Force Transmission In Offset Broach Handles Used For Hip Replacement:

Comparison Of Three Different Designs

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Introduction

- Double offset broach handles are used:
  - in minimal invasive direct anterior total hip arthroplasty
  - to facilitate the preparation of the femoral canal
Introduction

Aim of the study:

Quantify the differences in force and impulse transmission between two versions of double offset broach handles and a single offset broach handle.
Two types of double offset broach handles were compared to a single offset broach handle (all Stryker, Mahwah, NJ-USA)
Materials & Methods

- 30 measurements for five different falling heights for each broach handle
- Measurement of the force variations by a load cell
- Obtainment of the maximum force peak
- Calculation of the impaction impulse
- Non-parametric U-Test
Materials & Methods

- Calculation of the impaction impulse

Theoretical model:
- Mass concentrated in one point
- No friction
- No Loss of energy

\[
\vec{I} = \int_{t_1}^{t_2} f \, dt
\]

\[
\vec{I} = m\vec{\nu}
\]
Results

Maximum force peak $f(t)$ [kN]

Arch of angle [$^\circ$]

- 15
- 30
- 45
- 60
- 85

A
B
S
Results

Arche of angle [°]

Impulse [Ns]

15 30 45 60 85

A B S T
Results

- Broach handle S has a 18% higher force peak than B and 36% higher than A
- S has a 24% higher impulse value than B and a 19% higher impulse value than A
- A had higher impulse values (5%) and lower maximum force values (18%) compared to B
Conclusion

- The single broach handle has the highest force peaks in the direction of the tip, followed by broach handle B (22% lower than S) and A (36% lower than S).

- Higher instantaneous force peaks could increase the risk of bone fracture.

- Contact surface during the impact could be a determining factor in reducing the maximum force peak.

- Elastic properties of the broaches were not known.
Conclusion

- Impulse values are very similar between the two double offset broach handles (A has 6% higher impulse value than B) and different compared to the single offset broach handle (S had 31% higher impulse value than B and a 19% higher impulse value than A).

- The introduction of the lateral lever arm has a measurable effect in double offset broach handles.

- Less kinetic energy is transmitted in the direction of the tip.
Thank you!