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# Effects of Partial Immobilization After Eccentric Exercise on Recovery From Muscle Damage

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**Context:** Short-term strict immobilization of the arm using a cast enhances recovery of muscle function after eccentric exercise.

**Objective:** To determine if placing one arm in a sling ("light" immobilization) for 4 days after eccentric exercise of the elbow flexor muscles would reduce muscle soreness and enhance recovery compared with the exercised but not immobilized contralateral arm.

**Design:** Subjects performed 10 sets of 6 maximal isokinetic ( $90^{\circ}\cdot\text{s}^{-1}$ ) eccentric actions of the elbow flexors of each arm on a Cybex dynamometer, separated by 2 weeks.

**Setting:** University laboratory.

**Patients or Other Participants:** Ten healthy subjects (5 men and 5 women) with no history of upper arm injury or resistance training.

**Intervention(s):** One randomly assigned arm was placed in a sling for 4 days after the 30-minute postexercise measurement to secure the elbow joint at  $90^{\circ}$ ; the contralateral arm received no treatment. The subject removed the sling when showering and sleeping and during postexercise measurements.

**Main Outcome Measure(s):** We used an activity monitor to

record upper arm activity before and after immobilization. We also compared changes in maximal isometric and isokinetic voluntary strength, range of motion, upper arm circumference, plasma creatine kinase activity, and muscle soreness during 7 days postexercise between arms with a 2-way, repeated-measures analysis of variance.

**Results:** Eccentric exercise resulted in large losses in both isometric and isokinetic maximal voluntary contraction forces (approximately 40%), reduced range of motion (approximately 20%), increased arm circumference (approximately 10 mm), elevated plasma creatine kinase activity (approximately 2000 IU·L<sup>-1</sup>), and development of delayed-onset muscle soreness. No significant differences were noted between conditions for any measure except upper arm circumference, which increased significantly less for the immobilization than the control arm at 7 days postexercise ( $P < .05$ ).

**Conclusions:** Light immobilization had no effect on enhancing recovery of muscle function and delayed-onset muscle soreness after eccentric-exercise-induced muscle damage.

**Key Words:** muscle soreness, muscle strength, range of motion, swelling, creatine kinase

Rest is a common prescription for most musculoskeletal injuries, especially in the early stages of recovery.<sup>1</sup> Minimizing the use of the injured tissue is believed to prevent further damage and promote the processes of repair and regeneration.<sup>1,2</sup> In this context, immobilization is an effective treatment for injuries such as the lacerations, contusions, and strains that are common consequences of sporting activities.<sup>2</sup> Short-term immobilization accelerates the formation of granulation tissue matrix at the injury site and enhances recovery of muscle function.<sup>1,2</sup>

It is well known that repeated eccentric actions (particularly if they are unaccustomed) induce muscle damage,<sup>3–5</sup> characterized by sustained loss of muscle function, histologic disturbance of muscle and connective tissue, increases in muscle-

specific proteins in the blood, development of delayed-onset muscle soreness (DOMS), and swelling.<sup>4–7</sup> Although damage resulting from eccentric exercise is less severe than that associated with muscle strain injuries, the former also induces pain, swelling, and considerable loss of muscle function.<sup>4,5</sup> If DOMS is a warning signal not to use or move the sore muscles, complete rest would be optimal for recovery, and short-term immobilization is appropriate. In fact, Sayers et al<sup>8–11</sup> reported that 4 days of strict arm immobilization after a bout of eccentric exercise with the elbow flexors facilitated recovery of muscle strength and range of motion (ROM) and attenuated increases in plasma creatine kinase (CK) activity.

However, these studies involved fixating the arm in a cast at all times for the duration of immobilization. The effect of

inactivity is maximized, but subjects find the cast uncomfortable; therefore, it is of questionable practical benefit as a therapeutic modality. Other authors<sup>8–11</sup> have provided no information regarding the time course of any effects that occur over the immobilization period except for blood markers of muscle damage, such as CK activity and myoglobin concentration. If immobilization with a simple sling to secure the elbow joint at 90° could demonstrate positive effects in enhancing recovery from injury, it would have important practical implications. Furthermore, such a “light” immobilization method would allow the subject to periodically release the arm for functional activities or sleeping. If reducing the activity of the damaged muscles enhances recovery from eccentric-exercise-induced muscle damage, it seems reasonable to assume that a “light” immobilization is also effective. Therefore, our purpose was to investigate the effects of a light immobilization regimen on isometric and isokinetic muscle strength, ROM, upper arm circumference, plasma CK activity, and muscle soreness, which are often used as indirect markers of muscle damage.<sup>4,5,12</sup>

## METHODS

### Experimental Design and Procedures

Large intersubject variability in the indirect markers of muscle damage has been reported,<sup>4,13–15</sup> so we used an arm-to-arm comparison model. This model is also advantageous when comparing 2 conditions in a relatively small number of subjects. Based on previous findings that involved the same exercise,<sup>8,9</sup> we determined the number of subjects required for the present study with a sample size estimation ( $n = >9$ ). The control arm received no treatment, whereas the experimental arm was immobilized for 4 days postexercise. Dominant and nondominant arms were randomly chosen for the control and immobilization conditions, and the order in which the conditions were performed was counterbalanced among the subjects.

The experimental period consisted of 8 days for each term, with 2 familiarization sessions for all measurements without exercise. Measurements were taken twice in the familiarization sessions, immediately before exercise, immediately and 30 minutes postexercise and on 4 consecutive days postexercise and 7 days postexercise. Immobilization started after the 30-minute postexercise measurements and was maintained for 4 days except when measurements were taken on days 1 to 4 postexercise. Subjects were also allowed to remove the sling when showering and sleeping. Criterion measures were maximal voluntary isometric and isokinetic elbow flexor strength, ROM, upper arm circumference, plasma CK activity, and muscle soreness. Changes in the criterion measures were compared between the control and immobilized arms.

### Subjects

Ten healthy men ( $n = 5$ ) and women ( $n = 5$ ) with no history of upper arm injury gave informed consent for the study, which was approved by the research ethics committee of the institute. The mean age, height, and mass of the subjects were  $23 \pm 4.2$  years,  $163.2 \pm 15.2$  cm, and  $63.7 \pm 11.9$  kg, respectively. Before and during the experimental period, subjects were requested not to take any medications or undergo

any interventions other than those given by the investigators and not to perform any recreational exercise.

### Eccentric Exercise Bout

As described in detail in the preceding article,<sup>16</sup> the exercise protocol consisted of 10 sets of 6 maximal voluntary eccentric actions of the elbow flexors against the lever arm of the isokinetic dynamometer (Cybex 6000; Lumex Inc, Ronkonkoma, NY) moving at constant velocity of  $90^\circ \cdot s^{-1}$ , with torque output displayed and recorded throughout. Total work was calculated for each complete exercise bout from the product of torque and time summed for each muscle action.

### Immobilization Protocol

The arm was immobilized after the 30-minute postexercise measurement using a Montreal Sling (Bodyworks Orthopaedic Supports, Auckland, New Zealand) that consisted of 2 support pads attached to adjustable straps. The sling secured the elbow joint at the required angle (90°) and prevented extension, but flexing the elbow joint was still possible. Subjects were asked to record times of the day and night that they removed the sling during the 4-day period for showering and sleeping and during the daily laboratory testing.

### Activity Monitoring

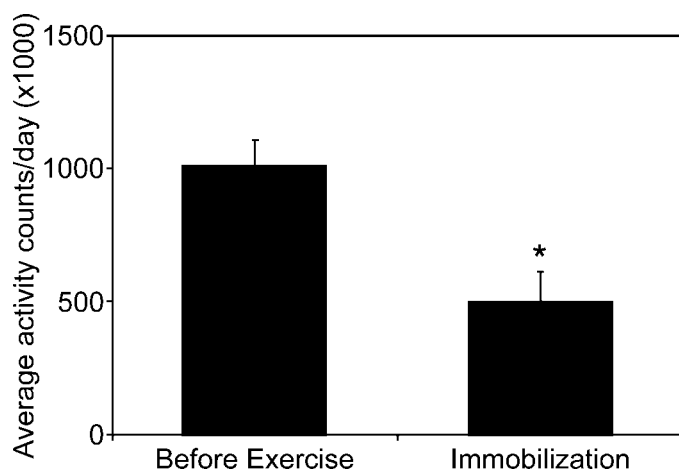
We assessed the extent of immobilization using an activity monitor (Actigraph model 7164; version 2.2, Manufacturing Technology Inc, Ventura, CA) fitted on the wrist of the immobilized arm. The monitor was  $50 \times 36 \times 15$  mm in size and weighed 45 g. The frequency and magnitude of the wrist movements were recorded for 2 days before exercise and 4 days after. Activity data were stored in the monitor and downloaded in units of counts per minute. The activity monitor was removed with the sling as stated previously. Metcalf et al<sup>17</sup> reported that intra-instrument coefficients of variation of the monitor are less than 2%, with intraclass correlation coefficients of 0.84 to 0.92.

### Criterion Measures

Maximal isometric and isokinetic strength, ROM, and upper arm circumference were measured twice during the familiarization session, before and immediately postexercise, and 30 minutes and 1, 2, 3, 4, and 7 days postexercise. Plasma CK activity and muscle soreness were measured at all time points except immediately and 30 minutes postexercise. The order in which measurements were taken was consistent throughout the testing period, starting with muscle soreness and followed by CK, elbow joint angles, upper arm circumference, and then strength measurements to minimize the interference of each measurement. The procedures for determining the criterion measures were identical to those described in detail in the preceding article.<sup>16</sup>

### Data Analysis

Changes in all criterion measures over time (pre-exercise, postexercise, 30 minutes, 1–4 and 7 days) were compared between the immobilization and control arms using a 2-way, repeated-measures analysis of variance (ANOVA). Where the ANOVA showed a significant difference between conditions,



**Figure 1.** Average activity counts 1 to 2 days before exercise and at 1 to 3 days of immobilization. Results are in counts per day, where a count is the product of movements per minute produced by subjects. \* Indicates a significant difference from the value before exercise.

the Tukey post hoc test was applied to locate any significant interactions. We also calculated a 1-way ANOVA to assess the changes in each arm's measures and locate the differences from the baseline. Paired *t* tests were also used to examine differences between conditions for peak plasma CK activity and peak muscle soreness scores. Effect size was calculated by comparing the mean values of the 2 conditions for selected time points. Data analyses were performed using SPSS (version 11.0; SPSS Inc, Chicago, IL). Statistical significance was set at  $P < .05$  for all analyses. Unless otherwise stated, data are presented as mean  $\pm$  SEM.

## RESULTS

### Exercise

The total work during the exercise was not significantly different between the control ( $963.9 \pm 155.5$  J) and immobilization ( $1092.3 \pm 170.1$  J) conditions. No significant difference in the average peak torque during exercise between the control ( $26.0 \pm 1.6$  Nm) and immobilization ( $26.9 \pm 1.9$  Nm) conditions was evident.

### Activity Monitoring

Immobilization resulted in a large reduction in arm movement (Figure 1), with average activity levels decreasing by approximately 50% during the 4-day period compared with baseline levels. Some of the activity recorded represents that associated with whole-body movement, as opposed to that specific to the arm.

### Muscular Strength

Mean peak torque value for isometric contraction before exercise was  $38.0 \pm 5.10$  Nm for the control and  $39.0 \pm 5.84$  Nm for the immobilization arm, and no significant difference between arms was evident. Maximal voluntary isometric torque decreased by approximately 40% from the pre-exercise level immediately postexercise, showed little change during the next 2 days, and started to recover appreciably after 4 days

postexercise (Table 1). No significant differences in the magnitude of strength loss immediately postexercise or changes in strength over time were evident between conditions.

The magnitude of decrease in isokinetic torque immediately postexercise (approximately 35%) and the overall changes were similar among the 5 velocities (see Table 1). At 7 days postexercise, isokinetic torque was still significantly lower than the pre-exercise values. Changes in isokinetic torque postexercise were not significantly different between conditions for all velocities.

### Elbow Joint Angles and Range of Motion

Significant changes in elbow joint angles were observed postexercise (Table 2). Range of motion decreased by approximately  $15^\circ$  immediately postexercise and showed further reductions during the next 2 days, with recovery starting 4 days postexercise. The ROM was still approximately  $8^\circ$  less than baseline at 7 days postexercise. Changes in arm angles and ROM tended to be greater after immobilization, but the differences did not prove significant for active flexion; relaxed, active extension; and ROM between conditions.

### Upper Arm Circumference

Significant increases in upper arm circumference were observed at all 5 sites postexercise for both conditions. Figure 2 shows changes in average upper arm circumference of the 5 sites from the pre-exercise value. Upper arm circumference increased similarly until 4 days postexercise for both conditions; however, the immobilized arm showed a significantly smaller value at 7 days postexercise than the control arm.

### Plasma Creatine Kinase Activity

Significant increases in plasma CK activity occurred 2 days postexercise, peaked at 4 days postexercise for both the immobilization ( $1631 \pm 755$  IU·L<sup>-1</sup>) and control ( $2455 \pm 596$  IU·L<sup>-1</sup>) conditions, and remained elevated at 7 days postexercise (Figure 3). No significant differences between the conditions were evident for the changes or peak activity.

### Muscle Soreness

Muscle soreness developed postexercise in both conditions for extension, flexion, and palpation measures; peaked 2 to 4 days postexercise; and subsided by 7 days postexercise. No significant differences between conditions were observed for the development of palpation, extension, or flexion soreness. Figure 4 shows peak soreness of the 3 types assessed. No significant differences were evident between the immobilization and control conditions for extension, flexion, or palpation soreness.

## DISCUSSION

We were the first to examine the effect of light immobilization on eccentric-exercise-induced muscle damage. The use of an arm-to-arm comparison model and assessment of changes in markers of muscle damage during the immobilization period were also novel aspects of this investigation. With the exception of upper arm circumference, light immobilization had no significant effects on the criterion measures postexercise. Although we tested an adequate number of subjects based

**Table 1. Normalized Changes in Isometric Torque ( $0^{\circ}\cdot s^{-1}$ ) and Isokinetic Torque at 5 Velocities from Baseline (100%) Immediately After (Postexercise) and 30 Minutes and 1 to 4 and 7 Days After Exercise for the Control and Immobilization Conditions (N = 10)**

Velocity and Condition	Mean (SEM) Percentage of Pre-exercise, %						
	Postexercise	30 Minutes Postexercise	Days After Exercise				
			1	2	3	4	7
0°.s <sup>-1</sup>							
Control	63.5 (3.5)	62.5 (3.5)	63.3 (6.3)	62.6 (4.5)	69.2 (3.4)	66.5 (4.4)	81.6 (4.1)
Immobilization	57.7 (4.6)	57.1 (4.7)	55.9 (2.0)	64.6 (3.2)	66.6 (3.7)	70.0 (3.7)	83.3 (4.4)
30°.s <sup>-1</sup>							
Control	65.0 (3.9)	64.8 (4.9)	56.3 (5.8)	62.1 (5.7)	74.0 (5.5)	76.0 (5.2)	85.8 (7.3)
Immobilization	67.6 (4.7)	67.9 (3.7)	67.3 (2.9)	66.7 (4.4)	68.9 (2.9)	77.6 (5.0)	85.7 (4.9)
90°.s <sup>-1</sup>							
Control	63.6 (5.5)	59.1 (6.5)	49.5 (6.1)	60.2 (5.6)	67.0 (6.9)	73.2 (9.1)	81.8 (7.1)
Immobilization	66.8 (3.9)	59.1 (3.3)	62.5 (2.0)	64.4 (4.9)	71.1 (3.7)	76.6 (5.6)	86.6 (3.6)
150°.s <sup>-1</sup>							
Control	66.7 (6.5)	66.6 (7.4)	53.0 (6.8)	63.0 (4.8)	73.7 (4.8)	73.6 (6.4)	80.7 (6.1)
Immobilization	66.0 (3.5)	62.7 (3.8)	65.5 (3.7)	63.2 (3.7)	69.5 (3.5)	68.8 (3.6)	84.2 (4.5)
210°.s <sup>-1</sup>							
Control	59.9 (7.7)	61.5 (6.7)	60.7 (9.0)	59.4 (5.3)	63.5 (4.9)	73.4 (8.7)	83.1 (6.7)
Immobilization	68.7 (3.7)	65.5 (4.9)	63.3 (4.3)	56.2 (3.4)	76.1 (5.5)	67.1 (4.6)	77.7 (6.8)
300°.s <sup>-1</sup>							
Control	68.0 (7.6)	77.4 (7.2)	74.5 (10.8)	76.4 (8.7)	74.0 (11.0)	86.9 (17.4)	95.9 (13.6)
Immobilization	66.8 (4.0)	62.7 (4.2)	72.2 (8.1)	65.7 (6.5)	66.6 (4.9)	72.4 (5.9)	75.8 (7.8)

**Table 2. Changes in Relaxed, Actively Extended, and Actively Flexed Elbow Joint Angles and Range of Motion from the Pre-exercise Level Immediately (Postexercise) and 30 minutes and 1 to 4 and 7 Days After Exercise for the Control and Immobilization Conditions (N = 10)**

	Mean (SEM) Changes From Pre-exercise, °						
Variable and Condition	Postexercise	30 Minutes Postexercise	Days After Exercise				
			1	2	3	4	7
Relaxed							
Control	−3.7 (1.25)	−3.5 (1.37)	−8.3 (1.96)	−7.9 (1.51)	−7.4 (1.77)	−9.1 (2.31)	−6.6 (3.53)
Immobilization	−4.3 (1.81)	−5.7 (1.57)	−8.1 (2.64)	−10.7 (1.97)	−12.5 (2.76)	−10.5 (3.23)	−5.1 (2.4)
Extended							
Control	−3.2 (1.34)	−3.3 (1.80)	−8.0 (2.19)	−6.8 (1.46)	−9.9 (2.78)	−10.6 (2.06)	−6.6 (2.36)
Immobilization	−3.0 (1.34)	−3.6 (1.43)	−8.4 (2.02)	−11.5 (2.53)	−12.9 (3.48)	−10.2 (2.81)	−4.2 (1.67)
Flexed							
Control	14.7 (1.97)	11.0 (1.70)	11.5 (2.01)	10.3 (2.62)	10.5 (3.91)	7.4 (2.41)	2.0 (2.23)
Immobilization	15.2 (1.69)	12.9 (1.13)	12.0 (1.70)	11.6 (1.93)	9.6 (1.77)	9.1 (1.46)	3.5 (1.13)
Range of motion							
Control	−18.4 (1.68)	−14.5 (1.60)	−19.8 (2.99)	−18.2 (3.32)	−17.9 (4.06)	−16.5 (3.94)	−8.6 (5.32)
Immobilization	−19.5 (1.63)	−18.6 (1.90)	−20.1 (3.15)	−22.3 (2.56)	−22.1 (3.17)	−19.6 (4.07)	−8.6 (3.05)

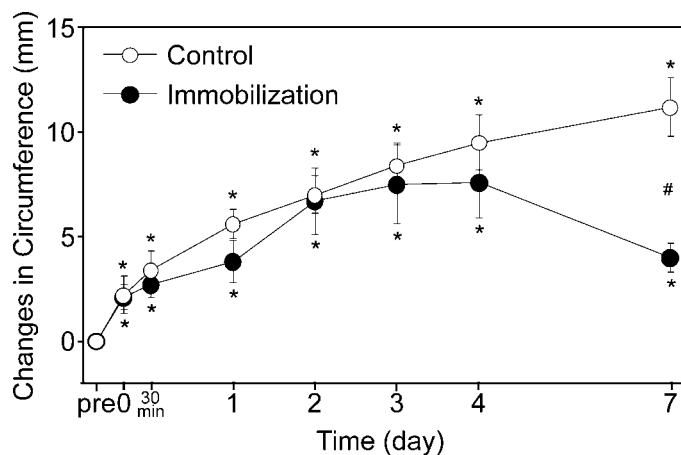
on a priori power calculations, the sample size was small. Some of the small differences between the immobilization and control conditions might have become statistically significant if a larger number of subjects had been included. However, it seems unlikely that the differences, if any, are clinically meaningful when considering the expected effects of the treatment on the criterion measures.

The magnitude of change in the criterion measures in the days postexercise was similar to that shown in the previous studies using the elbow flexor model.<sup>4,12,14,15</sup> The changes in the criterion measures in the present study were also comparable with those reported in the control condition of the im-

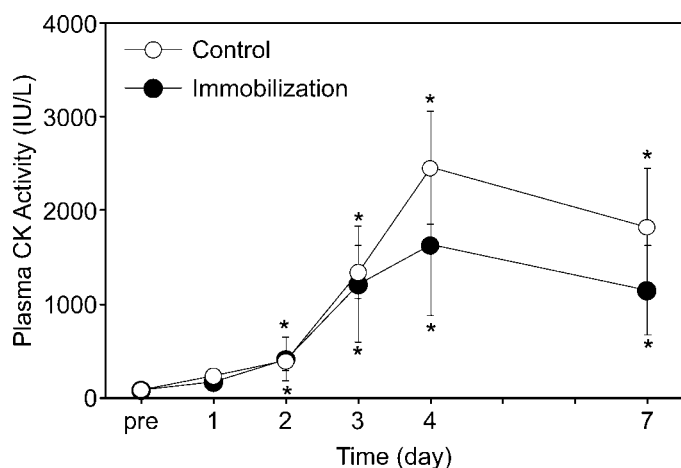
mobilization studies by Sayers et al.<sup>8-11</sup> Thus, our exercise protocol resulted in a comparable degree of muscle damage with that of Sayers et al,<sup>8-11</sup> although differences existed in the exercise protocols (6 sets of 10 repetitions for our study versus 2 sets of 25 repetitions in the former studies). Therefore, if the light immobilization we used had been as effective as the strict immobilization of the previous studies, we should have also demonstrated similarly enhanced recovery over the control. However, we did not find such effects, suggesting that the beneficial effects of immobilization are not applicable to less severe modes of limb restriction.

The most likely explanation for the absence of a beneficial

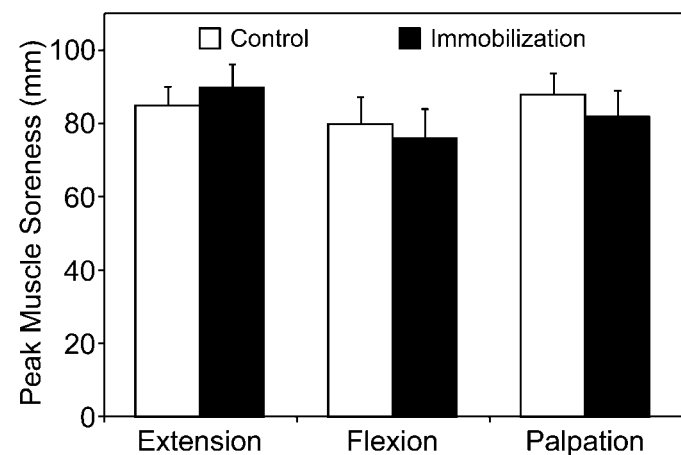




**Figure 2.** Changes in upper arm circumference from pre-exercise value (pre), immediately (0) and 30 minutes and 1 to 4 and 7 days after exercise for the immobilization and control arms. \* Indicates a significant difference from baseline; #, a significant difference between arms.



**Figure 3.** Changes in plasma creatine kinase (CK) activity before (pre) and 1 to 4 and 7 days postexercise for the immobilization and control arms. \* Indicates a significant difference from baseline.



**Figure 4.** Peak soreness with extension and flexion and on palpation postexercise for the immobilization and control arms.

effect of immobilization is the nature of the immobilization protocol used. Sayers et al<sup>8-11</sup> fixed the elbow joint angle at 90° permanently in a cast and a sling during the 4-day immobilization period. In contrast, we used a milder form of elbow-extension movement restriction that allowed very limited flexion. Also, subjects were allowed to remove the sling for sleeping and showering and during laboratory testing. Even so, subjects reported that their arms remained in a restricted position for an average of 13 to 15 hours a day, and this was confirmed by the 50% decrease in activity during the immobilization period (see Figure 1). This finding was similar to the arm activity movement decrements reported by Sayers et al<sup>11</sup> during the more severe immobilization (approximately 40% of baseline).

The potential effects of the test procedures during the 4 days of immobilization cannot be ruled out. We might have noted the same results reported by Sayers et al<sup>8,9</sup> if the sling had been applied for 4 days postexercise without muscle strength and elbow angle measurements on these days. We asked subjects to perform 14 brief maximal voluntary isometric and isokinetic contractions per day in the recovery period. It is conceivable that these brief periods of intense activity may have eliminated the possible beneficial effects associated with activity restriction. It is also possible that removing the sling when sleeping or during bathing affected the results. If this were the case, immobilization needs to be very strict to provide beneficial effects on the recovery of muscle function.

The arm-to-arm comparison model used in this study may have been responsible for the different results from previous studies.<sup>8-11</sup> However, the changes in muscle strength (see Table 1), elbow joint angles and ROM (see Table 2), and upper arm circumference (see Figure 2) immediately and 30 minutes postexercise were not significantly different between the control and immobilized arms. This result suggests that the eccentric exercise induced similar effects on the elbow flexors before the immobilization was applied. Moreover, the order of conditions was counterbalanced among subjects. Therefore, it seems unlikely that the experimental model could have contributed to the contradictory findings.

In animal studies,<sup>2,18</sup> significant benefits of immobilization on muscle regeneration after both traumatic and activity-induced injury have been demonstrated. On this basis, restricted activity could provide the basis for optimizing recovery from injurious sporting activity. However, it is questionable that immobilization should be applied for eccentric-exercise-induced muscle damage. Continuous complete immobilization for 4 days, as performed by Sayers et al,<sup>8-11</sup> is uncomfortable; imposes difficulties on the ability of subjects to perform everyday activities, such as showering; and causes sleep disruption. We designed our study to establish whether a milder form of movement restriction maintained any of the beneficial effects of immobilization. Although many therapeutic treatments have been examined for their effects on eccentric exercise induced muscle damage,<sup>19-23</sup> no individual treatment is particularly effective.<sup>24</sup> Contrary to what would appear to be common sense, rest is not required for eccentric-exercise-induced muscle damage, because active mobilization does not retard the recovery process.<sup>19,20,22,23</sup>

Only arm circumference showed significant positive effects of immobilization, with the extent of swelling being only 35% of control values 7 days postexercise. An increase in upper arm circumference reflects the degree of tissue swelling of the upper arm.<sup>12,25</sup> Swelling is always present to some degree in

acute inflammation and is a result of increased permeability of small blood vessels that allow protein-rich fluid (exudate) to escape into the tissue of the damaged area.<sup>17,26</sup> It is possible that the increase in arm movements after remobilization resulted in enhanced blood and lymph flow and accelerated the removal of exudate from the injured area. However, this is unlikely because the control arm would presumably have had a similar pattern of movement in the 4 to 7 days postexercise. Indeed, Sayers et al<sup>11</sup> reported no difference between the immobilized and control arms in arm activity for 5 days after removing the immobilization. We did not measure arm activity after removing the sling, but it seems unlikely that significantly large increases in arm activity would have been found for the immobilized arm between 4 and 7 days postexercise.

Sayers et al<sup>10,11</sup> reported attenuated increases in CK activity in the blood for the immobilization condition. They speculated that this was due to reduced lymph flow, with CK reported to enter the blood from the injured muscles through lymph.<sup>10</sup> We did not find such large differences in CK responses for the immobilized arm (see Figure 3). It is possible that muscle contractions during strength measurements were enough to equalize the CK response to the level of the control arm. If the CK response reflects the lymph flow level, our light immobilization method did not seem to affect the lymph flow. Furthermore, a notable finding of the previous study was that after arm remobilization, a large, sustained rise in plasma CK level was seen, which was explained by activity-related efflux of accumulated muscle exudates from the lymphatic vessels. Interestingly, we saw no such rise in the days after the immobilization was removed postexercise. Thus, the periods of activity during the immobilization period may have been sufficient to maintain lymphatic flow in the upper arm.

We found that muscle soreness was not affected by light immobilization (see Figure 4). Sayers et al<sup>8</sup> reported that residual muscle soreness was sustained longer for the immobilized arm than the control and attributed this finding to a delay in the removal of pain-generating inflammatory products. We did not find such an effect. Because our immobilization protocol was not as strict as that of Sayers et al,<sup>8-11</sup> it may be that under the conditions of this study, sustained lymph flow did not allow the pain-generating products to remain within the muscles.

Short-term immobilization after injury is believed to allow newly formed granulation tissue to achieve a more rapid increase in tensile strength, allowing it to better withstand the forces created by contracting muscle.<sup>1,2</sup> It may be that remobilization at some optimal point in the recovery period acts to accelerate the formation of new granulation tissue, allowing a more rapid reduction of tissue swelling. In this context, further studies will be required to determine the optimal period of immobilization, as well as whether the pattern of activity after remobilization plays a role in the time course of recovery to complete function after injury.

In conclusion, we did not find any beneficial effect of the light immobilization on the recovery of muscle function and muscle soreness, although swelling at 7 days postexercise was less for the immobilized condition than the control. The fact that our findings did not agree with those of previous studies<sup>8-11</sup> probably reflected our less severe immobilization protocol. Considering its uncomfortable nature, immobilization does not appear to be an effective treatment for eccentric-exercise-induced muscle damage.

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