Original Article

MEDICINE PALLIATIVE CARE

DOI: 10.47582/jompac.1212503

J Med Palliat Care 2023; 4(1): 28-33

Is it possible to reduce treatment costs in distal radius torus fractures?

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Cite this article as: Alıç T. Is it possible to reduce treatment costs in distal radius torus fractures?. J Med Palliat Care 2023; 4(1): 28-33.

ABSTRACT

Aim: The aim of the study was to evaluate the effect of parental information on the number of radiological examinations, the number of orthopedics outpatient visits, the duration of early orthopedic outpatient admission, the fracture recovery scores of reduction, and the cost of treatment of torus fractures in children in in the emergency service.

Material and Method: A total of 85 patients having stable torus fractures, aged between 0-16 years have been included to the longituidinal study during the period of first of April 1, 2020 and first of September, 2022. A total of 44 patients whose parents are not informed were evaluated in the emergency department and were transfered to the Orthopedics polyclinic (No Information group- No-INF), whereas 41 patients were evaluated by the Orthopedist in the emergency department and their parents were informed directly (Information group-INF). The groupd were compared in terms of the duration of the first admission to the orthopedic polyclinic, the number of applications to the orthopedic polyclinic, the number of radiological examinations performed, whether reduction has been performed, fracture healing scores and current treatment costs and correlation was analyzed.

Results: The MAYO Wrist Score (p=0.80), age (p=0.712), gender (p=0.815), and complications (p=0.482) did not differ significantly between the No-INF and INF groups. Patients in the INF group whose parents have been directly informed in the emergency department had lower orthopedic polyclinic application rates (p<0.001), longer delay for the first orthopedic polyclinic admission (p<0.001) and a lower probability and/or less number of X-Ray evaluation(p<0.001). Correlation between the variables such as Patient's Modified MAYO Wrist Scores, the number of orthopedic polyclinic visits, the first orthopedic polyclinic admission time, the reduction procedure and the number of X-Rays was not ststistically significant (p>0.05). Findings show that additional tests and procedures such as radiography has increased the costs of 6-41% in the present study.

Conclusion: It can be concluded that adequate information in the emergency services for parents of children with stable torus fractures might provide a reduction in treatment costs due to lower orthopaedic polyclinic admission and reduced radiographic examination. Wrist MAYO scores have not been affected application of reduction, radiographic evaluation, polyclinic admission and time.

Keywords: Distal radius, torus fracture, parents information, polyclinic application frequency, radiography frequency, treatment cost

INTRODUCTION

The pediatric torus fractures (TF) are frequently seen at the junction of the metaphyseal diaphysis in the distal radius and are stable in nature having a good prognosis and usually heal well. When the load on the bone exceeds the plastic deformation threshold, the cortex apex swells outward. TF is usually not displaced, but it can rarely be angulated (1). Thus, non-rigid immobilization methods such as removable braces and bandages are prefered instead of rigid immobilization methods such as plaster and splint for fracture fixation (2-7). In TF, pediatric orthopedists prefer to fix with 30% brace (14). TF resembles the common cold that does not require medical treatment, and frequent radiographs are unnecessary in the follow-up period (8,9). For TF treatment, only pain control is recommended, whereas any hard immobilization and serial radiographic (X-Ray) requests are accepted as excessive treatment (9-11).

Undoubtedly, the information obtained by educated parents and the cooperation with the physician plays a key role in the management of TF (11-13). However, to omit fixation with rigid immobilization, to change the routine clinical follow-up and to coordinate the process with the parents is very challenging and difficult in developing countries. Unnecessary radiation exposure, decreased cost and time loss can be avoided with better prognosis of TF in children. For this reason, we aimed to evaluate the effect of parental information on the number of radiological examinations, the number of orthopedics outpatient visits, the duration of early orthopedic outpatient admission, the fracture recovery scores of reduction, and the cost of treatment of torus fractures in children in in the emergency service.

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Received: 30.11.2022 **Accepted:** 15.01.2023

MATERIAL AND METHOD

The procedures of the longituidinal study were carried out in accordance with the ethical rules and the principles of the Declaration of Helsinki and with the permission of Hitit University Non-interventional Clinical Researches Ethics Committee (Date: 4.11.2022, Decision No: 2022-23).

The population of the study are patients diagnosed with stable TF that did not show angulation between April 1, 2020 and September 1, 2022. The sample of the study consisted of a total of 85 patients which were classified as a) No-INF group (n=44) who are patients evaluated in the emergency department and were transfered to the Orthopedics polyclinic and parents did not receive information in the emergency department, and b) INF group (n=41) patients who were evaluated by the Orthopedist in the emergency department and their parents were informed directly in the emergency department. The diagnoses of the patients admitted to the emergency department were confirmed by bidirectional wrist X-Ray (**Figure 1**). A short arm splint was applied to all patients, while manual traction was applied to certain patients who needed reduction in their treatment. The information about TF was shared verbally with parents either in the emergency clinic by the orthopeadist (INF group) or at the orthopaedic clinic where the patients were send from the emergency clinic (No-INF group). Information shared verbally with parents was as follows; "Torus fractures are simple, fast-healing non-displaced fractures specific to children. A three-week short arm splint is required for treatment. In the third week, the split will be removed under the control of an orthopedist in the orthopedic polyclinic. There might be mild pain for a few days. There is no need to take an X-ray again.". The splint of the patients were removed in the orthopedics polyclinic at the end of three weeks. Wrist functions were evaluated with the Mayo wrist scoring system which evaluates range of motion, grip strength, satisfaction level, and pain as well in children (14) (**Table 1**).

Data of all patients was reviewed retrospectively from hospital records in terms of the number of orthopedic polyclinic visits, the number of radiographs, the day of admission to the orthopedics polyclinic, and clinical recovery scores and were compared between the groups with and without parental information, INF and No-INF groups respectively. The number of orthopedics polyclinic visits, X-Rays, orthopedics polyclinic admission days and clinical recovery scores were compared between the patients who received reduction treatment and patients who do not.

Table 1. Mayo modified wrist score

Category	Score	Findings
Pain (25 points)		
	25	No pain
	20	Mild pain with vigorous activities
	20	Pain only with weather changes
	15	Moderate pain with vigorous activities
	10	Mid pain with activities of daily living
	5	Moderate pain with activities of daily living
	0	Pain at rest
Satisfaction (25 points)		
	25	Very satisfied
	20	Moderately satisfied
	15	No satisfied, but working
	0	No satisfied, unable to work
Range of motion (25 points)		
	25	100% percentage of normal
	20	75%-99% percentage of normal
	15	50%-74% percentage of normal
	10	25%-49% percentage of normal
	0	0%-24% percentage of normal
Grip strenght (25 points)		
	25	100% percentage of normal
	20	75%-99% percentage of normal
	15	50%-74% percentage of normal
	10	25%-49% percentage of normal
	0	0%-24% percentage of normal
Final result(total points)		
	90-100	Excellent
	80-89	Good
	65-79	Fair
	<65	Poor

Figure 1. Anteroposterior and lateral radiograph demonstrating a torus fracture of the distal radius (a, b: X-Ray images of the first examination, c,d: X-Ray images with splint, e, f X-Ray image of the 3rd week)

Statistical Analysis

Statistical analysis of the data was performed with the SPSS (Version 22.0, SPSS Inc., Chicago, IL, USA, Undergraduate) package program. Kolmogorov-Smirnov test and Shapiro-Wilk test were used to test the normality of data distribution. Descriptive statistics for numerical data was presented as mean±standard deviation (SD) and median (Q1-Q3), depending on data distribution, whereas categorical variables were presented as frequency and percentage (%). Two groups were compared by using Student's t-test for normally distributed variables, whereas Mann Whitney U test was used as parametric test for independent sample comparisons. Correlations between numerical data were investigated using the Spearman correlation coefficient based on the assumption of normal distribution at a significance level of $p<0.05$.

RESULTS

A total of 85 patients were analyzed desriptively and the frequency of males was 67.1% (57), whereas 32.9% (28) of the patients were females with a mean age of 103.6±38.2 months for the whole sample. Only one pediatric patient had an angulation of approximately 20° in the fracture as a complication due to falling again. Descriptive demographic and clinical characteristics of the patients are presented in detail in **Table 2**. The MAYO Wrist Score (p=0.80), age (p=0.712), gender (p=0.815), and complications (p=0.482) of the INF group (n=41) and No-INF group (n=44) did not differ significantly as shown in **Table 3**.

Table 2. Descriptive statistics on the socio-demographic and clinical information of the patients

		n (%)
Gender	Male	57 (67.1%)
	Female	28 (32.9%)
Parent notification	No	44 (51.8%)
	Yes	41 (48.2%)
Reason for application	Control	55 (64.7%)
	Termination of treatment	29 (34.1%)
	Falling again	1 (1.2%)
Complication	No	84 (98.8%)
	Yes	1 (1.2%)
Reduction	No	40 (47.1%)
	Yes	45 (52.9%)
Splint	No	0
	Yes	85 (100%)
		Mean±SD / **Median (Q1-Q3)**
Age (month)		103.6±38.2 / 99 (69.5-133.5)
Follow-up time		6±0 / 6 (6-6)
Number of polyclinic admissions		2.247±1.1 / 2 (1-3)
First polyclinic admissions time (days)		9.564±8.098 / 5 (3-20.5)
Number of X-Rays taken		2.4±1.399 / 2 (1-3)
Splint duration (weeks)		2.976±0.21 / 3 (3-3)
Modified Mayo Wrist Score		93.94±4.16 / 95 (90-95)

SD: Standard deviation

Table 3. Statistical findings on the comparison of socio-demographic and clinical information between patients with and without parental notification.

		No-INF group (n=44)	INF group (n=41)	P values
Gender	Male	29 (65.9%)	28 (68.3%)	0.815[a]
	Female	15 (34.1%)	13 (31.7%)	
Complication	No	44 (100%)	40 (97.6%)	0.482[b]
	Yes	0 (0%)	1 (2.4%)	
Splint	No	0 (0%)	0 (0%)	-
	Yes	44 (100%)	41 (100%)	
Age (month)		105.1±35.6	102±41.1	0.712[c]
Modified MAYO Wrist Score		95 (90-95) (94.09±4.21)	95 (90-95) (93.78±4.15)	0.800[d]

[a]Chi Square, [b]Fisher Exact test with n (%), [c]Student's t-test with mean±standard deviation, [d]Mann-Whitney U test with median (Q1-Q3) and (mean±standard deviation) SD: Standard deviation

The reason for applying to the orthopedic polyclinic in the INF group was found as control, termination of the treatment and falling once again, whereas for No-INF group, the purpose of visiting the polyclinic was control and a significantly correlation was found between the reasons for admission and the information ($p<0.001$). In addition, the number of orthopedic polyclinic admissions of the patients in the INF group was significantly lower ($p<0.001$), while the first orthopedic polyclinic admission time was significantly later ($p<0.001$) and the number of X-Rays taken was significantly lower ($p<0.001$) compared to the No-INF group. (**Table 4**) .

The MAYO Wrist scores of patients with and without reduction in the emergency clinic did not differ significantly (p=0.903) (**Figure 2**, **Table 6**), whereas no statistically significant correlation was found among the MAYO Wrist Scores of the patients, the number of admissions to the orthopedics polyclinic, the time to the first orthopedics polyclinic admission, and the number of X-Rays taken ($p>0.05$) (**Table 5**).

Table 4. Comparison of the reason for admission, the number of patient visits, the time of first patient admission and the number of X-Rays received by the patients between the patients with and without parental information

		No-INF group		INF group		P values
Reason for application	Control	44 (100%)		11 (26.8%)		<0.001[a]
	Termination of treatment	0 (0%)		29 (70.7%)		
	Falling again	0 (0%)		1 (2.4%)		
		Medyan (min max)	**Mean±SD**	**Medyan (min max)**	**Mean±SD**	
Number of polyclinic admissions		3 (2-4)	2.863±1.00	1 (1-2)	1.585±0.773	<0.001[b]
First polyclinic application time (days)		4 (3-5.75)	4.59±2.705	21 (4.5-22)	14.9±8.569	<0.001[b]
Number of X-Rays taken		3 (3-4)	3.38±1.039	1 (1-1.5)	1.341±0.854	<0.001[b]

[a]Fisher Exact test with n (%), [b]Mann-Whitney U test with median (Q1-Q3) and (mean±standard deviation)

Table 5. Correlation analysis findings between the modified MAYO wrist scores and the number of patient visits, the time of first patient admission, and the number of X-Rays received by the patients

		Number of polyclinic admissions	First polyclinic admissions time (days)	Number of X-Rays taken
Modified Mayo Wrist Score	r	-0.100	0.138	0.003
	P	0.363	0.207	0.977

Spearman correlation analysis

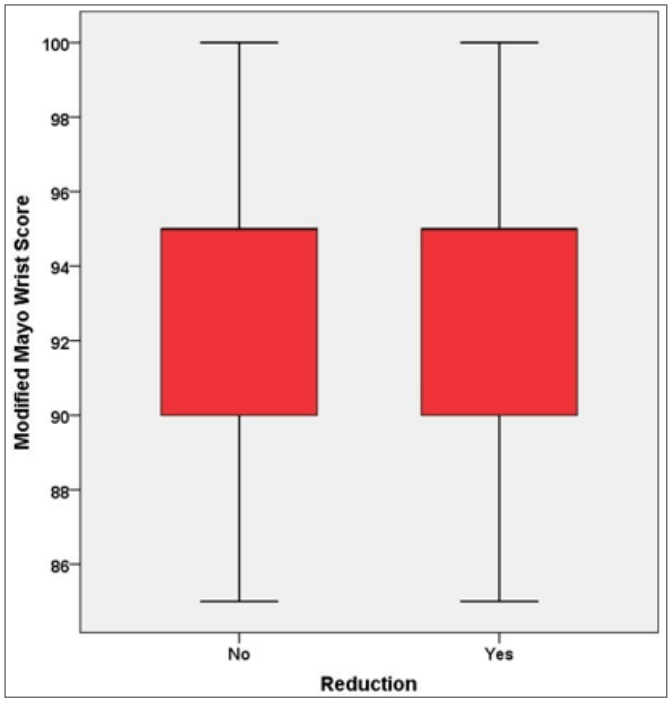

Figure 2. Box plot of the distribution of modified MAYO wrist scores between patients with and without reduction

Table 6. Comparison of Modified Mayo Wrist Scores between patients with and without reduction

	No-INF group	INF group	P values
Modified Mayo Wrist Score	95 (90-95) (94±3.95)	95 (90-95) (93.8±4.38)	0.903[b]

[b]Mann-Whitney U test with median (Q1-Q3) and (mean±standard deviation)

Emergency examination payment (EEP) is 135 TL, consultation payment (CP) is 50 TL, radiography payment (RP) is 30 TL, splint procedure payment (SPP) is 72.5 TL, orthopedics polyclinic examination payment (OPEP) is 135 TL and plaster removal payment (PRP) is calculated over 27.5 TL.

Minimum treatment payment (MTP) for a patient: EEP + CP + RP + SPP+ OPEP + PRP = 450 TL

- MTP + at least one RP=6.6% increase;
- MTP + at least one OPRP=30% increase;
- MTP + RP + OPRP = 41.1% increase

In addition to our patients, the treatment fee for the patient who comes to the control up to four times and has three radiographs is 1080 TL, causing an additional cost of 41.6%.

DISCUSSION

The time devoted to parental information in pediatric patients with TF having applied to emergency clinic plays an important role during the treatment. Providing simple information about the nature of the fracture and thereby calming parents facilitates the managment of fractures. Being selective about radiation exposure and to continue follow up with as few X-rays as possible is a key determinant for the treatment of TF in pediatric patients. It was hypothized that informing the patient's parents might reduce the number of orthopedic polyclinic applications which will reduce wasting time for the physician, decreases the costs for patients, and declines the cost for healthcare system by reducing the expenses. According to our findings, time for early orthopedic polyclinic admission, frequency of admission to orthopedics polyclinic, verbal information to parents, application of reduction procedure and the number of X-Rays requested were not effective in clinical recovery in the treatment of pediatric TF. Thus, different perspectives and practices are needed in the management of TF. We believe that this may place an excessive burden on health costs. According to the Public Health Services Price List (19) on 08.09.2022, costs can be reduced for each excessive performed transaction. According to the list, emergency room examination fee was determined as 135 Turkish Liras (TL), whereas the costs for specialist physician consultation is 50 TL, orthopedic polyclinic examination is 135 TL, short arm splint is 72.5 TL, bidirectional joint radiography is 30 TL, plaster removal is 27.5 TL, closed reduction is 939 TL. If a torus fracture admitted to the emergency service can be managed as expected, the total cost of the emergency examination, radiography, orthopedic consultation, short arm splint, orthopedic polyclinic control and splint removal costs only 430 TL. However, unneccessary additional radiography and orthopedic polyclinic applications raises the costs between 6-41% at varying rates. Findings of the study showed that there were patients who increased the cost of the treatment up to 630 TL by applying to the orthopedics polyclinic at most four times and having radiograph scanning for three times.

It has been reported that radiography does not change the course of fracture healing in TF (9,23). Our findings showed that the number of X-Rays do not play an important role in the clinical functions and healing of these fractures. In order to reduce radiological examinations, attention should be paid to informing parents in the first stage of treatment. However, the treatment proposal offered by the clinician has not been accepted by individuals with different beliefs and

sociodemographic backgrounds. Children are exposed to a radiation dose of approximately 0.05–0.005 mSv per extremity during radiography scanning (15). This dose is below the threshold for a carcinogenic effect, however, the least possible radiation exposure should be targeted, especially in children. Thus, it might be possible to reduce and prevent an unnecessary radiation exposure by informing the parents. In our study, a total of 204 bidirectional wrist radiographs (average 2.4 per person) were scanned, whereas the average of radiographs of INF group was lower compared to No-INF group, 1.3 and 3.3 respectively. Thus informing parents in the emergency clinic reduced the number of scans for approximately 60%. This means that 44 patients in the No-INF group received additionally radiographs with a mean of 2.1 scans per person.

In several countries, certain steps are taken to reduce cost loss and increase service quality in health services (16,17,22,23). We suppose that this will be achieved by preventing unnecessary examinations and patient referrals. Due to the changes in package pricing in health payments in our country, we did not have the chance to statistically compare net prices. However, the cost analysis was performed by using the rates for currency. The total expenditure of approximately 2880 TL was prevented and the costs were reduced by 64% by preventing 96 additional radiography scans as a result of briefing/informing parents in the emergency clinic. On the other hand, it can be argued that physicians have a vocation to apply frequent radiography scans during the follow-up period to avoid possible problems in fracture healing (9). The requested radiograph scans might prevent negative processes that will develop with the patient and their relatives, especially in an environment where violence against physicians and healthcare professionals might occur (18).

Literature showed that treatments of TF mainly consists of application of plaster, splint, removable splint and elastic bandage, and the use of rigid immobilization methods are not needed, especially in nowadays treatments (3,4,7,10,14). However, the advise of the physician not to use fixation in children with TF is mostly not well accepted by parents in the emergency clinic. Many families insistently prefer plaster cast, stating that they cannot keep the child stable (2,10,12). Due to the medicolegal challenges and to prevent overreaction of parents, we preferred to routinely apply splints in the TF treatments. On the other hand, families accepted the suggestions and advise that there is no need for reduction. There was a tendency to omit reduction from the treatment because of the belief that reduction is a painful procedure. Regulations are needed for the treatment of pediatric fractures to prevent loss of time and money spent in the polyclinic (20), since reduction or frequent orthopedic polyclinic follow-ups are not needed for already stable torus fractures (9,10,11). The findings of clinical improvement in patients with and without reduction were paralel with literature such that the number of orthopedic polyclinic visits and the time of early orthopedic polyclinic admission after the emergency service was not associated with clinical improvement, showing that unnecessary orthopedic polyclinic referrals can be prevented by briefing the parents of pediatric patients with fractures. When orthopedic polyclinic application reasons were considered, No-INF group outnumbered the INF group for the visit purpose for control which was reduced directly by informing parents. Another effect of the information was manifested in the significant increase in the group of patients who came for treatment termination at the end of the 3rd week. Moreover, the time of admission to the orthopedics polyclinic was shorther in the No-INF group compared to the INF group. Recently, studies focused on decreasing the appliction number of orthopedics polyclinic for fractures such as TF have reported not only decline in time and costs, but also ease of follow-up period (21). While 127 patients were admitted to the orthopedics polyclinic in the No-INF group group without parental information, this number was reduced to 64 in the INF group where parents were informed directly in the emergency clinic. The additional cost of 63 patient's admission to orthopedics polyclinic resulted in an additional cost of 8505 TL, and caused disruption in health services due to additional unnecessary examination. Considering the number of patients who are examined daily in our clinic (average 60-80 patients), it corresponds to a daily workload for each physician in the orthopedics polyclinic. Informing parents open and precise might reduce the time and costs without impairing the functional healing of torus fractures.

CONCLUSION

In pediatric patients admitted to the emergency department with a torus fracture, the time we will devote to parental information will result in less radiological examination, less radiation exposure, and fewer orthopedic outpatient referrals. This will prevent waste of time for the physician, decreases the treatment costs for the patient, and lightens the burden of healthcare system expenses. In the treatment of pediatric torus fractures, the time of early orthopedic polyclinic admission, the frequency of orthopedics polyclinic visits, and the number of radiography scans requested and also reduction of pediatric torus fractures have no effect on clinical recovery.

One of the limitations of the study is the lack of cost analysis which could not be calculated due to frequent price changes. Moreover, the waste of time for patient, parent and doctor examination could not be determined and calculated either. Since the study was retrospective, it was limited to a small sample size and the educational level of the the parents could not be determined to question whether they understood the information and recommendations during the treatment.

ETHICAL DECLARATIONS

Ethics Committee Approval: The study was carried out with the permission of Hitit University Non-interventional Clinical Researches Ethics Committee (Date: 4.11.2022, Decision No: 2022-23).

Informed Consent: Because the study was designed retrospectively, no written informed consent form was obtained from patients.

Referee Evaluation Process: Externally peer-reviewed.

Conflict of Interest Statement: No conflict of interest was declared by the author.

Financial Disclosure: The author declared that this study had received no financial support.

Author Contributions: The author declares that he has responsible for the design, execution, and analysis of the paper and that he has approved the final version.

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