Dissertation abstracts

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Fixation and load in total knee arthroplasty—a clinical, radiographic, radiostereometric and gait study

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The treatment of severe gonarthrosis by total knee arthroplasty is generally successful, but tibial component loosening remains a problem. The aim in the present work was to investigate if any association between loading and insufficient tibial component fixation could be found, and if the fixation was affected by the tibial component design differences. Further, to compare the outcome measures used and the instrumentation systems used.

A homogeneous group of 45 gonarthrosis patients were treated with TKA, where 3 different designs of uncemented tibial components were distributed by randomisation (Tricon-M, Tricon stem and PCA). Knee joint loading before and twice after the operation was assessed by use of gait analysis and tibial component fixation by use of radiostereometric analysis (RSA). Conventional radiography was used to assess leg alignment as the Hip-Knee-Ankle (HKA) angle and the positions of the prosthetic components. The clinical course from before the operation up to 4 (range 3–5) years of follow-up was monitored by Hospital for Special Surgery (HSS) scores and 4 different modes of pain in Visual Analogue Scales (VAS). Activity level was assessed postoperatively as well as quality of life by the Nottingham Health Profile (NHP) questionnaire. Two patients died before the 2-year control, 2 more before 3 and 4 years, respectively, otherwise all patients attended all controls.

Alignment was better by use of the Tricon instrumentation. Alignment correlated with frontal plane moments. No relevant differences between the 3 tibial component designs were shown in migration. Addition of a stem in the Tricon design was therefore not proven beneficial. However, when extemal forces were applied at 2 years of follow-up, the Tricon prostheses rotated more than the PCA prostheses, interpreted as a consequence of the more conforming articulating surfaces. Previously, long-term follow-up with RSA have shown all loosened prostheses to have had increased early migration, and a predictive value of 80% has been reported with 2 years of follow-up. Accordingly, a threshold of 200 µm migration the second year was applied, and the material divided into two groups with different prognosis, regardless of prosthesis design: 28 patients with good prognosis; and 15 patients with poor prognosis with risk of future loosening. The prognosis groups turned out to be different in several aspects. The risk group showed larger inducible displacement by external forces, the interface thereby interpreted as more compliant. The flexion moments during gait were increased in the risk group, as well as the mean moments, both before and after the operation. This finding was considered important and could imply a causal relationship between increased loading during gait and risk of tibial component loosening. The risk group had subtle symptoms after 4 (3–5) years of follow-up, only detected by the NHP, which should therefore be considered as a more sensitive, possibly also more relevant, measure of outcome than HSS and VAS.

Local corticosteroids and pain—a clinical and experimental study

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Background. Perineural administration of corticosteroids with or without local anaesthetics is frequently applied in the treatment of a variety of chronic, regional pain conditions. The rationale for this is not very clear, since an inflammatory cause of pain is rarely evident.

Methods. 1. A retrospective follow-up of all the patients from out pain clinic who had been given nerve blocks with corticosteroids and local anaesthetics during a 4 year peridod was carried out. The long term treatment results were evaluated from the patients' records and with a questionnaire. 2. The transmission in A- and C-fibers was investigated in a rat model after short-and long-term application of corticosteroids and a mixture of a corticosteroid and a local anaesthetic. 3. The microscopic structure of nerves was investigated after long-term application of a corticosteroid with light and electron microscopic techniques. 4. The effect of local application of corticosteroids on injured nerves was studied in a rat model producing neuropathic pain.

Results and conclusions. Nerve blocks alone are not very effective as a long-term treatment for chronic pain. Locally applied corticosteroids inhibit transmission in C-fibers but not in A-fibers during short-term exposure but not during long-term exposure. The microscopic structure is not affected. Corticosteroids do not improve the nerve blocks by local

anaesthetics but rater makes the nerve block less profound. They depress the heat hyperalgesia and the mechano-allodynia but not the mechanical hyperalgesia in rats with a neuropathic pain like condition. It is hypothesized that the latter effect is caused by suppression of ectopic neural discharges from injured nerve fibers.

Bone mass, fracture and physical activity

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The present study evaluates the influence on bone mass of physical activity and fracture. Measurements of bone mineral density (BMD) and soft tissue composition were undertaken by Dual Energy X-ray Absorptiometry (DEXA) and Single Photon Absorptiometry (SPA).

In a cross-sectional study of 324 individuals, 146 men (age 20–87) and 178 women (age 20–87), the age at peak bone mass and the rate of bone loss differed between skeletal regions. The main loss was found in the hip region in both men (25%) amd women (39%). The BMD values in women were similar to data found in the literature on white women in US but higher than in Japanese or French women. In spite of this, the hip fracture incidence is higher in the US and Sweden than in Japan and French speaking Swizerland.

BMD and soft tissue composition were investigated in 93 individuals with hip fracture, 26 men amd 67 women. Individuals with a hip fracture had lower BMD and lower weight as compared with controls. Women with a trochanteric hip fracture had lower BMD than women with a cervical fracture and also lower BMD in the fractured as compared with the uninjured hip.

In 102 individuals with a hip fracture prospective measurements were umdertaken. Post-traumatic osteopenia was noted in several skeletal regions, most obvious with a one year loss of up to an average of 9% in the fractured hip. The BMD loss was significantly higher in the injured as compared with the uninjured hip. Over the same time period there was a loss of 5% in lean body mass and a gain of fat of 11%. No difference was found between patients who died or developed pseudarthrosis or segmental collapse of the femoral head and those who survived the fracture incident or whose fracture healed either in the initial measurements or in the changes in BMD and soft tissue composition that followed the fracture.

Post-traumatic osteopenia seems to be irreversible, at least in younger individuals, since 22 patients with a tibial shaft fracture had—28 years after the fracture—still a lower BMD in the previously fractured as compared with the contra-lateral limb. Physical activity, on the other hand, seems to be beneficial for bone mass since active athletes (19 weight lifters and 28 ballet dancers) had higher BMD than age- and gender-matched controls. In close connection with the cessation of their active career weight lifters (n=21) seemed to retain BMD better than controls, whereas ballet dancers (n=14) seemed to lose BMD faster than controls. In ex-weight lifters over 65 years (n=24) no difference in BMD was found as compared with controls. BMD was correlated only to age and present physical activity level in these older ex-weight lifters.

In active athletes (56 men and 33 women) the BMD in weight-loaded skeletal regions was higher whereas the BMD in the upper part of the skull, which is assumed to be an unloaded region, was lower as compared with controls. After cessation of the active career these differences disappeared and after 65 years of age there was no BMD differences between either the upper part of skull or in the femoral neck or the total body in ex-weight lifters (n=24) as compared with controls.

Arthroplasty of the rheumatoid elbow with special reference to nonconstrained replacement and its complications

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Involvement of the elbow by rheumatoid arthritis may result in considerable pain and functional disability. The natural course and the outcome of different surgical methods for the treatment of the rheumatoid elbow with cartilage destruction were studied. 23 elbows, which had not been treated surgically, were followed prospectively for 5 years. 1/3 of them were severely painful at both the initial and the follow-up examination while there was radiographic progress of bone attrition in 1/3 of the elbows. 35 elbows, operated on with interposition arthroplasty, were evaluated retrospectively

after a median of 6 years. At follow-up 1/10 of the elbows were severely painful. There was radiographic progress of bone attrition in 2/3 of the elbows.

19 Wadsworth prostheses, implanted via a posterior approach, were followed prospectively for a median of 6 years. 5 elbows were revised because of aseptic loosening while there were radiographic signs of loosening in another 8 cases. 50 capitellocondylar prostheses, implanted via the lateral approach, were followed prospectively for a median of 3 years. There were only 2 major postoperative complications, but transient ulnar nerve palsy was common. At follow-up, all elbows were painfree or only slightly painful.

Pre- and postoperative laser-Doppler imaging of 5 elbows, operated on with the capitellocondylar prosthesis via the lateral approach, showed no impairment of microcirculation in the wound margins. Intraoperative motor neurography of the ulnar nerve in 8 elbows, operated on with the capitellocondylar prosthesis via the lateral approach, showed a reduction in the amplitude during elbow dislocation at surgery in all patients. One of them had a mild sensory ulnar nerve palsy postoperatively. The capitellocondylar type of prosthesis implanted via the lateral approach is recommended for surgical treatment of the painful rheumatoid elbow with cartilage destruction.

Legg-Calvé-Perthes disease—an epidemiological, clinical and radiological study

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The annual incidence of Legg-Calvé-Perthes disease (LCPD) was estimated to 8.5 per 100.000 and the attack rate to 1:770 in children 0–14 years of age during the years 1978–1989 in the Swedish County of Uppsala.

Arthrography revealed lateral subluxation of the femoral head in a large number of hips in children with LCPD in which plain radiographs could not demonstrate any subluxation.

In a radiological study the acetabulum-head index (AHI) was measured in 46 children (92 hips) with normal hips. The mean AHI –2 standard deviations (SD), which was used to define the border value for lateral subluxation of the femoral head, was 82.

The AHI was measured in the nonaffected hips, on both plain radiographs and arthrograms, in 37 children with unilateral LCPD. The mean vallue for the AHII –2 SD was used to identify the border value for lateral subluxation. On the plain radiographs, an AHI ≤ 81 indicated subluxation. On the arthrograms, however, the corresponding AHI value varied and depended upon how the line representing the lateral border of the acetabulum had been drawn. When the bony acetabulum was used to identify the lateral border, an AHI of ≤ 68 indicated subluxation and, when the labrum was used, an AHI of ≤ 86 indicated subluxation.

In a prospective study, 24 affected hips in 22 patients with LCPD were examined with plain radiogrraphy, arthrography, bone scintigraphy and magnetic resonance imaging (MRI), all of which were performed within one month. MRI scans were superior to plain radiographs and bone scans in the detection of the extent of necrosis. Revascularisation was more clearly demonstrated with MRI scans than with bone scans, irrespective of the duration of symptoms. MRI scans were as good as arthrograms in determining the occurrence of lateral subluxation.

In a retrospective study, 16 femoral and 18 innominate osteotomies in 31 patients with LCPD were compared with regard to clinical and radiographic results. The clinical results were the same in the two groups and all patients were asymtomatic in the previouslv affected hip(s) during daily activity. The radiographic results were also the same in the two groups when measuring the sphericity of the femoral head but the coverage of the femoral head by the acetabulum was better in the innominate osteotomy group.

In a prospective study, 10 affected hips in 10 patients with unilateral healed LCPD were examined with plain radiography and MRI. The results showed that the configuration and structure of the femoral head were demonstrated equally well by both plain radiography and MRI.

Experimental studies on the regeneration of skeletal muscles

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The regeneration process following experimental injury to rat skeletal muscle was studied for this thesis. Three different models of injury were used: blunt contusion to the gastrocnemius, sharp transection of the extensor digitorum longus, and toxic injury to the soleus or tibialis anterior by phospholipase A2, purified from a snake venom, notexin, or by local anesthetic drug bupivacain. The regeneration process was followed up to 56 days. Muscle samples were investigated by histological, enzymehistochemical and immunohistochemical staining methods, as well as by Northern blotting hybridization. The general findings and conclusions based on them are lisetd below.

In the early moments of regeneration, the markers for satellite cell differentiation were expressed prior to the first signs of cell proliferation. This observation challenges the prevailing concept that differentiation follows proliferation. This discrepancy can be explained by the presence of two different groups of myogenic precursor cells: stem satellite cells, which undergo proliferation prior to differentiation; and committed satellite cells, which are capable of immediate differentiation into myoblasts.

There were a few nuclei inside the plasma membranes of surviving fibers near the injured ones that were binding BrDU. These activated nuclei were probably myonuclei. Although the myonuclei are usually considered permanently postmitotic, the results of the present study suggest that they can be activated by the nearby injury to dedifferentiate and re-enter the cell cycle.

The abjunctional stumps of the transected myofibers, i.e. those fiber segments that do not contain the original neuromuscular junction, undergo definite neurogenic atrophy until they are reinnervated. Reinnervation takes place through neo-formation of primitive NMJs on their surface, to be later connected with axon sprouts emerging from proximal nerve terminals in the adjunctional part of the muscle. These axon sprouts are able to grow through a connective tissue scar of considerable thickness and density.

Cold therapy delays the onset of skeletal muscle regeneration slightly, and this delay is reflected throughout the repair process. However, there is no significant difference in the final outcome of the regeneration between cold treated and control muscles, and therefore the application of cold as the first aid of muscle injuries is safe. The clinically well documented advantages of cold therapy appear to emerge from its analgesic effects and the ability to limit hematoma and inflammation rather than from effects on the regeneration process itself.

Therapeutic ultrasound promotes the rate of satellite cell and fibroblast proliferation in muscle regeneration. The enhancement is, however, not reflected in the rate of myotube production. Increased fibroplasia and subsequent collagen synthesis may, in fact, be counterproductive since permanent scarring may result. Therefore it is concluded that routine use of US in the treatment of acute muscle injuries cannot be supported by the results of the present study.