

Comparison of Effect of Six Minutes of Effleurage and Kneading Massage on Alpha Motoneuronal Excitability in Normal Healthy Individuals

S. Singh*, A.G.K. Sinha**

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*Sandeep Singh, Assistant Professor, Department of Physiotherapy, Punjabi University, Patiala, Punjab, India. Email: sandyraina24@gmail.com

**Akhoury Gourang Kumar Sinha, Professor, Department of Physiotherapy, Punjabi University, Patiala, Punjab, India. Email: sinha2450007@yahoo.com

*Corresponding Author: Sandeep Singh, Assistant Professor, Department of Physiotherapy, Punjabi University, Patiala, Punjab, India-147002. E-mail: sandyraina24@gmail.com

ABSTRACT

There remains a dearth of scientifically documented evidence about the effects of massage on muscle tone mainly due to non-availability of sensitive and reliable tool for objective measurement of tone. Presently, H-reflex is considered as reliable tool to objectively measure motoneuronal excitability hence muscle tone. The purpose of this study was to investigate and compare the effects of 6 minutes of effleurage massage and 6 minutes of kneading massage on muscle tone as measured by changes in amplitude of H-reflex recordings. Seventeen healthy volunteers (8 male, 9 female, $\bar{x} = 26.53 \pm 5.67$ years of age) participated in the study. H-reflexes were recorded immediately before and after application of massage technique, peak to peak amplitude of ten H-reflexes was selected for analysis. The Student's t-test was used for comparison of pre and post-massage values of H-reflex amplitude and also for comparison between mean difference values for H-reflex amplitude of both massage interventions. Significant decrease in H-amplitude was observed after 6 min of effleurage massage ($t=3.57, p \leq 0.05$), reduction in H-amplitude albeit non-significant was also observed after 6 min of kneading massage ($t=0.69, p \leq 0.05$). Further comparison of mean difference values of H-amplitude for both massage techniques showed non-significant differences ($t=1.99, p \leq 0.05$) hence neither of massage technique proved to be effective over other in decreasing reflex activity of muscle.

Key Words: Effleurage, kneading, motoneuronal excitability, H-reflex amplitude

INTRODUCTION

Massage is one of oldest form of treatment utilized by man to alleviate multitude of symptoms (Morelli et al., 1990; Scull, 1945). In physiotherapy too, usage of massage has long tradition and it is held as 'nucleus of physiotherapy' along with heat and exercise (Callaghan, 1993). The application of diverse amount of physical forces to the skin and muscle during massage induces numerous effects such as biomechanical, physiological, reflexive and

psychological that is put to therapeutic use for improving circulation, reducing swelling and pain, improving soft tissue mobility and inducing relaxation (Sinha, 2001).

The use of massage to reduce pain and spasm, induce muscle relaxation and alter tonal states of muscle is often attributed to neurologic effects. However the exact mechanism underlying these effects of massage is yet to be elucidated. Alteration of neuromuscular excitability following massage leading to change in muscle tone is one such area where there exists paucity of literature. Often diametrically contradictory claims can be found that assert that massage has facilitatory as well as inhibitory effect on the muscle tone (Kamenetz, 1960; Morelli et al., 1991; David & Young, 2009). A single objective marker of muscle tone is yet to emerge however the H- reflex is widely used as a measure of neuromotor excitability (Schieppati, 1987; Pierrot- Deseilligny & Mazevet, 2000; Palmieri et al., 2004). H-reflex amplitude is considered reliable measure of motoneuronal excitability and has been used to investigate the efficacy of various therapeutic procedures on muscle response (Morelli et al., 1991; Goldberg et al., 1992). A series of studies examining the effects of duration and intensity of some deep massage techniques (petrissage and effleurage) on muscle tone using H reflex methodology reported decrease in H-reflex amplitude during the application of massage in healthy individuals (Morelli et al., 1990; Morelli et al., 1991; Sullivan et al., 1991; Goldberg et al., 1992; Sullivan et al., 1993). Other techniques of massage such as kneading, wringing, rolling etc are also widely used for relaxation purposes. However the effect of these techniques on muscle tone has not been investigated. Keeping this in view, the present study was designed to investigate the effect of two massage techniques i.e. effleurage and kneading on the H – reflex in healthy subjects.

MATERIALS AND METHODS

Subjects: Seventeen healthy volunteers (8 male, 9 female) with mean age 26.53 ± 5.67 years participated in this study. No subject had any history of back and lower limb injury, surgery or any symptoms of neurological disorders. Each subject gave informed written consent prior to participation in study. They were asked to refrain from any medication and heavy physical exertion on day of study. Study was approved by Institutional Ethics Committee of Punjabi University, Patiala,

Design: Same subject, pre-post test design, was used. Each subject was administered two techniques of massage for 6 minutes on two occasions, separated by a gap period of at least 15 hours to negate any carry-over effect. The subject was made to rest in prone for 10 minutes prior to recording of pre-intervention H-Reflex. Thereafter massage technique was administered for 6 minutes on left calf area. The post intervention H-reflex was recorded immediately after the completion of massage manoeuvre.

Massage Techniques:

Each subject was placed in prone position on padded wooden table with feet extending beyond the end of plinth. The left leg was supported on small pillow to keep knee in slight flexed position in order to reduce the stretch on triceps surae muscle. Area of left leg to be

massaged was exposed and talcum powder was applied to reduce friction during administration of massage. Effleurage massage was administered to whole length of left calf muscle from distal to proximal direction using both hands, right hand following left hand, with deep pressure as tolerated without causing discomfort to the subject. The rate of effleurage stroking was kept slow (10-12 strokes/min) (Sinha, 2001).

Kneading was administered to left calf muscle in distal to proximal direction with palm of right hand. Palmar kneading was initiated by making small circles while applying pressure in proximal half of circle and receding in distal half of circle (Sinha, 2001).

Recording of H reflex

The NCV/EMG machine (Neuroperfect-2000) manufactured and calibrated by Medicaid System (an ISO 9001:2000 certified Company), Chandigarh, India was used for H-reflex recording. Subject was positioned in prone position on padded plinth with knee in slight flexion and feet outside the plinth to allow for ankle movement. Head was rotated to right in an attempt to control the possible effect of the asymmetrical tonic neck reflex (Hayes & Sullivan, 1975). Two small (silver-silver chloride) electrodes were used for H-reflex recording. Prior to electrode placement area was cleaned with isopropyl alcohol solution to decrease skin resistance. Active surface electrode was placed at midpoint of line connecting proximal flare medial malleolus and popliteal crease. Reference electrode was placed over Achilles tendon and ground electrode was placed between the site of stimulation and active electrode (Braddom & Johnson, 1974; DeLisa, 1987; Han et al. 1997).

Rectangular electrical pulse of 1ms duration was applied at submaximal intensity through Bipolar method of stimulation to elicit H-waves and associated small M-waves from left calf muscle by stimulating posterior tibial nerve at popliteal fossa. Subsequent stimuli were kept 10 seconds apart to reduce the effects of post-activation depression. Twenty H-reflex waves were recorded in pre-massage session as well as in post-massage session, then out of them ten waves for each session exhibiting stable M-waves were selected and mean of peak to peak amplitude in milli-volts (mV) of their H-waves and M-waves was obtained. The size of M-wave was monitored continually and was kept constant by adjusting the intensity of stimulation during recording of H reflex. It is suggested that keeping M-wave stable eliminates that chances of artefactual changes and ensures that same set of neuronal pool is recruited in every recording session (Goldberg et al., 1992; Sullivan et al., 1993; Pierrot-Deseilligny & Mazevet, 2000; Palmieri et al., 2004).

Statistical Analysis: The Student's t-test was applied to compare pre and post-massage values of H-reflex amplitude for each massage intervention and also to compare mean difference values for H-reflex amplitude of both massage interventions. The significance level for the study was fixed at $P \leq 0.05$ for analysis of results.

RESULTS

Mean reduction of 9.81% in H-reflex amplitude was observed after the application of Effleurage technique which was statistically significant at alpha level of 0.05 but not for the kneading technique (Table 1). However the mean difference between pre and post

intervention of H-reflex amplitude of both the experimental conditions were not significantly different (Table-2). Inter-subject responses to these two massage techniques showed wide variation (Table 3).

Table 1. The comparison of pre and post values of H-reflex amplitude (milli-Volts) for 6 minutes of Effleurage and 6 minutes of Kneading massage

S.No	Massage Technique	Pre-values Mean± SD	Post-values Mean± SD	t-value
1.	Effleurage	5.30 ± 1.57	4.78 ± 1.36	3.57*
2.	Kneading	4.93 ± 1.81	4.8 ± 1.68	0.69

* P <0.05

Table 2. The comparison of mean difference values for H-reflex amplitude (milli-Volts) for 6 minutes of Effleurage and Kneading massage

S. No	Parametre	Mean difference values for Effleurage Mean± SD	Mean difference values for Kneading Mean± SD	t-value
1.	H.Amplitude	0.51 ± 0.59	0.12± 075	1.99

* P <0.05

Table 3. Descriptive Data of Participants and Inter-Subject Response of H-Amplitude Before and After 6 Minutes of Effleurage and 6 Minutes of Kneading Massage

Patient	Age	Gender	6 Minutes of Effleurage			6 Minutes of Kneading		
			Pre	Post	%age change	Pre	Post	%age change
1.	32	M	5.74	4.45	22.47 ↓	4.45	4.41	0.90 ↓
2.	24	M	5.12	4.28	16.41 ↓	4.1	4.02	1.95 ↓
3.	21	M	7.85	6.64	15.41 ↓	9.96	8.85	11.14 ↓
4.	25	M	7.07	6.68	5.52 ↓	6.09	4.53	25.62 ↓
5.	24	F	5.98	5.46	8.70 ↓	3.82	4.14	8.38 ↑
6.	24	F	7.03	6.78	3.56 ↓	5.16	5.82	12.79 ↑
7.	24	F	5.08	5.65	11.22 ↑	4.34	5.59	28.80 ↑
8.	24	F	2.95	3.17	7.46 ↑	3.56	2.88	19.10 ↓
9.	45	M	7.11	6.33	10.97 ↓	6.02	6.72	11.6 ↑
10.	29	M	3.98	3.55	10.80 ↓	3.12	3.46	10.90 ↑
11.	25	F	4.77	3.63	23.90 ↓	5.51	5.47	0.73 ↓
12.	25	F	3.44	3.28	4.65 ↓	3.24	2.85	12.04 ↓
13.	21	F	4.29	4.88	13.75 ↑	3.84	3.95	2.86 ↑
14.	24	F	2.84	2.43	14.44 ↓	2.17	2.17	0.00 [¥]
15.	24	F	4.77	4.34	9.01 ↓	5.82	5.74	1.37 ↓
16.	30	M	4.73	3.71	21.56 ↓	5.86	4.3	26.62 ↓
17.	30	M	7.38	6.14	16.80 ↓	6.8	6.8	0.00 [¥]
Total	26.53±5.67		5.30±1.57	4.79±1.36		4.93±1.81	4.8±1.68	

↓=decrease, ↑=increase, ¥ no change

DISCUSSION

It is often claimed that massage can have both stimulating as well as inhibiting influence on muscle tension depending upon rate of application and pressure exerted during massage administration (Kamenetz, 1960; Morelli et al., 1991; David & Young, 2009). However studies on the effect of massage on muscle tone are limited. The measurement of muscle tone itself presents a problem. Few researches in nineties have endeavoured to investigate effect of massage on muscle tone using H-reflex methodology (Morelli et al., 1990; Morelli et al., 1991; Sullivan et al., 1991; Goldberg et al., 1992; Sullivan et al., 1993). H-reflex represents degree of motoneuronal excitability that is considered more objective neurophysiologic measure of muscle tension (Field, 1998) and is being widely used to investigate response of neuromuscular system to the application of various therapeutic modalities. It is held that reduction of motoneuronal excitability is reflected as decrease in H-amplitude.

Administration of 6 minutes of effleurage massage in the present study demonstrated significant reduction in H-amplitude. Sullivan and colleagues (1993) investigated the effect of 3 min of effleurage on motoneuronal excitability of triceps surae muscle using H-reflex methodology on sixteen healthy adults and reported a mean reduction of 25 per cent in H-reflex amplitude only during the period massage was administered but after that effect did not last. Results of present study demonstrated 9.81 per cent reduction in mean values of H-amplitude after application of 6 minutes of effleurage massage. In present experimental set up of study, H-reflex was recorded not during massage but immediately after cessation of massage hence reduction in H-amplitude noticed can be regarded as carry-over effect of effleurage massage. This carry-over effect can be ascribed, in part, to difference in duration of massage, in part to possible differences in pressures exerted by effleurage massage in both studies. Longer duration used in present study may have caused pronounced effect. Constant pressure was maintained at 2.5 kPa during contact in previous study, but in the present study no quantification of pressure was done however attempt was made to keep rhythm of effleurage massage similar to previous study using stroke rate at 10-12 strokes /min.

Reduction albeit non-significant, was observed in H-amplitude immediately after 6 minutes of kneading massage. Kneading is a technique of pressure manipulation group of massage and has not been previously studied for its effect on H-amplitude. The other technique of pressure manipulation group of massage i.e. petrissage, was investigated in studies by Morelli et al (1990; 1991), they reported reduction in amplitude of H-reflex only during massage but not thereafter.

It is direction of application of pressure that differentiates kneading from petrissage. In petrissage, tissues are lifted away from long axis of bone and intermittent pressure is applied. In kneading intermittent pressure is applied parallel to long axis of bone and muscle tissue are compressed against the bone (Sinha, 2001), therefore it is plausible to hypothesize that both techniques produce different effect.

Both techniques of massage in present study have resulted in reduction of H-amplitude, however wide variation was observed in individual responses to these techniques. Technique

of effleurage resulted reduction in H-amplitude from its pre-massage values in 82.35 % (n=14) of subjects, whereas same technique has produced an increase in H-reflex amplitude in 23.53% (n=3) of subjects. Similar pattern was observed with kneading, where after massage, the reduction, increase and no change in H-amplitude was observed in 52.94% (n=9), 35.29%(n=6) and 11.76% (n=2) of subjects respectively. The amount of change H-reflex amplitude was small. The small change and large inter subject variability may account for the non – significant differences seen between two techniques. This necessitates use of sophisticated instrumentation and relatively larger sample size to arrive at definite conclusion. Further studies on larger sample size are required to cross validate the observations of this study.

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