Shoulder

239. Glenohumeral motion and contact force following anterior capsular repair

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Objective: One of the reported long-term effects of the surgical repair of anterior instability in the glenohumeral joint has been degeneration of the glenoid articular surfaces. It is possible that this degeneration is dependent upon the load environment in the joint. The goal of this in vitro study was to measure humeral head motion, contact force magnitude and location, and contact area in the glenohumeral joint during several clinical laxity maneuvers. The normal joint, and the joint with a repair of a Bankart lesion with normal capsular reapproximation, and with an overtightened capsule were tested in eight specimens.

Methods: Six clinical rotations and displacements describing humeral head motion were measured with an instrumented spatiallinkage (ISL). Foil strain gages were cemented to the neck of the glenoid to measure contact force and location. Weights were attached to each rotator cuff muscle to keep the humeral head firmly seated in the glenoid during testing. Using the ISL output as a guide, the intact joint was put through a simulated clinical laxity exam consisting of seven reproducible, hand-applied maneuvers: abduction (ABD), flexion (FLX), extension (EXT), internal rotation (IR), external rotation (ER), anterior apprehension (AAP), and posterior apprehension (PAP). A full Bankart lesion was then created, and the clinical maneuvers were repeated following a Bankart repair with normal capsular reapproximation, and a Bankart repair with an overtightened capsule (OTBR). After completing the test protocol, grid-points were marked on both articular surfaces. These points, together with the joint motion recorded by the ISL during the clinical maneuvers, were used to compute contact areas. The strain gages were calibrated by applying a known force at the glenoid grid-points. Using a mathematical technique, these data were used to predict the resultant glenohumeral contact force site and magnitude.

Results: Translations of the humeral head origin in the normal joints were superior during ABD, anterior during FLX, posterior during EXT, and anterior during IR and ER; contact force and area were centralized in the normal joint. The BR caused a significant posterior (EXT, AAP) and inferior (FLX, AAP, PAP) shift in the contact force and area, and significantly increased the contact force magnitude (AAP), compared with normal. The BR produced posterior humeral head displacements relative to normal (ER, AAP). The OTBR caused an additional significant posterior shift in the contact force (ER) and area (ER, ABD, FLX) and additional inferior shift in contact force (IR), and an additional increase in contact force magnitude (ER), compared to the BR. The OTBR caused additional posterior humeral head displacement (ABD, EXT, ER, AAP), and superior displacement (FLX), relative to the BR.

Discussion: Neither the regularly-tightened or over-tightened Bankart repair reproduced normal joint displacements or contact forces. The posterior shift of contact force and area, along with the increased contact forces, may be related to the observed degeneration at long-term follow ups of anterior repair.

240. Passive AP-translation in the gleno-humeral joint of the normal population, over-head athletes and patients with unstable shoulder joints

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We measured normative data of 150 healthy volunteers for passive translation of the humeral head in relation to the glenoid. With the same protocol we tested 23 patients with unidirectional instability, 34 patients with multidirectional instability and 25 handball players.

In the normal joint the humeral head stands 8-10 mm posterior to the glenoid rim. In the anterior drawer position we found posterior overhang of 3.3 mm of the dominant and 6.8 mm of the nondominant shoulder. The difference was statistically significant. In the posterior drawer position we found a posterior overhang of 9.9 mm in the dominant and 10.9 mm in the nondominant shoulder. In the anterior drawer position the group of over-head athletes showed a posterior overhang of 1.2 mm in the dominant shoulder and 6.5 mm in the nondominant shoulder. This difference was statistically highly significant. In the posterior drawer position we found a posterior overhang of 11.1 mm in the dominant shoulder and 9.8 mm in the nondominant shoulder. Patients with anterior shoulder instability had a negative posterior overhang with a statistically highly significant difference between the dominant and nondominant shoulders. With inferior stress the distance between the acromion and the humeral head increased by 2.4 mm in the group of volunteers in the dominant and 2.3 mm in the nondominant shoulder. In patients with multidirectional instability the distance increased by 6.1 mm and in the group of over-head athletes by 4.1 mm.

241. Investigation of posttraumatic nondislocated painful shoulder—preliminary results

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Introduction: Evaluation of patients with posttraumatic shoulder pain is often difficult. The present study was conducted in order to identify possible lesions responsible for the chronic pain by special roentgen examination, ultrasonography, MRI and arthroscopy. The results were compared with operative findings.

Material and methods: 10 consecutive patients suffering from chronic shoulder pain more than 6 months after a nondislocated shoulder trauma were evaluated. Mean age was 35 (20–55), 9 men and 1 woman. The traumas were blunt or simple distortion of the shoulder. Typical complaints were pain and a feeling of unstable shoulder especially during over the head activities. Symptoms of dead arm syndrome were also present. All patients had only been examined by plain roentgen, which revealed no abnormalities and all were resistant to nonoperative treatment. The patients were tested for instability in all directions, signs of positive apprehension, impingement and range of motion were recorded. All were evaluated by standard and special roentgenograms, ultrasonography, MRI, arthroscopy—the final standard of reference for comparison was operation. Examinations were carried out by different staff members.

Results: All patients had decreased range of motion. Six patients had a positive apprehension test and 3 of these suffered from unidirectional unstable shoulders. Three had signs of impingement. The special roentgen identified 3 bony Bankart and 1 Hill Sach's lesion. Ultrasonography showed 1 Hill Sach's lesion, 4 partial and 1 full-thickness rotator cuff lesions but no labrum tears. MRI revealed 7 labrum tears (2 bony Bankart lesions), 1 Hill Sach's lesion, 4 partial and 1 full-thickness rotator cuff lesions. Arthroscopic findings were 8 labrum tears (4 bony Bankart lesions), 1 Hill Sach's lesion and 3 partial and 1 total rotator cuff lesions. The operative findings included 8 tears of the glenoid labrum, (4 bony Bankart lesions), 1 had a Hill Sach's lesion. Five rotator cuff lesions were found (4 partial and 1 full-thickness). Nine patients were operated on, 7 with reinsertion of the detached labrum complex with Mitek anchors, 1 patient had the labrum tear resected and 1 rotator cuff repair was performed. The last patient is waiting for operation.

Conclusion: These preliminary results indicates a high incidence of intraarticular lesions in the glenohumeral joint in patients with chronic pain after a nondislocating trauma. MRI and arthroscopy identify the lesion with high accuracy, whereas ultrasonography only identifies cuff lesions with high accuracy.

242. The value of ultrasound for detecting Hill-Sachs lesions

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In a prospective study we evaluated the use of diagnostic ultrasound for Hill-Sachs lesion in unstable shoulder joints of 114 patients. In 38 patients we found a Hill-Sachs lesion by sonography. 31 patients underwent an arthroscopic procedure. The arthroscopic control of the sonographic findings showed a sensitivity of 95%, a specificity of 92%, an accuracy of 94%, a positive predictive value of 95% and a negative predictive value of 92%. We also documented posttraumatic joint effusion. With these results ultrasound seems to be more reliable than roentgen in the diagnosis of Hill-Sachs lesion.

Clinical relevance: With a high diagnostic value for detecting Hill-Sachs lesions ultrasound may replace difficult special roentgen techniques.

243. Shoulder function after displaced fractures of proximal humerus

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The functional outcome after treatment of comminuted fractures of the proximal end of the humerus can be poor and particularly in the elderly patients with osteoporosis. Various treatment modalities, i.e. open reduction with internal fixation, closed reduction and early physical training, endoprosthetic replacement, have been discussed but so far the most optimal treatment has not been found. The purpose of this study was to assess the functional result two years after treatment of displaced fractures of the proximal end of the humerus.

Material and methods: Radiographs of all shoulder fractures registered at Södersjukhuset in Stockholm in 1989 were reexamined and classified according to the AO system and to criteria described by Neer. In 31 patients, 2 men and 29 women, mean age 71 years, there was a comminuted proximal humerus fracture (15% of all fractures of humerus). At review in 1991 two patients were dead and two could not be traced leaving 27 shoulders for clinical and radiographical reexamination. Shoulder function was assessed with the Neer score and the Constant score, and the patients were asked about their acceptance of their condition.

Results: Four patients were operated on with internal fixation, and the others treated with active exercises after 2

weeks' immobilisation of the arm in a sling. There were no injuries on the vessels or the brachial plexus. Radiographically the fracture reduction was acceptable in 13 cases and there was severe osteoarthrosis in nine and slight in seven shoulders. At review, no patient stated severe pain. Three patients had moderate and nine slight pain and 15 stated no pain at all. Severe muscle hypotrophy was observed in three patients. Sixteen patients were able to elevate and hold their arm straight for one minute holding a weight of 1 kg in their hand. There was high conformity in score rates between the Neer and the Constant classifications (r=0.86). The shoulder function was graded as a failure in 15 cases (56%), 11 of whom had an unsatisfactory fracture reduction and nine a 4-fragment-fracture. Shoulder function was rated acceptable only in two out of eleven patients with 4-fragment-fractures. Eight patients accepted their condition in spite of very low scores.

Conclusion: The results indicate that 4-fragment-fractures need more active treatment than rest in a sling. We conclude that a prospective study comparing different surgical treatments with assessment of results with a long time follow-up is needed.

244. Hemiarthroplasty and total shoulder arthroplasty—preliminary results of 13 cases

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Patra Greece

The Neer II prosthesis was used for thirteen shoulder arthroplasties, five total shoulder arthroplasties and eight humeral hemiarthroplasties, which were followed for a relatively short average time of 12 (6–25) months.

The preoperative diagnosis was recent four-part fracture, old trauma with avascular necrosis of the humeral head and traumatic arthritis, secondary arthropathy resulting from "cuff tear arthropathy", or old fracture with locked posterior dislocation and impression fracture of the humeral head.

In all but one patient, the pain was relieved postoperatively. The active range of motion improved in all shoulders. Rotator cuff lesions were repaired intraoperatively and a specific rehabilitation programme was followed after operation. In one patient a noninflammatory reaction was detected and radioactive evidence of glenoid loosening was found. The glenoid component was removed, but the stem of the humerus was stable and was left in.

Our good results are encouraging and allow us to keep performing shoulder arthroplasty. Good functional results are related to the soft tissue condition, good operating technique and a careful rehabilitation programme.

245. Arthroscopic resection of the lateral end of the clavicle—anatomic and pathological bases and operative technique

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After an anatomic study, we devised an arthroscopic technique for removal of all degenerative parts of the acromioclavicular (ac) joint without destabilizing the joint. In the first part of the study, 111 ac joint specimens were dissected for analysis of the degenerative intra-articular changes. In all specimens the joint cartilage showed severe signs of chondromalacia or even ulcers. All articular discs showed degeneration, ranging from a meniscoid disc with a central defect through more distinct destruction with loss of substance even at the edge to total loss of the disc. All signs of degeneration—ulceration of the cartilage, destruction of the disc, osteophytes, and proliferation of the synovial membrane—were usually seen in the anterior-inferior part of the joint. On the basis of these results, we established an arthroscopic procedure for resection of all areas of degenerative changes in the joint without risk to the stabilizing structures. With this technique we operated on 26 patients between November 1989 and October 1990. There were no major complications. Our preliminary experience is encouraging. The surgical technique is standardized and reproducible. The short-term results are as good as those obtained with the conventional open technique. The long-term (2–4 years) follow-up results are needed to show whether maintaining the passive stabilizers of the joint improves the long-term results over those yielded by the open technique.

246. The results after arthroscopic subacromial decompression in relation with the joint mobility

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In 55 patients with subacromial pathology but without rotator cuff rupture, an arthroscopic subacromial decompression was performed. 52 patients were re-examined one year postoperatively. With the aid of a hundred point score the patients were analysed pre- and postoperatively. Also, the inferior translation of the humerus head was measured by sonography.

Preoperatively the mean score was 60.9 points. Postoperatively a significant increase to 84.7 points was seen. The result was classified as poor in 12 patients with a postoperative score as low as 85 points. Those patients with

more than 85 points (A) and those with less (B) were compared. There was no significant difference in age, preoperative complaints or preoperative score. Group B had more translation (4.6±1.9 mm) than group A (2.7±1.0 mm) ($p<0.01$).

We concluded that in patients with subacromial pathology and a hypermobile joint a subacromial decompression is not adequate.

247. Long term results of anterior dislocations of the shoulder operated with Bankart operation/subscapularis shortening

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Arthroscopic technique for repair of anterior shoulder dislocations is becoming popular. The aim of the present retrospective study was to evaluate the results of classic, open anterior soft tissue repair for these lesions.

Patients and methods: The study includes 72 shoulders operated on in 65 patients (53 men, 19 women) with a median age of 25 (14–59) years. Follow-up time was 11.8 (5.0–17.0) years. 15 patients had heavy occupational work. Hill-Sach lesions were present in 44 shoulders, and 3 patients had moderate arthrosis preoperatively. Bankart's lesions were reported in 41 shoulders, all operated a.m. Bankart. In addition, all patients were operated with shortening of the subscapularis tendon a.m. Putti Platt (62) or a.m. Magnusson-Stack (10).

Results: Postoperative sick leave was 2 (1–12) months. 4 heavy workers changed to easier occupations, the rest were rehabilitated to former activities. 7 postoperative redislocations were reported. 22 patients had various degrees of positive apprehension tests. Postoperative mild arthrosis was observed in 14 patients, there was no significant correlation to the type of operation. External rotation was redused from 70 (30–90) degrees preoperatively to 40 (0–80) degrees postoperatively, no patients had complaints about this. Two patients had lesions to the musculocutaneous nerve, 1 was temporary, 1 permanent. One patient had permanent axillary nerve paralysis. The patient assessments were excellent/good in 62 shoulders, fair in 5 and poor in 5. Carter Rowe scores were excellent/good in 59, fair in 5, and poor in 8 shoulders.

Conclusion: Anterior luxations of the shoulder operated with Bankart's procedure and/or shortening of the subscapularis tendon yield stable shoulders and good long term results in 85–90% of the cases.

248. Danger of a lesion of the suprascapular nerve by arthroscopic management of shoulder dislocation

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The aim of our study was to examine the anatomy of the suprascapular nerve and to find a secure area for posterior k-wires in shoulder surgery. The course of the suprascapular nerve was traced in anatomical specimens of 122 shoulders. In 50 shoulder joints k-wires were implanted under different angles. The distance betwen the most posterior and the suprascapular nerve was measured. The suprascapular nerve is closest to the glenoid cavity as it passes around the scapula spine (mean distance 1.9 mm). K-wires parallel to the glenoid cavity had a distance of 3–14 mm (mean 7 mm) to the nerve. K-wires implanted in the medial direction constituted a risk—distance was 0-6 mm. K-wires implanted in inferior direction were rather safe (13–38 mm, mean 24 mm).

In our experince K-wires inserted parallel with the glenoid cavity or directed medially are risky whereas an inferor direction is rather safe.

249. Protein gene product 9.5 (PGP 9.5), synaptophysin and neuropeptide immunoreactive nerves in human subacromial bursal tissue

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Nerves and their chemical constituents were studied immunohistochemically in subacromial bursal tissue specimens. The tissue was obtained at twelve routine shoulder operations. In seven patients the diagnosis at operation was tendinitis of the rotator cuff and/or impingement. Two patients had a partial tear of the rotator cuff, two a complete tear and one a therapy-resistant frozen sholder condition. Innervation was studied using specific heterologous antisera raised in rabbits, to protein gene product 9.5 (PGP 9.5) and synaptophysin, which are two of the best presently available immunohistochemical general markers for nerve structures, and to substance P and calcitonin gene-related peptide (CGRP), two important neuropeptides found in sensory nerves. PGP 9.5 immunoreactive nerves were abundant,

both freely in the deeper bursal stroma, and in the vicinity of blood vessels. Morphologically, they were thick, coarse and nonvaricose nerves, whereas synaptophysin immunoreactive nerves, observed adjacent to cells in the superficial zone, had a punctate appearance, possibly indicating axon varicosities or nerve terminals. Substance P and CGRP immunoreactive nerves were also varicose, and sparsely distributed. Such neuropeptide nerves were, similarly to the PGP 9.5 immunoreactive nerves, present adjacent to blood vessels and were also seen to course freely through the bursal stromal tissue. Compared with normal bursal tissue, the immunoreactive nerves were more sparse in the inflammatory bursal tissue in patients with chronic shoulder pain. The observed nerves may be important in bursal physiology and pathophysiology.

Foot

250. Hallux valgus correction using a modified Hohmann technique

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We have used a modified Hohmann technique with Kirschner wire fixation as routine treatment for hallux valgus in our department. The aim of this study is to investigate the results of this technique.

Material and methods: A total of 246 toes in 181 patients were operated on in 1984–1990. Twenty-two patients had died or their radiograms were missing, leaving 217 operated toes in 159 patients.

All patients were followed with roentgen examinations until the osteotomy had healed. Follow-up was by a questionnaire.

Results: The questionnaire was returned by 91%. The average observation time was 52 (25–97) months. The correction of the valgus angle was 10° (31°–22°). 55% of the patients were completely satisfied, and only 12% were dissatisfied with the outcome. There was a significant correlation between the correction of the valgus angle, the lateral displacdment and patient satisfaction but not to plantar displacement or preoperative intermetatarsal angle.

Conclusion: The modified Hohman procedure is a safe and reliable procedure in treating hallux valgus patients.

251. Free vascularized flaps for reconstruction of the foot

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Soft tissue defects and bone loss in the foot may lead to Syme or below knee amputation. Microvascular free tissue transfer can be a salvage procedure in many cases. The sole of the foot is one of the most specialized areas of the body. Some of the traditional techniques for resurfacing the foot sole suffer from the fact that there is no innervation and the coverage may break down. This may be overcome with transfer of sensory free flaps.

Material and methods: In the period 1985–1991 we have transferred 24 free flaps to the foot. The series consists of 11 lateral arm flaps and 13 scapular flaps, involving 3 women and 21 men, age 32 (4–69). The flaps covered partly the weight-bearing area of the foot sole in 10 cases, the heel in 5 cases and lateral, medial or dorsal aspect of the foot and ankle in 9 cases. In 3 cases the lateral arm flap was raised as a sensory flap using the posterior nerve of the arm and forearm. A compound osteocutan flap was raised in 2 cases.

Results: One flap was lost because of thrombosis of the flap vein. Successful revision of the anastomoses was carried out in 5 cases. 23/24 flaps revascularized and healed, and then provided the recipient area for full thickness skin coverage. In 7 cases the flap was later reduced. Secondary procedures (arthrodesis, osteotomy, bone resection) for which the flap was a prerequisite, were carried out in 7 cases. In one case a secondary below knee amputation was carried out because of nonunion. In 6 cases of weight-bearing flaps minor skin problems between the flap and the original skin occurred.

Conclusion: Free flap transfer to the foot may reduce the amputation rate in foot surgery and provide the patient with satisfactory skin coverage.

252. Avascular necrosis of the first metatarsal head after Chevron osteotomy shown by ^{99m}TC-MDP scintigraphy

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Introduction: Distal osteotomies of the first metatarsal such as Chevron osteotomies are often used for the correction of metatarsus primus varus. It has been suggested that there is increased risk for avascular necrosis (4–40%) of the distal fragment due to capsular stripping and to the transection of the circulatory apparatus of the neck, especially when combined with adductortenotomy. In a prospective, randomized study, early TCM scintigraphy was used to investigate the frequency of avascular necrosis.