IMPACTION BONE GRAFTING: COMPARISON OF TWO COMPACTION MODES

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Introduction

• During Total Hip Arthroplasty (THA) bone loss is recovered by using bone chips

• In order to guarantee sufficient mechanical strength, the porous bone chips have to be compacted

Aim of the study: comparison of two different compaction modes for bone impaction grafting in a in vitro study

$369 \text{ N (SD 95) } @ 4.5 \text{ Hz} \quad \leftrightarrow \quad 308 \text{ N (SD 115) } @ 44 \text{ Hz}$
Materials & Methods

• Cortical and cartilage tissue of human femoral heads were removed with a bone saw.

• From the sponges tissue bone chips were prepared using a bone mill.

• Filled into a plastic cup which simulated the acetabulum.

• Bone mass characteristics were evaluated by 30 measurements taken for each compaction method and for each time step at 0, 3, 6, 9, 12, 15 and 30 [s] of compaction time.
Materials & Methods

Design of the measurement system:

1. Inductive position sensor
2. Punch
3. Plastic cup filled with bone chips
4. Load Cell
5. Signal amplifier

- Bulk density, impaction hardness, contact stiffness and penetration resistance were the parameters of comparison
- The non-parametric U-Test was used for statistical analysis.
Materials & Methods

- **Bulk density**
  
  \[ \rho = \frac{m}{V_{cp}} \]

- **Penetration Resistance**
  
  \[ R = \frac{mgH}{\Delta zA} \]

- **Impaction hardness**
  
  \[ H = \frac{P_{max}}{A} \]

- **Contact stiffness**
  
  \[ Hs = \frac{P_2}{A} \]
Results

**Impaction hardness**

- Manual impaction
- Pneumatic impaction
- Trendline manual impaction
- Trendline pneumatic impaction

(p < 0.001)

**Contact stiffness**

- Manual impaction
- Pneumatic impaction
- Trendline manual impaction
- Trendline pneumatic impaction

(p < 0.01)
Results

**Apparent density**

(p < 0.01)

**Penetration resistance**

(p < 0.8)
Conclusion

• Manual impactions shows more variable results and depends greatly on the experience of the surgeon

• Pneumatic impaction of morsellised bone chips achieves higher density values in less time with less force applied

  This might reduce the risk of fractures!

• Pneumatic impaction shows more reproducible results than manual impaction

• Standardisation of the impaction process for acetabular bone defects

  Density reference value for optimal ingrowth of osteocytes?
Thank you!