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Evaluation of surgical site marking protocols in pelvic and knee procedures: a retrospective analysis in an orthopedic clinic

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ABSTRACT

Introduction:
The fundamental principle of "first, do no harm" underscores the importance of safety in healthcare, particularly in surgical settings where preventable errors may occur. The World Health Organization's concept of safe surgery emphasizes accurate surgical site marking to reduce such risks. Healthcare workers' awareness of this practice plays a vital role in ensuring patient safety. This study evaluates the prevalence and compliance of surgical site marking in an orthopedic clinic.

Materials and Methods:
This retrospective study reviewed patient records from the Hospital Information Management System of a university hospital's orthopedic clinic. It focused on pelvic and knee surgeries performed between January and March 2022. Out of 106 patients, 2 were excluded due to inaccessible surgical site marking forms, resulting in a final sample of 104 patients.

Results:
The mean age of patients was 54.4 years; 55.8% were female. Among the surgeries, 65.4% were elective, and 54.8% lacked surgical site marking. A significant association was found between the type of surgery (emergency vs. elective) and the presence of surgical site marking ($p<0.05$). Furthermore, surgical site marking status was significantly related to average hospital stay duration ($p<0.05$).

Conclusion:
Despite its critical role in patient safety, surgical site marking was often overlooked, especially in emergency surgeries. The findings highlight the need for improved compliance in orthopedic practices. Educational interventions, particularly those supported by artificial intelligence, are recommended to increase awareness and implementation of surgical site marking protocols.

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Introduction

Ensuring patient safety is a fundamental principle of healthcare services that embodies the "first do no harm" approach. A critical component of this is surgical safety. Studies conducted worldwide continue to explore various practices aimed at enhancing patient safety(1). Among these practices, marking the surgical site is done to prevent wrong-site surgeries in patients undergoing surgical procedures (2). This labeling is important for ensuring patient safety and reducing errors caused by healthcare workers.

Global studies have highlighted persistent challenges in implementing this practice uniformly across institutions. For instance, data published by Joint Commission International (JCI) reveal that between 2004 and 2010, thousands of adverse events were recorded, with a notable portion attributed to wrong-patient or wrong-site errors (3,4). These errors often stem from insufficient preoperative evaluations, deviations from standardized protocols, and a lack of personnel competency. Moreover, audits conducted by professional nursing associations have reported deficiencies in surgical marking procedures and emphasized that such oversights may result in wrong-side interventions (5). Despite the introduction of checklists and safety frameworks by organizations such as WHO and JCI, including the WHO's Surgical Safety Checklist which has demonstrated positive impacts on surgical outcomes, consistent global compliance remains elusive (6). Particularly in high-risk procedures such as orthopedic surgeries involving the pelvis and knee where anatomical complexity may increase error susceptibility—adherence to site marking protocols is vital (7). Quality improvement initiatives in healthcare have made surgical site marking mandatory for both surgical and high-risk procedures to enhance surgical safety (8). The effective use of the surgical site marking form and the surgical safety checklist are critical components of this approach(9). This study aims to evaluate the implementation and efficacy of surgical site marking procedures in an orthopedic clinic, focusing specifically on pelvic and knee surgeries. By identifying patterns of compliance or deviation, the research seeks to contribute to the development of targeted strategies that strengthen surgical safety and enhance patient outcomes.

Materials and Methods

This study was conducted using a retrospective review of patient records from the Hospital Information Management System (HIMS) of an orthopedic clinic at a university hospital for patients who underwent surgery on the pelvic and knee regions between January and March 2022.

Ethical approach

To conduct the study, approvals were obtained from the Non-Interventional Clinical Studies Ethics Committee of xxxxx University, with decision number 21 dated 15/12/2022, and from the hospital administration for the use of data, with approval number 189962 dated 25/07/2022

Data collection

Data were retrospectively collected from the Hospital Information Management System (HIMS), and it was determined that 106 patients underwent pelvic and knee surgery. Two patients whose surgical site marking forms could not be accessed were excluded from the study, resulting in a final sample size of 104 patients. Surgical types, status of surgical site marking, age, gender, and average length of hospital stay of the patients were statistically compared.

Analyses

The data were evaluated in terms of count, percentage, mean, and frequency, and it was determined that the data followed a normal distribution. Independent t-tests were used to compare independent variables. For evaluating the statistical significance of categorical variables, the chi-square test was employed. Statistical analysis of the data was conducted using SPSS 23 software.

Results

It was found that the average age of the patients included in the study was 54.4 years, with 55.8% being female and 44.2% male. The average age of males was determined to be 51.4 years, while that of females was 56.7 years. It was observed that

65.4% of the patients underwent elective surgery, 54.8% did not have surgical site marking, and the average length of hospital stay was 7.5 days. The average length of hospital stay was found to be 8 days for male patients and 7.2 days for female patients. The sociodemographic and patient characteristics of the patients included in the study are detailed in Table 1 (Table 1).

Table 1: Demographic and Patient Characteristics Table

Gender		Age	Number of Days Stayed in Hospital	Percentage (%)
Male (n=46)	Mean	51,4130	8,0652	44.2
	Std. Deviation	22,05204	4,05738	
Woman (n=58)	Mean	56,7931	7,2069	55.8
	Std. Deviation	24,18551	2,55301	
Total (N=104)	Mean	54,4135	7,5865	100
	Std. Deviation	23,31032	3,31402	
			n	Percentage (%)
Side Surgery Marking		Was	47	45.2
		None	57	54.8
Surgical Status		Emergency Surgery	36	34.6
		Elective	68	65.4

When examining the distribution of surgical site, surgical site marking, and surgical status by gender, it was found that 59.6% of patients undergoing pelvic surgery were male, while 40.4% were female.

Another notable finding was that 74.5% of patients undergoing knee surgery were female.

Additionally, it was observed that the majority of males (55.6%) underwent emergency surgery, while the majority of females (61.8%) underwent elective surgery.

When examining the status of surgical site marking, it was found that 47.4% of males and 52.6% of females did not have surgical site marking. Furthermore, a significant difference was found between surgical site and gender ($p<0.05$), while no significant difference was found between gender and surgical site marking status or surgical status ($p>0.05$).

The distribution of surgical characteristics and surgical site marking status by gender is detailed in Table 2(Table 2).

Table 2: Surgical Characteristics and Side Surgery Marking Status by Gender

		Gender		
		Male	Woman	
		%	%	P
Surgery Area	Pelvic Region	59.6%	40.4%	*0,000
	Knee Area	25.5%	74.5%	
Marking Side Surgery	Was	40.4%	59.6%	0,305
	None	47.4%	52.6%	
Surgical Status	Emergency Surgery	55.6%	44.4%	0,069
	Elective	38.2%	61.8%	

When examining the surgical site and surgical status in relation to the status of surgical site marking, it was found that 75.4% of patients undergoing pelvic surgery

did not have surgical site marking, while 24.6% did. On the other hand, 70.2% of patients undergoing knee surgery had surgical site marking. Additionally, a significant difference was found between pelvic and knee surgery and the status of surgical site marking ($p<0.05$). When analyzing the rates of surgical site marking according to whether the surgery was emergency or elective, it was found that surgical site marking was not performed in 100% of emergency surgeries, while it was performed in 69.1% of elective surgeries. A significant difference was found between the status of surgical site marking and whether the surgery was emergency or elective ($p<0.05$). The detailed distribution of surgical site, surgical status, and the status of surgical site marking is provided in Table 3 (Table 3).

Table 3: Side Surgery Marking Status According to Surgical Site and Surgical Condition

		Marking Side Surgery		P
		Was	None	
Surgery Area	Pelvic Region	24.6%	75.4%	*0,000
	Knee Area	70.2%	29.8%	
Surgical Status	Emergency Surgery	0.0%	100.0%	*0,000
	Elective	69.1%	30.9%	

When examining the surgical site, surgical status, and length of hospital stay, it was found that the average length of hospital stay for patients operated on under emergency conditions was 9 days, while for patients operated on under elective conditions, it was 6.7 days. Additionally, patients undergoing pelvic surgery had an average hospital stay of 8.9 days, while those undergoing knee surgery had an average hospital stay of 5.9 days.

A significant difference was observed in the average length of hospital stay between patients undergoing emergency and elective surgery ($p<0.05$).

Furthermore, a significant difference was found in the average length of hospital stay between patients undergoing pelvic surgery and those undergoing knee surgery ($p<0.05$). The details of the surgical site, surgical status, and length of hospital stay are provided in Table 4 (Table 4).

Table 4: Comparison of Surgery Area, Surgical Condition and Number of Hospitalized Days

		N	Mean	Std. Deviation	p
Number of Days Stayed in Hospital	Emergency Surgery	36	9,13	4,263	*0,003
	Elective	68	6,76	2,325	
	Pelvic Region	57	8,91	3,621	*0,000
	Knee Area	47	5,97	1,950	
	Side Surgery Marking Yes	47	6,31	2,207	*0,000
	Side Surgery No Marking	57	8,63	3,706	

Discussion

Proper marking of the side to be operated on is crucial for patient safety. In a study examining surgical site marking and verification errors, it was found that nurses and doctors encountered near-miss events related to surgical site marking in 26% of surgeries, while the rate of surgical site marking was 73.38% in the same study. In a study conducted by Çiftçioğlu and Kuzu in 2022, it was observed that surgical site marking was not performed in 50.2% of cases (10). Additionally, a study by Wang and Tao suggested that 50% of medical errors worldwide are attributable to surgical errors (11). In this study, it was found that the status of surgical site marking was similar to that reported in the literature. The

presence of similar rates in studies examining different samples indicates that surgical site marking and patient safety culture have not yet reached the desired level. It is believed that both developing their own strategies and aligning with international strategies are crucial for healthcare institutions to establish a culture of patient safety and provide error-free quality services. Furthermore, despite the use of advanced technology and educational services in healthcare institutions, the lack of sufficient emphasis on patient safety culture among staff members suggests that this culture has not yet been fully integrated into personnel training or university education. In this context, it is considered crucial for patient safety culture education to begin early in the health departments of universities.

Ensuring patient safety during emergency surgeries, where safe surgery and surgical site marking can be challenging during the preparation process, is crucial. Studies have shown that the World Health Organization's Safe Surgery Checklist reduced mortality rates from 3.7% to 1.4% in patients undergoing emergency surgery, with a significant decrease in mortality rates. Additionally, it was found that adherence to the Safe Surgery Checklist was 18.6%, and when adherence increased to 50.7%, complications significantly decreased (6,7).

In a study conducted by Sewell et al. in 2011 at an orthopedic clinic, the usage rate of the World Health Organization's published Safe Surgery Checklists, including surgical site marking, was found to be 7.9%, highlighting staff resistance to using safe surgery checklists(6). In a study by Toor et al. in 2013, which examined 103 cases, it was found that the rate of surgical site marking in cases where the checklist was used was 89.3% (12). In this study, it was observed that surgical site marking was not performed in any of the patients undergoing emergency surgery, while it was performed in 30.9% of patients undergoing elective surgery. The findings of this study suggest that the lower rate of surgical site marking in patients undergoing emergency surgery may be due to the tendency of staff to expedite procedures in emergency cases.

The use of surgical checklists has been proposed to be associated with mortality, morbidity, and complication rates in patients (13). When examining studies in the literature, it was found that the use of the Safe Surgery Checklist, including surgical site marking, published by the World Health Organization, reduced mortality rates from 1.5% to 0.8% in patients undergoing orthopedic surgery (6). In another study, the use of the Safe Surgery Checklist was found to reduce complications from 18.4% to 11.7% and decrease mortality rates from 3.7% to 1.4% (7). In this study, it was observed that patients who underwent surgical site marking had an average length of hospital stay of 6.3 days, while those without marking stayed for an average of 8.6 days. The utilization of safe surgical procedures and adherence to these checklists are believed to enhance patient safety, thereby increasing patient satisfaction and potentially reducing complication rates. When patients receive care in a safe environment, it can also affect their levels of anxiety and stress. In these scenarios, patient outcomes may be influenced positively or negatively by their anxiety and stress levels. From this perspective, the use of safe surgery checklists and surgical site marking suggests that they have an impact on patients.

Conclusion and Recommendations

According to the findings of this study, while side marking in multi-organ surgery is important for patient safety, it is generally not performed in orthopedic clinics. Furthermore, it has been observed that side marking is mostly conducted in elective surgeries, with almost no instances in emergency surgeries. A significant association has been identified between the surgical site and side marking, as well as between the surgeon's choice of elective or emergency procedures and the implementation of side marking. Additionally, there is a significant difference in the average length of hospital stay between elective and emergency surgeries. Moreover, patients who undergo side marking have a lower average length of hospital stay compared to those who do not.

Based on these findings, it is recommended that personnel in orthopedic clinics where multi-organ surgeries are performed receive training on side marking procedures. The effectiveness of this training should be assessed at regular intervals. Institutions should adopt a reward system strategy to encourage the use of safe surgery checklists that include side marking. In addition to traditional training methods aimed at increasing compliance with side marking among healthcare personnel and reminding the team of their legal responsibilities, the implementation of simulation, toolbox, and artificial intelligence-supported training methods is suggested. Furthermore, it is advisable to examine multicenter samples to gather more comprehensive data.

Limitation

This study was conducted on patients who underwent knee and pelvis surgeries in the orthopedic inpatient ward of a university hospital, using preoperative patient and surgical safety procedures and data obtained from patient files. The data collection is limited to the orthopedic inpatient ward and the surgical process applications. Therefore, the study results cannot be generalized.

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