This article explores the role of hemiarthroplasty in distal humeral fractures.

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Hemiarthroplasty in the treatment of distal humeral fractures

The distal end of the humerus has a particularly complex joint surface. When disrupted by fracture, displaced major load-bearing surfaces, if not perfectly reduced, will alter the kinematics of the joint. Fragments of cartilage and subchondral bone, deprived of blood supply will damage the normally friction-free joint surface leading to stiffness and pain.

The complexity of the joint and the difficulty in controlling relatively small fragments of broken bone make open reduction of fractures extending into the joint difficult. While surgeon skill and experience can make it possible to reassemble the principal fragments of capitellum and trochlea, imperfections in the joint surface may be unavoidable.

After distal humeral fractures, if it is not possible to reassemble a perfect joint surface, there is an immediate and obvious problem. In some imperfectly reduced fractures, pain and stiffness may not demand resolution for some weeks or months. In other situations one or more of the reduced and internally fixed fragments with a poor blood supply, may not be uniting with other fragments or with the main shaft of the humerus. A fourth situation is the even later development of post-traumatic osteoarthritis but with a retained, acceptable ulnar joint surface. A total replacement would of course have to be considered.

An imperfect joint surface after distal humerus fracture can be improved by the insertion of an idemorph implant (morphometrically identical to the original joint surface) made of a synthetic material such as cobalt chrome steel.

A three-part surface arthroplasty of the elbow joint (Sorbie-Questor, Wright Medical Technology, Arlington, Tennessee USA) was introduced in 1995 and has had a long experience of use in osteoarthritis of the elbow, inflammatory arthritis and some forms of congenital or acquired deformity of the joint. It consists of a cobalt chrome humeral component with an intramedullary stem, an ulnar component with a stem and a modular high-density polyethylene-bearing surface of varied thickness and a third part, a stemmed radial component also with a high-density polyethylene-bearing surface. The humeral component can be used alone as a resurfacing hemiarthroplasty after fracture of the distal humerus, at any post-fracture stage, if the ulnar surface is in an acceptably good condition.

The bearing surface is an exact reproduction of the distal humerus available in three sizes, small, medium and large. As the surface geometry of the right elbow mirrors that of the left, the implant has right and left versions. The dimensions of the implant and the surface geometry were obtained from specimens of the distal humerus mounted upside down and fixed in metal cube-shaped boxes containing epoxy resin. The line that joins the medial and lateral epicondyles was used as the reference line (trans epicondylar ‘axis’ or TEA). The specimens were moved past a thick circular saw blade on a milling
machine. It shaved off .76 mm with each pass. Color photog-
graphic films of the cut surfaces were analyzed using a digi-
tizer board. Cartesian mathematics and a computer program
were applied to “virtually” recreate the surface geometry and
determine the centroidal axis of flexion and extension around
which the ulnar and radial bearing surfaces move in normal
elbow kinematics. Overall dimensions were obtained from
120 standardized x-rays of normal adults.

The sagittal angle in the stem is an average of the normal
adult angle and the stem diameter is sufficiently small to fit all
medullary canals. The stem angle is 50º, with females nor-
mally having an angle that is towards the higher end of the 45
to 55º range.

The humeral implant can be inserted through a trans-olecra-
nion, a posterior or a lateral Kocher approach. The procedure
requires reconstruction of the medial and lateral pillars of the
distal humerus if they have been broken and displaced. In
fresh fractures, the reconstruction can begin with the tempo-
rary help of Kirschner pins. Plates may be used if the screws
holding them are placed not to interfere with the insertion of
the implant’s small diameter stem. A template is used to de-
termine the size of the distal humerus and locate the center of
a line extending from the medial surface of the trochlea to the
lateral surface of the capitellum. This is the centroidal axis of
flexion and extension (CAFÉ). Using the metal template, a
1/8” drill hole is made on the CAFÉ at the medial and lateral
sides. A clamp is applied which has rounded pins to engage
the drill holes on the medial side of the trochlea and lateral
side of the capitellum. When in position, a metal bar rests on
the back of the distal humerus, to guide an oscillating saw
blade which cuts through the distal humerus from posterior
to anterior surfaces, extending proximally through the thin
supracondylar area. The saw guide clamp is released and with
a bone rongeur, the fragment of bone between the saw cuts is
removed. The rongeur is used to open the distal part of the
humerus above the thin area, giving access to the medullary
canal. The medullary opening is enlarged using trephines and
a rasp. An angled rod to which has been attached a cutting
block, is inserted to the canal and side arms with pins, on the
cutting block, are used to engage the drill holes on the CAFÉ
axis. Five cuts are made in the distal humerus through slots,
using an oscillating saw. The blocks are in small, medium and
large sizes.

The cutting block is removed and a trial component is inserted
to check position and stability. After inserting a restrictor, a
small amount of PMMA cement is inserted to the canal and
over the cut surfaces. The sterile implant is then slid into pos-
tion. Any clamps or pins used for initial stabilization can be
removed and plates plus screws applied, if not already in posi-
tion.

Humeral components of the Sorbie-Questor surface replace-
ment for the elbow have been used in a number of centers to
treat fractures of the distal humerus when it has not been pos-
sible to restore perfect trochlear and capitellar surfaces. The
procedure and the implant has been used successfully over the
past eight years.

These are three examples:

A 53-year-old female fell injuring her left, nondominant
arm. Her elbow dislocated in a lateral direction, shearing-
off the capitellum. The comminuted capitellum was re-
constructed through a transulnar approach using five
screws and two short pins. Three days later, in spite of
being in a shoulder to hand cast, the elbow laterally sub-
luxed. A repeat visit to the operating room and a general
anaesthetic allowed the displacement to be reduced and a
new, ‘tighter-fitting’, cast applied.

Four weeks later, the elbow dislocated yet again. The avas-
cular capitellum had collapsed. The elbow remained pain-
ful and unstable. Six weeks after the initial injury, through
a lateral Kocher approach, the fragments of the capitellum
and the loose screws were removed. The base of the capi-
tellum and the lateral side of the trochlea were squared-
off and a full double cortical thickness bone graft similar
in size to the capitellum was taken from the anterior iliac
crest. It was held temporarily in place with pins and the
standard procedure for preparing the distal humerus,
using cutting blocks, followed. The blocks ensure that
the implant is placed in the correct kinematic axis. When
the graft had been accurately cut, it was fixed firmly in posi-
tion using a lag screw. The humeral hemiarthroplasty was
inserted with a small grout of bone cement.

The elbow was stabilized. It has been used without dis-
comfort and with a range of flexion of 30-135º for the past
eight years.
The S-Q humeral implant has been used as a hemiarthroplasty in Europe, North America and Australia. It appears to be an effective immediate or later way to rescue a painful, stiff or unstable elbow where the distal humerus has been fractured and conservative or open reduction has failed to provide a stable, painless, low friction joint surface.

Bibliography