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Original Article

Nerve conduction studies of ulnar and median nerves in elite rowers

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ABSTRACT

Introduction: Rowing is a strenuous sport that demands high levels of training, strength and repetitive motion. This study was conducted for assessing the impact of rowing act on the ulnar and median nerves which crosses the wrist area in elite rowers.
Method: Twenty asymptomatic professional male rowers and 20 non-active males were evaluated in this study. The neuro-physiologic evaluation comprised sensory and motor nerve conductions of median and ulnar nerves.
Result: The sensory conduction velocity of the ulnar and median nerves were noticably delayed in both extremities of rowers when they were compared with control group. There weren't any statistical differences in motor conduction velocities of ulnar and median nerves between the control group and rowers in not only dominant but also non-dominant extremities.
Discussion: In conclusion, the abnormal median and ulnar sensory nerve conduction at the wrist region might show a subclinical entrapment neuropathy as a result of arduous wrist moves in rowers.

1. Introduction

Rowing is a strenuous sport that demands high levels of training, strength and repetitive motion. In elite rowers, the most prevalent injury area is the lumbar spine followed by the chest, knee, shoulder, hip, cervical spine and forearm/wrist.[1,2,3] Landbase training, including ergometer and weight training is related to approximately 50% of injuries in elite rowers.[4,5] The injuries effecting rowers are primarily from overuse.[6,7] Higher training volume on the ergometer and poor technique on the water may have a role in overuse injuries in these athletes.

Competitive rowing has two forms. One of them is sweep rowing where each rower has one oar (or blade), held with both hands. The other one is sculling where each rower has two oars (or sculls), one in each hand.[8] Injuries which concerns the wrist are prevalent. The reason of it is the sweep and sculling grasp position. In fact the sport of rowing is described as a "wrist-loading focus sport" along with gymnastics, tennis, field hockey, volleyball and judo.[9] Poor technique or exhaustion frequently causes the forearm and wrist injuries. "The reason of this is exaggerated wrist motion during the action of feathering the oar (turning the oar so that it moves parallel to the water on the recovery), or a tight grip."[5] Injuries related to the wrist in rowing include exertional compartment syndrome, lateral epicondylitis, deQuervan's, intersection syndrome and tenosynovitis of the wrist extensors. On the other hand, nerve entrapments in variable forms are also seen in rowing. They vary between carpal tunnel syndrome brought about by tight hand grip and numbness of the legs originated from pressure on the sciatic nerve from a poorly fitted seat. We believe that many neurological cases remain subclinical and are only recognized after neurological damage is permanent. Therefore, we decided to assess the impact of paddling on the ulnar and median nerves that crosses the wrist area in elite rowers.

2. Materials and methods

2.1. Participants

Twenty male Olympian rowers (age 20.75 ± 3.14 years) and 20 non-active males (age 22.80 ± 4.34 years) participated. Table 1 shows physical characteristics of the participants. Before the initiation of the study, the participants were asked to fill out a

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Table 1
Mean results of participants.

	Rowers (n = 20)	Controls (n = 20)
Age(years)	20.75 ± 3.14	22.80 ± 4.34
Height(cm)	185 ± 0.04	180 ± 4.40
Weight(kg)	71 ± 1.94	73 ± 3.46

Values are given as mean ± SD.

survey to determine whether they had any musculoskeletal pain, discomfort, or known injury in their upper extremities. Rowers who had a recent upper extremity injury were excluded from the study. At the time of the study, all subjects regularly participated in national and international-level championships. In this study, rowers have one oar in each hand (sculling). All of them were lightweight rowers with a maximum weight of 72 kg. The participants in this study were training and competing as part of the Galatasaray Rowing Team.

Each rower was informed of the testing procedures, benefits and risks of this investigation and their written informed consent was obtained. This study was conducted according to the guidelines of the Declaration of Helsinki. The ethics committee of our university also accepted this study.

2.2. Neuro-physiological tests

The neuro-physiological study comprised motor and sensory nerve conduction of ulnar and median nerves.

All of the subjects were kept informed about the procedure of the study. The subjects lay supine on an examination bed with the upper limb supported. All of the studies were conducted in a warm room with the temperature maintained at 26–28 °C. The skin temperature of the upper limb was monitored to eliminate the effect of temperature on the conduction parameters. If necessary, the limb was warmed under an infrared heat lamp to maintain a temperature of 32 °C or higher. In an effort to reduce diurnal variation, all of the measurements were made at approximately the same time of day for each subject. The intercathodal distances were measured with an anthropometer. The dominant extremities of all subjects were tested by a neurologist using a Neuropack M1, MEB-9204 K (Nihon Kohden, JAPAN). The electrophysiological study was conducted according to the practice guidelines of the American Association of Electrodiagnostic Medicine (AAEM).

Nerve conduction studies were performed using standard techniques of supramaximal percutaneus stimulation with a constant current stimulator and surface electrode recording on both extremities of each subject. Sensory responses were obtained by antidromically stimulating at the wrist and the recording from the index finger (median nerve) and little finger (ulnar nerve) with ring electrodes. The median motor nerve was examined by stimulating the median nerve at the wrist between the tendons of the flexor carpi radialis and palmaris longus. The nerve was stimulated with bipolar surface electrodes and the recording was carried out over the abductor pollicis brevis muscle with surface electrodes. The ulnar motor nerve was examined by stimulating the ulnar nerve at the wrist with bipolar surface electrodes. The motor response was recorded from the abductor digiti minimi muscle with surface electrodes.

2.3. Statistical analyses

The study data were analysed using the SPSS package (SPSS for Windows v 18.0, SPSS, Chicago, IL, USA). The means and standard deviations of all the measurements were calculated. The differences between group means were determined using a non-parametric test for independent samples (Mann-Whitney U test). A p value of 0.05 was considered statistically significant.

3. Results

The sensory conduction velocity of the ulnar and median nerves were significantly delayed in both extremities of rowers compared with control subjects. There were no statistical differences in motor conduction velocities of ulnar and median nerves between the control group and rowers in both dominat and nondominant extremities (Tables 1–4).

4. Discussion

The rowing stroke is a repeatitive action that consists of two stages. One is "drive" and the other one is "recovery". The drive starts in the "catch" status with the rower's upper limbs in full extension and lower limbs and chest in full flexion. Then the blade of the oar enters the water. Flexion of the arms completes the drive and the blade is removed from the water when the rower arrives at the "finish" or "release" status. The recovery starts at the release. Once the oar is extracted from the water, rower rotates it. Therefore, the blade is "feathered" (parallel to water). In reverse order to the drive, upper limbs extend, followed by the chest moving forward in a flexed position and knees elevating to the chest while legs return to full flexion. Oar handle is rotated again thus the blade is "squared" (upright to water) in rehearsal for entry at the catch.[5]

Rowing includes repeating actions. Therefore, rowers encounter repeating stress injuries, which can happen anywhere in the kinetic chain of the rowing stroke.[10] Most every rowing-related overuse injury of the forearm and wrist can be attributed to persistent application of incorrect mechanics while feathering. Feathering requires rapid extension of the wrist, further stressing an already strained forearm. Problems arise with an overly tight grip coupled with excessive rotation of the wrist when feathering.[8] Smoljanovic et al. (2009) [7] exhibit that most of the rowing injuries are overuse problems, as the most of the injuries caused by trauma maintained during cross-training. Sustaining the tight hand grip that refers to clutch the oar(s) for prolonged periods of time is risky for overuse injuries at forearms. "Each rowing stroke also involves twisting the oar parallel to the water when feathering the oar in the recovery stage. This motion is carried out by extension at the wrist, further stressing the forearm."[11]

Most kinds of the peripheric nervous system injuries are related to the special sport branch.[12,13] In this study, we observed reduced mean sensory nerve conduction velocity in the median and ulnar nerves in the rowers compared with the controls. The ulnar and median nerves originate from the brachial plexus. Likewise the ulnar nerve, the median nerve passes from the axilla to the hand. Some potential areas of injury can be described through this long course. The median nerve reaches the hand through the carpal tunnel. Overuse syndromes related to activity on wrist area, containing also carpal tunnel syndrome, frequently happen when hand and wrist are used to convey force from a tool such as a tennis

Table 2
Mean results of nerve conduction velocity(Motor)(Dominant).

Nerve	Nerve Conduction Velocity (M ± SD) (m/sec)		*P*
	Controls (*n* = 20)	Rowers (*n* = 20)	
Median nerve	58.67 ± 5.09	59.32 ± 3.47	0.383
Ulnar nerve	61.38 ± 5.27	59.96 ± 3.78	0.398

Values are given as mean ± SD.

Table 3
Mean results of nerve conduction velocity(Sensory)(Dominant).

Nerve	Nerve Conduction Velocity (M ± SD) (m/sec)		P
	Controls (n = 20)	Rowers (n = 20)	
Median nerve	65.16 ± 4.13	58.52 ± 4.61	**0.000**
Ulnar nerve	65.38 ± 5.52	56.12 ± 4.26	**0.000**

Values are given as mean ± SD.

Table 4
Mean results of nerve conduction velocity(Sensory)(Nondominant).

Nerve	Nerve Conduction Velocity (M ± SD) (m/sec)		P
	Controls (n = 20)	Rowers (n = 20)	
Median nerve	63.03 ± 7.46	54.25 ± 13.40	**0.004**
Ulnar nerve	62.60 ± 7.60	54.07 ± 4.69	**0.000**

Values are given as mean ± SD.

racket, or to convey force to a ball such as basketball, or when extended compression can occur such as rowing or cycling. The ulnar nerve passes to the front and medial aspect of the forearm and becomes superficial just before the wrist. It runs through a tunnel named Guyon's canal at the wrist area. Injury to the ulnar nerve by compression is usually in the Guyon's canal in cyclists, and in racket sports, due to the effect of the handle on the hand with repeating and compelling gripping.[14,15] Our slower sensory nerve conduction velocity findings in the neurologically asymptomatic rowers may correspond to preclinical lesions. "Certain postures or positions can place increased pressure either directly or by increasing tension on the nerves at different entrapment points."[16] In rowing, during the scrulling grip, the wrist extends and causes the oar to rotate (Fig. 1). At this moment dorsiflexed wrist may put extraordinary tension on the median and ulnar nerves. We suggested that high repetitive stress placed on the wrist during rowing and atypical wrist mechanics such as prolonged extension of the wrist make rowers susceptible to ulnar and median nerve disorders.

The findings in the present study demonstrate that the sensory conduction velocities of median and sural nerves were significantly delayed in the rowers' both dominant and nondominant extremities. Looking at movements specific to rowing (especially in sculling rowing), the demands placed on the upper extremities ingenerate bilaterally. It may considered to be a reason finding similar results for both extremities.

In our study, no significant values concerning motor nerves were found. Sensory fibres are more sensitive to changes and thus may be affected earlier than motor fibres so sensory conduction studies might be more useful than motor studies in early diagnosis.

We could find no studies in the literature suggesting electrodiagnostic abnormalities in asymptomatic rowers. This study is the first reported observation of delayed sensory conduction velocity of the median and ulnar nerves in elite rowers' both arms compared with control subjects.

5. Conclusions

This study shows that rowers have an inclination to establish median and ulnar sensory nerve damage in the wrist area without any symptoms. The sculling grip position might cause delayed sensory conduction velocities both in the median and ulnar nerves.

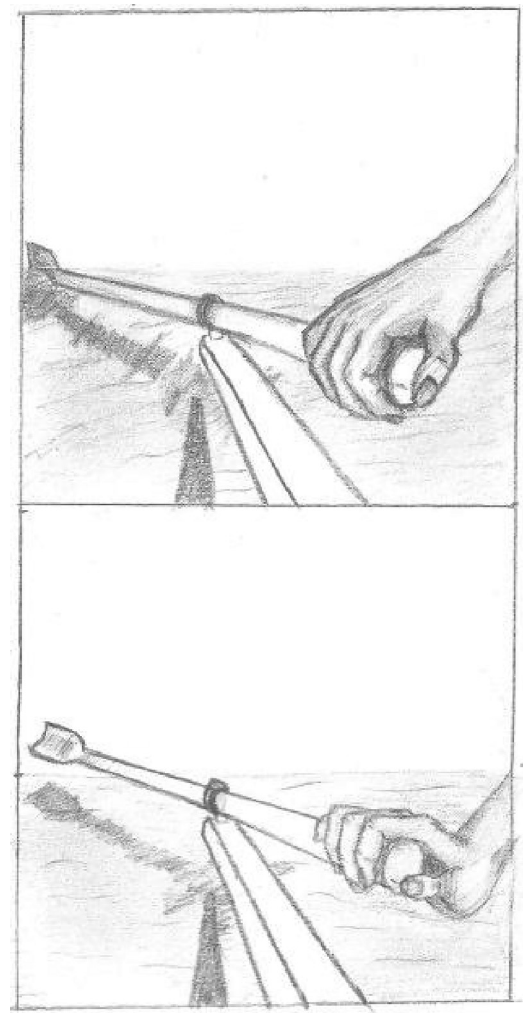

Fig. 1. Paddle grip position.

Repetitively exerting high stress on the wrist during rowing act might bring about traction injuries to the nerves that get through the area. Given the similar anatomic position of the ulnar nerve and the median nerve at the wrist, the risk factors involved in computer use may be similar. Understanding subclinic injuries in elite rowing is noteworthy to effectively evaluate and treat rowing injuries and to reduce the risk of nerve injury in these athletes.

This study was presented at the 8th European Sport Medicine Congress of EFSMA, 2013, Strasbourg, France.

Conflict of interest

The author(s) declared no potential conflicts of interest with respect to the research, authorship, and/or publication of this article.

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