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TRACTION SPLINT USAGE IN PREHOSPITAL EMERGENCY MEDICAL SERVICES: A CROSS-SECTIONAL ANALYSIS OF PERSONNEL KNOWLEDGE, APPLICATION FREQUENCY, AND ERGONOMIC CHALLENGES IN THE FIELD

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ABSTRACT

Introduction: Femur fractures are potentially life-threatening injuries requiring effective prehospital immobilization. Traction splints (TS) are standard equipment for this purpose, yet their infrequent use raises concerns about skill decay. This study aimed to assess the self-reported knowledge, frequency of use, and practical difficulties encountered by Turkish 112 Emergency Medical Services (EMS) personnel when applying traction splints, while acknowledging the limitations of self-reported data.

Methods: A cross-sectional study was conducted with 263 prehospital healthcare personnel across Izmir, Turkey. Data were collected via a structured survey covering demographic characteristics, traction splint (TS) training, self-reported knowledge, usage frequency, and ergonomic challenges. Categorical variables were analyzed using the Chi-Square test.

Results: Over half of the participants (52.9%, n=139) reported never having used a TS in their career. A significant difference was found between professional groups and self reported knowledge levels ($p < .001$). Over 50% of physicians and paramedics rated their knowledge as "Very good," while most emergency medical technicians (EMTs) described theirs as "Moderate." The most frequently reported challenge during application was "patient positioning/access difficulty" (52.5%, n=138). Only 10.6% (n=28) of participants found the device "very suitable" ergonomically.

Conclusion: The traction splint is a low frequency piece of equipment, carrying a high risk of skill decay. The findings highlight significant ergonomic limitations in field use and disparities in perceived competency among professional groups. To ensure effective application when needed, targeted simulation based training---especially for EMTs---and the design of ergonomic equipment adapted to real world field conditions are strongly recommended.

INTRODUCTION

The primary objectives of prehospital emergency care are to reduce morbidity, preserve vital functions, and prevent secondary injuries. Extremity traumas, if not managed correctly, can lead to serious complications. The femur, being the longest and strongest bone in the body, requires a high-energy mechanism to fracture. Such fractures carry life-threatening risks, including

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hypovolemic shock due to significant blood loss, fat embolism syndrome, and compromise of neurovascular integrity. The epidemiological profile of these injuries can vary significantly by region; for example, mechanisms may range from high-velocity traffic accidents in urban settings to falls or skiing-related trauma in specific geographic areas. In the Turkish context, traffic accidents represent a leading cause of such high-energy traumas.

Traction splints (TS) have been a standard component of ambulance equipment for decades for the field management of femoral shaft fractures. They aim to realign bone fragments, relieve pain by reducing muscle spasm, and limit soft tissue damage (National Association of Emergency Medical Technicians [NAEMT], 2020). While traditional views and international protocols such as Prehospital Trauma Life Support (PHTLS) recommend their use for isolated femur fractures, research over the past two decades has opened debate on their absolute necessity and safety profile (NAEMT, 2020; Philipsen et al., 2022). Recent statements from professional bodies like the National Association of EMS Physicians (NAEMSP) have further called the routine use of TS into question, adding to the clinical dilemma.

There is no consensus in the literature regarding the efficacy of TS use. Some studies report significant reductions in pain scores and analgesic requirements compared with simple splinting (Bumpass et al., 2015; Irajpour et al., 2012). In contrast, other researchers question the place of TS in modern trauma management, labelling it an "EMS relic," and cite concerns about time-consuming application, potential delays in the "golden hour" for multi-trauma patients, and specific contraindications (Agrawal et al., 2009; Bledsoe & Barnes, 2004).

The primary motivation for this study stemmed from the researcher's own educational experiences. While teaching traction splint application to students, significant practical issues were observed, including excessive application time, parts of the splint extending beyond the stretcher, and difficulties in positioning the device inside the ambulance. These observations raised the question of what frontline personnel truly think about this device. Therefore, this study aims to systematically collect feedback from field providers to identify the shortcomings of the current design and to lay the groundwork for developing a simpler, more user-friendly traction splint based on their insights.

In the context of Turkey's trauma epidemiology and diverse geographical conditions, the effective use of this equipment depends not only on theoretical knowledge but also on the practical skills of personnel and the ergonomic suitability of the device. However, as noted in recent reviews, low frequency of use increases the risk of "skill decay" among healthcare providers (Acker et al., 2021; Davis et al., 2023). This gap between training and field application is a core educational and operational challenge.

This study was guided by the following objectives and hypotheses:

- To assess the frequency of TS use among Turkish prehospital providers.
- To compare self-reported TS knowledge across professional groups (physicians, paramedics, EMTs).
- H_1: Professional group is associated with self-reported knowledge level.
- H_0: There is no such association.

- To identify the primary ergonomic and practical barriers to TS application in the field.

Through these aims, this study contributes local data to the international debate on the role of TS in modern paramedicine.

METHODS

Study Design and Setting

This is a descriptive, cross-sectional study conducted among active healthcare personnel working at 112 Emergency Medical Services stations throughout Izmir. The 112 service is the legally mandated public ambulance service providing emergency care and transportation throughout Turkey.

Participants

The study population comprised all 112 EMS personnel in Izmir, with a convenience sample of 263 participants included. Participants were eligible if they were actively working in the 112 system during the data collection period and consented to take part. No exclusion criteria were applied. Participants were categorized by professional title: physician, paramedic, emergency medical technician (EMT), and other healthcare personnel.

Data Collection

Data were collected using a structured survey form, titled "Questionnaire on the Use of Traction Splints among 112 Ambulance Staff." The questionnaire was developed based on a literature review and was pilot tested for clarity and face validity with 10 EMS professionals who were not included in the final sample. Feedback from the pilot led to minor wording adjustments. The internal consistency of the survey items related to knowledge and barriers was acceptable (Cronbach's $\alpha = 0.78$). The final questionnaire was distributed electronically via professional networks and completed anonymously. It consisted of three main sections:

1. Demographic information: Station location, professional title, and total service duration in the EMS system (0–2, 3–5, 6–10, and >10 years).
2. Training and knowledge level: TS training status (theoretical/practical), self reported knowledge level regarding indications and contraindications ("Very good," "Moderate," "Inadequate"), and perceived adequacy of the training received. For the analysis, "Very good" was operationally defined as the ability to list all key indications and contraindications without assistance.

Usage Frequency, Ergonomics, and Challenges

Frequency of TS use over the participant's career and in the last year, time since last use, type of splint used (e.g., Sager, Thomas, CT6), main difficulties encountered during application (e.g., patient positioning, time pressure), and opinions on equipment ergonomics. Participants were also asked for recommendations on the frequency of refresher training.

Statistical Analysis

Statistical analysis was performed using SPSS version 21. Descriptive data are presented as number (n) and percentage (%). The Chi-Square test was used to examine relationships between categorical variables, particularly differences between professional groups regarding knowledge level and usage habits. For significant Chi-Square results, effect sizes were calculated using Cramer's V. To account for multiple comparisons when analyzing subgroups, a Bonferroni correction was applied, adjusting the significance threshold to $p < .01$. A p-value < .01 was therefore considered statistically significant for group-wise comparisons.

Ethical Considerations

All procedures performed in studies involving human participants were in accordance with the ethical standards of the institutional and/or national research committee and with the 1964 Helsinki Declaration and its later amendments. Ethical approval was obtained from the Non-Interventional Research Ethics Committee of Izmir University of Economics (Approval Number: E-97429853-050.04- 120822). Completion of the survey was taken as implied consent.

RESULTS

A total of 263 healthcare personnel actively working at 112 Emergency Medical Services stations participated in the study. Data regarding demographic characteristics, knowledge levels, application frequencies, and ergonomic challenges are presented below.

Demographic Characteristics

The professional distribution showed that paramedics constituted 46.4% (n=122) and EMTs 37.3% (n=98) of the group. In terms of service duration, the profile was experienced, with 46.0% (n=121) having worked for 10 years or more. Detailed demographic data are shown in Table 1.

Groups	n	%
Profession		
Paramedic	122	46.4
EMT	98	37.3
Physician	31	11.8
Other*	9	3.4
Service Years		
0–2 years	44	16.7
3–5 years	37	14.1
6–10 years	59	22.4
>10 years	121	46.0

Note. "Other" includes healthcare personnel with titles such as nurse or health officer.

Table 1. Demographic characteristics of participants (n=263).

Training Status and Knowledge Level

The majority of participants (n=202, 76.8%) had received both theoretical and practical TS training. A statistically significant difference was found between professional groups and self reported knowledge levels ($p < .001$). Over half of physicians and paramedics rated their knowledge as "Very good," whereas the majority of EMTs (51.0%) described it as "Moderate." These findings are summarized in Table 2.

Usage Frequency and Equipment Preference

One of the most striking findings was the low rate of TS use in field practice. Overall, 52.9% (n=139) of participants stated they had never used this equipment throughout their career. The CT6

Profession	Very Good n (%)	Moderate n (%)	Inadequate n (%)	p-value
Paramedic	64 (52.5)	48 (39.3)	4 (3.3)	< .001
Physician	16 (51.6)	12 (38.7)	3 (9.7)	
EMT	33 (33.7)	50 (51.0)	11 (11.2)	

Table 2. Comparison of self reported knowledge level by professional group.

model was the most commonly used splint type, at 70.0% (n=184). Usage frequency and equipment preferences are detailed in Table 3.

Options	n	%
Usage Frequency		
Never used	139	52.9
1–3 times/year	97	36.9
4–6 times/year	21	8.0
7 times/year	4	1.5
Splint Type Used		
CT6	184	70.0
Thomas	40	15.2
Other	9	3.4

Table 3. Traction splint usage frequency and equipment preferences.

Field Challenges and Ergonomics

"Patient positioning/access difficulty" was the most frequently reported challenge (52.5%, n=138), followed by "Time pressure" (17.9%, n=47). Only 10.6% (n=28) of participants found the device "very suitable" ergonomically. The "Other reasons" category (8.4%, n=22) included open-ended responses such as "device is too heavy to carry," "difficult to clean," and "lack of clear protocols." These qualitative insights are summarized in Table 4 and Table 5.

Difficulty Encountered	n	%
Patient positioning/ access difficulty	138	52.5
Time pressure	47	17.9
Lack of knowledge/ experience	26	9.9
Other reasons	22	8.4
Lack of equipment	9	3.4

Table 4. Main difficulties encountered during application.

Other Reason	n	%
Device is too heavy to carry	8	36.4
Difficult to clean/ maintain	6	27.3
Lack of clear protocols	5	22.7
Patient discomfort	3	13.6
Total	22	100

Table 5. Specified "other reasons" for difficulty (n=22).

DISCUSSION

This study reveals that the traction splint is used very infrequently in prehospital practice in Turkey. It identifies differences in perceived knowledge levels among professional groups and highlights ergonomic constraints as the primary barrier to application.

Low Usage Frequency and Skill Decay

The finding that over half of the participants had never used a TS aligns with international literature (Abarbanell, 2001; Campagne et al., 2020; Nackenson et al., 2017). This infrequency poses a significant risk of skill decay, a phenomenon well-documented in low-frequency, high-acuity procedures (Davis et al., 2023). The reported "lack of knowledge/experience" as a challenge underscores that theoretical training is not reinforced by practical experience, potentially eroding provider confidence. In the Turkish system, where no national real-time EMS database (comparable to NEMSIS in the US) exists to track intervention-specific outcomes, reliance on self-reporting and periodic training becomes even more critical.

The Dilemma of Clinical Necessity, Pain Management, and Time

"Time pressure" was a cited barrier, supporting arguments that TS application may prolong on-scene time (Bledsoe & Barnes, 2004). This creates a field dilemma between swift transport and the benefits of fracture stabilization (Bumpass et al., 2015; Irajpour et al., 2012). Furthermore, local protocols in many Turkish EMS regions do not explicitly mandate TS use in multi-trauma scenarios, which may contribute to both the low usage frequency and the perception of time pressure. The skill decay observed is therefore likely a product of both low opportunity and protocol-driven hesitation.

Ergonomics and the Impact of Field Conditions

The most salient finding is that "patient positioning/access difficulty" is the foremost barrier. Traditional TS designs often require full leg extension and ample working space, conditions frequently unmet in real-world scenarios (Auerbach et al., 1984; DeFroda et al., 2016). This ergonomic mismatch is a primary deterrent. The "other reasons" provided by participants, such as the device being too heavy or difficult to clean, point to further human-centered design flaws that are rarely discussed in the clinical literature but are paramount for field providers.

Professional Competencies and Training Needs

The disparity in self-reported knowledge, with EMTs feeling less competent, points to a specific need for targeted education. To mitigate the identified skill decay, EMS systems should consider implementing low-cost, high-frequency simulation-based training. For example, a "deliberate practice" model using simple, home-made mannequins in 15-minute station drills every six months could maintain psychomotor skills without requiring real-life opportunities. This is particularly relevant for EMTs, who represent a large segment of the workforce and have less initial training than paramedics.

Generalizability and System-Level Context

While these findings are specific to Turkey, they are likely relevant to EMS systems of similar maturity where TS is a standard but rarely used device. In systems with broader paramedic scopes of practice or more mature trauma systems, the barriers might shift from basic knowledge (as seen with EMTs) to system-level time pressures or protocol restrictions. The ergonomic challenges, however, are universal and independent of clinical training level.

LIMITATIONS

This study has several limitations. The use of self-reported data may introduce recall or social desirability bias, and the study did not assess actual clinical competence through objective testing. The cross-sectional design captures only a snapshot in time. The sample may not be fully representative of all Turkish 112 personnel. Furthermore, the study did not collect objective data on call types (e.g., traffic vs. fall), urban vs. rural station locations, or specific transport times, which could influence TS use. The absence of a national EMS database in Turkey to link patient outcomes with specific prehospital interventions prevented a more robust, objective analysis of TS application and its clinical impact.

CONCLUSION

The traction splint remains a part of EMS inventories but is characterized by infrequent use, which jeopardizes skill retention. Application is significantly hindered by ergonomic challenges. To address these issues, we recommend: (1) the development of next-generation traction splints with improved ergonomics; (2) the implementation of mandatory, periodic, simulation-based training programs, particularly for EMTs; and (3) the revision of clinical protocols to provide clear guidance on TS use in multi-trauma scenarios.

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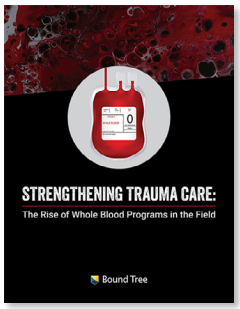

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