

# Retrospective Examination of the Clinical and Demographic Characteristics of Patients with Geriatric Forensic Trauma Admitted to the Emergency Department: A Single-center Experience

Acil Servise Başvuran Geriatrik Adli Olguların Klinik ve Demografik Özelliklerinin Retrospektif İncelenmesi: Tek Merkez Deneyimi

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## Abstract

**Objective:** To determine the demographic and epidemiological characteristics of geriatric patients with forensic trauma admitted to the emergency department of our hospital and to examine factors associated with forensic events in our country.

**Methods:** The data of individuals aged 65 years and older who were admitted to the emergency department of our hospital due to forensic events between 2013 and 2023 were retrospectively analyzed. The patients' demographic characteristics, date and nature of the forensic incident, injury zones, final diagnoses of the forensic patient, and nature and content of the forensic report were examined from the forensic records.

**Results:** Of 173,080 geriatric patients admitted to the emergency department during the study period, 679 were forensic cases. Most patients were men (n=481, 70.8%). The most common type of forensic incident was falls (37.4%), followed by assault (18.1%). Half of the intoxication cases were caused by carbon monoxide. The most frequently injured body areas were the head and neck (39.8%), followed by the upper limbs (27.4%) and lower limbs (19%). Forensic admissions were most common during the summer months (August, July, and June).

**Conclusion:** In this study, falls were the most common cause of geriatric forensic trauma. Therefore, potential fall-related complications can be prevented by carefully evaluating older adults at high risk of falls and taking necessary precautions.

**Keywords:** Geriatrics, trauma, forensic case, emergency, elderly



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## Öz

**Amaç:** Hastanemiz acil servisine başvuran geriatrik adli travma hastalarının demografik ve epidemiyolojik özelliklerinin saptanması, adli olaylarla ilişkili faktörlerin irdelenerek ülkemizdeki literatüre katkıda bulunulması amaçlandı.

**Yöntem:** Hastanemiz acil servisine 2013-2023 yılları arasında adli olaylar nedeniyle başvurusu yapılmış 65 yaş ve üzeri bireylerin verileri retrospektif olarak incelendi. Hastaların demografik özellikleri, adli olay tarihi, niteliği, yaralanma bölgeleri, adli olgu sonuç tanıları, düzenlenen adli raporun niteliği ve içeriği adli rapor kayıtlarından incelendi.

**Bulgular:** Araştırma süresince acil servise başvuran geriatrik hasta sayısı 173.080 olup, bu kişilerin 679'u adli olgu olarak değerlendirilmiştir. Hastaların 481'i (%70,8) erkekti. Adli olguya konu olan en sık olay türü %37,4 ile düşme idi, ikinci sırada %18,1 ile darp yer aldı. İntoksikasyonların ise %50'sinin karbonmonoksit nedeniyle gerçekleştiği görüldü. En sık yaralanan vücut bölgesi %39,8 ile baş-boyun iken, sonrasında %27,4 oranında üst ve %19 oranında alt ekstremiteler yer aldı. Adli olay başvurularının en sık yaz ayları olan Ağustos, Temmuz ve Haziran aylarında olduğu görüldü.

**Sonuç:** Çalışmamızda düşmenin geriatrik adli travmaların en sık nedeni olduğu saptanmıştır. Bu nedenle düşme riski yüksek olan yaşlılar ayrıntılı değerlendirilerek gerekli önlemlerin alınması ile düşme sonrası gelişebilecek komplikasyonların önüne geçilebilir.

**Anahtar Kelimeler:** Geriatri, travma, adli olgu, acil, yaşlı

## Introduction

The older population is growing in Türkiye and worldwide. The geriatric population in Türkiye was 7,186,204 in 2018 and increased by 21.4% over the last 5 years to 8,722,806 in 2023. The proportion of older adults in the population rose from 8.8% in 2018 to 10.2% in 2023. According to population projections, this rate is expected to increase further to 12.9% in 2030, 16.3% in 2040, 22.6% in 2060, and 25.6% in 2080<sup>(1)</sup>.

With this growth of the older population, increased participation in active lifestyles<sup>(2,3)</sup> and age-related physiological changes, such as decreases in perception and attention, visual acuity, and mental and motor activity, as well as postural changes, can increase rates of trauma and injury in older adults<sup>(4)</sup>. Epidemiological studies have shown that 23% of all trauma admission involve geriatric patients<sup>(2)</sup>.

Trauma is the fourth most common cause of death after heart disease, cancer, and stroke in all age groups<sup>(5)</sup> and the fifth most common cause of death in the geriatric population<sup>(2,6)</sup>. Geriatric traumas are mostly caused by falls (from a height or at the same level) or motor vehicle accidents (driver, occupant, pedestrian, or cyclist)<sup>(7,8)</sup>. Trauma is associated with high morbidity and mortality and has more severe consequences in older adults than in other populations because of the presence of concomitant diseases and limited physiological reserves<sup>(8,9)</sup>.

Our aim in this study was to determine the demographic and epidemiological characteristics of geriatric forensic trauma patients admitted to the emergency department of our hospital and to contribute to the literature by examining the factors associated with forensic incidents in our country.

## Materials and Methods

In this retrospective cross-sectional study, we examined the records of individuals aged 65 years who presented to the emergency department of the Atatürk University Faculty of Medicine Hospital due to forensic incidents between 2013 and 2023. The patients' demographic characteristics (age, gender, occupation, education level, cohabitation, marital status, place of residence), chronic diseases, and drugs used were obtained from the hospital information system and patient files. The date, nature, and setting of the forensic incident, injury zones, related outcomes (hospitalization, mortality), diagnosis of the forensic patient, and the nature and content of the forensic report were examined from the forensic records. In addition, we recorded the mode of admission to the emergency department, the consultations requested in the emergency department, the mode of discharge, and the length of stay in the emergency department and hospital if admitted.

## Statistical Analysis

The data were analyzed using SPSS version 21.0 (IBM, USA). Categorical descriptive data were expressed as frequency distribution and percentage; continuous variables were expressed as mean, standard deviation, median, and range. The independent samples t-test, Fisher's exact test, and Pearson's chi-square test were used for intergroup comparisons of categorical data, and  $p \leq 0.05$  was considered statistically significant.

Permission to conduct the study was obtained from the Atatürk University Faculty of Medicine Clinical Research Ethics Committee (date: 07.09.2023, approval no: 6/11).

Results

Of the 173,080 older adults admitted to the emergency department during the study period, 679 were forensic cases. The median age of the patients was 71 years (range, 65-107 years), and 481 (70.8%) were male. The demographic characteristics and chronic diseases of the participants are presented in Table 1. The most common chronic comorbidities were hypertension (n=306; 45.1%) and diabetes mellitus (n=117; 17.2%). The median number of diseases was 2 (range, 0-12) and the median number of drugs used was 1 (range, 0-6).

The distribution of the mode and time of admission and incident type of geriatric forensic cases evaluated in the emergency department is presented in Table 2. We observed that 51.3% of the patients were transported by ambulance, whereas the rest were transported by personal means. The most common type of forensic incident was falls (n=254; 37.4%), followed by assault (n=123; 18.1%). Of 20 traffic-related incidents, 8 (40.0%) were drivers/occupants, and the rest were pedestrian/cyclist (n=12; 60.0%). Of the 10 intoxications, 6 (50.0%) occurred as a result of carbon

monoxide (CO), 3 (25.0%) as a result of chemical inhalation, and 1 (8.3%) as a result of fungus, food, or drug exposure.

The distribution of forensic case presentations by months is presented in Figure 1. These cases occurred most commonly in the summer months of August (13.7%), July (12.4%), and June (11.9%). The injury zone distribution according to incident type is shown in Table 3. The most common injury site was the head and neck (n=270; 39.8%), followed by the upper limbs (n=186; 27.4%) and lower limbs (n=129; 19.0%). The most common sites of injury according to incident type were as follows: Head and neck in traffic accidents (n=10; 50.0%), lower limbs in firearm injuries (n=8; 61.5%), upper limbs in sharp trauma (n=8; 61.5%), head and neck in assault (n=82; 66.7%), head and neck in falls (n=106; 41.7%), upper limbs in occupational accidents (n=14; 48.3%), upper limbs in dog attacks (n=9; 62.2%), and the thorax in other animal attacks/kicks (n=27; 37.0%). The limbs of two patients with burns and electric shock were affected.

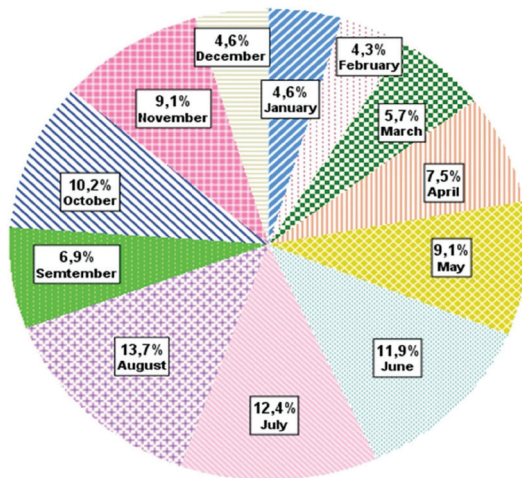
The injury type by incident type distribution is presented in Table 4. The most common types of injury were soft tissue trauma (n=251; 36.9%), bone fracture (n=170; 25.0%), and skin/mucosa laceration (n=163; 24.1%). The most common

Table 1. Demographic characteristics and chronic diseases of older forensic patients			
		n	%
Age (years)	65-74	466	68.6
	75-84	165	24.3
	≥85	48	7.1
Sex	Male	481	70.8
	Female	198	29.2
Chronic diseases	HT	306	45.1
	DM	117	17.2
	CHF	34	5.0
	CAD	95	14.0
	CVD	13	1.9
	COPD	58	8.5
	Asthma	11	1.6
	AF	28	4.1
	Depression	40	5.9
	Dementia	19	2.8
	CRF	9	1.3
	Arthritis	3	0.4
	Parkinson	16	2.4
HT: Hypertension, DM: Diabetes mellitus, CHF: Congestive heart failure, CAD: Coronary artery disease, CVD: Cerebrovascular disease, COPD: Chronic obstructive pulmonary disease, AF: Atrial fibrillation, CRF: Chronic renal failure			

Table 2. Distribution of mode and time of admission and incident type of older forensic patients evaluated in the emergency department			
		n	%
Mode of admission	Walk-in/personal transportation	331	48.7
	Ambulance service	348	51.3
Incident type	Traffic accident	20	2.9
	Intoxication	12	1.8
	Firearm injury	13	1.9
	Sharp trauma	50	7.4
	Blunt trauma	123	18.1
	Fall	254	37.4
	Electrocution	2	0.3
	Occupational accident	29	4.3
	Burn	2	0.3
	Suspicious death	4	0.6
	Dog attack	13	1.9
	Other animal attacks	73	10.8
	Other	84	12.4
Admission time	00:00-08:00	61	9.0
	08:00-16:00	316	46.5
	16:00-00:00	302	44.5

injury types according to incident type were as follows: Bone fracture in traffic accidents (n=9; 45.0%), soft tissue trauma in firearm injuries (n=7; 53.8%), skin/mucosa laceration in sharp trauma (n=30; 60.0%), soft tissue trauma in assault (n=50; 40.7%), bone fracture in falls (n=96; 37.8%), skin/mucosa laceration in occupational accidents (n=14; 48.3%), skin/mucosa laceration in dog attacks (n=13; 100%), and soft tissue trauma in other animal attacks/kicks (n=27; 37.0%).

The length of stay in the emergency department, treatments/consultations, and outcomes of the forensic



**Figure 1.** Distribution of geriatric forensic cases by months

cases are presented in Table 5. Only 13 patients (1.9%) had life-threatening injuries upon admission, and almost half had injuries that could be treated with simple medical interventions (n=329; 48.5%). The three most frequently consulted clinics were orthopedic, neurosurgery, and thoracic surgery. In total, 409 (60.2%) were discharged as outpatients, 212 patients (31.2%) were hospitalized.

## Discussion

A total of 173,080 geriatric patients presented to the emergency department of our hospital during the study period, of which 679 were forensic trauma patients. The majority of patients were male (70.8%). The most common types of forensic incidents were falls (37.4%), assault (18.1%), and sharp trauma (7.4%). The rate of traffic accidents was 2.9%, and the majority were drivers/occupants. The most common cause of intoxication (50.0%) was CO poisoning.

With the aging of the global population, the number of older people with active lifestyles has increased. This is associated with an increase in older patients admitted to hospitals because of trauma<sup>(10-13)</sup>. A study by Chang et al.<sup>(14)</sup> showed that extreme efforts are needed to diagnose and treat older adults. Therefore, traumatic injuries are less frequently overlooked.

In addition, population aging also brings about an increase in individuals with cardiovascular, pulmonary, neurological, and cognitive disorders, malnutrition,

**Table 3.** Distribution of injury zones according to incident type

	Head/neck	Thorax	Abdomen/ pelvis	Upper Limbs	Lower Limbs	Spine
Traffic accident	10 (50.0)	4 (20.0)	4 (20.0)	6 (30.0)	1 (5.0)	2 (10.0)
Intoxication	-	-	-	-	-	-
Firearm injury	1 (7.70)	-	2 (15.4)	3 (23.1)	8 (61.5)	-
Sharp trauma	5 (10.0)	3 (6.00)	2 (4.0)	37 (74.0)	9 (18.0)	-
Blunt trauma	82 (66.7)	10 (8.10)	10 (8.10)	22 (17.9)	11 (8.9)	3 (2.4)
Fall	106 (41.7)	57 (22.4)	40 (15.7)	56 (22.0)	59 (23.2)	14 (5.5)
Electrocution	-	-	-	1 (50.0)	1 (50.0)	-
Occupational accident	10 (34.5)	3 (10.3)	-	14 (48.3)	6 (20.7)	-
Burn	-	-	-	2 (100)	-	-
Suspicious death	-	-	-	-	-	-
Dog attack	1 (7.70)	1 (7.70)	-	9 (69.2)	3 (23.1)	-
Other animal attacks/kicks	23 (31.5)	27 (37.0)	9 (12.3)	9 (12.3)	21 (28.8)	1 (1.4)
Other	32 (38.1)	9 (10.7)	2 (2.40)	27 (32.1)	10 (11.9)	-
Total	270 (39.8)	114 (16.8)	69 (10.2)	186 (27.4)	129 (19.0)	20 (2.9)

Row percentages are presented as n (%)

**Table 4. Distribution of injury type by incident type**

	Soft tissue trauma	Bone fracture	Tendon laceration	Skin/mucosa laceration	Intracranial hemorrhage/contusion	Internal organ/large vessel damage
Traffic accident	4 (20.0)	9 (45.0)	1 (5.0)	2 (10.0)	2 (10.0)	-
Intoxication	-	-	-	-	-	-
Firearm injury	7 (53.8)	2 (15.4)	-	2 (15.4)	-	2 (15.4)
Sharp trauma	14 (28.0)	9 (18.0)	7 (14.0)	30 (60.0)	1 (2.0)	1 (2.0)
Blunt trauma	50 (40.7)	22 (17.9)	-	28 (22.8)	1 (0.8)	1 (0.8)
Fall	90 (35.4)	96 (37.8)	-	47 (18.5)	2 (0.8)	8 (3.1)
Electrocution	2 (10.0)	-	-	-	-	-
Occupational accident	11 (37.9)	6 (20.7)	1 (3.4)	12 (41.4)	-	4 (13.8)
Burn	2 (100)	-	-	-	-	-
Suspicious death	-	-	-	-	-	-
Dog attack	-	1 (7.70)	-	13 (100)	-	-
Other	42 (50.0)	7 (8.30)	1 (1.2)	18 (21.4)	1 (1.2)	1 (1.2)
Other animal attacks/kicks	27 (37.0)	18 (24.7)	2 (2.7)	14 (19.2)	1 (1.4)	2 (2.7)
Total	251 (36.9)	170 (25.0)	12 (1.8)	163 (24.1)	8 (1.2)	19 (2.8)

Row percentages are presented as n (%)

**Table 5. Duration of hospital stay, treatment/consultations, and outcomes of forensic cases**

		n	%
Life-threatening	Yes	13	1.9
	No	475	70.0
	Unspecified	191	28.1
Treatable through simple medical interventions	Yes	329	48.5
	No	142	20.9
	Unspecified	208	30.6
Length of stay in ED	0-1 hours	81	11.9
	1-4 hours	329	48.5
	4-8 hours	105	15.5
	>8 hours	164	24.2
Consultations requested	Orthopedics	163	24
	Neurosurgery	88	13
	Thoracic surgery	87	12.8
	Plastic surgery	29	4.3
	General surgery	24	3.5
	Neurology	11	1.6
	Internal medicine	6	0.9
	Intensive care	3	0.4
	Infectious diseases	1	0.1
Outcomes after ED treatment	Referral to another hospital	4	0.6
	Mortality	4	0.6
	Discharged after refusing treatment	50	7.4
	Hospitalization	212	31.2
	Discharge	409	60.2

ED: Emergency department



osteoporosis, electrolyte imbalance, and polypharmacy<sup>(15)</sup>. For these reasons, posttraumatic complications also increase. Delirium and infections are among the most common posttraumatic complications<sup>(15)</sup>. Low cardiac output, perioperative hypotension, postoperative hypoxia, time spent in surgery, excessive postoperative analgesia, immune suppression, and the presence of chronic comorbid diseases are factors that increase the risk of posttraumatic delirium and infection<sup>(16,17)</sup>. All of these factors necessitate close observation and multidisciplinary management of this population. In our study, we observed that consultation was frequently requested from the orthopedic, neurosurgery, and thoracic surgery departments after trauma.

Falls are among the most common causes of trauma in the elderly population. Approximately one-third of older adults die annually<sup>(18,19)</sup>. Risk factors contributing to falls include physical and mental disorders, such as osteoarthritis, osteoporosis, visual impairments, polypharmacy, balance and gait disturbances, depression, vertigo, cognitive impairment, diabetes, and sarcopenia<sup>(20)</sup>. The frequency of osteoporosis and sarcopenia is higher in the geriatric population, thereby increasing the risk of traumatic fractures. Moreover, this procedure leads to a protracted hospitalization and rehabilitation process after injury<sup>(21)</sup>. In studies conducted in the early 2000s, the most common cause of injury in seriously injured geriatric patients was falls (50-60%), followed by motor vehicle accidents (pedestrian or driver/occupant) (9-20%)<sup>(22,23)</sup>. However, recent epidemiological studies on trauma in geriatric patients have shown a decline in the rate of injuries due to vehicle accidents and an increase in fall-related injuries<sup>(11,24)</sup>. Our study is similar to the recent literature, with falls being the most common cause of trauma (37.4%) and traffic accidents being relatively less prevalent (8%). This decline in traffic accidents as an etiology of trauma worldwide and in our country may be related to more careful urban planning and road construction and better implementation of traffic rules. In contrast, the increasing rates of assault are related to social and moral factors and are thus more difficult to regulate. Similar to our study, traffic accidents are decreasing but assault rates are increasing in countries such as South Africa<sup>(25)</sup>. In addition, because livestock farming is common in our country and especially in the region where this study was conducted, most blunt traumas in relation to animals occur in rural areas. In countries where animal husbandry is common, there is also a high rate of animal-related trauma, which is similar to the results of our study<sup>(26)</sup>.

The most commonly injured parts of the body in patients with geriatric trauma are the head and neck, upper limbs, and lower limbs<sup>(27-29)</sup>. Head and neck trauma is important for older adults because of the risk of traumatic brain injury. An increase in the frequency of falls is associated with an increase in brain injuries. The subgroup of older adults aged 75 years and older constitutes the highest risk of hospitalization and mortality<sup>(30-32)</sup>. Older adults with head trauma may present with mild symptoms. These patients can develop intracranial hematomas without any neurological deficits<sup>(33)</sup>. This may cause diagnostic delays and poor outcomes<sup>(30)</sup> and can be even more complicated in individuals using anticoagulants, such as vitamin K antagonists<sup>(34)</sup>.

Geriatric patients are usually exposed to blunt rather than penetrating trauma<sup>(35)</sup>. Animals such as cattle or horses that can kick, crush, and cause head and facial injuries are characteristically the most common causes of blunt trauma. Agricultural workers in particular face a risk of fatal injuries involving the head and body<sup>(36)</sup>. Cattle cause a significant number of trauma-related deaths worldwide. Behavior can be unpredictable even among domesticated animals, and attacks by individuals or herds are possible. Trauma due to kicking, trampling, goring, or crushing can often cause head or chest injuries. The risk of trauma and trauma-related death is higher among men living in rural areas<sup>(37)</sup>. In our study, the most frequently injured body areas were the head and neck at a rate of 39.8%, consistent with other studies, followed by the upper limbs at a rate of 27.4% and the lower limbs at a rate of 19%. We found that the head and neck region and upper limbs were most frequently affected by blunt trauma, sharp trauma, falls, dog attacks, and traffic accidents. In attacks and kicks, the thoracic region was the most frequently affected area.

In our study, 12 patients presented with intoxication, and most of these cases were CO poisoning. CO is an odorless, colorless, tasteless, non-irritant gas that is also a highly reactive and flammable molecule that mixes with air. Gas can be produced from natural or anthropogenic sources, especially as a result of incomplete fossil fuel combustion or biomass combustion. It is extremely poisonous<sup>(38)</sup>. CO exposure and poisoning can occur in environmental, occupational, and domestic settings. The causes of home exposure include fires, malfunctioning heating systems, and suicide attempts. CO poisoning and related deaths should be considered in workplaces with machines in closed and poorly ventilated areas<sup>(39)</sup>. Although there is no gender-based difference in the incidence of CO poisoning, mortality

rates are twice as high in men. The prevalence showed two distinct peaks between the ages of 0-14 and 20-39 years. The mortality rate among these patients also increases with age, peaking in those 80 years and older<sup>(40)</sup>. The geriatric status is an independent factor associated with increased mortality in CO poisoning cases. With aging, individuals become frail, and adaptive responses to stressors decrease because of increased rates of comorbid diseases and decline in physiological reserves<sup>(41)</sup>. Cardiorespiratory capacity decreases and the half-life of CO elimination increases in the elderly because of increased cardiovascular and respiratory system diseases<sup>(42)</sup>. For these reasons, older adults are more severely affected by CO poisoning and often cannot be saved due to late diagnosis. Unfortunately, sufficient studies on this topic have not been conducted in the geriatric population. Factors that may explain the high frequency of CO intoxication include the long, severe winter season and the living conditions associated with the socio-economic level in our region.

Although women outnumber men in older populations, trauma cases are more common in men<sup>(23,24,43-46)</sup>. In our study, the majority of individuals who presented with forensic cases were men. Similar rates have also been reported in the literature. This pattern of older men being disproportionately affected by trauma may be related to their more active work and social lives.

When the seasonal distribution of the forensic cases was evaluated, we observed that most cases occurred in summer (August, July, and June). Another study showed that accident rates peaked between June and September, the hottest period of the year, and decreased in the winter months<sup>(47)</sup>. We attribute this decrease in our study to the severe winter in our region and the limited social activity during this season.

Nearly one-third of the forensic patients in our study were hospitalized after trauma (31.2%). This rate was found to be 58.4% and 57.4% in other studies conducted in our country by Yildiz et al.<sup>(48)</sup> and Akköse Aydın et al.<sup>(49)</sup>, respectively. Our findings may have differed from those of the other studies because most patients were followed up and treated in the emergency department observation room of our hospital.

### Study Limitations

The main strengths of our study are that it covers a long period (10 years) and includes a large number of patients. The limitations of the study are that it was retrospective

and conducted in a single center; the etiology of falls in the patients was not determined; and the medications used by the patients were not examined.

### Conclusion

The geriatric population is more affected by trauma than other age groups, and trauma-related morbidity and mortality are high among older adults. Older patients presenting with trauma should be closely followed. In our study, falls were the most common cause of geriatric trauma. Potential post-fall complications can be prevented by carefully evaluating older adults at high risk of falls and taking the necessary precautions.

### Ethics

**Ethics Committee Approval:** Permission to conduct the study was obtained from the Atatürk University Faculty of Medicine Clinical Research Ethics Committee (date: 07.09.2023, approval no: 6/11).

**Informed Consent:** Retrospective study.

### Footnotes

### Authorship Contributions

Surgical and Medical Practices: A.L.T., S.T.A.G., Concept: M.K., S.T.A.G., P.T.T., Design: M.E.Ş., M.K., P.T.T., Data Collection or Processing: M.E.Ş., A.L.T., S.T.A.G., Analysis or Interpretation: Ö.K., Literature Search: M.E.Ş., M.K., Ö.A., Ö.K., P.T.T., Writing: M.E.Ş., M.K., Ö.A., Ö.K., P.T.T.

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