

The knees and ankles in sport and veteran military parachutists

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SUMMARY 112 actively parachuting sport (free fall) parachutists with more than 200 descents each and 109 veteran military parachutists no longer active returned a postal questionnaire about their parachuting activities, injuries, and current and past musculoskeletal symptoms. A high frequency of fractures and injuries was reported by each group, both in relation to parachuting and to other activities. 58 sport parachutists aged 23 to 57 years (mean 33.3 years) had weight-bearing antero-posterior and lateral radiographs taken of each knee. These showed a prevalence of radiological osteoarthritis of 10.4% which was mild in degree in all but one knee in one subject. 46 ex-military parachutists aged 50 to 70 years (mean 55.2 years) had weight-bearing anteroposterior radiographs taken of both knees and showed a prevalence of radiological osteoarthritis of 41.3%. Moderate and severe changes were found in 10.9%. In both groups of parachutists six of the eight knee joints showing either moderate or severe radiological osteoarthritis had been subjected to a previous meniscectomy.

Forty ex-military parachutists had anteroposterior radiographs of the ankles (talotibial articulation) and showed a prevalence of osteoarthritis of 17.5%, with the majority showing mild changes. There was a poor correlation between radiological osteoarthritis, ankle symptoms, and previous fractures.

With the reservation that the great majority of the sport group are still young (95% aged <50 years), it is concluded that parachutists as a group do not show an increased prevalence of radiological osteoarthritis of the knee or ankle.

It is only in the last 36 years that large numbers of parachute descents have taken place in the United Kingdom. Large scale military parachuting began in 1940 (Newnham, 1974), and the first world parachuting championship held in 1951 marked the advent of parachuting as a sport (Hearn, 1976).

The frequency of parachuting injuries requiring hospital treatment has been given as 0.25 per 100 jumps over a 5-year period in the British Army by Kirby (1974), and as 0.13 per 100 jumps over 3 years in one civilian sport parachuting centre by Quinlan (1975). The type of injuries and their relative frequency in military parachuting have been determined by Essex-Lopresti (1946), Ciccone and Richman (1948), Kiel (1965), and Kirby (1974).

Despite much information on the acute injuries

received while parachuting, no adequate study of the long-term effect of parachuting on the bones and joints has been made. Essex-Lopresti (1946) and Kirby (1974) stated without giving figures that osteoarthritis of the knees and ankles of parachutists may occur after many descents. Ciccone and Richman (1948), also without giving figures, stated that certain cases of multiple ankle fractures may lead to permanent arthritic disability. The department in Leeds has a particular interest in the aetiological factors of osteoarthritis from clinical and bio-engineering viewpoints. This paper, therefore, describes a study to determine the long-term effects of parachuting on the knees and ankles.

Material and methods

The names and addresses of 125 of the most experienced sport (free fall) parachutists who had carried out from 200 to nearly 3000 descents each

Accepted for publication November 26, 1976
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were obtained from the British Parachute Association. Between August 1973 and March 1974 each was sent a postal questionnaire relating to their medical history and parachuting experience. Those who agreed underwent a radiological examination of both knees (anteroposterior views with subject weight bearing, and lateral views, all with gonadal screening).

The names and addresses of 368 ex-military parachutists in Leeds and Bradford who were no longer parachuting but who had served in the Parachute Regiment at various times since its formation during the second world war were obtained from the Parachute Regimental Association. In 1975 each was sent a postal questionnaire similar to the one sent to the sport parachutists. In addition the names and addresses of 10 ex-RAF parachute instructors who had served in the second world war were supplied by the Canopy Club and these were also contacted by postal questionnaire. All military parachutists who returned questionnaires and who were aged 50 years or over at the time of the survey were invited to undergo a radiological examination of the knees (anteroposterior, weight bearing) and ankles (anteroposterior views of the talotibial articulation only).

RADIOLOGICAL METHODS

All radiographs from both groups were read by D.J.L. in randomized sequence and in ignorance of the history or identity of the subjects. In both groups the tibiofemoral articulation was assessed for osteoarthritis in respect of both osteophytosis and joint-space narrowing using 5 grades of severity (0=normal, 1=doubtful, 2=mild, 3=moderate, 4=severe). In cases where narrowing of the tibiofemoral joint space was suspected, direct measurements were made of the medial and lateral compartments of each knee. Joint-space narrowing was considered to be present if either the medial or lateral compartment measured 4 mm or less at its midpoint, or a compartment was less than half the width of the other compartment of the same knee, or less than half the corresponding compartment of the opposite knee (Ahlback, 1968; Adams, 1973).

The patellofemoral joints of the sport parachutists and the talotibial joints of the veterans were assessed according to the 5 grades of severity (0=normal, 1=doubtful, 2=mild, 3=moderate, 4=severe).

Results

QUESTIONNAIRE DATA

Completed questionnaires were returned by 112 sport parachutists (102 men, 10 women) aged 23 to 57 years (mean age 29.2 years), and 109 veteran

military parachutists (99 ex-Army and 10 ex-RAF instructors) aged 28 to 70 (mean age 47.8 years).

SPORT PARACHUTISTS

These were very experienced parachutists, each with a large number of descents (mean 778, range 200–2966) performed over relatively few years. 70% were qualified sport parachute instructors, 55% had had some experience of military parachuting, and 30% were in the armed forces at the time of the study. The frequency of fractures and knee and ankle soft tissue injuries occurring during parachuting and at other times is given in Table 1. 52 (42%) individuals from this group had sustained at least one fracture while parachuting. The heights and weights of the group sustaining lower limb and spinal fractures were not significantly different from those not sustaining such fractures.

Despite the frequency of soft tissue knee and ankle symptoms in the group, the questionnaires indicated that recurrent or persistent ankle (1.8%) and knee (7.1%) symptoms were not common. 12 (10.7%) parachutists had required hospital treatment for knee injuries at some time and 3 (2.6%), one of whom had radiology in this survey, had required meniscectomy with or without repair of the collateral or cruciate ligaments.

EX-MILITARY PARACHUTISTS

As a group these men had made far fewer descents (mean 236, range 7–700) with the exception of the

Table 1 Comparison of fractures and knee and ankle injuries occurring during parachuting and while not parachuting in 112 sport and 109 ex-military parachutists

	Ex-military parachutists (109)		Sport parachutists (112)	
	Injuries		Injuries	
	Parachuting (n)	Non- parachuting (n)	Parachuting (n)	Non- parachuting (n)
<i>Fractures</i>				
Below knee	8	9	29	8
Femur	1	6	2	1
Pelvis	0	2	5	1
Vertebral	2	2	17	0
Upper limbs	3	16	21	17
Total (subjects with 1 or more fractures)	13	19	52	29
<i>Soft tissue</i>				
Knee	4	16	18	6
Ankle	5	2	31	7
Total (subjects with 1 or more injuries)	9	14	42	11

ex-RAF instructors (mean 659, range 200–1600) and had carried out their parachute jumps longer ago than their sport counterparts. They were also, with a few exceptions, a much older group. The frequency of the fractures and knee and ankle injuries occurring during parachuting and at other times is given in Table 1. In all, 13 (11.9%) of this group had sustained at least one fracture while parachuting. The heights and weights of those sustaining lower limb and spinal fractures was not significantly different from those not sustaining such fractures. Ankle symptoms were present at the time of the survey in 11 subjects (10.1%) (pain in 8, swelling in 2, and feelings of instability in 1). In only 2 cases were those symptoms other than mild and in only one case were they related to a previous fracture. Knee symptoms were present at the time of the survey in 19 subjects (17%) and consisted of pain in 16 subjects and swelling in 3. In 4 subjects pain was described as moderate or severe. 9 subjects had received hospital treatment for knee symptoms and 4 had undergone meniscectomy (3 of the 4 subjects with a history of previous meniscectomy had radiological examinations in this survey).

As these men were no longer parachuting they were asked if they had any symptoms that they considered were attributable to parachuting. Of the 18 (16.5%) who replied in the affirmative, 6 specified back pain, 2 neck pain, 4 ankle symptoms, 3 knee symptoms, and 3 pain at an old fracture site (femur, elbow, shoulder).

RADIOLOGICAL FINDINGS

Radiological examinations were carried out on 58 (69.8%) of the 83 sport parachutists who were

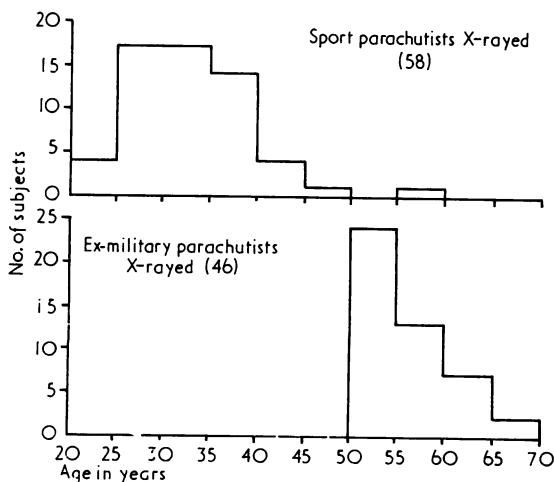


Fig. 1 Comparison of the age distribution in those sport and ex-military parachutists x-rayed in survey.

invited and 46 (73%) of the 63 ex-military parachutists aged 50 years or over. The age distribution and parachuting experience of those x-rayed are shown in Figs. 1–3.

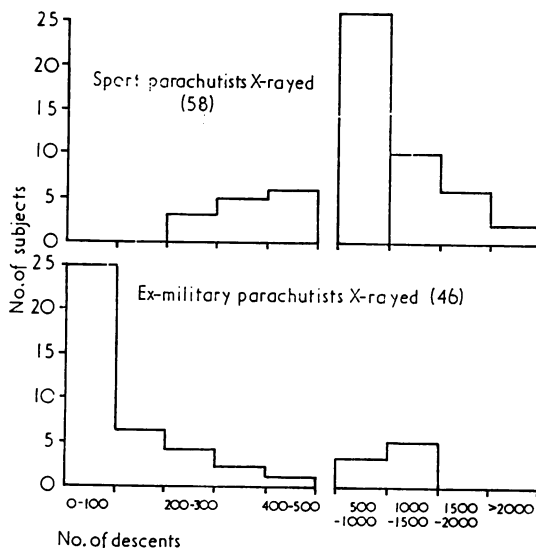


Fig. 2 Comparison of the number of descents in those sport and ex-military parachutists x-rayed in survey.

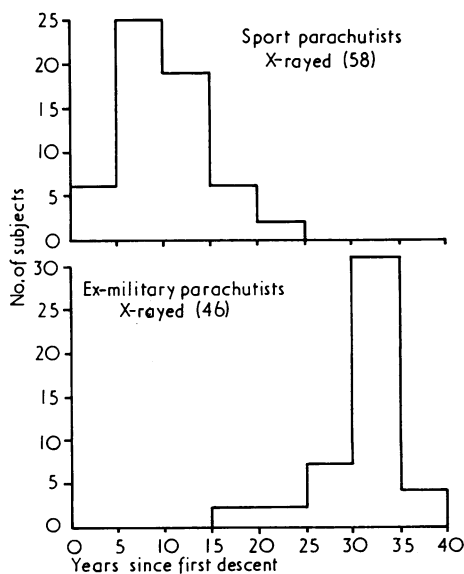


Fig. 3 The length of time which elapsed between the first descent and this survey in the sport and ex-military parachutists x-rayed.

Table 2 Prevalence of radiological osteoarthritis of the knee in 58 sport and 46 ex-military parachutists

	Ex-military parachutists (46)					Sport Parachutists (58)									
	Tibio-femoral joint (92)					Tibiofemoral joint (116)			Patellofemoral joint (116)						
Grade of severity	0	1	2	3	4	0	1	2	3	4	0	1	2	3	4
No. of subjects	11	16	14	4	1	43	11	3	1	0	48	4	5	1	0
% frequency	23.9	34.7	30.4	8.7	2.2	74	18.9	5.3	1.8	0	82.7	6.9	8.6	1.8	0
No. of knees	38	25	22	6	1	93	19	3	1*	0	103	7	5	1*	0
% frequency	41.3	27.2	23.9	6.5	1.1	89.6	6.9	2.6	0.9	0	90.5	4.3	4.3	0.9	0

Note: The grades of osteoarthritis shown (0-4, normal-severe) are the more severe of the two separate grades given for osteophytosis and joint-space narrowing for each joint assessed.

* Same knee.

Table 3 Details of parachutists showing an association between radiological osteoarthritis (OA) of the knee and previous meniscectomy

Parachutist	Age (years)	Knee	Grade of OA	Years since meniscectomy	Cause of meniscal injury	Present symptoms and severity
<i>Ex-military</i>						
1	62	R	3	41	Rugby	Yes (moderate)
		L	2	40	Rugby	No
2	53	R	3	22	Soccer	No
		L	3	27	Parachute training	No
3	50	R	3	12	Soccer	Yes (severe)
		L	3	28	Soccer	Yes (severe)
<i>Sport</i>						
4	32	R	3	10	Soccer	Yes (moderate)

Knees

The prevalence of osteoarthritis of the knee for each radiological projection for both groups of parachutists is shown in Table 2. The overall prevalence of radiological osteoarthritis (grade 2 to 4) was 10.4% in the sport and 41.3% in the ex-military group, with most subjects showing only mild changes.

Taking both groups of parachutists together moderate (grade 3) or severe (grade 4) osteoarthritis was found in eight knees in 6 subjects, and in six knees (all grade 3) in 4 subjects it was found to be related to a previous meniscectomy (Table 3). In fact, in every knee where a meniscus had been removed and which had been x-rayed, definite radiological changes of osteoarthritis were present (moderate changes in 6, mild in 1). Symptoms were present in 75% of the knees from both groups of parachutists which showed moderate or severe radiological changes (grades 3 and 4) and 30% of the knees which showed mild changes.

Ankles

The prevalence of radiological osteoarthritis in the ankles of 40 ex-military parachutists is shown in Table 4. Some degree of radiological osteoarthritis (grades 2 to 3) was found in nine ankles in 7 subjects (17.5%), with seven ankles in 5 subjects (12.5%) showing only mild changes. Four of the nine ankles showing radiological osteoarthritis were symptomatic and no ankle with osteoarthritis had been the site of previous fracture.

Table 4 Prevalence of radiological osteoarthritis (OA) of the ankle (talotibial articulation, anteroposterior projection) in 40 ex-military parachutists

<i>Ex-military parachutists (79 ankles in 40 subjects, aged over 50 years)</i>		
Grade of severity OA	No. of ankles	No. of subjects
Grade 0 (normal)	64 (81.0%)	30 (75%)
Grade 1 (doubtful)	6 (7.6%)	3 (7.5%)
Grade 2 (mild)	7 (8.9%)	5 (12.5%)
Grade 3 (moderate)	2 (2.5%)	2 (5%)

Discussion

The excellent completion rate (90%) of the questionnaire survey in sport parachutists was probably due to the fact that the majority of these were known personally to one of the authors (C.F.M-L.). In the case of the ex-military parachutists, many of the addresses supplied by the local branches of the Parachute Regimental Association no longer existed due to extensive demolition of housing in Leeds and Bradford, but when incorrect addresses and deaths were allowed for, 60% of those approached returned questionnaires.

The two groups of parachutists differed considerably in age, numbers of descents, and length of parachuting experience (Figs. 1 to 3). Although none of the ex-military group was currently parachuting, 8 had had to terminate their parachuting career through injury, often war wounds, and through

knee symptoms. All the sport parachutists, however, were still active.

The results show that both groups of parachutists studied have suffered many injuries (Table 1). The sport parachutists showed particularly high injury figures, which probably reflects their greater number of descents and greater frequency of parachuting with greater opportunity for injury, but also in some cases low standards of physical fitness, poor handling of sophisticated parachutes, and jumping in unsuitable weather conditions. Knee injuries were reported commonly by both groups (Table 1), but in sport parachutists they occurred more commonly while parachuting, in contrast to the veteran military group where knee injuries had occurred more frequently playing soccer or rugby football. The difference may be explained by the fewer descents made by the military parachutists with their meticulous attention to landing techniques or the frequency with which this group were involved in contact sports. A further factor may be the high frequency with which the sport parachutists took part in precision parachuting competitions where caution and the usual 'military legs together' landing technique is abandoned in the interest of greater accuracy.

However, the questionnaires also showed that recurrent or persistent knee or ankle symptoms were not a common problem in either group of parachutists. The fractures and injuries received while not parachuting were similar for both groups, suggesting a similar active mode of life and a similar liability to injury (Table 1).

The frequency of radiological osteoarthritis of the knee (tibiofemoral and patellofemoral) in sport parachutists was low and in those which did show changes all but one were mild. In this group the overall frequency of osteoarthritis (including mild grades) of 10.4% is similar to the figure of 10.6% found at Leeds by Adams (1973), using similar radiological criteria for 51 professional footballers and 15 ex-professional footballers. In the 46 ex-military parachutists, all of whom were aged 50 years or more, the frequency of mild osteoarthritis of the knee (grade 2) was 30.4%, and moderate and severe osteoarthritis of the knee (grades 3 and 4) was 10.9% when the tibiofemoral compartments only were studied. This compares with frequencies of 18.7% and 11.1% using similar grading methods (Jeffrey *et al.*, 1963) for the same two grades of severity among men aged 55 to 64 years in a population survey in the town of Leigh (Kellgren and Lawrence, 1958).

The association found between the severer grades of osteoarthritis of the knee and a history of meniscectomy is of interest in view of the findings of Jackson (1958). In the parachutists it was not

usually possible to compare the postmeniscectomy knee with a nonoperated knee in the same subject, as in 4 out of the 5 subjects menisci had been removed bilaterally.

Radiological osteoarthritis of the talotibial articulation (anteroposterior view only) was mild, very infrequent, and not associated with past fracture. However, since it would be natural to expect that osteoarthritis would inevitably follow a fracture across a joint line, the low prevalence of ankle fractures (5%) in those x-rayed may have favourably influenced the frequency of osteoarthritis of the ankle in this study.

With the reservation that the effects of age and time have yet to be superimposed on the high frequency of jumping in the sport parachutists, it is concluded that parachutists as a group do not have an increased prevalence of osteoarthritis of the knee and ankle. In the knee well developed osteoarthritis seems to be related more to meniscectomy than to parachuting.

We acknowledge the generous help of the British Parachute Association and secretaries of B.P.A. affiliated clubs, the Parachute Regimental Association Leeds and Bradford branches, the Canopy Club, the RAF Sports Parachute Association, the Joint Services Parachute Club, and the many participating parachutists and Military and Civilian radiologists and radiographers. Mrs. B. Gordon and Mrs. J. Battersby gave valuable secretarial assistance.

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