Client Background
Integra LifeSciences produces MicroMatrix®, a skin regeneration product that requires porcine bladder tissue cells. Employees must remove unnecessary smooth muscle fibers from the raw organ using a rectangular prism acrylic piece. This repetitive process has led to hand/wrist discomfort and injuries.

Problem Statement
Develop an ergonomic approach incorporating both physical modifications and procedural protocols to the porcine organ scraping process to mitigate upper extremity injury occurrences in workers while preserving practicality.

System Model
A fishbone diagram model was developed to identify relevant subsystems to individually address for an overall effective solution for upper extremity injuries.

Scraper Handle Design
A comparative analysis approach was used to develop three distinct prototypes, each with unique trade offs in strengths and weaknesses.

Methodology
The following quantitative analysis was performed to evaluate the designs:

- Step 1: Employees evaluate the control and prototypes using the System Usability Scale (SUS) survey.
- Step 2: Perform one-way ANOVA for analysis of variance
- Step 3: Perform t-testing for analysis of statistical significance against the control

The experimental data from the prototypes are to be compared against the control to determine if the proposed solutions were considered effective.

Results

<table>
<thead>
<tr>
<th></th>
<th>Control</th>
<th>Design #1</th>
<th>Design #2</th>
<th>Design #3</th>
</tr>
</thead>
<tbody>
<tr>
<td>SUS Score</td>
<td>76.5</td>
<td>97.5</td>
<td>93.25</td>
<td>52.5</td>
</tr>
</tbody>
</table>

ANOVA Test

- p-value: 0.01245

T-Test

<table>
<thead>
<tr>
<th></th>
<th>Design #1</th>
<th>Design #2</th>
<th>Design #3</th>
</tr>
</thead>
<tbody>
<tr>
<td>t-value</td>
<td>0.0019</td>
<td>0.0504</td>
<td>N/A</td>
</tr>
</tbody>
</table>

Discussion

- SUS Score: Designs #1 and #2 outperformed the control with ratings considered “Excellent”.
- ANOVA: Data obtained from testing holds quantitative validity due to p-value < 0.05
- T-Test: Designs #1 and #2 show that they are statistically significant in outperforming the control group data as the t-value < 0.05

Further Recommendations

- Workstation
  - Keep items within normal reach envelope
  - Adjust chair height to ensure shoulders are relaxed and forearms remain parallel to the worktable

- Technician
  - The pulling motion places less strain on hand/wrist than pushing
  - Practice a natural grip, neutral wrist position, and avoid forearm pronation (inward palm rotation)

- Policy
  - Implement and enforce frequent short breaks
  - Suggestion: 30-minute work segments followed by 5-minute breaks to perform stretching exercises

Limitations: Testing was only done during brief sessions. Long-term usability studies could provide additional relevant insight.