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# International Journal of Surgery

journal homepage: [www.theijs.com](http://www.theijs.com)

Original research

## Resident work hour reforms: Implications regarding hip fracture surgery

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### ARTICLE INFO

#### Article history:

Received 3 May 2012

Received in revised form

9 August 2012

Accepted 31 August 2012

Available online 13 September 2012

#### Keywords:

Hipfracture surgery

Resident duty hours

Reforms

### ABSTRACT

**Background:** Resident work hour reforms were developed by Aga Khan University Postgraduate Medical education committee in the year 2005. These reforms were implemented by the section of Orthopedics in winter 2006. We designed this study to determine if there is a difference in morbidity and mortality following Dynamic Hip Screw (DHS) fixation for intertrochanteric fracture patients before and after implementation of work hour reforms.

**Methods:** Patients who underwent DHS fixation for inter-trochanteric fracture from January 2005 to December 2008 were included. These patients were divided into two groups. Group A included those patients who underwent DHS fixation prior to the implementation of work hour reforms and Group B patients had their hip fracture surgery after the implementation of these reforms.

**Results:** The mean operative time was  $1.6 \pm 0.6$  h and  $1.3 \pm 0$  h for group A and B patients respectively ( $p < 0.001$ ). There was no change in the rates of wound infection, length of hospital stay, post operative ambulation status, inadequate fixation, repeat surgeries and mortality in the two groups.

**Conclusion:** Resident work hour reform was associated with a significant decrease in the mean operative time for patients undergoing DHS fixation. However morbidity and mortality following DHS fixation for Intertrochanteric fractures has not decreased after implementation of these reforms. Further research evaluating patient outcomes in orthopedic surgery following work-hour restrictions are needed. Moreover, the impact of these reforms on the educational and research activities of the residents also needs to be determined.

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## 1. Background

Traditionally, the cumbersome duty hours that an average surgical resident was expected to comply with were assumed to enhance hands on experience on the trainee's part. However this also overburdened the residents and a concern about potentially compromising patient care was raised.

In order to improve patient quality of care, reduce resident fatigue and enhance their educational and research activities, Aga Khan University (AKU) Post-Graduate Medical Education Committee (PGME) developed its resident work hour reforms in 2005 as it has been done elsewhere.<sup>1</sup> Under these rules; resident surgeons may not work more than 80 h per week averaged over a four-week period and must have one day in seven free from all educational and clinical responsibilities. Furthermore, in-house calls may not occur more than once every four nights and must be limited to 24 h with a 6 h extension for continuity of care.

Although many different surgical specialties are investigating the effect of these reforms on patient morbidity and mortality, not much data pertaining to orthopedic patients in teaching hospitals exists.

At our University hospital, the senior most residents (PGY 4, 5) play a substantial role in the surgery under direct supervision of the attending surgeon for DHS fixation for intertrochanteric femur fracture fixation. Therefore this procedure was selected as a benchmark quality of care indicator, pre and post work hour reform implementation.

The null hypothesis for this study was that the implementation of these work hour reforms does not affect care of patients undergoing surgery for intertrochanteric fracture fixation. Hence, our primary aim was to investigate any changes in the morbidity and mortality in patients undergoing DHS fixation before and after implementation of the resident work hour reforms.

## 2. Materials and methods

### 2.1. Patient population

A total of 144 patients presenting to our University Hospital from January 2005 to December 2008 with femoral inter-trochanteric fractures who underwent

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Dynamic Hip screw fixation were included in the study. Patients with femoral neck and hip fractures that required surgery other than DHS fixation were excluded. These 144 patients were then divided into two groups. Group "A" included those patients who had undergone DHS fixation before the implementation of the resident duty hour reforms ( $n = 70$ ) and group "B" patients included those who underwent DHS surgery after implementation of the said reforms ( $n = 74$ ).

## 2.2. Outcome measures

The outcomes in this study included operative time, post operative morbidity such as surgical wound infection, post operative ambulation status, DVT, UTI, inadequate fixation (increased tip-apex distance) and the need for repeat surgery, if any. Numerical variables were described as mean  $\pm$  SD. Categorical variables were compared between groups using Chi-squared test and continuous variables were compared using student's *t*-test; for skewed data Mann–Whitney test was applied. A significance level of 0.05 was chosen for statistical significance. Statistical analysis was done on SPSS version 15.0.

## 3. Results

The demographics of the patient groups are shown in Table 1 and are comparable. Surgical patients from group A and B were investigated in terms of patient mortality and morbidity post DHS fixation. Mortality rates in both group A and B was low and one patient died in each group.

The mean operative time for patients undergoing DHS fixation before the work hour reforms was  $1.62 \pm 0.62$  h while it reduced to  $1.25 \pm 0.44$  h for patients undergoing surgery after the reforms ( $p < 0.001$ ). Refer to Table 2.

The length of hospital stay however does not seem to have significantly changed after the reforms as the hospital stay (in days) in group A was  $8.3 \pm 3.0$  as compared to  $9.2 \pm 10.0$  in group B ( $p = 0.48$ ). Similarly other variables also showed that statistically there was no significant difference between patients in group A and B. For instance, the mean of tip apex index in the two groups, which is a reflection of adequacy of fixation is also similar 18.58 in group A and 20.83 in group B. These results clearly indicate that post reform implementation the chances of residents performing inadequate DHS fixations have not increased as compared to the pre-reform era.

Ambulatory status of patients was either one of the following four categories i.e. Bed to chair (BTC), Non weight bearing (NWB), Partial weight bearing (PWB) and Full weight bearing (FWB). The ambulatory status thus defined remained inconsequential post-procedure, pre and post reform ( $p = 0.50$ ). Both the groups were comparable in terms of post operative complications ( $p = 0.15$ ). Incidentally, the number of patients requiring repeat surgery reduced from 5 in Group A to 2 in Group B ( $p = 0.2$ ).

## 4. Discussion

Enhanced quality of patient care and striking a balance between resident workload and learning has been the principal motivation behind the implementation of the new postgraduate medical education guidelines at the Aga Khan University. The aim of this regulation has been to improve patient care and learning of surgical skills by offsetting the detrimental effects of fatigue and sleep deprivation on surgical residents.<sup>1</sup>

The scarcity of data on the consequences of the work hour reform in orthopedic surgery has made it difficult to draw

**Table 2**  
Variables.

	Group A	Group B	<i>p</i> value
Mean operative time (hours)	1.63	1.25	<0.001
Mean length of stay (days)	8.26	9.16	0.477
Mean tip apex index (mm)	18.58	20.83	0.084

conclusions regarding its effect on this particular specialty. This study has been able to show a positive association between the implementation of the resident duty hour reform and a significant decrease in the mean operative time in the DHS fixation procedure. However, the reforms have had little or no effect on the length of hospital stay or the morbidity and mortality following DHS fixation for an inter-trochanteric fracture.

The myriad of literature available on the subject matter in difference specialties draws mixed conclusions.

A study on the effect of short term sleep-deprivation on cardiac surgery residents, conducted by Ellman et al., demonstrated no significant decrease in operative efficiency or morbidity and mortality in cardiac surgical procedures.<sup>2</sup> Similar studies published recently have likewise been unable to note any variation in the morbidity or mortality after the institution of the duty hour restrictions in trauma, vascular and general surgery.<sup>3–5</sup> However, Yaghoubian et al., noted a decline in the rate of intra-operative complications during a laparoscopic cholecystectomy after the introduction of the ACGME restriction, with the incidence of bile duct injury and total complications diminishing from 1% to 0.4%.<sup>6</sup>

Several studies from the internal medicine literature have found no significant increase in mortality after the implementation of the ACGME restrictions while subgroup investigations have shown an improvement in mortality in some medical specialties.<sup>7,8</sup> However, the effect on the outcome of surgical patients has largely remained unchanged. Some studies have even shown an increase in mortality for surgical patients.<sup>7</sup> Scant data is available on the morbidity linked by way of medical care in these studies.

Conflicting data demonstrating the unfavorable upshot to the work hour restriction has also been published. Studies have shown that since the inception of the reform there has been a paradoxical decrease in the quality of care as a result of suboptimal medication administration but also to an increase in the duration of hospital stay. These observations have been attributed to the increasing number of handoffs and the resultant discontinuity that occurs in patient care as a result of shorter call duration.<sup>9</sup> Studies have also shown a positive association between handoffs and the occurrence of adverse medical incidents.<sup>9,15–18</sup>

Kort and colleagues reported a survey of perception of the work hour reforms amongst general surgery residents. Most residents (57.3%) believed that the work-hours cutback and the consequent reduction in case load would adversely influence their surgical education as a result of reduced operative experience.<sup>10</sup> With a similar nation-wide survey of program directors and neurosurgical residents; Cohen-Gadol et al. demonstrated an existing dissatisfaction with the work hour restrictions with 61% of residents unhappy with the new ACGME guidelines.<sup>11</sup>

An elaborate undertaking on determining effects of sleep deprivation on the operative efficiency was carried out by Goldman et al. Videotapes of procedures performed by post-call residents were compared with videotapes of the same residents performing the same procedure after being fully rested. The study found a 30% increase in operative time when the procedure was performed by sleep deprived residents, mostly due to faulty planning and poor execution.<sup>12</sup> Similar studies observing the effects of sleep deprivation on the operative efficiency of post-call residents were able to demonstrate a significant increase in the operative time and errors made intra-operatively.<sup>13,14</sup>

**Table 1**  
Demographics.

	Group A	Group B	<i>p</i> value
Mean age (years)	67.0 $\pm$ 14.8	67.7 $\pm$ 13.3	0.492
Mean weight (kg)	64.5 $\pm$ 13.9	63.3 $\pm$ 12	0.078
Gender			
M ( <i>n</i> )	40	34	0.179
F ( <i>n</i> )	30	40	0.187

According to some critics, the reforms are bound to generate the greatest impact on work intensive surgical specialties, such as orthopedics.<sup>7,8</sup> With a reduction in work hours, the numbers of resident surgeons present at any particular instant will decline. Hence, the few residents that are present at any given time will have their work and patient load intensified; leading to much greater work related fatigue thus offsetting any potential benefits the reforms may have.<sup>8</sup> To counteract this detrimental effect on resident well-being numerous institutions have upped funding to support the hiring of additional residents, attending physicians and physician extenders to maintain quality of patient care.<sup>19,20</sup>

There are several shortcomings to this study that require comment. The association between work-hour limit and OR time does not necessarily imply causal relationship. At our hospital this procedure is being performed for more than 15 years. During the time period of this study there was no change in the surgical technique. Being a retrospective review, this study draws its conclusion about the impact of the reforms, indirectly, from the surgical outcomes of patients undergoing DHS fixation for inter-trochanteric fractures, due to the lack of direct evidence. The limited time period examined soon after the implementation of the work hour and the apparent lack of changes in the rate of complications amongst patients may reflect weak adherence to the regulation and possible experimentation by the resident and faculty with techniques to cope with the changes brought on by the reform.

In conclusion, even though the work hour restriction has had little effect on the relative peri-operative morbidity and mortality associated with a DHS fixation for inter-trochanteric fractures, it has shown to significantly decrease the mean duration of the operative procedure – time that can be better spent by residents and trainees on educational or research related activities. The short-term findings of the study merely exhibit association. These findings, however, do not entail causality. A large scale, prospective study will help assess the true impact of the reforms on resident performance, learning and health-care delivery, which have yet to be fully evaluated. Till then the work hour reforms will continue to provoke debate. The impact of the regulation needs to be assessed in order to better formulate future policy.

#### Ethical approval

NO ERC approval was required as it was a chart review.

#### Funding

None.

#### Authors contribution

All the authors actively participated in the data collection and writing of this manuscript.

#### Conflicts of interest

None.

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