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Meniscal lesions

With special reference to diagnostic procedures and childhood conditions

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Forty-six patients with clinical symptoms of only medial meniscal lesions had double-contrast arthrography followed by arthroscopy. At arthroscopy, 38 medial lesions were found—four of them were false-positive and another false-negative. Seven lateral lesions were detected at both arthrography and arthroscopy. Arthrography is considered reliable in diagnosing both medial and lateral meniscal lesions.

In a prospective series of 145 patients having arthroscopy due to a clinical suspicion of only a meniscal lesion, the clinical diagnosis was correct in 88 (61 percent) patients. Discriminant analysis determined a set of clinical variables—locking (positive) and multiple localization of pain (negative)—that predicted the presence of a meniscal lesion in 8 out of 10 patients.

In a retrospective investigation of 324 meniscectomies performed in children, 54 percent of the removed menisci were considered to cause the patients' symptoms. Discrimination analysis determined a set of factors—decreased range of motion (pos.), general tenderness on palpation (neg.), pain (neg.), and giving way (neg.)—which predicted the presence of meniscal lesions in 7 out of 10 children.

The average annual incidence of meniscectomy in children increased from 0.7 to 2.5 per 10,000 from 1960–1965 to 1980–1985. The increase was associated with the introduction of arthroscopy.

The results after total meniscectomy in 89 children were analyzed at an average of 17 years after surgery. Three quarters of the patients were pleased with the outcome, but only half of the patients had satisfactory results using objective scoring systems.

Anteroposterior and rotatory instabilities were significantly increased after lateral meniscectomy. The joint spaces were significantly reduced, and gonarthrosis was recorded in every tenth patient.

Irrespective of age, the clinical diagnosis of meniscal lesion is poor. Every effort should be undertaken to save the meniscus.

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Biomechanical properties of the femoral neck relative to osteosynthesis methods and bone mineral content assessed by computed tomography

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Mechanical studies were made on osteoporotic cadaver specimens with vertical femoral neck osteotomies parallel to the shaft of the femur. Screws with varying diameters and different hip compression screws were tested in axial bending and in rotation in an Instron machine. The tests indicated that screws with shank diameters less than 5 mm were too resilient to maintain a strong fixation of a femoral neck osteotomy. Hip compression screws did not increase the stability of the osteotomy compared with two 5.5-mm screws. Studies on intact control femora indicated that the bone density per se influenced the stability of a femoral neck osteosynthesis on cadavers independent of the implants used. The study also suggested that three 5.5-mm screws may be mechanically favorable compared with the construct of two screws or the hip compression screw.

In a separate clinical study of 244 elderly patients with displaced femoral neck fractures, the early mechanical failures were related to the screw dimensions and the number of screws. Resilient screws with diameters less than 5 mm gave significantly increased redisplacement rates compared with 5-mm screws. Three 5-mm screws showed the best retention of the femoral neck fractures, but the difference was not significant compared with the use of two 5-mm screws. The study suggested that increasing the number of screws from 2 to 3, and finding an optimal screw diameter, may be favorable for the fixation of a femoral neck fracture.

Quantitative computed tomography (QCT) bone density related recordings on cadaver femora were correlated with the axial bending strength and also with the torsional strength of the femoral neck. The QCT density recordings at different levels correlated significantly with the bending and torsional strength of the intact femoral neck. The correlation was even enhanced when QCT bone mass related measures were used. The highest correlation coefficients were obtained in the diaphyseal and in the condylar area, probably due to better standardization of QCT measurements in these regions.

In a separate study, scanned slices of femoral condyles were neatly cut with a saw and chemically analyzed. The highly significant correlation ($r = 0.96$, $P < 0.001$) between calcium content and QCT mass recordings confirmed the hypothesis that QCT bone measurements may give valid information of the actual bone mineral content.

In conclusion, the study suggested that femoral neck fractures ought to be treated by three screws with a diameter of 5 mm or more. The stability of the osteosynthesis was related to the bone mass, which may be determined by QCT from the femoral diaphyseal or condylar area.

Dissertation University of Oslo 1990

On shoulder muscle load

An experimental study of muscle pressures, EMG, and blood flow

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Repetitive or static work situations with elevated arm positions are one major cause of shoulder pain syndromes, which are common in the industrialized society. Previous electromyography (EMG) studies have shown that the supraspinatus muscle is heavily loaded in elevated arm positions. Besides EMG, *intramuscular pressure* (IMP) can describe local muscle load, but has not previously been studied in shoulder muscles. Further, intramuscular pressures exceeding 40–60 mmHg may reduce muscle blood flow. The aims of the present study were to describe shoulder muscle load based on IMP recordings from shoulder muscles. Simultaneous EMG was used as a reference method. The IMP in the suprasinatus was also related to muscle blood flow, measured with the Xenon-133 clearance technique.

The microcapillary infusion technique was used for measurement of IMP in all the studies. The method had good dynamic properties even at low infusion rates (1.5–3 mL/h). A high IMP (mean 81 mmHg) was found in the supraspinatus early in shoulder abduction, even without hand load, indicating impaired muscle blood flow in the supraspinatus already at this low shoulder load. Increasing arm elevation and additional hand load increased IMP up to over 200 mmHg in 90 degrees of abduction with a 2 kg hand load. Elbow flexion reduced IMP in the supraspinatus muscle approximately 30 percent in abducted arm positions. Simultaneous intramuscular bipolar EMG and IMP was recorded in the supraspinatus, infraspinatus, deltoid (anterior part), and trapezius (descending part). Both methods gave a similar description of relative shoulder muscle load both under isometric conditions and in the standardized arm position/hand load combinations. Pressures in the supraspinatus and intraspinatus muscles were high compared with the trapezius and deltoid both at maximal voluntary contraction and at abducted arm positions. The differences between the muscles may be due to differences in muscle anatomy, function, and compliance of surrounding tissues.

Only in abducted arm positions, the IMP (and EMG) in the supraspinatus showed a close correlation to the trapezius EMG, indicating a similar relation to shoulder load in this plane of motion. Muscle blood flow in the supraspinatus muscle was significantly impeded at an IMP of 42 mmHg (SD 1.5). The high IMP in the supraspinatus in elevated arm positions supports previous EMG studies that this muscle is heavily loaded in work situations with prolonged arm elevation. Further, the arm must be almost totally relaxed for the muscle blood flow to not be impeded in the supraspinatus.

The effect of arm suspension on supraspinatus muscle load was assessed in simulated work situations with measurement of IMP and EMG. Both EMG and IMP showed a moderate reduction of supraspinatus muscle load by arm suspension. In welding, the arm suspension did not reduce mean IMP below 40 mmHg.

This study shows that IMP offers a new possibility for evaluating shoulder muscle load. Intramuscular pressure measurements give the same information of relative muscle load as EMG, and can also give a relation of muscle load relative to muscle blood flow during muscle contraction

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Management of the acute rupture of the anterior cruciate ligament

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This study deals with the treatment of the acute complete anterior cruciate ligament rupture. The accuracy of the Lachman test and the anterior drawer test was analyzed in patients with acute and old anterior cruciate ligament ruptures. The long-term results of nonoperated on anterior cruciate ligament ruptures were analyzed concerning knee stability and function. A surgical procedure is described using the longitudinal patellar retinaculum as an augmentation of the acutely repaired anterior cruciate ligament, and furthermore, this procedure was compared with repair alone of the ruptured ACL. A new testing device is described, which measures the anterior tibial displacement in normal knees, in patients with an ACL deficient knee, and in patients treated conservatively or surgically for acute rupture of the ACL. An analysis of the effect of electrical muscle stimulation in combination with voluntary contractions during immobilization after knee ligament surgery was done.

The Lachman test was superior to the anterior drawer test in unanesthetized patients to diagnose acute ACL ruptures. The results after conservatively treated ACL ruptures in nonselected patients were unsatisfactory in the majority of the cases. All the patients had a positive Lachman test and positive anterior drawer test, and 83 percent had a positive pivot shift test. Twenty-eight patients surgically treated with repair with augmentation gave satisfactory results in 86 percent. Patients treated with repair and augmentation had a significantly higher Lysholm score than a group of patients with repair alone. The objective measurements with our testing device showed no significant mean right/left difference between two knees of normal subjects, but a significant difference between the injured and uninjured knee in patients with an ACL deficient knee.

Electrical muscle stimulation combined with simultaneously performed voluntary muscle contractions can limit weakness, wasting, and reduction in oxidative and glycolytic muscle enzyme activity during immobilization after knee ligament surgery.

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Patients with blunt injuries treated in an intensive care unit

An analysis of 2,002 cases

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Totally, 2,002 trauma patients admitted to the Intensive Care Unit were analyzed. Special regard was given to patient groups that would benefit from intensive care and to prognostic factors. Sixty-five percent of the patients were injured in road traffic accidents. Injuries to the lower extremity were the most frequent (60 percent). The ICU mortality was 9.0 percent, and the total hospital mortality was 11.9 percent. For 1,169 patients with multiple injuries, the average time of treatment in the ICU was 10.8 days and in the hospital 50.7 days. Treatment in a respirator was necessary in 46 percent.

A dramatic fall in mortality from a level of 14.6 percent to 4.8 percent by 1981 was observed. The attitude of prophylactic treatment in a respirator and a well-organized, coordinated injury care system were among the most important factors in reducing mortality.

Important parameters for good prognosis were no cardiopulmonary resuscitation, no need of respiratory treatment, young age, low number of initial blood transfusions, less severe brain and thoracolumbar spine injuries, no renal complications, no previous mental disturbance or alcoholism, few complications during treatment, and a swift start of necessary operations.

Flail chest injuries should be treated by endotracheal intubation, IMV, and PEEP to shorten the time of treatment in a respirator, and to get better oxygenation. Forty-three out of 54 patients with a high spinal cord injury needed ventilatory support, the duration of which depended on the level and completeness of the injury. Bradycardia, hypotonia, and tachypnea at admission were prognostically bad signs.

Follow-up and treatment in the intensive care unit are recommended for all trauma patients with multiple injuries who need treatment in a respirator and patients with tetraplegia. Long bone fractures should be stabilized immediately, and those patients should readily receive prophylactic mechanical ventilation. Serious hidden thoracic, abdominal, and brain injuries, and complications leading to respiratory distress must be actively searched for. The prevention of complications and a thorough understanding of each single injury and its treatment are prerequisites for the successful treatment of multiply injured patients. In addition, a well-organized and coordinated trauma care system is mandatory.

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Bicycle accidents in Gothenburg 1983–84

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The aims of the present study were to describe bicycle accidents in Gothenburg, including the mechanisms behind the accidents, the injuries, and the injury sequelae. The purpose was also to evaluate the effectiveness of protective helmets and to suggest preventive measures.

The study included basic accident and injury data for all the injured cyclists registered during 1983–84 at the casualty departments of the hospitals in Gothenburg. Interviews about the accident circumstances were performed at the time of the accident and about the sequelae 3 years after the accident. In a separate study, 36 matched pairs of helmeted and nonhelmeted cyclists were investigated as to the occurrence and severity of head injuries.

Totally, 1,611 injured cyclists were registered; 25 percent were known by the police. Most of the accidents were single accidents (71 percent), and they were often caused by the cyclists themselves. Fourteen percent were injured in collisions with cars and 9 percent in collisions with other bicycles. Children (< aged 16 years) accounted for 43 percent and adults (aged 16–39 years) for 41 percent. Males constituted 62 percent. The cyclists suffered a total of 2,955 injuries. Most of the injuries were of minor or moderate severity (AIS 1 or 2) and were located in the head/face (39 percent) and in the upper extremities (31 percent). Young children (aged 0–8 years) sustained more often head/facial injuries.

In all, 1,031 (64 percent) cyclists answered a questionnaire on causes and mechanisms of the accident. The children were usually injured in single accidents while playing or learning to ride. Accidents on their way to and from school, as well as collisions with cars, were uncommon among children. The adults were injured on their way to and from work as often as during leisure time. There was no relationship between the type of bicycle and the risk of injuries.

Totally, 1,122 (70 percent) cyclists answered the questionnaire on sequelae 3 years after the accident. The incidence of sequelae was between 12 and 17 percent. The severity of the sequelae was scored on a scale called the Permanent Impairment Scale (PIS). The incidence and severity of sequelae increased with age. The incidence was equal in different body regions, except for the neck region, where it was higher. The most severe sequelae were due to injuries to the head and neck. In 18 cases, there were sequelae because of injuries that were not noted at the time of accident.

The number and the maximum severity of the injuries in the helmet area were significantly lower in the helmeted cyclists.

Bicycle accidents and injury prevention should be based on data obtained from medical records and interviews. Cyclists should be informed about the causes of single accidents and motorists about changes in cycling traffic. Parents should be informed about the suitable ages to learn to ride a bicycle and to ride in traffic. The school must intensify traffic education, and society must make quite clear the need of bicycle helmets.

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Stress shielding of diaphyseal bone

Experimental studies in the rabbit

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Application of a rigid internal fixation plate to the tibial diaphysis in adult rabbits resulted in a decreased mechanical strength of 25 percent after 6 weeks and 35–50 percent after 12 weeks. The decreased bone strength was caused by an increased porosis of the cortical bone, whereas the ratio of organic to inorganic components of the cortical bone remained unaltered.

Bone atrophy did not develop when an osteotomy was performed simultaneously with application of the plate. Plate fixation with or without a simultaneous osteotomy induced a 2–4-fold increase of incorporation of ^{3}H-proline and ^{45}Calcium at 3 weeks. The incorporation rate was normalized at 6 weeks in plated bones, but remained elevated in osteotomized and plated bones. At 12 weeks the effect of the osteotomy had vanished completely. Thus, a reparative process counteracted the atrophy of diaphyseal bone due to load protection. However, atrophy followed bone healing.

After removal of the fixation device from atrophied bone, both mechanical and morphological properties rapidly returned to normal. Following a 12-week period of atrophy, inducing a 35 percent decrease in torque capacity, strength returned to normal values within 3 weeks of removal of the rigid internal fixation plate. A decreased bone mineral content (BMC) was similarly normalized within 3 weeks.

Human growth hormone did not affect the rate of regeneration of atrophied bone, but induced increased periosteal new bone formation. In growth hormone treated rabbits, periosteal new bone formation was increased by 2–5 times in both tibiae operated on with a rigid internal fixation plate and in sham operated on bones.

To verify these findings, plastic cerclage bands were used to induce periosteal new bone formation in the femoral diaphysis. In control rabbits, this procedure caused a 7–8 percent increase in BMC and a 9–12 percent increase in maximum torque capacity. Treatment with human growth hormone increased maximum torque capacity by an additional 15 percent, whereas BMC was only slightly affected.

Dissertation Karolinska Institute 1990

Low-back pain as a biopsychosocial problem

A controlled clinical trial and a cost-effectiveness analysis

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A hospital-based method for managing low-back pain, based on the biopsychosocial concept of illness, was evaluated. Totally, 203 patients with prolonged low-back pain suitable for conservative treatment were randomized into groups. Complete follow-up data were obtained for 159 patients who remained in the study until it ended. The study group patients were managed for 5 days as inpatients at Jorvi Regional Hospital. The control group attended an ordinary orthopedic outpatient clinic. The outcome variables of the groups did not differ significantly after a 1-year follow-up. The cost of the illness in the multidisciplinary group was FIM 5,000 higher per patient than the cost in the control group. The patients' own estimations proved to be the best predictors. Evaluations of illness behavior also proved useful in the physician's work. The Jorvi model of low-back illness in which the social situation plays a central role was presented. It was suggested that the clinical diagnosis should combine traditional somatic diagnosis with illness behavior diagnosis.

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Open reduction for old unreduced dislocation of the elbow

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The attitude towards open reduction of old unreduced elbow dislocations in adults is generally negative; and in *Campbell's Operative Orthopaedics*, as well as in Watson-Jones' *Fractures and Joint Injuries*, it is not recommended as a sole procedure, but possibly in conjunction with arthroplasty.

The purpose of this study was too prove the feasibility and results of open reduction of old unreduced elbow dislocations any time from 3 weeks to 18 months.

Methods and patients: The technique of open reduction as described in *Campbell's Operative Orthopaedics* employs a posterolateral approach (J. S. Speed). Here, bilateral exposure, as popularized by S. Bhattacharya, was used with its consequent advantage of extensive exposure of the joint.

Forty-six cases are presented. Seven of these were children below 12 years of age. Fourteen cases had an old dislocation between 3 weeks and 3 months, 9 cases between 3 and 6 months, 20 cases between 6 and 12 months, and 3 cases between 12 and 18 months.

Active elbow exercises were started a fortnight after surgery.

Rating of results was done on the basis of functional range of motion (ROM 60°–120°), lateral instability, functional recovery, and pain

Results: Eight elbows were graded as excellent (ROM 10° to full flexion), 30 as good (ROM 20°–120°), 7 as fair (ROM short of functional), and 1 as a failure.

Complications in 1 case each included redislocation, tear in the brachial artery, fracture of the olecranon, infection, posterior interosseous nerve palsy, and migration of the K-wire in the humeral shaft.

One case not included in the series, and operated on after 2 years of dislocation, had completely degenerated articular cartilage and ended up as a stiff joint requiring subsequent excision arthroplasty. The articular cartilage was found to be healthy in dislocations up to 18 months old. Biopsies on many of these cases indicated no adherent chondrofibrosis or extensive cartilage exfoliation with necrobiotic fibrillation.

Discussion: Excision arthroplasty gives an unstable relatively weak and painful joint. Replacement arthroplasty has the disadvantage of not preserving the bone stock, is not easily available in our country, and needs delay in awaiting bone growth in children and adolescents. Arthrodesis gives a fixed joint and also needs to be delayed in children. Hence, the advantage of open reduction.

Dissertation University of Bombay 1978

Low molecular weight heparin

Animal experiments and clinical studies

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Two low molecular weight heparins (LMWHs) were investigated: LHN-1 (Logiparin; A) and Kabi-2165 (Fragmin; B). The effects of the LMWHs and unfragmented heparin (UH) on wound healing and on induction of osteoporosis were investigated in experiments using rats. In pharmacokinetic studies in humans, the effects on factor Xa inhibition (XaI) and thrombin inhibition (IIaI) were investigated in healthy volunteers and in patients subjected to a surgical trauma. The thromboprophylactic effect of the LMWHs as compared with UH or dextran 70 was investigated in patients subjected to elective general abdominal surgery and in orthopedic patients undergoing total hip replacement. It was also studied whether or not a LMWH passes the placental barrier in humans.

In *animal experiments* neither the LMWH(B) nor the UH influenced the healing of abdominal wounds and colonic anastomoses negatively. UH induced osteoporosis to the same degree after 33 days as after 65 days of treatment. The LMWH(A) induced osteoporosis to the same degree as UH, and the effect of the LMWH was dose dependent in this respect.

In *studies in humans* the LMWH(A) had a longer biological half life than UH in healthy volunteers and was best dosed according to body weight. The surgical trauma had no major influence on the XaI and IIaI activities or the heparin concentration after s.c. injections of LMWH(B). LMWH(B) given 10 hours before surgery resulted in higher XaI and IIaI levels than when given 2 hours before the operation. In patients undergoing general abdominal surgery, the LMWH(B) given once daily had a better thromboprophylactic effect than UH given twice daily. The frequency of clinically minor important bleeding side effects was higher after LMWH as compared with UH. After total hip replacement the LMWH(A) given once daily had a better thromboprophylactic effect than dextran without increased bleeding side effects. In women undergoing abortion by hysterotomy, no evidence of transplacental passage of either the LMWH(A) or the UH was found.

In conclusion, the studied LMWHs have improved properties over UH, and are an advantageous alternative for postoperative thromboprophylaxis. The effects of the LMWH with regard to osteoporosis and wound healing in rats are similar to those of UH.

Dissertation University of Lund 1990

Impact and vibration and their effects on the lumbar spine

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The work involves several studies of the effects of vibration and impact on the lumbar spine. The epidemiology of the relationship of whole body vibration (WBV) to low back pain (LBP) is reviewed. A survey of orthopedists in the United States established their opinions of that relationship. The preliminary experimental studies determined the need to make measurements from skeletally fixed accelerometers. An impact method was developed and was found to be favorably compared to a sinusoidal excitation. This method was subsequently used to find the dynamic response of both the seated and standing subject under a variety of conditions. These conditions included different postures, different muscle contractions, and the use of cushions and shoes. The first resonance was found to occur in the range 4.5 and 5.5 Hz, and was found to be due to the buttocks and pelvis. Pelvic rocking was found to be important in affecting the response. The gain increased in the relaxed posture while sitting. Cushions increased rather than decreased the gain. In standing, the bent knee stance was found to markedly attenuate the response. Under sinusoidal excitation, the muscles fired at high levels and were out of phase with the input, thus adding to the load on the spine.

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Fixation of cancellous bone osteotomies with biodegradable polyglycolic acid thread

Comparison of combined cyanoacrylate, bone cement, and biodegradable thread fixation to fixation with biodegradable thread alone: An experimental study

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The purpose of the present study was to investigate and compare the use of cyanoacrylate, bone cement and biodegradable thread or the use of biodegradable thread alone in the fixation of osteotomies of the cancellous metaphysis of the distal femur and to declare histomorphometrically the influences of these procedures on the articular cartilage and adjacent subchondral bone of the femoral condyles.

A total of 117 rabbits were included in the series. Osteotomies of the distal femur and the medial condyle of the femur were fixed with (n-butyl-2-)cyanoacrylate and PMMA in 59 rabbits. The fixation was secured with biodegradable threads around the fragments. According to the macroscopic and radiographic studies, the osteotomies seemed to heal well during the first 3 to 6 weeks of follow-up. However, later, according to histologic, microradiographic, and OTC bone-labeling studies, the results were unsatisfactory. The fixation materials used could not provide sufficient stability for the healing of most osteotomies, and granulation tissue grew between the bone fragments. Normal healing was prevented, and nonunion occurred in 69 percent of the cases.

Osteotomies of the distal femur and the medial condyle of the femur were fixed with biodegradable threads alone in 58 rabbits. According to macroscopic studies, 90 percent of fixations were firm. Radiographic, histologic, microradiographic, and OTC bone-labeling studies showed satisfactory healing of osteotomies, since histologic union occurred in 71 percent of the cases. The results were promising taking into account that the rabbits were allowed to walk without any external support immediately after the operation. However, the results were not good enough to prompt to try thread fixation in clinical practice.

The comparison between the healing results of osteotomies fixed with cyanoacrylate, bone cement and biodegradable thread or with pure biodegradable thread revealed clear superiority of the latter method to create sufficient stability for successful bone union. The difference of the histologic healing results was more prominent between the fixation of the osteotomies of the femoral medial condyle than between the fixations of the osteotomies of the distal femur. Probably the polymerization of cyanoacrylate monomer was responsible for the poor results created with the combined method.

Quantitative histomorphometric analysis of articular cartilage and adjacent subchondral bone of both femoral condyles in 234 rabbit knees was performed. The right femurs were intraarticularly osteotomized and the left femurs served as a control material. A semiautomatic computer linked via a television camera to a light microscope was used. A marked increased of the amount of articular cartilage and a decrease of the amount of subchondral bone matrix were noticed in the medial condyle as compared with the controls. In the lateral condyle the corresponding changes were not as prominent. The increase of the amount of cartilage was larger in the cases where the healing of the osteotomies was disturbed than in those cases where the healing of the bone was normal. The diminished use of the painful limb was regarded as a cause of the changes. In spite of the marked difference between the healing results after the two fixation methods, there was not a significant quantitative difference in the changes in condylar cartilage and subchondral bone.

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