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Clinical and Demographic Features of Pediatric Patients with Limb Loss

Ekstremite Kaybı Olan Pediatrik Hastaların Klinik ve Demografik Özellikleri

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ABSTRACT Objective: Limb loss frequently leads to permanent disability and there is a lack of information on the characteristics of children with limb loss in Turkey. This study was aimed to present the clinical and demographic features of pediatric patients with limb loss for helping preventive actions of extremity loss. **Material and Methods:** This retrospective study comprised patients aged 0-16 years at the time of injury who were admitted to the rehabilitation center for prosthesis. Analysis was made of the demographic and clinical features including age, time since amputation, gender, etiology, level and side of the amputation. **Results:** Evaluation was made of 32 patients (20 boys and 12 girls) with the loss of 41 limbs. The mean age at the time of the study was 11.46 years. Acquired amputations were seen in 23 patients (71.9%) and in the other 9 cases, congenital limb deficiency was the cause of limb loss. Motor vehicle accident (MVA) was the leading cause of acquired amputation in the pediatric population (28.1%). The mean age at the time of amputation related with MVA, industrial injury and burning due to electric shock was 9.44, 15.25 and 5 years, respectively. There was a statistically significant difference between acquired amputation and congenital limb deficiency in respect of time since injury (p: 0.01). **Conclusion:** Traumatic amputations were the cause of limb loss in most of the pediatric patients. The leading causes of the amputation were MVA, industrial injury and electric shock. Education of children and their parents is of paramount importance in order to prevent acquired amputation.

Keywords: Rehabilitation; pediatric amputation; limb loss

ÖZET Amaç: Ekstremite kaybı sıklıkla kalıcı dizabiliteye neden olur ve Türkiye'de ekstremite kaybı olan çocukların karakteristikleri ile ilgili bilgi eksikliği vardır. Bu çalışmada ekstremite kaybını önleyici çalışmalara yardımcı olması için ekstremite kaybı olan pediatrik hastaların klinik ve demografik özelliklerinin sunulması amaçlanmaktadır. **Gereç ve Yöntemler:** Bu retrospektif çalışma populasyonu olay zamanında 0-16 yaş arasında olup protez için rehabilitasyon merkezine başvuran hastalardan oluşmaktadır. Hastaların yaş, olay sonrası geçen süre, cinsiyet, etiyoloji, ampütasyon seviyesi ve tarafını içeren demografik ve klinik özellikleri analiz edildi. **Bulgular:** 41 ekstremite kaybı olan 32 hasta (20 erkek ve 12 kız) değerlendirildi. Çalışma zamanındaki ortalama yaş 11.46 yıldı. Edinilmiş ampütasyon 23 (%71.9) hastada mevcuttu ve diğer 9 vakada ekstremite kaybının nedeni doğumsal ekstremite yokluğuydu. Motorlu taşıt kazaları (MTK) pediatrik popülasyonda edinilmiş ampütasyonların en önemli nedeniydi (%28.1). MTK, iş kazaları ve elektrik çarpmasına bağlı gelişen ampütasyonların ortalama oluş yaşları sırasıyla 9.44, 15.25 ve 5 yıl idi. Edinilmiş amputasyon ve doğumsal ekstremite yokluğu arasında olay sonrası geçen süre açısından istatistiksel anlamlı fark tespit edildi (p: 0.01). **Sonuç:** Pediatrik hastaların çoğunda ekstremite kaybının nedeni travmatik ampütasyondu. Amputasyonların en sık nedeni MTK, iş kazaları ve elektrik çarpması idi. Çocukların ve onların bakıcılarının eğitimi travmatik amputasyonların önlenmesinde büyük öneme sahiptir.

Anahtar Kelimeler: Rehabilitasyon; pediatrik ampütasyon; ekstremite kaybı

Limb loss in pediatric patients may be the result of congenital limb deficiency or acquired amputations. Congenital limb deficiency and acquired amputations present both physical and financial challenges

for the affected children and their families. As limb loss frequently leads to lifelong disability, it is crucial to identify clinical characteristics in order to ensure prevention and treatment strategies.

Children should not be regarded as small adults as there are some important differences in the management of children and adult patients with limb loss. The etiology of the limb loss, musculoskeletal growth, functional demand and expectations on the locomotor system and prosthesis, bone overgrowth, and psychological conditions, all make caring for limb loss in the pediatric population obviously difficult.

There are published studies in literature about the features of the pediatric amputee population, including demographic and clinical features and the economic burden to the family.[1-11] However, there is a lack of Turkey-based literature on this topic. The aim of this study was to report the demographic and clinical features of congenital limb deficiency and acquired amputations in pediatric population admitted to a tertiary rehabilitation center and thereby to ensure assistance for the implementation of preventive measures.

MATERIAL AND METHODS

This study was designed as a retrospective study to investigate the clinical and demographic features of the pediatric individuals with limb loss. The study protocol was approved by the Gülhane Military Medicine Academy Ethics Committee (170/2015). The cases for study were selected from a search of the computerized database of admissions to a single tertiary rehabilitation center during 2011 and 2017. Children aged 0-16 years at the time of injury with a congenital limb deficiency or acquired amputation were included. Exclusion criteria were partial foot, hand or finger loss.

A chart review was performed to identify demographic and clinical data including the age (current and at the time of injury), time since injury, gender, etiology, affected limb number, side and level of limb loss and currently used prosthesis. Patients were divided into two groups according to the etiology (congenital vs. acquired). Congenital limb deficiency was defined as partial or total loss of one or more skeletal parts of the limbs at birth. The mechanisms of the acquired amputations were recorded as motor vehicle accident (MVA), industrial injury, infection, electric shock, crush under heavy equipment, rheumatological disease and tumor.

Statistical analysis was performed using SPSS v.15.0 for Windows (SPSS, Inc., Chicago, IL, USA). Categorical variables such as gender and etiology were shown as percentage and frequencies and were compared between groups using the Chi-square test. Continuous variables such as age and time since injury were presented as mean±standard deviation and range (min.-max.). The normality of the distribution of numeric variables was examined using the Kolmogorov-Smirnov test. Differences between groups were determined via the Mann-Whitney U test when there was non-normal distribution of data. For all statistical tests, a value of $p<0.05$ was considered statistically significant.

RESULTS

Evaluation was made of 32 children (20 boys and 12 girls) with a total loss of 41 limbs. The mean age at the time of the study was 11.46 years (SD 4.72; range 1-18 years). Acquired amputations were seen in 23 patients (71.9%). The other 9 children had congenital diseases as the cause of limb loss. The demographic and clinical features of the patients are summarized in Table 1.

ACQUIRED LIMB AMPUTATION

This sub-group comprised 16 males (69.6%) and 7 females (30.4%) with a mean age of 12.21 years (SD 4.83; range 1-18 years). The mean time since injury was 3.43 years (SD 3.4). One extremity was amputated in 17 (73.9%) cases, 2 in 5 cases and 4 extremities in 1 case. Of the 31 acquired amputations, 18 (58%) were lower limbs, and 13 (42%) were upper limbs. There were 11 (35.4%) below-the-knee and 7 (22.5%) below-the-elbow level amputations. The level and side of the amputations are shown in Table 1.

TABLE 1: Demographic and clinical features of the patients.

	Total	Congenital	Acquired	p value
Current age (years)	11.46±4.72	9.55±4.06	12.21±4.83	0.094
Time since injury (years)	5.15±4.52	9.55±4.06	3.43±3.4	0.01
Gender				0.187
Male	20 (62.5)	4 (44.4)	16 (69.6)	
Female	12 (37.5)	5 (55.6)	7 (30.4)	
Level of amputation (total of 41 amputations)				0.332
Lower limb	24 (58.5)	6 (60)	18 (58)	
Above knee	5 (12.1)	2 (20)	3 (9.6)	
Knee	6 (14.6)	4 (40)	2 (6.4)	
Below knee	11 (26.8)	-	11 (35.4)	
Syme	2 (4.8)	-	2 (6.4)	
Upper limb	17 (41.5)	4 (40)	13 (42)	
Above elbow	4 (9.7)	-	4 (12.9)	
Elbow	2 (4.8)	1 (10)	1 (3.2)	
Below elbow	10 (24.3)	3 (30)	7 (22.5)	
Wrist	1 (2.4)	-	1 (3.2)	
Side				0.258
Left	14 (43.8)	6 (66.7)	8 (34.8)	
Right	13 (40.6)	2 (22.2)	11 (47.8)	
Bilateral	5 (15.6)	1 (11.1)	4 (14.4)	

MVA was the leading cause of acquired amputation (28.1%). Other reasons for amputation were industrial injury, burning due to electric shock, infection, crushing under heavy equipment, rheumatological diseases and tumor (Figure 1).

The mean age at the time of amputation secondary to MVA, industrial injury and burning due to electric shock were 9.44, 15.25 and 5 years, respectively. The distribution of the age of the children with acquired amputations is shown in Figure 2.

The most frequently used upper and lower extremity prosthesis were myoelectric (7 cases) and modular (11 cases), with respectively (Table 2).

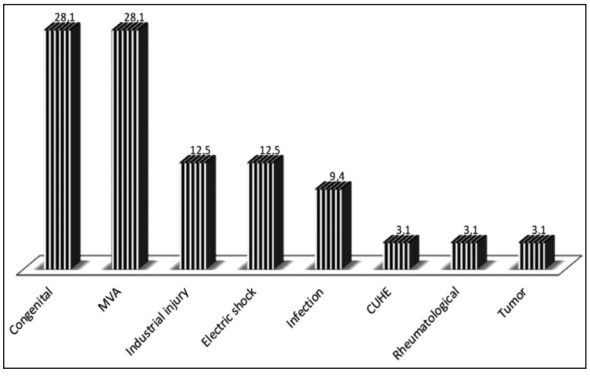

FIGURE 1: Percentage of congenital and acquired pediatric limb loss.
MVA: Motor vehicle accident; CUHE: Crushing under heavy equipment.

CONGENITAL LIMB DEFICIENCY

Congenital limb deficiencies were seen in 9 children (5 male and 4 female). The mean age at the time of the study was 9.55 years (SD 4.06; range 2-16 years). The mean time since injury was 9.55 years (SD 4.06). One extremity was involved in 8 patients and 2 in 1 patient. The level and side of the limb deficiencies are shown in Table 1.

The two groups (acquired and congenital) were compared according to the demographic and clinical features. There was a statistically significant difference between the groups with regard to the time since injury (p:0.01).

There were 2 myoelectric and 2 mechanical upper limb prosthesis users in patients with congenital limb deficiency (Table 2). Most frequently used lower limb prosthesis type was microprocessor knee (4 cases).

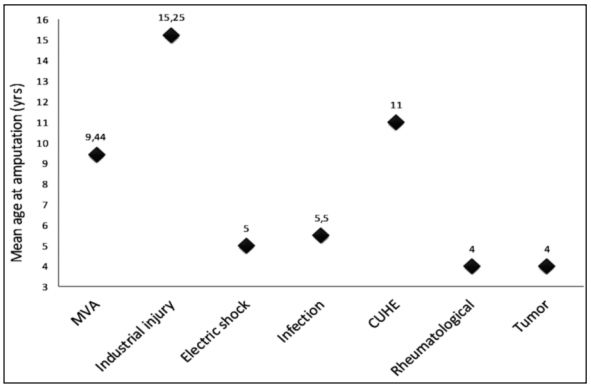

FIGURE 2: Age distribution of acquired amputations.
MVA: Motor vehicle accident; CUHE: Crushing under heavy equipment.

DISCUSSION

This study presented the basic demographic and clinical information about limb loss in pediatric patients admitted to our hospital. The majority of the patients had acquired amputations, for which the leading reason was MVA. Industrial injury and burning due to electric shock were other common preventable causes which resulted in amputations in the pediatric population. The mean age at the time of amputation was found to vary according to the etiology. In addition, the duration of the disease was significantly longer in patients with congenital limb deficiency.

Previous literature related to pediatric limb loss has reported a congenital limb deficiency rate of 60-73% compared to acquired amputations.[11-15] However, in the current study, acquired amputations were found to be much more common than congenital limb deficiencies (71.9% vs 28.1%). This contrast can be explained in several ways. First is that patients with congenital limb loss and their parents might have thought that the residual limb could serve as a functional limb or that it would heal. Secondly, they might have not applied for prosthesis because of the fear of further amputation of the residual limb. Thirdly, there might have been unwilling acceptance of the limb deficiency. Thus, it is not meaningful to generalize these results.

Children with acquired amputations differ from adults with regard to etiology. Two of the main causes of acquired amputations in the pediatric population are trauma and neoplasm.[11-15] Few childhood amputations are caused by vascular disorders which are highly prevalent among older patients.[16] Unlike in our country, traumatic amputation injuries related to power tools and other cutting instruments, especially lawn mover, were most common reason of traumatic amputations.[17] Main causes of traumatic amputations in Turkey differ from developed countries. MVA, industrial injury and electrical burns were found to be the leading causes of acquired amputations in the current study. The majority of traumatic causes resulting in amputation in childhood have a significant common feature; they are preventable. Therefore, medical and education professionals should have a key role in actively promoting the prevention of these injuries. MVA-related extremity loss can be reduced by designing safe and protected playgrounds and sports facilities and raising parental awareness of the importance of child seats and seatbelts in cars. Physical proximity and continuous visual and auditory contact with a child, who is vulnerable and undefended against all kinds of accidents, could significantly reduce amputations and other childhood injuries.[18,19]

TABLE 2: Type of currently used prosthesis.

Type	Congenital Limb Deficiency	Acquired Amputation	Total
Upper extremity			
Myoelectric	2 (50)	7 (53.8)	9
Mechanic	2 (50)	6 (46.2)	8
Lower extremity			
Modular	2 (33.3)	11 (61.1)	14 (58.3)
Microprocessor knee	4 (66.6)	7 (38.9)	10 (41.7)

Loder reported that the mean age at the time of injury ranged from 1.9±1.9 years (burn related amputation) to 11.5±4.4 years (boating accident) and the mean age at the time of injury related to MVA was 11.1 years.[2] In the current study, the highest mean age at the time of injury was found in children with an industrial injury-related amputation (15.25±1.25 years). It can be explained by child labor in Turkey. Children can be found working in many dangerous places like factories, mines, quarries, on the land and other worse industries. Strict restrictions could lower the industry related amputations in Turkey. The lowest mean age was found in patients with neoplasm and rheumatological disease (4 years) in the current study. Knowledge of the mean age at the time of injury may be helpful in organizing age-appropriate educational activities for children and their parents to raise awareness.

The time since injury in patients with congenital limb deficiency was nearly threefold longer than in those with acquired amputations. It could be commented that patients with congenital limb deficiency have a naturally longer duration as they born with this loss. However, the children with congenital limb deficiencies may try to overcome their disabilities by using their residual and intact limbs, and the families may not seek medical and prosthetic care. In addition, patients with acquired amputations and their parents may have difficulty in adapting to the newly developed condition. Therefore, to overcome this handicap, they may be keen to have a new limb as soon as possible.

Prosthesis use rejection rate in children is higher than adult.[20,21] In order to increase this rate, a multidisciplinary/interdisciplinary approach is recommended because differences between fitting adults and fitting children with prostheses truly exist.[22] The various limb anomalies and configurations without or after surgery create challenges to the prosthetic team. Another difference is that the unpredictable growth of the child must be considered when deciding the design. In most instances, in pediatric fittings, some type of growth compensation is suggested.

There are some limitations in the current study. As we assessed specific age group, sample size was small. In addition this study was conducted in a single center. In future, new studies evaluating prosthetic use in pediatric population with larger sample size in multi-center design would be more beneficial.

CONCLUSION

Most of the children admitted to the rehabilitation center for prosthesis had acquired amputations. The leading causes were MVA, industrial injury and electrical burns. Education of the children and their care givers is of paramount importance to prevent these injuries.

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