Imaging in Fracture surgeries - a tool for quality assessment

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ABSTRACT
Radiation in orthopaedic surgeries was considered to be commonly hazardous, but also can be used as tool to improvise the surgical skills, limitations of exposure, risk analysis and making of alternate arrangements whenever required. We aim to analyse the number of times of imaging taken intra-operatively with C-arm for all acute closed lower limb fractures, which are all electively planned for intramedullary nailing fixation. It was a single centre, prospective randomized control double blind study, acute closed single plane fracture of lower limb like tibia shaft fracture, femur shaft fracture and intertrochanteric fracture electively posted for intramedullary nailing fixation were included. Total of 168 fractures, 38 intertrochanteric fractures (22.61%), 52 femur shaft fractures (30.95%), 78 tibia shaft fractures (46.42%) were electively planned for nailing fixation with intra-operative image guidance. Mean age was 42 which was statistically significant. Males were more than females, (89 male 52.97% and 79 female 47.02%) observed to be statistically not significant. Right lower limb 90 (53.57%) was observed to be more injured than the left lower limb 78(46.42%) which was statistically not significant (p<0.56). Mean imaging for intramedullary fixation in intertrochanteric fractures was 75 (17.30%) , femur 120 (37.76%) and tibia 95 (44.93%) was observed to be statistically significant. Radiation in orthopaedic surgeries can be otherwise and also be utilized by operating primary trauma surgeon with focus on average number of imaging for the elective nailing procedure as a self-monitoring tool for skill improvement with reproducible potential, radiation minimisation, call for help and technical improvisation for the future years, besides its occupational ill effects.

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MATERIALS AND METHODS

This study was conducted at Sri Ramachandra institute of Higher Education and Research, Porur, Chennai from March 2018 to June 2019. It was a Prospective randomized control double blind study.

Study population included acute lower limb fracture cases presented to SRIHER emergency department within 24 hours of the injury which were planned for elective nailing fixation.

Inclusion criteria, all acute closed single plane fracture of lower limb like tibia shaft fracture, femur shaft fracture and intertrochanteric fracture electively posted for intramedullary nailing fixation admitted across all orthopaedic trauma units were included.

Exclusion criteria were intra-articular fractures, multilevel/multiplane fracture pattern, pathological fracture, mechanism of injury, paediatric fracture, floating knee injuries, bilateral lower limb fractures, indigenous treated fractures planned for open nailing with bone grafting, open nailing surgeries, revision nailing, conversion procedures performed as a part of DCO, retrograde femur nailing, nailing with multiple locking screws (more than two proximal and distal locking screws), nailing done for joint fusion.

Blinding, operating primary surgeon and patient were blinded. Randomization, simple randomisation was done as of the fracture pattern on x-rays and ascertained to groups. Ethical clearance obtained from Institutional ethics committee of SRIHER, Porur, Chennai. Informed consent was received from all cases. Statistical analysis, was done at central research facility of SRIHER institution after data collection.

RESULTS AND DISCUSSION

In our study of total 168 population, we observed 38 intertrochanteric fractures (22.61%), 52 femur shaft fractures (30.95%), 78 tibia shaft fractures (46.42%) electively planned for nailing fixation with intraoperative image guidance (Table 1). Mechanism of injury was not included in our study. Age, gender, side of limb injured and number of intraoperative imaging during nailing procedure were analysed. The mean age of the population was 42 which was statistically significant. Males were more injured than females, (89 male 52.97% and 79 female 47.02%) observed to be statistically not significant (Table 2). Right limb 90 (53.57%) was observed to be more involved than the left limb 78 (46.42%) which was statistically not significant (p<0.56) (Table 3). Mean imaging for intertrochanteric fractures was 75 (17.30%), femur 120 (37.76%) and tibia 95 (44.93%) was observed to be statistically significant (Table 4).

Intramedullary fixation a common trauma surgery performed by all orthopaedic surgeons throughout the globe on daily basis with varied nail types and designs, biomechanically superior and its surgeon preferred techniques with intra-operative imaging then and there needed, from the start to the completion of the nailing procedure. (Kyle, 1985)

This study is independent of duration of surgery, number of assistants, fracture pattern, type of implant/nail design, quality of imaging and radiation equipment (Madan and Blakeway, 2002; Blattet et al., 2004), OR staff/personnel, type of anaesthesia, position of patient, patient comorbidities, entry point of nail, surgeon expertise (consultant to resident) (Tasbas et al., 2003; Blachut et al., 1997).

In our study, we analyse only the number of times of intra-operative imaging in all elective nailing surgeries for the lower limb long bone fractures from the start to end of the procedure as a tool for quality assessment and improvisation of skill for the same type of procedure across the surgeons in our workplace based on number of imaging taken by each primary operating surgeon, herewith can plan to minimise exposure, improve self-surgical skills on instrumentation for the next consecutive procedure and reproducible results within that times of imaging amongst all trauma operating surgeons.

In our study, operating surgeon decision is the main say to ask for sequential imaging at different steps of nailing from the entry of guide wire, fracture reduction, serial reaming of the canal, nail measurement, intramedullary nail insertion (reamed/unreamed) (Court-Brown et al., 1996; Leroux et al., 2015) two proximal and two distal locking screws done with the jig and free hand technique (Wang et al., 2018; Whatling and Nokes, 2006), intramedullary fixation with two proximal and two distal locking screws for tibia and femur shaft fractures only were considered with inbuilt static and dynamic options.

We observed that different surgeons perform their own methods of distal locking from drilling with smaller drill to point out the far cortex for the original drill to be used later, using the same length nail to be kept outside over the skin and performing the locking, some surgeons use Steinmann pin of varying sizes to locate the far cortex for upcoming distal locking screw and varying nail designs like sure shot nail; this invariably adds on or minimises to the number of imaging taken at the end of the surgery. Order of interlocking of nails with screws also dif-
### Table 1: Intraoperative Imaging in Elective Fracture surgeries

| Diagnosis       | Surgical technique                   | Number of surgeries | Numbers of imaging Minimum to Maximum | Average number of imaging |
|-----------------|--------------------------------------|---------------------|---------------------------------------|---------------------------|
| Inter trochanteric# | Closed reduction and pfn fixation    | 38                  | 57-110                                | 75                        |
| Femur shaft#     | Closed reduction and Nailing         | 52                  | 89 - 162                              | 120                       |
| Tibia shaft#     | Closed reduction and Nailing         | 78                  | 67 - 134                              | 95                        |

### Table 2: Gender distribution

| Variables/Group | Intertrochanteric | Femur | Tibia | Total |
|-----------------|-------------------|-------|-------|-------|
| Gender Female   | 13                | 25    | 41    | 79    |
| % within Gender | 16.5              | 31.6  | 51.9  | 100.0%|
| % within group  | 34.2%             | 48.1% | 52.6% | 47.0% |
| Male            | 25                | 27    | 37    | 89    |
| % within Gender | 28.1%             | 30.3% | 41.6% | 100.0%|
| % within group  | 65.8%             | 51.9% | 47.4% | 53.0% |
| Total           | 38                | 52    | 78    | 168   |
| % within gender | 22.6%             | 31.0% | 46.4% | 100.0%|
| % within group  | 100.0%            | 100.0%| 100.0%| 100.0%|

### Table 3: Limb injury distribution

| Group / variable | Intertrochanteric | Femur | Tibia | Total |
|------------------|-------------------|-------|-------|-------|
| Limb injured     | Left              | 15    | 24    | 39    | 78    |
| % within study population | 19.2% | 30.8% | 50.0% | 100% |
| % within group   | 39.5%             | 46.2% | 50%   | 46.4% |
| Count            | 23                | 28    | 39    | 90    |
| % within study population | 25.6% | 31.1% | 43.3% | 100.0%|
| Right            |                  | 60.5% | 53.8% | 50%   | 53.6% |
| % within group   | 60.5%             | 53.8% | 50%   | 53.6% |
| Count            | 38                | 52    | 78    | 168   |
| % within side-limb injury | 22.6% | 31.0% | 46.4% | 100.0%|
| % within group   | 100.0%            | 100.0%| 100.0%| 100.0%|

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Table 4: Groups and variables

| Variables/Groups          | Intertrochanteric | Femur       | Tibia       | P value |
|---------------------------|-------------------|-------------|-------------|---------|
| Age                       | Mean + sd         | Mean + sd   | Mean + sd   | <0.001  |
|                           | 41.89±6.84        | 35.90±10.50 | 35.69±8.12  |         |
| Number of C-arm imaging   | 75.60±11.86       | 120.56±17.27| 95.63±14.77 | <0.001  |
| Gender                    | N (%)             | N(%)        | N(%)        |         |
| Female                    | 13 (34.2%)        | 25 (48.1%)  | 41 (52.9%)  | 0.175   |
| Male                      | 25 (65.8%)        | 27 (51.9%)  | 37 (47.4%)  |         |
| Side of limb injury       | N (%)             | N(%)        | N(%)        |         |
| Left                      | 15 (39.5%)        | 24 (46.2%)  | 39 (50%)    | 0.564   |
| Right                     | 23 (60.5%)        | 28 (53.8%)  | 39 (50%)    |         |

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CONCLUSION

Radiation in orthopaedic surgeries can be otherwise and also be utilized by operating primary trauma surgeon with focus on average number of imaging for the elective nailing procedure as a self-monitoring tool for skill improvement with reproducible potential, radiation minimisation, call for help and technical improvisation for the future years, besides its occupational ill effects.

Conflict of interest

Nil

Ethical clearance

Obtained

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