ORIGINAL ARTICLE

INTERNATIONAL JOURNAL OF RESEARCH IN PHARMACEUTICAL SCIENCES

Published by JK Welfare & Pharmascope Foundation Journal Home Page: www.ijrps.com

Imaging in Fracture surgeries - a tool for quality assessment

Ashok Thudukuchi Ramanathan*, Kevin lourdes

Department of Orthopaedic Surgery, Sri Ramachandra Institute of Higher Education and Research, Porur, Chennai-600116 Tamil Nadu, India

Article History:

Received on: 29 Dec 2019
Revised on: 25 Jan 2020
Accepted on: 10 Jan 2020

Keywords:

Radiation, intramedullary nailing, long bone fracture, C-arm imaging

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.

*Corresponding Author

Name: Ashok Thudukuchi Ramanathan
Phone: +91 99405 25045
Email: drtrashok83@gmail.com

ISSN: 0975-7538

DOI: https://doi.org/10.26452/ijrps.v11i2.2056

Production and Hosted by

IJRPS | www.ijrps.com

INTRODUCTION

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. Intra-medullary fixation (nailing) is a common orthopaedic surgical procedure, as all trauma surgeons prefer to perform on day to day practice for closed long bone fractures, which was proved to preserve the biology of fracture site and load sharing implant of biomechanically superior. In our study, 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.

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 24hours 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; Blattert *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 dis-

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	Count	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	Count	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		Count	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	Count	15	24	39	78
		%within study population	19.2%	30.8%	50.0%	100%
		% within group	39.5%	46.2%	50%	46.4%
	Right	Count	23	28	39	90
		% within study population	25.6%	31.1%	43.3%	100.0%
		% within group	60.5%	53.8%	50%	53.6%
Total		Count	38	52	78	168
		% within side-limbinjury	22.6%	31.0%	46.4%	100.0%
		% within group	100.0%	100.0%	100.0%	100.0%

Table 4: Groups and variables

Variables/Groups		Intertrochanteric	Femur	Tibia	P value
Age		Mean + sd 41.89±6.84	Mean + sd 35.90±10.50	Mean + sd 35.69±8.12	<0.001
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%)	

tal 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 differ, some surgeons go for proximal locking first and then to distal, whereas others do distal first and then lock proximally (Antonini *et al.*, 2016; Caiaffa *et al.*, 2016).

In our study, all intertrochanteric fractures planned for short proximal femur nail with single headscrew and one distal locking screw were included, as of nailing for intertrochanteric fracture though technically similar but biomechanically and principle wise differs (Brin *et al.*, 2014). In our study, we utilized only single C-arm for intra-operative fluoroscopy throughout the procedure for all necessary views and steps (Kalem *et al.*, 2018).

In our study, we focus only on an average number of imaging required for common orthopaedic surgical procedure (nailing) for tibia and femur shaft fracture, intertrochanteric fracture to set as a base limit, so an operating surgeon can plan and decide at the earliest for any unexpected and untoward events intra-operatively like change of plan/procedure, surgeon fatigue, not your day (free hand locking difficulties), need to call for help on time even at non-modifiable and non-favourable circumstances for the surgeon (Malik *et al.*, 2019; Singer, 2005). The main limitation of the study is the population size and subjective decision on imaging by the operating surgeon skill and expertise.

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.

Funding

Nil.

REFERENCES

Antonini, G., Stuflesser, W., Crippa, C., Touloupakis, G. 2016. A distal-lock electromagnetic targeting device for intramedullary nailing: Suggestions and clinical experience. *Chinese Journal of Traumatology*, 19(6):358–361.

Blachut, P. A., O'brien, P. J., Meek, R. N., Broekhuyse, H. M. 1997. Interlocking Intramedullary Nailing with and without Reaming for the Treatment of Closed Fractures of the Tibial Shaft. A Prospective, Randomized Study. *The Journal of Bone and Joint Surgery (American Volume)*, 79(5):640–646.

Blattert, T. R., Fill, U. A., Kunz, E., Panzer, W., Weckbach, A., Regulla, D. F. 2004. Skill dependence of radiation exposure for the orthopaedic surgeon during interlocking nailing of long-bone shaft fractures: a clinical study. *Archives of Orthopaedic and Trauma Surgery*, 124(10):659–664.

Brin, Y. S., Palmanovich, E., Aliev, E., Laver, L., Yaacobi, E., Nyska, M., Kish, B. J. 2014. Closed reduc-

tion and internal fixation for intertrochanteric femoral fractures is safer and more efficient using two fluoroscopes simultaneously. *Injury*, 45(7):1071–1075.

Caiaffa, V., Vicenti, G., Mori, C., Panella, A., Conserva, V., Corina, G., Moretti, B. 2016. Is distal locking with short intramedullary nails necessary in stable pertrochanteric fractures? A prospective, multicentre, randomised study. *Injury*, 47:98–106.

Court-Brown, C. M., Will, E., Christie, J., Mcqueen, M. M. 1996. Reamed or unreamed nailing for closed tibial fractures. *The Journal of Bone and Joint Surgery. British Volume*, 78(B(4)):580–583.

Kalem, M., Başarır, K., Kocaoğlu, H., Şahin, E., Kınık, H. 2018. The Effect of C-Arm Mobility and Field of Vision on Radiation Exposure in the Treatment of Proximal Femoral Fractures: A Randomized Clinical Trial. *BioMed Research International*, 2018:1–6.

Kyle, R. F. 1985. Biomechanics of Intramedullary Fracture Fixation. *Orthopedics*, 8(11):1356–1359.

Leroux, T., Khoshbin, A., Nousiainen, M. T. 2015. Training Distal Locking Screw Insertion Skills to Novice Trainees. *Journal of Orthopaedic Trauma*, 29(10):441–446.

Madan, S., Blakeway, C. 2002. Radiation exposure to surgeon and patient in intramedullary nailing of the lower limb. *Injury*, 33(8):42–48.

Malik, A. T., Rai, H. H., Lakdawala, R. H., Noordin, S. 2019. Does surgeon experience influence the amount of radiation exposure during orthopedic procedures? A systematic review. *Orthopedic Reviews*, 11(1).

Singer, G. 2005. Occupational Radiation Exposure to the Surgeon. *Journal of the American Academy of Orthopaedic Surgeons*, 13(1):69–76.

Tasbas, B. A., Yagmurlu, M. F., Bayrakci, K., Ucaner, A., Heybeli, M. 2003. Which one is at risk in intraoperative fluoroscopy? Assistant surgeon or orthopaedic surgeon? . *Archives of Orthopaedic and Trauma Surgery*, 123(5):242–244.

Wang, Y., Han, B., Shi, Z., Fu, Y., Ye, Y., Jing, J., Li, J. 2018. Comparison of free-hand fluoroscopic guidance and electromagnetic navigation in distal locking of tibia intramedullary nails. *Medicine*, 97(27):e11305.

Whatling, G. M., Nokes, L. D. M. 2006. Literature review of current techniques for the insertion of distal screws into intramedullary locking nails. *Injury*, 37(2):109–119.