

## Causes of open fractures: orthopaedic injuries related to home-made agricultural vehicles in the eastern Black Sea region of Turkey

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**Background/aim:** Small vehicles known locally as pat-pats, which are used in agricultural work, are forbidden in traffic. The inherent instability of the vehicle may result in accidents, both on farmland and in traffic. The aim of this study was to evaluate orthopaedic injuries related to pat-pats.

**Materials and methods:** Patients hospitalised for pat-pat accidents in two central hospitals in Samsun between December 2006 and October 2013 were scanned using ICD codes. A total of 46 patients with orthopaedic injuries (43 male, 3 female) with a mean age of 36 ± 13.3 years were evaluated.

**Results:** The most injured age group was between 10 and 49 years (n = 40, 87%), and accidents occurred most in summer (n = 30, 65%). Open fractures were determined in 42 (91%) patients. Amputation was necessary in 4 (8%) patients. The hospitalisation period was a mean of 17.1 ± 14 days. A statistically significant relationship was determined between open fracture type and the hospitalisation period (P < 0.001).

**Conclusion:** As most of the orthopaedic injuries related to home-made agricultural machines are open fractures, it is important to guard against these types of injuries. The regulations that these machines are not used in traffic should be enforced and safer practices should be applied for use in agriculture.

**Key words:** Agriculture, accidents, open fractures, traffic

### 1. Introduction

Together with industrial development, there is an ongoing increase in the use of modern agricultural machines. Even though these machines have made a great contribution to agriculture, inexperience and careless use have resulted in significant accidents. Injuries associated with agricultural vehicles are often seen in countries where agriculture is a significant source of livelihood. In Turkey, where approximately 20 million people are involved in agriculture, the risk of agriculturally related injuries has been reported to be 909/100,000 (1). The mean cost of accidents to the Turkish agricultural sector is 81% greater than the cost of accidents in other sectors (2). As in other countries, tractor accidents are the most common agriculture-related accidents in Turkey (3,4). The extremities are most often involved in agricultural injuries (4).

The pat-pat, which is so-called because of the sound emitted, is a vehicle resembling an ATV used in the agricultural sector. It consists of two parts, the engine and

the trailer (Figure 1a). There are three or four forward gears and one reverse; it is 7.5–12 horsepower and 300–350 kg in weight. By attaching a trailer approximately 90 cm in length to the back, it is possible to use it for carrying goods or as an agricultural vehicle with special equipment (Figures 1b and 1c). One ton or the equivalent weight of 10–15 people can be carried. These vehicles were designed for use on rough ground and the recommended maximum speed is 40 km per hour (5). As the pat-pat is economical on petrol and thus low cost and does not require a licence or registration, it is an attractive choice for use as an agricultural vehicle in Anatolia. It is in widespread use in the eastern Black Sea region as the regional geography is rough and mountainous. Another characteristic of the pat-pat is that it is able to go into fields that tractors cannot. Balance problems of the pat-pat and inadequate safety precautions taken by those using them, result in overturning accidents. Most accidents are caused by balance problems when the trailer is attached and overloaded. Pat-pat accidents

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**Figure 1a.** Pat-pat with attached trailer.



**Figure 1b and 1c.** Pat-pat as an agricultural vehicle with special equipment.

generally occur as a result of it overturning. The use of these vehicles in traffic is forbidden, but the illegal use of these vehicles in traffic can result in accidents. Another form of injury is from agricultural accidents when the pat-pat is used with special agricultural equipment.

This study aimed to evaluate the demographic and epidemiological characteristics of orthopaedic injuries resulting from pat-pat accidents in the eastern Black Sea region where they are widely used in agriculture.

## 2. Materials and methods

A retrospective evaluation was made of computer and hospital records using ICD codes of patients who presented at the two central hospitals of Samsun Training and Research Hospital and Ondokuz Mayıs University Medical Faculty Hospital in the province of Samsun between December 2006 and October 2013. After listing agricultural accidents according to the ICD codes, the patient records were examined and patients involved in pat-pat accidents with orthopaedic injuries were included in the study.

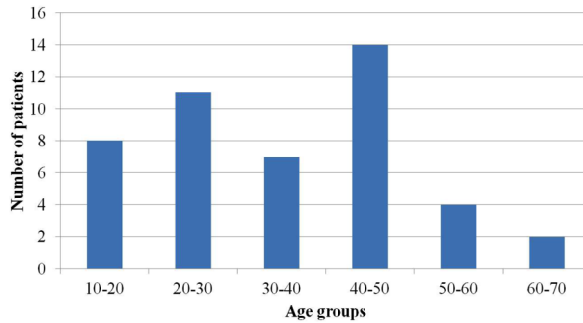
Patients were evaluated in respect of sex, age, month and season of injury, diagnosis, period of hospitalisation, and requirement for amputation. Patients with head, chest, or abdominal trauma were excluded from the study. Open fractures were classified according to the Gustilo–Anderson classification (6). Time spent in intensive care was included in the hospitalisation period of the patients.

### 2.1. Statistical evaluation

Results were stated as mean  $\pm$  SD. In the data evaluation, the SPSS (Windows Version 16.0) was used. Regression analysis was used in the evaluation of data with each other and in paired relationships.

## 3. Results

A total of 46 patients were evaluated with extremity injuries related to pat-pat accidents. The patients were 43 (93%) males and 3 (7%) females with a mean age of  $36 \pm 13.3$  years. When the age groups of the patients were examined, the most injured age group was between 10 and 49 years, with 40 (87%) patients (Figure 2).



**Figure 2.** Distribution of the patients based on age groups.

The months when the most injuries occurred were July (n = 8, 17%), August (n = 16, 34%), and September (n = 12, 26%). When the accidents were evaluated seasonally, the most accidents were determined to occur in summer (n = 30, 65%).

The mechanisms of injuries were evaluated as 34 (74%) agricultural accidents and 12 (26%) traffic accidents. Of the traffic accidents, the pat-pat of 10 patients had overturned and in 2 cases there had been a collision with another vehicle.

With regard to anatomic localization of fractures, the pelvis or lower extremities were involved in 39 (84%) patients and the upper extremities in 7 (16%). The most common fracture was determined as the tibia with 32 cases (65%) (Table 1).

On presentation, 42 (91%) patients had an open fracture (Figures 3a and 3b). According to the Gustilo–Anderson classification, the open fractures were Type 1 (19%) in 8 patients, Type 2 (38%) in 16 patients, and Type 3 (43%) in 18 patients (Table 2).

Four patients (8%) required amputation: 2 below-the-knee, 1 above-the-knee, and 1 finger.

The hospitalisation period was a mean of 17.1 ± 14 days. On the first day of hospitalisation, 1 patient with

fractures of the femur, scapula, and iliac wing died from hemorrhagic shock.

The relationship between the fracture type and the hospitalisation period was statistically significant when evaluated with regression analysis (P < 0.001). No statistically significant relationship was determined between age and hospitalisation period when evaluated with regression analysis (P: 0.651).

**4. Discussion**

Agricultural accidents not only cause physical damage but also lead directly and indirectly to economic loss (2,7). The incidence of these accidents varies from country to country. In a comparison of the UK and Germany, which have similar agricultural techniques, the mortality rate related to agriculture in the UK was observed to be lower but the reason for this difference was not fully explained (8). When all agricultural accidents are examined, in addition to tractors being often involved, they are seen to have more serious and even fatal results (3,4,9–11). Although tractors are a widely used agricultural vehicle, in regions such as the eastern Black Sea where the topography is rugged, they are not often used in practice. In these areas, the pat-pat is used as a tractor.

**Table 1.** Anatomic location of fractures.

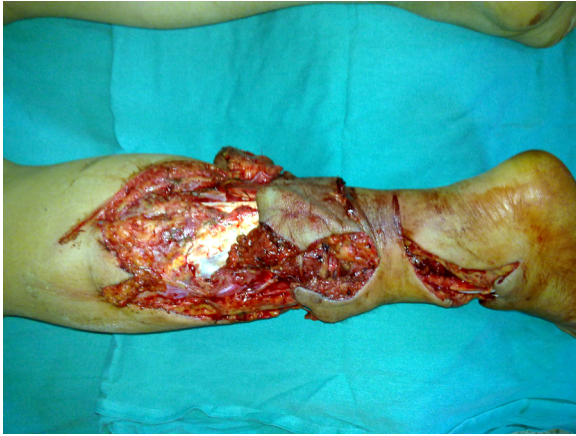
	n
Clavicle	1
Forearm	5
Phalanx	2
Femur	3
Patella	1
Tibia	32
Ankle	5

n : number of fractures

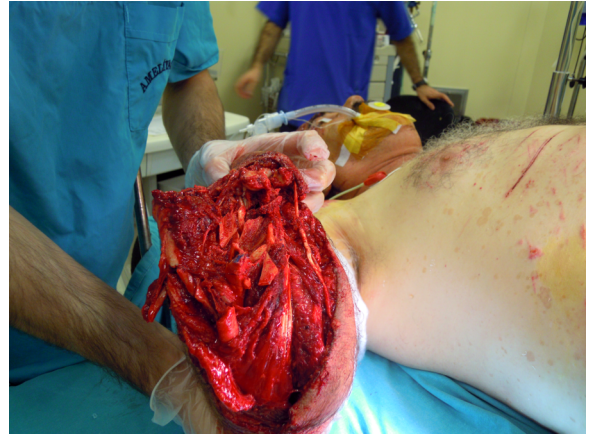
**Table 2.** Open fractures according to the Gustilo–Anderson classification.

	n (%)
Type I	8 (19%)
Type II	16 (38%)
Type IIIA	8 (19%)
Type IIIB	5 (12%)
Type IIIC	5 (12%)

n : number of fractures



**Figure 3a.** A Type 3a open ankle fracture according to the Gustilo-Anderson classification.



**Figure 3b.** A Type 3b open forearm fracture according to the Gustilo-Anderson classification.

In the literature, the proportion of males involved in tractor accidents has been reported as 69.5%–77% (5,11,12). In the current study, the proportion of male patients was 93.4%. The mean age of patients in the current study was  $36 \pm 13.3$  years and the majority of the patients were in the 10–49 years age group. This is explained by the greater proportion of the population living in the region being young males involved in agriculture.

Karapolat et al. (5) reported that traffic accidents were the most frequent mechanism of pat-pat injuries and these occurred most in summer. In the current study, the most common mechanism of accident was agricultural accident. Traffic accidents and the overturning of the pat-pat were the second highest incidence. In the current study, the season when most injuries occurred was summer and the beginning of autumn. The increase in accidents in this period can be explained by it being a time of intensive pat-pat use as the local crop of hazelnuts is harvested in August and September.

Open fractures are often the result of high energy trauma and are complex injuries involving both the bone and the surrounding tissue. All open fractures are regarded as contaminated (13). As these injuries are generally associated with a dirty environment, they carry the risk of infection and healing problems are often seen (14). Injuries resulting from agricultural accidents come from an extremely contaminated environment bacterially. Generally, the use of dirty, old agricultural machinery has been found to contribute to the contamination of open fractures (7).

Even if open fractures require emergency surgical intervention, the priority must be for the patient to be stable in respect of vital signs (15). After it has been ensured that the patient is stable, debridement and irrigation are important factors in the prevention of infection in open fractures (16). Irrigation should not be performed under

emergency conditions as there is a risk of inoculation of deeper tissue by nosocomial microorganisms (17). Only foreign bodies that can be easily reached should be removed before irrigation (18). If irrigation bottles generally contain 3000 cc of fluid, it is recommended that 1 bottle (3000 cc) be used for Type 1 open fractures, 2 bottles (6000 cc) for Type 2 open fractures, and 3 bottles (9000 cc) for Type 3 open fractures (19,20). This irrigation protocol was followed for the open fractures in the current study. Although the treatment of open fractures included debridement and irrigation, 4 patients required amputation. In a study by Hansen et al. (21) of 64 patients with agricultural accident injuries, the most frequently seen injuries following fracture were reported to be lacerations and amputation. The rate of amputation was 8.6% in the current study. Amputation was applied to 2 patients below the knee, to 1 patient above the knee, and to 1 patient's finger. This distribution can be explained by the rate of salvage indications being greater in the upper extremities than in the lower extremities (22).

In the current study, a correlation was found between the hospitalisation period and the severity of the injury. While 1 patient with a Type 3 open fracture was hospitalised for 56 days, the hospitalisation period for an open phalanx fracture was 1 day. Thus, with increased types of open fractures and greater degrees of injury the period of hospitalisation is extended. However, no correlation was determined in the current study between age and hospitalisation period.

The limitations of the study were that the number of patients was low, a separate evaluation was not made of drivers and passengers, and the follow-up period was short.

In conclusion, pat-pat accidents in the eastern Black Sea region, particularly in August and September, are frequently seen accidents that can result in open fractures

and amputation. All systems must be assessed in the affected patient and open fracture treatment protocols that include debridement and irrigation must be followed. To prevent pat-pat accidents, programs should be organised to raise public awareness. These vehicles should not be

used in traffic and regulations should be implemented to provide safer usage as an agricultural vehicle. A review of pat-pats by an engineer could be another option in the prevention of accidents.

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