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OVERUSE INJURIES IN CROSS-COUNTRY SKIING

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INTRODUCTION

Cross-country skiing has always been one of the most popular winter sports in Scandinavia (Eriksson, 1976). Although downhill skiing has become more and more popular during the last ten years, cross-country skiing is still the most important mass sport in Finland. The number of competitive skiers has been increasing owing to the fact that the younger age groups as well as the veteran series have been better organised (Sandelin et al, 1980).

Skiing injuries have been noted to be more common in alpine skiing and ski-jumping than in cross-country skiing (Eriksson, 1976; Westlin, 1976; Sandelin et al, 1980; Ellison, 1977). It has been shown earlier that overuse injuries are typical of endurance sports (Orava, 1980; Brody, 1980; Clement et al, 1981). Cross-country skiing has been reported to be a relatively safe sport in this respect (Orava, 1980). The statistics for skiing injuries usually only describe acute injuries or their consequences (Boyle et al, 1981; Clancy, 1982).

In this study the overuse injuries seen in cross-country skiers were studied. Special attention was paid to the exertion injury profile — which injuries were caused by skiing and which by other types of training. One of the purposes was to examine the "typical" skiing injuries and consider the causes of these.

MATERIALS AND METHODS

We studied 194 overuse injuries (10.6%) sustained by 187 cross-country skiers in a series of 1,827 overuse injuries caused by sports and physical activity. The patients were seen at two sports injury clinics over a ten year period; 166 of the injuries (85.6%) were seen in competitive skiers and 28 (14.4%) in keep-fit athletes, who also trained regularly and took part in mass sports events or competed in veteran classes.

An overuse injury in this series was considered to be a painful condition of non traumatic origin which appeared during a training session or competition or followed any other form

of training with no direct or indirect trauma or disease.

The mean age of the patients with overuse injuries was 22.4 years (12-57 y). The female patients were clearly younger than the males. The mean ages were ♀ 17.6 years and ♂ 23.8 years respectively.

Of these overuse injuries 33 (17.00%) were sustained by women and 161 (83.0%) by men. Six patients (2 women, 4 men) had two different exertion injuries and one man three consecutive different injuries.

About 15% of the injuries occurred in "top athletes", representing the national or international top level. About 70% of the injuries hampered the training and competitive performance of "normal" athletes and 15% of the injured athletes were middle-aged keep-fit athletes.

RESULTS

Of the 194 overuse injuries in this series 116 (59.8%) occurred in modes of training other than skiing. This training included running (on road, field, cross-country, forest, etc.), jumping exercises and power training (weight lifting, circuit training, sequence training, rowing, etc.). There were 78 overuse injuries (40.2%) following cross-country skiing or roller-ski training. All exercises simulating skiing biomechanically were included in this category.

The most typical overuse injuries from skiing were those of the shoulder region, back and trunk as well as injuries located in the ankle, foot and heel (Table I).

TABLE I
Anatomical location of overuse injuries in cross-country skiing.

	Other exercises	Skiing	Total
Scapulae, shoulders, upper extremity	1	12	13
Back, trunk	—	17	17
Pelvis, hip, groin	13	6	19
Thigh	3	2	5
Knee	41	11	52
Lower leg	40	6	46
Ankle, Foot, Heel, Achilles tendon	18	24	42
Total	116	78	194

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TABLE II
Overuse injuries in cross-country skiing and other exercises.

	Other Exercises	Skiing	Total
a. Scapulae, shoulders and upper extremities			
Sterno-clavicular pain	—	1	1
Supraspinatus syndrome	—	1	1
Diffuse rotator cuff pain	1	2	3
Radiculating pain of arm	—	1	1
Exertion pain of scapular region	—	2	2
Pain in scapular elevators	—	4	4
Olecranon bursitis and lesions of the triceps insertion	—	1	1
Sub-total	1	12	13
b. Back and trunk			
Scheuermann's disease	—	3	3
Insufficiency of back	—	5	5
Recurrent lumbago	—	2	2
Spondylolysis/-olsthesis	—	3	3
Intercostal neuralgia	—	1	1
Lumbar hyperlordosis and pains	—	2	2
Scoliosis/muscle imbalance	—	1	1
Sub-total	0	17	17
c. Pelvis, hip and groin			
Trochanteric bursitis	2	3	5
Psoas tendinitis	2	1	3
Painful snapping hip	1	—	1
Adductor/gracilis syndrome	1	1	2
Periarthritis of hip joint	3	1	4
Stress fracture of femoral neck	3	—	3
Stress fracture of pubic bone	1	—	1
Sub-total	13	6	19
d. The thigh			
Stress fracture of femoral shaft	2	—	2
Hamstring muscle pain	—	1	1
Adductor muscle pain	—	1	1
Quadriceps muscle pain	1	—	1
Sub-total	3	2	5
e. The knee			
Exertion synovitis	3	2	5
Patello-femoral pain/malalignment	7	3	10
Iliotibial tract friction syndrome	11	2	13
Patellar tendon pain	10	—	10
Medial ligament/condylar pain	4	1	5
Pain in insertion of superior patella	2	—	2
Pes anserinus bursitis	3	—	3
Exertion pain of popliteal fossa	1	—	1
Peroneal nerve entrapment syndrome	—	3	3
Sub-total	41	11	52
f. Lower leg			
Medial tibial syndrome/shin splints	12	—	12
Anterior tibial syndrome	5	2	7
Calf muscle pain	1	3	4
Muscular hernia	—	1	1
Stress fracture of tibia	19	—	19
Stress fracture of fibula	3	—	3
Sub-total	40	6	46
g. Ankle, foot and heel			
Stress fracture of metatarsal bones	5	2	7
Stress fracture of sesamoid bones (MTP1)	—	2	2
Peroneal tenosynovitis	1	1	2
Tibialis posterior tenosynovitis	1	—	1
Tenosynovitis of ext. hallucis longus	1	4	5
Achilles tendon peritendinitis	4	—	4
Retrocalcaneal bursitis	1	4	5
Plantar fascitis	1	—	1
Proximal metatarsalgia	4	3	7
Distal metatarsalgia	—	3	3
Exertion pain of talo-crural joint	—	2	2
Exertion pain of first MTP joint	—	3	3
Sub-total	18	24	42

Overuse injuries to specific anatomical regions were divided into different sub-groups according to the diagnosis, divided between skiing exercises, and other forms of exercises causing the injury.

Only once was an overuse injury of the shoulder and upper arm caused by exercises other than skiing (Table IIa). Pains in the suprascapular muscles was the most common exertion injury in this group.

All of the overuse injuries located in the back and trunk were caused by skiing exercises (Table IIb). The diagnoses in this group were common disorders associated with the hard physical exercise seen in athletes.

About two thirds of the overuse injuries located in the pelvis, hip and groin were caused by other forms of training and one third by skiing exercises (Table IIc). Trochanteric bursitis and stress fractures were the most common diagnoses. All the fractures were, however, caused by running or jumping exercises.

Of the exertion injuries of the thigh, the stress fractures were caused by running (Table IId) while muscle pains, on the other hand, were associated with skiing exercises.

About 21% of the overuse injuries of the knee followed skiing and 79% other exercises (Table IIe). Iliotibial tract friction syndrome and patellar tendon pains were the most common injuries and were all caused by running or jumping except for two iliotibial tract friction cases. Irritation of the peroneal nerve at the fibular neck was caused in all cases by skiing exercises.

Of the exertion injuries of the lower leg 13% followed skiing and 87% other exercises (Table IIIf). All stress fractures as well as medial tibial stress syndromes were caused by running. Calf and anterior tibial muscle pains were seen in skiing.

The majority (about 60%) of the overuse injuries located in the ankle, foot and heel were caused by skiing exercises. Two cases of metatarsal bone stress fractures and two sesamoid bone stress fractures were the only stress fractures resulting from skiing in this series (Table IIg). Tenosynovitis of the extensor tendon of the great toe and retrocalcaneal bursitis were also typical overuse injuries attributed to skiing exercises.

In Table III the distribution of overuse injuries in the upper and lower extremities are shown divided according to the type of tissue affected. Bone and muscle injuries seemed to result from modes of training other than skiing. Disorders of muscle and tendon insertions, bursae and nerves were seen relatively more often to follow skiing exercises.

TABLE III
Distribution of overuse injuries in cross-country skiing in upper and lower extremities.

	Other exercises	Skiing
Muscle injuries	28	9
Tendon injuries	9	6
Bone injuries	31	7
Insertion injuries	3	8
Joint pains	14	14
Bursitis	6	7
Nerve pains	—	4
Undefined	8	7
Total	99	62

Twelve of the overuse injuries in the series were treated surgically because of chronic and disabling symptoms. In Table IV the most typical "skiing injuries" are shown.

TABLE IV
Typical overuse injuries associated with cross-country skiing.

Cross-country skiing causes exertion injuries, which are most often located at:

1. Scapular and shoulder region
2. Lumbar spine
3. Ankle, foot and heel area

Most typical cross-country skiing injuries are:

- metatarsal pains
- retrocalcaneal bursitis
- tenosynovitis of big toe extensor
- entrapment of peroneal nerve (at the neck of the fibula)
- trochanteric bursitis
- pain of scapular muscles
- rotator cuff pain syndromes
- lumbar spine pains
- stress fractures caused by skiing are:
 - metatarsal bone stress fractures
 - sesamoid bone stress fractures (MTP I joint)

Differences between sexes were minimal in the series.

DISCUSSION

The appearance of overuse injuries in athletes has been shown to be greater than the number of acute injuries, if the most common forms of sport are considered (Orava, 1980). Contact and team sports are associated with a greater number of acute injuries (Devereaux and Lachman, 1983). In pure endurance sports overuse injuries occur much more often and top level athletes suffer from these more often (Brody, 1980; Clement et al, 1981). Cross-country skiing can be considered to be a relatively safe sport in relation to the risks of injury (Eriksson, 1976; Westlin, 1976; Lyons and Porter, 1978). Skiing has actually been used as a rehabilitational exercise for weak back and trunk muscles as well as to improve cardiorespiratory fitness (Niinimaa et al, 1979; Clancy, 1982).

The results of this report showed that about 60% of the overuse injuries in cross-country skiers were caused by forms of exercise and training other than skiing itself. The majority of these exertion injuries represented common overuse injuries associated with endurance sports. The 40% of reported injuries connected with classical skiing or roller skiing can be regarded as typical overuse injuries of cross-country skiing. In this group of injuries there were only a few, which were caused by "skating style" or "Siitonen's style", so commonly used in skiing competitions during the season 1984-1985.

The profile of "skiing injuries" and "other injuries" seems to be quite different. Typical overuse injuries from skiing are located in the shoulder and scapular region, lumbar spine,

foot, heel and ankle. The stress of these parts of the body is great with the modern equipments and style. High strain of shoulders is associated with maximal extension-flexion movements of the lumbar spine. Injuries of the foot and ankle can be said to have been associated with the bindings. In no case did the skier suffer from overuse injury when using bindings which fixed the heel. Boyle et al (1981) had shown that heel fixation increases acute injuries in cross-country skiing. The toe fixation of the ski shoes was thought to have been too distal, allowing excessive dorsiflexion of the toes with stress on the distal foot. This phenomenon may have caused some of the metatarsalgias and the stress fractures. Ski shoes, in addition to their light weight, should also have sufficiently rigid soles.

Overuse injuries seem to be relatively common in athletes at the competitive level, but relatively uncommon in older keep-fit athletes. The more athletes are training the more overuse injuries occur (Orava, 1980). Running and jogging cause more exertion injuries than other sports at all ages (Clement et al, 1981). During the period over which the overuse injuries of this material were collected, about four times more exertion injuries were seen in endurance runners and joggers. These injuries were similar to the overuse injuries caused in this study by exercises other than skiing excluding those resulting from weight or circuit training.

With the better design of training schedules as well as improved equipment some of the overuse injuries might be prevented. It does not, however, seem possible to prevent all the exertion injuries connected with Nordic skiing. The appearance of exertion injuries should be accepted as one of the risks associated with sport and physical exercise. The evaluation of the possible harmful effects of the skating style skiing on the musculoskeletal system needs further studies. In spite of overuse injuries, cross-country skiing is one of the safest and most recommendable sports in the world.

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