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Stress lesions of the locomotor apparatus in ballet dancers

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The classical ballet positions require about 60° external rotation of the hip with the leg extended. This implies that forced external rotation of the knee and foot or marked lordosis of the lumbar vertebral column must compensate the limited possibility of external rotation of the hip. The resulting stress is readily conceivable.

An inquiry among 234 professional ballet dancers (173 women and 61 men) confirmed our practical experience with this group. Some 60 percent had a history of acute lesions, and 70 percent reported recurrent symptoms of stress.

In the men the acute lesions were distributed more or less evenly over foot, knee, ankle and back, while the chronic lesions mostly involved the back and knee. In the women, two-thirds of the acute lesions were found in the foot and ankle; as in the men, the chronic lesions predominantly involved the back and knee.

Most acute and chronic lesions were not ballet-specific, were tractable to therapy and often self-limiting. Ballet-specific lesions were *stress fractures*, *peritendinitis of the posterior tibial and the flexor hallucis longus muscle*, and the *posterior talocalcaneal joint syndrome* described by us.

Indications for operative therapy are rare. Surgical techniques should aim at maintaining maximum articular function. Much can be achieved without a radical rest period by modifying the exercise programme and by technical corrections. The principal task is to create confidence and to reassure ("medical shopping" is common).

Operative therapy of achillodynia in athletes

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Achillodynia is defined as pain along the course of the Achilles tendon which may or may not be related to athletic activities. Pathologically, the features of mucoid degeneration are predominant. A phasic clinical course is characteristic.

Between March 1976 and April 1981, 17 patients (all athletes) were treated operatively. *Indication:* Resistance to conservative therapy over at least 1 year, severe limitations in daily or in athletic activities, and localized focal lesions.

Operative technique: Enucleation of the focal lesions and, if necessary, reconstruction of the plantar muscle tendon (depending on the size of the defect). Post-operative immobilization in a plaster cast for 6 weeks.

Results: Results were subjectively assessed as good to very good by 12 patients; two patients assessed the situation as better than before the operation but still experienced some limitations; two patients assessed the situation as unchanged; one patient was worse than before the operation. After an average of 9 months, 12 patients were able to resume athletic activities at their former level.

Results obtained with a new operative technique in the treatment of adductor tendinopathies in athletes

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The technique proceeds from the postulate that both the adductor muscles and the abdominal rectus muscle serve to stabilize the pelvic ring, and that these muscles have a pointed insertion. In this operation the lateral wall of the rectus sheath is sutured to the ligament of Poupart and the pecten ossis pubis, thus changing the pointed insertion of the rectus muscle into a broad, bandshaped insertion. Whenever there is also specific pain at the level of the adductor longus insertion, this is separated via the same incision. *Indication:* Symptoms for at least 1 year and resistance to physiotherapy (including a programme of well-controlled exercises) aimed at strengthening of the abdominal wall muscles; severe limitation of athletic activities with pain indicated not only at the level of the adductors but also at the insertion of the rectus muscle.

An unmistakably insufficient, bulging posterior wall of the inguinal canal was found at operation in 15 of the 23 patients treated. In one case a preperitoneal lipoma with sliding hernia was found.

Results: Excellent (no complaints, no limitations) in 19; good (slight local pain but no limitation during athletic activities) in three; poor (both complaints and significant limitations) in one case. Of the 23 patients, 20 resumed athletic activities at their former level, two resumed limited athletic activities, and one was unable to practice any kind of sport.

Ectopic ossifications; results of resection

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Ectopic ossifications occur not only in various forms of myositis ossificans but frequently also after traumata involving a central or peripheral nerve lesion, and after hip replacement. It is not inconceivable that similar pathogenetic factors play a role in all these cases. There are several aetiological hypotheses without conclusive proof. Resection of the ossifications often gives disappointing results because of recurrence. Temporary and sometimes even lasting prevention of re-ossification can be achieved with the aid of the diphosphonate EHDP (Didronel). During the period 1973–1981, EHDP was used in 25 pa-

tients with ectopic ossifications treated by resection. The dosage applied was 20 mg/kg from 1 month before to 2–3 months after the operation. Results were good in 18 patients. The finding suggest that EHDP, used in appropriate doses over a sufficiently long period, can contribute to the prevention of re-ossification.

The patellofemoral syndrome and sports

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The patellofemoral syndrome consists of various diseases with one characteristic complaint in common: patellar pain. The two principal syndromes under this heading are: patellar hypermobility and the group of anatomical lesions of the patellofemoral joint. Patients with patellar pain based on a hypermobile patella require conservative therapy. Various forms of operative therapy increase patellar mobility and have an untoward effect on the patellar cartilage.

For conservative therapy an exercise programme has been developed which is described in a booklet illustrated with line drawings. The exercises comprise strength training of the medial and lateral vastus muscles, enhancement of strength and endurance with the aid of brief dynamic contractions, stretching of muscles which have or tend to become shortened, and restoration of coordination and of defence reflexes.

After 2 years' experience with this programme the results can be described as very encouraging.

The patellofemoral syndrome shows an increased incidence in active athletes. The complaints result from a disproportion between the strength of the cartilage and the strain to which it is exposed. In athletes the syndrome can be prevented by training programmes in which the strain on the patellofemoral joint is gradually increased, thus ensuring undisturbed thickening of the cartilage lining. In the treatment of athletes with a patellofemoral syndrome it is very important to analyse the type of sport practised and the training programme used.

Myositis ossificans traumatica

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Myositis ossificans traumatica is a form of heterotopic reactive ossification caused by acute or recurrent injury of the muscles. Its histology is characterized by inflammatory changes followed by explosive proliferation of undifferentiated mesenchymal cells from the viable tissue, extending into the fibrous tissue septa. Cartilaginous ossification gradually occurs. After 3–4 weeks a zone of plexiform bone tissue at the periphery of the focus demarcates it from the surrounding muscle tissue. The amount of bone tissue gradually increases in a centripetal direction, while the coarsely fibrous bone tissue is converted to lamellar bone. The result is the formation of an "osteotome": an osseous focus made up of an external layer with cortical characteristics (osteons) and a centre of cancellous bone tissue with fatty marrow.

Clinical and radiographic features can be readily understood from this histology. The plexiform structure seen radiographically corresponds with the intra- and intermuscular septal patterns. Ultimately one observes a sharply defined osseous focus which either lies detached in the soft tissues or shows some connection to the periosteum. This bone focus can disappear by resorption. Possibilities to be considered in differential diagnosis are above all subperiosteal and juxtacortical osteosarcomas; the principal histological difference is the centrifugal growth of these malignant processes. Therapy is nearly always conservative; massage, etc., is to be avoided. Yet the SMR data show that over the period 1973–1982, 90 patients were hospitalized annually and that 75 percent of them were treated by surgery.

Jumper's knee; diagnosis and treatment

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The term jumper's knee is used to describe various peripatellar tendopathies, of which patellar apicitis is discussed in detail here. Aetiological factors mentioned are: repetitive peak strain and strength training of the quadriceps muscle as commonly seen in track and field sports, volley-ball and bicycle racing. There are four clinical stages, ranging from pain after exertion to rupture in the final stage. Examination reveals circumscribed tenderness at the lower pole of the patella and pain at extension against resistance. In some cases there are radiographic

changes such as calcifications at the lower pole of the patella or osteosclerosis. Conservative therapy comprises rest, application of ice-packs, taping, antiphlogistic medication and physiotherapy. Operative therapy which is seldom required consists of wedge excision of necrotic tissue. Seventy patients were treated over the period 1981–1984. In nine refractory cases an operation was performed, with good results in eight. In four cases a lateral chondropathy of the patella necessitated additional cleavage of the lateral retinaculum.

Jumper's knee; results of operative therapy

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The incidence of jumper's knee – an overstress syndrome at the level of the insertion of the patellar ligament – has in recent years been increasing due to intensive strength and speed training. The treatment of choice is conservative: rest, plaster cast, isometric exercises and applications, and corticosteroid injections. Operative therapy is indicated if conservative measures fail to result in improvement within 6 months. The operation consists of wedge excision of degenerated tendinous tissue and re-insertion of the tendon after resection of the lower pole of the patella. Over the period 1981–1984 this operation was performed on 36 jumper's knees in 34 patients with an average age of 25 years, including 26 active athletes. The follow-up ranges from 6 months to 3 years (average 20 months)

The results were excellent in 28 cases with return to previous activities without complaints, good in five cases with minor complaints during athletic activities, and poor in three cases with unchanged complaints.

Of the 26 active athletes 24 returned to their former level of athletic activity within 3 months (range: 6 weeks to 7 months). Early results of operative therapy can be described as very satisfactory.

Conservative therapy of achillodynia with the aid of visco-elastic heel-inlays

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Pain in the Achilles tendon and its insertion on the calcaneus (achillodynia and achillo-tendinitis) results from overstress. The literature reveals a correlation between this pain and the forces exerted on the heel during walking. If these forces could be reduced to within normal physiological limits, the pain should diminish or disappear. This can be achieved with the aid of a visco-elastic heel-inlay which reduces the forces exerted on the heel by 40 percent.

A retrospective study of 22 patients with achillodynia (average duration 1 year) advised to wear such heel-inlays revealed that the pain was greatly alleviated or disappeared completely within 3 months in 17 patients. Reduction of forces exerted on the heel with the aid of visco-elastic heel-inlays constitutes an effective and inexpensive therapy of achillodynia.

The fibrous tissue apparatus around the radial humeral condyle; implications for the treatment of tennis elbow

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Muscles, tendons, capsules and bones all contain fibrous tissue components which form a continuum. The structural aspects of this fibrous tissue vary: fascia, septum, sliding tissue, bursa and tendon sheath. Only where the fibrous tissue presents as low-density tissue or contains crevices can these structures be isolated in classical anatomical description via so-called natural planes. These isolations involve division of the fibrous tissue continuum. In an articular region it is difficult to divide the fibrous tissue continuum because these "natural planes" are absent. This can be readily illustrated on the radial aspect of the elbow: structures such as the radial collateral ligament, the radial annular ligament, the fibrous membrane of the articular capsule and the caput commune extensorum can be isolated only by sharp dissection, which disturbs the pre-existing continuity. When the collagenous fibrous tissue is studied in its spatial configuration (in relation to the other tissues), using a dissection technique which spares fibrous tissue and with the aid of radiolucent anatomical slices, CT-scans and images obtained by nuclear

magnetic resonance (NMR), it may be observed that the above-mentioned structures form part of a coherent system of fibrous tissue septa. A study using the above-mentioned techniques revealed that most fibres extend from the muscle fasciculi of the caput commune to the humerus. It is plausible that forces are conveyed in accordance with this pattern.

Operative therapy of radial humeral epicondylitis

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Between 1st January 1981 and 31st December 1983 operations were performed on 165 patients (94 male and 71 female) with radial humeral epicondylitis (bilateral in 13 cases) refractory to conservative measures. The average age was 42 years. The dominant arm was involved in 71 percent of the cases. At the time of the first specialist consultation 55 percent of the patients had had complaints for more than 6 months. Conservative therapy lasted 12 weeks. An extensor release according to Hohman was the procedure performed in 70 percent, with additional operations in 30 percent of the cases.

Out-patient check-ups were made over an average period of 17 weeks, and $\frac{2}{3}$ of the patients showed moderate-to-marked postoperative improvement.

A subsequent follow-up was performed by questionnaire (95 percent response). This follow-up covered a period of from 7 months to 3.5 years (average 2 years). Results: $\frac{2}{3}$ of patients were satisfied; 7 percent were moderately satisfied, and 28 percent were dissatisfied with the outcome; 57 percent reported some loss of muscular strength after the operation. The results were less favourable than those commonly reported in the literature.

The treatment of radial humeral epicondylitis

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The treatment of radial humeral epicondylitis should aim at pain control and avoidance of loss of function. The adage "*primum non nocere*" is important in this harmless affliction. One hundred patients with chronic tennis elbow (108 elbows) were treated by operation over the period 1975-1980. Treatment was

successful in 92 patients. It should be borne in mind that this condition involves a painful spot with a diameter of only about 1.5 cm in the extensor region. For this reason it is important in injection therapy to use fluids which cannot cause local tissue damage.

Operative therapy aims at release of tension at the painful spot. A carefully performed open tenotomy of the extensor origin is sufficient. Partial epicondylectomy, synovial fold excision, partial excision of the annular ligament and Z-extension tenotomy of the short radial extensor muscle of the wrist extend the operation beyond what is necessary and may protract convalescence. An operation more extensive than a tenotomy is required only if the negative effects of injection therapy are to be controlled. In this series a partial epicondylectomy was performed in six cases, leading to a much longer period of convalescence and with a good ultimate result in only three cases.

The adductor syndrome and the functional anatomy of the adductors

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Athletes often describe pain in the insertion region of the adductors as an inguinal injury. We prefer the term adductor syndrome. The literature mentions two principal causes of the adductor syndrome: muscular imbalance and overstretch. EMG findings obtained in 18 healthy test subjects show that several muscles of the adductor group are active in different positions. A computer model was studied in order to determine the extent to which combinations of muscles of the adductor group can, by virtue of their anatomical position, contribute to the stability of the hip-joint. Basic data were obtained from a human cadaver. The two studies complemented each other.

The adductors should be regarded as important stabilizers of the hip joint. The theory of muscular imbalance was confirmed by the functional anatomical findings. The computer model study supplied few indications that passive overstretch can be regarded as one of the principal causes of the adductor syndrome. Whether passive stretch in combination with active tension may be responsible for microtraumata in the insertion region cannot be demonstrated with the techniques used.

Sports after patellectomy

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A retrospective study was performed with special reference to knee function during daily and athletic activities. The study comprised 34 patients below 50 years of age operated on with patellectomy 1961–1980. There were 22 men and 12 women. The reason for the patellectomy had been a traumatic injury in 14, chondropathy in 16 and a slipping patella in four cases. The age at the time of operation was 30 (15–45) years. The follow-up period was 10 (5–16) years.

Results were assessed subjectively with the aid of the Lysholm score and objectively regarding restricted mobility, instability and atrophy of the quadriceps muscle. Radiographs were obtained to assess calcifications and osteoarthritis. Muscular strength was measured with the Cybex® dynamometer.

Results. Twelve of the 16 chondropathy patients and 4 of the 14 traumatic patients continued to have some degree of pain. The Lysholm score averaged 52 in the chondropathy and 83 in the traumatic group. Athletic activities were reported by four patients in the chondropathy and 11 in the traumatic group (including six who had resumed competitive sports). Objective findings revealed no marked differences. There was no correlation between loss of function, calcifications and complaints. A striking finding at Cybex evaluation was loss of strength in the hamstrings (average loss 21 percent in the chondropathy and 9 percent in the traumatic group).

Conclusions. 1) The results of post-traumatic patellectomy were good; 2) athletic activities were possible; 3) no accelerated arthrosis was observed; and 4) the results of patellectomy for chondropathy were poor.

Apophysiolysis and apophyseal lesions in young athletes

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Apophyses are secondary ossification centres at sites where strong muscle groups and tendons attach. Towards the end of growth in the second decade of life, these apophyses start to ossify and become attached to the adjacent bone. Before the ossifying apophyses become attached, they are sites of reduced resis-

tance. Acute strong contractions of the attaching muscles can separate the apophysis. Chronic over-stress also may cause apophyseal lesions. In some cases diagnosis is difficult, and the possibility of a bone tumour must be taken into account.

The literature and our observations (at three centres) indicate that in most cases the diagnosis is not made early. In five patients with apophysiolysis of the ischium, the diagnosis was made 2–18 months after injury (in one patient 20 years after injury). In two patients with an apophyseal lesion of the inferior anterior iliac spine, one with an apophyseal lesion on the anterior third of the iliac crest, and one with imminent avulsion of the tibial tuberosity, the diagnosis was made a few months after injury.

Spondylolysis, a stress fracture? Therapy with a delordosing Boston brace

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Of 22 patients (13 men and 9 women, average age 18.5 years) with spondylolysis treated with a Boston brace since August 1981, 15 had low back symptoms associated with athletic activities, four had scoliosis and three had Scheuermann's disease. Spondylolysis can be interpreted as a stress fracture caused by repeated hyperextension and/or torsion of the vertebral column.

Treatment consisted of Boston bracing for 23 hours per day, gradually reduced after disappearance of symptoms and radiographic consolidation of the defect.

At follow-up after an average of 18 months (5 months to 3.5 years) 13 patients showed an excellent result with resumption of previous (including athletic) activities; four patients had minor problems during athletic activities; two patients showed a poor result with unchanged symptoms. Radiographic consolidation of the defect was observed after an average of 6 months' bracing in 18 patients; two patients showed no consolidation.

Results indicate that Boston bracing for at least 6 months can lead to a good result with consolidation of the defect in patients with spondylolysis.

Disc lesions of the wrist joint

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The ligaments of the distal radio-ulnar and the carpo-ulnar joint comprise structures collectively known as the triangular fibrocartilaginous complex. This complex includes the articular disc: a triangular fibrocartilaginous body whose base is connected with the edge of the radius while its apex is connected with a fossa at the base of the styloid process of the ulna. The disc functions as a ligament and tenses on rotation. It possibly serves as a buffer between carpus and ulna. As a result of trauma or degeneration, the disc may rupture; this causes pain on motion, tenderness, clicking or crepitation.

Between 1972 and 1982, operations were performed on 33 patients aged 16–60 years. In 10 cases there was radiographic evidence of a detached styloid process; 16 of the 33 patients showed no radiographic changes. Arthrography was not routinely used because interpretation is difficult. An isolated disc lesion seems to exert but little influence on the stability of the radio-ulnar joint and complaints can be successfully controlled by removing the disc. Of the 33 patients treated by operation, 30 were satisfied and resumed their former activities.

Rower's wrist: diagnosis and therapy

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Rower's wrist or tenosynovitis crepitans, otherwise known as intersection syndrome, is a stress injury commonly found in rowers but also encountered as a stress syndrome associated with other activities. The principal symptoms are pain in the forearm, a crepitating swelling 7–8 cm proximal to the wrist-joint or radiating pain in the thumb. The condition clearly differs from Quervain's disease, both pathologically and anatomically. Eleven cases of rower's wrist were diagnosed and treated over the period 1979–1984. Therapy consisted primarily of the application of an immobilizing plaster splint for 2 weeks, followed by 2 weeks in a removable plaster splint with a controlled exercise programme. Competitive rowers and refractory cases were subsequently treated by fasciotomy of the long abductor and the short extensor muscle of the thumb (under local anaesthesia in an out-patient setting).

Conservative therapy sufficed in three cases and surgical intervention was required in eight. The

average follow-up period was 3 years (9 months to 5 years). Results were excellent in all the rowers; of the remaining seven patients, four showed an excellent, one a good and two a moderate result.

Particularly in the absence of crepitations, rower's wrist is a frequently unrecognized stress syndrome which, in its classical form, rapidly responds to fasciotomy, sometimes with additional tenolysis of the second dorsal compartment.

Injuries associated with squash

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Data on injuries in 395 beginners, 198 advanced and 94 top-level squash players were obtained by questionnaire. The male beginners and advanced players reported a total of 1090 acute injuries. Related to the number of playing years, this implies 86 injuries per 100 squash players per year, 11 of which necessitated more than 2 weeks' interruption of athletic activities. The corresponding figures for the females were 87 and 7 respectively.

The racket or ball caused 65 percent of the acute injuries. Of the remaining injuries the most important categories were ankle distortions (35 percent) and muscular lesions (26 percent) of: 1) the back, 2) the thigh, and 3) the shoulder. Players with muscular lesions performed significantly less stretching exercises than those without these lesions ($p < 0.01$).

The effect of stretching exercises on four articular functions was measured in 40 volunteers. All articular functions measured increased by 10–30 percent after stretching exercises. It is concluded that stretching exercises can prevent muscular lesions by means of increased excursion of motions ensuring better shock absorption. Stress injuries in male and female players amounted to 9 and 3 injuries per 100 players per year respectively, the principal localizations being the back (30 percent), the wrist (21 percent) and the knee (16 percent). The main cause of dorsal stress was fatigue (33 percent) and that of squash wrist was poor technique (58 percent): forced dorsal flexion in backhand strokes.

Conclusion: Squash is an injury-prone sport, but the injuries involved are generally not very serious.

Hydrocortisone iontophoresis in the treatment of entesopathies

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The use of corticosteroids poses many problems. Procaine hydrochloride iontophoresis is used in physiotherapy, and a possible alternative is hydrocortisone iontophoresis. This was used in the treatment of entesopathy patients with diagnoses such as epicondylitis, shin splints and tendinitis of the Achilles tendon or of the adductor muscle tendons, in order to establish whether this was effective where hydrocortisone injections would normally be given. The 15 patients thus treated had previously received neither analgesics nor physiotherapy. After three treatments weekly during a period of 4 weeks, results were evaluated on the basis of swelling, pain and ability to resume athletic activities.

Subjective improvement of pain was reported by 11 of the 15 patients; 10 were able to resume athletic activities. In four cases surgical intervention was required.

Physiotherapy in a stress syndrome

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Athletes accustomed to regular physical exertion will find it particularly difficult, after sustaining a stress injury of the locomotor apparatus, to impose a rest period on themselves before gradually resuming their athletic activities. They may well wish to avail themselves of facilities which can ensure the quickest possible return to their sport. The management and evaluation of curative health care – in this case physiotherapy requires an audit frame. A study was performed of the methodical approach in physiotherapy to one of the stress syndromes: radial humeral epicondylitis (RHE). In Zwolle (population 87 000) 222 patients with a diagnosis of RHE received an average of 24 treatments in 1983. There were 19 recurrences. An attempt to evaluate the results of the physiotherapeutic treatments given revealed that many practices used no established protocols and did not register the RHE symptoms encountered.

A methodical physiotherapeutic approach is presented in which unequivocal registration and reporting is the principal feature. For this purpose the various symptoms in 14 cases of EHE were qualified and quantified before, during and after treatment, in

accordance with a protocol. Registration of the course of the various symptoms makes it possible to compare different methods of treatment and ensures early registration (and correction if possible) of a deviant course during therapy.