Hindfoot and Ankle Fusions: Does Acellular Micronized Placental Connective Scaffold Accelerate Bone Healing? A Pilot Study

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To compare fusion rates and return to activity between patients who underwent ankle or hindfoot fusion with an autogenous, decellularized, particulate human tissue and patient who underwent an ankle or hindfoot fusions without an autogenous, decellularized, particulate human tissue.

METHODOLOGY & HYPOTHESIS

Study Design: Chart Review

- A chart review was performed to compare fusion rates and return to activity between consecutive patients who underwent an ankle or hindfoot fusion with and without use of an autogenous, decellularized, particulate human tissue.

Inclusion Criteria

- ≥ 18 years of age
- Underwent hindfoot or ankle fusion with or without an autogenous, decellularized, particulate human tissue
- Procedure performed by one surgeon (S.A.B.)

Outcomes

- Fusion: defined as boney trabeculation as observed on the fusion site in all 3 radiographic views.
- Return to Activity: defined as the initiation of physical therapy

Statistical Analyses

- Outcomes were compared between the two groups using an independent samples t-test.
- Nominal variables were compared using Fisher’s exact test.
- Statistical significance was set at the 5% level (p ≤ 0.05).

Hypothesis

Considering the promising results of biological augmentation in bone healing and increased fusion rates, we hypothesized that the decellularized placental human tissue will accelerate bone healing and aid in faster return to activity.

LITERATURE REVIEW

- Autologous bone graft is the gold standard in reconstruction of bone defects and adjunctive tissues for orthopaedic procedures. The use of autologous bone graft has several disadvantages. As a result, bone graft substitutes have been developed including osteoconductive materials (sponge, granules, or chips) which have shown to be significantly more reliable than CT scans (11). Future randomized controlled trials are needed to further assess the efficacy of biological augmentation for hindfoot arthrodesis.

RESULTS

- Table 1: Patient Demographics

<table>
<thead>
<tr>
<th>All Patients</th>
<th>Treatment Group</th>
<th>Control Group</th>
<th>P-Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Patients</td>
<td>14 (100.0)</td>
<td>7 (100.0)</td>
<td>7 (100.0)</td>
</tr>
<tr>
<td>Age (years)</td>
<td>61.8 ± 14.1</td>
<td>67.5 ± 10.0</td>
<td>74.7 ± 16.0</td>
</tr>
<tr>
<td>Body Mass Index (kg/m²)</td>
<td>34.8 ± 7.2</td>
<td>36.0 ± 0.5</td>
<td>33.3 ± 6.1</td>
</tr>
<tr>
<td>Gender</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Men</td>
<td>5 (35.7)</td>
<td>2 (28.6)</td>
<td>4 (53.3)</td>
</tr>
<tr>
<td>Women</td>
<td>9 (64.3)</td>
<td>5 (71.4)</td>
<td>3 (46.7)</td>
</tr>
<tr>
<td>Operative Limb</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Left</td>
<td>7 (50.0)</td>
<td>3 (42.9)</td>
<td>4 (57.1)</td>
</tr>
<tr>
<td>Right</td>
<td>7 (50.0)</td>
<td>4 (57.1)</td>
<td>3 (42.9)</td>
</tr>
</tbody>
</table>

- Table 2: Outcomes

<table>
<thead>
<tr>
<th>Fusion (days)</th>
<th>Treatment Group</th>
<th>Control Group</th>
<th>P-Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Mean</td>
<td>43.3 ± 14.9</td>
<td>56.2 ± 15.3</td>
<td>0.135</td>
</tr>
</tbody>
</table>

- Figure 2: Outcomes

- There has been an increased prevalence in the literature examining the use of orthobiologics in hindfoot arthrodesis. Design et al at al. (1) demonstrated the efficacy and outcomes of Porous resorbable human platelet derived growth factor (PDGF-BB) in ankle and hindfoot arthrodesis. They showed complete fusion at 24 weeks in 84% of patients treated with the PDGF versus 66% of patients treated with autograft (1). PDGF has been shown to stimulate blood vessel and play a key role in promoting tissue repair (2). The angiogenic properties of PDGF, combined with strong mitogenic chemotrophic effects on mesenchymal cells, play a central role in the early phases of the healing cascade (3).

ANALYSIS & DISCUSSION

Biological augmentation avoids the complications of autograft augmentation including, donor site morbidity, increased operative bleeding, post-operative pain, and increased infection risk (4). At the same time it can help to mobilize key osteoinductive, osteoconductive and mitogenic factors and play a central role in the early phases of the healing cascade (5).

- Zhang et al. showed Placental derived mesenchymal stem cells (PDMSCs) have a promising advantage for bone tissue engineering. In their study PDMSCs offered advantages in cytokine production, and differentiation (6). Until recently bone graft is the gold standard in reconstruction of bone defects and adjunctive tissues for orthopaedic procedures. The use of autogenous donor site morbidity, increased operative bleeding, postoperative pain, and increased infection risk (4). At the same time it can help to mobilize key osteoinductive, osteoconductive and mitogenic factors (7).

REFERENCES