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Conservative treatment of the distal radius fracture using thermoplastic splint: pilot study results

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Abstract

Introduction Fractures of the distal radius are common accounting for approximately one-sixth of all fractures treated in the emergency room. This study reviews a series of patients with stable distal radius fractures who have been treated with thermoplastic splint.

Methods This study was undertaken between November 2009 and May 2010 in a single orthopaedic fracture outpatient clinic. All patients had undisplaced or minimally displaced distal radius fractures. Children and open fractures were excluded. Patients had been reviewed in the outpatients with radiographs on 1, 2, 6 and 12 weeks after injury. Skin condition and satisfaction were assessed on splint removal. Radiological parameters of radial inclination, radial length and palmer tilt were measured.

Results In total, 26 patients were treated with the splint. The average age of the patients was 45.1 (range, 21–73), and male/female ratio was 12:14. On average, the splint was removed at 5.1 weeks (mode = 6 weeks). The right-to left-side ratio was 11:15. Eleven of those fractures were on the dominant side. There was no significant difference in the radiological outcomes pre- and post-splinting. Nearly all patients had been satisfied with the splint. Two patients had minor cast complications whilst 23 patients were able to shower whilst in splint.

Conclusion Patients treated with thermoplastic splint showed no deterioration in their radiological outcomes. Nearly all the patients had been satisfied with the splint.

Keywords Distal radial fractures · Splint · Thermoplastic splint

Introduction

Fractures of the distal radius are common accounting for approximately one-sixth of all fractures treated in the emergency room [1–3], with increasing numbers of low-energy fractures seen in the elderly [4]. Immobilization in cast is the most appropriate treatment modality in 75–80 % of cases [4]. There have been numerous studies to compare the outcomes or various forms of casting [1, 2]. However, none of these studies used a removable thermoplastic splint for the total period of immobilization. The purpose of this study was to review all the patients who have been treated in a single outpatient fracture clinic using a thermoplastic splint.

Patients and methods

Study protocols

Patient data collection was done prospectively by senior nurses in the fracture clinic and plaster technician in the plaster room. We studied the data collection sheets, patients' medical notes and follow-up radiographs of all identified patients retrospectively who were treated with the FastForm® thermoplastic splint (FastForm Research Ltd, Co. Waterford, Ireland) in a single outpatient fracture clinic in our hospital. All patients are with minimally

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displaced fractures of the distal radius and had been referred to a single consultant's fracture clinic between November 2009 and May 2010. The definition for the minimally displaced fracture in this study is that a fracture that has a loss of palmar tilt of less than 10 degrees, radial shortening of 2 mm or less and a lateral shift of 2 mm or less with intra-articular step-off of less than 2 mm. All of these patients were initially treated with a dorsal plaster cast by the emergency room physicians. All patients were assessed by a consultant orthopaedic surgeon prior to treatment with the thermoplastic splint. Open fractures and fractures in children were excluded from the study. Patients were reviewed in the outpatient clinic with radiographs at 1, 2, 6 and 12 weeks after injury, and all splints were removed by a senior plaster nurse at the 6-week visit. Patients were reviewed by the orthopaedic team to confirm fracture healing clinically and radiologically. In the event healing was in doubt, the splint was re-applied again by using the same splint and tightening the straps again. Patients were followed up clinically and radiologically again in the orthopaedic clinic in a 1–2 weeks time. The skin beneath the splint was assessed on the removal of the splint. The patients' satisfaction with the splint was also recorded.

Radiological outcome was obtained using standardized antero-posterior and lateral radiographs of the wrist with the forearm in neutral rotation [5]. Radial inclination, radial length and palmar tilt were measured at each time point [5–7].

This project was submitted to the local ethical committee and was deemed exempt from formal ethical approval.

Splint

In this study, FastForm[®] splint (FastForm Research Ltd, Co. Waterford, Ireland) was used to immobilize the forearm in a manner similar to a Colles cast (Fig. 1). Prior to application, the thermoplastic splint was warmed up for few minutes in a microwave oven to achieve the best contour around the patient's wrist following the instructions provided with the splint. This was secured by a layer of a bandage until setting was complete. All straps adjustment and tamper strap were checked prior to discharge by the applying cast technician (Fig. 2). Casting advises were given to the patients, and patients were informed that the splint is wettable. In follow-up clinics, the splint was adjusted using the Velcro adjustment straps to correct for the reduced swelling. All x-rays were taken without splint removing because of radiological translucency (Fig. 3).

Statistics analysis

Statistical analysis of the pre- and post-treatment radiological measures was performed using the paired Student's *t* test using Minitab 14[®] and Instat Grafpad[®] software.

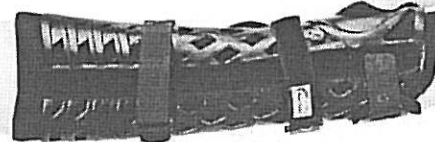


Fig. 1 FastForm[®] cast

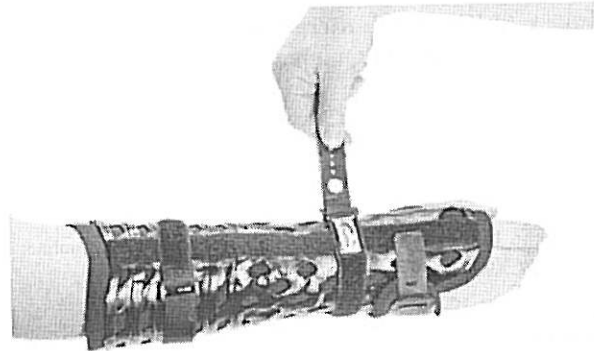


Fig. 2 Convenient strap application



Fig. 3 Radiolucent splint

Results

Demographics

In total, 31 patients were treated with the splint but 5 of these patients were excluded. Four patients did not have minimally displaced Colles fractures, and 1 patient was lost to follow-up. The average age of patients was 45.1 (range, 21–73), and the male to female ratio was 12:14. On average, the splint was removed at 5.1 weeks (mode = 6 weeks) (Table 1).

Outcomes

There was no significant difference in the radiological outcomes pre- and post-splinting (Table 2), indicating that

Table 1 Patients demography

Characteristics	Results
Mean age in years (range)	45.1 (21–73)
Male/female	12:14
Dominant side injury	11
Non-dominant site injury	15
Average duration of treatment in weeks (range)	5.1 (4–6)

there was no fracture displacement in the splint. There were no superficial burns from application of the splint. No patients needed re-application of the cast or any manipulation after application. Two patients had light damage of the splint on removal, one of them following a fall. Fastform splint price was almost 3 times the price of water-proof fibreglass cast.

Patient satisfaction

Two patients had previous immobilization experience before and found the splint much more comfortable than conventional casting. A minor cast complication was found in 2 patients, one of which could not tolerate the splint, requiring conversion to conventional cast, and one patient found the splint had an unpleasant odour at the end of their treatment. Twenty-three patients were able to shower whilst in the splint.

Discussion

This study reported that using thermoplastic splint in the management of minimally displaced fractures of the distal radius had shown satisfactory results with no deterioration in radiological outcomes. Immobilization of undisplaced fractures of the distal radius in splints has been shown to yield satisfactory results in adults [8] and in children [9]. However, the splints used in previous studies have been short volar splints such as the Futura [8]. The Futura splint is very convenient to use but has no potential for moulding to provide additional support and cannot prevent forearm rotation and as such are only suitable for very stable fractures in relatively good bone. The Futura splint is also easily removable, and therefore compliance may be an issue. In this study, thermoplastic splint was well tolerated

and adequately held minimally displaced distal radius fractures in a satisfactory position, whilst also providing tamper-free immobilization with customizable support of fractures.

Several studies have suggested that there is a direct relationship between the anatomical position of union and the functional outcome [4, 10, 11] of distal radius fractures. Closed reduction and immobilization in a plaster cast remains the accepted method of treatment for 80 % of fractures if the distal end of the radius and for extra-articular fractures that are minimally displaced or impacted and, thus, are judged inherently stable [5, 12–15]. Suitability for cast treatment includes fractures with minimal displacement and comminution, or displacement deemed stable following reduction [4].

Displaced fractures of the distal radius are considered to be unstable when alignment cannot be maintained in a forearm cast after closed reduction; however, this is a retrospective definition [4, 16]. Many studies tried to define the risk factors for instability [6, 17–19]. These include fracture pattern (dorsal comminution beyond midaxial plane of the radius, intra-articular fractures, associated ulnar fracture), the severity of primary displacement (dorsal angulation $>20^\circ$, radial shortening >5 mm) and patient factors (age >60 years, quality of the bone). Management must also take into account other local factors such as inherent stability after reduction and severity of soft-tissue injuries, and those associated with the individual patient such as lifestyle, associated medical conditions and compliance [4, 16]. There is a proportion of unstable fractures that re-displace after closed reduction and external splintage alone, resulting in a poor functional outcome [10, 17].

The application of the thermoplastic splint is straightforward, being very quick and clean to apply. The additional benefits of lightweight, water tolerance, comfort, adjustability and radiolucency are added bonuses. An added benefit is the ability to covert the thermoplastic splint to a volar splint for those patients who require additional period of support. The more expensive price might be a limitation factor for using the cast frequently and limit using it in specified group of patients that require a water-resistant cast such as athletes and an easy removal immobilization method in frequently travelling patients.

Our study was principally limited by small sample size and lack of a control group. Results from this pilot stage

Table 2 Radiological outcomes

	On starting of Fastform splint	On removal of Fastform splint	<i>p</i> value
Mean radial inclination in degrees (CI)	16.072 (14.99–17.16)	14.925 (14.52–16.96)	0.31
Mean radial length in mm (CI)	9.604 (8.57–10.64)	14.925 (4.70–25.15)	0.15
Average palmer tilt in degrees (CI)	5.002 (1.13–8.87)	4.635 (0.98–8.29)	0.3342

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