ISAKOS
CONGRESS
2023

Boston
Massachusetts
June 18 – June 21

Welcome

isakos.com/2023 • #ISAKOS2023

ISAKOS CONGRESS 2023

Boston
Massachusetts
June 18–June 21

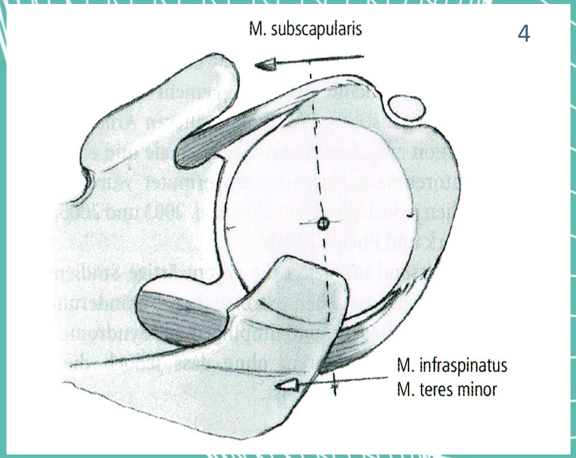
The Influence of Different Rotator Cuff Tears In Relation to Glenoid Depth on Glenohumeral Stability – A Robotic Biomechanical Analysis

M Wiethölter, J Wermers, P Michel, C Schenk,
S Tänzler, M J Raschke, J C Katthagen

University Hospital Münster - Departement for Trauma, Hand and Reconstructive Surgery, Münster, Germany
(Director: Univ.-Prof. Dr. med. M.J. Raschke)

- No conflicts of interest
- No financial support from any kind of third-party funds

Backround – Influence of rotator cuff and concavity on joint stability

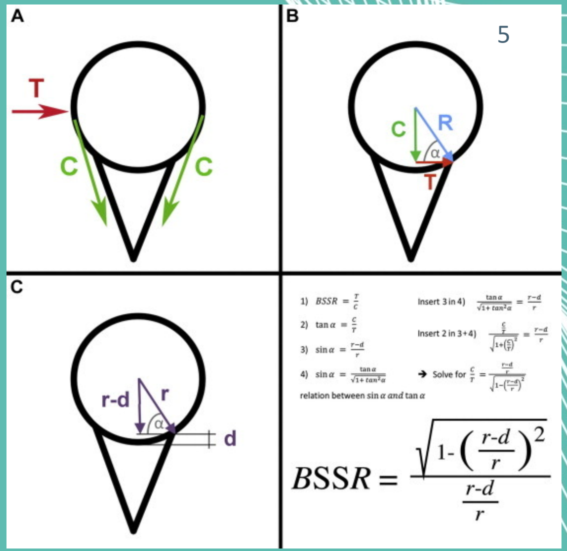


Active partner - Rotator cuff

- Crucial role of „the force couples“ [1]
- Preservation of the coronary and transverse couple essential [2]
- Outstanding role for M. subscapularis (SSC) [3]

Passive partner - Glenoid concavity

- Bone loss alone is not sufficient to represent biomechanical situation [5,6]
- Bony shoulder stability ratio (BSSR) as a calculation method [5]
- Confirmation of the theory and the finite model by biomechanical studies of our group [6]



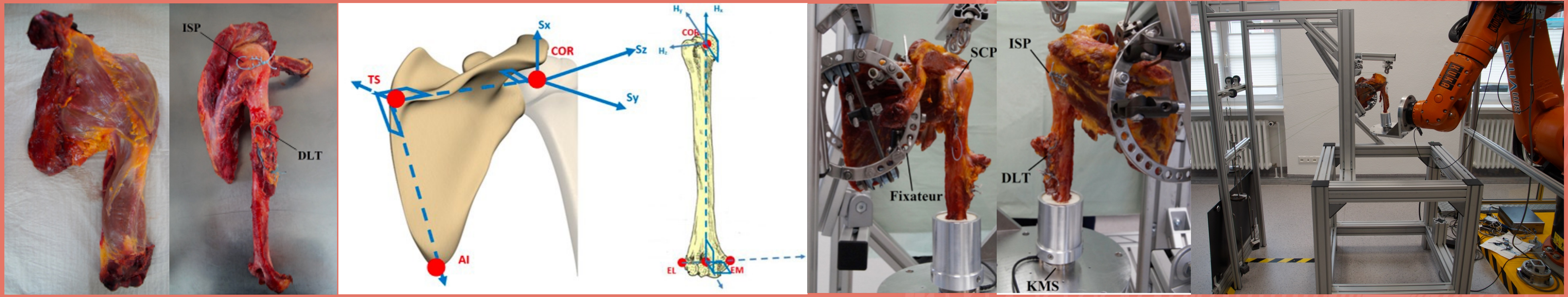
Introduction

- Aim of this study
  - Investigation of the Influence of different Rotator Cuff Tears (RCTs) in relation to glenoid depth on glenohumeral stability (GHS) by robotic biomechanical analysis

- Hypotheses
  - M.subscapularis (SSC) rupture has a greater impact on the GHS than other ruptures of single tendons
  - A distinctive glenoid depth or high BSSR increases the GHS

Material and methods

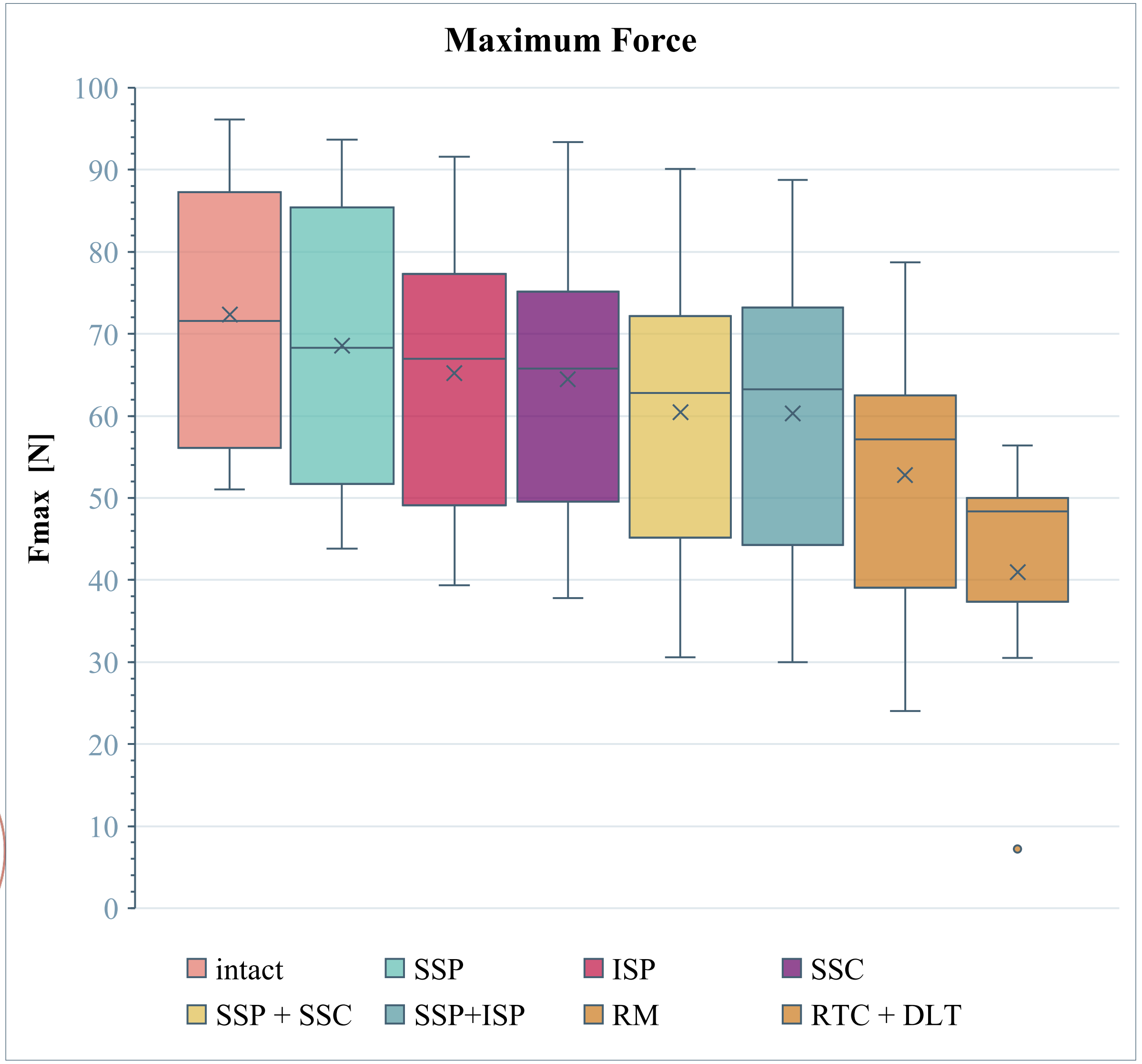
- 8 human cadaver shoulders included (⌀ Age 82,25 ± 8,12 (76-98) years)
  - Dissection of the rotator cuff and the long biceps tendon
- Coordinate system based on marked anatomical landmarks + CT
- Fixation of the scapula as well as the humerus in rail construct
- Movement and measurement of forces with industrial robot, robot-specific software and force-torque sensor



Test Execution

- Loading of the reinforced tendons according to their cross-sectional area [7,8]
  - 8 optional configurations (SSP, SCP, ISP/TM, DLT)
- Glenohumeral abduction of 60°
- Starting position by centering the humeral head
- Subsequently Start Load & Shift sequence
- Analysis of
  - Maximum force (Fmax) in N
  - Maximum force increase (dFmax) in N/mm
  - Glenoid depth in mm

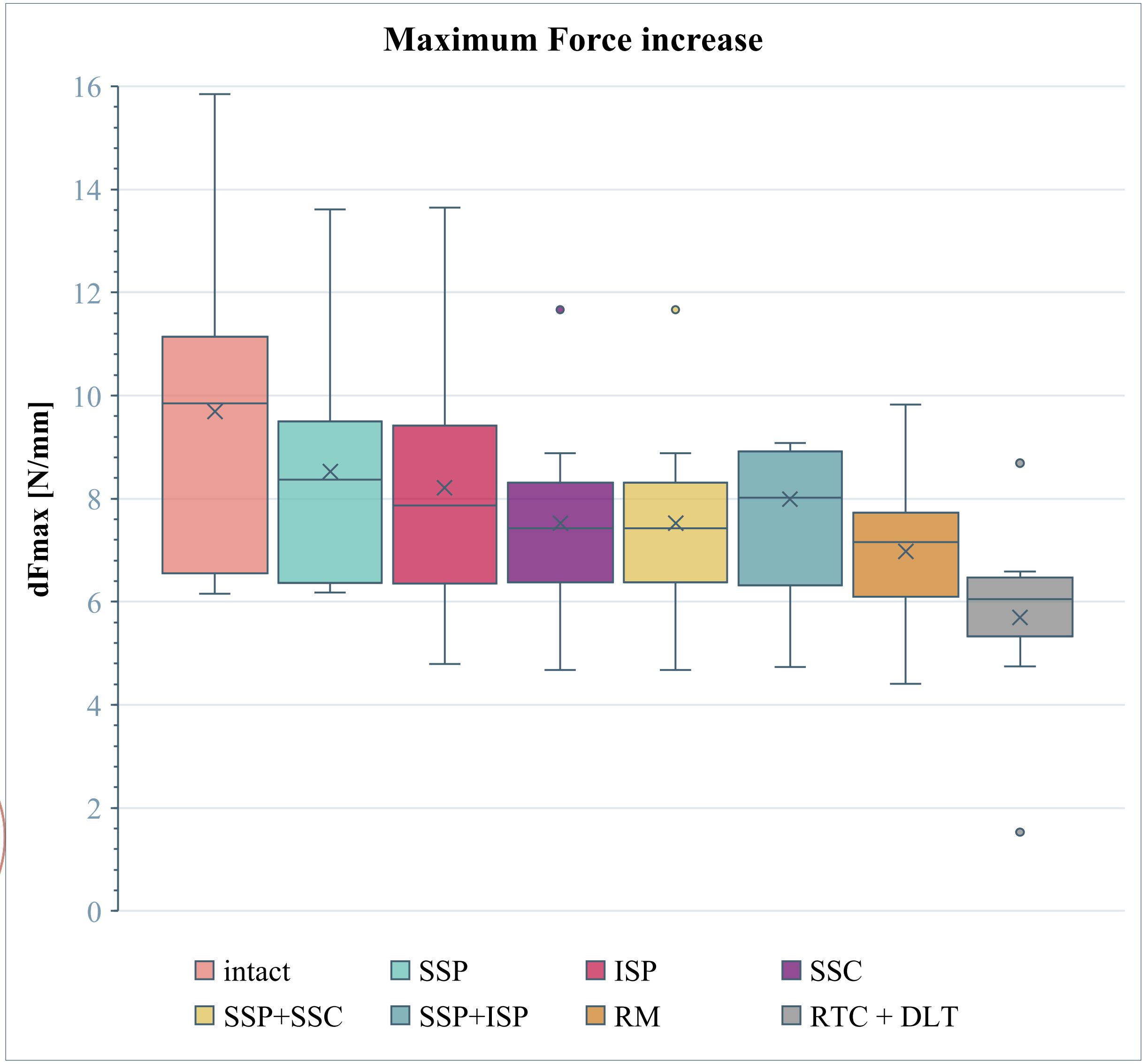
Results – Force maximum



- $p < 0,001$ to intact RTC + DLT
- Single tendon ruptures
  - ΔFmax SSC 7,9 N
  - ΔFmax ISP/TM 7,2 N
  - ΔFmax SSP 3,8 N
- Combined ruptures
  - ΔFmax SSP + ISP/TM 12,1 N
  - ΔFmax SSP + SSC 11,9 N
- Mass rupture
  - ΔFmax SSP + SSC + ISP/TM 19,6 N

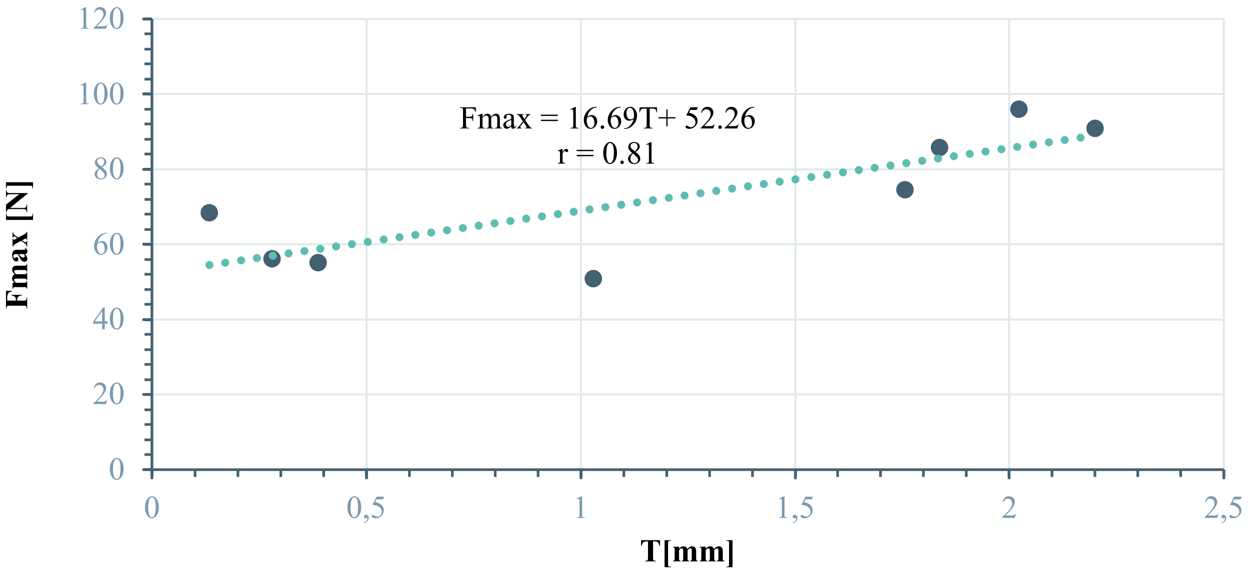
ISAKOS CONGRESS 2023 Boston Massachusetts June 18–June 21

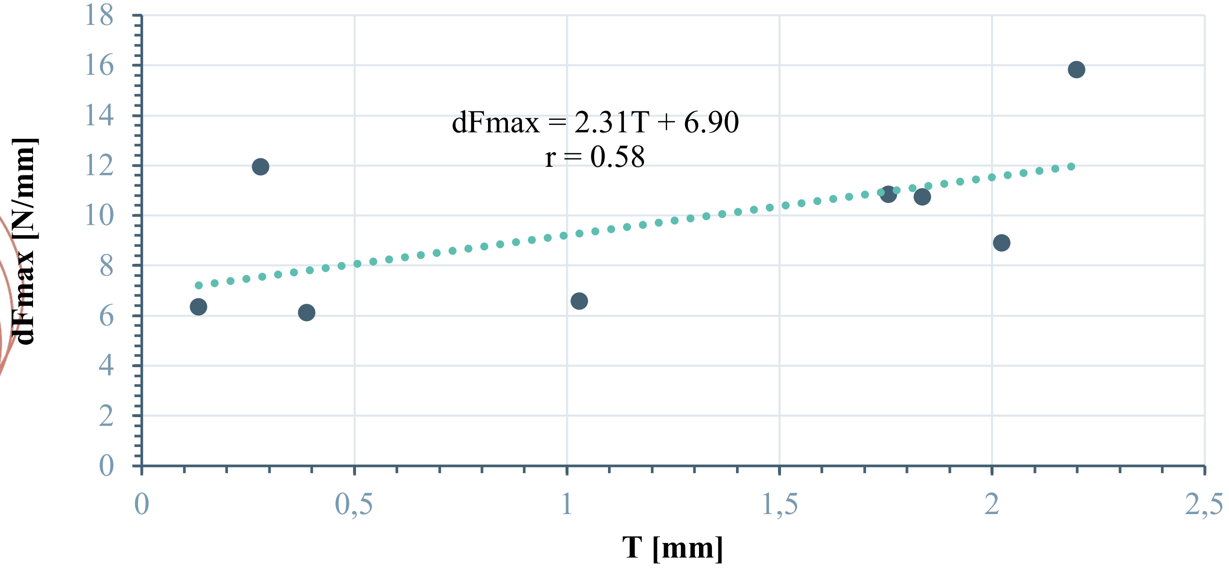
Results – Maximum force increase



- $p < 0{,}05$ to intact RTC + DLT
- Single tendon ruptures
  - ΔdFmax SSC 1,5 N/mm
  - ΔdFmax ISP/TM 1,5 N/mm
  - ΔdFmax SSP 1,2 N/mm
- Combination ruptures
  - ΔdFmax SSP + ISP/TM 1,7 N/mm
  - ΔdFmax SSP + SSC 2,2 N/mm
- Mass rupture
  - ΔdFmax SSP + SSC + ISP/TM 2,7 N/mm

Results – Correlation with glenoid depth





- Linear regression between glenoid depth and maximum force

→ r = 0,81

- Linear regression between glenoid depth and maximum force increase

→ r = 0,58

Limitations

- Simplified model
  - Absence of muscle loading does not simulate rupture (but atony)
  - Soft tissues remain as passive stabilizer
- Physiological pull depends on training condition
- Relatively small number of specimens