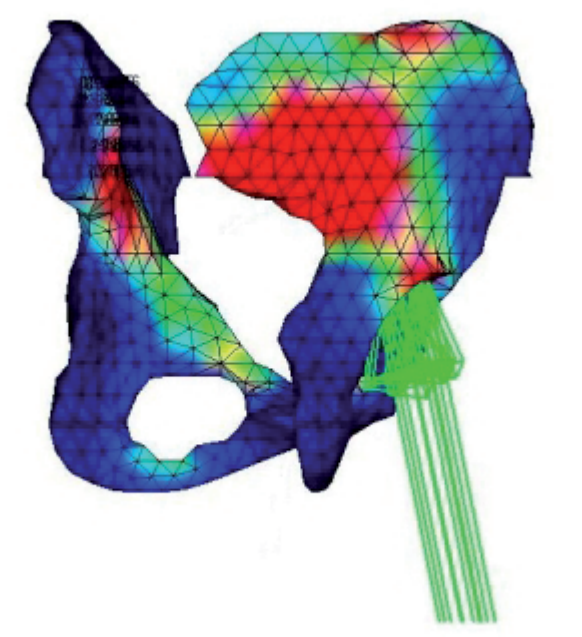




# Impaction Bone Grafting: Comparison of two compaction modes



D.Putzer, E.Mayr, A.Reinthaler, C.Haid, M.Nogler  
Medical University of Innsbruck - Experimental Orthopaedics  
Contact: david.putzer@i-med.ac.at

## INTRODUCTION:

In revision Total Hip Arthroplasty (THA) bone defects can be treated with impaction bone grafts. In a technique, developed by Sloof et. al. and described as acetabular impact-grafting procedure, a hammer and an impaction stick are used for manual compaction (1-3). In another technique a compressed air hammer (Bittenbinder Rabbit) is used, which could lead to a higher density and improved stability of bone chips in the acetabulum. The aim of this study was to compare and evaluate both methods described above, by determining some material characteristics.

## METHODS:

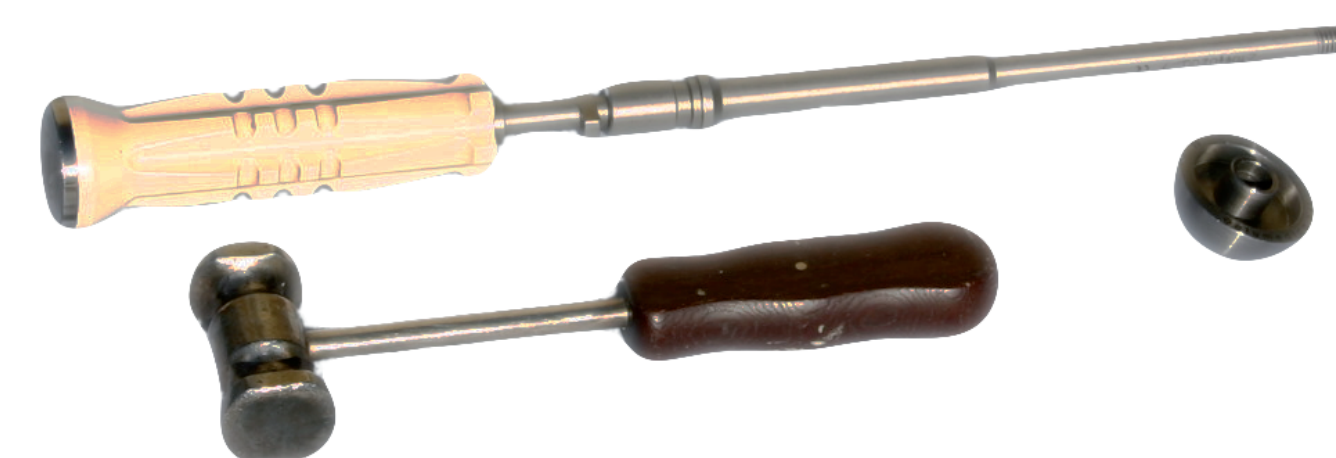
For the experiments 30 g of swine bone chips with a size from 8-10 mm were used. Manual as well as pneumatic impaction was conducted by the same person. The measurement was conducted by lowering a punch with predefined load into the impacted bone mass. Resisting force and distance were measured to calculate the stiffness, density and indentation hardness variation.

Bone chips



8-10 mm  
30 g

Instrumentation for manual impaction

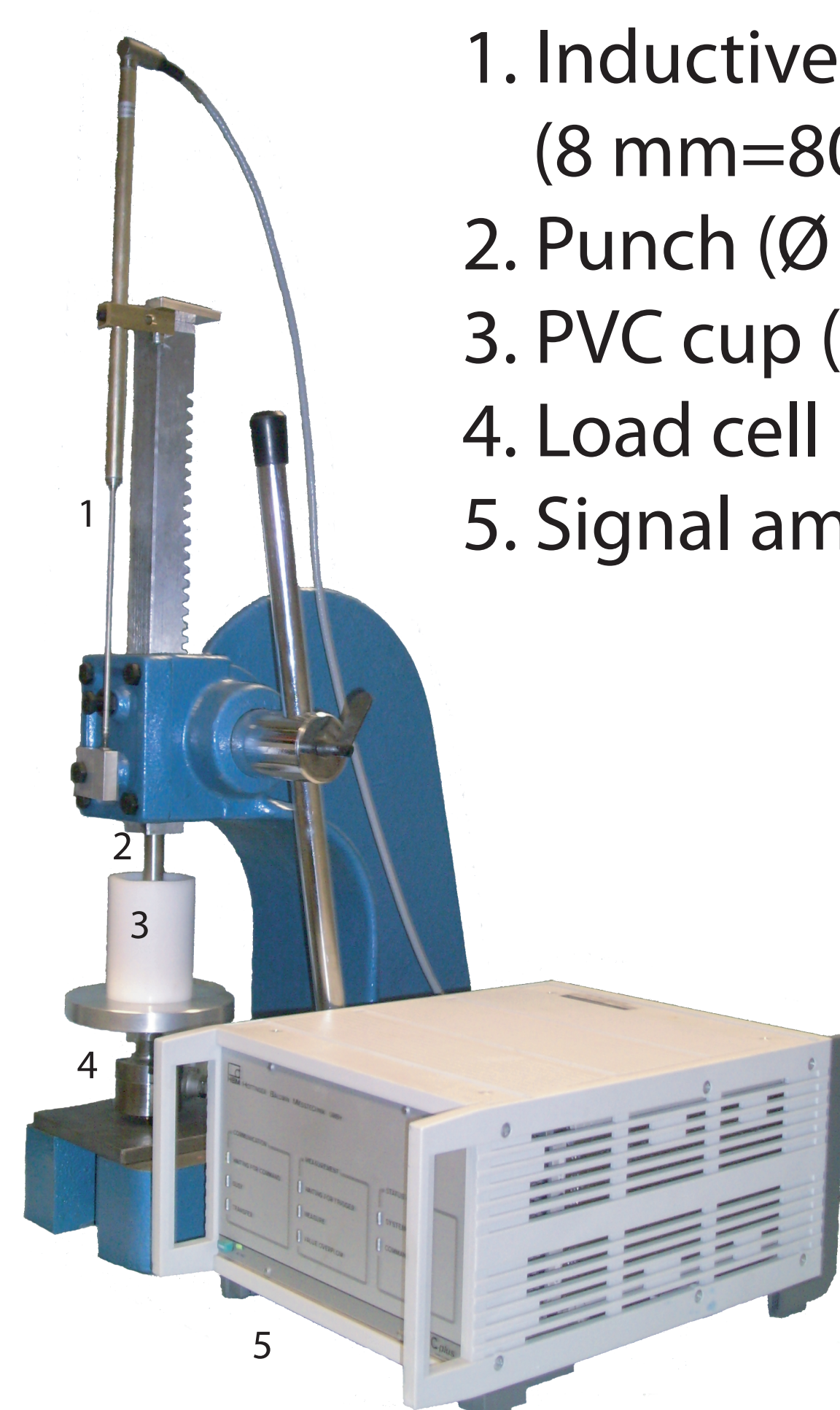


368 N (SD 70)  
ca. 5 Hz

Instrumentation for pneumatic impaction

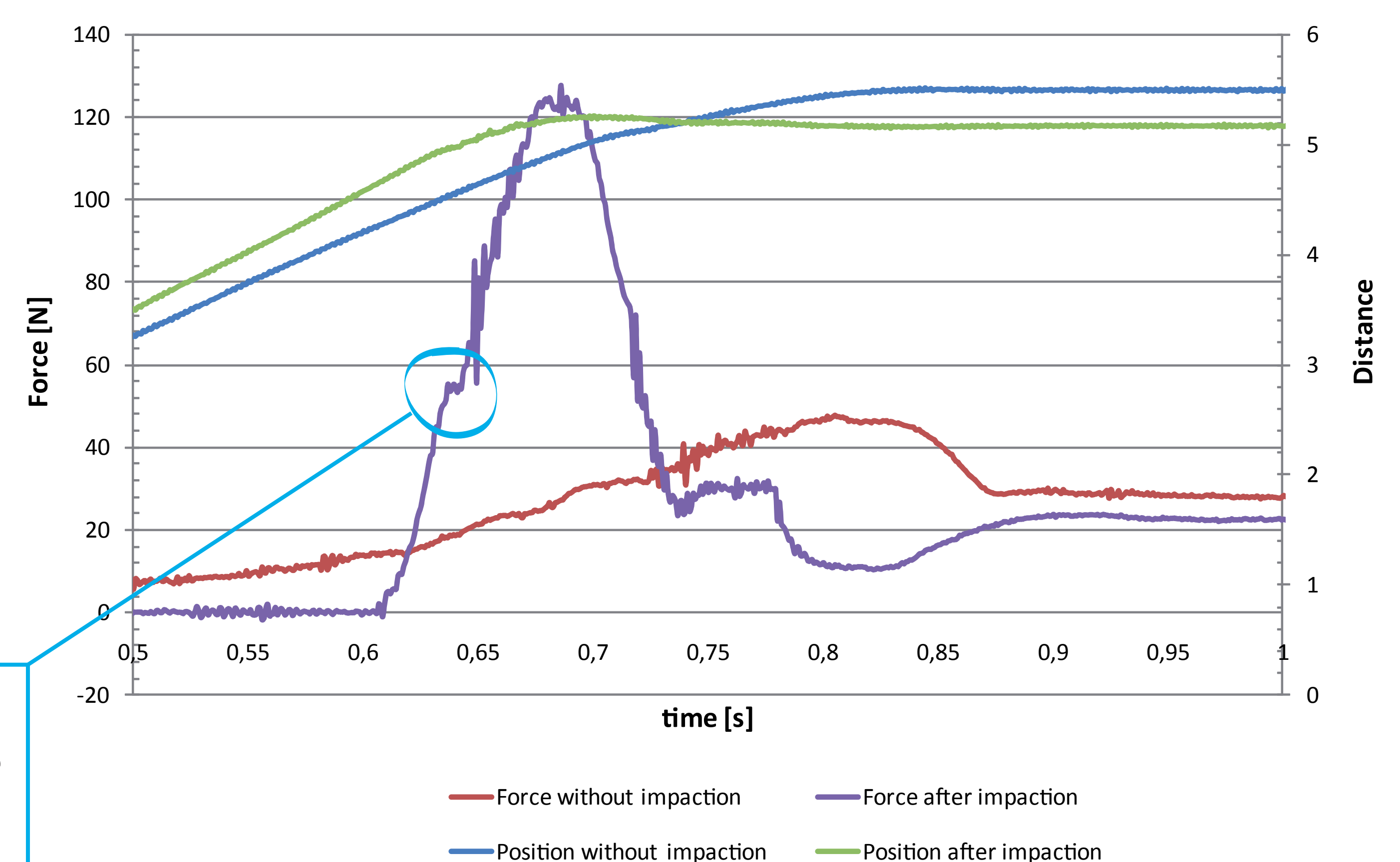


310 N (SD 113)  
ca. 41 Hz



1. Inductive position sensor (8 mm=80 mV/V±1)
2. Punch (Ø 1,5 cm)
3. PVC cup (Ø 5,1 cm, h 6,6 cm, m 164 g)
4. Load cell (500 N= 2 mV/V±1)
5. Signal amplifier (sample rate 1,2 kHz)

The punch wins the resistance of the bone chips on surface.



## RESULTS:

A t-Test was used to evaluate the two investigated impaction methods. The two methods didn't differ significantly in stiffness (T=0,978, Sig=0,332), impaction hardness (T=0,563, Sig=0,575) and apparent density (T=1,16, Sig=0,251) after 15 seconds of impaction.

|  | Manual impaction  |       |       |                        |       |       | Pneumatic impaction |        |       |                        |       |       |
|--|-------------------|-------|-------|------------------------|-------|-------|---------------------|--------|-------|------------------------|-------|-------|
|  | Without impaction |       |       | After 15 [s] impaction |       |       | Without impaction   |        |       | After 15 [s] impaction |       |       |
|  | MW                | SD    | MED   | MW                     | SD    | MED   | MW                  | SD     | MED   | MW                     | SD    | MED   |
| Impaction hardness [MPa]                 | 0,103             | 0,043 | 0,103 | 0,197                  | 0,035 | 0,193 | 0,096               | 0,0294 | 0,096 | 0,192                  | 0,034 | 0,189 |
| Stiffness [MPa]                          | -                 | -     | -     | 0,076                  | 0,008 | 0,076 | -                   | -      | -     | 0,075                  | 0,006 | 0,074 |
| Apparent density after impaction [g/cm³] | 0,426             | -     | -     | 0,884                  | 0,312 | 0,814 | 0,426               | -      | -     | 0,812                  | 0,242 | 0,777 |

## DISCUSSION & CONCLUSIONS:

Both investigated methods can be used for impaction bone grafting. The characteristics of the bone mass impacted with the pneumatic method showed less variation and therefore it was easier to reproduce a similar situation in all measurements. However it seems that a surgeon can easily achieve similar results after 15 seconds of compaction. In the pneumatic method the single beats are executed with lower force but higher frequency, therefore it could be a more suitable impaction process. Further research has to be done, to evaluate if the bone graft density, stiffness and indentation hardness are comparable to clinical results.

## REFERENCES:

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## ACKNOWLEDGEMENTS:

This research was supported by D. Huber, scientific collaborator, M.Haselbacher and D.Schraffl, medical students.