



Experiences of orthopaedic and traumatology surgeons with fasciotomy in the 2023 Kahramanmaraş earthquake in Türkiye

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■ MAIN POINTS

- Surgical Burden in Disaster Settings: During the Kahramanmaraş earthquakes, fasciotomies were frequently performed outside the operating room under limited sterile conditions.
- Lack of Standardization: The high rate of inadequate decompression (86%) and variability in incision techniques indicate the need for standardized fasciotomy protocols.
- Impact of Surgical Environment: Fasciotomies performed in operating rooms had significantly lower complication rates, highlighting the importance of appropriate surgical infrastructure.
- Need for Preparedness: Regular training programs and the development of national and international disaster surgery guidelines are essential to improve preparedness and reduce complications.

■ ABSTRACT

Aim: February 6, 2023 Kahramanmaraş earthquakes were among the most devastating disasters in Türkiye, causing numerous musculoskeletal injuries. This study evaluated orthopedic surgeons' experiences with fasciotomy in disaster zones, focusing on surgical practices, complication rates, challenges, and the adequacy of training.

Materials and Methods: Between March–April 2023, an 18-item online survey was conducted among orthopedic surgeons serving in the earthquake-affected region. A total of 114 surgeons participated. The questionnaire covered demographics, surgical experience, fasciotomy techniques, complications, and training perceptions. Subgroup analyses were performed by experience level, surgical setting, incision preference, and prior fasciotomy exposure.

Results: Fasciotomies were mainly performed in the operating room (74%; n=85), followed by the emergency department (12%; n=14), field hospitals (7%; n=8), intensive care units (4%; n=5), and temporary areas (3%; n=3). For leg fasciotomies, double incisions were preferred in 81% (n=92) and single incisions in 16% (n=18). For forearm fasciotomies, volar incisions were used in 74% (n=84), and combined volar+dorsal incisions were used in 26% (n=30). The overall complication rate was 43% (n=49); the most common complications were bleeding (16%; n=18) and wound problems (12%; n=14). Inadequately decompressed compartments were reported in 86% of cases (n=98). Complications were more frequent among surgeons with 1–5 years' experience (58%; n=18) compared with those with >10 years' experience (35%; n=17) (p=0.03), and were more frequent when procedures performed outside the operating room (55%; n=16) than within it (29%; n=25) (p=0.01). Surgeons with prior fasciotomy experience reported higher confidence (76%; n=73) than those without (41%; n=7) (p<0.01).

Conclusion: The fasciotomy experiences of orthopedic surgeons during the Kahramanmaraş earthquake revealed deficiencies in standardization and competency in disaster surgery. Outcomes depended on the surgeon's experience and on the surgical conditions. Strengthening disaster preparedness requires structured training, simulation-based exercises, national and international guidelines.

Keywords: Earthquake, Fasciotomy, Orthopedic surgeon, Compartment syndrome, Disaster surgery

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■ INTRODUCTION

The earthquakes centered in Kahramanmaraş on February 6, 2023, were among the most devastating disasters in Türkiye's recent history, resulting in thousands of deaths and tens of thousands of injuries [1]. Earthquakes differ from other natural disasters as they cause a large number of traumatic injuries within a short period and can paralyze healthcare systems [2,3].

Earthquake-related injuries predominantly involve the musculoskeletal system. Previous studies have shown that a significant proportion of these injuries consist of soft tissue damage, long bone fractures, and crush injuries [2-4]. The management of crush injuries requires a multidisciplinary approach, as they may lead to acute compartment syndrome (ACS). If not properly managed, ACS can result in limb loss or mortality [2,4,5]. The most effective method to relieve increased intracompartmental pressure in ACS is urgent fas-

ciotomy [2,6,7]. However, in disaster conditions, controversies exist regarding the timing, incision preference, and sterilization standards of fasciotomy, though the first 24 hours represent a critical time window [5-8].

Earthquakes in Türkiye and other parts of the world can generate a patient burden that challenges or even exceeds healthcare system capacity [9,10]. In such situations, the preparedness level of the health system directly influences survival and rehabilitation outcomes [11,12]. Globally, earthquake-related deaths have averaged around 27,000 annually since the 1990s, with higher mortality and morbidity reported in low-income countries [3].

This study aimed to evaluate the experiences of orthopedic and traumatology specialists who were actively working in disaster zones during the Kahramanmaraş earthquake, focusing on fasciotomy practices, surgical technique preferences, complication rates, and perceptions of training adequacy. Our study aims to provide novel contributions that may support practical approaches and guide educational planning in disaster surgery.

MATERIALS AND METHODS

This study was a cross-sectional, descriptive survey. The study population consisted of orthopedic and traumatology specialists who actively served in disaster zones during the earthquakes that were centered in Kahramanmaraş on February 6, 2023. Inclusion criteria were: working in regional healthcare facilities or field hospitals during the earthquake, and completing the questionnaire in full. Physicians who partially completed the survey or belonged to non-orthopedic specialties were excluded. This cross-sectional survey study was reported in accordance with the strengthening the reporting of observational studies in epidemiology (STROBE) statement [13]. No randomization or allocation was performed because this was a cross-sectional, descriptive survey; groups were defined based on participants' characteristics for comparative analyses.

Primary outcome measure of this study was the self-reported occurrence of fasciotomy-related complications (yes/no) and the distribution of complication types. Secondary outcomes included the frequency of inadequately decompressed compartments and surgeons' self-perceived competence and training adequacy regarding fasciotomy in disaster settings.

Data were collected using an 18-item online questionnaire developed by the researchers based on a literature review of disaster surgery and expert opinion. The survey included questions on demographics, surgical experience, practices, complications, and perceptions of training adequacy. The demographic section assessed age, gender, workplace, years of specialty practice, and type of institution. The surgical practice section included experience with fasciotomy before and after the earthquake, the number of fasciotomies performed, surgical settings (operating room, emergency department, field hospital), and types of incisions. The final section addressed

the frequency and types of complications, the adequacy of sterilization conditions, and the self-assessment regarding disaster surgery training.

The questionnaire was prepared using Google Forms and distributed to orthopedic surgeons via email and professional communication groups. It remained open for four weeks, from March to April 2023, and was completed by 114 orthopedic surgeons. Participants were recruited by non-probability convenience sampling via professional communication groups and e-mail lists; participation was voluntary. Data confidentiality was ensured: no personal identifiers were recorded, and results were reported anonymously. No formal a priori sample size calculation was performed due to the descriptive survey design and the disaster context. The questionnaire was distributed to all eligible orthopaedic surgeons serving in the earthquake zone and remained open for four weeks. The final sample size was determined by the number of complete responses received during this period (n=114).

Subgroup analyses were performed based on predefined variables: incision type during leg fasciotomy (double vs. single), sterile conditions (sterile vs. non-sterile), years of surgical experience (1–5 years, 6–10 years, >10 years), prior fasciotomy experience (yes vs. no), and work environment (state or university hospital vs. field hospital). These groups were compared in terms of complication rates, perceptions of training adequacy, incision preferences, and fasciotomy case volume.

Ethics approval for the study was obtained from the Clinical Research Ethics Committee of Mersin University on 17/09/2025 (decision no: 16/1003); informed consent was obtained online from all participants. The study was conducted in accordance with the principles of the Declaration of Helsinki.

Statistical analysis

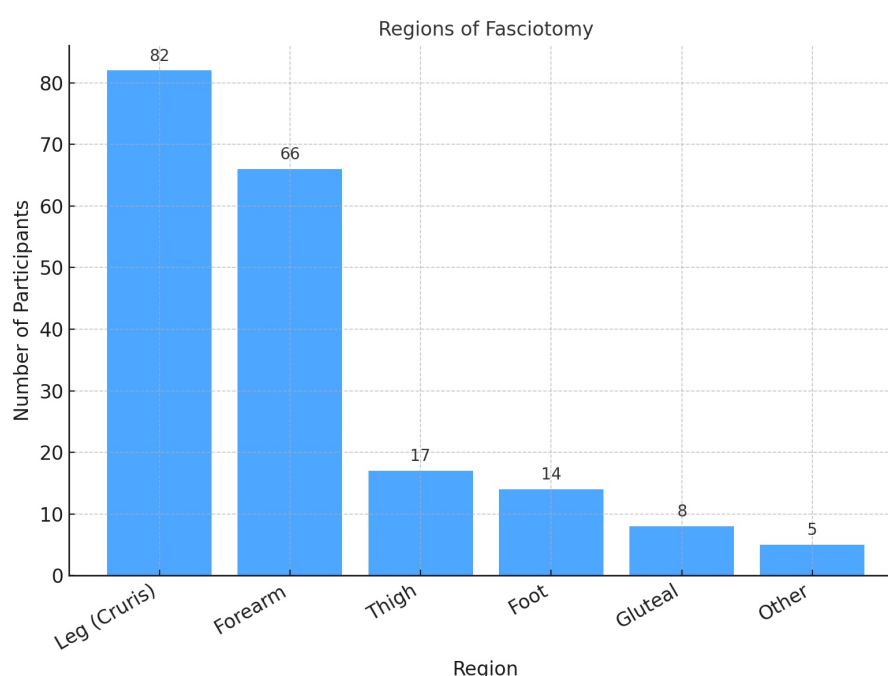
Statistical analyses were performed using IBM SPSS Statistics for Windows, Version 26.0 (IBM Corp., Armonk, NY, USA; licensed to our institution). Descriptive statistics for continuous variables were presented as mean $\pm$ standard deviation (SD) for normally distributed data and as median (interquartile range, IQR) for non-normally distributed data. Categorical variables were expressed as number (n) and percentage (%). Normality was assessed using visual methods (histograms) and the Shapiro–Wilk test. For group comparisons, Student's t-test was used for normally distributed continuous variables, and the Mann–Whitney U test was used for non-normally distributed variables. Categorical variables were compared using the chi-square test or Fisher's exact test, depending on expected cell counts. A two-sided p-value < 0.05 was considered statistically significant.

RESULTS

Total of 114 orthopedic surgeons participated in the study. Of these, 27% (n=31) had 1–5 years of experience, 14% (n=16) had 6–10 years, 44% (n=50) had more than 10 years, and 15%

Table 1. Subgroup analyses of complications and self-perceived competence.

Variable	Group	Complications (n, %)	p value	Self-perceived competence (n, %)	p value
Experience	1–5 years (n=31)	18 (58%)	0.030*	19 (61%)	0.080
	>10 years (n=50)	17 (35%)		39 (79%)	
Sterile conditions	Sterile (n=73)	23 (32%)	0.004*	–	–
	Non-sterile/partially sterile (n=41)	25 (61%)			
Working environment	Operating room (n=85)	25 (29%)	0.010*	65 (77%)	0.090
	Emergency department/field hospital/intensive care unit (n=29)	16 (55%)		19 (66%)	
Previous fasciotomy experience	Yes (n=96)	39 (41%)	0.210	73 (76%)	<0.001*
	No (n=18)	9 (50%)		7 (41%)	
Incision preference leg	Double incision (n=92)	More skin problems	0.110	–	–
	Single incision (n=10)	More bleeding		–	
Incision preference forearm	Volar only (n=84)	Lower complications	0.090	–	–
	Volar + dorsal (n=30)	Higher bleeding/skin issues		–	
Adequacy of prior training/experience	Adequate/partly adequate (n=85)	26 (31%)	0.040*	69 (81%)	<0.001*
	Inadequate (n=29)	16 (54%)		11 (39%)	

**Figure 1.** Regions of fasciotomy.

(n=17) were residents. Prior to the earthquake, 84% (n = 96) of participants reported a prior fasciotomy. Fasciotomies were most frequently performed in operating rooms (74%; n=85), followed by emergency departments, field hospitals (7%; n=8), intensive care units (4%; n=5), and temporary surgical areas (3%; n=3). For leg fasciotomies, 81% (n=92) preferred double incisions, 16% (n=18) preferred single incisions, while 2% (n=2) reported using both methods, and 2% (n=2) had not performed a fasciotomy in this region. For forearm fasciotomies, 74% (n=84) used a single volar incision and 26% (n=30) used combined volar and dorsal incisions.

The most common fasciotomy site was the leg (72%; n=82), followed by the forearm (58%; n=66), the thigh (15%; n=17),

the foot (12%; n=14), and the gluteal region (7%; n=8). A smaller proportion (4%; n=5) reported fasciotomies in other areas, such as the hand or upper arm (Figure 1). In terms of patient volume, 55% (n=63) operated on 1–5 patients, 28% (n=32) operated on 6–10, 12% (n=14) operated on 11–20, and 5% (n=5) operated on more than 20 patients.

Regarding complications, 43% (n=49) reported none. The most frequent complications were bleeding (16%; n=18) and wound problems (12%; n=14). Combined bleeding and wound complications occurred in 14% (n=16), while nerve or vascular injuries or multiple complications occurred in 10% (n=11) (Figure 2). Regarding self-assessment, 31% (n=35) reported feeling fully competent, 52% (n=59) partially compe-

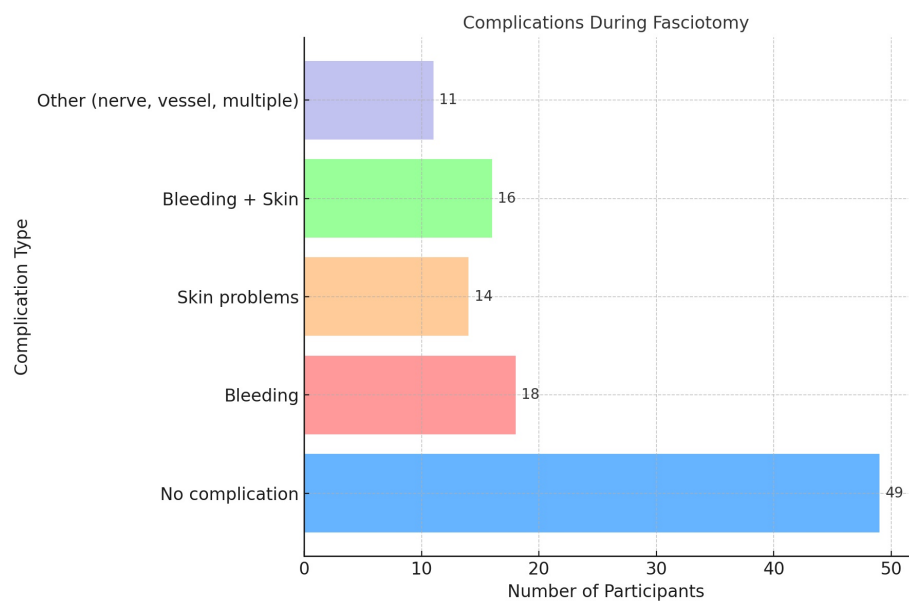


Figure 2. Complications during surgery.

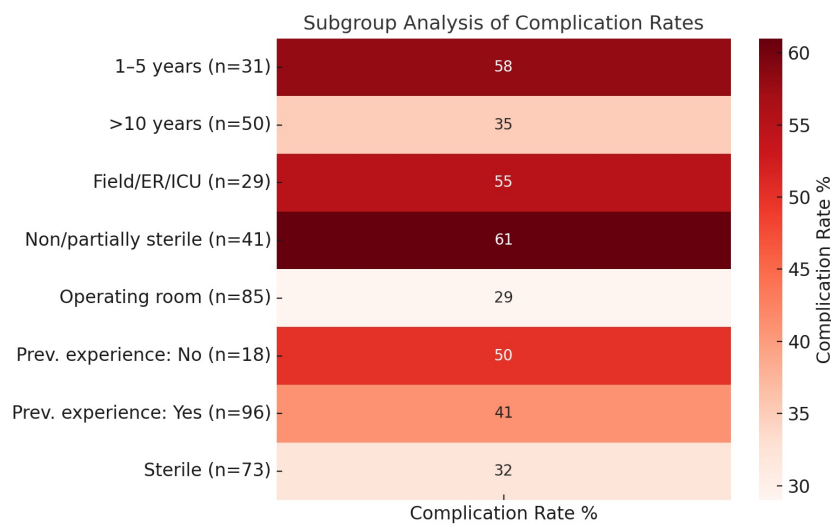


Figure 3. Subgroup analysis complication rates.

tent, and 17% (n=20) inadequate.

Subgroup analyses revealed a significant relationship between years of experience and complication rates. Among surgeons with >10 years of experience, 17 of 50 (35%) reported complications, compared with 18 of 31 (58%) among surgeons with 1–5 years of experience ($p=0.03$). Complication rates also differed by surgical setting: 25 of 85 fasciotomies (29%) performed in operating rooms had complications, compared with 16 of 29 (55%) performed in emergency departments, field hospitals, or ICUs ($p=0.01$) (Figure 3). Surgeons with prior fasciotomy experience reported greater confidence (76%; n=73) than those without such experience (41%; n=7) ($p<0.01$). However, complication rates did not differ significantly between the two groups ($p=0.21$). Incision preference was not associated with statistically significant differences in complication rates ($p>0.05$). These comparisons are

presented in Table 1.

A majority of participants (86%; n=98) reported encountering at least one inadequately decompressed compartment during the earthquake. The most common reasons were short skin incisions, failure to open certain compartments, and insufficient fascial release. These three factors occurred together in 38% of cases (n=43). Only 14%(n=16)reported no such issues. Regarding skin closure, 57% (n=65) stated they used sutures when necessary, 29% (n=33) never used them, 11% (n=12) always applied sutures, and 2% (n=2) reported initially suturing but later continuing with dressings.

Suggested improvements included increasing training and course offerings (61%; n=70) and developing disaster surgery protocols (52%; n=59). Other recommendations included preparation of surgical equipment (47%; n=54), interdepartmental coordination (36%; n=41), strengthening communi-

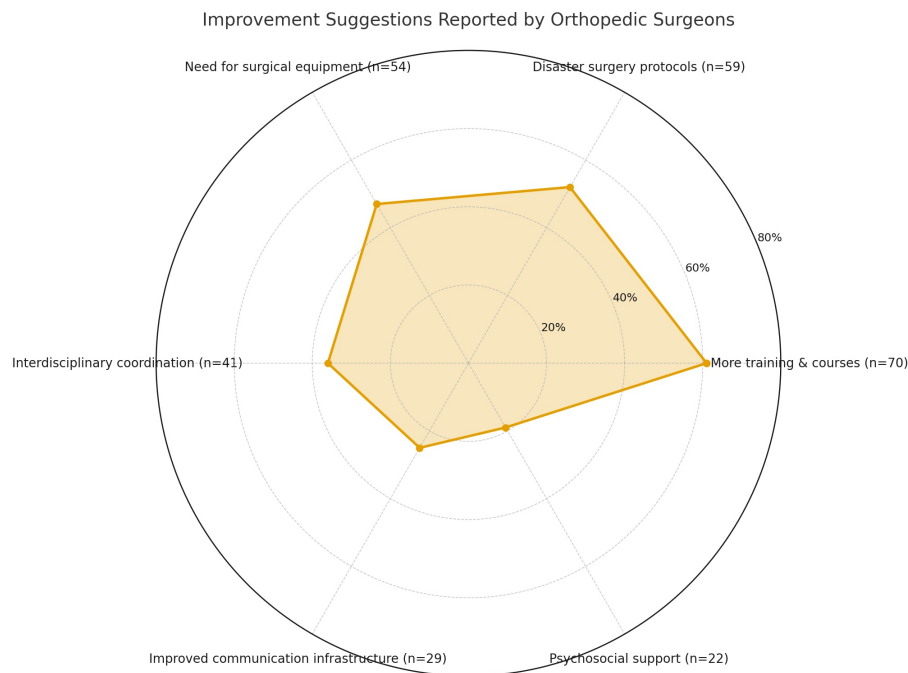


Figure 4. Improvement suggestions reported by orthopedic surgeon.

cation infrastructure (25%; n=29), and psychosocial support (19%; n=22) (Figure 4).

■ DISCUSSION

This study is among the first to systematically evaluate orthopaedic surgeons' experiences performing fasciotomy while working under earthquake conditions. Although previous studies have addressed the epidemiology and surgical management of earthquake-related orthopaedic injuries [13–15], surgeons' preferences, technical approaches, complications, challenges, and training needs related to fasciotomy in disaster settings have not been sufficiently explored. Therefore, our findings provide important insights into surgical decision-making and practice variability under extraordinary circumstances.

A key finding of this study is the lack of standardization in fasciotomy practice during disaster response. Surgeon experience significantly influenced outcomes; higher complication rates among participants with 1–5 years of experience suggest that technical proficiency and clinical judgement are critical determinants of success. This aligns with Lu-Ping et al. [16], who highlighted better outcomes in disaster injury management by experienced teams.

The surgical environment was another major determinant. Fasciotomies performed outside the operating room were associated with higher complication rates, consistent with prior reports indicating increased infection risk in non-standard settings, including field hospitals [17]. Similarly, organized triage systems and access to appropriate operating room infrastructure have been shown to reduce adverse outcomes in earthquakes [18]. Collectively, these findings emphasize the need for logistical preparedness and structured surgical systems in disaster medicine. These findings are consistent with

earthquake-related orthopaedic reports from Türkiye, which emphasize the overwhelming patient load, disruption of hospital logistics, and the critical importance of organized triage and prioritization of urgent procedures (e.g., fasciotomy) during the early disaster response period [19,20].

With regard to technique, double-incision leg fasciotomy and volar forearm fasciotomy were the most commonly used approaches. Although incision type was not significantly associated with complications, heterogeneity in surgical practice was evident. As noted in the literature, multiple fasciotomy techniques may yield favourable results when correctly performed; therefore, the focus should remain on adequate decompression and adherence to trauma principles, including damage control surgery [21–24].

Notably, most participants reported encountering inadequately decompressed compartments, primarily due to short incisions, unopened compartments, or insufficient fascial release. This finding is clinically relevant, as incomplete decompression can increase morbidity and negatively affect long-term functional outcomes. In disaster settings where systematic monitoring and serial reassessment are limited, the risk of technical inadequacy may be higher.

Decision-making for fasciotomy remains challenging in earthquake zones. In the absence of compartment pressure monitoring, clinical examination becomes the main diagnostic tool; when serial assessments are not feasible, early fasciotomy may be considered despite an increased risk of infection [25]. In our cohort, the high frequency of fasciotomy, the complication burden, the frequent reports of inadequate decompression reflect the complexities and constraints of disaster surgery.

Finally, surgeons with prior fasciotomy experience reported greater confidence in both decision-making and technical execution, supporting the importance of structured training. Standardized disaster surgery courses, simulation-based training, and field exercises may improve preparedness and reduce complication rates in future disasters [14,17,23,26].

This study has limitations. Its survey-based design may introduce recall and self-reporting biases, and complications may not be objectively verifiable. Nevertheless, the strength of this study lies in capturing the experiences of a large cohort of orthopaedic surgeons working under unprecedented earthquake conditions.

In conclusion, our findings reveal substantial variability in fasciotomy practice during the Kahramanmaraş earthquake and highlight the influence of surgeon experience, surgical environment, and training adequacy on outcomes. These results may inform the development of disaster-oriented training programs and contribute to establishing standardized protocols for fasciotomy in mass casualty settings.

■ CONCLUSION

This study highlighted the experiences of orthopedic surgeons in performing fasciotomy during the Kahramanmaraş earthquakes. The findings revealed that many surgeons were compelled to perform fasciotomies outside the operating room, frequently encountered inadequately decompressed compartments, and experienced complications at a considerable rate. The lack of standardization in disaster surgery influenced surgeons' approaches to patient management and led to variations in treatment protocols.

Our results indicate that patient management and surgical success in disaster settings depend not only on individual experience but also on appropriate surgical conditions, logistical support, and pre-established standardized protocols. Therefore, regular training programs, field exercises, and the development of standardized national and international disaster surgery guidelines are critically important for future disaster preparedness.

Ethics Committee Approval: Ethical approval for the study was obtained from the Mersin University Ethics Committee (Date: 17.09.2025, Approval number: 16/1003).

Informed Consent: Informed consent was obtained online from all participants.

Peer-review: Externally peer-reviewed.

Conflict of Interest: The authors declare no conflicts of interest.

Author Contributions: Conceptualization: ÖK, FG, İD, BS; Methodology: ÖK, FG; Formal analysis and investigation: ÖK, FG, İD, BS; Writing - original draft preparation: ÖK; Writing - review and editing: ÖK, FG, İD, BS; Funding acquisition: ÖK, İD; Resources: ÖK, BS; Supervision: ÖK, FG, İD, BS.

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Artificial Intelligence Disclosure: In this study, an artificial intelligence-based tool (ChatGPT, OpenAI, GPT-5) was used. This tool was used solely for language editing, translation, and improving the clarity and readability of the text. It was not used in the stages of study design, data evaluation, analysis of results, or generation of scientific interpretations. All parts of the manuscript, including data collection, statistical analysis, and interpretation of findings, were carried out entirely by the authors. All text revised with the assistance of artificial intelligence was carefully reviewed, revised, and validated by the authors. We confirm that the authors take full responsibility for the content of the manuscript and that the use of artificial intelligence complies with the ethical guidelines of the journal.

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