# Fist fractures at child's age

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# Fist Fractures at Child's Age

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**A B S T R A C T**

*The aim of this work is to confirm or deny the hypothesis that the fist fracture medical treatment at child's age in the General Hospital in Zadar does not differ much from the medical treatment method in other centers which have already published their results. The work is based on the retrospective study. The examinees are children with fist fractures in the General Hospital in Zadar from 1999 to 2003. The control group is formed by the examinees of the published studies about children fist fractures, which have been collected and statistically elaborated. The examinees of our group and the control group are classified by the same criterion: age, sex, place, sort and type of fracture as well as the method of medical treatment. The used statistical methods are the testing of frequency differences and $\chi^2$ test. Statistically essential differences between our group and the control group have been noticed. There are also differences among the control group subgroups. The difference in the method of medical treatment is statistically essential and shows that the methods are not the same as in our group and the control group. The surgical way of treatment is less represented by our results than in those of the control group. The different attitude in medical treatment is conditioned by the attitude that surgical intervention of finger bones does not always give us the expected functional result.*

***Key words***: *fist fractures, children, epidemiology, medical treatment, Zadar, Croatia*

## Introduction

Fractures and dislocations of the fist are much more frequent by children than grown-ups[1–4]. Amongst children examined in daily hospital, these injuries have been represented with 2.1 cases, or 1.8 cases on 100,000 healthy children. Fractures of fingers[5–7] are especially frequent. If the fracture has occurred in the ossification growth zone, it can lead to mal growth and permanent deformity[4,7–12]. In correlation with bone fractures there are frequent damages on joint connections system and tendon's device[1,8,13]. Therefore, it is complex to treat such fractures.

The bones of the fist are being moved by 35 different muscles. Fist consists out of 27 basic and 3–5 pisiform bones, which are divided in three groups: bones of fingers, metacarpal and carpal bones.

The parietal mesoderm (on the ventrolateral side of the body wall at the end of the forth week of the embryonic growth) represent the basis for the development of fist bones. In the twelfth week, all diaphysis of the long bones contain primary ossifying centers. From those ossifying centers, ossification gradually advances towards cartilaginous bases. All fist bones develop hondral ossification[21].

In evaluating bone fractures of the fist, clinic exam is the first step[11,17]. Due to negation of severity of injury and compulsory immobilization, the evaluation of injury is often delayed, compared to fractures of other bones. Only when edema and hematoma with partial loss of function appear, children are submitted to physician's exam. It all happens because the child has hidden the injury, fearing the medical examination and treatment procedures.

Review of fist injury first includes inspection of soft tissues. It is necessary to notice all changes on the skin: swelling, redness, excoriations, hematoma[19,23,24]. Neutral fist position shows the presence of dislocation or asymmetries in fist structure, whereas the presence of swelling or hematoma shows possible bone trauma. Execution

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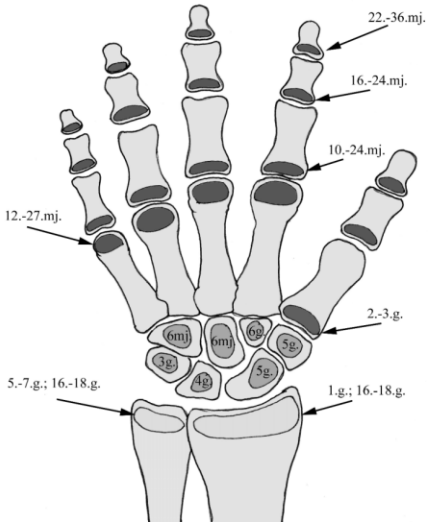


*Fig. 1. Development of ossification cores in bones of the fist.*

of functional movements in the wrist and fingers show the severity of the injury and function loss. Dysfunctional finger joints, apart from showing bone fractures, can show lesion of interphalangeal ties and tendon's device[25].

Thorough examination is especially important in multiple traumas where the attention has been directed towards larger violations, overlooking fist fractures (traffic accidents). Detailed physical examination is the first step. Further on we use different diagnostic methods:

X-ray, ultrasound, computed tomography (CT), and magnetic resonance imaging (MRI). Unlike bone fractures by adults, who finished growing, at child age fractures are frequent in bone growth zones[29]. In case of the germinitative centre damage, we can expect further irregular bone growth, which leads to its deformity[18].

Fist fractures can be classified and divided in several subgroups:Diaphyseal fractures: opened and closed fractures; due to the shape of the break – transversal, oblique, spiral, cominutive; with or without diastasis. Bone growth zone fractures: separation and break of epiphyseal plateau. There are various classifications of epiphyseal plateau fractures. Today the most often used are the classifications sec. Salter-Harris, Aitken, and secondarily sec. Weber, Poland and Ogden. These classifications are based upon the radiological findings of epiphyseal fracture, position of fragments and fracture line. Finally, the type of fracture determines medical treatment and represents basis of prognostic assessment. Treatment of fractures depends on the age of child's age, fracture type and positioning. Conservative techniques involve immobilization using classic cast splints, polymer materials or using pre made orthosis. Immobilization usually lasts 2–4 weeks. This is the proper management of fractures with dislocation or diastasis under 2 mm and angulation under 15°. Operative techniques using the open or closed method of reposition and stabilization are applied in cases with diastasis around 2–4 mm and angulation around 5°–15°. Fractures involving diastasis greater than 4 mm and angulation higher than 15°, demand open reposition and fixation. In the operative process different osteosynthetic material is being used : small diameter K-wires, screws and plates, various titanium wires, external fixators and systems of extensions.Due to possible development of contractures, it is imperative to begin as soon as possible with physical therapy of fractured bone joints. This early physical therapy can be performed without direct surveillance of medical professionals. All this is possible due to immobilization with adequate orthosis which can be removed during exercises[12,29]. In the beginning, exercises can be performed at home for several minutes daily. If the limitation of movement is greater, it is necessary to introduce professionally guided exercising. The physical therapist can choose from wide range of methods involving hydrotherapy, paraffin oil, ultrasound massage, electro stimulation and machine assisted exercising. Exercises must be implemented as long as it is necessary to achieve levels of movements same as in healthy fist[34]. Complications of fist fractures most often involve residual deformities and unstable joint[22,33,37]. Swelling in the area of fracture and adhesions of the soft tissue, frequently obstruct mobility of joints[16]. Long-lasting immobilization leads to damaged cartilaginous surface of joint, and numbness joint limits movements. Even with proper bone healing, damaged jointed connections, tendon stiffness or lesions of nerves can obstruct the normal function of hurt extremity.

## Patients and Methods

The main hypothesis of this study: the results of medical treatment of fist fracture by the child population in the Zadar General Hospital doesn't much from the results obtained in other centers, which results have been announced. In this study we used the retrospective method and statistical analysis. Examinees have been divided in two groups: examinees of the Zadar General Hospital and examinees of the Control Group-World.

### *Examinees of the Zadar General Hospital*

We gathered our data by processing patients treated in the Zadar General Hospital. This group is made of children with fist fractures, registered in the period from 1999 till 2003. In that period, the total number of cases of children with fist fractures in this area was about 1400. The determined number of cases had to be excluded from the study, because of the defectiveness of gathered data concerning age and diagnoses. After cleansing all faulty data, the number of patients satisfying the given criteria, was 1120.

### *Examinees of the Control Group-World.*

Examinees of the control group are made of cases of children with fist fractures which have been published worldwide. The criteria in each of those published studies had to comply with the criteria in our study: the ob-

served population of children at 16 years of age and under, gender, age, location, types of fractures and medical treatment.

### *Methods of data processing of the Control Group-World*

Collected data from the world literature were assembled in the control group named World. It consists of 18 studies which have been divided in to three groups: studies from Europe, studies from North America and studies from the rest of the world. Studies have been chosen concerning strict determined criteria, which were also applied for our examinees. Collected data have been expressed numerically and in the frequency of appearance. Analysis was executed using parallel test and $\chi^2$ test between single groups of data. Used methods tested the difference between frequencies and $\chi^2$ test.

## Results

The epidemiology of fist fractures by children differs from the one by adults. During the summer months and school holidays, there is significant growth in number of all fractures.

Frequency of fist fractures is constant throughout all months of the year, with some the milder growth during spring (April-June). Unlike fist fractures, the incidence of other fractures by children, shows rapid growth during summer holidays (June-August), early spring (April) and late autumn (November).

The most frequent causes of children examinations in the ER are bruises and violations of fingers (28%) and fist fractures (18%). Burns are in the third place, especially by the younger population (16%).The most frequent cause of fist fractures by children is sport related injuries (44%), followed by all kinds of falls (24%). Falls usually take place by chance or during stuffing from the other child.In ball related sports the highest frequency of fist fractures is 60%, which usually happen by direct contact of hand with ball (handball, basketball, volleyball, water polo), after that comes football (12%).

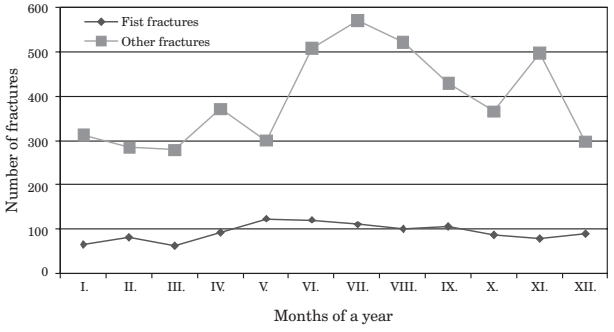


*Fig. 2. The yearly frequency of fist fractures compared to incidence of all other fractures at child.*

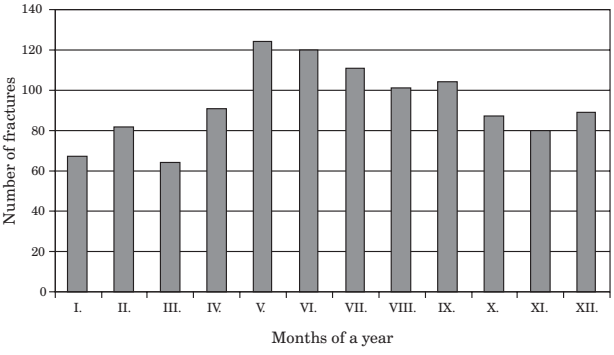


*Fig. 3. Distributions of cause of fist fractures registered in the Emergency Room in the observed. period 1999–2003*

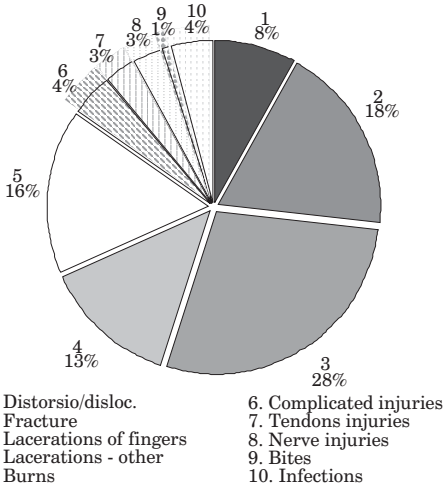


*Fig. 4. The frequency and type of fist injuries for the period 1999–2003 on surgical Emergency Room in the Zadar General Hospital.*

The frequency of fist fractures varies during the year. The highest number of cases (38%) has been registered during the end of the school year and summer months (May-August). The highest number of cases has been registered in May (126 registered breaks 11.2%). In course of the rest of the year, the incidence rises during winter (December) and spring (April) school holidays.

Children with fist fractures, most often (30%) come to surgical ER to be examined in the evening hours (1800–2200). The frequency of these examinations is somewhat diminished during the afternoon hours (1200–1800), and in the morning period (0900–1200). Morning is usually the time when children with injuries from the day before report (delayed examination/late review).

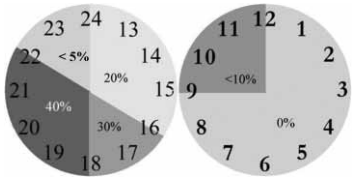


*Fig. 5. Twenty-four hour frequency of examinations of children with fist fractures for 1999–2003 (data from surgical Emergency Room protocol of the Zadar General Hospital).*

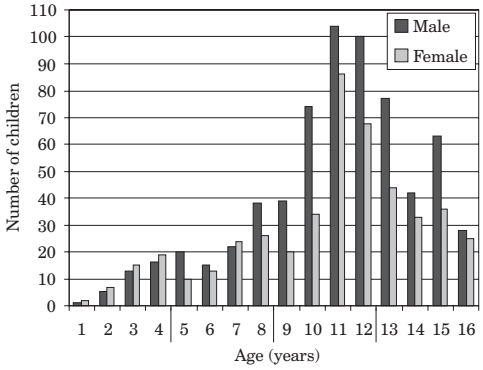


*Fig. 6. Distribution of fist fractures concerning age and gender (period from 1999 till 2003).*

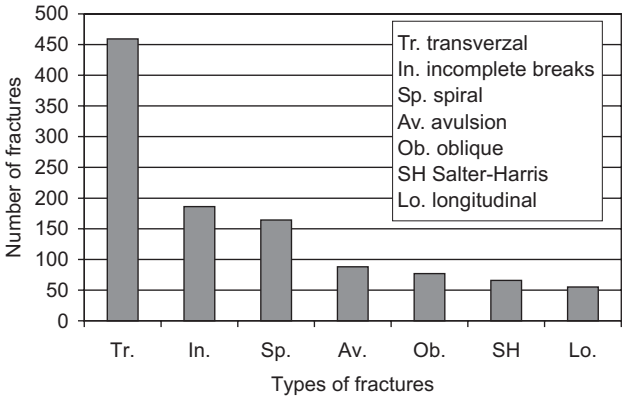


*Fig. 8. Frequency of main types of fractures*

When we divide children with breaks of fist bones along the age and gender, we can see the difference in frequency of fist fractures concerning the age group.The first age group, 0–4 years of age, has been represented in total with 7% of all fractures. The difference between girls and boys is 52.5%:47.5%.The second age group, 5–8 year of age, has been represented with 15%, and the relation concerning gender is to the advantage of boys (59.3%: 40.7%). Only in the age of 7, girls are more represented with this type of injuries than boys (52.1%:47.9%).The third age group, 9–12 years of age, is most represented with 47%, and the difference between genders is also on boys behalf (60.2%:39.8%) and represents the largest sexual difference in all age groups.In the fourth age group, 13–16 years of age, which has been represented with 31% of cases, the relation of genders are on boys behalf (60%:40%).

The overview of all fist fractures clearly shows that several bones are more frequently afflicted. We most often find of middle phalanx fractures of the fourth finger, middle and proximal phalanxes of the fifth finger and fractures of the fourth and the fifth metacarpal bones (56% of all fractures). Fewer fractures afflict middle phalanxes of the first to the fourth finger, distal phalanx of thumb, proximal phalanx of the third finger and the second metacarpal bone (27% of all fractures). Fractures of distal phalanxes of the second to the fifth finger, proximal phalanx of the index finger, the first and the third metacarpal bone and navicular bone are yet less prone to fracture (15% of all fractures). We rarely encounter fractures of capitatum**,** hamates and lunate bones of wrists (less than 1%). Fractures of trapezium, trapezoideum and triangle bones have not been registered in our study. However, the incidence of fracture of single bone varies concerning the age of a child. Fractures of thumbs and distal phalanxes are more frequent by younger children, whereas older school children more often experience fractures of the fourth and the fifth finger and metacarpal bones.

After the insight in the medical documentation, we came to the conclusion that most of the cases involve the

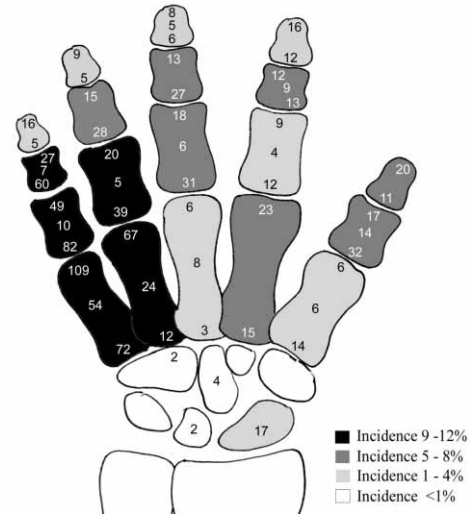


*Fig. 7. Frequency of main types of fractures (numbers mean registered fractures of that bone).*

**TABLE 1**
$\chi^2$ TEST OF FRACTURE TYPES OF BOTH MAIN AND CONTROL GROUP

| Type of fracture | World | Zadar (Croatia) | Total |
|---|---|---|---|
| Epiphyseal | 1411 | 292 | 1703 |
| Non-epiphyseal | 5811 | 828 | 6639 |
| Total | 7222 | 1120 | 8342 |

**TABLE 2**
$\chi^2$ TEST OF TREATMENT METHOD OF BOTH MAIN AND CONTROL GROUP

| Treatment method | World | Zadar (Croatia) | Total |
|---|---|---|---|
| Conservative | 6628 | 1078 | 7706 |
| Operative | 626 | 42 | 668 |
| Total | 7254 | 1120 | 8374 |

transversal type of fracture (41%). Incomplete breaks (the torus, greenstick, and bowling) were included in the group of cracklings (16%). Spiral fractures represent 14% and the avulsion type of fractures 8% of cases. Oblique fractures have been represented by 6% of cases. Types of fractures involving epiphyseal core have been registered in 5.5% and the rarest of them all were longitudinal fractures with 4.5% (usually distal phalanx's fractures).

Statistical analysis concerning fracture types shows that there is significant difference between the main and control group. There were more epiphyseal than non-epiphyseal fractures, which are more susceptible to complications and may require additional operative treatment.

The other analysis, involving treatment methods, shows that the conservative treatment was a method of choice much more than in the control group (world).

## Discussion

Diagnostically methods evaluating target and control groups are identical. They include the following: clinical examination, X-ray, ultrasound, CT, MRI.

Reviewing all of our examinees, in 96.2% cases, the method of choice was a conservative treatment. The operative treatment was indicated in 3.8% fracture cases. When applying a conservative method, immobilization is a necessity, especially with orthosis and splints. Fractures with angulation of more than 15° in the area of phalanxes epiphyseal plates and 30° in the metacarpal bones area, were treated operativelly. Open or closed method of reposition was used (percutaneous K-wire introduction or stabilisation with leg screws by adolescents). The functional and aesthetic result of medical treatments of our examinees is very satisfactory. From all registered fracture cases, 60 patients experienced longer, than the routine, treatment period; limited movements were registered with 25 cases, unstable joint in 3 cases. The good functional result is more important than the short term aesthetic appearance problems (swelling, asymmetry, etc). Results of the control group show differences in single subgroups (Europe, North America and others). Percentage of boys in countries of the other world-63% (Australia and East Asia) is larger than in other parts of the world-57%. There are differences in positioning of fractures; in Europe metacarpal fractures are more represented (35%), than in North America (25%). Statistical tests show that this difference is not accidental, but statistically important. We also find differences while observing types of fractures, in North America epiphyseal fractures are more represented (33%) than in Europe (20%). There are also differences in the medical treatment of fist fractures. In Europe and North America about 8% of patients are operatively treated, and in other parts of the world/control group about 16%. Since we have had a larger number of epiphyseal fractures than in the control group (26.1%:19.5%), this is yet another reason why operating treatment represents just a small portion of all treatment methods. The differences, in medical treatment of fist fractures in the world and in our hospital, are obvious. Thus, our hypothesis for this study, that the treatment methods are the same, cannot be confirmed. Regarding the control group, fist fracture types are similar, we have a greater number of epiphyseal fractures, and all this advises us that we must pursue a more aggressive attitude towards fist fracture repositions/treatment. Microsurgical techniques and new synthetic materials allow us more freedom and better results, making operative treatment more successful than the conservative approach. All quoted makes us question our today's attitudes and calls for the change in the nearby future.

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## PRIJELOMI KOSTIJU ŠAKE U DJEČJOJ DOBI

### S A Ž E T A K

Cilj rada je da potvrdimo ili demantiramo hipotezu da se liječenje prijeloma kostiju šake u dječjoj dobi u Općoj bolnici u Zadru ne razlikuje od metoda liječenja u drugim centrima koji su publicirali svoje rezultate. Rad se zasniva na retrospektivnoj studiji i statističkoj analizi. Ispitanici su dječja populacija s prijelomom kostiju šake koja su liječena u Općoj bolnici u Zadru u periodu 1999–2003. godine. Kontrolnu skupinu čine ispitanici publiciranih radova s prijelomima kostiju šake u dječjoj dobi koji su prikupljeni i statistički obrađeni. Ispitanici naše i kontrolne skupine razvrstani su po istim kriterijima: dob, spol, mjesto, vrsta i tip prijeloma te način liječenja. Korištene statističke metode su testiranje razlika frekvencija i $\chi^2$ test. Nakon obrade dobivenih podataka uočene su statistički značajne razlike između naše i kontrolne skupine, a postoje razlike i unutar podgrupa kontrolne skupine. Razlika u načinu liječenja je statistički značajna i pokazuje da načini liječenja nisu jednaki u našoj i kontrolnoj skupini. Operativni način liječenja manje je zastupljen u našim rezultatima nego u kontrolnoj skupini. Mikrokirurške tehnike i novi osteosintetski materijali danas omogućuju da operativnim zahvatom s boljim rezultatom zbrinemo određene prijelome koji su do sada tretirani konzervativnom metodom.