Effects of Obesity on Overall Bone Health
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"I'm not fat, I'm big-boned"
Background Information

- The World Health Organization (WHO) defines overweight and obesity as “abnormal or excessive fat accumulation that may impair health” (“Obesity and overweight”)
- Body mass index (BMI) as the typical metric of overweightness to relate subject weight and height
  - Measured in kilograms per square meter \((kg/m^2)\) - measurement of size, not health.

<table>
<thead>
<tr>
<th>Population Group</th>
<th>Overweight</th>
<th>Obese</th>
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</thead>
<tbody>
<tr>
<td>Adults</td>
<td>BMI &gt; 24.9</td>
<td>BMI &gt; 29.9</td>
</tr>
<tr>
<td><strong>Children (5-19 years old)</strong></td>
<td><em><em>BMI-for-age &gt; 1 Standard Deviations</em> above median</em>*</td>
<td><em><em>BMI-for-age &gt; 2 Standard Deviations</em> above median</em>*</td>
</tr>
<tr>
<td><strong>Children (&lt;5 years old)</strong></td>
<td><em><em>BMI-for-age &gt; 2 Standard Deviations</em> above median</em>*</td>
<td><em><em>BMI-for-age &gt; 3 Standard Deviations</em> above median</em>*</td>
</tr>
</tbody>
</table>

* Based on established median for reference population by WHO Growth Reference standards
Overweight and obesity in children 5-19 years old, rose from 4% to 18% from 1975-2016

U.S. Overweight and Obese 2016: 41 million children under 5 years old
340 million children 5-19 years old
1.9 billion adults

Globally, overweight and obesity are linked to more deaths than underweight
Obesity Demographics

Numbers of Overweight & Obese by Region for individuals ≥15 years
Impacts of Obesity

- Higher fracture risks
- Lowered mobility and range of motion
- Reported joint and foot pains
- Psychological effects
- Increased bone mass density (BMD)
  ○ Only aspect governed by Wolff’s Law

Wolff’s Law: States a healthy bone has the capability to adapt to and compensate for its load
Concentrated Areas of Effect

- Increased weight translates to increased force on the weight-bearing joints (knees and ankles).
- During the single-leg stance, a force of 3-6 times that of body weight is transmitted across the knee joint.
- Excessive joint stress is related to the progression of knee OA.
Proposed Solution: Part 1

- These braces will significantly reduce pain, increase function, and reduce excessive loading to the damaged compartment.
- Our design will help mitigate the degradation of cartilage in joints.
- Each pound of weight lost will result in a 4-fold reduction in the load exerted on the knee per step.
Proposed Solution: Part 2

- These orthotics will be specifically designed for morbidly obese patients.
- Custom made to contour to each patient (size, arch height, and shape).
- The orthotics will significantly help in shock absorption, and reduce excessive loading to the ankles.
Conclusion

- Obesity accompanied by arthritis creates a vicious circle of inactivity and pain that prevents exercise.
- Obesity is a major risk factor for OA, but it is also a modifiable risk factor.
- Our design will help reduce the progression of OA in two critical weight-bearing joints.
- This preventative measure will be paired with a comprehensive work out schedule and diet to maximize weight loss.
References

Questions?