Dissertation abstracts

Management and prognosis of patients with high-grade soft tissue sarcomas

An evaluation of a Scandinavian joint care program

Thor Andreas Alvegård

Lund University Hospital Department of Oncology, S-221 85 Lund, Sweden

Doxorubicin is one of the most active single agents in metastatic soft tissue sarcoma. This was the rationale for the evaluation of doxorubicin in an adjuvant situation for patients with high-grade soft tissue sarcoma in a randomized, Scandinavian, multicenter joint care program, which was carried out from January 1981 to February 1986, and included 240 patients. These patients comprised the base series for the investigations of the importance of the surgical margin and radiotherapy for local tumor control; the accuracy of malignancy grading and tumor typing; prognostic factors, including DNA content; and epidemiologic risk factors.

The results showed that the use of doxorubicin as adjuvant chemotherapy did not have clinical benefit in patients with high-grade soft tissue sarcoma.

The overall local tumor control was high (94 percent) for radically operated on extremity-located tumors due to strict classification of surgical margins. The only risk factor for local recurrence was marginal surgery without radiotherapy with a four times higher risk than after compartmental or wide surgery. Twelve percent of the operations reported as radical were reclassified as marginal, demonstrating the importance of reevaluation of surgical margins, and in these patients the local recurrence rate was 37 percent. One fourth of the tumors were reclassified as regards tumor type and 40 percent as regards malignancy grade. Reclassification of 20 tumors resulted in ineligibility for the trial, underlining the importance of histologic review in sarcoma studies. Also grading highly malignant soft tissue sarcoma in two grades (Grades III and IV) increased the prognostic information.

Histologic malignancy grade IV, increasing tumor size, vascular invasion by the tumor, male sex, and DNA aneuploidy were identified as independent prognostic factors. The 5-year metastasis-free survival for the whole patient series was 55 percent, with the extremes 79 percent for the patients with no or only one risk factor and 0 percent for those with four or five risk factors. The five prognostic factors found could be used for selection of high-risk patients for adjuvant chemotherapy in the future.

The epidemiologic study gave limited support for an association between occupational phenoxy-acid exposure and soft tissue sarcoma development.

Dissertation University of Lund 1989

Unicompartmental and bicompartmental knee replacement

Longitudinal and predictive analyses

Anders L. Barck

Departments of Orthopedics, Karolinska Hospital and Södersjukhuset, Karolinska Instituted, S-104 01 Stockholm, Sweden

Compartmental replacement was thought to lead to a more natural feeling of the replaced knee and less risks than the hinged replacement used at the time of its introduction. The design and clinical results of the Gunston-Hult prosthesis, which is a modification of the original concept introduced by Frank Gunston in the late 1960s, was described.

The prosthesis had a polycentric femoral component and a flat tibial plateau fixed to bone with small pegs and cement. The prosthesis had been used for substitution of worn-out joints surfaces in inflammatory and noninflammatory disease. A consecutively treated series of the first 116 knees treated with this prosthesis has been followed from replacement (which was performed between 1973 and 1976) until 1986.

All the patients had intolerable pain, reduced walking capacity, and radiographically verified reduction of the tibiofemoral joint line before replacement. The pain decreased in all the patients within a year, and 82 percent had a good clinical result. Adequate range of motion and pain alleviation was attained within a year in 47 percent of the arthrotic knees and in 36 percent of the rheumatoid arthritic knees. Of conventional clinical characteristics, only flexion was not significantly improved. The risk expressed as early general and local complications was 7 percent. Reoperations were performed in 19 percent of the arthrotic knees and in 31 percent of the rheumatoid arthritic knees, forced mobilization being the most common procedure. The original treatment was abandoned in 12 percent of the knees.

After 10 years, 75 percent of the arthrotic knees and 33 percent of the rheumatoid arthritic knees still had a good result. At the final follow-up, the clinical score was lower than before replacement in 6 percent of the arthrotic knees and in 21 percent of the rheumatoid arthritic knees. The best results were attained in unicompartmentally replaced arthrotic knees.

The Gunston-Hult surface replacement system yielded results similar to other prosthetic methods for the knee.

Dissertation Karolinska Institute 1988

ISBN 91-7900-562-4

Neuroendocrine peptides in bone

Anders Bjurholm
Department of Orthopedics, Karolinska Hospital, S-104 01 Stockholm, Sweden

The present work on skeletal innervation focused on identification of nerves according to transmitter content and their possible physiologic role.

Indirect immunohistochemical technique was applied to long bones in the rat. In a methodologic study, demineralization of bone specimens in cacodylate-buffered EDTA after animal in vivo perfusion with Zamboni's fixative was found to preserve transmitter antigenicity. In long bones, nerve immunoreactivity was detected to substance P (SP), calcitonin gene related peptide (CGRP), vasoactive intestinal polypeptide (VIP), neuropeptide Y (NPY), tyrosine hydroxylase (TH), and interleukin-1 (IL-1). Analysis of the distribution disclosed that all parts of long bones were supplied with peptidergic and noradrenergic nerves. However, they were sparse in cortical bone. In contrast, there was an abundance of immunoreactive nerves in cancellous bone, particularly along the osteochondral junction of the epiphyseal plate, and in the periosteum. The majority of nerves were found close to or within blood vessel walls. However, free nerve endings were observed between osteal and chondral cells of the epiphyseal plate, amidst bone marrow cells, and in the periosteum. The occurrence of IL-1 in marrow nerves among immunocompetent cells may prove to reflect a neuronal regulation of the immune system. The predominance of SP, CGRP, NPY, and TH nerves in regions of high osteogenic activity may reflect, apart from sensory mediation and vasoactivity, a neuronal involvement in bone physiology, hypothetically, also in bone development.

Therefore, the occurrence of different nerves was analyzed at different stages of heterotopic bone formation induced by allogeneic bone matrix. Within 3–4 weeks, ossicles with red bone marrow developed after a preceding chondral phase. The first nerve structures were discernible in the beginning of the second week. Thus, fibers immunoreactive to SP, CGRP, NPY, and TH occurred amidst differentiating chondroblastic cells in fibrous tissue around and within the implants. Over the next 3 weeks, the nerves increased in number and gradually attained a shape and distribution as previously observed in normal bone. The experiment shows that immunoreactive nerves appear at an early stage of bone formation, presumably coinciding with angiogenesis. The temporal occurrence and distribution of different nerves during bone formation may indicate a neurogenic involvement in early bone development and metabolism.

To assess a possible physiologic role of different transmitters in bone, three cell lines of osteoblastic phenotype (UMR 106-01, ROS 17/2.8, and SaOS-2) were challenged with SP, CGRP, VIP, NPY, and NA; for comparison also with PTH and PGE_2. Enhancement of cAMP formation by UMR cells was elicited by CGRP, VIP, NA. NPY was found to reduce cAMP rise induced by NA and PTH. In ROS cells, only NA and PTH stimulated cAMP formation. SaOS cells were found to increase formation of cAMP when challenged with NA, VIP, and PTH. The results indicate that osteoblastic cells are equipped with receptors to CGRP, VIP, NA, and NPY utilizing cAMP as transducer. Moreover, in UMR cells, NPY inhibits cAMP formation induced by NA and PTH. The latter finding represents the first demonstration of a receptor interaction between a local neuropeptide and a systemic calcium regulating hormone.

The combined findings indicate that there is a neuroendocrine influence on bony physiology, and hypothetically also skeletal ontogeny.

Dissertation Karolinska Institute 1989

On the development of a new concept for orthopedic implant fixation

Lars V. Carlsson

Biomaterials Group, Departments of Handicap Research and Orthopedics, Mölndal Hospital, and Department of Orthopedics, Sahlgren Hospital, University of Gothenburg, Brunnsgatan 2, S-413 12 Gothenburg, Sweden

The interface of cemented, as well as uncemented, arthroplasties are usually of a fibrous nature, and aseptic loosening is a major problem. In order to develop a fixation method of direct bone anchorage for orthopedic implants, the significance of implant design, initial implant fit, surface texture, and energy and loading conditions have been investigated. In humans and in animals screws, double cylinders, and T-plates were histologically examined after 4 to 14 months in situ. The screws showed a direct bone apposition at the cortical passage, whereas the double cylinders and the T-plates showed mostly a fibrous tissue interface. In a rabbit model, c.p. titanium cylinders with an initially differing fit to the bone were inserted in circumferential tibial defects. Histologic examination after 6 to 12 weeks revealed that a very close initial adaption was a prerequisite for direct bone-to-metal apposition. An initial gap of 0.35 mm was too large to be reliably bridged by bone. Polished and unpolished screws were inserted in the rabbit femoral condyles for 6 weeks. Smooth surfaced implants showed a significantly ($P < 0.01$) decreased resistance to unscrewing compared with rough surfaced ones. A computer-based image analysis showed a similar histologic interfacial reaction for the two types of implants. Plasma-treated and conventionally treated c.p. titanium screw-shaped implants were inserted in the vicinity of the knee of rabbits, and were biomechanically and histologically examined after 6 weeks. There were no differences in removal torque or histologic outcome between the implants. A prosthesis for the femoral part of the femoropatellar joint in the rabbit was developed. The articulating element was fixed to the bone by a c.p. titanium screw implant. The joint was dynamically loaded immediately after insertion. Computer-based histomorphometry after 3 months in situ revealed a direct osseous apposition of the threaded implants of the order of approximately 60 percent.

In conclusion, a direct bone apposition may be established to solid c.p. titanium implants in the vicinity of the knee joint. Screw-shaped c.p. titanium implants developed more direct contact to the bone than did T-plates and cylinders. A close initial fit between bone and implant is mandatory to achieve a direct bone contact. Smooth-surfaced implants have less resistance to unscrewing than have rough-surfaced ones. Similar interfacial reactions were found for plasma-treated and conventionally treated c.p. titanium endoosseous implants. C.p. titanium screw-shaped implants may develop a direct bony contact, even if they are immediately dynamically loaded.

Dissertation University of Gothenburg 1989

ISBN 91-7900-798-8

Anterior cruciate deficient knees
Arthrometry, stabilization

Lars Dahlstedt
Department of Orthopedics, Karolinska Institute, Danderyd Hospital, S-182 88 Danderyd, Sweden

Studies on different treatment principles and on arthrometry were performed on patients with anterior cruciate ligament injuries.

The results after combined medial and lateral extraarticular stabilization on 39 patients showed that 10 patients had secondary intraarticular reconstructions and that the remaining patients had an acceptable Lysholm score, but an anterior laxity of the same magnitude as nonoperated on chronic anterior cruciate ligament deficient knees on a waiting list for reconstruction.

The use of artificial materials in anterior cruciate ligament reconstruction was evaluated in two studies.

A bovine tendon prosthesis (Xenograft) was used as a substitute in 28 patients. Five patients underwent reoperation due to synovitis and graft rupture during the first postoperative year. After 3 years, most of the patients with a remaining graft (n 21) had good function, but more than half of the operated on knees were considered to have a nonfunctioning graft with an injured-uninjured arthrometric difference ≥ 3 mm.

In a prospective study, 23 patients were randomized to augmentation reconstruction with a polypropylene augmentation device (Kennedy LAD) and 18 to reconstruction with a polytetrafluoroethylene ligament prosthesis (Goretex). At follow-up after a median of 36 months' improvement in Lysholm scores, activity scores and arthrometry values were registered in both groups. Effusions, however, were an unacceptable problem in the Goretex group.

Arthrometric measurements of anterior laxity were performed before and during anesthesia on patients with tears of the anterior cruciate ligament. The influence of anesthesia on the anterior stability was distinct especially in acute injuries.

Patients selected for conservative treatment after an acute anterior cruciate ligament injury were evaluated, and a reference group consisted of patients who were selected for acute operative augmentation reconstruction and 50 knee-healthy students. Patients selected for conservative treatment were satisfied with acceptable scores, but showed increased sagittal laxity.

It is concluded that 1) arthrometry is valuable and has good reproducibility, but that the results are influenced by the examining situation; 2) results after extraarticular stabilization, Xenograft substitution, and Goretex substitution are not acceptable; 3) short-term results after augmentation of an autologous graft with a synthetic polypropylene braid seem to be acceptable; and 4) patients with acute anterior cruciate ligament injuries who are selected for conservative treatment are often satisfied, but they have unstable knees.

Dissertation Karolinska Institute 1989
ISBN 91-7900-822-4

Dynamic ultrasonic evaluation of congenital hip dislocation

Håkan Dahlström
Department of Orthopedics, University of Umeå, Umeå, Sweden

The dynamic anterior ultrasonic approach was developed with the aim to improve diagnosis of neonatal hip instability. The basic goal for the ultrasonic technique was to create a method for visualization of the actual degree of joint instability during provocation of the hip joint. This was achieved if the transducer was applied in the groin with the child in the frog-leg position. The projection visualized the entire hip joint and produced an image corresponding to an ordinary AP plain radiograph of the proximal femur and a lateral view of the acetabulum and coincided with the plane of instability when the hip joint was provoked according to Barlow. Thus, the ultrasonic technique provided the opportunity to quantify the actual degree of joint instability. As it was shown that the size of the hip joint varies, it was concluded that instability was best described as a percentage of the femoral head diameter.

The anatomy of 20 stable hips and 35 hips with varying degrees of instability was investigated in newborns. Statistical evaluation could not reveal any safe definitions for determining, on behalf of the static anatomy only, if a hip was unstable or not. The only exception was a femoral head diameter below 14 mm (n 8), which always indicated instability.

The normal amount of hip instability was investigated with ultrasound in a consecutive cohort of 108 healthy newborns. One day after birth, the normal instability was 4 percent (SD 4 percent) diminishing to 2.1 percent (SD 3.4 percent) on the fifth day of life. At one month of age, all the hips were completely stable. All the hips studied developed normally without treatment. In the same study of 108 newborns, as well as in another consecutive study of 108 newborns referred for suspected hip instability, manual determination of instability was found to be highly unreliable. In both groups during physical investigation, a vast overdetection of instability was evident, while a great number of highly unstable hips were classified as stable. In the two materials, only the infants with hips classified as unstable or dislocatable at the ultrasonic investigation were treated. All the hips in the infants treated developed normally and no late CDH has been found in the group not treated.

In 9 infants with late CDH, joint stability was evaluated with ultrasound immediately after reduction of the dislocation. Ninety degrees of hip flexion was not sufficient in any of the infants to prevent redislocation when the child spontaneously tried to extend its legs. In 2 of the infants as much as 120° of flexion was necessary to achieve a stable reduction. Ultrasonic evaluation immediately after reduction in 15 infants with late CDH revealed that the congruency of the joint was deficient due to soft tissues in the acetabulum. The dysplastic femoral head was lateralized up to 8 mm (mean 5.5 mm). During abduction treatment (mean 8 weeks), joint congruency normalized and the soft tissues in the acetabulum disappeared without any surgical intervention. During this period, the femoral head regained in size, and complete hip stability was achieved.

Dissertation University of Umeå 1989
ISSN 0346-6612

Risk exposure and incidence rates of acute injuries from sports and physical exercise in a total population

Marianne de Loes

Karolinska Institute, Department of Social Medicine, Kronan Health Center, Sundbyberg and Department of Orthopedic Surgery, Karolinska Hospital, Stockholm

A prospective study of acute injuries from sports and physical exercise was carried out in a total population of a municipality with 31,620 inhabitants. An Injury Surveillance System registers continuously all the acute visits to the five clinics of the Public Health Care Service. The amount of sports and physical exercise practiced in the population was investigated and incidence rates of injury in 17 sports are presented.

Three sources were used for estimating the population at risk: (1) a mailed questionnaire to a random sample of the population in the age range of 15–59 years; (2) reports from the sports clubs of the region; and (3) information about the number of pupils and school physical education.

Altogether, 571 injuries occurred in 28 different sports. Sixty-five percent of the injured persons were males. The majority of the injuries were from team and contact sports. Soccer was the most popular sport and accounted for 42 percent of the injuries, but the highest risks of injury were found in ice-hockey and handball, followed by soccer. As a group, intercompany players had the highest risk, especially in soccer. The lowest incidence rates were found in individual sports, such as cross-country skiing, swimming, running, and racket sports.

There were 53 injuries from school physical education in the ages 14–19 years. The levels of physical activity during leisure time of those injured were related to the activity levels of the whole population. An increased risk of injury (7 times) was found in pupils with a low activity level compared with those with a medium or high level, and the risk of injury in females with a sedentary life style was 10 times as high as in active females.

Sports injuries accounted for 3 percent of all the acute visits, with a mean of 1.9 visits per injury. Related to the total consumption of outpatient visits to the five clinics in the municipality, sports injuries also accounted for 3 percent. Forty-four patients were hospitalized; the proportion of inpatient care due to sports injuries was 0.6 percent, and the mean length of stay in the hospital was 3.7 days.

The total number of days of sick leave compensated for sports injuries (3,477 days) was 1.2 percent of all the days compensated for in 1984.

The overall mean cost per injury was USD 335 (SEK 2,769), 62 percent of which was health care costs. Individual sports (motorcycle, downhill skiing, and equine sports) were by far the most costly, the most expensive of the team sports ranking only fifth (handball followed by soccer).

A modified and extended form for coding sports injury mechanisms according to the NOMESCO codes is proposed as a supplement. It would ensure conformity in the coding, allow comparisons, and facilitate epidemiologic research and prevention.

Dissertation Karolinska Institute 1989

ISBN 91-7900-810-0

Prospective 2-year study of early rheumatoid arthritis in southern Sweden

Assessment methods and outcome

Kerstin Eberhardt

Department of Rheumatology, Lund University Hospital, S-221 85 Lund, Sweden

A prospective study of early definite rheumatoid arthritis (RA) started in 1985, and 180 patients have been included. Standardized clinical, biochemical, and radiographic assessments were performed at regular intervals. Eighty-nine patients, 33 men and 56 women, with a mean age of 53 years and a mean disease duration at enrollment of 11.5 months, have been followed for 2 years, and the course of their disease and early outcome are described. Features of possible prognostic significance were sought. Some new assessment methods were developed and tested. Joint function was evaluated with a new performance index, SOFI (Signals OF Functional Impairment), designed to detect early impairments. The SOFI index was found adequately reliable, valid, and sensitive. Disability was assessed with the Stanford Health Assessment Questionnaire disability index (HAQ). This index was adapted for Swedish patients, and has shown to possess the same measurement properties as the original version. A radiologic index measuring the Change in Progression Rate (CPR) was constructed and found applicable. The clinical course was mostly benign. Patient-relevant measures, such as pain, patient's assessments of disease activity, and anxiety, decreased significantly during follow-up. Disability remained small. Remission occurred in 16 percent. The initial HAQ score and patient's assessments of disease activity were the best predictors of clinical and functional outcome. The amount of radiographic changes increased steadily, and only 18 percent were nonerosive after 2 years. The rate of joint-damage progression was retarded in 28 percent during the second year of study. A subgroup of 6 patients with rapidly progressive damage in larger joints was identified. Only one third of the variance of joint-damage progression over 2 years could be explained by conventional clinical and laboratory variables at entry. Application of sensitive immunochemical assays for rheumatoid factor isotypes or for the connective tissue related substance aminoterminal type III procollagen peptide did not improve the ability to predict radiologic outcome.

Dissertation University of Lund 1989

Bone mineral content and fracture risk

A methodological and clinical study of bone mineral measurement in the spine and proximal femur

Staffan A. V. Eriksson

Department of Orthopedics, Huddinge University Hospital, Karolinska Institute, S-141 86 Huddinge, Sweden

The purpose of the present study was to investigate two techniques, i.e., dual photon absorptiometry (DPA) and computed tomography (CT), for bone mineral assessment and for prediction of bone strength. These studies were carried out on vertebrae because of the comparatively simple geometry of vertebral bodies. In addition, with regard to its importance for the risk of fracture, we measured bone density in patients with fragility fractures, especially those with fractures of the proximal femur.

DPA, as well as CT, was found to be accurate for determination of bone mineral density in the vertebral bodies. In some aspects, dual-energy CT was superior to single-energy CT. Dual-energy CT was the most accurate method for studies of a single vertebral body, but not for spinal segments. The ultimate load of an intact vertebra was better predicted from the bone mineral content measured by the DPA technique than by CT.

Subnormal bone density of the proximal femur was found in patients less than 70 years old with fragility fractures. Men and women with a femoral neck fracture had approximately the same degree of regional osteopenia in the femoral neck area. The mineral density of the radius appeared to be much less useful for predicting the risk of proximal femur fractures than direct measurement of the proximal femur using DPA. The femoral neck index and the Singh index appeared not to be adequate for the determination of bone-mineral density.

In conclusion, bone mineral assessment particularly with the DPA technique can be used in the determination of the fracture risk. For example, a bone density of the femoral neck area greater than 0.8 g/cm^2 in women and 0.9 g/cm^2 in men is consistent with a low risk of femoral neck fracture.

Dissertation Karolinska Institute 1989

Fractures and dislocations of the clavicle

Antti Eskola
Department of Orthopedics and Traumatology, Helsinki University Central Hospital,
SF-00250 Helsinki, Finland

Totally, 234 clavicular injuries were examined: 136 fractures, 86 dislocations of the acromioclavicular joint, and 12 dislocations of the sternoclavicular joint.

Eighty-nine patients with clavicular fractures treated in 1982 attended a follow-up examination in 1984. Eighty-three fractures had been treated with immobilization using a sling. Four lateral clavicular fractures had been treated primarily with plate fixation and two had been operated on for delayed union. Six fractures had been operated on. The result of treatment was good in 65 cases, satisfactory in 20, and poor in 4 cases. Patients with a primary dislocation exceeding the thickness of the clavicle (15 mm) or with shortening (> 12 mm) observed had more pain than patients without these findings ($P < 0.05$ and $P < 0.001$, respectively). Such fractures should be treated operatively. Otherwise, clavicular fractures should be treated primarily conservatively, except type II (Neer 1963) lateral fractures.

Twenty-three, fresh, type-II lateral clavicular fractures had been treated operatively. In 19 cases, fixation had been achieved with two Kirschner wires and in 4 cases with a plate. The average follow-up period was 4.5 (1–12) years. In 22 of 23 cases the subjective outcome was good or satisfactory. These fractures united with few complications.

Twenty-four, primarily, conservatively-treated ununited clavicular fractures were treated operatively. In all the cases the primary dislocation had been at least equal to the clavicular thickness. Patients older than 40 had nonunion more often ($P < 0.001$) than younger patients. Following operative treatment the nonunion united in 20 cases. The clinical outcome was good in 17, satisfactory in 6, and poor in 2 patients. After operation for nonunion, 4 patients had shortening of the clavicle and abduction weakness of the upper extremity. Therefore, shortening of the clavicle should be avoided.

Eighty-six patients with complete dislocation of the acromioclavicular joint, verified by stress radiographs, were operated on. Two smooth Kirschner wires or two threaded Kirschner wires or one cortical screw was used at random. The acromioclavicular ligaments were sutured, but the coracoclavicular ligaments were left unsutured. The clinical result was good in 82 patients. The clinical outcome did not differ statistically when the three different modes of operative fixation were compared. Eight out of 13 cases with osteolysis of the lateral head of the clavicle had been treated with screw fixation ($P < 0.001$).

Twelve cases of dislocation of the sternoclavicular joint were studied. Eight cases had been treated by closed reduction, and redislocation had occurred in 5. The result was good in 5 of 8 patients. Four patients with sternoclavicular dislocation had good results following primary open reduction, fixation with two Kirschner wires, and suture of the ruptured ligaments and capsule. Primary open reduction is probably to be preferred in acute cases of sternoclavicular dislocation.

Dissertation University of Helsinki 1989
ISBN 952-90053-2-6

Experimental limb lengthening by external gradual distraction in the growing long bone

Terje O. Fjeld and Harald Steen

Sophies Minde Orthopedic Hospital, University of Oslo, and The Norwegian College of Veterinary Medicine, Department of Surgery, Oslo, Norway

The aim of this experimental investigation was to analyze effects of various methods of limb lengthening by external gradual distraction in the growing long bone. By experimental studies, we wanted to investigate (1) physeal distraction as a method of limb lengthening in normal bone; (2) physeal distraction as a method of limb lengthening in chondrodystrophic bone; (3) the effect of distraction physiolysis on the normal and chondrodystrophic growth plate evaluated by postoperative longitudinal growth; (4) the effect of dynamic axial fixation on bone healing in limb lengthening; (5) regional differences in bone healing after a lengthening osteotomy in the metaphysis or diaphysis; (6) the influence of different biomechanical factors that affect healing in limb lengthening by use of a model analysis; and (7) effects of stretching on skeletal muscles in limb-lengthening procedures.

Taking into account that the small number of animals (range 10–20) in the various experimental studies places limits on the conclusions, the following effects were demonstrated: (1) Physeal distraction is a valid method for limb lengthening in the tibia. A daily distraction rate between 0.25 and 0.5 percent of the original bone length is suggested in limb lengthening by physeal distraction. (2) Clinical events in limb lengthening by physeal distraction appear to be analogous in normal and chondrodystrophic bone. Physeal distraction cannot be recommended as the preferable method of limb lengthening of the femur due to degenerative joint changes observed. (3) Distraction physiolysis produces a substantial and consistent reduction in growth potential in the normal and chondrodystrophic growth plate. This implies a significant loss in gained length unless the individual is near skeletal maturity. (4) Introduction of dynamic axial fixation to enhance consolidation in lengthening by osteotomy does not seem to be of significant value. An ample sufficiency of micromovement for adequate stimulus of osteogenesis probably exists by use of current external fixators in limb lengthening. (5) No regional difference in bone healing after a lengthening osteotomy in the metaphysis compared with the diaphysis was found. Accordingly, the empirical assumption that healing in the metaphyseal region of the bone is superior to the diaphyseal region may be erroneous in limb lengthening. (6) In a biomechanical model analysis of external fixator performance and the ability to neutralize forces of muscle activity and weight bearing, motions between bone segments were up to 4.9 times larger at the metaphyseal compared with the diaphyseal lengthening osteotomy level. The results indicate that the effect of any superior biologic healing potential in the metaphysis compared with the diaphysis may be nullified by inferior mechanical conditions for healing in the metaphyseal region. (7) In limb-lengthening procedures a significant decrease in size of type-2 fibers occurs in skeletal muscles subjected to continuous stretching.

Dissertation University of Oslo 1989

ISBN 82-991752-0-8

Induction and correction of scoliosis by unilateral regulation of rib-length growth

Mamoun Abdel Gadir
Department of Orthopedics, Karolinska Institute, Huddinge University Hospital,
S-141 86 Huddinge, Sweden

It has been stated that osteotomy of ribs in the growing rabbit results in scoliotic deformity, probably owing to stimulation of rib growth by the fracture. Subsequent studies revealed that in women with right convex thoracic idiopathic scoliosis the left ribs are longer than the right. Moreover, the left breast in girls with right convex thoracic idiopathic scoliosis is heavier and more highly vascularized than the right, but this is not the case in girls without this anomaly.

The aims of the studies included in the present investigation were (a) to design reliable, reproducible, and easily interpretable animal models for induction of scoliosis, (b) to investigate the role of the ribs in the mechanical induction of thoracic scoliosis, and (c) to correct experimentally induced scoliosis by unilateral manipulation of rib growth.

Resection of three intercostal nerves on the right side of young growing rabbits induced progressive left convex thoracic scoliosis with typical vertebral rotation and rib-hump deformity. The denervated right ribs were longer, with significantly increased growth activity at their costochondral junctions. The vascularity of the anterior chest wall muscles and the costal periosteum on the denervated, right side was significantly increased by an amount that was closely correlated with the degree of scoliosis. It is concluded that abolition of the sympathetic vasoconstrictive effect on the intercostal arteries induces a state of hypervascularization of the right thorax. This probably stimulates the growth activity at the corresponding costochondral growth plates, with ultimate increase in the longitudinal growth of the ribs on the denervated side. The unilateral elongation of the ribs would in turn be the underlying mechanical cause for the development of the scoliotic deformity.

A further investigation on the mechanical impact of the unilateral elongation of one rib on the right side with a metallic expander after osteotomy revealed immediate development of moderate scoliosis convex to the left and significant decrease in the normal cervicodorsal lordosis and dorsolumbar kyphosis, vertebral rotation and rib-hump formation on the right side, and deviation of the spinous processes to the left. The observed changes were considered to be identical to those seen in idiopathic scoliosis in man.

In an attempt to correct scoliosis by acting against the line of the proposed deforming pathomechanisms, a 1-cm elongation of one rib on the side of the convexity of adult scoliotic rabbits resulted in an immediate correction of the deformity. In young growing rabbits with left convex scoliosis induced by intercostal nerve resection, surgical resection of corresponding intercostal nerves on the left side reversed or halted the progress of both the frontal and the sagittal deformations.

These results further support a new concept according to which the precipitating factor in the development of scoliosis might be ascribed to asymmetric longitudinal growth of the ribs. They also suggest that regulation of the rib length could be a promising approach to the effective correction of progressive scoliosis at an early stage in man.

Dissertation Karolinska Institute 1989

Implication of heel strike

An anatomical, biomechanical, physiological and clinical study with focus on the heel pad

Uffe Jörgensen

Department of Orthopedics and the Sports Medicine Unit, University Hospital, S-581 85 Linköping, Sweden

Previous studies have indicated a connection between repetitive impacts and injuries. The interest for the implications of heel strike and for the role of the heel pad was initiated by observations of soft heel pads on the affected side in some patients with Achillodynia. This generated the hypothesis that low shock absorption in the heel pad could predispose to overuse injuries. Shock absorption provides protection to the body by reducing the impact force. Low heel-pad shock absorbency would subject the body to a higher impact force at heel strike and thereby a greater injury risk. This was confirmed.

The heel pad was found to be the quantitatively most important shock absorber compared to a shock-absorbing shoe-sole and inserts. The interindividual heel-pad shock absorbency varied up to 100 percent. Trauma to the heel pad decreased the shock absorption 24 percent and could explain low heel-pad shock absorbency. Confinement of the heel pad by external support increased the shock absorption in normal and traumatized heel pads by 25 percent and 49 percent, respectively.

Anatomical studies showed that the shock absorbing capacity of the heel pad was correlated with the anatomical structure and revealed a not previously described structure, "the internal heel cup," which seems to be essential for the dynamic function of the heel pad.

The confinement produced in vivo by a rigid well-fitted heel counter (the heel counter effect) was found to increase the shock absorbency at heel strike. The effect was greatest in persons with low heel-pad shock absorbency. The relative heel counter effect was greatest in a soccer shoe that provided 30 percent of the shock absorbency. The heel counter effect caused a significant reduction of 2.4 percent of the total VO_2 in submaximal running. This was explained by a significant decrease in the activity of the quadriceps and triceps surae muscles following heel strike.

Qualitative assessment of the heel pad as soft or not soft is possible by palpation. Quantitative assessment is possible with the HPC device, which was constructed for the purpose. It was used in a clinical study that revealed a high correlation between the heel-pad shock absorbency and the development of overuse injuries in a homogeneous group that had been exposed to similar levels of activity.

High muscle activity due to increased musculoskeletal transients at heel strike when the shock absorbency is low can explain the increased risk of overuse injuries.

Dissertation University of Linköping 1989

ISBN 91-7870-262-2

Transient synovitis of the hip

Pentti Kallio
Children's Hospital, The University Central Hospital of Helsinki, SF-29, 00290 Helsinki, Finland

A total of 132 consecutive children with 155 episodes of transient synovitis of the hip were examined during a prospective 18-month period from May 1, 1982 to December 31, 1983. The diagnosis was verified by joint aspiration and/or ultrasonography in 110 children, and by radiography and clinical methods only in 22 children. Intraarticular pressure was measured in 73 episodes.

The annual incidence rate was 52/100,000 in urban children under 16 years of age. The sex ratio (boys:girls) was 1.6:1. The mean age was 6 (2–13) years. Bilateral synovitis was diagnosed in 6 percent. The duration of symptoms before admission was less than 1 week in 93 percent of the cases.

The initial radiographic medial joint space was widened by 1 mm or more in 42 percent of the patients with unilateral disease. The mean initial ultrasonographic joint space was 6.3 mm for the symptomatic hip and 3.9 mm for the opposite hip. Ultrasonography is sensitive (84 percent) and specific (67 percent) in diagnosing an effusion of the hip and an absolute width of 6 mm for the ultrasonic joint space or a difference of 1–2 mm compared with the healthy side should be considered indicative.The ultrasonic effusion had disappeared by the 2-week follow-up whether or not the hips had been aspirated. The mean synovial fluid volume was 2.6 mL, and the intraarticular pressure was elevated. It was highly dependent on joint position, and it was highest in neutral extension (17.3 kPa), particularly when simultaneously rotated inwards (26.6 kPa), and lowest in 45° of flexion (2.3 kPa).

Nine percent of the patients had recurrences during the 1-year follow-up. Three children had an erroneous initial diagnosis of transient synovitis, and Perthes' disease was diagnosed later. However, the initial radiographs revealed mild changes typical of early avascular necrosis. Transient synovitis and Perthes' disease seem to have no causal pathogenetic relationship. Asymptomatic osseous asymmetry of the femoral heads of 2 mm or more (coxa magna) developed in 31 percent. This was predicted by the initial widening of joint space, with a sensitivity of 74 percent and a specificity of 73 percent.

In sum, ultrasonography is recommended for diagnostics and monitoring of the clinical course. Radiography and routine laboratory investigations are necessary to rule out other diagnoses. The hip with effusion should not be immobilized in extension. A satisfactory relief of effusion-induced pressure is achieved by allowing the child to spontaneously flex the hip. Decompressive joint aspiration is not necessary, and should be reserved for diagnostic purposes. The clinical prognosis of transient synovitis is good, and routine follow-up is unnecessary.

Dissertation University of Helsinki 1988

Fractures of the distal forearm

A clinical study with special reference to external fixation

Juha-Pekka Kaukonen

Department of Orthopedics and Traumatology, Helsinki University Central Hospital, SF-00260 Helsinki, Finland

The approximate annual incidence of distal forearm fractures was 36.5 per 10,000. The highest figure, 119.5 per 10,000, was found among women of aged 60–70 years, whereas the lowest figure was found in the youngest male age group. Colles' fractures comprised 91.5 percent of all the cases, while the percentage of Smith's fractures, distal antebrachium fractures, and Barton's fractures were 3.0, 5.0, and 0.5, respectively.

Generally, the anatomic result was good or excellent in more than half of the cases. Still, marked deterioration of the position during the first weeks of plaster-cast treatment was found in 60 percent of the cases. In the more serious cases treated with external fixation, no deterioration was noted.

A new grading of Colles' fractures based on the degree of fracture lines into the radiocarpal joint is presented. This grading correlates well with other measurements including dorsal tilt, shortening of the radius, and the tendency towards redislocation.

The functional result was good or excellent in 77 percent of the cases. It was observed to be affected by the anatomic result,the patient's age, sex, intraarticular grading, and the fracture of the ulnar styloid. Despite the more serious nature of the fractures treated with external fixation, the functional result was equally good or better in this treatment group. There were no serious complications after external fixation with the Hoffmann medium-size device.

External fixation can be recommended for the treatment of the more serious fractures of the distal forearm.

Dissertation University of Helsinki 1989

ISBN 952-60020-2-0

Shoulder joint stability

Aspects on muscle function and skeletal anatomy

Margareta Kronberg
Department of Orthopedics, Karolinska Hospital, S-104 01 Stockholm, Sweden

Shoulder joint dislocation occurs predominantly in young athletes. Ninety-eight percent of the dislocations are of anterior direction. Two basic types of dislocation can be distinguished: traumatic (96 percent) and nontraumatic type (4 percent). The nontraumatic group often consists of patients with generalized joint laxity. The aim of the present study was to analyze muscle function and skeletal anatomy, and to determine if there were any differences between the two basic types of dislocation.

A new method for EMG recordings from the subscapularis has been developed. Fine-wire electrodes, with a diameter of 0.025 mm, were inserted into the muscle at the posterior axillary line. EMG recordings have been made from eight shoulder muscles in parallel during standardized loaded movements. The EMG was normalized allowing a comparison to be made between muscle activity in a subject's different muscles, and activity in specific muscles among different subjects. The muscles investigated were the subscapularis, supraspinatus and infraspinatus, pectorialis major, anterior, middle, and posterior parts of the deltoid, and the latissimus dorsi. The movements investigated were abduction, external and internal rotation in neutral, 45° and 90° abduction, flexion, and extension.

Muscle activity was recorded simultaneously in both agonistic and antagonistic muscles in healthy subjects, as well as in patients with generalized joint laxity and nontraumatic shoulder instability. An altered muscular activity was found in the patients, an imbalance among agonistic and antagonistic muscles. During abduction and flexion, muscle activity in the anterior and middle parts of the deltoid was decreased, and during internal rotation activity in the subscapularis was increased. During external rotation, the subscapularis acted as a stabilizer, and during extension it stabilized the joint together with the supraspinatus. These results indicate that physical training of muscle strength and coordination might be the treatment of choice in patients with nontraumatic shoulder dislocations.

A method for assessment of humeral head retroversion has been developed. The retroversion angle could be assessed with high accuracy from one radiograph in the semiaxial view. The mean retroversion angle for healthy subjects was 33° on the dominant side and 29° on the nondominant side. The 95 percent two-tail confidence interval for normal reference values was 30°–35° on the dominant side and 26°–31° on the nondominant side.

Reference values for normal range of shoulder motion have been presented, and increased rotation was found compared to previous presented normal values. A large humeral head retroversion angle was associated with a large range of external rotation, and a small retroversion angle with an increased internal rotation.

Patients with traumatic anterior shoulder dislocations had decreased retroversion angle in the unstable shoulder, but normal angle in the contralateral stable shoulder. Patients with nontraumatic shoulder instability had decreased retroversion in both shoulders, irrespective of symptoms of instability, compared with normals, and the retroversion angle was smaller than that for traumatic unstable shoulders.

The results confirmed the hypothesis that a small retroversion angle might predispose to anterior shoulder dislocation by moving the humeral head out of the glenoid cavity during external rotation, particularly in the abducted position. In patients with recurrent anterior shoulder dislocation and altered humeral head retroversion, correction of the anatomy using a proximal humeral osteotomy can be considered, and if necessary this can be combined with soft-tissue repair.

Dissertation Karolinska Institute 1989
ISBN 91-7900-833-X

Energy cost of level walking

Eva Mattsson

Departments of Orthopedics, Baromedicine, and Physical Therapy, Karolinska Hospital, S-104 01 Stockholm, Sweden

Devices and methods have been developed for determining speed and oxygen cost of level walking. Speed was recorded and controlled using a speedometer cart. Oxygen uptake was determined with an argon-dilution method using a mixing box mounted on a backpack. The method was found valid, coefficient of variation (cv) less than 2.1 percent, and to give excellent reproducibility with regard to self-selected speed, cv < 1.9 percent, to predetermined speed, cv < 1.3 percent, and to oxygen cost, cv < 3.2 percent. Artificially arranged immobility of the knee or instability of the ankle decreased comfortable walking speed 23 percent and 4 percent, respectively. Oxygen cost increased 23 percent and 10 percent, respectively. Stabilizing splints allowing some flexion could, if possible, be advocated, particularly with elderly patients.

Patients with coxarthrosis were studied before and after THA. One year after surgery, the Harris hip score had increased from 35 to 85 points and maximal walking speed from 62 to 80 m/min. The oxygen cost had decreased from 0.267 to 0.221 $mL/kg^{-1}/m^{-1}$. The onset of and the recovery from complications, as well as differences between patients with unilateral and bilateral diseases, were reflected in a change in oxygen cost, but not in clinical scoring.

Patients with moderate gonarthrosis were studied before and after unicompartmental knee prosthetic replacement. No major benefit or preoperative physical therapy, mainly aiming to improve thigh muscle strength, was observed 3 months after surgery. One year after surgery the patients had improved in clinical score rating and recovered an almost normal walking ability. Measurements of pain and self-selected walking speed were found to be sufficient for assessing effects of treatment in these patients.

Patients with severe gonarthrosis had improved in clinical score rating 1 year after TKR. The oxygen cost of walking was unchanged. An acquired uneconomical walking pattern was considered to be the reason for unimproved walking efficiency.

Patients with spastic paraparesis were treated with long-term stretch of the hip adductor muscles. Either the oxygen cost or the blood lactate level was decreased during walking, indicating that even during moderate exercise blood lactate must be taken into consideration when energy cost is measured in these patients.

Measurements of walking speed and oxygen cost of level walking were found to be useful objective parameters for assessing walking and to be a valuable supplement to clinical assessment of effects of treatment in patients with walking disorders.

Dissertation Karolinska Institute 1989

ISBN 91-7900-787-2

Fixation properties and biodegradation of absorbable implants in growing bone

An experimental and clinical study

E. Antero Mäkelä

Helsinki University Department of Orthopedics and Traumatology, Helsinki University Central Hospital, SF-00260 Helsinki, Finland

Physeal fractures comprise 15 percent of all the long-bone fractures in children. The vast majority of these fractures can be treated by conservative methods. However, in certain types of physeal fractures, i.e., in types III and IV according to the classification of Salter and Harris, accurate reduction and internal fixation are essential to avoid growth disturbances. The most attractive solution to the operative treatment of physeal fractures consists of the use of an internal fixation device that ensures a progressive stress transfer to the growing bone without disturbing the growth potential and that subsequently biodegrades eliminating the later removal operation. The present study concerns the fixation properties and biodegradation of absorbable implants in growing bone.

A total of 198 five-week-old rabbits were used in the experimental studies concerning the biodegradation of polyglactin 910 and polydioxanone (PDS) in growing bone, and the biodegradable fixation device for transphyseal fixation of experimental physeal fractures. The changes produced by experimental trauma to the growth plate were quantitatively analyzed by histomorphometric techniques. Polyglactin 910 and PDS were biocompatible in growing bone. The biodegradation started peripherally and was especially intense at the plane of the growth plate. The implant was broken at the plane of the growth plate at 3 and 6 weeks, respectively. The regeneration of the growth cartilage was evident in the gap between the broken ends of the implants. The biodegradation of the polyglactin-910 implant proceeded about two times faster than the biodegradation of the PDS implant. The implants had virtually disappeared and had been subsequently partially replaced with cancellous bone at 24 and 36 weeks. Histomorphometry gave detailed information of the changes in the growth plate due to a transphyseal trauma.

In a prospective clinical study, 6 children with a severely displaced supracondylar fracture of the humerus or other physeal fracture were treated using biodegradable fixation with self-reinforced (SR-) polyglycolide pins of 1.5-mm in diameter.

The preliminary results indicated that in most of the cases sufficient stability for uneventful healing of these fractures could be achieved. No signs of impairment of the function of the growth plate was seen. The advantage of the transphyseal biodegradable fixation is the avoidance of the later implant-removal operation.

Dissertation University of Helsinki 1989

ISBN 959-90043-8-9

Primary osteosynthesis for femoral neck fractures

Lars T. Nilsson
Lund University Department of Orthopedics, S-221 85 Lund, Sweden

Subsets of 1,066 femoral neck fractures treated with closed reduction and internal fixation at the Department of Orthopedics in Lund from 1977 to 1985 inclusive were studied.

From 1977 through 1980, 510 consecutive femoral neck fractures had an osteosynthesis with a spring-loaded four-flanged nail. The outcome was studied retrospectively for 5 years. Healing complications were seen in 34 percent of the total material; 21 percent had a secondary arthroplasty performed. Seventy-nine percent of the patients retained their own femoral head; 67 percent had no secondary operation. Eighty percent of the patients admitted from independent living returned home.

In a prospective and consecutive series, 6 surgeons performed osteosynthesis in 152 femoral neck fractures in 1981 and 1982. The fractures were randomized to treatment with a four-flanged nail or two hook-pins. Complications during 2 years after fixation with the nail were more frequent than after fixation with the hook-pins ($P < 0.01$).

Totally, 300 consecutive and prospective patients were treated from 1981 through 1983 with hook-pin fixation by 6 surgeons. During a 2-year period, healing complications were seen in 19 percent of the patients; arthroplasty was performed in 11 percent. Of 215 displaced fractures, nonunion was seen in 15 percent and segmental collapse in 7 percent; secondary arthroplasty was performed in 14 percent of the displaced fractures. Ninety-five percent of the undisplaced fractures had no healing complications.

Hook-pin fixation was adopted as the clinical routine, and 191 prospective patients were treated by all the surgeons (n 35) in the department in 1984 and 1985. There was no period of training of the inexperienced surgeons before the commencement of this series. During 2 years, healing complications were encountered in 29 percent of the patients, and secondary arthroplasty was performed in 16 percent.

Early results of secondary arthroplasty for a femoral neck fracture complication were investigated in 75 hips; the mean age was 77 years. Mortality at 6 months was 5 percent; significant complications were seen in 12 percent; restoration of function was rapid.

The risk of prosthetic failure in 84 patients with secondary arthroplasty for a femoral neck fracture complication that were followed 8 (5–12) years was 2.5 times higher than the risk of failure following primary arthroplasty for coxarthrosis. Primary arthroplasty for a femoral neck fracture has been reported to have even higher rates of prosthetic failure. At follow-up after 8 years, 6 of 34 femoral stems were radiographically loose; no cups were loose.

Perceived health after 8 (5–12) years, measured with the Nottingham Health Profile, was better in patients with a retained femoral head than in a matched group of patients with secondary arthroplasty for a femoral neck fracture complication.

Dissertation University of Lund 1989

The excessive drinker in somatic outpatient care

Jesper Persson
Department of Internal Medicine, Lund University Hospital, S-221 85 Lund, Sweden

Totally, 2,114 patients in somatic outpatient care were studied with the following methods of detecting persons with excessive consumption of alcohol: blood tests (GGT, ASAT, ethanol), questionnaires to patients and doctors, and register data (records from the psychiatric clinic, alcohol ambulatory service, social welfare registers). According to the criteria employed, 17 percent of the men and 4 percent of the women were excessive drinkers. In 35 percent of the excessive drinkers, the overconsumption was "hidden." Of the consultations made by the excessive drinking patients, 77 percent were related to alcohol. Of the excessive drinkers, 48 percent were detected through the records of the psychiatric clinic and 40 percent through an elevated GGT (> 0.9 microkat/L) due to alcohol. Drugs and diseases were together a more common cause (57 percent) than alcohol (36 percent) of an elevated GGT. Patients with excessive drinking had more sickness days and sick-listing occasions as compared with patients without excessive drinking. The mortality was also considerably higher among the excessive drinkers. Intervention in patients with excessive drinking and without advanced alcohol problems ("early stage problem drinkers") resulted in reduced consumption of alcohol, reduction of their GGT and triglyceride values, and reduced number of sickness days as compared with a control group.

In a separate study of the small intestine after heavy drinking, a reduced villus ratio (villus height/crypt depth) was observed, which was increased after abstinence. Marked ultrastructural (SEM) changes were seen that were only partly reversible after several weeks of abstinence.

Dissertation University of Lund 1989

On the developments of a new arthroplasty with special emphasis on the gliding elements in the knee

Tord V. Röstlund

Biomaterials Group, Department of Handicap Research, University of Gothenburg, and Department of Orthopedics, Mölndal Hospital, Sweden

Contemporary designs of knee arthroplasties, cemented or not, are fixed to bone by fibrous tissue. The fibrous tissue anchorage of implants is relatively unstable with subsequent risk of loss of fixation.The goal of implant fixation should preferably result in a stable bone-to-implant anchorage.

Two animal experiments were performed to achieve this mode of fixation. In a canine study, different designs of c.p. titanium prostheses were inserted in the knee joint as a two-stage procedure. At follow-up 7–15 months postoperatively, all the implants were clinically stable. Semiquantitative microscopic evaluation revealed good bone anchorage of screw-shaped implants, whereas nonthreaded implants only showed patches of bone-to-implant contact.

In the patellofemoral joint of rabbits, a c.p. Ti femoral resurfacing implant was inserted as a one-stage procedure. At follow-up 12 weeks postoperatively, the histologic analysis showed newly formed bone appositioned to the metal in three consecutive threads with the bone-to-metal contact ranging from 42 percent to 90 percent, with an average of 63 percent. These results accord with what was previously found with implants in the same region not subjected to immediate dynamic loading.

Two aspects of designing the resurfacing part of the femoral prosthetic component are dealt with. In the first study, we explored the possibility of using an impression technique for designing individually fitting components. Alginate is widely used in dentistry for impression techniques. In this experimental study, cheek pouches of the hamster were subjected to alginate with and without additives. It was concluded that alginate without additives caused minor tissue response in comparison with commercially available alginate, which resulted in a severe tissue reaction. In another study, 36 human cadaver knees were investigated. It was found that the paramedian sagittal curve of the medial and lateral femoral condyles, respectively, seemed to be identical for all the knees. The curvatures can be mathematically expressed to fit any knee size. Further, a great dimensional, as well as a geometric, intervariation was found between different size groups, suggesting individual designs for the medial and lateral condyle substitutes in a bicondylar knee prosthesis.

In two studies the wear behavior of N-ion implanted c.p. Ti and Ti alloy was tested on a joint simulator. In neither test did ion implantation affect the polymer wear. On the other hand, the metal wear was significantly reduced in both studies, under both clean conditions and in the presence of PMMA particles.

It is concluded that Ti allow should not be used as a bearing material without proper surface treatment. Ion implantation seems to be a promising method, although further improvement of the technique is recommended.

Dissertation University of Gothenburg 1989

ISBN 91-7900-866-0

A sensory role for the cruciate ligaments

Regulation of joint stability via reflexes onto the muscle-spindle system

Per Sjölander

Departments of Physiology and Zoophysiology, University of Umeå, Umeå, Sweden

Reflex effects evoked by graded electrical stimulation of the posterior articular nerves (PAN) of the ipsilateral and contralateral knee joints were investigated using both microelectrode recordings from γ-motoneurons and recordings from single-muscle muscle-spindle afferents. Single afferent responses were also recorded using natural stimulation of different types of receptors to elucidate if the articular reflexes onto the γ-motoneurons were potent enough to significantly alter the muscle-spindle afferent activity. Stretches of the ipsilateral posterior (PCL) and anterior (ACL) cruciate ligaments, pressure on the ipsilateral and contralateral knee and ankle joint capsules, and passive flexion/extension movements of the joints in the contralateral hind limb were performed. The occurrence of different sensory endings in the ACL and PCL was examined using gold chloride staining for neuronal elements. All the experiments were performed on chloralose anesthetized cats.

More than 90 percent of the static and dynamic γ-motoneurons were responsive to electrical stimulation of the PAN. Most γ-cells responded to low-intensity electrical stimulation. Excitatory reflex effects predominated on both static and dynamic posterior biceps-semitendinosus (PBSt) γ-cells., while excitatory and inhibitory effects occurred with similar frequency on triceps-plantaris (GS) γ-cells. The fastest segmental route for excitatory PAN effect on hind-limb γ-motoneurons seems to be disynaptic or trisynaptic, whereas the path for inhibitory effects seem to be at least one synapse longer.

Physiologic stimulations of ipsilateral and contralateral joint capsules and of ipsilateral cruciate ligaments were all found to evoke frequent and potent changes in spindle afferent responses from the GS and PBSt muscles. It was shown that these effects were due to reflexes onto dynamic and static fusimotor neurons caused by physiologic activation of articular sensory endings. Both ipsilateral and contralateral joint receptor stimulation evoked excitatory as well as inhibitory fusimotor effects. The highest responsiveness was found during stimulation of the cruciate ligaments, i.e., 58 percent for GS and 47 percent for PBSt primary spindle afferent to PCL stimulation, and 73 percent for GS and 55 percent for PBSt primary-spindle afferent to ACL stimulation. Significant alterations in spindle afferent activity was encountered at very low traction forces applied to the cruciate ligaments (5–10 N). The low thresholds, the tonic character of the stimuli, and the fact that different types of sensory endings were demonstrated in the cruciate ligaments (i.e., Ruffini's end organs, pacinian corpuscles, Golgi tendon organ-like endings, and free nerve endings), indicate that the fusimotor effects observed were caused by activation of slowly adapting mechanoreceptors, most likely Ruffini's end organs and/or Golgi tendon organ-like endings.

The potent reflex effects on the muscle-spindle afferents elicited by increased tension in the cruciate ligaments indicate that these ligaments may play a more important sensory role than hitherto believed, and it is suggested that they may be important in the regulation of the stiffness of muscles around the knee joint, and thereby for the joint stability.

Dissertation University of Umeå 1989

ISBN 91-7174-408-8

The back of the young top athlete

Symptoms, muscle strength, mobility, anthropometric and radiological findings

Leif Swärd
Department of Orthopedics, East Hospital, University of Gothenburg, Gothenburg, Sweden

The aims of the present study were to contribute to the knowledge of the effects on the back of elite training from a low age. Top athletes from four different sports—wrestling, gymnastics, soccer, and tennis—were studied.

The maximum voluntary strength of the trunk muscles was measured isokinetically and isometrically in 57 male elite athletes, 14 female elite gymnasts, and in a control group of 87 conscripts. All the groups of male athletes showed higher strength than the controls. The difference was largest in trunk flexion and hip extensions. The male conscripts were only stronger than the female gymnasts, when expressed as strength per kilogram body weight, in trunk extension. In lateral flexion the wrestlers and tennis players were stronger in the nondominant side than in the dominant one.

To study the incidence and types of abnormality in the thoracolumbar spine, 143 elite athletes (117 males and 26 females) and 30 nonathletes were examined radiographically. Abnormalities were more common in all the groups of athletes than in the nonathletes. The highest incidence was found in wrestlers, where 55 percent had abnormalities. Multiple abnormalities were most common in male gymnasts. The occurrence of spondylolysis was correlated with an increased inclination of the pelvis measured as the sacro-horizontal angle when standing.

The relation between back pain and radiographic abnormalities in the group of 142 athletes (116 males and 26 females) and anthropometric and mobility findings in the group of 116 male athletes was investigated. Male gymnasts reported the highest incidence of back pain (85 percent). Back pain was correlated with the number of radiographic abnormalities.

The course of a traumatic injury to the ventral part of the vertebral ring apophysis of Th 12 was followed clinically and radiographically in 2 female gymnasts. An injury to the ring apophysis in adolescents may be traumatic and may result in disc degeneration.

Magnetic resonance imaging (MRI) was used to assess disc degeneration, defined as reduced disc signal intensity, in the thoracolumbar spine of 24 male elite gymnasts and 16 nonathletes. Disc degeneration was more common in the athletes. Three fourths were found to have discs with reduced signal intensity, whereas this was only found in one third of the nonathletes. The gymnasts also had a higher incidence of other abnormalities of the spine, and there was a significant correlation between reduced disc signal intensity and each of the other abnormalities.

Dissertation University of Gothenburg 1989
ISBN 91-7900-890-9

Social and clinical consequences of total hip replacement

Tuomo Visuri

Orthopedic Hospital of the Invalid Foundation, Helsinki, and Department of Public Health, Helsinki University, Helsinki, Finland

This study reports the clinical results of total hip replacements (THR) operated on at the Orthopedic Hospital of the Invalid Foundation, Helsinki, Finland, during the years 1967–74. The effect of THR on the quality of life of the patients is also presented.

The results of a 2–3-year follow-up of 189 Brunswik operations (metal-to-plastic prosthesis) indicate that there were fewer aseptic loosenings with this type of prosthesis than with the all-metallic McKee-Farrar prosthesis during the same follow-up period.

The 10-year survivorship of 511 McKee-Farrar prostheses was 76 percent. The clinical results of the retained prostheses were stable during the whole follow-up period. Aseptic loosening was the most common local complication requiring a reoperation in 91 cases (18 percent). The risk factors in aseptic loosening appeared to be the type of prosthesis, lengthening of the leg operated on, and a right-sided hip prosthesis.

In a study of 539 patients, THR proved to have a decisive impact on the everyday life of the patient. Walking ability was limited in 95 percent before and in 12 percent after surgery. The proportion of patients who were able to take care of themselves increased from 21 percent to 62 percent due to THR.

THR significantly increased the participation of the patients in walking, bicycle riding, swimming, and cross-country skiing for pleasure.

In a series of 511 THR patients, there was a marked pain reduction. The proportion of regular users of all analgesics decreased from 75 percent to 17 percent.

Socioeconomic state of place of residence had no effect on the recovery of functions after THR. These factors did, however, influence the stage of hip disease at which the patients underwent THR. Patients of lower social classes and those living in rural areas were more disabled both before and after surgery than those in higher social classes and living in urban areas.

Fifty-nine of the 112 working age patients returned to their previous work. Age, quality of work, social class, and "non-hip joint" disease were more important factors suggesting that the patient would return to work than improvement in walking capacity or decrease of pain due to THR.

Dissertation University of Helsinki 1989

ISBN 951-99990-7-8