Short- or long-stem prosthesis for intramedullary bypass of proximal humeral fractures with severe metaphyseal bone loss: evaluation of primary stability in a biomechanical model

Christian Spross,Lukas Ebneter,Emanuel Benninger,Matthias Erschbamer,Johannes Erhardt & Johannes Erhardt

BACKGROUND
Proximal humeral fractures with substantial metaphyseal comminution are challenging to treat. In the elderly with osteoporotic bone, arthroplasty sometimes remains the only valuable option; however, the minimally required length of stem fixation is not known. The aim of this study was to investigate the primary stability of cemented short- and long-stem prostheses with different intramedullary fracture bypass lengths.

MATERIALS AND METHODS
Osteoporotic composite bone models of the humerus (Synbone, Malans, Switzerland) with 3 different fracture levels (group A, 6 cm distal to surgical neck; group B, 7 cm distal to surgical neck; and group C, 8 cm distal to surgical neck) were prepared with a cemented standard short (S)- or long (L)-stem prosthesis and were tested for torque to failure. As a reference, we used models with intact bone (group R-O) and a short-stem prosthesis implanted at the surgical neck (group R-P). The radiographic bypass index (BI) was calculated before testing (fracture level to stem tip [in millimeters]/outer cortical diameter at fracture level [in millimeters]).

RESULTS
The resulting BIs of each group were as follows: 1.7 in group A-S, 3.4 in group A-L, 1.4 in group B-S, 3.2 in group B-L, 1.0 in group C-S, and 2.9 in group C-L. Compared with group R-O, the torques to failure of groups B-S and C-S were significantly lower, whereas only group C-S was significantly weaker than group R-P ($P < .01$). Comparing short- and long-stem bypasses of different fracture heights, we found that only group C-L showed a significantly higher resistance to torque ($P < .01$).

CONCLUSIONS
A short-stem bypass with a BI of 1.7 was sufficient for primary stability tested by torque to failure in this biomechanical setting. For smaller BIs, a long-stem prosthesis should be considered.

Kantonsspital St.Gallen

LEVEL OF EVIDENCE
Basic science study, biomechanics.

type	journal paper/review (English)
date of publishing	22-4-2013
journal title	J Shoulder Elbow Surg (22/12)
ISSN electronic	1532-6500
pages	1682-8