

Foot and ankle injuries occurring in inflatable rescue boats (IRB) during surf lifesaving activities

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ABSTRACT

Inflatable Rescue Boats (IRBs) are utilised by the Surf Life Saving Association (SLSA) in Australia to perform rescue operations and in regional competitions between surf clubs. These activities have resulted in a number of serious foot and ankle injuries which reflect the high impact of this activity in heavy and unpredictable surf. We have retrospectively reviewed 12 significant injuries relating to IRB usage presented to our regional hospital emergency department over a 3-year period. These include 6 Lisfranc fracture dislocations of the midfoot, 4 ankle fracture variants, one tibial shaft fracture, and one traumatic rupture of the peroneal retinaculum leading to peroneal tendon dislocation. Analysis of IRB footstraps in current usage shows they are directly related to the patterns of injury seen. We have recommended modifications to footstraps and handgrips currently in use with the aim of minimising or preventing these injuries.

INTRODUCTION

The activities of the Surf Lifesaving Association (SLSA) are integral in keeping Australian beaches safe for general recreational surfing and water sports. To this end SLSA utilises IRBs in performing rescue operations and in regional surf lifesaving competitions. The boats are inflatable 4-metre rafts powered by 25 horsepower outboard motors and are designed to carry two crewmen.

The use of IRBs in this capacity has resulted in a number of serious foot and ankle injuries to crewmen. We have reviewed these injuries to highlight the issue and to suggest modifications to IRBs with the aim of preventing such injuries.

Of particular interest is the occurrence of a number of Lisfranc fracture dislocations of the midfoot. This injury was originally described by the French field surgeon Lisfranc in the Napoleonic wars.⁶ The injury occurred in cavalry troops when they were knocked from their horses, catching and twisting their feet in the stirrups as they fell.^{2,8} Lisfranc described a midfoot amputation as treatment for the injury.⁹

A literature review reveals a number of studies reporting foot and ankle injuries from different

activities. Snowboarding,⁵ martial arts,¹ rock climbing,⁴ and water sports, (whereby inflatable water tubes⁷ and 'bananas'³ towed behind speedboats have caused injury) have all been the subject of published articles. No published reports of foot and ankle injuries occurring through surf lifesaving activities in IRBs have been found.

MATERIALS AND METHODS

Foot and ankle injuries were evaluated that occurred during IRB usage presented to the regional hospital emergency department between March 1996 and June 1999. 12 foot and ankle injuries were treated by the same surgeon, 10 of which required operative stabilisation and repair. The mechanisms and circumstances surrounding injury were analysed and preventative measures were recommended.

RESULTS

12 injuries occurred which were predominantly fractures of the ankle and midfoot. 6 were Lisfranc midfoot fracture dislocations, 5 of which were unstable and required open reduction and internal fixation. One was examined under X-ray control, assessed as stable and treated non-operatively in a plaster cast.

Four ankle fractures of varying severity were treated, one a pilon fracture involving the distal tibial plafond and the lateral malleolus. This injury required open reduction and internal fixation of the lateral malleolus and application of an external fixateur to the tibia. Of the remaining 3 ankle fractures, 2 were Weber B lateral malleolus fractures requiring open reduction and internal fixation, and one was a Weber A lateral malleolus fracture treated non-operatively in plaster.

One patient suffered a tibial and fibula shaft fracture which required operative fixation with an intramedullary nail, and one patient suffered a traumatic dislocation of his peroneal tendons which required operative repair of the ruptured peroneal retinacula.

Circumstances surrounding the injuries were as follows: 3 injuries occurred when waves overturned the IRB throwing occupants from the boat, 4 injuries occurred when the IRBs landed heavily after driving over large waves, 4 injuries occurred when IRBs were hit by broken waves, and one injury occurred when an occupant alighted from the IRB as it approached

the beach at speed. Table 1 summarises age, sex, crew position, mechanism of injury, injury and treatment of sustained injuries.

DISCUSSION

The majority of these injuries could in part be attributed to the use of footstraps fixed to the floor of the boat (Fig. 1). The driver at the back of the boat uses one footstrap on his right foot while the other foot remains unrestrained. The crewman at the front of the boat uses two footstraps. The function of footstraps is to provide a stable platform enabling the riders to remain in the boat. The danger is that the footstraps lock the feet in a stable position while the rest of the body may be thrown or twisted around the feet when waves hit the IRB. This is especially the case when operating in heavy and unpredictable surf.

Ten of the 12 injuries (6 Lisfranc injuries, 3 ankle fractures and one tibial fracture) occurred from either the rider being twisted around his locked feet or from the rider being catapulted from the boat while his feet remained fixed to the floor in the footstraps. One injury (peroneal retinaculum rupture) occurred when a crewman jumped from a moving IRB onto the beach, and the other injury (plafond tibial fracture plus lateral malleolus fracture) occurred to a driver's unrestrained foot when the boat was hit by a broken wave.

Perhaps not surprisingly 11 of the 12 injuries occurred to the crewman at the front of the boat and only one to the driver at the back. This could be explained because the crewman, being at the front of the boat, takes the initial impact of the wave while having no control over the direction of the boat. He is in a less stable position than the driver and consequently needs two footstraps for stability. This in turn renders him more susceptible to a twisting injury as both feet are locked by the footstraps in a fixed position.

The current footstraps in use are made of rigid plastic bolted to the floor. There is no provision whereby straps may be adjusted in size to fit different feet or adjusted in position to suit different stance requirements. The material used does not have any 'give' or elasticity to allow any rotation of the foot within the straps or allow quick release.

The use of these footstraps is consistent with the pattern of injuries seen: homolateral Lisfranc injuries occur with midfoot abduction, and the ankle fractures treated are consistent with external rotation as the deforming force.

Table 1
IRB foot and ankle injuries

Case	Age Mechanism	Sex Treatment	Crew Position	INjury
1	14 thrown from IRB by wave	M Examination under anaesthesia treated in Plaster of Paris	Crewman	Lisfranc fracture dislocation
2	18 thrown from IRB by wave	M Open reduction internal fixation (ORIF)	Crewman	Lisfranc fracture dislocation
3	22 thrown from IRB by wave	M ORIF	Crewman	Lisfranc fracture dislocation
4	33 IRB heavy landing fracture after passing over wave	M ORIF	Crewman	Lisfranc dislocation
5	48 IRB heavy landing fracture after passing over wave	M ORIF	Crewman	Lisfranc dislocation
6	52 IRB heavy landing fracture after passing over wave	M ORIF	Crewman	Lisfranc dislocation
7	16 IRB hit by wave	F ORIF	Crewman	Weber B ankle fracture
8	19 IRB hit by wave	M ORIF	Crewman	Weber B ankle fracture
9	44 IRB hit by wave Plaster of Paris	M	Crewman	Weber A ankle fracture
10	44 IRB hit by wave and External fixateur	M ORIF	Driver	Tibial plafond lateral malleolus fracture
11	23 IRB hit by wave intramedullary nail	M ORIF	Crewman	Tibia and fibula shaft fracture
12	18 alight from moving IRB on beach	M Operative Repair	Crewman	Rupture peroneal s tendon retinaculum

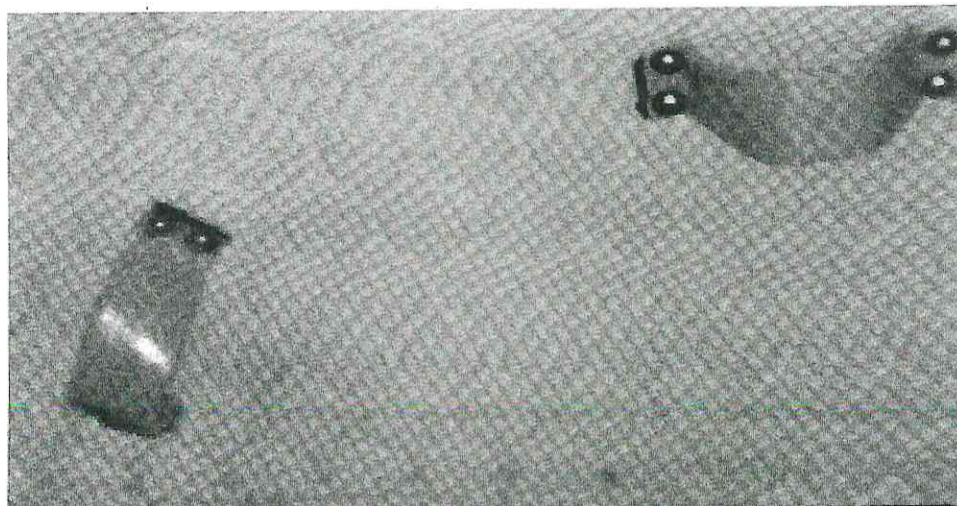


Figure 1 IRB Footstraps



(a)



(b)

Figure 2 IRBs in action

PREVENTATIVE MEASURES

When the severity of the injuries are analysed in relation to the design of the IRB, a number of possible modifications to minimise the extent of such injuries exist:

1. Abandon footstraps and rely on handgrips on the sides of the IRB. This recommendation is limited in practice, however, because with only handgrips to hold onto, the crewman would be at risk of falling back onto the driver or being thrown out of the boat.
2. Design a body harness attached by elastic straps or rope onto the boat. This, however, would probably be too restrictive on the crew, especially when surf conditions or rescue requirements necessitated maximum mobility.
3. Modification of footstraps to improve their performance. Beneficial changes would be to use an elastic material with increased 'give' that would allow some rotation of the foot while providing a stable support. In addition, footstraps should be adjustable in size and stance position to allow greater comfort, support and balance. A further

possibility would be to add a heel support that would aid in preventing foot abduction.

4. In addition to footstrap modification, it would be beneficial to remove the hood, the canvas boat cover at the bow of an IRB, and add a hand grip at the front of the boat to allow the crewman to hold his body firmly against the bow and shield himself against impact.

CONCLUSION

IRB usage is a dangerous activity because difficult and dangerous surf conditions are frequently encountered. However, it is our belief that the serious nature of the injuries suffered could be decreased if a few simple modifications to the IRB were implemented.

The current footstraps should be replaced with a rubber support similar to a recreational water ski boot. This would offer the benefit of allowing greater elasticity and 'give', allow adjustment to foot size and stance position, and have a heel support to prevent midfoot abduction. In addition the front hood should be removed and an additional hand grip added to allow the crewman greater protection against impact.

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