

The RCSEng DCOTS Course - Resuscitative Knowledge and Confidence in Surgical Skills are Reliably Maintained at Six Months Post-Course

Introduction

Since its introduction in 2012, 17 iterations of the Damage Control Orthopaedic Trauma Skills (DCOTS) course have trained over 250 surgeons in the principles and practice of Damage Control Orthopaedics (DCO) and Early Appropriate Care (EAC) (1). These courses, held under the auspices of the Royal College of Surgeons of England (RCSEng), took place initially at the College in London and more recently at the RCSEng Partner cadaver lab at Brighton and Sussex Medical School. With trauma being a leading cause of morbidity and mortality in the UK, the course has tried to pass on lessons of war and conflict from its military faculty and hard-won lessons of ‘developed-world’ trauma from its experienced civilian faculty.

Each course lasts two days and its content is described in greater detail below (Table 1 - Course Program). The course has always benefitted greatly from the input of the college’s in-house education faculty. Although the clinical faculty were confident in their belief that the programme met the intended educational objectives, the educationalists encouraged this to be evidenced. The Holy Grail of all education is to effect a learned change in behaviour. Proving that post-graduate education in clinical decision-making and skills results in improved patient outcomes is fraught with difficulty. This is especially in the clinical context of time-critical emergencies. Such circumstances are relatively rare and personal series of significant numbers can take decades to accumulate. Amongst surgical trainees, there is an established acceptance that self-reported confidence in executing a clinical skill does not correlate well with actual competence (2). However, this relationship is not well established in those more senior, whose surgical skills are more honed.

After recognizing a time-critical emergency, lack of confidence in executing the required procedure may lead a perfectly competent surgeon to a delay or even failure to perform the procedure at all (3). Although far from being a measure of improved outcome, self-reported confidence may be a reasonable surrogate marker of the likelihood of the correct intervention being delivered in a timely manner in an emergency.

To evidence the educational impact of the DCOTS Course, a survey was conducted immediately before and after the course; and most importantly, six months later. Damage Control Resuscitation (DCR) with Damage Control Surgery (DCS), Pelvic External Fixation, and Pelvic Packing were perceived to be the three most important elements of the course..

Day 1			Day 2		
Time	Session	Faculty lead	Time	Session	Faculty lead
0815 – 0830	Faculty meeting	All	0815 – 0830	Registration and refreshments	
0830 – 0845	Introduction		0830 – 0835	Introduction	
0845 – 0900	Lecture: Lessons from war			Reflection on day 1 and introduction to day 2	
0900 – 0930	Lecture: Damage Control concepts		0835 – 0855	Lecture: Surgical Damage Control concepts	
0930 – 1015	Demonstration: Crew resource management DCR/DCO simulation		0855 – 0935	Interactive session: Early appropriate care (EAC) and decision making	
1015 – 1030	Refreshments		0935 – 0950	Refreshments	
1030 – 1140	Practical Open tibia – principles of debridement Primary haemorrhage – tourniquet use Excise, extend, explore – clock face system Application of total external fixator to RIGHT TIBIA Perform 4 compartment fasciotomy		0950 – 1120	Practical Distal humerus fracture with brachial artery injury and compartment syndrome Management priorities in the polytrauma patient including use of tourniquet Brachial artery exploration Review forearm compartment anatomy Two incision forearm fasciotomy Spanning external fixator LEFT elbow The mangled hand (discussion)	
1140 – 1300	Practical Open distal LEFT femoral with vascular impairment/bleeding Different approach to arterial bleeding vs arterial insufficiency Haemorrhage control options – limitations of tourniquet use Demonstration of vascular anatomy Spanning external fixator across knee Priorities, eg control vessel, fasciotomy, shunt, extir, definitive repair Temporary vascular shunt to femoral artery		1120 – 1215	Lecture: when things go bang – blast and ballistic injuries	
1300 – 1345	Lunch		1215 – 1315	Lunch	
1345 – 1405	Lecture: Thoracic injury		1315 – 1545	Practical Pelvic bleeding: binder application – self-cadaver Bilateral pelvic packing Pelvic Exfix application Exposure and control of iliac vessels	
1405 – 1505	Practical Rib plating		1545 – 1600	Refreshments	
1505 – 1520	Refreshments		1600- 1630	Wrap up How this course has changed you, and other reflections	
1520 – 1630	Practical Clamshell thoracotomy Shoulder/neck junctional haemorrhage control: control of bleeding at the shoulder girdle				
1630 – 1645	Wrap up				
1645 – 1700	Faculty meeting	All			

DCOTS 16-17/08/2022
© Royal College of Surgeons of England 2019. All rights reserved.

Method

Participating surgeons were invited to score their self-reported confidence prior to attending the DCOTS Course, immediately at its conclusion and then again 6 months later. A modified Likert scale was used (4), with responses made on a 4-point scale from 1=No Confidence to 4=Very Confident. This data was collected voluntarily from participants via an on-line form.

Simple descriptive analysis was used to categorise the responses and comparisons between time points were made using non-parametric tests. The data for 3 the key facets of participants' responses was examined. First, the application of Damage Control Resuscitation and Surgery (DCR/DCS) principles, as this is the prime goal of the Course. Second, pelvic external fixation, given familiarity with the equipment required, this was anticipated to be an area in which the participants might be expected to feel confident at the

outset. Finally, the responses for pelvic packing for haemorrhage control are presented, as this is widely felt to be an area of great uncertainty in the Orthopaedic General on-call community.

Results

Because of the iterative nature of the course, the number of responses obtained at each time-point is different. Pre-course responses totalled 53, immediate post-course responses 58 and responses at 6 months numbered 26.

Summary: Table 2

Question	Pre-training	Post-training	6m follow up
	Mean (SD)	Mean (SD)	Mean (SD)
DCR/DCS	2.45 (0.64)	3.52 (0.54)	3.58 (0.50)
Pelvic Ex Fx	2.19 (0.94)	3.45 (0.63)	3.15 (0.67)
Pelvic Packing	1.71 (0.87)	3.22 (0.62)	2.77 (0.71)

Question	Pre-training	Post-training	6m follow up
	% confident	% confident	% confident
DCR/DCS	49%	98%	100%
Pelvic Ex Fx	40%	93%	85%
Pelvic Packing	19%	90%	62%

Statistical Testing (Mann-Whitney)

Question	Post vs Pre	6m vs Pre	6m vs Post
DCR/DCS	<0.001	<0.001	0.675
Pelvic Ex Fx	<0.001	<0.001	0.058

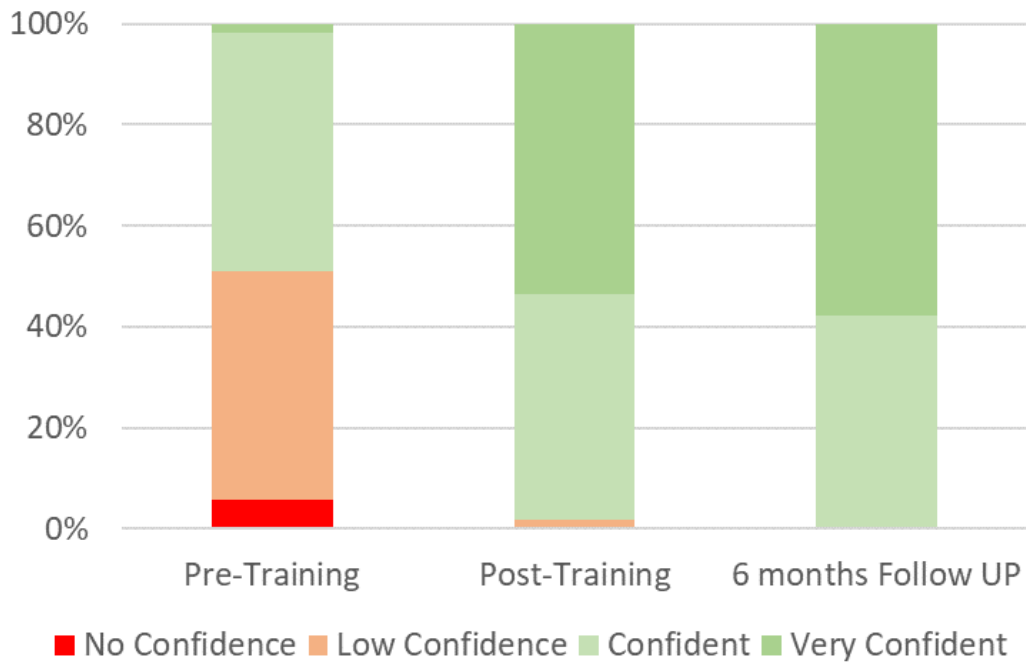
Pelvic Packing	<0.001	<0.001	0.005
----------------	--------	--------	-------

Effect Sizes (Standardised Z statistic)

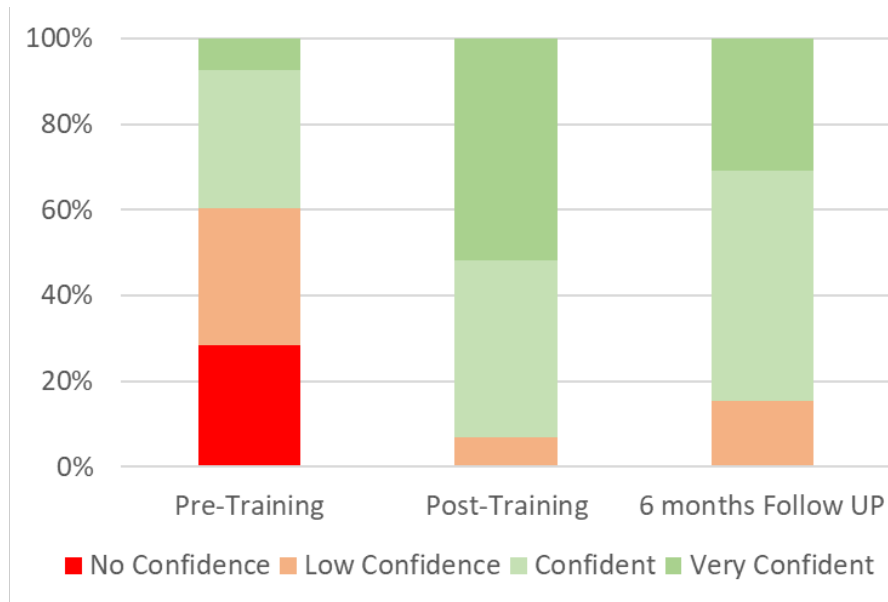
Question	Post vs Pre	6m vs Pre	6m vs Post
DCR/DCS	0.68, large	0.57, large	0.04, small
Pelvic Ex Fx	0.62, large	0.39, medium	0.18, small
Pelvic Packing	0.71, large	0.45, medium	0.27, small

Visual Display of Changes

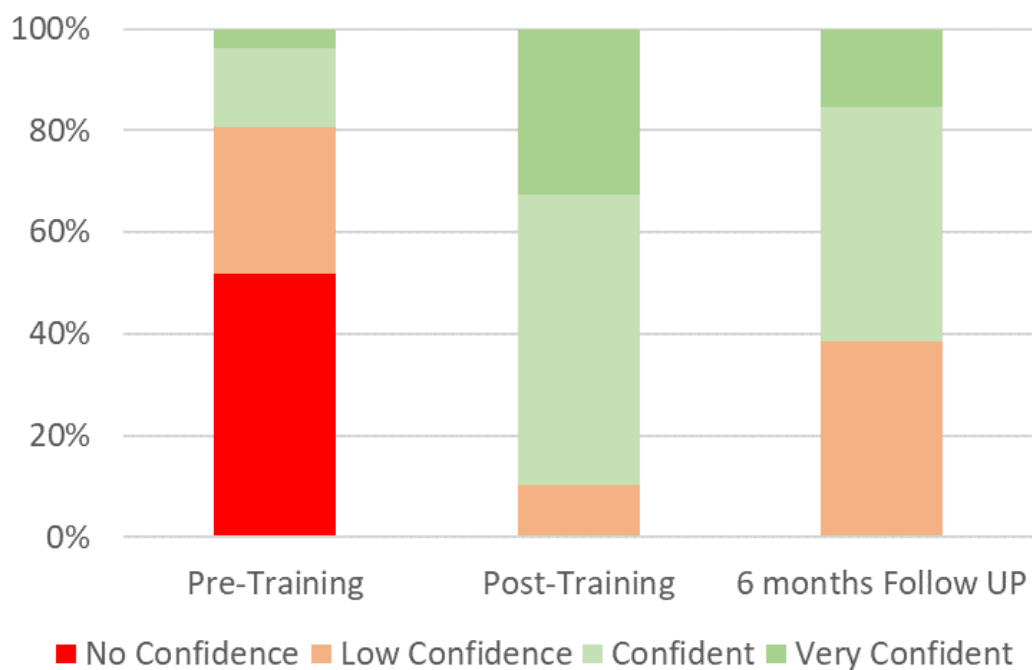
DCR/DCS



Pelvic Ex Fix



Pelvic Packing



Correlations (Spearman's Correlation)

Between measures (across all time points)

	Pelvic Packing	DCR/DCS
Pelvic Ex Fx	0.629**, strong	0.575**, moderate
Pelvic Packing	-	0.639**, strong

Discussion

The analysis of the results supports the initial premise of the study. Based upon the initial self-reported confidence responses, it can be inferred that the participants do not overstate their confidence in the areas studied. Only half of the participants had any confidence in the principles of DCR with DCS. Six months after the Course all participants were confident (45%) or very confident (55%) in these principles.

With Pelvic External Fixation, pre-course, 40% of participants had confidence in the technique. This improved initially to 93% and declined to 85% 6 months later. Only 19% of participants had any confidence in Pelvic Packing pre-course, which improved to 90% post-course but dropped to 62% by 6 months.

This may relate to the low familiarity of UK trainees with the concept and the fact that it is not performed often. A 2010 survey of 232 UK Orthopaedic Trainees revealed that over 2/3 of trainees surveyed had no confidence in their ability to pack a pelvis and 60% had never even seen a case (5). In a more complicated cases of spanning external fixation for a 'floating knee, trainees also reported a decreased level of perceived confidence and limited exposure to the technique.

Skills do fade with time. Thirty-eight (95%) of 40 surgical residents and 10 'expert' traumatologists who were evaluated before and within 4 weeks of ASSET (Advanced Surgical Skills for Exposure in Trauma) training completed follow-up evaluations 12 to 18 months later (6). Performance was measured during extremity vascular exposures and lower extremity fasciotomy in fresh cadavers before and after taking the course. Interval experience, rather than time since training, affected skill retention: Only 4 experts and 16 residents (40%) adequately decompressed and confirmed entry into all 4 lower extremity compartments 18 months later.

Norwegian geography has led to several initiatives to train surgical staff from their rural hospitals in damage control surgery using a team-oriented approach. Their courses run on interactive lecture modules and operative sessions on live porcine models that emphasize communication, collaboration and team-based problem solving. Surveying 38 teams from 21 hospitals over 10 courses showed a mean increase of 2.3 points in proficiency with extra-peritoneal pelvic packing and 1.5 points with emergency thoracotomy on a 5-step Likert scale. This team approach was perceived as crucial by 218 (94%) of participants. A phone survey revealed 12 cases of lifesaving rural damage control operations by course participants in the past 3 years (estimated cost: \$15,075 per life saved). Of the 18 hospitals surveyed, 17 had also modified their trauma protocols as a result of the course (7).

Cadaver training improves all the time and perfused fresh frozen (unembalmed) cadavers are seen as a very positive step. Preliminary data highlight its utility for open vascular, thoracic, and other high-acuity/low-volume procedures relevant to combat casualty care. Further work is needed for model optimization and validation of an objective structured technical assessment tool as the current courses only measure skill retention at course end and not at a later period (8). Highly responsive to feedback, we have altered our DCOTS course almost every year since its introduction. Since 2020 we have added rib-plating, resuscitative thoracotomy and more extensive junctional haemorrhage control to the program.

Educationally we also now very clearly understand that pre-course learning can cause significant anxiety! We are aware of one cadaver course where, if one were to watch all the pre-course videos, it would take 3-4 days without sleep or comfort breaks. The recommended (and supplied) pre-course for DCOTS is currently just one short podcast (CRM), one 10 slide presentation ('A good save') and three 5-7 minute videos (the Hoffmann 3 external fixation system, femoral artery control in the groin, and spanning knee external fixation). We have also combined this with a novel course manual sent as a PDF well before the course begins and supplied as a bound paper copy on day 1 of the course (Fig 1. Pic of manual). Again this is on educational advice.



Conclusion

In this short report, we have demonstrably shown that three of the main skills taught on DCOTS are effectively retained at 6 months post course. We believe that an experienced and approachable faculty; teaching in an immersive adult learning environment, with 4 short didactic lectures and 9 intense practical sessions delivers a reproducible, entertaining and highly valuable course.

References

1. Bates P, Parker P, McFadyen I, Pallister I. Demystifying damage control in musculoskeletal trauma. *The Annals of The Royal College of Surgeons of England*. 2016 May(98(5)):291-4.
2. Pietroni M. The assessment of competence in surgical trainees. *Annals of the Royal College of Surgeons of England*. 1993;75(6 Suppl):200.
3. Nathdwarawala Y, Bodger O, Pallister I. Simulation education for lower limb fasciotomy: improving surgical trainee confidence in executing a time-critical limb-saving procedure. *BMJ Simulation and Technology Enhanced Learning*. 2018:bmjstel-2018-000321.
4. Likert R. A technique for the measurement of attitudes. *Archives of Psychology*. 1932;22:1-55.
5. Eardley WGP, Taylor DM, Parker PJ. Training in the practical application of damage control and early total care operative philosophy—perceptions of UK orthopaedic specialist trainees. *The Annals of The Royal College of Surgeons of England*. 2010;92(2):154-8.
6. Hansen KS, Uggen PE, Brattebø G, T. W. Team-oriented training for damage control surgery in rural trauma: a new paradigm. *J Trauma*. 2008 Apr;64(4):949-53.
7. Mackenzie CF, Garofalo E, Puche A, Chen H, Pugh K, Shackelford S, et al. Performance of vascular exposure and fasciotomy among surgical residents before and after training compared with experts. *JAMA surgery*. 2017;152(6):581-8.
8. Grabo D, Polk T, Minneti M, Inaba K, Demetriades D. Brief report on combat trauma surgical training using a perfused cadaver model. *Journal of Trauma and Acute Care Surgery*. 2020;89(2S):S175-S9.