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Arthroplasty

Survival of total hip arthroplasty after previous femoral neck fractures

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Introduction: The Survival of total hip arthroplasties (THA) after previous hip fractures was studied. These prostheses were compared with prostheses in patients who were operated because of osteoarthrosis (OA).

Patients and methods: From September 1987 to January 1994 the Norwegian arthroplasty register had collected data on 3,864 THA performed because of sequelae after hip fractures. During the same period 19,607 patients were operated with THA because of OA. Prothesis survival was evaluated using the Kaplan-Meier method.

Results: During the period of registration the revisions constituted 98 (2.5%) in the group of fracture and 449 (2.3%) in the group of arthrosis. The first 6 months of the postoperative period, the survival analyses revealed better results for the arthrosis group. After 6 months there was no significant difference between the survival distribution.

The reasons for reoperations differed in the two groups. Reoperations due to dislocations were performed in 29% of all reoperations in the fracture group compared to 9% in the arthrosis group ($p<0.001$). Revision due to femoral shaft fracture was reported in 6% of the reoperated patients in the fracture group, versus 2% in the group with arthrosis ($p=0.02$). More patients with arthrosis needed, however, a revision arthroplasty because of loosening of the acetabular component (29% of the reoperations) than in the fracture group (11%) ($p<0.001$). We found no significant difference between the two groups concerning deep infection, loosening of the femoral component or pain.

Conclusion: Except for the first 6 postoperative months, the prosthesis survival in patients with sequelae after femoral neck fracture was as good as for THA in patients with OA. Compared to patients with arthrosis more patients with femoral neck fracture had to be reoperated because of dislocation or femoral shaft fracture. Fewer fracture patients, however, had to be reoperated because of loosening of the acetabular component.

Local hypercoagulation and methyl methacrylate monomer (MMA) cytotoxicity contribute to induction of femoral vein thrombosis during hip replacement surgery in pigs

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Introduction: Cemented total hip replacement surgery is associated with a high frequency of femoral deep vein thrombosis (DVT). We have previously shown that this process seems to be initiated by a tremendous systemic thrombin generation during bone traumatization, impaired fibrinolysis, and upregulation of tissue factor (TF) expression in monocytes. MMA has been shown to induce endothelial cell and leukocyte damage *in vitro* with release of harmful substances and exposure of subendothelial matrix as potential consequences *in vivo*. These processes may be operating locally in veins draining the surgical area and may thus contribute to the formation of solitary femoral DVT. An *in vivo* animal study in pigs was initiated to test this hypothesis.

Materials and methods: Two groups with eight pigs in each, were anesthetized, tracheotomized, intubated and ventilated. Catheters were inserted into the deep femoral veins draining the femoral shaft both on the operated and unoperated sides. Blood samples were withdrawn simultaneously from both femoral veins at frequent intervals during femoral shaft broaching, cement impaction and up to 90 minutes after prosthesis implantation. Plasma thrombin-antithrombin complexes (TAT) (Enzygnost TAT, Behringwerke AG, Marburg, Germany), tissue plasminogen activator (t-PA) and plasminogen activator inhibitor-1 (PAI-1) activities (Biopool, Umeå, Sweden) were analyzed. Temperature registration was performed inside and outside the femoral cortex during cementation using copper/constantan thermocou-

ple electrodes (Thermospannungsmesser, Knick, Berlin, Germany). At the completion of the experiment the femoral veins from both control and operation sides were removed and subjected to scanning electron microscopic (SEM) examination. In one *in vivo* substudy, a jejunal mesenteric segment was flushed with 10µg/mL MMA for five minutes followed by blood reperfusion. In another *in vitro* substudy vein segments were incubated with MMA (10µg/mL) for 10-30 minutes and the vessel wall examined by SEM.

Results: TAT increased in the femoral blood during preparation of bone and decreased following femoral implantation of cement and prosthesis. At the same time an increase in plasma t-PA levels and a depression of PAI-1 activity were found. The values indicated a significantly higher activation of coagulation and fibrinolysis on the operated side compared to the control side in both groups. However, they were markedly lower in the uncemented group compared to the cemented group in veins draining the operation field. The femoral veins from the operated pigs contained thrombi in 62% on the operated side in the cemented group and in 25% in the uncemented group. With the marrow cavity completely filled with bone cement, the temperature increased to nearly 80 °C at the inner surface of the femoral cortex and to 42 °C on the outer side. With a prosthesis introduced the temperature scarcely exceeded 40 °C on the inner side, and was close to normal extracortically. SEM examination of the MMA-incubated vein segments showed endothelial cellular derangement. The MMA-flushed mesenteric veins were covered with fibrin deposits on the inner wall.

Discussion: This study showed that bone traumatization and prosthesis implantation using bone cement induced local activation of coagulation and fibrinolytic shutdown as reflected in blood sampled from the deep femoral veins draining the operation area. MMA caused detrimental effects on the endothelial coverage of intact venous walls. The high incidence of femoral thrombus formation found in this study may therefore partly be related to the local cytotoxic effects of MMA which was confirmed by the higher incidence of DVT in the cemented compared to the uncemented group. The hyperthermia generated by curing cement probably has no influence on the pathophysiological processes at sites distant from the immediate cement/bone tissue interface.

The Norwegian Arthroplasty Register—the first 6 months of registration of prostheses in knees, fingers, shoulders, elbows, toes, wrists and ankles

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Introduction: The Norwegian Arthroplasty Register was established for prospective registering of hip arthroplasties in 1987. The recording of other joint replacements started January 1, 1994, and a survey of the registered data for the first 6 months is presented.

Material: 784 prostheses were registered: 486 knee, 144 finger, 58 shoulder, 40 elbow, 39 toe, 10 wrist and 7 ankle arthroplasties. Rheumatoid arthritis was the predominant reason for joint replacement except in the knee arthroplasties were arthrosis dominated and for the shoulders were 35% given a prosthesis because of fractures.

Knee prostheses: 463 (95%) of the knee arthroplasties were primary operations. These operations were carried out in 36 different hospitals. Mean age of these patients with primary knee joint replacement was 70 (18–87) years and 74% were women. 69% were operated because of arthrosis and 18% because of rheumatoid arthritis. 10% were sequelae after traumatic events and 1% after infections. Median operation time was 100 (45–240) min. 1.7% peroperative complications were registered. In 67% of the arthroplasties cement with antibiotics was used, in 22% cement without antibiotics and only 2% were uncemented. 8% were hybrids i.e. uncemented component in femur and cemented in tibiae. Systemic antibiotic prophylaxis was used in 98%. A patellar component was used in 30% of the primary total knee replacements. 11% (50) knees were operated with unicondylar prostheses. Infection was the reason for revision in 8 of the 23 reoperated knee arthroplasties. The most common total knee prostheses used were TriconC/TriconII (215), the Genesis (75), the Kinemax (31), the AGC (30), the TriconM/TriconII (29) and the Duracon/PCA (25). The following three unicondylar prosthesis were registered: Mod III (30), Genesis Uni (16) and Oxford Meniscal (4).

Follow-up examination of Souter elbow prostheses

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During the period 1984–1992, 34 patients (37 elbows) had Souter elbow prosthesis replacement. One patient did not meet at the follow up examination and six patients had died.

Material and methods: 27 patients (26 female) with 30 elbow replacements, were examined at the follow up. 25 patients had rheumatic arthritis and one patient had sequelae from tuberculosis. Seven patients had elbow synovectomy previously and one patient was operated because of an elbow fracture. The average age at the time of operation was 62 (47-76) years. The mean observation time was 62 (18-117) months. The indication for surgery in all patients was severe pain and a reduced elbow function. Preoperative radiological examination revealed considerable pathological changes in all the elbows.

Results: Six of the patients underwent revision with new

prosthesis replacement. One patient was reoperated with extirpation of cement and scar tissue resulting in a ulnar nerve palsy. The indications for the reoperations were fractures, loosening of prostheses and luxations. Peroperative fractures, all in or around the ulnar epicondyle, occurred in six operations. Three prosthesis luxated shortly after the operation. All the complications except one luxation, occurred during the primary operations. No postoperative infections were observed.

All patients answered a questionnaire. According to this 19 elbows (63%) were improved after the prosthesis operation, eight elbows (26%) were in a poorer condition and three patients had no definitive opinion. Clinical examination showed that all patients had an extension deficit, mean range -36° (-10° to -90°). The mean flexion range was 128° (100°–145°). Follow up radiographic examination showed that six of the humerus components were firmly fixed. The other 24 humerus components had a varying degree of radiographic loosening around the cement (1–4 mm). 19 of the ulnar components were firmly fixed. 11 had a varying degree of loosening around the cement (1–3 mm). 17 humerus components had a cranial migration and 15 of them had a volar tilt with an angle of 5°–40°. One prosthesis had dislocated totally. Four of six elbow prostheses replaced with a new prosthesis, were worse than before the first operation. Two improved after the operation. All patients that had a fracture during the operation are, or will be reoperated.

Conclusion: More than half of the elbows had improved after the operation. Radiographic loosening of the prostheses makes an uncertain prognosis for the majority of the patients. Peroperative fractures give a poor result. Revision by a new prosthesis gives a unsatisfactory result.

Ultrasonic device for revision arthroplasty

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The quality of bone present at revision arthroplasty is often extremely poor. Using manual instruments, complications such as cortical perforations and fractures are well known. Recently, ultrasonically driven tools have been developed for use in revision arthroplasty. We report our preliminary results with this device, Ultra-Drive Biomet.

Methods: The ultrasonic console converts electrical energy into synchronous waveform. This electrical energy is converted to mechanical energy by the handpiece. The tool tips shape and concentrate this mechanical energy, and a variety of tool bits have been developed that perform specific functions.

Materials: We have used the device in 4 revisions of cemented total prosthesis, 3 hips and one elbow. All revisions were performed using a combination of ultrasonic and hand tools.

Results: The cement removal time was 46, 30, 24 and 45 minutes. The operation time was 105, 110, 150 and 140 minutes. There were no complications such as bone perforation or fracture during the operations and no postoperative complications.

Conclusion: The advantages of this new device include the ease of cement removal and preservation of bone stock. This improves the revision surgery.

Spine

Severe spondylolisthesis (ptosis) treated with laminectomy and in situ posterolateral and interbody fusion

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An accepted treatment of symptomatic spondylolisthesis is posterolateral fusion. In high grade of slipping, laminectomy is often indicated, and higher incidence of nonunion is reported. Some authors advocate reduction and fusion, but the risk of complications is high according to most reports. The method described by Bohlman in 1982, and Smith and Bohlman in 1990, has as far as we know not been used in this country before. We therefore want to describe one case:

A 17-year old girl presented with L5–S1 ptosis and back- and thigh- pain during activity, and by extension of the spine (prone position). MRI revealed severe spinal stenosis. In prone position a broad L4-S1 laminectomy was performed. After using a guide pin and cannulated drill, a graft taken from fibula was placed from the anterior edge of the spinal canal through the body of the S1 and L5 vertebrae. Then posterolateral grafting (autogenous) was performed. She was mobilized with a brace. 9 months later the radiographs showed fusion. After the first week she had very few complaints, and before one year she resumed all normal activities. The typical spondylolisthetic posture does not bother her.

Conclusion: Severe spondylolisthesis is uncommon. When it appears, the method of treatment described by Bohlman, and used in our case, is safe, and simple, and should be considered.

Reference: Smith M D and Bohlman H H: Spondylolisthesis treated by a single stage operation combining decompression with in situ posterolateral and anterior fusion. J Bone Joint Surg 1990, 72-A, No. 3.

Idiopathic scoliosis operated with interspinous segmental instrumentation ("Wisconsin", or Issi)

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10 girls with idiopathic scoliosis were treated with correction and spondylodesis with Harrington and Luque rods and spinous process wiring ("Drummond" or "Wisconsin"). As far as we know, our hospital is the only one in Scandinavia using this method, and we therefore bring the results.

At the time of operation the mean age was 15 (13-18), and the follow up time was 2.5 (1–4) years. The main curve was thoracic in 7 cases (King 2 and 3). The 3 patients who had the lumbar or thoracolumbar curve instrumented had a back-brace postoperatively, the others were mobilized without. 12 curves were instrumented. The mean operation time was 256 (145–385) min., mean transfused blood 3.7 (0–9) units, and mean time in hospital 13 (8–14) days.

No serious complications were noted, but one girl had transient backache for months, and one had facial muscle pain for about one month.

Results: The curves were reduced from mean 52 degrees preoperatively (43–60) to 28 (19–38) degrees postoperatively (correction 47%). The final result was mean 31 (21–38) degrees (correction 40%). The median values are very similar to the mean. The thoracic kyphosis was unchanged (19 towards 19.5 degrees). The rib-hump was reduced in half of the cases, unchanged in 4 patients, and enlarged by 40% in the last case. 4 girls were at least 2 cm out of balance before, none afterwards.

Conclusion: Using this method in treating idiopathic scoliosis, is relatively simple, and is connected with very few complications. It is a good method of choice in a center like ours, which has relatively few cases. Our 10 patients now have no complaints.

Boston brace—activity level and self-esteem

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Introduction: The purpose of this study was to see if Norwegian youths with idiopatic scoliosis and ongoing Boston brace treatment had a lower activity level and a reduced self-esteem compared to a control group.

Material and methods: 25 patients (23 girls and 2 boys) treated conservatively with a Boston brace were compared to 19 healthy girls of similar age. Both groups individually answered a questionnaire.

Results: Activity level: The brace group had a lower percentage of club memberships, but participated in a larger number of organized activities compared with the control group. Time used on organized activities was equal in both groups. About 60% had changed types of activity during the last year in both groups—25% in the brace group because of the brace. Friends, physical activity and pet care were favorite activities during leisure time in both groups. The control group had a higher physical activity level during their time off.

Self-esteem: The braced group was more satisfied with the situation at school. They did not try to deny or hide the brace. Their friends accepted them as fully normal individuals as none was mobbed because of the brace. Most patients thought they did not differ from their friends, and did not hesitate to make contact with others because of the brace.

Conclusion: The brace group had a slightly decreased activity level compared to the control group. Their self-esteem was as good as the controls.

Upper extremity

Secondary displacement in Colles' fracture

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Patients and methods: 645 patients (517 women and 128 men, mean age 61 (SD 16) years) with conservatively treated Colles' fractures were prospectively followed until union. 199 fractures were undisplaced (Older type 1), 148 minimally displaced (type 2), 161 displaced with comminution of the dorsal radius (type 3), and 137 displaced with severe comminution (type 4). Severely displaced Older type 4 fractures were primarily operated and not included in the study. The length of the radial styloid distal to the ulna in the anteroposterior view and the dorsal angulation in lateral radiographs were measured at four different points: prior to the reduction, after cast application, after 11–12 days and after 4 weeks.

Results: The fractures subsequently lost some of their reduced position during the immobilization period. The mean shortening of the radius during plaster-cast treatment was 3 mm, and the mean increase of dorsal angulation was 7 degrees. Multiple regression analyses showed that initial dorsal angulation, age and Older type were important predictor variables for the end result of dorsal angulation. Initial radial length, age and initial dorsal angulation were of importance for the end result of radial length. The strongest linear relationship was found between the end result of radial length and the initial radial length (r=0.67).

Conclusions: The results indicate that the patients at risk of malunion with radial shortening are those with significant

radial axial shortening at the initial presentation. Thus, these patients should not be treated with plaster-cast, but with a more stable fixation device.

Postoperative anti-edemic effect of paracetamol, naproxen and placebo in hand surgery—results from a double blind, randomized study

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Introduction: The aim of the study was to assess the postoperative anti-edemic effect of paracetamol and naproxen in hand surgery.

Patients and methods: 77 patients with either a primary one-finger Dupuytrens' contracture (DC) (33 male, 2 female, age 62 ± 14 years) or a primary carpal tunnel syndrome (CTS) (16 male, 26 female, age 57 ± 13 years) participated. The study had a double blind randomized design with double dummy technic. The patients were treated with paracetamol 1g x 4, naproxen 0.5g x 2 or placebo for 3 days. The volume of the hand was recorded preoperatively and at 72 hours postoperatively. Postoperative swelling was assessed by subtracting these two volumes. Volume was recorded as follows: A waterproof horizontal mark was made at the wrist. Up to this mark the hand was immersed in a calibrated glass beaker with overflow pipe (NaCl 0.9%). The displaced saline solution was weighed and converted to millilitres. The average of 3 consecutive recordings was used for further calculations. The same hand mark was used for all measurements.

Results: Compared to placebo there was significant difference in postoperative swelling between DC and CTS patients. For this reason the results from the two groups could not be pooled as planned, but had to be tested separately. For both DC and CTS patients there were no significant differences in swelling in either of the 3 treatment groups. In the DC group there was a tendency towards best anti-edemic effect of naproxen, least effect of placebo. Untreated postoperative swelling (placebo) after CTS and DC operations were respectively 14 ± 11 mL (4 + 2% of hand volume) and 37 ± 28 mL (8 ± 5% of hand volume), significantly different from zero. 10 patients needed additional analgesic treatment (8 CTS, 2 DC), 8 of these were in the placebo group, 2 in the paracetamol group. The figures might indicate that postoperative pain is worse after CTS-operation compared to DC, even though the development of swelling is greater in the DC-group. Negligible gatrointestinal adverse effects were recorded in 2 patients in the naproxen- group, 1 patient in the paracetamol-group and 1 patient in the placebo-group.

Conclusion: In this study on patients operated for CTS and DC, there were no significant differences in anti-edemic effect between naproxen, paracetamol and placebo. Both operations yield significant postoperative swelling.

Osteoarthrosis of the acromioclavicular joint, an underestimated cause of shoulder pain

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Osteoarthrosis of the acromioclavicular (AC) joint is a well known, but rarely mentioned cause of shoulder pain in recent literature. In a Swedish thesis (Stenlund, Stockholm 1992) axial loading of the AC-joint by forced adduction of the arm is documented to reveal 27% more AC-osteoarthrosis than with traditional radiography. This study shows that an even larger number of AC-joint osteoarthrosis is revealed by using the immediate effect of intraarticular injection of marcaine into the AC-joint as a diagnostic criterion.

Material and methods: In the course of a 5-month period from September 1993, 50 patients, aged 15–70 years, were referred to our department due to shoulder pain. Conservative treatment for more than half a year had been ineffective. The patients were examined clinically and radiographically included with axial loading. Suspicion of AC-osteoarthrosis led to diagnostic injection of marcaine into the AC-joint. Instant pain relief led to resection of 0.5 cm of the lateral part of the clavicle in 7/50 patients (group A). 16/50 patients (group B) were treated also for co-existing causes of shoulder pain. The material was somewhat special: patients in groups A, B and C had an oxygen uptake below average.

Results: Following a mean observation period of 6 months, the results were satisfying regarding shoulder pain, mobility and working capacity. In group A 4 patients reported sick returned satisfied to work. Of 11 patients reported sick in group B, 9 patients returned to work. None of the 4 disabled patients returned to work although 14 patients were satisfied, 1 was better and 1 unchanged.

Conclusion: In this prospective study of patients with shoulder pain, the occurrence of AC-osteoarthrosis was surprisingly frequent. The simple treatment which may be performed in the out-patient department has so far shown gratifying results.

Peripheral nerve entrapment as a cause of shoulder pain

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Only 7 authors have seriously spoken of a connection between peripheral nerve compression and proximal pain, that is referred pain to the arm, shoulder and neck. In recent studies by the first author, on decompression of early peripheral nerve entrapment in patients with normal conduction time, such a connection has been frequent. In addition, pain from acromiclavicular osteoarthrosis has been surprisingly frequent. We report the first prospective study taking both these diagnostic alternatives into account.

Material and methods: In the course of a 5-month period from September 1993 50 patients, aged 15–70 years, were referred to our department due to shoulder pain. Conservative treatment for more than half a year had been ineffective. The patients were examined clinically, radiographically with axial acromioclavicular loading, neurophysiologically, and in cases of doubt an additional manual work-test and thermography was carried out. In 6/50 patients (group C) entrapment was the only cause of shoulder pain, leading to decompression of peripheral nerves. 16/50 patients (group B) suffered from a combination of peripheral nerve entrapment and acromioclavicular osteoarthrosis (see former abstract on groups A and B), and these were treated with both lateral resection of the clavicle and decompression of peripheral nerves. 21/50 patients (group D) had other causes of their shoulder pain and were treated accordingly, some conservatively.

Results: Following a mean observation period of 6 months, the results were satisfying in relation to shoulder pain, mobility and working capacity. Of 11 patients reported sick in group B, 9 patients returned to work. None of the 4 disabled patients returned to work although 14 patients were satisfied, 1 was better and 1 unchanged. In group C all patients were satisfied, but only 3 patients reported sick returned to work while 3 disabled patients did not change employment status.

Conclusion: In this prospective study of patients with shoulder pain, the occurrence of peripheral nerve entrapment and osteoarthrosis of the acromioclavicular joint was surprisingly frequent. In this material, being somewhat special, these 2 diagnostic alternatives seem to replace the diagnosis of shoulder impingement. The symptoms of shoulder impingement presently appear to be secondary to the former conditions. The simple treatment, which may be performed in the out-patient department, has so far shown gratifying results.

Varia

Congenital pseudoarthrosis of the tibia corrected with the Ilizarov external fixator

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Introduction: Congenital pseudarthrosis of the tibia with or without axis- or shortening deformities is a difficult problem to solve in pediatric orthopaedics and a variety of operating procedures have been described to treat patients with this diagnosis. In our hospital we have used the Ilizarov external fixator and method to treat 4 children with congenital pseudarthrosis during the last 12 months.

Material: Three girls and one boy 2.5 to 6 years of age were treated. All had previously been operated one to three times. The patients were operated with resection of the pseudarthrosis and acute shortening distally combined with corticotomy and callotasis lengthening proximally. Correction of malalignment was performed as an acute intraoperative procedure over an intramedullary nail in all 4 patients. In one patient the nail was kept intramedullary during the fixation period to prevent axis deformation during the lengthening procedure.

Results: In all 4 patients the pseudarthrosis healed, in one an axis deformation occurred. In spite of short observation time, the results look promising. In our hands the Ilizarov procedure is a good method in treatment of these children.

Preliminary studies of the biomechanical environment in experimental distraction osteogenesis

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Introduction: The gradual distraction of an osteotomy in a long bone with an external fixator creates a unique mechanical environment which leads to the formation of new bone. The purpose of this experiment was to investigate the net force acting on the gap tissue as the interaction between the distraction tension from the fixator and the compressive forces applied to the limb from muscle activity and weight bearing during functional loading and to investigate the average strains occurring within the gap tissue.

Material and methods: Measurements of the distraction tension and functional loads were done in 8 rabbits using a custom made strain gauge instrumented external fixator. The rabbits underwent bilateral tibial lengthenings with a distraction rate of 0.75 mm per day. The force in the fixator was recorded once daily during distraction with the animals sus-

pended in a mesh sling and during functional activity with the rabbits walking on the floor. At 5 days post distraction strain in the gap was directly observed and videotaped through fluoroscopy using a mini C-arm while recording the load in the fixator. To investigate the interaction between the distraction tension and functional loads, a standard Ilizarov frame (four rings and eight wires) was constructed and mounted in a MTS machine for axial loading in compression. The distraction gap tissue stiffness was modeled by a linear spring and placed in series with a load cell to directly monitor the gap force. The frame was distracted to create a baseline tension in the gap spring. Five loading cycles of 0–225 N were applied and a data acquisition system was used to record the applied external load and the gap load cell output.

Results: The average peak force generated in the fixator during functional loading was 71.2 (SD 5.1) N. The average post sacrifice fixator stiffness was 46.6 (SD 9.9) N/mm. The final distraction gap was in average 8.2 mm with a range of 7.5–8.8mm. The associated average deflection of the fixator and strain in the gap were calculated to be 1.5 mm and 18%, respectively. These values were verified by the 1–2 mm deflection seen on the fluoroscopic images. As the external load was applied to the Ilizarov frame in the MTS machine the average gap distraction force showed small fluctuations and went from 90 to 76 N. Thus, tension was maintained as the primarily net gap force despite the application of 225 N to the frame.

Conclusion: Global gap tissue strains during functional activities are very high. According to traditional theories of fracture healing, this level of strain would lead to nonunion, but new bone formation in the gap is normally both successful and rapid. The distribution of strain across the gap is unknown and depends on local tissue geometry and material properties. Accordingly, the local tissue and it's mechanical environment must be characterized to analyze the influence on the local bone formation process.

Muscle function after bilateral femoral lengthening—a prospective study with a two-year follow-up

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Introduction: Limb lengthening of the femur may be indicated both in leg-length discrepancies and in young people with short stature. The purpose of this study was to evaluate how muscle strength in quadriceps and hamstrings change after a bilateral femoral lengthening procedure.

Material and methods: From 1989 to 1992 nine short statured people (mean age 15.6 years) underwent bilateral lengthening osteotomies (18 segments). All lengthenings were performed by a transverse osteotomy of the proximal femur and a unilateral Orthofix device was used for distraction and fixation. The distraction rate was 1mm per day in four increments. Muscle performance was tested isokinetically in knee extension and flexion on a Cybex 340 dynamometer. The test protocol consisted of 5 repetitions at an angular velocity of 60°/sec followed by 25 repetitions at 180°/sec.

Results: The average femoral lengthening was 7.5 (5–10) cm, giving a relative lengthening (lengthening/original length x 100) of 17.1 (12.4–18.6)%. The mean observation time for the first and last operated limb was 3.6 and 2.3 years, respectively. There were three major complications; two femoral fractures through the lengthening zone and one case of varus deformity.

Small changes in muscle performance were found postoperatively for both muscle groups. Except for quadriceps peak torque at 60°/sec (last operated femur) which showed a reduction of 18.7% ($p<0.01$), there were no statistical significant difference between the pre- and postoperative isokinetic measurements.

The average VAS score pre- and postoperatively was 99.8 (98–100) and 75.5 (5–100) respectively. For the patient's subjective opinion of the overall result the mean score was 92.6 (72–100). Two patients had problem with patellofemoral pain. All patients had normal range of motion.

Conclusion: The results from this study indicate that femoral lengthenings up to 18% of the original femoral length lead to minimal reduction in muscle force both in quadriceps and hamstrings. However, two fractures, one varus deformity and two patients with patellofemoral pain were registered.