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Effects of Intensity and Set Method on iEMG of Flexor Carpi Ulnaris and Performance Speed Decrease Point during Barbell Curl Exercise

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ABSTRACT

The purpose of this study was to investigate the effects of repetition time changes during barbell curl exercise on EMG responses.In this study, the subjects were selected from twelve men in their twenties who had more than 3 years of resistance exercise experience. In this case, the subjects were randomly assigned to three conditions at intervals of one week with different rest interval and intensity (50%1RM/1min, 70%1RM/2min, 90%1RM/3min). When each condition was performed, each one repetition time and iEMG of the agonist were measured and reviewed. In each instance, a statistical analysis was performed by repeated measures of two-way ANOVA, with a p value=.05. In the review of the results of this study, iEMG of flexor carpi ulnaris during the performance of the barbell curl movement increased significantly with the occurrence of performance speed decrease point in all intensity,. and was significantly noted with the progression of the set only at 50%1RM and 70%1RM. The point of occurrence of repetition speed decrease point was significantly different according to exercise intensity. Generally speaking, the heavier the weight, the closer was the point of performance speed decrease point and the end of exercise. To that end, the point of occurrence of performance speed decrease point according to the set also showed a significant difference. In this case, as the set progressed, there was a tendency that the point of performance speed decrease point was close to the point of stopping motion. There In conclusion, it is important to consider the fatigue facstor associated with decreased performance during resistance exercise, and the important role of a supporter should be considered and utilized when exercise speed is decreased as an exercise set progresses during a regimen.

Keywords: *Resistance exercise, Barbell curl, integral EMG, Repetition time, Maximum repetition exercise*

Introduction

Resistance training is effective in improving muscular strength and muscle strength[1]. This conditioning also has a positive effect on exercise performance and health by using coordination, balance, increase of nervous system reaction and decrease of body fat[2]. The intensity of the resistance exercise is set differently according to the purpose of the exercise regimen and proposed training routine[3].

When the maximum repetitive resistance exercise is performed, fatigue occurs in the agonist and the exercise velocity is decreased[4]. In most cases, the decreased speed of exercise means that the function of the agonist has decreased[5]. The decrease in the exercise performance rate is attributed to the decrease in exercise intensity at the onset of concentric movement[6], In this condition, fatigue is generally caused by repetition of motion, which reduces energy until the repetition of motion fails[7]. At this time, the repeated maximum muscle contraction uses additional motor units to maintain exercise performance[8]. For instance, at a single iteration, the point at which the velocity of motion is reduced occurs at the upward motion of the resistor[9,10]. As we have seen, this decrease in muscle strength increases the level of effort required until exercise fails[11], The force velocity power is reduced[12], and a marked increased curvature in the force-velocity relationship is the main cause of muscle strength loss[13]. In this case,[14] concluded that there is a high correlation

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between the speed and height reduction of exercise and the occurrence of lactic acid and ammonia, as well it is noted that there is a reasonable possibility to predict muscle fatigue.

When muscle contraction begins, EMG provides information on bioelectrical activity related to muscle regulation, such as force generation and muscle fatigue levels[15]. This is important to note, based on the muscle electrical characteristics and changes in exercise unit activity during maximal contraction, and in the case where non- contraction of muscles are similar to changes in iEMG[16]. The lack of increase in iEMG at low exercise intensity means that muscle strength is low because of the condition of muscle mobilization[17]. When performing a motion requiring constant force, a new exercise unit is mobilized in place of the motion-depleted motion unit as the initial mobilized motion unit becomes fatigued[18], As momentum and muscle contraction increase, iEMG increases due to increased muscle activity due to increased workload[17]. To this end, the iEMG slope increases during the same intensity exercise., This is due to the accumulation of lactic acid and the decrease in pH due to muscle fatigue, and the binding force between calcium and troponin, In this case, these conditions can affects the affinity of the sarcoplasmic reticulum for calcium, and has effects on the recruitment of additional motor units [19], which can be used to determine when muscle fatigue begins[20].

In this case, the Babel Curl is known as the biceps Brachii which was used as the main muscle[21]. The force output of the flexor carpi ulnaris, which contributes to the stabilization of the wrist, appears to influence the maintenance of movement., In this study at three loads During the maximum repetitive barbell curl of 5 sets, iEMG of flexor carpi ulnaris, and the relationship between the stability of the wrist muscle and change of repetition time to provide basic data, for the performance of safe and effective resistance training.

Materials and Method

Subjects: The subjects were enrolled as 20s healthy men, people with at least three years of resistance training experience. All experiments have explained the significance and specific research methods of the study, and were selected whereby twelve person agreed to participate. Characteristics of the subject is shown in Table1.

Table 1: Characteristics of the subject

	Age (yr)	Weight (kg)	Height (cm)	Experience (yr)
N = 12	26.08 ± 2.94	81.08 ± 8.56	174.50 ± 3.50	3.33 ± 1.55

RM Measurement: It is emphasized that the 1RM measurement was made by referring to the method of[22], and the maximum weight can be measured within 4 sets. Based on the measured maximum weight, 90% 1RM, 70% 1RM, 50% 1RM weight was calculated.

Electromyography Measurement: In this case, the EMG measurements were performed using a wire EMG (LXM 5308, Korea) and surface electrodes. During the exercise, the area of the surface electrode was shaved and cleaned before the experiment. Next, the electrode attachment portion was attached to a distance of as much as two finger widths from the ulnar surface of 1/3 of the[23]. fore arm was presented. After the measurement, the electromyogram law data was filtered using a band pass filter of 10-400 Hz, full wave rectification was performed, and iEMG was calculated by integrating the signal section. Electromyography measurement is shown in Figure1.

Figure 1: Electromyography Measurement

Repetition Time Measurement: In the study, a digital camera (Nikon D750, Japan) was used to measure exercise time by repetition frequency during exercise. The moment the bar returns to the thigh from the moment it fell off the thigh to the maximum bending point, was recorded using a video editing program (Kinovea, France). This exercise is performed with slower time, and was calculated as a percentage of the total number of repetitions, which is selected as the time (reps) slower than the first repetition times for the average per person.

Data Analysis: Law data in this study was calculated for the mean and standard deviation by using the SPSS 22.0 program. The iEMG of Flexor carpi ulnaris between before and after Performance speed decrease point occurrence (2) and set (5) of 50% 1RM, 70% 1RM, 90% 1RM was analyzed using a Repeated measures two-way ANOVA method. Performance speed decrease point according to exercise intensity (3) and set (5) were analyzed using the Repeated measures two-way ANOVA method. In this study, the statistical significance was set at α = .05.

Results

50% 1RM Change of iEMG according to Performance speed decrease point during barbell curl exercise: As has been seen and reviewed, in this case a 50% 1RM, iEMG showed significant difference according to the exercise time (p<.01), and it tended to increase with Performance speed decrease point. There was also a significant difference between the sets (p<.001) and increased as the set progressed. There was no interaction effect between exercise time and set.Two-way ANOVA analysis for the iEMG Flexor carpi ulnaris difference of during the 50%1RM barbell curl exercise according to repetition time and set is shown in Table 2.

Table 2: Two-way ANOVA analysis for the iEMG Flexor carpi ulnaris difference of during the 50%1RM barbell curl exercise according to repetition time and set (μV)

	1set	2set	3set	4set	5set		F	P
Pre Speed decrease point	21.39 ± 15.40	68.82 ± 41.91	115.43 ± 57.31	121.94 ± 112.49	191.88 ± 170.19	Repetition time(R)	11.473	.006
Post Speed decrease point	56.92 ± 41.99	110.34 ± 68.36	169.60 ± 122.28	259.82 ± 161.58	324.31 ± 227.40	Set(S)	21.945	.000
						(R)x(S)	2.467	.059
M ± SD								

70% 1RM Change of iEMG according to Performance speed decrease point during barbell curl exercise: The prevailing disciplie notes that the iEMG at 70% 1RM showed a significant difference (p<.001), indicating a tendency to increase at the Performance speed decrease point. In this context, there was also a significant difference between the sets (p<.001) and increased as the set progressed. It is noted also that there was no interaction effect between exercise time and set. Two-way ANOVA analysis for the iEMG Flexor carpi ulnaris difference of during the 70%1RM barbell curl exercise according to repetition time and set is shown in Table 3.

Table 3: Two-way ANOVA analysis for the iEMG of Flexor carpi ulnaris difference during the 70%1RM barbell curl exercise according to repetition time and set (μV)

	1set	2set	3set	4set	5set		F	P
Pre Speed decrease point	55.35 ± 21.31	118.67 ± 52.33	165.50 ± 72.61	255.81 ± 180.32	283.60 ± 196.09	Repetition time(R)	48.622	.000
Post Speed decrease point	127.26 ± 85.45	180.63 ± 92.79	328.56 ± 239.42	341.55 ± 124.85	435.95 ± 172.85	Set(S)	25.931	.000
						(R)x(S)	.799	.532
M ± SD								

90% 1RM Change of iEMG according to Performance speed decrease point during barbell curl exercise: The iEMG at 90% 1RM showed a significant difference according to the repetition time (p <.05), and it tended to increase at the performance speed decrease point. In this respect, There was no significant difference between the sets, which was seen to have. And increased as the set progressed. In this relation, There was no interaction effect between exercise time and set.Two-way ANOVA analysis for the iEMG Flexor carpi ulnaris difference of during the 90%1RM barbell curl exercise according to repetition time and set is shown in Table 4.

Table 4: Two-way ANOVA analysis for the iEMG of Flexor carpi ulnaris difference during the 90%1RM barbell curl exercise according to repetition time and set (μV)

	1set	2set	3set	4set	5set		F	P
Pre Speed decrease point	304.55 ± 209.75	379.51 ± 240.95	351.41 ± 212.21	344.66 ± 221.14	326.15 ± 195.61	Repetition time (R)	3.239	.021
Post Speed decrease point	338.87 ± 177.64	444.02 ± 244.59	427.90 ± 273.92	422.54 ± 258.57	422.14 ± 190.91	Set(S)	2.192	.167
						(R)x(S)	.456	.767
M ± SD								

Change of Performance speed decrease point according to intensity and set during barbell curl exercise: The performance speed decrease point was significantly different according to exercise intensity (p <.001). In its most positive context, as the exercise intensity increased, performance speed decrease point and exercise stop were close. There was also a significant difference between the sets (p <.001). Furthermore, as the set increased, the performance speed decrease point and exercise stop were close to each other. Finally, there was no interaction effect between exercise time and the exercise set. Two-way ANOVA analysis for the Performance speed decrease point difference during the barbell curl exercise according to intensity time and set is shown in Table 5.

Table 5: Two-way ANOVA analysis for the Performance speed decrease point difference during the barbell curl exercise according to intensity time and set (%)

	1set	2set	3set	4set	5set		F	P
50%1RM	72.89 ± 11.13	68.95 ± 10.43	78.96 ± 6.24	89.41 ± 11.85	93.98 ± 13.29	Intensity (I)	17.420	.000
70%1RM	75.79 ± 11.76	75.02 ± 7.64	85.56 ± 13.64	88.20 ± 14.85	97.22 ± 9.62	Set(S)	22.881	.000
90%1RM	83.75 ± 14.89	94.45 ± 12.97	94.45 ± 12.97	97.22 ± 9.62	100.00 ± 0.00	(I)x(S)	1.729	.136
M ± SD								

Discussion

In the present study, iEMG of the flexor carpi ulnaris at 50% 1RM, 70% 1RM, and 90% 1RM intensity showed a significant difference(p<.01)(p<.001). As the performance speed decrease point occurred, it is recorded that all of the iEMG increased. During the same intensity exercise, accumulation and pH decrease of lactic acid by muscle fatigue the affinity of calcium and troponin and affinity to calcium and sarcoplasmic reticulum, and iEMG slope increases were due to and the result of additional motor unit recruitment[17,19]. It is thought that the mobilization of additional exercise units was carried out to keep the muscle contraction with the decrease of the muscular force as the exercise progresses slower and the closer to the end of the exercise, the slower the muscular contraction[8,10,12]. It is considered that muscle activity is maximized as the work load ratio increases as the exercise is stopped[23].

Upon review, it is seen that the 50% 1RM and 70% 1RM intensity condition showed significant difference in the iEMG between sets (p <.001) and the tendency to increase as the set continued. The question then is noted that the increase in iEMG as the set increases seems to be due to the lack of time to recover from the rest interval, as the fatigue caused by the repetition of the slow exercise interval is repeated[26]. On the other hand, iEMG at 90% 1RM showed no significant difference between sets, and iEMG changes at performance speed decrease point was less than 70% 1RM and 50% 1RM intensity. To this end, when strength is exerted, the Type I muscle fiber with low mobilization threshold is mobilized first, then Type II fiber is mobilized in order, but in exercise requiring large force, the motor unit is large according to size principle. Most types of exercise units are mobilized up to Type II fiber, and the firing rate of the motor unit is accelerated[4]. In the present study, there was a significant difference between the exercise intensity and the exercise intensity in all repetitions (p <.001). The light load showed a tendency to continue the exercise after the performance speed decrease point. At this time, as the weight increased, the performance speed decrease point appeared and the exercise performance tended to stop. The lighter weight is thought that the incident would occur with less mobilization of the motor unit[23], This subsequently created a loss of speed of exercise performance. For this reason, it is considered that the number of repetitions can be maintained even after the performance speed decrease point[15].At 90% 1RM weight, the movement failure occurred rapidly after performance speed decrease point., This factor is noted as an increase of the delayed neural responses that appeared to lift the load from the heavy weight[9], whereby the rate of lifting of the resistance is reduced, resulting in muscle strength loss[15]. Therefore the exercise is considered to this point stop occurred rapidly[8,12]. As the set progressed, the performance speed decrease point tended to appear just before the failure ($p < .001$). Lactic acid produced by continuous exercise appears to be due to more fatigued[29,30], The time required to remove lactic acid from continuous exercise is 4-10 min[31], with ATP and CP recovering to 85% within the timeframe of 3 min[32]. It is thought that low repetition frequency and fast movement discontinuity appeared because the exercise was performed in the condition that the energy supplement was insufficient due to a short rest time. Also fatigue by-products that were not removed during the rest period seemed to have an effect on the premature termination[31].

Conclusion

In formulating a summation of the results of this study, as the set progressed, there was a tendency that the point of performance speed decrease point was close to the point of a stopping motion. In conclusion, it is important to consider the muscle fatigue associated with decreased exercise performance during resistance exercise, and the role of an attending exercise assistant should be important when the exercise speed is decreased as the set progresses.

Ethical Clearance: Not required

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Conflict of Interest: Nil

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