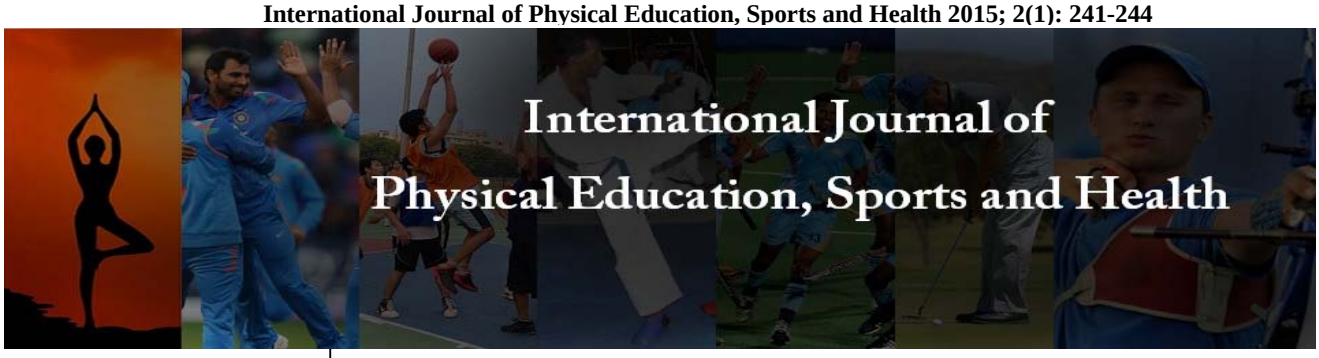

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Jimshad TU
Dayananda Sagar College of Physiotherapy, Shavige Malleshwara Hills, K-S lay out Bangalore 560078, India.

Subin Solomen
Padmashree Institute of Physiotherapy, Kommaghata Campus, Kengeri, Bangalore-60, India.

Pravin Aaron
Padmashree Institute of Physiotherapy, Kommaghata Campus, Kengeri, Bangalore -60 India.

Anil T John
Dayananda Sagar College of Physiotherapy, Shavige Malleshwara Hills, K-S lay out Bangalore 560078, India.

Correspondence:
Jimshad TU
Dayananda Sagar College of Physiotherapy, Shavige Malleshwara Hills, K-S lay out Bangalore 560078, India.

Effect of hand dominance on late responses in young adults

Jimshad TU, Subin Solomen, Pravin Aaron, Anil T John

Abstract
Background: Late responses are the potentials appearing after motor response (M-wave) following mixed nerve stimulation. There are 2 important late responses H-reflex and F-response. In past decades, several researchers reported differences in electro physiological properties between dominant and non-dominant upper extremities. Objective of the study was to find out the effect of hand dominance on the H reflex latency and amplitude and to find out the effect of hand dominance on the F wave latency and FM ratio.
Methods and Material: Healthy subjects of either gender between the age group of 17-25 years and with BMI of 18-23 were included. Subjects divided in to two groups, 15 right handed and 15 left handed and late responses study were conducted to find out the effect of hand dominance on H-reflex and F-wave parameter.
Results: H-reflex latency of dominant group, dominant was 23.40 and non-dominant hand was 24.31 which was statistically significant (p<.0001). Also H-reflex amplitude dominant hand was 0.89 and non-dominant hand was 0.67 which was statistically significant (p<.0001) F-wave latency of dominant group, dominant hand was 23.24 and non-dominant hand was 24.50 which was statistically significant (p<.0001).Also F-M ratio of dominant hand was 21.22 and non-dominant hand was 22 .68 which was statistically significant (p<.0001).
Conclusions: Results suggest that Hand dominance has an significant effect on the H-reflex latency and amplitude and also significant effect on F-wave latency and F-M ratio.

Keywords: Hand dominance, H-reflex, F-wave.

1. Introduction
The hand of man is a remarkable instrument capable of performing countless actions, from the functional view point the hand is the effecter organ of the upper limb which supports it mechanically and allows it to adapt the optimal position of any given action [1]. The hand arm system is the most active part of the human upper extremities [2]. Human body is seemingly symmetrical but actually functionally asymmetrical. Our hands, feet, eyes, and even sides of the face while seemingly the same, are actually quite different. Because of the different between right hand and arm and our left hand and arm, nature has provided a physical characteristics that we call dominance [3].
Dominancy is the preference that most human show for one side of their body over the other, example right handedness or left footedness. It provides the basis for measurement of differences. It is also known as brains lateralization, it refers to the fact that the two halves of the human brain are not exactly alike and one hemisphere dominates over the other ,the cerebral hemisphere that is more involved in governing certain body function such as controlling arm and leg used preferentially in skilled movements known as dominant hemisphere. Handedness is defined as when the arms and the hands are symmetrical in use and function as to reliably favour one hand or other across a range of skillful act [3, 4]. The hand preference is a popular method of checking hand preference of a subject .The most popular research tool is the handedness inventory, which provides quantitative index of handedness, rather than binary classification and is quick and convenient to administer, without requiring the equipment or even the presence of the examiner validity and reliability is reasonable [5]. In past decades, several researchers reported differences in electro physiological properties between dominant and non-dominant upper extremities. Electro physiological properties of peripheral nervous system can be studied by using late responses [3].

Late responses are the potentials appearing after motor response (M wave) following a mixed nerve stimulation. There are 2 important late responses H reflex and F response [6]. H reflex was described by Hoffmann in 1918, hence called H reflex. H reflex is a monosynaptic reflex elicited by sub maximal stimulation of the tibial nerve and recorded from the calf muscle. In normal adults, it can also recorded from other muscles of the limbs but not from the small muscles of hand and feet except in children below 2 years of age [6]. H reflex of flexor carpi radialis muscle have been well documented [7]. H reflex amplitude reflects the excitability of spinal alpha motor neuron, which is under the control of multitude of segmental and supra segmental influences (Schieppati 1987). H reflex latency provides information about the conduction velocity in the afferent and efferent components of reflex arc. This method should be useful for electrophysiological testing in disorders of the proximal parts of the peripheral nervous system [8].

F wave is a late response resulting from antidromic activation of motor neurons involving conduction to and from spinal cord and occurs at the interface between the peripheral and central nervous system [6]. In the upper extremity when median and ulnar nerves are stimulated at wrist and recorded from the small muscles [9]. F-wave of abductor pollicis brevis well documented [10]. F-M ratio are the two latencies compare proximal and distal nerve conduction, F-M ratio F represents the latency of the F- wave and M that of M response. It represents conduction time from the cord to the stimulus site and M that of the remaining distal nerve segment to the muscle [11]. There is paucity of research regarding effect of dominancy on electric properties of nerves. In order to improve the diagnostic yield of electrophysiological studies in individual patients with various peripheral neuropathies. This study has been attempted in young population to find out whether hand dominance has any effect on H-reflex and F wave parameters.

Objectives of the study were to find out the effect of hand dominance on the H reflex latency and amplitude and to find out the effect of hand dominance on the F wave latency and F-M ratio.

2. Materials and Methods

The study was conducted at Padmashree Diagnostic centre, Bangalore. Ethical clearance was obtained from institutional ethical committee, Padmashree Institute of Physiotherapy, Bangalore as per ethical guidelines for biomedical research on Human subjects, 2001 ICMR, New Delhi. The study design was within-subject evaluation study. Inclusion criteria was Healthy subjects of either gender between the age group of 17-25 years and with BMI of 18-23. They were identified from Padmashree group of institution and informed consent was obtained from the subjects who were willing to participate in the study. By using EHI (Edinberg handedness inventory) [12] 30 subjects were taken, Group1 included 15 right handed subjects and Group 2 included 15 left handed subjects. Exclusion criteria was Subjects with any neurological conditions affecting the upper limb, Subjects with any musculoskeletal conditions affecting upper limb, Subjects with any congenital anomalies, Subjects who are not cooperative, Subjects who are ambidextrous. Materials used for this study are Recorded Medicare system (RMS) stimulator's contains stimulating part, processing part, and printer Stimulations part consist of surface électrodes (stimulating ground and recording) H-reflex and F-wave testing was administered to the both the group in an air conditioned room with temperature controlled between 22-25 degree Celsius.

Procedure Included H-Reflex Recording, For all the subject H-reflex was obtained from the flexor carpi radialis, subject was positioned in a high sitting on a couch with elbow joined positioned in 30 degrees of flexion and fore arm positioned in complete pronation, the reflex is recorded with surface EMG electrode the active electrode was placed over the belly of FCR and inactive electrode was placed over the ulnar styloid, the signal was recorded throw an EMG amplifier with the high and low filter seted 2 K Hz and 22100 hz, amplitude was measured from baseline to higher negative peak, the latency of H-reflex measured from stimulus artifact to the first reflex from the base line [7,8].

F-wave recording, F-wave was recorded from the abductor pollicis bravis subject was positioned in a high sitting on a couch with elbow joined positioned in 30 degrees of flexion and fore arm positioned in supination, supramaximal stimulation (25% above maximal) at a rate not more than 0.5 Hz was used, recording electrode was placed in a belly tendon montage, amplifier gain of 200-800 micro voltage per division at a sweep speed 5-10 ms/ division was set [7].

The latency of H-reflex measured from stimulus artifact to the first reflex from the base line, and F-M ratio was recorded which represent the ratio of latencies of F-wave and M response. Effect of hand dominance on the H-reflex and F-wave parameters was statistically analysed [7].

Data analysis was performed using SPSS software (version 17). Alpha value was set at 0.05. Descriptive statistics was used to find out mean and standard deviation (SD) for demographic and outcome variables. Unpaired t-test was used to compare the difference among the outcome variable between the groups. Paired t-test was used to compare the difference in dominance and non-dominance within same subject

3. Results & Discussion

3.1 Results

Base line characteristics of 30 subjects shown in the table 1, Mean age of right hand dominance group was 22.33 and left hand dominant group was 22.33 which was not statistically significant (p>1). Right hand dominant group gender was 10 and 5 respectively and in left hand dominant group was 7 and 8 which was not statistically significant (p > 0.269). BMI distribution between the two group was not statistically significant with the p-value of (>0.112). Distribution of female were higher in left hand dominance, were as it was lower in right hand dominance group The BMI values were higher in left hand dominant subjects compared to the right hand dominant subjects.

Table1: Baseline data of the study subjects (n=30)

Variable	Right dominance	Left dominance	P value
Age	22.33±0.89	22.33±1.23	> 1
Gender (M/F)	10/5	7/8	> 0.269
BMI	22.62±0.81	23.06±0.63	> 0.112

Table 2 show that for H-reflex latency of right hand dominant group, dominant hand was significantly better compared to non-dominant side (p<.006). Also H-reflex amplitude of right hand dominant group, dominant hand was significantly better compared to non-dominant side (p<.016).F-wave latency of of right hand dominant group, dominant hand was significantly better compared to non-dominant side (p<.011) Also F-M ratio of right hand dominant group, dominant hand was significantly better compared to non-dominant side (p<.0001).

Table 2: within group comparison of right hand dominant H- reflex and F wave parameter.

Variable	Parameter	Dominant	Non dominant	p-value
H-reflex	Latency	23.87±1.51	24.55±1.21	<.006
	Amplitude	1.07±0.3	0.80±0.37	<.016
F-wave	Latency	23.79±1.87	25.17±1.78	<.011
	F-M ratio	22.22±1.50	23.41±1.43	<.0001

Table 3 show that for H-reflex latency of left hand, dominant hand, was significantly better compared to non-dominant side (p<.006). Also H-reflex amplitude dominant hand, was significantly better compared to non-dominant side (p<.003). F-wave latency of left hand dominant group, dominant hand, was significantly better compared to non-dominant side (p<.002). Also F-M ratio of dominant hand, was significantly better compared to non-dominant side (p<.001).

Table 3: Within group comparison of left hand dominant H- reflex and F wave parameter.

Variable	Parameter	Dominant	Non dominant	p-value
H- reflex	Latency	22.92±1.46	24.06±1.55	<.006
	Amplitude	0.70±0.24	0.54±0.17	<.003
F-wave	Latency	22.70±1.55	23.84±1.34	<.002
	F-M ratio	20.22±1.39	21.94±1.27	<.001

Table 4 show comparison of dominant and non-dominant hand in both right and left hand dominance group. H-reflex latency of dominant group, dominant hand, was significantly better compared to non-dominant side (p<.0001). Also H-reflex amplitude dominant hand, was significantly better compared to non-dominant side (p<.0001). F-wave latency of dominant group, dominant hand, was significantly better compared to non-dominant side (p<.0001). Also F-M ratio of dominant hand, was significantly better compared to non-dominant side (p<.0001).

Table 4 comparison of all dominancy and non-dominancy.

Variable	Parameter	Dominant	Non dominant	p-value
H- reflex	Latency	23.40±1.54	24.31±1.38	<.0001
	Amplitude	0.89±0.34	0.67±0.31	<.0001
F-wave	Latency	23.24±1.78	24.50±1.69	<.0001
	F-M ratio	21.22±1.75	22.68±1.53	<.0001

3.2 Discussion

Objective of the study was to find out the effect of hand dominance on the H reflex latency and amplitude and to find out the effect of hand dominance on the F wave latency and FM ratio.

In this study it is found that H-reflex and F-wave parameter were significantly better in dominant hand than the non-dominant. In the past decade several researcher reported difference in the physiology between the dominant and non-dominant upper limb. Most of the results suggested the presence of higher percentage of slow twitch type1 muscle fiber in the preferentially used muscle fiber [13-16]. H-reflex mediated via 1a afferent impinging primarily on anterior horn cell of low threshold motor units, because low threshold motor units associated with type1 muscle fiber, the finding of contralateral H-reflex result can be viewed as another sign of asymmetric fiber composition.

There is also evidence on greater motor neuron excitability and greater number of pyramidal tract fibers on the dominant side nearly about 80% of the adult human brain [17-19]. The preferential lateralization of H-reflex and F-wave parameter on the dominant hand could be due to the 3 reasons Greater force output for low threshold motor units throw the selective hypertrophy of slow fibers. Longer twitch duration time resulting in greater twitch fusion at low fire rate. Greater number of motor units recruited at low force level [20]. A study demonstrated that higher median nerve conduction velocities in the dominant arm for both left hand and right hand subjects [21].

Limitations of this study was small Sample size, This study can be effected with confounding variables like limb length and skin temperature, Recommendations Further studies should do with larger sample and consider involvement of confounding variable like skin temperature, limb length

4. Conclusion

Supporting evidence from the literature though seems to be controversial in certain areas ;the outcome of this study with significant statistical changes lead us to the conclusion that hand dominance has an significant effect on late response parameters. As the result show H-reflex latency and amplitude significantly better in dominant hand compared to non-dominant hand. Also F-wave latency and F-M ratio significantly better in dominant hand compared to non-dominant hand

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