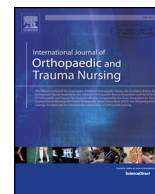




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## An audit of complications of fiberglass cast and hybrid cast for fractures of the foot, ankle and forearm in a Swedish emergency department

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### ABSTRACT

Patients of all ages present to the Emergency Department (ED) with fractures that require immobilization using a cast. Various casting materials are used, all with advantages and disadvantages and there are considerable risks associated with fracture management using cast immobilization. The frequency and severity of complications from fiberglass or hybrid casts applied in the emergency setting has not previously been studied.

The aim of this audit was to describe all the complications that occurred within 30 days in patients who had a fiberglass cast applied for immobilization of uncomplicated, non-angulated fractures of the foot, ankle or forearm.

A retrospective care record audit was conducted that included 430 patients.

**Results:** The most common complications found were skin complications and cast related problems. No severe complications (e.g. compartment syndrome, venous thromboembolism or infection) were found.

**Conclusion:** Fiberglass casts did not cause severe complications in this group of patients with uncomplicated fractures of the extremities. However, 25% of the patients experienced some form of complication. Interventions are needed that minimize the frequency of complications. As with all healthcare interventions, it is crucial that staff applying casts and providing follow-up care are competent. If casts are applied correctly and the patient is well informed and concordant, complications can be avoided.

### Introduction

Patients of all ages present to the Emergency Department (ED) with fractures that require immobilization or fixation. The most common treatment for non-angulated, or minimally angulated, fractures of extremities is immobilization in a cast; a practice that has been performed for hundreds of years (Szostakowski2017).

### Background

There are a variety of different casting materials, each with their own advantages and disadvantages (Szostakowski et al., 2017). There are also significant risks associated with cast immobilization for fracture management and casts that are incorrectly applied or managed are threats to fracture healing and the comfort and safety of the patient. Common complications of casts include: infection; venous thromboembolism (VTE); pressure injuries and friction burns; moisture damage/maceration; poor immobilization of the fracture, soft tissue swelling; neurovascular compromise; paraesthesia/numbness of extremities; compartment syndrome and joint stiffness (Halanski&

Noonan, 2008; Guillen et al., 2016). Complications that result in significant harm to the patient and require medical intervention such as antibiotics or surgery are the most severe, but all complications should be avoided.

The application of a cast is a complex process that is much more than the actual application, but also requires giving information to the patient/carer to ensure proper cast maintenance (Nguyen et al., 2016). Compliance with instructions for maintenance, such as keeping the cast and lining dry, also affects the frequency and severity of complications (Guillen et al., 2016). Wetting of a cast, for example, can happen if the patient does not follow instructions, with a wet cast lining leading to skin breakdown and potential infection. (Delasobera et al., 2011).

Plaster of Paris casts are considered to be cheaper, easier to apply and associated with less complications (Smith et al., 2005), making this a common choice among ED practitioners, despite lack of certainty about the best material for avoiding the risk of compartment syndrome. The competence of the practitioner applying the cast may be as important as the material in avoiding complications (Smith et al., 2005) Patients often prefer fiberglass casts as they are lighter and stronger; they are also more radiolucent (Charles and Yen, 2000; Smith2005).

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Lightness and strength are especially important qualities in casts for children and older people (Smith et al., 2005). Fiberglass casts require greater skill during application as the material molds faster, is stiffer and, because there is less padding, it is less forgiving if edges or folds occur during application, increasing the risk of complications if the cast is not correctly applied (Chaudhury et al., 2017). The nature and application of the lining of the cast is also an important consideration (Guillen et al., 2016). In Sweden, application of a casts in the ED is prescribed by the ED physician (often an orthopedist) and applied by orthopedic plaster technicians who are specialists in applying casts for many types of fractures.

When two different orthopedic EDs were merged in the author's region, two casting materials (fiberglass and plaster of Paris) were being prescribed by the ED physicians who, after the organizational change, worked in both EDs. The other staff (nurses and casting technicians) did not rotate. This situation provided the opportunity for a review of the previous year's patient records, focusing on adverse effects and complications due to fiberglass casts. This enabled the team to explore the frequency and severity of complications in patients treated with fiberglass casts.

## Aim

The aim of the audit was to describe all 30-day complications in patients who had a fiberglass or hybrid cast applied to immobilize an uncomplicated fracture of the foot, ankle or forearm in all age groups.

## Methods

A retrospective care record audit was conducted that included all patients who sustained trauma to the foot, ankle (all ages) hand or forearm (children < 16 years). Two different computer systems were used; one (the patient administration system) for identifying eligible patients and one for accessing information from the medical records and deciding whether they met the inclusion criteria. The patient administration system was used to identify the sample using the search terms “fracture” and “cast”. The medical records were used to identify whether each patient met the inclusion criteria. The inclusion criteria were: 1) fracture of the foot, ankle or forearm, not more than three days since trauma, 2) not needing surgery initially, and 3) a fiberglass cast prescribed for application in the ED.

This resulted in 430 patient records being identified; 208 adult and child patients with a foot or ankle fracture, and 222 children with a radius or ulna fracture. To structure the review of the included care record, a data collection proforma was used to record relevant information including; age (child or adult); fracture type; cast type; presence of compartment syndrome; surgery; infection; VTE and other complications (any) within 30 days of cast application. The complications listed on the proforma were based on cast complications and severity described in the literature.

This audit was considered a clinical project for quality improvement and was therefore did not required ethical consideration, according to Swedish law (SFS, 2003).

## Results

The following fractures were present in the sample of patients with foot or ankle injuries (n = 208, all ages): distal fibula fractures, metatarsal fractures and Lisfranc injuries. Children (n = 222, aged < 16 years) presented with either radius or ulna fractures. All patients had had the injury 1 or 2 days prior to the ED visit. Of the 430 care records reviewed (including both children and adults), no severe complications (compartment syndrome, VTE or infections) were found. However, 111 less severe complications were identified from the care records (See Table 1), most of which were related to the application of the cast. Some complications could also be attributed to poor compliance with

**Table 1**  
Complications in patients with fiberglass cast

Complication	All ages, foot or ankle fracture (n = 208)	Children, fracture forearm (n = 222)	Due to cast/application
Chafing	23	11	yes
Cast too loose or bad fitting	21	44	yes
Swollen	8	1	yes
Broken	0	3	no
Wet	2	3	no
Numbness	1	1	yes
Dislocation needing surgery	0	3	yes

cast care instructions.

In the group of children with forearm fractures (n = 222), three children needed fracture reduction surgery because of displacement after casting within 30 days of injury.

## Discussion

As there were no severe complications identified by this audit of 430 patient care records, fiberglass (or hybrid plaster of Paris and fiberglass) casts for uncomplicated, acute fractures of the foot, ankle and forearm appears to be a safe method for fracture immobilization. The risk of compartment syndrome has been discussed in the literature and plaster of Paris casts have been recommended following an experimental study (Chaudhury et al., 2017), but our findings suggest that the actual risk for fiberglass or hybrid casts is very low. From the patient's perspective, fiberglass casts have several advantages compared to plaster of Paris including being light-weight, needing a shorter time to set and not needing the use of a saw for removal (Smith et al., 2005; Halanski, 2016; Nguyen et al., 2016). In the children in the audit, three patients needed surgery due to dislocation. This may have been due to the nature of the fracture or a result of a cast that was applied too loosely. A difficulty when applying casts to small children is the shape of their extremities, often short, and their inability to communicate how it feels. More than one quarter of the patients experienced some form of complication which the department needs to study in more detail in order to understand the causes and best methods of prevention. It is important to identify how best to prevent all complications as most of them are likely to be avoidable. The importance of padding to prevent skin and neurovascular complications is one example of how competent application may prevent complications (Nguyen et al., 2016). The risk of complications due to application by inexperienced practitioners (Szostakowski et al., 2017), was avoided in this audit as the cast technicians were skilled. However, it has been shown that most unplanned cast changes were not due to the cast application, but to patients' non-adherence to instructions (Nguyen et al., 2016). Thus patient information is central, both for avoiding complications and helping the patient/carer/family to identify problems early (Delasobera et al., 2011; Nguyen et al., 2016).

## Conclusion

Severe complications in patients with fiberglass casts applied for uncomplicated fractures of the extremities are rare. However, less severe complications are common. With correct application and well informed patients, even the less severe complications can be avoided. As in all medical interventions, the need for competence and technical skill, as well as communication skills, is crucial in providing patients with the best conditions for healing and health.

**Appendix A. Supplementary data**

Supplementary data related to this article can be found at <http://dx.doi.org/10.1016/j.ijotn.2018.05.005>.

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