

**Effects of Massage on Muscle Soreness and  
Parameters Associated With Muscle Damage  
Following Eccentric Exercise of the Elbow  
Flexors**

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**BACKGROUND**

- Muscle Damage
- Symptoms and indicators
  - Prolonged loss of muscle strength
  - Reduced range of motion
  - Swelling
  - DOMS
  - Increased in muscle proteins in the blood

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## Massage

- Massage is widely used as a therapeutic modality for recovery from muscle fatigue and injury (Robertson, 2004) and DOMS (Tiidus 1997)
- Massage is common among Malaysian to cure the injury
- However the results on effects of massage are varies
- Some studies found the positive effect of massage (Tiidus & Shoemaker, 1995, Hilbert et al. 2003) but others are negative or no effects ( Tiidus 1997, Isabel et al 1992, Rodenburg et al 2003)

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## PURPOSE

To investigate the effect of specific form of massage to exercise arm at 3 hours after eccentric exercise of the elbow flexors on DOMS and parameters associated with muscle damage using the arm to arm comparison.

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## Experimental Design

- Arm to arm comparison where the control arm received no treatment while contralateral arm received treatments
- One randomly assigned arm underwent 10 minutes massage treatment 30 minutes post exercise
- Compared changes in markers of muscle damage between arms

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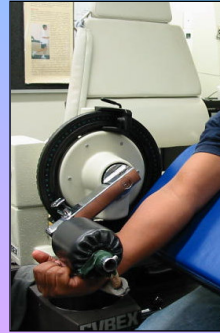
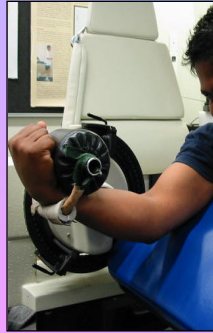
## Subjects

- Ethical approval
- 5 men, 5 women  
Age:  $23 \pm 4.2$  yrs, Height:  $163.2 \pm 15.2$  cm, Weight:  $63.7 \pm 11.9$ kg
- No history of upper arm injury
- No resistance training
- No medication, nutritional supplement
- No strenuous exercise

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## Eccentric Exercise

10 sets of 6 maximal isokinetic eccentric actions of the elbow flexors (Cybex 6000)  
ROM: 90-180°, Velocity: 90°·s<sup>-1</sup>  
Rest : 10 s (actions) 3 min (sets)



Each arm separated by 2 weeks

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## MASSAGE TREATMENT



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## Sports Massage

- **10-min sports massage by professional masseur 3 hours post exercise.**
  - effleurage of the hand (30 s), wrist to elbow (1 min),
  - elbow to shoulder (1 min),
  - petrissage of the wrist to elbow (30 s), elbow to shoulder (30 s),
  - cross fibre massage to the forearm (1 min),
  - biceps, triceps, and deltoids (1 min),
  - thumb petrissage of the wrist to elbow (1 min) elbow to shoulder (1 min),
  - effleurage of the hand (30 s), wrist to elbow (1 min),
  - and elbow to shoulder (1 min).
- **Effleurage refers to stroking whereas petrissage refers to kneading.**
- **Performed under a verbal cues recorded**
- **Depth and rate of massage were kept consistent**

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## Criterion Measures

- Maximal Isometric Torque (90°, 150°)
- Maximal Isokinetic torque  
(30,90,150,210,300°·s<sup>-1</sup>)
- Range of motion (ROM)
- Upper arm circumference (5 sites)
- Muscle soreness: palpation, extension, flexion (VAS: 0=no, 100=extremely painful)
- Plasma CK activity
- Measurements: pre, immediately post, 30-min post, 1, 2, 3, 4, 7 and 14 days post exercise

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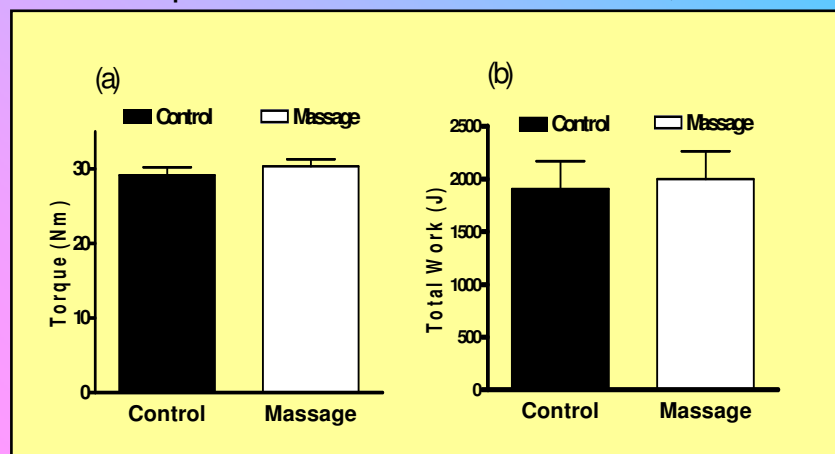
## Statistical Analyses

- Changes in the criterion measures over time between conditions (Massage vs control) : 2-way repeated measure ANOVA
- When a significant interaction effect (conditions x time) was found: Tukey post hoc test
- Peak muscle soreness, upper arm circumference, CK activity: paired t-test
- Significant level:  $p < 0.05$

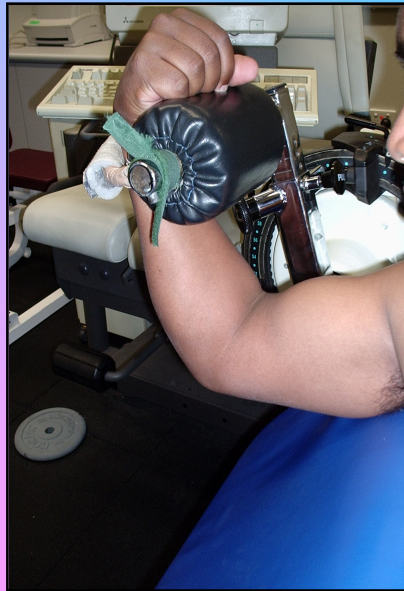
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## Strength

- Baseline values for the maximal isometric and isokinetic strength showed no significant differences ( $P=0.93$  and  $P=0.95$ , respectively) between massage and control arms. peak torque and total work values recorded over the course of the eccentric exercise protocol were similar for the two conditions.



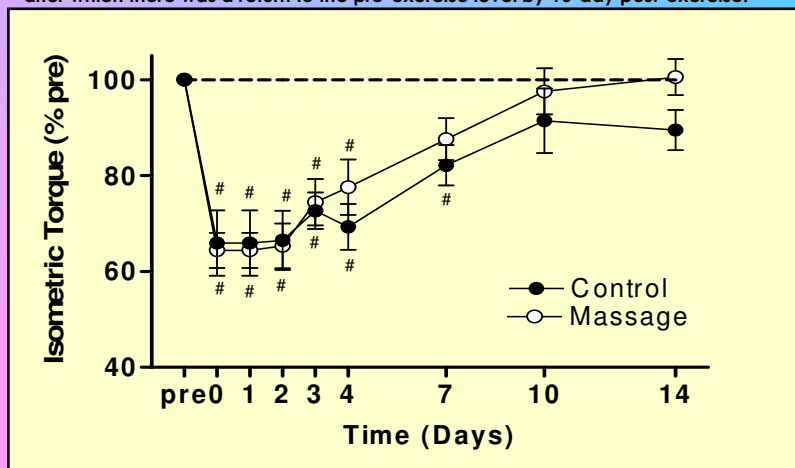
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## Muscular Strength

- No significant differences ( $P=0.64$ ) in either maximal isometric torque at either angle or maximal isokinetic torque at the five velocities were observed between massage and control arms. Iso torque decreased to approximately 40% of pre-exercise values immediately after exercise, and remained at this level for a further 2 days, after which there was a return to the pre-exercise level by 10-day post-exercise.



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## isokinetic torque

- no significant differences ( $P=0.82$ ) were evident between treatment and control arms for any of the velocities tested and recovered to the pre-exercise level by 10-days after exercise for both conditions.

|   |         | Time post exercise (days) |      |      |      |      |      |      |      |      |      |
|---|---------|---------------------------|------|------|------|------|------|------|------|------|------|
|   |         | pre                       | post | 1    | 2    | 3    | 4    | 7    | 10   | 14   |      |
| Torque<br>$30^{\circ}\cdot s^{-1}$<br>(Nm)  | CONTROL | Mean                      | 25.8 | 17.3 | 14.8 | 16.0 | 19.0 | 20.2 | 21.6 | 22.2 | 23.3 |
|   |         | SEM                       | 4.8  | 3.2  | 2.8  | 2.5  | 3.9  | 4.2  | 4.1  | 4.1  | 4.5  |
|   | MASSAGE | Mean                      | 25.6 | 17.7 | 18.9 | 19.5 | 21.0 | 23.0 | 23.1 | 25.7 | 25.4 |
|   |         | SEM                       | 4.4  | 2.9  | 4.4  | 3.9  | 4.5  | 4.3  | 3.9  | 4.2  | 4.7  |
| Torque<br>$300^{\circ}\cdot s^{-1}$<br>(Nm) | CONTROL | Mean                      | 19.8 | 14.8 | 14.5 | 15.0 | 14.2 | 14.8 | 16.2 | 19.2 | 18.1 |
|   |         | SEM                       | 4.2  | 3.8  | 2.9  | 3.4  | 3.2  | 3.3  | 3.6  | 3.5  | 3.7  |
|   | MASSAGE | Mean                      | 19.3 | 13.2 | 13.9 | 15.2 | 17.2 | 16.7 | 17.0 | 19.4 | 18.3 |
|   |         | SEM                       | 4.2  | 3.2  | 3.9  | 3.7  | 3.7  | 3.9  | 4.1  | 4.1  | 3.6  |

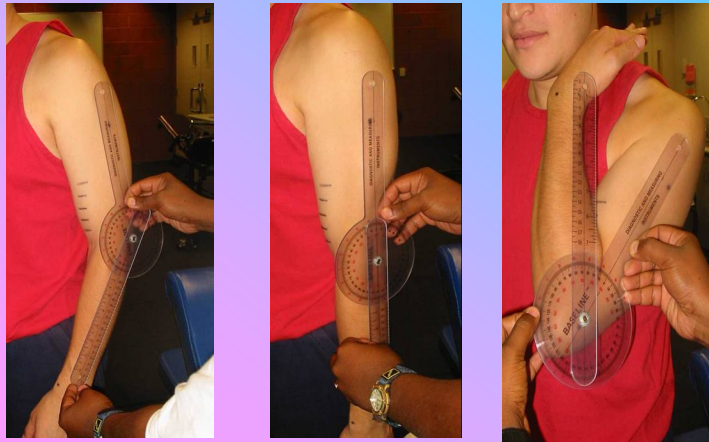
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## ROM

- No significant difference ( $P=0.70$ ) in the pre-exercise ROM values was evident between the control and massage arms. ROM values decreased significantly ( $P=0.04$ ) immediately after exercise by approximately 30% from baseline, and did not recover for the next 4 days.

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## ROM

|                         |                | Time post exercise (days) |       |       |       |       |       |       |      |     |
|-------------------------|----------------|---------------------------|-------|-------|-------|-------|-------|-------|------|-----|
|                         |                | post                      | 1     | 2     | 3     | 4     | 7     | 10    | 14   |     |
| <b>ROM<br/>(degree)</b> | <b>CONTROL</b> | Mean                      | -15.2 | -16.4 | -15.1 | -17.4 | -19   | -10.3 | -2.8 | 0.8 |
|                         |                | SEM                       | 1.9   | 3.2   | 3.6   | 4.6   | 4.1   | 3.7   | 3.4  | 2.1 |
|                         | <b>MASSAGE</b> | Mean                      | -16.6 | -14.3 | -11.8 | -10.2 | -7.8  | -1.6  | -0.5 | 0   |
|                         |                | SEM                       | 4.3   | 3.8   | 3.4   | 2.2   | 1.9   | 2.3   | 1.7  | 1.7 |
| <b>CIR<br/>(mm)</b>     | <b>CONTROL</b> | Mean                      | 2.3   | 5.2   | 5.9   | 7.8   | 10.4  | 10.9  | 6.5  | 4.8 |
|                         |                | SEM                       | 1.3   | 1.6   | 1.5   | 1.4   | 2     | 2.1   | 1.8  | 2   |
|                         | <b>MASSAGE</b> | Mean                      | 1     | 1.1   | 4.1   | 2.5 # | 3.3 # | 6.8   | 2.8  | 0.7 |
|                         |                | SEM                       | 1.2   | 1.6   | 2.1   | 1.2   | 1.3   | 1.8   | 1.8  | 1   |

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## Upper Arm Circumference

- The baseline upper arm circumference was not significantly ( $P=0.74$ ) different between arms.
- Increased significantly ( $P=0.04$ ) after exercise in both conditions
- Massaged arm showed a significantly ( $P=0.04$ ) smaller increase compared to the control arm
- Post-hoc analysis revealed significant differences in circumference between massage and control arm were recorded at 3 ( $p=0.04$ ) and 4 days ( $p=0.03$ ) following exercise.

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## Plasma CK Activity

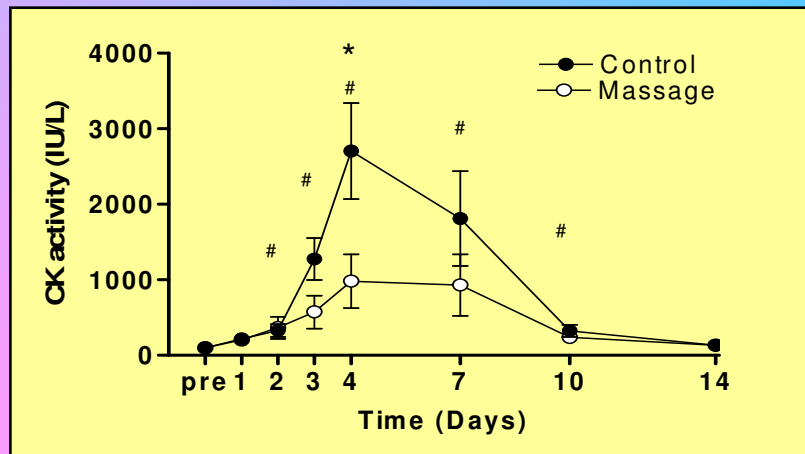
- No significant difference ( $P=0.90$ ) in plasma CK activity between the arms before exercise.
- Massage had a significant ( $P=0.03$ ) effect on plasma CK activity following exercise.
- Smaller CK efflux occurred for the massaged arm.

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Plasma creatine kinase activity before (pre) and 1-14 days after exercise for massage and control arm. \* represents a significant difference between arms;



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## Muscle Soreness

- Muscle soreness developed after both exercise bouts.
- Peak soreness for palpation of the brachioradialis and brachialis, and flexing the elbow joint was reported 1-3 days after exercise,
- whereas soreness on extension of the elbow joint occurred 4 days after exercise
- All reports of soreness had resolved by 10 days post-exercise.

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## Soreness and tenderness



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**Peak Muscle Soreness with Palpating the Brachialis and Brachioradialis (B/radialis), and Flexing (FLX) and Extending (EXT) the Elbow Joint After Exercise for the Control and Massage Condition.**

|                                 |      | Peak soreness (mm) |            |            |            |
|---------------------------------|------|--------------------|------------|------------|------------|
|                                 |      | Brachialis         | B/radialis | FLX        | EXT        |
| <b>CONTROL</b><br>(0-100 scale) | Mean | 46.7               | 51.6       | 42.1       | 52.8       |
|                                 | SEM  | 6.58               | 6.93       | 6.45       | 7.02       |
| <b>MASSAGE</b><br>(0-100 scale) | Mean | 35                 | 33         | 25.1       | 42.9       |
|                                 | SEM  | 7.87               | 8.05       | 7.46       | 5.57       |
| <b>Significance level</b>       |      | $p = 0.06$         | $p = 0.01$ | $p = 0.07$ | $p = 0.02$ |

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## Discussions

- **Massage reducing DOMS**
  - no positive previous study except Weber et al (1995).
  - Therapeutic or prophylactic
  - stimulation of type IV muscle fibres
  - increase in lymph and blood flow

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## Discussions (Cont'd)

- **Massage reducing CK**
  - Reduce the CK efflux from the damage area by increasing circulation and lymph flow
  - Assist flushing neutrophils from injured area
  - Psychological aspect

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## **DISCUSSION**

- **DOMS does not reflect the magnitude of muscle damage**
- **Massage reducing DOMS –might be beneficial for people who do not like DOMS**

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## **CONCLUSION**

- **It should be noted that massage had no effect on muscle strength and ROM and reducing swelling**
- **Massage following high intensity eccentric exercise reduced DOMS and lowering CK activity**

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**Thank you very much**

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