Minor Amputation Levels For Limb Salvage

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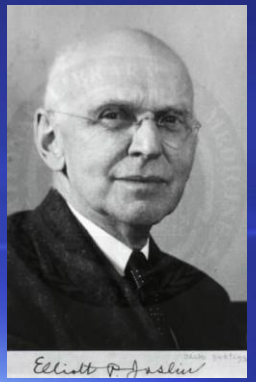
Author Disclosures:

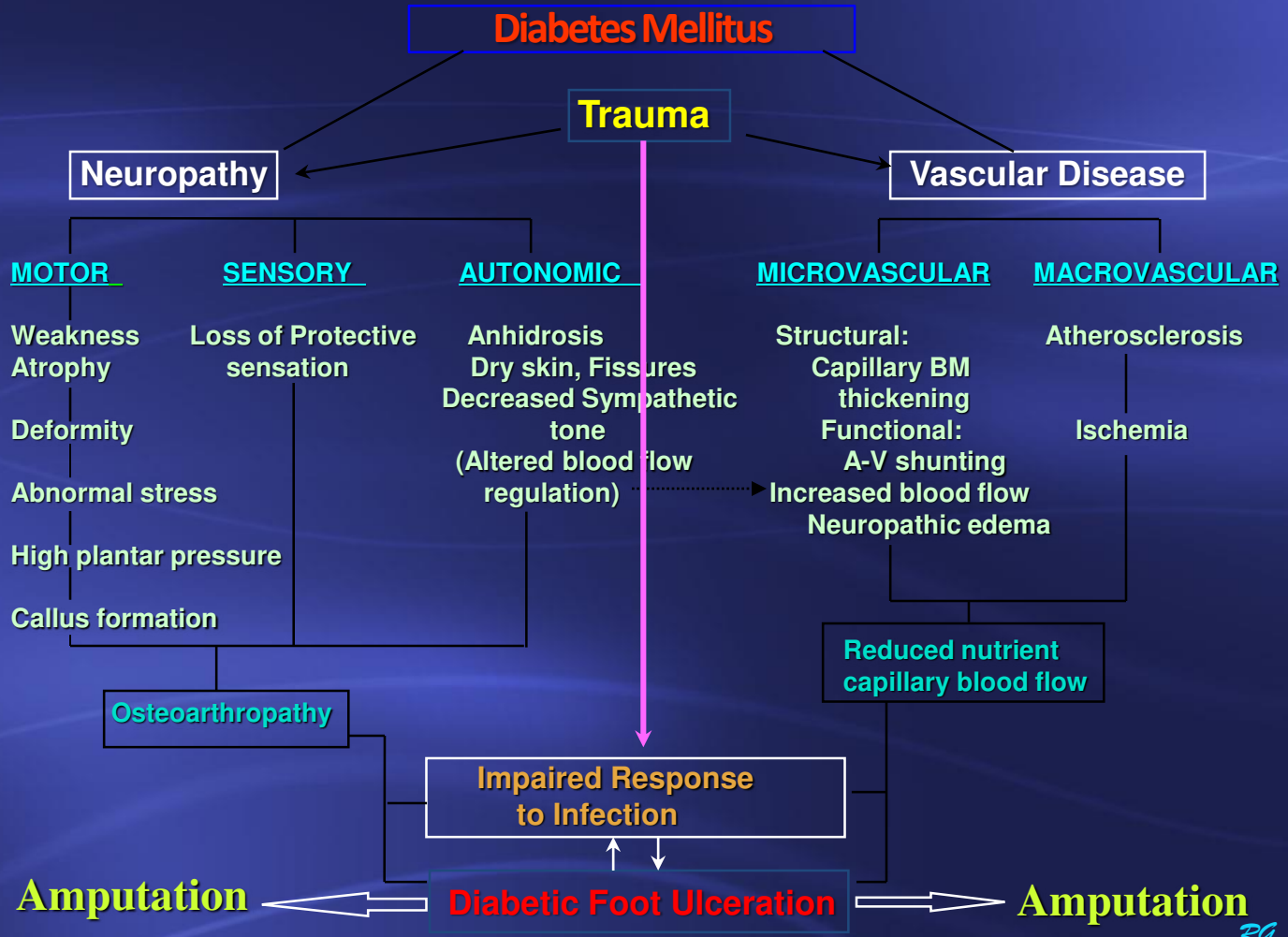
- Nothing to disclose for this presentation

“Diabetic gangrene has been increasing as a menace to my patients”

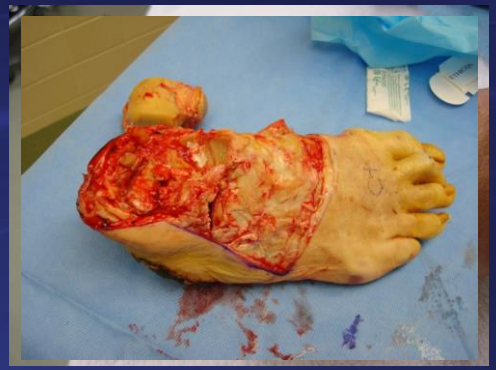


1869-1962

Elliott P. Joslin, M.D.
“The Menace of Diabetic Gangrene”
NEJM Vol 211:No 1;16-20, July 5, 1934


Diabetes Mellitus
Trauma
Neuropathy
Vascular Disease
MOTOR
SENSORY
AUTONOMIC
MICROVASCULAR
MACROVASCULAR
Weakness
Atrophy
Deformity
Abnormal stress
High plantar pressure
Callus formation
Loss of Protective sensation
Anhidrosis
Dry skin, Fissures
Decreased Sympathetic tone
(Altered blood flow regulation)
Structural:
Capillary BM thickening
Functional:
A-V shunting
Increased blood flow
Neuropathic edema
Atherosclerosis
Ischemia
Reduced nutrient capillary blood flow
Osteoarthropathy
Impaired Response to Infection
Amputation
Diabetic Foot Ulceration
Amputation

Stairway to Amputation



Amputation

Gangrene

Infection

Wound

Injury

Neuropathy
± PAD

High Risk Foot

Opportunities for amputation prevention

After Rogers 2010

Differences in minor amputation rate in diabetic foot disease throughout Europe are in part explained by differences in disease severity at presentation

van Battum, Schaper, Prompers et al: Diabet Med:199 (2011)

- Eurodiale study, N=1232 patients with new DFU
  Followed up to 1 yr
- Results
  - 194 Minor amps (18%)


Article: Complications
Differences in minor amputation rate in diabetic foot disease throughout Europe are in part explained by differences in disease severity at presentation

	OR	95% CI	P-value	Coefficient (log OR)	Score*
Male sex	1.42	0.99–2.04	0.056	0.351	4
Deep ulcer	6.08	4.10–9.03	<0.001	1.805	18
Infection	1.56	1.05–2.30	0.027	0.445	5
Peripheral artery disease	1.84	1.30–2.60	0.001	0.610	6

*A score was attributed to each independent predictor by multiplying the logistic regression coefficient by 10 rounded to the nearest integer. For each patient, a disease severity score can then be computed by adding the scores of each of the four characteristics if present.

Independent predictors of minor amputation and scoring rule

Assessing the Long-Term Outcomes of Minor Lower Limb Amputations: A 5-Year Study

Uzzaman et al: Angiology 2011, 62(5) 365-371

- Retrospective study 126 *Minor amp* patients

  Mean age 70 yrs (92 Digits 14 ray 20 TMA)

  DM (group A) n=79 NDM (Grp B) n=47

- Overall 5 yr Mortality: 27% (37/126)
  - 58% of deaths in 1st year
  - Greater in NDM group (n.s.)

Assessing the Long-Term Outcomes of Minor Lower Limb Amputations: A 5-Year Study

Mohammed Mohsin Uzzaman, MBBS, MRCS, MSc[1], Saud Jukaku, MBBS[1], Amir Kambal, FRCS, DIC, MEd, and Syed Tahir Hussain, MD, FRCS[1]

Abstract

Our aim was to assess the long-term outcome for minor forefoot amputations. A retrospective study of 126 patients who had such amputations between 1999 and 2004 was performed. Patients were divided into 2 groups, diabetic (group A; 79 patients) and nondiabetic (group B; 47 patients). Angiograms were requested in 45 patients in group A compared with 31 patients in group B ($P = .77$). In group A, 11 patients underwent further ipsilateral amputations compared with 30 patients in group B ($P = .02$). The 2 groups were equally likely to have vascular reconstruction (35% vs 37%). The overall 5-year mortality was 27%, with 58% of deaths occurring within the first year. This study shows that foot amputees have high mortality and reintervention rates. Adequate utilization of vascular services, extra vigilance in the prevention of complications, and risk factor modifications are required to improve postoperative outcomes.

Keywords

toe, transmetatarsal, amputation, minor amputation, outcome, north London

Introduction

Amputation was first performed by the Hammurabi tribe in Babylon, as a form of punishment.[1] It was then implemented in clinical practice by Hippocrates in order to save a life.[2] Since then amputation has remained an important part of surgical practice. Diabetic patients are more likely to need a lower extremity amputation, and it is estimated that almost 50% of nontraumatic amputations occur in these patients.[3] The remainder of patients usually undergo amputations due to extensive, irreversible peripheral arterial disease (PAD). Long-standing diabetes causes ischemia and sensory neuropathy.[3] This results in trauma, ulceration, infection, and gangrene formation, especially around the toes.[4] Foot problems are the commonest cause of diabetes-induced hospital stay.[5] After an amputation, diabetic patients are at increased risk of morbidity (eg, poor wound healing) and mortality. There are also reports of higher revision and reamputation rates to a more proximal level in diabetic patients.[6] As a result, there have been recommendations such as the St Vincent's Declaration that aim to reduce the rate of amputations in diabetic patients.[7] This is through improvements in multidisciplinary foot care, "amputation prevention programs," better glycemic control, and lifestyle changes. In addition, better investigation and treatment of concomitant vascular disease has made it possible to perform limb salvage through revascularization and "minor" amputations. Unlike major limb amputations, a "minor" amputation is a less disabling procedure.

The long-term outcomes of major amputations have been described with 5-year survival rates of 30% to 40%.[8] The main causes of death after a major amputation are due to concomitant comorbid conditions such as ischemic heart disease (IHD), stroke, and renal impairment. Conversely, the long-term outcome of minor amputation is currently debatable. We were only able to find one study in the literature, which looked at the long-term outcomes after minor amputation—reporting 1-year and 5-year mortality rates of 16.1% and 56.5%, respectively.[9] Therefore, we assessed the population profile, management, and outcome of minor amputations at a London teaching hospital. We considered whether the improvements in vascular services, diagnostic modalities, and a multidisciplinary approach improved the outcomes of minor amputations. We also compared outcomes in diabetic and nondiabetic patients.

Materials and Methods

Patients who had a primary minor amputation between January 1999 and December 2004 were retrospectively identified.

[1]Vascular Surgery, Northwick Park University Hospital, London, United Kingdom

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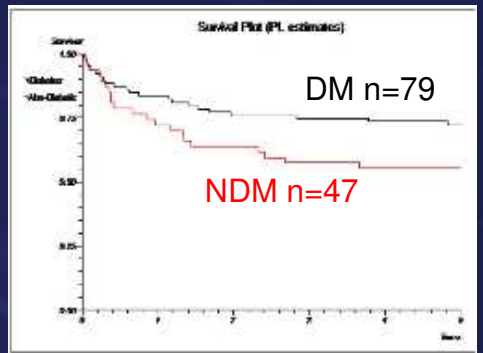


Minor amputation in patients with diabetes mellitus and severe foot ulcers achieves good outcomes

Svensson et al: Journal of Wound Care, June 2011

- N=410 consecutive minor amps (309 pts) in defined DM Swedish population over 25 yr period Median age 73 (32-93) yrs
  - 94% with deep infection (39%) and /or gangrene (55%)
  - 61% with severe PAD or CLI
  - 19% died before healing
- Results
  - 79% of surviving pts healed below ankle level
    - Median healing time 26 (2-250) weeks
    - 21% required re-amputation above ankle
  - None of the analyzed parameters *excluded* healing at below ankle level


research

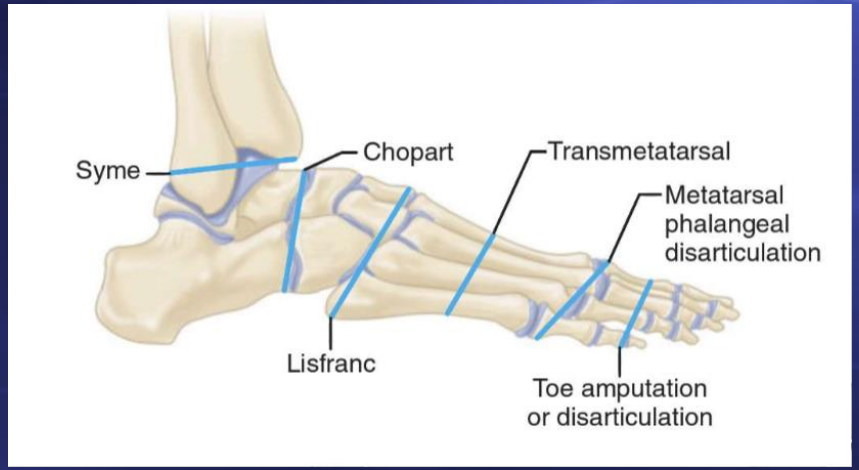
Minor amputation in patients with diabetes mellitus and severe foot ulcers achieves good outcomes

Indications for Diabetic LEA

- Fulminant infection / Chronic osteomyelitis
- Gangrene or chronic ulceration
- Extensive tissue loss
- Non-reconstructable ischemia
- Severe deformity or instability

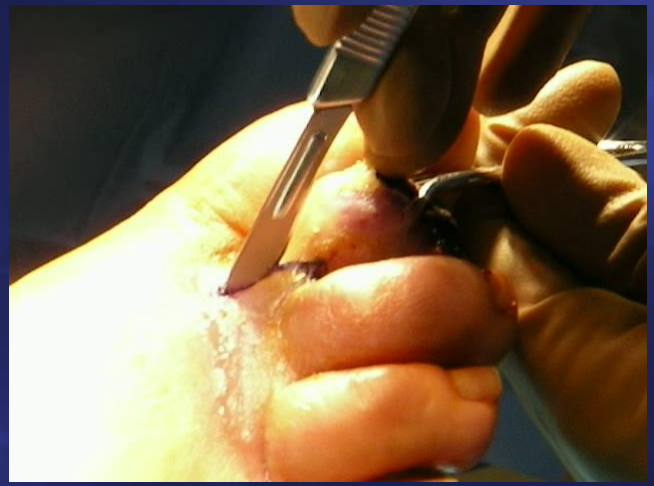
Foot / Leg Sparing Amputations

- Lesser toe
- Hallux
- Ray (1st and lesser)
- Transmetatarsal (TMA)
- Chopart's
- Boyd
- Pirogoff
- Syme's



Foot / Leg Sparing Amputations

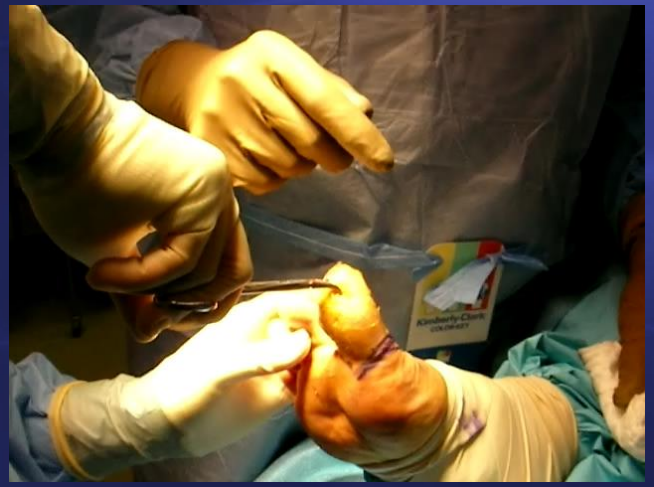
- **Lesser toe Amputations**
  - Intraphalangeal
  - Joint disarticulation
- **Indications**
  - Gangrene of toe not involving MTP joint
  - Osteomyelitis
  - Recalcitrant ulcer in presence of ischemia



Foot / Leg Sparing Amputations

- Hallux Amputations
  - Intraphalangeal
  - Joint disarticulation

- Indications
  - Gangrene of Hallux not involving MTP joint
  - Osteomyelitis
  - Recalcitrant ulcer in presence of ischemia



Three-Year Morbidity and Mortality Rates After Nontraumatic Transmetatarsal Amputation

Adams, Edinger, Weintraub, Pollard: *J Foot Ankle Surg (2018) 967–971*

Retrospective chart review: TMA 3/ 2007 to 1/ 2012 (**n = 375**)

- 3-year mortality, proximal limb amputation, and lack of healing.

Results:

- 136 (36
- 138 (36 …utation
- 83 (22.
- Nonpal
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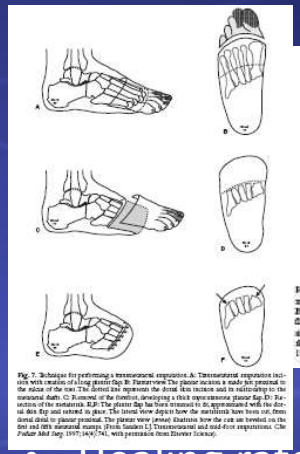
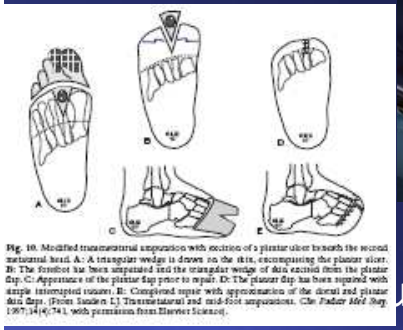
  - Faile
  - Deat
- ESRD (a …eath

Transmetatarsal Amputation (TMA)

Popularized by McKittrick: Ann Surg 1949





- Healing rates between 50% and 74%
- Postoperative Complications as high as 87%

Sanders 2007
Younger 2009
Boffeli 2016

Rear Foot Amputations

- Lisfranc's
- Chopart's
- Pirogoff
- Boyd
- Syme

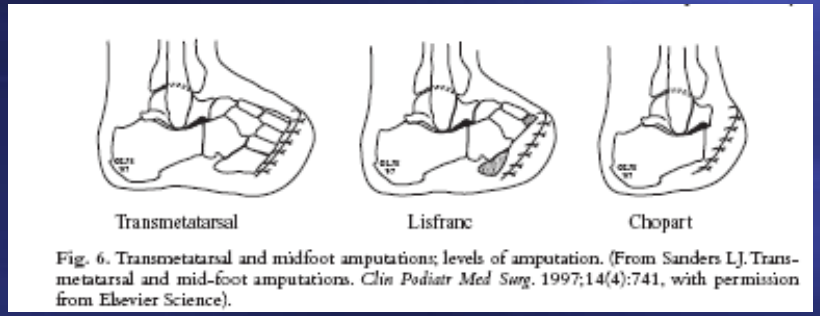


Fig. 6. Transmetatarsal and midfoot amputations; levels of amputation. (From Sanders LJ. Transmetatarsal and mid-foot amputations. *Clin Podiatr Med Surg.* 1997;14(4):741, with permission from Elsevier Science).

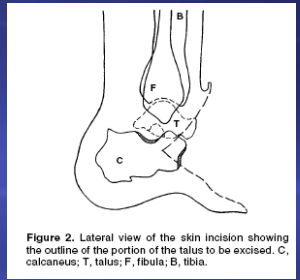
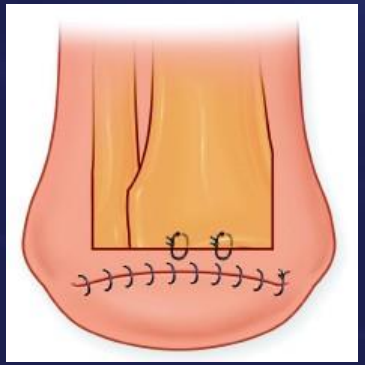
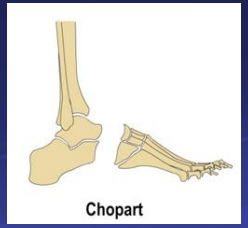
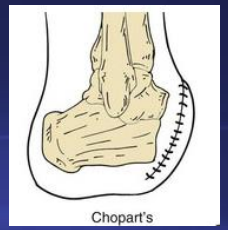


Figure 2. Lateral view of the skin incision showing the outline of the portion of the talus to be excised. C, calcaneus; T, talus; F, fibula; B, tibia.



Chang 1994
Sanders 1997
Pinzur 2003
Evans 2011





Chopart Amputation

- Reserved for extensive tissue loss of forefoot
- Osteomyelitis of forefoot, midfoot
- Resection of forefoot at Midtarsal Joint
  - Talo-Navicular Joint and Calcaneo-cuboid joint
  - Requires a fairly long plantar flap
  - *Must* perform Achilles Tenotomy / Tenectomy
    - Avoid severe ankle equinus
- Must use Prosthesis/ Ankle Foot Orthosis

Chang et al JVS 1994
Faglia et al: JFAS 2016

SUMMARY

- Minor amputations are critical components of care for the acute or chronic diabetic foot
- Infection, gangrene, and osteomyelitis with or without ischemia most frequent indications
- Frequently staged procedures (to control infection) and often need revision




"… it has been forced upon me that gangrene is not Heaven-sent but is earth-born."

Elliott P. Joslin, MD

"The Menace of Diabetic Gangrene"

NEJM 211:16-20, 1934

Thank You!

Robert G. Frykberg, DPM, MPH, MAPWCA
rfrykberg@dmprevent.com

DMPREVENT Improving Outcomes. Changing Lives.

Diabetes, Lower-Extremity Amputation, and Death

Hoffstad, Mitra, Margolis :Diabetes Care 2015:1852–1857

- Longitudinal cohort study : The Health Improvement Network (THIN).
  - N=416, 434 6,566 (1.6%) LEA 77,215 Deaths
- Primary exposure was LEA : outcome was all-cause death

- All cause death after an LEA (vs No LEA) :
  - HR 2.37 (2.27, 2.48) Fully adjusted


Diabetes, Lower-Extremity Amputation, and Death

"Indivi d a lie at any given w LEA.. "

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research

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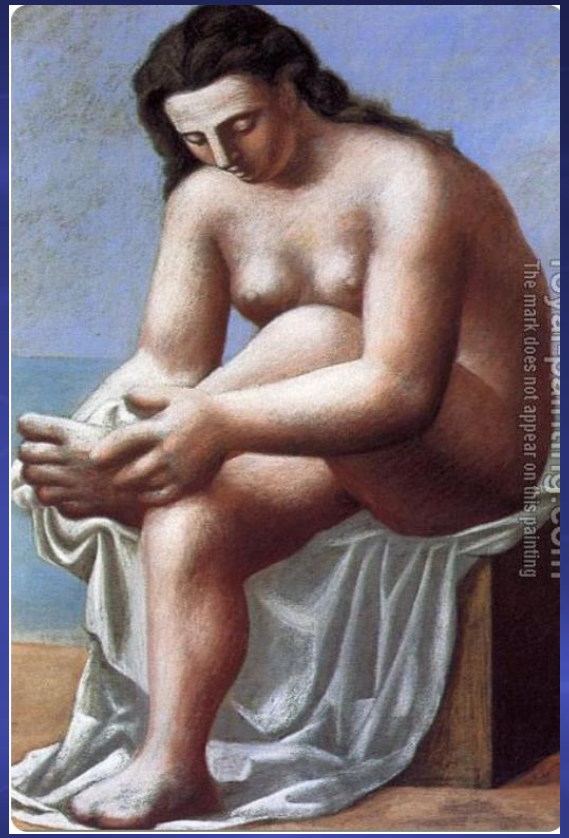
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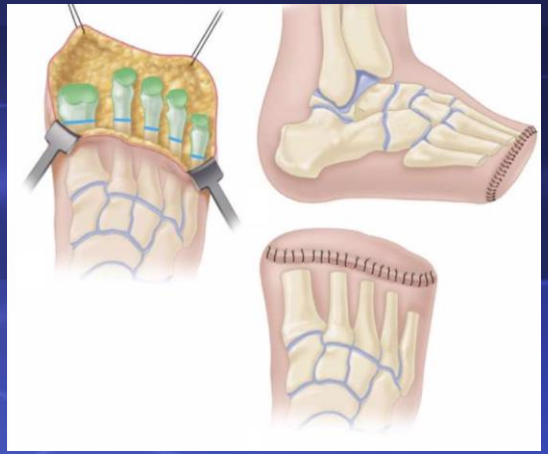
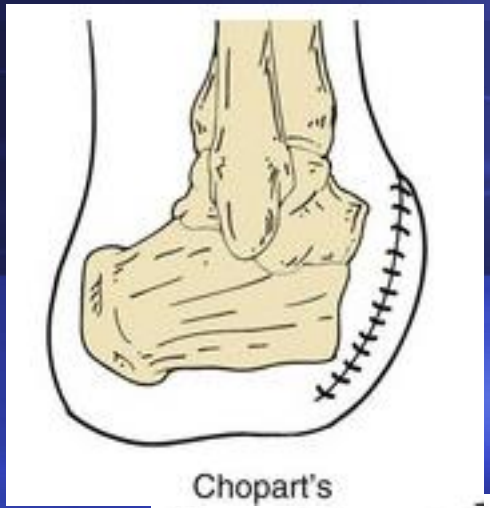
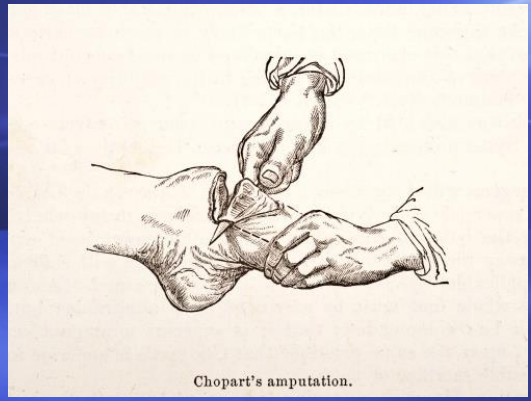
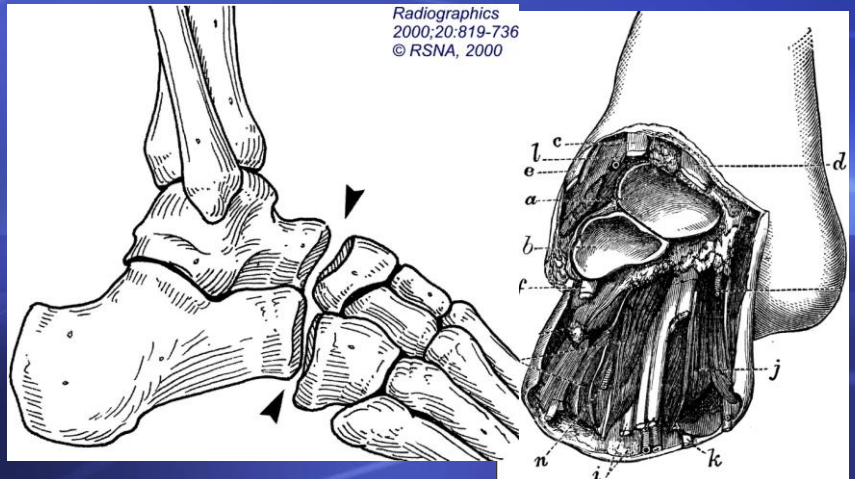


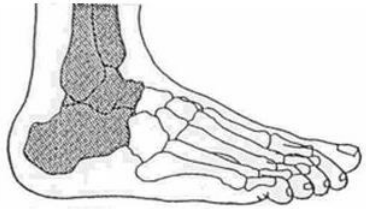


Chopart's

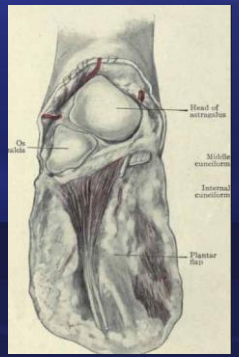




Chopart Amputation



Midtarsal (Transverse tarsal)
(Preserve the Talus & Calcaneum)



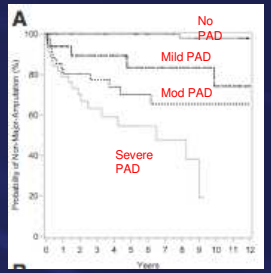
Long Term Prognosis of Diabetic Foot Patients and Their Limbs

Morbach, Furchert, Groblinghoff et al: Diabetes Care 35:2021, 2012

- 10 yr prospective f/u of 247 DFU patients without prior major amputation in a single German diabetes center
  - Mean age 68.8 yrs, DM duration 15.7 yrs, 87.5% T2DM

Results:

- A first major amputation occurred in 38 patients (15.4%)
- All but one of these pts had evidence of PAD at entry
  - 51.4% had severe PAD [ankle- brachial pressure index ≤0.4]).
- Multivariate Predictors of first major amputation: (HR, [95% CI])
  - Age (per year) 1.05 [1.01–1.10]
  - Hemodialysis 3.51 [1.02–12.07]
  - PAD 35.34 [4.81–259.79]



Foot Complications and Mortality
Results from Translating Research Into Action for Diabetes (TRIAD)

L McEwen, K Ylitalo, M Munson, W Herman, J Wrobel: JAPMA 106(1): 7-14, 2016

- Prospective Observational Study N=6,992 DM pts.
- 10 years of follow-up (2000-2009)

Table 2. Unadjusted and Adjusted Cox Proportional Hazards Models Predicting All-Cause Mortality

	HR (95% CI)	
Complication	Unadjusted	Fully Adjusted[a]
Charcot's neuro-osteoarthropathy	1.87 (1.24–2.81)	1.25 (0.72–2.16)
Diabetic foot ulcer	1.93 (1.56–2.39)	1.18 (0.86–1.62)
Lower-extremity amputation	3.21 (2.50–4.12)	1.84 (1.28–2.63)

ORIGINAL ARTICLES

Foot Complications and Mortality

Results from Translating Research Into Action for Diabetes (TRIAD)

CN= 55 (1%)
DFU = 205 (3%)
LEA = 101 (1.4%)

Long Term Prognosis After Healed Amputation in Patients with Diabetes
Larsson et al: CORR, 1998

Although healing minor amputations takes 3 x longer than major amps, the long term results are more favorable than are those for patients who undergo major amputation

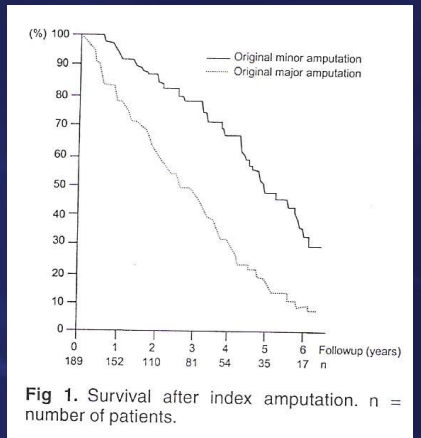


Fig 1. Survival after index amputation. n = number of patients.

Assessing the Long-Term Outcomes of Minor Lower Limb Amputations: A 5-Year Study

Uzzaman et al: Angiology 2011, 62(5) 365-371

- Retrospective study 126 *Minor amp* patients

  Mean age 70 yrs (92 Digits 14 ray 20 TMA)
- DM (group A) n=79 NDM (Grp B) n=47
  - PAD 42 (53%) vs 10 (21%) p=.02
  - Renal Failure 9(11%) vs 2 (4%) p=.04
  - Re-amp 11 (14%) vs 30 (64%) p= .02
  - Revascularized 35 vs 37 (n.s.)
- Overall 5 yr Mortality: 27% (37/126)
  - 58% of deaths in 1st year
  - Greater in NDM group (n.s.)

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[1]Vascular Surgery, Northwick Park University Hospital, London, United Kingdom

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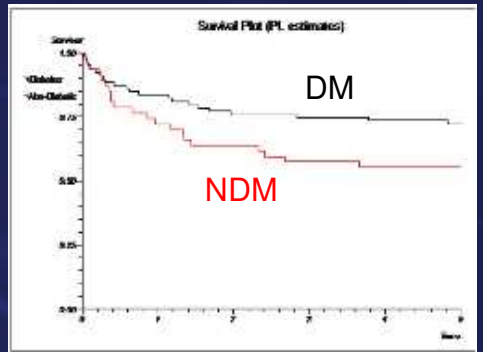
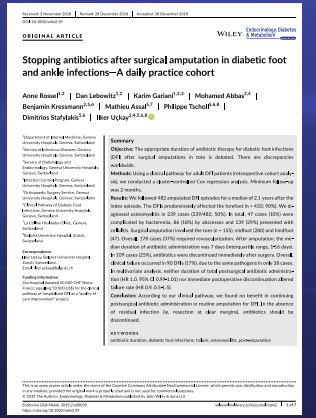


Stopping antibiotics after surgical amputation in diabetic foot and ankle infections—A daily practice cohort

A Rossel, D Lebowitz, K Gariani et al: *Endocrinol Diab Metab.* 2019

- **Objective:** The appropriate duration of antibiotic therapy for diabetic foot infections (DFI) after surgical amputations in toto is debated. There are discrepancies worldwide.
- **Results:**
  We followed 482 amputated DFI episodes for a median of 2.1 years after the index episode.
- The DFIs predominately affected the forefoot (n = 433; 90%).
- We diagnosed osteomyelitis in 239 cases (239/482; 50%).
- In total, 47 cases (10%) were complicated by bacteremia, 86 (18%) by abscesses and 139 (29%) presented with cellulitis.
- Surgical amputation involved the toes (n = 155), midfoot (280) and hindfoot (47).
- Overall, 178 cases (37%) required revascularization.
- After amputation, the median duration of antibiotic administration was 7 days (interquartile range, 1-16 days).
- In 109 cases (25%), antibiotics were discontinued immediately after surgery.
- Overall, clinical failure occurred in 90 DFIs (17%), due to the same pathogens in only 38 cases.
- In multivariate analysis, neither duration of total postsurgical antibiotic administration (HR 1.0, 95% CI 0.99-1.01) nor immediate postoperative discontinuation altered failure rate (HR 0.9, 0.5-1.5).

- **Conclusion:** According to our clinical pathway, we found no benefit in continuing postsurgical antibiotic administration in routine amputation for DFI.
- In the absence of residual infection (ie, resection at clear margins), antibiotics should be discontinued.



ORIGINAL ARTICLE

WILEY Endocrinology, Diabetes & Metabolism

Stopping antibiotics after surgical amputation in diabetic foot and ankle infections—A daily practice cohort

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Summary

Objective: The appropriate duration of antibiotic therapy for diabetic foot infections (DFI) after surgical amputations in toto is debated. There are discrepancies worldwide.

Methods: Using a clinical pathway for adult DFI patients (retrospective cohort analysis), we conducted a [illegible] regression analysis. Minimum follow-up was 2 months.

Results: We followed 482 amputated DFI episodes for a median of 2.1 years after the index episode. The DFIs predominately affected the forefoot (n = 433; 90%). We diagnosed osteomyelitis in 239 cases (239/482; 50%). In total, 47 cases (10%) were complicated by bacteremia, 86 (18%) by abscesses and 139 (29%) presented with cellulitis. Surgical amputation involved the toes (n = 155), midfoot (280) and hindfoot (47). Overall, 178 cases (37%) required revascularization. After amputation, the median duration of antibiotic administration was 7 days (interquartile range, 1-16 days). In 109 cases (25%), antibiotics were discontinued immediately after surgery. Overall, clinical failure occurred in 90 DFIs (17%), due to the same pathogens in only 38 cases. In multivariate analysis, neither duration of total postsurgical antibiotic administration (HR 1.0, 95% CI 0.99–1.01) nor immediate postoperative discontinuation altered failure rate (HR 0.9, 0.5–1.5).

Conclusion: According to our clinical pathway, we found no benefit in continuing postsurgical antibiotic administration in routine amputation for DFI. In the absence of residual infection (ie, resection at clear margins), antibiotics should be discontinued.

KEYWORDS

antibiotic duration, diabetic foot infections, failure, osteomyelitis, postamputation