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Descriptions of Research Activities and Strategic Research Aspects

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The major part of the health care consumption in musculoskeletal disorders is caused by fractures, joint diseases (osteoarthritis and rheumatoid arthritis), back problems, injuries and tumors. This pattern is reflected in the research activities within the Department of Orthopedics at Lund University Hospital.

Research on joint disease and its consequences spans from basic genetic and biochemical investigations to applied projects which monitor nationwide the outcome of arthroplasty and includes the following aims:

- Develop methods for diagnosis and monitoring of early-stage osteoarthrosis through patient-administered outcome scores, radiography, arthroscopy, MRI and analysis of joint fluid and serum markers of cartilage turnover as well as investigate the disease mechanisms;
- Epidemiology and risk factors for osteoarthritis following joint injuries;
- Improve diagnostic and reconstructive techniques after knee ligament injury;
- Improve and develop techniques for joint replacement in the rheumatoid joint;
- Study the process and causes of joint implant loosening in hip and knee;
- In a nationwide, prospective multicenter study investigate patterns of knee joint implant failure related to time, implant type, infection, age, etc.

Fracture research includes:

- In a nationwide, prospective multicenter study investigate the epidemiology and treatment of hip fractures and its effects on health care economics;
- Improved methods for osteosynthesis of hip fractures and study effects on femoral head vitality, fracture healing, and rehabilitation;

Biomaterial, Bone and Matrix Biology Research includes:

- A study of the process of bone induction and its stimulation by human recombinant growth factors;
- Tendon and cartilage repair using cell culture techniques;
- Synthetic bone substitutes for repair of fragility fractures;
- A study of a new radiopacifier for bone cement.

Research on lumbar back pain and sciatica aims to optimize patient information, surgical methods, postoperative treatment and utilization of hospital resources.
Research on different methods of treatment for gangrene of the lower extremity caused by diabetes is evaluated with regard to quality of life, cost, etc.

Research on orthopedic oncology evaluates diagnostic procedures, surgical techniques and prognostic classification of soft tissue tumors. Surgical treatment of skeletal metastases is studied concerning technique and outcome.

Research in hand surgery includes evaluation and treatment of ligament injuries in distal radius fractures in young patients.

Research in pediatric orthopedics targets gait and function analysis in children with cerebral palsy and pathophysiology in Perthes’ disease.

Laboratory facilities exist within the Department for the following areas: biomaterial, biomechanics, cartilage metabolism, animal experiments, bone transplantation and radiostereometry. In addition to some 30 M.D. clinical investigators, a total of 3 laboratory technicians, 4 engineers/engineering students, 5 statisticians and 6 secretaries are engaged in the research work. Currently, a total of around 15 graduate students are working on their Ph.D. thesis within the Department. With the opening of the Biomedical Center (BMC), linked to the University Hospital, the collaboration with preclinical research in cell- and molecular biology within connective tissue was enhanced.

In 2004 a National Competence Center for studies on musculoskeletal disorders (NKO) giving statistical, epidemiological health economy advices to researchers, funded by Federation of Swedish County Councils and National Board of Health and Welfare, was opened and moved into new facilities in the hospital 2007 http://www.nko.se.

The MORSE project - a longterm collaboration between the Southern Sweden regional health authority and the Swedish Social Insurance Agency – started September 1, 2006 and focus on research and development on musculoskeletal health problems, sick leave, and health services utilization and also developed guidelines for the treatment and rehabilitation of musculoskeletal disorders and the effect of implementation of these guidelines http://morse.nu.

In December 2007 the department has been designated as a World Health Organization Collaborating Centre for Evidence-Based Health Care in Musculoskeletal Disorders http://bjdonline.org.

Future
The five new activities: Swedish National Competence Center for Musculoskeletal Disorders, MORSE, Tissues in Motion, Centre for Biomechanics and the WHO center, will all have a significant input on future research as well as the close research interaction between biomaterial, biomechanics, cartilage metabolism, animal experiments, bone transplantation and radiostereometry.

In the external evaluation of the whole University (RQ8), Orthopedics in Lund has been graded excellent and also top ranked in a national review concerning clinical research. This has now led the University to increase our unrestricted departmental funding during a 3-year period.

Two competitive research positions for 4 years have been granted from the Swedish Research Council to Martin Englund and Eva Ageberg. The reviewed research grants from the Medical Faculty increased during 2009 as well as the total external funding, now reaching 3.5 million Euro.

A major 4-year EU grant of 2 million Euro on implementation research will be coordinated through Professor Anthony Woolf, at present Visiting Professor at our department, with our department as one of the major partners in the consortium.

WHO has for the first time decided to have a separate global group for musculoskeletal disorders in their revision to ICD 11. The work is chaired by Martin Sundberg assisted by Anette Dahl, both from Lund.

In 2009 it became clear that Lund and Malmö will form one clinical unit. As a result a musculoskeletal science institute will be formed in 2010 with a broad representation from different fields including inflammatory diseases as well as basic research. Financial support of 0.3 million Euro for a start up period of 3 years has been given by the Region of Scania.

These research projects thus involve the whole staff at the Department of Orthopedics at Lund University Hospital. For a complete listing of participants in each project, please contact the primary investigator. A list of publications printed in 2009 is enclosed. For further information you may also visit our website at http://www.med.lu.se/klinvetlund/ortopedi.

The two graphs below summarize some aspects of the academic activities of the Department during the last few years.
The research is financially supported by:

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Early range of motion exercise in Achilles tendon ruptures treated nonoperatively

Sylvia Resch, Sara Ericsson, Eva Ageberg

At the Department of Orthopedics in Lund we generally treat Achilles tendon ruptures conservatively with an Aircast walker for 8 weeks. During this time, the patient may bear weight within pain limits. The purpose of the project is to see if early training improves the functional outcome of the calf muscle in these patients thus leading to a more satisfactory result.

Background
There is no consensus regarding the treatment of these patients. Previous studies have shown that conservative and operative treatments have a similar re-rupture rate. Operated Achilles tendon ruptures have more complications (Nistor, 1981). Our own studies (Ingvar et al.) show a re-rupture rate in conservatively treated patients of 7%, which is considered acceptable. In our present protocol, patients start physiotherapy after removal of the walker at 8 weeks.

Early training in tendonjuries has been successful in hand tendon injuries (Twadle et al.). Early motion has a positive effect on tendon healing and tendon function in both animal and human studies. Lengthening of the tendon occurs in both operated and non operatively treated tendons and affects function adversely (Mullaney et al., Järvinen). It has been shown that it is not due to early motion (Palmer). Early mobilisation is said to minimise hypotrophy of the calf muscle (Möller et al.).

Purpose of the study
To evaluate the effect of early physical training on the function of the calf muscle in persons with total rupture of the Achilles tendon. Our hypothesis is that early training leads to a better functional outcome without an increase in complications.

Methodology and implementation
Prospective randomized study of all patients with Achilles tendon rupture in Lund. Two groups: 1. Earlier and more intense training according to a special protocol which includes motion without weight bearing in increasing portions. 2. Standard training according to our protocol which includes non weight bearing the first 8 weeks. The study is limited to otherwise healthy individuals with no other musculoskeletal complaints.

Outcome measures
Achilles tendon total rupture score (ATRS), achievement in physical tests, and patient satisfaction and quality of life as measured by SF-36.

Significance
If rehabilitation can be made more effective, persons with Achilles tendon ruptures can return to their previous level of activity and be able to exercise regularly instead of being forced to have a more sedentary life style.

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Joint Arthroplasty in the Hip and Knee – fixation, function and survival

Gunnar Flivik, Uldis Kesteris and Martin Sundberg

Total joint arthroplasty in the hip and knee is successful operations with generally good results. Developments have been fast and indications for operation have gradually widened, with younger patients being considered for surgery as operation results have been improving. However, late aseptic loosening as well as wear remains a problem, and sometimes early loosening occurs without an obvious reason. The consequence of component loosening and the ensuing bone loss is often a re-operation, which is a major, costly and for the patient trying operation.

We are studying different factors involved in the fixation and function of the prosthesis components, both initial and long-term variables. Our aim is to evaluate and improve the surgical technique and to analyze factors of importance for the implant survival and patient satisfaction, such as prosthesis design, material and positioning, but also pre- and postoperative levels of activity, exercise and pain level.

At present we have several patient studies in progress. In different studies we are evaluating surgically relevant factors such as types of bone cement, operative techniques, different bone preparation models and different component designs and the effect of periarticular analgesia during surgery. We are exploring the importance of anatomic restoration in THA with the use of modular prosthesis and hip navigation evaluated with for example gait analysis. We are looking into the fixation of both uncemented and cemented components. We are also carrying out studies on the relatively new concept of resurfacing hip replacements as well as the role of patella resurfacing in knee replacements. Furthermore we are investigating the effect of exercise pre- and postoperatively for total joint replacement patients with pain thresholds as an important factor, and with the aim of identifying non-responders to exercise and joint replacements. Another area of ongoing study is the role for bisphosphonate in joint arthroplasty, both in revisions and primary prosthesis.

In many of these studies we use RSA (RadioStereometric Analysis) which is a radiographical method by which the three-dimensional movements of the implant can be followed with a very high degree of accuracy. This is the most exact method there is when it comes to measuring migration patterns of prosthesis components. With this technique, within two years and with a limited number of patients, differences can be demonstrated between various operation techniques, materials and prostheses. With conventional methods this would take many years and call for a much larger number of patients at risk. Our groups of patients are also being followed up with strictly clinical and conventionally radiological examination methods as well as a comprehensive package of questionnaires, covering both general health and disease specific questions.

Furthermore, we carry out complementary biomechanical laboratory studies, in which factors such as operation techniques, materials and surface finishes are being evaluated. Concurrently with the continuous data we contribute to both the National Hip and Knee Registers we are also following up our own hospital’s material of primary as well as revision hip and knee prostheses. The main goal of our studies is to contribute to even better joint function and life quality for patients with hip and knee prostheses and to decrease the need for re-operations.

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Long term follow up of children treated for congenital clubfoot.

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Background
Pes equinus varus adductus excavatus (PEVA), more known as clubfoot, is a complex congenital deformity of the foot, with a prevalence of 1/1000 newborn. Treatment of this deformity is still controversial. The most accepted methods during the initial correction are serial casting or intensive manual mobilization with stretching often followed by surgery. There is no consensus regarding treatment after the correction phase. Orthoses in different models with varying time schedules, use of orthopedic shoes and physiotherapy in different forms are a few of the alternatives available. Evidence based knowledge is scarce concerning factors affecting long term result.

We have followed all children treated for clubfoot in Lund since 1993 prospectively. First we developed the Clubfoot Assessment Protocol (CAP) to meet the requirement for a reliable and valid instrument. The aim was to comprehensively describe functional aspects according to International Classification of Function and Disability (ICF) issued by WHO 2001. CAP may be utilized throughout childhood and adolescence both in clinical settings and in research. It has been shown to have good reliability, validity and sensitivity to change and has increased the quality of care in a standardized and structured way.

Aims
Our aims are to evaluate the children treated for congenital clubfoot on different functional domains over time and in comparison to treatment given. Since 1993 two different treatment groups are followed prospectively; intensive physiotherapy (Copenhagen method) and serial casting (Ponseti).

Specific aims:
- Are there any differences in long term outcome of mobility, muscular function, morphology and quality of movement between the modified Copenhagen and Ponseti method?
- Which are the sensitive periods with increased risk of relapse?
- To study the effect of our orthotic treatment, Knee Ankle Foot Orthosis (KAFO) and Ankle Foot Orthosis (AFO) in comparison to other studies using the Foot Abduction Orthosis.
- To study these children’s motor ability and possible need for specific motor training.
- Patient /parents perspective on treatment outcome.

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Prevention of hip dislocation and musculoskeletal deformities in children with cerebral palsy

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CPUP, a cerebral palsy register and a health care programme for children with CP, was established in Southern Sweden in 1994 as a joint project between the orthopaedic departments and child rehabilitation units. The reason for this co-operation was that we saw that a number of children with CP had developed hip dislocation and severe contractures.

The purpose of CPUP is:

- To prevent hip dislocation and severe contractures by continual and long-term examination of joint motion and if necessary, early preventive treatment.
- To increase the knowledge of CP and the effects of different treatments.
- To improve the co-operation between the different professionals involved in the care of children and young people with CP.

The basis of CPUP is to identify all children with CP and offer them participation in the programme. CPUP includes a standardized follow-up of each child in terms of an assessment form. The children are assessed 1-2 times a year. The form includes information on the child’s gross and fine motor function, passive range of motion, use of orthoses and treatment. The programme also includes a standardised radiographic follow-up of the children’s hips and spine. All reports are administered via Internet.

In 2005, we were able to present with a 10-year follow up, that hip dislocation is preventable and also that there was a decrease in the number of children that developed severe contractures in a total population.

In 2005, CPUP received funding as a National Quality Register. Since 2007 all counties in Sweden have joined CPUP. In 2009 CPUP became a National quality register in Norway, and in 2010 registration starts in Denmark.

At present about 2700 children with cerebral palsy are followed in CPUP. This total population followed prospectively is used for several research projects. More information: www.cpup.se

PhD Students: Måns Persson Bunke, Elisabet Rodby Bousquet

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Optimized biomaterials for tissue reconstruction

Lars Lidgren

The overall aim of the project is to develop improved biomaterials for increased implant survival, to obtain a better understanding of the biomaterial tissue interface, and to exchange knowledge between different disciplines and institutions. The project consists of a basic/preclinical part and a clinical part. The basic/preclinical part will focus on (1) molecular and cellular binding patterns and mechanics of existing and new chemically and structurally tailored surfaces and materials (2). The biological function of calcium sulfates and phosphates as replacement, implant coating and as a filler in PMMA (polymethyl methacrylate) are studied in animal models. A new PMMA with water soluble radiographic filler is studied (3). Research on material degradation focus on polymers in bearing surfaces and around implants to study chemical, physical, mechanical, biological, rheology and tribology properties (4). A new patented method with focused high intensity ultrasound is developed for discal hernia (5). Several imaging techniques are measuring implant motion and degradation. Multicenter survival studies including outcome measurements will be used for the clinical biofunction evaluation.

- Ad (1). Materials will be modified to achieve different tissue organization by functionalization of the surface by attachment of biologically active ligands primarily chosen from normally occurring matrix components. Techniques to characterize and quantitate tissue organization will be refined.

- Ad (2). Cell cultures and experimental models, which are closer to clinical applications, are used. The idea is to use synthetic bone or bone grafted knee prosthesis in rabbits, in which we will try to stimulate incorporation and remodeling of the grafts by, for example, growth factors. Chamber models are used for further characterization. New technique for tenocyte and chondrocyte cell cultures on a novel fleece are now in clinical studies.

- Ad (3). Multiaxial joint wear simulations are carried out on different material combinations. The chemical, structural and rheological properties of the materials are characterized prior to and after testing by using spectroscopic and microscopic techniques. Analysis of components from retrieved clinical and donor implants constitutes a reference to the in vitro studies.

- Ad (4). The effect of focused ultrasound on discs is studied biochemically and in clinical studies. For mechanical studies a multiaxial Instron/MTS machine is used.

- Ad (5). A national implant and biofunction study is run by the Department of Orthopedics in Lund, including all clinics in Sweden. In a later stage of this program alternative material will be followed by survival analysis.

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Osteoarthritis research from gene to patient – a continuum

Stefan Lohmander

**Background** – Osteoarthritis (OA) is a major cause of disability. OA represents a final common end stage with pain, stiffness and radiological changes. OA is caused by many interacting factors such as heredity, joint injury, ageing. Current methods for diagnosis and assessment of progression are based on clinical and radiographic signs. Therefore, the disease is diagnosed only in its final stages and progression is difficult to assess.

**Objectives** – To identify risk factors and disease mechanisms for (OA) on gene, molecule and patient level; To develop methods for assessment and monitoring of patients with OA; To develop and test new treatments for OA.

**Results** – Patients with total hip replacement (THR) for OA are more related to each other than matched controls, showing heredity for hip OA. We have identified chromosomal loci associated with increased risk for OA, and genetic and phenotypic variability in OA. We conduct studies with the large Malmö Diet and Cancer cohort and the Swedish Twin Registry to further explore the roles of heredity and environment for OA.

Joint injury is an important risk factor for OA. We use this disease model of OA to further explore interactions between genetic and environmental factors for OA. Biomarkers released from the OA joint help us understand the dynamic changes of cartilage metabolism that occur after joint injury which precede OA development. New treatment is needed that intervenes in this cartilage degradation. We monitor the development of OA in longterm studies of groups of patients with injury to the menisci or ligaments of the knee.

We have developed patient administered questionnaires to monitor pain, function and quality of life in patients with OA. These instruments are used to validate results of imaging and biomarkers. Together, patient-administered, imaging and biomarker outcomes support our efforts to improve treatment for OA.

**Clinical Relevance** – OA is a major global disease burden. We identify genetic variations associated with increased OA risk. With biomarkers as surrogate outcomes for OA, we have revealed new and critical events in the early development of OA. Our improved patient-relevant measures allow a more sensitive assessment of new treatments for OA. These research results are used in studies of people with joint injuries: *young patients with old knees*.

Our longterm studies of patients with meniscus injuries have led to an international re-evaluation of the importance of these injuries for the development of knee OA. We conduct a first high quality controlled randomized trial to compare surgical and non-surgical treatment after rupture of the anterior cruciate ligament of the knee. Results of this RCT will influence future management of these serious injuries.

Our work is done in collaboration with groups in Iceland, England, Germany, USA, Canada, Australia and Japan.

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Paradoxically, with improved survival after treatment for cancer, the need for surgical treatment of skeletal metastases has increased. Until a decade ago, those with symptomatic skeletal metastases very seldom underwent surgery. A substantial development has taken place in other treatment modalities: e.g. radiation therapy, pain management, and in the field of prevention of symptoms from skeletal metastasis. Today, a growing body of evidence shows that some, but not all, patients with symptomatic skeletal metastases can gain from surgery. The main issue today is to be able to offer the patient the right combination of multi-modality treatment.

Our research is aimed towards identification of prognostic factors for long or short survival, which is of importance in deciding the right combination of treatment, and also in the development of surgical techniques for metastases in the spine and in the long bones.

Prospective registration of all patients undergoing surgery in the spine or in the long bones is done. The register is used for analyses of factors influencing the survival time. This is of importance, since patients must be able to gain from the often large operations. Furthermore, specific surgical techniques are analyzed with regard to symptom control and risk of complications.

Clinical relevance: Our results have immediate clinical relevance, foremost as regards who will, and who will not, gain from surgery, and also in refining surgical techniques and implants for maximum benefit of the surgery, while still minimizing the risks associated with surgery.

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Health services use and work disability in patients with musculoskeletal disorders

Ingemar F Petersson

Every third visit to a GP as well as one third of the disease burden in sick leave practice comes from musculoskeletal disorders. This also causes a high degree of functional impairment and decreased quality of life for people of all ages. The annual costs for musculoskeletal disorders in Sweden range up to Euro 15 billions and most of the indirect costs come from people being on sick leave and disability pensions. Treatment and rehabilitation methods for people of all ages with musculoskeletal disorders have greatly improved in western countries over the past decade. However, few studies have been undertaken to estimate how this influences public health, work disability and health care costs. Furthermore, studies of the implementation of existing guidelines for treatment, rehabilitation and sick leave in those patients have been scarce.

Interventions within the musculoskeletal disorders in the population (about 1.15 million) in southern Sweden are studied in the MORSE project (www.morse.nu). This includes new pharmacological treatment for inflammatory rheumatic disorders, orthopedic procedures as well as structured rehabilitation.

In the unique MORSE project, we have access to both sick leave data and health care utilization data for the whole population of the southern region of Sweden, Skåne. This covers both urban and rural areas as well as population with different educational, employment and ethnical patterns. We also link to the national registers for drug prescriptions, occupation and educational levels as well as the registers for causes of death. The MORSE project works in close collaboration with the Swedish National Insurance Agency (Försäkringkassan), the local health authorities of Region Skåne, the Medical Faculty, Lund University (courses in Insurance Medicine) and patients/consumer’s organizations. The MORSE project is also connected to European and international collaborative networks.

The MORSE project has a focus on

- Studies of the detailed prevalence of musculoskeletal disorders in the population
- Finding the positive and negative predictive and prognostic factors of musculoskeletal disorders and their co morbidities
- Studies on the effects on the burden of disease from pharmacological, rehabilitative and surgical procedures in musculoskeletal disorders.
- The impact of musculoskeletal disorders on the health care system and the national social insurance system including health economic analyses
- Studies of the impact on Functioning, Activity and Participation due to musculoskeletal disorders
- Studies of the attitudes and processes in the health care system, the national social insurance system and other NGO and GO organizations responsible for work disabled people with musculoskeletal disorders
- Development and implementation of guidelines for the treatment, rehabilitation and sick leave procedures for patients with musculoskeletal disorders
- Studies of the effects of knowledge transfer and implementation of guidelines on the health in the population

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Musculoskeletal diseases and injuries are among the leading causes for individual suffering and burden on society. Twenty-two percent of adults in Europe have experienced long-term muscle, bone, and joint problems; 32 percent had such symptoms limiting their activities in the previous week, and they are the second most common complaint underlying long term treatment (Health in the European Union - Eurobarometer 2007).

Osteoarthritis is believed to be the most common cause of musculoskeletal disability in developed countries, and is listed among the top 10 of the global disease burden according to the World Health Organization. Neck, low back, and shoulder pain and chronic inflammatory musculoskeletal disorders such as rheumatoid arthritis and spondyloarthritis have a major impact on function, quality of life. Despite the high frequency of musculoskeletal disorders and injuries, there is limited knowledge of its true occurrence leading to health care seeking, etiology, prognosis, comorbidities, treatment consequences, and the burden on society.

**Wp1:** Regional and national health care registers in Sweden have so far been poorly utilized in this field despite it is vast resource of carefully collected population-based prospective data. Utilizing this data for research purpose is cost and time effective and highly internationally competitive. Via linkage to other register resources, e.g., Statistics Sweden and the National Population Register and Insurance Agency, we can obtain novel information on disease occurrence, risk factors, comorbidities, the burden of disease on society, and monitor societal effects of medical and surgical treatments in an entire population.

**Wp2:** Also, in collaborative projects using data from the Unites States, we study large prospective observational cohorts with repeat assessment using magnetic resonance imaging to learn more about knee osteoarthritis, e.g., the Osteoarthritis Initiative (n=4796), the Multicenter Osteoarthritis Study (N=3026), and data from the general population of Framingham Massachusetts (N=1039), with focus on the role of the meniscus and knee injury in osteoarthritic disease. The work is ongoing and has lead to several important publications including general medical journals such as the New England Journal of Medicine (Englund et al 2008) and the Annals of Internal Medicine (Felson et al 2007).

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National musculoskeletal competence centre – NKO

Jonas Ranstam

Musculoskeletal research has become increasingly oriented towards collection and interpretation of large amounts of data. National knee and hip arthroplasty registries, and a national hip fracture registry, were established already about 25 years ago. New registries have evolved since and continue to evolve in more and more areas.

This development increases the demands on both the technical systems used for handling data and on the statistical methods for analysing them. The increasing complexity of the work implies that quality assurance is becoming an important part of the activities.

The national competence centre incorporates professional resources in data management, programming, biostatistics, epidemiology and health economics as well as medical expertise. With these resources the competence centre constitutes a national education and consultation organization supporting both old and new registries. The competence centre has developed a general and dynamic database system for collection of data and establishment of registers. The system is based on modern relational database technology and includes secure patient data registration over the Internet.

The joint methodological know-how and development of a general database system reduce time and costs for initiation of registries for new purposes, for example evaluation of patient satisfaction and cost-benefit analyses, leaving more resources for assessments and improvement of data quality and for data analysis and reporting.

Record linkage with registers from the National Board of Health and Welfare (causes-of-death, cancer, diagnoses in in-patient care, etc.) and the databases of Statistics Sweden (population register and predictions) provides technical opportunities for developing new knowledge on etiology, treatment and prognosis of diseases and a for a better use of health resources.

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The Swedish Knee Arthroplasty Register (SKAR)

Otto Robertsson

The number of knee replacement operations is continuously increasing. During 2008 11,000 primary arthroplasties were performed in Sweden, and during the next years changes in the age-profile of the population are expected to still increase the demand.

During the first ten years after surgery, five percent of the primary operations can be expected to be revised because of loosening, mechanical complications, infections, etc. The cost for revisions is substantially higher than that for primary operations, especially in infected cases.

The number of revisions is affected by many factors such as unsuccessful methods or implants, where the revision rate will be higher than the average. Therefore, it is of the highest importance that the use of such methods, implants and techniques can be limited to reduce the extra cost and suffering.

To maximize participation and facilitate complete reporting, the register has only gathered a minimal set of data for each primary operation containing information on identity, age, disease, treating hospital, what implant was inserted and the method of fixation. However, this year the register added a number of questions to its form which is to be filled in during or immediately after surgery. The new question concern previous surgery on the affected knee, methods used (tourniquet, drainage, CAS, MIS), prophylaxis (infection, thrombosis) as well as timing. We hope that this new information in the short term will contribute to continuous improvement of quality as well as to scientific studies in the long term.

After surgery, the patients are followed prospectively to identify failures, which are defined as re-operations if implant components are added, exchanged or removed.

Through statistical analyses it is then possible to estimate the risk of failures and to compare hospitals, implants, diagnoses, and surgical methods.

A further measure of the results is gained by the use of self-administrated questionnaires that are sent to patients to evaluate patient-satisfaction and health measures.

Process measures such as volumes and need of surgery can be evaluated by comparing regions, studies of age-distribution, and the use of questionnaires.

All hospitals that perform knee arthroplasty surgery participate in the project. In 2009 the register was compared with the National Patient Register (an inpatient-care register of the health authorities, based on ICD coding) and the coverage was found to be 96% (SKAR annual report 2009).

The registry has in the past succeeded in giving early warning about inferior techniques and implants as well as stimulating hospitals and surgeons to improve their routines. It is therefore important to continue this work as new implants and operation techniques are continuously being introduced that needs monitoring.

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Musculoskeletal diseases and disorders involve 1/3 of the adult population, leading to functional limitations, decline in quality of life, and high costs for the society. This project focuses on sensorimotor function after joint injury, using the injured knee as model. A joint injury leads to impaired sensorimotor function. Sensorimotor function is the complex interaction between sensory and motor pathways, and the central nervous system (CNS) and is assessed by measures on different levels of function, such as proprioception and performance tasks.

It was suggested that sensorimotor function is of importance for the outcome after injury and in preventing knee OA. Our studies are on the young and middle aged, with or at high risk of OA. With an innovative approach and using large cohorts, we develop and validate clinical methods that can be used in large groups of patients. We and others have shown that sensorimotor function is persistently impaired after knee injury, despite treatment. In experimental studies, we elucidate the effect of knee injury and of treatment on sensory and motor functions and on CNS mechanisms. Osteoarthritis (OA) is a major public health problem. Knee injury is the major risk factor for OA development in the young and middle-aged. In epidemiological large cohort studies, we test the hypothesis that poor muscle function predicts OA. Training is an effective treatment for these individuals, reducing pain and improving function and quality of life. In intervention studies, we study the effects of various training methods with the aim of optimizing training as treatment.

Given that we can optimize training as treatment and determine the role of muscle function, this will have large impact on the disease burden for the individual, the health care system and society.

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Knee injuries and the risk of early osteoarthritis

Harald Roos

It is known from many studies that there is a risk for early radiographic and symptomatic osteoarthritis after major knee injuries. Our previous studies have shown that an ACL injury in soccer players will cause osteoarthritis in almost 50% already in the age of 30 in female players and just some years later in male players. These findings indicate that there might be a need for major knee surgery because of symptomatic knee osteoarthritis in many cases before the age of 50. The data from the Swedish Knee register show that knee arthroplasty in the younger age groups has an increased revision rate compared to knee arthroplasty in older patients. Early symptomatic posttraumatic osteoarthritis might thus be a therapeutic challenge for the orthopaedic surgeon.

We have also studied the long term outcome of primarily non-operated ACL injuries. All patients were included in a randomized trial comparing two different training regimes in the late 80ies. The patients were also advised to avoid sports activities like football and team handball. At the follow up 15 years after the injury about 20% had been treated with an ACL reconstruction. The subjective outcome according to the KOOS (Knee Injury Osteoarthritis outcome Score) is much better in this group compared to the injured soccer players after the same time interval from the ACL injury. Interestingly enough, compared data from the Swedish ACL Registry these patients feel better 15 years after the initial injury compared to the one-year follow up of patients that have undergone ACL reconstruction and they have just marginally lower activity level. The prevalence of osteoarthritis is much lower in this primarily non-operated cohort and in the patients that have no meniscus injury and no reconstructive surgery there is no radiographic OA at all. The research has focused on identifying different factors that may have contributed to the good results in that cohort.

We also use these cohorts to study different radiographic aspects of osteoarthritis, such as primary compared to posttraumatic osteoarthritis. The distribution of the different radiographic features associated with osteoarthritis is such a part.

The benefit of a systematic use of subacute MRI in the handling of acute knee sprains in the EU setting is studied, with the purpose to study if this will reduce the missed ACL tears. The result of such a routine would thus be that a higher incidence of ACL injuries in the population would be found. The rationale behind this, in the shorter perspective, expensive routine could hypothetically be that an immediate diagnosis will reduce the risk for re-injuries and enhance the chance to provide an early adequate treatment. Theoretically, this may be beneficial both from an economical and an osteoarthritis perspective.

In a randomized multicenter trial we study the short and long-term outcome after an ACL injury treated with or without ACL reconstruction. All other aspects of the treatment are identical. In the short term perspective we focus on whether the patients are able or not to return to their previous activity level and on the subjective outcome and quality of life measured by patient-relevant instruments. The primary outcome is the KOOS. The long term consequences are studied with repeated MRI examinations and conventional radiographs. To identify determinants for the development of osteoarthritis, bone bruises on MRI and body fluid markers (blood, urine, synovial fluid) are specifically studied.

The 2 year follow up is completed and the process of publishing the report in one of the more generalized medical journals is ongoing.
The patients will be followed for 5 years according to the original plan, but it seems relevant to plan for at least a 10 year radiographic follow up. From this study of 121 patients included in a randomized trial there is much data and several interesting comparisons between different measurements can be performed.

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Sarcoma Research
Anders Rydholm

Soft tissue sarcoma is a heterogenous group of tumors with some 50 histopathologic types. Broadly, the tumors can be divided based on presence of specific gene fusions or more complex genetic aberrations, with a need for refined diagnostics in the latter group. One third of the patients die because of metastases and novel prognostic tools as well as treatment-predictive markers and development of targeted therapies are needed for improved survival.

The management of soft tissue sarcoma patients in southern Sweden is since long centralized to the Sarcoma Group in Lund. A large data base on tumor characteristics, treatment and outcome and a tissue bank comprising close to 1000 patients have been created. We apply a translational approach to study genetic and proteomic profiles, validate gene/protein expression patterns in large clinical materials, link novel markers to prognosis, and apply the findings for refined diagnostics and prognostics.

The research group involves 5 senior researchers (Rydholm, Vult von Steyern, Nilbert, Domanski, and Engellau), one postdoctoral fellow (Jönsson) and 2 PhD students (Carneiro and Styring). The projects are carried out in collaboration between the departments of Orthopedics, Oncology, Pathology and Clinical Genetics.

The projects can be exemplified by array-based genetic and proteomic profiling with clinical applications for refined diagnosis and prognosis. We have recently

- Demonstrated diagnostic and prognostic gene expression signatures across the soft tissue sarcoma subtypes
- Identified novel subgroups within leiomyosarcoma
- Demonstrated a prognostic importance of tumor hypoxia
- Found and validated the prognostic importance of invasive growth pattern, which is now included among the high-risk criteria used to recommend adjuvant chemotherapy
- Further refined the Scandinavian Sarcoma Group prognostic system, now referred to as SING
- Described the changing clinical spectrum of angiosarcoma after breast cancer treatment

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Reconstructive surgery in rheumatoid arthritis

Urban Rydholm

Patients with severe or longstanding disease benefit from joint reconstruction with endoprostheses in terms of pain relief and improved function. Prosthetic replacement of the knee, shoulder, elbow and ankle are well established and the long-term results so good that only marginal gain can be achieved with improved prosthetic design or fixation methods.

At the moment surface replacement of the hip is under investigation. The patients are followed by clinical examination, radiography and radiostereometry. RSA findings after 2 and 6 years show the same result as stemmed femoral implants. Early revisions due to femoral neck fractures have been done but mid-term results seem promising.

Infection is an uncommon but serious complication of knee arthroplasty. The Swedish Knee Arthroplasty Register contains data on patients operated on with a knee prosthesis since 1974, and gives unique opportunities to study specific complications, for example infection. A current research project concerns all patients that have been reported as having been revised due to infection during 1985-2000. Information is collected regarding patient-related factors such as type of infection, bacteriology, and treatment modalities. The outcome will be analyzed and the results compared with the patients’ self-experienced quality of life as reported in questionnaires. Part of this project is the development of PCR (polymerase chain reaction) methods in the diagnosis of prosthetic infection, which is performed in co-operation with the Department of Microbiology.

Follow-up of RA patients having been operated with arthrodesis of the ankle or hind foot has recently been published. New techniques with the use of trabecular metal for filling of bone defects in connection with subtalar fusion and in revision surgery for failed ankle prosthesis are under evaluation. A new ankle implant is under development in co-operation with the industry.

5-years follow-up of ankle arthroplasties has just been finalised.

The long-term results of stabilizing and decompressive surgery of the cervical spine in patients with RA are investigated in co-operation with the Department of Neurosurgery.

A new RA-surgery quality register has just been launched and is under administration of the Swedish RA Register. It is owned and handled by the Swedish rheumatoid surgical society.

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Deep infection after knee arthroplasty.

Anna Stefánsdóttir, Kaj Knutson

The incidence of deep infection after a primary knee arthroplasty is approximately 1 %. As the number of operations performed steadily increases so does even the number of patients that are affected by this serious complication increase.

Since 1975 the Swedish knee arthroplasty register (www.knee.se) has registered information on knee arthroplasties performed in Sweden. This large nation-wide database provides unique possibilities to study a low-frequent complication like deep infection. Information on 478 first time revisions performed on primary knee arthroplasties because of infection have been collected for detailed analysis. The microbiology has been described and the work proceeds with description of the surgical modalities used for treatment and an evaluation of the results with respect to healing of infection and function. Health related quality of life outcome measurements are available for a group of the patient.

Deep infections are caused by bacteria that normally colonize the skin of the patient or the personal at the surgical department, and at the time of operation contaminate the joint. Prophylactic antibiotics are routinely used and in Sweden cloxacillin is the most commonly used systemic prophylaxis whereas gentamicin is added to bone cement. In an ongoing study the bacterial colonization of the skin of patients undergoing primary hip or knee arthroplasty is being studied both pre-operatively and after hospitalization. Even the resistance pattern of the bacteria is studied.

The administration of prophylactic antibiotics has been studied and the timing of the first dosage was found to be sub-optimal in many cases. The results have put focus on the problem and stimulated to improvements which are observed in the continuous registration in the Swedish Knee Arthroplasty Register.

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Amputations: Epidemiology, prevention, healing and quality of life — Treatment of foot ulcers and joint destruction in diabetic patients— Analysis of dynamic pressure in the foot sole

Anders Stenström, Jan Larsson, Ilka Kamrad, Sylvia Resch, Hedvig Svensson, Magnus Eneroth

There is an increased risk of developing foot ulcers in persons with diabetes compared to healthy individuals. More than 50% of all amputees suffer from diabetes. A research program at our department has shown that the annual number of amputations has decreased with two thirds and this decrease has been sustained for more than 20 years. The amputation level is more distal than before. More than 50% of the amputations in diabetic patients are now performed through the foot.

Several patients with a below knee amputation get problems with the fitting of the prosthetic liner. Increased pressure and shear forces on the skin may cause new wounds which increases the risk of another amputation at a higher level. New types of liners made of silicone or polyurethane are now evaluated with respect to socket fitting and walking ability. Initial results show a considerable improvement of the patient’s satisfaction and walking ability compared to conventional liners.

Factors related to the healing of diabetic foot ulcers and specific treatment modalities of diabetic foot ulcers are being evaluated. Prospective studies are in progress: Supplementary nutrition to diabetic patients with foot lesions, granulocyte-colony stimulating factors in foot infections, and randomized comparison of surgical and conservative treatment of plantar forefoot ulcers. Different ways to treat severe foot deformity due to joint destruction in the diabetic foot (Charcot foot) are studied.

A detailed analysis and follow-up of more than 2400 diabetic patients with foot ulcer is ongoing. Eighty percent of all amputations in diabetic patients are initiated by a foot ulcer, often due to narrow shoes or shear stresses on the foot because of overloading. A continuous follow-up of patients undergoing amputation has been performed and a 20-year material in this regard has been published. A national amputation register has recently been established and is currently being tested.

To study the initiation mechanisms of plantar foot ulcers a 3-D gait analysis (Vicon system) is performed to evaluate the gait pattern. Thin insoles (EMED) with electronic sensors are placed in the shoes of the patient to investigate dynamic loads and stresses on the foot sole during walking. Special insoles and shoes are made and the procedure is then repeated to register if the intended unloading effect is achieved, thus leading to prevention of ulcers and prevention of eventual amputation.

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Surgical treatment of lumbar spine disorders is becoming more common. The main reason for this is the detailed information on anatomic structures obtained by modern radiological techniques such as MRI and CT, and also by diagnostic injections. The main aim of the surgical treatment is pain relief/pain reduction but retained or improved nerve and muscle function may also be achieved. To demonstrate the utility of new treatments, prospective long-term follow-up using multiple result parameters is required. In prospective outcome studies of decompressive surgery and disc herniation operations and, subsequently, also fusion for degenerative disorders, tumors and fractures, the short- and long-term effect of these treatments has been documented. The aim is improved selection criteria for surgery in the individual and also to improve patient information.

Prospective long-term studies were initiated in 1986 and have resulted in a large database stepwise analyzed regarding short- and long-term outcomes, especially concerning diagnostic data and patient selection. Since 1993 a national register for lumbar spine surgery is run which covers 75-80 % of the degenerative lumbar spine surgery in Sweden providing an excellent source for indication and outcome analysis. Current analyses focus on gender differences and regional variations. From 2006 the register covers all spinal disorders.

With the aid of precise radiographic measurement techniques [radiostereometry, (RSA), distortion compensated radiography], mobility patterns of the spine have been documented in healthy subjects and in defined disorders. This technique has also been used to evaluate the outcome after surgical interventions, especially fusions. An algorithm for evaluation of new implants has been presented. The importance of this is emphasized by the high number of new implants emerging on the market, such as disc prostheses, nucleus prostheses, and mobility retaining implants. A radiostereometric disc prosthesis study is being initiated.

Biochemical studies of cartilage markers in disc herniation are performed in collaboration with the department of Cell and Molecular Biology. The aim is to enable monitoring of the disorder with a blood test from a prognostic and perhaps therapeutic point of view. This technique is also being applied to spinal trauma.

Bone inductive substances have been evaluated in conjunction with fusion. A study of non-invasive treatment of lumbar disc herniation using high intensity focused ultrasound is running currently. If this proves successful, surgical treatment could be diminished. A pilot study of its safety in humans has been completed recently and a RCT is ongoing. The development of a non-heat curing bone substitute for expanding painful vertebrae with osteoporotic fractures or tumors, vertebroplasty, is being conducted.

Evaluation by functional and ADL parameters is studied in multidisciplinary projects before and after disc herniation surgery. The effect of surgical treatment, determined with health related quality of life protocols, is analyzed. Correlations between various outcome parameters are studied and patient selection for spinal surgery is gradually improved.

**Clinical relevance**

All aspects of the research protocol are dedicated to clinically relevant questions for spine patients. Main benefits obtained will be improved patient information and patient selection for surgery, pinpointing the best surgical techniques and deleting non-efficient treatment modalities.

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Osteoporosis and fragility fractures, especially hip fractures

Karl-Göran Thorngren

Patients with hip fractures constitute one of the most resource consuming groups in health care. They consume 25 percent of all bed days in orthopedic departments in Sweden. We have pioneered a treatment program with fracture repair (osteosynthesis), immediate direct weight bearing, and continued walking rehabilitation in the patient’s own home. During the last twenty years the risk of hip fracture has doubled in persons above 80 years of age and the total number of elderly in the population is increasing. We must therefore continue the improvement in operation techniques and rehabilitation of the hip fracture patients.

The research project contains epidemiological, prognostic, operative, and technical as well as rehabilitation and economical aspects on the hip fracture treatment. The project further contains optimized patient care including rapid handling to operation, prevention of infection and pressure ulcers, pain management and improved nutrition. It also includes a nationwide study of parameters for quality assurance (RIKSHÖFT, see www.rikshoft.se). In a European Commission project called Standardized Audit of Hip Fractures in Europe (SAHFE), the Swedish national registration has spread internationally widely also outside Europe.

Projects:

- Fracture epidemiology, background factors, screening and prevention of osteoporosis and falls
- Comparison of operation methods
- Investigation of femoral head blood circulation and vitality after femoral neck fracture
- Hip joint tamponade after trauma, i.e. increased pressure within the hip joint capsule due to bleeding
- Acute fast track treatment from hip fracture to operation
- Nutrition, pain relief and prevention of pressure ulcers and cognitive impairment in hip fracture patients
- Bone transplantation
- Osteonecrosis (cell death and bone compression within the femoral head)
- Nationwide, multicenter registration of quality in treatment of patients with hip fractures and international comparisons

Techniques: epidemiology, balance testing, patient inquiries, skeletal scintimetry, bone densitometry, histology, MRI, CT, X-ray, ultrasound, pressure measurement.

The optimal treatment of this large and increasing group of patients has great importance both for the individual and the society with its limited resources for health care.

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Biomaterials and Biomechanics Unit
Jian-Sheng Wang, Magnus Tägil, Gunnar Flivik and Liz Tanner

Since May 1997, the biomaterials and biomechanics laboratory has provided an interface for researchers with engineering and medical backgrounds, bridging the biomaterial/biomechanical research with more biologically oriented animal models and clinical research. The facilities within the unit are: (1) a mechanical testing laboratory; (2) computational facilities for mechanical analysis; (3) an RSA laboratory (RadioStereometric Analysis), utilizing a technique that with a very high degree of accuracy can measure the relative motion of two segments such as artificial joints implanted into the body or across a fused joint; (4) a biomaterials laboratory that enables production of ceramics for use as bone substitute materials and (5) animal model facilities. In 2004, a Centre for Biomechanics at Lund University (CBML) was established. The centre combines the research activities in groups from the Medical Faculty, Science Faculty and Lund Institute of Technology. CBML offers a multi-disciplinary environment for researchers and research groups to tackle biomechanical problems, and this laboratory is an active participant in the centre.

The general aim of the biomaterials/biomechanics laboratory is to use the techniques of biomaterials and bioengineering sciences together with biological and animal models to improve the repair and regeneration of tissues in the skeletal system. A clear link to clinical use and clinical trials is prioritised. Our biaxial machine is used for mechanical testing of new materials before or after their incorporation into bone tissue. The RSA laboratory assesses the behavior of joint implants in the body while using limited number of patients in the clinical trials. A large number of RSA-studies are ongoing evaluating factors such as cementing technique, bone preparation, prosthesis design and fixation methods, both cemented and uncemented. We are developing injectable bone substitute materials, that have a similar composition to bone, and which can integrate with normal tissue. We are also studying how these materials can stimulate repair of tissue, through optimizing the chemical composition or the mechanical properties of the materials. We are also studying how the function of tissues can be modified non-invasively through mechanical load.

Further information about the unit can be obtained from www.ort.lu.se/BBL/

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Experimental orthopaedics and clinical studies to improve treatment of skeletal and joint diseases

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Our aim is to improve the treatment of fractures as well as control the consequences of joint diseases such as osteonecrosis, osteoarthritis and rheumatoid arthritis. We use experimental implants in animal models to test drugs or basic biologic parameters like mechanical load.

The research program starts with the single undifferentiated mesenchymal progenitor cell as it enters into the field of injury and how its fate is determined by the mechanical environment and by locally released differentiating proteins. In animal models we can alter the differentiation pathway for this cell to become cartilage by mechanical load. We describe the influence of different mechanical stimuli on the cell and determine the boundary conditions for tissue differentiation, when and how differentiating proteins are expressed during fracture healing, and finally match the mechanical and humoral stimuli in a computer finite element model.

Using pharmacological substances we are able to manipulate the anabolic and catabolic components of bone healing, separately or in combination, and inhibit bone resorption with bisphosphonates or increase the bone formation with morphogenic proteins (BMPs, PTH). In complex fractures with bone loss or infection, but also in cancer metastases, rheumatoid arthritis or aseptic loosening of a joint prosthesis, large bone volumes are lost and must be replaced by bone transplant or artificial bone substitute. We have shown that this loss can be decreased by bisphosphonates and that it is feasible to use bone substitute, maybe in combination with morphogenic proteins.

The aim of the experimental research is to implement the result in the clinical practise. Bisphosphonates are being tested in ongoing randomized and non randomized studies regarding osteonecrosis of the knee, fracture healing and prosthetic fixation. With our research we aim to add a more biologic thinking into the classical orthopaedics compared to a previously more mechanistic view.

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Hand and upper extremity surgery
Treatment of distal radial fractures and prosthetic replacements in the hand and wrist.

Antonio Abramo, Philippe Kopylov and Magnus Tägil

The distal radial fracture is the most common fracture in the emergency clinic. To determine the outcome and morbidity of the fracture in the population and validate the present treatment flow-chart, all distal radial fractures in Lund are followed prospectively. Since 2002, a subjective functional outcome score (DASH) is sent to all patients, approximately 350 a year, at three and twelve months and the outcome is registered prospectively. The majority of the patients return to an almost normal function but about 10-15% has substantial functional impairments at one year. Prospective studies and randomised series are added to the registration system comparing open versus closed treatment or various plates. Artificial bone substitutes have been tested in distal radial fractures and osteotomies as presented in a thesis by Antonio Abramo in 2008.

In some fractures, the joint surface is destroyed and artificial joint replacement necessary. Joint destruction is also found in diseases like rheumatoid arthritis and in joint infections. We evaluate old and new prosthetic concepts in prospective and/or randomised studies in the thumb-CMC, finger-MCP and PIP-joints as well as in the wrist RC and DRU-joints. A new prosthesis has been developed at the department for the distal radioulnar joint and is in clinical trial. A register for all prosthesis in the hand and wrist has been initialized together with the NKO with the aim of becoming nation-wide.

A collaboration with the LTH is ongoing for mechanical testing and computer modelling of joints and prosthesis (www.cbml.lu.se). New materials are tested experimentally for cartilage repair.

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Tibial osteotomy of severe knee osteoarthritis and knee deformities in younger and/or physically active patients

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We study prophylactic methods and risk factors with the aim to reduce the risk of complications during the treatment of tibial osteotomy by the hemicallotasis technique (HCO). HCO is a method used to unload the damaged medial or lateral compartment of the knee joint by correction of the mechanical axis, in order to reduce pain and enhance function. HCO is used on 50-60 patients per year in Lund. 597 patients (654 knees) have been treated by the HCO since the modest start in 1993. HCO is an alternative surgical treatment of younger and/or physically active patients with severe knee osteoarthritis (OA) and knee deformities. HCO is a callus distraction for correction of angular deviation, which utilizes the regenerative potential of the bone to achieve bone healing to the desired correction, and is based on an external fixation. A successful tibial osteotomy is dependent on a proper patient selection, achieved and maintained adequate correction and avoidance of complications.

Pin site infection is the most common complication of external fixation. By changing the pin site care step-by-step, from daily to weekly care, using Chlorhexidine instead of Sodium chloride solution and decreasing the prophylactic antibiotics from 14 days to no prophylaxis at all, we are able to reduce pin site infections and decrease the use of antibiotic during the time in external fixation from, on average, 47 to 11 days. Leaving the theatre dressing undisturbed during the first postoperative week resulted in less use of antibiotics compared with change of the theatre dressing during the first postoperative week.

Complications such as delayed bone healing and non-union generally imply longer time in external fixation and increased risk of further complications. We have shown that smoking is the single most important risk factor for complications. An extension of the study on smoking including patients using oral snuff – “snus” – indicates that the use of oral snuff does not have the negative effects, as delayed bone healing or increased risk for complications, as cigarette smoking.

We compare patient characteristics and patient-related outcomes with short- and long-term surgical and biological outcome of the HCO in collaboration with the Lund OA research group. In an evaluation of 500 patients, 92% of the patients were operated on for knee OA (82% for medial knee OA Ahlbäck grade I-III and 8% Ahlbäck grade IV-V). 13% of all patients were operated on for lateral deformity, showing similar improvements as patients operated on for medial deformities. We have shown that the HCO improves self-rated pain, function and quality of life already during the treatment in external fixation and the improvements continue during a 2-year follow-up. Evaluation of mid-term results of HCO with special focus on clinically extended diagnosis criteria is ongoing.

**Clinical relevance**

Reduction of pin site infection decreases the risk of severe complications and the use of antibiotics. The pin site care developed from these studies is used in fracture healing and other corrections treated by an external fixation. The experience from the HCO cohort could be used in the selection of patients, to optimize the treatment as well as in the information to the patients.
Pathophysiology of synovitis in the hip

Hans Wingstrand

This project focuses on hip joint soft tissues. Sonography, intracapsular pressure measurements, MR and CT techniques were used in this clinical project to diagnose and follow hip synovitis in various disorders.

In one project, the soft tissue biomechanics of the hip joint capsule in and its influence on clinical symptoms, radiological findings and subsequent loosening in hip joint arthroplasties is studied. We use ultrasonography (US) as a method of examination THA hips for signs synovial edema/free fluid in the joint. Pain in OA hips might be of capsular/synovial origin due to its rich sensory innervation. We investigate the intracapsular pressure and the elasticity of the hip joint capsule in OA and correlated these parameters to pain and to the radiographic stage of OA. Joint dislocation remains one of the most disturbing complications after THA. We investigate the soft tissue reaction in relation to soft tissue repair, component wear in relation to aseptic loosening of the prosthetic components.

The etiology in Legg-Calve-Perthes Disease is a disturbed blood supply to the proximal femoral epiphysis resulting in an aseptic necrosis. The cause of this disturbance is unknown but scintimetric studies indicate that synovitis with effusion in the hip joint and subsequently increased intracapsular pressure is important. We have measured the intracapsular pressure in LCPD and have found pressures that could compromise the blood supply to the proximal femoral epiphysis. Synovitis causes cartilage oedema and ensuing cartilage hypertrophy with a risk of joint deformation, incongruency and poor containment. Serial MRI and plain radiography was used to follow the development of the femoral head. In cases of incongruency we have performed a proximal femoral varus derotation osteotomy. A follow-up study indicates that this results in reduced cartilage incongruency and an improved sphericity of the femoral head.

Five theses have to date been defended as results of these projects, which are now continued. This project is supported by the Swedish Research Council, Lunds sjukvårdsdistrikt and the Medical Faculty.

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Radiostereometric analysis of skeletal growth in children

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RSA (Radiostereometric analysis) as developed by Göran Selvik 1974 has been used extensively for orthopaedic and radiographic research. The radiostereometric technique can be used to determine the three-dimensional dynamics of one skeletal structure relative another and therefore we found it suitable for investigating physeal growth.

RSA permits accurate determination of longitudinal growth and rotational movements over short periods of time. This makes it possible to detect an incomplete physiodesis at a very early stage, and, if necessary, do a repeat operation before an angular deformity or inaccurate correction of LLD is of any clinical importance.

After establishing the accuracy of the method on the first 10 children and following another 30 children closely with this technique, we now perform RSA on all physiodesis as a routine follow – up postoperatively and at 12 and 15 weeks postoperatively.

**Leg Length Discrepancy:** Children with LLD are treated with percutaneous physiodesis and followed with RSA. The time perspective from physiodesis to physeal arrest is evaluated in relation to age and gender. A prospective study using eight plates instead of percutaneous physiodesis is carried out with the potential possibility of this method to be reversible and making correction of LLD a very accurate procedure.

**Varus – valgus correction:** The introduction of the eight plates has largely replaced the need for correction osteotomy in a number of paediatric diagnoses. Correction of varus- and valgus deformities can be followed clinically but with much more precision with RSA.

**Extreme tall stature:** Girls with predicted height > 187cm (+3sd) and boys >200cm were earlier on occasionally treated with hormones by the paediatricians to reduce height at skeletal maturity. This treatment includes very many complications and risks, and normally not very much correction. In corporation with the paediatricians we now treat some of these children with knee physiodesis and follow them with RSA.

**Fractures:** Physeal fractures can result in partial or complete arrest of the physis leading to asymmetrical growth or growth arrest. Conventional radiographs are not able to predict whether the physis has been damaged or not but with RSA this can be revealed before any malalignment occurs.

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Knee injury & Osteoarthritis – outcomes, relations and treatment alternatives

Richard Frobell

Osteoarthritis (OA) is the most common reason for musculoskeletal disability in the western world and accounts for a large proportion of the global disease burden. Although OA is highly frequent, little is known about the pathogenesis and there is currently no disease modifying treatment available. OA often occur in the knee joint and previous knee trauma has been identified as a potent and independent risk factor for later OA development.

We are conducting a randomized controlled trial (the KANON-study) involving young active adults with an acute tear of the ACL of the knee to assess whether a strategy of structured rehabilitation plus early ACL reconstructive surgery is superior to a strategy of structured rehabilitation with delayed ACL reconstruction offered to patients who continue to have symptomatic instability. We will specifically assess short term (2 year) and long term (5 years) outcomes of self-reported knee function, return to activity, and molecular and imaging biomarkers. In a cross sectional study of clinical and quantitative analysis derived from baseline MR images, we showed that almost 60% of all ACL injured knees had an associated osteo-chondral fracture that was strongly related to the existence and size of post traumatic bone marrow lesion. Using quantitative analysis of MR images over the first year after ACL injury we found cartilage thickening in the central part of medial femur and cartilage thinning in trochlea femur. We aim to further investigate the correlation between imaging findings and molecular biomarkers collected at the time of MRI.

In close collaboration with the department of Orthopedics in Helsingborg, we have prospectively collected a cohort of more than 1300 patients with acute knee trauma. All patients received treatment in the normal clinical setting and a 5-7 year follow up is planned. Besides some 600 patients with ACL injury, this cohort involves approximately 200 patients with patellar dislocation, 100 patients with a complete medial collateral ligament tear and 200 patients with isolated meniscus injury. Using this cohort, we first aim to describe the epidemiology of acute knee injury, and secondly to analyze the ‘diagnose-specific’ clinical and radiographic outcome.

In pilot studies, ‘joint distraction’ was shown to be efficient as treatment for later stage OA and could possibly be an option to postpone total knee replacement. In collaboration with the department of Rheumatology in Utrecht, the Netherlands, we are currently designing a randomized controlled trial to compare the clinical and radiological outcome of ‘joint distraction’ and total knee replacement.

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**Dissertations**

Anton Johannesson
Lower limb amputation in patients with vascular disease.
Incidence, postoperative care, and prosthetic functional outcome with focus on transfibial amputation.

Sarunas Tarasevicius
The soft tissues in osteoarthritis and arthroplasty of the hip.
Thesis, Department of Orthopedics, Clinical Sciences Lund, Lund University, 2009