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Assessment of left right judgement task in patients with chronic musculoskeletal shoulder pain

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Abstract
Background and objectives: Mapping of the body schema is an important tool to establish relationship between chronic pain and cortical reorganization. The The left/right judgement task (LRJT)is related to processes involved with cognitive function, sensorimotor integration, movement planning, and execution and hence, will be a good tool in identifying alterations of the body schema due to chronic pain. The objective of the study was to find the prevalence of LRJT affection in patients with chronic musculoskeletal shoulder pain.
Method: A total of 71 patients from age group of 18-60 years with chronic musculoskeletal shoulder pain were included in the study based on inclusion and exclusion criteria. To assess LRJT Individuals were first explained and made to perform a trial of the LRJT and were then made to perform the actual test using the Recognise Shoulder App.
Result: Prevalence of individuals having affection of LRJT was calculated based on test results suggest 10 (14.08%) out of the 71 participants having chronic musculoskeletal shoulder pain had affection of the LRJT.
Conclusion: 14.08% had below normal responses to the Left Right Judgement Task amongst patients of chronic shoulder pain.

Keywords: assessment, shoulder pain, judgement task, chronic

Introduction

The International Association for the Study of Pain defines pain as "An unpleasant sensory and emotional experience associated with actual or potential tissue damage or described in terms of such damage" [1]. It is a complex experience unique to each individual, encountered by everyone at some point in their life. People often find it difficult to define and it's a challenge for clinicians to treat it [2]. As such, pain has both a subjective and an objective dimension to it. The objective dimension includes the physiological tissue damage which causes pain whereas, the subjective dimension includes *perceptual*, *affective*, *cognitive* and *behavioural* component [3].

Acute pain arising due to damage to non-neuronal structures by stimulation of nociceptors is called Nociceptive Pain. Whereas pain due to disease or lesion in the somatosensory nervous system is called Neuropathic Pain [2]. When this pain lasts beyond the tissue healing time or, at least, long after pain can serve any useful function, it becomes chronic in nature. International Association for the Study of Pain (IASP) defines chronic pain as pain without apparent biological value that has persisted beyond the normal tissue healing time (usually taken to be 3 months) [4]. Chronic regional pain is present in 20% to 25% of the population and chronic widespread pain is present in approximately 10% of the population [2].

The first-ever pan India prevalence survey found that 19.3% of the Indian adult population suffers from chronic pain. This study showed a huge chronic burden in India with a prevalence rate of 19.3%, which translates into 180–200 million adults having chronic pain as of 2018 [5].

With chronic pain, there are certain changes that occur in the cortical representation of the brain. These cortical representations are made up of 'neurotags'. A neurotag is a network of interconnected neurons which when activated, produces an output. These neurons of the neurotag fire together in a particular pattern and have an activation threshold [6]. It's well established in literature that transition of acute pain into chronic is due to interplay between an individual's demographics, psychosocial factors, biology as well as self-efficacy of an individual to cope with things. [9]

Mapping of the body schema is an important tool, which will help establish relationship between chronic pain and cortical reorganization [6]. Body schema is the internal representation of the body in peri-personal space derived from sensory, proprioceptive, and visual input. [10] The The left/right judgement task (LRJT) is related to processes involved with cognitive function, sensorimotor integration, movement planning, and execution and hence, will be a good tool in identifying alterations of the body schema due to chronic pain.[6] The test performance differences reflect changes in central nervous system processing, errors in judgement and changes in bodily representations in individuals with and without pain via changes in the motor, premotor cortex as well as sensory association areas [12].

Studies have already shown performance differences of the LRJT in patients with musculoskeletal wrist and hand pain, complex regional pain syndrome, in patients with spinal cord injury. [6] The results of LRJT in chronic musculoskeletal pain have been inconclusive. Recently LRJT responses of a cross sectional observational study between patients with and without shoulder pain was published. The results of the study proved that there were no differences in implicit motor imagery between both groups [12]. However, the limitation of the study was that, the study groups weren't homogenous and the chronicity of the pain was not undertaken.

This study will help put forth the results of LRJT performance of chronic shoulder pain and whether chronic pain leads to alterations of the body schema. Establishment of performance differences in the LRJT in chronic

musculoskeletal shoulder pain will help prove cortical reorganization in these patients.

Aim and Objectives

To assess the Left-Right Judgement Task in patients with chronic musculoskeletal shoulder pain

Materials and Methodology

Type of study: Cross-sectional Observational Study
Study Population: Patients of chronic musculoskeletal shoulder pain.
Sample Size: 71
Sampling Method: Convenient Sampling

Incluion Criteria

- Patient willing to participate
- Patients suffering from chronic musculoskeletal shoulder pain. (Pain lasting for more than 3 months)
- Age:18-60 years

Exclusion Criteria

1. Patients suffering from complex regional pain syndrome (CRPS)
2. Patient in acute exacerbation of their chronic conditions

Procedure

- Sample size of 71 was selected depending upon the inclusion and the exclusion criteria and appropriate sampling technique.
- The need of conducting the study was explained to the individual depending on the language he/she understands.
- Informed consent was taken and case record form was filled.
- For selection of subjects, individuals with chronic musculoskeletal shoulder pain (more than 3 months) were identified.
- The individuals were explained how to perform the Left Right Judgement Task and were made to do a trial test.
- The individuals were then made to solve the Left Right Judgement Task and were given the Interpersonal emotion Regulation Questionnaire depending on the language they understand (English, Hindi, Marathi).
- Data analysis was done.
- Statistics Analysis was carried out using appropriate technique.

Outcome Measure

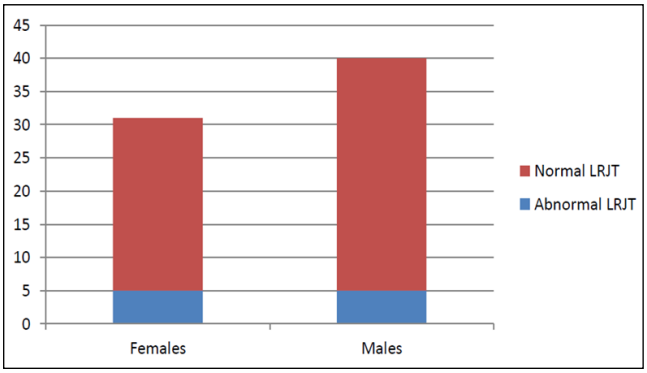
For the assessment of Left Right Judgement Task Recognise Shoulder App was used. The shoulder specific LRJT was found to be highly reliable [39]. The Application is installed on the tablet. A series of basic 20 images of the shoulder (both left and right) are displayed one after the other. The individual has to choose an appropriate response from Left/ Right as quickly as possible without moving their limbs to identify whether it is the left or the right shoulder. At the end of 20 images, accuracy score and reaction time for the right and left side are displayed. Individuals with accuracy more than 80% and reaction time of <2.5 seconds are said to have normal results. Completion of 20 images, accuracy and reaction time results are displayed. Accuracy of >80% and reaction time of <2.5 seconds is considered normal.

Data Analysis and Results

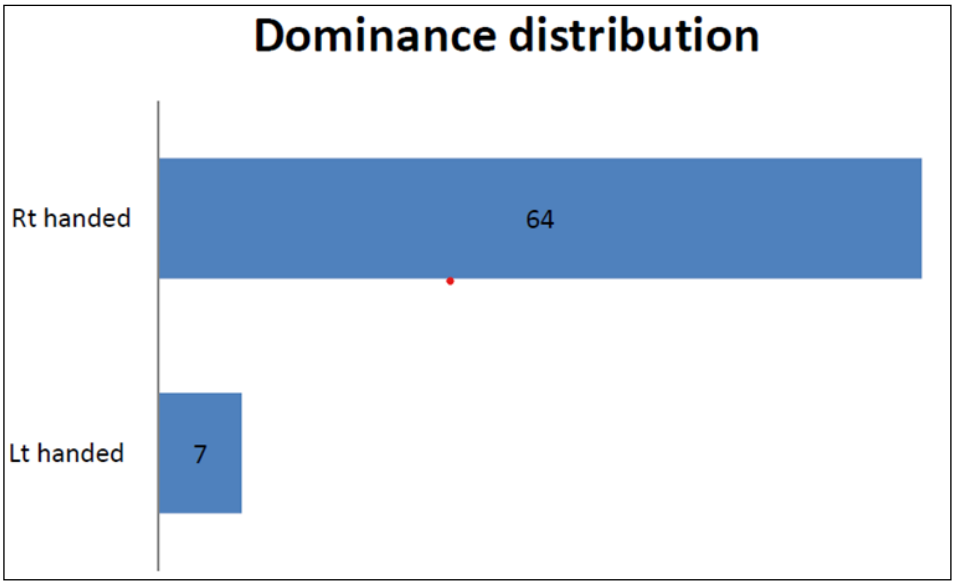
- All data analysis was performed using Microsoft Excel 10. Descriptive statistics were calculated for all demographic data and outcome measures.
- The average age from the population taken for the study lies within 47.33 +/- 12.1 years.
- The average duration of the symptoms of shoulder pain in the subject population was 8.46 months +/-7.33 months.
- In the study, 56% (40 out of 71) of the sample population were males and 44% (31 out of 71) were females. Among them 5 out of 31 (16%) females and 5 out of 40 (12.5%) males had abnormal LRJT results.
- 90.14% (64 out of 71) of the sample population was right handed and 9.8% (7 out of 71) were left handed. Among them 1 out of 7 (14%) left handed and 9 out of 64 (14%) right handed individuals had LRJT affection.
- In the study, 14.08% (10 out of 71) had below normal responses to the Left Right Judgement Task amongst patients of chronic shoulder pain. Out of the 14% (10 out of 71) of patients with affected Left Right Judgement Task responses, 50% (5 out of 10) have >2.5 sec of reaction time, 40% (4 out of 10) have <80% accuracy and >2.5 sec of reaction time, 10% (1 out of 10) have <80% accuracy.

Table 1: Descriptive Statistics for Demographic Data and Outcome Measures

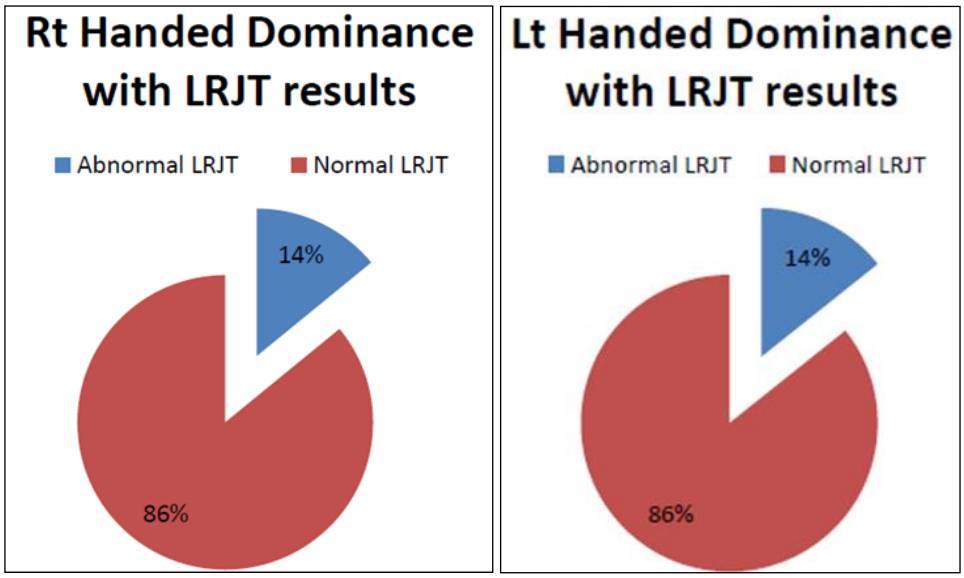
N=120	Mean ± SD
Age (Y)	47.33 ± 12.01
Gender, % (N)	
Men	40 (56%)
Women	31 (44%)
Duration of Shoulder Pain	8.46 ± 7.33
Dominency	
Right	64(90.14%)
Left	7 (9.8%)
LRJT	
Affected	10(14.08%)
Normal	61 (85.92%)



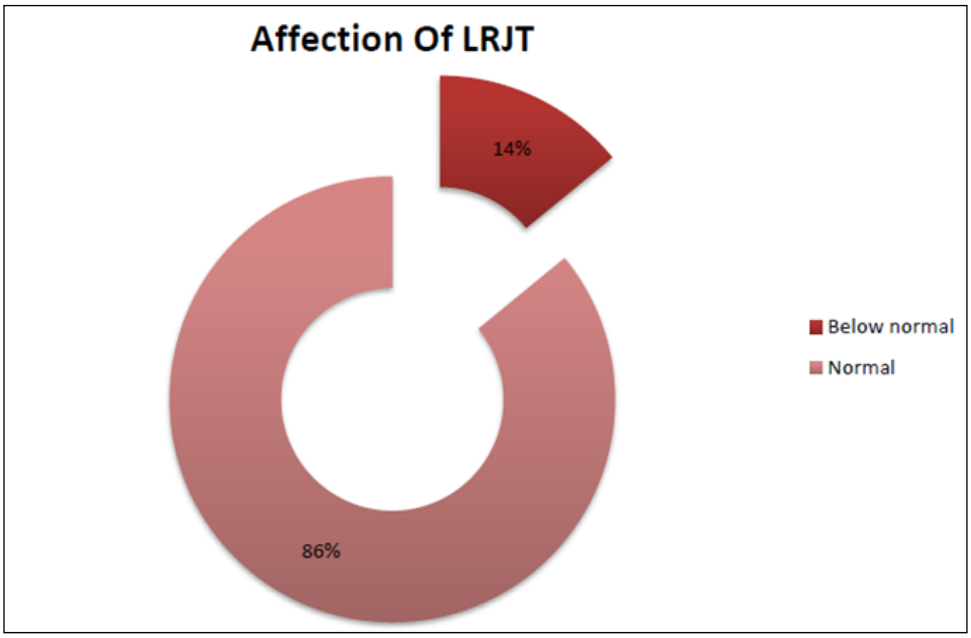
Graph 1



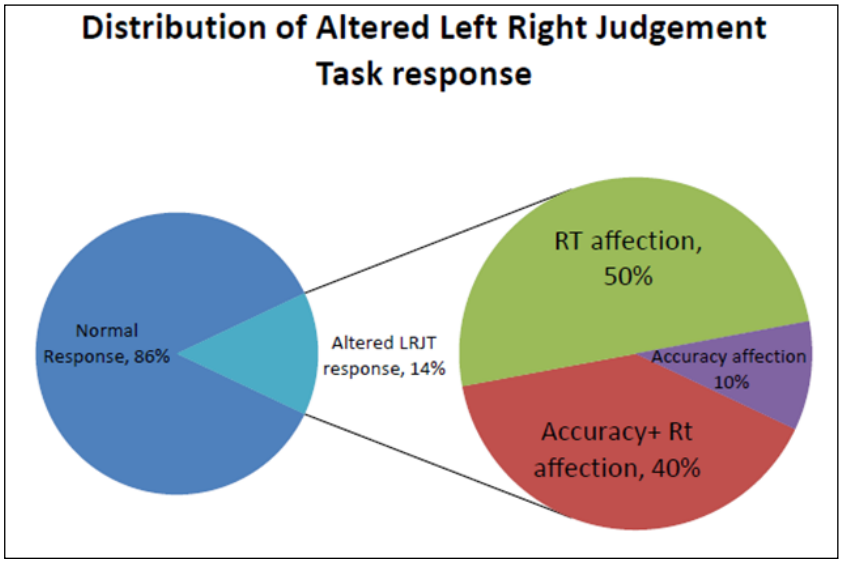
Graph 2: LRJT and dominance



Graph 3: Prevalence of affection of Left Right Judgement Task



Graph 4: Prevalence of affection of Left Right Judgement Task



Graph 5: Distribution of Altered Accuracy and Reaction time of the Left Right Judgement Task response

Discussion

In this study, 71 chronic musculoskeletal shoulder pain patients were participated. The average age from the chronic shoulder pain population in our study was found to be 47.33 years similar to the study done by Mario Pribicevic from October 2012, where most of the individuals affected were in the age group of 45-64 years [10]. In our study, individuals having affection of the LRJT were also in the age group ranging from 45-60 years. The average duration of shoulder pain in our population was found to be 8.46 months ranging from a period of 3.5 months to 3 years.

Our study also showed that 56% (40) of the sample population were males and 44% (31) were females out of which 5 males and 5 females had affection of LRJT which accounts to 16% females and 12.5 % males. This is consistent with the work done by Sarah B Wallwork *et al* in 2013 where she found the Reaction time of the LRJT was higher in females leading to more females having abnormal LRJT results.[11] Since chronic pain is found to be more prevalent in females (41.3%) than in males (29.1%) according to a study done by M Cimas in Feb 2018 [12], it can be inferred that higher number of females would have Abnormal LRJT results thus indicating higher number of females would be having changes in body schema due to chronic pain.

90.14% (64) of the sample population of this study was right handed and 9.8% (7) were left handed. Out of these 64 right handed individuals, 9 (14%) had LRJT affected and 1(14%) out of 7 left handed individuals was affected according to observation 6 indicating there is no correlation between dominance and abnormal LRJT results. This is inconsistent with the study done by Sarah B Wallwork *et al* in 2013 where she found the Reaction time of the LRJT was higher in left handed individuals than right handed. However, she also states that Accuracy of the LRJT is unaffected by gender or handedness [11].

14.08% (10 out of 71) of the sample population had below normal responses of the Left Right Judgement Task in our study. This is inconsistent with study done by John D Breckenridge *et al* who did a study published in August 2020 on the shoulder left right judgement task to see if implicit motor imagery is affected in patients with shoulder pain and found no difference between people with and without pain [9]. However, the limitation of that study was that the groups were non homogenous and chronicity were not taken into consideration.

To our knowledge, this is the first LRJT study to be done in chronic musculoskeletal shoulder pain patients. Since the LRJT is tool used to identify changes that occur in the body schema of individuals which are predicted to happen due to chronic nature of the pain, it helped identify 14.08% of the sample population of our study to have this affection which is hypothesized to occur due to cortical reorganization of the somatosensory and primary motor cortex. This is also demonstrated by a study done by Crystal A Rosser *et al* in 2019 that normal LRJT results were a sign of a working body schema and that post rehabilitation of a TKR improved the body schema of patients and caused no difference in the LRJT results of the replaced knee compared to the normal knee [13].

Similar results were found in a study done by S Mena-Del Horno *et al* in June 2020 where they found impaired laterality (LRJT) results in patients of Frozen Shoulder between their affected and unaffected shoulder.[14] A comprehensive systemic review and meta-analysis done by John D Breckenridge *et al* in 2019 also indicated that chronic musculoskeletal pain conditions affecting the limbs and face were associated with altered motor imagery performance when assessed by the LRJT and they were more consistent with peripheral than axial pain conditions [17]. Chronicity causes these changes in the neurotags of the brain which lead to their sensitization and disinhibition and causing cortical reorganization.

Out of these 14.08%, 50% of them had delayed reaction time as seen in observation 8. Delayed reaction time (of more than 2.5 seconds) is thought to reflect delay in the processing of the bodily representation in the brain [6]. When the side-to-side differences are more than 0.3 seconds, the delay is thought to be present in the initial judgement or final response.

Usually in chronic pain, the patient tends to neglect the painful side. Hence when a right sided shoulder pain patient is shown a right sided image, his initial judgement is the left shoulder. However, the mental movement of the image does not coincide with the actual image and hence the process begins again. Now he makes the judgement about it being

the right shoulder and it matches with the image. Hence, the reaction time is delayed. The delayed reaction time is theorized to be due to the disinhibition of the pain neurotag. The literature is however insufficient. 10% individuals have a delayed reaction time and reduced accuracy amongst the 14.08% population. The decreased accuracy is thought to be a function of fault in the mental movement of the limb to match the picture. 40% of individuals have both delayed reaction time and reduced accuracy. It is owing to the loss in precision of the pain neurotag that there is reduced accuracy and disinhibition causing delayed reaction time.

All of the above was inferred in a study done by Rene Pettelier in August 2018 where 61 patients with wrist or hand pain had poorer accuracy and reaction time of the LRJT and had poorer cognition, motor function and higher pain severity scores indicating LRJT is a complex mental task involving cognitive, sensory, motor as well as behavioural processes [15].

Our present study results contributed to identify the link between chronic pain and body schema changes using the LRJT. These changes in the somatosensory cortex and primary motor cortex due to the sensitization and disinhibition of the pain neurotages cause the vicious cycle of chronic pain

Strategies to treat pain at cortical level and desensitize pain neurotags should be adapted by all treating therapist will in turn help patients have fuller pain free lives. These strategies can include the use of graded motor imagery where an individual is given intervention using the left right judgement task, motor imagery and mirror therapy [6]. The LRJT along with being used as a screen tool can also be used as treatment to help bring neuroplastic changes in the sensory and motor body schema. Use of motor imagery helps an individual by imagining movement without eliciting the pain neurotag and the mirror therapy helps desensitize and inhibit pain neurotag. All these strategies can be implemented to treat pain at cortical level by bringing neuroplastic changes in the somatosensory and primary motor cortex and preventing recurrent pain episodes in individuals of chronic pain [6].

Conclusion

14.08% had below normal responses to the Left Right Judgement Task amongst patients of chronic shoulder pain.

Limitation

- Patient of chronic pain only were included in the study and hence chronicity could not be determined as the only cause of affected LRJT results.
- Patients with acute on chronic pain were excluded from the study.

Recommendations

- LRJT results can be compared between two groups of acute and chronic pain keeping all the biases common to establish chronicity as the only cause of affected LRJT scores.
- Factors responsible for only a limited percent of chronic population to have altered LRJT results can be determined.
- Patients with acute exacerbations of their chronic conditions can be incorporated in the study to determine if the acute exacerbations increase the affection of the LRJT.
- Follow up of the LRJT test results can be done to see the changes in them over time.

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