International Journal of Medical and Health Research
www.medicalsciencejournal.com
ISSN: 2454-9142
Received: 01-03-2022, Accepted: 16-03-2022, Published: 31-03-2022
Volume 8, Issue 3, 2022, Page No. 64-68

A comparative study: Removable splinting versus casting for wrist torus fractures in children

Shah A B, Limbu A, Baral P, Pradhan S R
Department of Orthopedics, BPKIHS, Dharan, Nepal

Abstract
Background: Forearm fractures account for 40% of pediatric long bone fractures. Buckle or Torus fractures are the most common forearm fractures in children, and these are stable fractures, where fracture occurs in the transition zone between woven metaphyseal bone and lamellar diaphyseal bone. Treatment of these torus fractures differ from each hospital. Options include rigid full below elbow cast for 3 weeks, removable pre-fabricated splints, back-slabs, bandages and soft cast.
There has also been some concern among clinicians about increased pain and re-fractures occurring in children treated with immobilisation. The purpose of this study is to determine whether rigid cast could maintain the reduction of distal pediatric torus fractures as well as a removable splint in a prospective, randomized manner. Hence, we compared these two methods with respect to functional outcome, delayed union, nonunion, malunion and related complications, so that we have a better and clear evidence and guideline for managing pediatric torus fractures.
Methods: A total of 110 children eligible to participate in the study were included in the study and randomized into 2 groups (55 each). In the 1st group above elbow splint was applied for 6 weeks and in the second group cast was applied after fracture reduction and subsequently followed up. Assessment of fracture was done regular interval of 1 week, 3 week, and 6 week in terms of union, activity scale for kids, safety and neurovascular compromise.
Results: There was no statistically significant relation in elbow flexion (p value - 0.397). Mean loss of flexion was 9.44 degrees (S.D. – 9.22) in Cast and 11.94 degrees (S.D. – 8.25) in Removable Splint group. There was no statistically significant difference in limitation in pronation/supination (p value -0.814). Mean loss of pronation was 8.55 ± 6.431 and 7.81 ± 5.613 in Removable splint and Cast group respectively and the mean loss of supination was 8.45 ± 5.763 and 6.82 ± 5.302 in the Removable splint and Cast group respectively.
Conclusion: Removable splint is safe and as effective as Cast for 6 weeks in the treatment of Torus fractures in children. Both methods were identical in terms functional outcome, maintenance of reduction and other complications and time to union.

Keywords: torus, pediatric, cast, splint

Introduction
Forearm fractures are common in children. They account for 40% of paediatric long bone fractures. Among all forearm fractures, the distal radius and ulna are most commonly affected [1].
In children closed treatment is usually successful because the tough periosteum tends to guide and control the reduction [2]. The normal process of bone remodelling in the diaphysis and metaphysis in children may realign initially malunited fragments, making anatomic reduction less important than in a comparable injury in an adult [3, 4].
Buckle or Torus fractures are the most common forearm fractures in children [5], and these are stable fractures, where fracture occurs in the transition zone between woven metaphyseal bone and lamellar diaphyseal bone [6]
Torus fracture produces a characteristic bulge or "Buckle" on radiographs and these are inherently stable. They clinically exhibit minimal symptoms, usually only local tenderness, and little deformity. Treatment of buckle fractures varies from hospital to hospital. Traditional practice has been to place children in a rigid full elbow cast for between 2 and 4 weeks.
Treatment of these torus fractures differ from each hospital. Options include rigid full below elbow cast for 3 weeks, removable pre-fabricated splints, back-slabs, bandages and soft cast.
There has also been some concern among clinicians about increased pain and re-fractures occurring in children treated with immobilisation.
When the fracture is correctly diagnosed, and not con- fused with a true cortical fracture, we consider that soft immobilization is sufficient and the most comfort- able, and that follow-up in this type of fractures is not necessary [8]. The purpose of this study is to determine whether rigid cast could maintain the reduction of distal pediatric torus fractures as well as a removable splint in a prospective, randomized manner. Hence, we compared

these two methods with respect to functional outcome, delayed union, nonunion, malunion and related complications, so that we have a better and clear evidence and guideline for managing pediatric torus fractures.
BPKIHS has been the referral center of the eastern part of Nepal. There is still a variation in the treatment of buckle fracture of the distal radius in children. Treatment in most standard texts is immobilization in a standard forearm cast for three weeks. Various studies have shown that a torus fracture is stable and follow-up radiographs are not required because the tensile side of the cortex remains intact and thus does not deform.
Recent studies recommend treatment of these fractures with removable splints or back slabs as it is easier to apply and are also cost effective. However, a high rate of loosening was reported in this treatment, requiring further application of the splint or back slab. Treatment with rigid casts mentioned in most standard texts are heavy and bulky and requires a second visit for cast removal whereas soft cast is a semi rigid cast which allows some movements of the joints to avoid stiffness and it can be removed at non-hospital setting easily with the scissors. A recent Cochrane review has suggested that treatment of these stable fractures with removable splints could be equally effective as treatment in full plaster cast.

Methods

The study was conducted in the Department of Orthopedics, B.P. Koirala Institute of Health Sciences, a tertiary care hospital in Eastern Nepal, over a period of six months from October 2020 to March 2021. All children between four to 12 years with isolated traumatic closed torus fractures without distal neurovascular deficit presenting to Emergency and the outpatient Department of Orthopedics, BPKIHS and giving written and informed consent were taken into consideration. Patient were allocated using computer generated excel random number generation technique in two groups.
A total of 110 patients (55 in each Group) were included in the study and Patients with refractures, polytrauma, fracture dislocations, pathological fracture, open fractures, Salter Harris III/IV fractures, compromised soft tissue (e.g., Compartment Syndrome) and not giving Consent/ Assent form were excluded from the study. A through general physical and systemic examination was carried out to look for underlying exclusion criteria. Informed consent was obtained from parents during consultation in the emergency department, or directly through the orthopedic surgery clinic before fracture manipulation or immobilization. The two immobilization modalities and study objectives were thoroughly discussed with an intention to evaluate the efficacy of two universally accepted immobilization modalities. Participation was strictly voluntary. All injuries were confirmed with physical examination and AP/lateral radiographs of the forearm with wrist and elbow. Fractures were manipulated and reduced by orthopedic residents under supervision after appropriate analgesia if required.
All initial immobilization were utilized into two groups i.e., removable splint and cast groups.
AP and lateral radiographs were obtained at all scheduled follow-up appointments. Follow-up visits was done at one week post reduction, three weeks post reduction then at six weeks post reduction. The option to convert to a short-arm cast was available at the 3rd week appointment based on clinical and radiographic evidence of healing.
Fractures with concern for loss of reduction outside the acceptable parameters was considered for re-manipulation and a new cast was applied irrespective of the group enrolled.
Radiographic measurements were taken at initial presentation, post reduction, and at each follow-up visit with assessments for cast index, sagittal and coronal angulation, displacement, and apposition. All radiographs were digital. If re-reduction is performed, all patients were placed into a long arm cast.
All patients were followed to clinical and radiographic union, typically at the three or six-week mark, when the immobilization was removed. They were then asked to return at least one more time between two and four weeks after cast removal to ensure a return of full range of motion and repeat radiographs. The outcome was measured by various activity scale for kids, Loss of reduction, Fracture union, Nonunion, Delayed union, Deformity, Malunion. Safety was evaluated based on the occurrence of associated complications, including compartment syndrome or neurovascular compromise, or cast saw injuries, by four weeks post randomization.
The 95% confidence interval for relative-risk and prevented fraction was calculated using Epi-info 6 software (WHO, Geneva) and intervention were tested by appropriate parametric and non-parametric statistical technique (example t-test, z-test, X^2- test etc.) depending upon the nature of the variables in both the groups. Multivariate analysis (regression analysis) was applied to control confounding effect of different variables on dependent variables (i.e., outcome variables). The level of significance was set at P>0.05, power of study was 80%. (α=0.05, β=0.8). Ethical clearance was obtained from Institutional Research Committee (IRC).

Results and Discussion

Pediatric forearm fractures are commonly seen and heal reliably [20]. Nonunion in children is essentially only seen in the setting of a pathologic condition or disruption in vascular supply. These fractures are known to have a substantial capacity to remodel due to proximity to the physis. The principle of treatment is to provide adequate immobilization, which can maintain the reduction in the form of cast or removable splint. Our study between these two groups had no significance difference in term of age, gender, side distribution, mode of injury, maintenance of reduction, cast related complications, union time, post reduction displacement and physical function. There was no evidence of distal neurovascular complications, post reduction radiographic angulation, need for re-manipulation or surgery. The mean age distribution was comparable between the two groups: it was 8.76 years (S.D. 2.365 years) in the Removable splint group and 8.96 years (S.D. 2.748 years) in the Cast group.

The difference in mean age distribution was not statistically significant between the two groups (Independent Sample T-test, p-value 0.621).

Injury to the right forearm was higher than left forearm, which was true for both the groups. In Removable splint group the right side was injured in 40 (72.7%) patients and the left side in 15 (27.3%) patients, and in the Cast group the right side was injured in 42 (76.4%) patients and the left side in 13 (23.6%) patients.

The difference in side distribution was not statistically significant between the two groups (Chi Square test, p-value 0.729).

Most of the patients were right hand dominant in both the groups (72.7 % in Removable splint group and 78.18% in Cast group).

In our study, most of the patients sustained injury due to fall from height (61.8% in Removable splint group and 60% in Cast group) followed by fall while playing (30.9% Vs 25.5% respectively) which was similar to the findings by Thapa PB [20] *et al* in 2015.

There was no significant difference in limitation of elbow flexion in 2 groups with mean limitation of flexion being 9.44 degrees (S.D. – 9.22) in Cast Group and 11.94 degrees (S.D. - 8.25) in Removable splint group. In the previous study conducted by Colaris JW etal. (2013) [13], the limitation of flexion and extension of the elbow was 1.2 (4.4) degrees in long arm cast group. The cause of limitation in our study could be the fact our assessment was done at 3 months while in the previous study final assessment was done at 6 months.

Using Daruwalla grading system for limitation of pronation and supination, excellent result was seen in 33.3% cases, good in 27.78%, fair in 16.17% and poor in 22.22% in the Cast group while in the Removable splint group, excellent result was seen in 11.11%, good in 44.44%, fair in 27.78% and poor result in 16.17% of cases. In the previous study by Khan KS [10] *et al* in 2007 the results in the Cast group were excellent in 21%, good in 38%, fair in 26%, and poor in 15%.

There was no significant difference in the cast comfort as evidenced by VAS score of 6.35 ± 0.799 and 6.38 ± 0.757 respectively in the Cast and Removable splint group. The findings match the previous study done by Riera Alvarez L [8] *et al* in 2019.

Comparing the functional result in recent literature is complicated by different outcome measures and treatment techniques. Activity score for children was used as a measure for functional outcome and was no significant difference (p value- 0.436) was found between two groups regarding total and sub group scores. Similar finding was found by Bae DS *et al* [1] in 2017, there were no significant differences in activities of daily living in the two groups.

There was no statistically difference in the no. of days of school missed (mean loss of 4.62 days (S.D. – 2.041)) in Removable splint group and 4.98 days (S.D. – 1.758) in Cast group. (P value - 0.436).

There is no statistically significant difference in complications in the two groups. The previous study by Williams BA [18] *et al* in 2018 shows no significance in complications as well.

Fig 1: Managed by Removable Splint

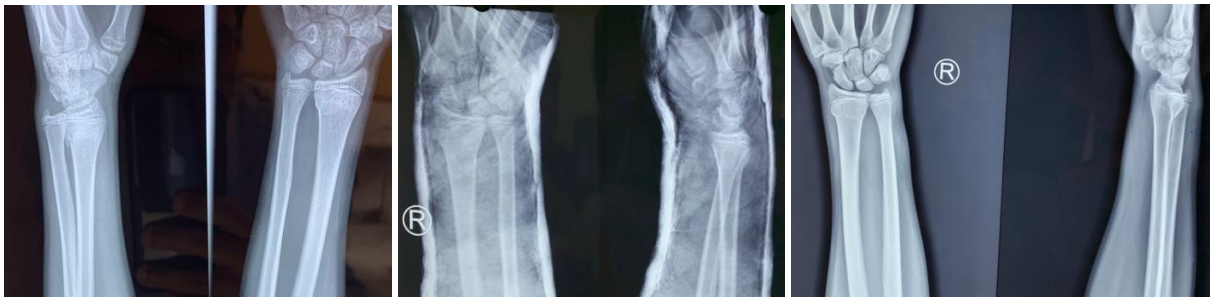

Fig 2: Managed by CAST

Summary
Torus fractures are one of the common problems encountered in children. Most of them are closed injuries and can be treated conservatively. They are generally treated with closed reduction and above elbow cast 6 weeks. Some study advice for conversion of above elbow cast to below elbow in 3 weeks.
We conducted this study to find out whether Removable splint was as effective as cast for 6 weeks in Torus fractures in children.
A total of 110 children eligible to participate in the study were included in the study and randomized into 2 groups (55 each). In the 1st group above elbow splint was applied for 6 weeks and in the second group cast was applied after fracture reduction and subsequently followed up. After final follow up all cases were available for analysis.

1. Out of 110 cases, 74 patients were male (63.8%) and 36 (31%) were female.
2. Out of 110 cases, 83 were right-handed and 27 were left-handed. Fractured limb was right in 82 cases and left in 28 children.
3. The mean age in Cast group was 8.96 ± 2.748 years and in Removable splint was 8.76 ± 2.365 yrs.
4. The most common cause of fracture was fall from height in both the groups.
5. About 89% cases involved fracture of both bone and isolated distal radius involved in 11% of cases.
6. All the cases had clinical and radiological union at 6 weeks follow up.
7. Cast comfort was statistically not significant in two groups (p value –0.524). Mean VAS score were 6.35 and 6.38 respectively in Cast and Removable splint group.
8. There was no statistically significant relation in elbow flexion (p value - 0.397). Mean loss of flexion was 9.44 degrees (S.D. – 9.22) in Cast and 11.94 degrees (S.D. – 8.25) in Removable Splint group.
9. There was no statistically significant difference in limitation in pronation/supination (p value -0.814). Mean loss of pronation was 8.55 ± 6.431 and 7.81 ± 5.613 in Removable splint and Cast group respectively and the mean loss of supination was 8.45 ± 5.763 and 6.82 ± 5.302 in the Removable splint and Cast group respectively.
10. There was no statistically significant difference in activities of daily living.
11. There was no case of cast complications and DNVD reported in both the groups.
12. No cases of Malunion and Non-union was reported in either of the group.

Conclusion
Removable splint is safe and as effective as Cast for 6 weeks in the treatment of Torus fractures in children. Both methods were identical in terms functional outcome, maintenance of reduction and other complications and time to union.

Limitation and Recommendation
The purpose of this study was to establish, in a prospective manner, that initial immobilization of a pediatric Torus fracture with a Removable splint was as effective as a Cast, which has long been viewed as the standard treatment.
Our study had limitations as it was a study with a small sample size done in a single institution and follow-up was done for a smaller period of time. As remodeling process is faster in children management of nonunion/ delayed union could not be assessed and the recovery of movement of forearm could not be evaluated properly. So, a longer duration of study is recommended for better evaluation and management of complications.
The strength of our study was that follow-up assessment of every patient was done by the same doctor during the entire study period. In addition, even though the reduction and cast application were performed by multiple orthopedic residents, which could have resulted in variations in the cast parameters, the similar results in both the groups indicate that the residents were equally competent and there were not many differences in their performance.

References
1. Bae DS, Valim C, Connell P, Brustowicz KA, Waters PM. Bivalved versus circumferential cast immobilization for displaced forearm fractures: a randomized clinical trial to assess efficacy and safety. Journal of Pediatric Orthopaedics,2017:37(4):239-46.
2. Boutis K, Willan A, Babyn P, Goeree R, Howard A. Cast versus splint in children with minimally angulated fractures of the distal radius: a randomized controlled trial. Canadian Medical Association Journal,2010:182(14):1507-12.
3. Bohm ER, Bubbar V, Hing KY, Dzus A. Above and below-the-elbow plaster casts for distal forearm fractures in children: a randomized controlled trial. JBJS,2006:88(1):1-8.
4. Bong MR, Egol KA, Leibman M, Koval KJ. A comparison of immediate postreduction splinting constructs for controlling initial displacement of fractures of the distal radius: a prospective randomized study of long-arm versus short-arm splinting. Journal of Hand Surgery,2006:31(5):766-70.
5. Rockwood CA, Wilkins KE. Fractures in children. 7th ed. Lipincott: Williams & Wilkins; 2010. p. 317-320.
6. Solan MC, Rees R, Daly K. Current management of torus fractures of the distal radius. Injury,2002:33(6):503-5.

7. Abraham A, Handoll HH, Khan T. Interventions for treating wrist fractures in children. Cochrane Database Syst Rev,2008:16(2):CD004567.
8. Riera-Álvarez L, Pons-Villanueva J. Do wrist buckle fractures in children need follow-up? Buckle fractures' follow-up. Journal of pediatric orthopedics. Part B,2019:28:553-554.
9. Farbman KS, Vinci RJ, Bauchner H. The role of serial radiographs in the management of pediatric torus fractures. Archives of Pediatrics and Adolescent Medicine,1999:153:923-925.
10. Khan KS, Grufferty A, Dowling F. A randomized trial of "soft cast" for distal radius buckle fractures in children. Acta Orthopaedica Belgica,2007:73:594-597.
11. Oakley EA, Ooi KS, Barnett PLJ. A randomized controlled trial of 2 methods of immobilizing torus fractures of the distal forearm. Pediatric Emergency Care,2008:24:65-70.
12. Firmin F, Crouch R. 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, 2009.
13. Kropman RH, Bemelman M, Hammacher ERJ. Treatment of impacted greenstick forearm fractures in children using bandage or cast therapy: A prospective randomized trial. Journal of Trauma - Injury, Infection and Critical Care,2010:68:425-428.
14. Vernooij CM, Vreeburg ME, Hammacher ER. Treatment of torus fractures in the forearm in children using bandage therapy. Journal of Trauma and Acute Care Surgery,2012:72:1093-1097.
15. Witney-Lagen C, Smith C, Walsh G. Soft cast versus rigid cast for treatment of distal radius buckle fractures in children. Injury,2013:44:508-513.
16. Callender O, Koe S. Using softcast to treat torus fractures in a paediatric emergency department. Irish Medical Journal, 2015, 108.
17. Jiang N, Cao ZH, Yu B. Management of Pediatric Forearm Torus Fractures: A Systematic Review and Meta-Analysis. Pediatric Emergency Care,2016:32:773-778.
18. Patel N, Wilson L, Wansbrough G. Is softcast (3M) strong enough for potentially unstable paediatric forearm fractures? Injury,2016:47:2258-2265.
19. Williams BA, Alvarado CA, Blakemore LC. Buckling down on torus fractures: Has evolving evidence affected practice? Journal of Children's Orthopaedics,2018:12:123-128.
20. Thapa P, Marasini R, Thapa S, Pradhan N, Giri S. Soft bandage versus casting in the treatment of torus fracture of distal radius in children; a prospective randomized study. Journal of College of Medical Sciences-Nepal,2016:11(4):3-8.