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EFFECT OF CIRCUMFERENTIAL AIR-SPLINT PRESSURE ON THE SOLEUS STRETCH REFLEX DURING A VOLUNTARY RAMP PLANTAR FLEXION

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Circumferential pressure (CP) applied to the limb has been shown to decrease muscle activity in subjects without neuromuscular disorders and in individuals with a spinal cord injury and cerebrovascular accidents. Thus far, studies estimating the CP efficacy with respect to reflex excitability of motoneurons mainly used the H reflex technique on a resting muscle. The purpose of our study, therefore, was to investigate the effect that CP exerts on the soleus stretch reflex (SSR) when superimposed onto a voluntary ramp plantar flexion movement in subjects without neuromuscular disorders. Forty-eight subjects volunteered for this study. SSRs were investigated before, during, and after the application of pressure to the calf. An inflated air-splint connected to a pressure transducer was used to administer and measure the pressure set to 45-50 mm Hg. SSRs were elicited by dorsiflexing the subject's ankle by 10 deg at 180 deg/sec, while the subject plantarflexed against a moving footplate at 20% of the maximum voluntary contraction through a 30 deg arc at 90 deg/sec. Twenty-five SSRs were recorded and averaged for each experimental phase; peak-to-peak amplitudes were measured and normalized, and reflex latencies were also measured. Friedman Repeated Measures Analysis of Variance on Ranks was used to analyze the differences in the SSR latency and amplitude from the baseline values. No significant general difference in the SSR amplitude was found during pressure application, although individual responses varied widely. The post-pressure values returned to the baseline, and the differences were insignificant. The reflex latencies were also unchanged with respect to the baseline levels. Thus, a CP inhibitory effect on reflex excitability of motoneurons is mild, on average, and variable when a voluntary movement is a condition. The CP technique may not be as efficacious in reducing muscle hyperactivity as was previously thought.

Keywords: soleus stretch reflex, circumferential pressure, H reflex, ramp movement.

INTRODUCTION

Many investigators have studied the effects of pressure applied to the muscles on muscle reflex excitability, in particular on the H reflex amplitude, and supposed that such a technique can provide a significant effect on the activity of motor segmental neuronal mechanisms. Kukulka et al. [1], and Leone and Kukulka [2] studied the application of continuous pressure over the Achilles tendon. A decrease in the soleus H reflex amplitude was demonstrated, but this decrease was short-lasting and independent of the intensity of pressure applied [1, 2]. The duration of H reflex reduction by pressure applied to the tendon correlated with the type of pressure applied, with intermittent pressure providing longer-lasting decreases than continuous pressure. Morelli et al. [3, 4] showed that pressure from massage over the *mm. triceps surae* also produced a short-duration decrease in the H reflex. These results were reported for subjects with both no history of neurological disease (S_{nd}) and cerebrovascular accidents (S_{cva}) [1-4].

Robichaud et al. further investigated the effects of pressure by applying an air splint around the calf and recorded the soleus H reflexes in S_{nd}, S_{cva}, and subjects with spinal cord injuries [5, 6]. These authors demonstrated a significant pressure-induced H reflex depression that lasted within the entire time when pressure was applied in all the three subject groups. The amplitudes returned to baseline values

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immediately after air pressure release. The authors suggested that their results were partly due to the technique of pressure administration. Pressure applied by an air-splint exerts constant pressure stimulation of cutaneous and muscle receptors of both agonist and antagonist musculature (circumferential pressure), thus causing longer-lasting H reflex inhibition, as compared with other types of pressure administration, such as massage or continuous/intermittent tendon pressure [1-6].

The H reflex is an EMG manifestation of the electrically elicited monosynaptic reflex [7-9]. Obtaining of this response is rather simple and gives an estimation of the alpha motoneuron reflex excitability (MNRE). It is an electrical equivalent to the soleus stretch reflex (SSR) except it bypasses muscle spindles and, therefore, does not take into account the respective receptor influence [10-12]. The SSR has an advantage over the H reflex in that it uses a more natural stimulus (physical stretch) to elicit the reflex. The nature of this stimulus differs in that it evokes a relatively desynchronized and dispersed activation of Ia afferents, whereas electrical stimulation used to evoke the H reflex elicits a single largely synchronized activation of Ia fibers. The two elicited reflex responses, therefore, are different and may affect spinal motoneurons (MNs) in a variety of ways (i.e., affecting the subliminal fringe in dissimilar ways), which result in varying efferent outputs [10-12].

Studies of the H reflex have other methodological considerations that make interpreting their results a challenge. For example, when a muscle is activated electrically compared to more natural forms of stimulation, the pattern of motor unit recruitment was shown to be nonselective, spatially fixed, temporally synchronous, and predisposing the muscle to fatigue [13, 14]. This recruitment pattern may be responsible for systematic alterations observed in the maximum M response (M_{max}) when the H reflex is evoked during a voluntary movement. To compensate these factors, a strict adherence to experimental techniques is mandatory [15]. Studying the H reflex, therefore, may not be the most appropriate way of investigating the effects of pressure on normal movements in humans [13]. Differences between the H reflex and SSR may account for variations in the results following pressure application.

Finally, investigations looking at the effect of circumferential pressure (CP) on MNRE have been mostly conducted on a resting muscle [5, 6, 16]. It is well known that when an H reflex is superimposed on a muscle contraction resulting in a limb movement, the H reflex amplitude increases dramatically before and during the voluntary contraction of the homologous muscle [17]. This facilitation has been attributed to a decrease in the intensity of presynaptic inhibition at the Ia terminal level rather than by subthreshold activation of MNs that is seen in the resting muscle studies. Thus, inhibitory effects of CP on the H reflex, SSR, and on MNRE in general may be concealed during voluntary movements [15, 17-20].

In summary, the effect of CP on MNRE remains uncertain. This is especially true when a combination of the limb movement and muscle contraction is considered. Studies using a more natural form of reflex stimulation superimposed on the limb movement need to be conducted to understand fully the effect of CP on MNRE. Therefore, the purposes of our study were: (i) to determine the CP effect on spinal MNRE using the more natural SSR experiential technique, and (ii) to assess CP effects on MNRE during a ramp voluntary movement.

METHODS

Subjects. Forty-eight subjects with no neurological deficits volunteered for this study. All subjects read and signed an informed consent form approved by the University of Rhode Island Institutional Review Board. The subjects had no history of neurological disease or lower limb muscular disorders. All subjects were asked to refrain from alcohol, caffeine, aspirin, and heavy exercise 12 h prior to testing [21, 22].

EMG recording. Skin overlying the *soleus* and *vastus lateralis* muscles and over the fibular head were cleaned and shaven for the EMG electrode placement. Two 9-mm cup silver/silver-chloride EMG electrodes filled with conductive gel were then placed approximately 3 cm apart on the skin overlying the distal *soleus* muscle belly in alignment with the Achilles tendon. A rectangular metal plate (3-5 cm) was used as the ground electrode; it was placed on the skin over the fibular head. A second set of EMG electrodes was placed on the skin of the anterior lateral thigh, to monitor the *quadriceps* activity. This set of electrodes was used to ensure knee extensors were not compensating for ankle plantar flexion torque during the experiment. The EMG electrical activity was amplified (10^3) at a bandwidth of 3 to 20 kHz and digitized at a sampling frequency of $4 \cdot 10^3$ sec^{-1} using a data acquisition analysis system (ADInstruments, USA). Recorded data were numerically coded, stored, and analyzed by a computer using the respective data acquisition and analysis software.

Pressure. Depending on the leg length, a 16-21 cm pneumatic air-splint was applied around the dominate calf of each subject. The air-splint was fitted midway between the head of the fibula and the proximal EMG recording electrode. A pressure transducer connected to a bridge amplifier and an oscilloscope monitored pressure within the air-splint during the experiment. To decrease the chance of ischemia: (i) the subject's blood pressure was taken before the beginning of data recording. If the diastolic pressure was below 45 mm Hg, the experiment was terminated; (ii) skin color distal to the splint was closely monitored during the pressure phase of the experiment, and (iii) pressure values were continually monitored and adjusted during the experiment, to maintain pressures that remained within a 45-50 mm Hg window.

In addition, it was shown that the methods used in this study do not cause significant ischemia [23].

Elicitation of the soleus stretch reflex (SSR). These reflexes were elicited by imposing a 10 deg dorsiflexion perturbation at a 180 deg/sec velocity, while the subject plantarflexed against a footplate moving at 90 deg/sec through a 30 deg arc. The perturbation was initiated at the point when the footplate moved 15 deg. Randomized perturbations were not performed between and within subjects, because the ankle position was shown to affect the reflex amplitude [24-26]. The footplate movement was applied using a torque motor that was under the control of a Galil Motion Control four-axis servo system (Rocklin, USA) and a laboratory computer (Dell Inc., USA). The torque motor/servo system was powerful enough to impose stereotyped movements irrespectively of changes in the limb inertia or resisting forces produced by the subject.

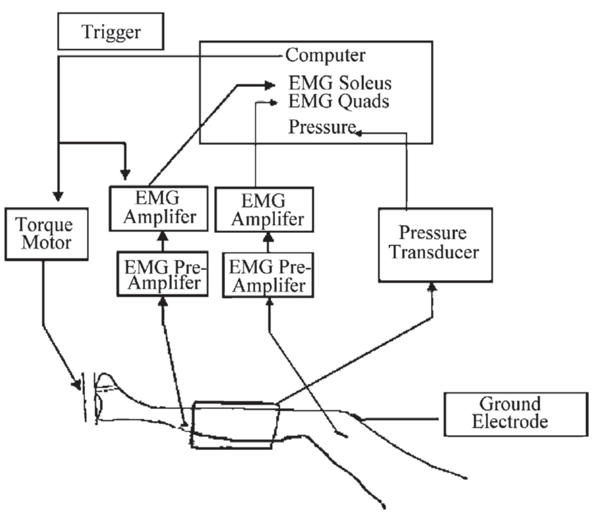

Fig. 1. Scheme of the experimental setup.

Р и с. 1. Схема експерименту.

Experimental procedure. This research project consisted of four phases, a setup/practice phase and three experimental phases (control phase, pressure phase, and a second control/postpressure phase). All the three experimental phases were nearly the same, with an exception of the pressure application in the pressure phase. The experimental setup is illustrated in Fig. 1.

Setup/practice phase (Phase 1). The experiment began with the subject comfortably seated in a specially designed chair with his/her dominate knee bent in 50 deg of flexion and the foot resting on a footplate in 20 deg of dorsiflexion. The ankle's axis of rotation was aligned with the axis of rotation of the torque motor displacement shaft. The subject's leg was then stabilized with straps to the footplate, to prevent any extraneous movement. A pneumatic air-splint was then placed around the subject's calf. The air-splint was briefly inflated, to allow the subject to become accustomed to the pressure sensation and provide time for the air-splint to adjust to the leg dimensions. The air-splint valve was then opened and allowed to deflate passively.

At this time, subjects performed three plantar flexion maximal voluntary contractions (MVCs) against a stationary footplate, while watching a horizontal line on a monitor elevating with each contraction. The monitor provided subjects with visual feedback of their force production. Maximal voluntary torque (MVT) was determined from the highest of the three MVCs and recorded. A twenty-percent MVT ($MVT_{20\%}$) was then calculated and displayed by a second horizontal line on the monitor. During the experiment, subjects were asked to press against the footplate until the two lines on the monitor were superimposed on each other. Subjects were allowed to practice until they felt comfortable with the experimental procedure. Once proficient, the experiment began. It should be noted that maintaining $MVT_{20\%}$ throughout the movement arc was not easy, and the subjects had to closely attend to their performance, to execute this procedure sufficiently accurately. This arduous task had the added benefit of decreasing the probability of subjects anticipating the time the dorsiflexion perturbation occurred during each SSR cycle.

Experimental phases (phases 2-4). Three phases were conducted in the experimental portion of this study. In phase 2 (control phase, $SSR_{baseline}$), subjects were asked to plantar flex their foot at $MVT_{20\%}$ against a moving footplate, until the dorsiflexion perturbation was introduced by the torque motor. Subjects were not required to resist the perturbation. This procedure (cycle) was repeated 25 times with randomized 5- to 10-sec-long rest intervals between the cycles. This was done to decrease the probability of anticipating the next movement cycle and reflex perturbation. The SSR EMGs were recorded for each cycle and stored on a computer for future analysis. Phase 3 (pressure phase, $SSR_{pressure}$) began by manually inflating the air-splint and maintaining it within a 45 to 50 mm Hg range throughout the phase. With the pressure applied, the phase 2 procedure was then repeated. The air-splint was deflated directly after the last recording was taken. Phase 4 ($SSR_{postpressure}$) repeated the phase 2 procedure. Subjects were given approximately 1-min-long rest period between the phases. Experimental phases lasted approximately 3-4 min each.

Data acquisition and statistical analysis. For each subject, 25 EMG samples from each experimental phase were displayed on a computer screen for SSR identification (Table 1). The SSR latency and peak-to-peak amplitude were measured and averaged. The latency was defined by identifying the first point of a triphasic waveform from time zero. Time zero was defined as the first point of the downslope of the angle change curve (Fig. 2). To ensure the latency measurement reliability, one experimentally blinded person performed all latency measurements. The measurements were conducted twice on two separate occasions. A paired *t*-test was conducted on the two latency measurements, and no statistically difference was found. Therefore, when a discrepancy between the two measurements occurred, the shortest latency was used in the data analysis.

TABLE 1. SSR Inclusion Criteria

1) SSR latency between 35-65 msec
2) Similar SSR configuration throughout experiment
3) No *quadriceps* activity
4) Able to maintain $MVT_{20\%}$ throughout experiment

Peak-to-peak amplitudes were defined by the sums of the highest and lowest points of the SSR wave (Fig. 2). Twenty-five SSRs from each recording phase were then averaged and normalized, by subtracting the pre-movement mean EMG measurement from the SSR amplitude mean value [27]. The pre-movement

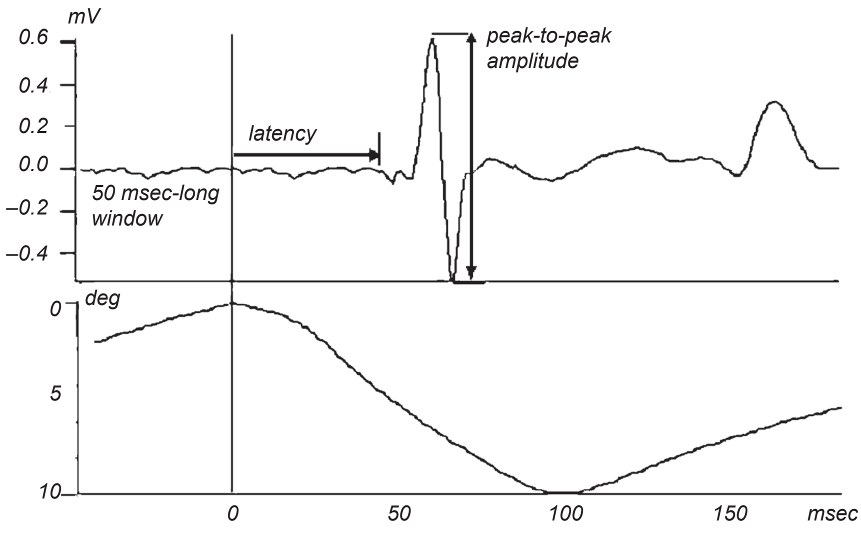

Fig. 2. Representative trace of the soleus stretch reflex, SSR. A raw averaged record (25 realizations) of the reflex evoked by a 10 deg dorsiflexion perturbation superimposed on a voluntary ramp plantar flexion. The principle of calculating the SSR latency and amplitude is graphically shown. The pre-movement mean EMG level was measured within a 50-msec-long window recorded while the subject volitionally performed contraction before each movement cycle. Lower trace is the record of dorsiflexion perturbation (degrees) in the ankle joint. The EMG activity was then full-wave rectified, and the average amplitude (500 points) was calculated.

Р и с. 2. Типовий приклад ЕМГ-реєстрації стретч-рефлексу в *m. soleus*.

EMG value was determined from a 50-msec-long window recorded during the time the subjects were volitionally contracting before each movement cycle. EMG activity was full-wave rectified, and the average amplitude was calculated. SSR amplitude values from the before-pressure application were used as the baseline measurement for each individual subject, and all other data were compared with the above value. Each subject, therefore, had his/her own controls.

Friedman Repeated Measures Analysis of Variance on Ranks tests were used to analyze the pressure effects for the average latency and average peak-to-peak amplitude measurements. Parametric testing was not performed because the data were not normally distributed and, thus, did not meet parametric testing criteria. Dunnett's post-hoc tests were used when the significance was found ($P < 0.05$).

To check for experimental consistency, the pre-perturbation EMG activity (50 msec) and reflex configurations were closely monitored throughout the experiment, and any notable change (f > SD) found in the subject's data was discarded and not included in the statistical analysis.

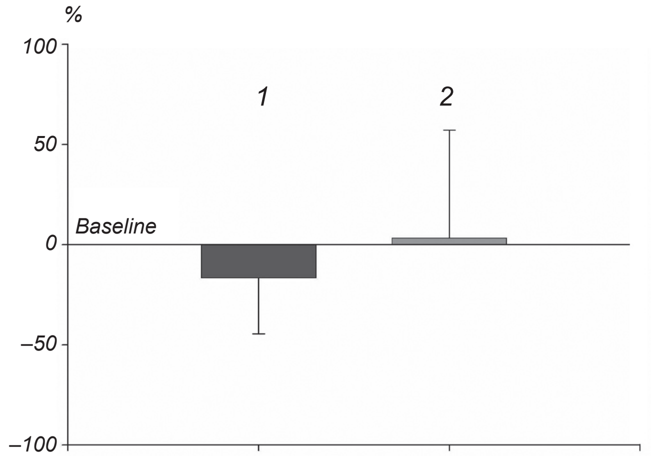

Fig. 3. Normalized mean changes and their standard deviations (%) for the SSR amplitude measured in all 43 subjects under conditions of application of circumferential pressure and within the post-pressure period (1 and 2, respectively).

Р и с. 3. Нормовані значення середніх та стандартних відхилень (%) амплітуди стретч-рефлекса, зареєстрованих у групі із 43 тестованих в умовах прикладання кругового тиску та після його зняття (*1* та *2* відповідно).

RESULTS

Statistical analysis was performed on the raw data from 43 subjects. The data of 5 subjects were omitted due to SSR instability or inability to contract consistently at the $MVT_{20\%}$.

No general significant difference in the SSR amplitude was found during pressure. Postpressure values returned to the baseline and were not significant. Latency measurements also did not differ significantly from the baseline levels.

Descriptive statistics on the data revealed that the responses under pressure conditions were variable with a net mean decrease of 13% (Figs. 3 and 4). The reflex variability was the likely reason for the nonsignificant results, with 11 subjects (26%) demonstrating SSR facilitation, 6 subjects (14%) showing no change, and 26 (60%) subjects demonstrating SSR inhibition (Fig. 4). A change in the SSR amplitude was defined as having a > 10% change from the baseline values [16].

DISCUSSION

Our study showed that circumferential pressure applied by an air-splint around the lower leg does not significantly reduce the soleus stretch reflex during voluntary plantar flexion in subjects without neurological disorders. These findings contradict the results of previous soleus H reflex studies where significant reflex inhibition was reported in all subjects tested. The insignificant global change in SSR amplitude was most probably due to great interindividual variability (Fig. 4): 40% of the subjects responded with either reflex facilitation (26%) or no change at all (14%). This variability in the reflex amplitude has not been reported in other soleus H reflex studies [5, 6].

It is an arduous task to decide, which mechanism is primarily responsible for the reflex variability observed in our study. The application of continuous pressure around a limb activates a wide spectrum of afferents and spinal circuits. This is further complicated by superimposing an SSR onto a voluntary contraction. Burke et al. [28] showed that the fusimotor system is co-activated with the skeletal motor system when a voluntary contraction (movement) is initiated. This increase in fusimotor drive is especially evident when movements are conducted slowly against an external load.

The role of the fusimotor system is to increase the gain of muscle spindles when voluntary movements

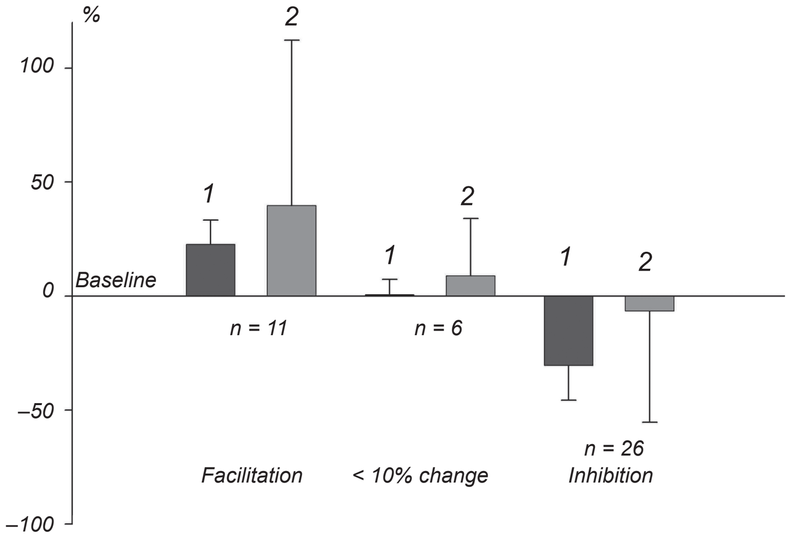

Fig. 4. Soleus stretch reflex peak-to-peak amplitude data grouped according to the effects of circumferential pressure on this parameter. Subjects were grouped by having a >10% facilitation of the SSR, negligible changes, and >10% inhibition of the reflex. Means, standard deviations, and number of subjects *n* are shown. 1 and 2 are the same as in Fig. 3.

Р и с. 4. Значення амплітуди стретч-рефлексу в *m. soleus*, згруповані відповідно типу впливу кругового тиску на цей параметр.

are initiated. The resulting increase in Ia activity accompanying muscle contraction is postulated to provide an overall excitatory effect on the MN pool rendering support to the muscle contraction [29]. Contractions requiring greater effort levels would presumably enhance fusimotor drive, while less effort would result in diminished fusimotor activity. In this study, subjects were required to plantar flex their foot through a 30 deg arc, while pressing against a footplate with $MVT_{20\%}$ at a velocity of 90 deg/sec. Thus, the variable SSR responses observed in this study may be a direct result of the effort level maintaining $MVT_{20\%}$ by the subject superimposed onto general inhibition caused by CP. Subjects requiring greater efforts would have an enhanced reflex arc activity, while a less effort corresponds to a more inhibited reflex arc. Conversely, when a muscle is completely relaxed, as in standard H reflex studies, the fusimotor activity is insufficient to maintain a significant spindle discharge (unloaded muscle spindles) [28]. The Ia afferent activity in response to a random stretch would be lower and more stereotypic. All results of the studies investigating the effect of ramp movements on the H reflex support this hypothesis [28, 30].

The feasibility of this hypothesis depends on the ability of muscle spindles to communicate with spinal MNs during the muscle contraction without their activity being inhibited by presynaptic inhibitory interneurons. Hultborn et al. [31] showed that, just before a voluntary movement onset, the excitability of interneurons mediating presynaptic inhibition is decreased by higher centers allowing afferent activity to be transmitted to the MN pool. This concomitant mechanism of activation of the spindles simultaneously with decreasing presynaptic inhibition of Ia terminals will undoubtedly result in varying afferent activity, depending on the relative exertion each subject requires to accomplish the movement.

Another possible spinal mechanism that may account for the SSR variability is the simultaneous decrease in non-reciprocal inhibition (autogenic inhibition) that occurs when a limb contracts against a resistance. Agostinucci et al. [16] suggested Golgi tendon organs (GTOs) may be partly responsible for the H reflex variability in the *flexor carpi radialis* when CP was applied around the forearm. They argued stating that GTOs were not just simple predictable pathways with a single function but have rather variable effects depending on the task performed, the muscle activated, and the inputs from other neuronal systems [32-35]. It is quite plausible that the effect of CP on MNRE may change when a reflex is elicited in a contracting muscle. Faist et al. [36] supported this conclusion. They showed that Ib inhibition onto MNs is present only during non-loaded situations; when a limb is loaded, Ib inhibition is reduced. With less inhibition projecting onto MNs, the SSR amplitudes would presumably be higher and more variable, again depending on the subject's relative exertion.

Methodological considerations. It has been suggested that the SSR may be a more appropriate technique than the an "electrical" equivalent (H reflex) to assess MNRE because it uses a more natural stimulus to elicit the reflex. This argument is based on the well-know fact that the H reflex bypasses muscle spindles and, therefore, does not take into account their influence [7, 8, 10]. Results of our study show that circumferential pressure does not inhibit the SSR to the same extent as the H reflex demonstrated. In fact, H reflex inhibition exceeds the SSR suppression even when the subjects with SSR facilitation are not included in the analysis [5]. It was suggested above that fusimotor drive and the resulting change in Ia facilitatory input onto MNs during voluntary contractions were partially responsible for the SSR variability observed in this study. The SSR may simply represent the effect that CP has on MNRE when the influence of muscle spindles has been included. Since the fusimotor/muscle spindle system plays an important modulatory role affecting MN excitability [29], the SSR may be a more appropriate technique to use in assessing MNRE. This is especially evident when voluntary movements are conducted. This view is supported by studies by Morita et al. [37] and Baudry et al. [38] who showed that the SSR and the H reflex have different sensitivities to presynaptic inhibition. Further studies are needed to determine the effects of CP on MNRE during voluntary movements. It seems quite possible that the role of CP in influencing the reflex excitability of motoneurons is more limited than that previously thought, especially when evaluating its effects on the voluntary movements in people with no neuromuscular disorders.

Postpressure phase. The SSR amplitude did not differ significantly from the baseline levels (Figs. 3 and 4). However, the mean normalized change in the SSR amplitude was facilitatory; this index exceeded the pressure trial values whether the subjects responded to pressure with facilitation or not (Fig. 4). This increase in the SSR amplitude above pressure levels is likely due to a cooling effect of ambient air entering underneath the splint when the splint loosens around the leg. Skin cooling was shown to facilitate both the H reflex and the SSR [39-41].

In conclusion, the results of our study clearly show that CP effects may noticeably differ from each other when movements are a condition. This view is in agreement with several critical reviews where task-oriented interventions induced a more substantial functional improvement in people post CVA [42, 43]. Although these results cannot determine the mechanism specifically involved, they do bring into question the usefulness of conducting treatments on resting muscles. In addition, when assessing MNRE during voluntary movement, the SSR may have a conceptual advantage over the H reflex.

Clinical implications. CP studies on the *soleus* have shown that reflex excitability of motoneurons decreases in all subjects and patients tested [5, 6]. These authors supported the use of circumferential pressure as a therapeutic modality when treating the lower limb muscle activity. Our results, however, are not as conclusive because they showed circumferential pressure does not affect everyone in the same way when muscle contraction and movements were a condition. A therapist must be cognizant of these contrasting affects and only use circumferential pressure in appropriate individuals. This is especially true after pressure release, where a temporary increase in MNRE was observed in ~70% of the subjects. Clinicians, therefore, should routinely monitor their treatment effects to assure if functional outcomes in their patients are what was expected, since individual responses may vary significantly.

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ВПЛИВ ПРИКЛАДАННЯ КРУГОВОГО ТИСКУ (ЗА ДОПОМОГОЮ ПНЕВМАТИЧНОЇ МАНЖЕТИ) НА СТРЕТЧ-РЕФЛЕКС У КАМБАЛОПОДІБНОМУ М’ЯЗІ, ЗАРЕЄСТРОВАНИЙ НА ТЛІ ДОВІЛЬНОЇ ПЛАНТАРНОЇ ФЛЕКСІЇ

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Р е з ю м е

Було показано, що круговий тиск (КТ), прикладений до кінцівки, зумовлює зменшення м’язової активності в осіб без нервово-м’язових розладів і у пацієнтів з пошкодженнями спинного мозку й цереброваскулярними патологіями. Донині в дослідженнях, спрямованих на оцінку ефективності КТ щодо рефлекторної збудливості нейронів, переважно використовувалася методика відведення Н-рефлексу від м’яза в стані спокою. У даній роботі вивчалися впливи КТ на стретч-рефлекс (СР) у *m. soleus*, котрий був зареєстрований на тлі довільної трапецієподібної плантарної флексії в осіб без нервово-м’язових розладів. У тестах брали участь 48 добровольців. СР реєстрували перед прикладанням тиску до литки ноги протягом і після такого прикладання. Для прикладання й виміру тиску використовували пневматичну манжету з’єднану з датчиком. СР викликали дорсифлексією ступні на 10 град зі швидкістю 180 град/с, тоді як тестована особа здійснювала плантарну флексію з упором на рухому педаль із зусиллям 20 % максимального довільного скорочення в межах дуги 30 град при швидкості 90 град/с. У межах кожної експериментальної фази реєстрували й усереднювали 25 реалізацій СР. Вимірювалися амплітуди СР

(від піка до піка); їх величини нормувалися. Вимірювалися також величини латентного періоду (ЛП) досліджуваного рефлексу. Відмінності величин ЛП й амплітуд СР від вихідних значень оцінювалися з використанням аналізу повторних змін рангових варіацій Фрідмана. Істотних загальних відмінностей амплітуди СР, пов'язаних з прикладанням тиску, не було виявлено, хоча індивідуальні величини відповідей варіювали в широких межах. Амплітуди в інтервалі після прикладання тиску поверталися до вихідних, і їх відмінності не були істотними. ЛП рефлексу також не змінювалися порівняно з вихідними значеннями. Отже, зниження рефлекторної збудливості мотонейронів під впливом КТ було в середньому незначним і демонструвало істотну варіабельність у тих випадках, коли ефект цього впливу реєструвався на тлі довільного руху. Методика КТ, видимо, не є настільки ефективною в аспекті зниження м'язової гіперактивності, як це вважалося раніше.

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