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Immediate effects of nerve sliders and nerve massage on vibration and thermal perception thresholds in patients with painful diabetic peripheral neuropathy- a pilot randomized clinical trial (UTRN 103229513-050820102510203)

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ABSTRACT

Background and purpose: Mechanosensitivity of peripheral nerves was earlier demonstrated in animal models and in experimental human models of diabetic neuropathy and also in asymptomatic human subjects. The purpose of this study was to assess the immediate effects of nerve sliders and nerve massage on vibration perception thresholds (VPT), heat perception thresholds (HPT) and cooling perception thresholds (CPT) in patients with painful diabetic peripheral neuropathy.,Materials and methods: The study was an observer-blinded pilot randomized sham-controlled clinical trial with concealed allocation on 34 patients (22 male, 12 female) of mean age 53.86 ± 9.85 years with type-2 diabetes mellitus, neuropathic pain for more than one-year, VPT > 25 volts in feet and positive lower extremity neurodynamic testing in bilateral lower limbs suggestive of distal symmetric type of diabetic neuropathy. The tester administered nerve sliders and nerve massage to one lower limb while sham intervention of passive joint movements was performed for the other limb. The choice of first limb was chosen randomly and block randomization was performed to minimize between-side confounding differences. The three outcomes of VPT, HPT and CPT were assessed pre, immediate post and 15 min-post intervention on both feet using a biothesiometer., Data analysis and results: The data was analyzed using repeated measures analysis of variance at 95% confidence interval using SPSS 12.0.1 for Windows. Secondary analysis was done using independent t-test for gender and choice of first side. The experimental side had a greater reduction of VPT (12.40 ± 4.90 volts), HPT (7.63 ± 5.18 degree Celsius) and CPT (8.02 ± 5.97 degree Celsius) from pre-treatment to 15-min post-treatment compared to the sham side ($p<.05$). The changes between immediate post-treatment and 15-min post-treatment was not significant ($p>.05$) for all three measurements., Conclusion: Neurodynamic mobilization comprising of nerve sliders and nerve massage was effective on short-term in reducing VPT, HPT and CPT in patients with painful diabetic peripheral neuropathy compared to a sham intervention. These immediate effects were maintained at 15 min post-treatment.

Key words: Neurodynamics, mechanosensitivity, diabetic neuropathy, manual therapy, quantitative sensory testing.

INTRODUCTION

Diabetic neuropathy is a descriptive term meaning a demonstrable disorder, either clinically evident or subclinical that occurs in a setting of diabetes mellitus without other causes of neuropathy. The neuropathic disorder includes manifestations in both somatic and/or autonomic parts of the nervous system.[1] The first description of "diabetic neuropathy as a presence of pain and paresthesiae in lower limbs" was done by Rollo

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in 1798.[2] Diabetic peripheral neuropathic pain (DPNP) or painful diabetic peripheral neuropathy (PDPN) affects approximately 11% of patients with diabetic peripheral neuropathy (DPN). The most common type of neuropathy in DM is DPN, with up to 50% of patients experiencing some degree of painful symptoms and 10% to 20% having symptoms severe enough to warrant treatment. A classic population- based study found some degree of neuropathy in 66% of patients with DM. Among those with type 1 and type 2 DM, 54% and 45%, respectively, had DPN and 15% and 13%, respectively, were symptomatic.[3]

Neuropathic pain was defined by International Association for the Study of Pain as "pain caused or arising from the lesion or dysfunction of the nervous system.[4]" The term "dysfunction" here encompasses anatomical and/or physiological abnormality. Central neuropathic pain arises from central nervous system dysfunction and peripheral neuropathic pain arises from peripheral nervous system dysfunctions.[5] Peripheral nervous system dysfunction clinically manifest as peripheral neuropathies in a large proportion of diabetic patients, presenting either as painful or painless neuropathies.[6] Peripheral neuropathic pain often presents as a combination of nerve trunk pain and dysesthetic pain.[7] Nerve trunk pain is typically described as a deep and aching sensation that has been attributed to increased activity from mechanically or chemically sensitized nociceptors in the connective tissue sheaths of the nervous system (i.e. nervi nervorum and sinuvertebral nerves).[8] Dysesthetic pain is often characterized as an unfamiliar or abnormal sensation such as burning, tingling, electric, searing, drawing, or crawling,[7] and it is thought to be the result of volleys of impulses originating from damaged or regenerating afferent fibers that have become hyperexcitable (i.e. abnormal impulse generating sites).[9]

Nerve trunk pain typically presents as pain or abnormal sensations along the course of the peripheral nerve that can be clinically tested using the concept of neurodynamics. Neurodynamics is the concept based on a close interaction of mechanics and physiology of the nervous system which is to be considered while assessing and treating patients via nervous system mobilization and manual therapy.[10] The foundation of knowledge behind neural tissue mechanosensitivity arose from the fact that peripheral nerve trunks in diabetic neuropathy exhibited mechanical allodynia[11] and mechanical hyperalgesia in animal and human experimental models of neuropathic pain.[12-15]

Neurodynamic assessment involves neurodynamic testing[16] and nerve palpation.[17] Neural tissue mechanosensitivity was to be confirmed during neurodynamic testing by positive response to structural differentiation so as to identify neural from the non-neural sources of patient symptoms.[10] Presence of mechanical allodynia on nerve trunk palpation was another key diagnostic sign of neural tissue mechanosensitivity.[8,18]

Neurodynamic mobilization and its effects were studied in many disorders such as carpal tunnel syndrome,[19-29] cubital tunnel syndrome,[30,31] radial tunnel syndrome,[32] lateral epicondylitis,[33,34] thoracic outlet syndrome,[35,36] cervical cord compression,[37] cervical radiculopathy,[38] cervicobrachial pain syndrome,[39-42] non radicular low back pain,[43] lumbar nerve root irritation,[44] lower extremity symptoms[45,46] and lumbar spine surgery.[47]

Recent systematic review by Ellis and Hing[48] on neurodynamic mobilization as a treatment concluded overall in favor of the techniques. Another review by Nee and Butler[49] earlier emphasized the application of neurodynamic techniques for the management peripheral neuropathic pain since the techniques were shown to influence neurophysiological mechanisms. Neurophysiological effects of straight leg raise (SLR), a lower extremity neurodynamic test was studied by Ridehalgh et al[50] who examined the effects of superficial peroneal nerve tensioner technique- a modified straight leg raise with plantar flexion and inversion on vibration perception thresholds (VPT) and the findings showed that the tensioner technique increased the VPT compared to sham technique but the effects were reversible within ten minutes among both runners and non-runners. Earlier study by Humphreys et al[51] on ten healthy subjects, demonstrated longer tibial nerve F-wave latencies when measured in straight leg raise position, proposedly indicating the neurophysiological effect of the SLR position and the author

recommended neurophysiologic testing in nerve lengthened positions so as to elicit subtle neural involvement signs. These two studies[50,51] involved the use of SLR as a neurodynamic technique and the authors were able to demonstrate neurophysiological effects. Such an effect would be invaluable in PDPN patients who have abnormal vibration, touch and temperature perception in their lower leg and feet.

The aim of this study was to evaluate the immediate effects of nerve sliders and nerve massage on vibration perception thresholds (VPT), heat perception thresholds (HPT) and cooling perception thresholds (CPT) in patients with painful diabetic peripheral neuropathy.

MATERIALS AND METHODS

Study design

Observer-blinded randomized, sham-controlled, clinical trial.

Ethical clearance

The study conduct and protocol was approved by Institutional Ethics Committee, Kasturba Medical College, Mangalore and the trial was registered at Clinical Trials Registry- India under universal trial registration number UTRN 103229513-050820102510203.

Study location

Out-patient treatment unit of department of physiotherapy in a multi-specialty teaching hospital.

Patient selection

Patients enrolled in diabetes clinic of the hospital were screened initially for the following inclusion criteria;[52-55]

Known case of type-2 diabetes, with stable glycemic levels (on HbA_1c) for a minimum of six months.

Complaint of bilateral neuropathic pain in the legs and feet (screened using neuropathic pain scale) for a minimum of six months.

Vibration perception thresholds greater than 25 volts in both feet when assessed using a biothesiometer.

Tested positive on structural differentiation during lower extremity neurodynamic testing on both sides lower limbs. Sciatic neurodynamic test, tibial neurodynamic test and common peroneal neurodynamic test were used for this purpose.

Mechanical allodynia to manual palpation of nerve trunks in bilateral legs and feet. Manual palpation of sciatic, tibial and common peroneal nerve trunks were done for this assessment.

Patients with comorbid musculoskeletal disorders, history of fractures, trauma and surgery to lower limbs, and inability to understand therapist's instructions were excluded.

PATIENT RECRUITMENT

All patients were required to provide a written informed consent prior to their participation in the study. The consecutive patients were randomly assigned to either of two groups- based on side of lower limb treated first by block randomization. The allocation method was concealed from the primary investigator using sequentially numbered sealed opaque envelopes, generated by computerized table of random numbers method.

OUTCOME ASSESSMENT

Vibration perception threshold (VPT):

The VPT testing was done using Vibrotherm™ Biothesiometer[56] with the probe placed on the subject's skin. The therapist slowly increased the intensity of vibratory stimulus until onset of vibration sense is reported. Minimum intensity of vibration felt as a sensation reported by the subject was taken as the VPT. Both appearance and disappearance of the sensation of vibration were measured. Appearance of vibration was measured by turning up the vibration stimuli until the subject was just able to perceive vibration. Disappearance was measured by increasing the stimuli to above that of the appearance value, and then slowly reducing the stimuli to where the subject no longer felt the stimulus.[50] The therapist

who performed the VPT testing using the equipment was trained prior and intra-rater reliability was established in five healthy subjects prior to the study. The ICC was found to be .91. The test was conducted after providing standardised instructions to the subjects, and was performed in a designated, quiet room without distractions (as per American Academy of Neurology guidelines).[57] The sites of measurement of VPT were shown in figure. The two (b, c) out of three sites of measurement coincided with the areas of cutaneous innervation by the two branches- medial and lateral plantar nerve and the third (a) with the main trunk of tibial nerve in the sole of foot. The total average score of the three values in volts was taken as the final value of the test for VPT in the tested foot. The procedure is then repeated on the other foot by the same therapist. The testing therapist was not aware of the treatment technique employed on the leg, during post-test measurement of VPT. The total contact duration was maintained to be less than 30 seconds to prevent adaptation and interval between two trials was maintained at 4 mins to facilitate recovery of cutaneous mechanoreceptor afferents to vibratory stimulus.[58] Total duration of testing VPT per side was then 10 mins.

Thermal perception threshold(TPT)- Methods of levels (MLE)

Each degree was kept for 4 seconds since the minimum time duration of stimulus exposure to evoke a subjective sensation for thermal stimuli is three seconds.[59]

The procedure for testing thermal perception thresholds was done as per described by Malanda et al.[60] The Methods of Levels (MLE) was used in this study.

MLE is characterized by confirming or denying a well-defined temperature change. Starting from 32°C, temperature rises (warm sensation) or decreases (cold sensation) with a 2°C step (rate of change 1°C/s). Based on the subjects answer ("yes" or "no" sensation) the °C amplitude of the following temperature step is doubled ("no" answer) or halved ("yes" answer) until a minimal perceptive criterion is established. In this "yes/no" procedure post-stimulus speed of reaction and by that reaction time does not play a role. By doing so a complete MLE test consists of several single stimuli resulting in a finally acquired reaction-time free temperature threshold. Anticipation or prediction of stimuli is prevented by random inclusion of "dummies" (no temperature change after the auditory signal) and combining two separate sequences of levels stimuli in a single test sequence. In this study levels thresholds were determined by applying temperature stimuli directly after an auditory cue (change rate 1°C/s). The testing of cold sensation sequence preceded warm sensation. Return to adaptation temperature (32°C) started as soon as participant responded "yes" or "no" (return rate 4°C/s). The inter-stimulus interval was randomized between 4 and 6 s and the minimal perceptive criterion was set to 0.1°C. Final MLE threshold for either cold or warm sensation was considered the mean of the last "yes" and "no" answered temperature step value.

The outcome measures were taken in random order, (selected by a toss of a coin method) for each leg separately both pre and post interventions by another physiotherapist who was blinded to intervention method applied. All subjects were seen at the same time of the day (preferably afternoons) to minimize the effects of diurnal influence on the thermal sensitivity in the subjects.[61]

INTERVENTIONS

The intervention consisted of one of the following two techniques on the first side lower limb and the next on the other side lower limb of the same subject. Thus subjects acted as their own controls with control side receiving the sham treatment and experimental side receiving nerve slider technique with nerve massage.

Control side- sham intervention

The sham intervention consisted of mid-range rhythmic passive joint movements performed by a physiotherapist at .5Hz, each movement for 5 repetitions, at ankle, subtalar, midfoot, forefoot and toes.[62] The control intervention hence was chosen with an intention to maximally influence tissues other than the nervous system like nociceptive structures.

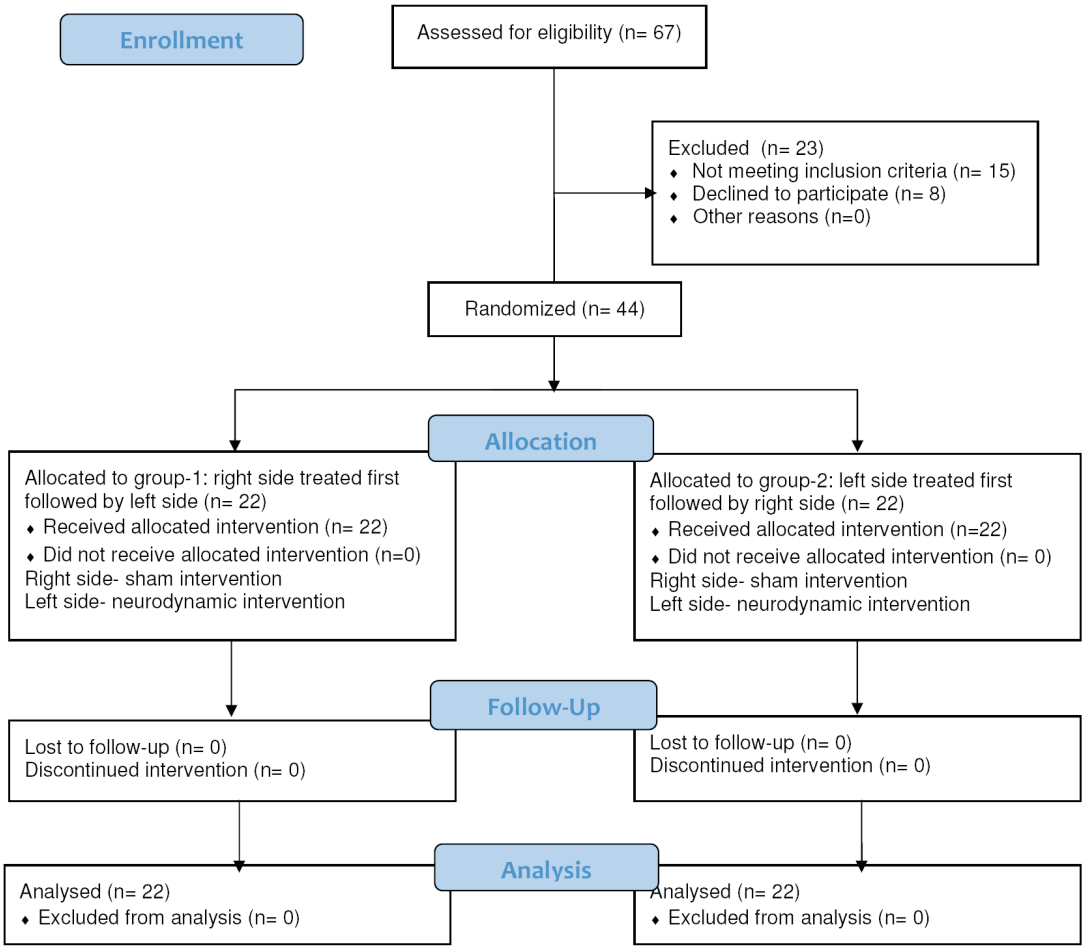
Experimental side- neurodynamic intervention

The experimental intervention consisted of nerve sliders performed for the positive tested nerve on neurodynamic testing at level-2b examination as described by Shacklock.[63] The second part of the experimental intervention comprised of transverse nerve massage along the nerve trunk found tender on manual palpation (sciatic, common peroneal and tibial nerves).[64] Both the experimental techniques were performed by a physiotherapist trained in neurodynamics under Neurodynamic solutions Inc., Australia with a post-graduate qualification and a clinical experience of eight years in manual physical therapy assessment and treatment methods. Slider dysfunction of the nerve was to be identified when mid-range symptom provocation during neurodynamic tests and decrease in symptom provocation during successive addition of neural tissue loading components.

Intervention duration was kept constant for both the sides to ensure adequate patient-blinding from experience bias. It took ten minutes per side. Total duration of both interventions together per patient was thus 20 mins.

The schematic representation of the study procedure was given in figure-1 as a CONsolidated Standards Of Reporting Trials (CONSORT) 2010 statement.[65]

Figure 1: Consort flowchart of participants in this study



DATA ANALYSIS

The data was analyzed using repeated measures analysis of variance at 95% confidence interval using SPSS 12.0.1 for Windows. Secondary analysis was done using independent

t-test for comparison between gender and the groups based on choice of first side for treatment. Pearson correlation coefficient was used for relationship between changes in outcome measures.

RESULTS

Sample size estimation

Estimation of sample size for our study was done based on minimum clinically important difference

Table 1: Overall baseline patient characteristics and between-group comparisons

	Group-1 (RL)	Group-2 (LR)	Between-group comparison- p value
Age (years)	53.45 ± 9.91	54.27 ± 10.01	.787 (NS)
Gender- male (female)	12 (10)	14 (8)	.551 (NS)
Duration of diabetes (years)	5.63 ±2.30	6.00 ± 2.30	.604 (NS)
Duration of neuropathic pain (years)	3.45 ±1.43	3.95 ± 1.91	.333 (NS)
Vibration perception thresholds (in volts)	46.25 ± 2.21	46.38 ± 2.71	.856 (NS)
Heat perception thresholds (in degree Celsius)	15.59 ± 1.90	16.09 ± 1.90	.389 (NS)
Cold perception thresholds (in degree Celsius)	15.75 ± 2.24	16.09 ± 1.90	.590 (NS)

NS: Not significant at $p<.05$

Table 2: Overall baseline findings of neurodynamic assessment in the patients

Nerves tested positive, N (%)	Neurodynamic testing		Nerve trunk palpation	
	Right	Left	Right	Left
Sciatic nerve	1 (2.3%)	1 (2.3%)	0	0
Tibial nerve	2 (4.5%)	5 (11.4%)	4 (9.1%)	8 (18.2%)
Common peroneal nerve	6 (13.6%)	7 (15.9%)	6 (13.6%)	10 (22.7%)
Sciatic + tibial nerve	9 (20.5%)	9 (20.5%)	5 (11.4%)	5 (11.4%)
Sciatic + common peroneal	3 (6.8%)	4 (9.1%)	2 (4.5%)	2 (4.5%)
Tibial + common peroneal	6 (13.6%)	6 (13.6%)	9 (20.5%)	9 (20.5%)
Sciatic + tibial + common peroneal	17 (38.6%)	12 (27.3%)	18 (40.9%)	10 (22.7%)

Table 3: Between-side comparison of changes in three outcome measures measured on three occasions (pre-treatment, immediate post-treatment and 15-min post-treatment) for both the interventions

	Control side- Sham intervention			Experimental side- Neurodynamic mobilization		
	T-1	T-2	T-3	T-4	T-5	T-6
VPT (volts)	45.88 ± 2.22	45.47 ± 2.68	46.20 ± 2.40	46.75 ± 3.21	32.31 ± 3.45	34.65 ± 4.04
HPT	15.72 ± 2.67	15.81 ± 2.77	15.40 ± 2.78	15.95 ± 2.77	7.79 ± .851	8 ± .835
CPT	15.63 ± 2.73	16.06 ± 3.16	15.59 ± 3.12	16.20 ± 3.23	7.93 ± .94	8.13 ± .90
	T-12	T-23	T-13	T-45	T-56	T-46
VPT (volts)	.40 ± 3.65	-.72 ± 4.00*	-.31 ± 3.41	14.43 ± 4.34*	-2.34 ± 6.04	12.09 ± 5.48*
HPT	-.09 ± 2.58	.40 ± 3.64	.31 ± 3.88	8.15 ± 3.18*	-.20 ± 1.06	7.95 ± 2.96*
CPT	-.43 ± 3.22	.47 ± 3.69	.04 ± 4.17	8.27 ± 3.52*	-.20 ± 1.13	8.06 ± 3.42*

in vibration perception thresholds between-treatments at 5 ± 2 volts and alpha level at 5% and a power of 90%, to get a sample of 22 per group. We thus multiplied into two to arrive at our present sample size 44. There were no expected drop-outs since the study was in a single session.

Patient characteristics

Of the 63 patients screened, 46 fulfilled the inclusion criteria and 44 volunteered to participate in our study. The study population of 44 patients was of age 53.86 ± 9.85 years, 26 male and 18 female, with diabetes duration of 5.81 ± 2.28 years and neuropathic pain duration of 3.7 ± 1.69 years. The patients' overall pre-treatment VPT was 46.31 ± 2.44 volts, HPT was 15.84 ± 1.89 degrees Celsius, and CPT was 15.92 ± 2.06 degrees Celsius. The overall patient demographic characteristics for patients' age, duration of diabetes, duration of neuropathic pain, VPT, HPT and CPT were shown in table-1 with between-group comparisons. Table-2 shows the overall baseline neurodynamic assessment (neurodynamic testing and nerve trunk palpation) findings for all three lower limb nerves (sciatic, tibial and common peroneal).

- : Negative sign indicates increase in values.

*- mean differences (changes) between-treatments were significant at p<.05 level.

(T-1 & T-4: pre-treatment; T-2 & T-5: immediate post-treatment; T-3 & T-6: 15-min post-treatment; T-12 & T-45: comparison between pre-treatment and immediate post-treatment; T-23 & T-56: comparison between immediate post-treatment and 15-min post-treatment; T-13 & T-46: comparison between pre-treatment and 15-min post-treatment).

COMPARISON BETWEEN INTERVENTIONS

The table-3 showed between-treatment comparison for the pre-post change in three outcome measures.

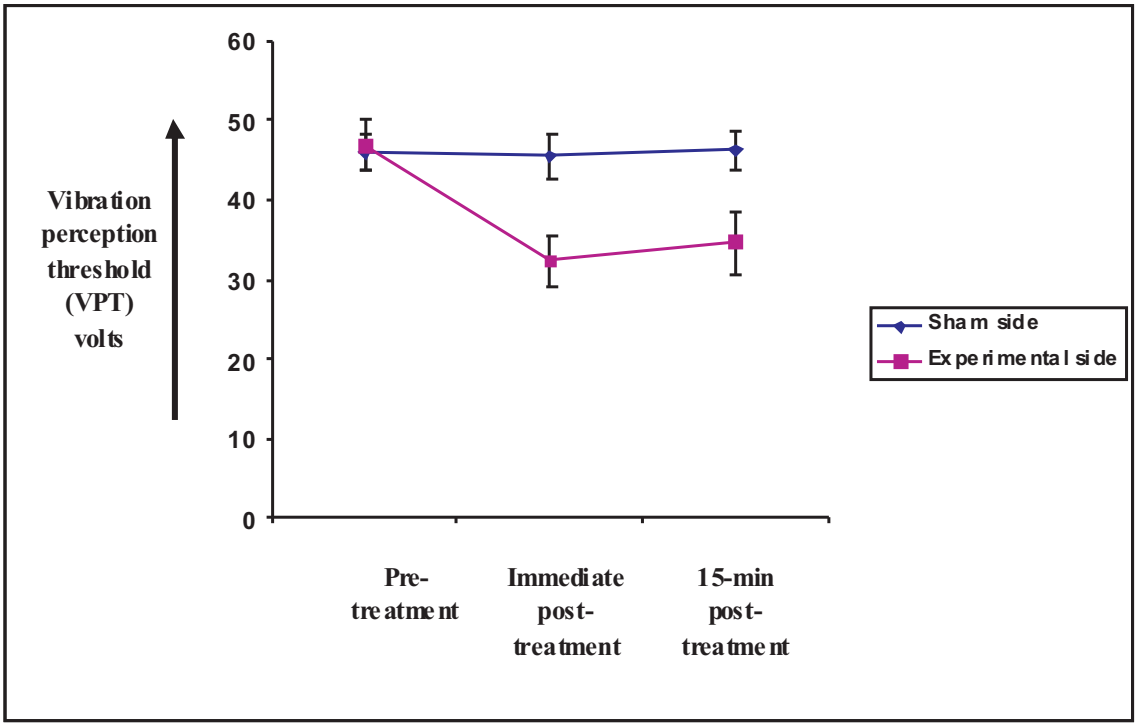
The experimental side had a greater reduction of VPT of about 14.02 ± 5.15 volts from pre-treatment to immediate post-treatment compared to the sham side (p<.05). The experimental side had a slightly greater increase in VPT of about 1.61 ± 6.83 volts from immediate post-treatment to 15-min post-treatment compared to the sham side (p>.05). The experimental side had a greater reduction of VPT of about 12.40 ± 4.90 volts from pre-treatment to 15-min post-treatment compared to the sham side (p<.05).

The experimental side had a greater reduction of HPT of about 8.25 ± 4.41 degree Celsius from pre-treatment to immediate post-treatment compared to the sham side (p<.05). The

experimental side had a slightly greater increase in HPT of about .61 ± 3.68 degree Celsius from immediate post-treatment to 15-min post-treatment compared to the sham side (p>.05). The experimental side had a greater reduction of HPT of about 7.63 ± 5.18 degree Celsius from pre-treatment to 15-min post-treatment compared to the sham side (p<.05).

The experimental side had a greater reduction of CPT of about 8.70 ± 5.62 degree Celsius from pre-treatment to immediate post-treatment compared to the sham side (p<.05). The

Figure 2: Comparison of changes in vibration perception thresholds (in volts) between sham-treated side versus neurodynamic-treated side at pre-treatment, immediate-post treatment and 15-min post-treatment



experimental side had a slightly greater increase in CPT of about .68 ± 3.94 degree Celsius from immediate post-treatment to 15-min post-treatment compared to the sham side (p>.05). The experimental side had a greater reduction of CPT of about 8.02 ± 5.97 degree Celsius from pre-treatment to 15-min post-treatment compared to the sham side (p<.05).

Comparison of change in VPT

Pre-treatment and immediate post-treatment-

The between-treatment difference (14.02 ± 5.15 volts) was statistically significant (p=.000) with greater decrease in VPT observed for the experimental side compared to the sham side.

Immediate post-treatment and 15-min post-treatment-

The between-treatment difference (1.61 ± 6.83 volts) was not statistically significant (p=.125) with greater decrease in VPT observed for the experimental side compared to the sham side.

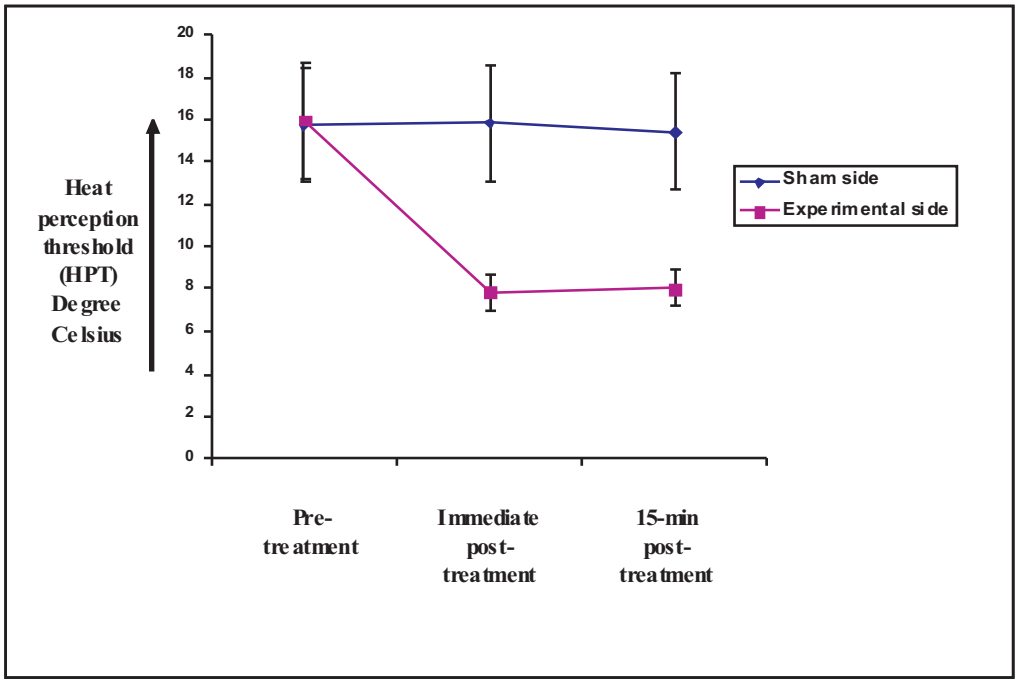
Pre-treatment and 15-min post-treatment-

The between-treatment difference (12.40 ± 4.90 volts) was statistically significant (p=.000) with greater decrease in VPT observed for the experimental side compared to the sham side.

Comparison of change in HPT

Pre-treatment and immediate post-treatment-
The between-treatment difference (8.25 ± 4.44 degree Celsius) was statistically significant (p=.000) with greater decrease in HPT observed for the experimental side compared to the sham side.

Figure 3: Comparison of changes in heat perception thresholds (in degree Celsius) between sham-treated side versus neurodynamic-treated side at pre-treatment, immediate-post treatment and 15-min post-treatment



Immediate post-treatment and 15-min post-treatment-

The between-treatment difference (.61 ± 3.68 volts) was not statistically significant (p=.275) with greater decrease in HPT observed for the experimental side compared to the sham side.

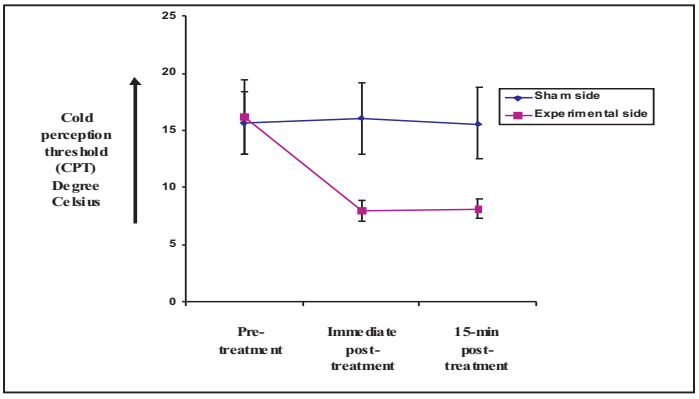
Pre-treatment and 15-min post-treatment-The between-treatment difference (7.63 ± 5.18 volts) was statistically significant (p=.000) with greater decrease in HPT observed for the experimental side compared to the sham side.

Comparison of change in CPT

Pre-treatment and immediate post-treatment-The between-treatment difference (8.70 ± 5.62 volts) was statistically significant (p=.000) with greater decrease in CPT observed for the experimental side compared to the sham side.

Immediate post-treatment and 15-min post-treatment-The between-treatment difference (.68 ± 3.94 volts) was not statistically significant (p=.257) with greater decrease in CPT observed

Figure 4: Comparison of changes in cold perception thresholds (in degree Celsius) between sham-treated side versus neurodynamic-treated side at pre-treatment, immediate-post treatment and 15-min post-treatment



for the experimental side compared to the sham side.

Pre-treatment and 15-min post-treatment-

The between-treatment difference (8.02 ± 5.97 volts) was statistically significant (p=.000) with greater decrease in CPT observed for the experimental side compared to the sham side.

DISCUSSION

Our study is the first of its kind reporting beneficial effects of nerve sliders and nerve massage in patient population of painful diabetic peripheral neuropathy. One study[66] earlier evaluated tibial nerve neurodynamic mobilization techniques for neuropathic pain in type-2 diabetic patients and another study[67] for sciatic nerve, both were conference presentations by Kumar et al. Published studies evaluating the techniques' effects were recently shown by Kumar et al[68] who studied nerve massage influence on the vibration and thermal perception in asymptomatic subjects when they tested the effects for tibial nerve. The authors concluded beneficial therapeutic effects for transverse nerve massage that made us to choose it as a part of experimental intervention. Another study by Kumar et al[69] on comparison between nerve sliders and tensioners for tibial nerve on their effects on vibration and temperature thresholds in asymptomatic subjects found slider techniques to be clinically useful that necessitated the inclusion of sliders into our experimental group.

Despite the existed controversy[70] about nerve mobilization and neurodynamics, the concept of specific nerve mobility and mobilization is growing in evidence.[48] Thus we based our patient selection not only based on clinical examination findings[71] to suit neurodynamic interventions but also based on evidence-informed clinical decision-making.[72]

The peripheral nerve trunks and their connective tissue sheaths have viscoelastic mechanical properties[73] and hence they can easily adapt to changes in their length by minimal metabolic and circulatory adjustments that manifest as neurophysiologic effects.[74] Of the reasons for rejection of null hypothesis, the contribution of clinical reasoning[75] in subject selection cannot be overemphasized in that all subjects had positive neurodynamic tests with mechanosensitivity on tibial nerve palpation.

One alternative explanation for the observed effects of the neurodynamic techniques could be due to the movement components which might have also induced afferent kinesthetic impulses from ankle and foot muscles which in turn could possibly influence the cutaneous receptor afferents thus altering perception of sensory thresholds.[76] This effect and possible acceptance of null hypothesis had been minimized by having a control side, where sham neurodynamic technique[77] was done including only ankle and foot movement components to stress local non-neural tissues. Such a sham intervention have enabled us to study the effects of cognitive-perceptual influences and the role of placebo associated with manual therapy interventions.[78] Caution should be exercised in that our study sample was small in size and it was a pilot study prior to start of a large-scale randomized controlled trial in patients with diabetic peripheral neuropathic pain.

The reason for choosing vibration perception threshold (VPT) and thermal perception thresholds (TPT) as outcome measures only instead of tactile threshold, current perception threshold, pressure pain threshold or thermal pain threshold is that VPT and TPT can be conveniently measured and they both in themselves depict an accurate measure of peripheral nerve function in neuropathies.[79]

The within-subject experimental design of our study eliminated the influence of confounding factors on sensory perception thresholds like age,[80] gender,[81] psychophysical factors,[82] room temperature,[83] skin temperature,[84] probe cross-sectional area[85] thus proving that the generalizability of the findings for the observed difference was due to the effects of techniques per se. Within-side skin temperatures can vary from 18-35^{o}C when noticed in a normal hand at a room temperature of 35^{o}C[85] measuring which was not under the scope of our study. Also within-side adaptation for vibratory stimulus[86] was best prevented in our study by selecting appropriate recovery times between successive stimuli.

The duration of thermal stimulus exposure used in our study was 4 min per degree Celsius (greater

than 3 min duration), which was shown to be the best duration to minimize the spatial summation effect of the sequential stimuli.[87] The other factor like frequency of stimuli was under control once the rate of exposure was maintained. The end-organ distribution[88] or cutaneous innervation[89] in the feet, if there was a difference between sides, which could influence thermal perception to a large extent, however was not under the control of our study.

The method of assessment used for measurement of thermal perception thresholds in our study was Method of Levels (MLE). Of the three methods of assessment[90], the Methods of Limits (MLI) was considered better than Methods of Levels (MLE) and Methods of Forced Choice (MFC) since it is inclusive of reaction time but is not suitable for distal body parts like feet since it is dependent on the distance of the part from the brain and hence the stimulus' conduction velocity.[91] For use in single part or a region, hence MLE method was widely preferable to MLI method. We hope this justifies our use of MLE method for thermal perception threshold testing.

The other significant implication of this study was the value of measuring the threshold for warming and cooling separately, since it is held that the two modalities are conveyed by different peripheral nerve fibres: sensations of warming in unmyelinated peripheral nerve fibres and those of cooling in small myelinated fibres. Estimation of thresholds can therefore be used to examine the functional integrity of these fibres which are inaccessible to clinical electrophysiological investigations.[92]

One of the acceptable limitations of this study was it was on immediate effects of the two techniques, the same when applied in a different duration and dosage might produce very different results. Post-intervention 15 min measurement of thresholds showed a trend towards reversibility of the effects of both the techniques, hence these techniques can be safely applied in patient population in that they are not detrimental to nerve function.[50] Of the major role in the effects of the techniques was the application of clinical reasoning in the selection criteria in that restricted tibial nerve mobility was confirmed with tibial nerve neurodynamic test and random selection of treatment side with blinded observer recording eliminated the bias to a large extent.

Another limiting factor of our study not controlled was the probable presence of anatomic variations in the tarsal tunnel[93] and also in both the course[94] and divisions[95,96] of tibial nerve which might have been present in subjects' either side lower limb which could not be ruled out. According to Shacklock,[63] presence of anatomical anomalies would mislead clinicians into misinterpretation of responses to neurodynamic testing. The effects of neurodynamic techniques were not attributed only to the peripheral mechanisms but also to the central neuromatrix.[97] The role of central neuromatrix in altering the sensory perception thresholds was a subject not yet studied so far.

There is scope for further research in patient populations with lower extremity peripheral neuropathic pain syndromes after knowledge of central and peripheral mechanisms for the symptoms,[98] with in-vivo non-invasive measurement techniques for outcome measurement such as real-time Spectral Doppler ultrasonography[99,100] for nerve mobility during the application of the two neurodynamic mobilization techniques. The techniques could also be studied in combination and/or comparison to other treatment techniques for peripheral neuropathic pain such as pharmacotherapy[101] and/or other physiotherapy treatment methods.[102] The effects of such treatment combinations should be evaluated using well established and validated clinical assessment scales[103] for PDPN patients.

CONCLUSION

Neurodynamic mobilization comprising of nerve sliders and nerve massage to sciatic , tibial and common peroneal nerves reduced vibration perception thresholds, heat perception thresholds and cold perception thresholds in the treated side significantly compared to the sham-treated side lower extremity in painful diabetic peripheral neuropathy patients in this study.

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Comparison of Acute Hemodynamic Effects of Straight Partial Sit Ups Versus Oblique Partial Sit Ups on Healthy Subjects

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Jamal Ali Moiz**
Altaf Hussain***

ABSTRACT

Objective: To compare the magnitudes of change in heart rate(HR), systolic blood pressure(SBP), diastolic blood pressure(DBP), arterial oxygen saturation(SpO_2),rate pressure product(RPP) and rate of perceived exertion(RPE) during straight partial sit-ups and oblique partial sit-ups **Design:** Randomized controlled parallel design. **Participants:** Thirty male volunteers with mean age 23.7±1.9 years, height 5.5± 0.2 meters, weight 59.2+5.7 kg and BMI of 21.4 ± 2.1were included in the study. **Methods:** 30 male healthy volunteers were randomly assigned to two groups and they performed 30 repetitions of SPU and OPSU depending upon the group they were allocated to. After recording there baseline HR, BP, SpO_2 for one minute same were recorded during and post exercise for 10 minutes with the help of monitors attached with a BP cuff and pulse oxymeter. **Result:** Data was analysed using SPSS 14.0 for window version. t-test was used to compare the pre-exercise, during-exercise and post-exercise effects on hemodynamic variables between SPSU and OPSU. Within group comparison was done using ANOVA. The level of significance was set at $p< 0.05$. Mean difference of pre and post exercise hemodynamic variables were compared and no significant difference was found between the two exercises at during exercise and post exercise levels However, within group analysis, a significant difference at pre exercise, during exercise and post exercise levels in each hemodynamic variables in both the abdominal exercises were found. **Conclusion:** The results suggest that there was no significant difference in rise in hemodynamic variables during the two exercises. However there was a significant difference between pre exercise and during exercise magnitude of hemodynamic variables of each exercise. This suggests that acute hemodynamic changes of these two abdominal exercises are clinically relevant, however both oblique partial sit-ups and straight partial sit-ups warrant same amount of concern.

Keywords: Hemodynamics, abdominal exercises, rehabilitation, blood pressure, rate pressure product

INTRODUCTION

Abdominal exercises are prescribed for variety of reasons but mainly for low back injury and as a component of fitness programs of person with cardiovascular disease.[1,2]

Low back pain is a health problem with a major societal impact and is most commonly treated in primary health care setting. Of those seeking medical attention, many are prescribed abdominal strengthening exercises as a part of treatment program.[3] Strong abdominal muscles help stabilize the trunk and unload lumbar spine stress. Abdominal muscles commonly are activated by active flexion of the trunk through a concentric muscle contraction. [4] although numerous abdominal exercises exist, researchers have reported that the strait partial sit-ups (SPSU) and oblique partial sit ups (OPSU) produce high muscle elecromyographic activity while maintaining low lumbar compressive and shear forces.[1] Consequently these two abdominal exercises are often included in therapeutic spine stabilization and general fitness program. Abdominal exercises are also recommended by American Heart

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Association in endurance and resistance training of person with cardiovascular diseases.[5]

It is generally agreed that the cardiac response to the exercise is complex and involves the interaction of number of variables such as heart rate, stroke volume, ventricular end diastolic volume and hearts neurohumoral mechanisms. To date exercise research has focused primarily on the elecromyographic and biomechanical aspects of exercise. The hemodynamic effect of abdominal exercise as used in rehabilitation low back injury and fitness training programs of cardiovascular disease are largely unknown.

It is clinical importance to determine the hemodynamic responses to common abdominal exercise during the actual exercises. With such information, clinician may make more informed decisions regarding the appropriateness of abdominal exercise prescription not only on a biomechanical basis, but also on a hemodynamic basis. This would be particular importance in population who have pre-existing cardiac or cerebrovascular disease, many of which may present in the office setting with low back ache.[3,6]

It is therefore, this study was designed to compare the hemodynamic variants of two abdominal exercises oblique partial sit ups versus strait partial sit ups.

METHODS

A total of 30 healthy male volunteers were selected for the study with mean ±SD age of 23.7±1.96 years, height of 5.5±0. 26 m, weight of 59.2 ± 5.7 Kg and BMI of 21.4 ± 2.1 after they met the following criteria:

Healthy, young males with a normal BMI in range of 18.5-24.9, Age: 18 to 30 years, abdominal muscle power grade-'Fair' and willingness to participate

Subjects with any history of acute or chronic illness, backache from last 6 months or any participation in any abdominal exercise earlier were excluded.

Hemodynamic parameters and instrumentation

The hemodynamic parameters monitored during this study included heart rate(HR),Diastolic blood pressure(DBP),systolic blood pressure(SBP),arterial oxygen saturation(SpO_2),Rate of perceived exertion on Borg's scale(RPE) and rate pressure product(RPP).

These parameters were monitored with the help of Phillips MP20 bedside monitor attached with BP cuff and pulse oxymeter. RPP was calculated by the formula (HR X SBP/100).

PROCEDURE

The purpose and the nature of the study was explained to the prospective participant and subjects were screened by filling up of the PAR-questionnaire and their height and weight was measured to ensure if they fulfilled the normal BMI criteria. Each subject's abdominal muscle strength was assessed by Kendall's manual muscle testing.[7] The procedure for the study was formulated on the basis of a pilot study conducted on two subjects to identify the possible difficulties that may be encountered during the process of data acquisition.

Each subject was randomly assigned to either group A or group B. Subjects assigned to group A were demonstrated and made to practice state partial sit up and subjects in group B were demonstrated and made to practice oblique partial sit up a day before the test day. Subjects were instructed to exhale during the concentric phase and inhale during the eccentric phase of contraction of exercise. Explanations about the exercise, post exercise rest period, Borg's CR-10 RPE scale and method of recording hemodynamic variables were given.

EXERCISE PROTOCOL

On the test day, one subject at a time was taken to the ICU and asked to lie supine with knees flexed after removing his shirt. Five ECG electrodes were fixed on their body. BP cuff and pulse oxymeter was attached to the subject's right arm and index finger respectively. When subject, allocated randomly to Group A was completely relaxed, each subject's HR, SBP, BDP, SpO_2 were monitored for 1 min before exercise. At the end of 1 min the subject was instructed to perform

straight partial sit ups, knees flexed to 90, hip flexed to 45 and the feet flat on the table. The subject was instructed to cross his arms across the chest and raise the upper back of the table. The rise was high enough to just clear the inferior angles of the scapulae.

This position was held for three seconds (timed by investigator with the help stop watch), and then the upper back lowered to the table. This was counted as one repetition. Each repetition took six seconds to complete, and a total of thirty continuous repetitions were performed. After completion of thirty repetitions the subject was asked to relax, his hemodynamic variables being monitored for ten minutes. All these data being saved on the monitor.

Subjects allocated to group B performed oblique partial sit ups in the same position as described above. With the arms across the chest, the subject raised the upper back off the table in an oblique direction high enough to just clear the inferior angles of bilateral scapulae. This was counted as one repetition. Each repetition took six seconds to complete, and thirty continuous repetitions were performed to alternating sides. The first repetition was performed to the subjects right side and then to the left and thirty repetition were completed in the same way. Subjects were instructed to exhale during the concentric phase of the abdominal muscle contraction and to inhale during eccentric phase of contraction.

RESULTS

The difference in effect of SPSU and OPSU on HR, BP, SpO_2, RPP and PRE was analysed by paired t-test using SPSS.14.0 for windows software. Within group analysis for all the variables was done using ANOVA. The level of significance for a two tailed experimental hypothesis was set at <0.05. the between group results are summarised in table 1 and graphically represented by figures bellow.

Table 1: Comparison of pre exercise, during exercise and post exercise effects on hemodynamic variables between SPSU and OPSU

Variables	SPSU Mean ± SD (n=15)	OPSU Mean ± SD (n=15)	t-test	
			t	p
HR_{Pre}	77 ± 9.3	73±6.2	1.4	0.15
HR_d	83±8.7	81±8.3	0.61	0.54
HR_{post}	78±8.8	75±4.8	0.94	0.35
SBP_{pre}	109.4±6.3	106±9.8	1.0	0.2
SBP_d	117±7.3	113.6±7.8	1.4	0.1
SBP_{post}	111.2±5.9	108.5±9.1	0.9	0.3
DBP_{Pre}	65.4±7.3	64±5.8	0.577	0.569
DBP_d	73.2±3.2	72.9±4.6	0.182	0.857
DBP_{post}	68.8±6.5	65.9±5.3	1.3	0.20
$SpO2_{Pre}$	99.3±0.8	99.4±0.5	0.2	0.06
$SpO2_d$	98.8±0.6	99.0±0.2	1.1	0.2
$SpO2_{post}$	99.2±0.8	98.8±0.6	1.4	0.1
RPP_{Pre}	84.2±9.6	77.4±11.03	1.8	0.08
RPP_d	97.8±15.4	92.2±13.6	1.0	0.3
RPP_{post}	86.2±11.3	81.6±10	1.1	0.2
RPE_{post}	3.6±2.1	4.6±1.8	1.3	0.18

The mean difference HR for group A and B, during exercise was statistically non significant with (p=0.15) and (p=0.54).

Figure 1: Comparison of HR between SPSU and OPSU

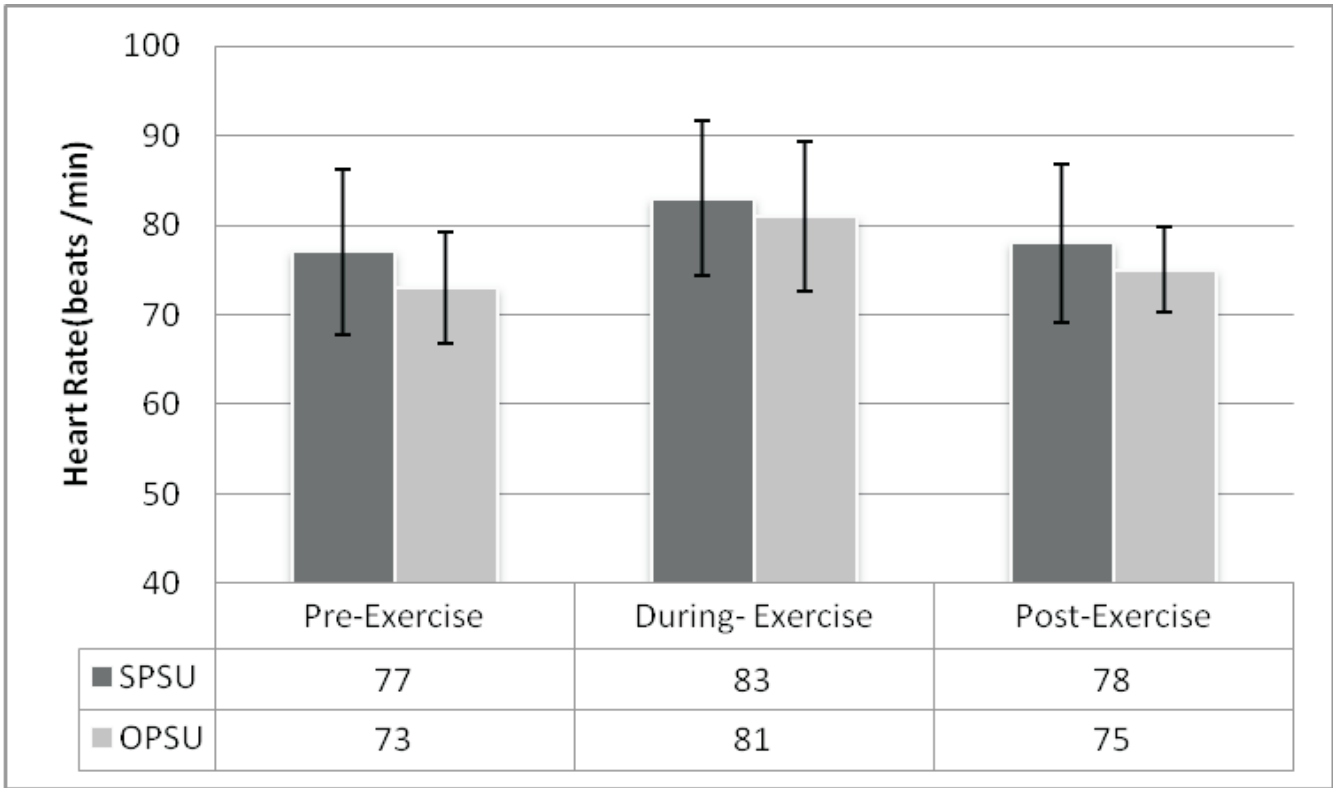


Figure 2: Comparison of SBP between SPSU and OPSU

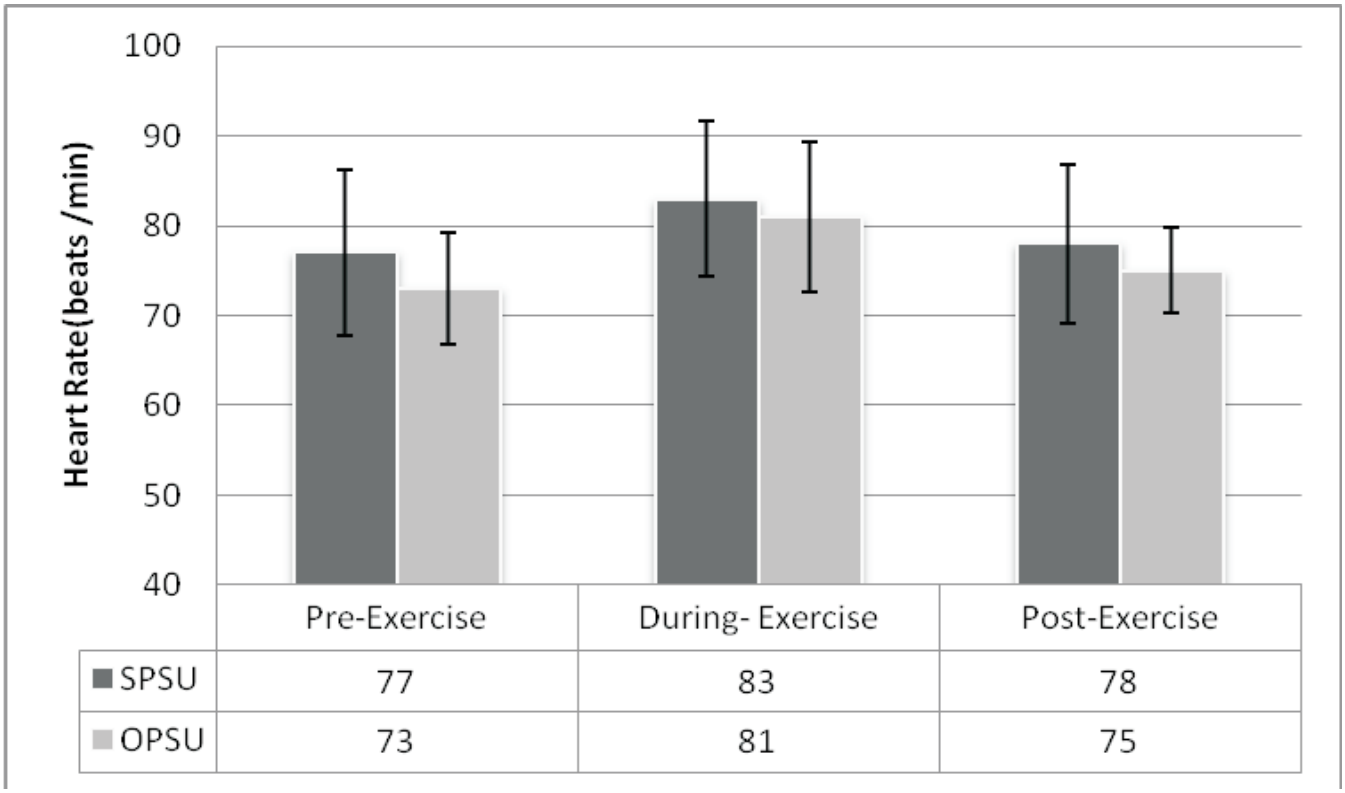


Figure 3: Comparison of DBP between SPSU and OPSU

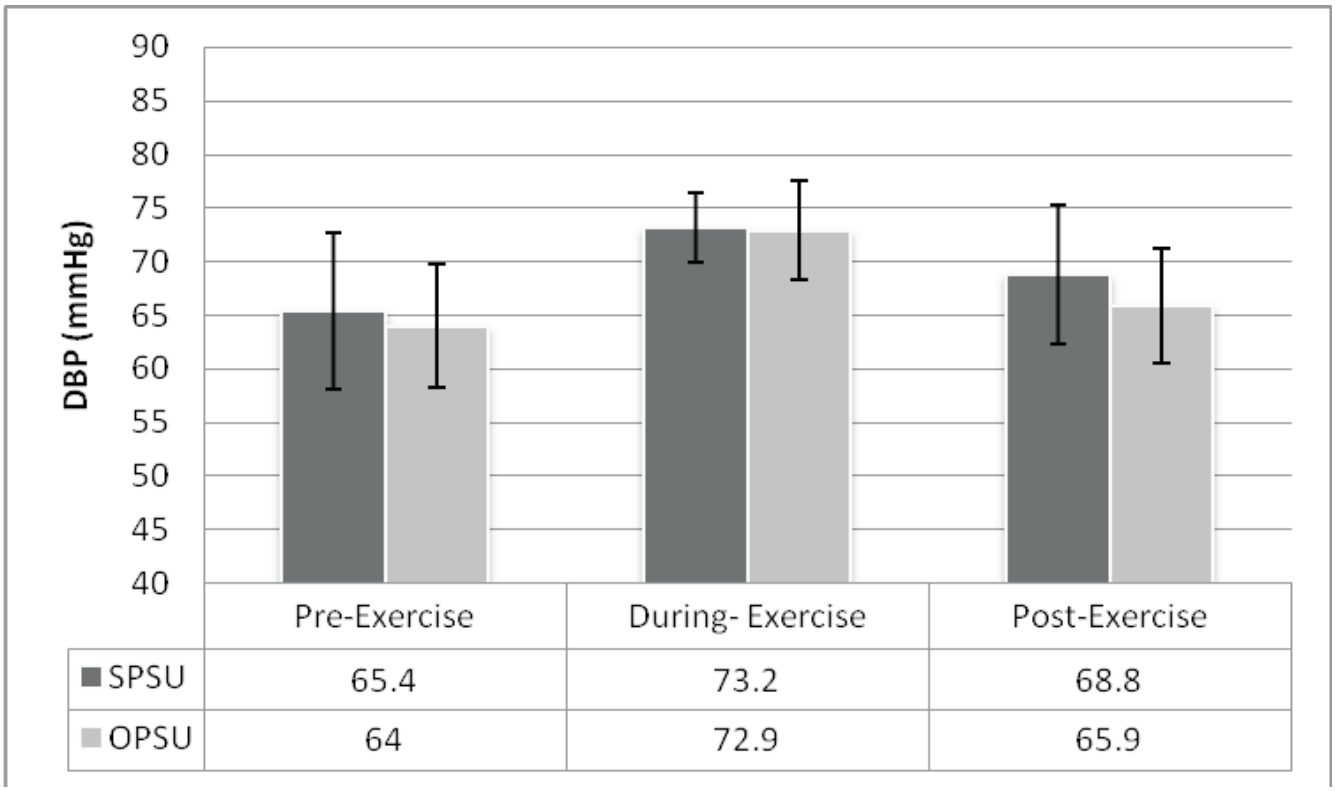


Figure 4: Comparison of SPO2 between SPSU and OPSU

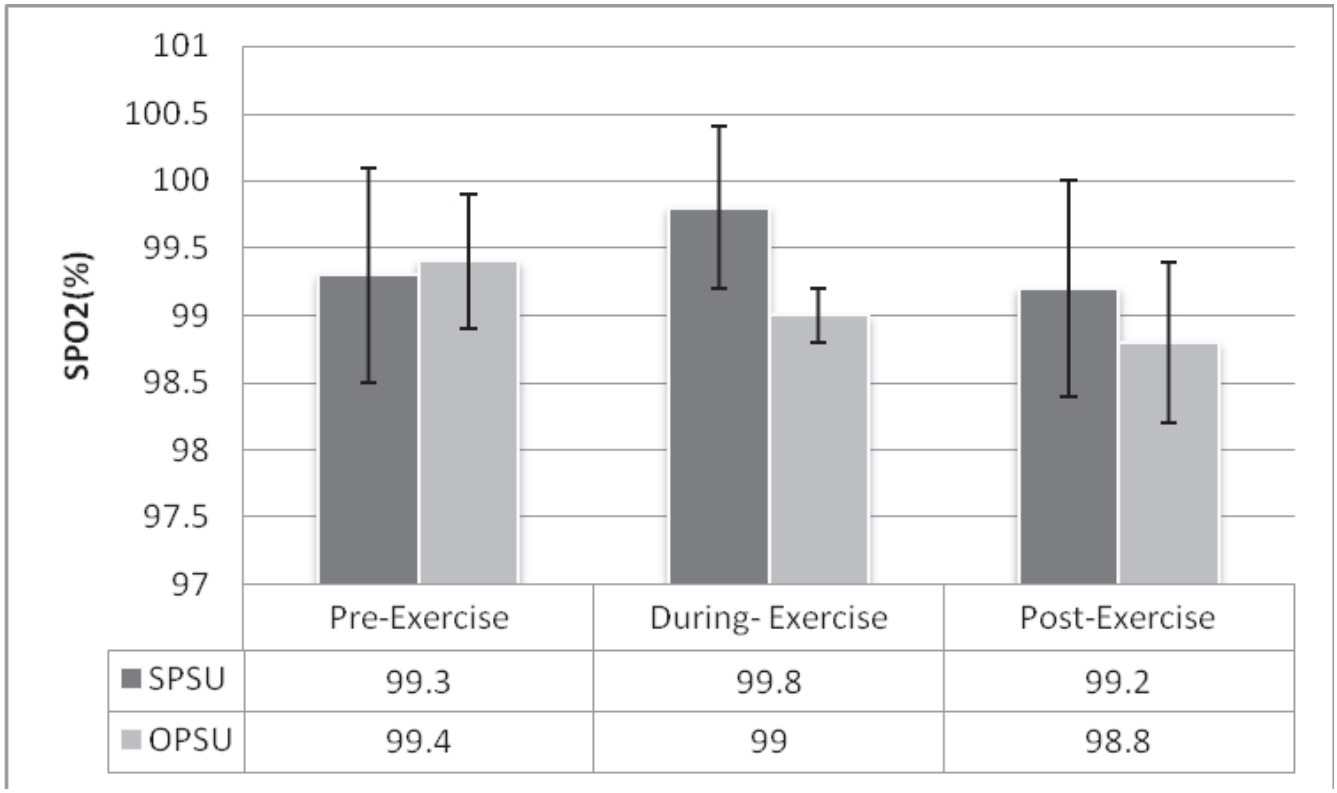


Figure 5: Comparison of RPP between SPSU and OPSU

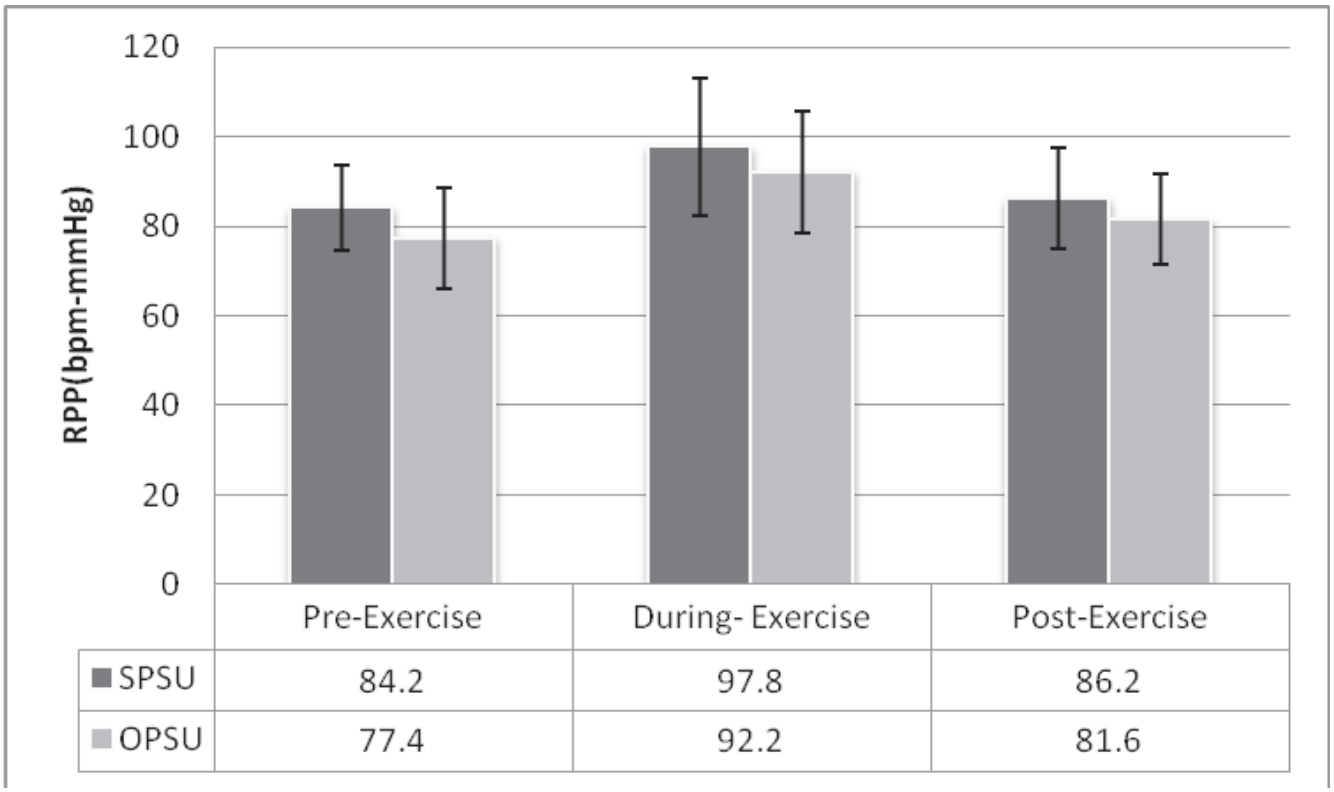
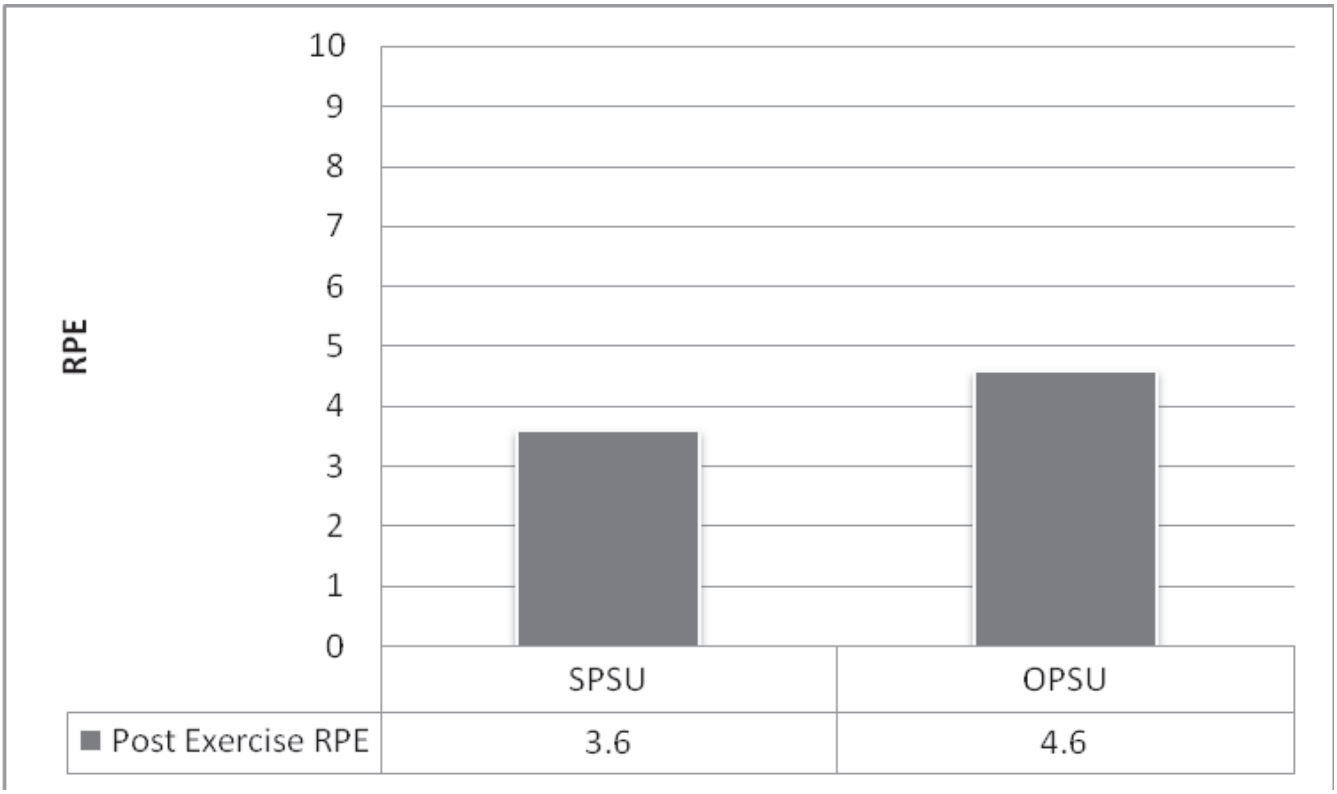


Figure 6: Comparison of post exercise RPE between SPSU and OPSU



Similar were the results for SBP and DBP, the mean difference of SBP and DBP for group A and B, during exercise, were statistically non significant with (p=0.1), (p=0.86) respectively.

The results SpO_2 were again insignificant with (p=0.06) . the mean difference of RPP for group A and B during exercise was statistically non significant with (p=0.3).

The RPE was also insignificant with (p=0.18) for post exercise in both the groups.

DISCUSSION

Abdominal exercises are prescribed for a variety of reasons but mainly for rehabilitation of low back injury and a component of fitness training programs of persons with cardiovascular diseases.[1,2]

Abdominal exercises are most appropriate for persons with back pain related to excessive lumbar lordosis and significantly increased sacrohorizontal angle and are best tolerated by persons with facet joint syndrome, spondylolisthesis, and vertebral or intervertebral foramen stenosis.[4] the study by Halpern and Bleck has shown that bent knee sit ups, in which subjects with their knee supported flex the trunk and hips simultaneously until the elbows are even with the knees , generate greater lumbar interdiscal pressure and compression largely because of increased lumbar flexion and muscle activity from the rectus femoris and psoas muscles than in SPSU and OPSU in which the rise from the bed is high enough only to clear the bilateral scapulae off the bed.[8] these findings suggest that the SPSU and OPSU may be safer exercises to perform and so based on their favourable biomechanical and electromyographic profiles were chosen for this study.[4]

To date, abdominal exercise research has focused primarily on the electromyographic research focused primarily on the electromyographic and biomechanical aspects of exercise. The hemodynamic effect of abdominal exercise as used in rehabilitation of low back injury and as a component of fitness training programs of persons with cardiovascular disease are largely unknown. It was believed in this study that obtaining these data would be of clinical importance , given the large blood pressure elevations previously reported during traditional weight training exercises. There has been only one published study that examined the hemodynamic parameters during OPS and SPSU and AbSculptor at a lower intensity in a within subject randomised crossover design and the authors reported that there were greater hemodynamic changes during OPSU as compared to other two.[4] as the hemodynamic variations at higher intensity were unknown and also ten repetitions of OPSU were compared to five repetitions of SPSU and AbSculptor in the previous study, this necessitated the need of this study and it was against this back ground, the current study was planned to compare HR,BP,RPP,SpO_2 and RPE while performing the SPSU and OPSU. This concern was validated by the finding of this study.

This investigation represents the first quantification of the acute hemodynamic changes that occur during OPSU and SPSU at a higher intensity comprising of thirty continuous repetitions in randomized parallel sample design, in males, to eliminate the carryover and gender difference effects. The results of the only study that monitored hemodynamic variables during SPSU and OPSU by Finoff et al (2003) formed the basis for comparison.

Hemodynamic monitoring during abdominal exercises at higher intensity had not been previously performed, therefore a homogenous, healthy group of subjects rather than a more heterogeneous clinical population were chosen . as the aim of the study was to compare hemodynamic variables of the two different abdominal exercises i.e. SPSU and OPSU, this kind of sampling and a randomized parallel design seemed appropriate. It also helped to get the subject's opinion on Borg's scale of RPE after they had performed the exercises.

It was found in this study there was no significant difference in increase of hemodynamic variables between the SPSU and OPSU in contrast to the findings of Finoff et al. The mean heart rate was 83±8.7 during SPSU and 81 + 8.3 during OPSU in this study. The difference heart rate between the two exercises was not statistically significant (with p=0.5). the difference in SBP and DBP between the two exercises was not statistically significant with (p=0.1) for SBP and

(p=0.8) for DBP between the two exercises. This means there was a similar increase in heart rate and blood pressure in both SPSU and OPSU. Similar were the findings of Finoff el al. For HR, SBP and DBP of SPSU and OPSU.

In this study, the mean RPP was found to be 97.8±15.4 during SPSU and 92.2±13.6 during OPSU. The difference between the two exercises were in significant with (p=0.3) in contrast to the finding of Finoff et al. in which the difference between RPP was significant with (p=0.05). this discrepancy may be explained in terms of the fact that Finoff et al. in his study compared five repetition of SPSU with ten repetitions of OPSU to alternating sides resulting in a total of ten continuous repetitions of OPSU. In comparison, this study compared same number of repetitions of SPSU to the same number of repetitions of OPSU. Another factor that may be responsible for this discrepancy was that each subject in the study by Finoff et al performed sis sets of exercises comprising five repetitions of SPSU, five recitations of AbSculptor and ten repetitions of OPSU, each set exercise being performed with and without breath holding. It was reported by the authors that some hemodynamic parameters did not reach the base line when subjects started a new set of exercises. This may have resulted in carryover effect to the next exercise and so the increase in hemodynamic parameters during that particular exercise could not be attributed to that particular exercise. In comparison, in this study, subjects were instructed to perform only one set of exercise of 30 repetitions at a time and the increase in hemodynamic variables was only because of that particular exercise beyond no doubt. It was because of this reason that subjects in this study showed lesser increase in all variables as compared to the previous study although subjects performed more repetitions. At the same time, valsalva manoeuvre was avoided by instructing patient to exhale during the concentric phase and inhale during eccentric phase of contraction of exercise.

The similar increase in hemodymic parameters in both SPSU and OPSU may be explained by the electromyographic findings of Rafael F et al (2006) and Cresswell et al (1994).[4,9] according to them transversus abdominis and internal oblique muscle is mainly responsible for increasing intra-abdominal pressure and both these muscles exhibited similar activation pattern and amplitude in both SPSU and OPSU. In their study on electromyographic analysis of abdominal exercises, Rafael F et al found that the EMG activity of internal oblique and transverses abdominis, in SPSU and OPSU, was similar.[4] According to Cresswell et al the common use of straight partial sit-ups as the training stimulus to increase IAP is questionable, as this form of abdominal exercise is known to predominantly activate and train the rectus abdominis muscle whose fibers primarily generate trunk flexor torque.[9] studies using intramuscular electromyographic recordings have substantiated this rationale.[10] it was found by Cresswell et al that the main muscles responsible for increasing IAP (i.e trasversus abdominis and internal oblique muscle) were active while performing loaded rotations in both sitting and standing position[10,11] the exercises, examined in this study, activate trasversus abdominis and internal oblique muscles by small and similar amplitude as per the study by Rafael et al, leading to a similar rise in hemodynamic variables in both the exercises, thus proving the null hypothesis

CONCLUSION

The results suggest that there was no significant difference in rise in hemodynamic variables during the two exercises. However there was a significant difference between pre exercise and during exercise magnitude of hemodynamic variables of each exercise. This suggests that acute hemodynamic changes of these two abdominal exercises are clinically relevant, however both oblique partial sit-ups and straight partial sit-ups warrant same amount of concern.

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Effect of Routine Physiotherapy Vs early mobilization in preventing postoperative pulmonary complications in subjects with specific risk factors: A randomized controlled Study

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ABSTRACT

This study compared the efficacy of Early Mobilization with routine Physiotherapy Technique (DBE + Splinted Cough) in 18 patients who had undergone upper abdominal surgery. Subjects were randomly allocated into two groups, following which one group received early mobilization and the other group received deep breathing exercises and splinted coughing. SpO_2 was documented every day from the 1st to 3rd postoperative day of surgery. Forced Expiratory values (FVC, FEV_1, and PEFR), Maximum Inspiratory Pressure and 2 minute walk test were measured on the 4th post operative day. All the parameters between two groups were compared and the results show similar values between two groups except PEFR which shows better results in Group 1. This study showed that early mobilization is as effective as routine physiotherapy in subject who underwent upper abdominal surgery and had a high risk of developing lung complications.

Key words: Early Mobilisation, Chest Physiotherapy, Pulmonary Complications, Upper Abdominal Surgery, General Anesthesia.

INTRODUCTION

Post operative pulmonary complications is defined as any pulmonary abnormality occurring in the post operative period that produces identifiable disease or dysfunction that is clinically significant and adversely affects the clinical course [1]. The incidence of postoperative pulmonary complications after surgery is very well documented in literature [2, 3, 4]. In upper abdominal surgery the incidence of these complications is seen to be as high as 5% to 30% [5]. The causes for the occurrence of post operative pulmonary complications is attributed to various procedures incorporated during or after surgery as well as the medical status of the patient preoperatively and the presence of risk factors [6].

Post upper abdomen surgery, patients develop a restricted pattern of breathing with a decrease in vital capacity (VC) and functional residual capacity (FRC) [6, 7]. This decrease in lung volumes and capacities is associated with hypoxemia, broncho-pulmonary infection, pneumonia, airway obstruction and Hypercapnia and eventually progresses to postoperative respiratory failure [8].Subjects with various predisposing factors like old age, history of respiratory disorders, and smoking are more prone to develop postoperative complications.

Chest physiotherapy is frequently used in the prevention and treatment of postoperative pulmonary complications after major abdominal

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surgery [1]. It includes preoperative assessment and instructions, breathing exercises emphasizing inspiration, incentive spirometry, techniques to clear bronchial secretions and early mobilization is given with an aim of increasing lung ventilation, preventing chest infections and rehabilitation of the individual to the activities of daily living [4, 9].

The rationale for the use of all these techniques is to promote the normal respiratory pattern and thus improve the distribution of ventilation. These techniques aid in clearing excessive or retained pulmonary secretions from the conducting airways and preventing or reversing areas of atelectasis thereby decreasing the incidence of lung infections.

Number of studies with varying quality are published in this regard and the results of these studies contradicts each other [1, 2, 10,]. Early mobilization is also an important treatment component of the postoperative care following upper abdominal surgery [10]. Low intensities of mobilization are seen to have a direct and profound effect on oxygen transport in patients with acute cardiopulmonary dysfunction [11]. Patients in upright sitting have demonstrated a small but significant increase in PaO_2 as compared to supine lying and sitting with the bed head raised 45^0 [12]. There is no standard definition for early mobilization and has been reported to include: moving in bed, sitting out of bed, standing, and ambulation on the spot, hallway ambulation, low intensity exercises[13]. Any upright positioning and mobilization of bed ridden patient has shown to have a positive effect on respiratory ventilation thus increasing the patients' oxygen saturation [14]

Hence this study has been conducted in subjects who have undergone upper abdominal surgery with predisposing factors for postoperative pulmonary complications, to find an answer to whether early mobilization is as effective as or better than routine physiotherapy in the prevention of postoperative pulmonary complications.

MATERIAL & METHODS

Sample of 19 subjects between 40 – 60 years who have undergone upper abdominal surgery between 24/06/2009 to 10/10/2009 at Father Muller Medical College Hospital aged 40-60 years with the history of smoking more than 20yrs, both males & females, diagnosed COPD or bronchial asthma and subjects who were haemodynamically stable were included in this study. Non smokers, subjects with respiratory insufficiency requiring artificial airway, systemic disorders, uncooperative and subjects with any musculoskeletal or neuromuscular disorders which can affect test procedure were excluded from the study. Informed consent was obtained from all the subjects. The study was approved by the institution ethical committee.

PROCEDURE

Those subjects were fulfilling the criteria were randomly assigned to both the groups, Group A (Early mobilization) n=10 and Group B (Routine Physiotherapy = Breathing exercises and splinted coughing) n=9 by using the A Randomization Plan [15]. Past medical history, smoking history and other demographic data were noted from the surgeon and anesthetists chart. Post operatively, on the day of the surgery vitals and oxygen saturation (SpO_2 in %) of the subjects were monitored by using Pulse Oximeter and the subjects were made to perform the particular maneuver depending on the group they belonged to, that is either Breathing exercises and splinted coughing or early mobilization under the supervision of physiotherapist thrice a day. They were also instructed to perform free ankle toe movement ten times every awake hour apart from the physiotherapy session on the day of the surgery

On the first post operative day Group 1 (Fig 1 & 2) patients received only early mobilization no other regular physiotherapy management. Treatment was given thrice a day. The average duration of the physiotherapy session was 20 minutes. Early mobilization gradually commenced in the following sequence -

- sit on the bed - sit out of the bed - walk 5 meter with assistance - walk 15 meter with assistance - walk 30 meter with assistance - walk 30 meter without assistance

Progression was made according to the vitals and subjects Rate of Perceived Exertion.

Group 2 received deep breathing exercises and splinted coughing. They were mobilized only by 3rd postoperative day. These deep breathing exercises consist of diaphragmatic breathing (deep breathing followed by splinted cough, huff, or forced expiratory maneuver). Instructions and supervision from the physiotherapist focused on bilateral basal expansion, avoiding upper chest

Table 1: Comparison of Temperature and auscultatory findings on 1st, 2nd, 3rd POD and CXR on 4th POD between the groups

	TEMPERATURE			AUSCULTATION			CXR
	1 st POD	2 nd POD	3 rd POD	1 st POD	2 nd POD	3 rd POD	4th POD
Early Mobilization	98.6	98.6	98.6	N	N	N	N
Routine Physiotherapy	98.6	98.6	98.6	N	N	N	N

Figure 1: Sitting Side of the Bed

Figure 2: Early mobilization with drainage tube in situ

Figure: 3 Spiro meter – (for PFT) [Micro Loop Spida 5 Spiro meter]

and shoulder elevation, and maximizing expansion of the lower chest diameters during inspiration, with a three second Inspiratory hold, followed by relaxed expiration. This was done with the subject in sitting with the physiotherapist providing bilateral proprioceptive feedback with the hands on the lower ribs. This cycle was repeated at least twice during each treatment.

They were also instructed to perform free ankle toe movement ten times every awake hour apart from the physiotherapy session on the day of the surgery.

OUTCOME MEASURES

At the end of the fourth post operative day, vitals, oxygen saturation (SpO2) and pulmonary function test were performed in both the groups. Pulmonary function test was performed in the upright sitting position by using Spida 5 (Figure 3). For forced expiration tests, as per previous instruction normal breaths followed by one deep breath and forced expiration with maximal forced followed by a normal intake of breath. All instructions were given by the same researcher throughout procedure in the language best understood by the subject. Once the subject was familiar with the maneuver, the readings were recorded. They were made to perform three trails with adequate rest. The trails were repeated if the variation was more than 10%. The Maximal Inspiratory Mouth pressure was measured by using a simple Mano Meter. (Figure 4)

Two minute walk test was performed in the hospital corridor which was of 35 meter in length. The subjects were instructed to walk as fast as possible and to cover as much as possible in two minutes. A constant encouragement was given by the researcher. They were instructed to stop the test if they felt dyspnea, fatigue, pain and any other abnormal symptoms. A stop watch was used to monitor the time. The total distance walked in two minute was recorded. Apart from this body temperature, auscultatory findings and chest 'X' ray findings were noted and documented.

Though the outcome measures were taken preoperatively in most of the patients, only the

Figure 4: MIP Instrument

postoperative measures were considered for statistical analysis.

DATA ANALYSIS

Repeated measures of variance was (ANOVA) used to analyze within the group difference. Mann- Whitney Test was used to compare the outcome between the groups followed by post surgical analysis. The software used for statistical analysis was SPSS 13.

RESULTS

18 subjects completed the study out of which 4 were females and 14 males.

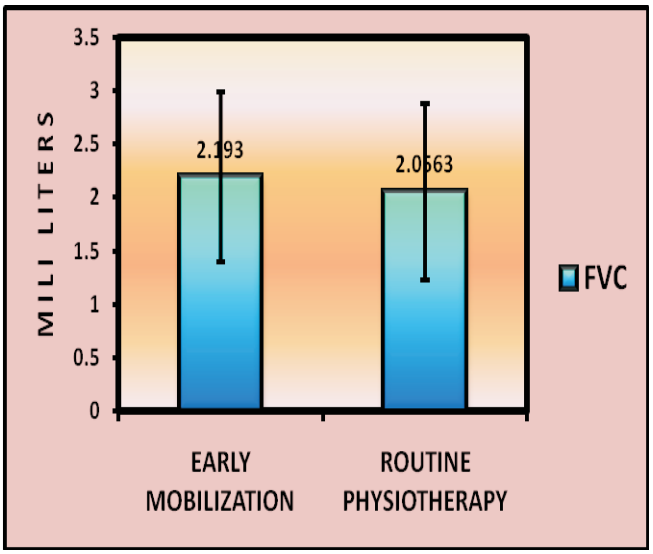
In Group 1 (Early Mobilization), 10 subjects with a mean age of 50.30(SD 7.718) and Group 2 (Routine Physiotherapy), 8 subjects with a mean age of 50.25(SD 5.80) were completed the study. In Group 1 there were 2 females and 8 males. In Group 2, there were 2 females and 6 males. Figure 5

The mean FVC value on 4th post operative day in Early Mobilization and Routine Physiotherapy was 2.193(SD +.79862) and 2.0563(SD + .82904) respectively. It was statistically not significant (p = 0.534). Figure 6

The mean FEV_1 value on 4th post operative day in Early Mobilization and Routine Physiotherapy was 2.07(SD +.78) and 1.75 (SD + .76) respectively. Difference of FEV_1 values in between two groups on 4th post operative day was statistically not significant (p = 0.141).

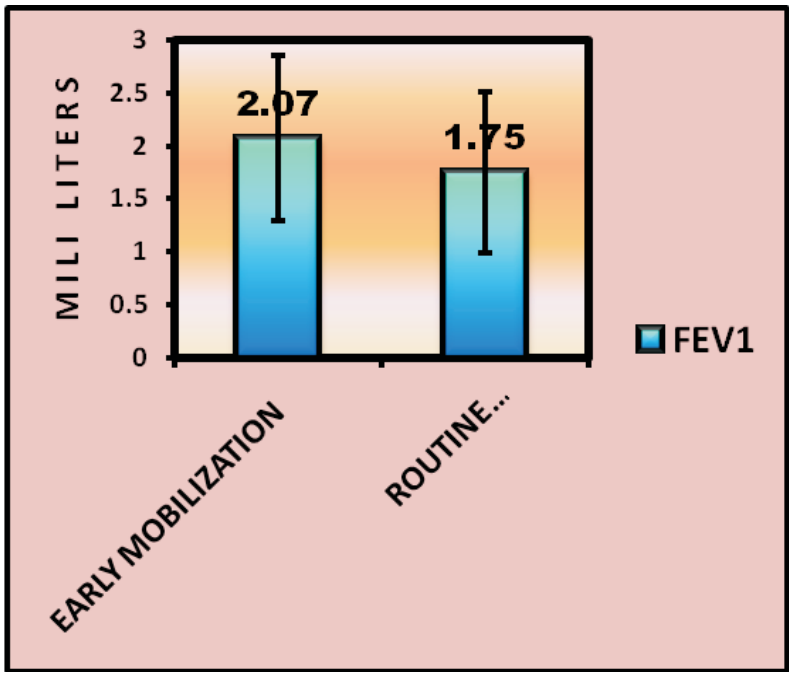
The mean PEFR value on 4th post operative day in Early Mobilization Group and Routine Physiotherapy Group was 240.40(SD + 93.646)

Figure 5: Comparison of Force Vital Capacity (FVC) between the groups



and 193.75(SD + 102.45) respectively. The P value was 0.046. Difference of mean PEFR values between two groups was statistically significant and in Early Mobilization Group Subjects PEFR

Figure 6: Comparison of Force Expiratory Volume in 1 st second (FEV_1) between the groups

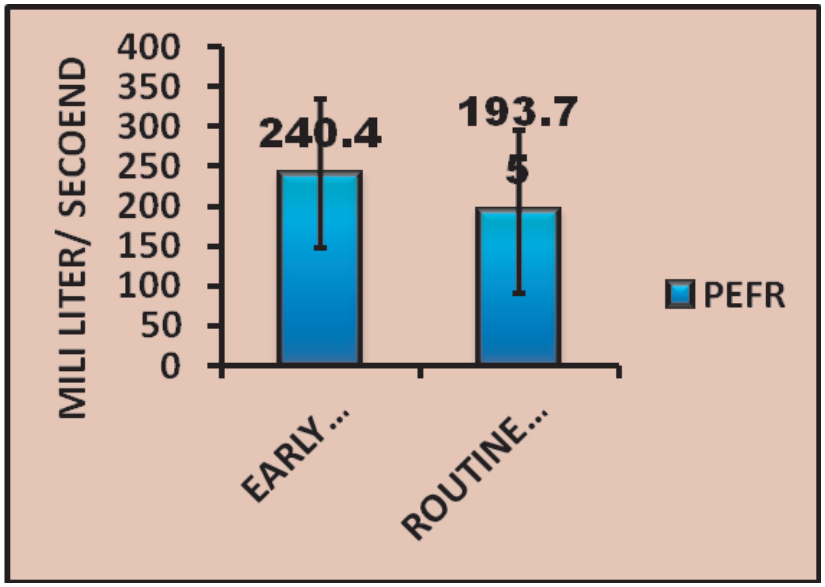


values is more than Routine Physiotherapy subjects. Figure 7

The mean MIP value on 4th post operative day in Early Mobilization and Routine Physiotherapy was 76.00(SD + 18.306) and 20.612 (SD + 20.612) respectively. The P value was 0.893. The difference of MIP values between two groups was not significant. Figure 8

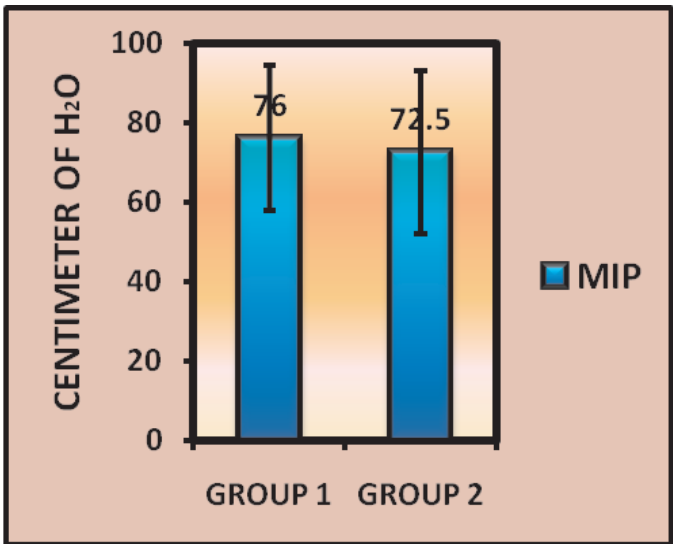
The mean 2 MIN WALK TEST value on 4th post operative day in Group 1(Early Mobilization) and Group 2 (Routine Physiotherapy) was 140.00(SD + 24.944) and 134.38 (SD + 20.255) respectively. The difference of 2 min walk distance values between two groups was not significant. Figure 9

Figure 7: Comparison of PEFR between the Groups



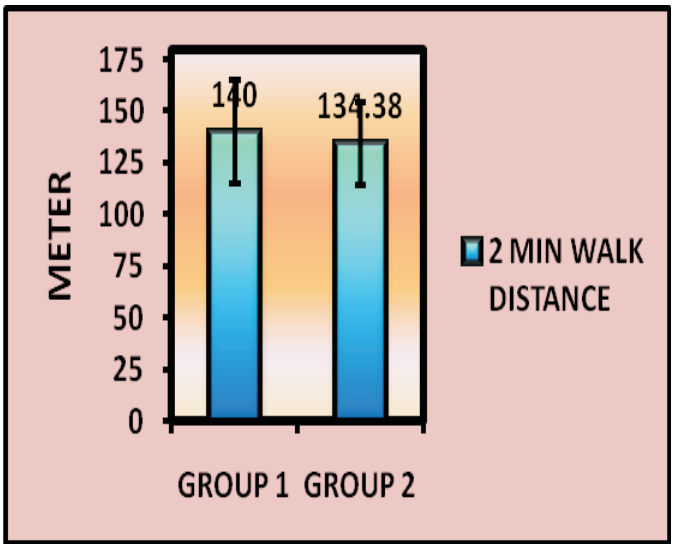
The mean SPO_2 value on 1th post operative day in Early Physiotherpy Group and Routine Physiotherapy Group was 99.90 (SD + .316) and 98.88 (SD + 1.642) respectively.

Figure 8: Comparision of Maximum Inspiretory Pressure (MIP) between the groups



Clinically Early Mobilization Group patients had better SpO_2 in compare to Routine Physiotherapy Group on 1st POD. Early Mobilization Group patients had better SpO_2 in compare to Routine Physiotherapy Group on 2nd POD. The mean SPO_2 value on 3th post operative day in Early Mobilization Group and Routine

Figure 9: Comparision of 2 Min Walk Distance between the groups



Physiotherapy Group was 100.00(SD + 0.000) and 99.63(SD + 0.744) respectively. On the 1 st POD, 2 nd POD and 3 rd POD the difference of SpO_2 between two groups are statistically not significant. Figure 10

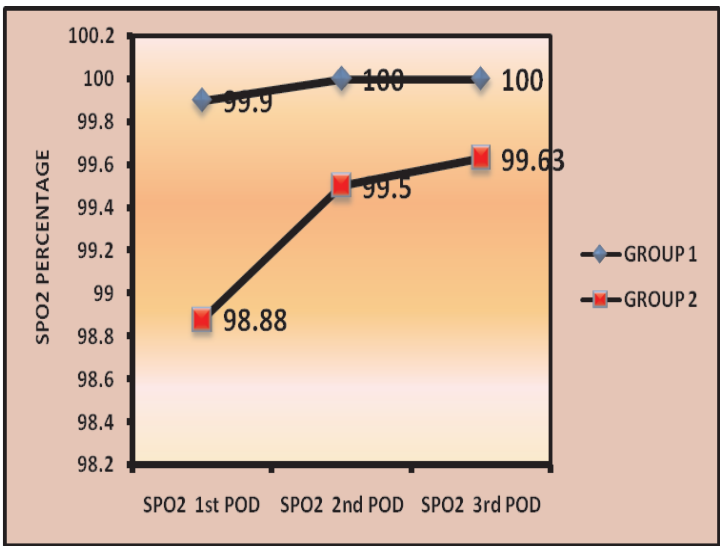
N = NORMAL

TEMPERATURE ON FAHRENHEIT

DISCUSSION

The role of physiotherapy in prevention and correcting postoperative pulmonary complications are yet to be established. In this context, this study aimed to compare the routine physiotherapy with early mobilization to prevent pulmonary complications. To identify the efficacy of two

Figure 10: Comparison of MEAN SpO_2 with in 1st , 2nd and 3rd POD between the groups



different techniques, subjects with history of smoking more than 20 years or diagnosed with COPD or asthma were included in this study with the fact that these subjects have an overall increased rate of postsurgical complications of about 26- 78 % In order to assess the occurrence of pulmonary complications, pulmonary function test was used in this study along with oxygen saturation as suggested measures. Similar outcome measures have been used in previous studies [4, 5].

Though it is proved that there will be significant reduction on Forced Vital Capacity in postoperative patients, in this study these measures were used to quantify the respiratory impairment. Apart from these parameters, the temperature was noted from the nursing chart and auscultatory findings as per the researcher.

The Preoperative measurements were not considered for analysis since most of the subjects that were included underwent emergency laprotomy procedure. The randomization procedure used in this study was from www.randomization.com (No-10181) [15]

There was no significant difference in the parameters such as FVC, FEV_1, and MIP between the groups except PEFR. The early mobilization group had statistically better PEFR when compared to routine physiotherapy group which was contributed to the effect of gravity. The clinical improvement in the SpO_2 of the early mobilization group was also attributed to the

effect of gravity which was explained by Dean [13]. Both groups with respect to temperature and chest x-rays did not show any significant difference with regard to pulmonary complications. To measure the functional capacity, monitor the treatment effectiveness, and to establish prognosis in upper abdominal surgery a 2 min walk test is used. In this study on the 4th post operative day at the end of the treatment session 2 min walk test was done and it was found that the comparison of distance parameter between two groups in not significant statistically. This study was mainly done to demonstrate the efficacy of early mobilization and routine physiotherapy and comparison between two techniques in the management of patients who have undergone upper abdominal surgery.

Though there was no statistically significant difference in most of the parameters used in this study, the early mobilization group had higher values when compared to routine physiotherapy group. This shows that early mobilization has a positive effect in preventing pulmonary complications.

All the outcome measurements in this study were taken postoperatively because maximum subjects had under gone emergency upper abdominal surgery so it was not possible to take preoperative outcome measures. This study included subjects with more than 20 years of smoking history along with COPD and Asthma subjects, with most of the male subjects. This might have affected the outcome, in either way.

CLINICAL IMPLICATIONS

Early mobilization is also as effective as routine physiotherapy to prevent pulmonary complications on upper abdominal surgery. This technique is easy for the patients to understand and can be stated by other healthcare professionals also.

CONCLUSION

Early Mobilization statistically has all most equal effects but clinically has better effects when compared to routine physiotherapy (DBE+ Splinted Coughing) for preventing post operative pulmonary complication. More studies with large number of patients should be conducted to find out the efficacy of Early Mobilization in preventing post operative pulmonary complications.

List of abbreviations

BP: Blood Pressure, **COPD**: Chronic Obstructive Pulmonary Diseases, **HR**: Heart Rate, SPO2**:** Oxygen saturation in percentage, **PaO_2**: Partial Pressure of Oxygen, **PFT**: Pulmonary Function Test, **POD**: Post Operative Day, PPC: Postoperative Pulmonary Complication., **RR**: Respiratory Rate, **PEFR:** Peak Expiratory Flow Rate, **FVC:** Forced Vital Capacity, **FEV1:** Forced Expiratory Volume in one second, **MIP:** Maximal Inspiratory capacity

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Scarf ratio in the evaluation of muscle tone in preterm infants intrarater and interrater reliability

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Sanjay Eapen Samuel**

ABSTRACT

Background and objectives: Early identification of postures and movements possibly associated with a poorer quality of developmental outcome is very desirable. Assessment of gestational age of the infant help to identify the developmental status of the infant . One of the widely used tools in gestational age assessment is the scarf sign . Recently, a new method of measuring scarf sign called scarf ratio was described. This scale being relatively new , the available literature reflects a need for estimating intrarater and interrater reliability of scarf ratio., **Subjects and measurments** : Thirty two preterm infants recruited from neonatal ICU at district maternity hospital who met the inclusion & exclusion criteria were examined to estimate interrater and intrarater reliability of scarf ratio . Intrarater reliability for scarf ratio was estimated with a second assessment following a brief interval. Simultaneously, interrater reliability of scarf ratio was estimated with second therapist, **Conclusions :** Scarf ratio can be used as an efficient individual tool to estimate gestational age in preterm infants. It is also a reliable measure when conducted by two different clinicians who are well versed with the method.

Key words: Preterm infants, Gestational age assessment, scarf sign , scarf ratio.

INTRODUCTION

'Prematurity', as defined by the World Health Organization is a baby born before 37 weeks of gestation counting from the first day of the last menstrual period. In the past four decades specialized neonatal intensive care units and technological advances have contributed to a dramatic decline in neonatal mortality , particularly among low birth weight (< 2,500grams) infants. The combined effect of immature physiological systems, poor muscle tone and lack of resistance against gravity lead to development of abnormal postures in preterm neonates.[1,2] The assessment procedures which demands least handling and are quick to administer helps in the early diagnoses of abnormal postures associated with poor development outcome in the later life.

One means of identifying the neonate who may develop problems early in life is the "gestational age assessment". It is determination of the approximate duration of fetal development and a comparison against standardized norms of neonatal growth versus weeks of gestation, to identify those infants unusually large or small for gestational age. There are several approaches to measure gestational age like one of them being to obtain a careful menstrual history as according to the Naegele's rule where the date of onset of the last menstrual period determines the estimated date of confinement. According to Korones, recall of the date of onset of the last menstrual period is accurate in 75% to 85% of women .Also miscalculation is possible, for reasons other than an inadequate history (e.g. irregular menses, post conceptual bleeding). Although according to

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Lippink , electroencephalogram patterns and motor nerve conduction times correlate well with gestational age, to date there seems to be no rationale for using them as routine screening tools. Gestational age can also be ascertained by ultrasound examination within a range of ± 1 week in early pregnancy (six to eight weeks) , decreasing in certainty to ± 3 weeks from 29 weeks to term as according to Petrucha .

Saint Anne Dargassies described that changes occur during the second half of gestation in the quality of passive and active tone, up to term there is an ascending wave of increased flexor tone in the limbs and of extensor postural reactions in the body axis (spine and lower limbs). Based on her work with Andre-Thomas, Saint-Anne Dargassies developed sequential, stage oriented neurological examination techniques for assessing neuromaturation of premature infants between 28 and 41 weeks of gestation . It was also suggested by Amiel-Tison that observation of the presence of primitive reflexes may also be used to assess gestational age in combination with measure of active and passive muscle tone .[3] According to him the passive tone was assessed by six items i.e. posture , heel to ear maneuver , popliteal angle, dorsi flexion , scarf sign , return to flexion of forearms.

Later Dubowitz LM ; Dubowitz V and Goldberg C developed a "clinical assessment of gestational age", which has 10 neurologic signs and 11 external signs.[4] The totals are added to give a composite score , which is correlated with weeks of gestation. He included the same components to assess the passive tone, as Amiel -Tison, but few new items were also added from the work of Dubowitz [5] Dargassies,[6] Prechtl [7], Parmelee and Michaelis [8] and Brazelton [9]. Dubowitz and associates found a positive correlation between the neurologic portion of the gestational examination when done at 40 weeks gestational age and the neurologic status of the child at the end of the first year of life. As the Dubowitz examination appear to over estimates gestational age by about two weeks for low birth weight infants, later Ballard , Novak and Driver, developed the "newborn maturity rating", a simplified version of the Dubowitz tool. This version was later modified by Ballard in 1988 to assess neonates from 20 weeks to 40 weeks.

The Ballard examination is currently the most commonly used gestational age assessment tool. [10, 11] The passive tone assessment components included scarf sign . "Scarf sign" is widely used to identify shoulder posture in neonatal assessments [3] .A new method of measuring the scarf sign ; called the " Scarf ratio " has been described recently , in which data derived were reported on a continuous scale [12]. Scarf ratio being a relatively new scale, its efficacy in estimating gestational age needs to be studied further . The available literature reflects the need to estimate the interrater and intrarater reliability of scarf ratio .

METHODOLOGY

Thirty two preterm infants were recruited from neonatal intensive care unit at a 260 bed district maternity hospital. The Infants with gestational age of less than 37 weeks post conceptional age, who were free of any congenital and genetic disorders were included in the study whereas those infants who under went surgical procedures or had complications as hydrocephalus, periventricular hemorrhage grade III and above , ventricular dilatation ,retinopathy of prematurity stage III were excluded . A total of 45 infants were examined during the study out of which 13 preterm infants were excluded. Five of the preterm infants had the intravenous line attached to the right forearm. Since, in the study done by Raweewan Lekskulchai and Joan Cole, only right arm was examined to calculate the scarf ratio, the same was done in the present study to maintain consistency.[12] Three preterm infants were excluded as they required surgical intervention and were constantly monitored in the intensive care unit. Two of the preterm were extremely low birth weight infants (ElBW = < 1,500grams) and so were not included in the study sample.

Preterm infants usually have low birth weight as compared to full term born infants. In order to keep uniformity, all the preterm infants included in the study have their birth weights in between the range of 1.5 kg to 2 kg, One of the infant developed hydrocephalous and two of the preterm infants were excluded due to poor

compliance of the infant's parents. Thirty two preterm infants made up the study population

Preterm infants are examined after the informed consent of their parent , to estimate the gestational age using component of passive muscle tone assessment that is scarf ratio [12] . The assessment was performed midway between the feeds to avoid any possible complications. Infants suffering from fever were tested later. Infants on the mechanical ventilator or respirator were also examined once they were free of it . Infants with an intravenous line attached to the right arm also have their measurements delayed until the line is removed. Prior to the assessment, the infant's records were checked for Apgar scores and neuromotor behaviour assessment to rule out those who have serious complications which are likely to affect the further development. Infants with similar scores were included in the study.

To provide the same surface texture for the assessment at each occasion of measurement, a thin wooden board covered by a diaper is used to support the infants in supine . As the head position can alter muscle tone ; eliciting a symmetrical tonic neck reflex , a midline adjustable pillow is used to support the infant's head in the middle so that head turning during the examination is prevented . In addition to the positioning devices, a tape measure with one millimeter increments is required for the measurement of scarf ratio.

Intrarater reliability for the scarf ratio is estimated with a second assessment done after a gap of half an hour by the first rater. Simultaneously, interrater reliability of scarf ratio is estimated with the second rater of similar educational qualification after a gap of five minutes following initial reading by the first rater. Both the raters are blind to the result of one another and are well familiarized with the method to be followed for consistency.

To obtain the right scarf ratio , the method of assessment of the scarf sign as described by Amiel-Tison 1968 is first followed , that is ,the right arm is moved across the trunk until a resistance is **met (fig 1).**[4] At the end of this manoeuver , the

Fig 1: Measurement of scarf sign

distance between the tip of the olecranon process of the right arm and a line specifically identified for this test known as the left acromial line, is measured. The left acromial line is an imaginary construct which consists of a line beginning from the tip of left acromion process and running parallel down the side of the trunk. To determine scarf ratio, the distance between the olecranon process and the infant's left acromial line is compared with biacromial width, that is distance between the tips of infant's right and left acromion process [11].

RESULTS

A total of 32 preterm infants constituted the study population and were examined to estimate gestational age using scarf ratio. The data obtained

Table 1: distribution of scarf ratio at various post conceptional,Ages (pca) ranges in weeks

< 32 weeks	N	6	6	6
	Mean	0.185	0.183	0.185
	Std. Deviation	0.005	0.003	0.006
	Minimum	0.171	0.181	0.171
	Maximum	0.191	0.188	0.191
32 wk – 36 wk	N	14	14	14
	Mean	0.546	0.545	0.546
	Std. deviation	0.026	0.024	0.025
	Minimum	0.490	0.490	0.490
	Maximum	0.580	0.580	0.580
37 wk-39 wk	N	10	10	10
	Mean	0.570	0.570	0.571
	Std. Deviation	0.005	0.008	0.008
	Minimum	0.561	0.560	0.561
	Maximum	0.578	0.585	0.585
>40 weeks	N	2	2	2
	Mean	0.673	0.673	0.671
	Std. Deviation	0.004	0.004	0.002
	Minimum	0.670	0.670	0.670
	Maximum	0.676	0.676	0.673

was classified into four categories that is according to their post conceptional ages. The number of preterm infants varied in each group (table 1). The mean value of scarf ratio was obtained for the first and the second rater both for the first and the second reading respectively for each of the groups .At the same time the minimum and the maximum value of scarf ratio out of the total set of readings was also recorded. The readings of scarf ratio obtained by the first rater (SR1)was compared with the second reading by the first rater after an interv al of thirty minutes (SR 2) to estimate the intrarater reliability of scarf ratio. Wilcoxon's signed rank sum test was used to calculate the reliability in each of the groups. In the group of preterm infants less than 32 weeks , the z value of 1.000 and p = 0.317 was obtained . In the next group of preterm between 32 to 36 week the values obtained were z = 0.944, p= 0.345. Preterm infants between the post

conceptional age of 37 to 39 week had z and p values as 0.000 and 1 respectively. In the last group of infants of more than 40 week PCA, the reliability couldn't be estimated as only two preterm infants constituted the group. The p value obtained for all the three group of preterm infants shows that the difference between the

PCA Range (weeks)	Scarf Ratio Ist Rater (SR1)	Scarf Ratio Ist Rater (After 30 min) (SR2)	Scarf Ratio IInd Rater (SR3)

Table 2: Intrarater Reliability

PCA (Weeks)	Paired		Z	p
	Difference SR1 – SR2 (mean)	Std. Deviation		
< 32 wks	0.003	0.005	1.000	0.317 ns
32 wk- 36wk	0.002	0.005	0.944	0.345 ns
37 wks-39wks	0.000	0.005	0.000	1 ns

readings of the first rater and second reading by the first rater after 30 minutes is not significant which indicate a high intrarater reliability. (Table 2) (fig 2)

Scarf ratio values estimated by the first rater (SR1) and the second rater (SR3) were compared to determine the interrater reliability using Mann-Whitney U test { Z }. In the group of pretern infants <32 wk ; the z value of 0.147000 and p value of 0.883 was obtained . In the next group which included infants between PCA 32 wk to 36 wk the z value of 0 and p value of 1 was noted. Subsequently in the group of preterm between the PCA of 37 wk to 39 wk, the z and p values were 0.114000 and p = 0.909 respectively. And the last group of preterm infants of more than 40 wks PCA had a z value of 0.408000 and p value of 0.683. The p values obtained for all the four groups

Table 3: Interrater Reliability

PCA (weeks)	Scarf Ratio By Raters	N	Mean	Std. Deviation	Z
< 32 wks	SR1 SR3	6 6	0.185 0.185	0.005 0.006	0.147000 p =0.883 ns
32wk-36wk	SR1 SR3	14 14	0.546 0.546	0.026 0.025	0 p=1 ns
37wk-39wk	SR1 SR3	10 10	0.570 0.571	0.005 0.008	0.114000 p =0.909 ns
>40 wks	SR1 SR3	2 2	0.673 0.671	0.004 0.002	0.408000 p =0.683 ns

Fig. 2: Intrarater Reliability

Intrarater Reliabilitry of Scarf ratio is pound to be High

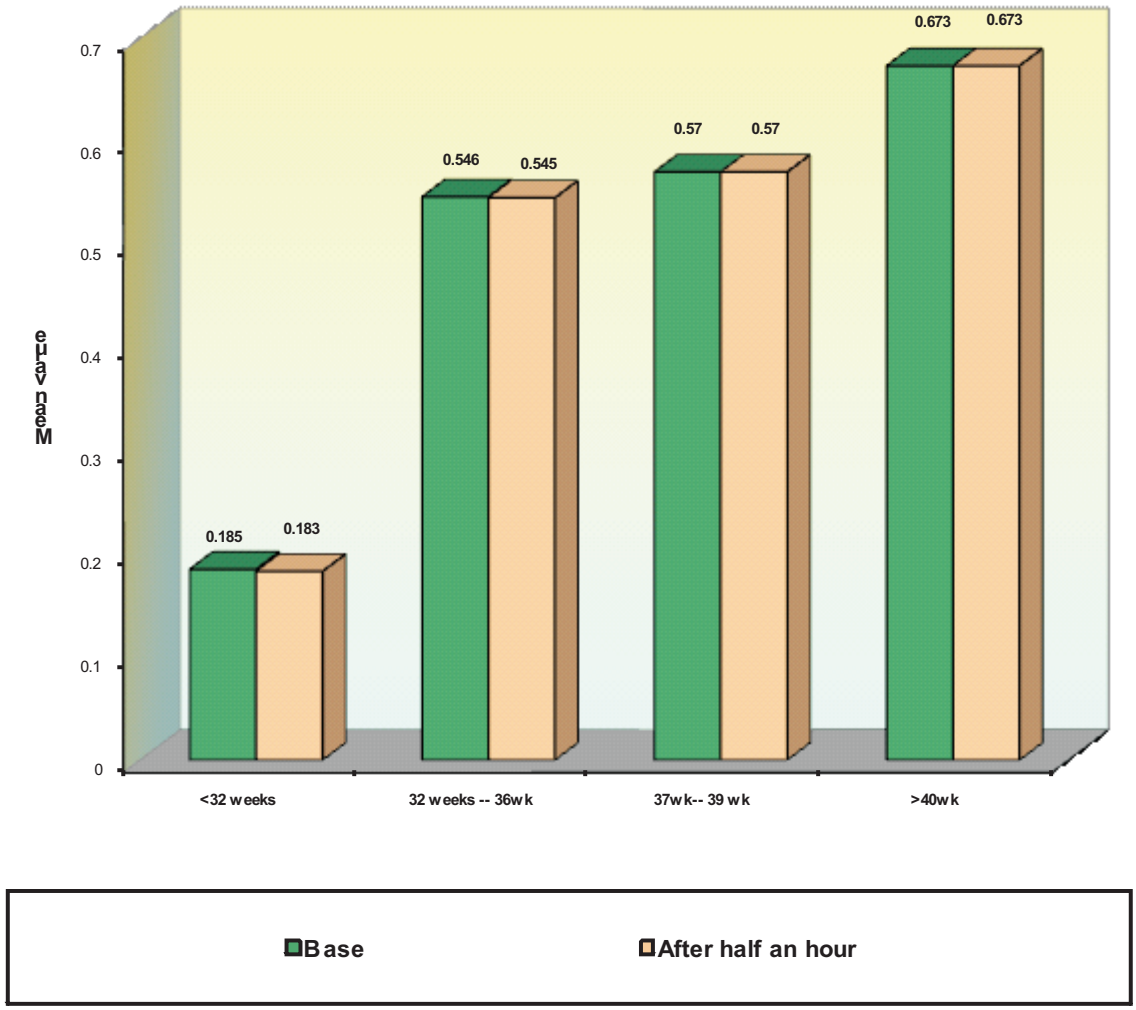
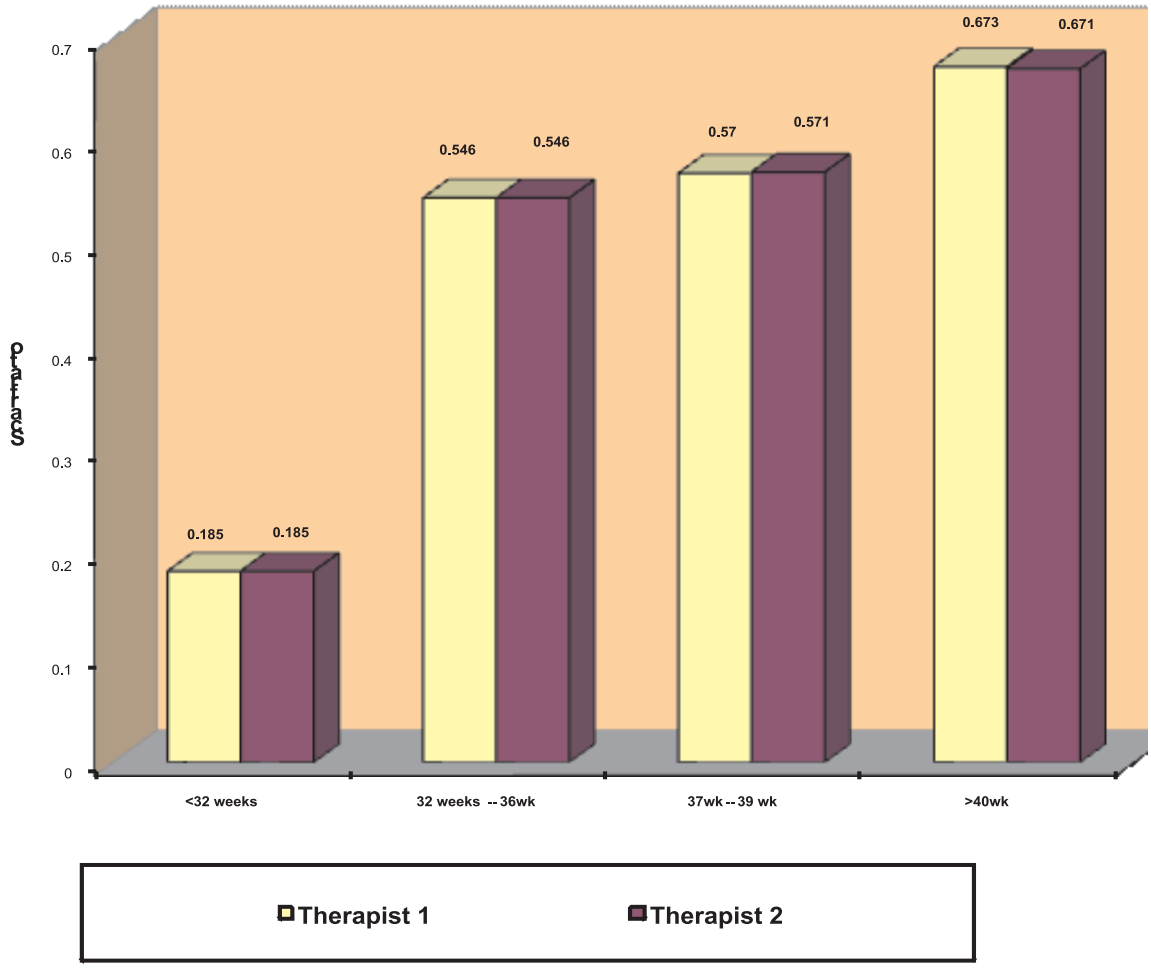


Fig. 3: interrater reliability

Interarater reliability of scarf ratio is high



indicated that there wasn't a significant difference between the readings of the first rater and the second rater indicating a high interrater reliability . (Table 3) (Fig 3)

DISCUSSION

A preterm born infant differ in its needs from the full term born infant even though if he is born without any neurological deficits, and require special care nursery [13]. The extent of the premature infant's adjustment to an environment depends largely on the gestational age and weight of the infant . The neurodevelopmental outcome for infants born prematurely; or for term infants with prenatal or birth complications, depends on the timing of the brain injury as well as on the nature of an insult to the developing brain. Different components of fetal central nervous system are more vulnerable to noxious events or exposures at specific times in maturational process. For e.g. insult occurring in early pregnancy typically results in neural tube defects, dimorphic features, and congenital malformations. The subcortical periventricular region of the fetal brain is more vulnerable to injury during gestational period spanning the late second trimester and early third trimester whereas the basal ganglia and cerebral cortex are more susceptible as the fetus approaches term.

Periodic, sequential examinations over time are the most useful method of determining the developmental outcome of an individual infant.

[3] Also gestational age assessment help to predict possible insult and later developmental outcome. Prenatal brain damage may be roughly separated into events during the first half of gestation versus later events as according to Evrard P et al.[14] .Perfusion failures caused by placental, embolic, and other factors are more common in the second half of gestation and lead to conditions such as ; Hydranencephaly, Destructive microcephalies and Periventricular leukomalacia. Cerebral convolutions first appear in the fetal human brain during the fifth month of gestation and continue to develop into the first postnatal year. During the sixth and seventh months of gestation, the cerebral cortex remains largely underdeveloped with smooth surfaces quite uncharacteristic of the full term brain with its many cerebral cortical convolutions.

The preterm infants included in the present study were in between the PCA of 32 weeks to 39 weeks. The major reasons for the variations between different groups being that extremely premature infants has much lower survival rate and are mostly associated with other anomalies or require surgical interventions. Hence, the number of preterm's who can be included in the study was less for this group and those infants who were above 40 weeks were mostly discharged from the hospital.

Most of the mother's whose preterm infants were included for the present study were of age between the ranges of 25 to 35 years. As various studies indicate that age of the mother can be of significance as far as prematurity is concerned hence the data was recorded to see any variation in scarf ratio with the advancing mother's age , no relevant information could be inferred from the present study and further studies are needed to evaluate the effect of other maternal factors on scarf ratio as multiple births. Although, most of the parents of the preterm infants included for the study belonged to the low economic status , the mothers have been going for regular check ups and had immunization done at appropriate times. Twenty five out of the 32 preterm infants were females ; but no inference could be drawn regarding the sex of the premature infant from this sample size.

Twenty one mothers had normal vaginal delivery, about seven of them had vaginal assisted breech delivery and rest four mothers have undergone caesarian section. Birth trauma especially with assisted or forceps delivery can also lead to various neurological deficits for e.g. brachial plexus injury can alter the readings of scarf ratio, but none of the infants included in the present study had such a problem. No inference could be drawn on the effect of consanguineous and non consanguineous marriage from this sample size but most of them had non consanguineous history.

Information was also obtained about the personal habits of the mother in the past and during the time of pregnancy. As habits like consuming alcohol, smoking and drugs like marijuana and narcotics can lead to premature births. A study of Hadeed AJ and Siegel SR showed that the immediate complications in cocaine using pregnant women include increased incidence of ; Abruptio placentae, Spontaneous abortion, Fetal death, and Premature delivery. Even on neurobehavioral testing, infants demonstrate poor motoric and state control and orientation / interaction ability.[15] There is strong evidence to show that maternal smoking, and possible maternal passive smoking, is harmful to the fetus, and that it can affect the pregnancy and the subsequent development and health of children after they are born. [16]

Excessive drinking during pregnancy causes a condition known as fetal alcohol syndrome, which presents a growth retardation, craniofacial and cardiac defects and mental retardation, and that alcohol has been linked with increased risks of spontaneous abortion, still birth, congenital abnormalities and abnormal neurobehavioral development. Many women planning pregnancy are now aware that it is advisable to eliminate alcohol from their diet prior to conception. Two out of 32 mothers of the present stage had a history of consuming alcohol in the past.

Almost all the preterm infants of the present study were kept in the intensive care unit for the period of five to eight days. Preterm infants who stayed in intensive care unit for a much longer time were not included as the environmental exposure of intensive care unit can also alter the developmental outcomes of these infants. [17] Further studies are needed to see the variation in the value of scarf ratio in infants who are kept in the ICU for longer durations.

The estimation of scarf ratio in 32 preterm infants of the present study revealed that the intrarater and interrater reliability of this tool is quite high. The results of the present study are well consistent with the findings of study done by Raweewan LeksKulchai and Joan Cole. As the PCA increases, the mean value of scarf ratio was found to increases. This suggests that infants at older PCA showed more resistance to the passive movement of the arm which reflects the greater muscle tone of upper trunk and extremities in older infants.

Further study may be undertaken to find the gestational age using scarf ratio in preterms who were excluded in the present study to see if it differs from the results of the present study.

CONCLUSION

The good intrarater and interrater reliability of scarf ratio is of great importance when the data obtained need to be compared between the two different raters and even the readings obtained by the same rater at two different times are comparable. Hence, it may be indicated that scarf ratio is an efficient individual tool to assess gestational age in preterm infants.

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Ansari Mehtab Alam, Kamal Mohd. Research on "Meningitis': a Bibliographic Study. Ind J Lib & Info Sci, 2008; 2(1): 5-12 (name of journal, year of publication, volume (issue) and pages).

Magazine

Gakhar Isha. Eco-friendly Bags in Fashion. Women on the Earth, 2008; 2: 28-28.

Newspaper

Parmar Vijaysinh. All this family got was their son's head, Times of India. 2008; July 29.

Book

Benjamin Lewin. Genes VI. New York; Oxford University Press, 1997

Book Chapter

Fisher M. Nosocomial. Infection and Infection Control. In Jenson H, Baltimore R. Pediatric Infectious Diseases. 2nd Ed, W.B. Sounders Company; 2002: 1221.

World Wide Web

Jutta M. Joesch et al. Does Your Child Have Asthma? Filled Prescriptions and Household Report of Child Asthma. Elsevier. http://www.jpedhc.org/article/S0891-5245(06)00129-5/abstract (August 21, 2008).

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Tables should be typed in double spaced on separate sheets with table number (in Roman Arabic numerals) and title above the table and explanatory notes below the table.

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