EFFECT OF A NEW REPAIR TECHNIQUE AND AN EARLY ACTIVE MOBILIZATION PROTOCOL OF CANINE FLEXOR TENDONS - IN CADAVERIC AND ANIMAL STUDIES

*Wada, A., +Kubota, H., Miyashita, K., Hoshino, S., Hatanaka, H., Iwamoto, Y., ++Department of Orthopaedic Surgery, Faculty of Medicine, 3-1-1 Maidashi, Higashi-ku, Fukuoka, 812-8582, Japan; 81-92-641-1151 (Ext. 5488), Fax: 81-92-642-5507, E-mail: kubota@ortho.med.kyushu-u.ac.jp

Methods
Our new repair technique is shown in Fig.1. The technique consisted of four-strand core suture by double modified Kessler method with only one suture thread, in combination with the cross-stitch circumferential suture. A 5-0 coated braided polyester was used as a core suture, and a 6-0 polypropylene monofilament was used as a circumferential suture.

In cadaveric study, fresh frozen 24 canine flexor digitorum profundus (FDP) tendons of 8 pigs were used. A transverse laceration was made in zone 2. All tendons were repaired by 3 suture techniques below. The 3 subgroups (A-C) were compared by biomechanical testing.

Group A: 2-strand modified Kessler only
Group B: 4-strand double modified Kessler only
Group C: 4-strand double modified Kessler + cross-stitch (our new technique)

In animal study, 16 FDP tendons of fourth and fifth digits from 16 mongrel dogs were surgically exposed, and a transverse laceration was made in zone 2. All tendons were repaired by this new technique (Group C). Postoperatively, the dogs were allowed an active mobilization immediately under a spica cast control. Twelve tendons were harvested for biomechanical testing at 14, 28 and 42 days (N=4), and 6 tendons for histologic examination at 14, 28, and 42 days (N=2). Four fresh canine cadaver FDP tendons of fourth and fifth digits were used as day 0 controls.

Biomechanical testing: Repaired tendons in cadaveric study and harvested tendons in animal study were secured in tendon clamps on the Tensile Testing Machine and loaded to failure at a constant cross head. Force deformation curves were generated and analyzed for gap and breaking strengths, in addition to stiffness properties and histological healing of flexor tendons repaired by this technique using an early active mobilization protocol in cadaveric and animal studies.

Results
In animal study, macroscopic appearance showed a smooth gliding surface with no adhesions and no gross synovial tissue around the repair site in all time specimens. Furthermore, it showed a poor gap formation between tendon ends. It appears that the repair site directly united. Histologically, the number of endotenon cells increased compared with epitenon cells as the time passed. Masson's stain showed increased longitudinally oriented blue-stained collagen fibers at the repair site. Tendon callus and gap formed poorly in all time specimens (Fig. 2).

Discussion
Repaired tendons by this technique had 2.1 kgf gap strength and 6.1 kgf breaking strength in cadaveric study and could overcome the strength (mean of 1.9 kgf and maximum of 3.5 kgf) to be expected during an active mobilization. In animal study, breaking strength did not diminish and gap strength increased significantly throughout 42 days. This study supported the concept that an active mobilization improved the strength of repaired tendons. An important observation of this study is that macroscopic and histological appearances. The tendon surfaces were smooth without adhesions and the tendon ends united directly. Increased endotenon cells near the repair site and poor tendon callus formations demonstrate that endotenon cells might play a more important role than epitenon cells in intrinsic healing response in a good milieu. The combination of this technique and an early mobilization protocol stimulates intrinsic healing and has a potential to apply clinical cases.

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References

One or more of the authors have received something of value from a commercial or other party related directly or indirectly to the subject of my presentation.

The authors have not received anything of value from a commercial or other party related directly or indirectly to the subject of my presentation.

- Table 1

<table>
<thead>
<tr>
<th>Subgroup</th>
<th>Gap strength (kgf)</th>
<th>Breaking strength (kgf)</th>
<th>Stiffness (kgf/mm)</th>
</tr>
</thead>
<tbody>
<tr>
<td>A (8)</td>
<td>0.19 ± 0.07 ♦</td>
<td>3.13 ± 0.18 ♦</td>
<td>0.31 ± 0.07 ♦</td>
</tr>
<tr>
<td>B (8)</td>
<td>0.39 ± 0.16 ♦</td>
<td>3.92 ± 0.29 ♦</td>
<td>0.77 ± 0.13 ♦</td>
</tr>
<tr>
<td>C (6)</td>
<td>2.07 ± 0.46 ♦</td>
<td>6.03 ± 3.67 ♦</td>
<td>1.77 ± 0.38 ♦</td>
</tr>
</tbody>
</table>

* The value of Group A was significantly lower than any other group. P<0.05

- Summary of results:

In animal study, macroscopic appearance showed a smooth gliding surface with no adhesions and no gross synovial tissue around the repair site in all time specimens.

In cadaveric study, fresh frozen 24 canine flexor digitorum profundus (FDP) tendons of 8 pigs were used. A transverse laceration was made in zone 2. All tendons were repaired by 3 suture techniques below.