The Humeral Head Push-Pull Plate Technique significantly diminishes secondary screw-penetration in the treatment of osteoporotic Varus Displaced Proximal Humeral Fractures.

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Introduction:

Locking plate fixation of displaced osteoporotic fractures of the proximal humerus have been associated with a high complication rate , especially when they are varus displaced (1,2). Counteracting the deforming varus force either through a calcar locking screw or through tension-reducing rotator cuff sutures have not been proven to reduce this complication significantly (3,4). Endosteal fibular strut augmentation showed promising results in these fractures , but this is a technically demanding technique and relies on the availability of fibular allografts (5). The author developped the humeral head push-pull plate technique (H2P3), a modification of the locking plate technique with existing implants aiming to decrease the complication rate.

Study design and Methods :

It is a retrospective study comparing two groups of a prospectively collected consecutive case series , treated by a single surgeon.
Included were patients with a minimum age of 70 y with varus-displaced two- or three-part fractures of the proximal humerus (11A2 and 11B1.1 according to 2018 revision AO/OTA classification or type 1 or 7 according to the Lego classification) treated with an angular-stable plate osteosynthesis. Varus displacement was defined as neck-shaft angles equal or less than 120° degrees Indication for operative treatment was based on a combination of physiological age , pain and degree of displacement. Demented patients were excluded. The first group was treated with a proximal humeral locking plate (Depuy Synthes, Raynham, Massachusetts, USA or Zimmer Biomet, Warsaw, Indiana, USA) with

tension reducing sutures, inserted through an anterolateral deltoid split. (table1)
The second group was treated using a PHL locking plate (ITS, Med-Hold, Lassnitzhöhe, Austria), which was proximally molded (Fig 3) to allow inferior direction of the variable-angle locking screws into the lower half of the humeral head and medial calcar (Fig 1) and was inserted through an anterolateral deltoid split (N° 7) or deltopectoral approach (N° 16). Additionally, one or two Lupine anchors (Depuy Synthes, Raynham, Massachusetts, USA) were inserted into the subchondral bone through a split of rotator cuff or rotator interval at the apex of the humeral head (Fig 2) and the suture-wires were passed through the rotator cuff insertion and fixed to the proximal plate-holes.

Fig 1. diagram of the forces acting on the humeral head using the H2P3 technique

Fig 2.. Lupine anchor and its subchondral position in a retrieved humeral head

Fig 3.. Profile view comparing normal ITS plate with a molde one allowing inferior direction of the screws

Group:	A	B
<u>Implant:</u>	1. a proximal humeral locking plate Fixed angle screws - Philos Depuy Synthes - PeriarticularPHLP Zimmer Biomet	1. a molded proximal humeral locking plate variable-angle locking screws directed inferiorly - small proximal humeral locking plate ITS , Austria
<u>Technique:</u>	2. Cuff Traction sutures	2. subchondral Lupine anchors DPS (1 or 2)

Table 1.: used implant and type of varus force neutralising technique

Outcome measures and analysis :

Penetration of the screws to the humeral head, recurrence of varus displacement and reoperation were evaluated and statistically compared between the two groups using the chi-squared test. Results were considered significant at a p-value of 5%. SPSS (IBM, Armonk, New York, USA) was used for the statistical analysis.

Results:

Group:	A (4 y period '10-'14)	B (3 y period 'oct 15-' july '18)
11 A2 / type 1	5 (4/1)	10 (6/1)
11 B1.1 / type 7	7 (6/1)	13 (10/3)
Total N° (F/M)	12 (10/2)	23 (19/4)
<u>Preop angulation</u>	87° (65°-120°)	83.4 ° (60°-120°)
<u>Mean age</u>	82.4 y (72-87)	80 y (70-92)
<u>FU (months)</u>	5	7

Table 2.: epidemiological data, fracture data and FU duration

Group :	A(12 patients)	B (23 patients)
<u>Partial recurrence of varus</u>	3 (25%)	2 (8.7%)
<u>Full recurrence</u>	2 (16%)	2 (8.7%)
<u>Secondary screw penetration</u>	5 (41%)	0 (0%)
<u>Revision surgery</u>	3 (25%)	1 (4.3%)

Table 3.: complications and their N°

Fig 4.. Pre- and postop Xray at one month of a typical varus displaced proximal humeral fracture in a 92 y old female successfully treated with the H2P3 technique

Video: peroperative endresult in an 82 y old lady where one Lupine anchor was applied through a rotator interval split

Statistical analysis:

The statistical analysis showed a **significant difference** in screw penetration (p=0,022) and a **none** significant difference in recurrence (p=0,218) and reoperation rate (p=0,110).

Conclusion:

Although this small study lacks power to statistically prove a decreased operation rate and recurrence, it was proven that the screw penetration rate diminishes. It is therefore the author's believe that the humeral head push-pull plate technique in the treatment of osteoporotic varus displaced fractures of the proximal humerus improves stability of the construct and should be considered as a means of improving results in this difficult to treat type of fracture.

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