Paraspinal muscle contractile function is impaired with chronic spine disease: a study using the ENT1 KO mouse

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Disclosures

• Funding: Natural Sciences and Engineering Research Council of Canada (NSERC)

• No other disclosures
Introduction

- Altered muscle structure and function have been associated with various spine pathologies.\(^1\)\(^2\)\(^3\)
- Cellular mechanisms for active contraction not investigated in any manner, let alone compared between healthy and pathological spine conditions
- Mice lacking ENT1 (ENT1 KO) demonstrate progressive ectopic calcification of the spinal tissues including the ligaments & intervertebral discs\(^1\)

**Question:** How does progressive spine pathology affect the fundamental ability of spine muscles to contract and generate force?

**Aim:** To understand the mechanical interplay between spine pathology (stiffer spines) and the surrounding spine musculature

**Hypothesis:** Contractile function of the paraspinal muscles would be impaired in the KO when compared to the WT mice

\(^1\)Brown et al. 2011; \(^2\)Mika et al. 2005; \(^3\)Danneels et al. 2000
Methods

- 12 (KO)
- 12 (WT)

- Multifidus; Erector Spinae; Tibialis Anterior
- Dissecting Soln
- Chemically permeabilized (Roche et al., 2015)
- Storage Soln -80
- Fibre Typed
- Sarcomere length and force acquired ASI 600A
- Maximally activated in Ca2+ (pCa 4.2).
Results – Specific Force

Multifidus

Erector Spinae

Tibialis Anterior

Maximal isometric steady-state force / CSA
Results – Active Modulus

Proxy for # of attached cross-bridges during maximal activation
Results: Unloaded Shortening Velocity

Myofilament speed of shortening under zero load
Discussion

• Significant impairment in the force generating capabilities of the spine muscles in \textit{ENT1}^{-/-} (KO) mice

• Previously shown that an inverse reciprocal relationship existed between the passive mechanical properties of the spine and musculature\textsuperscript{1}

• This work expands these findings:
  • Delineating the relationship between mechanical properties of the spine and spine muscles.
  • Likely a consequence of the pathology in the spines of the \textit{ENT1}^{-/-} mice.

\textsuperscript{1}Gsell et al. 2017
Summary

• First evidence of cellular impairment in the contractile properties of the muscle in response to pathological changes to the spine

• Demonstrates that the paraspinal muscles remodel at the cellular level

• This work lays a foundation to enhance clinical efforts to prevent and rehabilitate spine related disorders

• Future efforts will aim to identify the subcellular mechanisms responsible for the impaired contractile function