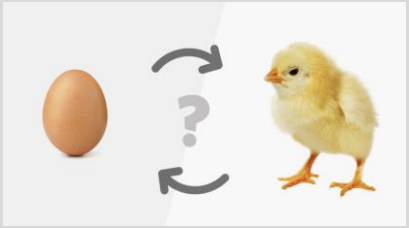
Pathoanatomy, Diagnosis and Therapeutical Options in AC Dislocations



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University of Bern
Switzerland
www.shoulderteam.ch

DISCLOSURES

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I declare that I have:

- **held shares in:**
- **received royalties from:**
- **done consulting work for:**
- **given paid presentations for:**
- **received institutional support from:**

Medacta International

VIMS

bonebridge
reducing complexity

BeeMed

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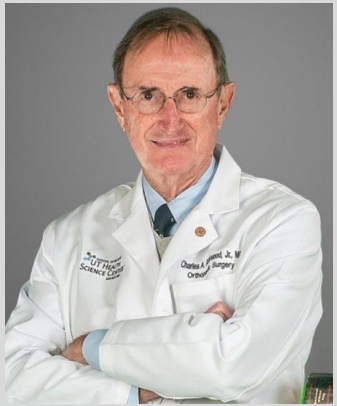
THE JOURNEY FROM....

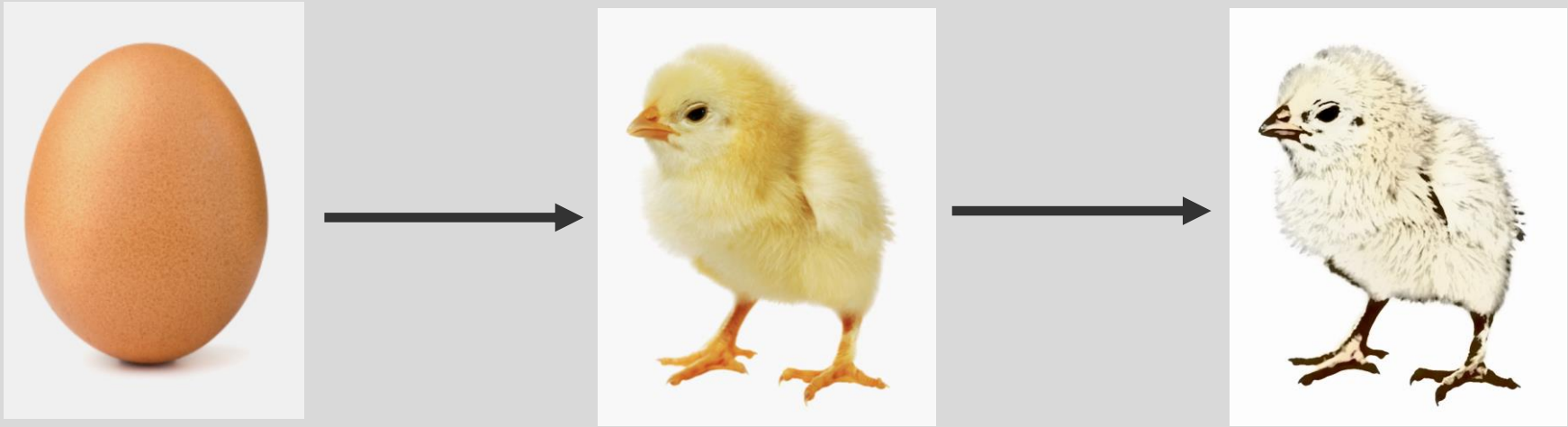


Rockwood

AC/DC

Kandinsky

THE JOURNEY FROM....



SCHEDULE

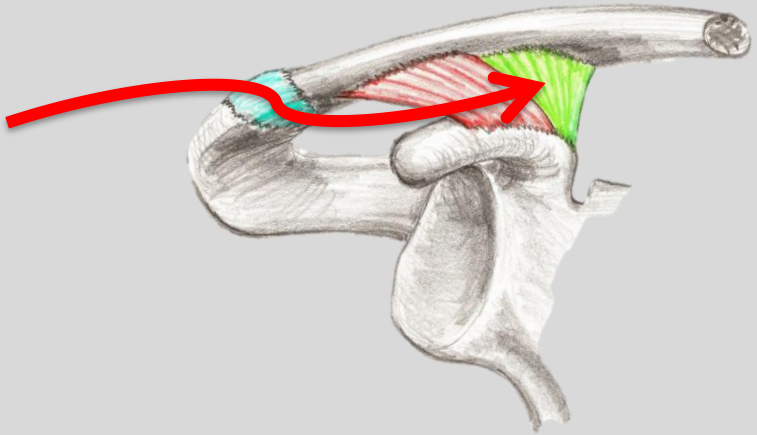
- **Pathoanatomy**
- Indication
- Techniques

ARE WE TALKING ABOUT THE SAME?

- First, we have to define the pathomechanism -> pathology?

MAIN QUESTION TODAY?

- Do we agree that the 3D pathomechanism starts **LATERAL**?



Cadenat FM, Int Clin 1917

AC JOINT STABILITY -> 3 PILLARS

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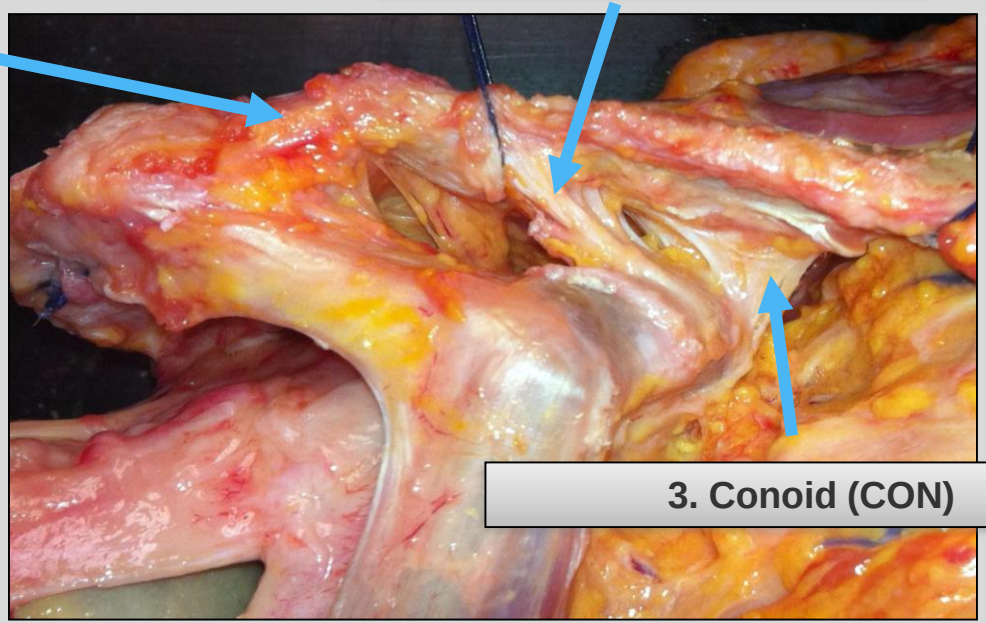
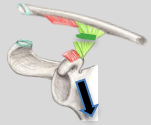
1. AC Capsule (CAP)

2. Trapezoid (TRAP)



3. Conoid (CON)



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1. AC CAPSULE (CAP): LATERAL

2/3 HORIZONTAL

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- An intact CC ligament <u>cannot</u> compensate the horizontal effect of the AC capsule (CAP)
- importance of the AC capsule for resisting rotational loads.

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Debski RE, Ann Biomed Eng: 2000 Dyrna F, AJSM: 2018 Luis GE, J Orthop Res: 2007

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2. TRAPEZOID (TRAP): CENTRAL

1/3 HORIZONTAL

1/3 VERTICAL

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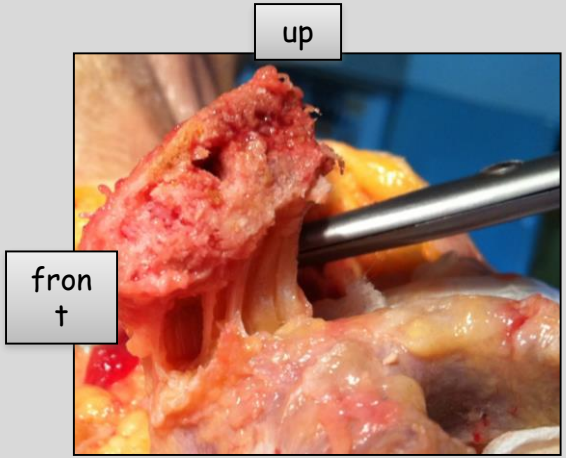

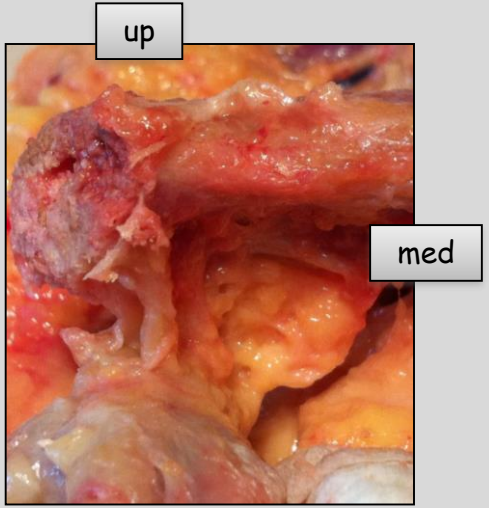

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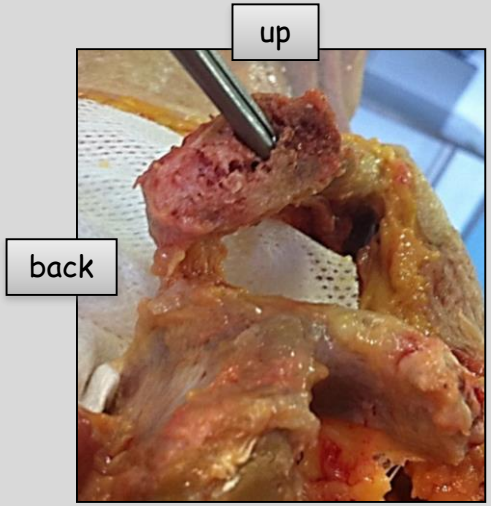
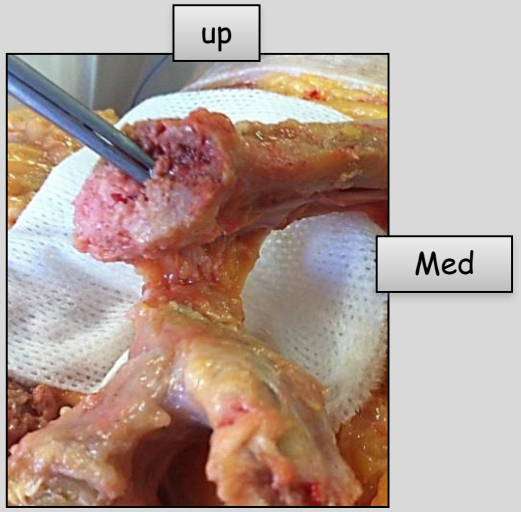
3. CONOID (CON): MEDIAL

2/3 VERTICAL

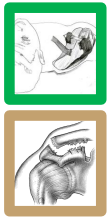




CAP+TRAP+CON

1x HORIZONTAL

1x VERTICAL



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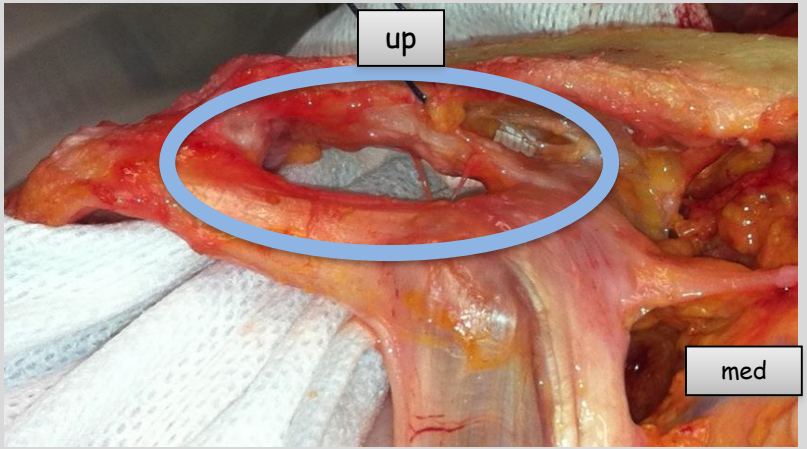

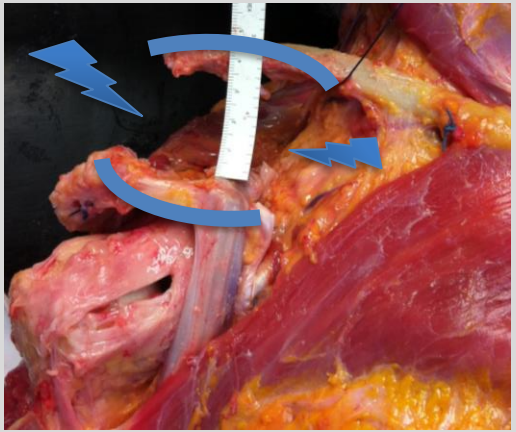

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AC INSTABILITY:
STARTS LATERAL (CAP)…

2/3 HORIZONTAL

0 VERTICAL

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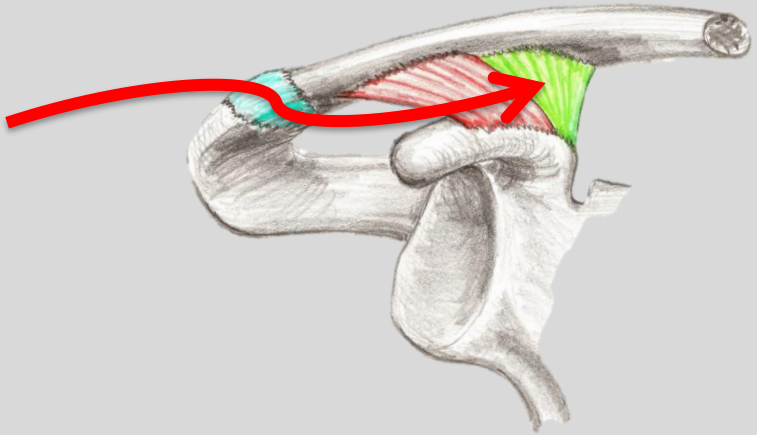

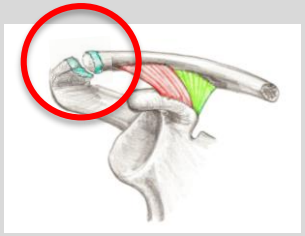

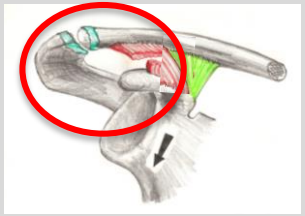

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I THINK …

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1. There is a horizontal instability at the beginning

CAP

2/3 HORIZONTAL

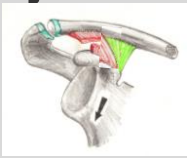
2. There is a horizontal instability without major vertical instability

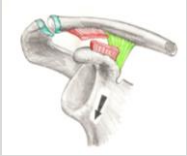
CAP - TRAP- (PLUS)

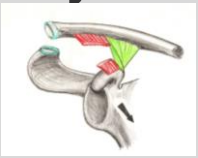
2/3 HORIZONTAL

1/3 HORIZONTAL

1/3 VERTICAL







3. There is no vertical instability without a horizontal instability!

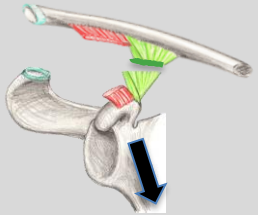
CAP - TRAP - CON

2/3 HORIZONTAL

1/3 HORIZONTAL

1/3 VERTICAL

2/3 VERTICAL



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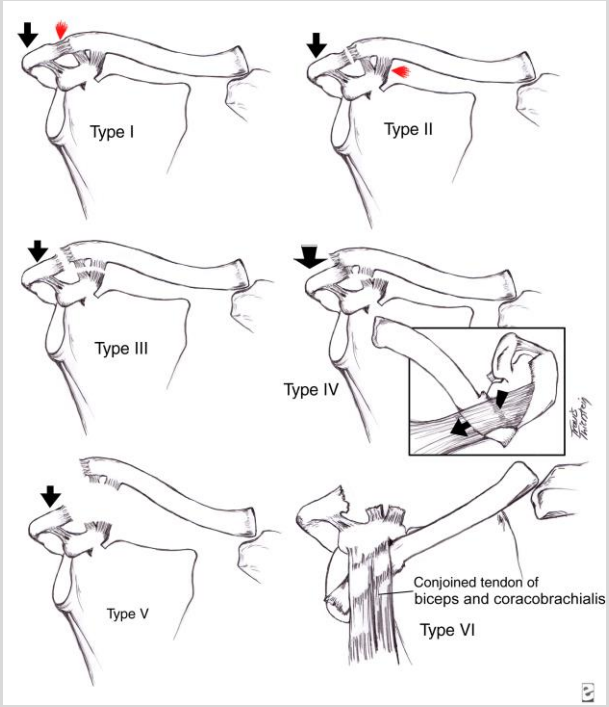
SCHEDULE

- Pathoanatomy
- **Indication**
- Techniques

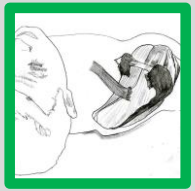
ACROMIOCLAVICULAR-JOINT DISLOCATION: OLD CLASSIFICATION

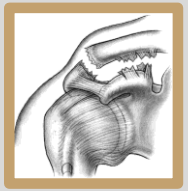


Rockwood CA. Rockwood CA, Matsen FA, eds. The shoulder: 1998

TO CONFIRM THE PATHOANATOMY

We have to assess and quantify the horizontal and vertical instability





1. **Experimentally**
2. **Clinically**

IF YOU DEFINE YOUR GROUPS BASED ON...

- the RW classification
- the CC distance

- Real 3-dimensional displacement of the clavicle and the acromion

IF YOU DEFINE YOUR GROUPS BASED ON...

- the RW calssification
- the CC distance

- **Real 3-dimensional displacement of the clavicle and the acromion**

AC-JOINT MODEL

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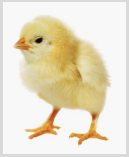
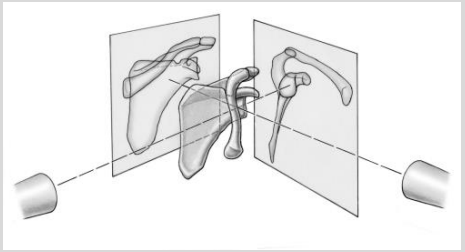
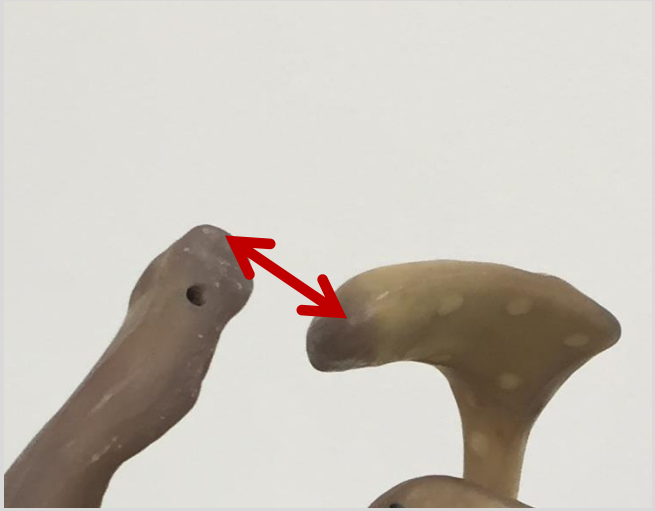


Correlation between the real CT-based AC-distance

and the radiographic parameters

- **horizontal** parameters
- **vertical** parameters





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CT -> X RAYS WITH DIFF. ROCKWOOD (=RW) INSTABILITIES

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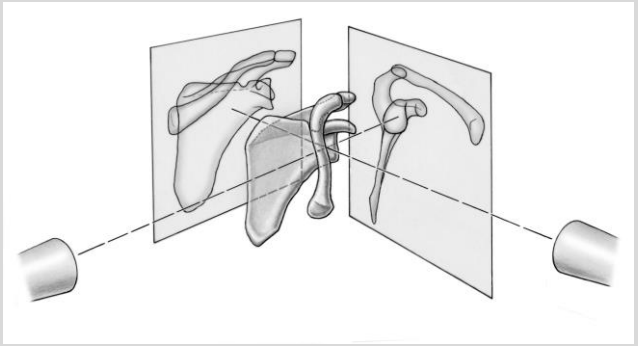
AC joint model

- CT assessment
- Rx in Zanca und Alexander x-ray
  - 120 cm
  - Centered on Glenoid-midpoint



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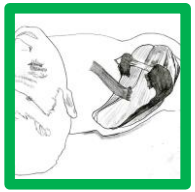
HORIZONTAL POSITION OF THE AC-JOINT



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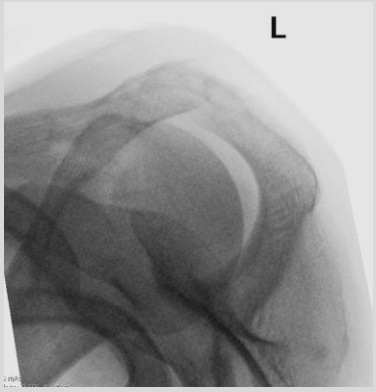

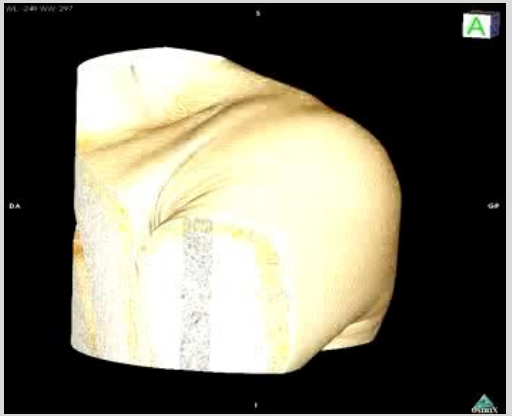

- horizontal stability in Alexander
- no axillary views!

Alexander OM, Radiography: 1949

Tauber M, AJSM: 2010

Rahm S, J Trauma: 2013

Zumstein MA, KSSTA: 2016

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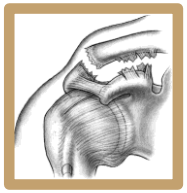
VERTICAL POSITION OF THE AC-JOINT -> CC IN ZANCA



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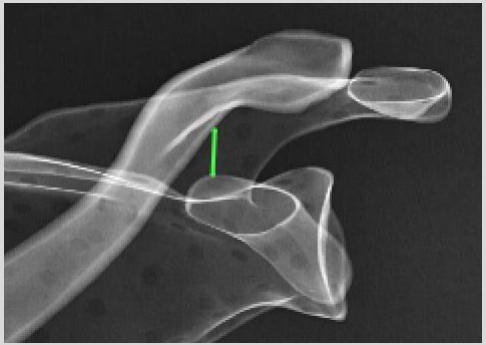
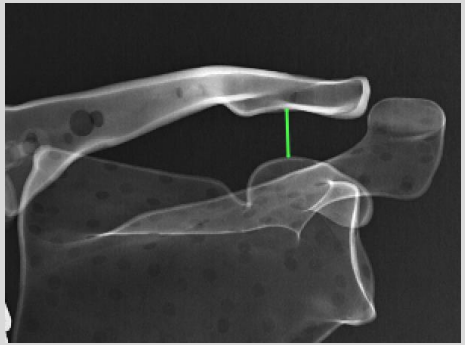
- vertical stability





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EXPERIMENTALLY: ASSESSED HORIZONTAL AND VERTICAL MEASUREMENTS

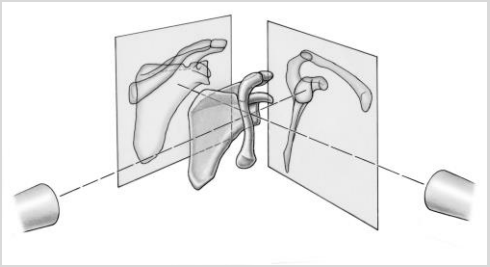
- All known parameters in the literature with CT
  - overlap. OA_{AC}, $OL_{AC,}$ dynamic horizontal translation (DHT)
  - new parameters....

Zumstein MA, KSSTA: 2016

EXPERIMENTALLY: ASSESSED HORIZ. AND VERT. MEASUREMENTS

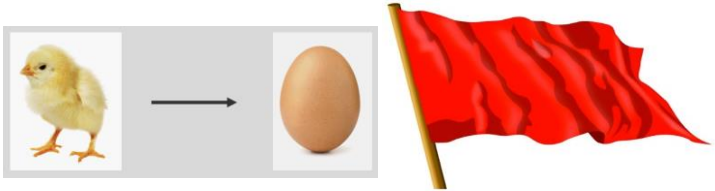
- All known parameters in the literature with CT
  - overlap. OA_{AC}, $OL_{AC,}$ dynamic horizontal translation (DHT)
  - **new parameters....**

- **<u>Highest correlations</u>: ONLY in Alexander‘s**



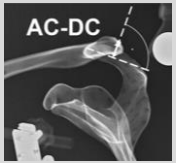
Zumstein MA, KSSTA: 2016

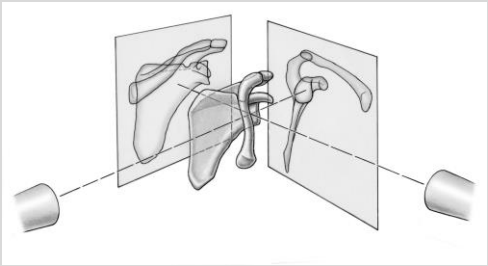
EXPERIMENTALLY: ASSESSED HORIZ. AND VERT. MEASUREMENTS



- All known parameters in the literature with CT
  - overlap. OA_{AC}, $OL_{AC,}$ dynamic horizontal translation (DHT)
  - **new parameters....**

- **<u>Highest correlations</u>: ONLY in Alexander‘s**
  - **Real horizontal distance ~ GC/PC**
  - **Real vertical distance ~ AC/DC > CC**
  - **CC distance was <u>not useful</u>**
    -> low correlation until RW V (>11±2 mm)





- **Interobserver reliability of these parameters was very high (.945-.999)**

Zumstein MA, KSSTA: 2016

TO CONFIRM THE PARAMETERS

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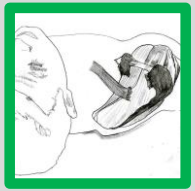
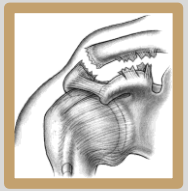
We have to assess and quantify the horizontal and vertical instability





1. Experimentally
2. Clinically

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2. CLINICALLY: VALIDATION OF THE PARAMETERS IN RW II-V

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- Prospective consecutive study (2013 - 2017)
- patients (n) 90
- female/male 12/78
- age (yrs) 43 (18-82)

- Radiographic evaluation
  - Zanca (Panorama)
  - Neer
  - Alexander bilateral

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Karargyris O, Murphy RW, Zumstein MA, JSES: 2020

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AGAIN HERE: CC DISTANCE WAS NOT USEFUL

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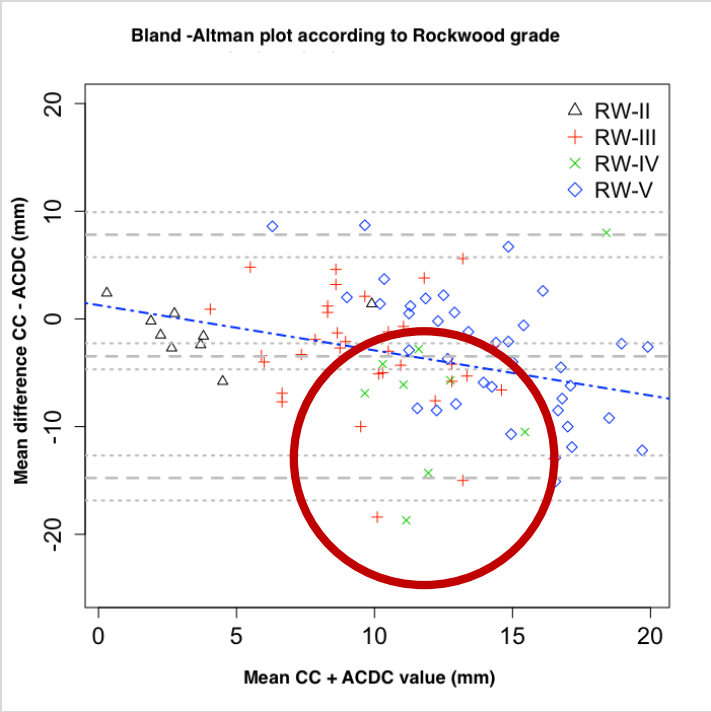
- Analysis per Rockwood grade

Systematic bias in <u>all</u> Rockwood IV grade injuries measuring CC distance by 3.9 mm

-> **underestimation of the pathology by assessing it using the CC distance**



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Karargyris O, Murphy RW, Zumstein MA, JSES: 2020

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AGAIN HERE: CC DISTANCE WAS NOT USEFUL

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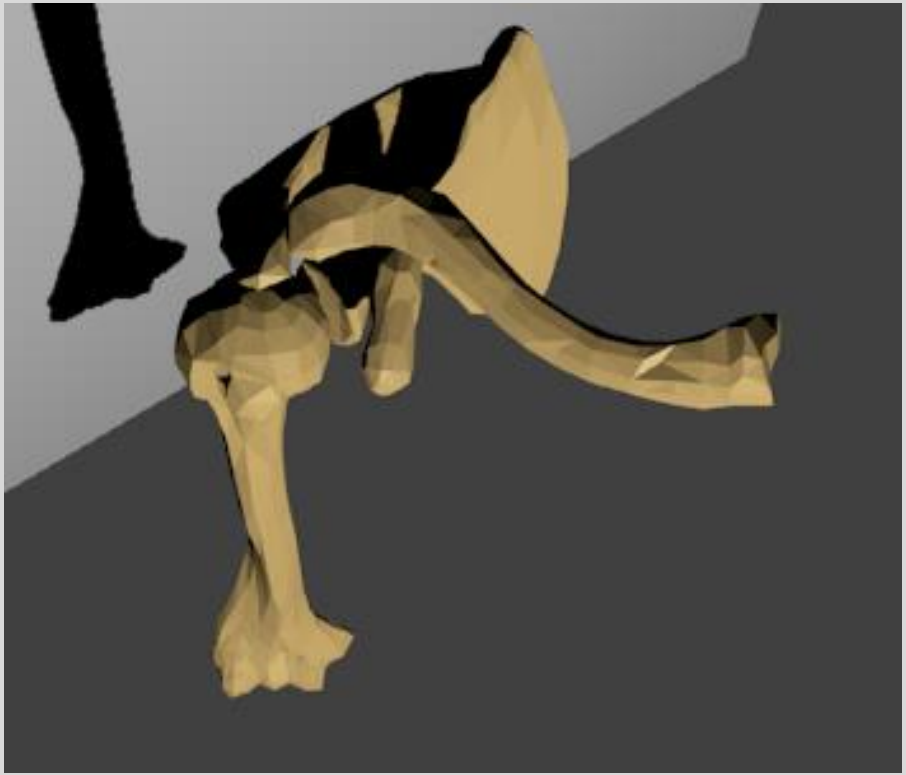
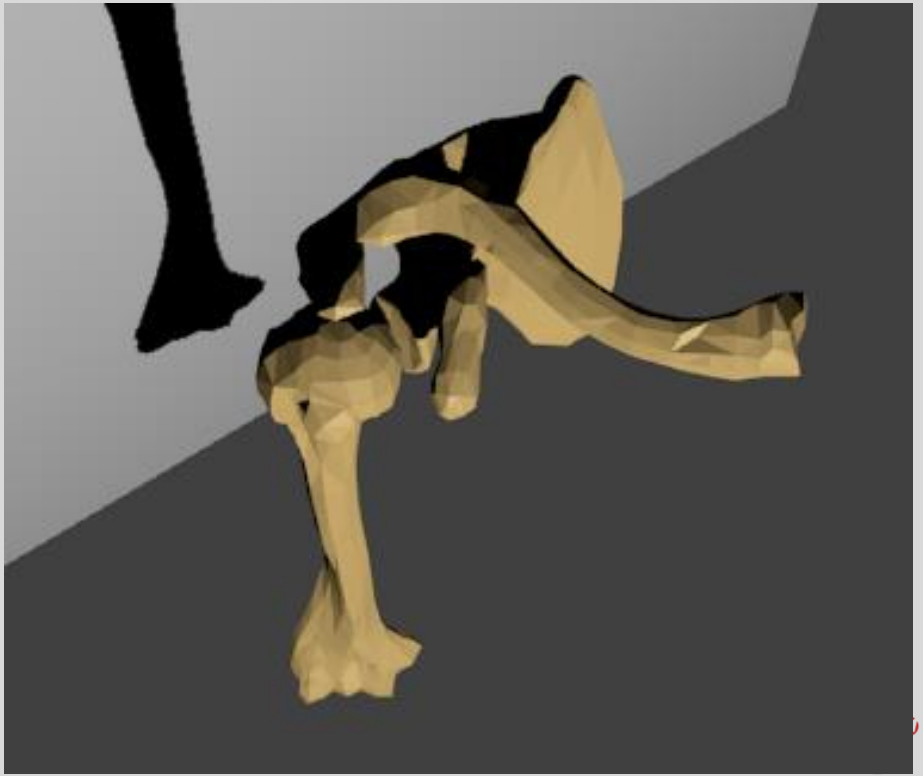
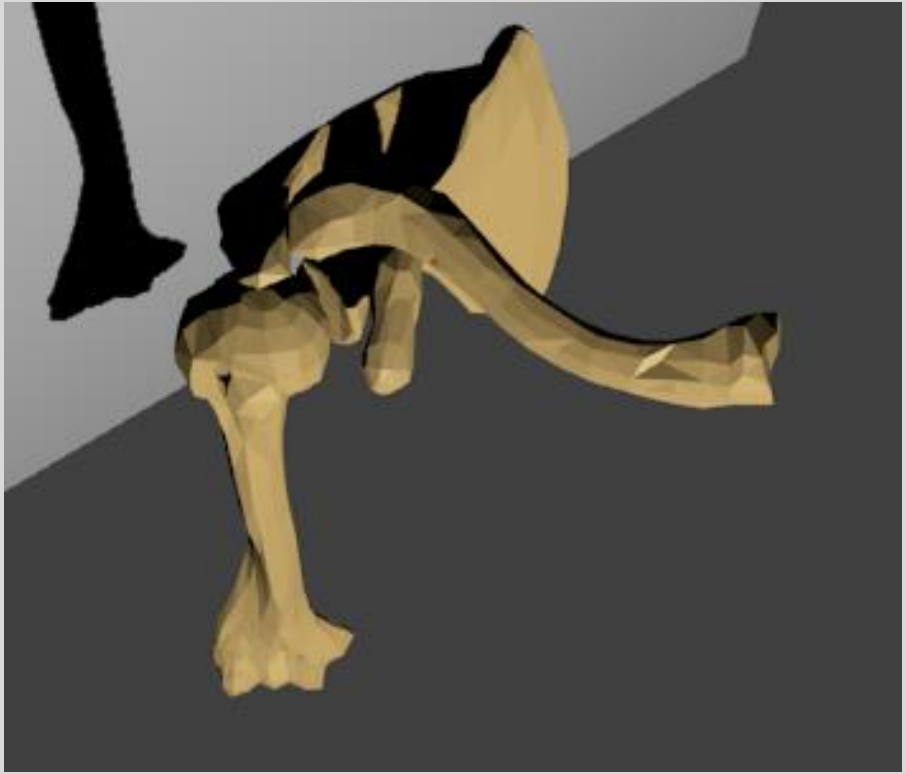
ortho ▪ spine ▪ sport

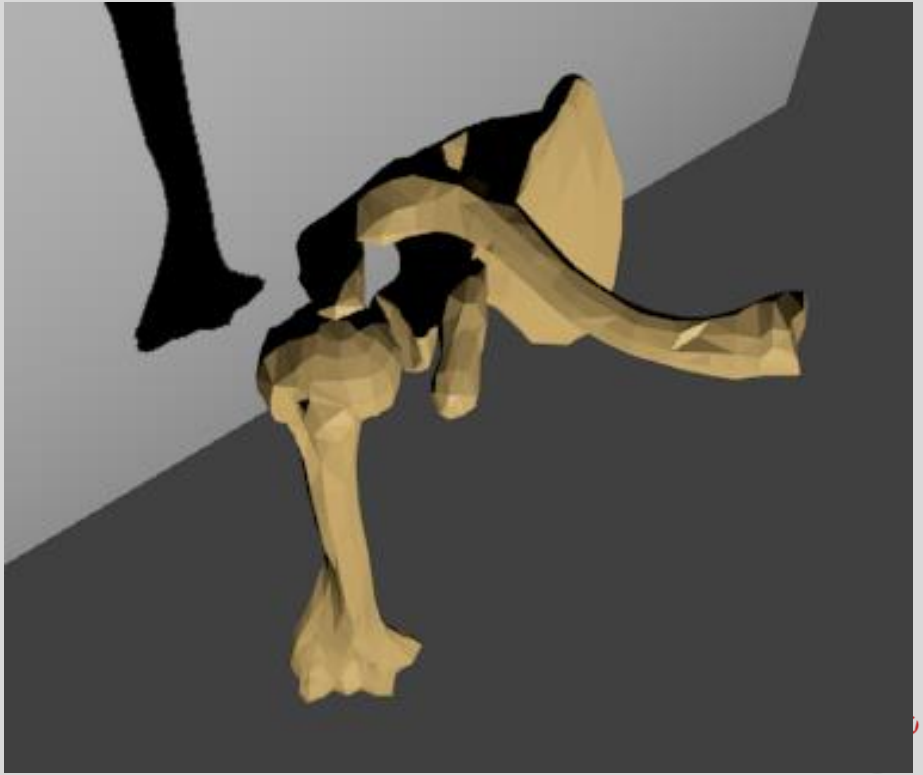




AGAIN HERE: CC DISTANCE WAS NOT USEFUL

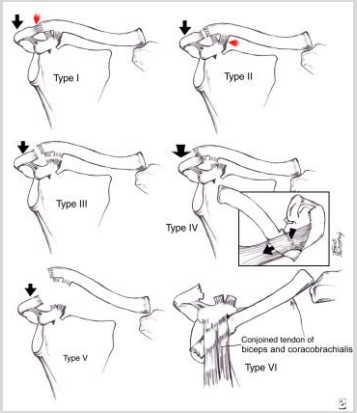
ORTHOPÄDIE SONNENHOF
ortho ▪ spine ▪ sport



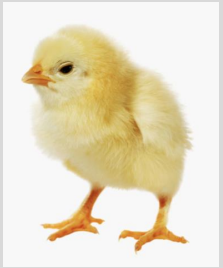


AGAIN HERE: CC DISTANCE WAS NOT USEFUL

- Don‘t look at the CC distance...
  - ...to assess the displacement
  - ...to classify



- Look at the real 3 dimensional displacement of the clavicle and the acromion directly



Karargyris O, Murphy RW, Zumstein MA, JSES: 2020

BUT BOTH AC/DC AND GC/PC....

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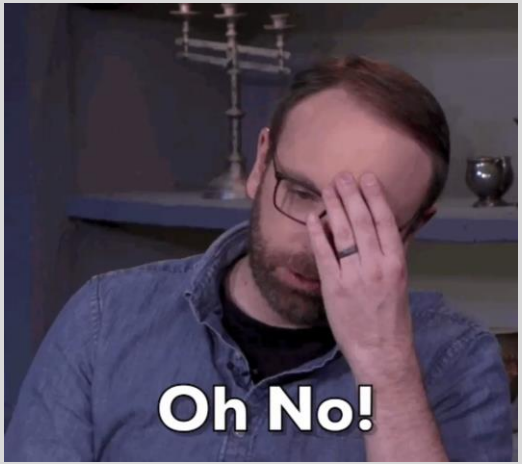
… was still too complicated to quantitatively assess…



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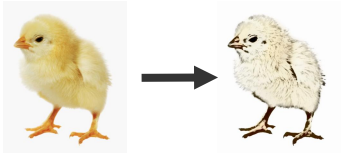
… BOTH, THE HORIZONTAL AND VERTICAL DISPLACEMENT



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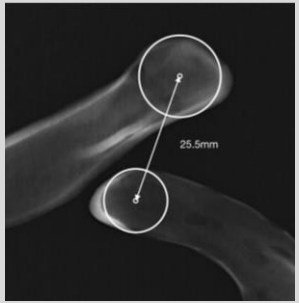
- At least 100% dislocation
- Classification
- Impact on “Clinical Decision Making”



Evaluation of the Circles Measurement and the ABC Classification of Acromioclavicular Joint Injuries

Richard J. Murphy,*†‡§ MBChB, MA, DPhil, Beat K. Moor,‖ MD, Piotr J. Lesniewski,†‡ MD, Annabel Hayoz,†¶ MSc, Wolfan Alcantara,† MD, and Matthias A. Zumstein,*†‡¶ MD
Investigation performed at Inselspital, Bern, Switzerland, and Sonnenhof Orthopaedics, Bern, Switzerland

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Murphy RJ, Zumstein MA, AJSM: 2021

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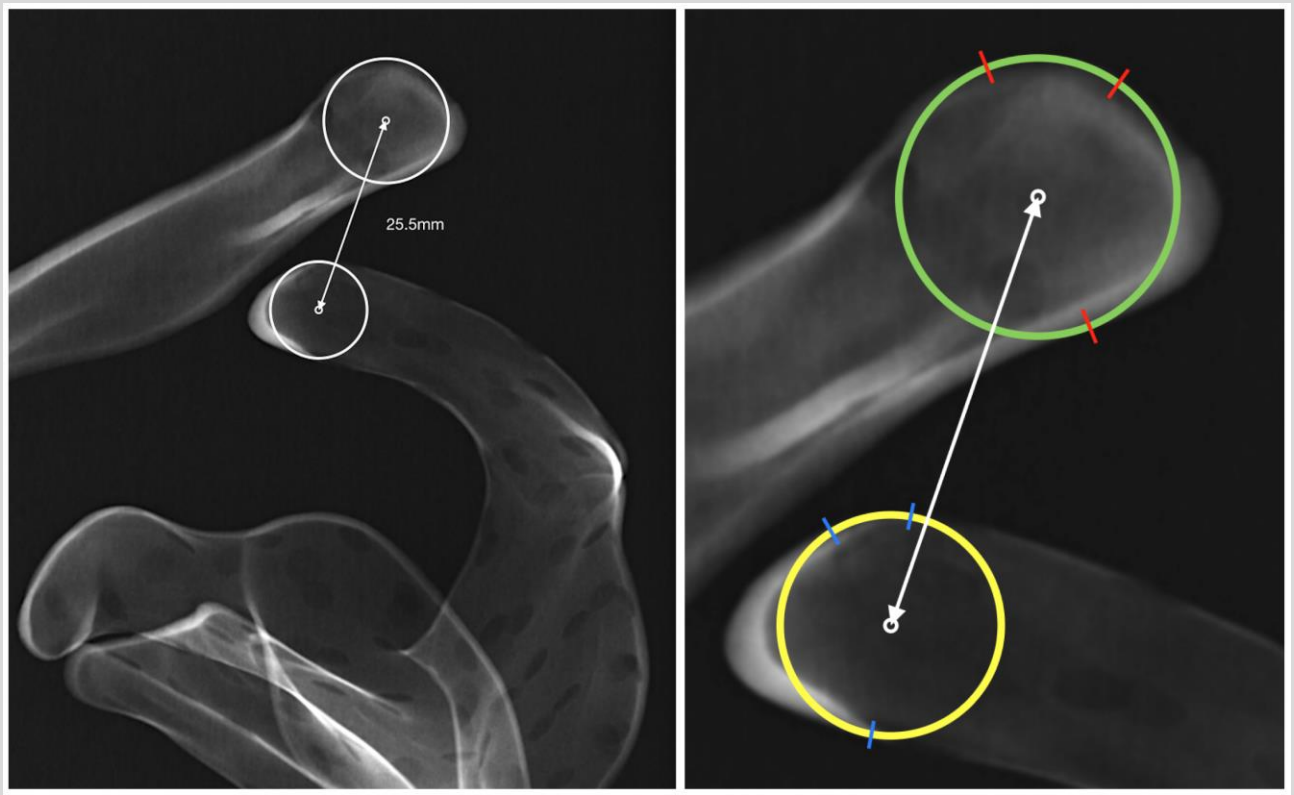
1. CIRCLES MEASUREMENT



2. VALIDATION

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- **Six Injury Groups**
  Control, RW II, RW IIIA, RW IIIB, RW IV, RW V

- **13 radiographs for each group (78 total) (+ 3D-CT)**
  Neutral image (perfect) and +/-20° malrotation
  in each of the 3 anatomical planes (12 rotated images)

- **4 observers, blinded reviewing all images, 1 observer twice**

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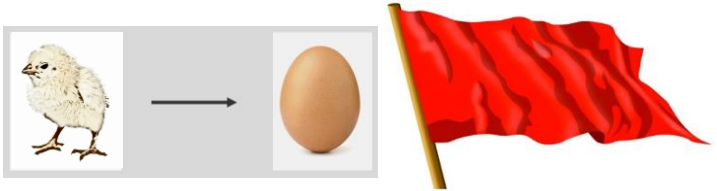
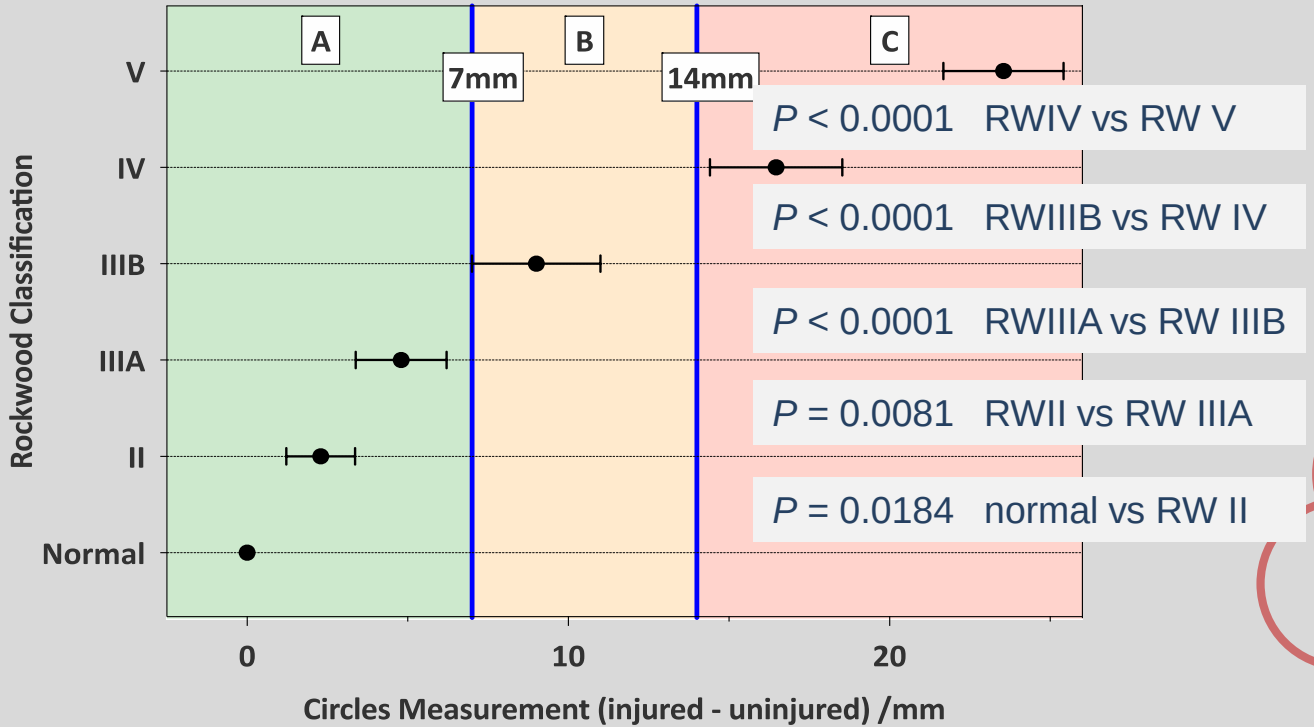
3. RESULTS: DISCRIMINATION



Circles Measurement by Rockwood Classification in Sawbone Inury Simulations



$P < 0.0001$ RWIV vs RW V

$P < 0.0001$ RWIIIB vs RW IV

$P < 0.0001$ RWIIIA vs RW IIIB

$P = 0.0081$ RWII vs RW IIIA

$P = 0.0184$ normal vs RW II

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4. BERNESE ABC CLASSIFICATION

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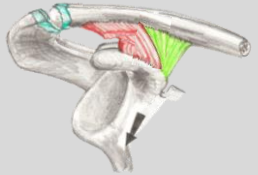
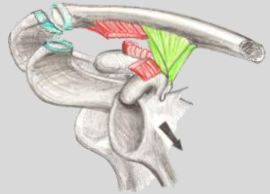
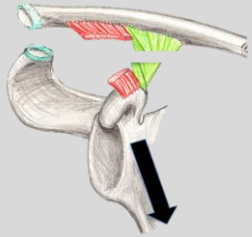
A minimally displaced, **< 7mm** (Rockwood IIIA or less)
CAP



B moderally displaced, **8 to 14mm** (Rockwood IIIB)
CAP-TRAP-(PLUS)



C significantly displaced, **> 14mm** (Rockwood IV or more)
CAP-TRAP-CON



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ALGORHYTHM

ACJ Injury

ORTHOPÄDIE SONNENHOF
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CC Diff > 11±2mm
Panorama Zanca views

yes

no

Circles measurement on bilateral
Alexander views

Difference between injured and uninjured sides

A
minimally displaced **< 7mm**

Non-operative management

B
mod. Displaced **8 - 14mm**

Initial non-operative management and reassess clinically in 10-14 days

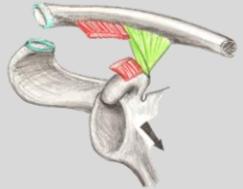
C
sig. displaced **> 14mm**

Consider surgical management

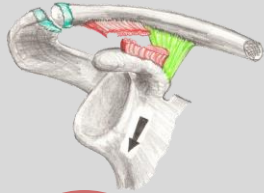
Not Improving clinically at 10-14 days
Consider surgical management

Improving clinically at 10-14 days
Non-operative management

CAP-TRAP (PLUS)



CAP-TRAP



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SCHEDULE

- Pathoanatomy
- Indication
- **Techniques**

SURGICAL TREATMENT OPTIONS SITUATIONS

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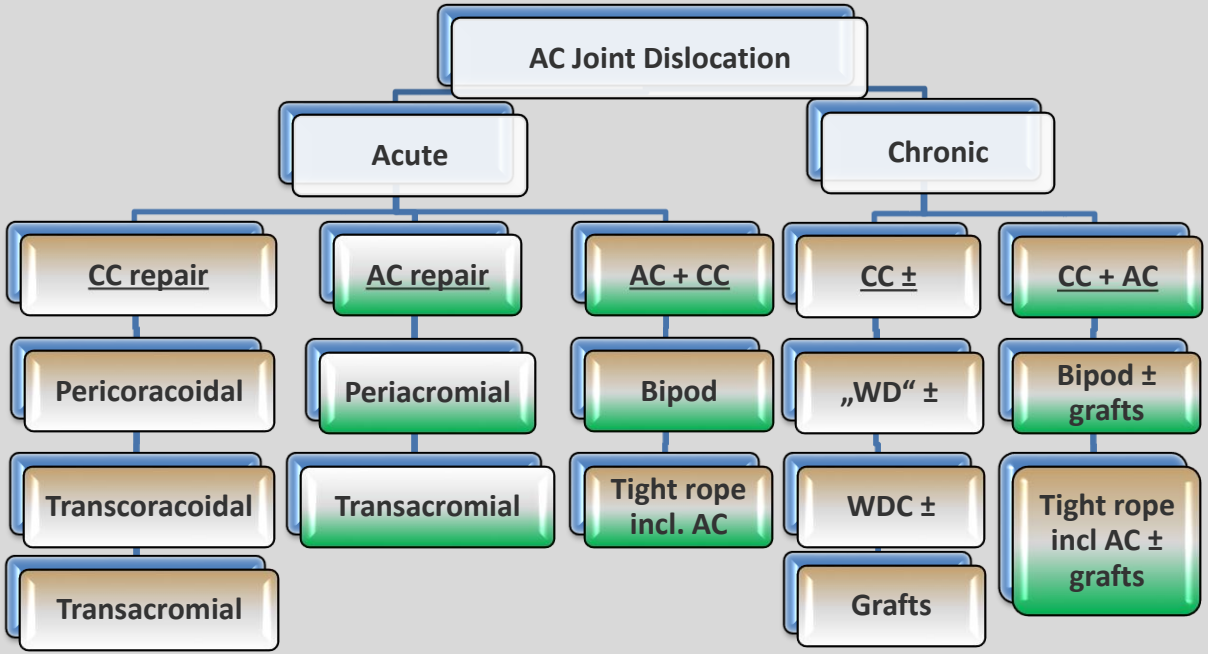
ortho ▪ spine ▪ sport



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BIPLANAR > SINGLE PLANAR RECONSTRUCTIONS BIOMECHANICAL TESTING

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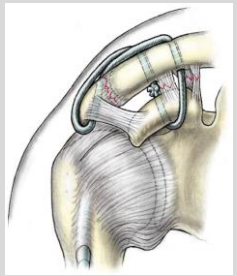
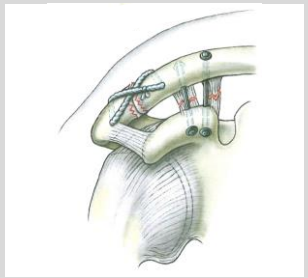
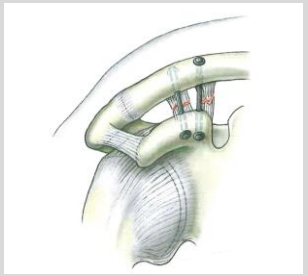
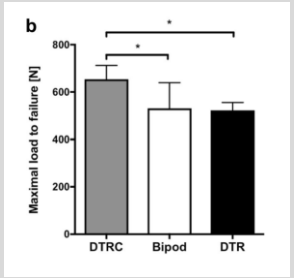
ortho ▪ spine ▪ sport

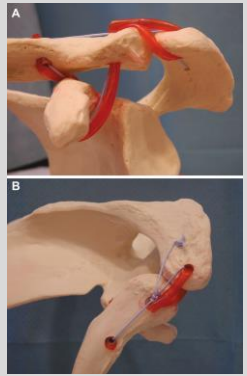
Bipod DTRC DTR











>

Schär MO, Scheibel M; Zumstein MA, Arch Orthop Trauma Surg: 2019

Saier T, KSSTA: 2015

Barth J, Gastaud O: OTSR, 2015

Dyrna F, AJSM: 2018

Tauber M, AJSM: 2016

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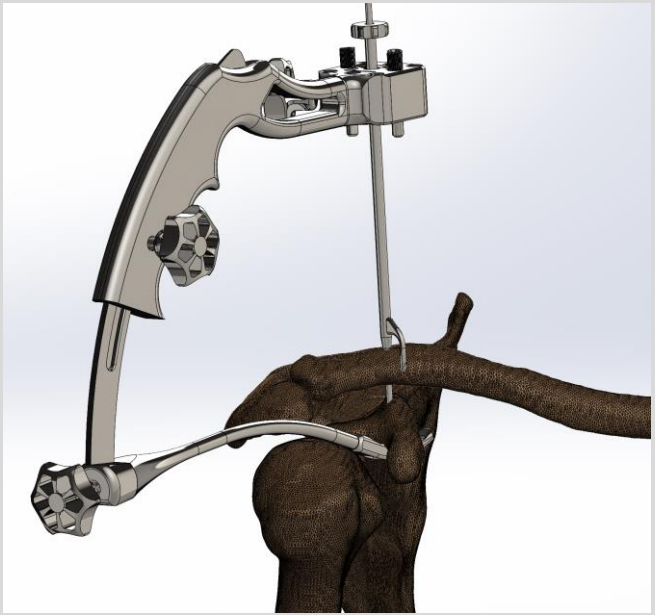
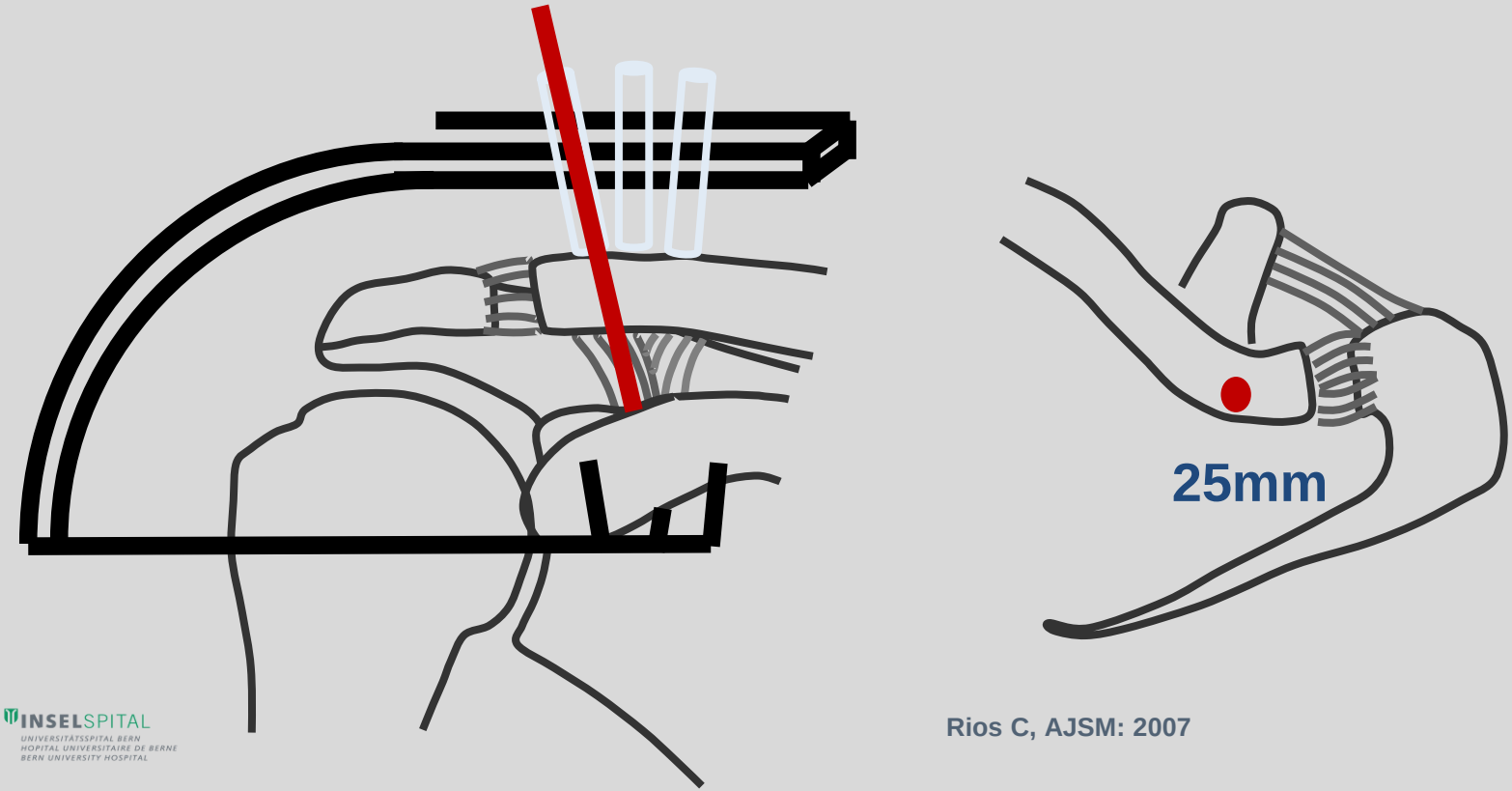
ALL OPTIONS ARE POSSIBLE WITH ONE GUIDE

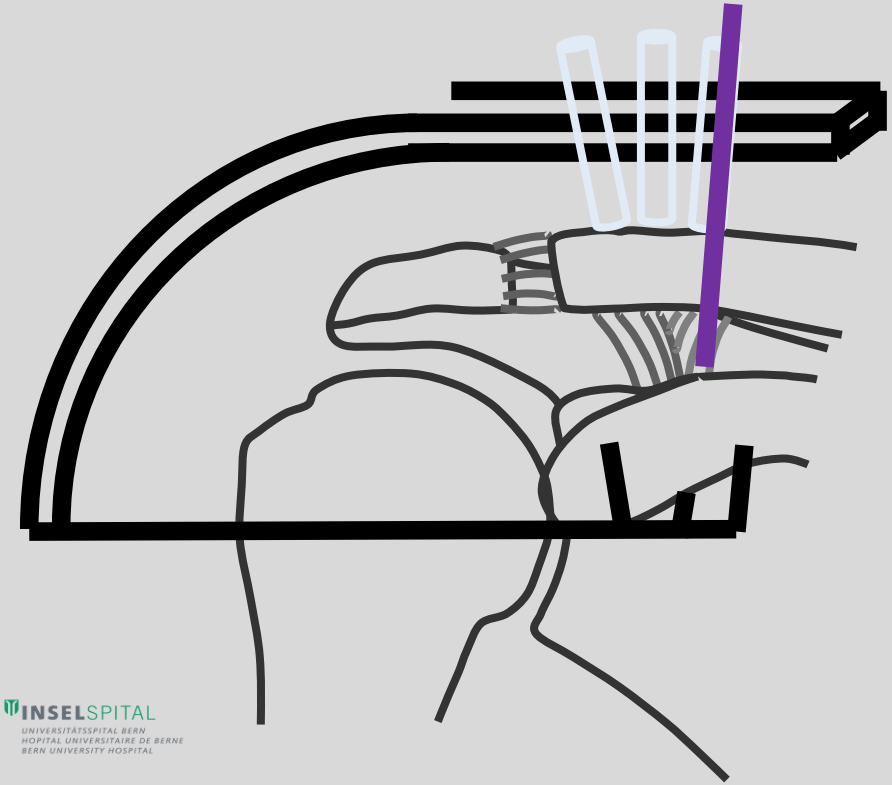


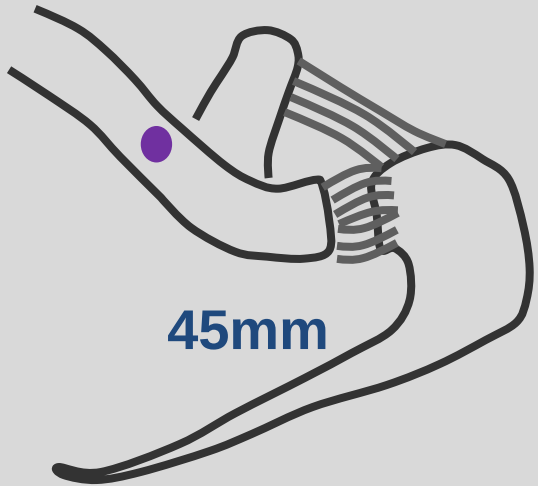
ARTHROSCOPICALLY ASSISTED AND GUIDED LATERAL



Rios C, AJSM: 2007

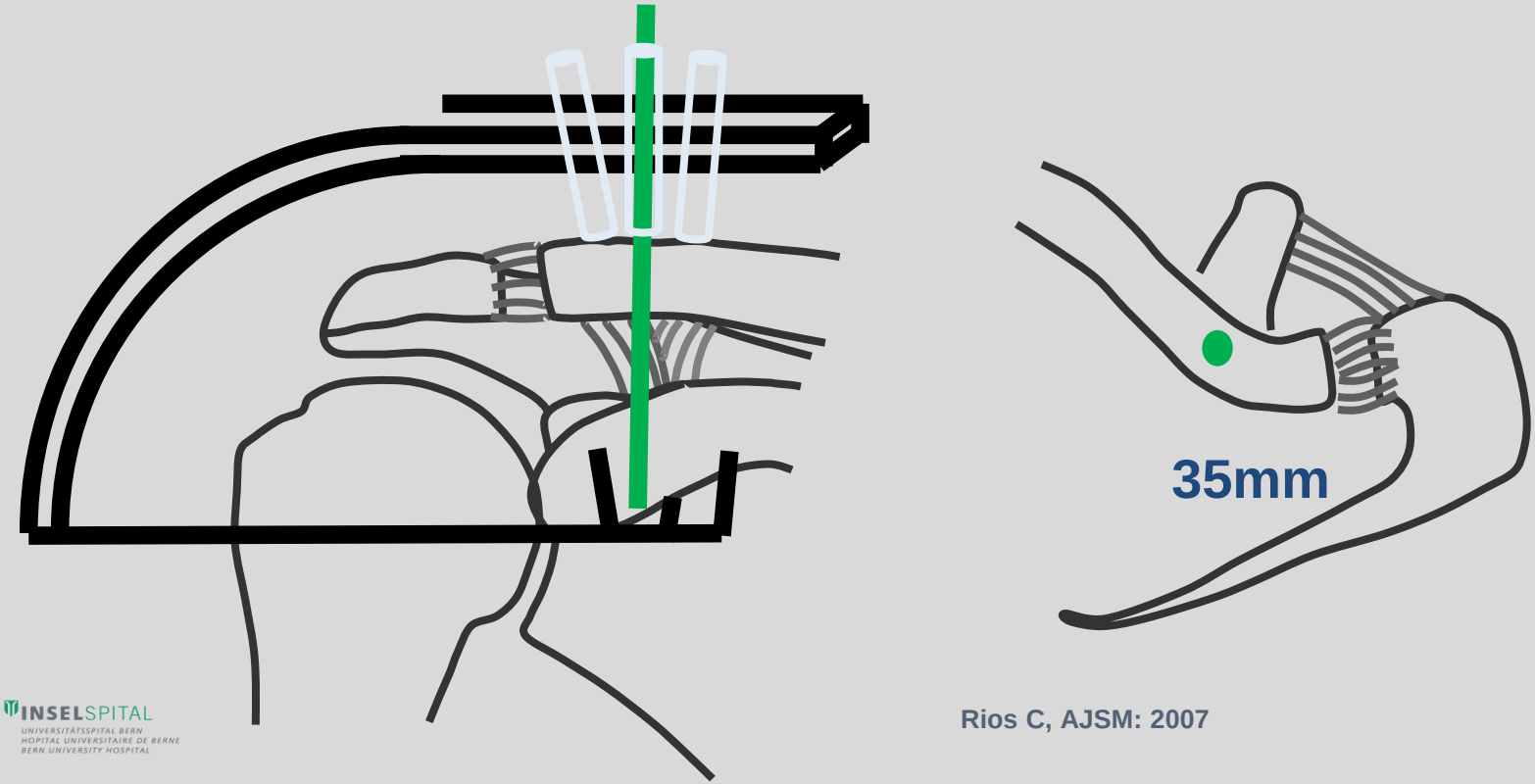
ARTHROSCOPICALLY ASSISTED AND GUIDED MEDIAL





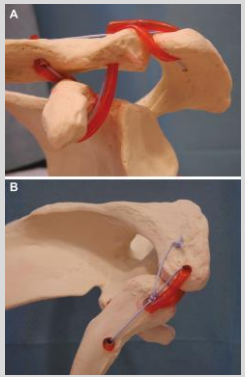
Rios C, AJSM: 2007

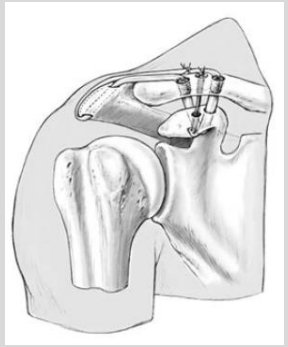
ARTHROSCOPICALLY ASSISTED AND GUIDED TRANSACROMIAL

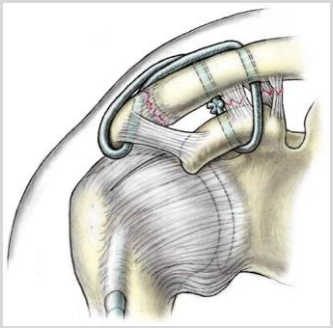


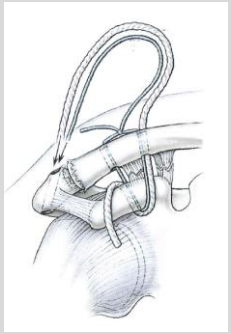
Rios C, AJSM: 2007

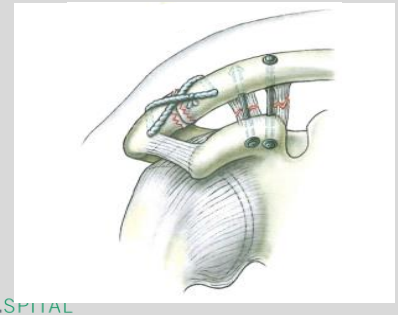
AC REPAIR AND RECONSTRUCTION

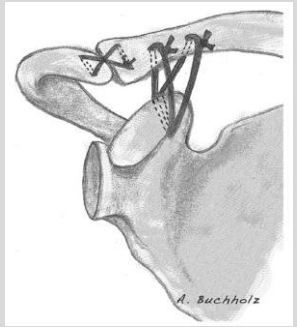












Gerhardt C, Scheibel M, Orthopaede: 2011

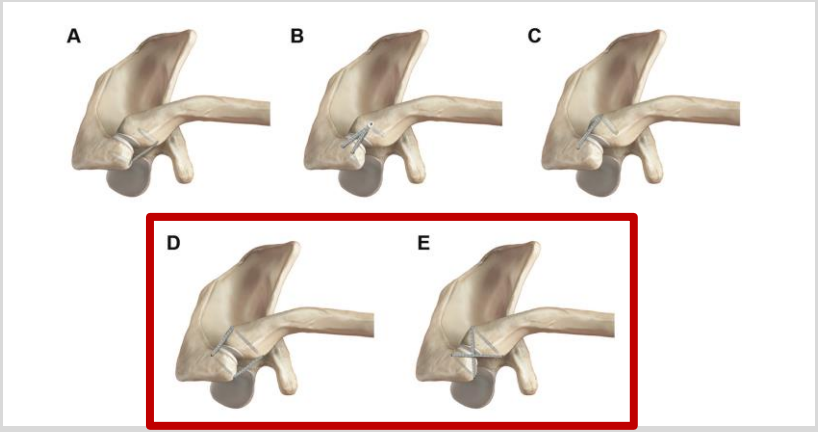
Sandmann GH, Pat Safety Surg: 2013

Kraus N, Scheibel M, Arthroskopie: 2010

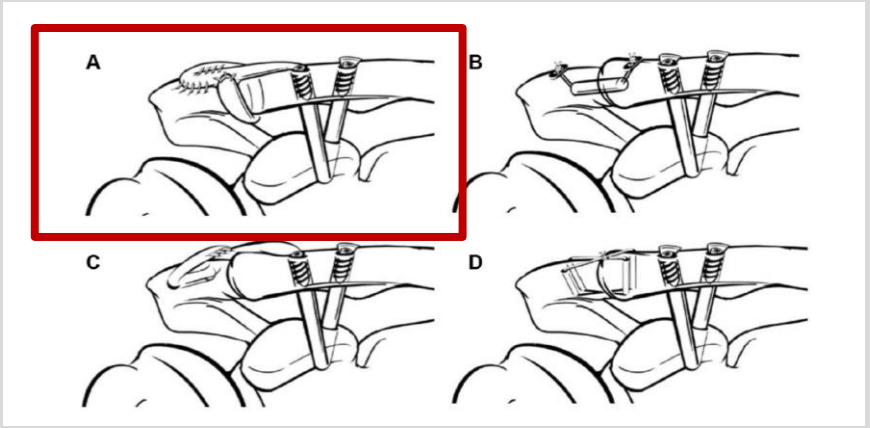
Tauber M, AJSM: 2016

De Beer J, Zumstein MA, Orthop: 2016

AC REPAIR AND RECONSTRUCTION



Dyrna F, AJSM: 2018



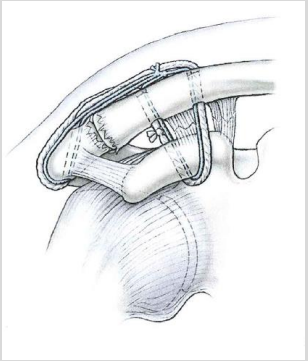
Beizel K, AJSM: 2014

BIDIRECTIONAL „BIPOD“ STABILIZATION IN ACUTE AND CHRONIC

ORTHOPÄDIE SONNENHOF
ortho ▪ spine ▪ sport

BiPOD Arthroscopic Acromioclavicular Repair Restores Bidirectional Stability

JOE DE BEER, MD; MICHAEL SCHAER, MD; KIM LATENDRESSE, MD, FRCSC, FRACS; SUMIT RANIGA, MBCHB, FRACS; BEAT K. MOOR, MD; MATTHIAS A. ZUMSTEIN, MD



- **The arthroscopically assisted Bipod-Stabilisation technique addresses both the vertical and horizontal instability**

De Beer J, Zumstein MA, Orthopaedics: 2016

Murphy RJ, Zumstein MA, AOTS: 2021

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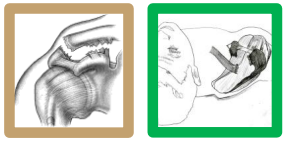
TISSUE ONGROWTH AND INGROWTH
-> POTENTIAL TO HEAL



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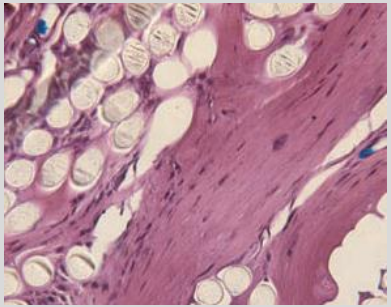
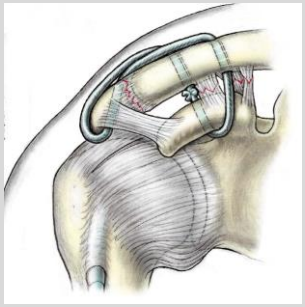
„Bipod“ technique **Arthro./Open:**

Augmentation with a polyesther tape as a synthetical scaffold





J. de Beer, Warwick Shoulder Meeting: 2007

A. Amis, JBJS Br. 1992

De Beer J, Zumstein MA, Orthop: 2016

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SPORTSCLINIC

OVERALL SERIES: TYPE B + C PATIENTS

- Prospective consecutive
- High grade AC-joint instability

• total (n)	= 41
• f / m	= 5 / 36
• mean age (yrs)	= 38 (21 - 61)
• mean f-up (mts)	= 26 (12 - 33)

RESULTS COMPLICATIONS
(n = 41, f-up 26 mts)

B C

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- Superficial infection = 1
- Low grade Infection = 1
- Knot removal = 2

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RESULTS CLINICAL
(f-up 26 mts)

B C

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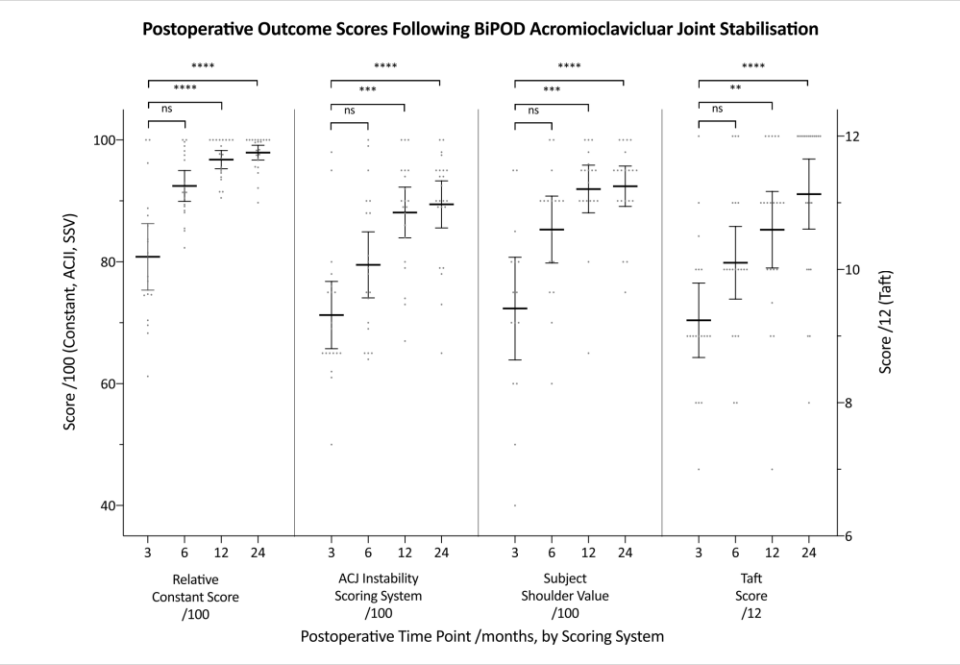
ortho ▪ spine ▪ sport



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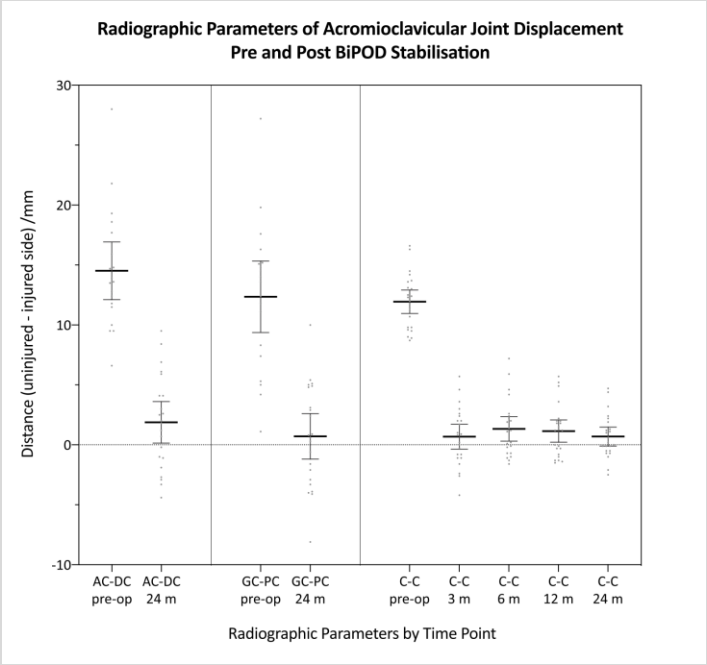
RESULTS RADIOGRAPHICAL
(f-up 26 mts)

B C



RESULTS RADIOGRAPHIC VERTICAL
(f-up 26 mts)

B C

ORTHOPÄDIE SONNENHOF
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- 19 % of all patients had a minimal loss of vertical reduction and showed no inferior clinical results
- In literature: 34 % of patients with x-ray loss of reduction in CC reconstructions

RESULTS RADIOGRAPHIC HORIZONTAL
(f-up 26 mts)

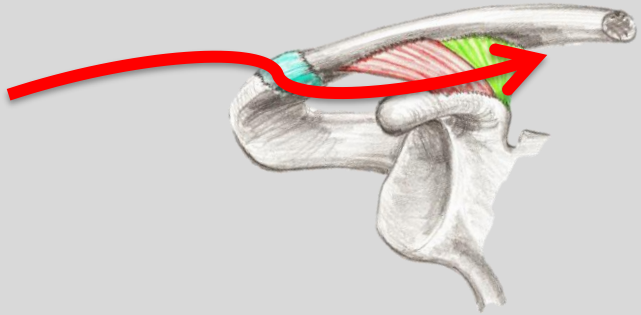
ORTHOPÄDIE SONNENHOF
ortho ▪ spine ▪ sport

- Radiological signs of horizontal instability were observed in 11 % of all cases

- ... if reported in literature: 43 % remaining horizontal instability in CC reconstructions

TAKE HOME MESSAGES

- **AC instability starts HORIZONTAL then becomes VERTICAL**



1 x HORIZONTAL

1 x VERTICAL

EXPERIMENTALY AND CLINICALLY RELIABLE MEASUREMENTS

- **Best radiographic assessment for horizontal and vertical displacement in AC dislocations are**
- **CC not helpful until Bern C/RW V with CC diff of > 11±2 mm**

  Zumstein MA, KSSTA: 2016

  Karargyris O, Murphy RW, Zumstein MA, JSES: 2020

- **Below 11±2 mm ONLY bilateral Alexander views**

CIRCLE MEASUREMENT IS...

- new,
- validated,
- realible,
- high ability to discriminate between key injury groups

<u>-> ABC classification</u> and algorithm

Murphy RJ, Zumstein MA, AJSM: 2021

ALGORHYTHM

ACJ Injury

ORTHOPÄDIE SONNENHOF
ortho · spine · sport

CC Diff > 11±2mm
Panorama Zanca views

yes

no

Circles measurement on bilateral
Alexander views

Difference between injured and uninjured sides

A
minimally displaced **< 7mm**

Non-operative management

B
mod. Displaced **8 - 14mm**

Initial non-operative management and reassess clinically in 10-14 days

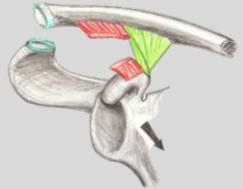
C
sig. displaced **> 14mm**

Consider surgical management

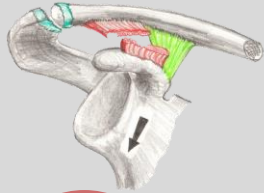
Not Improving clinically at 10-14 days
Consider surgical management

Improving clinically at 10-14 days
Non-operative management

CAP-TRAP (PLUS)



CAP-TRAP



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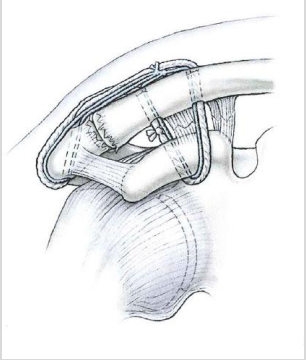
SPORTSCLINIC

SURGICAL INDICATION: BIDIRECTIONAL „BIPOD“ STABILIZATION IN ACUTE AND CHRONIC

BiPOD Arthroscopic Acromioclavicular Repair Restores Bidirectional Stability

JOE DE BEER, MD; MICHAEL SCHAER, MD; KIM LATENDRESSE, MD, FRCSC, FRACS; SUMIT RANIGA, MBCHB, FRACS; BEAT K. MOOR, MD; MATTHIAS A. ZUMSTEIN, MD



- The arthroscopically assisted Bipod-Stabilisation technique addresses both the vertical and horizontal instability...
- ... and yields clinically and radiographically good to excellent results

De Beer J, Zumstein MA, Orthopaedics: 2016

Murphy RJ, Zumstein MA, AOTS: 2021

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Thank you for your attention

MA Zumstein, MD

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University of Bern, Switzerland

www.shoulderteam.ch