flow.

When applying neurodynamics, tension occurs in the nervous system, and pressure within the nerve increases due to the decrease of the cross-sectional area, and the axonal transport system lengthens the sciatic nerve after shortening because of the influence of the surrounding related structures and hamstring flexibility. After extension of the nerve and muscle, muscle performance is improved because of increases in the number of muscle fibre segments and cross-sectional area of muscle fibers. Shacklock describes neurodynamic treatment for restricted sciatic nerve mobility in the hamstring in the form of a sliding dysfunction and tension dysfunction. Neurodynamic slider is a type of neural mobilization where one end of the neural system is elongated and other end is slackened. It produces a sliding movement of neural structures relative to their surrounding tissues. Neurodynamic tensioner is the second type of neural mobilization where joint movements are performed simultaneously in order to lengthen the nerve bed, which applies a tensile load to the nerve structures. It relies on the natural viscoelasticity of the nervous system.

Méndez-Sánchez *et al*. applied a neurodynamic sliding technique to the hamstrings of healthy male soccer players, observing a greater improvement in ROM than that after general stretching, and Castellote-Caballero *et al*. also applied a neurodynamic sliding technique to 28 healthy football players, with a significant increase in ROM demonstrated using the passive SLR test. These findings were consistent with the results of this study. These findings can beexplained as follows. If tension is applied to the nervous system while applying neurodynamics, the reduction of the cross-sectional area and increase in pressure in the nerve result in extension and movement of the sciatic nerve together with the hamstring and compliance of the nerve, resulting in increased flexibility.

Conclusion

Hamstring strain injuries are common both in athletic population and general population. Neural mobilisation methodology has been to improve the outcome measures in terms of pain and range of motion. Adverse neurodynamic tension tests(ANDT) are helpful in diagnosing the involvement of neural component in hamstring injury. Neural mobilisation provide facilitation of nerve gliding, reduction of nerve adherence, dispersion of noxious fluids, increased neural vascularity, and improvement of axoplasmic flow. Above this also helps in decreasing the number of AIGS (abnormal impulse generating sites). This thing along with the tensioning component in neural mobilisation helps in management of hamstring injuries.

References

1. Arnason, A.et.al; Risk factors for injuries in football.American Journal of Sports Medicine, 2004; 32(1 Suppl.):5Se16S.
2. Bahr, R., & Holme, I.; Risk factors for sports injuries e a methodological approach. British Journal of Sports Medicine, 2003; 37(5):384e392.
3. Baltaci G, Un N, Tunay V, et al. Comparison of three different sit and reach tests for measurement of hamstrings flexibility in female university students. Br J Sports Med; 2003; 37:59–61.
4. Bennell, K.et.al; Isokinetic strength testing does not predict hamstring injury in Australian rules footballers. British Journal of Sports Medicine, 1998; 32(4):309-314.
5. Butler, D. The sensitive nervous system. Adelaide: Noigroup Publications. 2005.
6. Butler DS. Adverse mechanical tension in the nervous system: A model for assessment and treatment. Aust/ Physiother 1089; 35:227-238.
7. Butler DS: Mobilisation of the Nervous System (1st Ed), Melbourne: Churchill Livingstone, 1991.
8. Butler DS, Gifford LS. The concept of adverse mechanical tension in the nervous system. Physiotherapy 1989; 75:622-636.
9. Brukner P, Nealon A, Morgan C, Burgess D, Dunn A. Recurrent hamstring muscle injury: applying the limited evidence in the professional football setting with a seven-point programme.10.1136; british journal sports medicine; 091400; 2012.
10. Croisier, J.L; Factors associated with recurrent hamstring injuries. Sports in Medicine, 2004; 34(10): 681-695.
11. Croisier, J. L.et.al; Hamstring muscle strain recurrence and strength performance disorders. American Journal of Sports Medicine, 2002; 30(2): 199-203.
12. David A. Opar et.al; Knee flexor strength and bicep femoriselectromyographical activity is lowerin previously strained hamstrings. Journal of Electromyography and Kinesiology 2013; 23:696–703.
13. Davis, D. S., Ashby et.al; The effectiveness of 3 stretching techniques on hamstring flexibility using consistent stretching parameters.Journal of Strength and Conditioning Research, 2005; 19(1):27-32.
14. Dadebo, B et.al; A survey of flexibility training protocols and hamstring strains in professional football clubs in England. British Journal of Sports Medicine, 2004; 38(4):388-394.
15. Davis DS et al. Concurrent validity of four clinical tests used to measure hamstring flexibility. J Strength Cond Res 2008; 22:583–588.
16. Decoster, L. C. et.al; The effects of hamstring stretching on range of motion: a systematic literature review. Journal of Orthopaedic and Sports Physical Therapy, 2005; 35(6):377-387.
17. Drezner J et.al ; Hamstring muscle injuries in track and field athletes: a 3-year study at the Penn Relay Carnival. Clin J Sport Med; 2005; 15(5):386.
18. Gabbe BJ et.al;. Risk factors for hamstring injuries in community level Australian football. Br J Sports Med ; 2005; 39:106–110;.
19. Gilliatt RW. Electrophysiology of peripheral neuropathies: an overview. Muscle Nerve, 1982; 5: S108–S116.
20. Hall T et.al;Adverse mechanical tension in the nervous system? Analysis of straight leg raise. Manual Therapy; 1998; 3:140–146.
21. Halbertsma, J. P et.al; Repeated passive stretching: acute effect on the passive muscle moment and

extensibility of short hamstrings.Archives of Physical Medicine and Rehabilitation, 1999; 80(4): 407-414.

22. Hartig, D.E., & Henderson, J.M.; Increasing hamstring flexibility decreases lower extremity overuse injuries in military basic trainees. The American Journalof Sports Medicine, 1999; 27(2): 173-176.
23. Herrington L, Bendix K, Cornwell C, et al. What is the normal response to structural differentiation within the slump and straight leg raise tests? Manual Therapy; 2008; 13:289–294.
24. Horre T. Finger-to-floor distance and Schober test: Validity criterion for these tests? [in German]. Manuelle Therapy; 2004; 8:55–65.
25. Kornberg C, Lew P; The effect of stretching neural structures on grade one hamstring injuries. J Orthopedic Sports Physical Therapy; 1989; 13:481–487.
26. Lindell O etal; The reliability of a 10–test package for patients with prolonged back and neck pain: Could an examiner without formal medical education be used without loss of quality? A methodological study. BMC Musculoskeletal Disorders. 2007; 8:31.
27. Malliaropoulos etal;. The role of stretching in rehabilitation of hamstring injuries: 80 athletes follow-up. Medicine and Science in Sports and Exercise, 2004; 36(5):756-759.
28. Majlesi J et al. The sensitivity and specificity of the slump and straight leg raising tests in patientswith lumbar disc herniation. J Clinical Rheumatology; 2008; 14:87–91;2008.
29. Me´ndez-Sa´nchez, et al; Immediate Effects of Adding a Sciatic NerveSlider Technique on Lumbar and Lower Quadrant Mobility in Soccer Players: A Pilot Study. The Journal Of Alternative And Complementary Medicine; 2010; 16(6):669–675.
30. Opar DA, Williams M, Shield AJ. Hamstring strain injuries: factors that lead to injury and reinjury. Sports Medicine; 2012; 42(3):209–26.
31. Opar DA etal;. Knee flexor strength and bicep femoris electromyographical activity is lower in previously strained hamstrings. Journal of Electromyography and Kinesiology; 2013; 23:696–703.
32. Opar DA etal; The role of neuromuscular inhibition in hamstring strain injury recurrence. Journal of Electromyography and Kinesiology 2013; 23:523–530;2013.
33. Ogura Y, Miyahara Y, Naito H, Katamoto S, Aoki J. Duration of static stretching influences muscle force production in hamstringmuscles. J Strength Cond Res; 2007; 21:788-92..
34. Orchard JW, Seward H. Injury report : Australian football league. Sport Health; 2010; 28:10–9.
35. Safran, M. R. Etal; The role of warmup in muscular injury prevention.American Journal of Sports Medicine, 1998; 16(2):123-129.
36. Shacklock, M.;Improving application of neurodynamic (neural tension) testing and treatments: a message to researchers and clinicians. Manual Therapy, 2005; 10(3):175-179.
37. Sharma S, etal;. Short term effectiveness of neural sliders and neural tensioners as an adjunct to static stretching of hamstrings on knee extension angle inhealthy individuals: A randomized controlled trial. Physical Therapy in Sport; 2016; 30-37.
38. Turl SE, George KP. Adverse neural tension: A factor in repetitive hamstring strain? J Orthop Sports Physical Therapy; 1998; 27:16–21.
39. Witvrouw, E etal; Muscle flexibility as a risk factor for developing muscle injuries in male professional soccer players. A prospective study.American Journal of Sports Medicine, 2003; 31(1):41-46.
40. Woods C etal; The Football Association Medical Research Programme: an audit of injuries in professional football: analysis of hamstring injuries. Br J Sports Med; 2004; 38(1):36–41.
41. Yolanda Castellote-Caballero etal; Effects of a neurodynamic sliding technique on hamstring flexibility in healthy male soccer players. A pilot study. Physical Therapy in Sport 2013; 156-162.

Manuscripts must be prepared in accordance with "Uniform requirements for Manuscripts submitted to Biomedical Journal" developed by international committee of medical Journal Editors.

Types of Manuscripts and Limits

Original articles: Up to 3000 words excluding references and abstract and up to 10 references.

Review articles: Up to 2500 words excluding references and abstract and up to 10 references.

Case reports: Up to 1000 words excluding references and abstract and up to 10 references.

Online Submission of the Manuscripts

Articles can also be submitted online from http://rfppl.co.in/customer_index.php.

I) First Page File: Prepare the title page, covering letter, acknowledgement, etc. using a word processor program. All information which can reveal your identity should be here. use text/rtf/doc/PDF files. Do not zip the files.

2) Article file: The main text of the article, beginning from Abstract till References (including tables) should be in this file. Do not include any information (such as acknowledgement, your name in page headers, etc.) in this file. Use text/rtf/doc/PDF files. Do not zip the files. Limit the file size to 400 Kb. Do not incorporate images in the file. If file size is large, graphs can be submitted as images separately without incorporating them in the article file to reduce the size of the file.

3) Images: Submit good quality color images. Each image should be less than 100 Kb in size. Size of the image can be reduced by decreasing the actual height and width of the images (keep up to 400 pixels or 3 inches). All image formats (jpeg, tiff, gif, bmp, png, eps etc.) are acceptable; jpeg is most suitable.

Legends: Legends for the figures/images should be included at the end of the article file.

If the manuscript is submitted online, the contributors' form and copyright transfer form has to be submitted in original with the signatures of all the contributors within two weeks from submission. Hard copies of the images (3 sets), for articles submitted online, should be sent to the journal office at the time of submission of a revised manuscript. Editorial office: Red Flower Publication Pvt. Ltd., 48/41-42, DSIDC, Pocket-II, Mayur Vihar Phase-I, Delhi – 110 091, India, Phone: 91-11-22754205, 45796900, 22756995. E-mail: author@rfppl.co.in. Submission page: http://rfppl.co.in/article_submission_system.php?mid=5.

Preparation of the Manuscript

The text of observational and experimental articles should be divided into sections with the headings: Introduction, Methods, Results, Discussion, References, Tables, Figures, Figure legends, and Acknowledgment. Do not make subheadings in these sections.

Title Page

The title page should carry

1) Type of manuscript (e.g. Original article, Review article, Case Report)
2) The title of the article, should be concise and informative;
3) Running title or short title not more than 50 characters;
4) The name by which each contributor is known (Last name, First name and initials of middle name), with his or her highest academic degree(s) and institutional affiliation;
5) The name of the department(s) and institution(s) to which the work should be attributed;
6) The name, address, phone numbers, facsimile numbers and e-mail address of the contributor responsible for correspondence about the manuscript; should be mentoined.
7) The total number of pages, total number of photographs and word counts separately for abstract and for the text (excluding the references and abstract);
8) Source(s) of support in the form of grants, equipment, drugs, or all of these;
9) Acknowledgement, if any; and
10) If the manuscript was presented as part at a meeting, the organization, place, and exact date on which it was read.

Abstract Page

The second page should carry the full title of the manuscript and an abstract (of no more than 150 words for case reports, brief reports and 250 words for original articles). The abstract should be structured and state the Context (Background), Aims, Settings and Design, Methods and Materials, Statistical analysis used, Results and Conclusions. Below the abstract should provide 3 to 10 keywords.

Introduction

State the background of the study and purpose of the study and summarize the rationale for the study or observation.

Methods

The methods section should include only information that was available at the time the plan or protocol for the study was written such as study approach, design, type of sample, sample size, sampling technique, setting of the study, description of data collection tools and methods; all information obtained during the conduct of the study belongs in the Results section.

Reports of randomized clinical trials should be based on the CONSORT Statement (http://www. consort-statement. org). When reporting experiments on human subjects, indicate whether the procedures followed were in accordance with the ethical standards of the responsible committee on human experimentation (institutional or regional) and with the Helsinki Declaration of 1975, as revised in 2000 (available at http://www.wma.net/e/policy/l 7-c_e.html).

Results

Present your results in logical sequence in the text, tables, and illustrations, giving the main or most important findings first. Do not repeat in the text all the data in the tables or illustrations; emphasize or summarize only important observations. Extra or supplementary materials and technical details can be placed in an appendix where it will be accessible but will not interrupt the flow of the text; alternatively, it can be published only in the electronic version of the journal.

Discussion

Include summary of key findings (primary outcome measures, secondary outcome measures, results as they relate to a prior hypothesis); Strengths and limitations of the study (study question, study design, data collection, analysis and interpretation); Interpretation and implications in the context of the totality of evidence (is there a systematic review to refer to, if not, could one be reasonably done here and now?, What this study adds to the available evidence, effects on patient care and health policy, possible mechanisms)? Controversies raised by this study; and Future research directions (for this particular research collaboration, underlying mechanisms, clinical research). Do not repeat in detail data or other material given in the Introduction or the Results section.

References

List references in alphabetical order. Each listed reference should be cited in text (not in alphabetic order), and each text citation should be listed in the References section. Identify references in text, tables, and legends by Arabic numerals in square bracket (e.g. [10]). Please refer to ICMJE Guidelines (http://www.nlm.nih.gov/bsd/uniform_requirements.html) for more examples.

Standard journal article

[1] Flink H, Tegelberg Å, Thörn M, Lagerlöf F. Effect of oral iron supplementation on unstimulated salivary flow rate: A randomized, double-blind, placebo-controlled trial. J Oral Pathol Med 2006; 35: 540-7.

[2] Twetman S, Axelsson S, Dahlgren H, Holm AK, Källestål C, Lagerlöf F, et al. Caries-preventive effect of fluoride toothpaste: A systematic review. Acta Odontol Scand 2003; 61: 347-55.

Article in supplement or special issue

[3] Fleischer W, Reimer K. Povidone iodine antisepsis. State of the art. Dermatology 1997; 195 Suppl 2: 3-9.

Corporate (collective) author

[4] American Academy of Periodontology. Sonic and ultrasonic scalers in periodontics. J Periodontol 2000; 71: 1792-801.

Unpublished article

[5] Garoushi S, Lassila LV, Tezvergil A, Vallittu PK. Static and fatigue compression test for particulate filler composite resin with fiber-reinforced composite substructure. Dent Mater 2006.

Personal author(s)

[6] Hosmer D, Lemeshow S. Applied logistic regression, 2nd edn. New York: Wiley-Interscience; 2000.

Chapter in book

[7] Nauntofte B, Tenovuo J, Lagerlöf F. Secretion and composition of saliva. In: Fejerskov O, Kidd EAM,

editors. Dental caries: The disease and its clinical management. Oxford: Blackwell Munksgaard; 2003. p. 7-27.

No author given

[8] World Health Organization. Oral health surveys - basic methods, 4th edn. Geneva: World Health Organization; 1997.

Reference from electronic media

[9] National Statistics Online—Trends in suicide by method in England and Wales, 1979-2001. www.statistics.gov.uk/downloads/theme_health/HSQ 20.pdf (accessed Jan 24, 2005): 7-18. Only verified references against the original documents should be cited. Authors are responsible for the accuracy and completeness of their references and for correct text citation. The number of reference should be kept limited to 20 in case of major communications and 10 for short communications.

More information about other reference types is available at www.nlm.nih.gov/bsd/uniform_requirements.html, but observes some minor deviations (no full stop after journal title, no issue or date after volume, etc).

Tables

Tables should be self-explanatory and should not duplicate textual material.

Tables with more than 10 columns and 25 rows are not acceptable.

Table numbers should be in Arabic numerals, consecutively in the order of their first citation in the text and supply a brief title for each.

Explain in footnotes all non-standard abbreviations that are used in each table.

For footnotes use the following symbols, in this sequence: *, ¶, †, ‡‡,

Illustrations (Figures)

Graphics files are welcome if supplied as Tiff, EPS, or PowerPoint files of minimum 1200x1600 pixel size. The minimum line weight for line art is 0.5 point for optimal printing.

When possible, please place symbol legends below the figure instead of to the side.

Original color figures can be printed in color at the editor's and publisher's discretion provided the author agrees to pay.

Type or print out legends (maximum 40 words, excluding the credit line) for illustrations using double spacing, with Arabic numerals corresponding to the illustrations.

Sending a revised manuscript

While submitting a revised manuscript, contributors are requested to include, along with single copy of the final revised manuscript, a photocopy of the revised manuscript with the changes underlined in red and copy of the comments with the point to point clarification to each comment. The manuscript number should be written on each of these documents. If the manuscript is submitted online, the contributors' form and copyright transfer form has to be submitted in original with the signatures of all the contributors within two weeks of submission. Hard copies of images should be sent to the office of the journal. There is no need to send printed manuscript for articles submitted online.

Reprints

Journal provides no free printed reprints, however a author copy is sent to the main author and additional copies are available on payment (ask to the journal office).

Copyrights

The whole of the literary matter in the journal is copyright and cannot be reproduced without the written permission.

Declaration

A declaration should be submitted stating that the manuscript represents valid work and that neither this manuscript nor one with substantially similar content under the present authorship has been published or is being considered for publication elsewhere and the authorship of this article will not be contested by any one whose name (s) is/are not listed here, and that the order of authorship as placed in the manuscript is final and accepted by the co-authors. Declarations should be signed by all the authors in the order in which they are mentioned in the original manuscript. Matters appearing in the Journal are covered by copyright but no objection will be made to their reproduction provided permission is obtained from the Editor prior to publication and due acknowledgment of the source is made.

but no objection will be made to their reproduction provided permission is obtained from the Editor prior to publication and due acknowledgment of the source is made.

Abbreviations

Standard abbreviations should be used and be spelt out when first used in the text. Abbreviations should not be used in the title or abstract.

Checklist

- Manuscript Title
- Covering letter: Signed by all contributors
- Previous publication/ presentations mentioned, Source of funding mentioned
- Conflicts of interest disclosed

Authors

- Middle name initials provided.
- Author for correspondence, with e-mail address provided.
- Number of contributors restricted as per the instructions.
- Identity not revealed in paper except title page (e.g. name of the institute in Methods, citing previous study as 'our study')

Presentation and Format

- Double spacing
- Margins 2.5 cm from all four sides
- Title page contains all the desired information. Running title provided (not more than 50 characters)
- Abstract page contains the full title of the manuscript
- Abstract provided: Structured abstract provided for an original article.
- Key words provided (three or more)
- Introduction of 75-100 words
- Headings in title case (not ALL CAPITALS). References cited in square brackets
- References according to the journal's instructions

Language and grammar

- Uniformly American English
- Abbreviations spelt out in full for the first time. Numerals from 1 to l0 spelt out
- Numerals at the beginning of the sentence spelt out

Tables and figures

- No repetition of data in tables and graphs and in text.
- Actual numbers from which graphs drawn, provided.
- Figures necessary and of good quality (color)
- Table and figure numbers in Arabic letters (not Roman).
- Labels pasted on back of the photographs (no names written)
- Figure legends provided (not more than 40 words)
- Patients' privacy maintained, (if not permission taken)
- Credit note for borrowed figures/tables provided
- Manuscript provided on a CDROM (with double spacing)

Submitting the Manuscript

- Is the journal editor's contact information current?
- Is the cover letter included with the manuscript? Does the letter:

1. Include the author's postal address, e-mail address, telephone number, and fax number for future correspondence?
2. State that the manuscript is original, not previously published, and not under concurrent consideration elsewhere?
3. Inform the journal editor of the existence of any similar published manuscripts written by the author?
4. Mention any supplemental material you are submitting for the online version of your article. Contributors' Form (to be modified as applicable and one signed copy attached with the manuscript)

STATEMENT ABOUT OWNERSHIP AND OTHER PARTICULARS

"Physiotherapy and Occupational Therapy Journal" (See Rule 8)

1. Place of Publication	:	Delhi
2. Periodicity of Publication	:	Quarterly
3. Printer's Name	:	**Asharfi Lal**
Nationality	:	Indian
Address	:	3/258-259, Trilok Puri, Delhi-91
4. Publisher's Name	:	**Asharfi Lal**
Nationality	:	Indian
Address	:	3/258-259, Trilok Puri, Delhi-91
5. Editor's Name	:	**Asharfi Lal** (Editor-in-Chief)
Nationality	:	Indian
Address	:	3/258-259, Trilok Puri, Delhi-91
6. Name & Address of Individuals	:	**Asharfi Lal**
who own the newspaper and particulars of shareholders holding more than one per cent of the total capital	:	3/258-259, Trilok Puri, Delhi-91

I Asharfi Lal, hereby declare that the particulars given above are true to the best of my knowledge and belief.

Sd/-

(Asharfi Lal)

Revised Rates for 2017 (Institutional)

Title	Frequency	Rate (Rs): India		Rate ($):ROW	
Community and Public Health Nursing	3	5000	4500	357	300
Dermatology International	2	5000	4500	357	300
Gastroenterology International	2	5500	5000	393	340
Indian Journal of Agriculture Business	2	5000	4500	500	450
Indian Journal of Anatomy	4	8000	7500	571	500
Indian Journal of Ancient Medicine and Yoga	4	7500	7000	536	500
Indian Journal of Anesthesia and Analgesia	4	7000	6500	500	450
Indian Journal of Biology	2	5000	4500	357	300
Indian Journal of Cancer Education and Research	2	8500	8000	607	550
Indian Journal of Communicable Diseases	2	8000	7500	571	500
Indian Journal of Dental Education	4	5000	4500	357	300
Indian Journal of Emergency Medicine	2	12000	11500	857	800
Indian Journal of Forensic Medicine and Pathology	4	15500	15000	1107	1050
Indian Journal of Forensic Odontology	2	5000	4500	357	300
Indian Journal of Genetics and Molecular Research	2	6500	6000	464	400
Indian Journal of Hospital Administration	2	6500	6000	464	429
Indian Journal of Hospital Infection	2	12000	9000	857	800
Indian Journal of Law and Human Behavior	2	5500	5000	393	350
Indian Journal of Library and Information Science	3	9000	8500	643	600
Indian Journal of Maternal-Fetal & Neonatal Medicine	2	9000	8500	643	600
Indian Journal of Medical & Health Sciences	2	6500	6000	464	410
Indian Journal of Obstetrics and Gynecology	4	9000	8500	643	600
Indian Journal of Pathology: Research and Practice	4	11500	11000	821	780
Indian Journal of Plant and Soil	2	65000	60000	4623	4100
Indian Journal of Preventive Medicine	2	6500	6000	464	410
Indian Journal of Research in Anthropology	2	12000	11500	857	800
Indian Journal of Surgical Nursing	3	5000	4500	357	300
Indian Journal of Trauma & Emergency Pediatrics	4	9000	8500	643	600
Indian Journal of Waste Management	2	9000	8000	643	579
International Journal of Food, Nutrition & Dietetics	3	5000	4500	357	300
International Journal of Neurology and Neurosurgery	2	10000	9500	714	660
International Journal of Pediatric Nursing	3	5000	4500	357	300
International Journal of Political Science	2	5500	5000	550	500
International Journal of Practical Nursing	3	5000	4500	357	300
International Physiology	2	7000	6500	500	450
Journal of Animal Feed Science and Technology	2	78000	70000	5571	5000
Journal of Cardiovascular Medicine and Surgery	2	9500	9000	679	630
Journal of Forensic Chemistry and Toxicology	2	9000	8500	643	600
Journal of Geriatric Nursing	2	5000	4500	357	300
Journal of Medical Images and Case Reports	2	5000	4500	357	300
Journal of Microbiology and Related Research	2	8000	7500	571	520
Journal of Nurse Midwifery and Maternal Health	3	5000	4500	357	300
Journal of Organ Transplantation	2	25900	25000	1850	1700
Journal of Orthopaedic Education	2	5000	4500	357	300
Journal of Pharmaceutical and Medicinal Chemistry	2	16000	15500	1143	1100
Journal of Practical Biochemistry and Biophysics	2	5500	5000	393	340
Journal of Social Welfare and Management	3	5000	4500	357	300
New Indian Journal of Surgery	4	7500	7000	536	480
New Journal of Psychiatric Nursing	3	5000	4500	357	300
Ophthalmology and Allied Sciences	2	5500	5000	393	340
Otolaryngology International	2	5000	4500	357	300
Pediatric Education and Research	3	7000	6500	500	450
Physiotherapy and Occupational Therapy Journal	4	8500	8000	607	550
Psychiatry and Mental Health	2	7500	7000	536	490
Urology, Nephrology and Andrology International	2	7000	6500	500	450

Terms of Supply:

1. Agency discount 10%. Issues will be sent directly to the end user, otherwise foreign rates will be charged.
2. All back volumes of all journals are available at current rates.
3. All Journals are available free online with print order within the subscription period.
4. All legal disputes subject to Delhi jurisdiction.
5. Cancellations are not accepted orders once processed.
6. Demand draft / cheque should be issued in favour of "Red Flower Publication Pvt. Ltd." payable at Delhi
7. Full pre-payment is required. It can be done through online (http://rfppl.co.in/subscribe.php?mid=7).
8. No claims will be entertained if not reported within 6 months of the publishing date.
9. Orders and payments are to be sent to our office address as given above.
10. Postage & Handling is included in the subscription rates.
11. Subscription period is accepted on calendar year basis (i.e. Jan to Dec). However orders may be placed any time throughout the year.

Order from

Red Flower Publication Pvt. Ltd., 48/41-42, DSIDC, Pocket-II, Mayur Vihar Phase-I, Delhi - 110 091 (India), Tel: 91-11-22754205, 45796900, Fax: 91-11-22754205. E-mail: sales@rfppl.co.in, Website: www.rfppl.co.in