



Major Limb Amputation – A Surgeon’s Perspective

Professor Mark E. O’Donnell

DipSEM(GB&I) MB BCH BAO(Dist) MFSEM(UK) MFSEM(RCSI&RCPI) MFSTEd
MMedSc(Dist) MD ECFMG RPVI(ARDMS) FRCSEd(Gen&VascSurg) FEBVS(Hon)

Consultant Vascular and Endovascular Surgeon, Royal Blackburn Hospital, East Lancashire Hospitals NHS Trust & Sport and Exercise Sciences Research Institute, Faculty of Life and Health Sciences, Ulster University, Northern Ireland.

ELHT Amputation Study Day
Dunkenhalgh Hotel - Lancashire
8th March 2017

Safe | Personal | Effective



Disclosure

- No disclosures declared.
- No financial relationship with content.



Peripheral Arterial Disease

- 20% of people over 55 years of age.
 - Hankey GJ, *JAMA* 2006
- 27 million people affected in Europe and USA.
 - Hankey GJ, *JAMA* 2006
- Only 10-30% of patients will have symptoms.
 - McDermott MM, *Cleve J Clin Med* 2006
- Symptoms deteriorate in 25% of patients.
 - Schmieder FA, *Am J Cardiol* 2001
- 2% to 4% will require amputation.
 - Dormandy J, *Semin Vasc Surg* 1999



Diabetes

- 15% affected by PAD at 10 years rising to 45% at 20 years.
 - Kreines *Diabetes Care* 1985.
- 20% of patients with PAD have diabetes.
 - Muribato *Circulation* 1997.
- PAD disease distribution different in diabetes.
 - Strandness *Diabetes* 1961.
- 11-times higher rate of major lower limb amputation and a doubling of the five-year mortality.
 - Elhadd *Pract Diabetes Int* 1999.
- Diabetic ulcers heal more slowly leading to increase amputation rates.
 - Caputo *N Engl J Med* 1994.



Learning Outcomes

- Explore Background, Indication and Overall Philosophy of Limb Amputation.
- Types of Amputation.
- Through-Knee Amputation Technique.
- Personal Technical Tricks.
- Royal Blackburn Case Volume and Outcomes.
- Future Strategy.



Zum/beyn abschneyden hat sein Kunst/
 Verreyben sans Antzehen püest.
 Gehör auch nicht ein yeden zů/
 Erschick sich dann weich yem thů.



No. 135. Gerdorff. Wunderzöl. Strassburg, 1517-8.
 (Reduced.)



Zum/dam abschneyden hat sein Pustf/
Verrreyben sans Antzehen pweist. Gehör auch nicht ein yeden zö/
Lefchick sich dann weich yem thö.



No. 135. C



East Lancashire Hospitals **NHS**
NHS Trust

Safe | Personal | Effective





Zum/daum abschneiden hat sein Funf/
Dertreyben sans Antennen puerst.
Gehör auch nicht ein yeden zü/
Lefchick sich dann weich yem thü.



Epidemiology

- Peripheral arterial disease accounts for the majority of lower limb amputations in the Western World.
 - Greater than 80% due to vascular disease in UK.
 - Six times higher in insulin dependent diabetic patients.
 - Epicentres based on location and population demographics eg. South Western USA & Navajo population.



Epidemiology

- Peripheral arterial disease accounts for the majority of lower limb amputations in the Western World.
 - Greater than 80% due to vascular disease in UK.
 - Six times higher in insulin dependent diabetic patients.
 - Epicentres based on location and population demographics eg. South Western USA & Navajo population.
- National Amputee Statistical Database reported that dysvascularity responsible for 70% of all lower limb prosthetic referrals in 2006-07.
 - 4574 referrals post-lower limb amputation.
 - 53% transtibial.
 - 39% transfemoral.







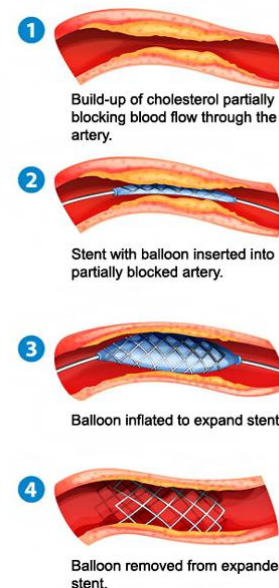
Impact of Modern Surgery

- Danish National Amputation Register demonstrated a 27% fall in major limb amputations due to increased utilisation of infra-inguinal bypass operations.
- Similar reports from Finland, United States and other Western Countries.



Impact of Modern Surgery

- Danish National Amputation Register demonstrated a 27% fall in major limb amputations due to increased utilisation of infra-inguinal bypass operations.
- Similar reports from Finland, United States and other Western Countries.



Survival following Major Limb Amputation

- Survival rates post-amputation remain bimodal.



Survival following Major Limb Amputation

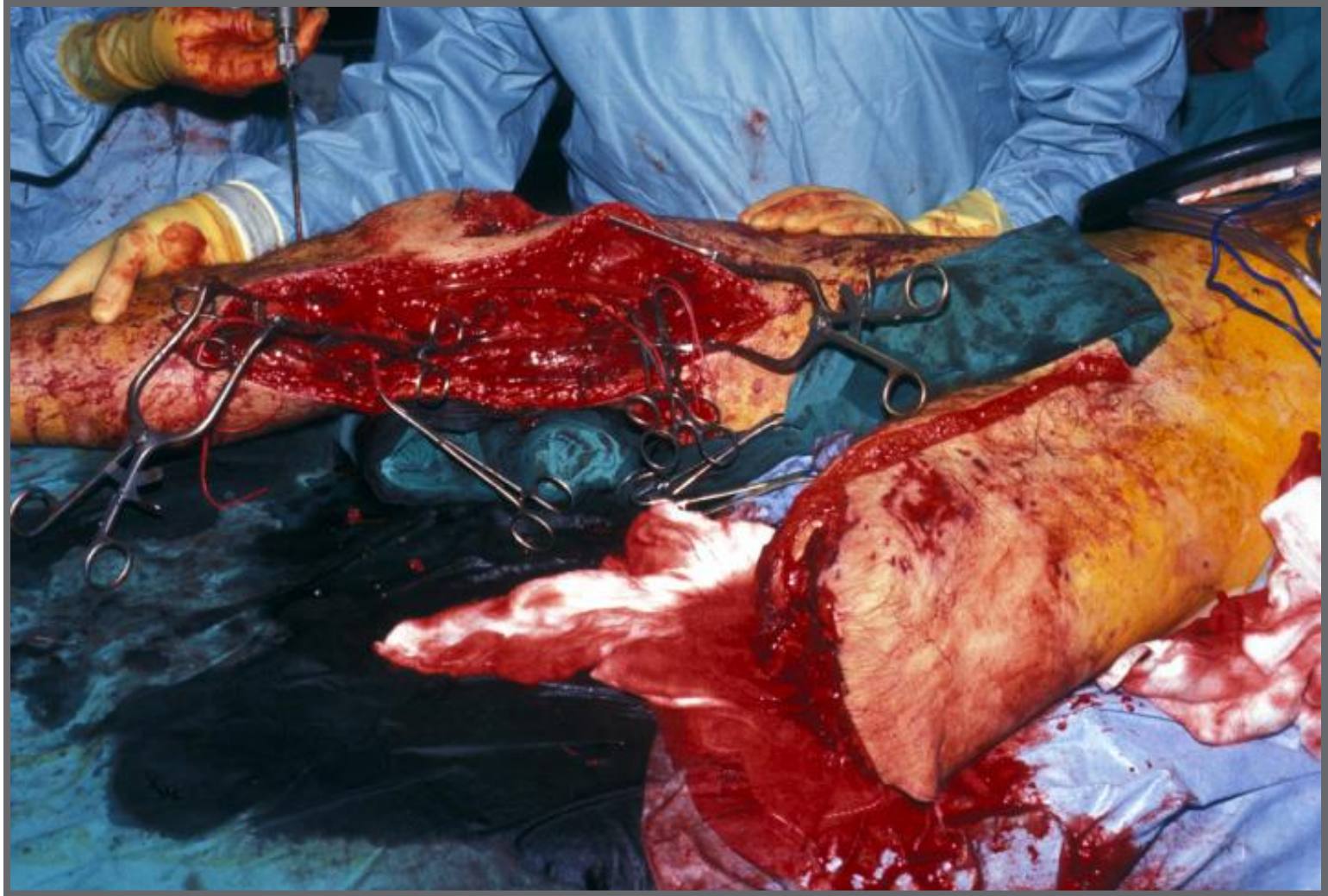
- Survival rates post-amputation remain **bimodal**.

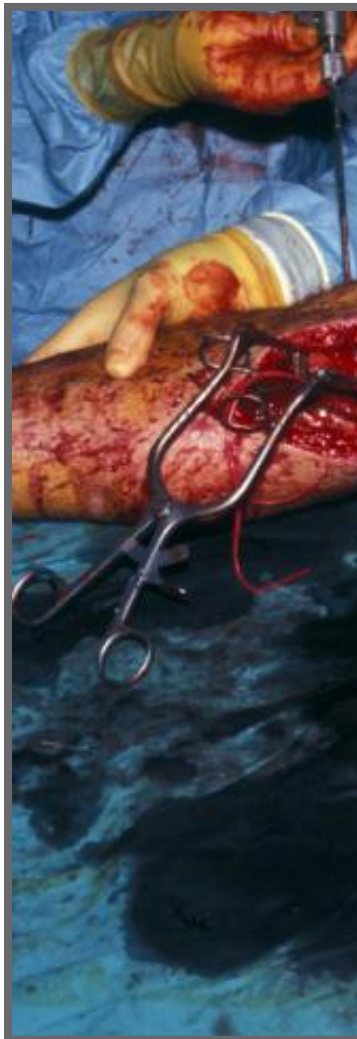


Survival following Major Limb Amputation

- Survival rates post-amputation remain bimodal.
 - If patient survives initial traumatic episode long-term survival is good.







Outcomes following Major Limb Amputation

- Mortality rates post-amputation remain bimodal.
 - For PAD patients, mortality rates are significantly affected by their underlying cardiovascular disease burden.



Vascular Disease – What Lies Beneath



Outcomes following Major Limb Amputation

- Mortality rates post-amputation remain bimodal.
 - For PAD patients, mortality rates are significantly affected by their underlying cardiovascular disease burden.
- **30-day mortality between 9% and 15%.**

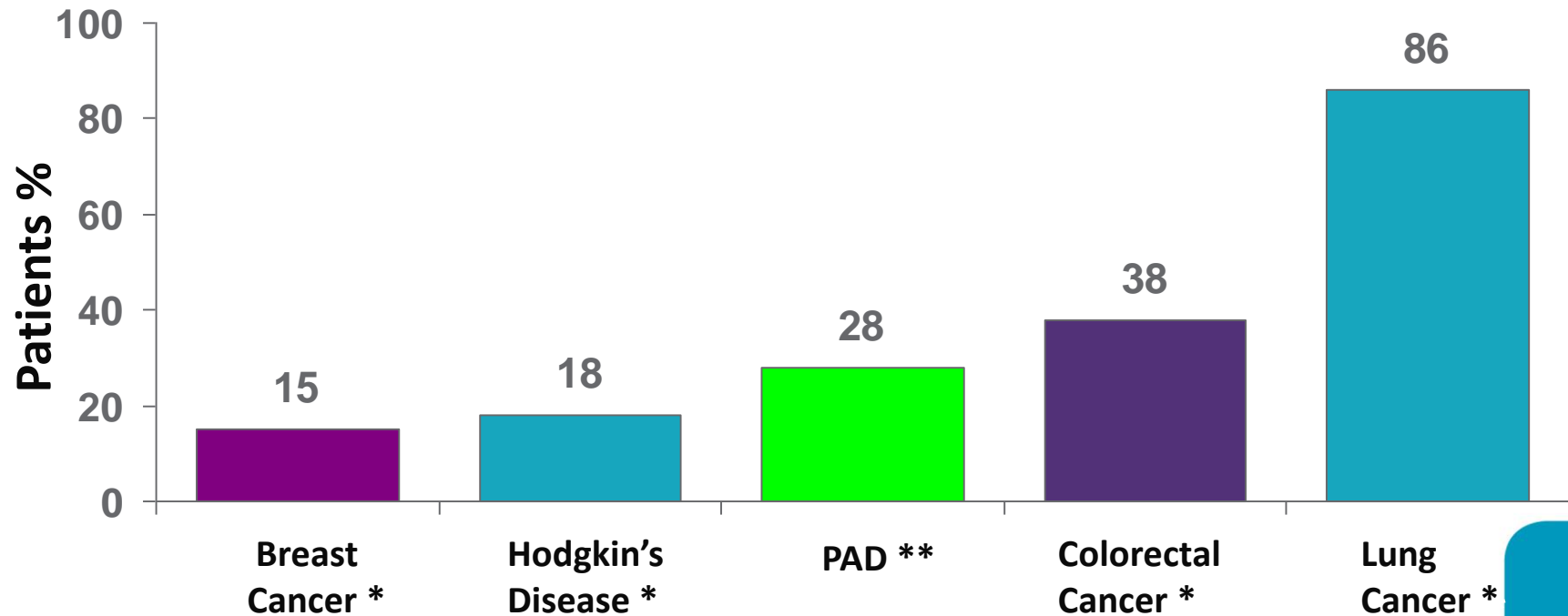


Outcomes following Major Limb Amputation

- Mortality rates post-amputation remain bimodal.
 - For PAD patients, mortality rates are significantly affected by their underlying cardiovascular disease burden.
 - 30-day mortality between 9% and 15%.
- Long-term survival rates deteriorate yearly;
 - **60% at one year.**
 - **42% at three years.**
 - **35% - 45% at five years.**



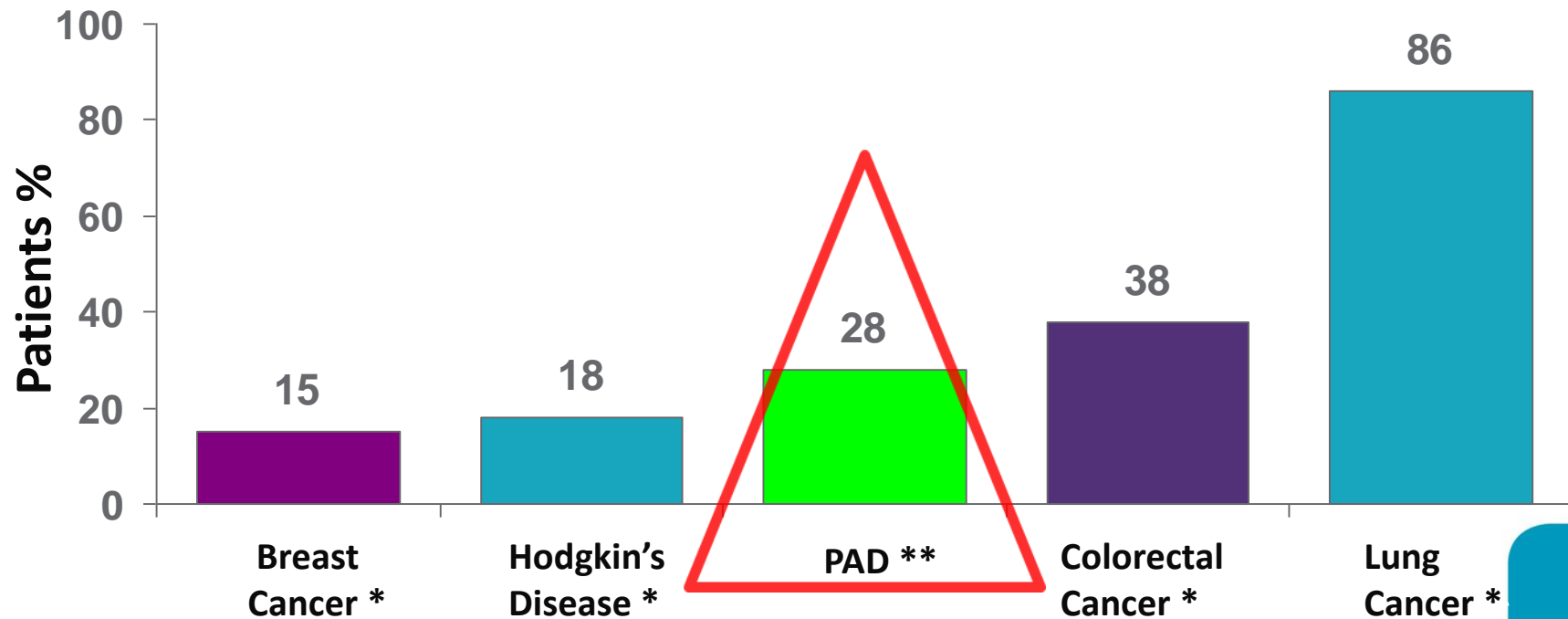
Relative 5-Year Mortality Rates



* American Cancer Society. *Cancer Facts and Figures*. 1997.

** Kempczinski, RF, Bernhard VM. IN: Rutherford RB, ed. *Vascular Surgery*. Philadelphia, PA: WB Saunders; 1989: chap 53.

Relative 5-Year Mortality Rates



* American Cancer Society. *Cancer Facts and Figures*. 1997.

** Kempczinski, RF, Bernhard VM. IN: Rutherford RB, ed. *Vascular Surgery*. Philadelphia, PA: WB Saunders; 1989: chap 53.

Surgical Philosophy

- Emergent status.
- Spectrum of disease severity;
 - No tissue loss extending to gross macroscopic destruction.
- Patient co-morbidities.
- Revascularisation possible.
- Rehabilitation potential.



Vascular Amputation – The Horror !!!!



Surgical Considerations

- Handle tissues with care and optimise haemostasis.



Surgical Considerations



Surgical Considerations

- Handle tissues with care and optimise haemostasis.
- Oversize flaps initially then trim and avoid dog-ears.



Surgical Considerations



Surgical Considerations

- Handle tissues with care and optimise haemostasis.
- Oversize flaps initially then trim and avoid dog-ears.
- Protect good quality skin and cover stump without tension.



Surgical Considerations

- Handle tissues with care and optimise haemostasis.
- Oversize flaps initially then trim and avoid dog-ears.
- Protect good quality skin and cover stump without tension.
- Bone edges should be bevelled and smoothed out.



Surgical Considerations

- Handle tissues with care and optimise haemostasis.
- Oversize flaps initially then trim and avoid dog-ears.
- Protect good quality skin and cover stump without tension.
- Bone edges should be bevelled and smoothed out.
- Think of stump shape for future prosthetic use.



Surgical Considerations

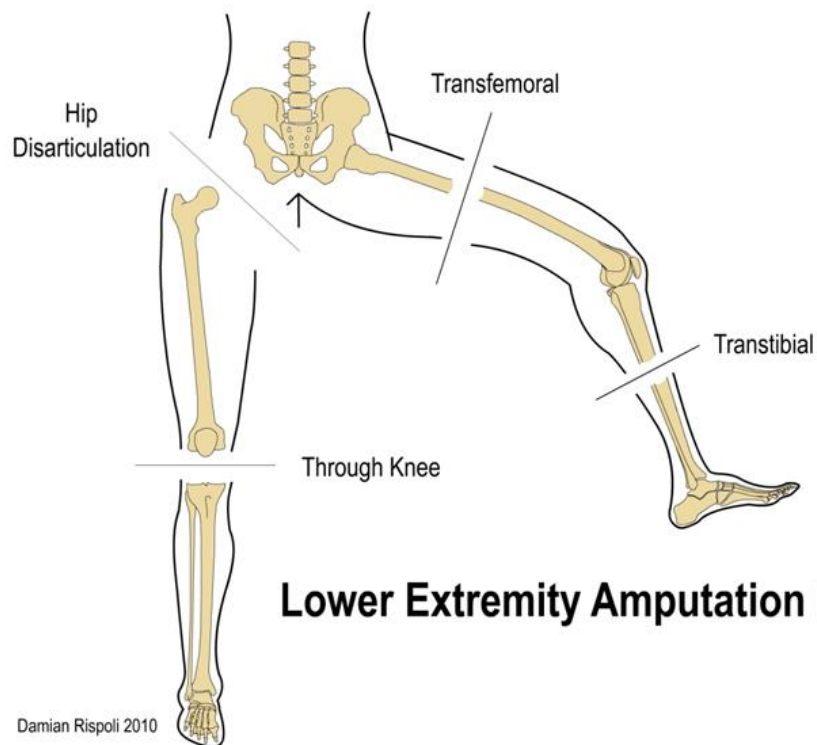
- Handle tissues with care and optimise haemostasis.
- Oversize flaps initially then trim and avoid dog-ears.
- Protect good quality skin and cover stump without tension.
- Bone edges should be bevelled and smoothed out.
- Think of stump shape for future prosthetic use.
- Tourniquet usage as per surgeon preference.



Optimisation of Wound Healing

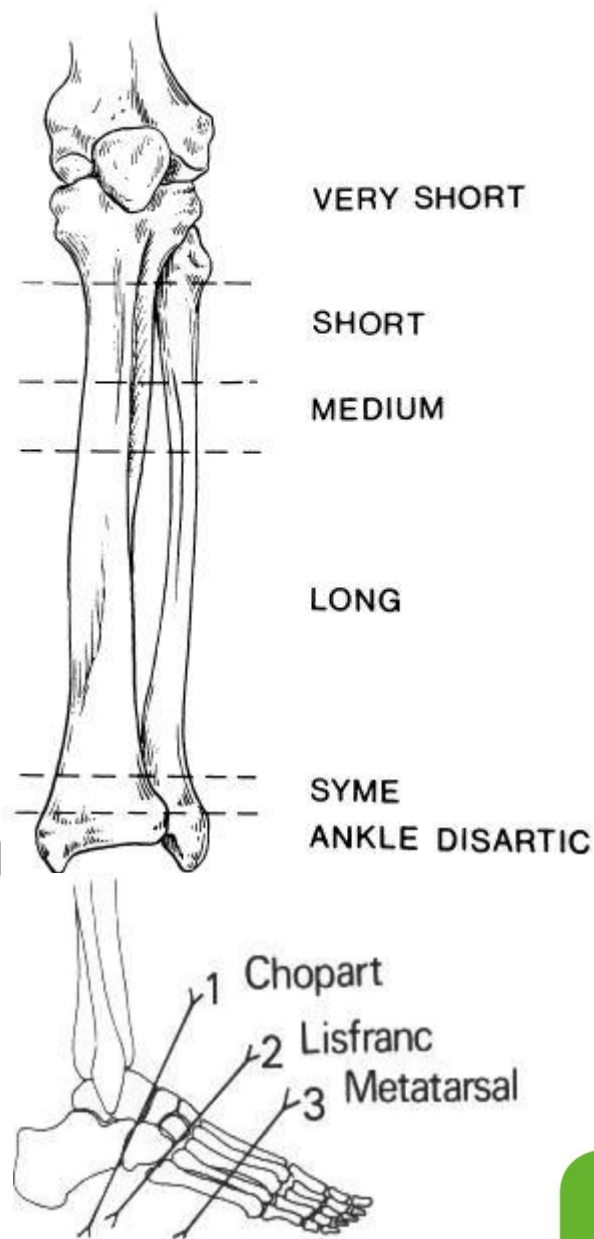
- Patient optimisation including MRSA screening.
- Antibiotic prophylaxis in accordance with local protocols.
- Patient physiology:
 - Normothermia.
 - Maintenance of glucose homeostasis.
- Operative technique:
 - Pre-operative patient washing ??
 - Anatomical marking.
 - Aseptic technique and precise tissue handling.
 - Theatre sterility and laminar air-flow.





Lower Extremity Amputation Level

Damian Rispoli 2010



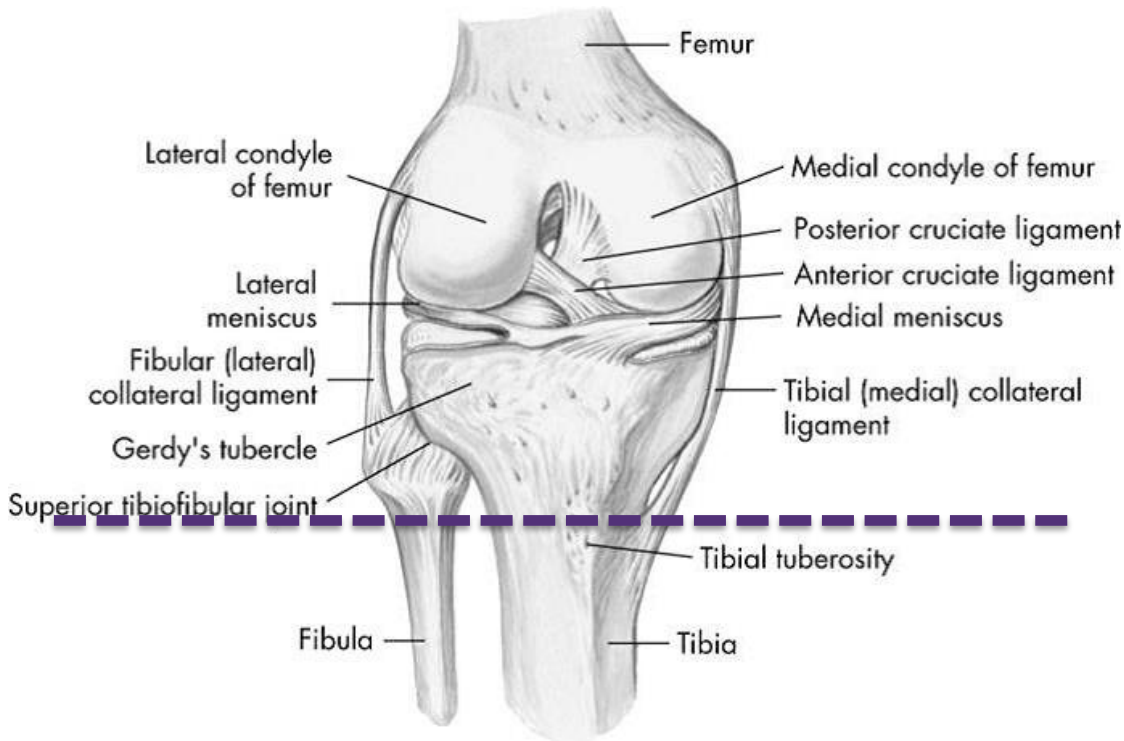
Through Knee Amputation



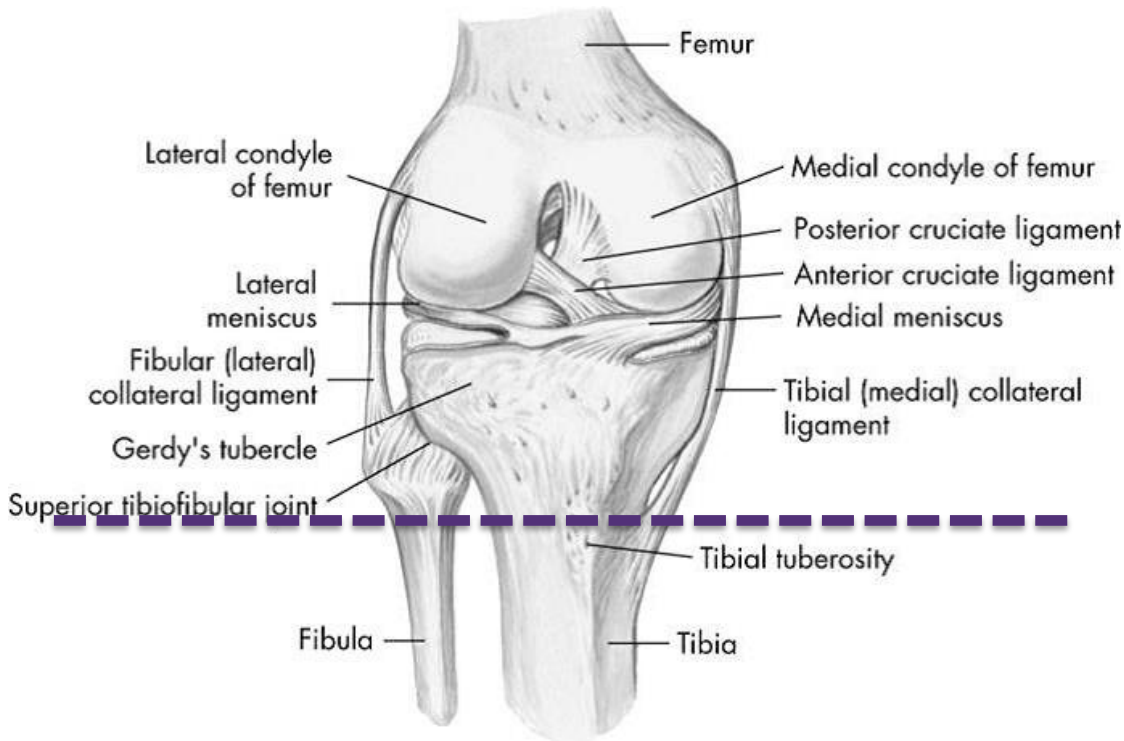
Safe | Personal | Effective



1 – Skin Marking



1 – Skin Marking



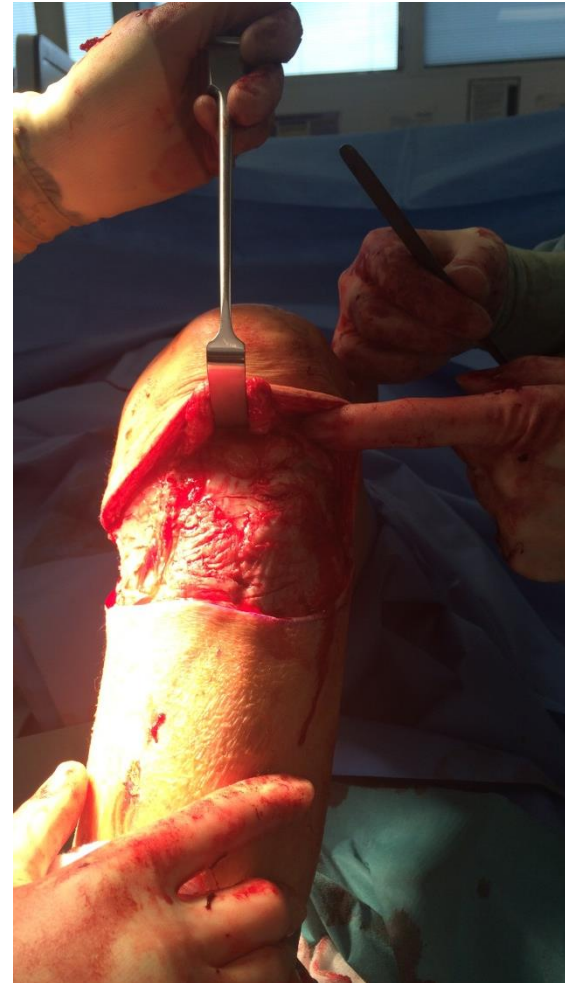
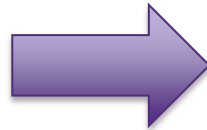
2 – Anterior Incision



Safe | Personal | Effective



2 – Anterior Incision



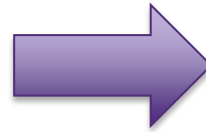
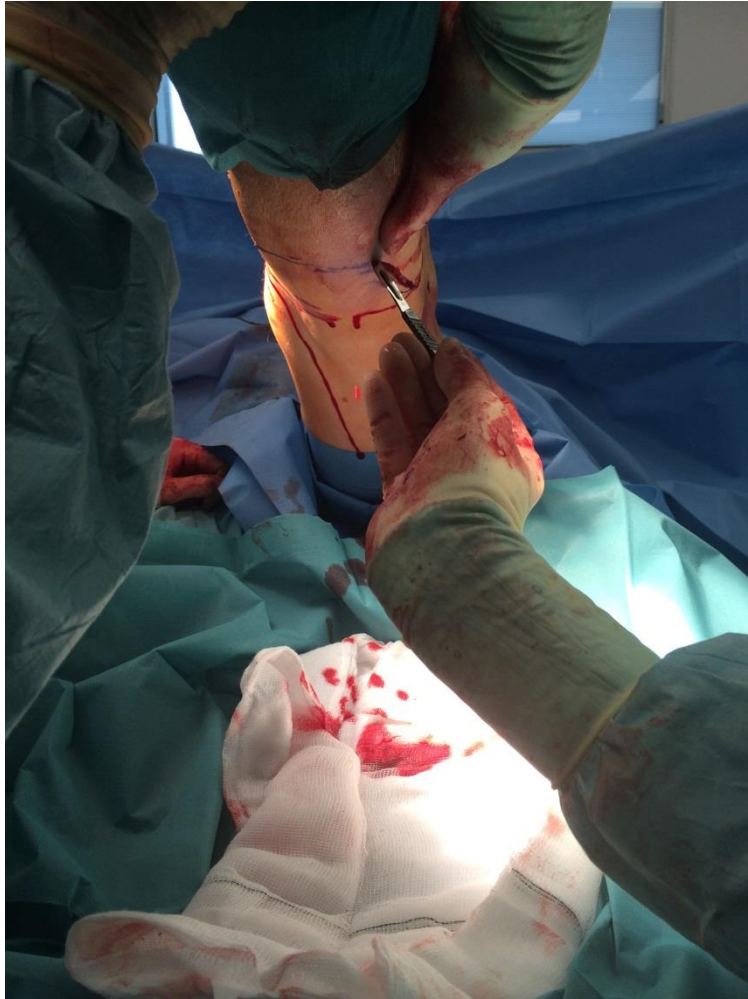
3 – Posterior Flap



Safe | Personal | Effective



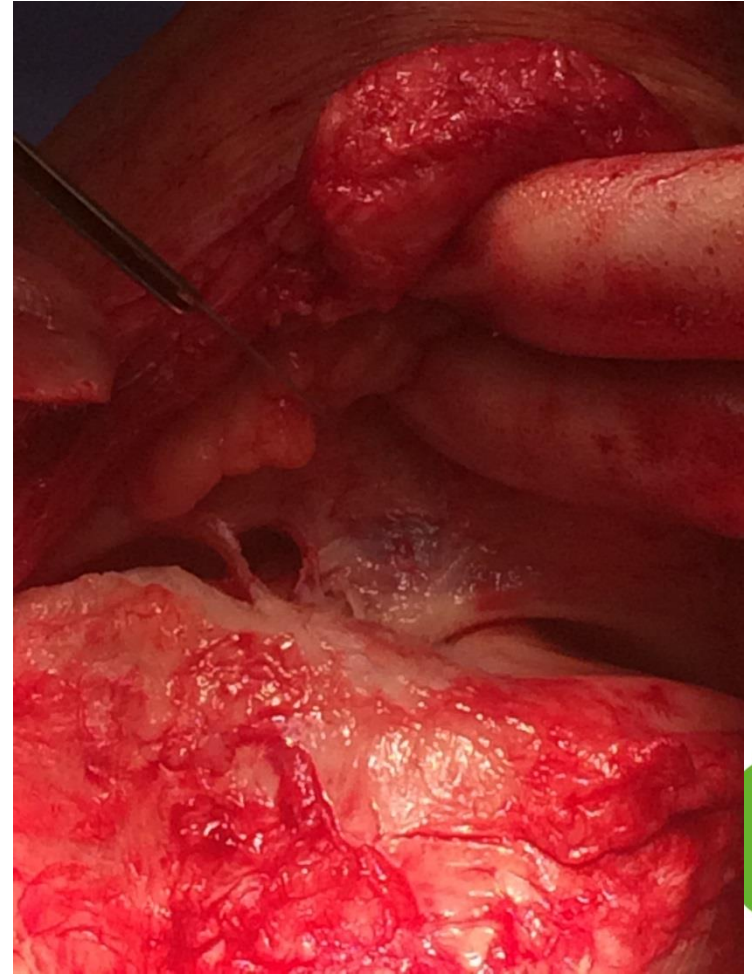
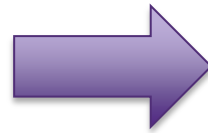
3 – Posterior Flap



4 – Menisci + Cruciates



4 – Menisci + Cruciates



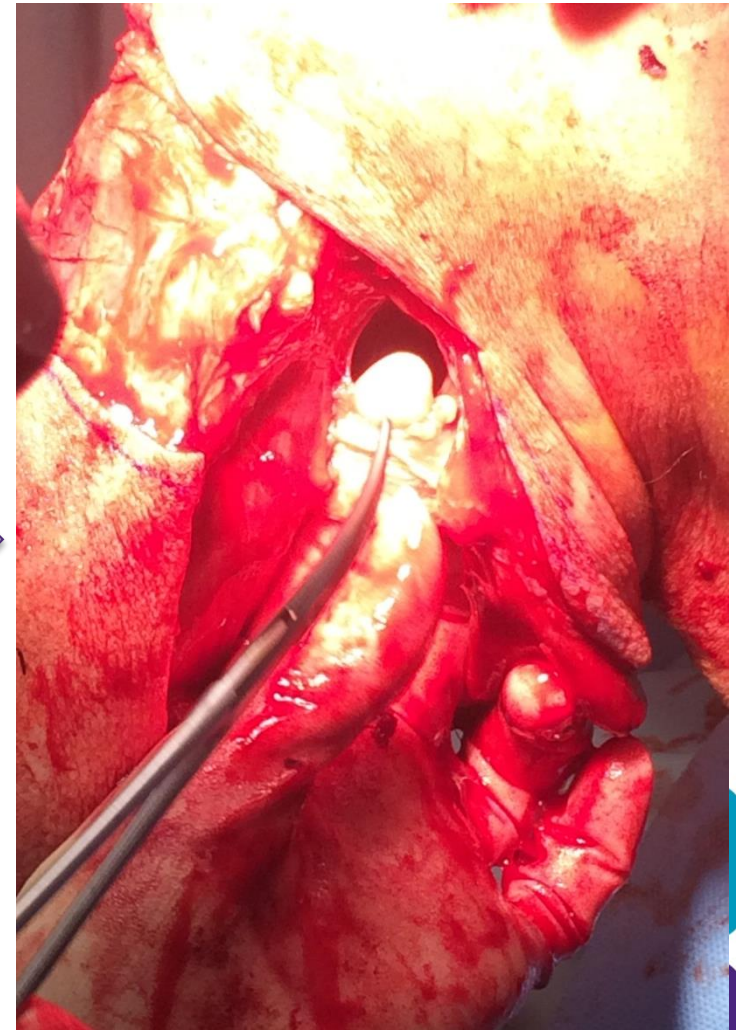
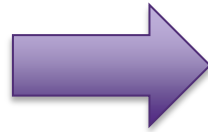
5 – Neurovascular Bundle



Safe | Personal | Effective



5 – Neurovascular Bundle



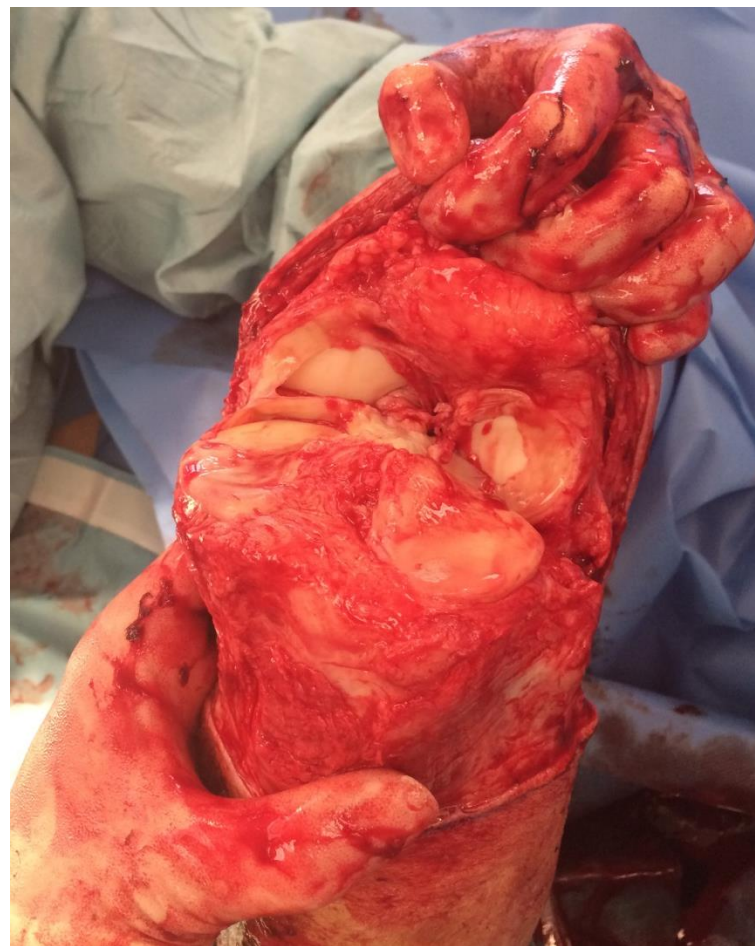
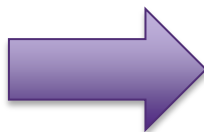
6 – Division of Cruciates



Safe | Personal | Effective



6 – Division of Cruciates



7 – Limb Amputation

East Lancashire Hospitals **NHS**
NHS Trust

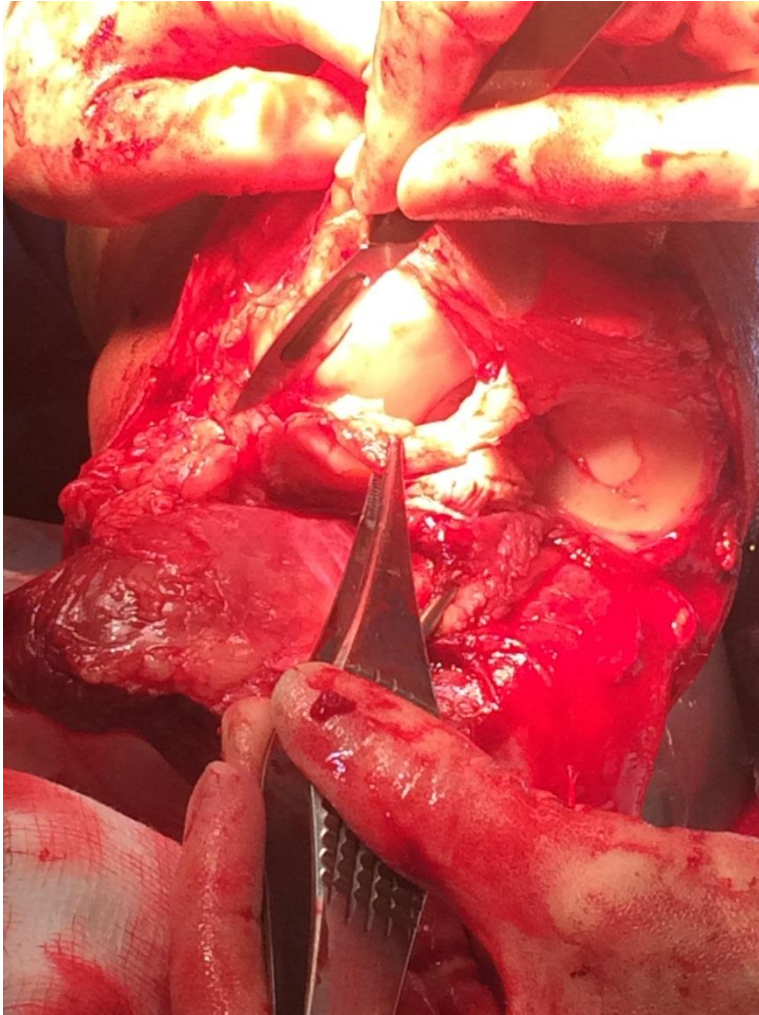


Safe | Personal | Effective



8 – Preparation of Cruciates

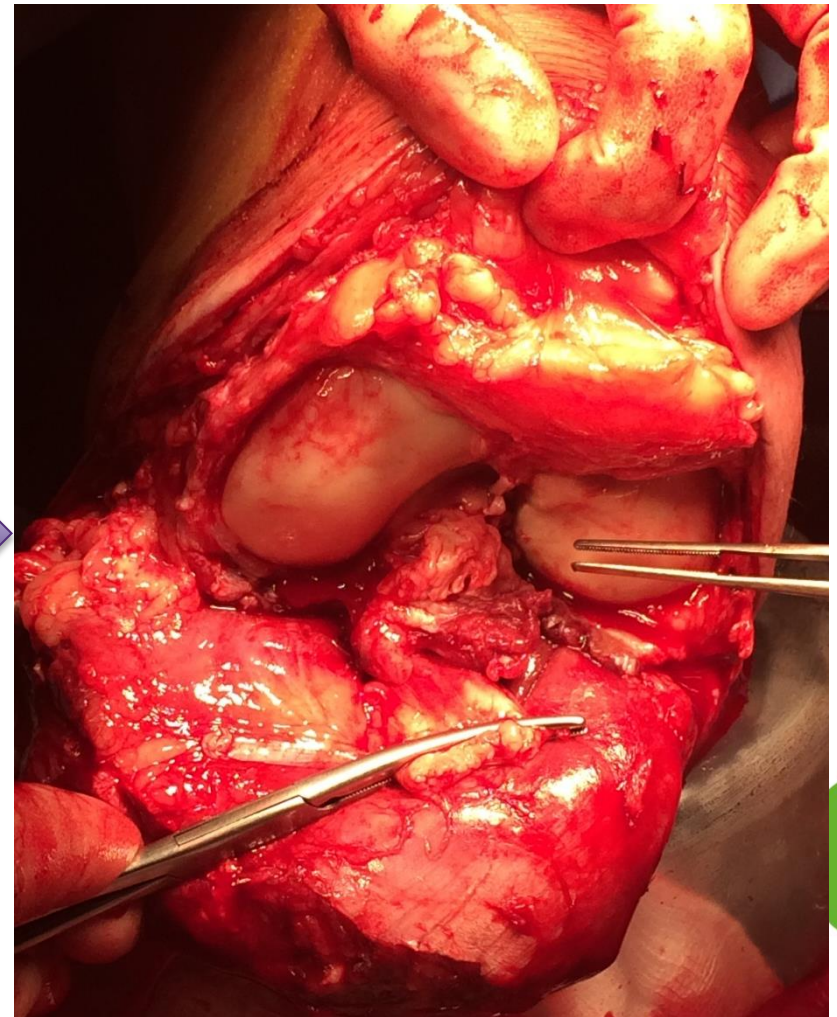
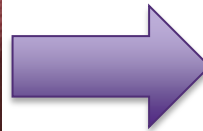
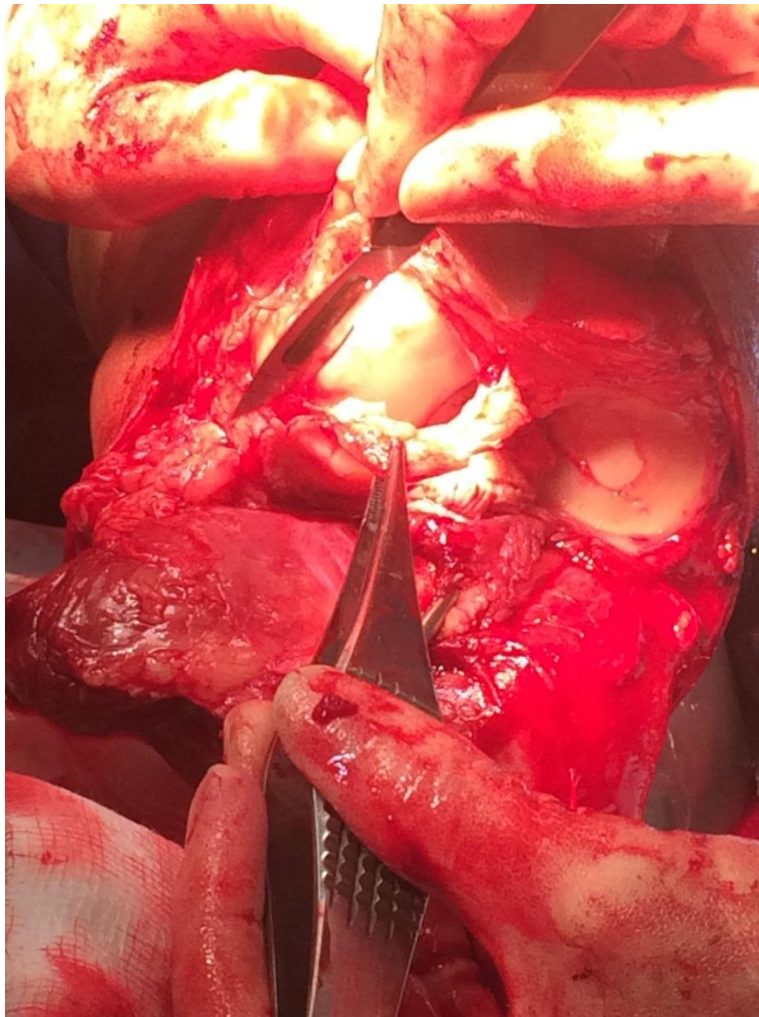
East Lancashire Hospitals **NHS**
NHS Trust



Safe | Personal | Effective

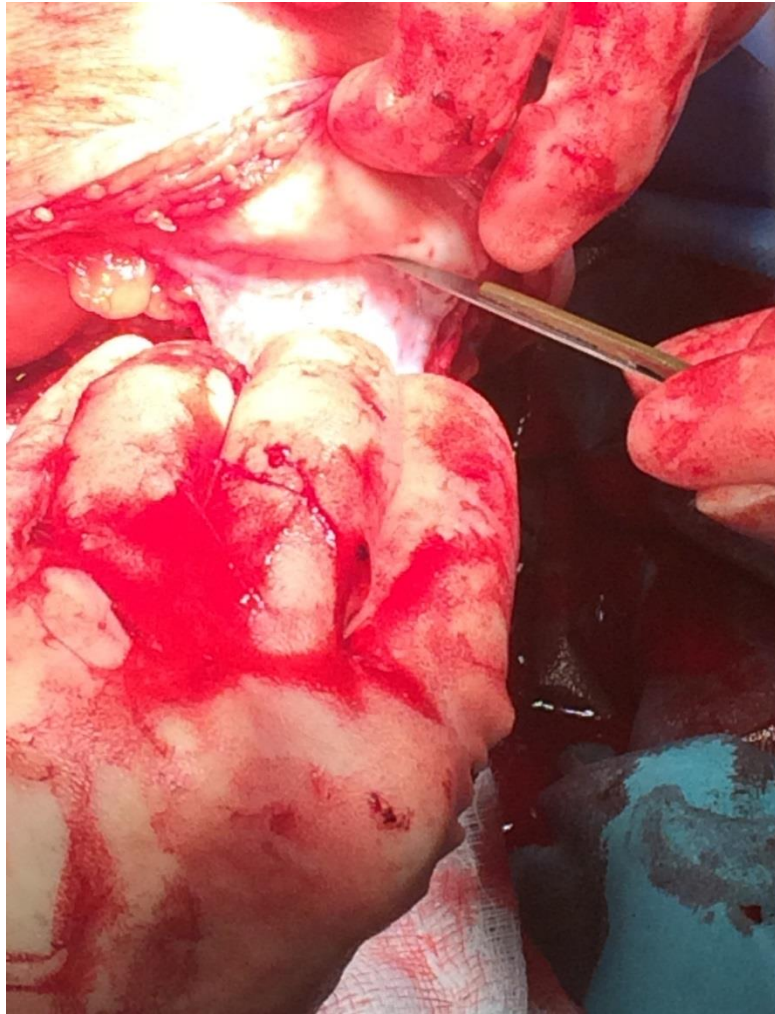


8 – Preparation of Cruciates



9 – Preparation of Patellar Tendon

East Lancashire Hospitals **NHS**
NHS Trust

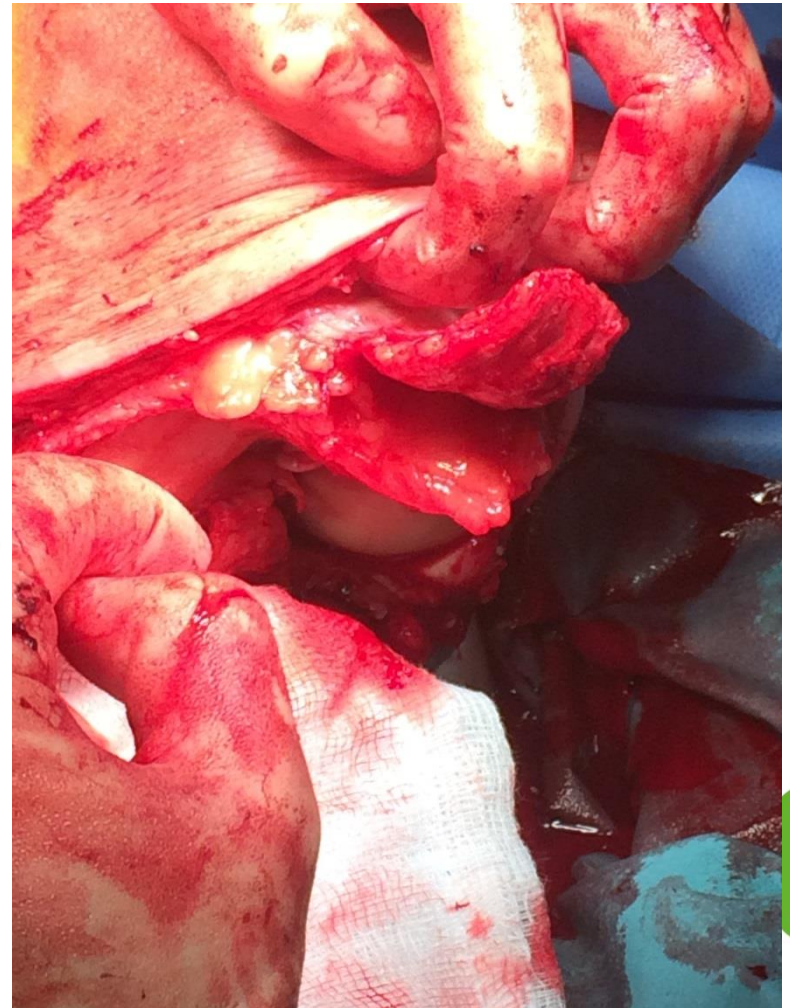
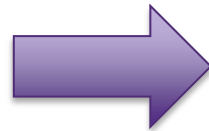
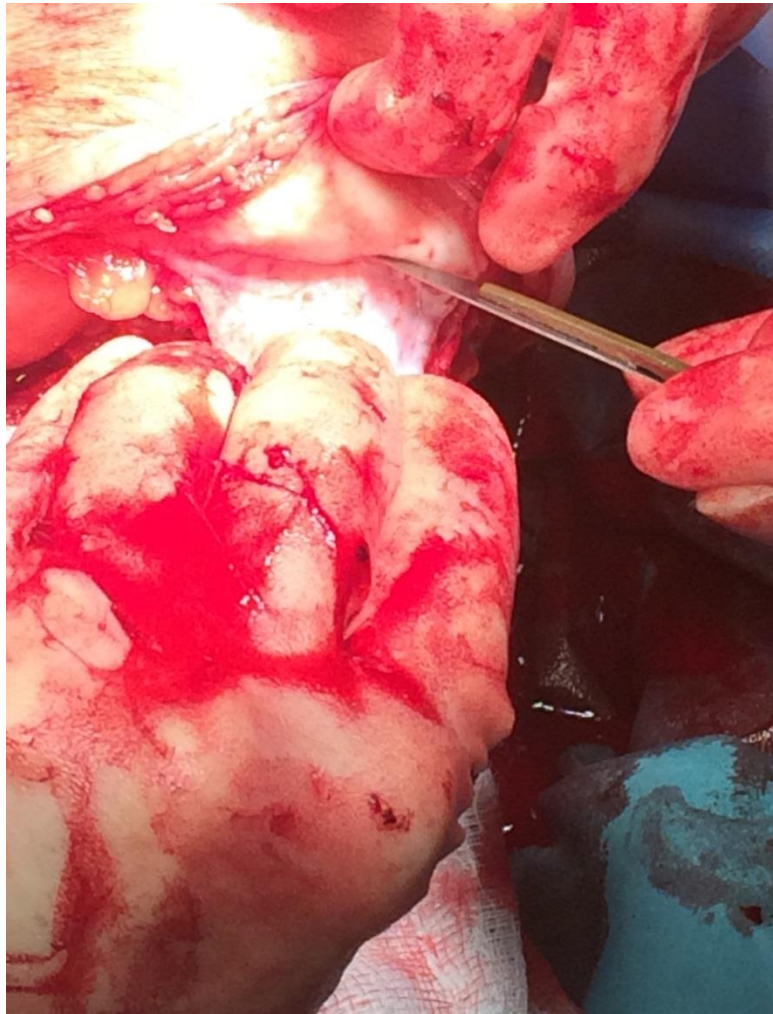


Safe | Personal | Effective



9 – Preparation of Patellar Tendon

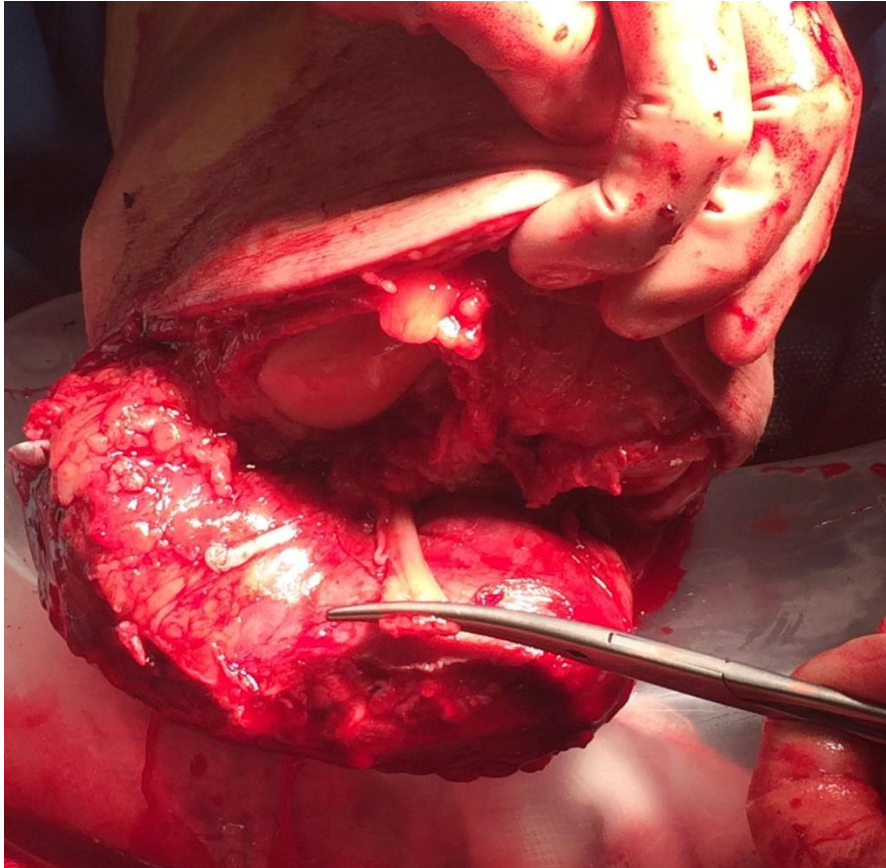
East Lancashire Hospitals **NHS**
NHS Trust



Safe | Personal | Effective

10 – Suturing of Patellar Tendon to Cruciate

East Lancashire Hospitals **NHS**
NHS Trust

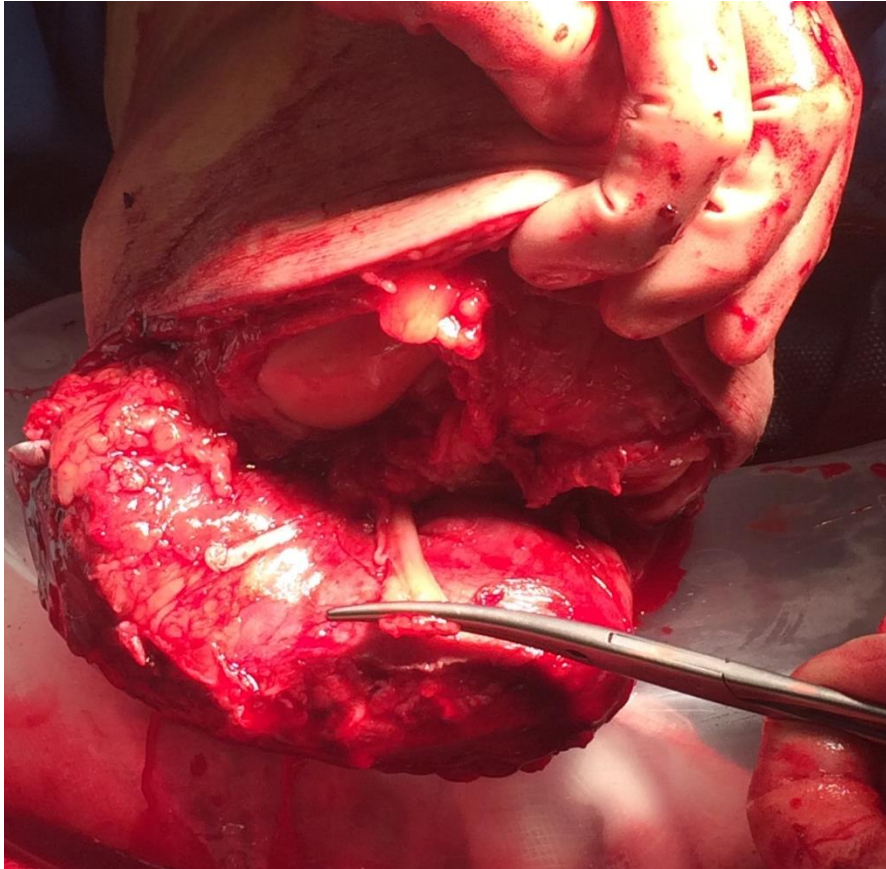


Safe | Personal | Effective



10 – Suturing of Patellar Tendon to Cruciate

East Lancashire Hospitals **NHS**
NHS Trust



Safe | Personal | Effective

11 – Fascial Layer Closure

East Lancashire Hospitals **NHS**
NHS Trust



Safe | Personal | Effective



12 – Skin Closure



Completion

East Lancashire Hospitals **NHS**
NHS Trust



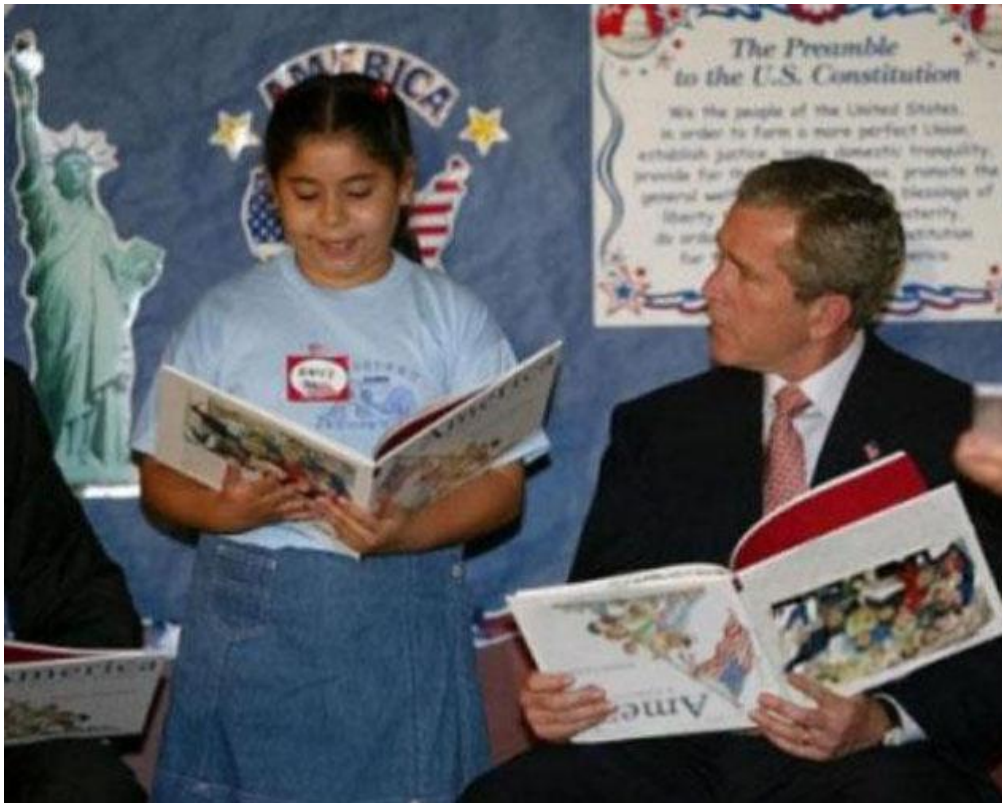


Tips and Tricks

- Pre-Operative Marking.
- Utilisation of Skew Flap Technique.
- Copious Betadine Lavage.
- Fastidious care of Fascial Layer.
- Perineural Infiltration Catheter.
- Subcuticular Closure – *Avoid Staples* and if concerned interrupted non-absorbent sutures.



How are we doing at ELHT ???



ELHT Amputation Annual Case Load

	ELECTIVE	EMERGENCY
2011	64	74
2012	84	57
2013	80	67
2014	83	57
2015	90	76
2016	90	56



ELHT Procedural Specific Case Volume

Procedural Volume	
Above Knee	163
Through Knee	3
Below Knee	136
Transmetatarsal	87
Great Toe	63
Other Toes	156




National Vascular Registry - MOD

Amputation Procedure

Record Status	Number of Records
All records	58
Submitted records	55
Submitted records with discharge date	55

Time Period: Start: 01/01/2012 

End (based on discharge date): 08/02/2017 

Run

Activity

Procedure Type	Elective	Non-Elective
Above/Thru knee amputation	5	15
Below knee amputation	3	7
Foot amputation	1	6
Toe(s) amputation	4	14
All	13	42



National Vascular Registry - MOD

Demographics

Variable	All Cases	Cases with Patient Data	Average Age	% Male	% Diabetes
Above/Thru knee amputation	20	20	73.29	75	30
Below knee amputation	10	10	62.54	40	90
Foot amputation	7	7	64.54	100	86
Toe(s) amputation	18	18	73.31	89	89
All	55	55	70.23	76	67

Outcomes

Variable	All Cases	Cases with Outcome Data	Return to theatre	Median LOS	% Referred to rehab/limb fitting *	In Hospital Deaths	Crude Mortality Rate
Above/Thru knee amputation	20	20	0	23	90	2	0.1
Below knee amputation	10	10	0	26	80	2	0.2
Foot amputation	7	7	4	39	100	0	0
Toe(s) amputation	18	18	1	22	44.44	6	0.33
All	55	55	5	25	74.55	10	0.18

*Referred to rehab/limb fitting uses a data item that was introduced in January 2014 and this percentage will be only accurate for tables based on procedures carried out after 01/01/2014.



National Vascular Registry - MOD

Demographics

Variable	All Cases	Cases with Patient Data	Average Age	% Male	% Diabetes
Above/Thru knee amputation	20	20	73.29	75	30
Below knee amputation	10	10	62.54	40	90
Foot amputation	7	7	64.54	100	86
Toe(s) amputation	18	18	73.31	89	89
All	55	55	70.23	76	67

Outcomes

Variable	All Cases	Cases with Outcome Data	Return to theatre	Median LOS	% Referred to rehab/limb fitting *	In Hospital Deaths	Crude Mortality Rate
Above/Thru knee amputation	20	20	0	23	90	2	0.1
Below knee amputation	10	10	0	26	80	2	0.2
Foot amputation	7	7	4	39	100	0	0
Toe(s) amputation	18	18	1	22	44.44	6	0.33
All	55	55	5	25	74.55	10	0.18

*Referred to rehab/limb fitting uses a data item that was introduced in January 2014 and this percentage will be only accurate for tables based on procedures carried out after 01/01/2014.



UK National Vascular Registry – 2014 to 2015

	Below knee	%	Above knee	%
Procedures	3,190		2,128	
Age group (years)				
Under 60	832	26.2	343	16.1
60 to 64	367	11.5	205	9.6
65 to 69	455	14.3	292	13.7
70 to 74	444	13.9	328	15.4
75 to 79	467	14.6	347	16.3
80 and over	622	19.5	613	28.8
Men	2,367	74.2	1,458	68.5
Women	823	25.8	670	31.5
Smoking				
Current	833	26.2	721	34.0
Ex-	1,548	48.6	1,056	49.8
Never	802	25.2	345	16.3
Presenting problem				
Acute limb ischaemia	313	9.8	481	22.6
Chronic limb ischaemia	596	18.7	481	22.6
Neuropathy	64	2.0	19	0.9
Tissue loss	1,271	39.9	754	35.5
Uncontrolled infection	933	29.3	368	17.3
Aneurysm	50	0.2	24	1.1
Previous ipsilateral limb procedure	2,001	62.8	1,311	61.7



UK National Vascular Registry – 2014 to 2015

	Below knee	%	Above knee	%
Procedures	3,190		2,128	
Age group (years)				
Under 60	832	26.2	343	16.1
60 to 64	367	11.5	205	9.6
65 to 69	455	14.3	292	13.7
70 to 74	444	13.9	328	15.4
75 to 79	467	14.6	347	16.3
80 and over	622	19.5	613	28.8
Men	2,367	74.2	1,458	68.5
Women	823	25.8	670	31.5
Smoking				
Current	833	26.2	721	34.0
Ex-	1,548	48.6	1,056	49.8
Never	802	25.2	345	16.3
Presenting problem				
Acute limb ischaemia	313	9.8	481	22.6
Chronic limb ischaemia	596	18.7	481	22.6
Neuropathy	64	2.0	19	0.9
Tissue loss	1,271	39.9	754	35.5
Uncontrolled infection	933	29.3	368	17.3
Aneurysm	50	0.2	24	1.1
Previous ipsilateral limb procedure	2,001	62.8	1,311	61.7



National Vascular Registry – Co-Morbidities

	Below knee	%	Above knee	%
Procedures	3,190		2,127	
ASA grade				
1 Normal	18	0.6	6	0.3
2 Mild disease	404	12.7	133	6.3
3 Severe, not life-threatening	2,222	69.7	1,293	60.8
4-5 Severe, life-threatening, or moribund patient	544	17.0	695	32.7
Comorbidities				
None	263	8.2	210	9.9
Hypertension	1,904	59.7	1,324	62.2
Ischaemic heart disease	1,201	37.7	908	42.7
Diabetes	2,157	67.6	873	41.0
Stroke	297	9.3	322	15.1
Chronic lung disease	444	13.9	551	25.9
Chronic renal disease	709	22.2	398	18.7
Chronic heart failure	268	8.4	230	10.8
Medication				
None	299	9.4	220	10.3
Anti-platelet	2,292	71.9	1,538	72.3
Statin	2,319	72.7	1,496	70.3
Beta blocker	836	26.2	564	26.5
ACE inhibitor/ARB	1,086	34.0	672	31.6

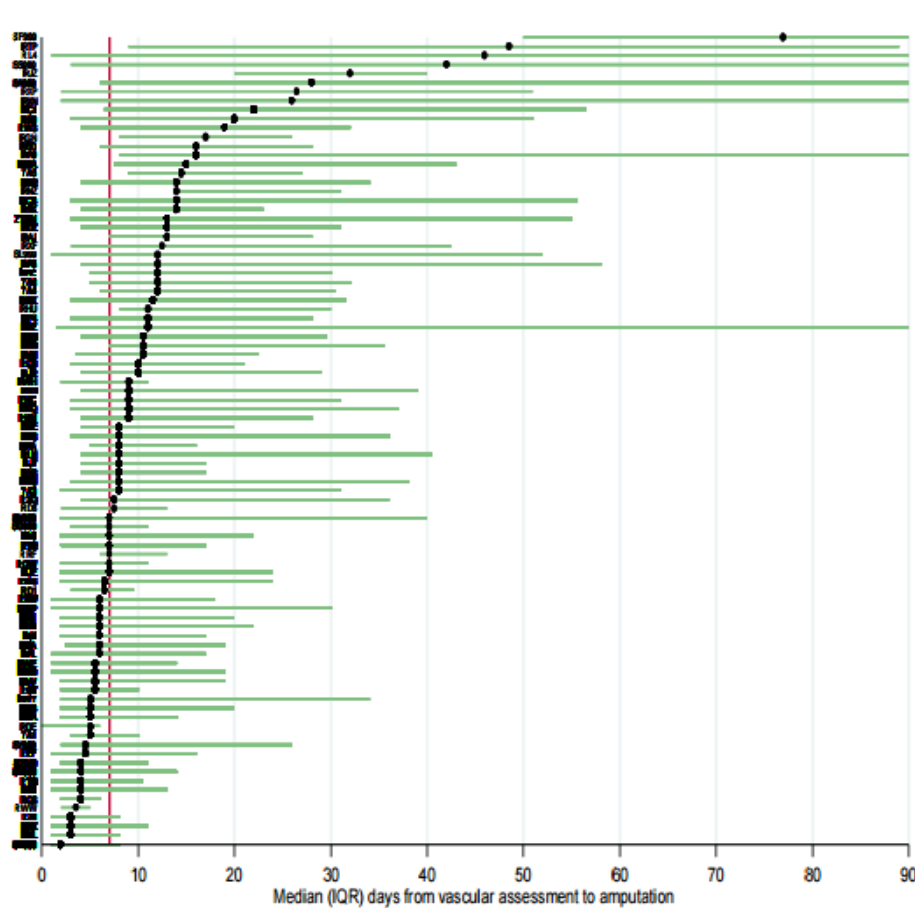


National Vascular Registry – Co-Morbidities

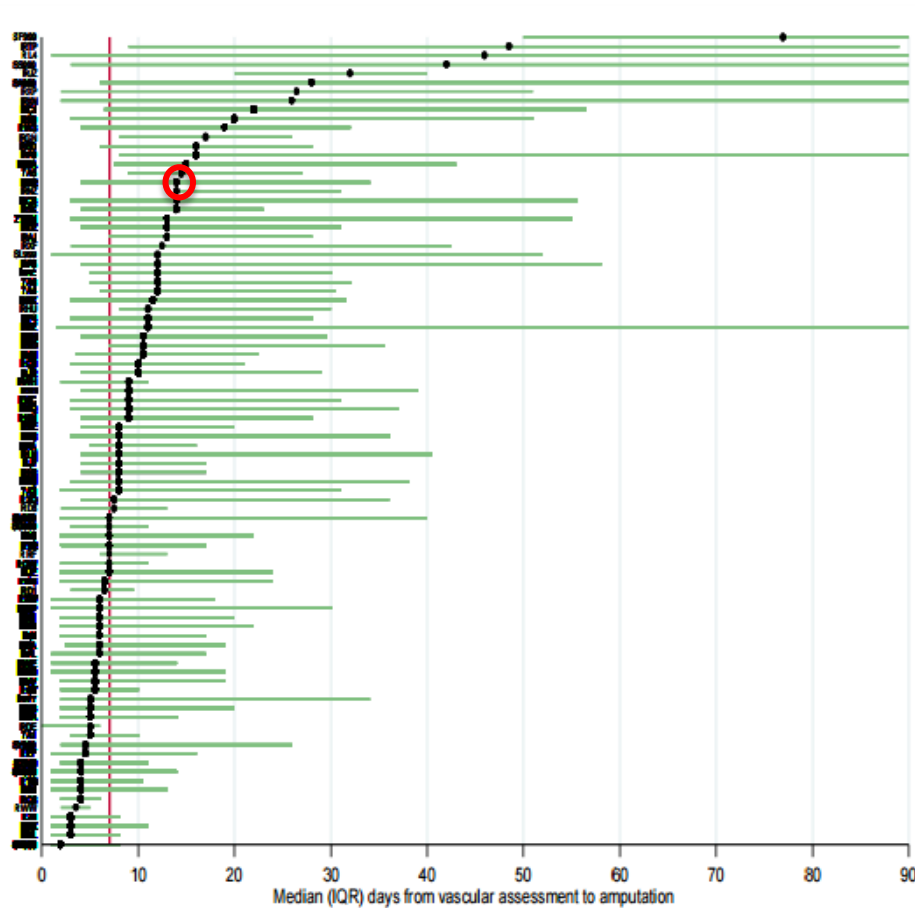
	Below knee	%	Above knee	%
Procedures	3,190		2,127	
ASA grade				
1 Normal	18	0.6	6	0.3
2 Mild disease	404	12.7	133	6.3
3 Severe, not life-threatening	2,222	69.7	1,293	60.8
4-5 Severe, life-threatening, or moribund patient	544	17.0	695	32.7
Comorbidities				
None	263	8.2	210	9.9
Hypertension	1,904	59.7	1,324	62.2
Ischaemic heart disease	1,201	37.7	908	42.7
Diabetes	2,157	67.6	873	41.0
Stroke	297	9.3	322	15.1
Chronic lung disease	444	13.9	551	25.9
Chronic renal disease	709	22.2	398	18.7
Chronic heart failure	268	8.4	230	10.8
Medication				
None	299	9.4	220	10.3
Anti-platelet	2,292	71.9	1,538	72.3
Statin	2,319	72.7	1,496	70.3
Beta blocker	836	26.2	564	26.5
ACE inhibitor/ARB	1,086	34.0	672	31.6



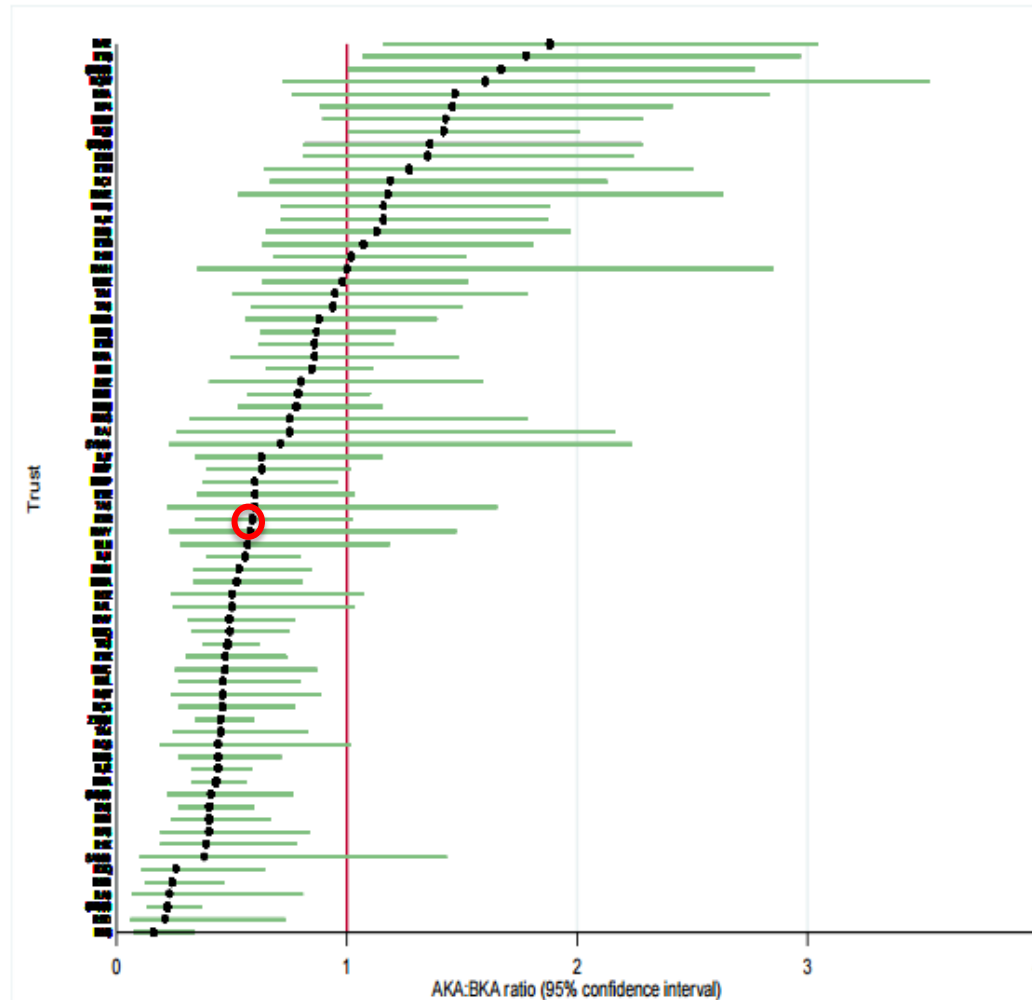
National Vascular Registry – Time to Surgery



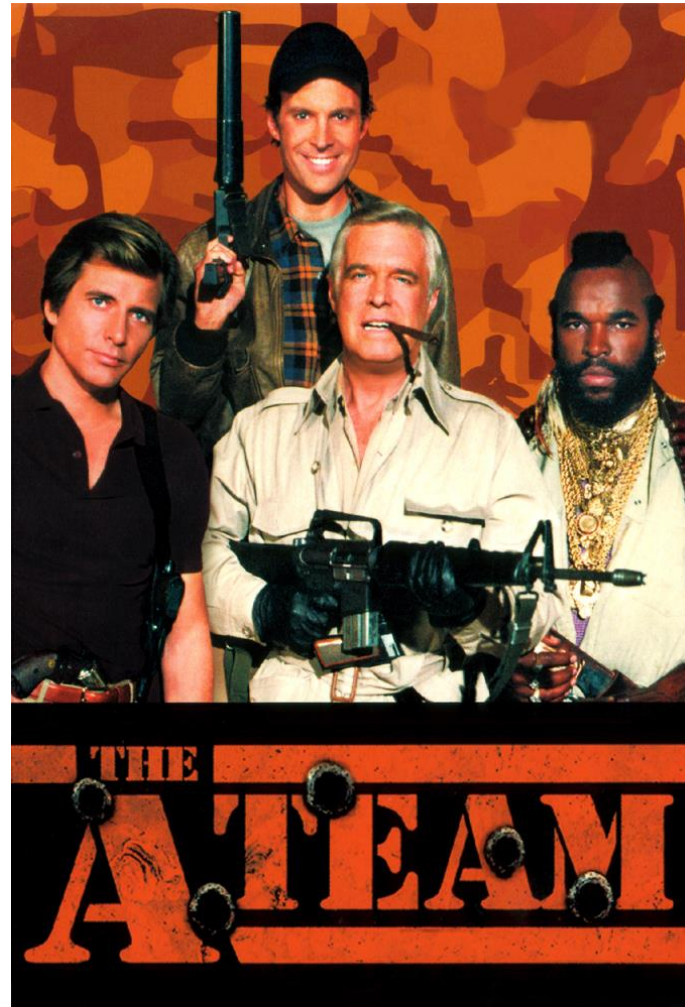
National Vascular Registry – Time to Surgery



National Vascular Registry – AKA: BKA Ratio



Future Care – LASER Team



Safe | Personal | Effective



LASER Team Conception

- Multidisciplinary Team Approach.
 - Specialised Vascular Services, NHS England 2014.
- Specialised Care Providers **with Passion.**
- Recognition of Patient Flow.
- Open Communication.
- Ability to influence management quickly.



LASER Team Recruitment

- Senior Podiatry Staff; Gill Lomax, Carl Kenright and Peter Reston.



LASER Team Recruitment

- Senior Podiatry Staff; Gill Lomax, Carl Kenright and Peter Reston.
- Senior Specialist Nursing Staff; Sister Sue Kenny and Trainee Advanced Nurse Practitioner Nurse Natalie Grady.



LASER Team Recruitment

- Senior Podiatry Staff; Gill Lomax, Carl Kenright and Peter Reston.
- Senior Specialist Nursing Staff; Sister Sue Kenny and Trainee Advanced Nurse Practitioner Nurse Natalie Grady.
- Diabetologist with an Interest in Complex Diabetic Foot Management; Dr Malcolm Littlely.



LASER Team Recruitment

- Senior Podiatry Staff; Gill Lomax, Carl Kenright and Peter Reston.
- Senior Specialist Nursing Staff; Sister Sue Kenny and Trainee Advanced Nurse Practitioner Nurse Natalie Grady.
- Diabetologist with an Interest in Complex Diabetic Foot Management; Dr Malcolm Littlely.
- Orthopaedic Surgeon with a Diabetic Foot Interest; Mr Jim Barrie.



LASER Team Recruitment

- Senior Podiatry Staff; Gill Lomax, Carl Kenright and Peter Reston.
- Senior Specialist Nursing Staff; Sister Sue Kenny and Trainee Advanced Nurse Practitioner Nurse Natalie Grady.
- Diabetologist with an Interest in Complex Diabetic Foot Management; Dr Malcolm Littlely.
- Orthopaedic Surgeon with a Diabetic Foot Interest; Mr Jim Barrie.
- Vascular Surgeon with an Interest in Limb Salvage; Mr Mark O'Donnell.



LASER Team Recruitment

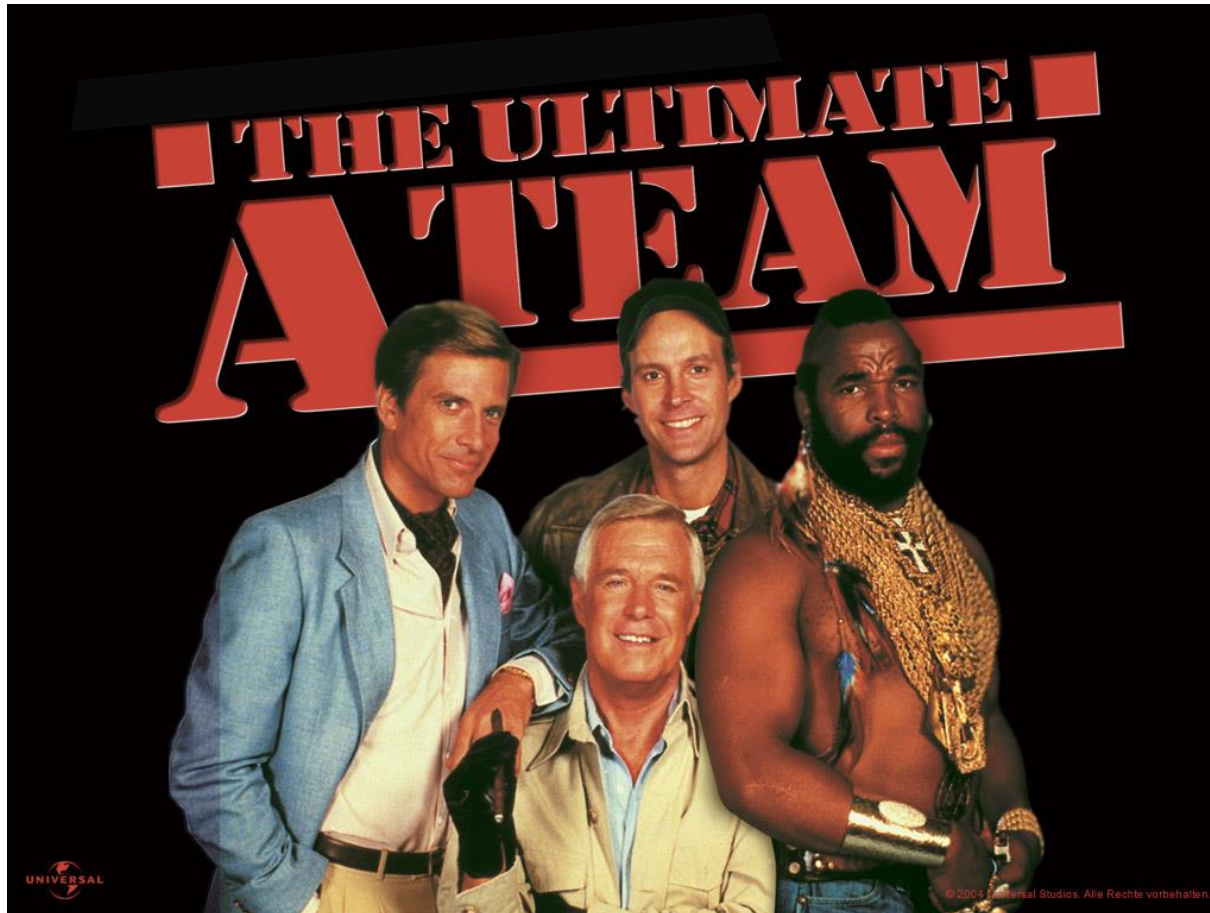
- Senior Podiatry Staff; Gill Lomax, Carl Kenright and Peter Reston.
- Senior Specialist Nursing Staff; Sister Sue Kenny and Trainee Advanced Nurse Practitioner Nurse Natalie Grady.
- Diabetologist with an Interest in Complex Diabetic Foot Management; Dr Malcolm Littlely.
- Orthopaedic Surgeon with a Diabetic Foot Interest; Mr Jim Barrie.
- Vascular Surgeon with an Interest in Limb Salvage; Mr Mark O'Donnell.
- Microbiologist; Dr Ruth White.



LASER Team Evolution

- Training / Education;
 - Orthopaedic Specialist Nurses.
 - Endocrinology Trainees.
 - Medical Trainees.
 - Vascular Surgery Trainees.
 - Nursing staff education.





What do we actually do???

- Patient Identification.
- Prioritisation Logistics.
- Clinical Review at Bedside – NOT AROUND A DESK.
- Expedited Care Management.
- Expert Review.



What do we actually do???

- Patient Identification;
 - Point of contact referral from podiatry / specialist nurse / vascular laboratory.
 - Real-time email correspondence.
 - Ward referral.



What do we actually do???

- Patient Identification.
- Prioritisation Logistics;
 - Most at risk patients.
 - LASER round ward attendance flow.



What do we actually do???

- Patient Identification.
- Prioritisation Logistics.
- Clinical Review;
 - Limb exposure.
 - Diabetic medical review and optimisation of co-morbidities.
 - Orthopaedic clinical and radiological evaluation.
 - Vascular assessment including bedside Doppler.



What do we actually do???

- Patient Identification.
- Prioritisation Logistics.
- Clinical Review.
- Expedited Care Management;
 - Bedside dressing optimisation / wound debridement / offloading.
 - Microbiological sampling – tissue and bone.
 - Pharmacological optimisation.
 - Same day vascular laboratory evaluation.
 - Radiological / surgical intervention within 24 hours.
- Expert Review.



What do we actually do???

- Patient Identification.
- Prioritisation Logistics.
- Clinical Review.
- Expedited Care Management.
- Expert Review;
 - Email summary of decision processes.
 - Vascular MDT discussion.
 - Diabetic / orthopaedic pathway.
 - Diabetic / vascular pathway.
 - Cross-over frequent.



Review of Practice

- Once weekly LASER round of 1 hour duration.
- 2-4 acute lower limbs.
- 56 patients managed – October 2015 to April 2016.
 - Male=46, Female=10.
 - Mean age 70 (range 28-92) years.
- Arterial assessments within 24 hours.
- Radiological / Surgical Intervention within 48 hours.



Future Aspirations

- Business Plan.
- Increased frequency of service.
- Education .
- Out-patient / Community expansion.



Future Aspirations

- Business Plan.
- Increased frequency.
- Education.
- Out-patient / Community expansion.

Fewer Amputations.



Questions ?



Safe | Personal | Effective

