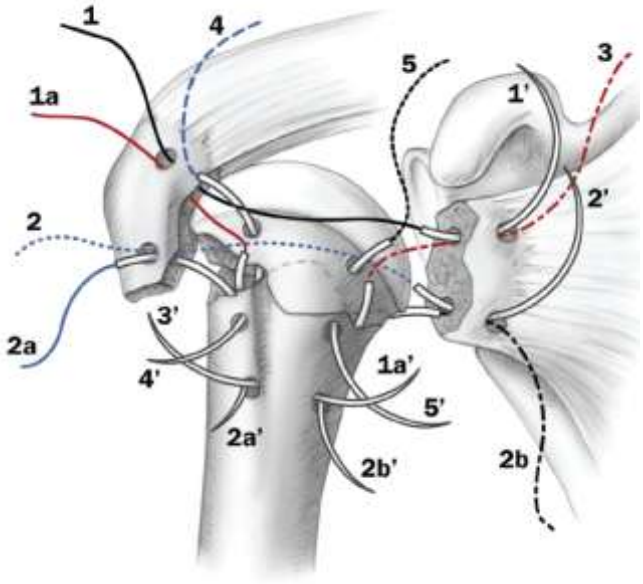
Minimal Invasive Fixation of Proximal Humeral Fractures



Andreas Panagopoulos, M.D., Ph.D.
Upper Limb & Sports Medicine Surgeon
Assistant Professor in Orthopaedics
University Hospital of Patras

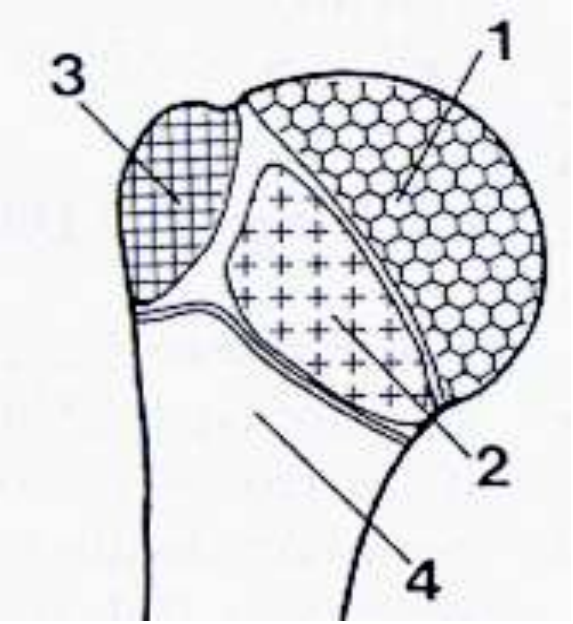
Epidemiology

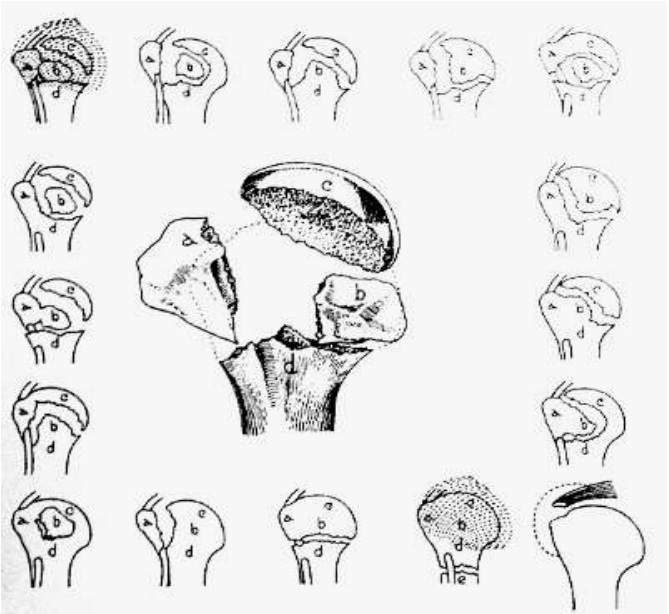
Fractures of the proximal humerus:

- Increased overall incidence (17,1% to 47,9% last 15 years)
- Increase annual incidence 13%
- Increased age of presentation (78 ♀ 73 ♂)

Classification

The fracture lines are follow the old epiphyseal plate





Codman E. A: The soulder, Boston, T. Todd, 1934

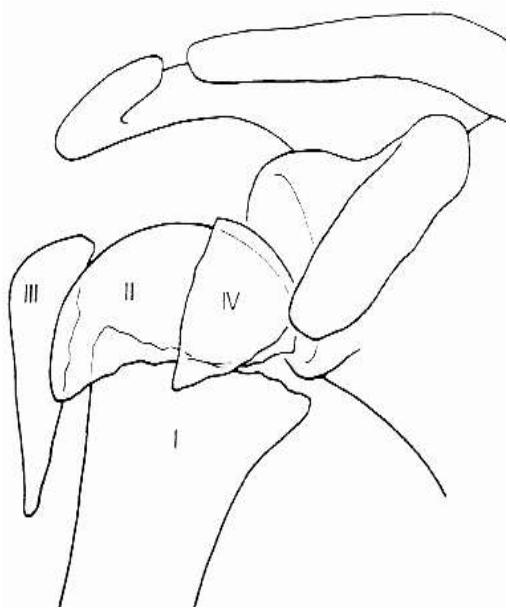
Classification

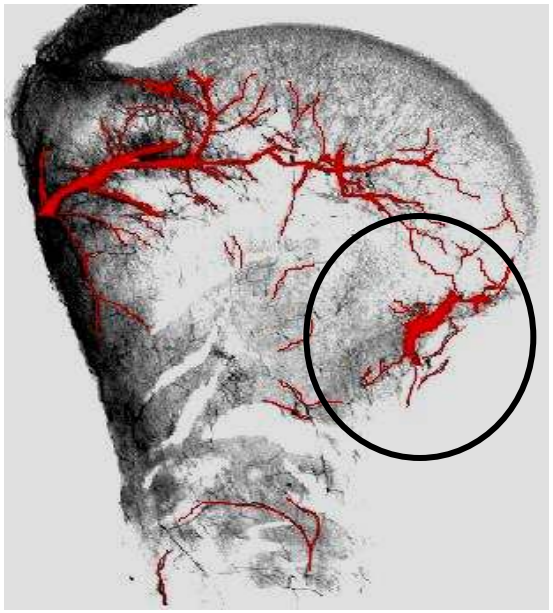
If any of the part has > 1cm of displacement or > 45^{o} of angulation the fracture will be considered as displaced

Neer C. S. JBJS A, 1970

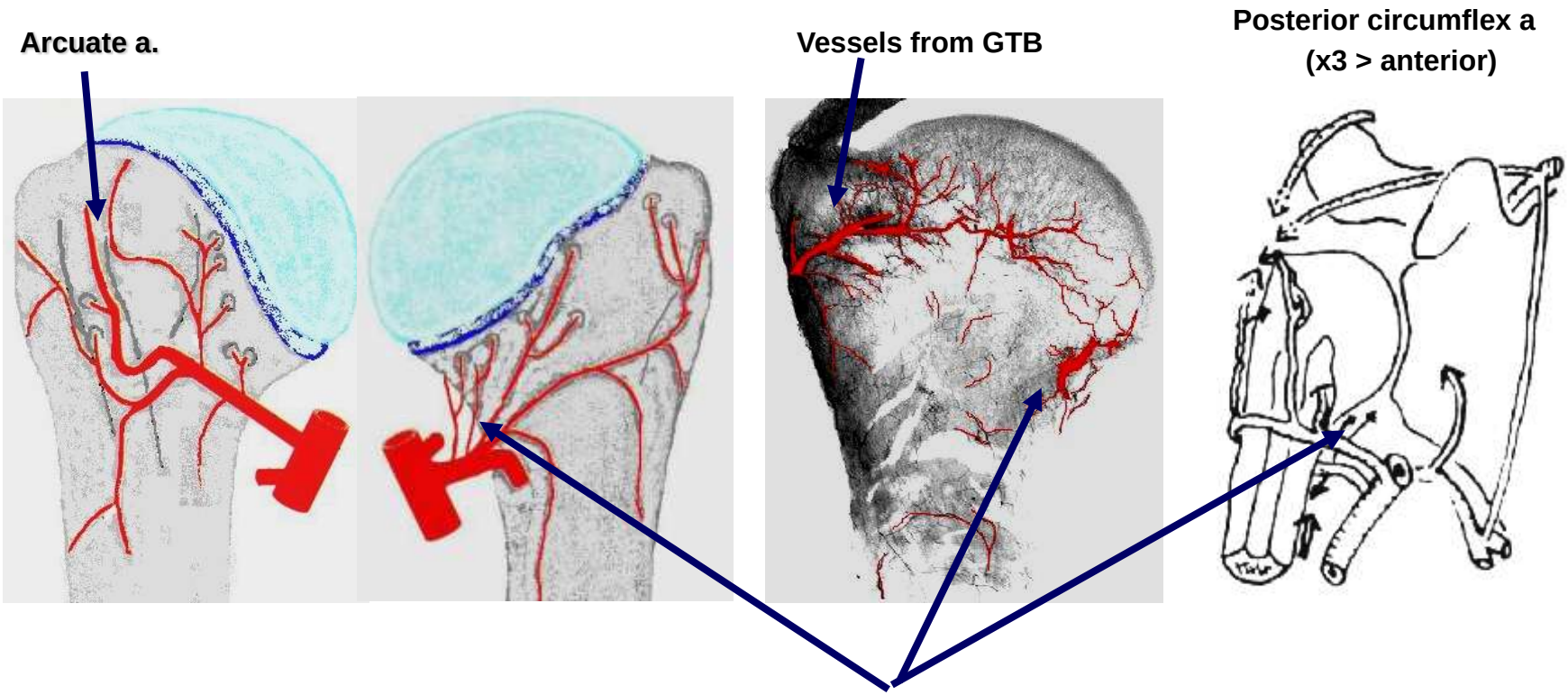
JSES, 2001

4-part valgus impacted fracture





Humeral head blood supply



Important anastomoses postero-medial hinge

Gerber C, et al. JBJS Am 1990
Brooks CH, et al. JBJS Br 1993
Duparc F, et al. Surg Radiol Anat 2001

International Orthopaedics (SICOT) (2004) 28: 333–337
DOI 10.1007/s00264-004-0581-y

ORIGINAL PAPER

Andreas M. Panagopoulos · P. Dimakopoulos ·
M. Tyllianakis · D. Karnabatidis · D. Siablis ·
A. X. Papadopoulos · E. Lambiris · P. Kraniotis ·
G. Sakellaropoulos

Valgus impacted proximal humeral fractures and their blood supply after transosseous suturing

preop 6 to 12 hours

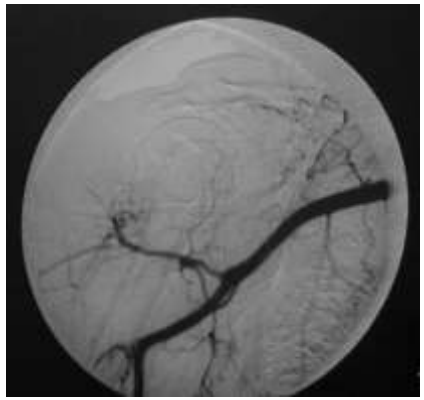
Postop 8-10 weeks

Axillary artery

Three images (0^o, -45^o και $+45^o$)

1 image per second

30 images / patient



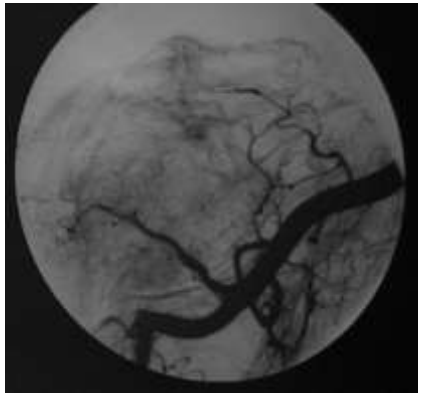
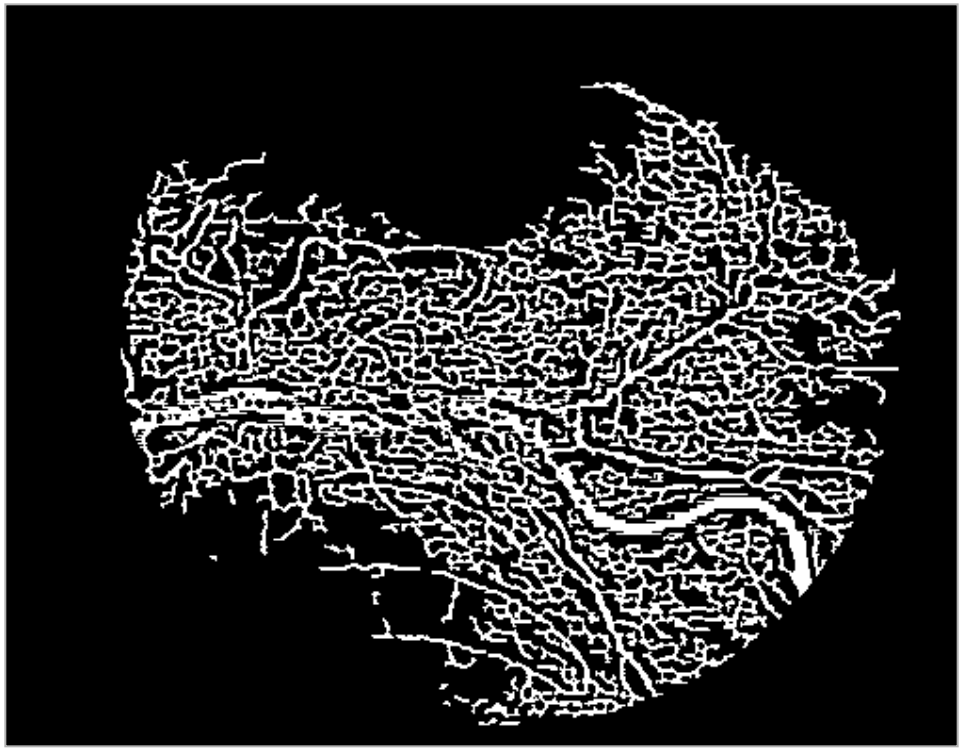


Image processing



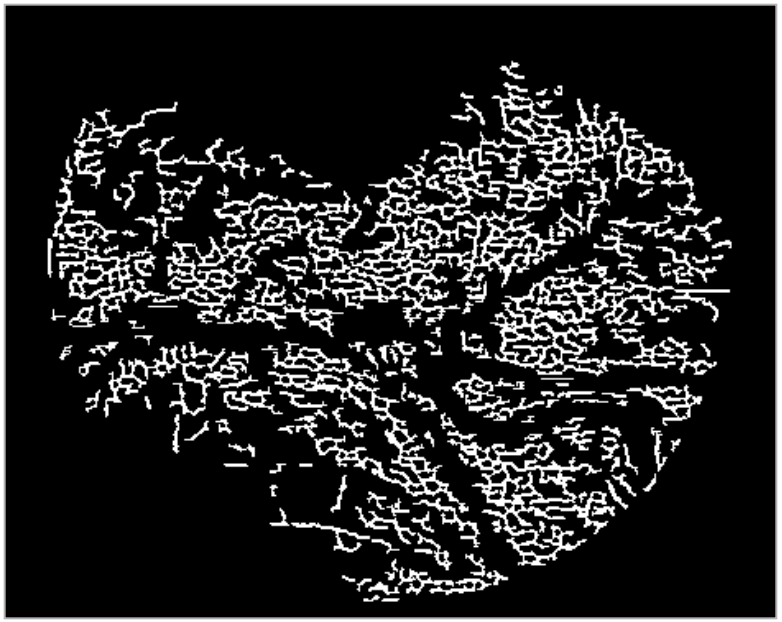
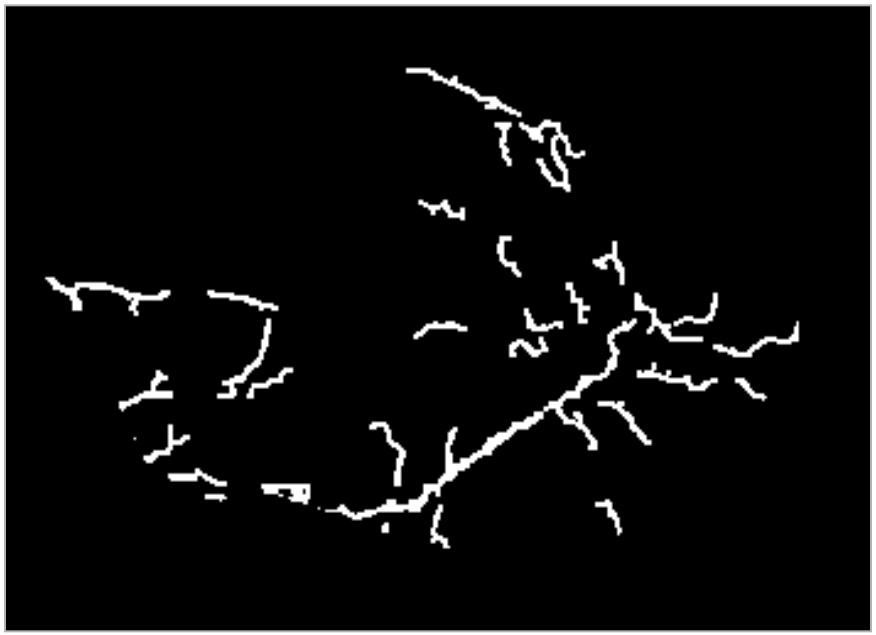
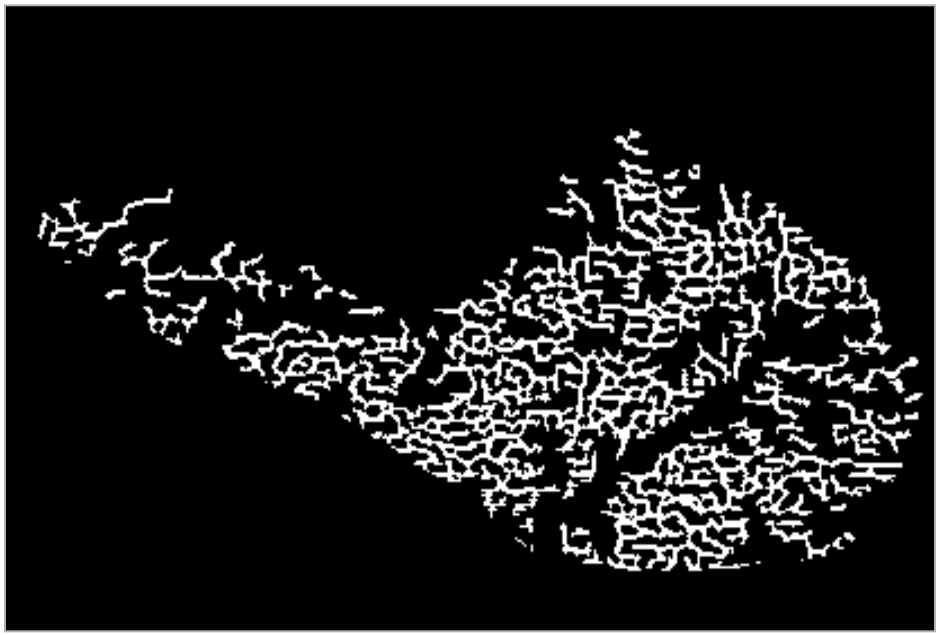


Image processing

PREOPERATIVELY



Big vessels

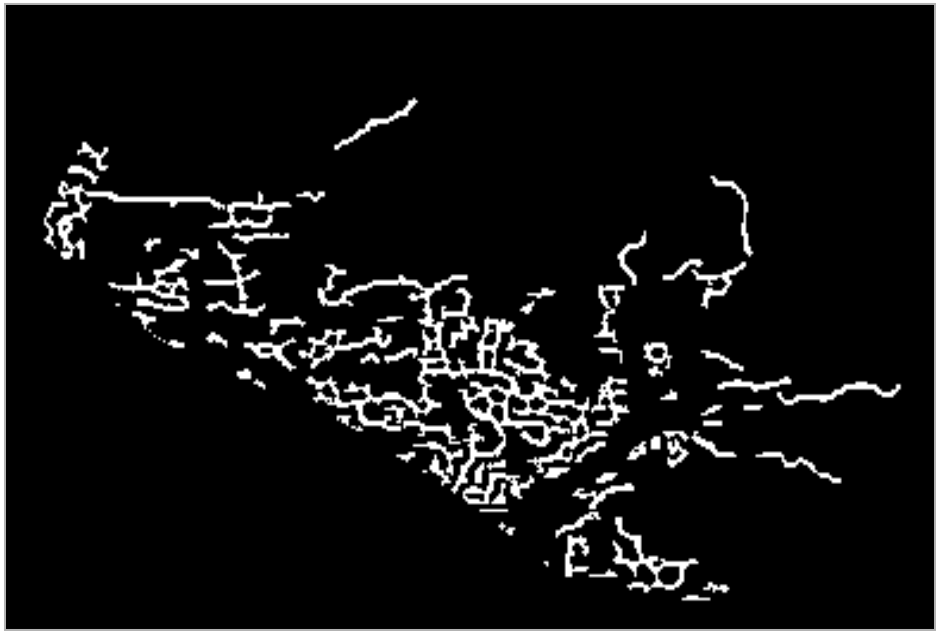


Small vesels

Image processing

POSTOPERATIVELY

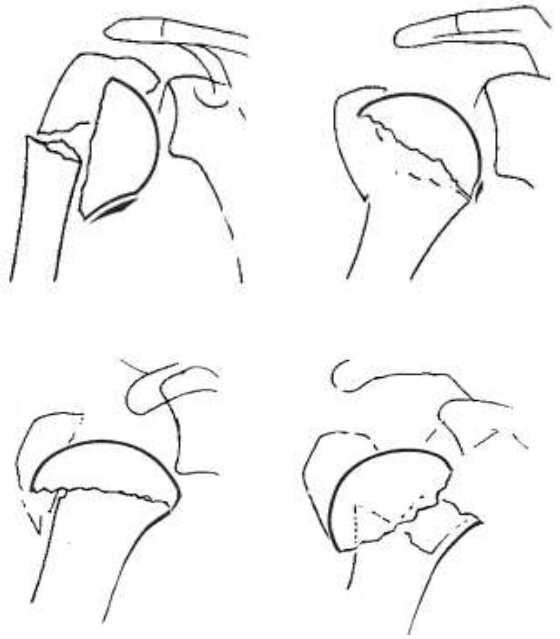
Big vessels



Small vesels

Ischemia predisposing factors

- a) length of medial metaphyseal head extension (< 8 mm in ischemic heads)
- b) integrity of the medial hinge (43 / 55 ischemic heads > 2 mm)
- c) splitting head component



Hertel R, et al. JESS 2004

Kralinger F, Unger S, Wambacher M et al. The medial periosteal hinge, a key structure in fractures of the proximal humerus: a biomechanical cadaver study of its mechanical properties. *J Bone Joint Surg Br* 2009;91:973–6.

Lateral or medial displacement of the head relative to the humeral shaft **>6 mm** or **>9 mm**, respectively, is an indication of periosteal rupture

Maintenance of some medial periosteal integrity may provide stability and allow **passive reduction** of the fracture

Current Surgical Treatment Options for Complex Proximal Humeral Fractures

George M Kontakis, MD[1], Theodoros Tosounidis, MD[2], and Kyriakos Kakavelakis, MD[3]

[1]University of Crete, Crete, Greece; [2]Leeds General Infirmary, Leeds, UK; and [3]University Hospital of Heraklion, Crete, Greece.

Adv Orthop 2010;**2**(2):43–50.

What is the fracture pattern?

Does it need to be treated surgically?

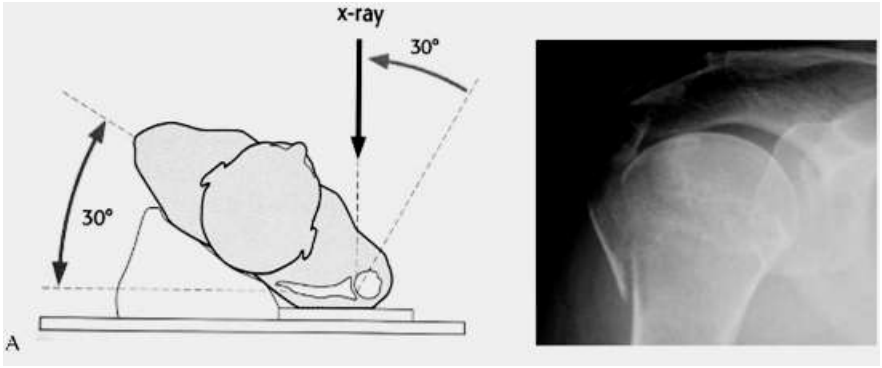
Does the medical status of the patient permit operative treatment?

Could the anatomy can be restored by means of stable and durable fixation?

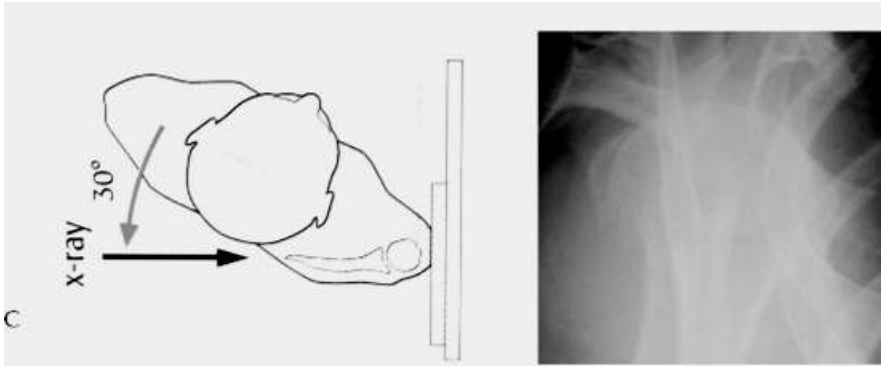
Is the humeral head viable?

Well informed patient about outcome & expectations

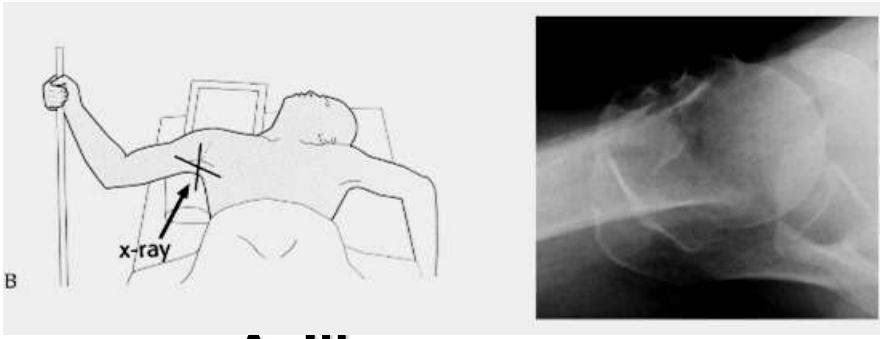
Radiological evaluation



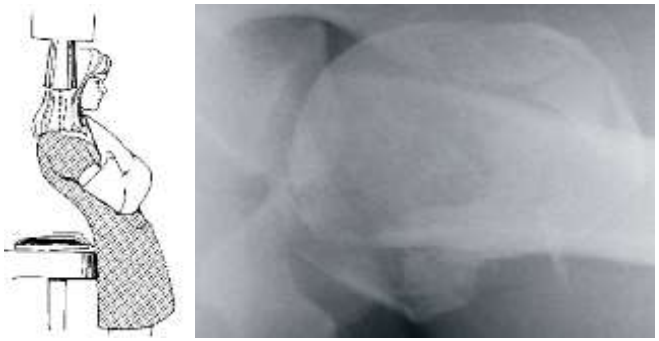
AP in the scapular plane



Y-view



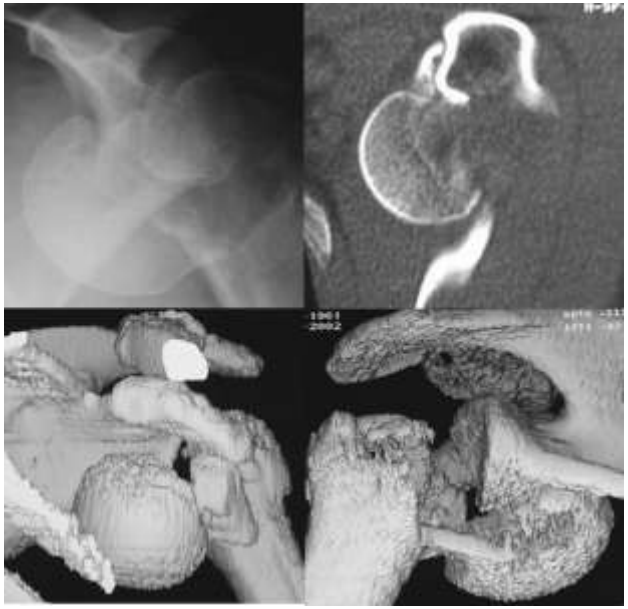
Axillary

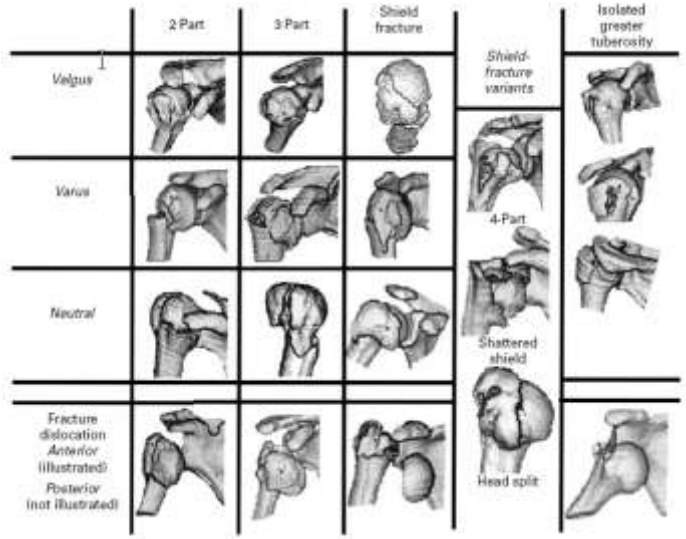


Velpau axillary

CT scan

- Tuberosities displacement
- Better visualization of the head
- Glenoid pathology





Jurik AG, et al. Clin Radiol 1994
Morris ME, et al. Orthop Trans 1997

Edelson G, et al. A three-dimensional classification for fractures of the proximal humerus. JBJS Br 2004

Treatment options

- Conservative
- Internal fixation
- External fixation
- Arthroplasty
- Reverse arthroplasty

Conservative

Impacted valgus fractures (B1.1) of the proximal humerus

THE RESULTS OF NON-OPERATIVE TREATMENT

C. M. Court-Brown, H. Cattermole, M. M. McQueen

From the Royal Infirmary of Edinburgh, Scotland

125 fractures[1] AO type B1.1 **(valgus impacted)**

Constant score 71.8/100 (1 year follow up)

80,6% excellent-very good

1- part → 3-part (CS: 74.5 →65.6)

507 fractures[2] AO type A

376 patients (1 year follow up)

88% excellent or very good

131 patients lost???

1 Court-Brown CM, et al. Impacted valgus fractures (B1.1) of the proximal humerus the results of non-operative treatment. JBJS Br 2002

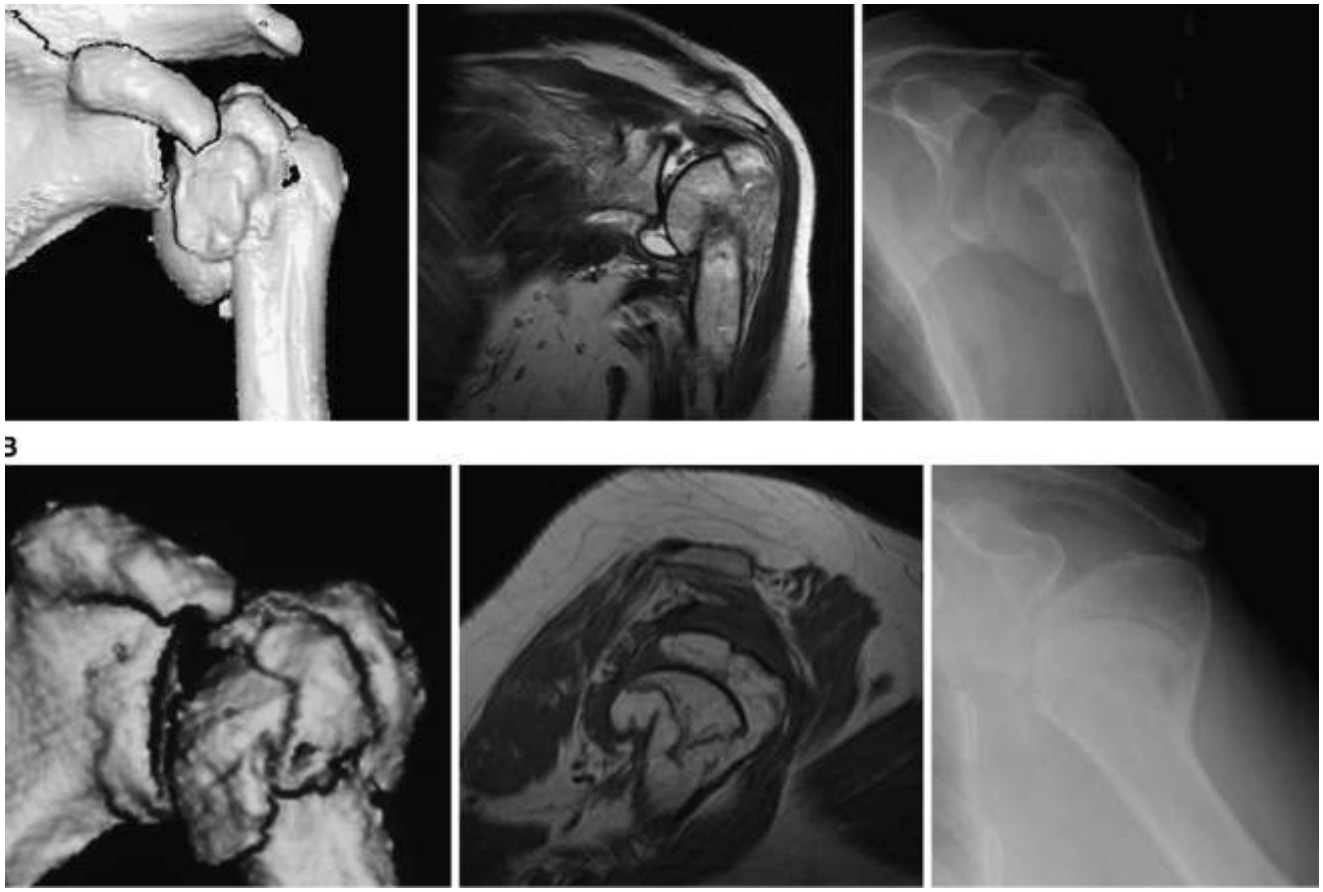
2 Gaebler C, et al. Minimally displaced proximal humeral fractures: epidemiology amd outcome in 507 cases. Acta Orthop Scand 2003

Conservative

Natural history of complex fractures of the proximal humerus using a three-dimensional classification system

(J Shoulder Elbow Surg 2008;17:399-409.)

Gordon Edelson, MD,[a] Husam Safuri, MD,[a] Joseph Salami, MD,[a] Fina Vigder, MD,[b] and Daniela Militianu, MD,[c] *Tiberias and Haifa, Israel*



3

…“contrary to the common belief – avascular necrosis of the humeral head may be related to the surgical intervention rather than to the lack of it”

Natural history of complex fractures of the proximal humerus using a three-dimensional classification system

(J Shoulder Elbow Surg 2008;17:399-409.)

Gordon Edelson, MD,[a] Husam Safuri, MD,[a] Joseph Salami, MD,[a] Fina Vigder, MD,[b] and Daniela Militianu, MD,[c] *Tiberias and Haifa, Israel*

THE JOURNAL OF BONE & JOINT SURGERY (BRITISH)

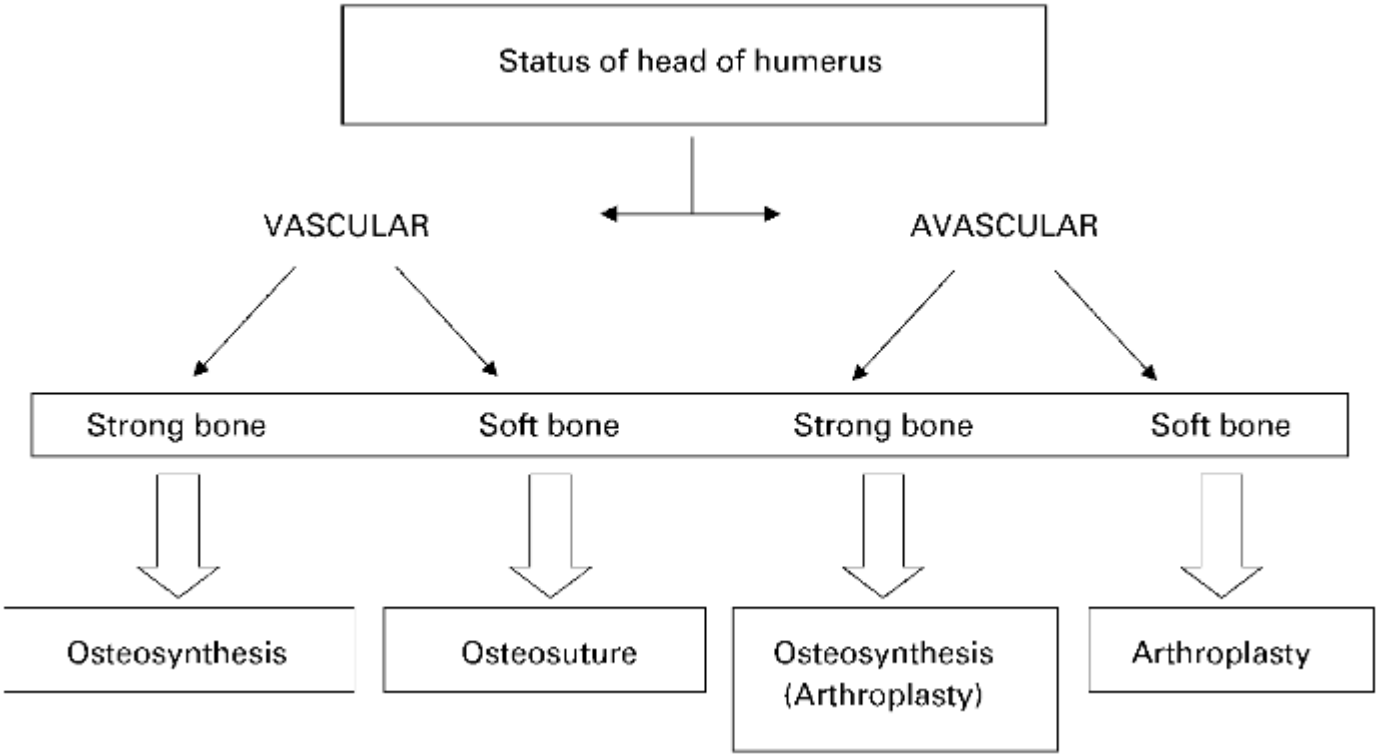
Review article

THE OPERATIVE MANAGEMENT OF DISPLACED FRACTURES OF THE PROXIMAL HUMERUS

P. Hoffmeyer

From the University Hospital, Geneva, Switzerland

(Printed with permission of EFORT. The original version of this article appears in *European Instructional Course Lectures* Vol 5, 2001.)



What kind of osteosynthesis?

How much minimal …?

Options for internal fixation

- Plate-screws
  (T, L, 90^{o} blade, cloverleaf, 1/3 tubular, Plantan, Philos)
- Percutaneous KW or cannulated screws
- Intramedullary KW or rods
  (Kapandji, Rush, Ender, Prevot, Zifko, Evans, Jig etc)
- Antegrade or retrograde intramedullary nailing
  (Polarous, Halder, PHN-T, PHN-S, Targon etc)
- Osteosuture
  (wiring, cross screw osteosynthesis, sutures, dacron tapes etc)
- Combined techniques $\pm$ grafting, cement, Norian

Options for minimal invasive fixation

- Percutaneous KW or cannulated screws
- Intramedullary KW or rods
  (Kapandji, Rush, Ender, Prevot, Zifko, Evans, Jig etc)
- External fixation
- Osteosuture
  (wiring, cross screw osteosynthesis, sutures, dacron tapes etc)

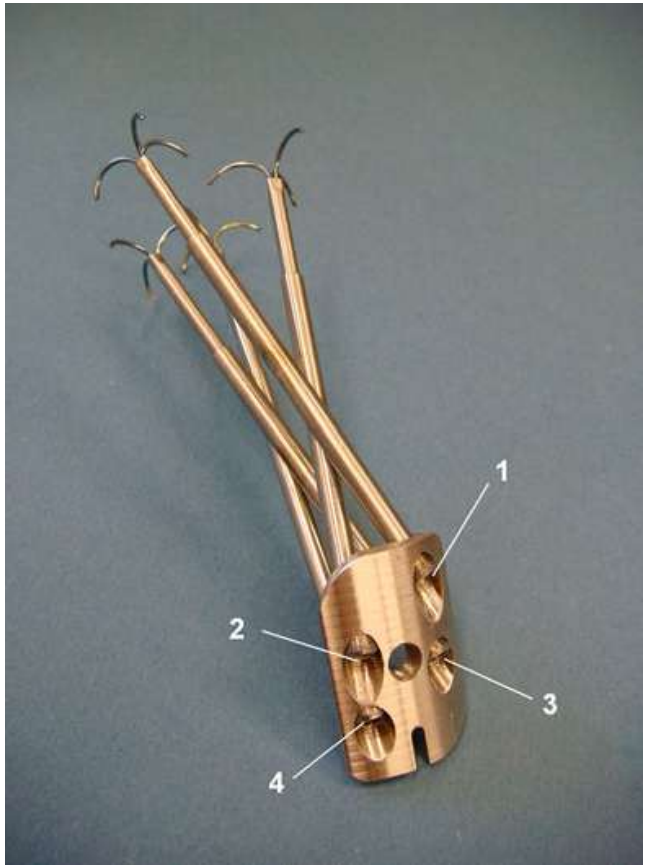
Arch Orthop Trauma Surg
DOI 10.1007/s00402-012-1503-x

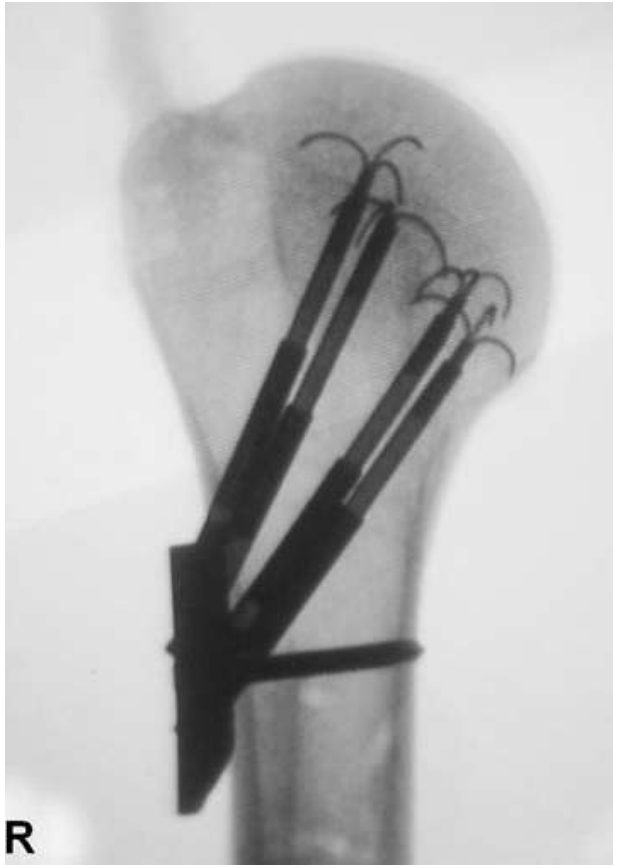
TRAUMA SURGERY

The Humerusblock NG: a new concept for stabilization of proximal humeral fractures and its biomechanical evaluation

Alexander Brunner · Herbert Resch · Reto Babst · Susanne Kathrein · Johann Fierlbeck · Alfred Niederberger · Werner Schmölz

Received: 28 November 2011





J Shoulder Elbow Surg (2012) ■, 1-7

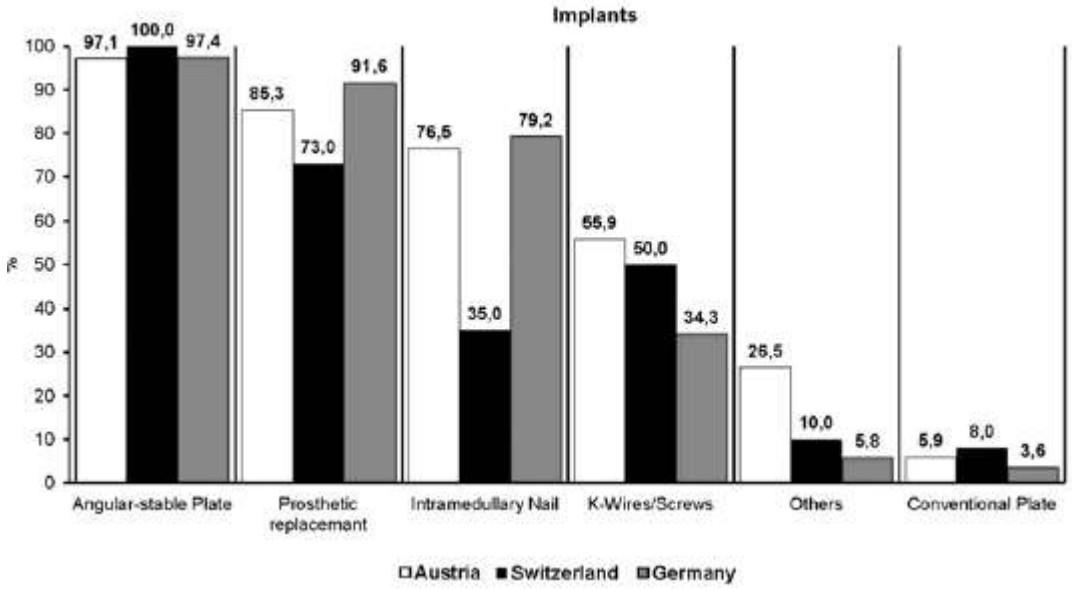
ELSEVIER

JOURNAL OF SHOULDER AND ELBOW SURGERY

www.elsevier.com/locate/ymse

Current strategies for the treatment of proximal humeral fractures: an analysis of a survey carried out at 348 hospitals in Germany, Austria, and Switzerland

Alexander Tepass, MD[a], Gunnar Blumenstock, MD[b], Kuno Weise, MD[a], Bernd Rolauffs, MD[a], Christian Bahrs, MD[a,*]



J Shoulder Elbow Surg (2012) ■, 1-7

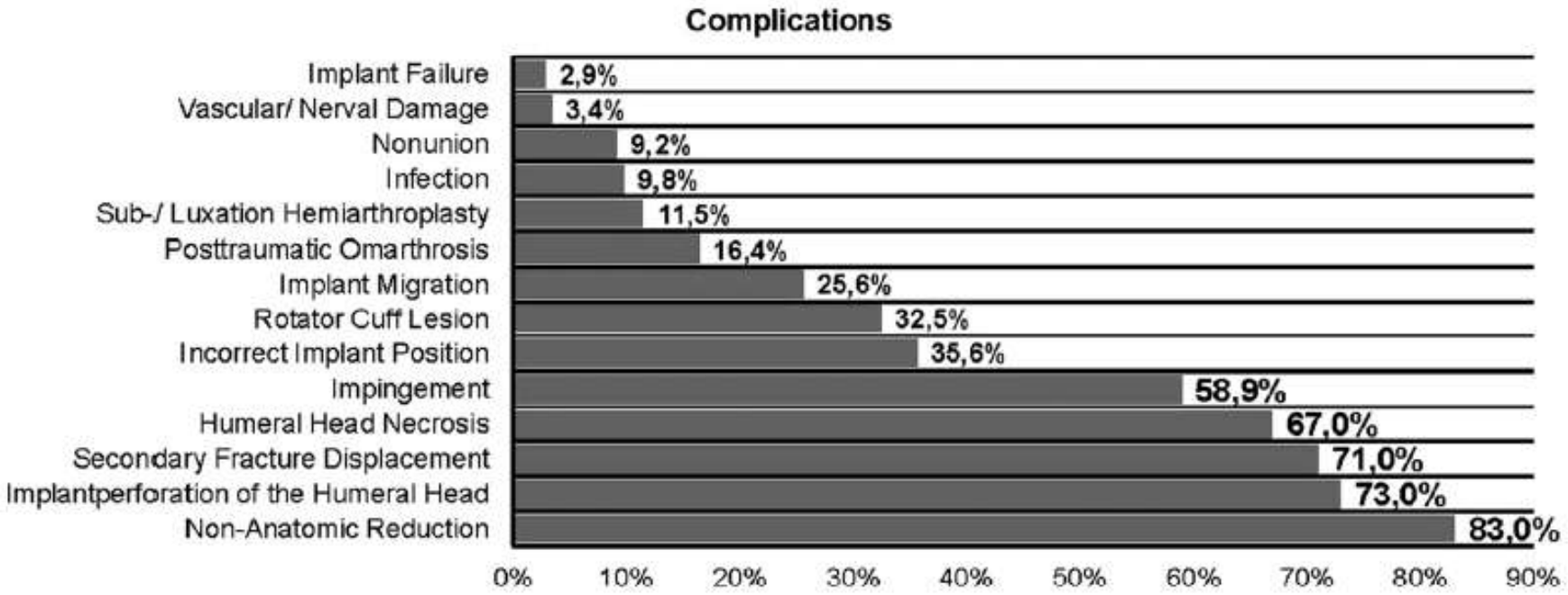
ELSEVIER

Journal of Shoulder and Elbow Surgery

www.elsevier.com/locate/ymse

Current strategies for the treatment of proximal humeral fractures: an analysis of a survey carried out at 348 hospitals in Germany, Austria, and Switzerland

Alexander Tepass, MD[a], Gunnar Blumenstock, MD[b], Kuno Weise, MD[a], Bernd Rolauffs, MD[a], Christian Bahrs, MD[a,*]



Injury, Int. J. Care Injured 42 (2011) 408–413

Contents lists available at ScienceDirect

Injury

journal homepage: www.elsevier.com/locate/injury

A systematic review of locking plate fixation of proximal humerus fractures

Robert C. Sproul, Jaicharan J. Iyengar, Zlatko Devcic, Brian T. Feeley *

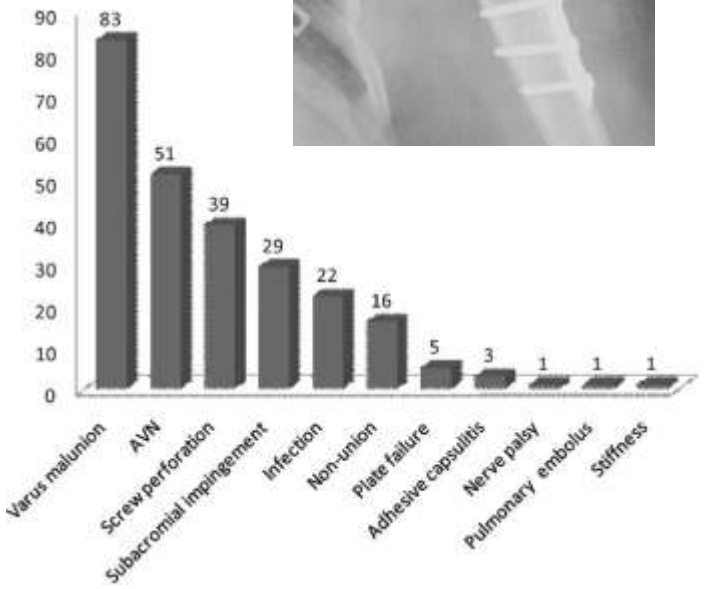
University of California, San Francisco, Department of Orthopaedic Surgery, Sports Medicine and Shoulder Surgery Service, 1500 Owens Street, San Francisco, CA 94158, United States

12 studies/ 514 patients

Constant score 74

DASH score 27

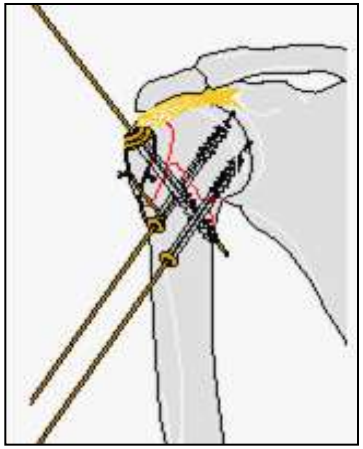
- Proximal humerus fractures due to trauma (excluding pathologic fractures).
- Patients greater than 18 years of age.
- More than 15 patients in the study or subgroup of interest.
- At least eighteen months follow-up.
- At least one relevant functional outcome score such as range of motion, pain, patient satisfaction, or complications.
- Quality outcome score of at least a 5/10 according to a previously published scoring system.[14,20]

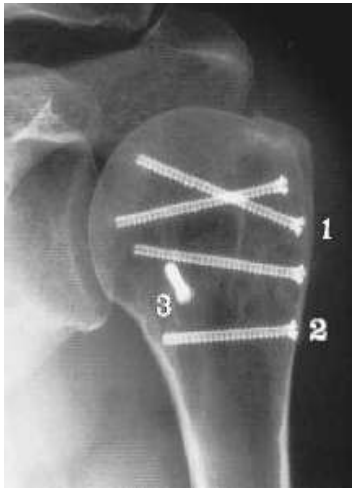


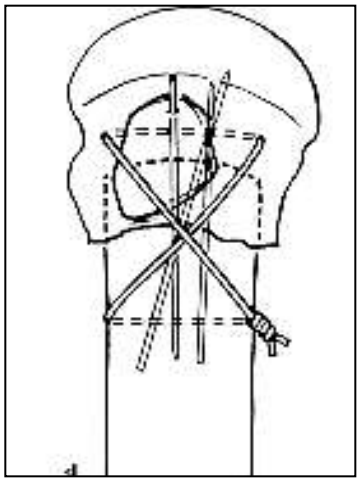
Complications

varus malunion 16%,
AVN 10%,
screw perforation 8%,
subacromial impingement 6%,
infection 4%

Percutaneous KW or cannulated screws





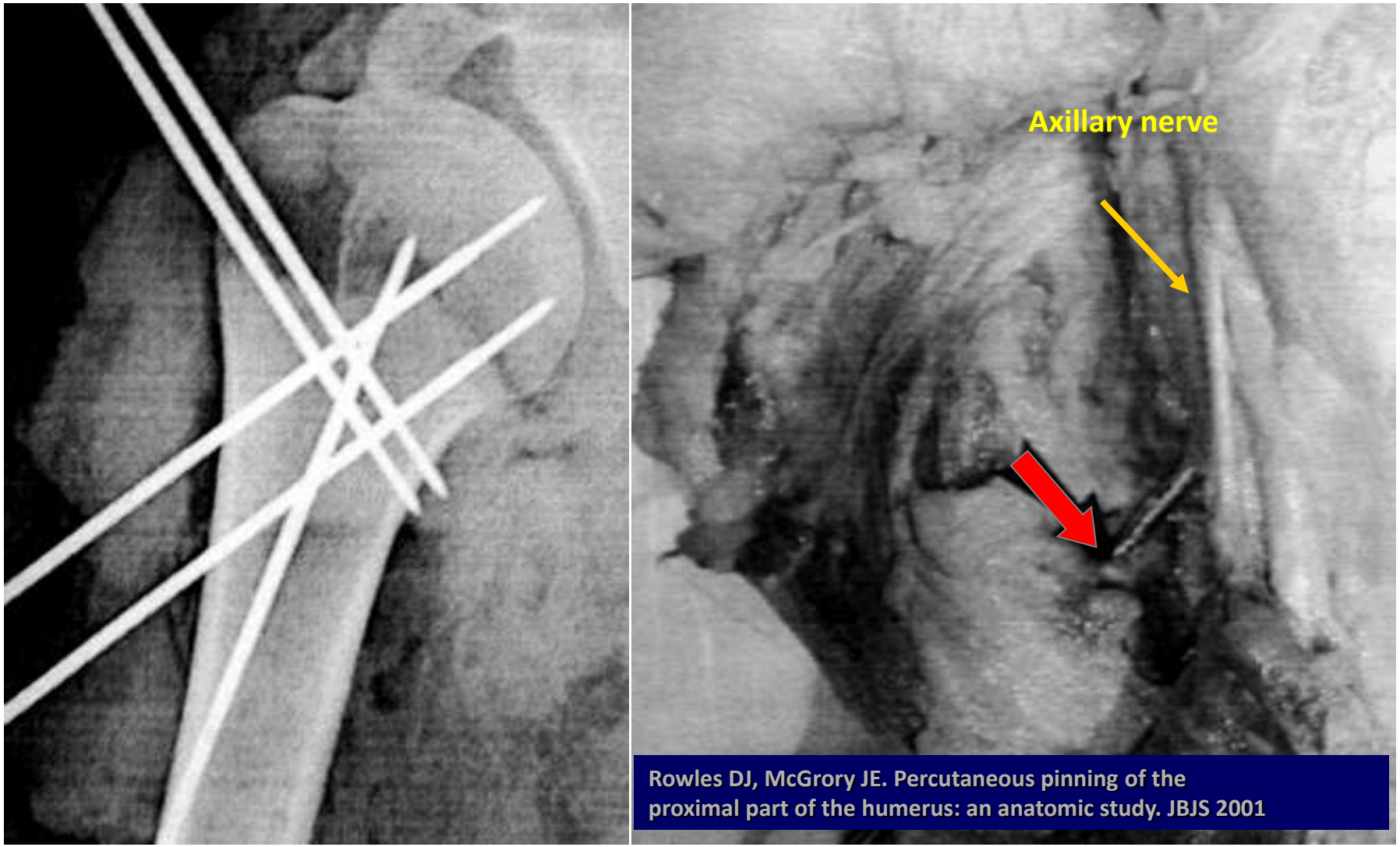


19%-55%

- Perforation
- Superficial infection
- Inadequate reduction
- Migration - breakage
- Nerve damage

Herscovici D Jr, et al. ClinOrthop 2000
Soete PJ, et al. JSES 1999
Darder A, et al. Orthop Trauma 1993
Resch H, et al. JSES 1995
Resch H, et al. JBJS Br 1997

Percutaneous KW or cannulated screws



International Orthopaedics (SICOT) (2010) 34:883–889
DOI 10.1007/s00264-009-0848-4

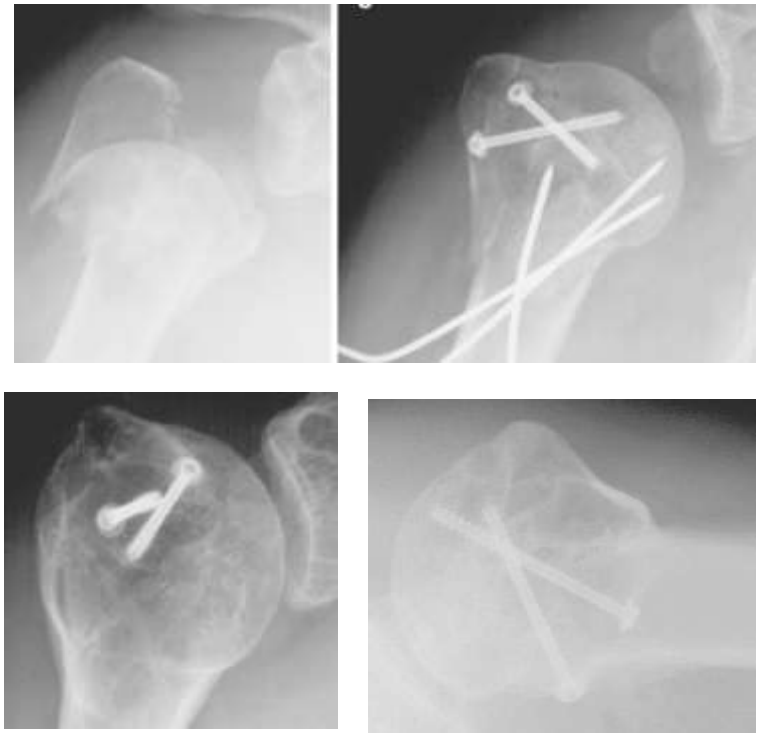
ORIGINAL PAPER

Long-term results after non-plate head-preserving fixation of proximal humeral fractures

Christian Bahrs · Andreas Badke · Bernd Rolauffs · Kuno Weise · Sebastian Zipplies · Klaus Dietz · Christoph Eingartner

105 patients (9 A-fractures, 36 B, 60 C)
median follow-up 79.7 months
70–75% excellent or good Constant and UCLA scores.
74% good or satisfactory quality of initial reduction

21% secondary displacement
27% humeral head necrosis
22% had implant related problems

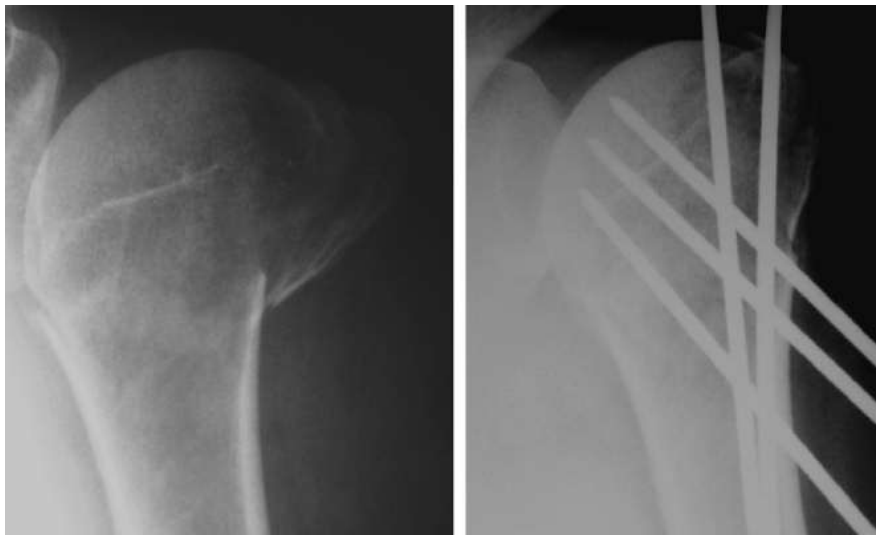


Percutaneous fixation of displaced proximal humeral fractures: Indications based on the correlation between clinical and radiographic results

(J Shoulder Elbow Surg 2007;16:774–781.)

Emilio Calvo, MD,[a] Ignacio de Miguel, MD,[a] Juan J. de la Cruz, PhD,[b] and Néstor López-Martín, MD,[a] *Madrid, Spain*

27 patients
mean age 61 years
7 two-part, 8 three-part, 12 VI
mean follow-up 35 months
All fractures healed
mean Constant 73.9
4 malunion
4 osteoarthritis

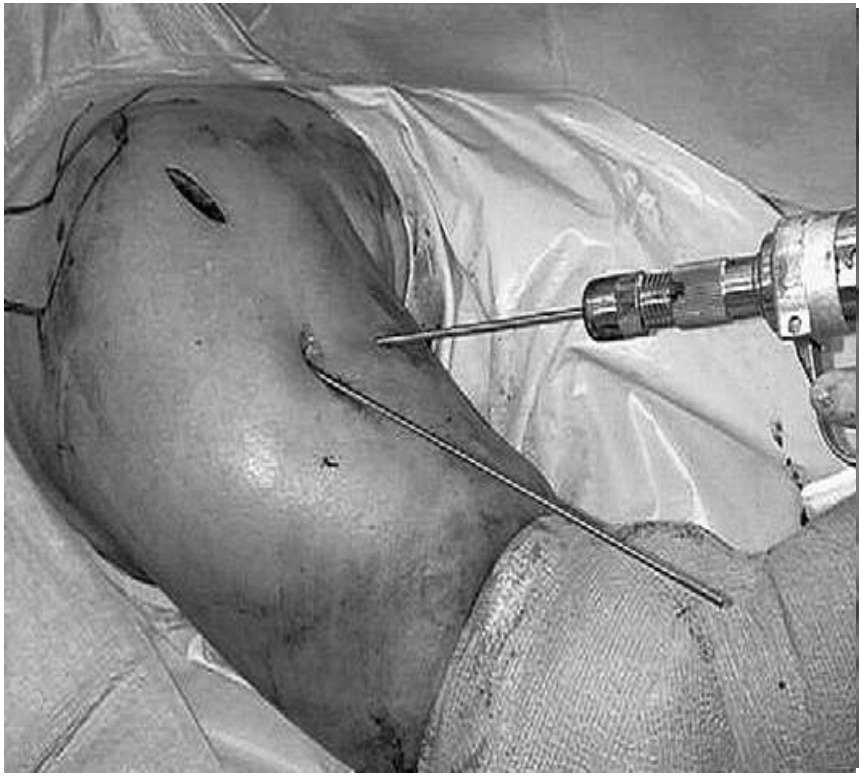


Fracture type, age, malunion, or osteoarthritis had no significance influence on measured outcomes.

Percutaneous fixation of displaced proximal humeral fractures: Indications based on the correlation between clinical and radiographic results

(J Shoulder Elbow Surg 2007;16:774–781.)

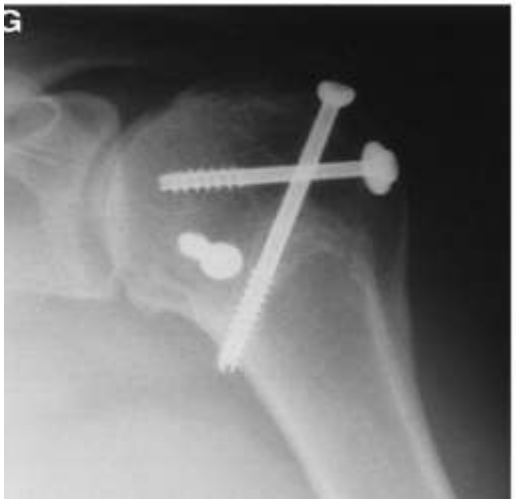
Emilio Calvo, MD,[a] Ignacio de Miguel, MD,[a] Juan J. de la Cruz, PhD,[b] and Néstor López-Martín, MD,[a] *Madrid, Spain*



Percutaneous fixation of displaced proximal humeral fractures: Indications based on the correlation between clinical and radiographic results

(J Shoulder Elbow Surg 2007;16:774–781.)

Emilio Calvo, MD,[a] Ignacio de Miguel, MD,[a] Juan J. de la Cruz, PhD,[b] and Néstor López-Martín, MD,[a] *Madrid, Spain*



J Shoulder Elbow Surg (2009) 18, 545-552

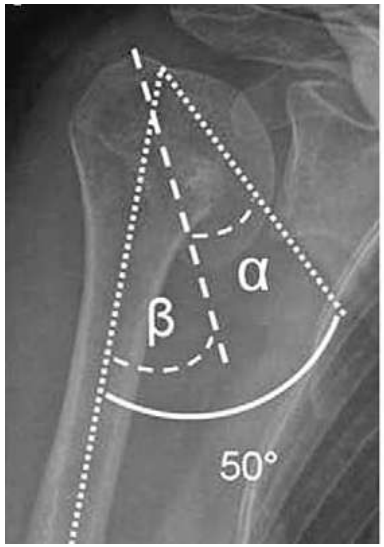
ELSEVIER

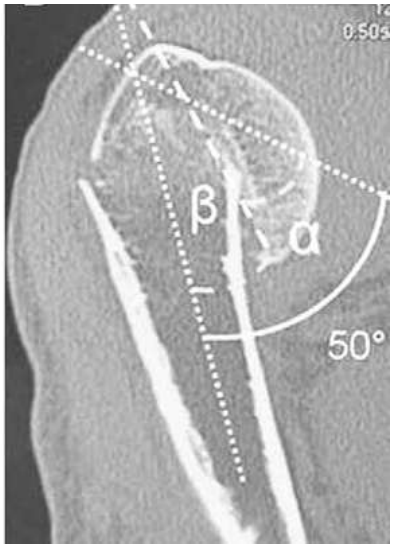
Journal of Shoulder and Elbow Surgery

www.elsevier.com/locate/ymse

The impacted varus (A2.2) proximal humeral fracture in elderly patients: Is minimal fixation justified? A case control study

Davide Blonna, MD*, Roberto Rossi, MD, Gianluca Fantino, MD, Alessio Maiello, MD, Marco Assom, MD, Filippo Castoldi, MD





J Shoulder Elbow Surg (2009) 18, 545-552

ELSEVIER

Journal of Shoulder and Elbow Surgery

www.elsevier.com/locate/ymse

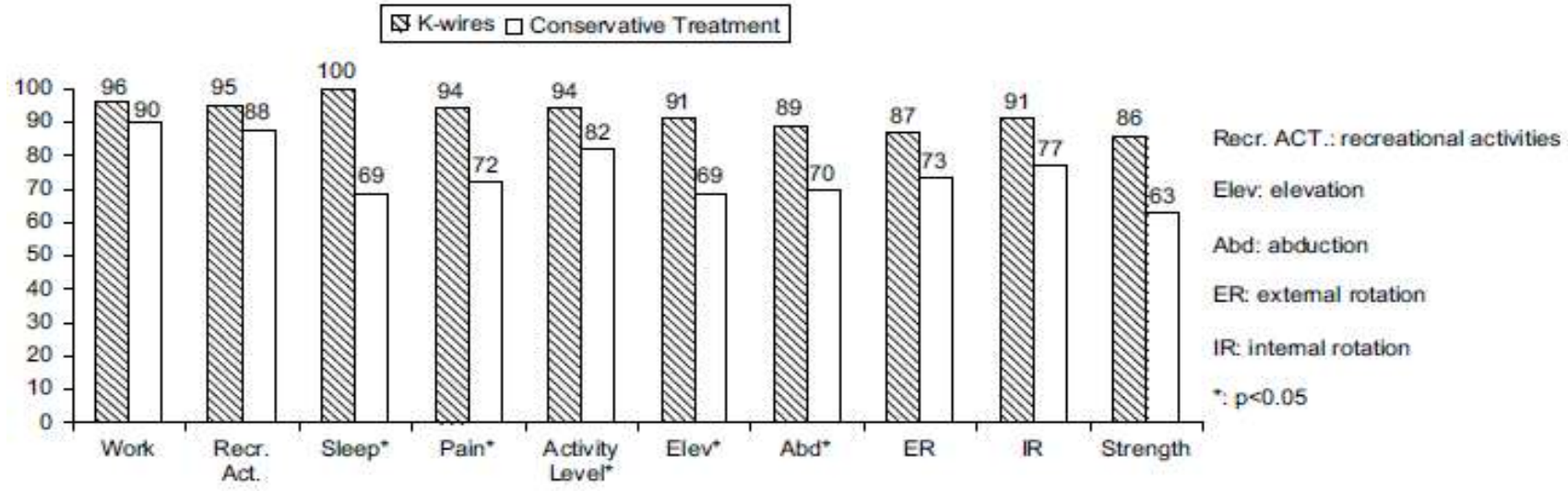
The impacted varus (A2.2) proximal humeral fracture in elderly patients: Is minimal fixation justified? A case control study

Davide Blonna, MD*, Roberto Rossi, MD, Gianluca Fantino, MD, Alessio Maiello, MD, Marco Assom, MD, Filippo Castoldi, MD

Table I Baseline data

Group	Pts	R/L	Age average ± SD (range)	F/M	CS normal side average ± SD (range)	Varus angle average ± SD (range)	Physiotherapy sessions average ± SD (range)
Surgery	32	23/9	73 ± 7.83 (66-85)	20 F 12 M	81.41 ± 6.7 (77-87)	32.53 ± 2.86 (25-40)	23.25 ± 10 (12-36)
Control	35	23/12	75.1 ± 8 (67-84)	26 F 9 M	80 ± 9 (74-86)	30.72 ± 3.6 (25-40)	19.5 ± 9 (12-36)

CS, constant score; *SD*, standard deviation, *M*, male; *F*, female; *R/L*, right-handed/left-handed; *Pts*, patients.
Number of sessions $P < .05$.



J Shoulder Elbow Surg (2009) 18, 545-552

ELSEVIER

Journal of Shoulder and Elbow Surgery

www.elsevier.com/locate/ymse

The impacted varus (A2.2) proximal humeral fracture in elderly patients: Is minimal fixation justified? A case control study

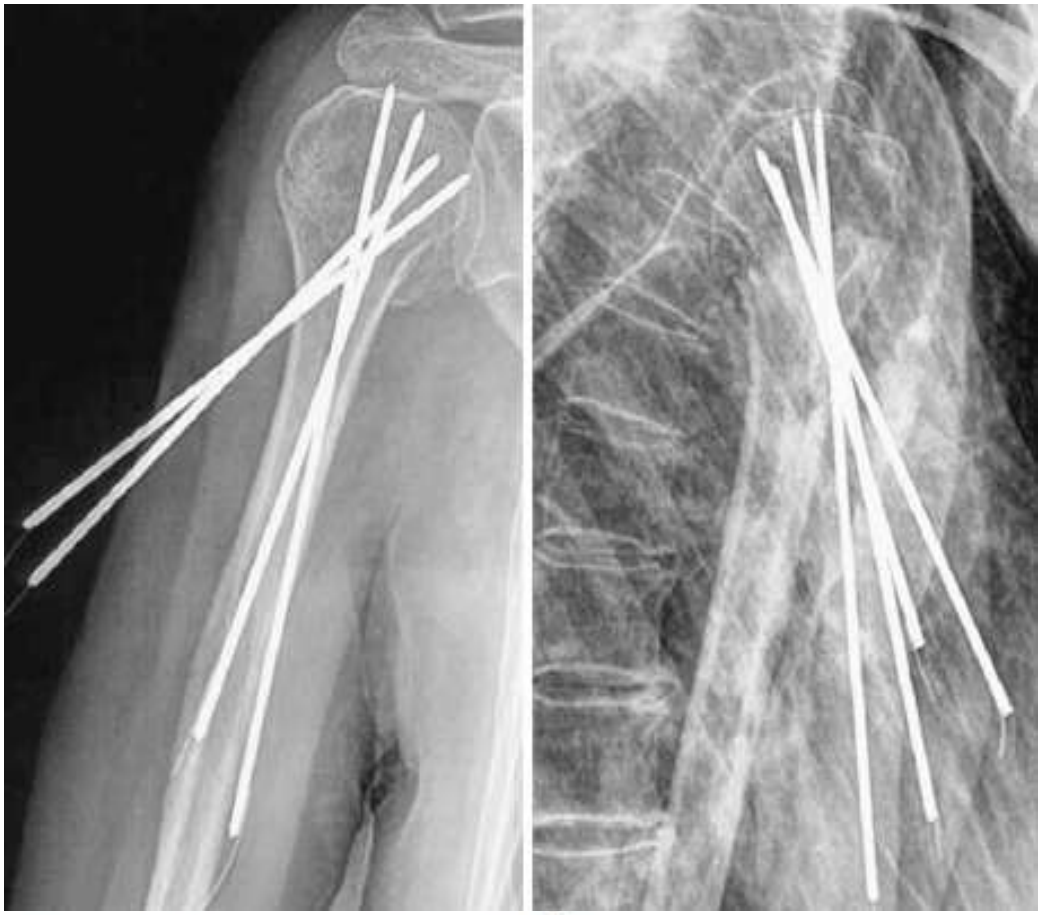
Davide Blonna, MD*, Roberto Rossi, MD, Gianluca Fantino, MD, Alessio Maiello, MD, Marco Assom, MD, Filippo Castoldi, MD

Patients> 65 years

1 superficial and 1 deep infection

KW migration in 3 cases

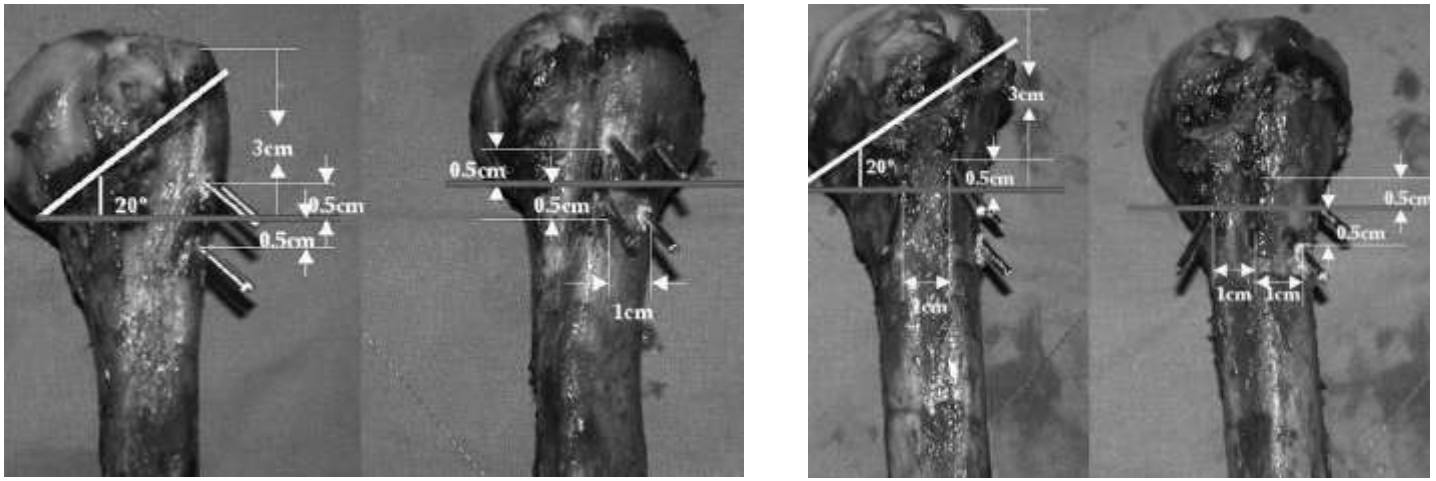
Good fracture reduction and clinical outcome



Biomechanical comparison of different pin configurations during percutaneous pinning for the treatment of proximal humeral fractures

J Shoulder Elbow Surg
March/April 2007

Chunyan Jiang, MD, PhD, Yiming Zhu, MD, Manyi Wang, MD, and Guowei Rong, MD, *Beijing, China*



Parallel pin fixation should be applied whenever possible, and a specially designed parallel drill sleeve with a 1-cm pin-to-pin distance is recommended during clinical application

Rev esp cir ortop traumatol. 2011;55(6):446–453

Revista Española de Cirugía Ortopédica y Traumatología

www.elsevier.es/rot

ORIGINAL ARTICLE

Results of percutaneous treatment of proximal humeral fractures in patients of working age☆

A. Montiel-Giménez[a,*], F. Granell-Escobar[a], S. Gallardo-Villares[a], R. Franco-Gómez[a], A. Escolà-Benet[b]

90 patients

“Palm-tree” wiring

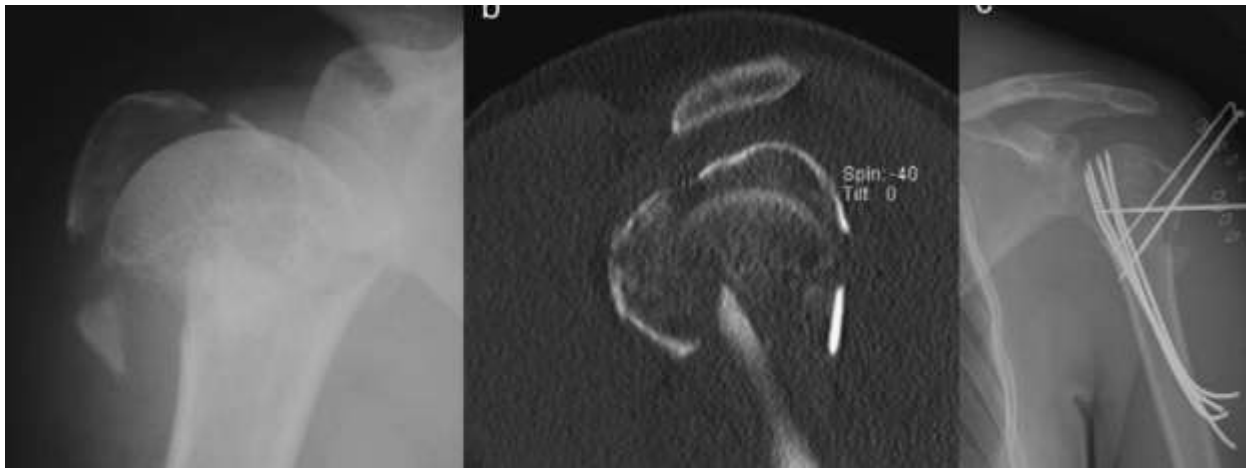
21 (2 part), 44 (3 part), 25 (4 part)

Mean Constant score 77

15 patients (17%) complications

most frequent AVN (4%)

3 pt migration



Rev esp cir ortop traumatol. 2011;55(6):446–453

Revista Española de Cirugía Ortopédica y Traumatología

www.elsevier.es/rot

ORIGINAL ARTICLE

Results of percutaneous treatment of proximal humeral fractures in patients of working age☆

A. Montiel-Giménez[a,*], F. Granell-Escobar[a], S. Gallardo-Villares[a], R. Franco-Gómez[a], A. Escolà-Benet[b]

Percutaneous surgery requires

(1) careful selection of cases, with conditions such as good bone quality and very little comminution of the tubercles;

(2) preservation of the medial cortex with its periosteum;

(3) that a stable, closed reduction be achieved; and

(4) that the patient be cooperative

Intramedullary KW or rods, nails, helix wires etc

34%-50%

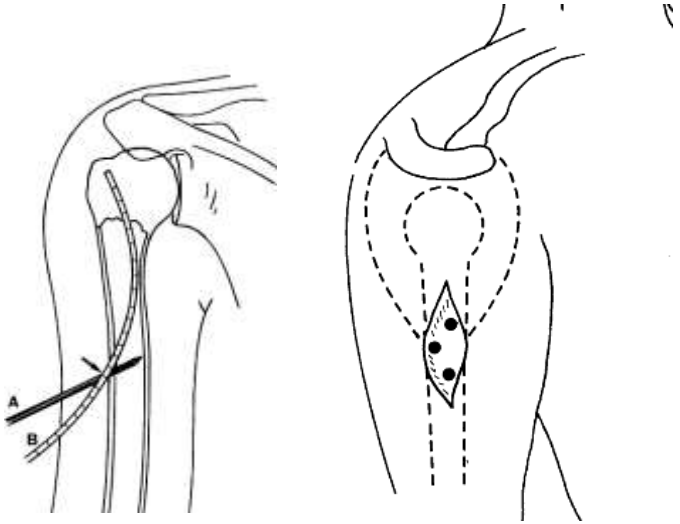
- head perforation
- infection
- loss of reduction
- migration
- Impingement

Ogiwara N, et al. Clin Orthop 1996
Wachtl SW, et al. Arch Orthop Trauma Surg 2000
Takeuchi R, et al. J Orthop Trauma 2002
Rosa MA, et al. J Orthop Trauma 2000
Mighell M, et al. Techn Shoulder Elbow Surg 2003

Journal of Orthopaedic Trauma
Vol. 16, No. 6, pp. 403–408

Minimally Invasive Fixation for Unstable Two-Part Proximal Humeral Fractures: Surgical Techniques and Clinical Results Using J-Nails

Ryohei Takeuchi, Tomihisa Koshino, Akihiro Nakazawa, Shin Numazaki, Rikimasa Sato, and Tomoyuki Saito



41 unstable 2-part fractures
mean age of 65 years
mean follow-up 29 months
excellent 25, satisfactory 12,
unsatisfactory 3, failure 1

Especially indicated for unstable two-part subcapital fractures

2.4 K-Wires

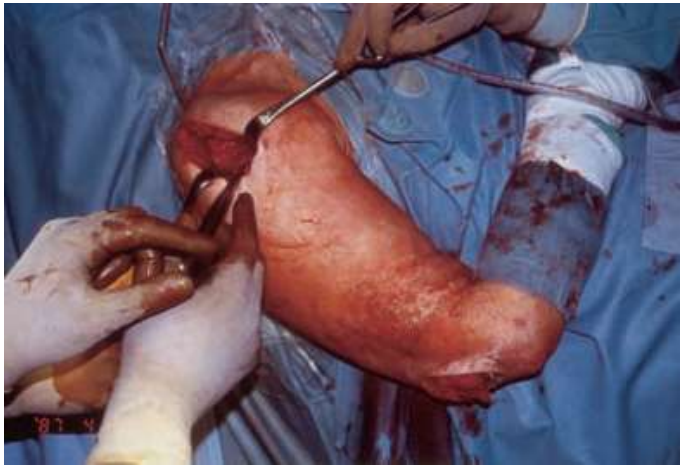
Langenbeck's Arch Surg (2002) 387:153–160
DOI 10.1007/s00423-002-0286-x

ORIGINAL ARTICLE

Cyrus Khodadadyan-Klostermann
Michael Raschke
Roger Fontes
Ingo Melcher
Allen Sossan
Kaushik Bagchi
Norbert Haas

Treatment of complex proximal humeral fractures with minimally invasive fixation of the humeral head combined with flexible intramedullary wire fixation – introduction of a new treatment concept

24 patients (3-part & 4-part)
40% excellent results
45% satisfactory
15% unsatisfactory



Techniques in Shoulder & Elbow Surgery 4(2):84-88, 2003

TECHNIQUE

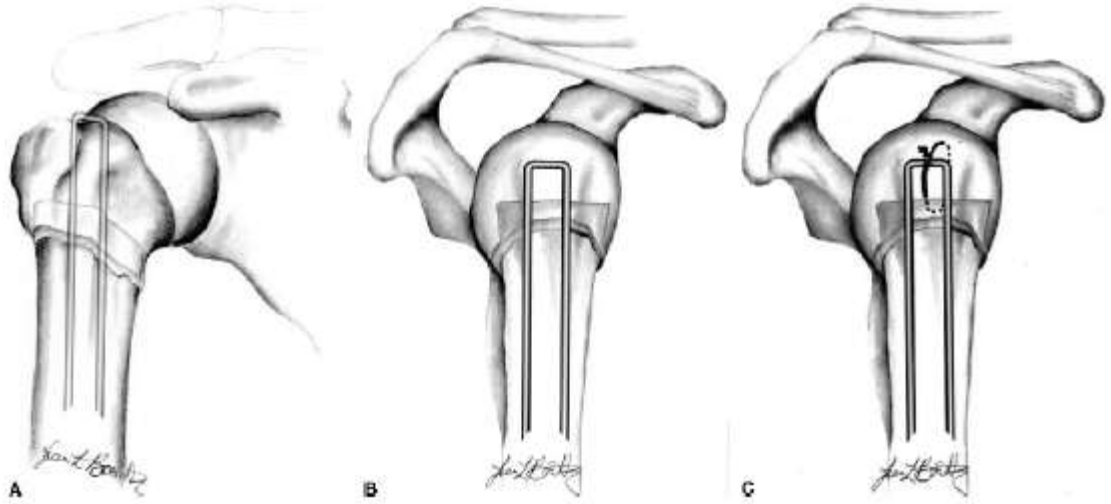
Technique for Unstable Two-Part Surgical Neck Proximal Humeral Fractures Utilizing an Intramedullary Staple Device: The Evan's Staple

Mark A. Mighell, MD
Uniformed Health Sciences Institute
Shoulder and Elbow, Upper Extremity Surgery
Florida Orthopaedic Institute
Tampa, FL

W. Bryan Jennings, DO
Department of Orthopaedic Surgery
Ohio University
Grandview Hospital and Medical Center
Dayton, OH

Mark A. Frankle, MD
Division of Orthopaedic Surgery
University of South Florida
Florida Orthopaedic Institute
Tampa, FL

12 patients
2 years follow-up
union in 3 months
7 pt excellent
3 good
2 satisfactory
1 case of impingement

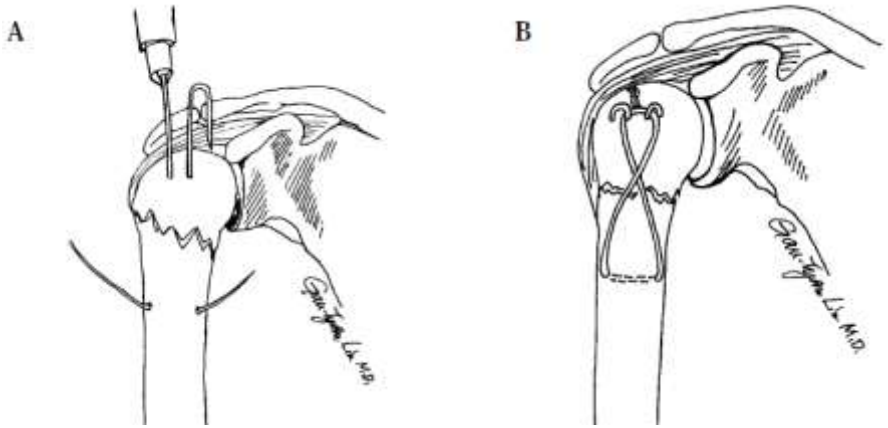


Intramedullary Pinning with Tension-band Wiring for Surgical Neck Fractures of the Proximal Humerus in Elderly Patients

J Med Sci 2004;20:538–45

Cheng-Chang Lu, Ming-Wei Chang, and Gau-Tyan Lin

10 female patients
mean age 73.0 years
mean follow-up 20.6 months.
Constant score, 80.8



J Shoulder Elbow Surg (2012) 21, 882-886

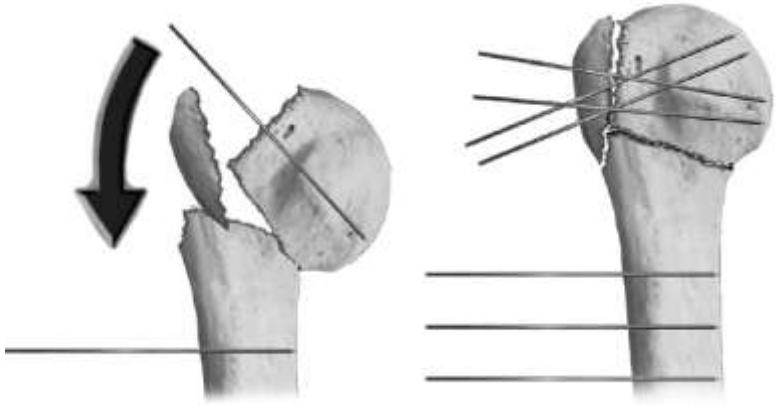
ELSEVIER

Journal of Shoulder and Elbow Surgery

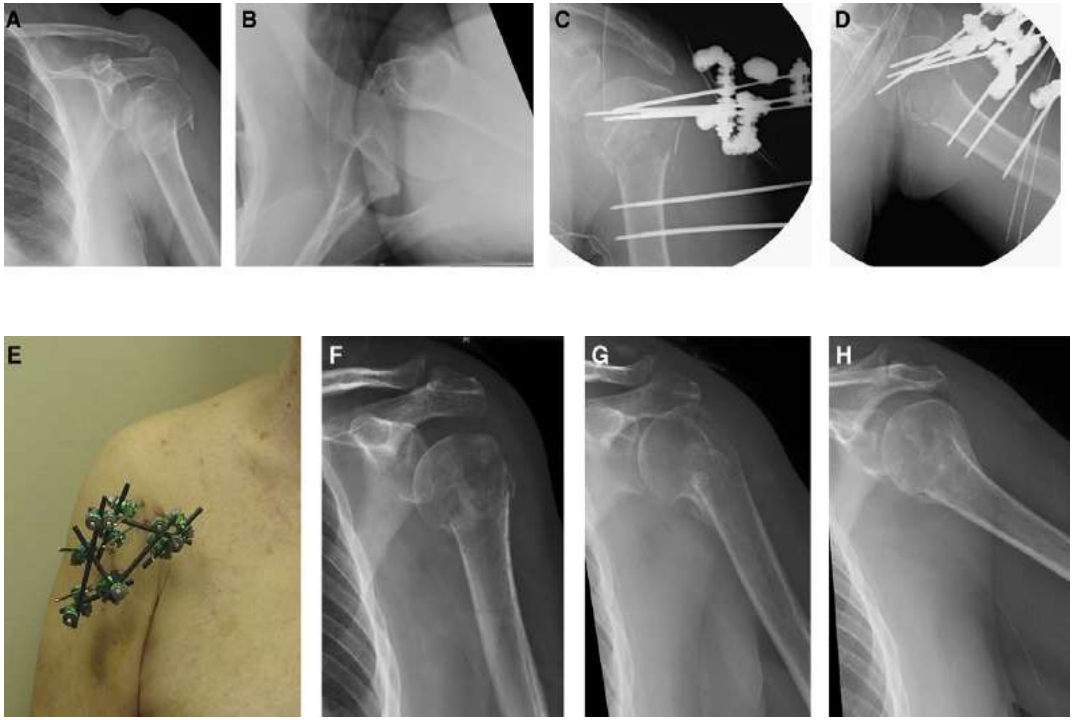
www.elsevier.com/locate/ymse

Surgical treatment of proximal humeral fracture with external fixator

Jingwei Zhang, MD[a,*], Nabil Ebraheim, MD[b], Gregory E. Lause, BS[b]



32 patients
mean age 56 years
mean fup 18 months
Mean union time 13 weeks.
Mean Neer score 83.2
2 pt pin loosening
1 patient AVN
no infection or impingement



J Shoulder Elbow Surg (2010) 19, 1218-1229

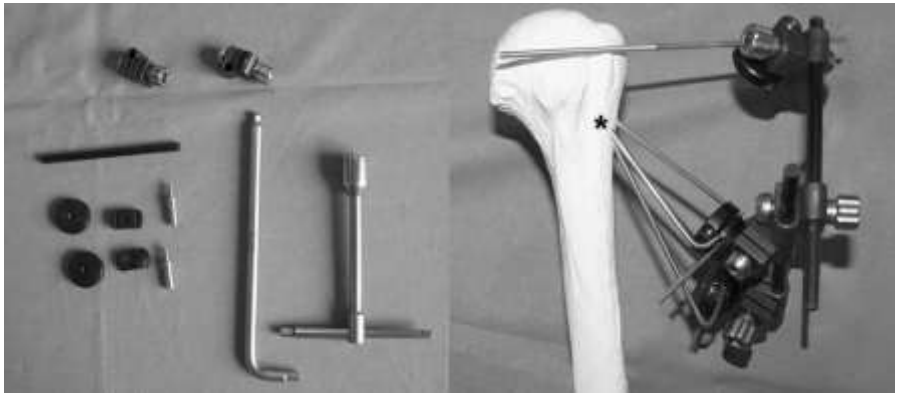
ELSEVIER

Journal of Shoulder and Elbow Surgery

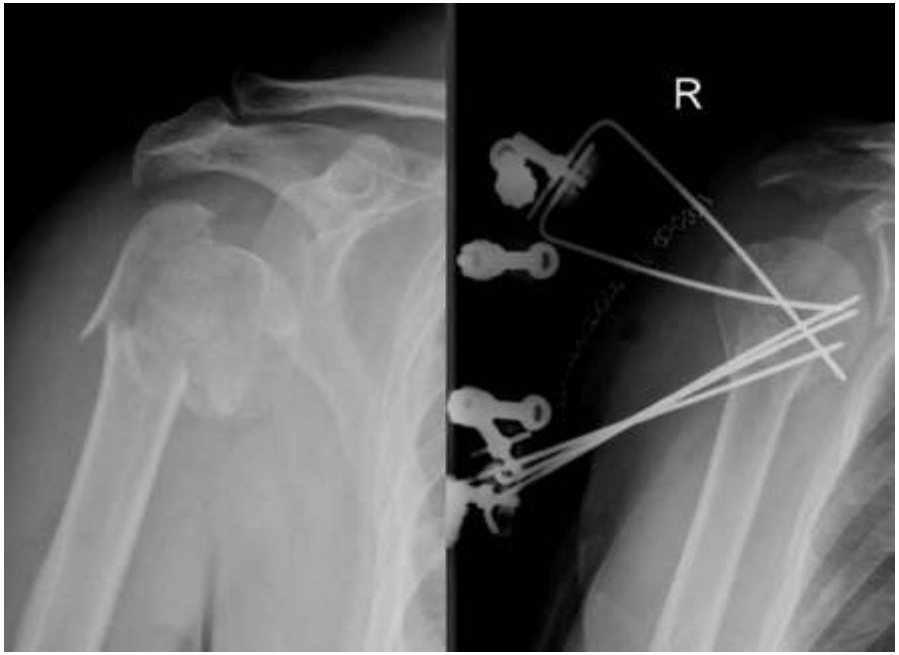
www.elsevier.com/locate/ymse

The hybrid technique: Potential reduction in complications related to pins mobilization in the treatment of proximal humeral fractures

Davide Blonna, MD*, Filippo Castoldi, MD, Michele Scelsi, MD, Roberto Rossi, MD, Giuseppe Falcone, MD, Marco Assom, MD



51 patients percutaneous fixation
55 patients Hybrid technique
Open reduction and osteosutures
Complications 16 patients/ 6 patients
Revision rate 19% /4%
Pins migration 8 /1 case
MCS at 12-months 77/ 89



J Shoulder Elbow Surg (2010) 19, 1218-1229

ELSEVIER

JOURNAL OF SHOULDER AND ELBOW SURGERY

www.elsevier.com/locate/ymse

The hybrid technique: Potential reduction in complications related to pins mobilization in the treatment of proximal humeral fractures

Davide Blonna, MD*, Filippo Castoldi, MD, Michele Scelsi, MD, Roberto Rossi, MD, Giuseppe Falcone, MD, Marco Assom, MD

Considerations for hybrid ex-fix

Not all fractures can be fixed
Risk of infection
Stability in osteoporotic bone
Patient discomfort

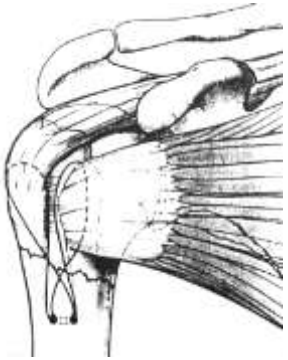
If the fracture is opened maybe is better to use a plate?

- since no hardware is left in the shoulder, some complications such as deep infection, nonunion, or avascular necrosis are potentially easier to treat

Transsoseous suturing, wiring etc

Cuomo et al (1992)

22 patients 2-, 3-part fractures
82% excellent or very good results

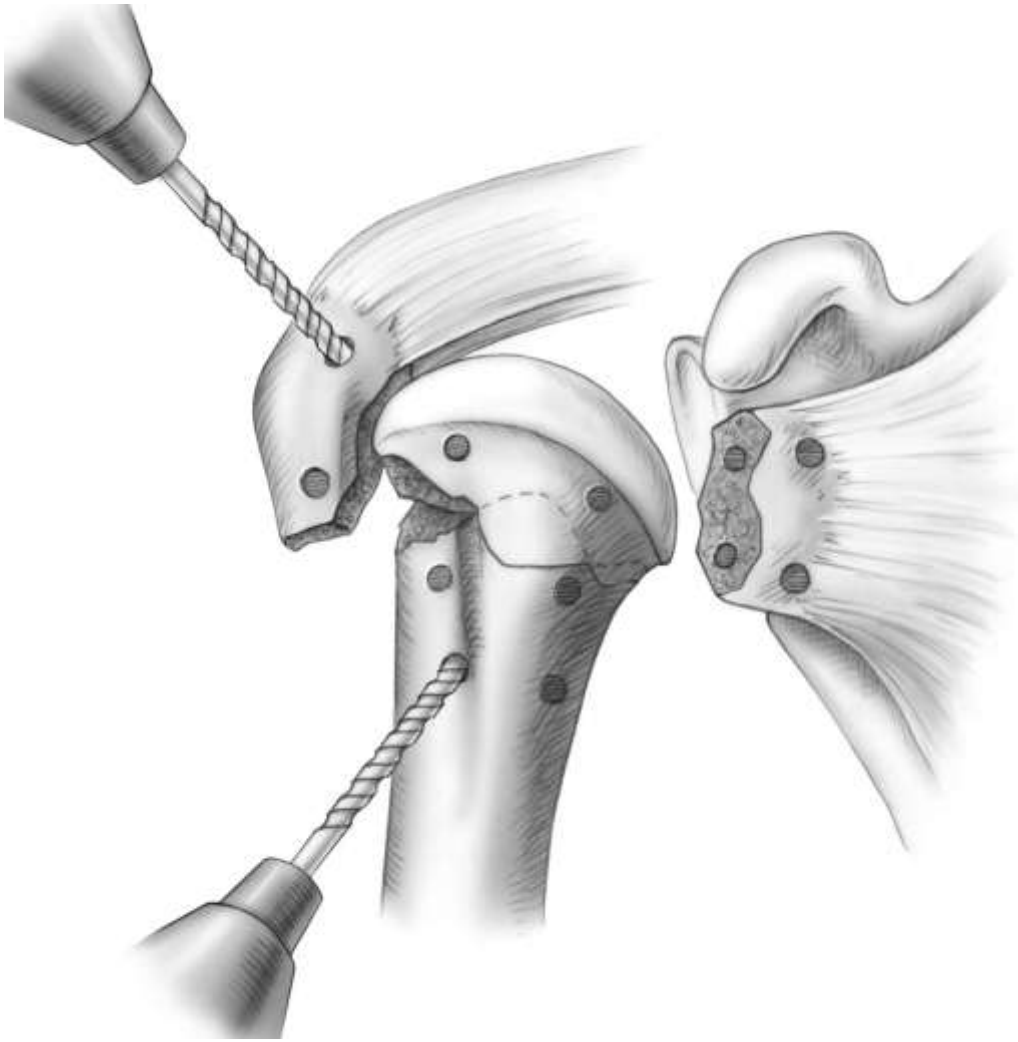


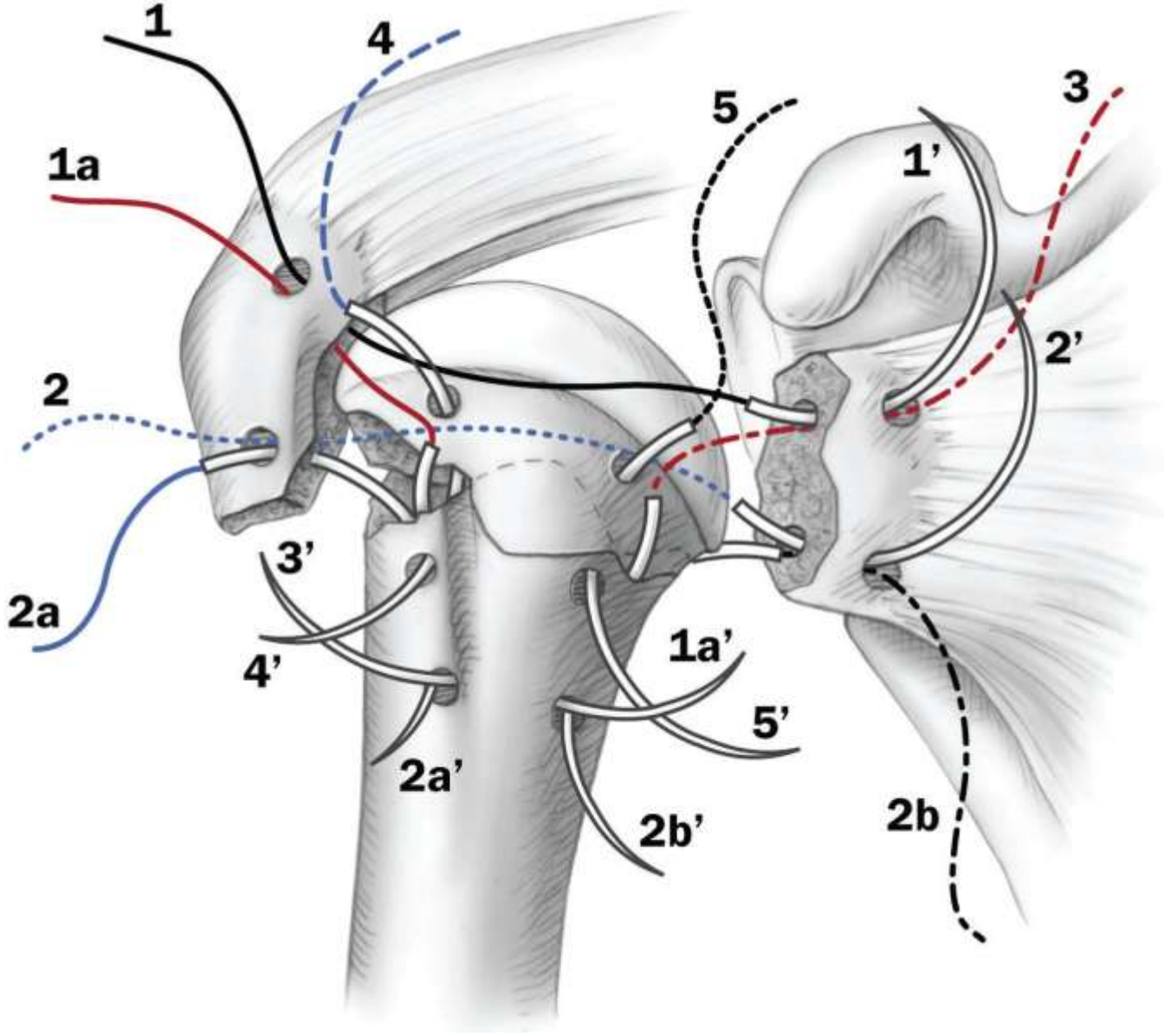
Park et al (2003)

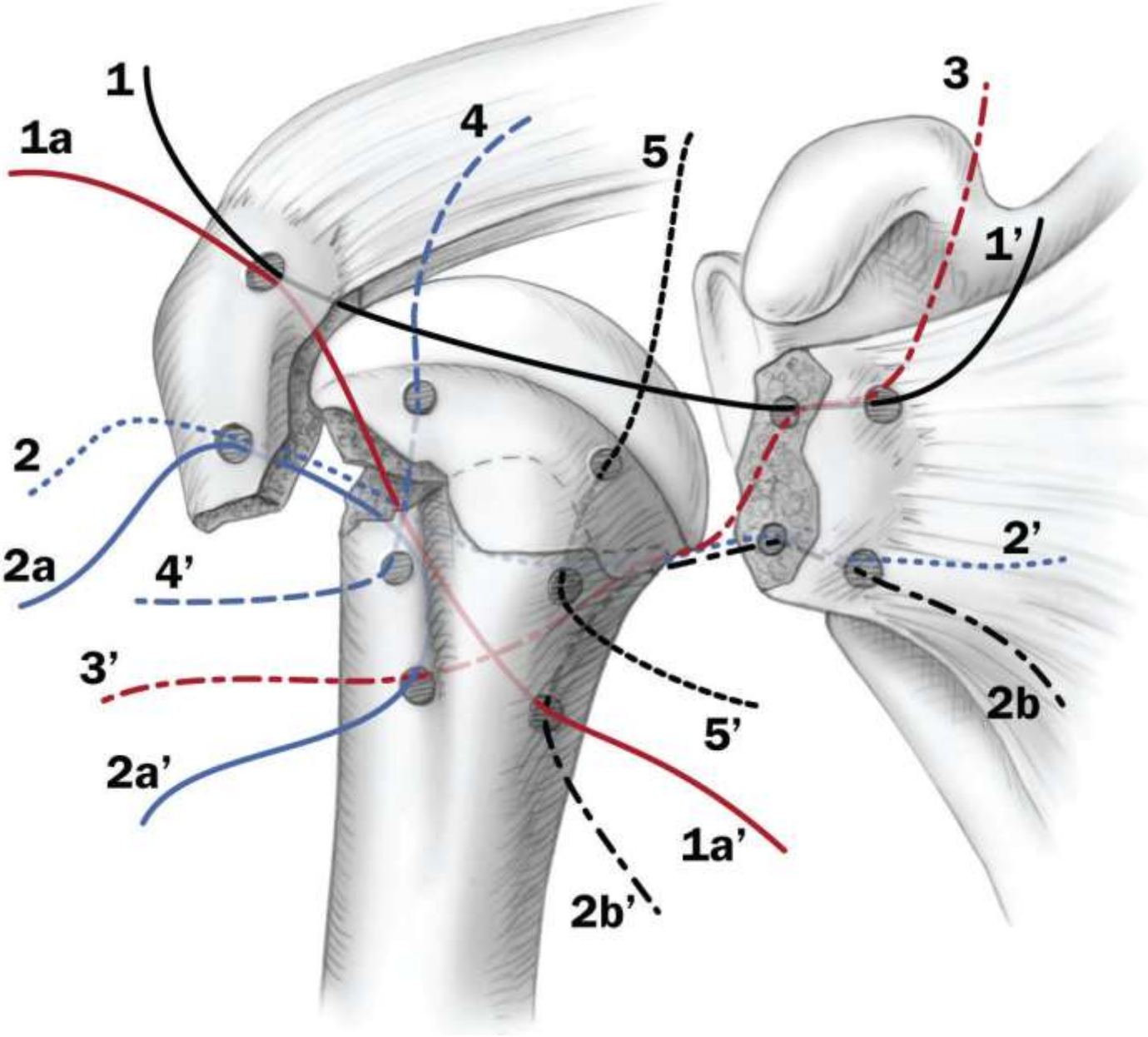
27 patients, 13 GTB, 9 surgical neck,
6 3-part 89% excellent or very good result

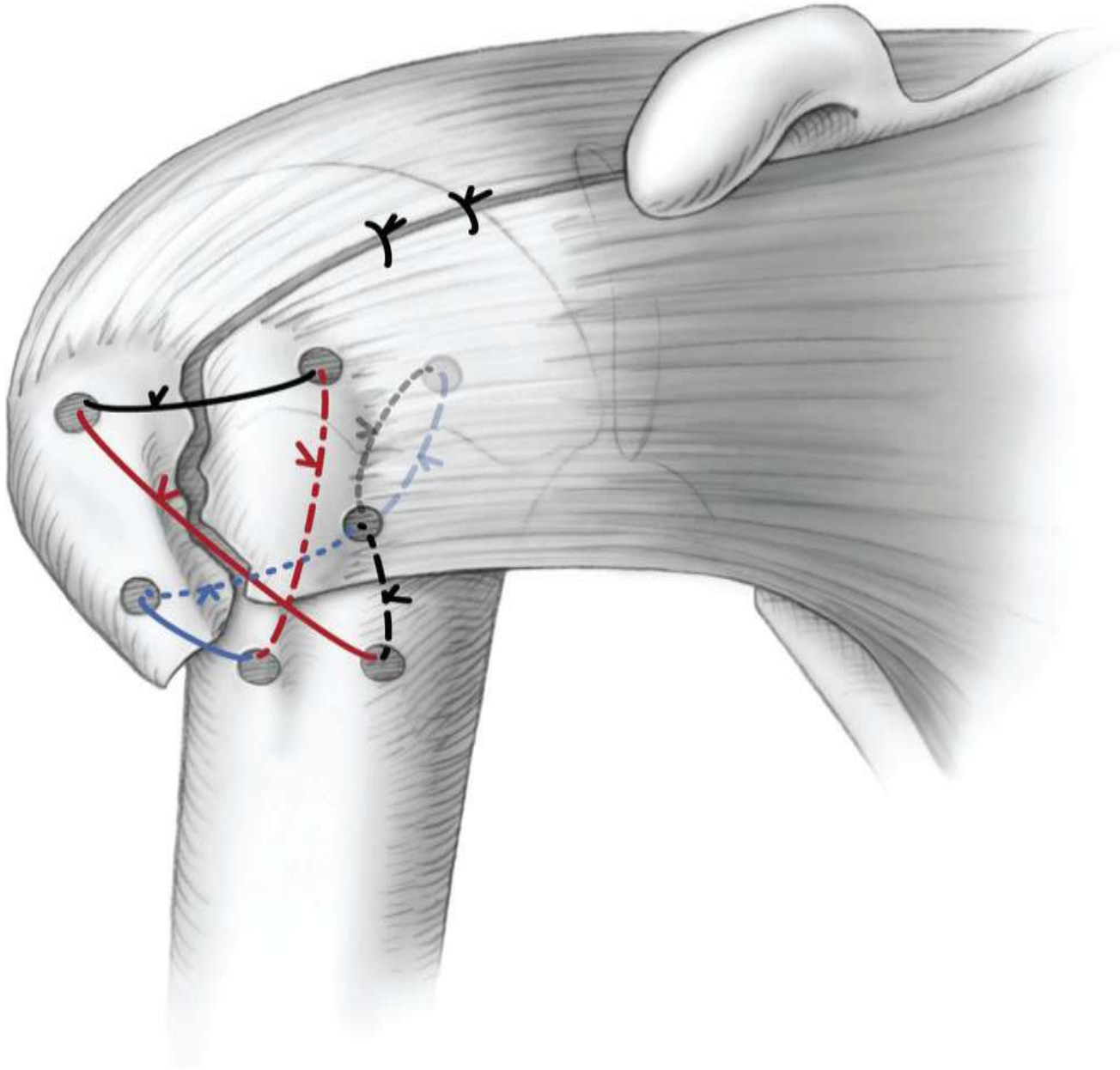
Branco et al (2001)

13 patients, Dacron sutures, small fup

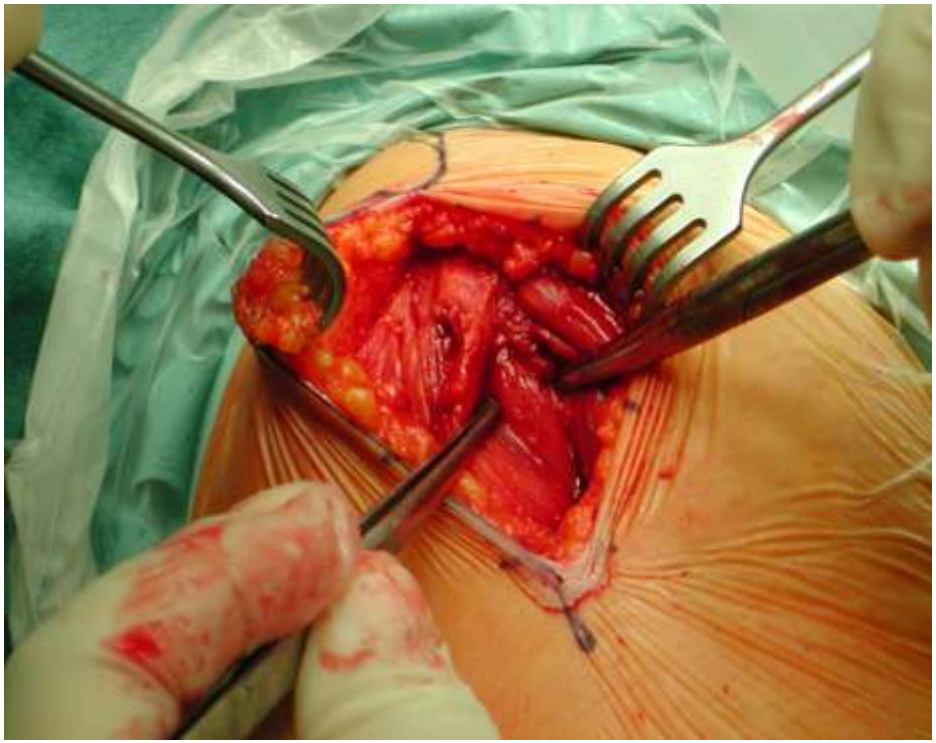



1
4
5
3
1a
1'
2'
2
3'
2a
4'
1a'
5'
2a'
2b'
2b

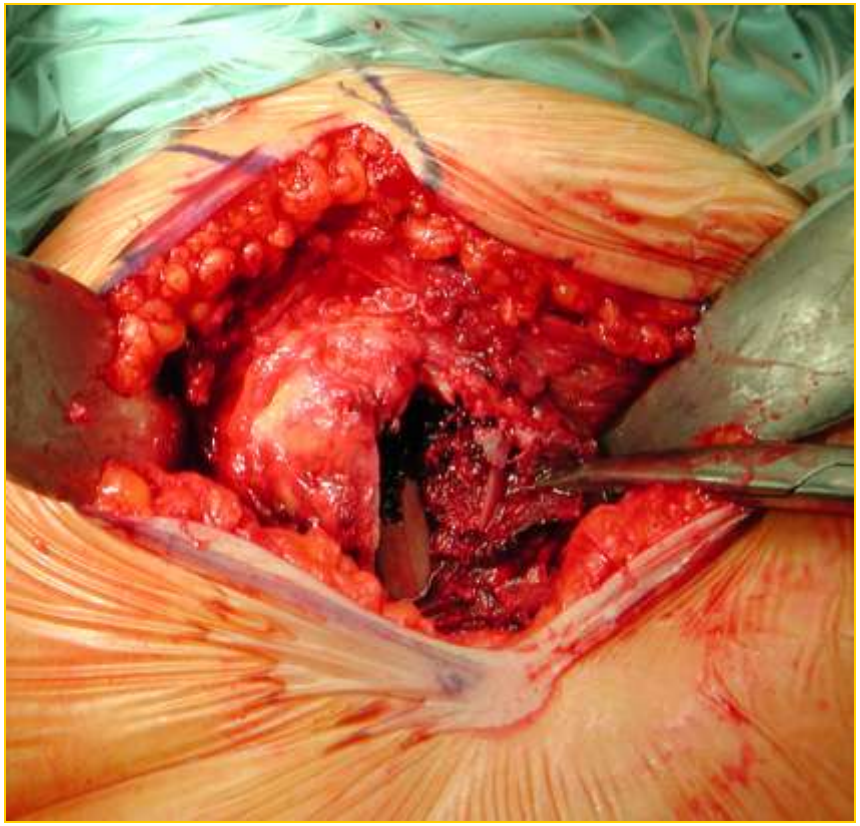

1
1a
4
5
3
1'
2
2a
4'
2'
3'
2b
5'
2a'
1a'
2b'



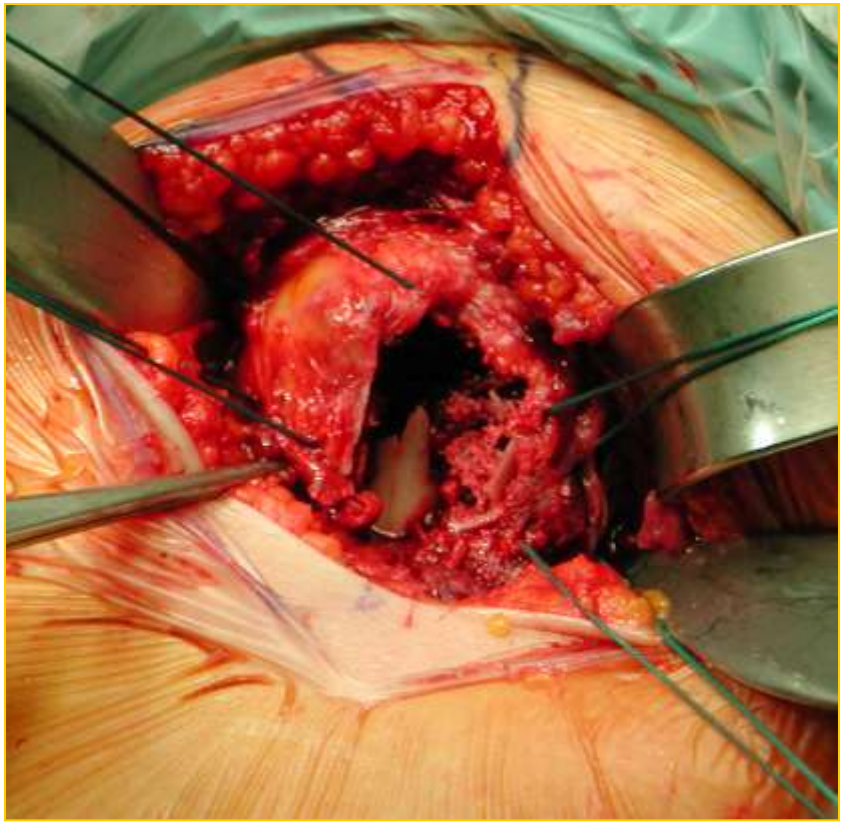
Skin incision



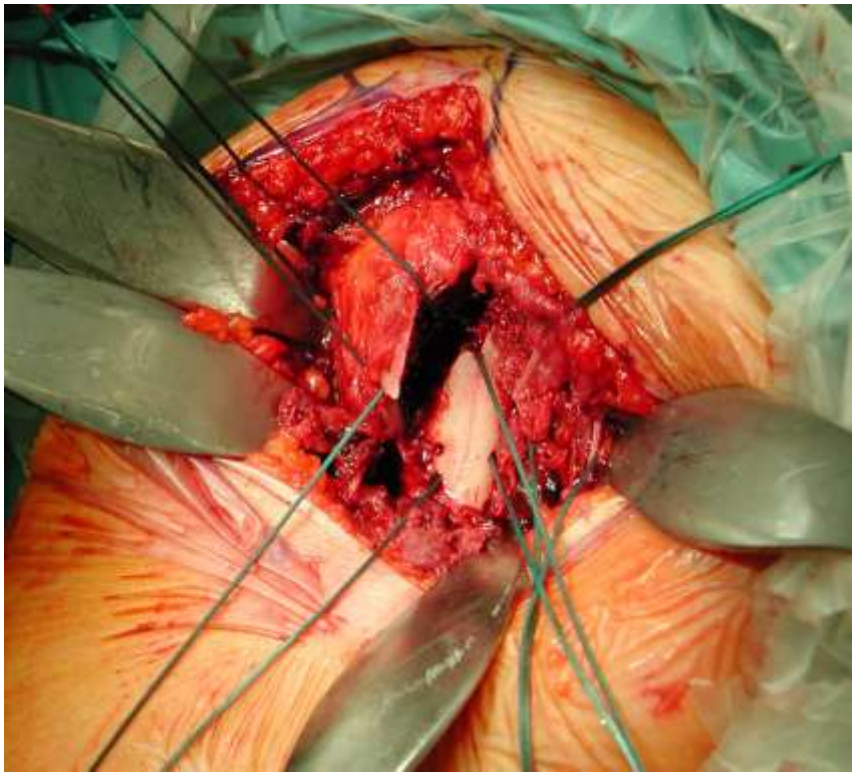
Deltoid splitting and bursa removal



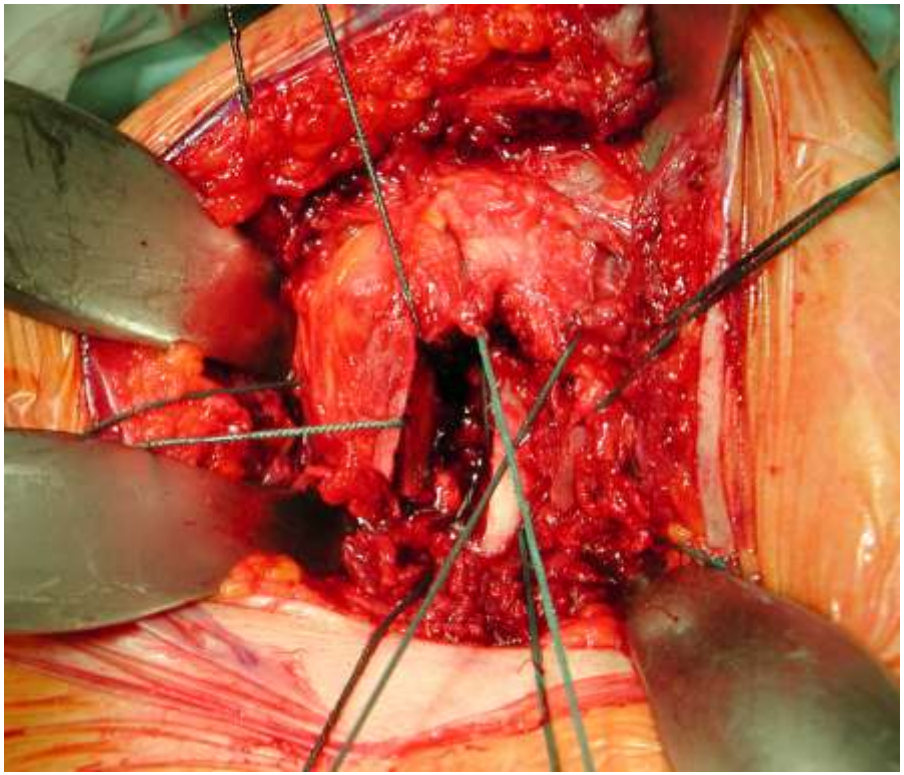
Recognition of
fracture pattern



Transosseous suturing
of the tuberosities

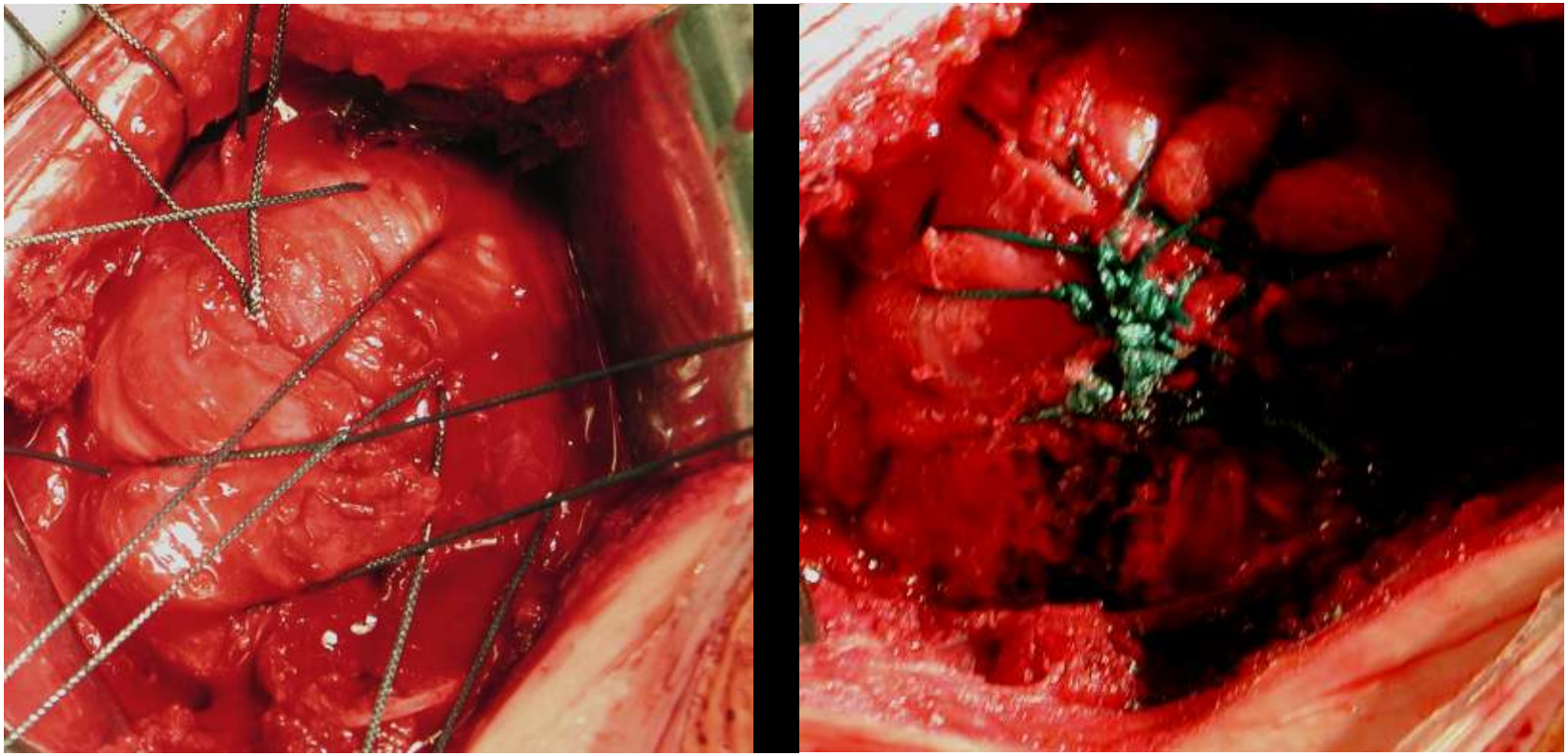


Sutures through the humeral head and diaphysis

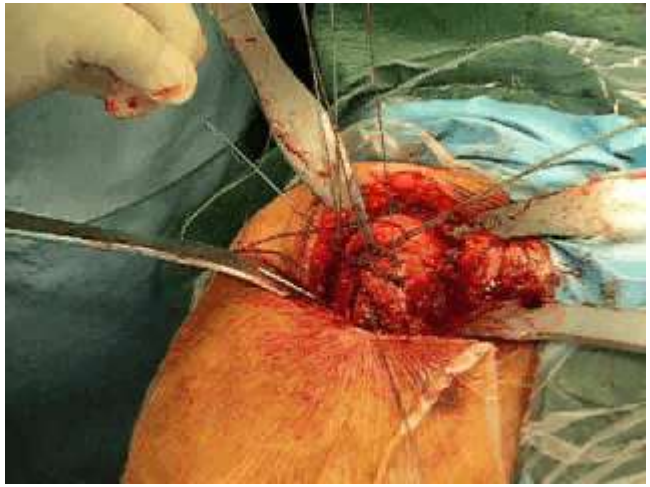


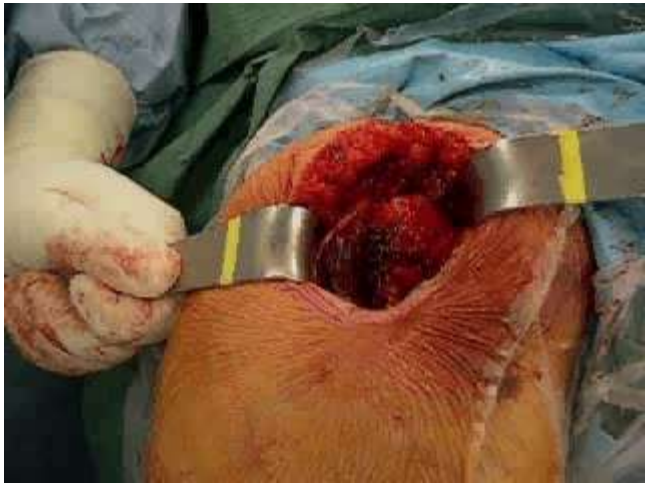
Cross-manner fixation with tension band effect

Minimal intraoperative reduction of the head fragment



Final assessment of reduction and knotting -





Transosseous Suture Fixation of Proximal Humeral Fractures

Panayiotis Dimakopoulos, Georgios Kasimatis and Andreas Panagopoulos
J Bone Joint Surg Am. 2007;89:1700-1709. doi:10.2106/JBJS.F.00765

11-year period
165 patients (94 f, 71 m)
mean age, 54 years
27% valgus impacted fractures
39% three-part fractures
34% two-part fractures

No 5 Ethibond sutures
All fractures united except 2
mean Constant score 91 points

Complications

Malunion nine patients (5%)

AVN eleven (7%)

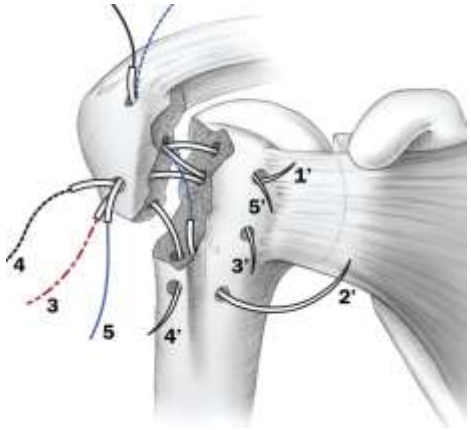
impingement syndrome 4

Arthritis 2

Transosseous Suture Fixation of Proximal Humeral Fractures

Surgical Technique

By Panayiotis Dimakopoulos, MD, Andreas Panagopoulos, MD, and Georgios Kasimatis, MD

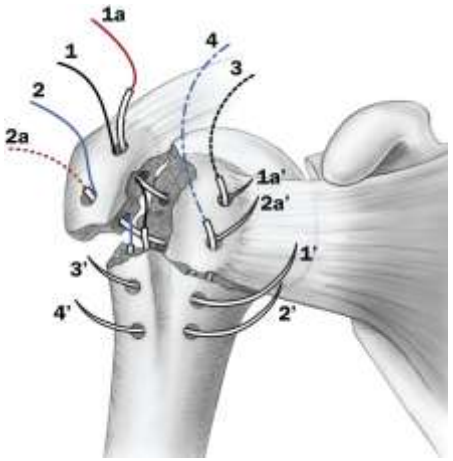


2-part

INDICATIONS:

- 2-part GT fractures with or without dislocation
- 3-part fractures or 3-part fracture-dislocations
- 4-part valgus impacted fractures

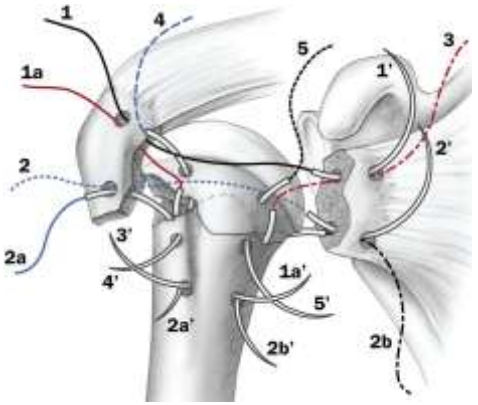
(no more than 45° of rotational deformity and <6 to 7 mm of lateral displacement)



3-part

CONTRAINDICATIONS:

- Complex 4-part or 4-part fracture-dislocations
- 2-part surgical neck fractures
- Head-splitting or anatomical neck fractures



4-part

ELSEVIER

Semin Arthro 23:74-82 © 2012

Seminars in Arthroplasty

Proximal Humerus Fractures: Pin, Plate, or Replace?

Charles M. Jobin, MD, and Leesa M. Galatz, MD

Key factors

- fracture type
- bone quality
- integrity of the medial calcar
- tuberosity comminution
- risk of AVN
- joint congruity
- functional demands

ELSEVIER

Semin Arthro 23:74-82 © 2012

Seminars in Arthroplasty

Proximal Humerus Fractures: Pin, Plate, or Replace?

Charles M. Jobin, MD, and Leesa M. Galatz, MD

Percutaneous fixation	ORIF (plates-sutures)	Arthroplasty
good bone stock preserved medial calcar 2-part surgical neck fractures some 3-part fractures 4-part VI fractures	good-quality bone displaced 2-, 3-, 4- part fractures 2-part surgical neck fractures with comminuted medial calcar head-splitting fractures in young patients >45 years old in an attempt at head salvage	head-splitting fractures, or significant head impaction fractures or in osteoporotic nonreconstructable 4-part fractures and fracture dislocations, or when the head is devoid of vascularity