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## Biomechanics responsible for effect of elbow position on biceps tendon reflex

Sir,

I read with interest the electrophysiological study published by Keles et al<sup>1</sup> quantifying the effect of elbow position on biceps tendon reflex in normal healthy volunteers. The amplitude and reflex onset latency were studied at 3 different elbow positions, at 90°, 120°, and 150° of joint angles. It was interesting to note in this study that the mean amplitude decreased progressively from 90° to 150°. The amplitude of the biceps tendon reflex is proportional to the net forces acting at the elbow in the direction of contraction of the biceps muscle during the biceps tendon reflex, which include the force of contraction (F) of the biceps muscle and the opposing force of the horizontal component of the 'tension' (T) in the forearm due to the weight of the forearm. The force of contraction of the biceps muscle during the reflex is again dependent on various factors such as the strength of tendon tap, influences of reciprocal inhibition etc. As mentioned in this study, if care is exerted to maintain the strength of the tendon taps similar, the amplitude may, hence depend primarily on the opposing force of the forearm tension.

When the elbow is placed at 90°, as seen in Figure 1, tension 'T' is equal to the component of the weight of the forearm in vertical direction i.e. 'mg' ('mass of the forearm' X 'acceleration due to gravity'). The horizontal component of this force which opposes the force of contraction of muscle is  $mg \cos 90^\circ$  i.e. zero.

When the elbow is placed at 120°, as seen in Figure 2, tension 'T' along the direction of the forearm will be  $mg / \cos 30^\circ$ . The horizontal component of this force opposing 'F' will be equal to  $(mg / \cos 30^\circ) \times \cos 60^\circ$  or 0.57 mg or approximately half the weight of the forearm.

When the elbow is placed at 150°, as seen in Figure 3, tension 'T' along the direction of the forearm will be  $mg / \cos 60^\circ$ . The horizontal component of this force opposing 'F' will be equal to  $(mg / \cos 60^\circ) \times \cos 30^\circ$  or 1.73 mg. Therefore at 150°, the opposing force to muscle contraction was almost

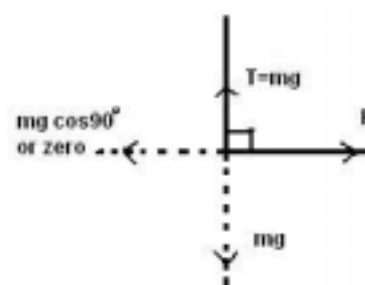


Figure 1: Elbow angle at 90°, 'F' force of biceps muscle contraction, 'T' tension in forearm due to weight of forearm 'm' mass of forearm, 'g' acceleration due to gravity

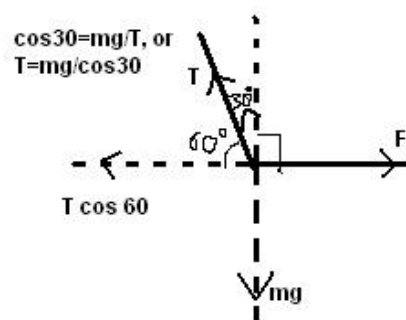


Figure 2: Elbow angle at 120°  
 $\cos 30^\circ = \frac{3}{2}$  or 0.86  
 $1 / \cos 30^\circ = 1.15$   
 $\cos 60^\circ = \frac{1}{2}$  or 0.5

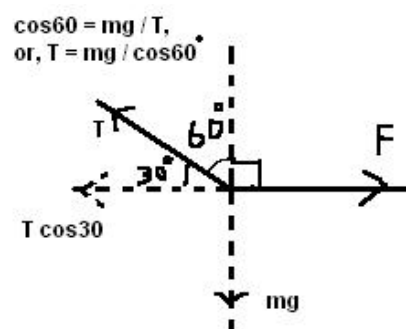


Figure 3: Elbow angle at 150°.  
 $\cos 60^\circ = \frac{1}{2}$  or 0.5  
 $1 / \cos 60^\circ = 2$ ,  $\cos 30^\circ = \frac{\sqrt{3}}{2}$

equal to twice the weight of the forearm, which led to a statistically significant decrease in the amplitude at 150° as reported by Keles et al.<sup>1</sup>

Evidently the opposing force to the muscle contraction due to the horizontal component of the tension in the forearm increased with the increase in the elbow angle and thence led to the decrease in the amplitude of the muscle reflex with increasing angle. Clinically, most commonly appreciated character of a DTR is its amplitude and is thus accordingly noted as exaggerated, normal or diminished reflex. Hence to obtain the maximum amplitude in order to make an appropriate clinical judgment about the biceps tendon reflex, it is best to tap the biceps tendon with the elbow placed at an angle of 90°.

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## Biomechanics responsible for effect of elbow position on biceps tendon reflex: Authors' reply

Sir,

We thank the author(s) of the letter for taking interest in our article "The effect of elbow position on biceps tendon reflex"<sup>1</sup> and appreciate the detailed comments concerning the biomechanical aspects of the subject. However, some minor points in this letter need clarifications.

Firstly, we think that the author(s) may inadvertently be mistaken in the comments by saying that the mean amplitude increased progressively from 90° to 150°, since the mean amplitude of the biceps tendon reflex was found to be decreased (not increased) progressively from 90° to 150° of elbow position in our study.

Secondly, the position of the forearm was not vertical at 90° or other elbow positions in our study, since we tested the biceps tendon reflex of the subjects on the examination table in a relaxed supine position with the elbow held at 90° and the hand on the abdomen. After the procedure was completed for 90° of elbow position, the angle of elbow was first extended to 120° and then to 150° for the same procedures. Thus, in addition to the other possible factors, the biomechanical aspects of this procedure may also account for the decrease in the amplitude of the tendon reflex by increasing the angle of the elbow; however, the changes in the biceps muscle size may be the most probable determinant of the variations in amplitude of biceps reflex.

Concerning the third point, as we mentioned in the article, maximum biceps tendon reflex amplitude was obtained at 90° elbow position, however, the mean amplitude of biceps tendon reflex obtained at 120° of elbow position was extremely close to that obtained at 90° of elbow position, and the difference between 90° and 120° of elbow position was not significant statistically in contrast to the difference 90° and 150° or to the difference 120° and 150° of elbow position. Thus, it is

evident that the amplitude of the reflex decreases with the increase of elbow angle, however, this result does not let to propose tapping the biceps tendon with the elbow placed at only an angle of 90° to get the maximum amplitude.

In clinical examinations, it is important to compare tendon reflexes in terms of magnitude and symmetry. However, in neurophysiological examinations, it is also important to determine the latency as well as the amplitude of a reflex. It is obvious that the magnitude of the reflex response alters depending on the several factors including particularly the rate of the stretch, angle of the joints, the intensity of the tapping and also the biomechanical factors.

As a conclusion, in clinical and electrophysiological practice, while testing the tendon reflexes, it may be better to keep in mind that the magnitude (electrophysiologic equivalent of amplitude) of a reflex may change due to various factors including the position of the extremity.

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## Concurrent intramedullary and intracerebral tuberculomas

Sir,

Eventhough central nervous system tuberculosis is an uncommon entity affecting 0.5% to 2% of patients with systemic tuberculosis, intracranial tuberculomas account for significant number of intracranial mass lesions in developing countries.<sup>1</sup> However, intramedullary tuberculomas are very rare, seen at a rate of 2/1000 cases of central nervous system tuberculosis. The incidence of concurrent spinal and cerebral tuberculomas is still very rare with less than ten cases reported in the literature.<sup>2-6</sup> An interesting case of concurrent spinal and cerebral tuberculoma who manifested simultaneously as acute quadriplegia and seizures reported here.

A 38 years old gentleman presented with sudden onset of weakness of all the four limbs of two weeks duration associated with retention of urine. Neurologically, his motor system examination revealed flaccid quadriplegia with grade 3/5 power proximally in both upper limbs and grade 0/5 power in both lower limbs with brisk deep tendon reflexes and extensor

