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Original Article

Physiotherapy and Occupational Therapy Journal
Volume 8 Number 3, July - September 2015

The Correlation of Subtalar Varus Angle with Balance, Physical Function and Activities of Daily Living (ADL'S) in Females with Stage 2 or 3 Unilateral Medial Compartment Knee Osteoarthritis (OA)

Jha Lalit M.*, Gupta Neha**

Abstract

Context: Osteoarthritis is a non-inflammatory degenerative disorder of joints characterized by progressive deterioration of the articular cartilage and formation of new bone i.e., osteophytes. As knee OA is very common in India especially in females and if we are able to correlate balance, physical function and ADL'S with subtalar angle deviation, a better physiotherapy protocol can be designed. *Aims:* The main objective of this study was to investigate the correlation of balance, physical function and ADL'S with subtalar varus angle (STVA) in females with unilateral medial compartment knee OA. *Settings and Design:* Correlational study design. *Methods and Material:* 30 females with stage 2/3 unilateral medial compartment knee OA, aged in between 40-65 years participated in the study. Assessments were made by the stair climbing test, timed up and go test, WOMAC scale, and goniometric assessment for subtalar varus angle. *Statistical analysis used:* Statistical analysis was done with the help of SPSS software by calculating the Pearson's correlation coefficient. Level of significance accepted is $p < 0.05$. *Results:* The Pearson's correlation coefficient between STVA and physical function is r=0.3830, between STVA and balance is r=0.0632 and between STVA and ADL'S r=0.1438. *Conclusions:* There is a low correlation present in between STVA, physical function, balance and the ADL'S.

Keywords: Subtalar Varus Angle; Balance; Physical Function; ADL'S; Medial Compartment; OA.

Introduction

Osteoarthritis is biomechanical, morphological and molecular changes of both cells and matrix which lead to fibrillation, softening, ulceration and lose of joint cartilage, sclerosis and eburnation of subchondral bone, osteophytes and subchondral cysts [1, 2].

Knee OA is chronic painful state affecting considerable number of old age people in all over the world. Because many physical changes occur with age and structures of body become more rigid and tightened, so the possibility of more wear and tear occurs very easily. Due to the balancing problems, bad posture frequently occurs because of which more deformity arises [1, 2].

People with OA of knee joint suffering from pain and disability are not able to perform their activities of daily living (ADLs). OA in Medial compartment of knee is very common and has been attributed to increase load transmitted across medial compartment of knee joint [3].

Many factors are related with occurrence and succession of knee OA; the cause of knee OA is not very clear. Many researches are going on but there is much confusion regarding the aetiology of knee OA. Knee OA is a commonly encountered pathological joint affection that leads to pain, problem in balance and physical function [4].

OA in particular causes degeneration of the knee joint, affecting the integrity of the joint arrangement and further disturbing the joint mechanics. This leads to the adjustment of the whole limb system in an alternate manner leading to pathogenesis [5].

Important factors such as physical function, balance and ability to perform ADL's can help clinicians in designing rehabilitation protocols for patients with knee OA. Physical function in people with OA knees may be affected when if there is balance dysfunction because balance is essential for daily activities. Furthermore static and dynamic balance may also affect the ADL activities [6].

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Subtalar varus or rear foot varus or calcaneal varus alignments may be contributed to medial compartment knee OA. In the presence of subtalar varus angle, knee adduction moment is exaggerated, so there are more rotations on tibia and femur and more medial joint loading. Bio-mechanical factors related with joint loading have been the focus of advanced researches as an important element in the progression and severeness of knee OA. As we know body biomechanics is the only important factor because of which the changes occurs in body alignments or misalignments [7].

Musculoskeletal problems are painful and may affect life style of patients in the society, hampering their activities of daily living. Prevalence of knee OA in India is higher in urban community being 5.5% and lower in rural community being 3.3%. Knee osteoarthritis is a very serious problem in females; the probability is more in females because of factors related to the physiology and metabolism of body [8].

The pathomechanics further aggravates in females because of their daily routine work which includes knee bending positions leading to more wear and tear of articular surfaces and more inflammation and deformity. Also faulty walking patterns of individual increases the knee adduction moment which may lead to more medial line joint forces and more medial knee joint pain and varus deformity [9].

However because of increased medial joint loading in case of subtalar varus misalignments there may be exaggerated load in the medial compartment of the knee, leading to a greater and faster degeneration compromising the balance, physical function and ADLs.

Knee involvement occurs less frequently than hand OA, although similarly it is more common in women, with female-to-male ratios varying between 1.5:1 and 4:1. Prevalence rates for knee OA, based on population studies in the U.S.A., are comparable to those in Europe.

Osteoarthritis is a common problem in India which has a probability of 22-39%, and has percentage of 30% among all joint diseases. It is commonly occurs in fourth and fifth decades of life [11].

As the probability of knee OA is very high and it causes disability at a large scale in the society. Thus there arises a need to ever improve the treatment. Further if correlation can be established between the studied variables the treatments can focus on corrective measures for subtalar angle misalignments.

This study aimed to investigate the relationship between subtalar varus angle and balance, physical function and ADLs in female patients with stage 2 or 3 unilateral medial compartment knee OA.

Subjects and Methods

Thirty female patients with unilateral medial compartment knee OA referred by physicians at Aruna Asif Ali Hospital, Delhi for outpatient physiotherapy participated in this study, which was conducted between December 2014 and March 2015. Consecutive female patients with complaints of knee pain with or without difficulty to walk were screened for eligibility. Out of 55 patients screened for enrolment in the study, 15 were excluded (Fig 1.). Patients meeting the eligibility criteria (Tab. 1) filled the informed consent form.

Table 1: Inclusion and Exclusion Criteria

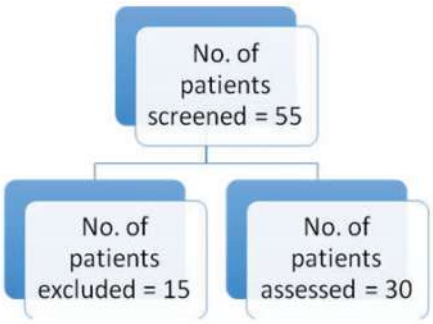
Inclusion Criteria [7]	Exclusion Criteria [7]
Age – 40 to 65 years	Related diagnosis of pre patellar bursitis or Tendonitis
Gender – females	Any previous knee surgeries, ligamentous knee injury or laxity
Clinicallyd iagnosed patient of knee OA with unilateral medial compartment involvement.	Sinding Larsen's disease
Stage of OA – Stage 2 or 3	Plica syndrome
	Osgood Schlatter's disease
	Any Infections
	Any Malignancy
	Patellar or tibiofemoral dislocation
	Any other orthopaedic condition which affect balance, PF and ADLs except unilateral medial compartment knee OA
	Any neurological or cardiac problem

Assessments

Following this all the 30 female participants were assessed for:

a. Balance by the stair climbing test [6] which was performed by the participants by ascending and descending a flight of three stairs bare footed.

Fig. 1: Flow diagram for patient participation



A wooden staircase that had three steps of 20 cm height on the ascending side and four steps of 15 cm height on the descending side was used for the test. On the command "Go", subject commenced the test, ascending and then descending the flight of stairs at a self selected comfortable pace.

The participants score was calculated as the time between instances when the first foot was off the floor to ascend the flight of stairs and when both feet were on the floor after completing the descent. The dependent variable was time taken in seconds to complete the test.

The SCT has shown to have test-retest reliability of 0.88 [6].

b. Physical performance by the Timed Up and Go test [6] was performed bare footed. Participants were asked to sit on a chair with arm rests and instructed to rise immediately from the chair without using the arms for support on hearing the command "Go". Participants then walked at a self-paced, comfortable speed for a distance of 3 meters on a marked, level corridor and returned through same distance to sit on the chair. The scores of the dependent variable for the test was the time in seconds taken to complete the task. The reliability (intra-class correlation coefficient= 0.99), content validity and predictive validity of the TUG test have been established [6].

c. The WOMAC (Westren Ontario and McMaster Universities) index uses 24 parameters to assess patients with osteoarthritis of the hip or knee. It can also be used to monitor the course of the disease or to determine the effectiveness of anti-rheumatic medications. 17 parameters come under ADLs or Physical function component. Other components are of pain and stiffness [15].

d. Subtalar angle is measured in the standing position with a goniometer as the angle between the lower leg and the calcaneus. The stationary arm of goniometer was aligned with line bisecting lower leg and moving arm is aligned on the bisecting line of calcaneus. (The intra-class correlation coefficient ICC 2, k was selected where 'k' denoted as the reliability of the mean of 'k' measurements.) The coefficient for standing rear foot angle is 0.960 as yielded by ICC (2, k) [13] (Fig. 2).

Fig. 2: Subtalar angle measurement with goniometer

Results

Pearson correlation coefficient [12] was calculated to study the relationship between various variables, using the SPSS software. Thirty female patients in the age group of 40 to 65yrs with unilateral medial compartment knee OA of grade 2 or 3 participated in the study. This study has 30 female subjects aged in between 40 to 65 years & have grade 2 or 3 unilateral medial compartment knee OA (Fig. 3).

The values (Mean+/-SD) of the four factors considered in the study are Subtalar varus angle 6.10+/-1.42, Balance 20.93+/- 4.04, physical performance 12.30+/- 5.40 and ADLs 46.10+/- 4.16.

A positive low correlation (r= 0.3830, p<0.05) was seen between subtalar varus angle and physical function with the help of goniometric readings and Timed Up and Go Test readings. A positive little correlation (r= 0.0632, p<0.05) was seen between subtalar varus angle and balance with the help of goniometric readings and stair climbing test readings. A positive little correlation (r= 0.1438, p<0.05) present in between subtalar varus angle and ADLs with help of goniometric readings and WOMAC scale readings (Table 2, Fig. 4).

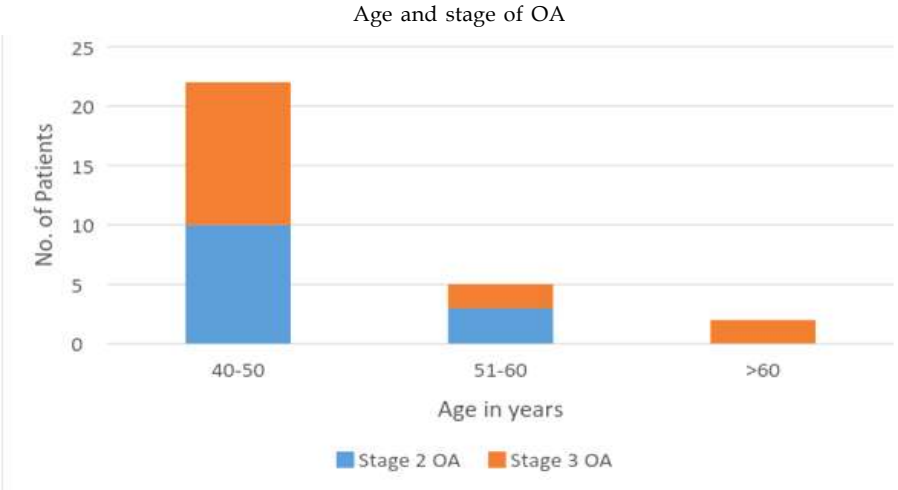


Fig. 3: Age and stage of OA

Table 2: Correlations matrix for participants with unilateral knee OA

		STVA	TUG	OD SCT	WOMAC
STVA	Pearson Correlation	1	.385 *	.063	.144
	Sig. (2-tailed)		.036	.740	.448
	N	30	30	30	30
TUG	Pearson Correlation	.385 *	1	.367 *	.146
	Sig. (2-tailed)	.036		.046	.442
	N	30	30	30	30
SCT	Pearson Correlation	.063	.367 *	1	.268
	Sig. (2-tailed)	.740	.046		.152
	N	30	30	30	30
WOMAC	Pearson Correlation	.144	.146	.268	1
	Sig. (2-tailed)	.448	.442	.152	
	N	30	30	30	30

*. Correlation is significant at the 0.05 level (2-tailed).

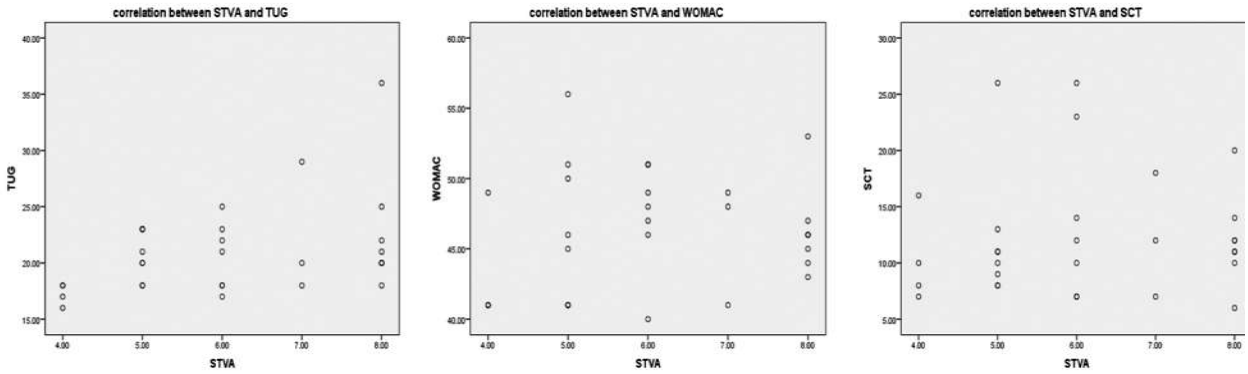


Fig. 4: STVA: Subtalarvarus angle; TUG: Timed up and go test timings (in sec.); WOMAC: Western Ontario Macmaster Osteoarthritis Index score; SCT: Stair climbing test timings (in sec.)

Discussion

The aim of this Paper was to study the relation between balance, physical function and ADLs with Subtalar varus angle (STVA) in females with stage 2 or 3 unilateral medial compartment knee OA.

A positive little correlation was seen between STVA and balance. It is indicative that STVA alone cannot affect balance in population of medial compartment knee OA, some other factor should be considered in conjunction. In a study by Babatunde O.A. Adegoke et al., (2012) [6], it is stated that in patients with knee OA, ageing process has a direct correlation with balance dysfunction i.e., more the age more will be the balance dysfunction but in our study, we have taken wider age range (40- 65 years), which could be a reason why there is little correlation between STVA and balance [6].

Another factor for balance impairment is the quadriceps muscle strength studies have shown that balance impairment decreases with improvement in the quadriceps muscle strength as it plays a significant role in opposing the knee adduction moment which is the major factor governing the medial knee joint loading [3, 6]. Also the STVA is an important contributing factor for producing knee adduction moment [14]. Thus along with STVA, quadriceps muscle strength is an important factor to be studied in knee osteoarthritis patients with balance impairment [14].

A positive low correlation is present between STVA and physical function. As known with ageing process the knee joint synovial fluid is gradually reduced leading to increased cartilage wear and tear. Thus this increases the physical dysfunction experienced by the patients [6].

Patel Birenkumar Jagdishbhai et al (2009) [7], in their study found a significant correlation between STVA and disability in patients with patellofemoral arthritis. The author used WOMAC scale for disability and discussed about the excessive subtalar joint pronation, which is a compensatory mechanism for rear foot varus and subtalar joint pronation is required to compensate any bony deformity but if this subtalar pronation is prolonged and excessive, then it prevents the supination of subtalar joint which is required for external rotation of tibia in mid- stance but a constant tibial internal rotation is present because of excessive subtalar pronation, so to compensate this lack of tibial external rotation as a result of abnormal pronation, the femur is internally more predisposed for patellofemoral pain [7]. But, in the medial compartment knee OA, knee adduction moment which is generated by the combination of the ground reaction force, which passes medial to the centre of knee joint, and the perpendicular distance to this force from the centre of the joint, is the main factor which is balanced or eliminated by the quadriceps muscle, so thus the quadriceps muscle strength must be considered [3].

Further studies can group patients according BMI, quadriceps strength and narrow age group to better correlate the subtalar varus angle with the factors. In addition, the study can be replicated with a larger sample size with inclusion of male population, utilizing sophisticated and advanced instruments for balance, physical function and ADLs assessment.

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Original Article

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A Study to Observe the Influence of Exercise in Brief Illness Perceptions on Cardiac Surgery Patients

Jain Swati*, Thangaraj M., Sharma M. D.*****

Abstract

Background and Purpose: The practice of physical activity is important for improving the health. Several studies suggested that the people who reported that they do not practice physical activity have a greater likelihood of exhibiting symptoms of depression and anxiety when compared with those who reported practicing postoperative physical activity on a regular basis. Therefore our study aims to observe the influence of exercise in illness perception on cardiac surgery patients. *Methods:* A sample of 80 subjects (50 males and 30 females), aged 20-70 years old were selected from large population based on the inclusion and exclusion criteria of the study. The follow-up cardiac surgery subjects were observed for post operative exercise activities, which they were already prescribed. The patients who did regularly exercises taken in Group-1 and those who were non-compliant (unable to do exercises) taken in Group-2. *Results:* The compliant group caused significant positive changes in patients' view of their illness. Patients in the compliant group also reported that they had better recovery and reduced the effect of symptoms of illness at significantly faster rather than the non-compliant group. There is a significant difference in between the two groups. *Discussion and Conclusion:* Altogether, these results suggest that people who do not practice postoperative regular exercise have a higher chance of exhibiting symptoms of distress, anger, fear and depression. So their illness perception is increased as compare to compliant group. However, the illness beliefs are significantly associated with the symptoms. The Brief IPQ could provide an ideal platform to determine illness perception as a part of recovery assessment in cardiac surgery patients.

Keywords: Physical Activity; Cardiac Surgery; Exercises; Illness Perceptions; Brief-IPQ.

Introduction

The aim of cardiac surgery is to prolong life and to reduce illness-associated disability of heart disease patients. Important outcomes from surgery include additional life years and symptoms reduction as well as improvements in the patient's quality of life [1, 2]. So, an alternative approach focuses on patient's perception about their illness [3, 4]. Patients' illness beliefs are closely tied to emotional reactions such as fear, anger, and distress. A person who has a positive illness representation accurately identifies signs and symptoms and the cause of the disease and thinks that the problem is curable or controllable, that the cause of the disease is intermittent, and that the level of disability or seriousness of the disease is low [5]. Several studies suggested that the people who reported that they do not practice physical activity have a greater likelihood of exhibiting symptoms of depression and anxiety when compared with those who reported practicing postoperative physical activity on a regular basis [6].

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Methodology

Sample

Sample Size

80 subjects were include in the study.

Source of subjects

CTVS department, Safdarjung Hospital, New Delhi.

Sample Method

Convenient Sampling.

Inclusion Criteria

- Age (20 – 70 years)
- Both male and female
- Cardiac surgery patients of CABG and Valve replacement (Mitral valve regurgitation, Aortic valve regurgitation)
- Follow-up cardiac surgery patients
- No significant complications
- At least 6 weeks post operatively
- Hemodynamically stable

Exclusion Criteria

- Psychiatric changes (both pre and post operatively).
- Patients taking any antidepressant or antipsychotic drug
- Uncontrolled Diabetes.
- Severe post operative complications (pneumonia, respiratory failure and bronchospasm etc.)
- Inability to understand language
- Serious co-morbid condition (Neurological disorders)

Method of assigning subjects

The follow-up cardiac surgery subjects were observed for post operative exercise activities, which they were already prescribed. The patients who did regularly exercises taken in Group-1 and those who were non-compliant (unable to do exercises) taken in Group-2.

Study Design

Case control prospective study design

Instrumentation

Brief Illness Perception Questionnaire (Brief IPQ)

Variables

Independent variables

Active Range of Motion (AROM) Exercises

Dependent variables

Brief Illness Perception Questionnaire (Brief IPQ and its nine elements of questions)

Procedure

Aim and procedure of the study were explained, and how the findings of the questionnaire who were relevant to their prognosis. The total 80 subjects were taken from CTVS department at Safdarjung hospital, New Delhi, according to inclusion and exclusion criteria. Subjects were divided into two uneven groups according to their history on the basis of exercise activity. All the subjects were assessed for illness perception. The subject was made to sit relaxed so as to prevent their distraction from the outside environment. The attendant was made to sit outside in order to avoid any disturbance while answering the questionnaire.

Once the subject becomes relaxed and comfortable with the environment, history regarding the disease, exercise and the demographic details of the subject were taken.

Once all the details were taken subjects were told regarding the significance of the questionnaire that how the information would be useful in improving their social and emotional wellbeing and helps in preventing the worsening of the symptoms and prognosis of the existing illness.

Before the use of questionnaire, it was translated into the subjects' language from English to Hindi.

All nine questions or items were explained to the patients, so that subject was made to familiarize with the questionnaire, and got the questionnaire filled up. Question contained 1 to 9 items, the 9^{th} item is subjective in nature and from 1 to 8 items that ranges from 0-10 scores, asked the patient to rate them.

Each item of the Brief IPQ assessed one dimension of illness perceptions.

The consequences score is simply the response to item 1. Item 2 signifies the timeline score. The third item represents the personal control. The treatment control score is the response of item 4. Item 5 is for identity score. Illness concern is measured by item 6, it reflects a combination of emotional and cognitive representations. The coherence score is the response of item 7. Item 8 is for emotional representation.

Item 9 is the casual item. Responses can be grouped into categories such as stress, lifestyle, hereditary, etc., determined by the particular illness studied. Categorical analysis can then be performed, either on just the top listed cause or all three listed causes. Questions were asked from the patients, according to questionnaire and then they were scored.

Result

80 subjects of both male (50) and female (30) cardiac surgery patients were participated in this study. The subjects were taken Brief Illness Perception Questionnaire (BIPQ) and divided exercise and non exercise group were compared by using student's unpaired 't' test to estimate the order of significance. The demographic data was analyzed by comparing means of descriptive. The Mean age of Exercise group 37.76±14.52 and Non-exercise group 35.15±12.51 (p=0.405) which was not significant.

Based on Brief Illness Perception Questionnaire (BIPQ)

There is a significant difference found in Consequences (CSQ) among Group 1(non-compliant) with the mean and standard deviation (8.57±0.83) as compared with Group 2 (compliant) with the mean of (6.02±2.13) {p=0.001}.

Significant difference found in Timeline (TL) among Group 1(non-compliant) with the mean and standard deviation (4.96±2.73) as compared with Group 2 (compliant) with the mean and standard deviation (3.51±2.23) {p=0.010}.

No significant difference was found in Personal Control (PC) between Group 1 and Group 2 (3.15±2.22 of non-compliant Vs 2.80±2.08 of compliant).

No significant difference was found in Treatment Control (TC) between Group 1 and Group 2 (1.21±1.34 of non-compliant Vs 0.91±1.08ss of compliant).

Table 1: Comparison of illness perception in between Group 1 and Group 2

Brief-IPQ	Group 1 Mean±S.D	Group 2 Mean±S.D	'p' value
CSQ	8.57±0.83	6.02±2.13	0.0001
TL	4.96±2.73	3.51±2.23	0.010
PC	3.15±2.22	2.80±2.08	0.466
TC	1.21±1.34	0.91±1.08	0.353

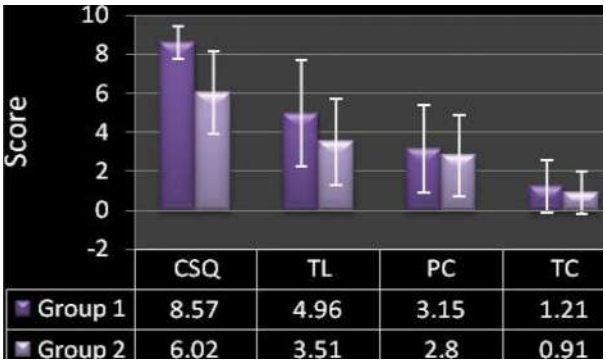

Fig. 1: Comparison of illness perceptions in between Group 1(Non compliant) and Group 2 (Compliant)

There is a significant difference found in Identity (ID) among Group 1(non-compliant) with the mean and standard deviation (3.51±2.06) as compared with Group 2 (compliant) with the mean and standard deviation (2.63±1.82) {p=0.04}.

No significant difference was found in Concern (CNS) between Group 1 and Group 2 (7.42±2.71) of non-compliant Vs compliant (6.31±3.11).

No significant difference was found in Understanding (US) between Group 1 and Group 2 (6.45±1.50 of non-compliant Vs 6.85±4.05 of compliant).

There is a significant difference found in Emotional response (ER) among Group 1 (non-compliant) with the mean of 7.45±1.48 as compared with Group 2(compliant) with the mean of 3.89±3.07 (p=0.0001).

Table 2: Comparison of illness perceptions in between Group 1 (Non compliant) and Group 2 (Compliant)

Brief-IPQ	Group 1 Mean±S.D	Group 2 Mean±S.D	'p' value
ID	3.51±2.06	2.63±1.82	0.045
CNC	7.42±2.71	6.31±3.11	0.116
US	6.45±1.50	6.85±4.05	0.788
ER	7.45±1.48	3.89±3.07	0.0001

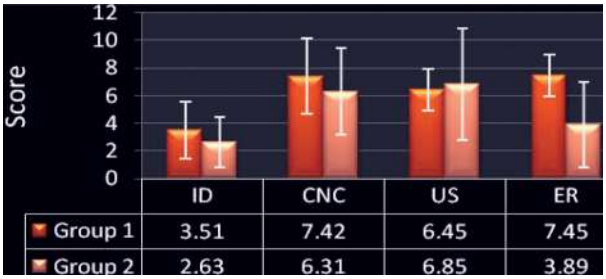

Fig. 2: Comparison of illness perceptions in between Group 1(Non compliant) and Group 2(Compliant)

There is a significant difference found in Total among Group 1(non-compliant) with the mean and standard deviation (42.75±6.53) as compared with Group 2 (compliant) with the mean and standard deviation (32.95±8.47) {p=0.0001}.

Table 3: Total score of Brief-IPQ between Non-compliant and Compliant group

Brief-IPQ	Group 1 Mean±S.D	Group 2 Mean±S.D	'P'value
Total	42.75±6.53	32.95±8.47	0.0001

Fig. 3: Total score of Brief-IPQ between Non-compliant and Compliant group

Discussion

The current study illustrated that people who reported that they do not practice physical activity have, at least partially, a higher chance of exhibiting symptoms of depression, distress, fear and anger, they had high illness perceptions when compare to those who perform physical activity regularly (as taught in the hospital postoperatively).

Several studies have systematically shown the importance of regular exercise in the improvement of symptoms related to illness perceptions in adult and elderly. Many hypotheses explained that these results are associated with social, behavioral and physiological aspects (Struder and Weicker, 2001) [10]. In the present study, being physically active was inversely associated with symptoms of depression, anxiety and illness perceptions. Although the practice of physical activity is important for improving the health, some studies have shown that, in the majority of health conditions, physical activity cannot be used as the sole form of health care, but it may be employed as an adjuvant strategy in some cases [10].

The illness-perception intervention has a number of differences from conventional approaches to improve recovery after cardiac surgery. Most formal treatment program after cardiac surgery are not theoretically based but tend to comprise a number of fixed components, usually including education about cardiac disease as well as advice regarding exercise and lifestyle changes. It is not always clear what patient attitudes are being targeted and what components are critical to achieve behavior change. In contrast, the illness perception program used the patient's view of his/her illness as a starting point for the intervention and built the material around these existing perceptions. Illness perceptions provide both an initial target for change and a way of evaluating the effectiveness of the intervention, as we know that these beliefs are related to later recovery of function and behavioral change.

Note that reported symptoms like depression, distress, fear, anger and illness perceptions may due to cardiac or non-cardiac origin. Fewer symptoms may be due to the lower level of worry about symptoms in the compliant group or may be associated indirectly through the higher level of confidence and work functioning in this group. The early research identified five dimensions with the cognitive representation of illness: identity- the label, the person uses to describe the illness and the symptoms they view as being part of the disease; consequences- the expected effect and outcome of the illness; cause- personal ideas about the cause of the illness; timeline- how long the patient believes the illness will last; and cure or control- the extent to which the patient believes that they can recover from or control the illness. The emotional representation incorporates negative reactions, such as fear, anger, and distress [11].

This study shows that, the properties of a new-item scale, the Brief IPQ. The scale measures patients' cognitive and emotional representations of their illness including consequences, timeline, personal control, treatment control, identity, coherence, concern, emotional response, and causes. The Brief IPQ demonstrated good predictive validity in patients recovering from post cardiac surgery. The consequences, identity, concern, understanding, and emotional response were all fairly consistently related to mental and physical functioning at 6 weeks follow-up cardiac surgery patients.

The significance of consequences in the study was that the exercise can improve the effect and outcome of cardiac illness. If the Timeline score is high, it shows that the illness perceptions of patient are higher. However, the present study showed a significance difference between compliant and non-compliant group. In Personal control and the Treatment Control showed no significance result between the compliant and non-compliant group. So there is lower representation of illness perception found among patients of compliant group. The outcome of Identity and Emotional response questions, showed significant improvement in the compliant group as compare to non-compliant group.

The Identity also predicted cardiac rehabilitation, while concern and treatment beliefs predicted speed of return to work. Personal control may be reflecting internal locus of control beliefs, while treatment control may be picking up external locus of control beliefs, and this aspect may be worthy of further research.

When should researchers choose to use the Brief IPQ over the IPQ-R?

The main advantages offered by the Brief IPQ to researchers are brevity and speed of completion for patients, as well as easy interpretation of scores. The Brief IPQ is most useful for ill and elderly populations who would find completion of a long questionnaire difficult. The Brief IPQ also offers advantages when researchers are already using a number of other pencil and paper measures.

Evidence shows the Brief IPQ to be a valid and reliable measure of illness perceptions in a variety of

illness groups. Patients find the Brief IPQ easy to understand and to complete [6, 4]. The significant result shows that the non-compliant group has high illness perception as compare to the compliant group or exercise group.

Limitations

- Study was performed on limited number of subjects.
- Samples included were only cardiac surgery patient.
- Only Brief IPQ was measured.
- Anxiety & depression scale was not measured.
- Study could have been more effective if prior to surgery and follow-up cardiac rehabilitation.

Future Research

- The study can be further repeated by overcoming its drawbacks more sensitive method can be used for measuring the Brief IPQ.
- The study can be done with elderly population.
- Study can be more refined by improving the inclusion criteria, such as Gender wise differentiation and including time also as one of the factor along with treatment.

Conclusion

Altogether, these results suggest that people who do not practice regular exercise have a higher chance of exhibiting symptoms of distress, anger, fear and depression. So their illness perception is increased as compare to compliant group.

However, the illness beliefs are significantly associated with the symptoms. The Brief IPQ could provide an ideal platform to determine illness perception as a part of recovery assessment in cardiac surgery patients. Therefore, research hypothesis is accepted.

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Original Article

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Efficacy of Phonophoresis, flexibility and endurance training along with wrist manipulation in Lateral epicondylitis: A Randomized Control Trial

Monika Moitra*, Sunita Sharma, Senthil P. Kumar***, Asir John Samuel****

Abstract

Aim: The aim of the study was to find out the efficacy of wrist manipulation and phonophoresis, flexibility and endurance training on pain and grip strength in lateral epicondylitis patients. *Methods:* A total of 30 patients having lateral epicondylitis, included both male and female, age ranges from 25 to 50 years were selected as subjects and they were further divided into 2 groups. Each group comprising of 15 subjects (male=7; female=8). Group A (Control) received phonophoresis, flexibility and endurance training and Group B (Experimental) received wrist manipulation along with phonophoresis, flexibility and endurance training for 3 days per week. For both groups total duration of treatment was for 4 weeks. Numeric Pain Rating Scale and Grip Strength were used as pre and post outcome measures. *Results:* Result of the study suggests that there was improvement in the mean value of Numeric Pain Rating Scale and Grip Strength after treatment in both groups. But the treatment was statically more significant in Experimental group than Control group. *Conclusion:* It was concluded that the patients of lateral epicondylitis show more improvement when receiving wrist manipulation along with phonophoresis flexibility and endurance training.

Keywords: Lateral Epicondylitis; Wrist Manipulation; Phonophoresis; Flexibility; Endurance Training.

Introduction

Lateral epicondylitis, more commonly known as "tennis elbow", is an overuse injury of the wrist extensor tendon that attach along the outer side of the elbow which leads to inflammation and ultimately degenerative changes such as tendinosis and micro-teared fibrous tissue at these points. Lateral epicondylitis occurs 7 to 20 times more frequently than medial epicondylitis [1].

Lateral epicondylitis is one of the most common lesions of arm. This is an injury that is difficult to treat, is prone to recurrent bouts and may lasts for several weeks or months. The average duration of a typical episode of tennis elbow is between 6 months to 2 years [2].

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It is a work related or sport related pain disorder with microscopic and macroscopic tears in Extensor Carpi Radialis Brevis (ECRB), usually caused by excessive quick, monotonous repetitive eccentric contraction and gripping exercises of wrist [3, 4]. The dominant arm is commonly affected with the prevalence of 1-3% in general population, but this increases to 19% at 30-60 years of age [5]. The condition is not differing between men and women [6]. There has been a well defined clinical presentation, the main complaints being pain and decreased grip strength. Diagnosis is simple and can be confirmed by the tests that reproduce pain such as palpation overuse lateral epicondylitis, resisted wrist extension, resisted middle finger tension and passive wrist flexion [7].

According to Shirley Kushner (1999), repeated wrist extension and rotation may produce "repeated minor trauma" and strains in the common wrist extensor origin at its attachment into the lateral epicondyle. The tissue attempts repair, but continued muscle contraction pulls the surfaces apart leading to multiple, repetitive tear. It has been suggested that a periostitis may occur at the tenoperiosteal junction. Excessive granulation tissue, with free nerve ending, has been identified in the subtendinous space. The

pathological changes in the tendons have been termed "fibroadenomatous hyperplasia" which describes a tissue of poor quality, slow to heal and painful [8].

Nirschl (1973) referred to dull greyish oedematous tissue replacing the normal glistening tendon. These tissues often encompassed the entire origin of the ECRB tendon to the level of the radial head. He found pathological changes on the inner side of the extensor aponeurosis in approximately 35% of cases. In 20% calcific exostosis of the lateral epicondyle was present [9].

Leonardo Viola (1998) described histopathologic examination of samples obtained from patients with chronic refractory lateral epicondylitis showed vascular proliferation and focal hyaline degeneration which is consistent with a degenerative rather than an inflammatory process. Histological examination of the bone- tendon junction in patient with tennis elbow has shown evidence of a repair response of variable degree, the most frequent feature being mucopolysaccharide infiltration and bone formation [10].

Traditional treatment program for people with lateral epicondylitis have focused primarily on the pain control by ultrasound, anti-inflammatory medication, iontophoresis or phonophoresis followed by rehabilitation program which ranges from flexibility to strengthening and endurance training. Numerous treatments have been, tried for lateral epicondylitis including drug therapies, corticosteroid injection, electrical stimulation, laser, accupuncture, counterforce bracing, ergonomics. Surgical treatment is needed in 5- 10% of patients who do not respond after many months of conservative treatment [11].

Struijis et al conducted a study on manipulation of wrist for management of lateral epicondylitis. They concluded that manipulation of wrist is capable of relieving symptoms in lateral epicondylitis patients [12]. Manipulation has been frequently used for the management of back and neck complaints and is thought to be free motion segment that have undergone disproportionate displacement or are felt to be hypo-mobile and causes muscle relaxation. These mechanisms are thought to be associated with distribution of abnormal stresses within the joint, resulting in pain, restriction of motion and potential inflammation [13-19]. The purpose of the present study was to evaluate the efficacy of wrist manipulation technique along with phonophoresis and graduated exercise therapy regimen in patients of lateral epicondylitis.

Methods

The sample consisted of 30 patients, both male and female. Their ages ranged from 25 to 50 years. All the patients received a written explanation of the trial before entry into the study and they were given informed consent to be signed for participation. Then the subjects were randomly allocated equally into Group A and Group B respectively. All 30 subjects met the following inclusion criteria -Patient's with age of 25-50 years, tennis elbow patients with positive Cozen's test, signs and symptoms of tennis elbow more than 6 weeks, pain over the lateral side of the elbow that provoked the lateral epicondyle region and gripping tasks. Pain had to be experienced over the lateral epicondyle during at least one of the following: resisted static contraction of the wrist extensors or ECRB muscle or stretching of the forearm extensor muscles.

The subjects with the following criteria were excluded from the study -Definite decrease in pain for last two weeks, severe neck and shoulder problem which can affect the diagnosis and results, patient received any steroid injection within the last 30 days in elbow, patient with patho neurodynamics around elbow, bilateral conditions, any history of rheumatoid arthiritis, systemic or neurological disease.

Procedure

30 subjects of lateral epicondylitis were selected according to inclusion criteria and allocated 15 each into Group A and Group B. All the patients in both the groups were pre-tested by Numeric pain rating scale and hand held dynamometer.

Group A: The subjects of Group A received phonophoresis during which pulsed ultrasonic therapy was given at the tenoperiosteal junction of the extensor carpi radialis brevis at 20% duty cycle, frequency 3MHz and an intensity of 1.2 W/cm^2 for 5 min. Diclofenac Sodium based gel was used as coupling medium. The protocol was followed 3 times a week for 4 weeks.

Group B: The subjects of Group B received Wrist manipulation technique in addition to phonophoresis. During manipulation of wrist each subject rested the forearm of his or her affected side on a table with the palmer side of head facing down. The therapist sat at right angle to the subject's affected side and gripped the subjects's scaphoid bone between his thumb and index finger reinforced by

placing the thumb and index finger of the other hand. The therapist then extended the subject's wrist dorsally at the same time the scaphoid bone was manipulated ventrally. This part of the maneuver was repeated approximately 15 times. This procedure was repeated about 2 times, alternated by either forced passive extension of the wrist or extension against resistance. The duration of intervention session was 15 to 20 minutes No restrictions in use of the arm were imposed. Both the groups also received flexibility and endurance training. The protocol was followed 3 times a week for 4 weeks.

Results

The statistical analysis for two groups were performed to find out the mean, standard deviation, p value, t value and the statistical significance between NPRS, grip strength in both groups having lateral epicondylitis. There was no significant difference between the groups in terms of age, BM and baseline measurements (NPRS, Grip Strength).

Table 1: Comparison of pre and post NPRS within Group A and Group B

Group		Mean	S.D.	t value	p<0.05
Group A	Pre NPRS	8.20	0.775	20.579	Significant
	Post NPRS	6.00	0.845		
Group B	Pre NPRS	7.93	0.961	31.588	Significant
	Post NPRS	4.20	0.826		

Table 2: Comparison of pre and post grip strength within Group A and Group B

Groups		Mean	S.D.	t value	p<0.05
Group A	Pre Grip Strength	15.13	0.990	14.491	Significant
	Post Grip Strength	17.13	1.125		
Group B	Pre Grip Strength	15.00	1.195	27.495	Significant
	Post Grip Strength	19.80	1.082		

Paired sample t-test has been used to compare pre and post NPRS within group A and group B. The table value (2.14) is less than the calculated t- value. Therefore, the results revealed significant difference between pre NPRS and post NPRS measurements at p<0.05.

Table 3: Comparison of Post NPRS between Group A and Group B

Post NRPS	Mean	S.D.	t value	p<0.05
Group A	6.00	0.845	5.775	Significant
Group B	4.20	0.862		

Paired sample t-test has been used to compare the mean for strength in Group A and group B. The table value (2.14) is less than the calculated t- value. Therefore, the results revealed significant difference between pre strength and post strength measurements at p<0.05.

Table 4: Comparison of Post Grip Strength between Group A and Group B

Post Grip Strength	Mean	S.D.	t value	p<0.05
Group A	17.13	1.125	6.614	Significant
Group B	19.80	1.082		

Unpaired sample t-test has been used to compare the mean of post NPRS between group A and group B. The mean and standard deviation for NPRS scores for Group A after 3 weeks was 6.00 ± 0.845 and for Group B was 4.20 ± 0.862. The table value (2.14) is less than the calculated t- value (5.775). Therefore, the results revealed significant difference between post NPRS measurements in both groups at p<0.05

Unpaired sample t-test has been used to compare the mean of post grip strength between group A and group B. The mean and standard deviation for grip strength scores for Group A after 3 weeks was 17.13 ± 1.125 and for Group B was 19.80 ± 1.082. The table value (2.14) is less than the calculated t value (6.614). Therefore, the results revealed significant difference between post NPRS measurements in both groups at p<0.05.

Discussion

The findings of this study indicated that subjects in both the groups had significant decrease in pain & increase in grip strength. However, out of the two groups, the group receiving manipulation of wrist had more improvement in both pain intensity & grip strength.

The reported success of manipulation of wrist in the present study is bolstered by the previously published trials. Struiji's et al compared the effectiveness of manipulation of wrist, ultrasound, friction massage and muscle stretching & strengthening exercises in managing lateral epicondylitis. They concluded that manipulation of the wrist produced the more effective results in improving outcomes [12]. Manchanda & Grover compared the effectiveness of movement with mobilization and manipulation of wrist in the lateral epicondylitis management. They concluded both are equally effective in its management.

The clinical efficacy of manipulation therapy has been demonstrated in randomized clinical trials which report benefits in term of pain relief and rapid restoration of function. This may be due to direct effects on articular structures, modulation of nociceptive afferent transmission within the CNS and psychological influences [20].

Recent evidence has indicated that the central nervous system may play a role in pain inhibition following joint manipulation. Vicenzino et al investigated the effects of a non-thrust cervical lateral glide in patients with chronic lateral epicondylalgia. This technique was shown to result in increased pain-free grip, pressure pain threshold, as well as a sympathetic nervous system response as indicated with measures of skin conductance and blood flux [21]. More recently, Paungmali et al found similar results with improved pain-free grip, pressure pain threshold, and sympatho-excitation following mobilization with movement directed at the elbow 22.

Clinical Implication

The result of this study may help the physiotherapists to use more effective intervention, in the form of manipulation of wrist along with conventional physiotherapy for reducing pain and improving grip strength in the clinical settings for lateral epicondyiltis patients.

Future Research

Whether the effectiveness of the interventions sustains for longer periods or not, is not known yet. Future randomized trials are required to determine the long term effects of the interventions.

Conclusion

Therefore the study concluded that wrist manipulation technique and conventional physiotherapy program including phonophoresis, flexibility and endurance training were effective in reducing pain and improving grip strength in lateral epicondylitis patients after the treatment sessions. But benefits of Manipulation of Wrist along with conventional physiotherapy program as compared to conventional physiotherapy alone in 4 week periods were substantial.

Conflict of interest: Nil

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Original Article

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Age Expansion of Multi-Directional Reach Test to Measure Limits of Stability in Children with Typical Development: A Research Protocol

Kavita Sharma*, Asir John Samuel, Divya Midha**, Senthil P. Kumar***, Vencita Priyanka Aranha***

Abstract

Background: Physical therapists regularly use various assessment tests to examine static and dynamic components of balance for children with typical development (TD) and with disabilities at various ages. One among them is multi-directional reach test (MRT). But till date, there is no normative data available for MRT in children with TD. *Objective:* To estimate the age expansion of MRT to measure the limits of stability in children with TD. *Study setting:* **S**ubjects will be taken from recognized primary school (Maharishi Markandeshwar International School, Mullana and Govt. Primary School, Mullana). *Procedure:* 194 will be asked to perform MRT and their maximum reaching ability in four directions, forward reach (FR), backward reach (BR), left lateral reach (LLR) and right lateral reach (RLR) will be measured. *Statistical analysis:* Kolmogorov Smirnov test will be used to establish normality and descriptive statistics for reporting the normative data of MRT. *Conclusion:* The normative data of MRT will be reported at end of the study might be beneficial in the assessment of balance in clinical practice.

Keywords: Balance; Functional Reach Test; Normative Data; Primary School; Reference Value.

Introduction

Balance is essential when an individual change his/her position in relation to the environment with feet stationary on the floor during activities like forward, backward, side bending and reaching [1]. Balance maintains body in equilibrium either at rest or during activity in context to centre of gravity (COG) and base of support (BOS). In balanced state forces acting on the body are balanced such that centre of mass (COM) lies within BOS with minimal sway [2-4]. Person's balance is greatest when COG or COM is maintained over BOS [2]. Balance results from the combined interaction of sensory, motor as well as central nervous system [3].

Balance is described in terms of COM, COG, BOS and limits of stability (LOS). BOS is the area of contact between body and its supporting surface. LOS refers to dynamic equilibrium, the boundaries within which individual maintains his/her centre of gravity with fixed BOS [2].

An attempt to save from sudden hazards, involves shifting of COG with fixed BOS to maintain balance [5]. When COG moves outside BOS an automatic strategy is executed to maintain balance either by realigning COG or establishing new BOS. If strategy does not act then person falls [6]. Postural stability is important to maintain balance by maintaining COG within LOS by interacting with musculoskeletal system [7].

Postural orientation is the control of positions of body parts with respect to each other and gravitational forces acting on body [2]. Postural control system aims at maintaining stability and function of the body which is achieved through integrated action of central nervous system. In normal development, postural stability proceeds in cephalo-caudal direction. Infant achieves neck control first followed by trunk and then limbs. Child achieves his complete balance and postural stability by the age of 6 to 10 years [4].

As infants grow they experience postural control difficulties due to change in their neural, sensory and musculoskeletal system with growing age [5]. Postural stability is crucial for maintenance of upright posture and gait. Stability maintenance is

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dynamic process that need continuous processing of sensory input from visual, vestibular and proprioceptive receptors in orders one supervising other [8]. Complex interaction between these systems results in condition that affects the potential to achieve stable posture [4].

There are many factors that interfere with normal balance which includes age of individual, diseased state, developmental or postural disorders like scoliosis, kyphosis [9] variability in movements [10] overweight [11] etc. These conditions in turn lead to falls which in turn leads to death or life long disabilities leads to state of psychological stress. These unintentional injuries due to falls are leading cause of death in elderly [11, 15] and leading cause of functional disability in children [13]. Failure to maintain COG leads to disturbance in balance results in falls which can occur in any age either in elders, adults or even in children [1-7].

Like elderly, balance is equally important in children as children are more prone to falls because of variability in their movement [10]. Children are engaged in more complex motor activities like swimming, sports activities, tracking, dancing, skating, mock-drills etc. [4, 8], which increases their risk of fall. Several factors are responsible for balance in children like age, gender, height, weight, BOS which are considered important in maintenance of balance.

Falls account for considerable morbidity in childhood [12]. Children exposure to traumatic injuries resulting from balance or any other cause hampers the normal patterns of proximal and distal development [13]. Falls lead to functional disability in children which leads to a state of distress. These injuries acts as source of private suffering and has its adverse effect on biological, psychological and social development [13].

In order to avoid falls during functional activities, it is important to establish functional balance norms to estimate risk of falls [14]. Therefore precautions can be taken in those who have less balance as per prescribed norms. There are various clinical tests to test static and dynamic balance ability of children with or without disabilities in any of the age groups [15]. These balance tests are helpful to know the present balance status of an individual and to find underlying cause for balance dysfunction so that intervention is given timely in case of altered balance [16]. Some tests are designed individually to access balance and some are framed to examine gross motor function including evaluation of balance [17].

There are many approaches use to measure balance. Laboratory balance measurement techniques includes stabilography, accelerometer, motion analysis, posturography which are non affordable and having complex functioning [3]. There are many tools available for accessing static as well as dynamic balance in clinical settings for accessing elderly people or people with neurologic deficit like balance berg test, time up and go test, step test etc., [18]. Some test are designed for normal individuals includes unipedal balance test, reach test which includes functional reach test (FRT) and multidirectional reach test (MRT) [19].

FRT was given by Duncan et al which is used to measure dynamic balance in forward direction in elderly population [6]. After a decade Newton gives MRT which incorporate the measurement of balance in all four directions (forward, backward, right lateral, left lateral) in his test that is proved to be more significant [7, 10]. MRT defines the maximal distance which individual can reach forward beyond arms length without loss of BOS in standing position [11, 18].

Disturbing balance in lateral directions with eyes closed are recorded as the increasing cause of falls risk [7]. Clinical assessment tool was developed to measure reach even in medio-lateral directions which was modified form of FRT [7]. MRT proves to be more challenging as it does not provide any security as the person is made to perform test without giving any support [6].

MRT is tool to measure LOS in all four directions [6, 8]. In this individual COG is made to shift with respect to BOS by making movements in different directions [2, 7, 18]. It is a reliable tool for assessing dynamic balance and LOS in antero-posterior and medio-lateral direction in elderly [19]. MRT is a single task test which examines voluntary postural responses of upper limb and limits of stability in different directions [2]. MRT proves to be very useful assessment tool for postural and balance control [19].

As children have variability in their movements we think that MRT will prove to be more beneficial in assessment of their functional balance. In response to findings of elder's accidently falling backward and lateral side, Tantisuwat et al, performed MRT on population range 20-79 years of age to determine LOS in this age group [19]. To our knowledge, this is the first published study will be available to investigate reach test in different directions in different age groups. Newton reveals that values of MRT decreases with age. There is no study which emphasize on limits of stability of children and adolescent. Therefore aim of this study is to quantify limits of stability of children aged between 5-12 years.

Review of literature

Balance is a complex process which involves the reception and integration of sensory inputs for planning and execution of meaningful movements, in order to achieve a upright posture (Leslie Allison) [19]. In system approach, the dynamic system's model for dynamic equilibrium recognizes that balance is a result of combined interaction between individual, task performed by the individual and the corresponding environment in which individual is asked to perform task [19-20].

Nasher explains various specific motor synergies which are achieved through synergistic actions of muscles. These strategy patterns for postural movements are executed to maintain equilibrium in various different situations [22]. Factors that influence balance ability include anthropometric measurements like height, weight, foot size etc, cognitive abilities, physical activity lifestyle and injury to limbs. Thus assessment of balance is necessary in examination of balance in order to frame effective rehabilitative measure or to prevent risk of injury [3].

There are various different techniques which are used to access balance which includes laboratory as well as clinical methods. Emery et al (2005) describes various different technical methods to access balance which includes stabilography, accelerometer, motion analysis etc., which have complex functioning and are unaffordable [3].

Berg et al demonstrates clinical methods of balance evaluation includes tinetti performance test, berg balance test, time up and go test. They conducted a study in which they came to a conclusion that clinical functional balance assessment measures were superior to laboratory measures in the measurement of dynamic balance during functional activity [22]. According to Powell et al (1995) balance assessment became more oriented to functional aspects, leads to development of test based on dynamic activities. Thus FRT came into existence which is a dynamic balance test developed to access dynamic balance test in elderly [23].

FRT is a single task test given by Duncan et al (1990) to access problems related to balance in older adults. It examines normal synergy patterns of upper limb and its limits of stability. It examines the maximal distance reached beyond arms length with feet stationary on the ground in standing position with palm facing upward. Purpose of his study was to find the validity of FRT in elders predisposed to recurrent falls. He included 217 males aged between 70-104 years with history of two or more falls within six months.

Bartlet and Birmingham (2003) conduct study to develop and evaluate the validity and reliability of a Pediatric Reach Test (PRT) [9]. In order to modify FRT he included side reaching component along with forward reaching both in sitting and standing positions. He took 19 normal children aged between 3 to 12.5 years. Children were made to complete session of PRT in standing position followed by laboratory force platform tests of dynamic balance. On different time, two different individuals evaluated 10 children with cerebral palsy aged between 2.6 to 14.1 years both in the sitting and standing sections of the PRT. ICC was found to be 0.84 for sitting section and 0.71 for forward reach, 0.75 for right reach and 0.82 left reach in sitting position. Score was 0.97 for standing Section and 0.86, 0.88, 0.94 for forward reach, right reach and left reach respectively in standing position .This study provides evidence that the PRT is a simple, tool with validity and reliability which can be used in children with cerebral palsy. Addition of a sitting component enables us to use the test in children with various classifications of cerebral palsy, including those children who are not able to stand on their own. Addition of lateral reach components both in sitting and standing positions, and use of orthoses and walking aids during performance of test indicates the functional aspects of balance in a more typical context than standing barefoot without aides.

Volkman et al (2007) perform study for examination of FRT scores for the effects of traditional and alternate methods and subject characteristics [11]. He took 80 subjects aged between 7 to 16 years. He tries to define a relationship among the effects of measurement method and style of reach. He concluded that FRT scores were affected both by style of reach and its method of measurement. Mean reach scores were compared among the 4 FRT methods. Summarizing across height, gender and strategy categories, the least squares mean ± standard error values for the reach scores were 30.92 ±0.80 cm for the 1 arm finger to finger approach, 82.32 ± 1.38 cm for the 1 arm toe to finger approach, 31.08 ± 0.79 cm for the 2 arm finger to finger approach, and 76.02 ± 1.28 for the 2 arm toe to finger approach. Significant interaction between the 2 variables of style of reach (1-arm or 2-arm) and also measurement method (finger-to-finger or toes-to finger) were defined. Different method for the calculation of FRT from toes to fingers was explored during this study. In this method, the FRT was measured as the distance between the starting point of the meter stick and the fingertips at the end of reach. For the calculation of the toe-to-finger score, there was no measuring of initial hand position as for the finger to-finger score.

The toes were aligned with the edge of the paper and the end of the measuring stick as previously. This method was applied for both the one-arm and the two-arm reach tests.

Norris et al (2008) perform study on FRT scores in young children to define the relationship between anthropometric measures and FRT scores. He took 121 normal children aged between three and five years in this study [16]. He analyzed mean of three successive trials on the basis of which he came to a conclusion that FRT is a feasible test to examine the balance of four and five year-old children and should be administered with care in three year old children. Mean standard deviation was calculated for all age groups. Values were: three year old children reached11.4 ± 2.6 cm, 4-year-old children 13.6 ±3.0 cm, and 5-year-old children 15.7 ± 4.4 cm. The 95% confidence intervals for the mean and the average reach value for 2 standard deviations below the mean are reported. He further concluded that significant predictor for FRT was weight in children and there is no affect of age, gender, height, arm length on functional reach in children as children used various strategies when challenged to do some action as explained by Nasher.

Deshmukh et al (2011) conducted a research in order to define normative values for reach in forward (FR) and lateral directions (LR) in school children and their relationship with anthropometric measurements like height, weight, gender etc. He included 350 children aged between 6 and 12 years by random sampling. On the basis of test performed and scores obtained he found value ranging between 22.7 cm to 37 cm for FR and 16.3 cm to 22.5 cm for LR. He established that height has significant relation with both FR and LR [4].

Later study was conducted by Deshmukh (2014) in order to find out the relationship of anthropometric measurements to the normal values of functional reach (FR) and lateral reach (LR) in school children with knee joint hyper-mobility (KJH). One hundred and forty children aged between 6 and 12 years with typical development (TD) and who have significant hyper-mobility of both the knee joint greater than 10° of hyper-extension were included in his study [25]. The values of FR for children with bilateral KJH ranged from 24.37±1.97 to 28.77±3.22 cm, and LR mean values ranged from 17.30±0.97 to 19.20±1.79cm in the age group of 6 to 12 years. Three successive trials of FR and LR tests were taken and analyzed. On the basis of his results he concluded that Height of children and hyper-mobility of their knee joint affect children scores in terms of functional reach. Successful significance of FRT was proved on the basis of different studies. But as children have variability in their movements it was thought that establishment of forward reach values are not sufficient to assess balance which leads to exploration of multidirectional reach test (MRT).

Newton (1999) performed a study which aims at developing portable and valid tool to measure limits of stability in all four directions (anterior, posterior, medial, lateral) [7]. He included 254 community-dwelling older persons. They were administered the Berg Balance Test (BBT), the Timed Up & Go Test (TUG), and the Multi-Directional Reach Test (MRT). For the MRT to perform, subjects were asked to reach maximal with the outstretched arm in all four directions. Based on his results he demonstrated that MRT has significant correlation with the BBT sum and significant inverse relationship with the scores on the TUG [1]. Mean scores on the MRT were 8.89±3.4 for reach in forward direction, 4.64±3.07 in backward direction, 6.15±2.99 in right lateral and 6.61±2.88 in left lateral direction. Interclass Correlation for the reaches were greater than 92. According to results obtained, scores on the MRT were directly affecting the scores of the BBT which concludes that more score scored on the BBT scale, the greater will be the distance reached in all four directions.

MRT scores shares inverse relationship with scores on the TUG which demonstrates faster the individual performed the TUG, the greater will be the distance reached in all directions. This significant relation in between the scores of MRT, TUG and BBT indicate that these screening measure to access balance are although similar but each shares unique aspects of balance abilities. Therefore, it will be justified to perform these tests in combination with one another to obtain a more improved and precise assessment of balance abilities. On the basis of these results he proves MRT as an inexpensive tool with adequate validity and reliability, for screening the limits of stability obtained by making the subject to reach in all four directions and this test can be performed including BBT and TUG test to obtain comprehensive clinical measure of balance abilities.

Hardy et al (2008) performed a study to determine prophylactic ankle braces affect on MRT distances during a test of dynamic balance [26]. Study was conducted to determine the effect of any prophylactic ankle braces on MRT score during a test of dynamic balance. Thirty six healthy, physically active volunteers were included in the study. Participants were asked to performed balance test first without brace, then perform test wearing a semi rigid ankle brace, and in last wearing a lace-up ankle brace. They used the Star Excursion Balance Test as an outcome

measure. Calculation was made by the mean of results obtained in three trials performed in eight directions. On the basis of results he came to a conclusion that orthrosis had no effect on any of the Star Excursion Balance Test directional measures [26].

Tantisuwat et al (2013) then conducted a study which aims at establishing MRT a validity and reliable tool for measurement of limit of stability. He aims at proving that MRT is a simple and inexpensive tool for assessment of balance. Basic aim of this study was to quantify the limits of stability of people aged between 20 and 79 years using the MRT. He included 180 subjects which were divided those subjects into the six groups in increasing order of their ages. The MRT performed in all four directions was used to measure the limits of stability. Subjects were asked to perform test by maximally outstretching their arm beyond their limits of stability with their feet flat over the examination area. Scores on the multi-directional reach test MRT (in cm) for different age groups were estimated and found to be decline with age . He found significant differences in values of test performed in the forward, leftward and rightward directions. No significant differences in scores were seen in the test performed in backward direction. Subjects in all age groups showed the greatest value of MRT in the forward direction, whereas the lowest values of MRT are obtained in the backward direction. This may be due to the biomechanics of the joints of lower limb, which allows greater capacity for forward reach than that for backward. This is thought to happen because majority of the activities of daily living are commonly performed in front of the body means in forward direction which proves to be helpful for subjects to have better control of balance in the forward direction. This study proves that MRT appears to be a useful assessment tool for Postural control and balance for older age group [19].

Sharma et al (2014) conducted a study in order to find the minimal detectable change of multi directional reach test in children and adolescent aged between 5 and 19 years. Eighteen children were included in study recruited in the study by convenience sampling technique. Measurement of height and weight was taken before initiation of the study. Evaluation is done using instrument consists of two metallic rulers and an adjustable wooden frame. Children were asked to perform test in all four directions with their feet flat on floor and shoe off. Three trials were taken in each direction and mean of three was calculated. Intra observer reliability was measured on intervals.ICC was calculated as 0.94, 0.93, 0.95, 0.79 and MDC values were 5.18, 4.46, 4.01, 7.87 for forward, backward, left lateral and right lateral directions respectively. At the end of the study MDC of MRT is established [27].

Need of the study

MRT is a tool which lacks in normative data for children. This study will help in establishing normal MRT values for children and adolescent.

Methodology

Sample size

It will be calculated using following formula

$$n = (Z\alpha\sigma/d)^2$$

$$n = 194$$

Sampling

Sequence sampling

Subjects selection criteria

Inclusion criteria

1. Children with typical development
2. Co-operative children
3. Aged between 5 and 12 years
4. Children with age appropriate height and weight

Exclusion criteria

1. Children having any visual impairment
2. Children having any vestibular impairment
3. Children with any hyper or hypo mobility
4. Children with previous history of upper or lower limb fracture
5. Functionally dependent children
6. Children with psycho-social disorder
7. Children suffering neurological disorders
8. Children with cognitive impairment
9. Non co-operative children
10. Other medical condition

Materials used for assessment

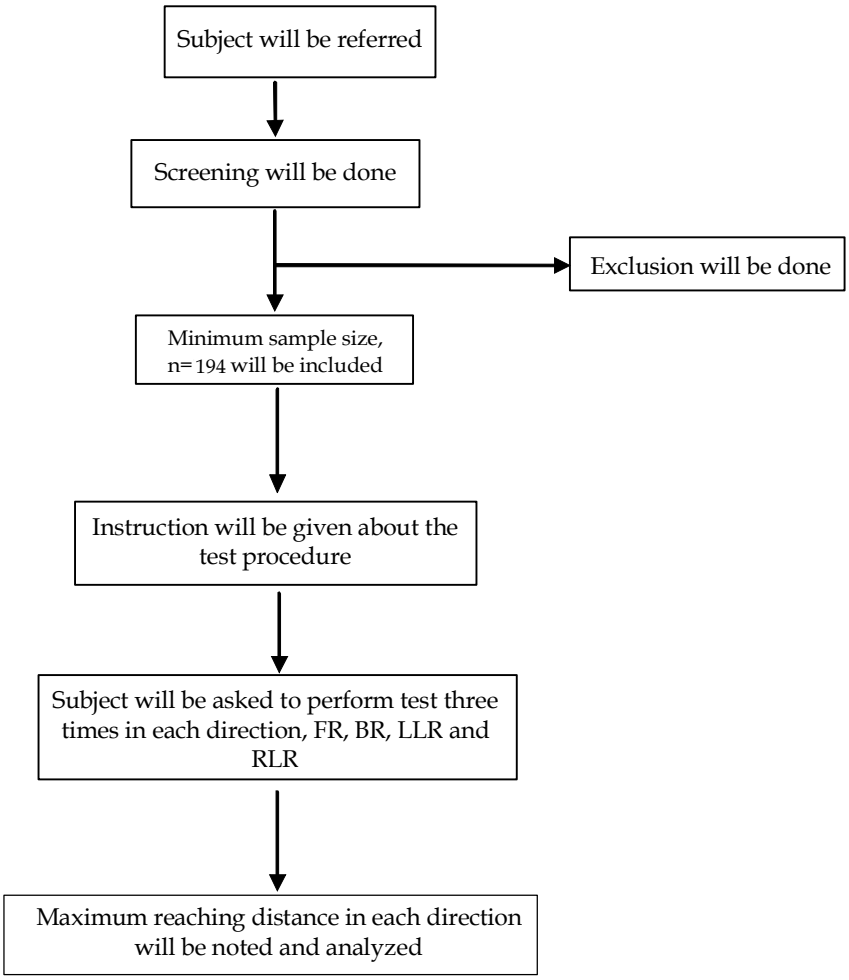
- White sheet/flex
- 3 Rulers (two with 60 cm and one with 30cm of length)

- Three adjustable wooden stand
- Measuring tape (Coman®)
- Weighing Machine (WC 150)
- Other necessary stationary (pen, paper, cardboard, scale)

Outcome measure

Maximum reaching distance measured in cm

Study protocol flow chart



Procedure

The study protocol has been approved by the university ethics committee (MMU/IEC/443). The study will be performed between October, 2014 and May, 2016. Before commencement of the study, assent from participating children and consent from their parent/guardian will be obtained. MRT consist of reaching maximum with outstretched hands in multiple directions (forward, backward, left lateral, right lateral) with feet stationary on floor without losing balance. Measurement will be taken from starting position to the point up to which participant can reach maximum in different directions. Anthropometric measurements will be taken prior to study which include estimation of height, weight, body mass index, arm length. Arm length is taken from acromion process of scapula to end of middle finger.

For performing MRT, three adjustable wooden frames with two metallic rulers each of 60cm will be used. White background will be kept behind the instrument. Subjects will be made to stand in front of the apparatus and ruler is adjusted at the level of acromion process. Subjects will be asked to reach maximum in each direction.

Subjects will be given demonstration regarding the procedure. After sufficient practice trials, they will be instructed first to raise their arm to 90° with palm facing outwards from starting position and asked to reach maximum in forward direction then come back to starting position. Followed by this the subject will be asked to reach in left lateral direction, come back to starting and then asked to reach right lateral direction without losing base of support. At the end subject will be asked to lean in backward direction as shown in figure 1 and 2. Maximum reaching ability in each direction will be recorded to tabulate the normative data of MRT.

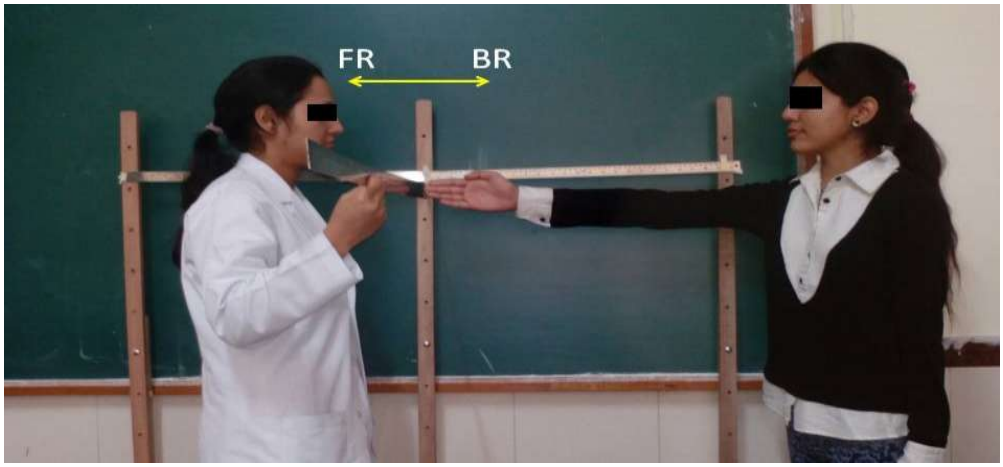


Fig. 1: Children with typical development (TD) performing forward and backward reach test (FR and BR), a subdivision of multi-directional reach test (MRT)

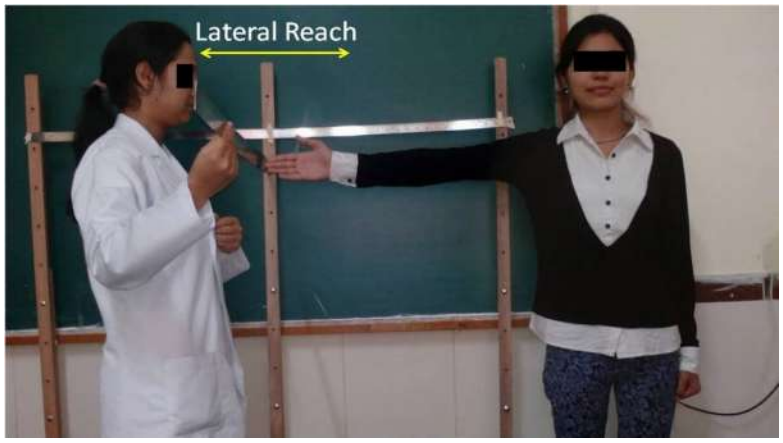


Fig. 2: Children with typical development (TD) performing left lateral and right lateral reach test (LLR and RLR), a subdivision of multi-directional reach test (MRT)

Data analysis

Data will be analyzed using software SPSS Version 16.0 (SPSS Inc. Chicago, IL, USA). Normality of collected data will be established using kolmogorov-Smirnov test of normality, which is used in case of sample size >50. If data follows normal distribution average MRT value will be expressed in terms of mean ± SD. If not, expressed in median and inter quartile range (IQR) or mean and 95% confidence interval (CI) or geometric mean and range. Independent t-test (parametric) or Mann Whitney u test (non-parametric) will be used for establishing significant difference in values based on normality. Alpha value will be analyzed if significance will be < 0.05 to minimize type 1 error.

Discussion

In this study, children will be made to perform the MRT in a free standing environment without support, which will be more challenging. Measurement of reach in one direction cannot predict value of other. Therefore it will be necessary to find value in each direction because falls occur in all directions. Hence, reach as a measure of the limits of stability needs to

be assessed in all directions. In a nutshell, the MRT will be a feasible clinical measure for limits of stability. On the basis of such assessments, effective preventative and rehabilitative measures could be developed.

Conclusion

The normative data of MRT will be estimated at the end of the study will be helpful in documenting the prognosis of dynamic balance after rehabilitation. This data will be first available normative report of MRT among the children aged 5 to 12 years.

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

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

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

Discussion

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

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Standard journal article

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

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

Article in supplement or special issue

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

Corporate (collective) author

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

Unpublished article

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

Personal author(s)

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

Chapter in book

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

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

No author given

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

Reference from electronic media

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

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