The Effect of Percutaneous Needling & Overuse Activity on Achilles Tendon in an Animal Model: a histological, biomechanical, and biochemical study

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Disclosure

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Introduction

Despite its strong necessity, development of an adequate chronic animal model for Achilles tendinopathy has not been successful.

Purpose of this study

To evaluate the effect of percutaneous needling and overuse activity in rat Achilles tendon
Materials & Methods

85 Sprague-Dawley rats

Initial injury
Percutaneous dry needling (23G needle)

Overuse activity
Enforced treadmill running

Running protocol
10° Uphill, 17m/min, 1 hour/day, 5 days/week
Tendons that received the needling procedure showed marked thickening and degenerative changes with increased vascularity, most severely in the Treadmill/Needling group followed by the Cage/Needling group.
Results

Histology

A) Normal tendon
B) Needling & Treadmill group at week 3. Collagen fiber dis-organization, Inflammatory cell infiltration, microcyst (arrow head), prominent nerve twig(*) (H&E, X200)
C) Needling & Treadmill group at week 4. diffuse chondroid metaplasia (arrow) and myxoid change (H&E, X40)

Modified Bonar scale for the histologic grading of tendon degeneration (median, range)

<table>
<thead>
<tr>
<th>Bonar scale</th>
<th>Cage/Contralateral</th>
<th>Cage/Needling</th>
<th>Treadmill/Contralateral</th>
<th>Treadmill/Needling</th>
<th>P value</th>
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<td>5 (4~5)</td>
<td>8 (8~12)</td>
<td>6 (5~6)</td>
<td>11 (11~14)</td>
<td>0.023</td>
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Treadmill/Needling: Severe degenerative changes more frequently observed. Cage/Needling: Moderate degree degenerative changes.
Results

Biomechanical test

- Decreased tensile modulus in the needling sides.
- Increased UTS in the contralateral sides, implying strengthening of the contralateral side through adaptation to the increased loading.
Results

Expression of MMP-2 & MMP-9 by Western blot

Elevated expression of MMP-2 and MMP-9, most severe in the needling and running group.

Functional Evaluation

Functional evaluation as determined by the number of times each rat drew back from the enforced treadmill and received electrical shock on its tail, significantly increased throughout the four weeks in all rats in the treadmill group (p<0.001).
Discussion

- This study provides efficient ways to produce chronic tendinopathy animal model.
- Needling procedure followed by treadmill running successfully induced severe tendinopathy in rat Achilles tendon while needling and cage activity resulted in moderate degree of disease.
- With the advantages of short induction period, high success rate, and physiologic similarity with the pathomechanism of tendinopathy in human, this model could be useful in the studies on chronic tendon diseases.
References