Orthopaedic surgical training exposure at a South African academic hospital – is the experience diverse and in depth?

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Abstract

Background

With increasing pressure on our training hospitals, we undertook to ascertain whether our clinical orthopaedic surgery training platform is providing adequate surgical exposure, both in diversity and the level of trainee participation.

Methods

The orthopaedic surgery database was interrogated for theatre procedures logged for the 12-month period 1 January to 31 December 2018. Each theatre case was assessed as to the level of trainee participation, whether it was performed during or after hours, and categorised as being elective or trauma in nature, as well as the orthopaedic subdiscipline.

Results

A total of 3 147 orthopaedic surgical procedures were logged with an even split of elective (51.1%) and trauma (49.9%) cases. Adults predominated in the trauma group while the paediatric service contributed most to the elective cases, followed by arthroplasty and spine. Overall, 25.5% of procedures were performed by consultants and 74.5% by registrars. Registrars were more frequently the primary surgeon in trauma cases (90%) compared to elective procedures (59%) ($p < 0.001$). Of the elective cases, 37% were performed by registrars as supervised unscrubbed and 22% as supervised scrubbed operations. In total, 17.5% of cases were performed after hours, with 31.7% of trauma surgeries and only 2.9% of elective surgeries occurring after hours. Registrars were the primary surgeon in 98.7% of after-hours trauma cases and 58% of after-hours elective cases under unscrubbed supervision.

Conclusion

Our study presents the surgical experience and level of participation available to orthopaedic surgical trainees in a South African training hospital where their exposure was an equal number of elective and trauma cases. The vast majority of the cases were performed by the registrars in their supervised unscrubbed capacity although the more complex, elective cases were performed by consultants. Almost all after-hours trauma cases were performed by registrars. This suggests the platform allows for a high level of registrar surgical participation and training despite the challenges. Further review is required to assess achievement of trainee competency and whether in fact the current experience is adequate.

Level of evidence: Level 4

Keywords: orthopaedic registrar surgical experience, South African orthopaedic training exposure, orthopaedic case exposure

Introduction

The practice of surgery encompasses both technical skills and an academic knowledge base which, traditionally, was transferred from teacher to student in an apprenticeship fashion. The concept of a more structured registrar training programme was initiated in 1880 in Germany to be followed by the United States (US) in 1889.[1] Today there are many variations globally with different entry levels, durations, experience and assessment processes.[2]

However, this fundamental mentorship of a trainee, transforming them from a novice to specialist and ready for independent practice, is challenged both by the sheer volume and diversity of modern orthopaedic surgical practice. In addition, there is increasing concern around reduced contact time by work hour reduction particularly in the US and United Kingdom (UK.)[3,4] There is also a loss of trainee autonomy with more consultant-performed surgery, possibly due to financial arrangements and medicolegal risk.[5]

Locally there are different challenges imposed by under-resourced, overburdened teaching hospitals. Service demands influence the spectrum of pathology managed with a bias towards trauma, risking an incomplete training. The pressure of limited theatre access time risks reducing trainee participation in elective surgery and paradoxical inadequate supervision while they perform complex trauma cases at night.[6-8]

As most examination processes are academic, success in this area does not necessarily confirm well-trained, safe surgeons. We attempt to ascertain whether our clinical training platform is providing adequate surgical exposure, both in diversity as well as the level of trainee participation.

Methods

The training programme

The registrar rotation entry criterion at our institution is the College of Medicine of South Africa (CMSA) 1B intermediate examination. This exam requires a minimum of one year of orthopaedic surgery, three months general surgery and three months accredited intensive care (ICU) experience with single best answer exams on orthopaedic principles and the care of the surgical patient. We run a pre-registrar medical officer training programme at our surrounding level 2 hospitals where these junior doctors work while obtaining the required qualification. By the time they join the registrar rotation, they are generally competent in limb fracture management, able to plate and nail fractures independently, and ready for more complex work. Due to the competitive nature of the rotation, they usually have more than the minimum experience.

The registrar rotation

Once on the programme, the trainee will spend 18–21 months in the trauma firms (three months being paediatric), six months hand unit, six months paediatric unit, six months spine/foot and ankle, six months upper limb, six months lower limb/oncology, and invariably three months on a relief slot. Sixteen funded and five self-funded registrars are on the programme supported by 11 full-time and three sessional consultants.

Surgical exposure

In each block, trainees will work with the consultant/fellow team predominantly in their discipline but on occasion with some involvement in other clinics and calls. Based on the consultant's assessment of the trainee's competence, they will be allowed to observe, assist or perform the procedure under supervision.

Database

All surgical cases are captured on a bespoke orthopaedic Research Electronic Data Capture (REDCap) based database.[9,10] REDCap is a secure, web-based software platform designed to support data capture for research studies. It provides an intuitive interface for validated data capture, audit trails for tracking data manipulation and export procedures, automated export procedures for seamless data downloads to common statistical packages and procedures for data integration and interoperability with external sources. The software is provided to our institution at no cost. We have customised it to facilitate our departmental requirements and have institutional ethics approval to use it for research purposes (R039/2013).

REDCap was queried to identify all orthopaedic surgical procedures performed at Groote Schuur Hospital (GSH), Red Cross Children's Hospital (RXH) and Maitland Cottage Home (MCH) for the year 1 January to 31 December 2018. This included all trauma and elective procedures except hand surgery, which unfortunately was not yet logged during this period.

The following data fields were exported to a Microsoft Excel spreadsheet: date, hospital, procedure start time, firm, hospital folder number, primary surgeon, assistant surgeon, status of surgery (with regard to registrar role), category of surgery, anatomical site of surgery, and description of surgery.

Using a list of consultants' and registrars' names, each surgery was determined to have been performed by either a consultant or registrar, and the level of supervision from a trainee perspective was noted. Therefore, consultant surgeries were labelled 'assisting'; registrar surgeries with a consultant scrubbed in were labelled 'supervised scrubbed'; and surgeries where the registrar was the primary surgeon but the consultant was not present in theatre were classified as 'supervised unscrubbed'. Despite the physical absence of the consultant, prior discussion and planning of the surgery takes place with the registrar, and the consultant is available by telephone; therefore, no surgeries were classified as 'not supervised'.

Procedures were classified as 'after hours' if outside 07h30 and 17h00 or Saturday/Sunday. Elective procedures with a missing procedure start time but occurring on a weekday were assumed to

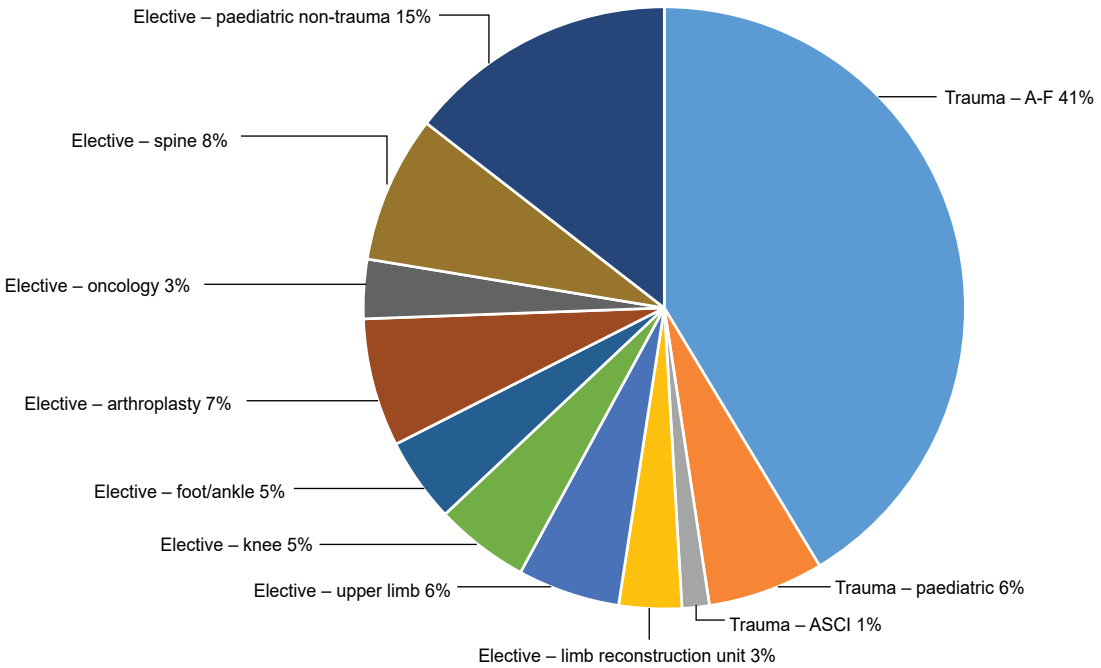

Figure 1. Pie chart of the distribution of total surgeries occurring at GSH, RXH and MCH in 2018 across firms

be 'work hours'. Trauma procedures without procedure start time were omitted from this part of the analysis.

Elective surgeries were divided into the respective firms: limb reconstruction, upper limb, spine, knee, arthroplasty, oncology, foot/ankle and paediatric non-trauma. Trauma surgeries were divided into the general four firms, the acute spinal cord injury (ASCI) unit and paediatric trauma. Procedures were divided into categories as per the database options of amputation, arthroplasty, arthroscopy, arthrotomy, closed reduction percutaneous pinning (CRPP), external fixator (ex-fix), manipulation under anaesthetic (MUA), open reduction internal fixation (ORIF) nail, ORIF plate, ORIF other (including titanium elastic nail system [TENS] nail, cannulated screws, K-wires, dynamic hip screws), osteotomy, spinal, soft tissue – Botox, soft tissue – lengthening, soft tissue – biopsy, soft tissue – arthrodesis, soft tissue – removal of hardware, and soft tissue – other.

These categories were further divided into anatomical sites. These were all analysed in terms of the registrar participation, namely, assist, supervised scrubbed and supervised unscrubbed.

Microsoft Excel was used to produce graphical representations of the data. Quantitative analysis was done, and Fisher's exact test used for the categorical data.

Results

During the 2018 year, 3 147 orthopaedic surgical procedures were logged. They were evenly split with 50.1% elective (n = 1 603) and 49.9% trauma (n = 1 544). This excludes hand surgeries, which were not logged.

Figure 1 represents the overall distribution where adult trauma represented 41%, paediatric trauma 6% and acute spine 1%. The paediatric service contributed the biggest proportion of elective cases, followed by spine, arthroplasty and upper limb firms.

Surgeon and level of supervision

Overall, 25.5% of surgeries were primarily performed by consultants and 74.5% were primarily performed by registrars. Registrars were more frequently the primary surgeon in trauma cases (90%) compared to elective procedures (59%) ($p < 0.001$).

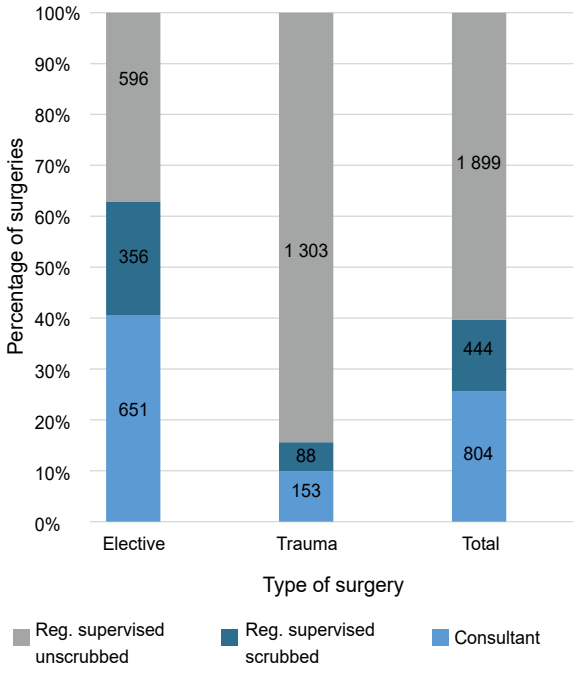

Figure 2. A stacked bar chart showing proportions of surgeries performed by either consultant or registrar (reg.) with their level of supervision for elective and trauma surgeries at GSH, RXH and MCH in 2018

Largely, registrars were supervised unscrubbed in 60.3% of cases and supervised scrubbed in 14.1% of cases. This was more skewed in trauma surgery where registrars performed 90% of the cases, with 84% supervised unscrubbed and only 6% supervised scrubbed (*Figure 2*).

More than 50% of trauma cases in all categories of surgery were performed by registrars supervised unscrubbed except for arthroplasty procedures where of the 80 cases, 24 were performed by consultants, 34 by registrars supervised unscrubbed and 22 cases by registrars supervised scrubbed. The only trauma surgery that had significantly more consultant cases than registrar cases was pelvic ORIF-plating (23/31 cases by consultant).

Of the elective cases, 37% were performed by registrars as supervised unscrubbed and 22% supervised scrubbed. Consultants performed more than 50% of elective cases in each of the categories of shoulder arthroplasty (14/25), ankle arthroplasty (100%, 5/5), knee arthroscopy (56/78), elbow ex-fix (100%), ORIF-nail lower leg (8/12), ORIF-plate upper arm (6/9), ORIF-plate ankle (8/12), osteotomy upper leg (11/17), spinal thoracolumbar (27/34), and soft tissue lengthening (16/20). Registrars performed more than 65% of elective cases in each of the categories of amputation, arthrotomy, CRPP, MUA, biopsy, and removal of hardware, with more than 50% of the surgeries in each category performed supervised unscrubbed.

Surgery after hours

Generally, 17.5% of cases were performed after hours, with 31.7% of trauma surgeries occurring after hours compared to only 2.9% of elective surgeries ($p < 0.001$). ORIF-plate, ORIF-nail and soft tissue procedures predominated (*Figure 3*).

Registrars were the primary surgeon in 98.7% of after-hour trauma cases and 58% of after-hour elective cases as supervised unscrubbed. No cases were supervised scrubbed, with the balance being performed by consultants.

Categories of surgery and general anatomical site exposure

Trauma surgeries consisted of three main categories of surgery in terms of frequency, namely, ORIF-plate (25%), soft tissue procedures (including general soft tissue procedures, biopsy and

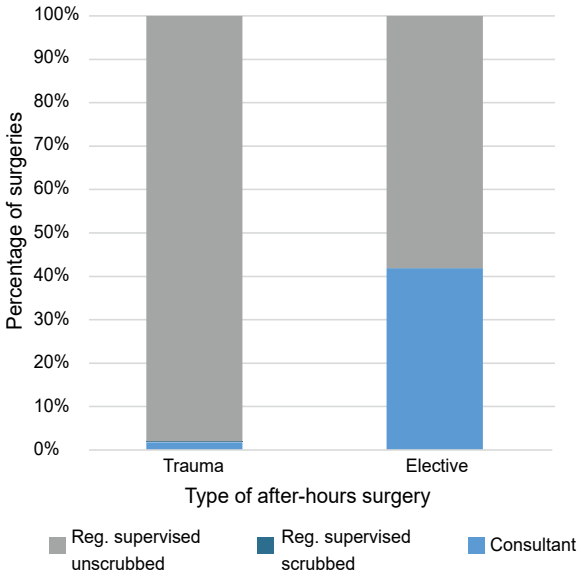

Figure 3. A stacked bar chart representing the proportion of after-hours trauma and elective surgeries performed by either consultants or registrars, with the relevant level of supervision at GSH, RXH and MCH in 2018

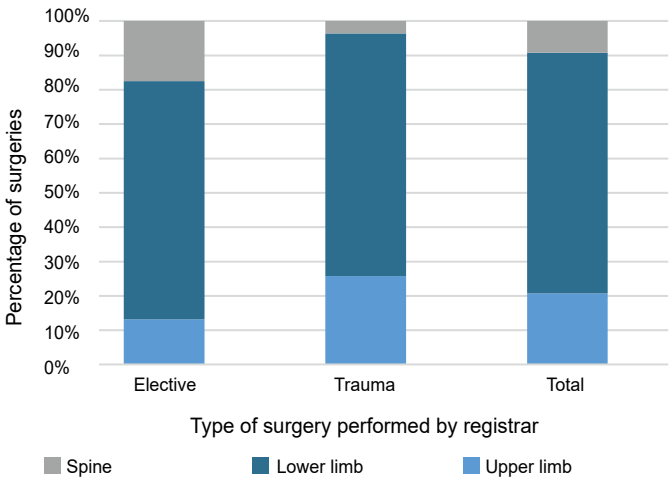

Figure 4. A stacked bar chart showing the proportions of logged cases to the broad anatomical sites in elective and trauma surgeries occurring at GSH, RXH and MCH in 2018

removal of hardware) (25%), and ORIF-nail (22%). Osteotomy, closed reduction/percutaneous pinning and arthroscopy trauma cases were very infrequent (*Figure 4*).

The three main categories of elective surgeries were soft tissue combined (Botox, lengthening, biopsy, arthrodesis, removal of hardware, general procedures; 30%), arthroplasty (22%), spinal surgery (16%).

Overall, trauma surgeries predominate categories of ex-fix, MUA and ORIF surgeries, whereas elective surgeries are predominant in all other categories of surgeries except for amputation and soft tissue general which have a more even distribution of trauma and elective cases as shown in *Tables I and II*.

Table I: Trauma surgeries and the level of the primary surgeon

	Reg. supervised scrubbed	Reg. supervised unscrubbed	Consultant	Total
Ex-fix				
ex-fix upper leg (incl. knee, pelvis)	0	16	0	16
ex-fix lower leg (incl. ankle, foot)	1	50	2	53
ex-fix arm (upper, lower, wrist, elbow)	0	13	0	13
	1	**79**	**2**	**82**
MUA				
elbow	0	47	0	47
lower arm (incl. wrist)	0	20	0	20
upper arm (incl. shoulder)	1	3	0	4
upper leg (incl. hip, knee)	0	12	1	13
lower leg (incl. foot, ankle)	0	16	0	16
	1	**98**	**1**	**100**
ORIF – nail				
hip	1	17	1	19
upper leg (incl. knee)	6	153	3	162
lower leg (incl. foot, ankle)	4	118	12	134
upper arm (incl. shoulder)	1	11	2	14
lower arm (incl. elbow)	0	14	1	15
	12	**313**	**19**	**344**
ORIF – plate				
upper arm	10	44	2	56
lower arm	4	36	0	40
upper leg	4	31	0	35
lower leg	1	24	5	30
shoulder	3	7	2	12
elbow	1	25	3	29
wrist	0	16	2	18
pelvis	4	4	23	31
hip	1	37	6	44
knee	6	9	0	15
ankle & foot	6	50	16	72
	40	**283**	**59**	**382**
Amputation				
upper leg (incl. knee)	1	7	0	8
lower leg (incl. foot)	0	6	0	6
upper arm	0	2	0	2
	1	**15**	**0**	**16**
Arthroplasty				
upper leg (incl. pelvis)	1	4	1	6
hip	21	29	22	72
arm (incl. shoulder, elbow)	0	1	1	2
	22	**34**	**24**	**80**
Arthroscopy	0	2	1	**3**
Arthrotomy	0	18	1	**19**
Osteotomy	2	2	1	**5**
Soft tissue – remove hardware	0	15	5	**20**
Soft tissue – biopsy	0	12	2	**14**
Soft tissue				
chest/spine/head	0	4	0	4
upper arm	0	17	1	18
lower arm	0	16	1	17
upper leg	2	26	3	31
lower leg	1	111	4	116
shoulder	0	13	0	13
elbow	0	11	0	11
wrist	1	0	0	1
pelvis	0	10	3	13
hip	0	15	2	17
knee	3	31	0	34
ankle & foot	1	64	5	70
	8	**314**	**19**	**345**
Spine				
cervical	0	18	4	22

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Table I continued

cervicothoracic	0	2	0	2
thoracic	1	12	1	14
thoracolumbar	0	6	0	6
lumbar	0	6	4	10
chest	0	1	0	1
wound washout/biopsy	0	2	0	2
	1	**47**	**9**	**57**
CRPP	0	2	3	**5**
ORIF – other				
head	0	1	0	1
upper arm (incl. shoulder)	0	4	0	4
lower arm (incl. elbow, wrist)	0	22	0	22
hip	0	8	1	9
upper leg (pelvis, knee)	0	19	3	22
lower leg (foot, ankle)	0	11	3	14
	0	**65**	**7**	**72**

Table II: Elective surgeries and the level of the primary surgeon

	Reg. supervised scrubbed	Reg. supervised unscrubbed	Consultant	Total
Amputation				
leg (upper, lower, hip, knee)	3	10	8	**21**
foot	3	2	0	**5**
arm (lower, upper)	0	1	2	**3**
	6	**13**	**10**	**29**
Arthroplasty				
shoulder	7	4	14	**25**
elbow	2	3	5	**10**
hip & pelvis	66	43	57	**166**
knee	41	46	66	**153**
ankle	0	0	5	**5**
	116	**96**	**147**	**359**
Arthroscopy				
shoulder	31	12	26	**69**
hip	1	1	2	**4**
knee	9	13	56	**78**
ankle	0	2	3	**5**
elbow/foot	0	1	1	**2**
	41	**29**	**88**	**158**
Arthrotomy	0	14	0	**14**
CRPP				
hip	2	6	1	**9**
leg (foot, knee, lower, upper)	1	3	1	**5**
	3	**9**	**2**	**14**
Ex-fix				
upper leg (knee)	2	1	2	**5**
lower leg	7	13	14	**34**
elbow	0	0	3	**3**
	9	**14**	**19**	**42**
MUA				
hip & pelvis	4	5	1	**10**
upper leg (knee)	0	9	5	**14**
lower leg (foot)	1	3	1	**5**
arm (upper, lower, elbow)	0	8	3	**11**
	5	**25**	**10**	**40**
ORIF – nail				
arm (upper, lower)	0	2	0	**2**
hip & upper leg	6	3	4	**13**
lower leg	4	0	8	**12**
	10	**5**	**12**	**27**
ORIF – plate				
shoulder	3	1	3	**7**
upper arm	2	1	6	**9**
elbow	1	3	2	**6**
hip, pelvis, upper leg	3	2	3	**8**
knee	3	4	2	**9**
lower leg	1	2	0	**3**
ankle	0	4	8	**12**
foot	3	1	4	**8**
	16	**18**	**28**	**62**
ORIF – other				
arm (incl. elbow, shoulder)	0	2	4	**6**
hip & upper leg	2	5	2	**9**
lower leg	1	2	3	**6**
foot	2	0	1	**3**
	5	**9**	**10**	**24**
Osteotomy				
full leg	2	1	2	**5**
hip & pelvis	3	3	6	**12**
upper leg	5	1	11	**17**
knee	2	1	2	**5**
lower leg	5	10	8	**23**
ankle &foot	12	4	9	**25**
shoulder	2	0	3	**5**
arm (elbow, lower, wrist)	3	3	0	**6**
	34	**23**	**41**	**98**
Spinal				
cervical	4	31	16	**51**
cervicothoracic	0	3	2	**5**
thoracic	1	22	11	**34**
thoracolumbar	0	7	27	**34**
lumbar	5	30	19	**54**
lumbosacral	1	10	11	**22**
chest	0	2	1	**3**
revision	0	8	4	**12**
washout/biopsy/removal of hardware	1	30	3	**34**
	12	**143**	**94**	**249**

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Table II continued

Soft tissue – Botox				
leg (full, upper, lower)	9	9	17	**35**
arm (upper, lower, wrist)	1	2	3	**6**
both (U/L limb)	0	4	6	**10**
	10	**15**	**26**	**51**
Soft tissue – lengthening	**1**	**3**	**16**	**20**
Soft tissue – biopsy				
upper leg	1	8	3	**12**
lower leg	1	6	3	**10**
hip & pelvis	2	3	1	**6**
knee	0	6	1	**7**
ankle & foot	1	2	1	**4**
upper arm & shoulder	0	2	3	**5**
	5	**27**	**12**	**44**
Soft tissue – arthrodesis	**3**	**3**	**9**	**15**
Soft tissue – removal of hardware	**14**	**21**	**13**	**48**
Soft tissue – other				
shoulder	5	3	9	**17**
upper arm	1	1	3	**5**
elbow	2	3	5	**10**
lower arm	1	0	4	**5**
wrist	0	5	1	**6**
hip & pelvis	3	16	6	**25**
upper leg	1	8	7	**16**
knee	6	22	7	**35**
lower leg	13	22	28	**63**
ankle	25	26	16	**51**
foot	9	21	24	**70**
full leg	0	1	3	**4**
U/L limb	0	1	1	**2**
	66	**129**	**114**	**309**

Discussion

This is the first South African paper to attempt to quantify the orthopaedic surgical exposure available to trainees and their level of participation in the surgery. Data collection is a ubiquitous problem with hospital systems seldom capturing useful enough clinical information and it largely being inaccessible to analyse. Our orthopaedic department has maintained some individual unit databases since 2001, but a universal collection database was only instituted in 2011. This was maintained physically on the main theatre computer which created access problems and risk of data loss.

In 2017 we converted to REDCap which is cloud-based and accessible via the internet. This allows trainees to enter data from any internet-connected device, which has markedly increased compliance. As it is now used for mortality and morbidity meetings and career progression logbooks, the compliance is much higher. With a recent 'white listing' of the REDCap site, meaning it is accessible on any hospital PC irrespective of internet access status, compliance is further improved as all hospital intranet PCs can be used.

As always this requires buy-in. At the time of this review, our hand unit had their reservations due to high-volume, short-duration procedures. Their non-compliance led to no day case hand data being captured. They have subsequently seen the value of database contribution. From our M&M data (personal data of senior author), the hand unit processes around an additional 2 600 outpatient surgeries a year with about a third for sepsis, a third trauma and a third elective cases, where the bulk of the electives are carpal tunnel and trigger releases. The vast majority of these cases follow the above trauma surgery trend of registrar surgery supervised unscrubbed.

Our data highlights the high proportion of trauma cases. This is often a criticism of our training as there is less elective training occurring. Lawrence compared the South African (SA) trauma load to the UK and found a more varied profile and higher case load in SA.[11] Our data is a snapshot of a year's cases, and not a registrar's total experience. As registrars will spend more time rotating through the elective firms than in trauma, the total experience will be more balanced. Greensmith et al. compared the UK and SA general surgical logbooks in two six-month windows during 1992–3 and 2009–12. They found that due to reduced UK work hours, the South African trainee completed 15% more hours per week in 2009–10. While elective cases predominated in the UK, the RSA trauma cases were substantial at 21–26%. The UK trainee was reduced from 72% to 30% as primary operator in the latter period, with the SA trainee consistent at 80%.[3]

The emphasis of different areas of training is a vexing issue often driven more by local personalities than science. This is really dictated by what product is desired at the end of training. In SA this is complicated by public practice being largely trauma and emergency driven with private practice requiring the trauma skills when starting out but usually maturing to management of elective pathologies. The requirements have not been formally defined locally.

Kohring et al. compared the US early career profile with training case load by comparing 4 329 561 registrar CPT codes and 413 370 procedures performed by board-registered surgeons in the three-year period following registration. They generally correlated well other than spine instrumentation which was done less once in practice. Of course, the training may well influence case load choice.[12]

The milieu is constantly changing with the junior doctor experience at risk. Rashid assessed UK junior doctor experience in trauma and orthopaedic surgery during their core surgical training before the start of higher surgical training in their chosen speciality. They reviewed the clinical duties of 935 doctors over a five-day period. Only 8.5% of their time was spent in theatre with 35% in the ward and 21% off duty post call. Only 5% of these junior surgical trainees met their minimal clinical exposure standards where two trauma operation sessions, one elective surgery session and one fracture clinic is expected. They also did not meet the required five consultant supervised sessions a week.[5] Registrars may well enter the training programmes with a lower level of skills than before, placing more emphasis on acquiring experience during their rotation. This development is further challenged by the loss of surgical autonomy of the trainee where 'see one, do one, teach one' is no longer acceptable to many. With higher productivity demands by institutions, theatre time at a premium, increased supervision requirements and patient safety concerns, the consultants tend to operate rather than assist.[13] This is less of an issue locally, and especially in trauma where the trainees perform the bulk of the surgery. In fact, in our department, if it were not for the bulk of the straightforward trauma being processed after hours, little elective work would be possible.

This leads to the number of cases required for competence to be discussed with little science and often unrealistic expectations. Stotts et al. surveyed US programme directors and early practice surgeons as regards the commonest procedures. Recently qualified surgeons consistently reported higher numbers required

for training than programme directors and both exceeded the national accreditation minimum numbers set. Although most adult procedural experience was recommended in the 20–30 range, directors suggested 36 knee arthroplasties and recently qualified surgeons 50. Likewise, 40 and 50 cases respectively for total hip replacement and 10 and 20 for shoulder arthroplasty were suggested.[14]

With the explosion of orthopaedic-associated technology and procedures this is clearly not attainable in a reasonable training period. This does not account for the translational skills where operative learning in high volume trauma procedures is carried across to other lower volume elective procedures in well-trained hands supported by academic knowledge and the ability to think.

This all begs for evolution of teaching methods. There is an increased interest in simulation training. Simulation ranges from simple knot-tying practice to complex IT virtual reality assisted tasks.[1,15] Newer technology provides haptic feedback where the sense of touch, motion and proprioceptive feedback can be delivered, allowing the requisite skills to be developed. Strom et al. confirmed better performance after a period of abdominal diathermy haptic training.[16]

These technologies are expensive and not readily available locally; however, cadaver-based courses are. Our department runs monthly workshops for our trainees to perform procedures on cadavers. These have to be well structured to maximise the learning outcomes.[17]

Simulation can never replace the real thing but may prepare the surgeon to maximally benefit from less live surgery training, making the process safer and more efficient. There is no doubt that surgery is not only a technical exercise but also an emotional challenge with a need to learn to override one's anxiety and deal with trouble when it occurs. Unlike simulation, where you can simply restart, surgeons have to complete whatever they are faced with in the real patient with all the fears and inadequacies they have. This ability to 'cope' is just as important to learn and practise as is the technical execution.[4,18]

Conclusion

Our study presents the surgical experience and level of participation available to orthopaedic surgical trainees in a South African training hospital where their experience is an equal number of elective and trauma cases. Most of the cases were performed by the registrars in the supervised unscrubbed capacity although the more complex, elective cases were performed by consultants. Almost all after-hour trauma cases were performed by registrars. This suggests the platform allows for a high level of registrar surgical participation and training despite the challenges.

Further review is required to assess achievement of trainee competency and whether in fact the current experience is adequate.

Ethics statement

All procedures performed in studies involving human participants were in accordance with the ethical standards of the institutional and/or national research committee and with the 1964 Helsinki declaration and its later amendments or comparable ethical standards.

The authors declare that this submission is in accordance with the principles laid down by the Responsible Research Publication Position Statements as developed at the 2nd World Conference on Research Integrity in Singapore, 2010.

Prior to commencement of the study, ethical approval was obtained from the following ethical review board: University of Cape Town Human Research Ethics committee (R039/2013).

Declaration

The authors declare authorship of this article and that they have followed sound scientific research practice. This research is original and does not transgress plagiarism policies.

Author contributions

CD: data collection, initial analysis and first draft preparation

MH, ML: data capture, study design, supervision of data collection, manuscript review and revision

MN, SR: data capture, study design, manuscript review and revision

RD: study conceptualisation, study design, supervision of data collection, data analysis, manuscript revision, submission

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References

1. Fritz T, Stachel N, Braun BJ. Evidence in surgical training - a review. Innov Surg Sci. 2019;4(1):7-13. https://doi.org/10.1515/iss-2018-0026.
2. Marais LC, Dunn R. Teaching and training in orthopaedics. SA Orthop J. 2017;16(4).15-19
3. Greensmith M, Cho J, Hargest R. Changes in surgical training opportunities in Britain and South Africa. Int J Surg. 2016;25:76-81. https://doi.org/10.1016/j.ijsu.2015.11.052.
4. Kalun P, Wagner N, Yan J, et al. Surgical simulation training in orthopedics: current insights. Adv Med Educ Pract. 2018;9:125-31. https://doi.org/10.2147/amep.s138758.
5. BOTA Collaborators, Rashid MS. An audit of clinical training exposure among junior doctors working in Trauma & Orthopaedic Surgery in 101 hospitals in the United Kingdom. BMC Med Educ. 2018;18(1):1. https://doi.org/10.1186/s12909-017-1038-5.
6. Kruger D, Veller MG. Exposure to key surgical procedures during specialist general surgical training in South Africa : general surgery. S Afr J Surg. 2014;52(4):96-100. https://doi.org/10.7196/sajs.2162.
7. Norman R, Matzopoulos R, Groenewald P, Bradshaw D. The high burden of injuries in South Africa. Bull World Health Organ. 2007;85(9):695-702. https://doi.org/10.2471/blt.06.037184.
8. Seedat M, Van Niekerk A, Jewkes R, et al. Violence and injuries in South Africa: prioritising an agenda for prevention. Lancet. 2009;374(9694):1011-22. https://doi.org/10.1016/s0140-6736(09)60948-x.
9. Harris PA, Taylor R, Minor BL, et al. The REDCap consortium: Building an international community of software platform partners. J Biomed Inform. 2019;95:103208. https://doi.org/10.1016/j.jbi.2019.103208.
10. Harris PA, Taylor R, Thielke R, et al. Research electronic data capture (REDCap)--a metadata-driven methodology and workflow process for providing translational research informatics support. J Biomed Inform. 2009;42(2):377-81. https://doi.org/10.1016/j.jbi.2008.08.010.
11. Lawrence JE, Khanduja V. From Cape Town to Cambridge: Orthopaedic trauma in contrasting environments. World J Orthop. 2016;7(5):308-14. https://doi.org/10.5312/wjo.v7.i5.308.
12. Kohring JM, Bishop MO, Presson AP, et al. Operative experience during orthopaedic residency compared with early practice in the U.S. J Bone Joint Surg Am. 2018;100(7):605-16. https://doi.org/10.2106/jbjs.17.01115.
13. Dougherty PJ, Cannada LK, Murray P, Osborn PM. Progressive autonomy in the era of increased supervision: AOA critical issues. J Bone Joint Surg Am. 2018;100(18):e122. https://doi.org/10.2106/jbjs.17.01515.
14. Stotts AK, Kohring JM, Presson AP, et al. Perceptions of the recommended resident experience with common orthopaedic procedures: a survey of program directors and early practice surgeons. J Bone Joint Surg Am. 2019;101(113):e63. https://doi.org/10.2106/jbjs.18.00149.
15. Atesok K, MacDonald P, Leiter J, et al. Orthopaedic education in the era of surgical simulation: Still at the crawling stage. World J Orthop. 2017;8(4):290-94. https://doi.org/10.5312/wjo.v8.i4.290.
16. Strom P, Hedman L, Särnå L, et al. Early exposure to haptic feedback enhances performance in surgical simulator training: a prospective randomized crossover study in surgical residents. Surg Endosc. 2006;20(9):1383-88. https://doi.org/10.1007/s00464-005-0545-3.
17. Klima S, Cornwall J, Kieser D, Hammer N. The utility and benefit of a newly established postgraduate training course in surgical exposures for orthopedic and trauma surgery. Arch Orthop Trauma Surg. 2019;139(12):1673-80. https://doi.org/10.1007/s00402-019-03189-5.
18. Kneebone R, Aggarwal R. Surgical training using simulation. BMJ. 2009;338:b1001. https://doi.org/10.1136/bmj.b1001.