DIRECT PATELLAR TENDON HEALING TO A POROUS METAL IMPLANT: AN EXPERIMENTAL CANINE STUDY

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Introduction:
In patients with patellar tendon avulsion associated with TKA, or those with massive proximal tibial bone loss, restoration of extensor mechanism integrity by direct patellar tendon healing to a prosthetic surface might provide for improved functional outcomes. Porous tantalum is a novel biomaterial which appears to provide for rapid bone and soft tissue ingrowth into the interconnected porosities of the material (Hacking et al. 2000). This study was done to determine if prior results showing successful reattachment of canine supraspinatus tendon (Reach et al. 2004) could be replicated in a patellar tendon model where the tendon was fixed to a porous tantalum surface isolated from the bone below via cement and exposed to physiologic loads.

Materials and Methods:
33 skeletally-mature canine patellar tendons were elevated sharply and then reattached to the area of the tibial tuberosity by fixing the tendon between two tantalum washers with a screw (see drawing). Animals were allowed full weight-bearing post surgery. Results were measured at 3, 6 and 12 weeks of healing. Clinical function using gait analysis, tendon mechanical stiffness and strength (to failure) and histomorphometric changes were evaluated at all 3 time points.

Results:
Gait analysis showed that the vertical ground reaction force from the operated hind limb recovered to the level of contralateral limb by 6 weeks (p>0.05). Compared to contralateral control limb intact tendon values, tensile strength and stiffness of the tendon implant constructs increased dramatically between 3 and 6 weeks with strength exceeding 75% of intact control, and stiffness values ranging between 80 and 90% after 6 weeks. (see table) Histological analysis showed extensive tendon tissue ingrowth deep into the voids of the material.

<table>
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<tr>
<th>Time Cohort</th>
<th>Tensile Strength (vs ipsilateral control)</th>
<th>Stiffness (vs control)</th>
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<tbody>
<tr>
<td>3 weeks</td>
<td>34 ± 13%</td>
<td>63 ± 41%</td>
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<tr>
<td>6 weeks</td>
<td>76 ± 12%</td>
<td>89 ± 46%</td>
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<tr>
<td>12 weeks</td>
<td>77 ± 3%</td>
<td>83 ± 33%</td>
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Conclusion:
This study confirms that under stable mechanical interface conditions patellar tendon healing to a porous tantalum surface can be achieved with rapid return of strength and stiffness over the first 6 to 12 weeks in this experimental model. These results suggest that tendon fixation and healing to prosthetic devices may well be feasible using this material. This should allow improved treatment of patients undergoing prosthetic reconstruction for massive bone loss or following segmental resection of the proximal tibia (and other critical tendonous attachment sites).

References: