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# REVIEW ARTICLE OF FLYING GUIDELINES WITH AN ORTHOPAEDIC CAST

Orthopaedics

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## ABSTRACT

Orthopaedic splints as well as immobilization casts are a common form of immobilization in the presence of fractures. Casts can be applied to both upper and lower limbs and can present problems for patients when travelling particularly on commercial airlines. Guidance to flying with splints is vague and varied between flight providers. This can lead to confusion amongst patients as well as clinicians whom prescribe the casts. Patients and clinicians often don't understand the risks of flying with immbolization as well the patient's fitness to fly. Two independent reviewers based in the United Kingdom, have reviewed flying guidelines for the major flight providers flying to and from the United Kingdom. The reviewers found that often the flying guidelines with splints is often difficult to come across and is not necessarily supplied on their websites. Thereby the reviewers proceeded to contact the providers by telephone to establish the guidance. It was found that the time before a patient is deemed fit to fly with immobilization varies between providers. Providers can often request fitness to fly certificates as well as request that patients purchase more than one seat if they are unable to bend their knee secondary to immobilization. We suggest further studies and in-depth analysis into cast pressures onboard a flight. We also suggest coordination with the IATA and CAA to establish accurate guidelines and attempt to standardize care amongst providers. In conclusion this would allow patients and clinicians understand the risks of flying with immobilization and avoid confusion on a patients fitness to fly.

## KEYWORDS

Orthopaedic Casts, Flying, Compartment Syndrome, IATA, CAA

## INTRODUCTION

Orthopaedic plaster cast as well as immobilization splints are common practice within the United Kingdom for management of limb fractures. There were an estimated 2,267,892 flights from all UK airports, transporting an estimated total of 292,359,234 passengers in 2018 that included both short and long haul flights.(1)

After reviewing current literature there are no studies outlining the best practice on how to manage patients with plaster cast or splint immobilisation whilst taking aviation travel. This leads to significant confusion both amongst patients as well as clinicians as to who can provide advice to patients on safety whilst travelling with plaster casts. This literature review is to address the ambiguity that exists amongst aviation providers.

Current flying recommendations with a cast works on the principle of Boyle's law (pressure × volume = constant), stating that at a constant temperature the given mass of a dry gas is inversely proportional to its pressure.(2) (3) During aviation flights as the flight ascends the air pressure relatively reduces in comparison to sea level atmospheric pressure and therefore volume can increase. This becomes of a particular concern in orthopaedic casts as they can be circumferential and rigid. This potentially can lead to increased swelling within a closed space and leading to neurovascular compromise and potentially compartment syndrome. Despite commercial flights being able to reach an altitude of 30000 to 43000 feet, the cabin pressures remain between 12-10 psi that is equivalent to 6000-8000 feet. This however is still low compared to the 14.7 psi atmospheric pressure at sea level. (4) (5)

There are also concerns regarding positioning of the affected limb whilst on board a commercial flight. Lower limb fractures immobilised in a cast may not be able to continue elevation in economy class which is standard advice given when fitted with a splint or cast. Consequently this could lead to potential pooling and clot formation especially on long haul flights. Concerns also exist on venous compression particularly in the popliteal fossa from direct pressure from the cast.

**Figure 1: Below- Knee fiberglass cast**

**Sources:https://benecaremedical.com/img_4915-unedited/**

### Pathophysiology

Compartment syndrome is an emergency condition whereby there is a significant increase in the osteofascial pressures within a compartment. As pressures continue to rise this can lead to irreversible nerve and vascular damage to the affected limb. The most common site of compartment syndrome is the lower limb and 36% of cases are based around the tibia. The most common cause of compartment syndrome is acute fracture which accounts for 69% of cases, however external factors such as circumferential dressings as well as casts are a recognized aetiology. The original injury can lead to soft tissue swelling as a result of the acute inflammatory response, which in turn increases the compartment pressure. The increased compartment pressures can lead to reduced tissue perfusion and hypoxia. Hypoxia triggers compensatory mechanisms such as vasodilation and reduction in peripheral vascular resistance as well as increased capillary permeability, which further increases compartment pressures. Once a critical pressure has been exceeded, whereby the compartment pressure exceeds capillary pressure tissue necrosis and cell death proceed. The most sensitive tissue are nerves whereby neuropraxic changes can occur as early as 1 hour. Muscle is more resilient however irreversible muscle damage can occur between 4 to 8 hours following insult.

The diagnosis is based on clinical examination which is characterised with pain out of proportion to the injury which is refractory to analgesia. Other symptoms include swelling, and pain on passive stretching of the compartment. This causes significant cell death and further inflammation and soft tissue swelling. This vicious cycle leads to the emergency of acute compartment syndrome.

The emergency is characterised by pain out of proportion which is refractory to analgesia, as well as swelling and pain on the passive stretch of the compartment. In certain circumstances whereby a history and examination cannot be conclusive such as a patient with a head injury or a patient who is intubated, intra-compartmental pressures can be taken. An absolute pressure of >40mmHg is diagnostic as well as a pressure within 20mmHg of the diastolic is also diagnostic.

A diagnosis is made with clinical examination and compartment pressures are only used in situations where clinical examination may not be reliable, i.e. a sedated patient. British orthopaedic association guidelines suggest all circumferential dressings should be removed immediately and the limb re-evaluated within 30 minutes (9). If at this point symptoms still persist fasciotomies should be performed within 1 hour (9).

## METHODS

On the 4th of February 2020, two independent reviewers conducted a

literature review on current guidelines on flying with cast immobilisation. After searching through pubmed the keywords, plaster, splint, flying, aviation were searched which revealed no current evidence of flying guidelines. Looking directly through specific aviation providers websites as well as calling aviation providers directly we were able to find individual guidelines from each provider as well as the variance in the recommendations.

## RESULTS

Below we have compiled a table including common aviation providers within the United Kingdom and their current flying guidelines with a cast.

| Airline | Flying Guidance |
|---|---|
| Easy Jet | Upper Limb - 1 seat<br>Lower limb - 1 or more seat dependant on leg position<br>All casts should be split if <48 hours |
| Jet2 Airways | <48 hours fit to fly certificate by medical professional as well as split cast<br>>48 hour no restrictions |
| RyanAir | <48 hours split cast<br>If unable to flex knee past 90 degrees, purchase more than 1 seat |
| Flybe | Cast >24 hours<br>Bend knee more than 90 degrees |
| Wizz air | <2 hr flight plaster >24 hours<br>>2hr flight >48 hours since cast application |
| BA | <2 hr flight plaster >24 hours<br>>2hr flight >48 hours since cast application |
| Vueling | >24 hour since application of cast |
| Virgin atlantic | <72 hours fit to fly certificate<br>>72 hours no restrictions |
| TUI | >24hr for <2hr flight<br>>48hr for >2hr flight<br>Fit to fly certificate |
| CAA | >24 hour for 2 hour flights<br>>48 hour for more than 2 hour flights<br>Full cast should be bivalved<br>Pneumatic devices not suitable |

## CONCLUSIONS

There is minimal literature available to assess the effects of flying on lower limb fractures/injuries requiring cast immobilisation (6). This can lead to much confusion amongst patients as well as clinicians. We feel more clarity is required to improve the safety of flying with a plaster cast in the presence of a limb fracture.

It is postulated that as the cabin pressure rises, air is trapped in fresh plaster cast leading to expansion that may cause constriction (6). There have been documented cases of transient compartment syndrome whilst flying, and patients should be made aware of this potentially devastating complication (7). It is advisable to split or bivalve tubular plaster cast if applied less than 48 hours to prevent further injuries (8).

There are significant discrepancies with regards to advice and recommendations by airlines and their regulatory bodies with regards to flying whilst limbs immobilised in either partial or full plaster casts. Our literature review and individual airline published data revealed that a minimum of 24 hours since the application of plaster cast is required for flights of less than 2 hours duration, and a minimum of 48 hours since immobilisation for long haul flights of more than 2 hours. Furthermore, most airlines require one seat booking if the knee is not immobilised and has full range of movement, otherwise two seats need to be booked. It is also necessary to acquire a “fit to fly” certificate from a healthcare professional in order to fly with immobilised lower limb/s.

We suggest that there should be further in-depth studies done on this topic for better understanding of this topic. This can include pressure changes in the plaster cast both before and during flights for comparison. We also suggest a coordination with IATA and CAA to establish accurate guidelines for both passengers and airline staff to standardise care across the aviation industry.

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