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The Effect of Compressed Air Massage On The Morphology Of Untraumatised Rabbit Skeletal Muscle

M.A. Gregory* and M.Mars**

*Electron Microscope Unit, University of Durban-Westville, Durban 4000, South Africa
**Department of Physiology, Nelson R. Mandela School of Medicine, University of Natal, Durban 4013, South Africa.

Massage, *per-se*, is designed to effect repair of damaged tissue as rapidly as possible. A potential hazard of massage is that direct and indirect pressure on muscle is known to damage skeletal myofibers[1]. The extreme local pressure employed during “deep transverse friction massage” (DTF) on rabbit skeletal muscle has been shown to cause myofibre oedema, supercontraction of myofibres, 2 types of inclusions and other reversible sarcoplasmic alterations[2]. In this study we examine the effect that a new form of treatment, “compressed air massage” (JET®), had on the morphology of rabbit skeletal myofibres when applied in a manner that has the potential to cause the most damage.

Twelve New Zealand, white rabbits were studied (R1 – R12). Before JET, the animals were anaesthetised by an intramuscular injection of equal parts Ketamine and Xylazine (10 mg/kg). The fur was removed from the skin over the left *vastus lateralis* at the level of the mid-thigh. Treatment consisted of a single, 10 minute episode of JET therapy using the "sport", single hole (mm) head and unheated air at 1 bar. Wedge biopsies were taken from the left *vastus lateralis* within 10 minutes (R1 – R4), 24 hours (R5 – R8) and 6 days after treatment (R9 – R12). To serve as controls, similar biopsies were taken from the right *vastus lateralis* of animals R9 – R12. The samples were bisected, one being processed and embedded in wax, the other being prepared for TEM using conventional techniques. Wax sections of 5µm were stained with haematoxylin and eosin and the cross-sectional diameter of a minimum 150 myofibres measured using an image analyser and SIS software. Thin sections (60nm) of longitudinally orientated myofibres were examined using a Jeol 1010 TEM at 60kv. Statistical analyses was by the Kruskal-WallaceANOVA and Dunn’s test.

Morphometry revealed a significant increase in myofiber diameters 10 minutes after JET massage, returning to normal values within 24 hours of treatment (Table 1 & Graph). The myofibers in control specimens were morphologically normal. Shortly after JET, the most consistent change was juxta-nuclear and intermyofibrillar oedema, the electron-lucent, sometimes “empty” spaces being filled with swollen elements of the sarcoplasmic reticulum (SR) and generally normal mitochondria and t-tubes (Fig. 1). In some fibres, sarcomeres were out of alignment, especially in peripheral regions (Fig. 2) where Z-bands exhibited various degrees of “streaming”. While glycogen was generally reduced in intermyofibrillar positions, it was sometimes aggregated in sub-sarcolemmal regions. Although there was a considerable reduction in intermyofibrillar oedema, the SR was still swollen 24 hours after JET. Occasional focal supercontracted sarcomeres were present, especially in sub-sarcolemmal regions. Z-band “streaming”, although still rare, was more prolific than 10 minutes after treatment. With the exception of very occasional Z-band streaming and some internalised nuclei, myofibres morphology had returned to normal 6 days after treatment.

The precise mechanisms by which massage is thought to help tissue repair is unknown. DTF, a well established, albeit traumatic mode of massage, has been shown to cause substantial reversible muscle injury in healthy muscle[2,3]. It has been proposed that DTF and other vigorous massage techniques may encourage damaged tissue to heal by causing an additional inflammatory reaction, which may trigger a cascade of healing responses. Compressed air massage, even when applied at high pressure through a single large hole, appears to cause less damage to the tissues. Whether this is a positive or negative with regards tissue repair is the subject of ongoing investigations.

References

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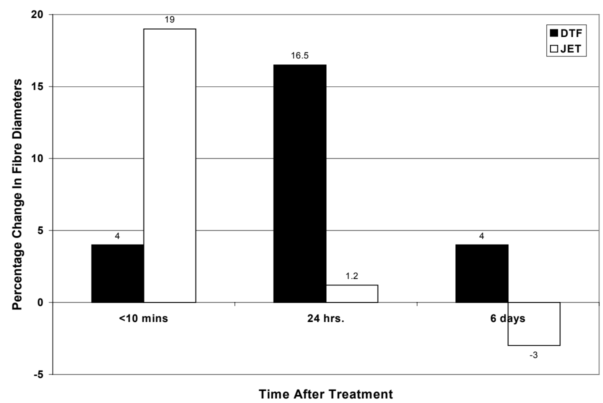
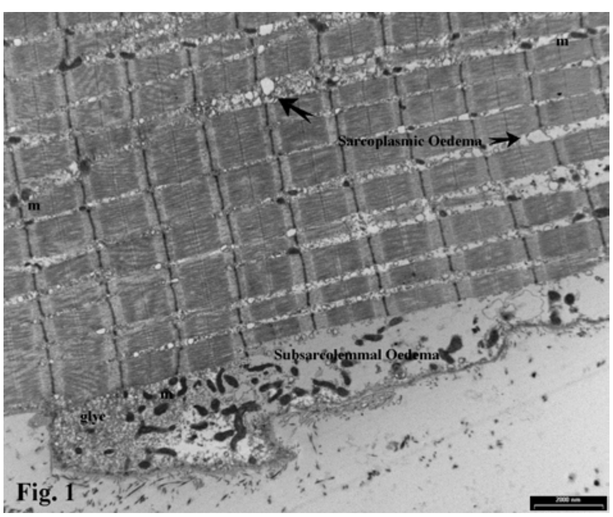
	Control	10 min JET	24 hrs JET	6 days JET
n	746	667	716	733
Mean	38.2	45.6	38.7	36.3
SD	10.2	14.6	10.1	10.9
EM	0.4	0.6	0.4	0.4
Max	72.4	96.4	68.0	65.6
Min	11.2	12.5	11.1	9.1
p =		<0.001	>0.05	<0.05

Table 1





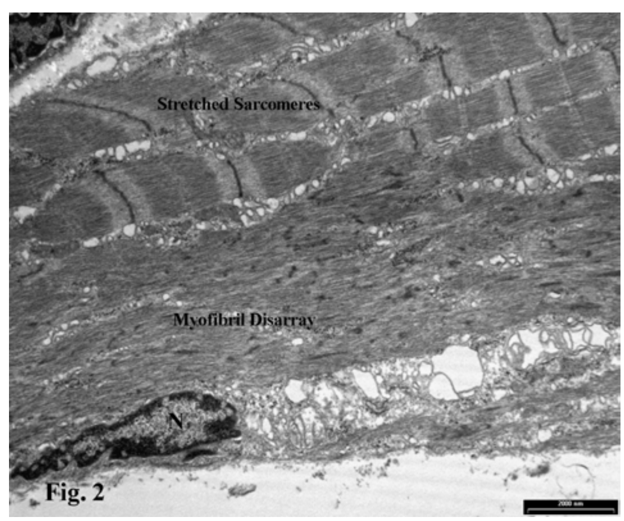


Table 1: Summary of morphometric data from control and post-JET treated muscle. n = number of measurements; Mean = average fiber diameters of group (μm); SD = standard deviation; EM = error of the mean; p = significance of difference between data when compared with control.
Graph: Compares the percentage change of fibre diameters after DTF[2], and JET massage. Note the altered pattern of oedema after the different massage techniques.
Figure 1: 10 minutes post-JET. Note sub-sarcolemmal and intermyofibrillar oedema.
Figure 2: 24 hours post-JET. Area of myofibrillar disarray.

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