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EXERTION INJURIES IN ADOLESCENT ATHLETES

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ABSTRACT

A series of 147 cases of exertion injuries in ⩽ 15 years old athletes is presented. All injuries occurred during training or athletic performances without trauma and caused symptoms that prevented athletic exercises. There were 67 girls (46%) and 80 boys (54%) in the material. About 90% of them had been training for more than one year before the onset of the symptoms; 65% were interested in track and field athletics, 13% in ball games, 11% in skiing, 4% in swimming, and 3% in orienteering. The rest were interested in other sports. About 33% of the injuries were growth disturbances or osteochondroses seen also in other children. About 15% were anomalies, deformities or earlier osteochondritic changes, which caused first symptoms during the physical exercise; 50% were typical overuse injuries that may bother adult athletes, too; 43% of the injuries were localized in ankle, foot and heel, 31% in knee, 8% in back and trunk, 7% in pelvic and hip region, and the rest in other parts of the body. The injuries were generally slight, no permanent disability was noticed. Rest and conservative therapy cured most cases; operative treatment was used in only eight cases.

Adolescent athletes' non-traumatic exertion injuries often differ from the usual overuse syndromes seen in adult athletes (Quinby, Truman et al 1964, Adams 1965, Torg, Pollack et al 1972, Cahill 1973, Schwerdtner & Schobert 1973, Shaffer 1973, Williams & Sperryn 1976). The strength and performance capacity of childrens' musculo-skeletal system is said to be lower than that of adults. However, the remodelling and reforming capacity is better and faster. Today intensive systematic training is started at a more and more early age in several sports. The safe amount or intensity of physical exercise in adolescence is not known exactly (Matthias 1972, Groh & Groh 1975, Morscher 1975). Because of continuous hard training both acute injuries and (over-)exertion injuries may appear also in young athletes. These injuries may prevent their sports activities, and is full justification for their proper examination and treatment.

The purpose of this study was to find out what kind of exertion injuries occur to growing Finnish athletes, to define the character of the most frequent injuries, and to find out the connection between their occurrence and the quality and quantity of the physical load encountered.

METHODS AND PATIENTS

The study was carried out prospectively during three years (1972-1975) at the Sports Clinic of Deaconess Institute of Oulu. An exertion injury was defined as longstanding or recurring orthopaedic trouble or pain in the musculo-skeletal system. It could also start instantaneously. It appeared during athletic training or competition without trauma. The patients were presupposed not to have had known diseases or earlier pains in the injury site. Stress fractures were not included in the material, but a note about their frequency is added as Table VIII. The symptoms usually started gradually.

The series consisted of 147 cases of exertion injuries found in athletes aged 15 years old or younger. The figure was about 11% of all exertion injuries treated in the Clinic during this time. All patients were examined, treated, checked and re-examined. There were 67 girls (46%) and 80 boys (54%) in the series (Fig. 1); 13% of them were 11 years old or younger.

About 80% of the patients came from the city of Oulu or from the close neighbourhood. They were referred by parents, coaches or other doctors. Some came on their own initiative.

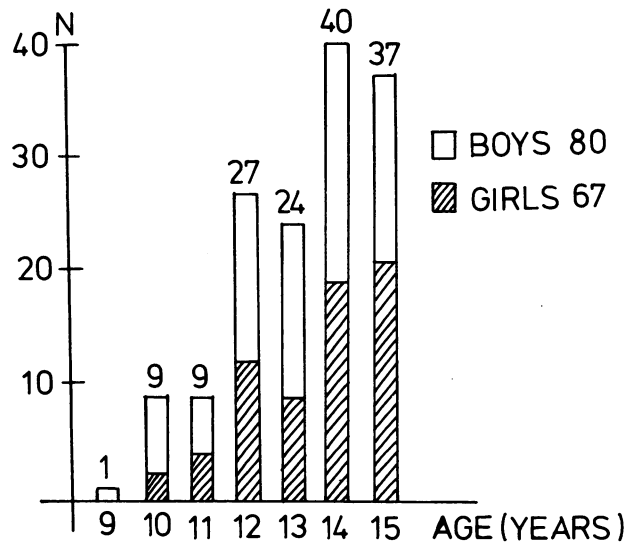

Figure 1. Age distribution of the material.

Before the onset of the symptoms more than 90% of the athletes had been training regularly for longer than one year (Table I). 39 athletes trained six times a week or more, 105 from three to five times and three athletes twice a week. There were no significant differences between the boys and girls.

About 65% of the patients were track and field athletes, most of them runners (Table II). Ball games (13%) and skiing (11%) events were next in the list of frequency. Athletes without a clearly defined main event were classified according to the event during which the symptoms appeared.

RESULTS

Exertion injuries took place in all months of the year, most often, however, in spring and summer (Fig. 2). No clear differences in severity were noted between boys and girls.

TABLE I

Duration of Regular, Controlled Athletic Training

Duration Time	Girls	Boys	Total	%
More than 2 years	26	18	44	29.9
1-2 years	35	55	90	61.3
6-11 months	5	3	8	5.4
Less than 6 months	1	4	5	3.4
	67	80	147	100%

TABLE II

Sports Events

	N	%		N	%
Track and Field	95	64.6	Long/Middle Distances	45	30.6
			Sprints/Hurdles	32	23.1
			Jumps	6	4.1
			Throws	2	1.4
			Youth Track and Field	8	5.4
Ball Events	19	12.9	Football (Soccer)	14	9.5
			Finnish Baseball	2	1.4
			Volleyball	1	0.7
			Ice-Hockey	2	1.4
Skiing Events	16	10.9	Cross-Country	13	8.8
			Nordic Combination	2	1.4
			Downhill Events	1	0.7
Swimming Sports	6	4.1	Swimming	5	3.4
			Diving	1	0.7
Orienteering	4	2.7		4	2.7
Gymnastics	3	2.0		3	2.0
Power Events	2	1.4	Wrestling	1	0.7
			Judo	1	0.7
Skating	2	1.4	Figure Skating	2	1.4
TOTAL	147	100%		147	100%

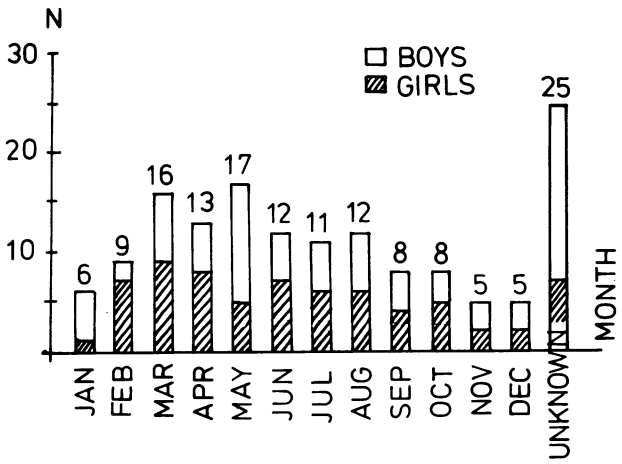

Figure 2. Time of occurrence of exertion injury (month).

Most exertion injuries were localized in the ankle, foot and heel (43%), in the knee (31%), and the back and trunk (8%); 82% of all injuries were localized in lower limbs (Fig. 3), in addition to the anatomical location shows also the relationship between it and the sports events.

About 46% of the exertion injuries lasted for more than 6 months, 25% lasted for 2-6 months, 16% 1-2 months, and 13% less than one month. The duration was considered to be both the period before attendance, the duration of definitive treatment, until the possible cure.

By estimating the anatomical and histological structure of the injuried tissue, about 47% of them were lesions at the insertions of tendons and muscle attachments (Table IV). Injuries to muscle bellies, joints and centres of tendons were less frequent.

Sixty-three exertion injuries centered in the area of ankle, foot and heel (Table V). The most common injury was the exertion pain in the heel (Sever's disease, apophysitis). It was found in 24 athletes, the mean age of whom was about 13 years. 22 were boys and half of them distance runners. The pain was bilateral in 11 cases, right sided in 7 and left-sided in 6 cases. Metatarsal arch pains formed the second common group of injuries. Painful accessory navicular bones were seen in six girls and one boy. In the cases of achilles tendon peritendinitis no crepitus was noticed. Two girls had pains from an earlier Freiberg's disease in the distal end of the second metatarsal bone.

Of the 46 exertion injuries in the knee Osgood-Schlatter's disease was most frequent (Table VI). Eight of the patients were girls, 16 boys. The mean age of the girls was 11.7 and of the boys 12.6 years. 6 cases were bilateral, 4 were in the right and 14 in the left knee. In girls the pain followed running and jumping exercises (6 times), figure skating and skiing. Boys got pain 6 times in ball games, 5 times in endurance running, twice in power events, and once in orienteering, jumping and javelin throwing. Ten of the injuries were localized in knee extensor system.

Three of the 12 athletes with exertion pain of back had spondylolysis in the fifth lumbar vertebral arch. They were a distance-runner boy (13 y), a girl high-jumper (14 y), and a girl diver (15 y). This last patient also had spondylolisthesis of 1.5 cm. The children were symptomless when not training. Scheuermann's disease was seen in four athletes, two had slight scoliosis, one intercostal neuralgia, and two undefined lower back pain. The average age of the back patients was around 14 years (13-15 y).

Of the 10 exertion injuries of the leg, 7 were medial tibial syndromes, one chronic form of anterior tibial syndrome, and two were chronic calf pain.

TABLE III

Connection Between Sports Event and Anatomical Location of Exertion Injury

	Back, Trunk	Shoulder	Elbow	Pelvis, Hip	Thigh	Knee	Leg	Achilles Tendon Ankle, Heel, Foot	Total
Track and Field	6			8	2	30	7	42	95
Ball Events	1					8		10	19
Skiing	3			1		3	2	7	16
Swimming	2	2	2						6
Orienteering						1	1	2	4
Gymnastics				1		1		1	3
Power Events						2			2
Figure Skating						1		1	2
Total	12	2	2	10	2	46	10	63	147

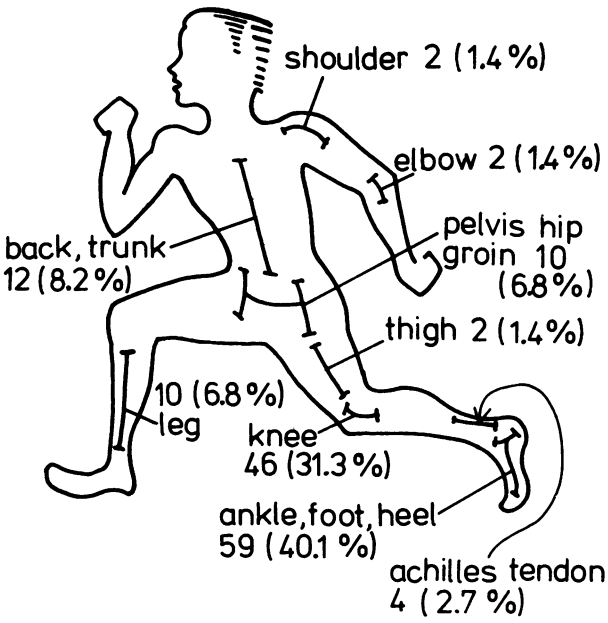

Figure 3. Anatomical location of exertion injuries.

TABLE IV

Division of Young Athletes' Exertion Injuries According to Structure and Tissue

	N	%
Muscle- and Tendon Insertion	69	46.9
Joint, Synovia, Ligament	22	15.0
Tendon, Tendon Sheath	15	10.2
Muscle, Fascial Compartment	15	10.2
Bursa	8	5.5
Undefined	18	12.2
	147	100%

In the pelvis, hip and groin there were 5 cases of pain localized in the anterior superior and one case in the anterior inferior pelvic spines. One long-standing pain was localized in the ischial tuberosity and one patient had trochanteric bursitis. A 14 years old boy doing Nordic Combination skiing had hip pain from an old previously symptomfree Perthes' disease of slight degree.

In about 15% the symptoms lasted for less than one month, in 17% for 1-2 months, in 24% for 2-6 months and in 44% for more than 6 months.

Most patients did not come to examination until 2-3 months after the first symptoms. In 34%, rest from physical exercise, explanation and advice were used as therapy. In 61% additional medical treatment; immobilisation of short duration, physiotherapy and special exercises were needed. 5% of the injuries were treated surgically (7 girls, 1 boy). In all these cases the symptoms lasted more than 6 months, clearly hampering athletic training. Conservative treatment had not helped. Chronic achilles tendon peritendinitis was operated upon twice (one girl and one boy). Two fasciotomies were made because of chronic medial tibial compartment syndrome. Kidner's operation was performed twice in cases of painful accessory navicular ("external tibial") bones; one metatarsal head was resected in case of Freiberg's disease with severe distortion of the joint surfaces and because of a recurrent patellar luxation Krogius' operation was carried out once.

TABLE V

Exertion Pains of Ankle, Foot and Heel in Young Athletes

	Girls	Boys	Total
Calcaneal Apophysitis	2	22	24
Metatarsalgia/Arch Pain	8	4	12
Painful Accessory Navicular Bone	6	1	7
Retrocalcaneal Bursitis	2	2	4
Achilles Tendon Peritendinitis	2	2	4
Tibialis Posterior Tenosynovitis	2	1	3
Peroneal Tenosynovitis	1	1	2
Talo-Crural Synovitis/Arthalgia	–	2	2
Freiberg's Disease (Metatarsal II)	2	–	2
Sesamoiditis (MTP I)	1	–	1
Hallux Valgus	–	1	1
	27	36	63

TABLE VI

Exertion Injuries of Knee in Young Athletes

	Girls	Boys	Total
Osgood-Schlatter's Disease	8	16	24
Hypermobile Patella Syndrome	4	2	6
Pain in Inferior Patellar Pole	2	1	3
Patellar Tendon Pain	1	3	4
Infrapatellar Bursitis	–	2	2
Iliotibial Band Friction Pain	1	1	2
Osteochondritis of Patella	–	1	1
Pain in Inferior and Superior Pole of Patella	–	1	1
Undefined Exertion Pain of Knee	1	2	3
	17	29	46

TABLE VII

Osteochondroses in Adolescent Athletes

Osgood-Schlatter's Disease	24
Sever's Disease	24
Scheuermann's Disease	4
Freiberg's Disease	2
Perthes' Disease	1
	55 (= 37.4%)
In addition there were	
Patellar Osteochondritis Dissecans	1
and	
Conditions Classed as "Apophysitis"	
Painful Accessory Navicular Bone	7
Sesamoiditis of 1st MTP Joint	1
Anterior Pelvic Spine Pains	6
Inferior Patellar Pole Pains	
	18 (= 12.9%)

TABLE VIII

Stress Fractures Found In Under 15-Year-Old Athletes

(Additional to those injuries included in the statistical analysis)

Site	Number
Tibia	4
Fibula – Lower End	1
3rd Metatarsal	1
Total	6

(These six cases are included in a survey by Orava et al 1977, in press elsewhere)

As to the degree of impediment, exertion injuries were not severe. Generally they caused trouble only during athletic activities. In only 17 cases (12%), including the surgically treated patients, temporary denial ofschool sports was needed. No permanent disability remained, and nobody was compelled to give up sports, although maximal training had to be stopped, often for several months. The sports event was changed to another in a few cases.

DISCUSSION

The figure of adolescent athletes with exertion injuries comprised only 10% of all the exertion injuries that were treated in the Clinic during the period of the survey. However, the number of children taking part in competitive sports in Finland is three times greater than that of older athletes. Boys have been estimated to take part in sports about four times more often than girls (Suomal.liikuntakäytt. 1975). In our series there were almost as many girls as boys. The reason for the relatively high percentage of girls may be poorer adaptation of their locomotor system to physical exercise, which may be intensive in adolescent athletes. Before the beginning of systematic training the girls' physical activity generally is lower than of boys'. Connective tissues in boys may thus be "readier" for training and they do not get so many exertion injuries. It is also possible that girls seek for treatment earlier than boys. As to the quantity of training there were hardly any differences between the boys and girls, the opposite situation to that in adult athletes. The quantity and intensity of training in athletes with exertion injuries was approximately similar to those without injuries. The mean degree of severity was about the same in both sexes. However, all the surgically treated cases except one were girls.

"Real" exertion injuries covered more than half of all injuries. About one third were various growth disorders and osteochondritic pains, which are seen also in other children. The rest of the disorders were minor orthopaedic problems that displayed their first symptoms during athletic training. These included anatomical deformities, anomalies and earlier osteochondritis changes, such as Legg-Perthes' and Freiberg's disease, hypermobile patella syndrome, painful accessory navicular bones, spondylolysis, hallux valgus etc. Reduced training and short rest periods were usually sufficient for the treatment of Osgood-Schlatter's disease. The number of girls (about 1/3) of these patients is more than in other surveys (Reichelt 1971, Schmidt 1972). On the other hand, calcaneal apophysitis was a typical exertion pain for boys. Short rests, reduced training (running) and proper shoes were used as the therapy. Metatarsal arch strains were typical in girls. The appearance of exertion pain in young athletes in the site of accessory navicular bone has not been mentioned earlier, although post-traumatic pain in this area has been described by Grasso & Zanchini (1976).

About half of all exertion injuries were localized in the insertion points of muscles and tendons. Adult athletes as well as middle-aged fitness sportsmen have relatively more exertion pains in muscles and their fascial compartments (Orava 1977). No joint cartilage injuries were seen except for osteochondritis of metatarsal heads, and in the hip. These changes had appeared before commencing regular training. It has been noticed that hard, long-standing, repeated throwing and kicking exercises may cause microscopic connective-tissue ruptures, even radiologically-detectable changes in the

elbow and talo-crural joints (Miller 1960, Junge & Känel 1964, Schmidt 1972, Torg, Pollack et al 1972). On the other hand, even heavy dynamic endurance exercises have not been seen to cause degenerative joint changes (Groh & Groh 1975, Puranen, Ala-Ketola et al 1975, Oka & Hatanpää 1976). Young athletes may also have muscle compartment syndromes in the leg, although less often than older sportsmen (Slocum 1967, Clement 1974, Puranen 1974). The number of cases of achilles tendon peritendinitis in the survey was smaller, compared with older athletes, in whom it is one of the most common athletic overuse syndromes (Snook 1972, Ehricht & Passow 1972, Kvist 1975). Nearly all exertion injuries in our survey occurred in endurance- or individual sports, and were located mostly in the lower limbs. In the literature young athletes have been noted to get overuse injuries mainly in events which need fast, powerful, repetitive performances, such as throwing, jumping, sprinting, gymnastics, football etc. (Crasselt 1965, Albrecht, Roick et al 1973, Blazina, Kerlan et al 1973, Krahl 1975). Exertion injuries that follow endurance training have been reported less often (Cahill 1973, Brubacker & James 1974, Kucera & Charvat 1976).

The exertion injuries were benign. Most athletes did not come to treatment until some months after the appearance of the injury. No special treatment was needed in one third of the cases. The cases treated surgically were chronic overuse injuries. Post-operatively the effective training could be started without difficulties.

The prognosis of young athletes' exertion injuries is obviously good. With adaptation of connective tissue to physical loading, symptoms usually disappear, while the disproportion between the training and the strength and performance capacity of the organism is normalized. It is possible that earlier osteochondritic changes, some anomalies and deformities may in future prevent extensive athletic performances of top level. The high-jump and swim-diver girls were told to consider the change of sports event to another, because of lumbar spondylolysis with recurrent exertion pains in hyperextension movements. This orthopaedic disorder is also found in top level athletes with only slight symptoms (Orava, Puranen et al 1977). However, because it often causes permanent symptoms, the choice of sports event as well close follow-up of athletes with this abnormality is recommended (Crasselt 1965, Schmidt 1972, Schwerdtner & Schobert 1973).

The treatment of exertion injuries in young athletes should start at the prevention. First of all, advice and information should be directed to the schooling of coaches and physical education teachers. If the technique of the performance is good, and the training controlled medically, probably only few harmful effects will appear. The prognosis of the exertion injuries of these kinds to the total health of the athletes' musculoskeletal organism later in life will obviously be good.

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