Danish Orthopedic Society

Copenhagen, October 28–29, 1994

Editor: Erik Tøndevold

Department of Orthopedics
Rigshospitalet
Blekdamsvej 9
DK-2100 Copenhagen Ø
Denmark

Shoulder

Functional assessment of the shoulder

Niels Holmark Andersen, Hans Viggo Johannsen and Jens Ole Søjbjerg

Shoulder and Elbow Clinic, Dept. Orthopaedic Surgery, University Hospital in Aarhus, Randersvej 1, 8200 Aarhus N, Denmark

Introduction: Constant's functional shoulder score was adopted by the SECEC in 1992 as the assessment of choice within this organization. The aim of this study is to present the Constant Score and to investigate whether its outcome-results equal those obtained by another score system.

Materials and methods: UCLA score was chosen for comparison, because this and Constant Score assess the same parameters, and UCLA score has also previously been used in publications concerning treatment of subacromial pain. Variable postoperative controls were performed on 34 patients all treated for subacromial pain. All patients were primarily examined by one observer (1) who performed a UCLA score, this followed by an examination by an impartial observer (2) who performed a Constant score.

Results: The postoperative score results were as follows:

	Constant score	UCLA score	
Excellent	47.1%	29.4 %	Satisfactory
Good	29.4%	44.2 %	results
Fair	8.8%	8.8 %	Unsatisfactory
Poor	14.7%	17.6 %	results

Conclusions: The Constant score assesses the essential factors concerning "the subacromial pain syndrome" and when applied on such a population there seems to be a good correlation between the outcome results with this assessment score and the UCLA score. When looking solitarily at the satisfactory/unsatisfactory ratio the difference between score-results was not significant ($p = 1.00$). It was not possible within this study to detect a conversion factor between the score-systems.

Arthroscopic repair of the recurrent traumatic anterior unstable shoulder

Uffe Jørgensen

Department of Orthopedics, Gentofte Hospital, University of Copenhagen, DK-2900 Hellerup, Denmark

The classic operative procedure for the recurrent traumatic anterior unstable shoulder is the open Bankart procedure. However, different arthroscopic procedures have been introduced in order to perform minimal invasive surgery.

Purpose: To compare arthroscopic (Morgan) with open (Mitec®) reinsertion of the Bankart lesion in patients with chronic anterior instability of the shoulder joint.

Material and methods: 41 patients were included in the investigation, 21 with arthroscopic and 20 with open reinsertion (Mitec®). The patients were followed prospectively and evaluated by a blinded observer at a 3-year follow-up.

Results: One patient had a reluxation with a relevant trauma 5 months after arthroscopic surgery. No patients in the open group had a reluxation ($p > 0.05$). Rowe score (95 in both groups).

Abduction–external rotation was decreased in the open group (from 0°–15° loss of motion) compared to normal motion in the arthroscopic group. Cosmetic complaints in 50% in the open group versus 10% in the arthroscopic. AP stability in the shoulder joint measured by Don-Joy KLT showed identical stability (+1 mm on the affected side).

There were no major complications and no differences in minor complications.

Conclusion: Both methods resulted in a good shoulder stability in this material with patients at different levels of activity. The open procedure results in a minor loss of motion, more cosmetic problems and a longer hospital stay.

Hemiarthroplasty for complex fractures of the proximal humerus

Hans Viggo Johannsen, Niels Holmark Andersen, Jens Ole Søjbjerg and Otto Sneppen

Shoulder and Elbow Clinic, Department of Orthopedics, University Hospital of Aarhus, Denmark

Aim: To evaluate the results of hemiarthroplasty in the treatment of acute, complex fractures of the proximal humerus after a minimum follow-up of two years.

Patients: From January 1989 through December 1991, proximal humeral arthroplasty (Neer Mark II) was performed in 38 shoulders (38 patients) with complex proximal humeral fractures. Average age at surgery was 66 (27–83) years, and average time from injury to surgery 7 (2–18) days.

Methods: Evaluation at follow-up included the Constant score, clinical examination and radiographic evaluation. Radiographic evaluation included measurements of the length of the reconstructed humerus and the uninvolved humerus, for comparison.

Results: 26 patients were available for a complete follow-up. 10 patients had died, 2 were unable to attend. Average follow-up was 41 (26–56) months. The average Constant score for the operated extremity was 49 (10–77) and for the uninvolved extremity 78 (49–93). Using the disability criteria of the Constant score 11 patients had a mild and 7 a moderate disability, 4 were severely and 4 totally disabled. Pain relief was excellent in 19 patients (no or only slight pain). 7 had moderate pain. Average active elevation was 100° (15°–160°). In 95% of cases the length of the reconstructed humerus was within ±5% of the uninvolved humerus. Shortening or lengthening of the reconstructed humerus did not seem to significantly influence the eventual functional outcome.

Conclusion: Hemiarthroplasty for complex fractures of the proximal humerus is a technically demanding procedure. The functional outcome was excellent or satisfactory in the majority of patients.

Chronic dislocation of the acromioclavicular joint treated with transfer of the coracoacromial ligament—functional and cosmetic outcome

Michael Toft Væsel, Bo Sanderhoff Olsen and Jens Ole Søjbjerg

Shoulder and Elbow Clinic, Deptartment of Orthopedic Surgery, University Hospital of Aarhus, Denmark

Aim: To evaluate the functional and cosmetic outcome in chronic type III acromioclavicular (AC) dislocations treated with excision of the distal clavicle and transfer of the coracoacromial ligament to secure the stability of the remaining clavicle.

Material and methods: 17 patients with a symptomatic chronic type III AC dislocation were treated. Mean age at operation 36 (25–51) years. The time from dislocation until surgery was mean 53 weeks. Average follow-up was 17 (6–26) months. The evaluation included radiography, with and without stress, evaluation of cosmetics and function, a neurologic examination and a Constant functional shoulder score. The data were statistically tested with a t-test.

Results: The mean Constant score of the affected shoulder was 88 (72–100). 9 were rated excellent according to the Constant score (Δ Constant score injured/noninjured shoulder < 10 points), 6 good (Δ Constant score10–20) and 2 poor (Δ Constant score > 20). Postoperatively the gain in activity was median two classes on an 8-step activity scale ($p < 0.001$). 9 patients reported complete restoration of pretraumatic activity level. The cosmetic outcome revealed a median gain of two classes ($p < 0.001$).

Conclusion: The present study has shown that reconstruction of the AC joint with excision of the distal clavicle and reinforcement with ligamentous transfer of the coracoacromial ligament is a reliable method to restore good function in the shoulder with a chronic dislocation of the AC joint.

Treatment of clavicular non-union using rigid plate fixation and autologous cancellous bone graft—functional and cosmetic outcome

Bo Sanderhoff Olsen, Michael T Væsel and Jens O Søjbjerg

Shoulder and Elbow Clinic, Deptartment of Orthopedic Surgery, University Hospital of Aarhus, Denmark

The aim of the present study was to investigate the functional and cosmetic outcome after fixation of symptomatic clavicular non-unions with rigid ASIF-plate fixation and autologous cancellous bone graft.

Material and methods: 16 consecutive patients, with a symptomatic clavicular non-union, were treated in the period 1990–1993 with reaming of the medullary canals, autologous cancellous bone graft and fixation of the non-union with an ASIF 3.5-mm plate with min. 6 screws. The time from trauma to final surgery was mean 135 (16–988) weeks. Follow-up examination was performed after a mean of 24 (9–51) months, and included an radiography of the shoulder girdle, evaluation of the cosmetics and function, examination for neurologic deficits and finally the Constants functional shoulder scoring. Statistically a t-test was used.

Results: Solid healing was achieved in 15 patients. The clavicular reconstruction ratio was 0.96 (0.88–1.03) compared to the nonoperated side.

A gain of median two classes in a cosmetic evaluation scale was reported postoperative compared to preoperative ($p < 0.001$), concerning activity a gain of median three classes in an activity scale was reported ($p < 0.001$), with 12 patients reporting complete restoration of their pretraumatic

activity level. Cases operated later than 40 weeks posttrauma and cases with atrophic non-unions had a significant poorer outcome ($p < 0.02$ and $p < 0.03$). We observed no cases of neurological deficits or operative complications, other than one failed case.

Conclusion: The present study confirms the plating technique as a reliable and safe method for treatment of symptomatic clavicular non-unions. The present surgical technique yielded close restoration of the pretraumatic clavicular length.

Adhesive capsulitis—arthroscopic evaluation, manipulation under general anesthesia, and early passive motion

Jens Ole Søjbjerg. Niels H Andersen and Hans V Johannsen

Shoulder and Elbow Clinic, Department of Orthopedic Surgery, University Hospital in Aarhus, Randersvej 1, 8200 Aarhus N, Denmark

Aim: To present the preliminary results of manipulation, arthroscopic evaluation and early passive motion in 20 consecutive patients suffering resistant frozen shoulders.

Materials and methods: 13 women and 7 men with a mean age of 48 (24–56) years were treated over a 15 months period. Ten could be classified as primary or idiopathic cases and 10 patients were secondary, including 5 systemic (DM), one extrinsic and four intrinsic. All patients had received conservative treatment. 16 patients had a reduction of active forward elevation > 50% compared to the unaffected shoulder and three a reduction between 25% and 50%. The mean preoperative Constant score of the affected shoulder was 29 (19–55) compared to mean 86 points of the unaffected shoulder.

Arthroscopy was performed in general anesthesia. Except for slight synovitis and a tight joint, the arthroscopy was normal. Manipulation was carefully undertaken after arthroscopy, including forced elevation followed by abduction, internal rotation and finally external rotation. Finally a catheter connected to an automatic marcaine pump system was introduced into the subacromial space for postoperative pain treatment. Early passive motion was started immediately guided by a physiotherapist often supplemented by CPM.

Results: At follow up mean 6 months postoperatively 11 patients had an active elevation > 135°, 7 between 90° and 135°, and 2 < 90°. The mean Constant score was 60 (32–91). 8 patients were classified excellent, 6 good, 4 fair and 2 poor. No early or late complications were recorded.

Conclusion: Arthroscopy and manipulation under GA followed by early passive motion seems to be successful in the treatment of patients with resistant adhesive capsulitis of the shoulder. The long term follow up will show if the improvements can be maintained.

Structural characteristics of the glenoid in rheumatoid arthritis

Lars Henrik Frich and Anders Odgaard

Biomechanics Laboratory, Shoulder and Elbow Clinic, University Hospital of Aarhus. Denmark

Introduction: Shoulder involvement is common in rheumatoid arthritis. The treatment of choice in the disabled patients is often total shoulder joint replacement. The results are generally good. However, complications due to loosening of the glenoid component have been reported in up to 15% of all cases. These loosening phenomena are often related to degenerative changes of the bone structure.

Materials and methods: Experiments including 6 normal autopsy shoulders and 6 shoulders with rheumatoid arthritis were conducted. The specimens underwent 3-dimensional serial reconstruction. Architectural analyses included density measurements and estimation of structural anisotropy.

Results: The thickness of the subchondral plate averaged 1.9 (0.8–2.8) mm. Cancellous bone density ratio was 2:1 from posterior to anterior. Three-dimensional reconstructions of the specimens showed a cancellous bone structure composed of thick platelike trabeculae interconnected by thin rods. Structural analysis of the subchondral regions revealed anisotropy. The bare area showed transverse isotropy displaying a tubular array of vertical trabeculae. In the posterior and anterior regions sagittal reconstructions revealed a secondary superior/inferiorly directed trabecular structure of the primary vertically orientated trabeculae. In the centre of the glenoid isotropy dominated. At the posterior vault horizontal anisotropy was found with trabeculae orientated towards the posterior cortex suggesting the existence of a Glenoid Centre of Pressure around the base of the scapular spine. Analysis of the specimens affected by early stages of rheumatoid arthritis showed a thinned, but intact subchondral plate. The cancellous bone, however, revealing the same architectural pattern as found in the normal glenoid. In advanced rheumatoid arthritis the subchondral plate was insufficient or absent and the cancellous bone structure was inhomogeneous.

Conclusion: The cancellous bone underneath the glenoid bare area is shaped to absorb vertical loads. Around that area trabeculae are shaped to withstand shear stresses from translational movements of the humeral head on the joint surface. The integrity of the cancellous bone stock in rheumatoid arthritis seems to be highly connected to the integrity of the subchondral plate. It therefore seems important that prosthetic replacement of the glenoid is performed as a minimal resection arthroplasty. Prosthetic replacement should be considered before erosion of the subchondral plate is complete.

Sonographic demonstration of the AP translation in the gleno-humeral joint

Annabel Lee Krarup, Michel Court-Payen, Bjørn Skjoldbye and Gunnar Schwarz Lausten

Departments of Orthopedic Surgery and Ultrasound, Herlev Hospital, Herlev, Denmark

Introduction: A new method of measuring the anterior-posterior (AP) translation of the gleno-humeral joint with ultrasound was tested by determining the observer variations and measuring the AP translation in normal persons and patients with signs of anterior instability.

Materials and methods: A 3.5 MHz ultrasound transducer was used at the front of the shoulder, and a pressure of 90 N applied to the back of the caput humeri, the underarm being fixed in a sling. The translation of the caput humeri was visualized and measured on the screen. 20 normal persons were scanned 5 times bilaterally by two observers, the inter and intra observer variations being determined. 10 patients with one or more former dislocations of one shoulder were scanned by the same observer.

Results: The mean AP translation was 1.9 (0.4–4.1) mm in normal shoulders, no significant differences found in sex, age or side. The mean translation measured by the two observers was 1.8 mm and 2.0 mm, respectively ($p < 0.02$). The standard error was 0.08 mm, 95% CI 1.6–2.0 and 1.9–2.2, respectively. In the 10 patients, the mean translation of the unstable shoulder was 5.7 (0.7–10.5) mm compared to 1.7 (0.5–3.1) mm in the normal shoulder ($p < 0.002$).

Conclusion: Sonographic measurement of the AP translation in the shoulder is a valid clinical method supplementing the diagnosis of anterior instability. It may help in deciding surgery indications, and if it is planned to be used for monitoring results of stabilizing shoulder surgery.

Evaluation of capsulolabral tears with dynamic sonography

P A Suder, 0 Schifter-Rasmussen and K Hougaard

Department of Orthopedic Surgery and Radiology

Purpose: The evaluation of dynamic sonography in order to identify capsulolabral tears.

Material and methods: 38 consecutive patients suffering from posttraumatic shoulder pain or instability were evaluated with dynamic sonographic examination prior to arthroscopy. The sonographic equipment was an Acuson 128/10 with a 5.0 mHz linear array transducer which made a sonographic evaluation of both the posterior and anterior aspect of the glenoid labrum possible. The major sonographic criteria used in the study in order to diagnose a capsulolabral tear included hyperechoic changes in the glenoid labrum or detachment of the structure from the glenoid rim or capsule. Standard of reference for comparison was arthroscopy. No information regarding the sonographic diagnosis of the status of the glenoid labrum was available before the arthroscopic examination. Both the radiologist and the orthopedic surgeon used the same scheme in order to classify the labral tears identically.

Results: Average age was 29 (17–51) years with 30 men and 8 women. The arthroscopic examination revealed 30 labral tears. The anterior labrum was damaged in t28 patients and the posterior in only 2. Sonographic evaluation enabled accurate diagnosis of the capsulolabral tears with a sensitivity of 0.93, a specificity of 0.63 and an accuracy of 0.87.

Conclusion: Dynamic sonographic evaluation of the shoulder joint allows an undifferentiated evaluation of capsulolabral tears.

Shoulder arthroscopy with the patient in the beach-chair position

Klaus Kjærulf Ruhnau, Søren Winge and Kurt Skovgaard Jacobsen

Department of Orthopedics, Slagelse Centralsygehus

Purpose: Review of the use of the beach-chair position in shoulder arthroscopy.

Material and methods: The review builds partly on previous literature on the subject, partly on our own experiences in 29 shoulder arthroscopies, performed on Slagelse Central hospital in the period May 13, 1993 – June 22, 1994.

Conclusion: We confirmed the advantages, previously described in the literature, with the use of the beach-chair position in shoulder arthroscopy. Especially there was excellent survey, which is facilitated by the mobility of the upper extremity during the operation. Also, as there is no traction on the extremity, we had no affection of plexus brachialis—a complication well known when using the lateral decubitus. Finally we found the setting fairly quick allowimg a fast transition to open procedure, when necessary. Of complications attributed to the beach-chair setup we only had one case of peroperative ortostatic hypotension, no lasting complications.

References:

1. Skyhar-MJ et al. Arthroscopy 1988; 4 (4): 256-9
2. Mullins-RC et al. J Bone Joint Surg (Am) 1992; 74 (1): 137-9.
3. Warner-JJP. Operative Techniques in Orthopaedics Vol 1, no 2 (April), 1991: pp 147-154.
4. Wakim-E et al. Rev Chir Orthop Reparatrice Appar Mot. 1991; 77 (8): 577-80.

Arthroscopic subacromial decompression

Hans Viggo Johannsen, Niels Holmark Andersen, Jens Ole Søjbjerg and Otto Sneppen

Shoulder and Elbow Clinic, Department of Orthopedics E, University Hospital of Aarhus, Denmark

Introduction: The aim of this prospective study was to evaluate the results of arthroscopic subacromial decompression (ASAD) in the treatment of impingement syndrome in patients without full thickness rotator cuff tears (Neer stage II).

Patients: From October 1992 through October 1993 34 patients (34 shoulders) underwent ASAD; 21 men, 13 women, average age 45 (31–65) years. The average duration of symptoms was 36 (8–120) months. Patients with calcifying tendinitis were not included.

Methods: Evaluation pre- and one year postoperatively included; Constant score, clinical examination and radiological evaluation (supraspinatus outlet view).

At follow-up the patients were also evaluated using the UCLA score. All follow-up examinations were done by an independent observer.

Results: 32 patients were available for follow-up. The average follow-up was 13 (10–22) months. 22 patients achieved a good or excellent result (Constant & UCLA score), 10 had fair or poor ratings and were considered failures. 10 patients had applied for worker's compensation benefits (WCB); only one patient in this group achieved a satisfactory result, whereas 9almost all of the non-WCB patients had a good or excellent result.

Conclusion: ASAD is an effective procedure for the majority of patients with stage II impingement syndrome. In this study WCB claims were associated with inferior results.

The lateral collateral ligament of the elbow joint—anatomy and kinematics

Bo Sanderhoff Olsen, M T Væsel, P Helmig, J O Søjbjerg and O Sneppen

Biomechanics Laboratory, University Hospital of Aarhus, Randersvej 1, Dk-8200 Aarhus

The aim of the present study was to evaluate the lateral collateral ligament (LCL) of the elbow joint with respect to anatomy and kinematics.

Material and methods: Ten osteoligamentous elbow joints, with a median age of 75 (61–84) years, were included. The specimens were tested in a stress apparatus. Potentiometers and strain gages registered the movement and the corresponding moment applied to the arm. A sliding potentiometer measured the anterior-posterior radial head translation during testing.

The specimens were stressed, during passive joint flexion, 0.75 Nm in varus, valgus or rotation. The test procedure was performed before and after cutting the posterolateral capsule and the LCL. Paired statistics were used.

Results: LCL originated from the lateral epicondyle, and inserted fan-shaped into the annular ligament (AL). The posterior fibers of LCL passed through AL and inserted on the supinator crest. Joint capsule puncture followed by severance of the posterolateral capsule produced a small clinical irrelevant laxity. Cutting LCL produced a maximal laxity in forced varus and external rotation of 11.8° and 20.6° at 110° of joint flexion. Measurements of radial head translation, showed a posterior translation during forced varus and external rotation of max. 5.7 mm and 8.1 mm at 80° and 100° of joint flexion.

Humeroulnar stability was unaffected by forearm rotation.

Discussion: The anatomy of LCL was described, and the ligament was shown to be an important stabilizer of the elbow joint and the radial head, during varus- and external rotatory stress. This study confirms the general perception of the elbow joint as a functional hinge joint.

Hemarthrosis as a sign of occult fracture of the elbow

Lis Andersen, Poul Einar Jensen and Niels Egund

Departments of Orthopedics andRadiology, Odense University Hospital

Introduction: A clinical review in elbow trauma with or without hemarthrosis in relation to the frequency of fracture.

Materials and methods: All patients (89) who contacted the hospital for acute elbow trauma in the period February through October 1992 were selected in 4 groups related to age ± hemarthrosis without fracture. MRI was done when hemarthrosis was found or if the patient had any complaints after ten days. Patients with hemarthrosis were treated with an angulated cast for 14 days.

A questionnaire was sent after 21 months, asking for pain, sensitivity disturbance or discomfort of any kind. Mobility was controlled by written instructions. Patients with disturbances were controlled clinically.

Results: 16 patients would or could not be followed up. Available for follow up: 20 patients with hemarthrosis under 16 years and 20 above 16 years. 9 had an MRI because of complaints at the control 10 days after trauma. 24 had no hemarthrosis or complaints at the 10 days control. Of 40 patients with hemarthrosis MRI showed fracture in the elbow joint in 31 cases and only 2 of the 9 patients MRI without hemarthrosis had a fracture. The fracture was located mainly in the supracondylar region in the group under 16 years and in the radial head in the group above 16 years. Ten patients had slight complaints.

Conclusion: Hemarthrosis of the elbow after a trauma is a sign fracture or contusion of the joint. The clinical progress in the different groups with or without haemarthrosis shows no difference.

Hand surgery

Double finger bandage versus Carstam splint for the treatment of volar plate injuries of the proximal interphalangeal joint

Michael Stage Pedersen, Niels O B Thomsen and Claus Hovgaard

Department of Orthopedic and Hand surgery, Gentofte Hospital, University of Copenhagen, Denmark

Introduction: The purpose of this study was to compare the treatment of volar plate injuries to the proximal interphalangeal joint (PIP-joint) with a double finger bandage (DFB) versus a Carstam splint (CS).

Material and methods: Prospective randomized study of 40 patients with acute volar plate injuries to the pip-joint; one patient was lost to follow-up. The study thus included 19 men and 20 women with a median age of 37 (18–79). Patients with prior injuries to the finger were not included. After 2 weeks immobilisation all the patients were examined clinically; the examination was repeated after 6 months, and the end result was assessed according to Benke and Stableforth (1).

Results:

Treatment	Patients	Avulsion	2 weeks ROM 0°–90°	6 months		
				Exc.	Good	Poor
CS	20	8	6	16	4	0
DFB	19	8	11	16	3	0

Conclusion: Patients treated with DFB seemed to have a better ROM after 2 weeks, but the result was not significant ($p = 0.15$; Fisher's test). The two methods were equally good as treatment for volar plate injuries to the PIP-joint. The advantage of DFB may be a quicker return to full ROM.

Reference: 1. Benke G, Stableforth PG. Injuries of the proximal interphalangeal joint of the fingers. The Hand 1979; 3: 263-8.

Arthroscopy of the wrist as a diagnostic tool for chronic wrist pain

Karsten Krøner and Henrik Staunstrup

Department of Orthopedic Surgery, Hand Surgery Unit, Aarhus Amtssygehus, Aarhus, Denmark. Danish Pain Research Center, University of Aarhus, Denmark

Introduction: The purpose of this study was to evaluate wrist arthroscopy as a diagnostic tool in chronic wrist pain.

Material and methods: 53 patients were included in the study. 56 wrist arthroscopies were made consecutively. Before the arthroscopy we evaluated clinical symptoms. The preoperative diagnosis was based on clinical evaluation and radiological examinations. During the arthroscopy we specified the diagnosis according to what we saw. We evaluated the patients' clinical symptoms at the last out patient visit, in relation to preoperative symptoms.

Results: We made 43 arthroscopies of the right wrist and 13 of the left wrist. At clinical evaluation we diagnosed 22 patients with a TFCC-lesion, 7 with synovitis, 18 with carpal instability and 22 were evaluated to have pathological cartilage changes. At the arthroscopy 41 patients had pathological findings. 15 wrists were found to be normal. The positive findings were 19 TFCC lesions, 6 ruptures of intercarpal ligaments, 8 arthroses, 5 cartilage contusions and 10 cases of chondromalacia. 10 had synovitis and 1 had a capsular lesion. Out of 19 TFCC lesions found during arthroscopy, 14 were diagnosed preoperatively. Out of 23 pathological cartilage findings found during arthroscopy, 10 were diagnosed preoperatively. During the arthroscopies we had 9 minor technical problems. Postoperatively we had no complications.

Conclusion: We found wrist arthroscopy to be a good tool for evaluating chronic wrist pain.

External tissue expansion—a new instrument in the management of skin closure

Jens Pilegård, Jens U Wester, Siems S Siemssen, Gunnar Blomquist, and Niels K Jensen

Departement of Plastic Surgery. Odense University Hospital, Odense, Denmark

Introduction: The aim of this study was to evaluate a newly developed external tissue expander for the closure of large-skin defects.

Material and methods: 12 women and 10 men were treated by the external expander. The expander was used for the closure of 9 fasciotomies and for preoperative skin expansion before excision of 6 tattooes, 7 split skin transplants, 4 giant naevi and 3 cicatrices. The expander was placed in the skin using local anesthesia. The expansion of the skin was carried out by the patient himself. The mean expansion time was 4.4 (0–11) days. No hospital stay was needed.

Results: 20 patients completed the expansion succesfully. The mean size of the defects was 7.3 (3–15) cm. In 2 cases we observed minor complications during the expansion. The pain was recorded by the use of a visual analogue scale. The mean pain score was 2.2 (0–9.0). At the time of the closure of the defects the histological biopsies showed edema. Three months later the biopsies showed inflammation and infiltration with plasmacells.

Conclusion: The external expander can be used to obtain primary closure of defects where split skin transplants otherwise should have been used. The device can be applied using local anesthesia and no hospitalisation is necessary.

The effect of endogenous TGF-ß 1 and 2 on epithelialization, neovascularization and scar formation in wounds

Anni Morsing, Torben M Christensen, Louise H Andersen, Dorthe Kjølseth, Ulrik Baandrup and Vibeke E Hjortdal

Inst. Exp. Clin. Res., University of Aarhus, Denmark

Introduction: Reduction of scar formation is often desirable to avoid complications like strictures, stenoses, contracture and keloids. Exogenous TGF-ß 1, 2 is known to increase epithelialization, neovascularization, and scar formation in normal wound healing. The role of endogenous TGF-ß 1, 2 has yet to be clarified. In the present study we neutralized endogenous TGF-ß 1, 2 in excisional and incisional wounds and measured epithelialization, neovascularization, and scar formation.

Methods: 32 adult male hairless mice (8–12 weeks, 20–30 g) were used.

Group I: (n 27) Bilateral excisional wounds were created on the dorsum of the ears down to the central cartilage. Epithelialization and neovascularization were measured every third day, using intravital microscopy and computer assisted planimetry.

Group II: (n 5) Three 1 cm incisional wounds were created on the backs, and were left unsutured to heal by second intention. Immunohistological examinations were performed at day 7,14, 28, 40, and 70 after wound creation using collagen type I, II, IV, and V antibodies. TGF-ß 1, 2 antibody, control-IgG, or PBS were applied in a blinded fashion at days 0, 1, and 2 after wounding in both groups.

Results: Group I: TGF-ß 1, 2 antibody treated excisional wounds (n 22) epithelialized in 11.2 ± 0.5 days, and control-IgG (n 17) and PBS (n 15) treated wounds epithelialized in 10.9 ± 0.6 and 10.6 ± 0.6 days, respectively. TGF-ß 1, 2 antibody treated wounds (n 17) neovascularized in 27.9 ± 0.5 days whereas the control-IgG (n 14) and PBS (n 10) treated wounds neovascularized in 27.0 ± 0.8 and 26.1 ± 0.8 days, respectively. The differences observed are not significant (mean ± SEM). Further, there was no significant difference in the average rate of epithelialization and neovascularization in the three groups throughout healing.

Group II: Ifn a semiquantitative evaluation the antibody treated wounds contained relatively less collagen I at 7 and 14 days after wounding compared to control wounds. At 28, 40, and 70 days after wounding no difference was observed in collagen content. No difference was observed in collagen II, IV and V content.

Conclusion: The neutralization of endogenous TGF-ß 1, 2 does not influence the rate of epithelialization and neovascularization in our wound model whereas early collagen I deposition is reduced.

Hip

Early experience with Boneloc® cement in total hip replacement

Lilli Sørensen, Henrik Morgen Andersen and Per Riegels-Nielsen

Department of Orthopedics, Esbjerg Centralsygehus, Denmark

Introduction: The purpose was to describe early experiences with Boneloc® bone cement in total hip replacement (THR).

Patients and methods: A retrospective review of 42 operations (25 Charnley and 17 LMT prostheses) inserted in the period January through August 1991. During the same period 48 patients had THR with Palacos® cement. The files and radiographs were reviewed according to complications, surgeon, position of the prosthesis, loosening of compartments, pain and reoperation.

Results: There were no differences between the 2 groups. Peroperatively the cement hardened quickly because of short dough period resulting in three trochanteric fractures. The patients were followed up to 3 years or until loosening of the prostheses. Median follow-up to radiological loosening was 19 (3–31) months. 25 had loosening of the stem. 16 had a revision hip arthroplasty, 1 is waiting for operation, 2 are not operated due to high age, 6 have no pain. One patient had a cerebral hemorrhage after revision and died 5 weeks later. 4 are under observation for loosening.

In the Palacos® group 2 loose prostheses are recorded but are still painless. The median follow-up of this group is 12 (1–39) months.

Conclusion: The Boneloc® cement is difficult to handle peroperatively. The outcome after three years showed disastrous results with early loosening. We can not recommended Boneloc® for THR. In case of re-THR with only one loose component, we recommend changing both.

Tenoxicam for 5 days can prevent heterotopic ossification after total hip arthroplasty

Peter Gebuhr, Jens Sletgård, Jesper Dalsgård, Michael Soelberg, Kjell Keisy, Antero Hänninen and Michael Crawford

Departments of Orthopedic Surgery and Anesthesiology, Hvidovre, Køge, Herning and Glostrup Hospitals, Denmark, Huddinge Hospital, Sweden and Kajaani Hospital Finland

Introduction: That NSAIDs can diminish heterotopic ossification after cemented total hip arthroplasty is beyond any doubt. One question still to be solved is the duration of the treatment.

Materials and methods: In a prospective, doubleblind, multicenter investigation, 147 patients, planned to have a cemented total hip arthroplasty, were randomized to receive either placebo, morphine (0.1 mg/kg), tenoxicam 20 mg or tenoxicam 40 mg. On the day of the operation, the first dose was given when the last stitch was made at operation. The first day the medicine was given intravenously; the following four days orally. The median age was 72 (32–88) years. The male/female ratio was 3/2 in all groups. The patients were followed for one year and the ossifications were evaluated according to DeLee. 24 patients were excluded from the study for various reasons.

Results: We found significantly more grade 2 and 3 heterotopic ossification in the placebo and morphine groups, than in the tenoxicam groups. There was no difference between the placebo and morphine group and between the two tenoxicam groups. There was no difference in the amount of ossifications between men and women. 8 patients had grade 3 ossification, all in the placebo and morphine groups.

Conclusion: Tenoxicam for 5 days postoperatively can diminish heterotopic ossification after total hip arthroplasty.

6 percent aseptic loosening of Müller prosthesis after 9 years

Kim P Sperling, Peter Gebuhr and Snorre Stephensen

Department of Orthopedics, Hvidovre Hospital, Copenhagen, Denmark

Introduction: There are only a few long-term reports about Müller Straight Stem prostheses. We have therefore found it of interest to make a long-term follow-up.

Patients and methods: From 1984 to 1988, 388 women and 178 men had a cemented Müller Straight Stem prosthesis, in 622 hips.

Median age at operation was 71 (24–94) years. 389 (429 hips) living patients were sent a questionnaire and all nonrevised patients were asked to come for a clinical and radiological examination.

Results: The observation time was 81 (1–150) months. 381 (95%) returned the questionnaire. 260 hips (62%) were examined clinically and radiographically. The rest of the patients had no pain and would therefore not participate in the clinical examination. 25 hips were reoperated or suspected of loosening. 5 were revised for infection. 9 hips were revised for aseptic loosening of the femoral and the acetabular component, and 4 hips because of loosening of the acetabular component. 2 acetabular components were revised for luxation. At the follow-up, 4 further femoral components were suspected to have aseptic loosening. 9-year survival analysis based on revision or suspected aseptic loosening showed 94% survival for the femoral component and 95% for the acetabular component. Survival based on performed revision for aseptic loosening was 96%.

Conclusion: The long term results after Müller Straight Stem are satisfactory.

Müller-Nelson cemented hemiarthroplasty

Martin Wyman Rathcke, Ilse Klint, Anna Rosted, Jon Ivar Tuxøe, Michael Laursen and Per Bildsøe Jensen

Departments of Orthopedics and Radiology, Sundby Hospital, Copenhagen, Denmark

We examined the result of 127 cemented Müller hemiarthroplasties with Nelson head inserted during the period 1985 through 1991.

Material and methods: 122 cemented hemiarthroplasties were inserted in 95 women and 27 men. Records of 5 patients were lost to follow-up. Mean age was 75 (44–93) years. 70 patients received primary hemiarthroplasty after a displaced femoral neck fracture. 43 patients received a secondary hemiarthroplasty after avascular necrosis or nonunion, and 10 patients after removal of a Moore prosthesis. At the time of follow-up 53 patients were dead and 26 patients were unavailable. 41 patients with 42 hemiarthroplasties underwent a clinical examination. Pain, function, complications and patient satisfaction were recorded. Standardized AP radiographs were obtained.

Results: 14 hips were reoperated. 12 patients received a total hip arthroplasty. In 2 cases the femoral stem was exchanged, while in 10 cases only the cup was exchanged. 8 of these patients had acetabular erosion. At follow-up 36 had no or little pain, 4 had pain on walking and 2 had pain at rest. Using the Hospital of Special Surgery hip rating system, 33 were graded excellent or good, 6 fair and 3 poor. 34 of the patients were satisfied. 22 hips had acetabular erosion and 9 had radiolucent lines radiographically.

Conclusion: The Müller-Nelson cemented hemiarthroplasty has been used with good results. Exchange to a total hip arthroplasty is possible by insertion of a cup.

The influence of smoking or alcohol consumption on the survival of noncemented primary hip arthroplasty

Morten B Petersen

Department of Orthopedic Surgery, Hillerød Hospital, DK-3400 Hillerød, Denmark

Hospital records of 330 consecutive primary noncemented hip replacements were examined regarding use of cigarettes and alcohol at the time of preoperative examination, and failures of the hip replacements. The median follow-up time was 47 (12–92) months.

Information about smoking was available in 295 replacements and about alcohol in 283 replacements. Aseptic loosening was seen in 3 hips out of 60 replacements in smokers with a daily consumption above 20 cigarettes, compared to 4 loosenings in 151 replacements in nonsmokers. In patients with an alcohol consumption above 3 drinks daily, the frequency of aseptic loosening was 2 in 28 replacements. In patients without daily alcohol consumption, we found 8

loosenings in 223 replacements. In the group of alcohol consumers, we found 3 revisions due to recurrent dislocations, compared to 2 in the group of nonconsumers. No alcohol consumers were revised due to deep infection.

No significant correlation between aseptic loosening and smoking or larger alcohol consumption could be demonstrated. There was a significant correlation between larger daily alcohol consumption and revision due to recurrent dislocations.

Knee

Postarthroplastic analgesia with intra-articular morphine

Inger Kjeldal, Birgitte Stenfeldt Nielsen and Stig Lau Hansen

Department of Orthopedics, Holstebro Central Hospital, Denmark

The present study was designed to determine whether administration of opiates results in postoperative analgesia following knee arthroplasty.

27 patients scheduled for elective knee arthroplasty were enrolled in the study and randomized to one of two groups. Patients in group A received 10 mL of normal saline and the patients in group B, 1 mg of morphine in a total volume of normal saline.

The VAS-score, postoperative pain medication and the level of residual spinal block were registrered at 2, 4, 8, and 24 hours postoperatively.

Table. Postarthroplatic analgesia with intraarticular morphine. Values are median (25%–75% quartile) and difference in median values with confidence limits. P-values with the Mann-Whitney test

	A	B	P-value	Diff (A–B)
N	12	11		
Age	75 (69–78)	67 (60–71)	0.03	8 (1–15)
Op.-time	98	85	0.03	15
(min)	(85–114)	(75–95)	0.03	(0–30)
Spinal time	268	345	0.14	58
(min)	(229–281)	(225–370)	0.14	(-130–40)
VAS (mm)				
0–2 hr	3 (0–5)	0 (0–2)	0.29	2 (0–5)
2–4 hr	10 (3–38)	14 (5–63)	0.60	4 (-34–8)
4–8 hr	30 (6–60)	12 (5–45)	0.54	5 (-12–36)
8–24 hr	17 (5–47)	15 (9–44)	0.94	-1 (-16–16)
Morphine (mg)				
0–2 hr	5 (0–10)	0 (0–10)	0.12	0 (0–10)
2–4 hr	9 (0–12)	0 (0–10)	0.13	3 (0–10)
4–8 hr	10 (8–16)	15 (0–20)	0.56	-1 (-10–8)
8–24 hr	20 (15–30)	20 (15–50)	0.18	-3 (-23–8)

A two-tailed Rank Sum analysis was used to compare pain scores and pain medication for the two groups. Results are shown as median ±25% quartiles. The Spearman Rank-order Correlation analysis was used to measure an association between variables. No significant difference between the two groups was observed for pain-score or pain medication.

We conclude that no evidence for a peripheral opiatreceptor mediated analgesia could be demonstrated in patients undergoing knee surgery under spinal anesthesia.

DEXA and uncemented total hip arthroplasty—a methodological study

P M Gehrchen[1], M M Petersen[1], P K Nielsen[2] and B Lund[1]

Departments of [1]Orthopedics and [2]Nephrology, Rigshospitalet, University of Copenhagen, Denmark

Introduction: Quantitative measurements of bone mineral density (BMD) in the proximal femur following Total Hip Arthroplasty (THA) are increasingly applied in the evaluation of bone remodeling. This study evaluates the feasibility of the method.

Material and methods: Bone mineral measurements were performed by Dual Energy X-ray Absorptiometry (DEXA). The BMD was measured in 9 regions around the femoral stem. The precision in vivo was evaluated from measurements in ten patients with uncemented THA. The patients were scanned twice on the same day with fully repositioning between the scans. For comparison a human femur with an uncemented femoral component was scanned three times at 200 of rotation. To evaluate the accuracy and lower detection limit, an in vitro study was performed using a series of canine bone meal (fat free dry weight, with steps of O.25g). Specimens of bone meal with known weights were ashed in a furnace and weighted again.

Results: Ash weight of bone was highly correlated to fat free dry weight of bone meal (R^2 = 99.97%). BMD was highly correlated with the measured weight of bone meal, but with a lower detection limit of 0.2g/cm^2 (R^2 = 99.47%). The mean precision error (expressed as the coefficient of variation = CV (%)) for measurements of BMD was 0.9 (0.5–1.5) percent for triple measurements of the phantom and 1.8 (1.1–2.8) percent for measurements in vivo.

Discussion: The highly significant correlation between ash weight and fat free dry weight of bone meal, confirmed that it was well suited for evaluation of the accuracy and lower detection limit of the scanner. The lower detection limit was far below the actual BMD values measured in the phantom study and in patients. BMD was highly correlated to the measured weight of bone meal. The CV in vivo of 1.8 percent showed that DEXA can be used for quantitative measurements of bone remodeling in the proximal femur.

The relation between penetration strength of trabecular bone and bone mineral density measured by DPA and DEXA in the proximal tibia

Michael M Petersen[1], Niels C Jensen[3], P Martin Gehrchen[1], Palle K Nielsen[2] and Poul T Nielsen[2]

The Departments of [1]Orthopedic Surgery U and [2]Nephrology P, Rigshospitalet, University of Copenhagen, Denmark and [3]the Biomechanics Laboratory, University Hospital of Århus, Denmark.

Introduction: The mechanical properties of the cancellous bone of the proximal tibia is of importance in orthopedic research because this part of the skeleton is responsible for the mechanical support and fixation of the tibial component in total knee arthroplasty.

Materials and methods: The proximal tibia of eight right knees was obtained from routine autopsies. Soft tissue was removed from the bone specimens and a bone mineral measurement was performed (in the coronal plane) with dual photon absorptiometry (DPA). Then a proximal slice (including the cortical bone of the subchondral plates) was removed and the scanning was repeated; first by DPA (n= 8) and then by dual energy X-ray absorptiometry (DEXA) (n=6). Based upon the second DPA measurement the corresponding level for BMD measurement was identified on the initial scanning, and within this area three regions (6 x 6 mm) of interest (ROI) were selected. Following the DPA bone mineral measurements ROI's were marked on the resection surface of each bone specimen, and later the average penetration strength of the trabecular bone medially, laterally and centrally in each tibia was measured with an osteopenetrometer (Hvid et al. Eng Med 1984;2:73-8). For each DEXA scanning BMD was measured in the identical ROI. Statistics: Linear regression analysis.

Results: The regression equations for the relation between penetration strength of trabecular bone (Y) and BMD (X) measured by DPA and DEXA were respectively: $Y = \div 5.4 + 22.5X$ ($R^2 = 81\%$, $p < 0.00000$) and $Y = \div 6.4 + 24.2X$ ($R^2 = 67\%$, $p = 0.00003$). As expected the BMD measured by DPA (Y) and DEXA (X) was highly correlated: $Y = 0.001 + 0.98X$ ($R^2 = 86\%$, $p < 0.00000$).

Conclusion: Noninvasive bone mineral measurements by DPA and DEXA are easly obtainable measurements highly correlated to bone strength. This study showed that even local variations in trabecular bone strength within the proximal tibia could be measured by these techniques.

Changes in bone mineral density in the proximal tibia following uncemented total knee arthroplasty—a prospective study with a 3-year follow-up

Michael Mørk Petersen, Poul T Nielsen, Jes Bruun Lauritzen and Bjarne Lund

Department of Orthopedic Surgery, Rigshospitalet, University of Copenhagen, Denmark

Introduction: Quantitative measurements of bone mineral by photon or X-ray absorptiometry have mainly been performed for the diagnosis and evaluation of treatment in postmenopausal osteoporosis. Recently these bone mineral measurements have been of growing interest to orthopaedic research by providing precise and quantitative analysis of bone changes adjacent to orthopaedic implants.

Material and methods: 25 patients treated by uncemented total knee arthroplasty (TKA) because of primary osteoarthrosis of the knee were included in the study. Measurements of bone mineral density (BMD) in the coronal plane of the proximal tibia was performed by dual photon absorptiometry. Scanning was performed after the operation and with follow-up after 1/2, 1, 2, and 3 years. Below the tibial component 3 areas of interest in the medial tibial condyle and 3 areas in the lateral condyle were selected for BMD-measurements. Based on measurements of pre- and postoperative alignment of the knee obtained from long standing radiographs, it was possible in 23 knees to select the tibial condyle where load was expected to respectively increase and decrease after the TKA-operation. Statistics: Nonparametric tests a.m. Wilcoxon (paired data) and Friedman (two way analysis of variance).

Results: In the tibial condyles where load was decreased after the operation a rapid and significant decrease in BMD of 7–20% was seen after 6 months. The bone loss continued at a slower rate throughout the study period, thus ending with a total decrease in BMD of 24–40%. BMD in the condyles where load was increased postoperatively showed a temporary but significant increase of 2–7%, followed by a slow decrease reaching BMD-values 12–22% below the initial values after 3 years.

Conclusion: Realignment of the knee joint during TKA induced an early and significant bone remodeling in the proximal tibia closely related to the altered loading pattern of the knee. The overall changes in BMD after 3 years was a bone loss of 12–40% which might be the result of disuse combined with a return to normal of the relatively high density osteoarthrotic bone.

Cemented Miller-Galante total knee arthroplasty

Martin Wyman Rathcke, Jacob Juel Grindsted, Lars Bjørn Marker, Karsten Gringer, Karl Erik Rønne and Tim Toftgaard Jensen

Departments of Orthopedics and Radiology, Hvidovre University Hospital, Copenhagen, Denmark

We examined the result of 116 cemented Miller-Galante Mark I total knee prostheses inserted during the period February 1991 – January 1993.

Material and methods: 116 cemented prostheses were inserted in 111 patients (85 women and 26 men), 63 with a patellar component. Mean age was 71 (45–86) years. The indications were osteoarthrosis in 98 knees and rheumatoid arthritis in 18 knees. At the time of follow-up 8 patients were dead and 14 patients were unavailable.

89 patients with 93 arthroplasties underwent a clinical examination with knee score according to the Hospital of Special Surgery. Standardized radiographs were obtained using fluoroscopy.

Results: At follow-up 61 had no or little pain, 21 had pain on walking and 11 had pain at rest. Using the Hospital of Special Surgery hip rating system the average score was 81, and 64 were graded excellent or good, 12 fair and 17 poor.

13% of the patients were discontented.

16 patients were reoperated: 3 had a revision prostesis, 8 had a higher tibial articular surface and 5 patients had lateral release. 3 superficial and 1 deep infection were recorded. Possible tibial migration was seen in 4 cases.

Conclusion: TKA with the Miller-Galante Mark I prosthesis has shown poor results. The problem is postoperative instability and problems with subluxation of the patella.

AGC 2000 tibial components with hydroxyapatite coating—a randomized series followed 5 years with RSA

Poul T Nielsen, Else Berg-Hansen, Søren Toksvig-Larsen, Leif Ryd, Kurt Rechnagel, Henrik Schrøder and Göran Selvik

Department of Orthopedics, Hillerød Hospital, Hillerød, Denmark, and Lund University Hospital, Lund, Sweden

Introduction: Hydroxyapatite ceramic enhances bone ingrowth into titanium-coated implants thereby improving primary and secondary implant stability. In published series of cementless total knee arthroplasty with titanium-coating aseptic loosening occurs in 2 to 4%.

The purpose of the present study was to evaluate the effectiveness of HA coatings in enhancing primary stability (0–3 months) and secondary stability (1–5 years) of Ti-porous coated tibial components in cementless TKA. Furthermore to reveal adverse reaction to the use of HA.

Material and methods: In the period October 1988 to May 1989 we randomized 30 patients with ostoarthrosis to either Ti-porous coated tibial components (AGC 2000) or tibial components with titanium + 75 microns of HA. The patients had full weight bearing from the second postoperative day.

All patients were marked for RSA during operation by insertion of tantalum markers in the tibial component polyethylene and the tibial metaphysis. Stereo radiograms were obtained in the immediate postoperative period and 3 months, 1 year, 3 years and 5 years postoperatively. Motion results were expressed as the Maximum Total Point Motion (MTPM) i.e. the 3-D vector of the prosthetic marker which moved the most.

Results: Nearly all tibial components migrated during the first year. MTPM 0-3 month: Ti 1.1 mm, Ti-HA 0.5 mm ($p > 0.05$); 0–1 year: Ti 1.5 mm, Ti-HA 0.7 mm ($p > 0.05$); 1–5 year: Ti 0.8 mm, Ti-HA 0.3 mm ($p < 0.05$). One titanium-coated component was revised 4 months postoperatively because of aseptic loosening.

Conclusion: The present randomized study showed that 75 microns HA on titanium-porous coated tibial components enhances the secondary stability. Whether HA enhances bone ingrowth or modifies an intercalated fibrous membrane is unknown.

Five years after operations we revealed no adverse reactions to the use of HA.

Transforming growth factor ß enhances fixation of ceramic coated implants

Martin Lind, Søren Overgaard, Kjeld Søballe, Steven L Beck[1], Tue Nguyen[1], Boonsri Ongpipattanakul[1] and Cody Bünger.

Biomechanics Lab, Orthopedic Hospital, University Hospital of Aarhus, Denmark, and [1]Genentech Inc. South San Francisco, USA

Introduction: Transforming growth factor ß (rhTGF-ß1) is a bone-derived growth factor with numerous stimulatory effects on bone cells and bone tissue. For prosthetic surgery tricalcium phosphate (TCP) and hydroxyapatite (HA) ceramic coatings have proven to be potent conductors of bone tissue. The purpose of the present study was to investigate if rhTGF-ß1 adsorbed onto TCP and HA ceramic coatings could further enhance mechanical fixation and bone ongrowth to ceramic coated implants.

Material and methods: Unloaded cylindrical sandblasted titanium implants (6x10 mm) were inserted into the proximal humerus and into the femoral condyles of 10 adult mongrel dogs. In the distal femoral condyles four implants were inserted, one with uncoated titanium surface, and three TCP coated implants with 0, 0.3 or 3.0 µg rhTGF-ß1. In the proximal humerus one HA coated implant with 3 µg rhTGF-ß1 and one control HA implant was inserted. All implants were initially surrounded by a 2 mm gap. The dogs were killed

after 6 weeks. Push-out testing was performed to assess shear strength, shear stiffness and energy absorption. Bone ongrowth and gap bone formation was assessed by histomorphometry.

Results: All dogs completed the study. Mechanical testing showed that shear strength, stiffness and energy absorption were significantly increased for rhTGF-ß1 stimulated TCP coated implants (Table 1). No significant differences between rhTGF-ß1 stimulated and control HA coated implants were observed. but higher mean values were observed for all three mechanical parameters for the HA/3.0 TGF-ß group. Bone ongrowth and gap bone formation was increased significantly by both 0.3 and 3.0 µg rhTGF-ß1 for TCP coated implants but not for HA coated implants (Table 1).

Conclusion: The present study demonstrated that rhTGF-ß1 is capable of increasing mechanical fixation, bone ongrowth and gap bone formation of TCP coated implants. The 0.3 µg rhTGF-ß1 dose was the best stimulator. For HA coated implants stimulated with rhTGF-ß1 no significant improvements were observed. These data are promising for future use of rhTGF-ß1 for stimulation of bone ingrowth and gap healing in endoprosthetic surgery.

Table 1.

	Ti	TCP			HA	
		0	0.3	3.0	0	3.0
Shear strength MPa	0.05	0.47	1.30	0.90	1.80	2.00
Bone ongrowth (%)	0.3	24.9	41.1	33.9	39.3	38.5
Bone in gap (%)	8.1	9.1	15.8	18.3	9.9	9.4

Foot and ankle

Correction of acquired foot deformities using the Ilizarov method

Hans Gad Johannsen, Jan Beck Mikkelsen, Carsten Ernst, Lis Andersen oand Rainer Weeth

Department of Orthopedics, Odense University Hospital, Odense, Denmark

Introduction: The purpose of the study was to describe the indications and results in 7 corrections of acquired foot detormities using the Ilizarov method.

Material: The indications were sequelae after a fracture in 3 patients, sequelae following a severe burn, sequelae after an embolus in the popliteal artery, deformity after a chronical severe crural ulcer, and deformity caused by Charcot-Marie-Tooth disease in one patient each.

The deformities were often complex and could be summarized as follows: equine position 43° (20°–60°), inversion 42° (30°–70°), adduction in the midfoot 26° (20°–30°), adduction in the forefoot 15° (10°–20°) and varus position at the hindfoot 17° (10°–15°).

Results: In the 5 patients who completed the full course, time of fixation varied from 48 to 169 days. In two of the patients the fixator had to be removed after 17 and 34 days, respectively because of pain. Both patients were treated with a cast. In one patient further surgery was necessary as the deformity partly recurred.

In 3 patients a neutral position was achieved, but in one of the patients there was a reformation of the deformity after 6 months. In the other patients we achieved a reduction of the equinus position of 25°–35°, supination was reduced 10°–70°, adduction in the midfoot was completely neutralized, adduction of the forefoot 10° and varus of the heel 15° reduced. One patient had to use a splint at night to prevent equinus and two patients had to use a special splint while walking.

6 cases of superficial pin-track infection were all treated with antibiotics. In one case the pins were re-positioned and in one case the infection required premature removal of the fixatorbut this did not influence the end result. In 2 cases removal of the fixator was necessary because of pain and in one case the patient was readmitted to the hospital for treatment of the pain. One patient developed 20° of contracture in the knee during the treatment but recovered completely after removal of the fixator.

No injuries of vessels or nerves and no dislocations were seen.

Conclusion: Using the Ilizarov method it is possible to correct complex foot deformities with a good result. Because of the many—often minor—problems the patient must be seen frequently.

Criteria at conventional radiography of the Lisfranc fracture dislocation

Sara Kristensen, Niels Egund, Lis Andersen, Bjørn Gotlieb and Poul Einar Jensen

Departments of Radiology and Orthopedics, University Hospital, Odense, Denmark

Introduction: The Lisfranc injury is basically a dislocation of the tarsometatarsal joints. The findings at radiography can be subtle and commonly are only evident on a single view and may easily be overlooked.

Materials and methods: In 1989, criteria at radiography of undisplaced Lisfranc injuries were introduced at our department of radiology which resulted in 41 additional CT examinations during 4 years. There were 24 men and 17 women aged 35 (15–69) years. CT examinations were performed with coronal and/or transverse sectioning with section thickness of 3 mm.

Results: At CT examination extensive and multiple avulsion fractures within the tarsometarsal joints appeared in 33/41. The findings at radiography were subtle in 29 patients with chip fractures at the base of the 1st and 2nd metatarsal bones and in between the 1st and 2nd cuneiform bone being most common. Transverse fractures at the base of the metatarsals II–IV and avulsion of the distal margin of the cuboid bone may also indicate the injury.

Conclusion: Any avulsion fracture adjacent to the tarsometatarsal joints is suspicious of Lisfranc injury to be confirmed at clinical and/or CT examination. CT with 3-D reconstruction is useful in the pre- and postoperative assessment of displacement.

Tarsometatarsal fracture/dislocation

Bjørn Gotlieb Jensen[1], Lis Andersen[1], Sara Christensen[2], Poul Einar Jensen[1] and Niels Egund[2]

Departments of [1]Orthopedics and [2]Diagnostic Radiology, Odense University Hospital, Odense, Denmark

Aim: To evaluate the condition after tarsometatarsal fracture/dislocation (TMFD) by clinical examination, radiography, CT-scanning and MR-scanning, and to evaluate the treatment in relation to the degree of damage.

Material and methods: 27 consecutive patients who had been treated for TMFD were included. Primarily all patients were examined by radiography and CT-scanning and the lesions were classified according to L P H Leenen. For the follow-up investigation, after 30 (10–49) months, 17 patients were included. Ten were not possible to investigate. All patients were examined clinically, by radiography, CT-scanning and MRI-scanning.

Results: There were 3 cases with grade 2 dislocation, 14 were not dislocated, all verified by radiography and CT-scanning. Two cases of grade 2 dislocations were treated operatively by reposition and fixation by K-wires. The rest were treated conservatively with plaster during 6 (3–9) weeks. At the follow-up, 8 patients had distinct signs of posttraumatic arthrosis, 3 patients had no pain, 10 light, 3 moderate and 1 patient had considerable charging pain, but the correlation between the degree of degenerative change and the symptoms were doubtful. Of those who could not participate, three cases had grade 2 dislocations and two of those were operatively treated. There were no functional differences between grade 1 and grade 2 dislocations. There were no grade 3 dislocations. In most patients the condition was stationary after 18 months.

Conclusion: The primary diagnosis can be difficult to achieve. In the investigation of the extension of the damage, CT-scanning is of great value. Most patients obtained a good function and were almost painless.

Orthopedic shoes and patient compliance

Anders B Philipsen, Niels Ellitsgaard, Michael R Krogsgaard and Stig Sonne-Holm

Orthopedic Department, Copenhagen University Hospital in Hvidovre, DK-2650 Hvidovre, Denmark

Orthopedic shoes are individually handmade after a prescription from an orthopedic surgeon. The literature has no information about the compliance of orthopedic shoes.

Material: Of 100 consecutive patients who had orthopedic shoes prescribed in the period 1990–1992, 85 were still alive. They all received a questionnaire concerning their use of the shoes. For all patients the median age was 64 years and ratio women:men was 70:30. The basic disease was rheumatoid arthritis in 52%, arthrosis in 13%, diabetes in 10%, consequences of trauma in 8% and other conditions in 17%. Of 85 living patients, 74 (87%) answered the questionnaire.

Results: For 62% it was their first orthopedic shoe. 57% used the shoes every day, 23% from time to time and 15% never. 18% used their shoes even though they gave no relief of symptoms. 64% of the patients felt that the shoes relieved the symptoms very much or to some degree. In 20% the symptoms increased with the use of the shoes. The main complaint was that the shoes were too heavy (36%). Only 16% of the patients were followed up by the orthopedic surgeon after the prescription of the shoes.

Conclusion: Only 2/3 of the patients who had orthopedic shoes prescribed used them regularly. 2/3 felt that the shoes relieved symptoms. Some used the shoes although the shoes did not relieve any symptoms. It is suggested that this can be improved if the patients are followed up by the prescribing orthopedic surgeon when the shoes have been delivered.

Pediatric orthopedics

Synovitis in Legg-Calvé-Perthes disease and its correlation to the clinical examination

Kurt Simesen and Niels Egund

Departments of Orthopedic Surgery and Diagnostic Radiology, Odense University Hospital, Odense, Denmark

Material: 33 children (8 girls, 25 boys) with Legg-Calvé-Perthes disease (LCPD) had magnetic resonance (MR) imaging with and without gadolinium carried out after 1, 3, 6, 12, 24 months. 102 MR results were evaluated. The results were compared to the clinical examination. The meam age of the patients at the onset of the disease was 6 (3–13). Bilateral disease was seen in 8. Fourteen children

underwent varus osteotomy and one valgus osteotomy following the MR examinations.

Methods: Synovitis, deformity of the cartilage, symptoms, movement were each graded I to IV. (I normal)

Results: Catterall group II in 2, group III in 8, group IV in 20 hips.

In the stage of condensation (13 MR): Synovitis in 13 examinations, grade III–IV in 9, deformity grade III–IV in 2, symptoms grade III–IV in 11, movement grade III–IV in 12.

In the stage of fragmentation (65 MR): Synovitis in 63 examinations, grade III–IV in 30, deformity grade III–IV in 28, symptoms grade III–IV in 34, movement grade III–IV in 37.

In the stage of restitution (24 MR): Grade I synovitis in 11 (all grade III–IV deformity). Symptoms grade III–IV in 1, movement grade III–IV in 4.

All grade III–IV synovitis had symptoms and movement grade III–IV. In 15 patients synovitis was found in the "normal" hip. Only 2 had symptoms.

Conclusion: Synovitis is normally found in the stage of condensation and fragmentation, but only in deformity of the femoral head in the stage of consolidation.

Good correlation between synovitis, symptoms and movement was found. In unilateral LCPD synovitis could be found in the "normal" hip.

Synovitis in Legg-Calvé-Perthes disease—assessment at Gd-enhanced MR imaging

Niels Egund, Kurt Simesen, Peter Hochbergs, Göran Eckerwall and Hans Wingstrand

Departments of Radiology and Orthopedics, Odense, Denmark and Lund, Sweden.

Patients: During 1991 to 1994, 46 children with Legg-Calvé-Perthes disease (LCPD) aged 3 to 13 years were followed continously with MR imaging. At radiography 35 patients were in the stage of condensation/fragmentation. 9 children had bilateral LCPD and 3 of these were followed during the development of LCPD. Both hips were examined with MR imaging which included T1 weighted Gd-enhanced studies. The size of synovitis and its enhancement at Gd-studies as well as vascularity and deformity of the epiphysis were graded 1-4 at MR imaging.

Results: Severe synovitis grade 3-4 appeared in most hips in early stages of the disease in the age of 6 to 13 years. It was related to age and without relation to deformity or vascularity of the epiphysis. During the course of LCPD, reduction of synovitis was slow. At the final follow-up examination including those with surgery, no synovial protusion or enhancement was recorded, except in those healed with irregular sphericity and reduced containment. 21/26 patients with early stages of LCPD had slight synovitis of the hip not affected by osteonecrosis.

Sonography and intracapsular pressure in Legg-Calvé-Perthes disease

Göran Eckerwall[1], Hans Wingstrand[1], Peter Hochbergs[2] and Niels Egund[3]

Departments of [1]Orthopedics and [2]Radiology, University Hospital, Lund, Sweden and [3]Department of Radiology, University Hospital, Odense, Denmark

Patients: 39 children with Legg-Calvé-Perthes disease (LCPD) and with a radiographically unsatisfactory development. 35 were boys. 5 had bilateral disease. The mean age at the time of the investigation was 7 (5-12) years. 30 hips were classified as Catterall group 4, 9 hips as Catterall group 3. 9 hips were in the condensation stage of the disease and 30 were in the fragmentation stage.

Methods: The children were examined with sonography regarding synovitis and with intracapsular pressure recording and aspiration in conjunction with arthrography performed 15 (2–36) months after the onset of symptoms.

Results: The mean anterior sonographic capsular distension was 3.3 mm compared to the nonsymptomatic hip. The mean intracapsular pressure was 4.5 kPa with the hips in extension and neutral rotation, 9.7 kPa with the hips in extension and inward rotation and 0.9 kPa in 45° of flexion. There was a decrease in capsular distension with the duration of time since onset of symptoms and a decrease in intracapsular pressure in extension and neutral rotation with the duration of time.

Discussion: We conclude that these children have a significant synovitis as diagnosed sonographically. This synovitis is most likely a symptomatically and prognostically important factor in LCPD due to increased intracapsular pressure, pain, a decreased range of motion and, potentially, joint contracture.

Remodelling of the femoral head following femoral varus osteotomy in Legg-Calvé-Perthes disease

Hans Wingstrand[1], Göran Eckerwall[1], Peter Hochbergs[2], Niels Egund[3] and Kjell Jonsson[2]

Departments of [1]Orthopedics and [2]Radiology, University Hospital, Lund, Sweden and [3]Department of Radiology, University Hospital, Odense, Denmark

Patients: 60 consecutive children were followed with serial radiography and MR imaging. Mean age at onset of symptoms was 5.7 years. 21 developed at MR imaging loss of containment and anterolateral flattening indicating surgery at which mean age was 7.2 years. 16/21 were in Catterall group 4 and 5 in group 3. All were in group C according to the lateral pillar classification of Herring.

Methods: Open wedge femoral 20° varus derotation intertrochanteric osteotomy stabilized with sliding screw and plate was performed. Immediate weight bearing and

physical activity ad libitum was allowed and physiotherapy was continued. Measurements of the bony and cartilaginous outline of the hips at radiography and MR imaging were performed using the method introduced by Hochbergs et al. (1994).

Results: There was a significant early and continuous cartilaginous remodelling of the deformed femoral head as the flattening decreased from 28% preoperatively to 14% at the third follow-up at 4 years postoperatively. There was a similar improvement of the bony outline. Sphericity improved in all cases, no case deteriorated. There were no surgical complications.

Conclusions: MR imaging provides early and reliable information on the shape and remodelling of the femoral head. In prognostically unfavorable cases osteotomy with immediate weight bearing. physical and physiotherapy activity ad libitum results in an early continuous spherical remodelling of the femoral head.

Slipped capital femoral epiphysis 10 years after epiphysiodesis

H H Strange-Vognsen, A Wagner, A Hede and S Bach Christensen

Departments of Orthopedics and Radiology, Rigshospitalet, Denmark

Patients and methods: 24 patients, 9–16 years old with 29 hips suffering from slipped capital femoral epiphysis. The slip was acute in 3 hips. The displacement was equally divided between the 3 groups mild, moderate and severe. Twelve were treated with osteotomy, five with reduction. All had epiphysiodesis with 2 AO screws and this was often performed on the asymptomatic side too. Follow-up included questionnaire, physical and radiographic examination.

Results: 4 patients had hip trouble during work and 2 others had stopped working or changed occupation due to hip problems. 8 had considered given information about the disease in their choice of occupation. 5 had often and 6 rarely hip pain. 11 had a mild limp after heavy exercise and 12 felt limitation in their walking distance. 7 who denied pain had discomfort from their hip during heavy exercise. None used crutches.

Radiography in standing AP-position and frog-leg lateral position showed signs of arthrosis in 8 hips. The displacement was measured in the frog-leg lateral position as the difference between the affected side and the normal side. We measured the displacement using acceptable radiographs from the time of operation and using the frog-leg lateral at follow-up. On the basis of 18 hips a spontaneous reduction of 11° (–3° to 32°) was found. In 18 unaffected hips the corresponding reduction was -3° (–18° to 7°).

Conclusion: The prognostic consequences regarding employment and recreational activities should be emphasized to each patient. At follow-up, discomfort as well as pain from the hip should be noticed. After the epiphysiodesis spontaneous reduction of the femoral head occurs, in average 10° measured in the frogleg lateral position.

Spine

Anterior decompression and reconstruction using the Kaneda device

Peter Blyme, Pavlos Katonis, Martin Gehrchen, Thomas Kiær and Erik Tøndevold

Department of Orthopedic Surgery, Rigshospitalet, Copenhagen, Denmark

Introduction: We report the short-time results of 17 patients treated by anterior decompression and stabilization using bonegraft and the Kaneda device.

Materials and methods: Since November 1992 until May 1994, 17 patients (9 women, 8 men) were treated by anterior decompression and reconstructive stabilization using bone graft and the Kaneda device. Age ranged from 31 to 63. The indications for surgery were compression of the spinal cord/cauda equina and pain. Diagnoses were congenital kyphosis (2), tumors (6), fractures (6), infections (3). Follow-up was 4–21 months.

Results/conclusions: Anterior decompression and reconstructive stabilization performed as a one-stage procedure was effective in the treatment of the anterior compression of the spinal cord. None of the patients got worse and most of them got better concerning neurologic deficit and pain. All the patients were mobilized in a brace shortly after surgery which is particularly important in the tumor patients.

Bone remodelling after lumbar spinal fusion with pedicle screw technique

P M Gehrchen[1], M M Petersen[1], P K Nielsen[2] and T Kiær[1]

Departments of [1]Orthopedics and [2]Nephrology, Rigshospitalet, University of Copenhagen, Denmark

Introduction: The purpose of this study was to measure changes in bone mineral content (BMC) at the site of the posterior fusion grafts and changes in bone mineral density (BMD) above the level of the fusion and in potentially stress shielded regions at the fusion level.

Material and methods: Bone mineral measurements were performed by Dual Energy X-ray Absorptiometry (DEXA). Ten patients who had a posterolateral fusion in the lumbar spine with pedicle screw technique and bone grafts were scanned antero-posteriorly the day before surgery, 7 days

after, and after 1.5, 3, and 6 months. BMC was measured at the fusion graft site. BMD was measured above the fusion (L1 and L2), below the proximal pedicle screws (PS) and above the distal pedicle screws (DS) (potentially stress shielded regions).

Results: In the sites of the fusion grafts a significant decrease in BMC was seen after 1.5 months (2.47 ± 1.11 g to 1.52 ± 0.74 g (means ± SD)). A slow decrease in BMC continued throughout the study period. When comparing to preoperative status a slow decrease in BMD in L1 and L2 was seen. After 6 months this was significant in L1 (0.95 ± 0.07 g/cm^2 to 0.88 ± 0.09 g/cm^2). Changes in BMD in the two stress shielded regions were compared with the 7 day postsurgery values (to avoid reposition error of the regions of interest). In these regions BMD decreased, although not significantly (1.09 ± 0.29 g/cm^2 to 0.98 ± 0.23 g/cm^2).

Discussion: Quantitative measurements of bone mineral at the site of the fusion grafts after lumbar spinal fusion with pedicle screw technique has not previously been performed in vivo. During the healing process the fusion grafts are non loaded regions and these early results could be explained as a local bone resorption during the induction of new bone formation. Long term follow-up is needed to determine the time of bone mineralization which is believed to be between 6 and 12 months after surgery. The decrease in BMD above the fusion and at the potential stress shielded regions after 6 months corresponds with earlier reports and may be the result of bone remodelling because of disuse or stress shielding.

Operative treatment of adult spinal deformity with CD-implants

Thomas Kiær, P Martin Gehrchen, Pavlos Katonis, Peter Blyme and Erik Tøndevold

Department of Orthopedics, Rigshospitalet, University of Copenhagen, Denmark

Surgery for adult spinal deformity is known for a high complication rate and variable success rate.

We present 17 consecutive cases (median age: 33 years) with severe spinal deformity (scoliosis and kyphoscoliosis) with the aim of clarifying the indications for surgery and the resources needed. All patients were treated in 1991–1993 and the median follow-up was 50 weeks. 10 patients had severe scoliosis and 7 had kyphosis or kyphoscoliosis. Indications for surgery were in all cases pain or the combination pain/paraparesis. 12 patients had a posterior approach with correction and fusion, 5 had a two stage anterior/posterior procedure.

2 patients had infection. 3 had reoperations, 1 with early loosening of the implant and 2 with late and repeated loosening (both operated on 4 times and both primarily fused to sacrum). 2 had the implant removed (1 after healing and the other had the implant removed at another hospital because of suspicion of neurological complication).

A mean correction of 50% of the Cobb angle and the kyphosis angle was obtained. The most significant complications were seen in patients out of balance. All patients with paresis were fully restituted. 14 patients healed primarily. 12 were satisfied with the operation. The complication rate was especially high in long fusions ending on sacrum (all out of balance had failure of the implant in this group).

Despite the demand for resources and the high complication rate in this group of patients with severe deformities and secondary symptoms (paresis), surgery seems to have a relative indication. All cases with paresis were restituted and the majority of the patients were satisfied with the operation.

Conclusion: The treatment is resource demanding and as such the decision of surgery and the treatment should be restricted to experienced spinal centers.

Neural blood flow in acute double level spinal stenosis

Stig M Jespersen. Kirsten Ø Christensen, Lene Svenstrup, Bent E Lindblad, Ebbe S Hansen and Cody Bünger

Departments of Orthopedics, Clinical Physiology, and Nuclear Medicine, Institute of Experimental Clinical Research, University of Aarhus, Denmark

Introduction: The mechanism behind neurologic dysfunction in spinal stenosis is controversial. The aim of this study was to determine the influence of different degrees of double level central spinal stenosis on blood flow in medullary tissue and spinal nerve roots.

Material and methods: 32 pigs, 3 months old, 33–38 kg. Regional blood flow (RBF) was determined by radioactive microspheres.

A) 24 pigs were randomly assigned to one of three groups, a control group, a group with 25% stenosis, and a group with 50% stenosis. In the control group, RBF was determined before surgery and after creation of a 0% sham stenosis. In the 25% and 50% stenosis groups, the first RBF measurement was performed after placement of the bands immediately before introduction of the stenosis, and the second flow was measured one hour after introduction of stenosis.

B) A 4th group with 75% stenosis was added when results of the randomized experiment were analyzed. Somatosensory evoked potentials (SSEP) and motor evoked potentials (MEP) were recorded. After termination the neural tissue was removed segmentally, separated into grey matter, white matter, and nerve roots, and counted. RBF (mL*min*100g^{-1}) was calculated.

Results: Latency changes >10% and amplitude changes >50% were observed in SSEP in 1 or 2 of 8 animals in 0%, 25% and 50% stenosis groups but in 7 of 8 animals in the 75% stenosis group. RBF increased from before surgery to after creation of the 0% sham stenosis. ANOVA revealed no differences in RBF between the three randomized groups.

Within groups before and after stenosis, no decrease in RBF was found in any of the four groups.

Conclusion: The blood supply of the spinal cord and nerve roots in the segments between two central stenoses is preserved, even when nerve conduction is impaired.

Oncology

MRI evaluation of sarcomas

Thorkil Christensen, Johnny Keller, Ole Steen Nielsen and Olaf Myhre Jensen

The Center for Skeletal and Soft Tissue Sarcomas, the MR-Center, the Departments of Orthopedics, Pathology and Oncology, University Hospital, Århus, Denmark

Aim: To evaluate the ability of MRI to differentiate between malignant and nonmalignant conditions in patients referred to MRI under suspicion of sarcomas.

Material and methods: A retrospective investigation including all examinations performed due to suspicion of sarcoma at the MR-Center, Skejby University Hospital in the period June 1990 – June 1994. Totally 429 patients were included, 211 with a histologically verified sarcoma or metastasis and 218 with nonmalignant disease.

Results: In all cases of histologically verified malignancy the MRI investigation also pointed at malignancy. Apart from five cases of liposarcomas, MRI was unable to clarify the histological nature of the tumor. In 218 cases of nonmalignancy MRI gave a suspicion of malignancy in 23%. In four of 56 lipomas MR suspected a malignant condition. In all 22 cases of a bursa or ganglion the MRI statement was correct. In 15 out of 16 cases of angiomas the MRI statement was correct. A muscle rupture was diagnosed in 10 cases.

Conclusion: In all cases of histologically verified malignancy MRI pointed at malignancy. In nonmalignant conditions MRI suspected malignancy in 23%. MRI was able to indentify a great number of lipomas, angiomas, bursae and ganglions.

Treatment of giant cell tumor in bone in a 13 year period

Karin Vissing, Johnny Keller, Ole Steen Nielsen, Olaf Myhre Jensen and Otto Sneppen

Center for Bone and Soft Tissue Sarcomas, University Hospital of Århus, Denmark

Aim: Giant cell tumors in bone are aggressive benign neoplasms with a tendency to local recurrence, and sometimes transformation to malignant neoplasms. In the present study our experience with giant cell tumors is analyzed.

Material: In the period 1980-1992, 37 patients (15 women and 22 men) with giant cell tumors were treated. Mean age was 35 (16–62) years. 19 tumors were located in the knee region, 5 in distal part of radius, 4 in the small bones of the hand, 3 in the spine, and 6 in the other parts of the skeleton. 5 patients were operated on before admission to our hospital. The mean time from onset of symptoms to operation in our center was 11 (1–60) months.

Results: 18 patients were treated with curettage. In 13 the cavity was filled with bone chips and in 5 the cavity was filled with bone cement. Excision of tumor was performed in 14 cases, 8 were reconstructed with a fibular graft, and 5 were operated on with an arthroplasty. One tumor was excised without reconstruction of the bone. Five patients were amputated. The patients were followed for mean 15 (9–60) months. We found local recurrence in 8 cases; 5 of 13 who were treated with curettage and bone chips, 2 with reconstruction of bone with fibular graft. One patient with recurrence was treated with curettage and bone cement. In 1 patient we found metastases in a pulmonary lymph node 2 years after the primary operation which was treated with radiation therapy.

Conclusion: The study shows good local tumor control in the group treated with curettage and filling of the cavity with bone cement, and in the group treated with tumor excision. The tumor control was markedly worse in the group treated with curettage and filling of the cavity with bone chips.

Giant-cell tumor—long-term follow-up of 31 cases

Peder Klement Jensen, Gunnar Schwarz Lausten, Torben Schiødt and Bjarne Lund

Departments of Orthopedics and Pathology, Rigshospitalet, University of Copenhagen, Denmark

We studied the prognostic value of the histopathological grading of giant cell tumor (osteoclastoma) and the long-term rate of local and distant recurrences in a consecutive series of 31 patients. We found no prognostic value of the histopathological grading. 18 patients were treated with excochleation, while 13 patients were treated with wide excision. 10 patients, all treated with excochleation had local recurrence, while none of the tumors treated with wide excision recurred ($p < 0.05$). 5 patients had local recurrence as well as distant metastases, usually to the lungs. In 3 patients, the recurrences developed later than average 12 years after the primary treatment. Wide excision and life-long follow-up should be considered in these rare bone tumors.

Varia

A rabbit model for local intraarterial infusion of drugs or hormones

Harald Moustgaard Knudsen, Malene Laursen, Bue Bak, Ivan Hvid and Troels Torp Andreassen

Department of Connective Tissue Biology, Institute of Anatomy and Department of Ortopedic Surgery, University of Århus, Århus, Denmark

Introduction: The aim was to develop a model for intraarterial infusion into the hind limb of the rabbit via the femoral artery by means of a miniosmotic pump. We have now developed the model and investigated to what extent the catheterization of the femoral artery influences the growth rate in the proximal tibial growth plate of the hind limb compared to the contralateral noncatheterized limb.

Materials and methods: Six female rabbits (New Zeeland White) age 9–11 weeks were used. The catheter was made of a 20 cm long polyethylene catheter with a diameter of 1.2 mm glued together with a 5 cm long polyethylene catheter with a diameter of approximately 0.6 mm. Surgical procedure: By means of an operating microscope, the femoral artery was exposed. The lateral circumflex femoral artery was exposed and catheterized. The thin part of the catheter was passed 1.5 to 2 cm into the femoral artery and was ligated to the lateral branch. The catheter was connected to a miniosmotic pump (Alzet) which contained isotonic saline with heparine 500 IE/mL and was placed inside the peritoneum. Growth rate in the proximal tibial growth plate: Five or six days after the operation Calcein 15 mg/kg was injected intravenously. The animals were killed 4 days later. The lateral tibia condyle was founded into methylmetacrylate and cut into 10-µ slices. Under a flourescence microscope the distance from the lower edge of the growth plate to the Calcein line was measured in 16 predefined spots. The thickness of the growth-plate was also measured in these 16 spots.

Results and conclusion: No significant difference was found in the growth rate in the proximal growth plates of the tibia (control 0.275 mm/day, catheterized 0.279 mm/day, [paired t-test; $p = 0.50$]). No significant difference was found on the thickness of the growth plates (control 0.506 mm, catheterized 0.491 mm, [paired t-test; $p = 0.39$]).

The model permits intraarterial infusion in the femoral artery without influencing the growth rate in the proximal growth plate of the tibia or the thickness of the proximal growth plate. We aim to use this model to investigate the possibility of enhancing longitudinal bone growth of the hind limbs of rabbits by means of local intraarterial growth hormone application.

The Medoff sliding plate for extracapsular hip fractures

Leif Ceder[1], Karl Lunsjö[1], Leif Stigsson[2] and Anders Hauggaard[2]

Departments of [1]Orthopedic Surgery and [2]Radiology, Helsingborg Hospital, Helsingborg, Sweden

A new concept in compression screw systems for use in high subtrochanteric and unstable intertrochanteric fractures was introduced in 1991 by Medoff. His device allows sliding to occur in a direction parallell to the longitudinal axis of the femoral shaft, but has also the option to slide in the direction of the femoral neck.

The Medoff device was used by 19 different surgeons in two prospective consecutive series consisting of 112 and 121 patients with a mean age of 81 years. In the first series only sliding along the femoral shaft was allowed and in the second series also along the neck. Clinical and radiographic examinations were conducted at day 1 and 7, at 4 and 12 months, postoperatively.

Series one: 99 intertrochanteric fractures – 8 technical failures; 13 subtrochanteric fractures – 0 technical failure. *Series two:* 107 intertrochanteric fractures – 1 technical failure; 14 subtrochanteric fractures – 0 technical failure.

We recommend sliding in both directions in intertrochanteric fractures in order to reduce the risk of screw penetration of the femoral head. Sliding only along the femoral shaft prevents medialisation of the femoral shaft in subtrochanteric fractures.

Arthroscopic partial meniscectomy—a long-term follow-up

Claus Möger, Allan Buhl, Anders Odgaard and Peter Faunø

Department of Orthopedic Surgery, University Hospital Århus, Århus, Denmark

A 10-year follow-up study was conducted to clarify the clinical and radiographic long-term consequences of arthroscopic meniscus resection. 177 patients who had unilateral arthroscopic resection of an isolated meniscal tear attended for an interview and a physical and radiographic examination. The patients were scored clinically according to the Lysholm and Tegner scoring scale and the radiographic changes according to the Fairbanks classification. The non-operated knees were used as control knees.

The reoperation rate was as high as 20% for the flap-tear group and 14% for the bucket-handle group. Pain after exercise was less frequent among patients treated for a bucket-handle tear compared to other lesions. According to the Lysholm score 70% of the patients had an "excellent function" (>90 points) and there was no difference in score between the groups.

55% of the patients had at least one of the Fairbanks changes in the operated knee and only 22% in the control knees. The radiographic result was not influenced by the type of meniscus lesion nor were high age or intraoperatively described cartilage damage factors of influence. Valgus and varus malalignment were found to be a significant risk factor for the development of degenerative changes following meniscus resection.

Vascular effect of norepinephrine and neuropeptide Y during ischemia in bone

Lars Bundgaard Nielsen[1], Bent Lindblad[1,2], Jacob Gjedsted[1], Reimar Thomsen[1], Anders Bjurholm[3], Ebbe Stender Hansen[1,2] and Cody Bünger[1,2]

[1]Institute of Experimental Clinical Research, [2]Department of Orthopedics, University of Århus, Denmark, and [3]Karolinska Hospital, Stockholm, Sweden.

Introduction: The sympathetic nervous system plays a major role in bone blood flow regulation. Norepinephrine (NE) and neuropeptide Y (NPY) are sympathetic transmitters with vasoconstrictive action on bone resistance vessels. The aim of the present study was to examine bone vascular resistance and vascular sensitivity to NE and NPY during ischemia.

Materials and methods: Nine pigs, 50–60 kg, were used. One was only accepted for the first two hours of study because of serious bleeding. The tibial nutrient artery was cannulated and perfused bilaterally in situ using peristaltic pumps at an initial bone perfusion pressure (BPP) equal to the mean arterial pressure (MAP). Every half hour, P02, pCO_2, and pH were measured in arterial blood, venous blood, and intraosseous blood drawn from the proximal metaphyses through bone cannulae. One tibia was perfused with arterial blood (control preparation). The other was perfused first with arterial blood for one hour, then with venous blood for four hours (ischemic preparation). Cumulative dose-response trials with NE and NPY in random order were performed simultaneously in the control preparation and the contralateral ischemic preparation. Each trial consisted of five log steps (NE 10^{-9}–10^{-5} M, NPY 10^{-10}–10^{-6} M), five minutes at each step. One hour washout was allowed before and after each trial. The vasoconstrictive response was expressed as percentual change in area under the BPP curve. Data (mean (SEM)) were analyzed with paired t-test (5% significance level).

Results: MAP and central blood gas tensions were steady throughout the study. Arterial blood (n 8): pO_2 = 14.1 (0.31) kPa, pCO_2 = 5.54 (0.18) kPa, and pH = 7.42 (0.03). Venous blood: pO_2 = 6.01 (0.27) kPa, pCO_2 = 6.49 (0.20) kPa, and pH = 7.37 (0.02). The difference between BPP of the control preparation and the ischemic preparation during venous blood perfusion was significant after 30 minutes (6.42%, $p < 0.01$, n 9), and marginally significant after 15 minutes (4.24%, $p = 0.06$), 45 minutes (4.69%, $p = 0.09$) and 60 minutes (5.72%, $p = 0.08$). The relative vasoconstrictive response to NE was (n 8) 22.8 (5.8) % in the control preparation and 32.8 (8.0) % in the ischemic preparation. The response to NPY was 14.1 (3.2) % in the control preparation and 17.1 (5.4) % in the ischemic preparation. None of these differences were statistically significant.

Conclusion: Perfusion of the porcine tibia with hypoxic blood at the venous level had a small but detectable dilating effect on the bone vascular tree after 30 minutes, but no detectable effect on the vasoconstrictive action of norepinephrine or neuropeptide Y on the bone vascular bed.

Regional blood flow measurement in bone with "molecular microspheres"

Hans Tromborg, Lene Birk-Sørensen, Dorthe Andresen, Vibeke Hjortdal and Ebbe Stender Hansen

Department of Orthopedics, Institute of Experimental Clinical Research, Department of Clinical Physiology and Nuclear Medicine, University of Aarhus, Denmark

Introduction: Arteriolar blockade with 15-µm microspheres (MS) has gained acceptance as the reference method for blood flow measurement in bone. The method suffers, however, from the problem of microsphere skimming which might skew flow measurements in bone, and the particular nature of the markers sets the resolution limit of the method at around 1 g of tissue.

Recently, a molecular deposition marker, 2-iodo-desmethyl-imipramine (IDMI, nicknamed the "molecular microsphere"), was introduced, primarily for myocardial blood flow measurement. The purpose of this study was to evaluate IDMI for blood flow measurement in bone.

Material and methods: The experimental model used was an isolated, blood perfused porcine tibia. Nine pigs, approximately 40 kg, were used. One tibia was removed, placed in a bath with 37 °C isotonic saline, and perfused through the cannulated nutrient artery with heparinized blood drawn directly from the anesthetized pig using a pulsatile pump. The blood was added first 15-µm MS and then a mixture of ^{131}IDMI and ^{125}I-fibrinogen, a large plasma protein which does not leave the blood stream. Samples were drawn serially from the bath to follow washout of tracers. The bone perfusion pressure (BPP) was monitored continuously.

Results: BPP was unchanged during IDMI infusion, but increased by mean (SEM) 16 (7) % during MS injection ($p < 0.05$). The fractions of tracers that had been washed out to the bath after 11.5 min. were 14.0 (3.5) % for MS, 42.0 (4.5) % for IDMI, and 90.5 (2.4) % for fibrinogen. Positive correlation was found between regional blood flow measured with IDMI and MS ($p < 0.001$). However, IDMI generally underestimated bone blood flow. The discrepancy between blood flow with IDMI and MS was less pronounced in low flow areas and more pronounced in high flow areas.

Conclusion: The disappointingly low IDMI retention tends to invalidate the method for flow measurement in

bone. The skewed blood flow values obtained suggest that extraction of IDMI in bone depends on blood flow.

Electrical stimulation of the anterior cruciate ligament elicits no muscular reflex

Michael Rindom Krogsgaard, Poul Dyhre-Poulsen and Adam Hede

Department of Orthopedic Surgery, Rigshospitalet, and Department of Medical Physiology, the Panum institute, Copenhagen, Denmark

Introduction: Mechanical traction on the intact anterior cruciate ligament (ACL) peroperatively has been shown to stimulate the hamstrings. This study was performed to clarify whether this reflex is initiated from sensory fibers in the ACL or in other structures.

Patients and methods: In 6 patients, who underwent knee arthroscopy and had no signs of cruciate ligament disease, two stimulation wires were inserted into the proximal and distal end of the ACL. The ligament was stimulated every 5 sec. with a monophasic constant current stimulus lasting 1 ms. Surface electromyogram (EMG) was recorded from biceps femoris, semitendinosus, the medial head of quadriceps and the rectus femoris muscle. 50 consecutive sweeps were full wave rectified and averaged both at rest and while the subjects flexed or extended against an external load. The experiments were performed with the knee in full extension and in 30 degrees flexion.

Results: There was no change in the EMG amplitudes following the stimulus, neither at rest nor during muscular contraction.

Conclusion: A strong electrical stimulus to the nerves in the entire ACL, was not able to elicit any increase or decrease in the EMG activities in hamstrings or quadriceps. This indicates that EMG responses to mechanical stimulation of the ACL, reported earlier, are elicited from other parts of the knee, or that it is impossible to elicit the reflexes with singular stimuli.

Posters

The changes of the injury pattern in the emergency department of a county hospital from 1983 to 1993

Henrik Husted, Jens Ole Laursen, Knud Clasen and Mette Nørgaard

Department of Orthopedics, Sønderborg Sygehus, Sønderborg, Denmark

Introduction: A material is presented to illustrate the injury pattern in the emergency department of a central hospital and compared to a similar material from the same department ten years ago (1).

Materials and methods: All patients addressing our emergency department during February, May, August and November 1993 were recorded and variables associated with their contact were analyzed. 3729 patient-contacts were evaluated and compared to the 2603 patient-contacts which were recorded during the same periods of time in 1983. A chi-square test ($p < 0.01$) was used to evaluate the changes in the variables from 1983 to 1993.

Results: We found an increase in patient number of 50% from 1983 to 1993 in our emergency department, although the number of inhabitants in the area had only gone up with 13%, with an incidence of patients contacting the casualty department of 13%. The suburban patients account for the greatest increase (57%), and very small or negligible injuries not needing any treatment at all count for the greatest increase among injuries (28% of all injuries in 1993 and 20% in 1983; an increase of 40%). The incidence of severe injuries needing hospital admission for proper treatment is unaltered in 1993 compared to 1983, and is found to be 8 per thousand patients per year at our department of orthopedics. There were significant increases in injuries contracted at home and related to sporting activities, while injuries related to working situations as well as to traffic situations and violent incidents did not increase.

Conclusion: The great and significant increase of 50% in the number of patients addressing the emergency department in 1993 compared to 1983 is mostly due to a large group of patients with minor injuries not needing any treatment at all. The incidence of severe injuries needing hospital admission has not increased, but is unaltered indicating that a shift in the population seems to have taken place as to when the extent of an injury necessitates visiting the casualty department. We, therefore, advise the distribution of further material with information to patients describing precautions to be taken when small injuries occur and including information about symptoms indicating the need for visiting the emergency department.

Reference: 1. Jensen TT, Holm L, Mossing NB. Skadestuemønstret på et centralsygehus. Ugeskr Læger 1985; 147; 117-21.

Variations in mechanical properties of trabecular bone from infancy to adulthood in lamb and sheep

Adel Nafei, Frank Linde and Ivan Hvid

Laboratory of Biomechanics, Århus University Hospitals, Århus, Denmark

Introduction: The aim of this study is to illuminate the relationship between age and mechanical properties of trabecular bone.

Materials and methods: Three groups of lamb aged 3, 6, and 9 months and two groups of sheep aged 36 and 80 months were studied. Sample sizes are 9, 10, 9, 8 and 10 respectively. A 4.2 mm cube of the subchondral trabecular bone was cut out of the center of medial tibial condyle according to a standardized protocol, in compliance with the 3 anatomical directions of the tibia. Nondestructive compression tests of the specimens in the three directions were performed in accordance with Linde's work (1). A compression test to failure in the axial direction of the specimens was later performed. The specimens were defatted to determine their apparent densities. The variables considered were age, stiffness, ultimate stress, ultimate strain, energy absorption to failure, viscoelastic energy, apparent density, and mechanical anisotropy ratio.

Results: Increasing age correlated significantly with the stiffness ($r = 0.59$, $p < 0.0001$), with energy absorption to failure ($r = 0.68$, $p < 0.0001$), and with ultimate stress ($r = 0.63$, $p < 0.0001$). The ultimate strain showed a significant inverse correlation with increasing age ($r = -0.41$, $p = 0.004$). A significant inverse correlation was found between increasing age and the viscoelastic energy absorption in the three directions (axial direction $r = -0.49$, $p = 0.0005$, average of the 3 directions $r = -0.54$, $p < 0.0001$). The apparent density correlated positively with age ($r = 0.72$, $p < 0.0001$) and with the stifness ($r = 0.79$, $p < 0.0001$). The stiffness was significantly higher in the axial direction than in the antero-posterior and medial-lateral directions (paired t-test, $p = 0.0002$). No significant difference was found between the mechanical anisotropy ratio in the different age groups (Chi square test, $p > 0.05$). The mechanical anisotropy ratio did not significantly correlate with age ($p > 0.05$).

Conciusions: 1. Age has a significant influence on most of the mechanical properties of trabecular bone.

2. The strength increased and deformation at the failure-point decreased with increasing age.

3. The viscoelastic energy absorption decreased with increasing age. This has not been reported earlier.

4. The trabecular bone specimens showed age independent mechanical anisotropy with highest stiffness in the axial direction, supporting Wolff's law and suggesting that the bone adapts only to load.

Reference: 1. Linde F. Elastic and viscoelastic properties of trabecular bone by compression testing approach. Thesis 1993; Lægeforenings Forlag, Copenhagen, Denmark.

The social consequences of sports injuries in school-aged children

Lilli Sørensen, Søren Larsen, Niels Dieter Röck and Torben Mørup

Department of Orthopedics, Esbjerg Centralsygehus, Esbjerg, Denmark

Purpose: To describe the social consequences of sport injuries among children aged 6–17 years.

Method: A questionnaire was handed to children with a sport injury attending the A&E department at Esbjerg Central Hospital in the period July through December 1993.

Results: 632 children were included in the study, 597 (94.5%) responded. 40 different types of sport were represented. Based on contacts from the municipality of Esbjerg the incidence rate was 74/1000/year. The highest numbers were seen in soccer (25%), handball (13%), gymnastics (11%), horseriding (10%) and basketball (9%). The types of injury were sprains 34%, contusions 31%, fractures 24%, abrations/lacerations 7%, strains 2%, luxations and others 2%. 3% were hospitalized, horseriding was the cause in 39%. 58% of the injuries occured during training/competition, 42% were sustained during recreational sporting activities or at school (18%). 78% af the children were organized in a club. As a mean they were training 2.3 times/week. 34% were absent from school in an avarage of 3.5 days after the injury, normally caused by fractures, distorsions and cerebral contusions (5.6 days). After the injury 108 children were not able to transport themselves to and from school. Absence from training/competition passes was 11.3 (mean). 97 children were absent 9 days (mean) from after school job. 6 were absent from full time work.

Conclusion: The social consequences of sportsinjuries are obvious. Most of the injured children were participating in organized sport activities or physical education in school. The target for preventive actions must be the sports associations or schools.

Postoperative autotransfusion of autologous shed blood

Martin Wyman Rathcke and Jan Bo Gynning

Department of Orthopedics, Sundby Hospital, Copenhagen, Denmark

We examined the efficiency of autotransfusion with autologous shed blood in reducing homologous blood transfusion.

Material and method: The CONSTAVAC autotransfusion has been used after knee and hip replacement on the department since 1991. In the period November 1991 through April 1993 the efficiency of autologous bloodtransfusion was evaluated comparing it to the period November 1989 through April 1991, before the use of autotransfusion.

The amount of blood given by autotransfusion and the number of postoperative bloodtransfusions were recorded

and compared. The results were grouped according to the type of operation (TKA/THA) and period (+/– autotransfusion). The null hypothesis was that no effect on the number of postoperative homologous transfusions could be seen.

Results: Average amount of autotransfusion:

TKA-group 743 (0–1800) mL,

THA-group 307 (0–1300) mL.

Average number of postoperative homologous bloodtransfusions:

TKA + autotransfusion (n=37) 1.37

TKA – autotransfusion (n=38) 1.53

THA + autotransfusion (n=63) 1.26

THA – autotransfusion (n=77) 1.35

Mann-Whitney test, confidence 95%:

TKA-group: $P = 0.19 > 0.05$,

THA-group: $P = 0.29 > 0.05$.

In both groups the null hypothesis is accepted, and no difference in the number of postoperative homologous transfusions after the use of autotransfusion can be demonstrated.

Conclusion: No effect on the number of homologous bloodtransfusion to patients receiving TKA or THA can be demonstrated after the use of autotransfusion.

Waiting list—are the official records valid?

Ole Brink, Bent Wulff Jakobsen and Jørn Jensen

Department of Orthopedic Surgery, Århus University Hospital, Denmark

Introduction: The aim of this study was to consider the validity of the orthopedic waiting list.

Materials and methods: Every patient listed in the county's central database as waiting for elective orthopedic surgery for more than 3 months were contacted by letter and questionnaire. The questionnaire addressed the current symptoms and desire for surgical treatment or if surgery already had been done elsewhere. The letter stressed that nonresponders would have their surgery cancelled.

Results: 809 were sent a questionnaire. 77 answered that no symptoms remained. Of 409 nonresponders 105 had their surgery cancelled after thorough review of the notes. 77 had improved in the waiting time, and did not want any surgery (Table).

111 were incorrectly registered in the hospital database and 26 were added to the list due to errors.

Table. Removed from the waiting list

Nonresponders	105 (9.9%)
No symptoms	77 (7.2%)
Referred to out-patient surgery	35 (3.3%)
Referred to another hospital	5 (0.8%)
Moved	16 (1.5%)
Surgery done already	24 (2.2%)
Registration errors	111 (10.5%)
Total	376 (35.6%)

Conclusion: A thorough review of the waiting list revealed cancellations of planned surgery in 36%, 17% due to improvement in symptoms and 10% registration errors.