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Article :Effect of proprioception on H- reflex in normal subjects

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Abstract: Many studies have been done on effect of proprioceptive stimuli on H-reflex but all have controversial results and comparitively less number of studies have been done to find out the effect of traction and approximation on H-reflex. In this study effect of traction and approximation was studied on 30 healthy normal subjects which included both males and females. The mean , standard deviation, t-value F-value and post hoc analysis for all the variables was significant It was concluded that H – reflex parameters show change during traction and approximation and also during standing and sitting.

Key words: joint traction, distraction, approximation, H-reflex, proprioception, knee joint, monosynaptic reflex.

Introduction

Proprioceptive sensation (kinesthesia and/or joint position sense), one of the most important somatosensory modalities, is known to play an important role in body balance and motor control (Mathews 1977, 1982; McCloskey 1978; Burgess et al. 1982; Wiesendanger and Miles 1982; Prochaska and Hulliger 1983; Hulliger 1984; McCloskey et al. 1987). Proprioceptive input can potentially influence multiple levels of CNS functions, all of those levels can potentially modulate the intensity or importance of that information through many different mechanisms. Proprioceptors are found in three peripheral anatomical locations: the muscle spindle, the tendon, and the joint. Type III Golgi type endings are slowly adapting joint receptors and seem to provide the brain with information about joint position. Studies reveal that an unidentified set of muscle afferent fibers and cutaneous receptors both contribute to the sense of movement and position.

Joint traction and approximation are two proprioceptive stimuli applied at the joint. Traction is the distraction and separation of joint surfaces. For distraction to occur at the joint the surfaces must be pulled apart. Compression is the decrease in the joint space between bony patners. Compression normally occurs in the

extremity and spinal joints when weight bearing. Some compression occurs as muscles contract; this provides stability to the joints.

The Hoffmann reflex (H- reflex), an electrically evoked monosynaptic reflex, is a measure of the final common pathway, or the motor output. The H- reflex of the soleus muscle, which is an antigravity muscle, is highly modifiable by peripheral sensory inputs and the descending postural commands from the CNS (Schieppati, 1987).

Nakazawa et al (2004) demonstrated that H-reflex was decreased as the ankle- or knee-joint load was increased. Kawashima et al (2003) also showed suppression of the H-reflex amplitude during the standing compared with the sitting condition especially in the spinal cord injury group. Also Hayashi et al (1992) found that the amplitude of the H-reflex increased when the muscle was shortened in both the sitting and standing conditions. The degree of increase in H-reflex was smaller during standing than sitting for the same change in muscle length. But Jawayed et al (1999) found no difference in H-reflex responses between sitting or lying and it is suggested that the subject/patient should be tested in a position which is most comfortable. Arnfred et al (2000) concluded that a brisk change of a hand held load elicits a significant evoked potential (EP) unlike the electrical somato-sensory EP (SEP). The above mentioned controversial results and comparatively less number of studies done about the effect of distraction and approximation on H- reflex have imbibed me to this study.

H- REFLEX: - The Hoffmann reflex (H- reflex), an electrically evoked monosynaptic reflex, is a measure of the final common pathway, or the motor output. The H- reflex of the soleus muscle, which is an antigravity muscle, is highly modifiable by peripheral sensory inputs and the descending postural commands from the CNS .

TRACTION: - Traction is the distraction and separation of joint surfaces. For distraction to occur at the joint the surfaces must be pulled apart.

APPROXIMATION: - Compression is the decrease in the joint space between bony patners. Compression normally occurs in the extremity and spinal joints when weight bearing. Normal intermittent compression loads help move synovial fluid and thus help maintain cartilage health.

Methods

Study performed on 30 normal subjects both males and females taken from the city Patiala under the age group of 17-47 years. This was an experimental study, which was performed in the Punjabi University, Patiala in Neurophysiology lab of Department of Physiotherapy. Study was performed in accordance with ethical considerations of the institute and their consent was taken prior to the study.

Testing equipment and procedure

H- reflex studies were performed on (Neuroperfect) EMG/NCV/EP system, EMG 2000; Medicaid system ISO (9001:2000) certified. Before beginning with the procedure, the subjects who were selected on the basis of convenient block sampling by applying inclusion criteria were explained the entire procedure in detail. They were then assessed according to the assessment chart.

Parameters studied: H-latency, H/M and H amplitude.

Procedure: The subject was made to lie prone comfortably on a plinth. They were given 5 minutes time for relaxation and her all physical activities was stopped prior to test. Any metallic ornaments on the limb were removed. The right leg was exposed from foot to popliteal fossa. The resistance of the skin of leg was reduced using cotton dipped in alcohol. The room temperature was noted. The electrodes were placed first on the right leg to record H- reflex. Pick up electrode: the patient is prone with feet suspended over the edge of table. The active surface electrode was placed on a point of bisection on the line connecting the popliteal crease and the proximal flare of the medial malleolus. Reference electrode: over Achilles tendon. Ground electrode:between site of stimulation and pick up. Stimulating electrode: at tibial nerve, the cathode is proximal and is placed over the tibial nerve in the popliteal fossa at the level of the popliteal crease. The sub maximal stimulation was given to the tibial nerve distally at the level of the popliteal crease and a motor response was recorded from the medial position of soleus muscle. A square wave pulse of 1ms duration is used for preferential stimuation of large sensory fibres. The stimuli are adjusted so as to evoke used for preferential stimulation of large sensory fibres. The stimuli are adjusted so as to evoke maximum H- response amplitude. At this strength a small M- response may also be present. Attention to M- response may help in monitoring the strength of stimulation. H/M ratio which is measured from peak to peak amplitude maximum H- reflex to maximum M – Amplitude(H/M) provides an easy estimate of motor neuron pool excitability. The latency of H reflex is measured from the stimulus artifact to the first deflection from baseline. The amplitude is measured from base to peak of the negative phases.

The subject was made to stand on the wooden board with same electrode arrangement to approximate the articular surfaces of the knee joint. The procedure was repeated to find H- latency, H/M ratio and amplitude of H- wave.

The subject was made to sit on the stool with same electrode arrangement and right leg hanging freely off the stool. A 2 kg weight was tied at the ankle to distract the knee joint. The procedure was repeated to find H- latency, H/M ratio and amplitude of H- wave.

RESULTS – tables and graphs

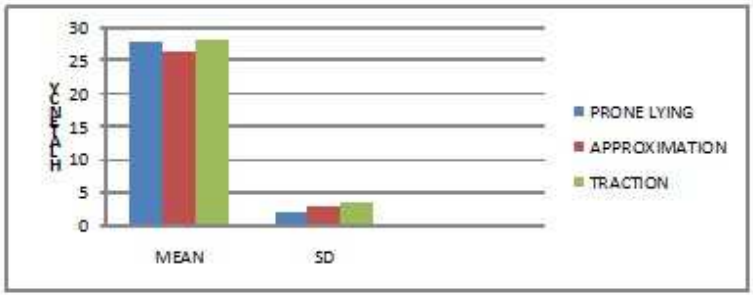
1. To find the effect of proprioception on H latency by calculating mean , standard

deviation, paired t- test, one way ANOVA and Post hoc analysis.

Table – 1 Mean and standard deviation of H latency

	Prone Lying	**Approximation**	**Traction**
Mean	27.793	26.299	28.21233
SD	2.136575	2.959865	3.497929

The table 1 describes the Mean and Standard deviation of H latency in prone lying, approximation and traction. Mean and standard deviation of H latency in prone lying is 27.793±2.136575, mean and standard deviation of approximation is 26.299±2.959865, mean and standard deviation of traction is 28.21233±3.497929.



Graph 1 shows mean and standard deviation (SD) of H latency in prone lying, approximation and traction.

Table -2 Paired t- test for H latency

	t value	**P value**
Prone lying – approximation	3.043502	P< 0.05
Approximation – traction	2.1781	P< 0.05
Prone lying – traction	0.74269	P> 0.05

Table 2 describes paired t- test for H latency between prone lying – approximation, approximation – traction and prone lying – traction. The results show significant difference of H latency between prone lying – approximation.

Table 3 One – way Anova for H Latency

	F value	**P value**

Prone lying- approx.- tract.	3.56128	P< 0.05

.Table 3 describes one way anova for H latency. The F- value is 3.56128 ≥ p 0.032614.

Table 4 Post hoc analysis of H latency

	Mean difference	**P value**
Prone lying- approx.	1.494	P> 0.05
Approx. – traction	-1.913	P< 0.05
Prone lying – traction	-0.4193	P>0.05

Table 4 describes post hoc analysis of H latency between prone lying- approx., approx. – traction and prone lying – traction. Significant difference is found between approx. – traction.

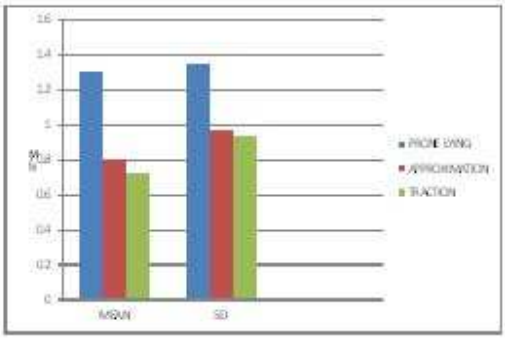
2. To find the effect of proprioception on H/M by calculating mean , standard

deviation, paired t- test, one way ANOVA and Post hoc analysis.

Table – 5 Mean and standard deviation of H/M

	Prone Lying	**Approximation**	**Traction**
Mean	1.300333	0.804	0.728333
SD	1.355447	0.974915	0.932106

Table 5 describes the Mean and Standard deviation of H/M in prone lying, approximation and traction. Mean and standard deviation of H/M in prone lying is 1.300333±1.355447, mean and standard deviation in approximation is 0.804±0.974915, mean and standard deviation in traction is 0.728333±0.932106.



Graph2 shows mean and standard deviation (SD) of

H/M in prone lying, approximation and traction

Table -6 Paired t- test for H/M

	t value	**P value**
Prone lying – approximation	4.182593	P< 0.05
Approximation – traction	0.372876	P> 0.05
Prone lying – traction	2.53301	P< 0.05

Table 6 describes paired t- test for H/M between prone lying – approximation, approximation – traction and prone lying – traction. The results show significant difference of H/M between prone lying – approximation.

Table 7 One – way Anova for H/M

	F value	**P value**
Prone lying- approx.- tract.	2.376261	P<0.05

. Table 7 describes one way ANOVA for H/M. The F- value is 2.376261 ≥ p 0.098902.

Table 8 Post hoc analysis of H/M

	Mean difference	**P value**
Prone lying- approx.	0.4963	P< 0.05
Approx. – traction	0.07567	P> 0.05
Prone lying – traction	0.5720	P<0.05

Table 8 describes post hoc analysis of H/M between prone lying- approx., approx. – traction and prone lying – traction. Significant difference is found between prone lying – approx. and very significant difference is found between prone lying- traction. There is non significant difference between approx. – traction.

2. To find the effect of proprioception on H amplitude by calculating mean ,

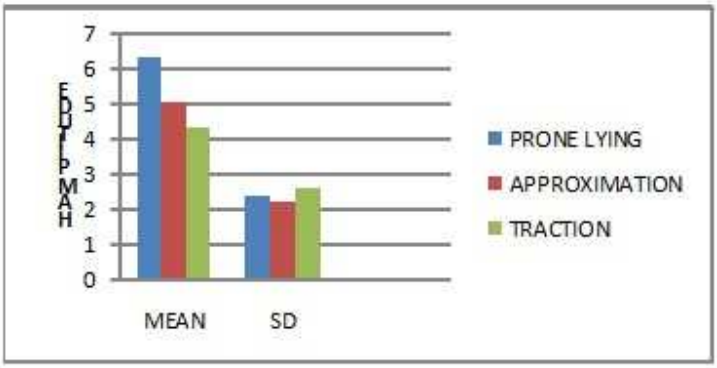
standard deviation, paired t- test, one way ANOVA and Post hoc analysis.

Table – 9 Mean and standard deviation of H amplitude

	Prone Lying	**Approximation**	**Traction**
Mean	6.311333	5.093333	4.342

SD	2.387239	2.228194	2.645704

Table 9 describes the Mean and Standard deviation of H amplitude in prone lying, approximation and traction. Mean and standard deviation of H amplitude in prone lying is 6.311333±2.387239, mean and standard deviation in approximation is 5.093333±2.228194, mean and standard deviation in traction is 4.342±2.645704.



Graph 3 shows mean and standard deviation (SD) of H

amplitude in prone lying, approximation and traction.

Table -10 Paired t- test for H amplitude

	t value	**P value**
Prone lying – approximation	3.994456	P< 0.05
Approximation – traction	1.542611	P> 0.05
Prone lying – traction	4.008526	P< 0.05

Table 10 describes paired t- test for H amplitude between prone lying – approximation, approximation – traction and prone lying – traction. The results show significant difference between H amplitude of prone lying – traction.

Table 11 One – way Anova for H amplitude

	F value	**P value**
Prone lying- approx.- tract.	5.032664	P< 0.05

. Table 11 describes one way anova for H amplitude. The F- value is 5.032664 ≥ p

0.008547.

Table 12 Post hoc analysis of H amplitude

	Mean difference	**P value**
Prone lying- approx.	1.218	P< 0.05
Approx. – traction	0.7513	P> 0.05
Prone lying – traction	1.969	P<0.05

Table 12 describes post hoc analysis of H amplitude between prone lying- approx., approx. – traction and prone lying – traction. Significant difference is found between prone lying- approx. Highly significant difference is found between prone lying – traction. There is non significant difference between approx. – traction.

Discussion

This was an experimental study was done to find the effect of knee joint traction and approximation on H reflex. By reviewing literatures it was found that H-reflex was decreased as the ankle- or knee-joint load was increased.

Nakazawa et al (2004) demonstrated that H-reflex was decreased as the ankle- or knee-joint load was increased. Kawashima et al (2003) also showed suppression of the H-reflex amplitude during the standing compared with the sitting condition especially in the spinal cord injury group. Also Hayashi et al (1992) found that the amplitude of the H-reflex increased when the muscle was shortened in both the sitting and standing conditions. But Jawayed et al (1999) found no difference in H-reflex responses between sitting or lying.

After calculating mean and standard deviation in prone lying, approximation and traction, paired t- test for H latency between prone lying – approximation, approximation – traction and prone lying – traction. The results show significant difference of H latency between prone lying – approximation and approx. - traction. The F- value shows significant difference of H latency between prone lying- approx. – traction. And finally the post hoc analysis of H latency between prone lying- approx., approx. – traction and prone lying – traction was done . The mean difference approx. – traction was greatest.

After calculating mean and standard deviation, paired t- test for H/M between prone lying – approximation, approximation – traction and prone lying – traction. The results show significant difference of H/M between prone lying – approximation and prone lying - traction. The F- value does not show significant difference of H/M between prone lying- approx.- traction. The mean difference as a result of post hoc between prone lying- traction was 0.5720. Significant difference was found between prone lying – approx. and very significant difference was found between prone lying- traction. There was non significant difference between approx. – traction.

The mean and standard deviation of H amplitude was calculated. The t- value for prone lying – traction was highest 4.008526 at $p< 0.05$. The results show significant difference between H amplitude of prone lying – traction and prone lying- approx.. The F- value of H amplitude shows significant difference of H amplitude between prone lying – approx. – tract.. Finally the the mean difference

between prone lying- traction was highest 1.969 at $p < 0.05$. Significant difference is found between prone lying- approx. Highly significant difference is found between prone lying – traction. There is no significant difference between approx. – traction.

These results may be attributable to three possible sources that could modulate the soleus H-reflex circuit 1) the vestibular system, 2) homonymous (from soleus) facilitation and 3) mechanical compressive forces in the spinal nerve roots. It was also observed that the pressure receptors within vertebral column and joints, such as ankles, knees, hips and neck joints possibly activate the inhibitory interneurons converging on the moto- neurons (Dietz, 1985).

It was also proposed that somatosensory inputs due to gravity inhibit the soleus H-reflex circuit. Segmental and supraspinal factors are possibly responsible for this phenomenon. The segmental factors consist of inhibitory interneurons and presynaptic inhibition of the Ia terminal (Iles, 1996). While transcranial magnetic stimulation studies revealed supraspinal (descending) modulation of the soleus H-reflex circuit under various postural conditions, such as the supine, sitting and standing postures (Schieppati, 1987).

But the results of my study are contradicted by Phadke et al (2006) who demonstrated that no significant modulation in reflex excitability was observed by change in loading conditions in either the non-injured or the injured spinal cord injury (i-SCI) subjects and that non-injured persons and persons with i-SCI respond similarly to bilateral limb unloading during standing with no change in H-reflex amplitude.

The review of literature that supports my study are by Ali and Sabbahi (2000) who stated that the H-reflex was inhibited during standing, loading and unloading as compared with prone lying. The H-reflex was recovered during loading as compared with during standing. Ken'ichi Egawa et al (2003) concluded that somatosensory inputs due to gravity exert an inhibitory effects on the soleus H-reflex circuit during upright standing in humans. Nakazawa et al (2004) investigated the effects of loading and unloading of the lower limb joints on the soleus H-reflex in standing humans and concluded that as the ankle- or knee-joint load was reduced, the H-reflex was significantly enhanced compared to that under the control condition.

According to alternate hypothesis of the study joint traction and approximation effect the H- reflex parameters that is H latency, H/M ratio, H amplitude and that

the sitting and standing positions significantly influence the H- reflex. Therefore, the null hypothesis is rejected.

In the end, we conclude that there is significant effect of knee joint traction and approximation on monosynaptic reflex Also the changes are observed in H-reflex parameters in sitting and standing positions.

CONCLUSION

From the data analysis of this study, it was concluded that there are significant changes in H- reflex when knee joint is approximated and distracted. Sitting and standing positions significantly influence the H- reflex. H- reflex is a sensitive tool to assess proprioception. Traction and approximation are good tools to facilitate proprioception.

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