

An Evaluation of the Mechanisms of Isolated Orthopedic Injuries in Farm Accidents

Çiftlik Kazalarında İzole Ortopedik Yaralanma Mekanizmalarının Değerlendirilmesi

Abstract

Aim: This study aimed to investigate the mechanisms and characteristics of isolated orthopedic injuries from farm accidents which involve the extremities.

Methods: The medical records of 138 patients (31 females, 107 males) who presented to the emergency department with isolated orthopedic injuries from farm accidents were reviewed retrospectively. Data on patient age and sex, mechanism of injury, injured site/extremity, injury type, treatment performed, distance from accident location to hospital, approximate time from accident to hospital arrival, season of injury, and whether skin integrity was impaired were recorded.

Results: The mean patient age was 35.08 (7–71) years. The injuries occurred during the use of riding animals (n=14, 10.1%), combine harvester/tractor equipment (n=14, 10.1%), cattle (n=24, 17.4%), saw/ax/hammer (n=47, 34.1%) and tractors (n=23, 16.7%) and due to falling from height (n=16, 11.6%). Of all accidents, 23 (16.7%) occurred in spring, 66 (47.8%) in summer, 30 (21.7%) in autumn, and 19 (13.8%) in winter. Mechanism of injury was statistically significantly related to season, sex, and site of injury (p=0.001). The time to emergency department visit was shorter in cases with impaired skin integrity (p<0.05).

Conclusion: The mechanism of injury can vary seasonally together with the works performed and machines used. The time to emergency department visit can vary according to whether skin integrity is impaired. As a result of the division of labor in families working in agriculture, mechanism of injury can also vary by sex.

Keywords: accident; agriculture; farm; injury; orthopedics

Öz

Amaç: Bu çalışmada çiftlik kazalarından ileri gelen ve ekstremitelerin etkilendiği ortopedik yaralanmaların mekanizmalarını ve özelliklerini incelemek amaçlanmıştır.

Yöntem: Çiftlik kazası kaynaklı izole ortopedik yaralanma ile acil servise başvuran 138 hastanın (31 kadın, 107 erkek) tıbbi kayıtları retrospektif olarak incelendi. Hasta yaş ve cinsiyeti, yaralanma mekanizması, yaralanan bölge/ekstremita, yaralanma tipi, uygulanan tedavi, kaza yerinin hastaneye uzaklığı, kaza ile hastaneye geliş arasındaki tahmini süre, kaza mevsimi ve cilt bütünlüğünün bozulup bozulmadığı ile ilgili veriler kaydedildi.

Bulgular: Ortalama hasta yaşı 35,08 (7–71) yıldı. Yaralanmalar; binek hayvanı (n=14; %10,1), biçerdöver/traktör ekipmanı (n=14; %10,1), büyükbaş hayvan (n=24; %17,4), testere/balta/çekiç (n=47; %34,1) ve traktör (n=23; %16,7) kullanımı sırasında ve yüksekte düşme (n=16; %11,6) sonucunda meydana gelmişti. Kazaların 23'ü (%16,7) ilkbahar, 66'sı (%47,8) yaz, 30'u (%21,7) sonbahar, 19'u (%13,8) kış mevsiminde gerçekleşmişti. Yaralanma mekanizması ile mevsim, cinsiyet ve yaralanan bölge arasında istatistiksel olarak anlamlı ilişki mevcuttu (p=0,001). Cilt bütünlüğünün bozulduğu vakalarda acil servise başvuru süresi daha kısaydı (p<0,05).

Sonuç: Yaralanma mekanizması yapılan iş ve kullanılan makinelerle birlikte mevsime göre değişebilir. Cilt bütünlüğünün bozulup bozulmaması acil servise başvuru süresini etkileyebilir. Tarımda çalışan aileler içindeki iş bölümü neticesinde yaralanma mekanizması cinsiyete göre de değişim gösterebilir.

Anahtar Sözcükler: çiftlik; kaza; ortopedi; tarım; yaralanma

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Received/Geliş : 24.09.2020
Accepted/Kabul: 11.01.2021

DOI: 10.21673/anadoluklin.799779

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INTRODUCTION

Occupational accidents in agriculture are defined as a sudden incident caused by external factors during agricultural activities. Agriculture is one of the few sectors where dangerous injuries are common (1). In Turkey, where nearly 20 million people are engaged in agriculture, the risk of injury during agricultural activity was reported as 909/100.000 (2).

While agricultural accidents involve injuries that can result in significant morbidity, mortality, and labor loss, access to health-care might be limited by distance and transportation problems in mountainous and rural areas. Although 40% of the Turkish population live in relatively rural areas, there have not been many studies on the extremity and other injuries occurring in farming areas in Turkey (2–5). Also, the distribution of farming activities varies between seasons and among the members of farmer families, creating additional factors for consideration. The present study aimed to investigate the mechanisms and characteristics of isolated orthopedic injuries from various farm accidents occurring in the Eastern Anatolian region of Turkey, where most people are engaged in farming and husbandry and where winters are usually long and harsh.

MATERIALS AND METHODS

We retrospectively reviewed the medical records of patients who had an isolated orthopedic injury from a farm accident and were seen by an orthopedics and traumatology physician at the Emergency Department of the Sarıkamış State Hospital between January 2018 and September 2019. We excluded patients who were seen by physicians from departments other than orthopedics and traumatology, who had additional organ injuries, and who could not be followed up due to referral to an external center with more advanced diagnostic and therapeutic facilities. As a result, we included a total of 138 patients with complete data, whose entire treatment was carried out at our hospital and whose immediate treatment and later follow-ups after treatment at another center were performed at our hospital.

Injuries were divided into 6 groups according to mechanism of injury: injuries from the use of (i) tractors, (ii) combine harvester/tractor equipment, (ii)

saw/ax/hammer, (iv) riding animals (horse/donkey), (v) cattle, and (vi) from falling from height. While falls from riding animals were included in the group of injuries from the use of riding animals, falls from tractors were included in the group of injuries from the use of tractors.

The injured areas/extremities were divided into three groups: the spine, the lower extremities, and the upper extremities. The site of injury was further studied in 12 categories: foot, ankle, leg, knee, hip and thigh, hand, wrist, forearm, elbow, arm, shoulder, and spine. One patient with thigh (quadriceps tendon) injury and 1 patient with hip injury (trochanter major fracture) were classified together under the category of hip and thigh injury.

Data on patient age and sex, mechanism of injury, injured site/extremity, injury type, treatment performed, distance from the accident location to the hospital, approximate time from accident to hospital arrival, season of injury, and whether skin integrity was impaired were recorded.

The distance between the accident location and the hospital was recorded in kilometers. Similarly, the patients were asked about the time of the accident and the time of admission was also obtained from the emergency department records. Then, the approximate time from injury to hospital admission was calculated.

In all cases with impaired skin integrity, irrigation and debridement using isotonic serum was performed before the treatment plan was established. All of these patients received combined antibiotherapy (cefazolin + gentamicin) together with tetanus vaccination.

In cases of non-operative fractures, a splint or circular plaster was used according to the procedure after closed fracture reduction (if reduction was required), and the patients were asked to revisit the outpatient clinic 10 days later. Patients with operative fractures were hospitalized and surgical treatment was scheduled. Patients whose surgery was not feasible in our hospital were transferred to another center where they could be further treated after the first intervention. Stump closure was performed in appropriate cases; however, cases requiring replantation and cases requiring hand surgery/plastic surgery for stump closure were referred to a fully equipped health-care center.

Table 1. The number of cases according to injury type

Injury type	n	%
Upper extremities	88	63.8
Tendon injury	11	
Finger loss	7	
Finger fracture / dislocation	14	
Distal radius / scaphoid fracture	12	
Metacarpal fracture	5	
Clavicle / proximal humerus fracture / shoulder dislocation	9	
Forearm / ulna shaft / radius shaft fracture	9	
Superficial skin cut	16	
Distal humerus / humerus shaft / olecranon fracture	5	
Lower extremities	47	
Anterior cruciate ligament / medial collateral ligament rupture	2	
Superficial skin cut / tendon injury	11	
Tibia plateau / patella / trochanter major fracture	5	
Malleolar fracture	8	
Metatarsal fracture / Lisfranc injury / navicular / cuboid / calcaneus fracture	14	
Quadriceps tendon injury	1	
Distal tibia / tibia shaft fracture	4	
	3	
Spine	3	2.2
Lumbar vertebra fracture	3	
Total	138	

Statistical analysis

Statistical analysis was performed using the SPSS (v. 24.0) software package. Normal distribution was assessed by the Shapiro–Wilk test. To compare quantitative data of independent groups, the Student t test was used for normally distributed data and the Mann–Whitney U test for non-normally distributed data. The chi-square test and Pearson correlation coefficient analysis were used to investigate the relationship between independent/quantitative variables. Numerical variables were described as mean±standard deviation and categorical variables as numbers and percentages. $p < 0.05$ was considered statistically significant.

Study ethics

The study protocol was approved by the ethics committee of the Kafkas University (approval no. 3/2/2020-01) and conducted in accordance with the 1964 Declaration of Helsinki and its later amendments.

RESULTS

The study included a total of 138 patients (31 females, 107 males), with a mean age of 35.08 (7–71) years. Regarding the mechanism of injury, the injuries occurred during the use of riding animals (n=14, 10.1%), combine harvester/tractor equipment (n=14, 10.1%), cattle (n=24, 17.4%), saw/ax/hammer (n=47, 34.1%) and tractors (n=23, 16.7%) and due to falling from height (n=16, 11.6%). Of all cases, 88 (63.8%) were injuries of the upper extremities, 47 (34%) were injuries of the lower extremities, and 3 (2.2%) were spinal injuries (2.2%) (Table 1).

Of all accidents, 23 (16.7%) occurred in spring, 66 (47.8%) in summer, 30 (21.7%) in autumn, and 19 (13.8%) in winter. Eighty-two (59.4%) patients presented with fractures. While surgical intervention was performed in 36 (26.1%) cases with fracture and/or tendon injury, conservative treatment was performed in 67 (48.6%) cases with fractures. Skin suturing was performed in the emergency room in 26 (18.9%) patients with a skin cut. Replantation was performed in 2 of the 9 cases with finger loss. In the remaining 7 cases, the injury was due to the use of combine harvester/tractor equipment and, in 2 of them, no repair was possible and stump closure was performed. Skin integrity was impaired in 51 (36.95%) cases: superficial cuts (n=27), finger loss (n=9), tendon injury (n=9), and open fracture (n=6).

The average distance between the accident location (village) and the hospital was 25.39 km (range: 1–65 km). In 7 cases, it took more than 72 hours before the patient came to the emergency department. While 4 of these patients stated that they could not reach the hospital due to winter conditions and transportation problems, the other 3 reported that they sought medical treatment only after their complaints continued as they initially thought that they were well. The time to admission was ≥ 24 hours in 30 (21.7%) cases. The average time from accident to admission for patients other than the abovementioned 7 cases was 10.3 hours (range: 1–72 hours).

There was a statistically significant relationship between mechanism of injury and season, sex, and site of injury ($p=0.001$) (Table 2). Cattle-related injuries were more common in women ($p=0.001$). No statis-

Table 2. Distribution of mechanisms of injury

		Mechanism of injury												p*
		Use of riding animals		Use of combine harvester/tractor equipment		Cattle-related		Use of saw/ax/hammer		Use of tractors		Falls from height		
		n	%	n	%	n	%	n	%	n	%	n	%	
Sex	Male	12	85.7	13	92.9	10	41.7	40	85.1	17	73.9	14	87.5	0.001
	Female	2	14.3	1	7.1	14	58.3	7	14.9	6	26.1	2	12.5	
Site of injury	Foot	0	0.0	0	0.0	8	33.3	5	10.6	3	13.0	2	12.5	0.001
	Ankle	0	0.0	1	7.1	4	16.7	2	4.3	1	4.3	4	25.0	
	Leg	0	0.0	0	0.0	2	22.2	6	66.7	0	0.0	1	11.1	
	Knee	1	16.7	0	0.0	1	16.7	1	16.7	3	50.0	0	0.0	
	Hip and thigh	0	0.0	0	0.0	0	0.0	1	50.0	0	0.0	1	50.0	
	Elbow	3	21.4	0	0.0	0	0.0	0	0.0	2	8.7	0	0.0	
	Hand	0	0.0	9	64.3	7	29.2	28	59.6	1	4.3	0	0.0	
	Wrist	3	21.4	3	21.4	2	8.3	0	0.0	6	26.1	1	6.3	
	Arm	0	0.0	0	0.0	0	0.0	0	0.0	1	4.3	0	0.0	
	Spine	1	7.1	0	0.0	0	0.0	0	0.0	1	4.3	1	6.3	
	Shoulder	1	7.1	0	0.0	0	0.0	0	0.0	3	13.0	5	31.3	
	Forearm	5	35.7	1	7.1	0	0.0	4	8.5	2	8.7	1	6.3	
Area / extremity	Lower extremities	1	7.1	1	7.1	15	62.5	15	31.9	7	30.4	8	50.0	0.006
	Spine	1	7.1	0	0.0	0	0.0	0	0.0	1	4.3	1	6.3	
	Upper extremities	12	85.7	13	92.9	9	37.5	32	68.1	15	65.2	7	43.8	
Was skin integrity impaired?	Yes	0	0.0	8	57.1	3	12.5	39	83.0	1	4.3	0	0.0	0.001
	No	14		6	42.9	21	87.5	8	17.0	22	95.7	16	100.0	
Season of injury	Spring	5	35.7	0	0.0	4	16.7	5	10.6	4	17.4	5	31.3	0.001
	Winter	0	0.0	0	0.0	9	37.5	9	19.1	0	0.0	1	6.3	
	Autumn	0	0.0	0	0.0	4	16.7	20	42.6	4	17.4	2	12.5	
	Summer	9	64.3	14	100.0	7	29.2	13	27.7	15	65.2	8	50.0	

* The chi-square test

Table 3. Patient sex and injury characteristics

		Male		Female		p*
		n	%	n	%	
Site of injury	Foot	11	10.4	7	21.9	0.940
	Ankle	6	5.7	6	18.8	
	Leg	8	7.4	1	3.2	
	Knee	4	3.7	2	6.3	
	Hip and thigh	2	1.9	0	0.0	
	Elbow	5	4.7	0	0.0	
	Hand	36	34.0	9	28.1	
	Wrist	12	11.3	3	9.4	
	Arm	1	0.9	0	0.0	
	Spine	3	2.8	0	0.0	
	Shoulder	7	6.6	2	6.3	
	Forearm	11	10.4	2	6.3	
Area / extremity	Lower extremities	31	29.2	16	50.0	0.072
	Spine	3	2.8	0	0.0	
	Upper extremities	72	67.9	16	50.0	
Season of injury	Spring	15	14.2	8	25.0	0.178
	Winter	14	13.2	5	15.6	
	Autumn	21	19.8	9	28.1	
	Summer	56	52.8	10	31.3	

* The chi-square test

Table 4. Skin integrity impairment and other injury characteristics

		Was skin integrity impaired?				<i>p</i> *
		Yes		No		
		n	%	n	%	
Site of injury	Foot	6	11.8	12	13.8	0.001
	Ankle	1	2.0	11	12.6	
	Leg	6	66.7	3	33.3	
	Knee	1	16.7	5	83.3	
	Hip and thigh	1	50.0	1	50.0	
	Elbow	0	0.0	5	5.7	
	Hand	28	54.9	17	19.5	
	Wrist	3	5.9	12	13.8	
	Arm	0	0.0	1	1.1	
	Spine	0	0.0	3	3.4	
	Shoulder	0	0.0	9	10.3	
	Forearm	5	9.8	8	9.2	
Area / extremity	Lower extremities	15	29.4	32	36.8	0.229
	Spine	0	0.0	3	3.4	
	Upper extremities	36	70.6	52	59.8	
Season of injury	Spring	3	5.9	20	23.0	0.001
	Winter	9	17.6	10	11.5	
	Autumn	19	37.3	11	12.6	
	Summer	20	39.2	46	52.9	

* The chi-square test

tically significant relationship was found between sex and site of injury, injured limb, and season ($p > 0.005$) (Table 3). There was a significant difference between patients with and without skin integrity impairment in terms of season and site of injury ($p < 0.05$) (Table 4). Skin integrity impairment was more common in hand and leg injuries and in accidents occurring in winter and autumn.

There was no significant relationship between distance-to-hospital and time-to-admission ($p = 0.183$). The time to emergency department visit was shorter in cases where skin integrity was impaired ($p < 0.05$). No significant difference was found between age and site of injury, injured limb, or season ($p > 0.05$).

DISCUSSION AND CONCLUSION

Acute agricultural injuries often involve the extremities and the non-fatal agricultural injuries are mostly related to falls, animals, use of machinery, and working in hazardous environments (2,4,6,7). Farm injuries involving the extremities are among the important orthopedic problems in developed countries (8), being associated with significant morbidity, mortality, and costs (5). The present study aimed to investigate the

mechanisms of such injuries from farm accidents occurring in Turkey, where agricultural activity has an important share in the national economy.

Farm injuries can occur far away from a healthcare center (9). Access to health-care can be difficult and inadequate due to transportation problems in mountainous and rural areas (3,4,10). Kumar et al. (3) reported that 38.44% of their patients were admitted to hospital 24 hours after injury, and noted that such delays might be due to the lack of transportation vehicles and connection roads, forests, wild animals, and road blockades (especially in rainy seasons). In our study, the rate of admission after ≥ 24 hours was 21.7%. This could be because our study included isolated orthopedic injuries only. There was no statistically significant relationship between distance-to-hospital and time-to-admission. Given the harsh winter conditions in the region, such as heavy snowfall, this result could be caused by transportation problems.

Farm accidents are associated with a wide range of injuries, from simple lacerations to limb losses (4). Kucaba et al. (1) reported that the level of knowledge about first aid among farm workers was insufficient, and that most farmers did not take preventive measures against pesticide poisoning despite their aware-

ness of its perils. Matthew et al. (10) also highlighted the need for first aid training in farmers. It has also been suggested that the existing studies in the literature represent only a small portion of all farm injuries, and that many patients with minor injuries do not visit hospitals (11,12). In our study, though not affected by distance from health-care centers, the time to emergency department visit was found to be significantly shorter in cases of accidents during which skin integrity was impaired. This could be explained by that the patients did not initially go to hospital for injuries without visible signs, such as in the form of closed fractures, and that they did so only in the case of fear of disability or serious injury due to impaired skin integrity, with a tendency to underestimate traumas with no visible sign as a result of insufficient knowledge.

Farm workers work in certain seasons (9) and, depending on harvest times, there might be seasonality in the annual distribution of farm injuries (4). In our study, injuries most frequently occurred in summer, and there was a significant relationship between mechanism of injury and season of injury. This finding could be due to an increase in the saw and ax use with the start of the forestry and wood-cutting season and winter preparations in the post-harvest period, as well as to an increase in the use of tractors and other agricultural machinery at the harvest time.

In the agricultural industry not all farm owners employ workers. Many farmers work as operators, decision-makers, and workers at the same time (13). Farm injuries are prevalent in males (14), and in our study we similarly observed a higher rate of injury in men, except for cattle-related injuries, which were significantly more common in women. This could be explained by division of labor, as often women undertake the task of animal care while men work in more difficult tasks requiring physical power.

Injuries of the hand and the upper extremities are common, representing 40 to 70% of farm injuries (14,15). Finger loss is one of the most common upper extremity injuries from the use of agricultural machinery (14). In our study, 77.8% of the cases of finger loss were related to agricultural machinery. Replantation is not possible in more than half of such accidents, due to irreversible damage to the limb. Preventive measures and increased awareness among farmers could

be more helpful to minimize disability in such cases.

Injuries of the upper extremities in farm accidents have been found to be related to the use of machinery and manual tools, including axes and saws (5,14). Similarly, in our study skin integrity impairment was prevalent in injuries of the hand and was more common in winter and autumn, a finding that could be attributed to increased lumbering activity in the region during these seasons. Farm injuries have also been reported to be frequently associated with fractures (2,6) and, consistently, most (59.4%) injuries in the present study were found to have involved fractures, 23.2% of which were treated surgically.

Finally, the major limitations of the present study are the retrospective design and the lack of long-term follow-up data on patient functional outcomes, mortality, morbidity, costs and loss of labor. In conclusion, it was found that the mechanism of injury could vary seasonally together with the works performed and machines used, requiring the routine and widespread use of protective equipment during farm activities. The time to emergency department visit can vary according to whether skin integrity is impaired. As a result of the division of labor in families working in agriculture, mechanism of injury can also vary by sex.

Conflict-of-Interest and Financial Disclosure

The author declares that he has no conflict of interest to disclose. The author also declares that he did not receive any financial support for the study.

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