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Reducing Rigid Immobilization for Toddler's Fractures: A Quality Improvement Initiative

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ABSTRACT

Background: Toddler's fractures are one of the most common orthopedic injuries in young walking-age children. They are defined as nondisplaced spiral-type metaphyseal fractures involving only the tibia without any injury to the fibula and are inherently stable. We aimed to use quality improvement methodology to increase the proportion of patients with toddler's fractures treated without cast immobilization at a large tertiary referral pediatric orthopedic center from a baseline of 45.6%–75%. **Methods:** Baseline data on patient volume and treatment regimens for toddler's fractures were collected starting in February 2019. Monthly data were collected from the electronic medical record and reviewed to determine treatment (cast versus noncast immobilization) and tracked using statistical process control charts (p-chart). After determining the root causes of treatment using immobilization, interventions tested and adopted included physician alignment of expectations for treatment, sharing unblinded compliance data with providers, updating patient education materials, and updating resident education and reference materials. **Results:** After interventions were in place, the percentage of patients treated without CAST immobilization increased from 45.6% to 90% ($P \leq 0.001$). We also observed improvement in our process measure to increase the percentage of this population receiving boot immobilization during new patient visits in our orthopedic clinics (4.15% to 52%, $P \leq 0.001$). **Conclusions:** By aligning provider and family expectations for treatment, demonstrating no clinical need for cast immobilization, and bringing awareness of compliance to appropriate guidelines, our institution was able to improve care for patients with toddler's fractures and reduce financial and care burdens for families. *(Pediatr Qual Saf 2024;9:e722; doi: 10.1097/pq9.0000000000000722; Published online April 3, 2024.)*

INTRODUCTION

Toddler's fractures are one of the most common orthopedic injuries in younger ambulatory children, usually between 9 months and 3 years of age. Generally caused by a twisting mechanism, it is defined as a nondisplaced spiral-type metaphyseal fracture involving only the tibia without any injury to the fibula.[1] Due to its inherent stability, there is little risk of displacement during the healing process.[2] In cases of a negative radiograph, any toddler with a limp and suspicion for a lower-leg fracture is treated similarly as a presumed toddler's fracture.[3]

Various treatment options are available,[4] including immobilization with a cast or splint, with a walking boot or brace, or without immobilization. In some instances, the recommended duration of immobilization can also range anywhere from 1 to 4 weeks, with variation in clinical and radiographic follow-up.

Several studies have shown that toddler's fractures can be effectively and safely treated with a walking boot rather than with rigid cast immobilization, reducing the need for formal repeat clinical or radiographic follow-up.[5–10] Advantages of this approach include decreased healthcare costs, elimination of cast complications, enhanced patient and family satisfaction, ability to remove the boot for hygiene purposes, and earlier return to activity.[4,5,8,10] Despite these benefits, the adoption of walking boot over cast immobilization has not been immediate. Our aim was to utilize quality improvement (QI) methodology to increase the proportion of patients with toddler's fractures treated without cast immobilization at a large tertiary referral pediatric center.

MATERIALS AND METHODS

Context

We instituted a QI program using concepts and methods aligned with the Institute for Healthcare Improvement model, including root cause analysis, process mapping (through a swim lane process map), key driver diagram

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To cite: Chen SN, Holstine JB, Samora J. Reducing Rigid Immobilization for Toddler's Fractures: A Quality Improvement Initiative. Pediatr Qual Saf 2024;9:e722.

Received for publication September 18, 2023; Accepted January 29, 2024.

Published online April 3, 2024

DOI: 10.1097/pq9.0000000000000722

(KDD) development, and Plan-Do-Study-Act cycles to improve rates of walking boot/noncast immobilization for children with toddler's fractures. We applied our interventions in a single, large, urban tertiary referral pediatric hospital with a high-volume orthopedic department. Children with musculoskeletal injuries were referred to the orthopedic clinics by local providers (emergency department (ED), urgent care (UC), and primary care providers) as well as providers in the surrounding area. Ten board-certified pediatric orthopedic surgeons provided care in the orthopedic clinics. Orthopedic residents also consult on these injuries for patients who arrive at our system's ED and UC facilities.

The multidisciplinary QI team was comprised of two attending pediatric orthopedic surgeons, two pediatric orthopedic fellows, and a QI specialist. Previous studies and established literature were used to build this project to update our practice to match current evidence-based practice, maintain excellent outcomes, and reduce healthcare costs. IRB approval was not required as this QI project implemented evidence-based interventions and did not involve patient randomization or the sharing of patient data outside of the institution.

As part of the root cause analysis, we surveyed providers to determine why clinicians were not universally treating toddler's fractures without cast immobilization. Concerns that were revealed included deviation from "typical" fracture care, risk of displacement, and variation in diagnoses. We addressed these concerns primarily through provider education, as the literature suggests that fracture immobilization is unnecessary for these injuries, which consistently heal with a low risk of displacement. The literature also supports the notion that a walking boot offers greater comfort, patient, and family satisfaction, and earlier return to activity, all while mitigating the risks of cast complications and decreasing healthcare costs. Another issue was the lack of age-appropriate walking boots in the ED/UC, and the concern regarding the availability of these materials. This was addressed through direct communication with the EDs and UCs. Similar education as previously described was provided, and direction was given to these providers that if a walking boot in the appropriate size were not available, to place these patients into a stirrup splint rather than a rigid cast and that the orthopedic team would transition them to a walking boot at their follow-up visit.

Intervention

A review of our electronic medical records identified patients under 5 years of age who had been diagnosed with a toddler's fracture and were seen in any of our orthopedic clinics between February 2019 and September 2022. The diagnosis was based on several applicable ICD-10 codes and verified through chart review. We identified those who had been evaluated in the ED or UC within 1 week of their presentation to the orthopedic clinic. We then investigated whether they were placed into a cast in the ED/UC or placed into a cast during their orthopedic clinic visit. These represented the 2 times that cast immobilization could have been initiated. We collected follow-up information, including whether the patient had a return visit to orthopedics or radiographs completed within the next three months of their initial visit.

Our project aim and outcome measure was to increase the percentage of toddler's fractures treated without cast immobilization for patients less than 5 years of age seen in orthopedic clinics for new patient visits from a baseline of 45.6% to 75% by June 2022. Our global goal was to establish a change in practice by implementing evidence-based medicine to decrease cost and complications, increase patient and family satisfaction, and maintain appropriate clinical outcomes. We identified two key drivers in the KDD needed to achieve our aim (Fig. 1). We

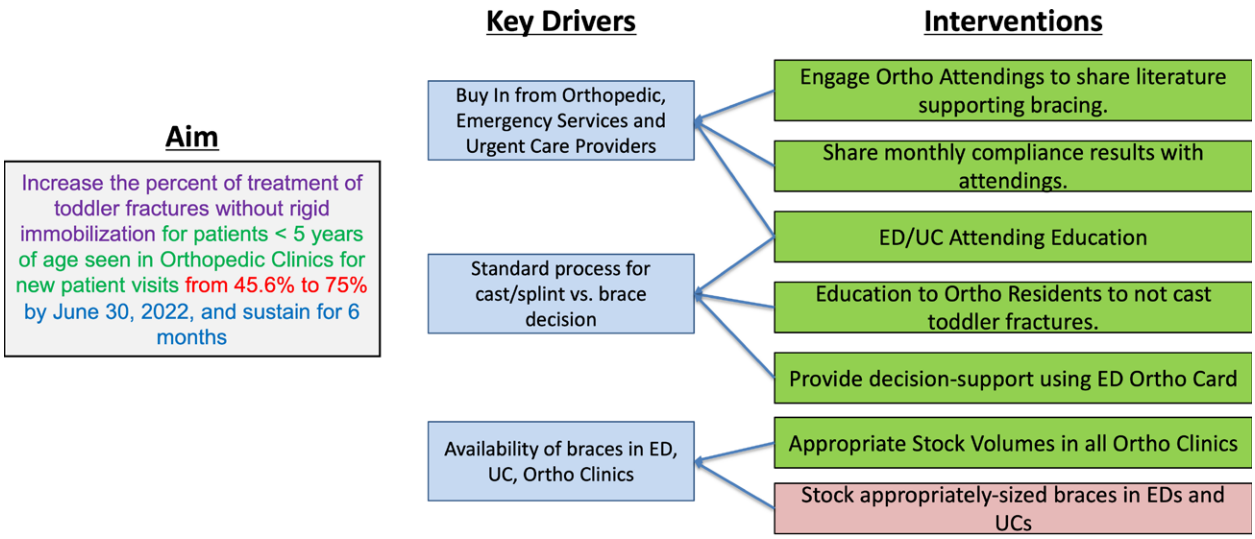

Fig. 1. The KDD with the QI aim, key drivers, and interventions listed.

utilized provider surveys and a swim lane process map to assess the root causes of noncompliance.

Process measures included the percentage of patients placed in a walking boot for toddler's fractures during their first clinic visit, provider-specific compliance with the treatment guideline, and the percent of the patient population who returned to the orthopedic clinic for a 3-month follow-up visit and radiograph.

Compliance with treating toddler's fractures without immobilization was tracked and unblended compliance data were shared in a funnel chart amongst orthopedic attendings/providers to encourage increased compliance through individual feedback loops. Throughout the course of the project, there was a significant variation in provider compliance (varying from 0% to 100%), with a reduction in variation over time as overall compliance improved. The project team reviewed all metrics on a bimonthly basis and shared them with the clinical attendings regularly throughout the year.

Education and Behavior Modification

An important aspect of this intervention was education for the rotating orthopedic residents and fellows, ED and UC providers, and attending orthopedic surgeons. We reinforced the recognition of toddler's fractures amongst all providers and sought to emphasize that cast immobilization was not necessary in the treatment of these stable injuries. Available literature supporting good outcomes without cast immobilization, repeat follow-up visits, or repeat radiographs was shared. At the start of this project, an individual in-person meeting confirmed alignment on treatment plan going forward from all attending orthopedic surgeons. Multiple in-person education sessions were held with the ED/UC attendings and advanced practice providers. Direct instruction to not cast toddler's fractures was provided to the orthopedic residents, fellows, and attendings, along with a reference card (Fig. 2) outlining appropriate toddler's fracture care.

Similarly, a decision-support card supplemented direct education for the ED/UC providers. The ED and UC providers use the orthopedic card as a reference point, understanding that the options are listed in order of preference. The guidance "may place in long leg cast if necessary" indicates that it is an option if the other preferred options are not indicated for unique patients (eg, patients with behavioral health concerns which may impact compliance with boot or splint wear) or unique situations (parental demand for a cast). Monthly unblinded compliance data were shared amongst the orthopedic attendings. For patients and their families, a toddler's fracture Helping Hand education packet[11]was created and given to families at their initial evaluation.

Equipment and Supplies

Walking boots of appropriate sizes were confirmed as available in all orthopedic clinics. Because age-appropriate walking boots are not always available in the ED/UC settings primarily due to the lack of storage space for the variety of size options, these providers were instead directed to place patients into a temporary stirrup splint for planned transition to a walking boot in the orthopedic clinic.

Intervention Analysis

A 45-month period of data collection began in February 2019. We tracked the total volume of patients presenting each month with a toddler's fracture, and the number who were treated without rigid cast immobilization in the orthopedic clinics and ED/UC. This would include those treated appropriately in a walking boot or with no immobilization. We also tracked the number of patients in the orthopedic clinic explicitly treated with a boot. Monthly percentages of those treated without cast immobilization or with a boot are illustrated using p-charts (Figs. 3 and 4) comparing the percent of noncast immobilizations or walking boot usage with the total number of patients with toddler's fractures over time. Starting in May 2021, our department initiated the guideline to use noncast immobilization for toddler's fractures. The guidelines and literature supporting this treatment protocol were reiterated multiple times during subsequent months to remind all providers involved. In December 2021, we began sharing unblinded data among the orthopedic

Site of Injury	Immobilization	Follow-up Timing/Where
TIBIA and FIBULA		
Toddler's Fracture = nondisplaced spiral/oblique Fx of the distal two-thirds without any involvement of fibula (or any toddler w/a limp and negative x-ray where there is suspicion for lower-leg fracture)	No immobilization OR Stirrup Splint OR Walking Boot **No splint – weight bear as tolerated** **In splint – NO weight bearing** May place in long-leg cast if necessary.	7-10 days w/Ortho **Provide Specific Helping Hand** [if casted, 3-4 weeks w/Ortho] *(family needs to let scheduling know child is splinted or casted)*

Fig. 2. Reference Card provided to Orthopedic providers and ED/UC providers with instructions for management of toddler's fractures.

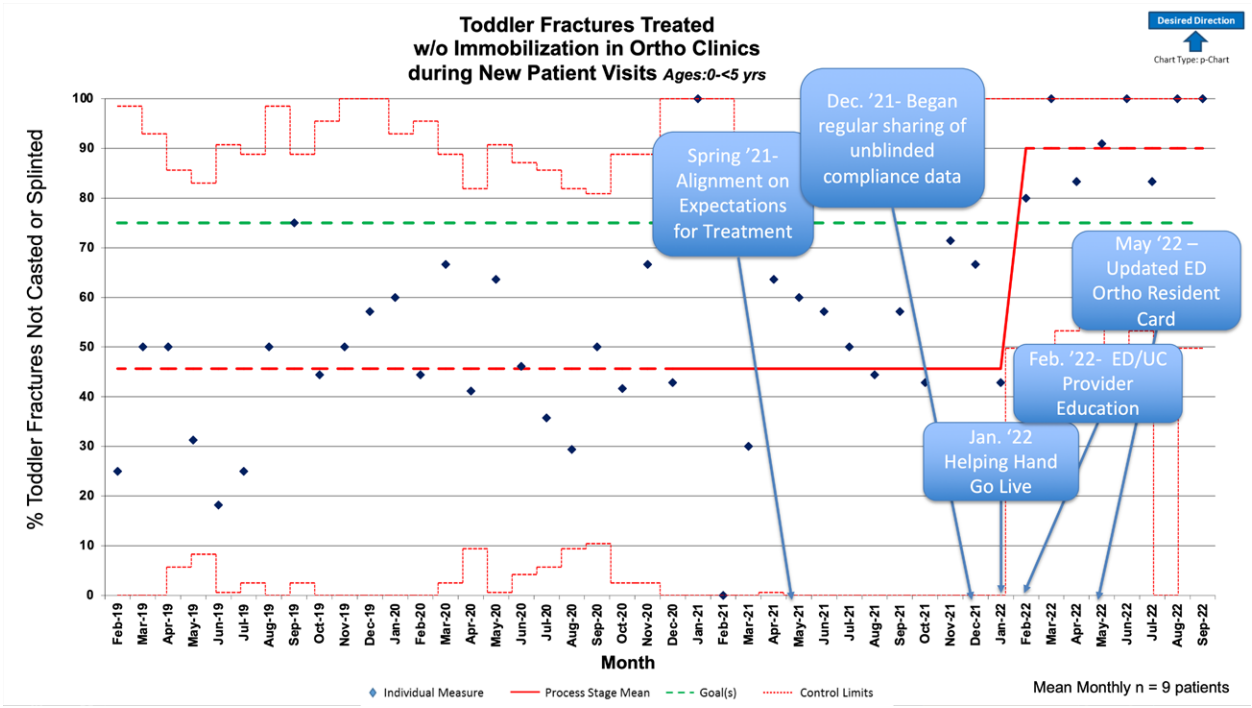

Fig. 3. P-chart demonstrating the percent of patients with a toddler's fracture who were treated without rigid immobilization in the orthopedic clinics.

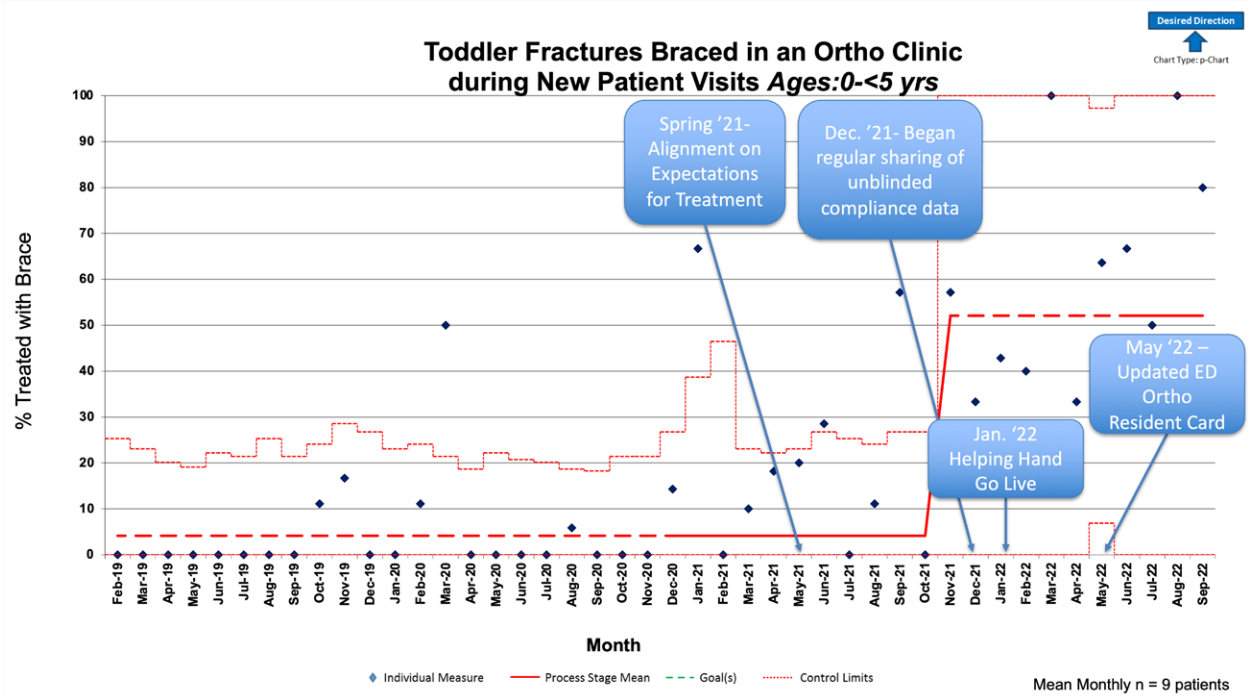

Fig. 4. Statistical process control p-chart showing percentage of patients who were treated with a boot at their first visit to the orthopedic clinic after sustaining a toddler's fracture.

attendings demonstrating each provider's compliance with nonimmobilization for this patient population. In January 2022, our toddler's fracture Helping Hand guideline[11] was approved and distributed to patients and their families at their initial appointment. In February 2022, our in-person education sessions with ED/UC providers were held. Moreover, in May 2022, after several Plan-Do-Study-Act cycles to elicit feedback, the toddler's fracture reference cards for ortho residents and the ED/UC were updated and distributed.

RESULTS

A total of 406 patients were assessed from February 2019 through October 2022 to review the treatment method for their individual toddler's fracture. These 45 months of study allowed us to evaluate all tests of change and allowed sufficient time to identify statistically significant changes in our metrics. These patients were seen by one of 17 orthopedic providers. The patient volumes were not evenly distributed by provider – the top volume provider saw 118 of the patients in our population, whereas other providers saw as few as one patient in the study population, with an average of 23 patients seen by each provider. After interventions were tested and implemented, the average percent of patients with toddler's fractures treated without rigid cast immobilization increased from the baseline of 45.6%–90% ($P \leq 0.001$), demonstrated on the statistical process control p-chart (Fig. 3). We also observed a positive shift in the percent of patients with toddler's fractures who were specifically treated in a boot during their first visit to our orthopedic clinics from 4.2% to 52% ($P \leq 0.001$) (Fig. 4). Using care techniques that did not use cast immobilization also allowed for a decrease in patients with a required 3-month follow-up visit from 93% to 65% ($P \leq 0.001$) (Fig. 5), reducing the financial burden on families and reducing the strain on clinic resources. Additionally, by reducing the need for the follow-up visit, we also reduced the need for follow-up radiographs and accompanying radiation exposure for our patients from 65% to 13% ($P \leq 0.001$; Fig. 6).

DISCUSSION

Management of toddler's fractures has evolved over the last several decades with continued variation in treatment options, ranging on one end from rigid long leg cast immobilization with repeat visits to remove the cast and re-image the leg to treatment with a removable boot without any repeat clinical or radiographic follow-up, to no immobilization at all.[4–10,12] A 2018 survey of the Pediatric Emergency Research Canada network[13] highlighted significant nationwide practice variation in the management of both confirmed and presumed toddler's fractures, ranging from no immobilization to splinting, short leg casts, and long leg casts. Although numerous studies and systematic reviews support the notion that toddler's fractures are inherently stable with an excellent prognosis, the ideal treatment option is still left up to the provider's preference. Regardless of the treatment method, successful healing and a full return to normal activity and development are nearly universal.

While there has been no clear consensus in the literature on the optimal treatment option, robust evidence does suggest that treatment of toddler's fractures with options other than rigid cast immobilization may have some advantages. A retrospective review by Bauer and Lovejoy[5] in 2019 concluded that initial immobilization of a toddler's fracture with a boot rather than a cast may allow for an earlier return to weight-bearing. There were no other differences in outcomes, and all fractures remained stable without any displacement regardless of management strategy. Nearly all patients regained full weight-bearing by four weeks postinjury.

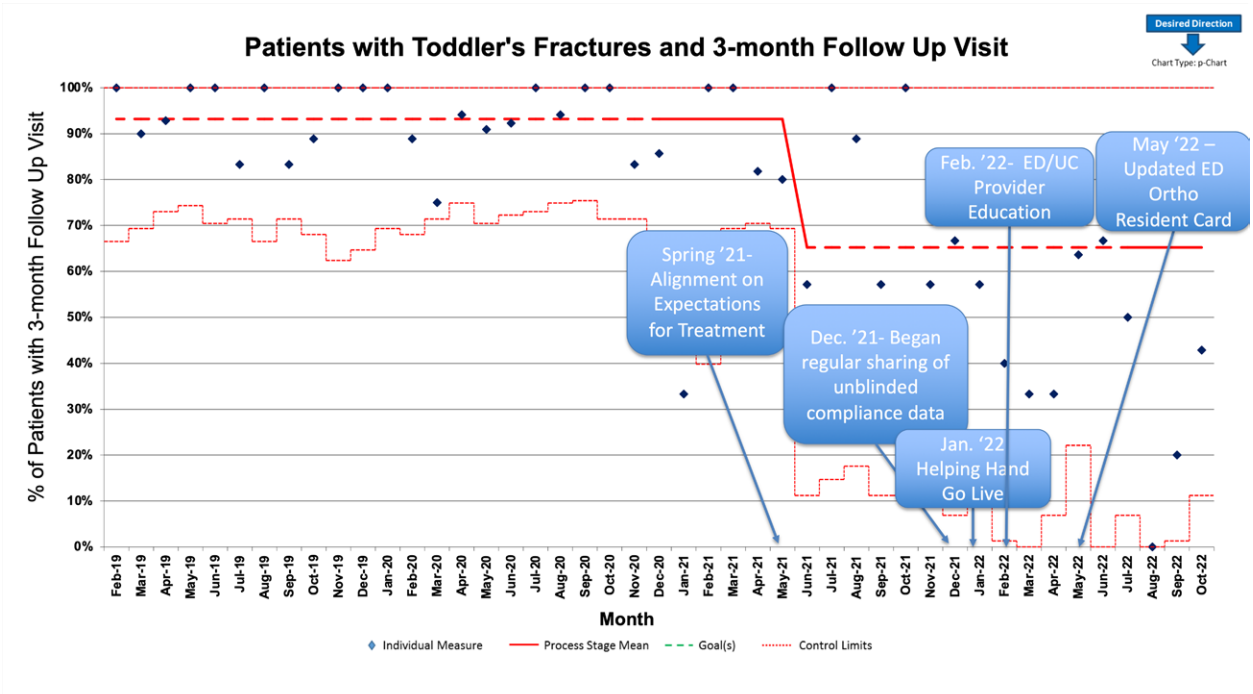

Fig. 5. P-chart with the percent of toddler's fracture patients with a follow-up visit 3-months after their initial fracture treatment.

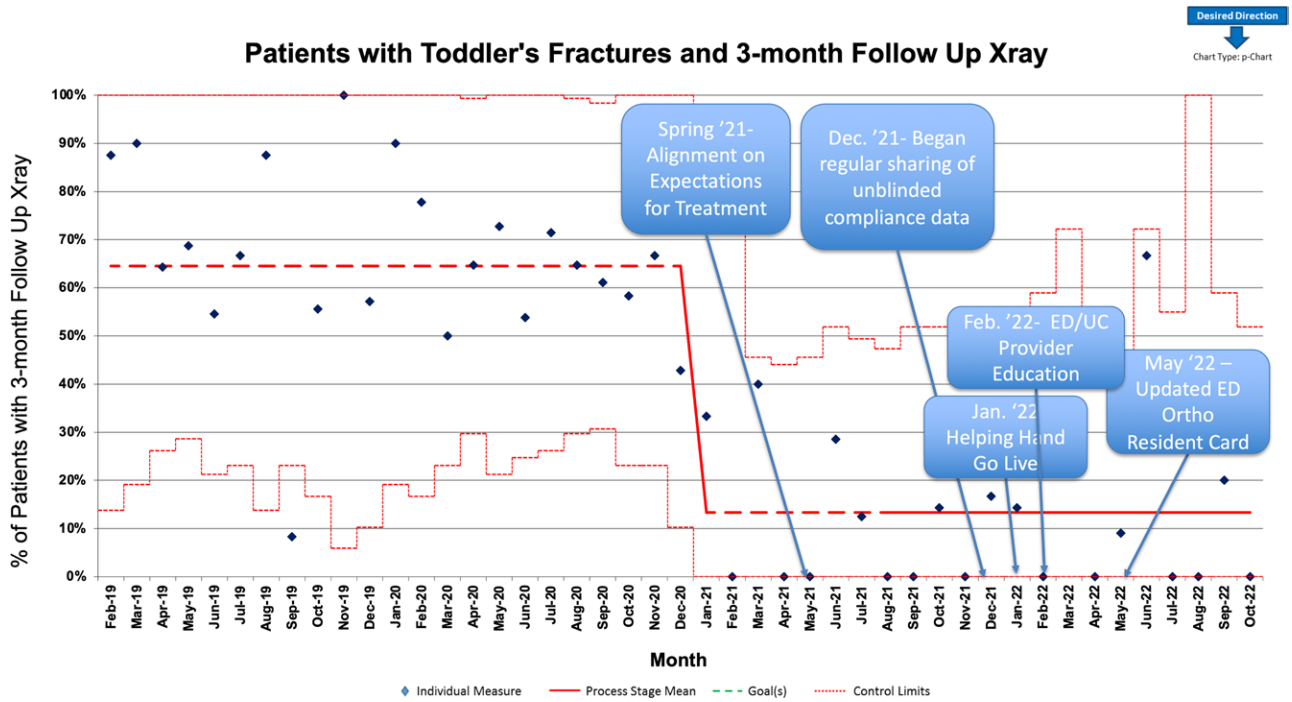

Fig. 6. P-chart highlighting the reduction in required x-rays after interventions to improve use of nonrigid immobilization treatment for toddler's fractures.

Another important advantage of this approach is the elimination of cast complications and need for follow-up or repeat radiographs. Schuh et al[4] reported a 17.3% rate of skin breakdown in patients with a toddler's fracture treated in a splint or cast. These patients also experienced a longer total duration of immobilization versus those treated in a boot, a higher rate of follow-up in the orthopedic clinic, and a greater number of repeat radiographs. Leffler et al[8] reported 11 casting complications out of 78 patients with toddler's fractures treated in short or long leg casts. They also noted no difference in outcomes between those casted versus those not immobilized, with no complications seen in the nonimmobilized group. Pelayo et al[12] additionally reported a higher complication rate in patients who were immobilized in a cast or splint (21.4%), with the majority of these complications involving skin injuries (19%). Again, there were no skin complications in the nonimmobilized group with no significant differences in time to weight-bearing.

Before our intervention, boot immobilization was only occasionally used to manage toddler's fractures. With an increasing amount of compelling evidence supporting its efficacy and cost-effectiveness, we aimed to increase the use of noncast immobilization and make this approach the new standard treatment protocol. We identified potential barriers to adopting this new practice, including a lack of awareness of recent literature amongst providers, reluctance to shift from an established treatment regimen, and resource availability, or more specifically, readiness for age-appropriate walking boots in the outpatient and emergent care settings. By identifying and addressing these barriers and using QI methodology, we increased our baseline use of noncast immobilization from 45.6% to 90%, while simultaneously reducing both follow-up visits and radiation exposure significantly. As this study also occurred during the coronavirus pandemic, our project recommendations aligned well with the global goal of minimizing unnecessary clinical visits, which was certainly beneficial for our institution.

To sustain these changes over time, continued education and feedback are critical. We plan to continue educating providers and trainees on best practice guidelines and families on what to expect with a toddler's fracture—Helping Hand.[11] The toddler's fracture reference card also remains readily accessible to rotating orthopedic trainees and the ED/UC. We hope that streamlining care with the focus on specifically not casting toddler's fractures over the length of this initiative has enacted a system change to make this the preferred treatment method across all providers.

There are limitations to this QI study. Although our intervention eliminated the need for orthopedic follow-up, there was no standardized method to assess patient or family satisfaction with the boot treatment. However, because existing evidence has shown patient and family satisfaction with this method, we did not similarly assess this variable as part of our study. There were no instances of any patients treated in a boot returning to the orthopedic clinic, ED, or UC with concerns, requests to change to cast treatment or complications. There is, however, a possibility that patients/families sought subsequent treatment at another institution or with their primary care provider instead. For this project, we did not expand our education efforts to pediatricians or primary

care providers in the community. However, this certainly could be a welcome addition in the future. Lastly, in one patient, our treatment team applied a cast at the first orthopedic clinic visit due to parent preference, as they indicated that the patient would not be able to keep a boot on for the duration of treatment.

In conclusion, a QI initiative emphasizing nonrigid immobilization for treating toddler's fractures resulted in a shift away from cast immobilization in most patients. By aligning provider expectations and patient family expectations for treatment, demonstrating no clinical need for cast immobilization, and bringing awareness of compliance to the appropriate guidelines, our institution improved care for patients with toddler's fractures and reduced financial and care burdens for families.

ACKNOWLEDGMENT

We acknowledge the contributions of Timothy Skalak and Christopher Jackson to this quality improvement project.

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