Analysis of Chitosan-Alginate Bone Scaffolds

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Outline

- Introduction
- Objective
- Methods
- Results
- Conclusion
- Future Work
Introduction

- Current medical procedure: bone grafts
- Need alternatives - scaffolds
Introduction

- Scaffold materials – synthetic, natural
- Chitosan and alginate – 1:1 bonds
- Scaffold structure – porosity, interconnectivity
Introduction

- Cell adhesion
- Cell proliferation and differentiation
Objective

To create the optimal chitosan-alginate scaffold by altering the proportions of chitosan-alginate

- Overall charge on scaffold changes
- Changes to mechanical structure and cell adhesion
Methods – Mechanical Testing

1. Make chitosan and sodium alginate solutions
2. Combine in different ratios
3. Freeze-dry
   (Forms pores)
Average Scaffold Porosity for Each Chitosan-Alginate Ratio

<table>
<thead>
<tr>
<th>Chitosan-Alginate Ratio</th>
<th>Porosity (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>90:10</td>
<td>99</td>
</tr>
<tr>
<td>80:20</td>
<td>98</td>
</tr>
<tr>
<td>60:40</td>
<td>97</td>
</tr>
<tr>
<td>40:60</td>
<td>96</td>
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<tr>
<td>20:80</td>
<td>95</td>
</tr>
<tr>
<td>10:90</td>
<td>95</td>
</tr>
</tbody>
</table>
Methods – Mechanical Testing

Apply force to compress to 10% of height

Record force
Methods – Mechanical Testing

- Room temperature (21°C), dry
- Body temperature (37°C), 7.4 pH solution
Elastic Moduli of Chitosan-Alginate Scaffolds
Dry (21°C)

<table>
<thead>
<tr>
<th>Chitosan-Alginate Ratio</th>
<th>Average Elastic Modulus (Pa)</th>
</tr>
</thead>
<tbody>
<tr>
<td>90:10</td>
<td>30000</td>
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<tr>
<td>80:20</td>
<td>50000</td>
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<td>60:40</td>
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<td>20:80</td>
<td>150000</td>
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<tr>
<td>10:90</td>
<td>40000</td>
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</tbody>
</table>
Elastic Moduli of Chitosan-Alginate Scaffolds
Wet (37°C)

Average Elastic Modulus (Pa)

*90:10 and 10:90 not shown – degraded during testing
Methods – Cell Cultures

Mouse embryonic stem cells plated on different ratios of chitosan-alginate

Observe cell adhesion with live/dead staining
Results – Cell Cultures

- Green is alive, red is dead
- Images showed fewer instances of cell adhesion compared to the image of the control
Results – Cell Cultures

- Green is alive, red is dead
- Greater cell adhesion compared to the image of the control
- Few dead cells
Conclusions

60:40 appeared to be the optimal ratio

- Greater mechanical strength – increased bonding
- Appeared to promote some cell adhesion – positive surface charge
Future Work

- Verification of results
- Additional materials for increased strength
- Stem cell differentiation for bone growth
- Timing of scaffold degradation
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Questions?