Preoperative Closed Reduction Versus In-Situ Splinting of Pediatric Type Three Supracondylar Humerus Fractures in the Emergency Department

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INTRODUCTION:
Traditionally, pediatric type three supracondylar humerus fractures have been treated in a “splint where it lies” position prior to undergoing definitive operative fixation. This philosophy is due to the concern for neurovascular injury during closed reduction, without literature support. Operating room (OR) access can be limited in certain practices due to limited OR time availability and finite staff. Therefore, our study evaluates the safety of controlled closed reduction of type three supracondylar humerus fractures in the emergency department by an orthopaedic resident prior to surgical treatment. In addition, preoperative and intraoperative data was compared between patients that were closed reduction versus in-situ splinted in the emergency department (ED).

METHODS:
A retrospective chart review was completed on pediatric type three supracondylar humerus fractures that were seen in the ED at a single level one trauma center from April 2022 through December 2023. Patients were grouped into those that were splinted in-situ (IS) and those that underwent closed reduction (CR) with splinting by an orthopaedic resident prior to surgical treatment.. Charts were reviewed for pre- and post-reduction neurovascular exams, time from injury and ortho consult to OR, OR fluoroscopy duration, and radiation dosage. AP and lateral radiographs were measured pre and post reduction. All data was compared between the CR and IS groups.

RESULTS:
29 patients underwent preoperative CR while 33 underwent IS splinting. There were seven patients in the CR group and seven patients in the IS splinting group with abnormal neurologic exams on presentation ($p=1$). There were three patients in the CR and two patients in the IS splinting group with abnormal vascular exams. One of these patients in the IS splinting group had a white pulseless hand requiring emergent surgery. All three patients in the CR group had improved vascular exams and two patients had improved neurologic exams post-reduction ($p=0.2$). There were no vascular injuries seen with CR. Three patients in the IS splinting group were found to have abnormal neurologic exams the next morning in the preoperative area with a normal exam on presentation.

AP and lateral displacement ($p<0.01$, $p<0.01$), anterior humeral line displacement ($p<0.01$), lateral Baumann angle ($p<0.01$), and hour glass angle ($p<0.01$) improved in the CR group. There was no difference in initial radiographic parameters between the CR versus the IS splinting groups except for a larger hourglass angle in the CR group ($p=0.01$).

The time from ortho consult to OR was less for the IS splinting group (9.7 hours) compared to time from reduction to OR in the CR group (14 hours, $p <0.01$). However, the time from injury to the OR was no different for the IS splinting group (17.7 hours) compared to the CR group (20.2 hours, $p=0.07$). There was no difference between fluoroscopic dosage or fluoroscopic time between the groups in the OR ($p=0.25$, $p=0.09$). There was no difference between OR time with closed reduction (31 minutes) and in-situ splinting (42 minutes) ($p=0.11$). Two patients required open reduction in the in-situ splinting group while none required open reduction in the closed reduced group($p=0.2$).

DISCUSSION AND CONCLUSION: Closed reduction of pediatric type three supracondylar humerus fractures in the emergency department by orthopaedic residents is safe and leads to improvement in radiographic parameters. In addition, reduction of these fractures may improve neurovascular exams on patients with abnormalities on presentation. These reductions allow for a more anatomic alignment which places less stress on the surrounding soft tissues including skin, subcutaneous tissue, muscle, and neurovascular structures. Three patients in the in-situ splinting group were found to have abnormal neurologic exams in the preoperative area which were not present on initial evaluation. This may be due to these displaced fractures putting tension on neurologic structures for hours prior to reduction in the OR. One patient was taken emergently to the OR in the in-situ splinting group due to a pulseless extremity and pulses returned after reduction in the OR. Closed reduction of this patient in the ED may have prevented the need for emergent surgery. While not currently significant, there was a trend towards significance for a reduction in time in the OR for the CR versus IS group, but our study was underpowered.. Controlled closed reduction of type three supracondylar humerus fractures is safe prior to definitive treatment and may improve neurovascular status in patients with a presenting deficit. Most pediatric extremity fractures are closed reduced in the ED and type three supracondylar humerus fractures do not need to be an exception.