

## **Abstract DSSAK 2018**

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## 1. Cross-cultural translation, validation, reliability and responsiveness of the Danish version of Western Ontario Rotator Cuff Index

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**Background:** The Western Ontario Rotator Cuff Index (WORC) is a self-reporting, disease-specific, quality-of-life assessment tool and has shown good validity, reliability and responsiveness.

**Purpose:** The purpose of this study was to translate and adapt the WORC into a Danish version (D-WORC) and evaluate the validity, reliability and responsiveness of the D-WORC in a cohort of native Danish-speaking patients undergoing surgery for arthroscopic subacromial decompression (ASD) or rotator cuff repair (RCR).

**Study design:** Cohort study (diagnosis).

**Material and methods:** In accordance with standard procedure, the original WORC version was translated and cross-culturally adapted into Danish. To test validity, 126 patients undergoing ASD or RCR were evaluated using the D-WORC, the Disabilities of Arm, Shoulder and Hand (DASH), Oxford Shoulder Score (OSS) and Short Form-36 (SF-36). The D-WORC was repeated three days later to evaluate test-retest reliability. Three months after surgery patients were asked to complete D-WORC, DASH, OSS, SF-36 and a Global Rating Scale to determine the responsiveness of D-WORC. Furthermore, construct validity, internal consistency, interclass correlation (ICC), limits of agreement (LOA) and an anchor Minimal Important Change (MIC) were assessed.

**Results:** Cross-cultural adaptation was performed successfully concerning content and language. The correlation between D-WORC and DASH was high (PCC=0.71; 95% CI 0.60-0.79) and moderate between D-WORC and OSS (PCC=0.67; 95% CI 0.55-0.76). Reliability analysis revealed an ICC of 0.80 (95% CI 0.69-0.87) and an internal consistency ( $\alpha$ ) of 0.94 (95% CI 0.92-0.95). The test-retest mean difference was 76.4 (SD 201.40) and LOA ranged from -318.3 (95% CI -387.8- -248.9) to 471.2 (95% CI 401.7-540.6) for the total WORC score. The MIC was a reduction of 211 in the total score.

**Conclusion:** D-WORC is a valid, reliable, and responsive questionnaire that can be used in Danish populations.

## 2. Time dependent supraspinatus muscle inflammation following experimental rotator cuff lesion

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**Background:** The prevalence of rotator cuff (RC) tears is wide and increases with age, mainly due to degeneration of the RC followed by trauma to the shoulder. Tear of the supraspinatus tendon is most often involved, either solely or in combination with two or more tendons.

Treatment of RC tear often is conservative, but full thickness tears may require operative treatment. The general healing of the RC post-surgery is often poor and re-tears of the tendon are common. Main reasons are timing of surgery and biology in the sense that the normal tendon-bone interface is not recreated; hence a fibrocartilaginous scar will be produced instead.

The biology and altered biomechanics of the tendon and muscle during RC tear and healing are far from fully understood. Greatest focus has been on the tendon lesions whereas the inflammatory response and regeneration of muscle tissue fairly have been studied. From a RC tear model in rats, macrophages and inflammatory cytokines have been shown to accumulate in the muscle tissue, indicating that chronic inflammation mediated by macrophages might be involved in RC muscle atrophy and degeneration. The hypothesis behind this project is that the supraspinatus (SS) muscle will show signs of inflammation and degeneration following experimental RC tear. We also predict that satellite cells will increase in number following SS tendon tear, as a consequence of muscle regeneration.

**Methods:** An experimental SS lesion was created in the adult mouse shoulder (C57BL/6 mice). Animals were then sacrificed at day 1, 3, 5, 7, 9, 14 and 28 post-surgery. Both SS muscles was removed from the mouse and processed for histology, immunofluorescence, flow cytometry, proteomics and multiplex analysis. The contra-lateral supraspinatus was used as a control.

Haematoxylin and Eosin was used to visualize inflammation, Oil Red O to visualize fatty infiltration, Sirius Red to visualize changes in collagen, and CD68 to visualize infiltrating macrophages. In addition flow cytometry was performed to investigate infiltration of CD45<sup>+</sup>CD11b<sup>+</sup>Ly6C<sup>+</sup>Ly6G<sup>+/−</sup> leukocytes and CD45<sup>+</sup>CD3<sup>+</sup> T cells into the injured muscle post-surgery. CD45<sup>+</sup>CD31<sup>−</sup>Sca-1<sup>−</sup>CD34<sup>+/−</sup>Integrin- $\alpha$ 7<sup>+</sup> cells were identified as resting and activated muscle stem cells. Proteomics was used to identify significantly up- and down-regulated proteins and multiplex ELISA to detect changes in cytokines in the musculature 5 days post-lesion.

**Results:** We found a time-dependent infiltration of leukocytes into the SS musculature, mostly dominated by macrophages. peaking at day 5-7. At this time point, cytokine levels were significantly upregulated in the ipsilateral shoulder. We also found that the SS musculature showed signs of fatty infiltration already 14 days post lesion and that collagen expression changed over time. The percentage of stem cells was found to change significantly over time on both the injured and non-injured sides.

**Perspectives:** The results of this project has increased the understanding of the inflammatory and regenerative responses in the SS muscle following a RC tear, which ultimately can help us identify better treatment strategies and help to avoid re-tearing and ensure improved healing of the RC.

### 3. Cost-utility Analysis of Operative versus Nonoperative Treatment of Displaced Midshaft Clavicular Fractures

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**Aim:** To assess the cost-utility of plate fixation compared with nonoperative treatment of displaced midshaft clavicular fractures in Danish adults.

**Background:** Conventional treatment of displaced midshaft clavicular fractures is nonoperative. Recent studies have implied that operative treatment might result in a faster return to work, resulting in a decreased productivity loss for society. The cost-utility of operative versus nonoperative treatment has not previously been investigated utilizing a societal perspective.

**Methods:** Decision analytic modelling of incremental costs and quality adjusted life years was applied. Data was primarily retrieved from a recent Danish randomized controlled trial (RCT), additional RCT's identified through a systematic literature review and field observations. A one-year time horizon was applied and all prices reported in 2016-level. Both a health sector and a societal perspective were applied.

**Results:** Operative treatment is associated with a larger gain in quality adjusted life years (QALYs) and a higher cost compared to nonoperative treatment. The incremental cost effectiveness ratio was estimated to DKK 1,273,455 (£ 142,764) per QALY from a health sector perspective and DKK 1,241,364 (£ 139,166) per QALY from a societal perspective. Considering a subgroup analysis of patients with a high-load shoulder profession, operative treatment is associated with a lower gain in QALYs and a higher cost compared to nonoperative treatment from a health sector perspective. Considering a societal perspective, the incremental cost effectiveness ratio was estimated to DKK -1,100,927 (£ -123,422) per reduction of one QALY.

Univariable and probabilistic sensitivity analyses showed that all results were subject to uncertainty.

**Conclusion:** Operative treatment is not cost-effective, considering a threshold of £ 30,000 per QALY as reported by NICE. However, for a subgroup of patients with a high-load shoulder profession, operative treatment might be cost-effective considering productivity costs.

#### 4. Can endogenous pain modulation capacity predict pain six months after shoulder arthroscopy?

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**Background and purpose:** Arthroscopic shoulder surgery, e.g. subacromial decompression (ASD) and acromioclavicular (AC) resection, usually results in significant improvement in pain and shoulder function; however, some patients report persistent pain after surgery. The aims of this prospective study were to determine the incidence of pain six months after outpatient ASD and/or AC resection, to reveal causes of the pain, and to investigate whether endogenous pain modulation capacity was a preoperative risk factor for unexplained persistent pain.

**Patients and methods:** Before surgery, 150 patients were enrolled and 95 patients were tested for endogenous pain modulation capacity using the cold pressor test. Patients with pain six months after surgery were examined by an experienced orthopedic surgeon to reveal medical explanations, if any, for the pain.

**Results:** Data from 101 patients were available for analysis six months after surgery. Thirty-six patients (35.6%) had persistent pain, and 32 underwent examination by the surgeon who identified medical reasons for the pain in ten patients (9.9%), but not in the remaining 22 (21.8%). Endogenous pain modulation capacity was not found to be risk factor, in the 22 patients with unexplained persistent pain.

**Interpretation:** Present results were unable to demonstrate that patients with unexplained persistent pain had a more inefficient endogenous pain modulation capacity than patients without persistent pain. These findings may be because of an already altered endogenous pain modulation capacity due to the high preoperative pain intensity.

## 5. Elbow biomechanics, radiocapitellar joint pressure, and interosseous membrane strain before and after radial head arthroplasty

Chalotte Hemmingsen, Theis Thillemann, Brian Elmengaard, Sepp de Raedt, Maiken Stiling.

**Aim:** To compare the elbow kinematics before and after anatomic RHA in an experimental study.

**Methods:** 8 human native elbows (mean age of 82 years, range 61-89) were recorded with dynamic radiostereometric analysis (dRSA) during forearm flexion motion in a motorized fixture with neutral rotation, and further in supination and pronation with/without a 10N varus-valgus stress. Model-based RSA (RSACore, The Netherlands) was used for calibration and initialization of the bone models on the first frame of the dRSA series, and further analyses were conducted using non-commercial AutoRSA software. Standardised anatomical axes and coordinate systems of the forearm were used. Translations of the radial head in the x-, y- and z-directions relative to the humerus and ulna were measured and kinematics were calculated. The contact pressure in the RCJ was measured using a thin-film pressure sensor (Tekscan) and the tension within the IOM was measured using a custom-made strain gauge. The experiment was repeated after insertion of an anatomical RHA (Acumed).

**Results:** After RHA the radial head was displaced approximately 1.8mm medially and 1.4mm distally compared with the native radial head. During unloaded flexion motion the mean difference in translation between the native radial head and the RHA was <1mm (CI95 +/- 0.5mm) (p=0.00), and with varus-valgus loading the difference was <1.5mm (CI95% +/- 1.5mm) (p=0.00). The mean difference in RCJ contact pressure was <0.30 MPa (CI95% ± 0.40 MPa) during unloaded flexion motion (p=0.00). The tension in the IOM in supinated (p=0.03) and pronated (p=0.00) forearm position was higher for the RHA compared with native elbows. Varus-valgus stress in supinated and pronated forearm position decreased the IOM tension in the RHA elbows (p=0.00).

**Conclusion:** There were only submillimeter kinematic changes and small joint pressure increases in the RCJ after optimal insertion of an anatomical RHA in an experimental setting

## **6. Reverse shoulder arthroplasty has a higher risk of revision due to infection than anatomical shoulder arthroplasty - 17,730 primary shoulder arthroplasties from the Nordic Arthroplasty Register Association**

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**Background:** The use of reverse shoulder arthroplasty has increased and the indications have expanded, but the incidence of revision due to infection may be higher than for other arthroplasty designs. The aim of this registry-based study was to estimate the risk of infection after primary reverse shoulder arthroplasty compared to anatomical designs.

**Methods:** The Nordic Arthroplasty Register Association (NARA) is a common set of prospectively collected data from the national shoulder arthroplasty registries in Denmark, Norway and Sweden. The national registers are designed to capture every shoulder arthroplasty thus providing a large dataset with individual-based data on diagnosis, arthroplasty design, revision and reason for revision. For the present study we included 17,730 primary shoulder arthroplasties reported between 2004 and 2013. The Kaplan Meier method was used to illustrate the 10-year cumulative rate of revision due to infection, and the Cox regression model was used to calculate the hazard ratios as a measure of the relative risk of revision due to infection.

**Results:** There were 188 (1.1%) number of revisions due to infection with a mean follow-up of 3 years and 9 months. The 10-year cumulative rate of revision due to infection was 1.4 % (standard error, <0.01) overall, but 3.1% (standard error, <0.01) for patients with reverse shoulder arthroplasty and 8.0% (standard error, 0.02) for men with reverse arthroplasty. Patients with reverse shoulder arthroplasty had an increased risk of revision due to infection (unadjusted relative risk, 3.78, [95% confidence interval, 2.23 to 6.41];  $p < 0.01$ ), also when adjusted for age, gender, primary diagnosis and year of surgery (relative risk, 2.41, [95% confidence interval, 1.26 to 5.59];  $p < 0.01$ ).

**Conclusions:** The overall incidence of revision due to infection was low. However, specific attention is required on the risk associated with reverse arthroplasty, especially in men.