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Are the Response Latencies of the Achilles and Patellar Reflex Responses as Recorded by the Action Current and Muscles Thickening Techniques Comparable?

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ARE THE RESPONSE LATENCIES OF THE ACHILLES AND PATELLAR REFLEX RESPONSES AS RECORDED BY THE ACTION CURRENT AND MUSCLE THICKENING TECHNIQUES COMPARABLE?[1]

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Two techniques for the measurement of the latent times of the Achilles and the patellar tendon reflexes have become more or less standardized in recent years. These are: (1) the recording of the currents of action from the executant muscle; and (2) the recording of the thickening of the muscle itself. Altho the latent times reported from the use of these two techniques are at considerable variance, those recorded by the muscle thickening technique being consistently longer than those recorded by the action current technique, there appears to have been no attempt to determine the time relationship between latent times recorded simultaneously from the same point on the muscle by means of the two techniques. This is the problem undertaken in this study. The immediate purpose of the study is to devise a technique whereby the latencies of the Achilles or the patellar reflexes as measured by recording the action currents and the mechanical thickening of the executant muscle may be recorded simultaneously from the same point on the muscle on a single film, reading both latencies from the same time line and the same signal line.

APPARATUS AND METHODS

The action current latencies were recorded by means of a three stage, resistance-coupled amplifier and a three element oscillograph on Eastman Number 1 Recording paper. A vacuum tube oscillator furnished a thousand cycle time line, and a signal circuit indicated the time of striking the tendon. This set-up has been described by Travis and Hunter and by Travis and Young in the journals. The muscle thickening was recorded by connecting an electrical current generator to one element of the oscillograph. This generator has a very light coil which moves freely in a strong magnetic field causing a change of electrical potential as it cuts the lines of force of the magnetic field, which change is recorded

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by the oscillograph. This generator has been previously described by Travis and Hunter.

In eliciting the Achilles reflex, the subject was seated in a heavy, specially constructed chair in which the right leg could be held immovable in such a manner that the foot was permitted to move freely at the ankle joint. The electrodes, thin brass strips, covered with Canton flannel and moistened with a saturated salt solution when used, were set in a thin wooden plate, which was placed over the motor point of the gastrocnemius muscle. From the thin wooden plate a short light wooden rod extended backward and slightly downward. At its end was a polished screw head which came in contact with the top of the light movable coil of the generator. As the muscle thickened during the reflex response the coil was depressed and the movement was recorded on the film of the oscillograph.

For the patellar reflex it was found to be unnecessary to support the leg rigidly, since the direction of the stimulating blow was at right angles to the direction of movement of the muscle and so permitted no jar to be conveyed to the generator when the tendon was struck, and since the weight of the body was sufficient to prevent any movement of the upper part of the leg. In this case, however, the generator was supported in an inverted position over the electrode, which was placed on the motor point of the executant muscle.

From six to ten records were taken from all subjects at a single sitting for each of the reflexes, except that for five subjects from thirty-five to sixty records were taken at a single sitting to determine the constancy of relationship between the two techniques over a long series of elicitations of the reflexes. In three subjects the gastrocnemius muscle was thoroughly fatigued and records taken both before and after the fatiguing.

In the case of the action current records the time elapsing between the signal deflection and the first deflection of the action current volley was counted off to the nearest .5 sigma. For the muscle thickening time the time elapsing between the signal and the beginning of the large deflection of the line following the first smaller deflection, which is caused by the mechanical stretching of the muscle by the blow on the tendon, was counted off to the nearest .5 sigma.

Data

Records were obtained from thirty men for the Achilles reflex, and from twenty-nine men for the patellar reflex.

For both the Achilles and the patellar reflexes from twenty-five to fifty consecutive elicitation of the reflex response were obtained from five subjects.

From three subjects records were obtained both before and after the gastrocnemius muscle had been thoroughly fatigued. The records of two of the subjects were readable.

Results

The averages of the latencies obtained by the action current technique were approximately the same as those previously obtained in this laboratory with this technique, as were also the standard deviations and ranges. The averages of the muscle thickening latencies were somewhat smaller than those reported by other workers using this technique, and the ranges decidedly smaller. This is taken to indicate that the technique for recording the muscle thickening latencies was more highly refined than any previously used.

A correlation of $.80 \pm .043$ was obtained by correlating the action current latencies and the muscle thickening latencies for the Achilles reflex. For the patellar reflex the correlation was $.78 \pm .054$. These correlations are considered high enough to indicate that either technique would be satisfactory for comparative purposes, if the muscle thickening technique were sufficiently refined and controlled. It is also taken to indicate that both latencies are dependent on the same or closely related factors.

The ranges for the various individual measures likewise indicated a constancy of relationship between the latencies recorded by the two techniques. In the Achilles reflex an average range of 1.3 sigma was found for the action current latency; and of 1.9 sigma for the muscle thickening latency. In the patellar reflex the action current latency range was 1.4 sigma; and the muscle thickening latency range 1.8 sigma. This essential similarity in the ranges of the measures obtained by the two techniques, while indicating that the action current technique is probably somewhat more precise and more highly refined than the muscle thickening technique, is taken to show that the latencies as obtained by the two techniques do not vary independently of each other.

An examination of the standard deviations from the means for each individual case likewise confirms the conclusions that there is an essentially constant relationship between the latencies obtained by the two techniques. This is particularly striking when it is recognized that, as stated above, the action current technique is

undoubtedly more highly refined and less subject to extraneous influences than is the muscle thickening technique.

The long series of consecutive measures were practically identical with those just given in respect to averages, standard deviations, and ranges, showing that the constant relation already indicated holds true for such a long series. It also indicates that the shorter series were adequate measures of the relationship.

Peripheral fatigue of the muscle had no effect either on the reflex times themselves or on their relationships. This tends to show that the reflex itself is unaffected by peripheral fatigue of the muscle involved in the reflex response.

CONCLUSIONS

The data obtained in the study seem to warrant the following conclusions:

1. An essentially constant relationship exists between the latent times of both the Achilles and the patellar tendon reflex responses as measured by the recording of the action currents from the executant muscles and the thickening of the muscle itself, since correlations of .80 .043 and .78 .054 respectively were obtained between the latencies as recorded by the two techniques; and since the ranges and the standard deviations for the individual latencies were approximately the same in any given case.
2. This essentially constant relationship between the two techniques holds true for a long series of consecutive measures.
3. Both latencies, i.e. the action current and the muscle thickening, are dependent on the same or closely related factors.
4. For comparative purposes either technique would be satisfactory if carefully controlled.
5. Peripheral fatigue of the gastrocnemius muscle has no effect on the reflex latencies as measured by either technique.

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