

## Use of EXOS® Thermoplastic Splint in the Treatment of Wrist Fractures: A Retrospective Cohort Study of Use – The Silverdale Medical Experience

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### Abstract

**Background:** There has been varying and divergent methods in the treatment of paediatric and adult wrist fractures. Current opinion and evidence suggest that in paediatric torus distal radius fractures, management with splinting is as comparable a method of treatment to the traditional plaster or Paris (POP) casting. This is a retrospective look at the safety of using the EXOS® thermoplastic (TP) splint to treat wrist fractures.

**Methods:** A retrospective review of 62 consecutive patients presenting to the Silverdale Medical Centre, Auckland, New Zealand with wrist fractures who were treated in the EXOS® TP splint. Outcomes included safety of use, complications of further fractures and patient satisfaction were measured.

**Results:** A total of 37 female and 25 male patients were treated. Age of patients were from 2.8 years to 72.8 years (mean 13.5 years, median 10 years old). Types of injuries treated with torus fractures (n=28), undisplaced distal radius fracture (n=12), clinical SH 1 (n=11), confirmed scaphoid fracture (=5), clinical scaphoid fracture (n=3), distal ulnar fracture (n=2) and SH2 fracture of distal radius (n=1). Average treatment time in splint was 35 days and average follow up visits was 2. All patients were totally satisfied with the splint treatment.

**Conclusion:** EXOS® is a treatment option that is suitable for paediatric wrist fractures and selected adult distal radius fractures.

**Keywords:** Wrist fractures; Splint treatment; Radiographic imaging; Bone growth

### Introduction

Wrist fractures are a common injury noted in both children and adults and is seen frequently in Urgent Care Clinics and Emergency Departments in New Zealand and throughout the world. In New Zealand, statistics from the Accident Compensation Corporation (ACC) show that from June 2013- 2018, there were 521,095 new claims for injuries to the wrist and hand that were lodged costing approximately NZD\$500,000,000 in total cost [1].

Wrist fractures are traditionally caused by falls from an outstretched arm. In the paediatric population, distal radial fractures account for 25% of all fractures and studies indicate an increase in prevalence of these fractures [2]. This has been thought to be due to increased involvement in formal sporting activities along with improved access to medical care, more accurate assessments of injuries and increased use of radiographic imaging [2]. Landin demonstrated that by the age of 16, boys had a 42% risk of a forearm fracture and girls 27% [3]. Nellans et al. reported the peak incidence of childhood distal radial fractures between ages 5-14. Their study summarises the rate differential and aetiological associations including the relative reduction of mineralisation of bone during puberty, when this process cannot keep up with the dramatic increase in new bone growth, leading to an increased risk of fracture in early puberty. Following puberty, bone mineral content increases markedly which protects the bones more effectively from traumatic events and the fracture rate drops [4].

The treatment of fractures, particularly in paediatrics wrist fractures, are multiple and varied with no common guideline being universally used. Traditional Plaster of Paris (POP) cast have been used to treat most of the variety of fractures. Lately, there has been evidence to suggest that the use of splints for torus fractures of the wrist may have more beneficial outcomes in terms of functional recovery, treatment cost and complication rates when compared to POP and fiberglass cast [5-7]. Despite this evidence, there is still hesitation and reluctance on

the part of majority of the medical fraternity to adopt the use of splints into routine daily practice [8,9].

Therefore, to try and shift the paradigm of treatment, the Silverdale Medical Centre via it's Urgent Care Clinic trialled the use of the EXOS® TP splint to treat wrist fractures, predominantly in the paediatric population but also for some selective adult wrist and hand fractures as well. The EXOS® from DJO global is a revolutionary, thermoformable technology, offering an adjustable and re-formable splint. The thermoformable material is light-weight, waterproof, can be easily cleaned, and is radiolucent. This is a retrospective case series of patients that presented to the Silverdale Medical Urgent Care Clinic with wrist fractures and were treated with EXOS® splinting of the wrist.

### Methods

A total of 102 patients who presented to Silverdale Medical Centre Urgent Care Clinic between Feb 2017 and 2018 were identified through the medical records to have been treated for a variety of wrist injuries. These included, torus fractures of the radius and/or ulnar with minimal or no angulation, Salter-Harris (SH) 1 and 2 type fractures of the radius with minimal or no angulation, scaphoid injuries with clinical suspicion and radiological confirmed fractures, distal ulnar shaft paediatric fractures and un-displaced distal radius fractures with minimal or no angulation or impaction.

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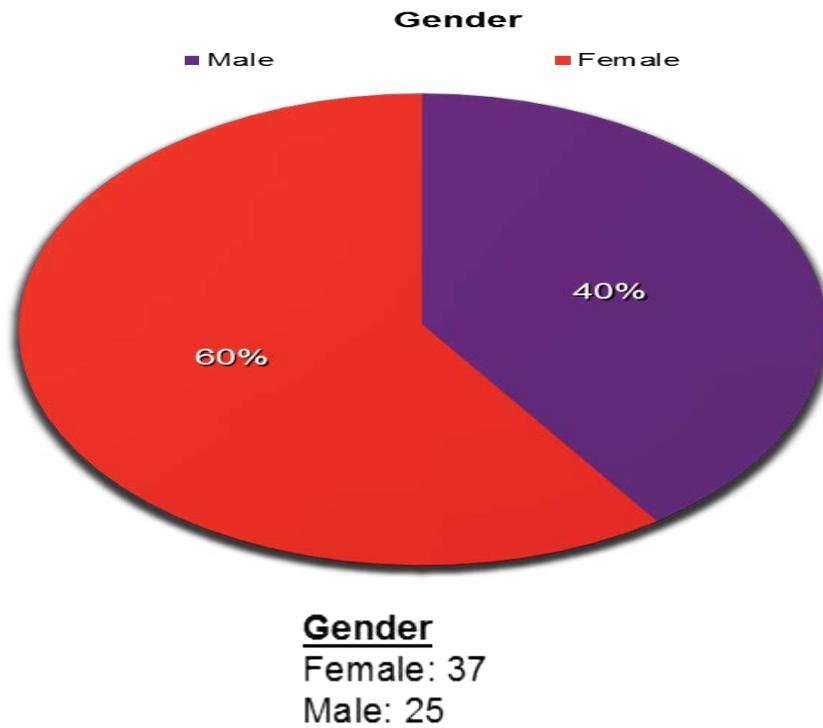


Figure 1: Gender split of patients treated.



Figure 2: Imaging of original injury (A) and subsequent follow up (B) radiograph.

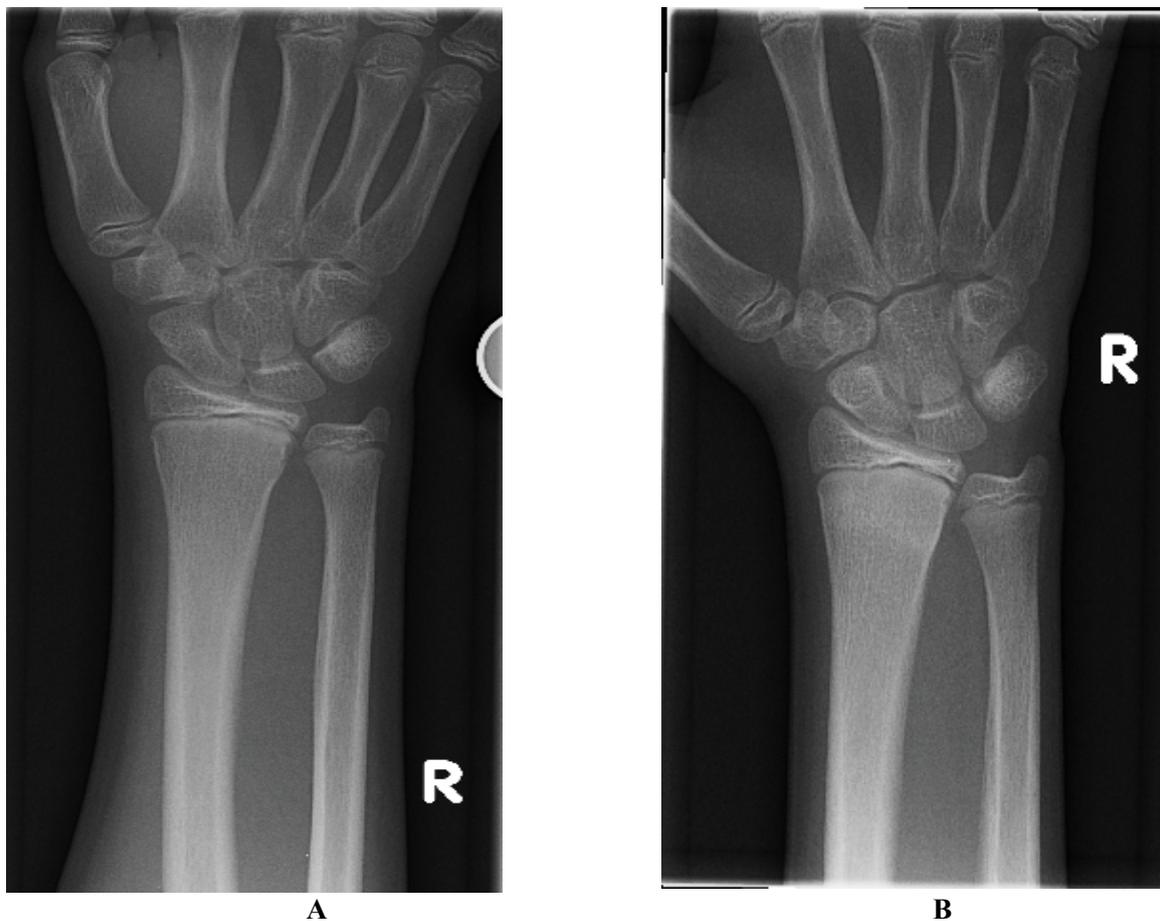


Figure 3: Example of non-angulated wrist fracture. Initial imaging A and follow-up B.

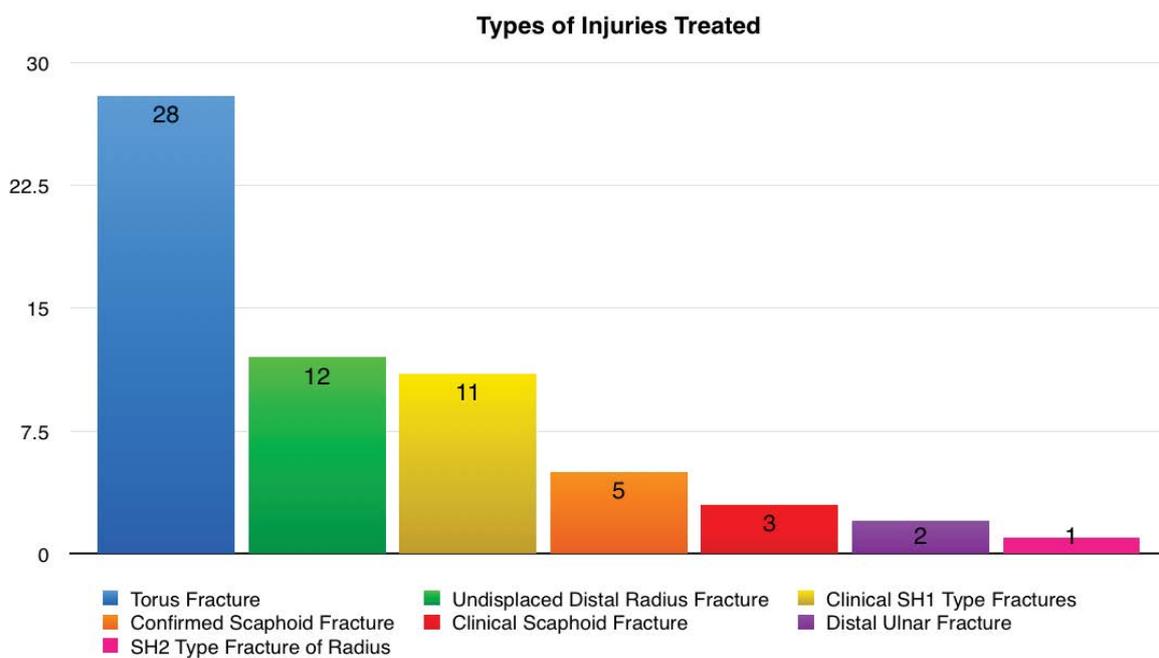


Figure 4: List of types of injuries and numbers treated.



Figure 5: Example of EXOS® thermoplastic splint. [Source: Image taken from [www.djoglobal.com/products/exos](http://www.djoglobal.com/products/exos)].

All patients that were examined by an Urgent Care Physician who was also a fellow of the Royal College of Urgent Care New Zealand and were upon confirmation of the injury, offered the option for conventional treatment with POP casting or the EXOS® splinting. 62 patients treated in the splints based on their fracture pattern are included in this case series review. The rest of the 40 patients were treated in traditional POP casting due to the type of injury that required further attention at the hospital for manipulation or operation for their fractures.

Patients had routine follow up protocols of initial clinic review at 2 weeks where a follow-up radiograph was obtained to assess for any change in alignment and evidence of bone healing in the form of

periosteal reaction or bony sclerosis. At that follow-up, the patients were assessed for any skin issues from using the splint. A secondary and final follow-up subsequently at 3-4 weeks was also done to assess for any bony tenderness at the fracture site, skin issues and any other complications that may have arisen.

The EXOS® TP splints were supplied and applied to each patient by a registered hand therapist, available adjacent to the medical centre at the request of the Urgent Care physician treating the patients. The splints were applied and a follow up check with the hand therapist was done at the end of the follow up period to start active range of movement and strengthening exercises as part of the patient's rehab. Any issues with the fitting of the splint were also referred back to the hand therapist

for appropriate adjustments with remoulding of the splints. The splints were removable but patients were expected to keep them on for the period of review with intermittent removal for skin cares.

Complications with regards to fracture malalignment, fracture fragment distraction, mal or non-union were assessed at each follow-up attendance. Primary outcome was the safe use of the EXOS® splint for treating the fractures with secondary outcome of patient satisfaction.

## Results

Of the 62 patients included, gender breakdown was 37 female and 25 male (Figure 1). Age of the patients at presentation varied from 2.8 years to 72.8 year with a mean age of 13.5 years and median of 10 years (Figure 2).

Most of the patients seen (n=57) presented either on the day of injury or the following day. There were 4 patients who presented 3 days after initial injury and one patient had a delayed presentation at day 10 post injury. Types of injuries treated were torus fractures (n=28), undisplaced distal radius fracture (n=12), clinical SH1 type fractures (n=11), confirmed scaphoid fracture (n=5), clinical scaphoid fracture (n=3), distal ulnar fracture (n=2) and SH2 type fracture of radius (n=1) (Figure 3).

At the time of initial follow up at day 10-14 post injury, most patients (n=58) were still clinically tender to palpate while at the 5-6 week check, 9 patients had very mild discomfort to palpation. The average number of clinic visits including the initial presentation was 3 visits, with 5 patients requiring an additional visit at 8 weeks post injury



**Figure 6:** Image of adult undisplaced distal radius fracture pre splinting, image A and post splinting image B.

for a final check. (Figures 2A and 2B), depicts imaging obtained at time of presentation and subsequent imaging at follow up.

The average time for treatment in the splint was 36 days with range from 16 days for the patients with clinical scaphoid fracture to 52 days for a patient with undisplaced distal radius fracture. Time spent in the splint was clinically dependent on age of the patient with younger patients spending less time in splint (average 34 days) while adult patients with undisplaced distal radius fractures spending more time in the splint (39-52 days). The average treatment duration was 5.27 weeks for all the patients. The number of follow up visits averaged 2 visits with ranges of 2-4 visits for all patients. Patients that had more than 2 follow-up visits were predominantly older patients with some issues about the initial fit of the splint that required remoulding of the splint.

There were no significant fracture healing complications noted. Primary complaint was related to skin irritation and dryness which were reported by 9 patients. Overall patient and parental satisfaction of the splint was 97% totally satisfied and 3% satisfied. Patients preferred the fact that the splints were lightweight and waterproof enabling them to perform most daily activities without any hinderance.

## Discussion

This retrospective case series has shown feasibility of using the EXOS thermoplastic splints to treat a variety of wrist fractures safely. Patients who had the splints applied were satisfied with the use and outcome of the splint application and their overall treatment.

Wrist fractures are one of the most common type of injuries world-wide and represent a significant proportion of presentations to emergency departments and urgent care centres. There are 3 major populations affected which are the young and adolescent, young adults and the elderly with paediatric and elderly at higher risk for these type of injuries [4]. In the paediatric and adolescent age group, falls are the predominant mechanism of injury with several studies demonstrating dissociation of skeletal growth and bone mineralisation during puberty accounting for the fragility of bones during this stage of development [4,10,11] (Figures 3-6).

There has already been work done by Boutis et. al. that previously showed the use of prefabricated splints to be as effective in the treatment of undisplaced distal radius fractures when compared with short arm cast in terms of recovery and function [12]. Previous work has shown that majority of these injuries can be safely managed in the community with minimal hospital involvement [13]. There is contention that with adequate instructions about splint usage and return to activities provided to patients and parents, no further input from physicians may be an option [14].

Despite the wealth of evidence, traditional management treatments of paediatric torus wrist fractures continue to be employed. Review of treatments in a Florida emergency department showed continual use of traditional methods of casting of torus fractures which is contrary to the present evidence [15]. There continues to be the tendency to over-treat and over utilisation of follow-up radiography as well [15]. Additionally, Williams et. al. reported that injuries treated in the traditional case had a 10% complication that required additional unscheduled visits [15].

This was also confirmed by a survey of 25 orthopaedic surgeons for reasons of this case series, within the Auckland region, New Zealand, all of whom opted for casting of any wrist fractures in the paediatric age group. None of those surveyed recommended splinting at any point for wrist fractures. The supposition for this opinion could be that

the orthopaedic surgeons are reviewing more complicated cases with fracture patterns that may not be generally suitable to be primarily splinted, hence their apprehension to treat fractures in splints. There is also the additional thought that as patients that are being sent to them are reviewed generally between 10 and 14 days after initial injury, there may be apprehension that if undertreating these injuries initially may lead to potential detrimental sequelae from a bone healing perspective. This may also be as a consequence that majority of the splints available presently in various clinics are of the Futuro® type variety which is less rigid and non-mouldable in nature. A canvas of wrist fracture protocols by urgent care centres within the Auckland Metropolitan region revealed that a very small proportion 15% were treating torus wrist fractures in splints with the rest opting for casting of all patients regardless of mode of injury.

In the adult population, there have been several studies that have shown similar results in patients that were treated non-operatively in casts [16,17]. Functionally, there has been little statistical difference in outcomes of grip strength and wrist movement function at one year post injury in patients that were treated non-operatively compared to surgical management. Conversely, the non-surgical group of patients were shown to have greater flexibility within wrist movements when compared to the surgically treated patients [17]. Reviews of the fractures in the elderly of serial case studies do not support the notion of improved clinical outcomes for elderly patients with distal radial fractures. The only improvement noted was that of better radiographic outcomes. There is therefore an argument for the careful consideration prior to performing operative fixation on elderly patients with distal radial fractures in general [17]. Given these findings, alternatives could be considered in the treatment of distal radial fractures with casting as the traditional alternative [16]. However, as similar to the paediatric group, casting in itself does have its issues that may require unscheduled visits for revision or recasting. Splintage with thermoplastic materials have also been considered and shown to have been useful in certain circumstances [17]. Therefore, consideration for newer products and materials should be given as technology advances. This study has demonstrated the feasibility of using the EXOS® thermoplastic splint to successfully treat adult patients with distal radius fractures.

The use of removable splintage may also have potential cost benefits to the healthcare system as well. This is due to the potential reduction of need for serial radiography in specific cases, reduction in consumable material cost for changing of casts and also reduction in the cost for follow-up visitation for serial reviews.

## Conclusion and Limitations

The results of this case series however point to a potential change in the way patients may be treated. Splinting with the EXOS® splint, in specific distal radius fractures has been shown to have good outcomes and return to full function with no detrimental sequelae. The ability of the EXOS® splint to be mouldable has additional advantages for its use in greenstick type fractures with slight angulation in comparison to the generic non mouldable version of splints available in the market presently.

Limitations of this series include the small numbers and the fact that it is a retrospective review of cases. However, given the evidence already available especially for torus fractures in the paediatric and adolescent subgroup, the scope for using such splints should be considered. Further investigation in the form of a prospective randomised study in other age groups could be considered to look at efficacy of using removable splints in the treatment of wrist fractures in the future.

## References

1. King D, Hume PA, Milburn PD, Gianotti S (2009) Rugby league injuries in New Zealand: A review of eight years of accident compensation corporation injury entitlement claims and costs. *Br J Sports Med* 43: 595-602
2. Cooper C, Dennison EM, Leufkens HG, Bishop N, Van Staa TP (2004) Epidemiology of childhood fractures in Britain: a study using the general practice research database. *J Bone Miner Res* 19: 1976-1981.
3. Landin LA (1983) Fracture patterns in children. Analysis of 8,682 fractures with special reference to incidence, etiology and secular changes in a Swedish urban population *Acta Orthop Scand* 54: 3-109
4. Nellans KW, Kowalski E, Chung KC (2012) The epidemiology of distal radius fractures. *Hand clinics* 28:113-25.
5. Jiang N, Cao ZH, Ma YF, Lin Z, Yu B (2016) Management of pediatric forearm torus fractures: A systematic review and meta-analysis. *Pediatr Emerg Care* 32: 773-778.
6. Firmin F, Crouch R (2009) Splinting versus casting of "torus" fractures to the distal radius in the paediatric patient presenting at the emergency department (ED): A literature review. *International emergency nursing* 17: 173-178.
7. Williams BA, Alvarado CA, Montoya-Williams DC, Matthias RC, Blakemore LC (2018) Buckling down on torus fractures: has evolving evidence affected practice?. *J Child Orthop* 12: 123-128.
8. Boutis K, Howard A, Constantine E, Cuomo A, Somji Z, et al. (2015) Evidence into practice: Pediatric orthopaedic surgeon use of removable splints for common pediatric fractures. *J Pediatr Orthop B* 35: 18-23.
9. Boutis K, Howard A, Constantine E, Cuomo A, Narayanan U (2014) Evidence into practice: emergency physician management of common pediatric fractures. *Pediatr Emerg Care* 30: 462-468.
10. Krabbe S, Christiansen C, Rødbro P, Transbøl I (1979) Effect of puberty on rates of bone growth and mineralisation: with observations in male delayed puberty. *Arch Dis Child* 54: 950-953.
11. Bailey DA, Wedge JH, McCulloch RG, Martin AD, Bernhardson SC (1989) Epidemiology of fractures of the distal end of the radius in children as associated with growth. *JBJS* 71: 1225-1231.
12. Boutis K, Willan A, Babyn P, Goeree R, Howard A (2010) Cast versus splint in children with minimally angulated fractures of the distal radius: A randomized controlled trial. *CMAJ* 182:1507-12.
13. Symons S, Rowsell M, Bhowal B, Dias JJ (2001) Hospital versus home management of children with buckle fractures of the distal radius: A prospective, randomised trial. *J Bone Joint Surg Am* 83: 556-60.
14. Ben-Yakov M, Boutis K (2016) Buckle fractures of the distal radius in children. *CMAJ* 188: 527.
15. Egol KA, Walsh M, Romo-Cardoso S, Dorsky S, Paksima N (2010) Distal radial fractures in the elderly: The operative compared with non-operative treatment. *JBJS* 92:1851-1857.
16. Ju JH, Jin GZ, Li GX, Hu HY, Hou RX (2015) Comparison of treatment outcomes between nonsurgical and surgical treatment of distal radius fracture in elderly: A systematic review and meta-analysis. *Langenbecks Arch Surg* 400: 767-79.
17. Chen Y, Chen X, Li Z (2016) Safety and efficacy of operative versus nonsurgical management of distal radius fractures in elderly patients: A systematic review and meta-analysis. *J Hand Surg Am* 41: 404-413.