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ORIGINAL ARTICLE

Operating room nurses' positioning of anesthetized surgical patients

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Aims and objectives. To describe the incidence of problems associated with the positioning of anaesthetised surgical patients.

Background. The positioning of the anaesthetised surgical patient is a complex task. The interdisciplinary nature with several professional groups in a surgical team may lead to conflict between the positioning standards and individual consideration for the patient. Existing knowledge of the relationship between the different positioning forms, surgical team competences and the applicability and availability of positioning equipment is sparse.

Design. A descriptive cross-sectional study.

Method. An electronic questionnaire was sent to 833 OR nurses employed at four public university hospitals. With 481 responses, a response rate of 57·7% was achieved. Descriptive statistical analyses were performed using the SPSS software package (version 19.00).

Results. Positioning of the patient was found to be particularly difficult for the prone (43·8%), lithotomy (53·4%) and lateral (65·5%) positions. Lack of positioning competences and equipment for arm support, standardised equipment for leg support and standard sizes of OR beds seemed to complicate positioning.

Conclusion. Lack of appropriate positioning equipment and positioning competences in surgical teams, combined with the poor availability of positioning equipment in ORs were found to cause problems.

Relevance to clinical practice. There is a need for innovative solutions to develop modern forms of positioning equipment allowing individual consideration of the patient. Further research is required on positioning equipment, optimisation of continuity and the establishment of permanent surgical teams.

What does this paper contribute to the wider global clinical community' section

- Positioning of the patient was found to be particularly difficult for the prone (43·8%), lithotomy (53·4%) and lateral positions (65·5%).
- There is a general need for positioning devices that can better accommodate patients' individual needs, particularly for the prone, lithotomy position and lateral positions.
- There is a discrepancy between what positioning devices are available on the market and what is found in operation rooms.
- The management and organisation of perioperative work call for examination of the need to establish permanent surgical teams and for special positioning competences to be available round the clock to ensure the continuity of positioning work.
- Further research is required on positioning equipment for developing equipment allowing individual consideration of the patient.

Key words: electronic questionnaire, operative surgical procedures, patient positioning, perioperative nursing, surgery

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Introduction

This study focuses on operating room nurses positioning of anaesthetised surgical patients in the operating rooms (OR). It is well known that optimal positioning aims to ensure patient safety and efficiency and to provide access to the surgical field (Timmons & Tanner 2005, Leach *et al.* 2009, Beckett 2010). Despite manuals and guidelines for the correct use of positioning equipment, knowledge about various positions of anaesthetised surgical patients, the competencies of the surgical team and the applicability and availability of the positioning equipment is sparse. The aim of this study was to describe the incidence of problems associated with the positioning of anaesthetised surgical patients. The results indicate a need for innovative solutions to develop modern forms of positioning equipment allowing individual consideration of the patient.

Background

Positioning of the anaesthetised surgical patient in an OR is a complex and difficult task. This is due to the need for considering existing standards, the individual patient and time constraints for the total time under anaesthesia (Sørensen 2011). Positioning devices often serve a number of different purposes, and the interdisciplinary nature of the positioning task involves several discipline groups such as OR nurses (circulator nurse and scrub nurse), nurse anaesthetists, surgeons and porters. As a result, optimal positioning cannot always be achieved, thus exposing patients to the risk of injury (Hove *et al.* 2006) and of infringement of their personal integrity (Sørensen 2011). To this, the socio-economic costs that occur as a result of incorrect positioning should be added (McInnes *et al.* 2011).

Globally, more than 100 million people require surgical treatment each year (WHO 2012). Before surgery, the patient is anaesthetised and positioned according to the planned procedure. Correct positioning aims to ensure safety and efficiency and takes the patient's subsequent well-being into consideration including reducing the risk of developing nerve and tissue damage (Beckett 2010). Optimal positioning aims to provide access to the surgical field for the surgeon and the operating team. Positioning is one among many tasks requiring collaboration between OR nurses and nurse anaesthetists, surgeons and porters. Existing research suggests a lack of recognition of the significance of such interdisciplinary collaboration in the surgical team (Timmons & Tanner 2005, Leach *et al.* 2009).

A Brazilian review (Lopes & Galvão 2010) finds that research on surgical positioning has so far focused on the risk factors influencing the occurrence of complications, complications as a result of positioning, and the key role of nurses' work in achieving optimal positioning. Risk factors for positioning problems include patients' age, weight, mobility, general state of health, total time on the OR bed and the impact of anaesthesia (O'Conell 2006, St-arnaud & Paquin 2008, Beckett 2010, Lopes & Galvão 2010). A presurgical assessment of the patient's risk factors should be conducted with a view of preventing complications during surgery. As anaesthesia blocks the patient's ability to react to pain and pressure, its impact on positioning is particularly important. Studies by (O'Conell 2006 and Hølmer 2010) emphasise the ubiquity of injuries caused by pressure. Although a review by (Lopes & Galvão 2010) provides extensive consideration of the risk factors and complications associated with positioning the patient during surgery, the significance of nursing for optimal positioning receives no further consideration.

Each surgical patient presents a unique case. The positioning of a new-born baby thus requires special equipment and other skills than are needed for the positioning of an adult patient (O'Conell 2006). This variety challenges the OR nurse's creative skills to ensure correct positioning with minimal risk of pressure damage while allowing optimal exposure of the surgical site (Gjødvad & Bruhn 2003). Individual consideration for the patient may be compromised by the use of standardised equipment (O'Conell 2006). Optimal positioning often requires forced lifting, pushing and pulling, with potential damage to the workers' back and shoulders (Waters *et al.* 2011). A study revealed scarcity of scientific knowledge and clinical guidelines on the positioning of surgical patients (Beckett 2010). This is supported by Pirie (2010), who expresses concern that lack of research leaves staff with little guidance on the considerations to be taken to secure the patients' and their own safety.

Tissue damage caused by pressure during positioning is prevalent (O'Conell 2006, Hølmer 2010). In the period, from 1996–2002, the Danish Patient Insurance Association-awarded a total sum exceeding DKK 10 million (US $ 1·8 m) in compensation to 100 surgical patients for physical and psychological injury caused by positioning (Hove *et al.* 2006). Regardless of whether an economic or a psychological perspective is adopted, positioning damage is a significant problem (McInnes *et al.* 2011) that calls for more focused interventions to optimise positioning practices. It is documented that the use of appropriate positioning equipment, e.g. pressure-relieving mattresses, stirrups or

leg holders, padding, tape, axillary and chest rolls, pillows and foam pads, helps reduce the risk of damage (O'Conell 2006, ECRI Institute 2011; McInnes *et al.* 2011). Manuals and guidelines for the correct use of positioning equipment may also be consulted, e.g. for descriptions of how patients are supported by positioning equipment to avoid excessive pressure (O'Conell 2006, St-arnaud & Paquin 2008). However, no documentation exists on the various positions and the appropriate equipment. Also, it is unknown whether the equipment is available when needed, so that it meets the surgical team's requirements for the specific position and the positioning competences of the surgeon and the team.

Aim

We aimed to describe the incidence of problems associated with the positioning of anaesthetised surgical patients.

Methods

This was a descriptive cross-sectional study. Respondents were OR nurses (circulator nurses and scrub nurses) working at one of four public university hospitals in Denmark: Aalborg University Hospital, Aarhus University Hospital, Odense University Hospital and Copenhagen University Hospital. To ensure that all OR nurses were invited to participate, the electronic mail addresses of the head nurses in all surgical specialties were collected by a head nurse at each of the hospitals. The questionnaire was subsequently sent via the head nurses to 833 OR nurses in 34 surgical specialties. After prolonging the response period by two months and dispatching four email reminders, 567 responses were obtained, 481 of which were complete (response rate = 57·7%).

Data collection

Data were self-reported via an electronic questionnaire administered by a commercial survey tool (SurveyXact) (Rambøll Management Consulting 2012). Data were collected between December 2012 and January 2013. The first seven questions in the questionnaire concerned demographic data such as the respondents' departmental affiliation. This was followed by questions eliciting information on the OR nurses' experiences concerning the positioning of the anaesthetised patient in the supine position, the prone position, the lateral position, the sitting position, the lithotomy position and in situations where the extension table is used. For each position, the respondents were asked whether they had experienced problems. The response options were: *Yes*, *No* or *The positioning form is not used in my surgical specialty*. For each of the six positions, an affirmative response activated a list of 11 options allowing respondents to indicate what they perceived to be the reason for the experienced problems, such as *Lack of competence among OR porters*, their *Own* (lack of) *competence* or (poor) *Availability of the positioning equipment*. The respondents were encouraged to give further comment. A Likert scale was used to capture a more detailed picture of the positioning problems (De Vaus 2002). The final four questions concentrated on the positioning equipment, asking respondents whether bespoke or adapted equipment was used in their ORs, and to indicate what specific types of equipment they had experienced as problematic. Two of these questions were dichotomous (De Vaus 2002), with an opportunity for elaboration on affirmative responses. The questionnaire was initially validated by four head nurses employed in different surgical specialties at Aalborg University Hospital. A subsequent pilot study involving five OR nurses identified no misunderstandings or omissions in the questionnaire.

Data analysis

Statistical analysis was performed using the IBM SPSS Statistics (Version 19.00, IBM Corporation, Armonk, NY, USA). Descriptive analyses were performed to test for the hypothesised association between the position of the anaesthetised surgical patient, the competencies of the surgical team and the applicability and availability of the positioning equipment. The summarisation of the data was enabled by the calculation of frequencies. A chi-square test of independence was used to test for independence among the main variables. The level of significance was 0·05.

Ethical considerations

Permission to perform the survey was granted by the hospitals' executive management. As no patients or personal information were involved in the project, registration with a health research ethics committee or the Danish Data Protection Agency was not required. The collected data were anonymised and safely stored according to regulations.

Results

Demographic characteristics

All respondents were OR nurses (n = 481) employed in surgical specialties at four public university hospitals

(Table 1). One hundred and two (21·2%) OR nurses had experience in abdominal surgery, 99 (20·6%) in orthopaedic specialties and 86 (17·9%) in heart and lung specialties. The majority of the OR nurses, 306 (63·8%), had been employed in their present specialty for 2–15 years. A total of 405 OR nurses (84·2%) had between 2–>15 years in their present specialty.

Table 1 Demographic characteristics

Characteristics*	*n* (%)
Gender	
Men	16 (3·3)
Women	465 (96·7)
Age	
25–30	23 (4·8)
31–35	55 (11·4)
36–40	64 (13·3)
41–45	83 (17·3)
46–50	92 (19·1)
51–55	88 (18·3)
56–60	52 (10·8)
>60	23 (4·8)
University hospital	
Aalborg University Hospital	102 (21·2)
Aarhus University Hospital	142 (29·5)
Odense University Hospital	123 (25·6)
Copenhagen University Hospital	114 (23·7)
Specialty*	
Orthopaedic	99 (20·6)
Abdominal	102 (21·2)
Heart and lung	86 (17·9)
Ear, nose and throat	56 (11·6)
Vascular	52 (10·8)
Plastic	16 (3·3)
Breast	32 (6·3)
Gastroenterology	34 (7·1)
Neurology	37 (7·7)
Urology	45 (9·4)
Gynaecology	72 (15)
Other	30 (6·2)
Years of employment in present surgical specialty	
<2	76 (15·8)
2–15	306 (63·8)
16–30	82 (17·0)
>30	17 (3·5)

n = 481.
*Total exceeds 481 as more than one specialty could be ticked.

Positions

The questionnaire focused on problems associated with the most frequently occurring positions: the supine, lateral, prone, sitting, lithotomy and in situations where the extension table was used. The result shows that 65·5% (182) of the OR nurses who had worked with the lateral position had experienced problems. In comparison, 53·4% (124) identified problems with the lithotomy position, 43·8% (182) with the prone position, 43·4% (56) with the extension table. The sitting position and the supine position had caused problems for 37·8% (45) and 17·4% (84) respectively (Data not shown). As the prone, lithotomy and lateral positions in particular seem to have caused problems, they are further presented below.

The results reported in Table 2 indicate a lack of appropriate equipment for three positioning forms. Such problems were reported by 56·4% (101) of the OR nurses using the prone position; the corresponding figures for the lithotomy position and the lateral position were 59·7% (74) and 55·2% (96) respectively. The availability of the equipment, in particular for the prone and lateral positions, also appeared to affect the work in the OR. In addition, 52·5% indicated that porters' lack of competence was a frequent cause of problems with the prone position, whereas 35·2% cited their own lack of competence as a contributing factor. They indicated that the prone position was rarely used. Several OR nurses indicated that their insufficient experience made them feel unsure about their own competence. The same applied to the lateral position in which 48·9% (85) of the OR nurses indicated that the porters' lack of competence had caused problems. Concerning the lithotomy position, porters' competence did not appear to be a decisive factor.

Positioning equipment

Table 3 shows the correlation between the OR nurses' assessments of causes of problems with positioning equipment and the three selected positions. With regard to lateral positioning, Table 3 shows that 68·5% of the OR nurses who had experienced this position as problematic reported that aids for arm support had contributed to the problem (χ^2 (2) = 19·662, $p < 0·001$). The comments elaborated on the difficulties in positioning the arms and shoulders securely to avoid injury. Problems were most pronounced for the upper arm, as anatomical constraints made it difficult to accommodate the surgeon's need for easy access. In addition, the lack of appropriate positioning pillows (χ^2 (2) = 19·572, $p < 0·001$) and fixation equipment (χ^2 (2) = 12·773, $p = 0·002$) were highly significant and were reported as a problem by 54·7 and 39·8% of the responses. Aids for arm support, positioning pillows and fixation equipment appear to have the strongest association for difficulties with positioning the anaesthetised surgical patient in lateral position.

Based on the results for the prone position most of the OR nurses (58·3%) reported barriers with aids for arm support (not statistically significant). On the contrary there seem to be a statistical correlation between the prone positions and positioning pillows (χ^2 (2) = 6·512, p = 0·039) as well as inadequate size of the bed (χ^2 (2) = 7·057, p = 0·029), even though the correlations are not strong. Problems with inadequate size of the bed was cited by approximately 50% of OR nurses for all positions. Comments revealed that beds were particularly found to be too small. Their nonadaptability also appeared to create problems.

Table 2 Frequencies of positioning problems: three selected positions*

	Prone *n* (%)	Lateral *n* (%)	Lithotomy *n* (%)
Total n	179	174	124
Collaboration			
Agree†	51 (28·5)	38 (21·8)	23 (18·5)
Neither	17 (9·5)	25 (14·4)	5 (4·0)
Disagree‡	111 (62)	111 (3·8)	96 (77·4)
Porters' competence			
Agree	94 (52·5)	85 (48·9)	23 (18·5)
Neither	17 (9·5)	15 (8·6)	9 (7·3)
Disagree	68 (38)	74 (42·5)	92 (74·2)
Anaesthesiology competence			
Agree	55 (30·7)	53 (30·5)	20 (16·1)
Neither	22 (12·3)	21 (12·1)	7 (5·6)
Disagree	102 (57)	100 (57·5)	97 (78·2)
Own competence			
Agree	63 (35·2)	46 (26·4)	10 (8·1)
Neither	19 (10·6)	27 (12·6)	11 (8·9)
Disagree	97 (54·2)	106 (60·9)	103 (83·1)
Communication			
Agree	56 (31·1)	49 (28·2)	26 (21·0)
Neither	27 (15·1)	29 (16·7)	8 (6·5)
Disagree	96 (53·6)	96 (55·2)	96 (72·6)
Lack of knowledge			
Agree	31 (17·3)	32 (18·4)	23 (18·5)
Neither	25 (14)	27 (15·5)	6 (4·8)
Disagree	123 (68·7)	115 (66·1)	95 (76·6)
Lack of appropriate positioning equipment			
Agree	101 (56·4)	96 (55·2)	74 (59·7)
Neither	17 (9·5)	12 (6·9)	6 (4·7)
Disagree	61 (34·1)	66 (37·9)	35·5 (35·5)
Unavailable equipment			
Agree	73 (40·8)	80 (46)	32 (25·8)
Neither	23 (12·8)	11 (6·3)	14 (11·3)
Disagree	83 (46·4)	83 (47·7)	78 (62·9)
Hygiene			
Agree	23 (12·8)	25 (14·4)	13 (10·5)
Neither	33 (18·4)	27 (15·5)	12 (9·7)
Disagree	123 (68·7)	122 (70·1)	99 (79·8)

*Respondents indicating that the position had caused problems were asked to state whether they found collaboration, etc., to be the cause of the problems.

†The response categories *To high degree* and *To some degree* were collapsed into agree.

‡The response categories *To a minor degree* and *Disagree* were collapsed into disagree.

The most predominant problem encountered by OR nurses working with lithotomy positioning was the lack of appropriate positioning equipment. Especially a lack of appropriate equipment for leg support was reported as a major problem by 86·3% of the OR nurses. A high number of significant interactions were found (χ^2 (2) = 51·688, p < 0·001) indicating a positive association between the problems associated with the lithotomy position and aids for leg support. This was supported by comments indicating that stirrups did not allow individual adaption and the reason that the patients' position often had to be shifted during surgery to prevent pressure damage.

Discussion

The study aimed to describe the incidence of problems associated with the positioning of anaesthetised surgical patients. We found associations between the various positions, the competences of the surgical team, organisational issues and the applicability and availability of positioning equipment. Problems were reported in particular for the prone, lateral and lithotomy positions, partly because appropriate positioning aids were unavailable and partly because the positioning competences of porters and OR nurses were inadequate. The scarcity of the existing positioning equipment was another contributing factor.

The prone position is used for spinal procedures, for accessing posterior cranial structures, certain orthopaedic procedures and some rectal procedures. Gynaecological and genitourinary patients are placed in the lithotomy position. The lateral position is used for orthopaedic procedures, and for kidney and thoracic surgery (O'Conell 2006). When positioning the patient in the three positions mentioned, it is clear that different competences are required. Thus, positioning competences are in demand among porters and OR nurses. Our study showed that a lack of positioning competences was considered particularly serious in procedures that were employed rarely, which made OR nurses insecure in certain situations. In particular, the porters' competences with regard to the prone position and the lateral position were seen as inadequate. This problem was most pronounced in the evening and night shifts, when porters with little experience were on duty. Leach *et al.* (Leach *et al.* 2009) showed that the day-to-day nature of *ad hoc* teams of workers with surgical experience weakens the team

Table 3 Cross-tabulations for positioning equipment and prone, lateral and lithotomy positions

	Prone $n = 180$		Lateral $n = 181$		Lithotomy $n = 124$	
	n (%)	χ^2 (p)	n (%)	χ^2 (p)	n (%)	χ^2 (p)
Bed size	92 (51·1)	7·087 (0·029)	81 (44·8)	2·923 (0·232)	68 (54·8)	14·290 (0·001)
Bed mattress	46 (25·6)	3·704 (0·057)	57 (31·5)	12·773 (0·002)	36 (29·0)	0·883 (0·645)
Positioning pillows	91 (50·6)	6·512 (0·039)	99 (54·7)	19·572 (0·000)	60 (48·4)	6·304 (0·0·043)
Fixation equipment	60 (33·3)	2·088 (0·352)	72 (39·8)	12·781 (0·002)	38 (30·6)	1·103 (0·576)
Technological aids	46 (25·6)	1·854 (0·396)	62 (34·3)	13·448 (0·001)	26 (21·0)	0·534 (0·765)
Aids for leg support	95 (52·8)	2·847 (0·241)	77 (42·5)	0·123 (0·941)	107 (86·3)	51·688 (0·000)
Aids for head support	83 (46·4)	1·084 (0·551)	80 (44·2)	6·492 (0·039)	43 (34·7)	3·303 (0·192)
Aids for arm support	105 (58·3)	3·067 (0·266)	124 (68·5)	19·662 (0·000)	74 (59·7)	0·894 (0·604)
Repositioning aids	52 (29·1)	1·813 (0·404)	68 (37·6)	9·467 (0·009)	34 (27·4)	1·283 (0·527)

'Agree' and 'Partly agree' responses ('Neither' and 'Disagree' not shown). n = Number of nurses who had worked with and experienced problems.

dynamics and work continuity in ORs. This problem is also acknowledged by Gillespie *et al.* (Gillespie *et al.* 2012), who stress that team members with daily collaboration adapt their behaviour more easily and are able to establish a shared understanding based on experience with their colleagues' handling of critical situations. Our study supports these and other studies (McGarvey *et al.* 2000, Beuzekom & Boer 2006, Mitchell & Flin 2008) by showing that lack of continuity and the variation in competence and experience in the surgical teams working outside day shifts seem to influence optimal positioning. Based on these findings, we suggest to establish permanent surgical teams ensuring continued collaboration among team members, and to improve practice among staff in the correct positioning of patients. We also suggest special positioning competences to be available 24 hours a day to ensure the continuity of work with specific positions. Our results challenge existing managerial and organisational routines in a workplace characterised by constant and staggered handovers and professional groups each with their own collective agreement.

The availability of equipment was seen as the most serious problem associated with the prone, lateral and lithotomy positions. Across specialties, inadequately sized OR beds, positioning pillows and the positioning of the patient's arms and legs were reported as particularly problematic. The size of the beds and the lack of opportunities for individual adaptation have recently been highlighted by Bennicoff (Bennicoff 2010) and Waters *et al.* (Waters *et al.* 2011). In particular, the positioning of bariatric patients appears to be an increasing problem. These findings are supported by the Danish National Board of Health (Sundhedsstyrelsen 2009) who indicate that the lack of appropriate equipment for bariatric patients is the primary cause of incidents. Although this issue was addressed a decade ago (Dybec 2004) including the need for access to special equipment, the present study shows the continued need for access to OR beds, particularly for bariatric patients.

The positioning of the patient's arms caused problems for all three positions. For the lateral position in particular, it was reported to be difficult to combine anatomical and physiological considerations with the surgeon's access to the upper arm. This is consistent with previous research in which OR nurses indicated problems with the lateral position and a lack of aids for upper arm positioning (Sørensen 2011, Sørensen *et al.* 2014). Thus, there is evidence to support the development of new devices for upper arm positioning in the lateral position. Aids for the positioning of the patient's legs were also experienced as a problem for all three positions. In particular, the lithotomy position with legs placed in stirrups caused problems as only standard models were available, offering no opportunity for individual adaptation. This problem was acknowledged by O'Connell in (2006). We were unable to identify scientific documentation for the availability of positioning aids designed for individual adaptation, but it appears that they are being marketed internationally (Universal Medical n.d.; Allen Medical n.d.). Although it was outside the scope of this study to examine the positioning aids available in each surgical section, we have evidence that the OR nurses employed at Danish university hospitals identify a need for positioning devices that can better accommodate their patients' individual needs. The discrepancy between what is being marketed and what is found in Danish ORs raises the question whether manufacturers lack incentive or those responsible for procurement in our hospitals are unaware of what is on offer.

The existing guidelines for the positioning of patients in the prone, lithotomy and lateral positions respectively (O'Conell 2006, St-arnaud & Paquin 2008) seem largely to have been dictated by tradition and normative considerations rather than by scientific knowledge. This view is supported by Beckett (2010), who points to the lack of evidence to underpin existing guidelines. Attree *et al.* (2011) recommend that evidence-based policies be implemented and assessed for effectiveness. The comments from our respondents provide further detail by indicating that repositioning during surgery to prevent pressure damage as a result of insufficient opportunities for individual adaptation of stirrups was not uncommon. Our study, however, is unable to document this and further research into OR nurses' experience is needed. This would allow an optimisation of positioning practices by studying the consequences of repositioning, such as whether this prolongs the surgical procedure or leads to other problems.

Our study indicates occasional problems with the scarcity of positioning equipment in the ORs. Staff reported that they had to search in corridors and other ORs, in particular for equipment for the prone and lateral positions. This suggests that the supply of devices was inadequate to secure that the needed equipment was available in the ORs at all times, which forced staff to share it. This is supported by a study on assistive functions in which competition for positioning equipment was found among staff from different ORs (Sørensen 2011). Overall, there is a need to re-evaluate the capacity of positioning equipment in ORs, its distribution, and to develop disposable equipment on par with other surgical appliances.

Limitations of this study

The response rate of 57·7% is less than optimal and indicates a potential weakness of the study. However, this is comparable to what has been obtained in other cross-sectional studies (Juul 2006, Statistics Norway 2013). To reach an acceptable sample, we prolonged the response period by two months and dispatched four email reminders. The study's methods may be a possible explanation for the low interest in participation. The electronic response format required access to a computer during working hours, when the use of such equipment is generally restricted to work purposes. As OR nurses are typically isolated for the majority of their working day, participation would require them to either use a break between two operations or spend time after work. These factors may explain the low response rate. In addition, existing studies on validity and response rates for questionnaire studies have shown declining participation rates over recent decades (Edwards *et al.* 2002, Morton *et al.* 2006).

The questionnaire included one question aimed at determining the respondents' competences. It can be argued that this was too subjective and a more rigid and well-defined measure of competence had been advisable. However, the main focus of this study was the problems associated with the positioning of anaesthetised surgical patients. Seeing that the competencies of the team turned out to play an important role for the positioning of the patient, we plan to conduct further studies in which the competences of the team are further defined and elaborated on.

Considering the nurses' seniority in OR work, it is surprising to find that approximately 20% of the responses were in the *Neither* category. With the nurses' experience, we would have expected the respondents to have sufficient background to answer questions concerning whether positioning problems were, for example, caused by a lack of appropriate equipment (Uhrenfeldt & Hall 2007, Benner *et al.* 2009). An explanation could be that the questionnaire failed to capture the relevant factors influencing positioning, which would affect the internal validity of the study (Jørgensen *et al.* 2007). Another possible explanation may be that the respondents had difficulty deciding on a response. The study was conducted at four public university hospitals in Denmark and should be understood in the national context. Although it has no pretention of being generalisable to other countries, it is hoped that it will attract international attention and provide inspiration for similar studies.

Conclusion

Problems associated with the positioning of surgical patients are caused by a lack of appropriate positioning equipment, surgery teams' inadequate positioning competences, and poor applicability and availability of positioning equipment in the ORs. Difficulties with positioning of surgical patients in the prone, lithotomy position and lateral position are particularly challenging. Efforts are needed to remedy a number of identified problems such as the need for adjustable OR beds to accommodate bariatric patients. Developing and improving equipment for upper arm support, in particular for patients in the lateral position, is also required.

Relevance to clinical practice

There is a general need for positioning devices that can better accommodate patients' individual needs. Finally, the

management and organisation of perioperative work call for examination, for instance of the need to establish permanent surgical teams and for special positioning competences to be available round the clock to ensure the continuity of positioning work. We hope that this study will inspire further research and discussion of the capacity and distribution of positioning equipment in ORs, and thus stimulate the development and innovation of improved equipment, for example in the form of disposable equipment.

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Contributions

Developed the idea for the study: EES; data collection and analysis: EES, KHK; literature review: EES, KHK, MG; critically reviewed the background, methods, results and discussion sections: EES, MG; drafted the first manuscript: EES and thorough review of manuscript: all authors.

Conflict of interest

No conflict of interest has been declared by the authors.

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