

MEDICAL ASPECTS OF PARATROOPER TRAINING

Sqn. Ldr. C. B. J. ALEXANDER,

Assistant Director of Hygiene,

There is a popular belief that parachuting is dangerous. While this is gratifying to the people who parachute, it is a poor compliment to the men who have made it almost foolproof by better selection and training methods. It is the purpose of this paper to discuss the medical aspects associated with this training.

The subject will be dealt with under the following headings:—

1. History of parachuting.
2. Selection of paratroopers.
3. Training.
4. Injuries associated with training.
5. Refusal to jump and its prevention.
6. Comparative analysis with injury rates of International Schools.

History.

Four and half centuries ago, versatile Leonardo da Vinci sketched the idea of a "Fall Breaker", but parachutes did not actually arrive till the latter part of the 18th Century. Its main use in the 19th Century was by professional stunt artists. The 1914 - 1918 War caused parachutes to be investigated as a safety device to enable pilots to escape from aircraft. Shortly before World War II, the Russians evolved the idea of a Parachute Army. The Germans noting this, soon had a Parachute Army themselves, and their successful capture of Crete with paratroopers proved that it was an effective striking force. Britain soon realised the potentialities of a Parachute Army and none will forget the exploits of the "Red Devils" at Arnhem. Thus in a century, a parachute had been transformed from a plaything to a safety device, and from a safety device to a menace.

Training in India started in 1941 at Delhi and to the everlasting credit of the Medical Corps is the fact that the first Indian to parachute was a doctor. In 1943, a Paratrooper Training School was started in Chaklala (now in Pakistan) and this school trained Indian, British, Gurkha and other allied troops. After partition in 1947 paratroop training in India came to a standstill till 1949 when the first Indian Paratroopers Training School was started at Agra. It is from experiences at this school that the subject will be discussed.

Selection.

Officers and men are selected by the Army from volunteers. A normal well disciplined soldier, willing to make descents and confident of his ability to do so is suitable.

Physical Standards of Fitness.

As a general consideration the medical category must correspond with category "A". Certain limitations are imposed owing to the nature of the training and the injuries sustained, and these limitations are gathered from actual experience.

- | | |
|----------------------|--|
| 1. Age | Upper limit is 34 years. |
| 2. Weight | Upper limit is 182 lbs. |
| 3. Height | Upper limit is 6 feet 1 inch. |
| 4. Previous injuries | Particular emphasis is laid in a sound lower limit joint history as old fractures and sprains tend to break down under training. |

These, though not an absolute bar to acceptance must be considered on merits. Thus a fracture, though healed, but involving a limitation of joint movement is an absolute handicap and must be rejected. Limitations of upper limb joint movement are of less consequence and are accepted unless they grossly interfere with the handling of the parachute. It is apparent from these limitations that a medical officer, trained in parachuting himself, is ideal for medical examination of volunteers.

Training.

The course lasts a fortnight. The first seven days are spent on ground training and during this period a pupil is taught to handle a parachute, make an exit, and to land. This training is carried out on synthetic apparatus which simulates the progressive stages of a parachute descent.

During the second week the pupil performs seven descents from a Dakota aircraft, from a height of 1000 feet - 800 feet. One of these descents is made at night.

One Sergeant Instructor teaches ten pupils and during training a close personal relationship is built up between himself and the trainees. This is essential as the policy adopted during training is to persuade the pupil through the course and not to drive him, but there is no coddling.

Injuries.

These occurred at two stages.

1. During ground training.
2. During descents.

Ground Training Injuries.—These did not differ materially from injuries sustained during any other form of physical exercise. There was, however, one type of injury peculiar to parachuting, particularly amongst troops with poor abdominal musculature. As the pupil had to perform a considerable number of rolls on the ground during training for landing, repeated violent contractions were imposed on the rectus abdominis muscles. This often caused a severe strain of that muscle and in some cases it ruptured with the formation of a large

painful haematoma. This injury, though amenable to treatment, often incapacitated the pupil for as long as a fortnight.

Injuries during Descent.

Before the various causes of injuries during descent can be appreciated, it is necessary to understand the parachute and its mechanism. Parachute is 86 square yards of nylon forming a canopy 28 feet in diameter and 28 rigging lines attached to the harness packed in a bag on the man's back. The bag is attached to the plane by a strong webbing belt called the static line. During the initial free drop following the jump, the static line is pulled out to allow the parachutist to get clear of the plane and the slipstream. His further fall pulls out, first, the rigging lines and then the canopy from the bag, which is ultimately left trailing behind the plane. As the canopy fills with air, i.e. develops, the free fall of the parachutist is slowed and he floats to earth at approximately 14 feet per second. During descent air has to escape from the canopy and a vent 22" in diameter is provided at the top which presents air spilling out at the periphery.

Injuries during descent occur at three distinct stages.

1. At exit.
2. During parachute development.
3. During landing.

At Exit:—Before making an exit, the leading man stands at the door of the aircraft with this static line fixed to the strong point in the aircraft. The remainder of the paratroopers are lined up behind him; each man guides the attachment of his static line along the strong point and then dropping it behind him, he jumps out.

There are three possibilities of injury at exit.

1. Entanglement with the static line.
2. Simultaneous exit by two pupils.
3. "Hooked up".

The static line, if not discarded at the right moment, or if held incorrectly tends to slip under the left arm and in this case as the man jumps out his arm is abducted into the extreme position and externally rotated. This causes a severe sprain of the shoulder with bruising of the arm or even a dislocation of the left shoulder joint.



FIG. 1.

The simultaneous exit by two pupils is rare and is normally prevented by one instructor standing on either side of the door, whose duty it is to see that only one man leaves the aircraft at a time. Should this happen, however, one parachutist is likely to pass through the rigging lines of the other parachutist. This entanglement prevents the development of either one or both canopies. The inevitable result of the ensuing free fall is death.

By "hooked up" is meant that the static line fails to break when the man jumps and he is left suspended beneath the tail of the aircraft. Provision is made to release such a man by specially designed equipment. One case of this nature occurred. The pupil was eventually released and descended with his own parachute fully developed. He sustained no injury other than a traumatic orchitis from the excursions of the static line between his legs, as he lay helpless beneath the tail of the aircraft. He felt quite unmoved by his unusual experience and never at any time showed reluctance to parachute again. He completed the course uneventfully.

Injuries during Parachute Development.

During this phase, the rigging lines are pulled out in two bands rising from the shoulder of the harness. The steady opening of the canopy is felt by the jumper as a smooth powerful pull and all at once he finds himself swinging gently, apparently stationary above the ground.

There are three possibilities of injury at this stage.

1. Feet caught in the rigging lines.
2. Direct injury from the rigging lines.
3. Twisting of rigging lines.

If there is a faulty exit from the plane causing the man to somersault or twist, it sometimes happens that his feet get entangled in the rigging lines. This only causes injury if the parachutist has not time to disentangle them and lands on one foot. Direct injury can be caused by a sharp flick across the face and neck from the developing rigging lines. This is an extremely common injury in which the epidermis is denuded leaving a raw area of dermis which burns and pains not a little. A twisted rigging line is dangerous only in so far as the parachutist tends to concentrate on kicking out of them and failing to watch the ground lands like a starfish.

Injuries during Landing

This is by far the most important stage. During training a man loses his anxiety in the exhilaration following the opening of his parachute. Landing is, therefore, considered a minor inevitable incident after the awe inspiring leap. But, it is on landing that most injuries occur. The experienced jumper knows this and his anxiety is an anticipation of the technical difficulties of meeting the ground.

To make a correct and safe landing quick thinking and determined effort are needed. The essence of parachuting is first, to make a good parachuting position.

"Head well forward, shoulders round, elbows in and watch the ground"

Secondly to keep the feet and knees well together. The correct landing procedure is to take the initial strain on both legs mutually splinted, with the toes pointing against the line of drift. Then to allow oneself to roll on the outer side of the leg, thigh, buttocks and opposite shoulder. Pitching directly forwards or directly backwards must be avoided.

Certain factors make the landing more difficult and contribute to injury.

These are :—

1. Oscillation.
2. Wind speed.
3. Nature of the ground.
4. Carriage of additional equipment.
5. Height and weight of the individual.

Increased wing speed produces gusting and gusting produces oscillation. Thus the parachutist in his parachute acts as a bob of a pendulum and oscillates violently. During this oscillation two velocities are imposed on the parachutist, the horizontal and vertical velocity. This vertical velocity increases with oscillation and the shock to the body increases as the square of the rate of descent, it is obvious that injuries will increase. These two velocities must, therefore, be absorbed and this is most efficiently produced in a parachute roll.

The harder the ground, the greater is the injury rate. During training a ploughed field 1,000 yards square known as a Dropping Zone is used. Sometimes pilots misjudge their drop and pupils are then exposed to more hazardous "landing grounds" e.g. trees, roads and rooftops.

The carriage of additional equipment was either a valise or kit bag strapped to the right leg. On exit the equipment was released from the leg and suspended below the parachutist by a 20 foot rope attached to his waist belt. Landing with the kit bag still strapped to the leg contributed to susceptibility to injury.

Excessive height interfered with exit from the door. As this was usually accompanied by excessive weight, the force of impact on landing was tremendous. If ungainliness accompanied this obesity, the result was disastrous. An Officer though heavy and ungainly was allowed to proceed with this training because of dearth of officer volunteers from his Corps. On his first descent he could not adjust himself to a sudden oscillation and fractured a femur.

Injuries to all parts of the body occurred on landing. A classification on a broad regional basis is given in table.

TABLE 1.

Classification of Injuries on Regional Basis.

	1951.	1950.
TOTAL DESCENTS.	14744.	16659.
TOTAL INJURIES	154.	122.
HEAD.	54.	36.
TRUNK.	16.	7.
UPPER LIMB.	21.	10.
LOWER LIMB.	51.	47.
MISC. i.e. abrasions etc.	12.	22.

Some of these injuries will be discussed clinically under the following heads:

- | | |
|-----------------|---------------------------------------|
| 1. Concussion | |
| 2. Strains | { Ankle
{ Knee
{ Erector spinae |
| 3. Fractures | { Upper limb
{ Lower Limb |
| 4. Dislocations | |

Concussions

A common injury caused by allowing the head to whip back on a backward landing (Fig. 2)

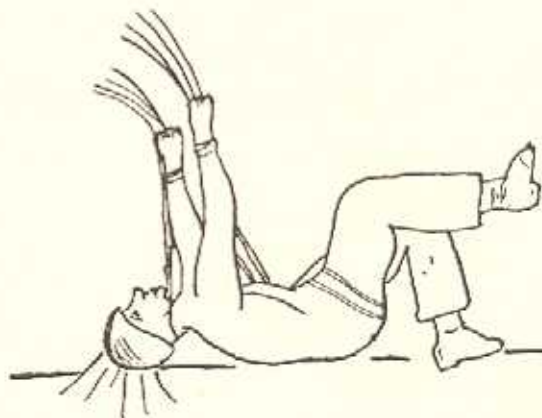


FIG. 2

It is thought that this is common amongst Indian troops because of their proneness to squatting on landing. Periods of unconsciousness varied from a few seconds to several hours. One case was accompanied by cerebral laceration and death. Post concussional neurosis was not common, but one case occurred in which the soldier felt that his head was too heavy for his shoulders, and walked with great care lest it fall off. He was seen after discharge from hospital, prior to going on leave and it is not known what was his eventual fate. Recurrent headaches sometimes occurred but with cheerful encouragement mended themselves. Post concussional giddiness was less easy to deal with and these cases were returned to their units as unfit for parachuting.

Except for the extremely minor cases, all were admitted to the local Military Hospital for observation. The minor cases were observed in Air Force Sick Quarters but were never allowed to continue training for at least a week.

Strains

Ankle and knee strains were generally caused by not splinting the feet on landing. Opening the legs causes the weight of the body to pass to one leg with resultant injury (Fig. 3). Erector spinae strains were due to holding the body too rigid thus failing to distribute the weight evenly over leg, thigh, and buttock.



FIG. 3

Of the ankle strains 27 in number, the vast majority were strains of the external collateral ligament. Most of these returned to full airborne duties within fourteen days of injury.

Knee Strains, 12 in number, were also collateral ligament injuries. In spite of actively contracting quadriceps muscles these sometimes recurred when put back to training after treatment.

Strains of the erector spinae were extremely common. There were 23 cases. They were difficult to distinguish clinically from fractures, but on discharge from hospital none were labelled as fractures. Immediate physiotherapy, particularly diathermy in hospital seemed the ideal form of treatment. Unfortunately there were recurrences and in these cases it was decided that it was better to make these cases unfit for further parachuting.

Fractures

Upper limb fractures, 4 in number, were caused by pitching forward on the outstretched hand or elbow. (Fig. 4)

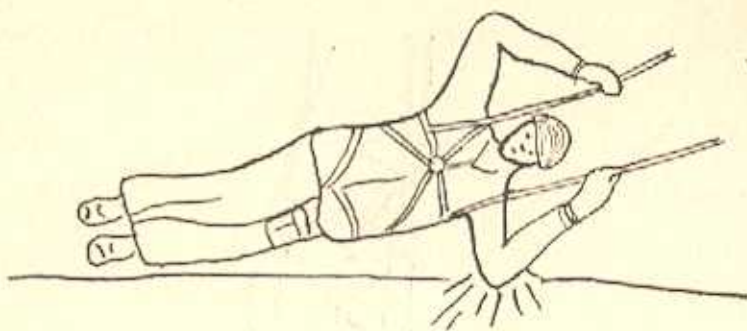


FIG. 4

Of the lower limb fractures, three were of the foot. These occurred on backward or forward landings when the legs were held too much underneath the body, with too much plantar flexion at the ankle joint. This resulted in pointing the toes on landing and the whole body weight was taken on the fore part of the foot. (Fig. 5).



FIG. 5

There were two fractures of the femur. The cause of these is easy to understand if we can appreciate that the instinctive method of landing from a height is with the knees

TABLE II.

Conclusion from this study is that our head injury rate is higher than the British, American and French Schools, and our overall injury rate is very much higher than the American School. Apart from head injuries, there is a favourable comparison with the British and a very much lower figure than the French.

	INDIAN				BRITISH				AMERICAN				FRENCH			
	TOTAL DESCENTS	TOTAL INJURIES	PERCENT. AGE.	RATE PER THOUSAND	TOTAL DESCENTS	TOTAL INJURIES	PERCENT. AGE.	RATE PER THOUSAND	TOTAL DESCENTS	TOTAL INJURIES	PERCENT. AGE.	RATE PER THOUSAND	TOTAL DESCENTS	TOTAL INJURIES	PERCENT. AGE.	RATE PER THOUSAND
HEAD INJURIES.	16659	122	7.32	Consolidated Fig. not available	512894	647	1.26	8259	240	2.50	29.06					
TRUNK INJURIES.		36	20.5	180,000	145	0.81			6	6.76	1.94					
UPPER LIMB INJURIES		7	5.74	280,000	137	0.49			16	3.75	23.49					
LOWER LIMB INJURIES		10	8.19	180,000	106	0.59			9	80.83	1.09					
MISCELLANEOUS.		47	38.52	280,000	794	2.84			194	6.25	1.86					
		22	18.03						15							

References.

1. Manual of Elementary Parachute Training Australian Military Force (1944)
2. British Journal of Surgery Vol. 34 No. 133 (July 1946).

bent and feet apart. If a pupil panics on landing he reverts to the instinctive method. This would be safe enough were it not for the fact that when the feet touch the ground, the pull of the parachute and the man's horizontal velocity drag his body onwards and twist it, thus producing a torsional strain on his long bones. These cases were never allowed to parachute again.

Strangely enough there was only one case of fracture spine and this was due to an abnormality in parachute development, the parachutist reaching the ground faster than normal.

Dislocations

These were all of the upper extremity. Two shoulder dislocations were due to the arm being wrenched by the static line during exit, as in Fig. 1. Two acromio clavicular dislocations were due to pitching forward on to the shoulder during landing.

Refusal to Jump and its Prevention.

At various stages during the training, usually during the early stages, refusals to jump occurred. Analysis of the reason for refusing to jump is the work of a psychologist, but in his absence we attempted this ourselves.

This was done firstly to improve methods of training and so prevent refusal and secondly to eliminate potential cases at the stage of ground training. The second criterion is essential as one refusal is often closely followed by others. An illustration of this occurred in our experience. During a course, one refusal was followed at subsequent intervals by four others. On interrogation it was learned that all the men were from the same unit, about the same age 19-20 years, and had left the recruiting centre to join their battalion a few weeks earlier. Before they could accustom themselves to the rough and tumble of soldiering with the battalion, they were sent to undergo Paratroopers training. They were obviously emotionally unsuitable for the task. Instructions were given to the battalion not to send such volunteers till they had matured with the battalion. No further refusals due to this cause occurred from this unit.

In general the usual reasons given for refusal to jump were the fear of falling unsupported from a height or the fear of the parachute not developing and consequent death. An attempt to overcome the former was made by increasing the pupils experience in making descents from high platforms during synthetic ground training. The latter was generally overcome by subtle propaganda and also by allowing trainees to visit the Dropping zone to see others jump. From November 1949 to December 1950 there were 20 refusals. Experience in dealing with these cases reduced the incidence to NIL in 1951.

Comparative Analysis

This analysis (Table II.) is made from information from the Indian Paratroopers Trg. School during the year 1950 only. Comparative study is carried out on injuries per 1,000 descents.