

Eliciting knee jerk - A new method of reinforcement

S Khana¹, RK Sainju,² P Adhikari³ and R Thapa⁴

¹Dept. of Ophthalmology B P Koirala Lions Centre for Ophthalmic Studies TU Teaching Hospital, ²Dept of Neurosurgery, Kathmandu Model Hospital, Kathmandu, ³Dept of ENT-HNS, TU Teaching Hospital Kathmandu Dept. of Emergency Medicine, Patan Hospital Kathmandu, Nepal

Corresponding author: Dr. Shankar Khanal, Department of ophthalmology BPKLCOS, Nepal,
e-mail:khanalshankar@hotmail.com

ABSTRACT

This study was designed to detect the sensitivity of different methods of eliciting knee jerks and to compare the conventional methods with the newly proposed maneuver. Knee jerk (a deep tendon reflex) was elicited in 123 apparently normal population (77 males and 46 females) with three different methods (1) without applying reinforcement, (2) applying Jendrassik maneuver (strong voluntary contraction of upper limbs) and (3) using the new method of reinforcement – that is by dorsiflexion of ankle joint of the same foot voluntarily as strong as possible on which the jerk would be elicited. The sensitivity of the method without reinforcement was found to be is 87.8%; that with Jendrassik maneuver was 93.5%, whereas the sensitivity of newly proposed maneuver was 99.2%. Results of the present study have served to demonstrate that elicitation of knee jerk with newly proposed reinforcement maneuver is the best among all three methods.

Keywords: Knee jerk, normal test without reinforcement, jendrassik maneuver.

INTRODUCTION

When the tendon of a slightly stretched muscle is tapped with a clinical hammer, the muscle contracts briefly. It is the test of integrity of afferent and efferent pathways and the excitability of the anterior horn cells in the spinal segment of the stretched muscle. Though Robert Whytt (1763) noticed that muscle activation could be caused by stretch¹ and Erb and Westphal (1875) first emphasized their usefulness in identifying an abnormality of the central nervous system,² there is some evidence that the knee jerk response was well known to laymen prior to that time.³ Gowers first coined the term knee jerk. By the turn of the last century, Sherrington had demonstrated the physiological anatomy of the monosynaptic reflex arc, of reciprocal inhibition, and of propriospinal neurones.⁴ Synaptic mechanisms themselves were subsequently analysed with extracellular and intracellular microelectrodes by Eccles.⁵

Quantification of tendon stretch reflex requires precise measurement of the tapping force of a reflex hammer.⁶ Sometimes when we fail to elicit knee jerk, reinforcement with Jendrassik maneuver⁷ (strong voluntary contraction of upper limb muscle) is applied. Using jendrassik's maneuver also, it is not possible to elicit knee jerk in some subjects. So a new maneuver of reinforcement was tried to elicit knee jerk.

SUBJECTS AND METHODS

The study was carried out among the healthy 123 persons were randomly selected (77 males and 46 females, age = 55 to 73yrs). The clinical test was carried out by tapping in patellar tendon with the same clinical hammer. The results were considered to be positive when there is contraction of ipsilateral quadriceps femoris muscle and / or extension at knee joint. All positive cases were taken as true positive and all negative cases were considered as false negative since each subject was neurologically intact. Clinical test was carried out for each subject in sitting position with the legs hanging freely over the edge of the bed. Below mentioned three methods were applied to each subjects on both lower limbs.

1. Knee jerk tested normally without applying any reinforcement maneuver.
2. Knee jerk tested applying jendrassik maneuver (strong voluntary contraction of upper limb muscle by asking the subject to hook the fingers of two hands and pull them against one another as hard as possible).
3. Knee jerk tested with new reinforcement as proposed by authors, asking each subject to dorsiflex ipsilateral ankle joint voluntarily as strong as possible. Sensitivity of each method were noted and results were analyzed using Z-test.

RESULTS

The characteristic pattern of the subjects are shown in Table-1. The sensitivity of the method without reinforcement was found to be is 87.8% and that with Jendrassik maneuver was 93.5%. The sensitivity of newly proposed maneuver was 99.2%.The results were analyzed and was found to be statistically significant at p=0.01.(Table-2). However there was no significant difference in sex and laterality.

DISCUSSION

Knee jerk is basically an example of monosynaptic, dynamic stretch reflex involving the spinal segment L_{2,3,4}. Reflex arc involves-receptor (muscle spindle), afferent (Ia fiber), center (Spinal cord L_{2,3,4}), efferent (alpha motor neurons), effector organ (skeletal muscle -quadriceps femoris).Muscle spindles found in skeletal muscles are most numerous towards the tendinous attachment of muscle. There are two types of intrafusal fibers -Type I and type II. There are two kinds of sensory endings in each spindle. Primary or annulospiral endings responsible for dynamic reflex and secondary or flower-spray endings responsible for static response.⁸ The muscle spindles are in parallel with extrafusal fibers. So, when the muscle is passively stretched spindles are also stretched, deforming the annulospiral ending. It generates the receptor potential, resulting in action potential in the sensory fibers Ia which reflexly contracts extrafusal muscle fibers. The muscle spindles also have their own motor supply by gamma-efferent fibers of Laksell³ or A-gamma group of Erlanger and Gasser.⁹ Gamma efferent discharge, by any means, causes shortening of contractile ends of the spindle resulting the reflex. The gamma efferent system is excited especially by signals from the bulboreticular facilitatory region of the brain stem. Bulboreticular facilitatory region and its allied areas in the brainstem transmit excitatory signals through the gamma nerve fibers to the intrafusal muscle fibers of the muscle spindles.¹⁰

When the rate of gamma efferent discharge is increased, the intrafusal fibers are shorter than the extrafusal one. If the whole muscle is stretched during the stimulation of the gamma afferents, additional action potential are generated by additional stretch and the rate of discharge in the Ia fibers is further increased. Increased gamma efferent discharge along with the increased discharge of the alpha motor neuron initiates movement. Reflexes may be difficult to elicit in normal subjects owing to global hypoexcitability of ventral horn motor neurons. Under these circumstances, motor neurons may be rendered more excitable by the Jendrassik maneuver (reinforcement). This was originally thought to enhance fusimotor drive, though it is now thought to reflect a direct excitatory effect on the a motor neurons.^{11,12}

It has been suggested that absent ankle jerks may not be abnormal in the elderly. However, only 6.0% of normal subjects over the age of 65 have absent ankle jerks.^{13,14} A recent study has focused attention on the technique for eliciting the ankle jerk in elderly people, suggesting that plantar strike is more effective than tendon strike.¹⁵

Other factors influencing knee jerk are, anxiety, stimulation of skin with noxious agents, reinforcement maneuvers all increases gamma discharge.⁹ Results of the present study demonstrated that elicitation of knee jerk with newly proposed reinforcement maneuver; ie, by dorsiflexion of ipsilateral ankle joint voluntarily as strong as possible is the best among the all three methods of reinforcements.

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Table-1: Subjects and methods

	Knee jerk elicited without reinforcement		Knee jerk elicited with Jendrassik maneuver		Knee jerk elicited with new proposed reinforcement maneuver	
	Male	Female	Male	Female	Male	Female
Right knee	67	40	71	43	77	45
Left knee	69	40	72	44	77	45
Total	136	80	143	87	154	90

Table-2: Sensitivity of all three methods

Methods	Knee jerk without reinforcement	Knee jerk with Jendrassik maneuver	Knee jerk with proposed reinforcement maneuver
Sensitivity	87.8%	93.5%	99.2%