

Analysis of Hand Injuries in Children Between 0-6 Years of Age

0-6 Yaş Grubu Çocuklarda El Yaralanmalarının İncelenmesi

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Geliş Tarihi/Received: 15.10.2014
 Kabul Tarihi/Accepted: 06.07.2015

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doi: 10.5336/pediatr.2014-42094

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ABSTRACT Objective: The motor development of the upper extremity and hand is actually a result of learning the intentional and fine motions in correlation with the physical growth, central nervous system differentiation and acquired cognitive abilities which are gained in early childhood. Therefore, such hand injuries in early ages may impair the process as whole. We aimed to investigate the epidemiology, etiology and the treatment outcomes in very young patients suffering from the hand injuries in this study. **Material and Methods:** A retrospective investigation of records of 507 patients, who admitted to our emergency department at last five years, between 0-6 years of age were analyzed according to etiology, the type of injury, anatomical localization of the injury, treatment approach and outcome. **Results:** Most of the hand injuries were simple injuries (75.3%) and occurred at home (72.6%). The most frequent cause of injuries was contusion (55%) and most frequent injured site of the hand was detected as finger. Female to male ratio was 1:1.5 and right hand to left hand ratio was 2:1. **Conclusion:** The hand injuries in the very young population seems to be common and the investigation of the etiology and type of occurrence might give us new and better modalities in preventing such injuries.

Key Words: Child; hand injuries; accidents, home

ÖZET Amaç: Üst ekstremitte ve el motor gelişimi fiziksel büyüme ve merkezi sinir sistemi farklılaşması ile ilişki içindedir. Edinilmiş bilişsel hareketlerin öğrenilmesi erken çocukluk döneminde oluşur. Çocukluk çağında görülen el yaralanmaları bu süreci bozar. Bu çalışma çocukluk çağı el yaralanmalarının epidemiyoloji ve etiyolojisinin ve tedavi sonuçlarının araştırılması amacıyla yapıldı. **Gereç ve Yöntemler:** Son beş yılda kurumumuz acil birimine başvuran ve 507 hasta incelendi. bulgular yaralanmanın görüldüğü yaş aralığına, yerleşimine ve tedavi süreçlerine göre değerlendirildi. **Bulgular:** El yaralanmalarının çoğunlukla basit yaralanma (%75.3) olduğu ve evde (% 72.6) olduğu, en sık kontüzyon tarzı (% 55) olduğu, ve en sık parmak yaralanması olduğu görüldü. Kadın erkek oranı 1:1.5 ve sağ el sol el oranı 2:1 bulundu. **Sonuç:** Çocukluk çağında da el yaralanmalarının sık görüldüğü düşünüldü. Etiyoloji ve sıklık incelemesi, bu yaralanmaların önlenmesi bakımından yeni ve uygun yöntemler önerebilir.

Anahtar Kelimeler: Çocuk; el yaralanmaları; kazalar, ev

Türkiye Klinikleri J Pediatr 2015;24(3):89-94

Motor development is the process by which an organism gains mobility, in parallel with physical growth and the development of the central nervous system. In children, mobility develops through a process starting with reflexes and resulting in a high level of coordinated motor skills. Hand injuries occurring in early childhood may adversely affect this development.

One-fifth of adult patients admits to emergency departments with hand injuries and the increase of this ratio in time is observed.^{1,2} The rate of hand injuries among all patients admitted to a children's emergency department was reported to be 1-2.1% by Fetter-Zarzeka et al.³ Vadivelu et al. reported the projected annual incidence rate for skeletal injuries for under 16 years of age group was 418/100,000.⁴ Ljungberg et al. reported the incidence of hospitalized children with hand and forearm injuries as 39.6/100,000 in the 0-6-year age group and 42.1/100,000 in the 7-14-year age group.⁵ In our country, Bostancı et al. stated that 8.6% of patients admitted to children's emergency clinics had upper extremity injuries.⁶ Other studies investigating hand injuries have reported incidences ranging from 13% to 50% for the 0-18-year age group.⁷⁻⁹

The type, form, region, and treatment of hand injuries in children aged 0-6 years have not been adequately investigated. Thus, the present study evaluated the type, cause, localization, treatment approach, and outcome of hand injuries in children aged 0-6 years admitted to emergency department of our hospital. It is aimed not only to analyze of the hand injuries in this age group, but also to develop a database for the investigation of possible risk factors and prevention methods.

MATERIAL AND METHODS

A total of 3,380 patients with upper extremity injuries admitted to emergency department of our hospital in last 5 years. 507 of 3,380 patients between 0-6 years of age who received treatment for hand-related soft-tissue and skeletal injuries or hand burns were included in the present study. This study was based on the recommendations of the institutional ethical committee of our hospital and informed consent was obtained for each patient from their parents (30.2.BAV.0A1.00). Cases were evaluated with regard to age, sex, type of injury, underlying cause, location, treatment approach, and outcome.

Patients who received local anesthesia were discharged on the same day, whereas those who re-

ceived general anesthesia were discharged within 1-7 days following surgery. The patients were invited to follow-up on day 1, weeks 1-3, and months 1 and 3 after surgery. Patients were referred to the physical therapy and rehabilitation starting from the first week.

The obtained results were evaluated using the SPSS software program (ver. 16.0; SPSS Inc., Chicago, IL, USA). The chi-square test was performed to compare age, sex, and injury localization among groups. A p value <0.05 was considered statistically significant.

RESULTS

507 (15%) of 3,380 patients admitted to our emergency department with upper extremity injuries were in the 0-6-year age group. Injuries were more common in patients with 5-years-old. Female to male ratio was 1:1.5 (202:305). Right to left affected hand ratio was 2:1 (325:164). 368 (72.6%) injuries occurred at home and 139 (27.4%) outdoors. Most outdoor injuries (76%) occurred in spring and summer. 80% of the injuries occurred between 14:00 and 20:00 pm (Table 1).

The causes of injury were contusion (n: 280, 55.2%), sharp trauma (n: 159, 31.3%), burns (n: 32, 6.3%), falling (n: 16, 3.1%), foreign objects (n: 9, 1.7%), gunshot injuries (n: 7, 1.3%), and infection (n: 4, 0.7%).

Injury types were skin injuries (n: 165, 32.5%), isolated tendon injuries (n: 68, 13.4%), isolated nerve injuries (n: 42, 8.3%), isolated artery injuries (n: 32, 6.3%), fractures-dislocations (n: 64, 12.6%) and total amputations (n: 6, 1.1%), and complex and other injuries (n: 130, 25.6%).

The injuries were located on the finger (n: 381, 75.1%), palmar side of the hand (n: 54, 10.6%), dorsal side (n: 47, 9.2%), and forearm (n: 25, 4.9%). Finger injuries were located on the third (n: 91, 23.8%), first (n: 88, 23%), second (n: 76, 19.4%), fourth (n: 61, 16%), and fifth finger (n: 65, 17%). In 18 cases, the injuries were more than one extremity (Figure 1).

Where as 322 patients (63.5%) had simple injuries such as nail-bed and nail-fold injuries, 185

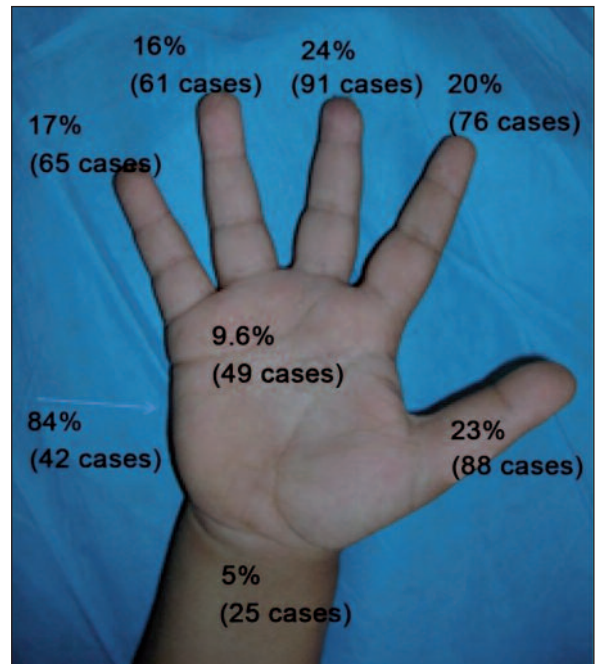
TABLE 1: Distribution of patients according to age, sex, injured side, accident location, and cause of injury.

Age (years)	Total	0-1	1-2	2-3	3-4	4-5	5-6
Sex (F:M)	202:305	14:23	36:50	32:49	33:48	42:63	45:72
Injured side							
Right	325	20	52	53	54	70	76
Left	164	14	27	26	24	34	39
Right and left	18	3	7	2	3	1	2
Accident location							
Indoor	368	35	71	60	58	71	73
Outdoor	139	2	15	21	23	34	44
Cause of injury							
Contusion	280	9	47	45	45	60	74
Sharp object	159	15	28	26	28	31	31
Burn	32	7	6	5	5	5	4
Falling	16	4	4	3	2	2	1
Gunshot	7	0	0	0	0	3	4
Foreign object	9	1	0	1	1	3	3
Infection	4	1	0	0	0	1	2

patients (36.4%) had complex injuries with bone fractures and tendon, arterial, or nerve injuries; or combinations (Table 2).

448 (88.3%) of patients underwent urgent surgical intervention and 59 (11.6%) underwent elective surgery (median, day 5; range, day 1-month 2). 68 patients (13.4%) had tendon injuries (extensor tendon injuries, (n: 27); flexor tendon injuries, (n: 41). 42 patients (8.2%) had nerve injury (digital nerve, n: 38; ulnar nerve, n: 1; cutaneous branch of the radial nerve, n: 1; median nerve, n: 2). All nerve injuries were accompanied by arterial injuries, except one with median nerve injury. 32 patients (6.2%) had arterial injuries (digital artery, n: 29; radial artery, n: 2; ulnar artery, n: 1). Fractures were observed in 12.6% of patients (distal phalanx, n: 46; medial phalanx, n: 10; proximal phalanx, n: 8).

Total amputation was detected in six patients (1.1%) and replantation was attempted in all cases. Successful outcomes were observed in four patients (>2 year old). Replantations were unsuccessful in two cases with contusion type injury. Distal phalanx subtotal amputation was observed in 90 patients (17.7%). According to Tamai's finger distal zone classification 82.2% of the subtotal amputa-

**FIGURE 1:** Localization of injuries.

tions (n: 74) were zone 1 injuries and 17.7% (n:16) were zone 2 injuries.¹⁰ Among 32 burn cases, aged 0-2 years (n: 13, 40.6%) had first- and second-degree superficial burns. Although the causes of

TABLE 2: Treatments used according to the type of injury.

Type of injury	No. of Cases	Treatment	No. of Cases
Fracture/dislocation	64	Fixation with K-wire	12
		Splint and wound dressing	52
Soft tissue			
- Simple	322	Primary skin sutures	165
- Complex	185	Nail-fold restoration	218
Tendon cut	68	Removal of foreign object	7
Nerve cut	42	Tendon restoration	68
Artery cut	32	Nerve/artery restoration	42/32
Burn	32	Restoration with flap	94
Amputation	6	Restoration with composite graft	23
		Revascularization	2
		Replantation	6

burns were similar among patients aged 2-6 years (n: 19, 59.3%), most of the burn injuries in this age group (n:12, 63.1%) were deep second-degree burns. Fasciotomy was performed in one patient with compartment syndrome.

DISCUSSION

Most of the previous reports were related to retrospective studies and they have addressed different age groups of children (<18 years). The reported annual incidence rates showed wide ranges due to this studies have dealt with the pediatric population as a single group.^{4,11-15}

Whereas there are very few studies on hand injuries in 0-6-year age group in the literature; in our country, studies in hand injuries of 0-16 years of age are also in limited number. Although, there are several studies analyzing epidemiology of hand injuries in children conducted in different countries and geographic regions, similar injury patterns seem to occur.^{3,5,16-21}

The most common cause of outdoor injuries was pinching in the front door of house or school. Most (80%) injuries occurred between 14:00 and 20:00 pm. This distribution was likely associated with the children's attendance of school or kindergarten before noon, and an increase in carelessness due to fatigue during this time period.

Consistent with other studies, the male to female ratio was 1.5:1 (305:202).

More injuries occurred in preschool-children (2-6 years; n: 384, 75.7%) than in children aged 0-2 years (n: 123, 24.2%; $p < 0.05$). In particular, the increased number of injuries in children aged 1-2 years (n: 86, 16.9%) was considered to be the result of newly developing hand-motor cortex associations and the related inability to walk in a controlled/skilled manner.

The 64.1% rate of dominant-hand injuries observed in our study was consistent with the findings of other studies conducted in the same age group. We considered this result might have been occurred due to the high rate of dominant right-hand use throughout society.

Although Ljungberg et al. reported the high hospitalization rate (65%), rate was varied from 1.4% to 3.4% in the other studies.^{3,5,11,16} This rate was 13.8% (70/437) in our study. This difference was likely associated with the location of our hospital in a metropolis and also with being the reference center for hand injuries.

Although third fingertip injuries were more common than other ones, this difference was not significant ($p > 0.05$). In this age group, because of the wound recovery is better than the adults, amputated fingertip can be used as a composite graft

instead of reconstruction of the defect with skin graft or flap in the early period (first 3 weeks).^{4,22,23} Thus we suggest that these patients can be followed-up weekly intervals and intermittent minimal debridements.

Most of the distal phalanx fractures occurred due to fingers being pinched in doors, they are typically comminuted fractures repaired with finger splint. Non-comminuted displaced fractures (29.5%) were treated with finger splint, following by reduction with K-wire.

The ratio of extensor to flexor tendon injury was 3:2. 45% of the extensor injuries were in zone 1 with mallet finger deformity. Contusion was the cause of injury in 89% of these cases. 76% of the flexor injuries were in zone 2 and 3. 91% of these cases were glass-related injuries. In our series, the flexor tendon injuries were mostly combined injuries. Because of the difficulty of physical examination in this age group delicate dissection should be done under microscope or loupe magnification to determine the all injured tissues. While 18 patients with extensor tendon injuries underwent urgent surgical intervention and two cases underwent elective surgery, 9 patients with flexor tendon injuries underwent urgent surgical intervention and 20 cases underwent elective surgery. The excess number of elective surgeries for flexor tendon injuries might be result of the late referral of the patients to our department due to the difficulty of detailed hand examinations in this age group.

The method and timing of rehabilitation of pediatric tendon injuries remain controversial.²⁴ Whereas Berndtsson et al. and O'Connell et al. considered early exercise to be unnecessary, Grobelaar et al. and Hölwarth et al. reported successful outcomes with early controlled exercise.²⁵⁻²⁸ O'Connell et al. recommended exercise after 3-4 weeks of immobilization.²⁶ We initiated controlled exercise after 2 weeks of immobilization. We tried to increase the child's compliance with a home-based exercise program by paying attention to the education of parents. Thus rehabilitation of the

children may be achieved and fear of hospitals may be reduced partially by taking child apart from the hospital setting.

Replantation is technically more challenging in children due to small vessel diameters and the tendency to vasospasm.²⁹⁻³¹ Therefore the missing limb can adversely affect the child's psychosocial development, replantation must be attempted in all amputation injuries of the children. Replantation was attempted in all cases admitted with total amputations. Our success rate was 66.6% (4/6 cases). Replantation was unsuccessful in two cases with contusion-related amputations.

Complications occurred in 10 cases (1.9%), nonunion (n:3), tendon rupture (n:2), and soft-tissue infection (n:2). Secondary tenolysis was performed in three cases. The complication rate in our study was consistent with other reports. Our infection rate (0.4%) was lower than other studies.^{3,32} Joint stiffness, tendon adhesion, and neuroma are less common in children than adults due to rapid wound healing.³³

In conclusion, children in the 0-6-years age group do not have adequate motor function to protect themselves against many accidents. Accidents have been demonstrated to be a major reason for disability and death in this age group. Despite variations among geographic regions and age groups, indoor accidents (e.g., at home) constitute 25% of all accidents. In a study conducted in our country, this rate was reported as 18%.³⁴ In another study including children aged 1-7 years, one-third of children were reported to have had a indoor accident.³⁵ A definitive scale for safety measurements taken by mothers against home accidents for 0-6-year-old children is defined as an useful tool by an investigator for preventing accidents.³⁶ Additionally, educational and informational studies conducted to prevent injuries also provided significant outcomes.³⁷ Protecting children against accidents is essentially based on the precautions taken by adults especially between 14:00-20:00 o'clock, at spring and summer time to the contusion injury.

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