Effects of Calcium on Muscular Training

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It is a well known fact that muscle contraction depends on calcium (Ca\(^{2+}\)) density. Muscle contraction is produced by nerve stimulation that is transmitted through muscle cell walls to the vacuole via the T channel system, where calcium is released. In other words, calcium is the regulating factor which possesses the effect of an “on-off” switch in muscle contraction, and it is also an important factor which exerts influence on muscular tension.

The development of the increase in muscle quantity and quality is promoted by the training. The effectiveness of the stimulative intensity and frequency of the isometric muscle training has already been reported (1, 2). However, it is not clear to what degree calcium exerts influence on muscle strength (3). This experiment examines the effects of strength training, combined with the excessive intake of calcium, and its effectiveness on influencing muscle strength (4).

Materials and Method

The subjects used were nine male university students (average age 19 yrs.).

For the training method, the elbow was fixed at 90 degrees and the maximum isometric muscle strength of the elbow flexibility and its tension variation were recorded by using the transducer.

For the training condition, the maximum isometric muscle strength was exerted at intervals of 10 sec, followed by a 3 sec rest period, which was carried out 3 times daily for 6 weeks. During the training period maximum muscle strength, instantaneous reflexive strength, and stamina were measured daily.

The instantaneous muscle strength is the unit of muscular strength acquired from the maximum slope of the tension curve, when strength is generated by maximum exertion in a short time period. Stamina is the maximum value of the tension curve labeled \(P_0\). Their tensions were measured 1 min after reaching that maximum point by the ratio of \((P_0 - P_1)/P_{\text{max}} \times 100\).

The conditions for calcium application was set at 900 mg per day, and to meet this condition two kinds of commercially marketed calcium, Manacal Calcium (1 tablet containing 25 mg) and Wada Calcium (1 tablet containing 43 mg), were used.

The calcium intake groups were classified as, A group, being Manacal Calcium group (12 tablets after every meal, 36 tablets daily), B group, being Wada Calcium group (7 tablets after every meal, 21 tablets daily), and C group, being the control group not taking any calcium. Each group consisted of 3 subjects.

Results

Figure 1 illustrates the movement in the maximum muscle strength of one subject from each group. There can be seen vivid individual variation in this movement in muscle strength; however, a common tendency of this movement, somewhat decreasing at about 1 week after the start of the training, but then increasing thereafter, was observed.

Figure 2 illustrates the value of the initial day's maximum muscle strength, which appeared during training and each day of the appearance of the maximum value of each group. Compared with groups A and B, the C group showed a lower rate of increase, and a tendency to delay was seen in regards to the appearance day of the maximum value when compared with groups A and B, but at any rate a clear difference could not be noticed.

Figure 3 illustrates the ratio of each week's maximum muscle strength of each group as opposed to the maximum muscle strength of the first day of training.

Group C had the largest decrease in the first
Fig. 1. Movement in the max muscle strength of one subject from each group.

Fig. 2. Value of max muscle strength and its day of appearance.

For the C group, the rate of increase showed a low tendency. All the groups showed the greatest increase in the fifth week, and a significant correlation between each group was noticed at the 0.5% level.

Figure 4 illustrates the ratio of each week's instantaneous muscle strength for each group, compared with that of the first week. In the sixth week, both A and B groups showed a similar rate of decrease, 47% for the A group and 38% for the B group. The C group, by the sixth week, decreased to 75% after a 129% increase in the second week. Group C's decrease was somewhat slight, compared with those of groups A and B.

Figure 5 illustrates the ratio of each week's stamina rate of each group, compared with that of the first week. As shown in the explanation for Fig. 1, the stamina rate is the ratio of tension strength acquired 1 min after the maximum tension strength. Consequently, the size of this value
shows the decline in the stamina rate. The stamina rate in all the groups increased during the period around the second and third weeks. In any case, in the sixth week a declining tendency could be seen; A group 124%, B group 117.3% and C group 113.4%.

Discussion

It has already been reported that maximum strength training increases muscle strength. The clear difference in its value was also recognized in our report. As for stamina, the appearance of the same tendency after the sixth week could be thought to be, as compared with maximum muscle strength, a value which appears delayingly. Also, when the calcium intake group was compared with the group not taking calcium, in spite of the short time period, it showed a tendency to promote the increase of muscle strength. However, compared with instantaneous muscle strength, a negative influence was provided, and in the calcium intake group it was recognized as producing a strong negative influence. Using these themes as a basis; amount of calcium application, time period, method and so on need to be examined.

Generally speaking, calcium, especially Mana Calcium, which carries two ions, as is concluded by this experiment and by its measure of ion density, can be surmised as being correlated with muscle strength training.

REFERENCES