Original Article

Quality of Care before, during, and after Casting: A Cross-sectional Study

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Abstract

Background: Casting is the most common treatment for managing limb fractures. Casts that are not properly provided or are not correctly cared for may hinder the healing of fractures. However, no study assessed the quality of care before, during, and after casting. **Objectives:** This study aimed to investigate the quality of nursing care before, during, and after casting. **Methods:** A cross-sectional study was conducted on 188 patients with limb fractures referred to Shahid Beheshti Hospital in Kashan, Iran, from July to November 2018. The data collection instrument consisted of 57 items on the quality of care before, during, and after casting. Descriptive statistics and Fisher's exact test were used to analyze the data. **Results:** A total of 188 patients were assessed, 94 cases regarding the quality of care before and during casting and 94 additional cases for the quality of care after casting. The quality of care before, during, and after casting was at a moderate level in 83%, 58.5%, and 63.8% of patients, respectively. A significant connection was found between the quality of care before casting and the type of damage ($P = 0.002$). Significant connections were also found between the quality of care after casting and the nurses' work shift ($P = 0.05$) and gender ($P = 0.05$). **Conclusion:** The quality of care before, during, and after casting was mostly at a moderate level. Educational interventions are needed for nurses to improve the quality of cast care.

Keywords: Casting, patients, quality of care

Introduction

Limb fractures are of the major consequences of traumas and accidents.[1] It has reported that 38.5% of patients with trauma suffer from fractures.[2] Some studies have also reported that 10%–25% of children and adolescents[3] and 57% of older adults[4] develop fracture after trauma. Accidents (in particular, traffic accidents) and subsequent fractures constitute a major part of hospital admissions in Iran.[5]

Casting is the most common treatment for managing limb fractures.[6] A study reported that casts are applied in 34% of all fractures.[7] Physicians and nurses' competence in casting technique and in caring for a patient with casts is essential to ensure favorable outcomes, saving expenses, and preventing possible cast-related complications.[4] Casts that are not properly applied or are not properly cared for may hinder the healing of fractures and threaten the patients' safety.[6] Failure to observe the principles of casting and cast care may predispose patients to a number of immediate and delayed complications such as severe pain, edema, compartment syndrome,[8,9] tissue necrosis, pressure ulcer,[10] malunion, delayed union, nonunion,[11,12] contracture, and neurological and paralytic problems.[13] A study in Sweden reported that 25% of patients with cast experienced cast complications.[6]

Orthopedic patients and especially those with cast are also susceptible to the side effects of immobility; therefore, they need quality care to prevent or manage the side effects.[6,14] Nurses are the main health-care providers and play a major role in the prevention or early diagnosis of cast complications during the patient's hospital stay. Orthopedic nursing is a

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specialty area.[15] Casting and cast care also require special skills, knowledge, and clinical judgments to provide safe care and to prevent complications.[10] However, a study reported that due to a myriad of reasons such as departments overcrowding and lacking specialized nurses, orthopedic patients are not usually cared for properly.[14] Szostakowski *et al*. also reported that cast complications might mostly be attributable to poor casting and cast care procedures rather than the patients' condition or casting materials.[16]

Despite the high incidence of fractures and the popularity of casting in patients with fractures, the quality of cast care has been neglected, and few studies are available on cast care quality. A number of studies are available on the quality of care in patients with traction,[17] infectious complications associated with cast/splint placement in children,[18] knowledge and attitudes of orthopedic nurses regarding pain management,[19] postoperative nursing interventions in patients with hip and knee surgeries,[20] experiences of patients with a plaster cast,[21] multidisciplinary approach to improve the quality of below-knee casting procedure,[22] the safety and efficacy of plaster checking by nurses,[23] and pain management in orthopedic patients.[24] Adib-Hajbaghery and Moradi examined 100 patients with traction and reported that the quality of traction care was low in most patients.[17] A study in Sweden also reported that 25% of patients with cast experienced cast complications.[6] A qualitative study on patients' experiences of lower limb cast also reported that having a cast is a difficult, problematic, and exhausting experience associated with pain, swelling, and discomfort. The authors recommended quantitative studies to be conducted for measuring the quality of cast care.[21] In another study, Ahmed and Hussein investigated the knowledge of 100 nurses working in orthopedic units in Baghdad, Iraq, and found that only 27% of nurses had high-level knowledge regarding cast-related complications.[25] Neuman also reported that orthopedic nurses did not have adequate knowledge and a suitable attitude toward pain management.[19] An interventional study also reported that a practical workshop of casting held for casting staff could significantly improve the quality of casting procedure and reduce cast reapplications.[22] However, no study is available regarding the quality of care before, during, and after casting. Considering the high incidence of trauma and its associated fractures and the lack of studies on the quality of cast care, this study aimed to investigate the quality of nursing care before, during, and after casting in patients with limb fractures.

Methods

Study design and participants

This cross-sectional study was conducted from July to November 2018 on 188 patients with limb fractures referred to Shahid Beheshti Hospital, Kashan, Iran. The sample size was estimated based on the results of an earlier study in which despite education delivered, the prevalence of good quality below-knee casting was 12%.[22] Then, considering Type I error of 0.05 and $P = 0.12$, a sample of 163 patients was estimated to be needed. However, due to the possibility of nonresponsiveness, the estimated sample size was increased by 15% to become 188. Nonetheless, as in the study setting, care before and during casting is usually done in the casting room of the emergency trauma department (ETD) and then the patients are discharged to go home or are transferred to the orthopedic care unit for aftercare and surveillance, it is decided to select half of the patients from the ETD and the other half from the orthopedic care unit. Then, 94 patients were observed in the ETD and 94 participants in the orthopedic care unit. The inclusion criteria were as follows: being alert, willing to participate in the study, having a limb fracture and being a candidate for casting or having a cast, and a hospital stay of at least a day for those recruited from the orthopedic care unit of Shahid Beheshti Hospital. Patients with inclusion criteria were consecutively recruited into the study until the sample size was completed.

Instruments

A two-part instrument was used in this study. The first part contained a question on the running working shift, four questions on nurse's features (i.e. age, gender, work experience, and history of passing special courses on casting and cast care), and six questions on patient's features (i.e. age, gender, broken limb, type and location of fracture, and length of hospital stay). The second section of the instrument was a three-part checklist for assessing the cast care quality before, during, and after casting. The first draft of the checklist was designed through a review of textbooks and articles related to the nursing care for orthopedic patients[10,12,26,27] and contained 65 items related to the care before (11 items), during (14 items), and after (40 items) casting.

Content validity of the checklist was verified by ten faculty members of the Faculties of Nursing and Midwifery at Kashan and Arak Universities of Medical Sciences. For determining the content validity ratio (CVR), the experts were required to comment on the necessity of each item. Then, the CVR of individual items was determined using the Lawshe's table and the following formula.

$$CVR = \frac{\text{Number of experts indicating the item as being ``essential'' - Total number of the experts / 2}}{\text{Total number of experts / 2}}$$

According to the Lawshe's table, items with a CVR value >0.62 were considered to be essential.[28] The content validity index (CVI) of individual items was also calculated based on the expert scores to individual items on a 4-point Likert scale (1 = it is not relevant, 2 = it needs serious revision, 3 = it is relevant but needs minor revision, and 4 = it is quite relevant). Then, the CVI of individual items was computed using the following formula:

CVI = Number of experts who selected the Code 3 and 4 / The total number of the experts

Usually, a CVI value >0.79 indicates good content validity, However, items with a CVI value from 0.70 to 0.79 need

revision, and items with a CVI value <0.70 are considered irrelevant and must be omitted.[29,30] Accordingly, eight items with a CVR <0.62 and CVI <0.70 were removed and 4 items were revised. Finally, 52 items were retained in the checklist. The CVR for the individual items in the final form of the checklist ranged from 0.80 to 1 and CVI ranged from 0.70 to 1.

The reliability of the checklist was also assessed through the inter-rater reliability method. For this purpose, the checklist was completed for ten patients (in the areas of before and during casting) and ten patients in the area of after casting. Using separate checklists, two nurses (including the second author of the article and another trained nurse) simultaneously observed every patient and examined the care quality. The overall reliability coefficients of the checklist and its three sections were 0.77, 0.81, 0.91, and 0.84, respectively.

The final 52 items assess the quality of care in three areas of before (9 items), during (11 items), and after (37 items) casting. All items were rated on a three-choice scale (i.e. 2 = done, 1 = failed, and 0 = not applicable). Overall, the checklist produces the minimum and maximum scores of 0 and 114, respectively. Higher scores indicate a higher quality of care. The scores in the three domains of before, during, and after casting were also ranged from 0 to 38, 0–22, and 0–54, respectively. The quality of overall care and also the care quality in each subscale were considered to be "favorable," "moderate," and "unfavorable." According to Rose *et al*., obtaining 0%–49% of the score was considered as an unfavorable care quality, 50%–74% as moderate, and 75%–100% as a favorable care quality.[31]

Data collection

The second researcher performed all observations in the ETD through the participant observation method. For this purpose, she was introduced as a trainee in the ETD unit – for staff to become accustomed to her presence – but started the data collection after 2 weeks. Observations in the orthopedic units were undertaken by two research assistants who were trained and tested before the study starts. They were also introduced as trainees in the concerned units and started their observations after 2 weeks. For observation, the observers stood in a corner of the unit and either watched or followed individual nurses. Even though the observers did not participate in direct patient care, minimal assistances were given upon some nurses' request.

The data regarding the patients' and nurses' features were gathered by reviewing the patients' records and interviewing nurses. The other parts of the checklist – according to the nature of the items – were completed through direct observation of the nurses' performance, interviewing patients, or reviewing the nursing reports. As all casting procedures have usually been performed in the morning and evening work shifts, all observations were conducted during these work shifts.

Ethical considerations

This study was approved by the Institutional Review Board and Ethics Committee of Kashan University of Medical Sciences, Kashan, Iran (grant number: 97010, ethics approval code: IR.KAUMS.NUHEPM.REC.1397.008). All patients were assured about the confidentiality of their information, voluntariness of participation in, and withdrawal from the study. They also were assured that a decision of withdrawal or their responses to the questions would not affect the care they receive. Written informed consent was obtained from all patients. Moreover, all the checklists were anonymous. All participating nurses also signed the informed consent form after collecting the data and were assured of the confidentiality of their personal information.

Data analysis

Data analysis was performed through the SPSS software (version. 13.0; SPSS Inc., Chicago, IL, USA). Data were analyzed using descriptive statistics such as frequency, percentage, mean, and standard deviation. Moreover, Fisher's exact test was used to compare the subgroups of the participants in terms of the quality of care before, during, and after plaster casting. $P < 0.05$ was considered statistically significant in all tests.

Results

In this study, the quality of care was assessed for a total of 188 patients with a cast. Among the patients, 94 patients were assessed before and during casting and 94 cases were assessed after casting.

Among the patients who were assessed before and during casting, 55.6% were male, and their mean age was 30.37 ± 18.0 years. However, of the patients who were assessed after casting, 80.9% were male and their mean age was 31.69 ± 20.1. All nurses who provided before and during casting care were male with a mean age of 32.35 ± 1.9 and a work experience of 9.34 ± 1.7 years. However, 66% of the nurses who provided after casting care were female, and their mean age and work experience were 32.1 ± 5.4 and 7.47 ± 4.51 years, respectively. In general, 58.5% of patients suffered from upper limb fractures, and 12.25% of them had open wounds in their fractured limb [Table 1].

Table 2 shows that the quality of care was at a moderate level in 83%, 58.5%, and 63.8% of the patients before, during, and after casting, respectively. Furthermore, as Tables 3 and 4 show, no significant relationship was found between the quality of care and variables such as the patients' gender, site of damage, and the type of fracture. However, a significant connection was found between the quality of care before casting and the type of damage, so that the quality of care was desirable in all patients with open fractures while it was at the moderate level in 85.7% of patients with closed fractures ($P = 0.002$). Moreover, significant connections were found between the quality of care after casting and variables such as work shift ($P = 0.05$) and nurses' gender ($P = 0.05$) [Tables 3 and 4].

Discussion

The present study showed that the quality of care before, during, and after casting was not at the favorable level in most

Table 1: The patients and nurses' demographic data before, during, and after casting[a]

Characteristics	Time of assessment	
	Before and during casting	After casting
Shift		
Morning	10 (10.6)	15 (16)
Evening	84 (89.4)	79 (84)
Site of damage limb		
Lower limb	57 (60.6)	53 (56.4)
Upper limb	37 (39.4)	41 (43.6)
Kind of damage		
Open	3 (3.2)	20 (21.3)
Closed	91 (96.8)	74 (78.7)
Kind of fracture		
Complete	0	16 (17)
Incomplete	94 (100)	78 (83)
Nurses' sex		
Female	0	62 (66)
Male	94 (100)	32 (34)
Patients' sex		
Female	41 (43.6)	18 (19.1)
Male	53 (55.6)	76 (80.9)
Nurse age	32.35±1.90	32.1±5.4
Working experience	9.34±1.71	7.47±4.51
Patient age	30.37±18	31.69±20.11
Length of hospitalization	0	2.25±3.10

[a]Data presented as *n* (%) or mean±SD. SD: Standard deviation

Table 2: Frequency and percentage of favorable, moderate, and unfavorable care before, during, and after casting[a]

Time of assessment	Favorable	Moderate	Unfavorable
Before	11 (11.7)	78 (83.0)	5 (5.3)
During	33 (35.1)	55 (58.5)	6 (6.4)
After	1 (1.1)	60 (63.8)	33 (35.1)

[a]Data presented as *n* (%)

cases. This finding reveals that nurses do not pay adequate attention to the patients precasting caring needs. The precasting phase is the time when patients are waiting for casting and are extremely worried about their condition. Deformity and edema of the injured limb, as well as the pain and disability to move it intensify the patient's concerns at precasting phase.[12,32] However, an expert nurse can relieve the patient's concerns through providing prompt interventions such as immobilization of the injured limb, implementation of pain reduction modalities, and informing the patient about the treatment process.[12] In addition, through careful and frequent checking of the neurovascular status of the involved area, elevating the affected part, and keeping it in the proper alignment in the precasting phase, nurses can prevent displacement of the fractured bones and reduce edema, pain, and the likelihood of ischemic injuries in the affected limb.[11,32,33] Moreover, prompt treatment of skin lesions and wounds in the injured limb can reduce the risk of infection.[11] Furthermore, in the precasting phase, the nurse should prepare all the necessary materials and equipment needed for casting.[12] Nonetheless, inattention to such a simple care measure may put patients at greater risk for fracture complications. A study showed that 25% of patients with casts experienced cast-related problems and complications.[6] Perhaps, nurses and staff involving in the process of casting need to be retrained regarding the patients' caring needs, especially during the precasting phase.

In the current study, the quality of care during casting was not at the favorable level in two-thirds of patients. In Iran, application of a cast is usually prescribed by physicians (often an orthopedist or a trauma specialist) and applied by nurses. The undesirable quality of care during casting may be due to the fact that casting nurses have not been specifically trained in this regard. Halanski and Noonan, in a study, reported that patients may experience more cast complications if casts are applied by unskilled staff.[34] Another study also reported that the qualifications of the staff applying casts is a crucial factor in preventing the cast-related complications.[6] Casting and care of patients with cast are complex processes and specialized tasks that require proper supervision and compliance with special guidelines. The frequency of cast complications would be decreased if casting guidelines are followed correctly.[4,35] Therefore, the competence of casting staff should be evaluated periodically, and then, they must be retrained if necessary.

In the present study, the quality of care after the casting was not at the favorable level in about 99% of the patients. A majority of cast and fracture complications occur during the postcasting period. Edema is one of the most common postcasting complications. Pressure ulcers and compartment syndrome are also among the dangerous complications associated with the increased pressure within the limited space of the cast. Moreover, patients are at high risk for developing contractures as a result of disuse syndrome due to the immobility, paralysis, and muscular atrophy.[8,10,13,22] All these complications can be prevented through meticulous nursing care, suitable patient education, and precise documentation of the caring process.[4,12,36] The undesirable quality of care after casting shows that patients are severely exposed to postcasting complications.

The undesirable quality of care after casting might be attributed either to the nurses' inadequate knowledge of postcasting care or to their simplistic view toward postcasting care. Perhaps, some nurses consider that the main work has been carried out with cast implementation. They might also think that postcasting care is so simple that all patients know it and are able to do so. In a study of the quality of care in patients with traction, Adib-Hajbaghery and Moradi reported that the quality of care was undesirable in 45%–96% of caring aspects.[17] Furthermore, a study of 100 Iraqi nurses has found that only 27% of nurses had good knowledge regarding postcasting care and complications.[25] Such a low knowledge may affect both the care quality and the frequency of complications. Therefore,

Table 3: Comparison of quality of care before and during casting in terms of patients' demographic variables[a]

Variables	Before casting			*P*	During casting			*P*
	Favorable	Moderately favorable	Unfavorable		Favorable	Moderate	Unfavorable	
Patients' sex								
Female	3 (7.31)	36 (8.8)	2 (4.87)	0.53	14 (34.14)	25 (60.97)	2 (4.87)	0.84
Male	8 (15.9)	42 (79.24)	3 (5.66)		19 (35.84)	30 (56.6)	4 (7.54)	
Work shift								
Morning	1 (10)	9 (90)	0	0.99	5 (50)	5 (50)	0	0.47
Evening	10 (11.9)	69 (82.14)	5 (5.95)		28 (33.33)	50 (59.52)	6 (7.14)	
The injured limb								
Lower limb	7 (12.28)	48 (84.21)	2 (3.5)	0.63	21 (36.84)	32 (56.14)	4 (7.01)	0.84
Upper limb	4 (10.81)	30 (81.08)	3 (8.1)		12 (32.43)	23 (61.16)	2 (5.4)	
Kind of damage								
Open	3 (100)	0	0	0.002	0	3 (100)	0	0.41
Closed	8 (8.79)	78 (85.71)	5 (5.49)		33 (36.26)	52 (57.14)	6 (6.59)	

[a]Data presented as *n* (%)

Table 4: Comparison of quality of care after casting in terms of patients' demographic variables

Variables	After casting[a]			*P*
	Favorable	Moderate	Unfavorable	
Nurses' sex				
Female	0	44 (70.96)	18 (29.03)	0.05
Male	1 (3.12)	16 (50)	15 (46.8)	
Patients' sex				
Female	0	10 (55.55)	8 (44.44)	0.52
Male	1 (1.31)	50 (65.78)	26 (34.21)	
Nurses' working shift				
Morning	1 (6.66)	7 (46.6)	7 (46.6)	0.05
Evening	0	53 (67.08)	26 (32.91)	
The injured limb				
Lower limb	1 (1.88)	37 (69.81)	15 (28.3)	0.99
Upper limb	0	23 (56.09)	18 (43.9)	
Kind of damage				
Open	0	11 (55)	9 (45)	0.55
Closed	1 (1.35)	49 (66.21)	24 (32.43)	
Kind of fracture				
Complete	0	13 (81.25)	3 (18.75)	0.31
Incomplete	1 (1.28)	47 (60.25)	30 (38.46)	

[a]Data presented as *n* (%)

it seems crucial for nurses to increase their knowledge and skills in managing patients with orthopedic problems including those with casts. In addition, weaknesses in the undergraduate and continual nursing education systems,[37] poor surveillance and supervision in clinical settings,[38] inadequate nurse–patient ratio, high workloads,[15] overcrowding of the wards, and lack of expert and knowledgeable nurses[14,39] can all affect the low quality of care in patients with cast, in particular in postcasting care. Therefore, strengthening both the basic and the continuing nursing education systems, increasing the nurse–patient ratio, intensification of clinical supervision systems, using of experienced mentors for nursing students in emergency and orthopedic departments, and the establishment of a specialized field of orthopedic nursing can help overcome these deficiencies.

In the present study, no significant relationship was found between the quality of care before casting and demographic characteristics such as patients' gender, type of the limb, and the type of fracture. However, a significant relationship was found between the quality of care before casting and the type of fracture (i.e. open or closed fractures), so that the quality of care was favorable in all cases with an open fracture. However, due to the small numbers of this type of fracture, the observed relationship might not be practically important. Moreover, we found significant relationships between the quality of care after casting and the nurses' gender and their work shift. However, due to the small numbers of casting procedures in the morning shifts and the small numbers of male nurses compared with female ones, these findings also seem not clinically important.

This study was conducted in a hospital and used a convenient sampling method. Then, the results might not be generalized to other hospitals. Therefore, further multicenter studies are recommended. Furthermore, we did not investigate the incidence of cast complications or the patient readmissions due to the complications. Therefore, studies are suggested to examine these important issues. Furthermore, examining the effect of staff training on the quality of care of patients with cast is suggested. Moreover, the presence of the researcher might have affected the nurses' performance. However, this presence might probably have had trivial effects, if any, because the researcher worked in the study setting from 2 weeks before the data collection started.

Conclusion

This study evaluated the quality of cast care and showed that the quality of care requires serious attention. The quality of care before, during, and after casting was mostly at a moderate level. Nevertheless, designing and implementing appropriate in-service training programs for nurses regarding the caring

needs of patients with cast are seriously recommended. Moreover, strengthening the supervisory system and providing evidence-based guidelines for casting and cast care might perhaps be effective in increasing the quality of cast care.

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Conflicts of interest

There are no conflicts of interest.

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