Results of a serie of modular locked-stem humeral prostheses in proximal humeral fractures

Anatomical and preliminary clinical multicenter study

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Conflict of interest
Introduction

- Limited evidence is available on the best choice in treatment (fixation, hemiarthroplasty, reversed prosthesis) of three- and four-part fractures of the proximal humerus.
- Tuberosity healing is strongly correlated with functional results in all series mentioning this parameter.
- We formed a working group to improve position of the implant and fixation of the tuberosities on an implant specifically intended for traumatology.
**Material and methods**

- **Anatomic study**: An anatomic study on 11 cadavers and a prospective multicentric clinical study of 32 cases were performed to validate extrapolable original solutions at the patient scale.

- **CT4 fractures**: Anatomic study: CT4 fractures were created in 11 fresh cadavers via the deltopectoral approach; afterwards, the implant, whose positioning height was aided by the locking ancillary device, was placed. Before locking the stem, a check was performed using an imaging intensifier to verify the positioning presented by the ancillary device, located more easily.

- **Clinical study**: Evaluation by Dash score and Constant score was correlated with positioning of the tuberosities using radiographic examinations.
Material and methods

Placement of the stem at a height indicated, in relation to the insertion of the clavicular bundle of the pectoralis major, locking of the stem
Material and methods

placement (based on bone quality) of a variable volume metaphyseal frame (offset modular system® OMS®), avoiding medialisation of the tuberosities

Without OMS®

With OMS®
Material and methods

fixation of the tuberosities using strong looped sutures
Results

- The clinical study enabled a distance of the top of the head/pectoralis major of 5.5 cm +/- 5 mm to be determined, confirming the results of the anatomic study and data from the literature, thus validating the height-adjusting tool developed.
- The distal double-locking ancillary device enabled all stems to be securely locked.
- The suturing technique for the tuberosities using looped sutures was reproducible and judged to be effective by all of the surgeons.
**Results**

- 23 patients (5 males, 9 CT4 and 8 CT3) with an average age of 69.6 (33-90) have been operated by 3 senior surgeons and reviewed with a mean FU 17.3 months (6-24). All patients were seen again at 3 months and 6 months and the average revealed at highest follow up an abduction of 90.7° (140-40), an active anterior elevation of 113.25° (160-60), an ER1 of 43.2° (55-30).

- One complication was noted: inadequate position of a locking screw due to a technical error by the surgeon, however the second screw ensured that the stem was locked.

*Case courtesy from JY Hery*
Results

- In the 17 patients operated on with a stem without oms®, we found a percentage of 50% adequate initial positioning of the tuberosities and 10% secondary displacement.
- In the 6 patients operated with the oms®, we found 100% adequate initial positioning of the tuberosities and no secondary displacement, which suggests the value of using a variable volume metaphyseal frame in synthesis of the tuberosities.
The use of a specific implant in proximal humeral fractures, designed based on the analysis of hemiarthroplasty series in the literature, helps limit technical problems, related in particular to the elevated positioning and to the long-term fixation of the tuberosities in an anatomical position.

The series from Sofcot, Boileau, and more recently Reuther yielded results of 40 to 66% malposition or non-union of the tuberosities.
Non union of tuberosities / type of stem

44 % - Conventionnal stem
Krishnan Clinical  2011

66% - Special huge stem dedicated to fracture
Falk Reuther Injury 2010

21% - stem for Fracture
Krishnan Clinical  2011

13 % - stem for Fracture
Boileau JSES 2011

5 % - Conventionnal stem …
Neer JBJS 1970
The initial clinical results from our series are encouraging and demonstrate that, based on all of the solutions proposed by the working group of the Humelock® project, this multicentric study should be extended by a more long-term analysis.

A CT scan analysis of all patients in order to follow up on the tuberosities with a clinical reevaluation is planned in one year.