Contractility of human and rat lumbar fascia

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BACKGROUND: Active contractility of fascial tissues has been proposed as an underestimated factor influencing myofascial stiffness. While several biochemical and biomechanical features of this potential influence have recently been confirmed many aspects remain to be elucidated.

METHODS: Density of myofibroblasts was assessed via immunostaining for alpha SM actin stress fiber bundles in samples of lumbar fascia from 20 Wistar rats (11 male, 9 females, ages between 60 and 580 days, mean age 90 days) and from lumbar fascia samples taken from human donors (n=12, 9 males, 3 females, mean age 52 years; range 19–76 years).

Strips of these rat and human lumbar fascia samples were suspended in an organ bath environment (Fig. 1). Their force responses were measured via mechanography in response to stimulation with the following pharmacological agents: angiotensin II, TGF-β1 at 15 ng/ml, and botulinum toxin type C3 at 30 µg/ml. The study conformed to the Declaration of Helsinki and was approved by the local ethical committee.

RESULTS: When compared to the rat specimens, the density in human lumbar fascia showed a statistical trend towards a higher density of myofibroblasts (p=0.059, median human lumbar fascia 1.52%, IQR: 0.16%–5.58%, rat lumbar fascia: 0.95%, IQR: 0.01%–0.40%).

Stimulation with angiotensin II yielded no recognizable force response (n = 8, n = 9, p > .05). In contrast, TGF-β1 stimulation yielded a clear contractile response when compared to untreated control samples (n=18, Hodges–Lehman estimate for the difference between relative prepost changes: 72.8%, 95% confidence interval: 42.6–157.9), p < .001. Botulinum toxin type C3 yielded a relaxation response when compared to untreated tissue samples (n=18, p < .001, Hodges–Lehman estimate for the difference between absolute prepost changes: 2.5 mN/mm², 95% CI 1.1–4.2).

In general, the mechanographic stimulation revealed a strong positive correlation between myofibroblast density and contractile response (r =.82, p <.001, n=12).
CONCLUSIONS: Contractility of rat and human lumbar fascia appears to be influenced by the density of myofibroblasts and their pharmacological sensitivity to different biochemical stimulators. The relaxing effect of the Rho inactivotor substance botulinum toxin type C3 together with the strong contractile potency of TGF-β1 suggests that the Rho/Rho kinase pathway plays a major role in myofibroblast contractility. The high myofibroblast density of the human lumbar fascia compared with rat lumbar fascia and also in comparison with other human fasciae suggests that fascial contractility may play an enhanced role for the myofascial stiffness in the human lower back.

References: