

Collagen Deposition and Biomechanical Behavior During the Healing Process of Gastrocnemius Muscle Injury Treated by Ultrasound in Rats

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BACKGROUND: Considering that ultrasound (US) treatment stimulates collagen deposition, and that the collagen maturation process can contribute to a better mechanical strength, it was proceeded a quantitative study of collagen and the histological findings were correlated to the biomechanics data in a rat muscle lacerated injury model treated by pulsed US.

METHODS: After lesion, rats were randomly divided into 2 groups: US group was treated daily with 1 MHz pulsed ultrasound 50% at 0.57 W/cm² for 5 min, and Control group that did not receive any treatment. Each group was further divided into subgroups (n=5) for histological and biomechanical evaluation at postoperative (p.o.) days 4, 7, 14 and 24. The absolute volume of lesions was estimated using the Cavalieri principle in serial tissue sections stained by hematoxylin-eosin and stereology tools of vertical sections were used in picosirius stained sections to evaluate the impact of US in absolute volume of collagen fibers within the lesion. A biomechanical analysis were performed to estimate the stress (KPa) and the rigid (N/mm).

RESULTS: Although the histological pattern was similar in both treated and control groups, the absolute volume of lesion (mean \pm SD, in mm³) is lower in all US subgroups when compared with the corresponding controls for each time p.o. (**4** - 21.05 \pm 4.37 vs 44.47 \pm 6.09, p=0.02; **7** - 9.87 \pm 4.49 vs 18.27 \pm 3.27, p=0.017; **14** - 6.01 \pm 1.82 vs 13.49 \pm 4.95, p=0.016; **24** - 5.41 \pm 1.57 vs 9.69 \pm 3.23, p=0.047). Stereological data showed that absolute volume (mean \pm SD, in mm³) occupied by collagen was higher in treated lesions at **4** (7.58 \pm 2.68 vs 2.32 \pm 1.01, p=0.006) and **7** (5.65 \pm 1.26 vs 1.91 \pm 0.69, p=0.011) days p.o. The stress and the rigid were greater at both groups (US and Control) as the healing process progressed, but the US treatment promoted an early improvement of these variables: Stress and Rigid at **4** days p.o., respectively (442.71 \pm 105.17 vs 287.90 \pm 71.66, p=0.049) and (2.47 \pm 0.37 vs 1.46 \pm 0.41, p=0.036). At **24** days p.o. these variables were even better at the US group (Stress: 701.40 \pm 83.96 vs 597.08 \pm 29.72, p=0.039) and (Rigid: 3.99 \pm 0.38 vs 3.38 \pm 0.30, p=0.027).

CONCLUSIONS: Based on our results, it study suggests that pulsed US induces to a better functional recuperation, which in practice means that the US group is able to perform heavier work sooner.