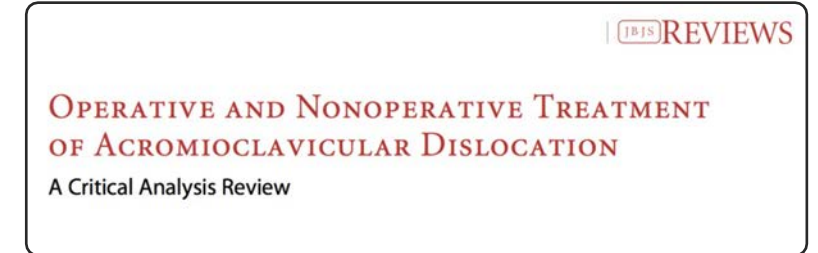


# Considerations for a successful treatment of AC Joint injuries

Prof. Dr. med. Knut Beitzel, M.A.

Schulterinstitut, ATOS Orthoparc Klinik, Köln

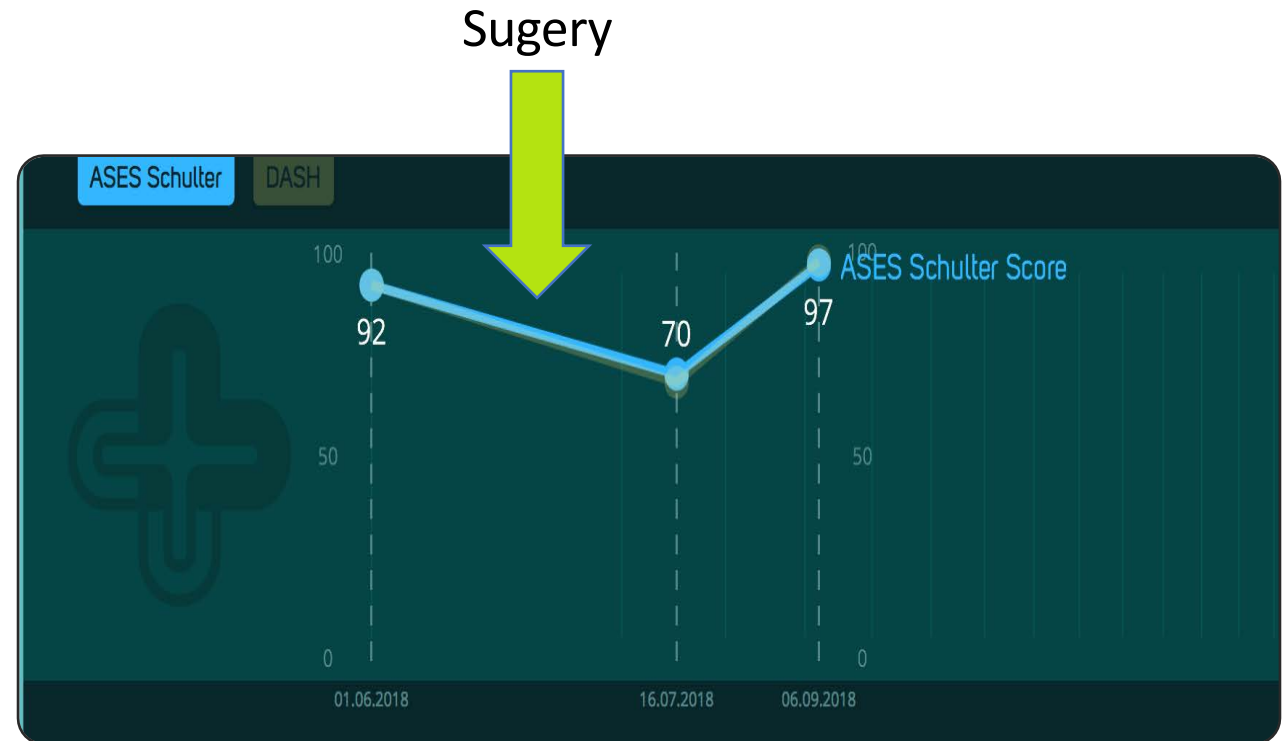
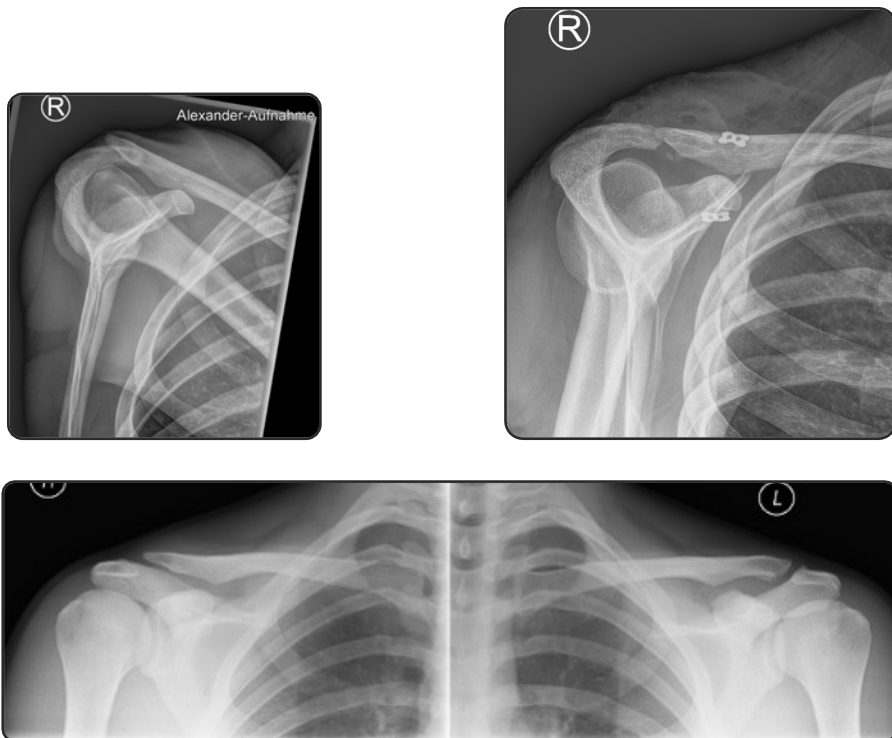
## *Should we operate on ACJ-Instability at all ?*



- Conservative and surgical management showed **similar clinical outcomes**
- **Persistence of pain** was less common with surgery
- **Complications** were more evident with surgery
- **Rate of recurrence in the surgical group** approx. 14%.

Beitzel, Mazzocca et al., Arthroscopy, 2013  
Virk, Beitzel, Mazzocca et al., JBJS Reviews 2015  
Longo et al., BMB, 2017

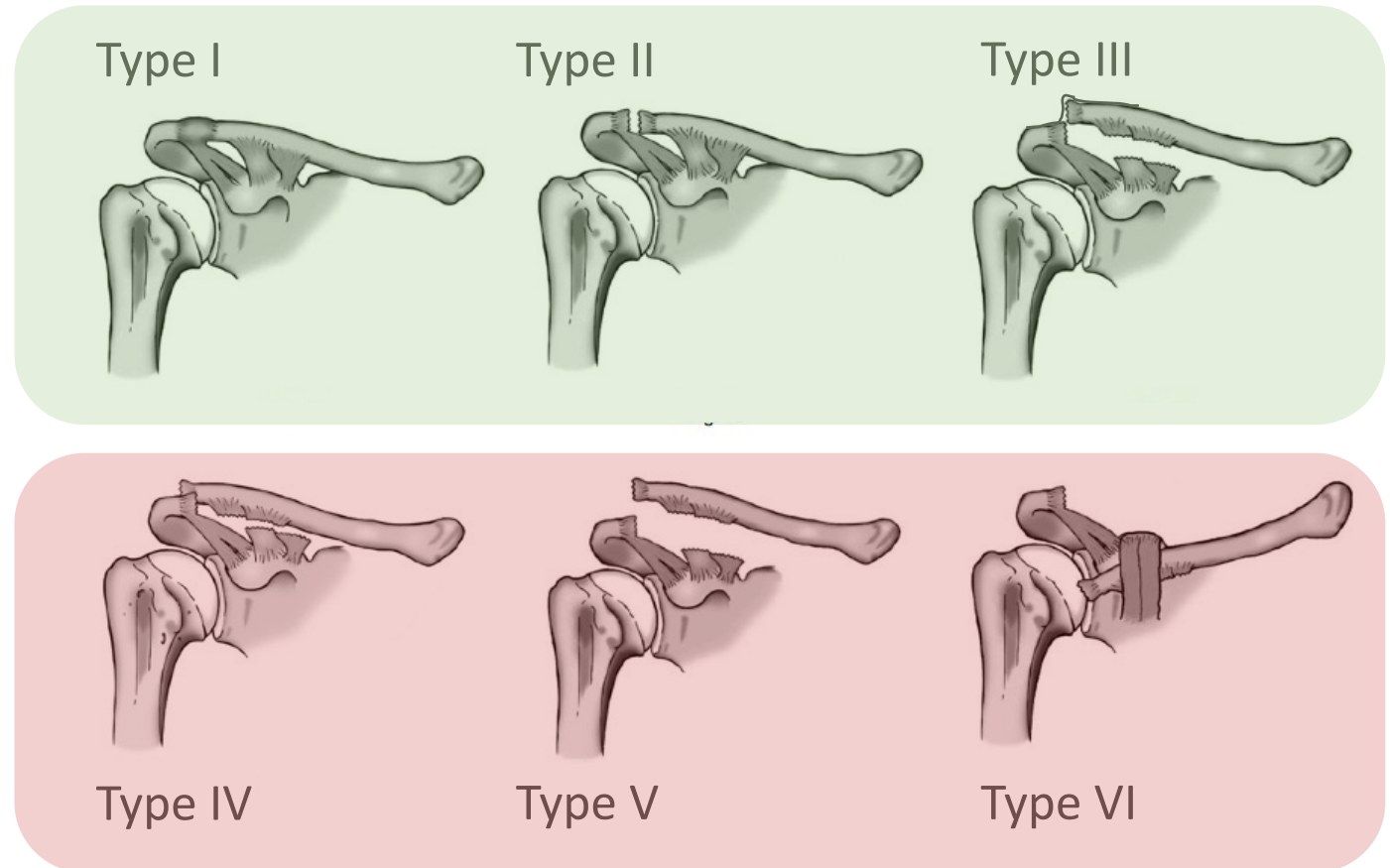
*Well – I do see patients with symptomatic chronic instabilities..*



Case: Failed conservative Treatment Type IIIb (Type IV)

## Factors for a successful surgery

- Diagnostic accuracy
- Biomechanical Understanding
- Correct Indication
- Avoiding Complications



Rockwood's Classification

Frazer-Moodie et al, JBJSbr, 2008

Beitzel et al., Arthroscopy, 2013

# 1. Evolution: Diagnostic Accuracy

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Where's the greater instability ?



w., 21y  
Rockwood V (chronisch)



# Advantage of bilateral imaging



m., 53y  
Rockwood IV (chronisch)





Pogorzelski et al. *BMC Musculoskeletal Disorders* (2017) 18:515  
DOI 10.1186/s12891-017-1864-y

BMC Musculoskeletal  
Disorders

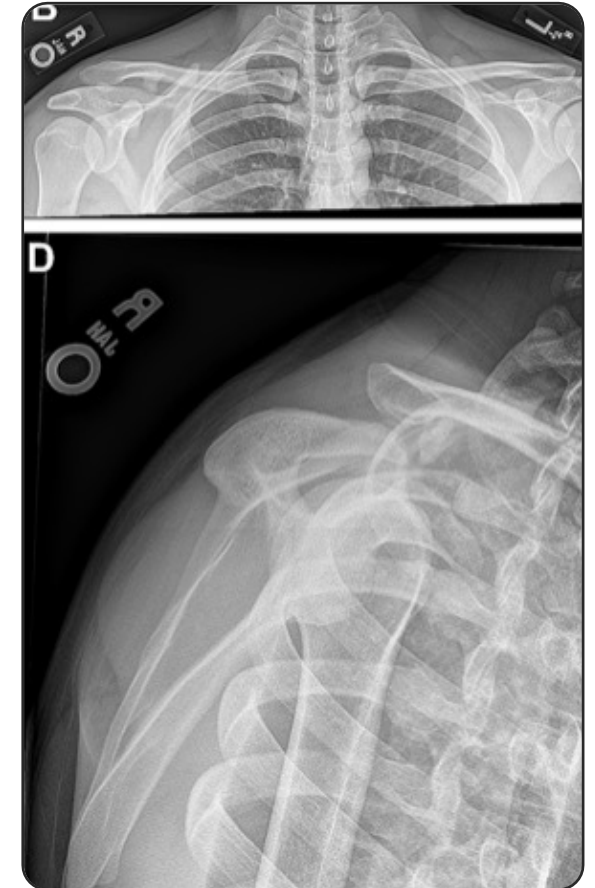
RESEARCH ARTICLE

Open Access

## The acutely injured acromioclavicular joint – which imaging modalities should be used for accurate diagnosis? A systematic review

Jonas Pogorzelski<sup>1</sup>, Knut Beitzel<sup>1</sup>, Francesco Ranuccio<sup>1</sup>, Klaus Wörtler<sup>2</sup>, Andreas B. Imhoff<sup>1\*</sup>, Peter J. Millett<sup>2</sup>  
and Sepp Braun<sup>1</sup>

- There is **no consensus** on a gold standard for diagnostic measures
- Reliability for diagnosing vertical instabilities of the clavicle using **bilateral projections** show a high level of reproducibility
- 
- For **horizontal instabilities** the results are much more inconsistent.



Pogorzelski, Beitzel, Wörtler, Imhoff, Braun et al., BMC, 2018

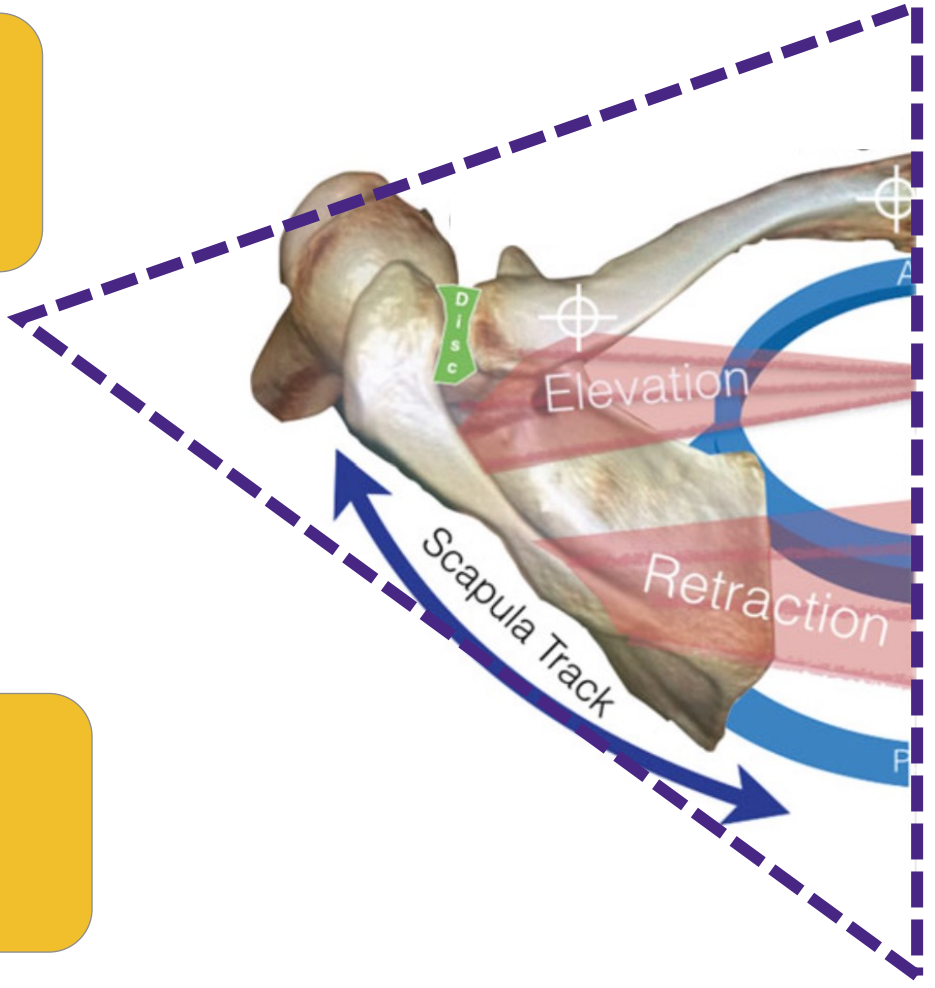
## 2. Evolution: Biomechanical Understanding

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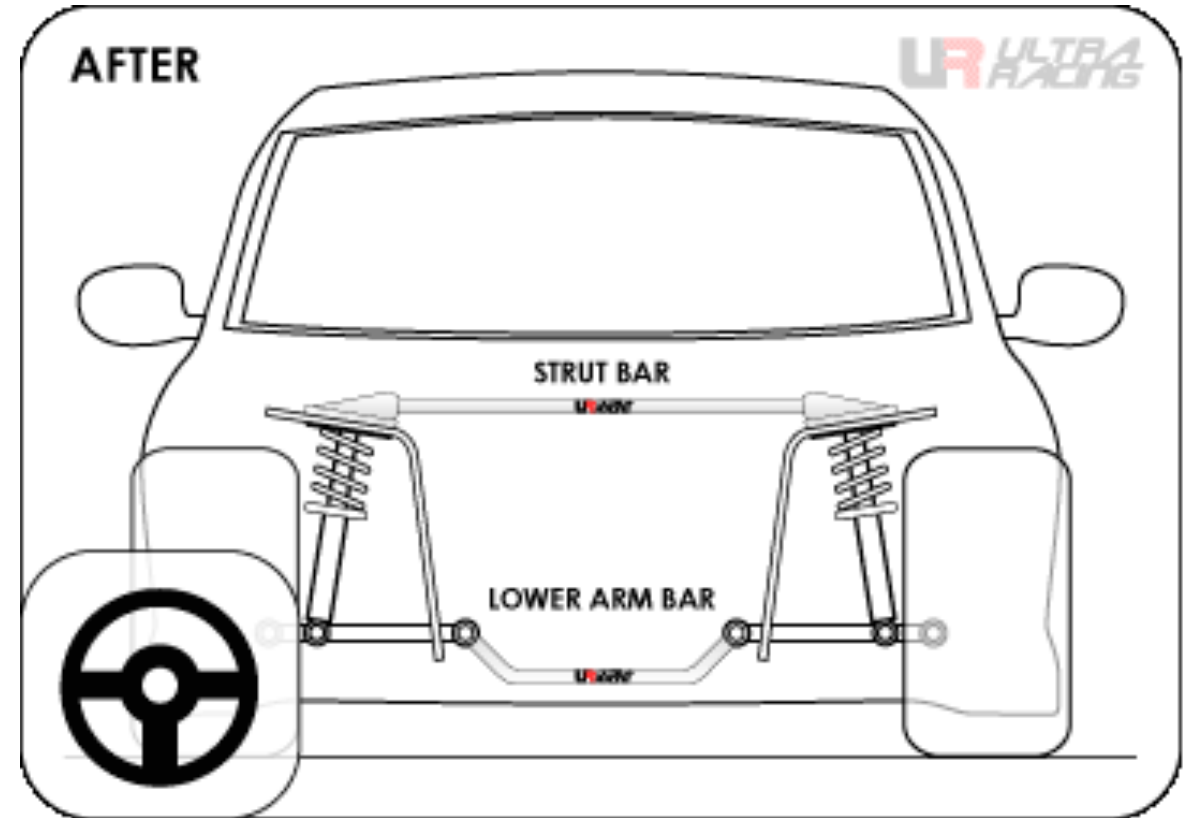
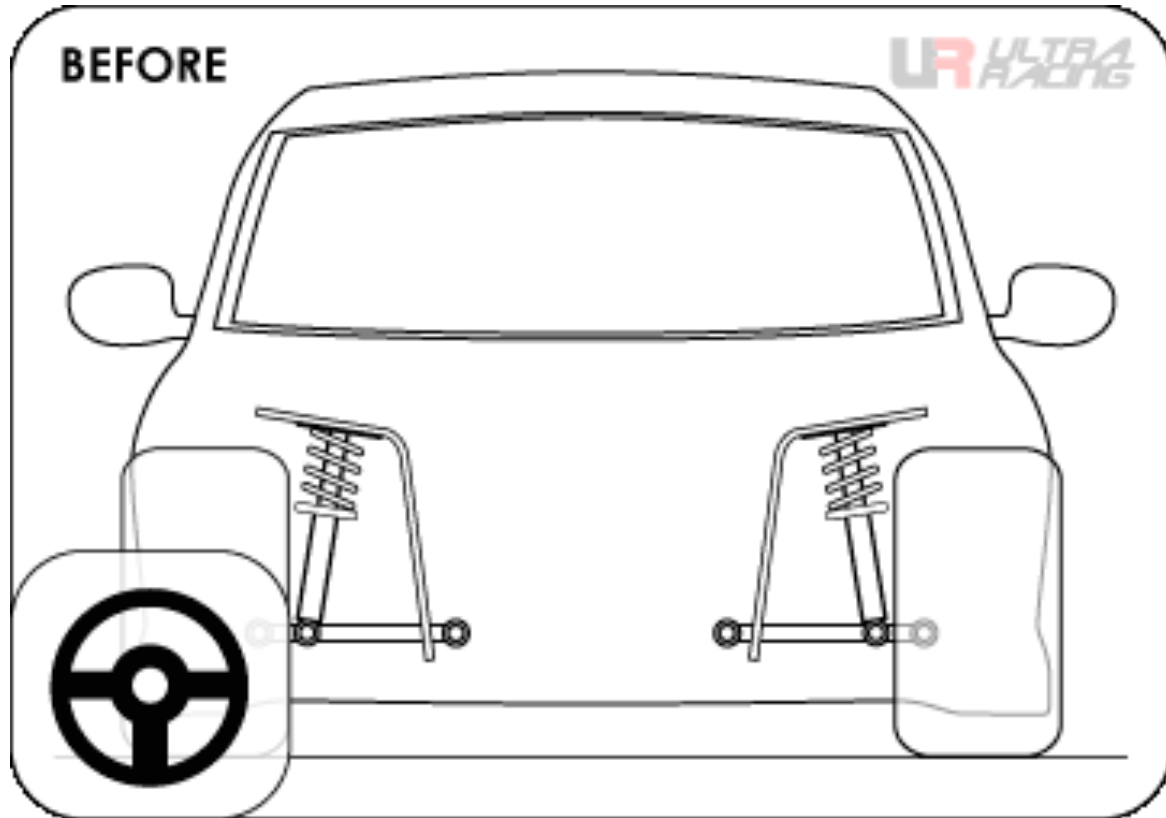
*Important for the physiologic motion of the scapula !*

Clavicular Arch  
(anterior)

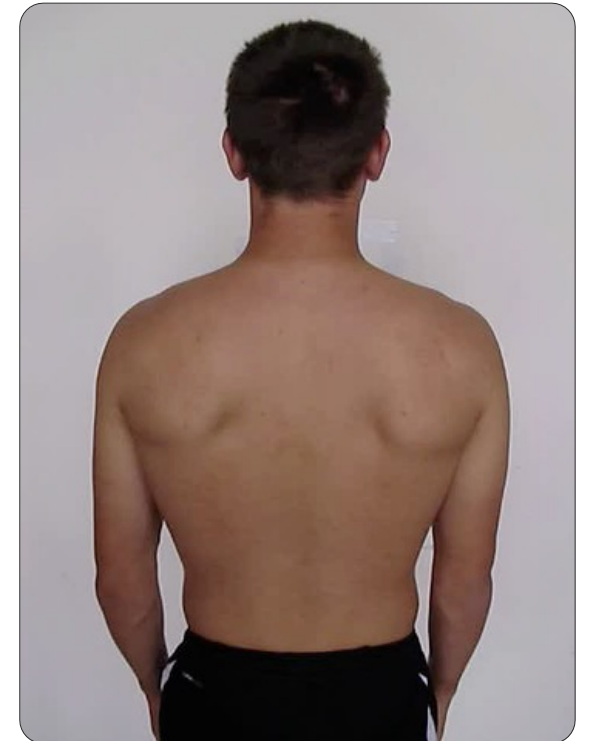
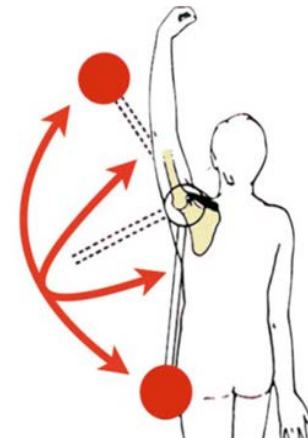
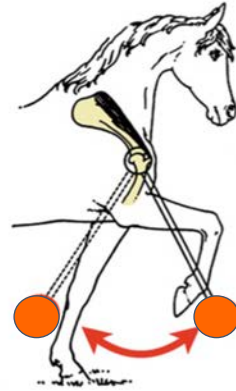
Scapulothoracic  
(posterior)

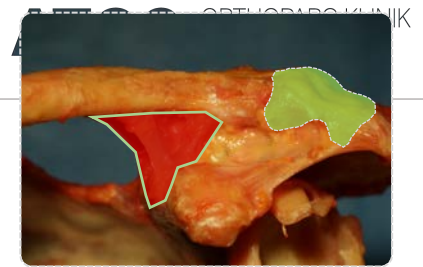






## „Strud“ Function of Clavicle





## Horizontal & Rotational Stability

- CC ligaments mainly vertical stability
- AC ligaments mainly horizontal stability



Vertical



Translation



Rotation

Fukuda K, et al, J Bone Joint Surg Am 1986.; Klimkiewicz JJ, et al, J Shoulder Elb Surg. 1999  
Debski et al, JBJS, 2001; Inman et al., J Bone Joint Surg, 1944; Oki et al., JSES, 2013

## *Integrity of AC capsule provides rotational and translational stability*

### **The Integrity of the Acromioclavicular Capsule Ensures Physiological Centering of the Acromioclavicular Joint Under Rotational Loading**

Felix G.E. Dyrna,<sup>1</sup> MD, Florian B. Imhoff,<sup>1</sup> MD, Andreas Voss,<sup>1</sup> MD, Sepp Braun,<sup>1</sup> MD, Elifho Obopilwe,<sup>2</sup> MS, John M. Apostolakis,<sup>2</sup> MD, MPH, Daichi Morikawa,<sup>1</sup> MD, PhD, Brendan Comer,<sup>2</sup> BS, Andreas B. Imhoff,<sup>1</sup> MD, Augustus D. Mazzocca,<sup>2</sup> MD, MS, and Knut Beitzel,<sup>1</sup> MD, MA  
Investigation performed at the Department of Orthopaedic Surgery, University of Connecticut Health Center, Farmington, Connecticut, USA

- 30 shoulders
- Sequential cutting of AC-ligaments (not CC)
- Rotation & Translation-Testing
  - Resistance against motion

- Cutting the capsule reduced stability to < 25 % trans. & 10 % rotation
- Anterior segments provided the greatest stability
- Amplitude of the joint's motion significantly increased



Test for Translation



Test for Rotation



## 3. Evolution: Correct Indication

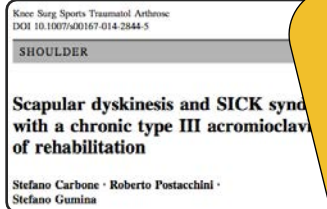
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Scapular Dyskinesis and SICK Scapula Syndrome in Patients  
With Chronic Type III Acromioclavicular Dislocation

Stefano Gumina, M.D., Ph.D., Stefano Carbone, M.D., and Franco Postacchini, M.D., Ph.D.

- Chronic type III AC dislocation causes **scapular dyskinesis in 70.6%**.
- The values for the **Constant score and SST were low**.

...if they do not respond to the programme within 6 weeks, it is reasonable to consider a surgical stabilization of the joint.

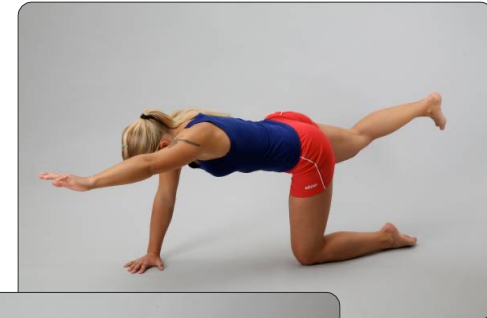
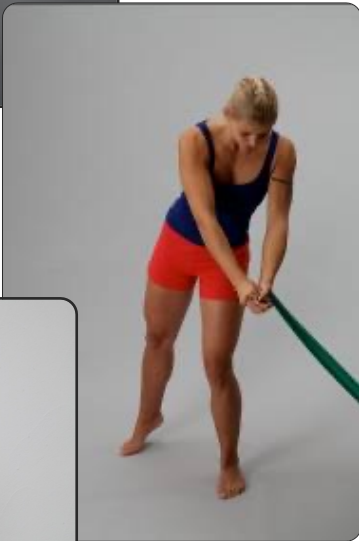
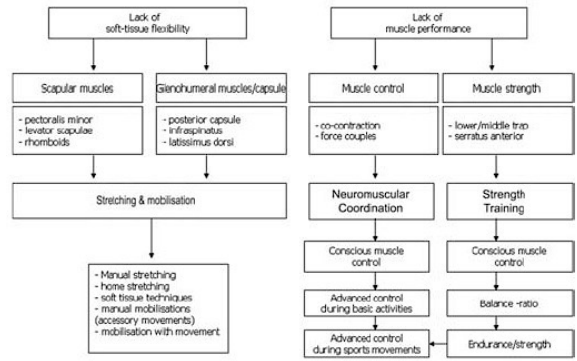


- Scapular dyskinesis and SICK syndrome secondary to chronic type III AC dislocation can be **successfully treated with the rehabilitation protocol**
- Patients that do not respond will not improve with extended rehabilitation time.

Gumina et al., Arthroscopy, 2009

Carbone et al., KSSTA, 2014

**Scapular Rehabilitation Algorithm**



Imhoff, Beitzel, Stamer et al., Springer 2015

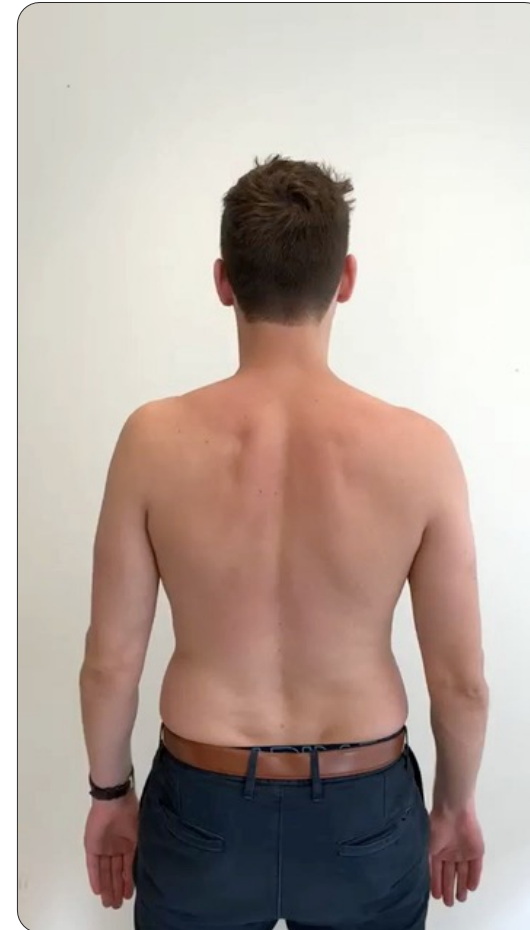
Ellenbecker & Cools, Br J Sports Med 2010

## *Conservative Treatment (focus on scapula-thoracic motion)*

Case:

Type IIIa – conservative Thx

FU 8 weeks



## *Do we miss something, if we start non-op?*

### Clinical Results After Conservative Management for Grade III Acromioclavicular Joint Injuries: Does Eventual Surgery Affect Overall Outcomes?

Maximilian Petri, M.D., Ryan J. Warth, M.D., Joshua A. Greenspoon, B.Sc., Marilee P. Horan, M.P.H., Rachel F. Abrams, M.D., Dirk Kokmeyer, P.T., S.C.S., C.O.M.T., and Peter J. Millett, M.D., M.Sc.

- **A trial of nonoperative treatment is warranted because successful outcomes** can be expected even in patients who eventually opt for surgery
- Patients who presented more than 30 days after their injury were less likely to complete non-operative treatment successfully.

Knee Surgery, Sports Traumatology, Arthroscopy  
<https://doi.org/10.1007/s00167-020-06159-2>

SHOULDER 

### Conversion to anatomic coracoclavicular ligament reconstruction (ACCR) shows similar clinical outcomes compared to successful non-operative treatment in chronic primary type III to V acromioclavicular joint injuries

Lukas N. Muench<sup>1,2</sup> · Daniel P. Berthold<sup>1,2</sup> · Colin Uyeki<sup>1</sup> · Cameron Kia<sup>1</sup> · Mark P. Cote<sup>1</sup> · Andreas B. Imhoff<sup>2</sup> · Knut Beitzel<sup>2,3</sup> · Katia Corona<sup>4</sup> · Augustus D. Mazzocca<sup>1</sup> · Simone Cerciello<sup>5,6</sup>

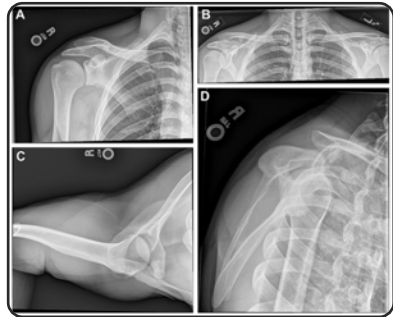
- At a minimum 5-year follow-up, patients with successful non-operative treatment for type III-V ACJ injuries achieved **similar clinical outcomes** compared to those who were converted to ACCR

Petri, Millett et al., Arthroscopy, 2016  
Münch, Beitzel, Imhoff et al. KSSTA, 2020,

**Scientific Committee Report**

**ISAKOS Upper Extremity Committee Consensus Statement on the Need for Diversification of the Rockwood Classification for Acromioclavicular Joint Injuries**

Knut Beitzel, M.A., M.D., Augustus D. Mazzocca, M.S., M.D., Klaus Bak, M.D., Eiji Itoi, M.D., Ph.D., William B. Kibler, M.D., Raffy Mirzayan, M.D., Andreas B. Imhoff, M.D., Emilio Calvo, M.D., Ph.D., Guillermo Arce, M.D., Kevin Shea, M.D., and the Upper Extremity Committee of ISAKOS



General Suggestion:

- Type I, II & III -> conservative
- Type IV, V -> surgically
- Watch out for Type III a/b

## Higher Risk

- Heavy manual workers
- Overhead Athletes
- Males
- Young and middle age



## Lower Risk

- Contact athletes (Ice Hockey)
- Not heavy workers
- Female
- Older age

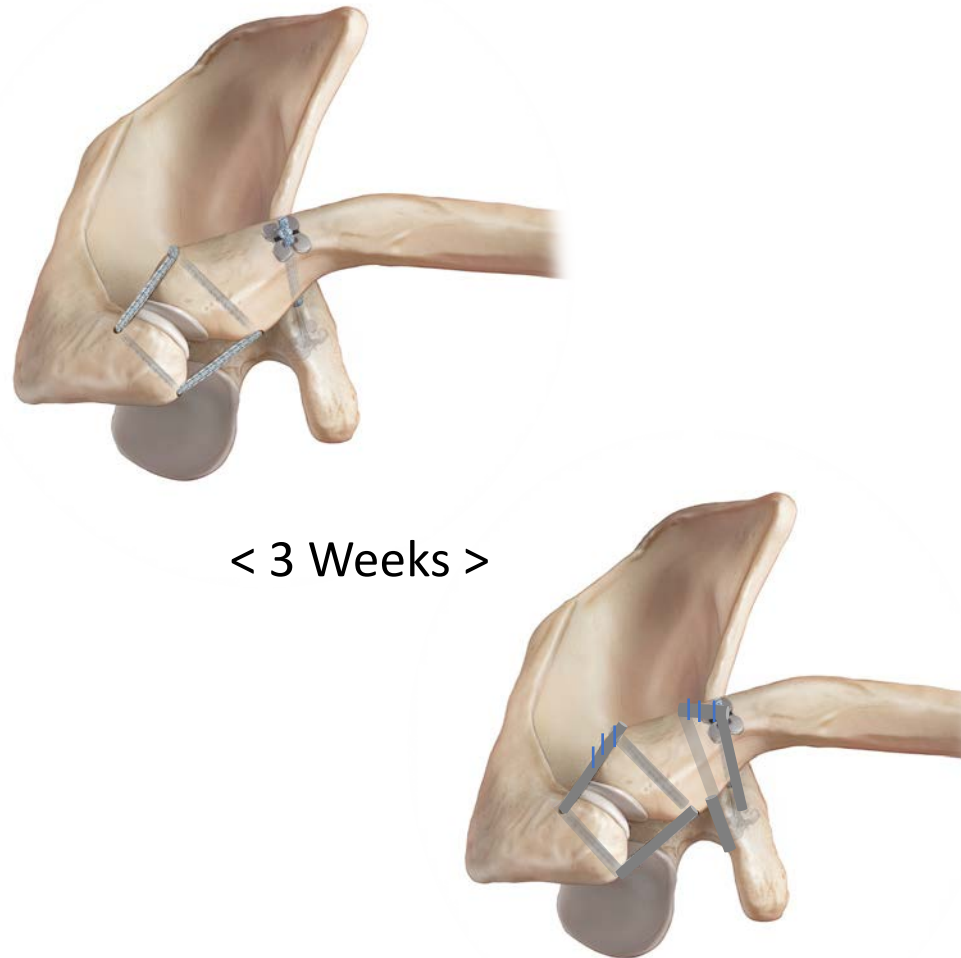
Murena et al., KSSTA, 2013  
Rosso, Beitzel, Milano, ESA Group et al., KSSTA, 2020  
Beitzel, Imhoff et al. ISAKOS Upper Extremity Committee et al., Arthroscopy, 2014

## 4. Evolution: Avoiding Complications

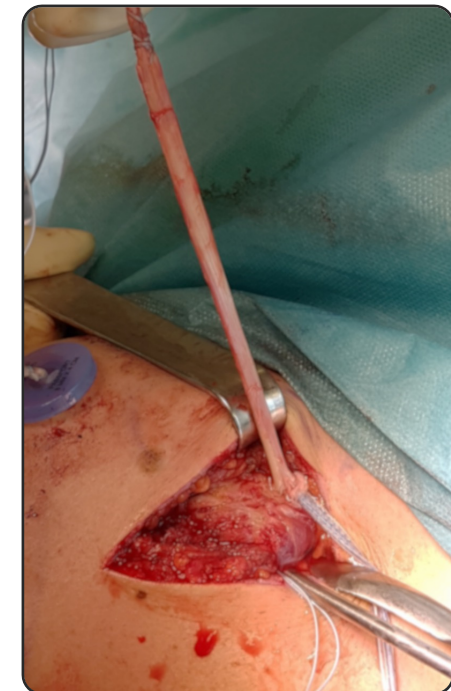
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„Stay Simple“ → one anatomic technique for acute and chronic

## Acute



## Chronic



Venjakob, Imhoff et al., AJSM 2013  
Braun, Imhoff et al., OOT 2014  
Salzmann, Imhoff et al., AJSM. 2010  
Mazzocca, Arciero et al., AJSM, 2007

Beitzel et al., Arthroscopy, 2013  
Edgar, Beitzel et al.; Curr. Orth. Pract.; 2011  
Scheibel et al., AOTS, 2006  
Walz, Imhoff et al, AJSM, 2008



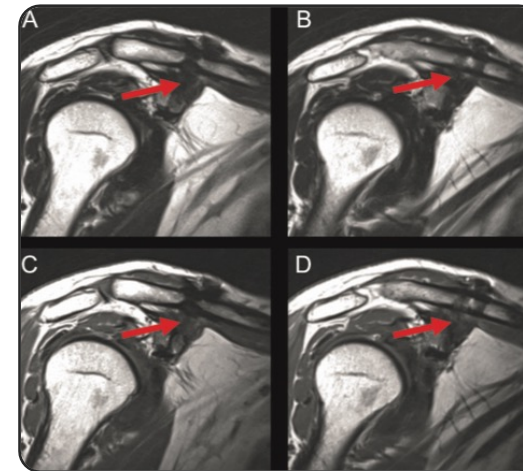
## Suture Pulley Systems (Internal Bracing) demonstrated excellent results

### Arthroscopically Assisted 2-Bundle Anatomic Reduction of Acute Acromioclavicular Joint Separations

#### 58-Month Findings

Arne J. Venjakob,<sup>1\*</sup> MD, Gian M. Salzmann,<sup>1</sup> MD, Florian Gabel,<sup>1</sup> Stefan Buchmann,<sup>1,2</sup> MD, Lars Witzl,<sup>3</sup> MD, Jeffrey T. Spang,<sup>4</sup> MD, Stephan Vogt,<sup>5</sup> MD, and Andreas B. Imhoff,<sup>1\*</sup> MD  
Investigation performed at the Department of Orthopaedic Sports Medicine, Technical University of Munich, Munich, Germany

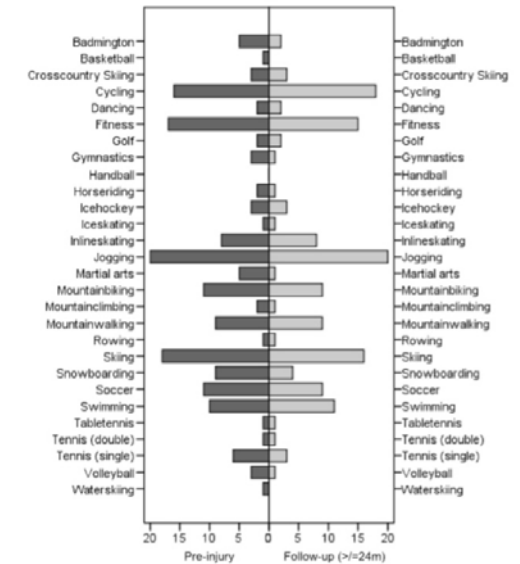
- 96% very satisfied or satisfied



### Return-to-activity after anatomical reconstruction of acute high-grade acromioclavicular separation

T. Saier<sup>1,2</sup>, J. E. Platt<sup>1</sup>, K. Beitzel<sup>1</sup>, P. Mordt<sup>1</sup>, J. M. Fouchy<sup>1</sup>, S. Reuter<sup>1</sup>, F. Marnett<sup>1,2</sup>, A. B. Imhoff<sup>1,2</sup>, M. Kowalek<sup>1,2</sup> and S. Braun<sup>1</sup>

- All patients participated in sporting activities after surgery
- No significant change in activity level (Tegner) and participation in overhead and/or contact sports observed.



Saier, Beitzel, Imhoff et al., BMC, 2016

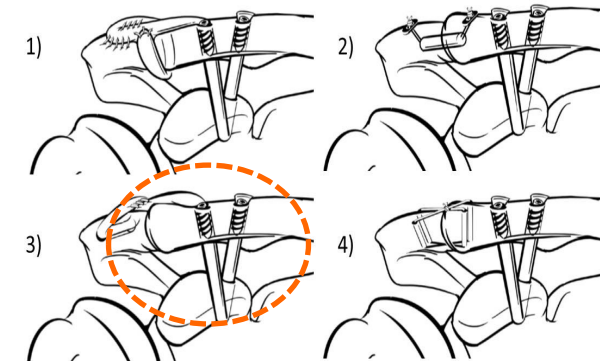
Venjakob, Imhoff et al., AJSM, 2013

## Additional Cerclage (AC) provides biomechanical advantages

### Rotational and Translational Stability of Different Methods for Direct Acromioclavicular Ligament Repair in Anatomic Acromioclavicular Joint Reconstruction

Knut Beitzel,<sup>1</sup> MA, MD, Eifho Obopilwe,<sup>1</sup> MS, John Apostolakis,<sup>1</sup> BS, Mark P. Cote,<sup>1</sup> PT, DPT, Ryan P. Russell,<sup>1</sup> MA, Ryan Charette,<sup>1</sup> BS, Hardeep Singh,<sup>1</sup> BS, Robert A. Arciero,<sup>1</sup> MD, Andreas B. Imhoff,<sup>1</sup> MD, and Augustus D. Mazzocca,<sup>1,2</sup> MS, MD  
Investigation performed at the University of Connecticut Health Center, Farmington, Connecticut, USA

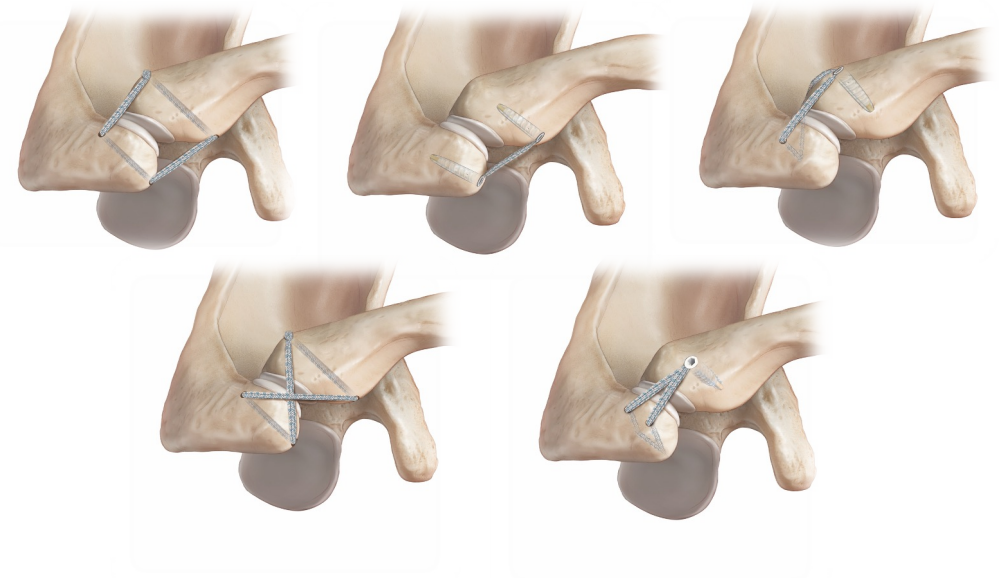
- **Highest stability** with tunnels close to the joint



### Primary Stability of an Acromioclavicular Joint Repair Is Affected by the Type of Additional Reconstruction of the Acromioclavicular Capsule

Felix Dyrna,<sup>1</sup> MD, Florian B. Imhoff,<sup>1,2</sup> MD, Bernhard Haller,<sup>1,2</sup> Sepp Braun,<sup>1</sup> MD, Eifho Obopilwe,<sup>1</sup> MS, J. M. Apostolakis,<sup>1</sup> MD, MPH, Daichi Morikawa,<sup>1,2</sup> MD, PhD, Andreas B. Imhoff,<sup>1</sup> MD, Augustus D. Mazzocca,<sup>1</sup> MS, MD, and Knut Beitzel,<sup>1,2</sup> MA, MD  
Investigation performed at the Department of Orthopaedic Surgery, University of Connecticut, Farmington, Connecticut, USA

- **Native translational stability** could be restored by the addition of AC capsule augmentation, while partial rotational instability remained.
- The tested constructs revealed **no significant individual differences**.

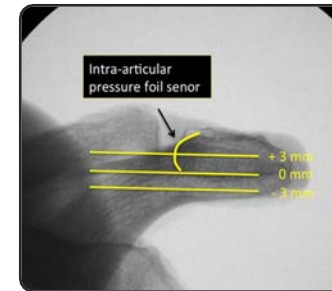


Beitzel, Imhoff, Mazzocca et al.; AJSM; 2014; Dyrna, Beitzel et al. AJSM, 2018

**Factors Predicting the Outcome After Arthroscopically Assisted Stabilization of Acute High-Grade Acromioclavicular Joint Dislocations**

Nina Maziak,\* MD, Laurent Audige,<sup>†</sup> PhD, Carmen Hann,\* MD, Marvin Minkus,\* MD, and Markus Scheibel,<sup>††</sup> MD  
Investigation performed at the Department of Shoulder and Elbow Surgery, Center for Musculoskeletal Surgery, Charité-Universitätsmedizin Berlin, Campus-Virchow, Berlin, Germany; and the Department of Shoulder and Elbow Surgery, Schulthess Clinic, Zurich, Switzerland

- Overreduction of the AC joint may lead to favorable radiological results.

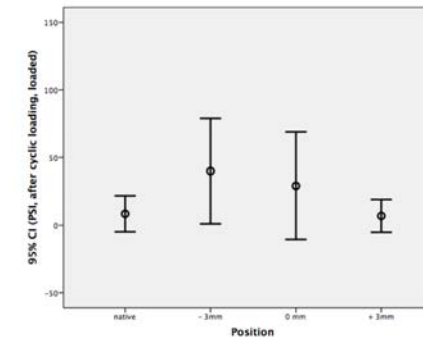
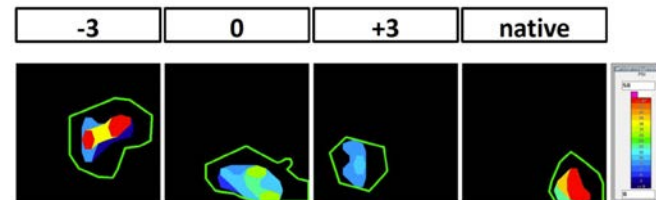


Maziak, Scheibel et al., AJSM, 2019

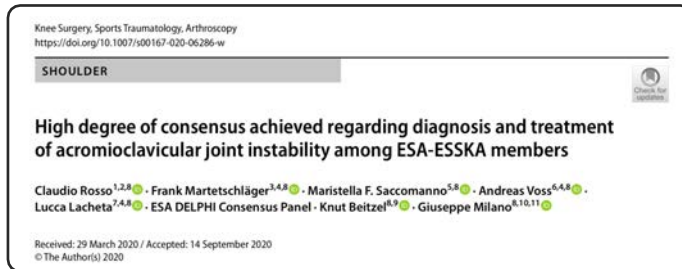
**Biomechanical Analysis of Intra-articular Pressure After Coracoclavicular Reconstruction**

Andreas Voss,<sup>††</sup> MD, Hardeep Singh,\* MD, Felix Dyrna,\* MD, Stefan Buchmann,<sup>†</sup> MD, Mark P. Cote,\* DPT, MS-CT, Andreas B. Imhoff,<sup>†</sup> MD, Augustus D. Mazzocca,\* MS, MD, and Knut Beitzel,<sup>††</sup> MA, MD  
Investigation performed at the Department of Orthopaedic Surgery, University of Connecticut, Farmington, Connecticut, USA

- Anatomic position within 0 – 3 mm does not result in increased joint pressure.



Voss, Beitzel et al., AJSM, 2016



- **True AP view or a panoramic view (bilateral Zanca)**
- **Rockwood classification, as modified by the ISAKOS statement** still considered the most valid
- Separation of Acute and Chronic cases defined **at 3 weeks.**
- **Arthroscopically assisted anatomic reconstruction using a suspensory device** (synthetic augmentation) with no biological augmentation could be recommended in acute injuries
- **Biological reconstruction with tendon graft** should be preferred in chronic cases

Rosso, Beitzel, Milano, ESA Group et al., KSSTA, 2020



ATOS Orthoparc Klinik  
Aachener Straße 1021 B  
50858 Köln  
T +49 (0)221 484905-0  
service-opk@atos.de  
www.schulterinstitut-beitzel.de

**Thank you !**