“Balanced”
Transmetatarsal Amputations

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Disclosures

- Arthrex - Speaker
- Celularity - Speaker
- Stryker - Consultant
Brief History of TMA

• Bernard and Huete – (1855)
  • Originally described transmetatarsal amputation in a patient with trench foot
    • Originally describes as an amputation at the: anatomic metatarsal necks

• McKittrick et al – (1949)
  • Applied transmetatarsal amputations for gangrene in diabetic foot infections

• Banks et al – (2001)
  • Diabetic patients are 15x more likely to undergo major limb amputation
  • ~50,000 diabetic amputations annually
Transmetatarsal Amputations

- **Indications:**
  - Trauma
  - Congenital deformities
  - Tumors
  - Frostbite
  - Embolic phenomena
  - **Peripheral vascular disease**
  - Acute diabetic foot infections
  - Chronic diabetic foot infections
  - Ulcerations
  - Failed toe or ray amputations

- **Pecoraro et al - 1990**
  - Triad leading to amputations
    - Minor trauma/Pressure
    - Cutaneous ulcerations
    - Poor wound healing (PVD, neuropathy, hyperglycemia, renal disease)

Transmetatarsal Amputations

• “To TMA or not to TMA”
  • Debridement alone?
  • Digital amputations?
  • Ray resection?
  • Transmetatarsal amputation?
  • Proximal amputation?
Balanced Transmetatarsal Amputations

• “To TMA or not to TMA”
Balanced Transmetatarsal Amputations

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• “To TMA or not to TMA”
Transmetatarsal Amputations

• “To TMA or not to TMA”

• Soft tissue assessment
• Vascular status
• Patient goals and expectations
Transmetatarsal Amputations

• “To TMA or not to TMA”

  • Ray resection vs Transmetatarsal amputation
    • >2 rays require resection = TMA?
    • 1st Ray resection = TMA?
    • Lateral ray resection = better tolerated?
    • Peripheral vascular disease = more proximal amputation?
    • Loss of plantar soft tissues = TMA?
The First Step

• Admission of failure
  • Recognition
    • Recognize your limitations
    • You can’t win them all
  • Admit Powerlessness
    • You are powerless over our patients who are unmanageable and noncompliant
  • Acceptance
    • Accept defeat
    • “Acceptance in human psychology is a person’s assent to the reality of the situation, recognizing a process or condition (often an uncomfortable situation) without attempting to change it”
The First Step

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Modern Paradigm

“Limb Salvage”

- Transmetatarsal amputation is a limb salvage procedure
- Transmetatarsal amputation is not surgical failure
- The TMA is a positive procedure:
  - The 1st step on the road to rehabilitation
  - “Lose the battle, but win the war”

Goal:

- Achieve a stable, painless, plantigrade foot without areas of excess pressure or prominence
Transmetatarsal Amputations

-**Outcomes:**

  - **Anthony et al:**
    - 82% of patients required further surgery due to complication

  - **Pollard et al:**
    - 32% of patients required more proximal amputation

-This highlights the need for a well “BALANCED TMA” and for close attention to factors that contribute to soft tissue breakdown-


Balanced Transmetatarsal Amputation

• Balancing your TMA:

  • Selection of proper level of amputation:
    • More distal amputation can maximize function
    • More proximal amputation is better if it yields a more functional result

  • Soft tissue coverage:
    • More proximal amputation is better if it allows for more complete soft tissue coverage
Balanced Transmetatarsal Amputations

- Balance between the length of preserved bone and the available soft tissue envelope
  - Closed transmetatarsal amputations
    - Immediate primary closure
    - Delayed primary closure
  - Open transmetatarsal amputations
    - Negative pressure therapy (VAC)
      - Secondary intention
    - Skin grafting
    - Biologic synthetics
Balanced Transmetatarsal Amputations

- Planning
Surgical Technique

• Technically Simple?
  • Fishmouth Incision
  • Plantar Flap Incision
  • Rotational Flaps
Surgical Technique

- Incision and Flap Planning is Key

Fig. 6. (A) The Sander’s technique for plantar flap revision with transmetatarsal amputation in the presence of a distal plantar ulcer. (B) The margins of the ulcer site are then approximated with closure as shown.
Surgical Technique

• Technically Simple?
  
  • Plantar flap vs Fishmouth incision
    
    • Full thickness flap dorsally
    
    • Long plantar flap
    
    • Tendons transected under tension
    
    • Cascade metatarsals to restore anatomic parabola
      
      • Each successive metatarsal ~2mm shorter than adjacent
      
      • 2nd metatarsal vertex
    
    • Bevel metatarsal 15-20 dorsal distal to plantar proximal
      
      • 5th metatarsal beveled in 2 planes
Transmetatarsal Amputations

- Complications:
  - Recurrent ulcerations
  - Recalcitrant ulcerations
  - Residual equinus contracture
  - Bony prominence
  - Dorsiflexory imbalance
    - Pressure points
  - Inadequate soft tissue coverage
    - Open TMA
    - Residual ulcerations/wounds
Transmetatarsal Amputations

• Complications:
  
  • Most common site of re-ulceration in TMA:
    • Styloid process
    • 5th metatarsal head
    • Distal plantar lateral forefoot.

  • Achilles and TA now invert forefoot without opposing EDL.
    • Increased plantarflexion
    • Lateral metatarsals are completely weight bearing from proximal to distal
    • Medial metatarsals are only weight bearing at the metatarsal heads.
      • Leads to medial proximal shaft floating while lateral shafts bear more weight
Transmetatarsal Amputations

• **Outcomes with adjunctive procedures:**
  • McCallum and Tagoe (2012):
    • 12 Transmetatarsal amputations
    • 0% of TMA patients died within 30 days compared to 3.6% of those patients who had a BKA
  
  • Mayfield et al (2001):
    • 5,180 amputations
    • 30 day Mortality Rates
      • Toe – 1.7%
      • TMA – 2.7%
      • BKA – 7.0%
      • AKA – 11.0%
    • 5 year Mortality Rate
      • Toe – 46.0%
      • TMA – 45.0%
      • BKA – 56.0%
      • AKA – 70.0%

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Surgical Technique

• Balanced TMA:

  • Preserve length, but soft tissue coverage and viable margins take precedence
    • Shorter healed stump is better than a longer, incompletely healed one

  • Preserve metatarsal bases
    • TA and Peroneal tendon insertions

  • Preserve your Tibialis Anterior
    • Preserves active dorsiflexion
      • Extensor tendon contribution is reduced
    • Consider lateralizing TA transfer (STAT, Hibbs)

  • Evaluate Equinus contribution
    • TAL
    • Gastroc recession
Surgical Technique

• Balanced TMA:
  • Forefoot Pressures
    • TAL
    • Gastroc recession
  • ABI’s
    • Inexpensive
    • Easy to perform
    • But are not good predictors of healing
      • Calcification can mask disease
  • TCOP and skin perfusion pressure may be better predictors of wound healing after amputations

• Landry et al:
  • 62 TMAs
  • No predictors of wound healing
  • Poor HgbA1c increases risk of more proximal amputation

Landry et al. *Archives of Surgery*. 2011;146(9):1005–1009

Post-operative Management

- Post-op management
  - Appropriate wound healing
  - Footwear modifications
  - Prostheses

- Mueller et al – 1997
  - Total Contact Shoes
  - Rigid Rocker Bottom Shoes

- Foot-ankle orthosis
- Short shoes

- TMA patients were less functional than their age-matched controls, however they were more functional than those with a more proximal level of amputation.

Summary

• Balance is Key
  • TMA is a positive limb salvage procedure, not a surgical failure
    • A balanced “TMA may provide a more functional and reliable weight bearing foot and should be considered at the initial presentation” - Roukis
  • Achieve a stable, plantigrade, painless without areas of excess pressure
  • Surgical planning (soft tissue coverage)
    • Selection of proper level of amputation
    • More distal amputation can maximize function
    • More proximal amputation is better if it yields a more functional result
  • Adjunctive procedures (STAT, Hibbs, TAL, Gastroc recession)
  • Close Post-op management and follow-p
Thank You