Severe hand injuries in children related to farm tractors: a report of 70 cases

Çocuklarda traktöre bağlı ciddi el yaralanmaları: 70 olgunun sunumu

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BACKGROUND
The purpose of this study was to review tractor-related childhood hand injuries.

METHODS
Seventy children (53 males, 17 females; range 1 to 11 years) were admitted to our unit. Patients were analyzed according to sex, age, pattern of injury, type of treatment and functional results. The first step of the treatment included extensive debridement and irrigation. Patients with complex tissue defects were treated with multi-stage reconstruction procedures. Patients with amputations or partial amputations were treated with amputation of the devascularized digits.

RESULTS
The most common injuries were amputations and complex tissue defects. Other types of injuries were fractures, partial amputations and skin defects. In 20 cases, skin defects were covered with split-thickness skin grafts and the functional results were good. In 40 cases with complex soft tissue injuries, skin defects were covered with flaps. The functional results were good in 30 and fair in 10. In 50 digits with complete amputations, attempts at revascularization immediately after injury failed in all patients. The functional results were good in 40, fair in 5 and poor in 5. All fractures healed in 6 weeks and no complications related with bone healing were observed.

CONCLUSION
The concepts of aggressive debridement, fracture reduction, and early soft tissue coverage are central to the care of these hand injuries.

Key Words: Accidents; agriculture; child; tractor-related hand injuries; wounds/surgery.

AMAÇ
Bu çalışmada, çocukluk döneminde görülen traktöre bağlı el yaralanmaları gözden geçirildi.

GEREÇ VE YÖNTEM
Merkezimize 70 çocuk hasta (53 erkek, 17 kız; dağılım 1-11 yaş) kabul edildi. Hastalar cinsiyet, yaş, hasarlanmanın tipi, tedavinin şekli ve fonksiyonel sonuçlar açısından analiz edildi. Tedavinin ilk basamağı geniş debridman ve irigasyondu. Kompleks yumuşak doku defekti olan hastalar çok seanslı rekonstrüksiyon girişimleri ile tedavi edildi. Amputasyon veya kısmi amputasyonlarda dolaşımı olmayan parmaklara amputasyon uygulandı.

BULGULAR
En sık karşılaşılan hasarlanma tipi, amputasyonlar ve kompleks yumuşak doku defektleri idi. Diğer hasarlanmalar içerisinde, kırıklar, kısmi amputasyonlar ve cilt defektleri yer almakta idi. Yirmi olguda cilt defekti kısmi kalınlıkta deri grefti ile kapatıldı ve fonksiyonel sonuçlar iyi idi. Kompleks yumuşak doku hasarlanması olan 40 olguda cilt defekti flep ile kapatıldı. Fonksiyonel sonuçlar bu olguların 30'unda iyi ve 10'unda orta idi. Tam amputasyon olan 50 parmak da hasarlanmadan hemen sonra revaskülarizasyon denendi ancak olguların hepsinde başarısızlıkla sonuçlandı. Fonksiyonel sonuçlar olguların 40'ında iyi, 5'inde orta ve 5'inde kötü idi. Bütün kırıklar 6 hafta içerisinde iyileşti ve kemik iyileşmesi ile ilgili komplikasyon gözlenmedi.

SONUÇ
Bu ciddi el yaralanmalarında agresif debridman, kırık redüksiyonu ve erken yumuşak doku örtümü temel tedavi yöntemleridir.

Anahtar Sözcükler: Kazalar; tarım; çocuk; traktöre bağlı el yaralanmaları; yaralanma/cerrahi.

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New hazards, especially for children, have emerged as a result of modern high-technology farming. Farm machinery has increased in work-power, but has not become safer for use. Since the incidence of tractor-related injuries has risen, increased awareness and preventive measures need to be implemented to alter the incidence of accidental injury on the farm. Tractor roll-over structures are the leading cause of this serious injury.[1]

Agricultural safety and occupational health specialists reported that roll-over protective structures significantly reduce the rate of severe injuries on farms.[2,3] However, even in many developing countries, tractors generally do not have these simple protective structures.

Our aim in this clinical study was to review the childhood hand injuries due to tractor roll-over structures, to discuss the treatment strategies, and to reemphasize the preventive measures.

MATERIALS AND METHODS

Seventy children with hand injuries due to tractor-related accidents were treated in the Division of Hand Surgery, Medical Faculty of Uludağ University, Bursa, Turkey between 1990 and 2002. All patients were analyzed according to sex, age, pattern of injury, type of treatment and functional results. The functional results were assessed as good, fair or poor on the basis of the parents' subjective evaluation of the usefulness of the injured hand. A good result implied a hand capable of grasp and pinch. A fair result implied that the treated hand was useful in conjunction with the opposite hand. A poor result implied that the hand had no useful function and was of little value.

Since these injuries usually presented as a contaminated burn-like appearance caused by heat and friction (Fig. 1), the first step of the management included extensive debridement and irrigation. After the wound was free of infection, the defect was covered with split-thickness skin graft when possible, otherwise a flap was performed. For more complex injuries, multi-stage reconstruction including soft tissue coverage and nerve and tendon grafting was planned. In these injuries, in the first stage, soft tissue coverage was provided using distant pedicled flaps. In the second stage, tendon and nerve reconstructions were performed.

RESULTS

The study group included 53 boys and 17 girls, ranging in age from 1 to 11 years. Fifty-five patients were less than 6 years old, and peak incidence was at the age of 4 years (Fig. 2).

Tractor roll-over structures were the cause of these injuries. These patients usually have several hand injuries (154 injuries in 70 children). The most common hand injuries were amputations and complex soft tissue defects. Other types of injuries were fractures, partial amputations and skin defects (Table 1).

In 20 cases, skin defects were covered with split-thickness skin grafts. Two surgical procedures were required. In all cases, wounds healed completely and no infection was reported. The functional results were good. In 40 cases with complex soft tissue injuries, skin defects were covered with flaps; groin flaps were performed in 30 cases and reverse ulnar flaps in 10 cases (Fig. 3). The func-

Fig. 1. Tractor-related injury of the right hand: devascularization of the fourth finger.

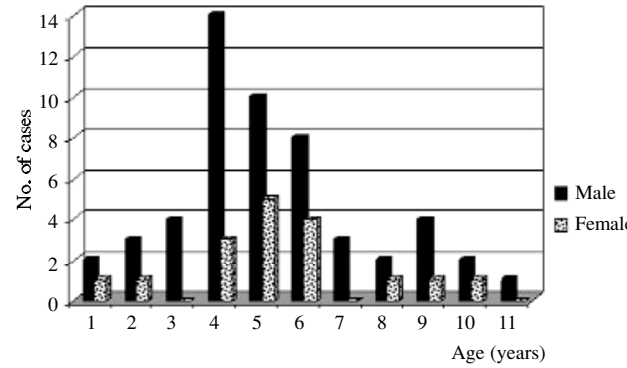

Fig. 2. Age and sex distribution of 70 tractor-related hand injuries in children.

Table 1. Tractor-related hand injuries

Type of injury	Cases
Skin defect	20
Complex soft tissue defect	40
Amputation	50
Single digit	30
Multiple digits	20
Fractures	30
Single digit	20
Multiple digits	10
Partial amputation	14
Single digit	10
Multiple digits	4

tional results were good in 30 and fair in 10. Five operations (range: 6 to 10) were required. In 50 digits with complete amputations, attempts at revascularization immediately after injury failed in all patients. The functional results were good in 40, fair in 5 and poor in 5. The number of the digits involved and the level of the amputation affected the outcome results.

All fractures healed in an average of 6 weeks (range: 5-9 weeks). None of the patients reported problems with bone healing.

DISCUSSION

Tractor-related hand injuries are a significant problem among children, especially in rural environments.[4-9] In such injuries, tractor roll-over structures play a prominent role. Since these injuries cause catastrophic results, effective safety regulations should be implemented. Several preventive strategies that could reduce the incidence and severity of these injuries were reported in previous studies.[10,11]

First, parents should be informed by physicians, communication media and government agencies about the hazards their children may face. In our study, the peak number of accidents occurred at 4 years of age. This age group generally includes curious individuals who are unable to be responsible for their own safety, so parents should observe their children carefully and keep them away from farm hazards. On the other hand, any rotating pieces of the tractor should be hidden by an inviolable protection. All tractors should be equipped with roll-over protective structures and these structures should be designed so that they can not be removed.

Hand injuries caused by tractor roll-over structures are basically severe, and generally require multiple reconstructive surgical procedures. Heat and friction are the mechanism of this serious injury. The first step should be debridement and local wound care. Wound coverage should then be performed with skin graft or flap depending on the nature of the defect. We mostly preferred groin flaps to provide soft tissue coverage because the donor site morbidity is minimal and the surgical procedure is simple and short. However, disadvantage of this flap is the requirement of a two-stage procedure. Patients with defected tendons should immediately undergo effective rehabilitation care

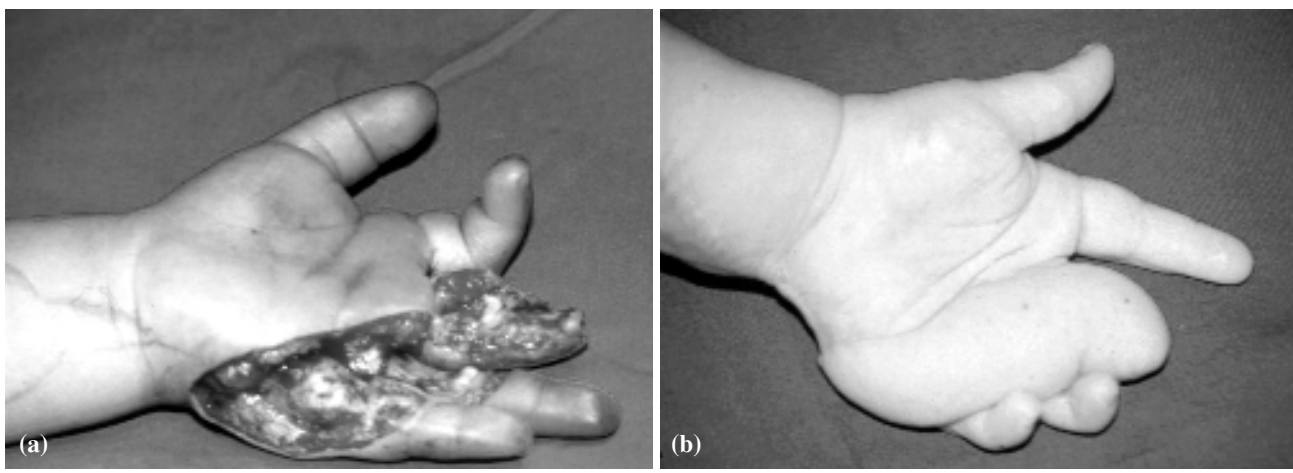

Fig. 3. (a) Tractor-related injury of the left hand after initial debridement. **(b)** Reconstruction of the injury with reverse ulnar flap.

after adequate coverage of the wound in order to spare the range of motion of the affected fingers. The final treatment includes tendon reconstruction and nerve grafting when needed.

Reconstruction of the vascular injury at the digital level is generally impossible because of the intimal damage to the entire digital arterial segments. If the digital vascular injury is bilateral, amputation is almost inevitable.

In conclusion, these complex heat and friction injuries present a real challenge for hand surgeons. Therefore, every attempt should be made towards the prevention of these peculiar injuries.

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