MANAGEMENT OF DIABETIC FOOT INFECTIONS & OSTEOMYELITIS

DR. P.C. CHYE
Consultant Orthopaedic Surgeon
Dept. Orthopaedic Surgery & Traumatology
Hospital Kuala Lumpur
Global Prevalence:
- 2003: 194 million
- 2010: 252 million
- 2025: 380 million
Global projections for the number of people with diabetes (20-79 age group), 2007 and 2025 (millions)

- Africa
  - 28.3 in 2007, 40.5 in 2025, +43%
  - 16.2 in 2007, 32.7 in 2025, +102%

- Eastern Mediterranean and Middle East
  - 24.5 in 2007, 44.5 in 2025, +81%
  - 10.4 in 2007, 18.7 in 2025, +80%

- Europe
  - 53.2 in 2007, 64.1 in 2025, +21%
  - 46.5 in 2007, 80.3 in 2025, +73%

- North America
  - 67.0 in 2007, 99.4 in 2025, +48%

- South and Central America
  - World
    - 2007: 246
    - 2025: 380
    - Increase: +55%
PREVALENCE OF DM IN MALAYSIA
(Population >30 years)

Prevalence of Diabetes Mellitus in Malaysia

Year
Prevalence
1960 0.65%
1982 2.10%
1986 6.30%
1996 8.30%
2006 14.90%

22%

3rd National Health and Mortality & Morbidity Survey
DIABETIC FOOT INFECTIONS – RISK FACTORS

- **HOST DEFENSE:**
  - Neutrophil functions: chemotaxis, phagocytosis, intracellular killing
  - Monocyte & complement functions

- **PERIPHERAL VASCULAR DISEASES:**
  - In blood supply needed to heal ulcers and infection

- **SENSORY NEUROPATHY:**
  - In appreciation of pain and temperature → injuries not noticed, severity underestimated

- **MOTOR NEUROPATHY:**
  - Anatomical foot deformity → abnormal pressure points → ulceration

- **AUTONOMIC NEUROPATHY:**
  - Sweating, dry & cracked skin → portal of bacteria entry
DIABETIC FOOT INFECTIONS - SPECTRUM

- Ranges from cellulitis to infected ulcers, abscess, osteomyelitis, wet gangrenes and necrotising fasciitis
7% of Population Diabetic

15-25% Develop Foot Ulcer

40-80% Infected (or suspected)

40% Mild
30-40% Moderate
20-30% Severe

49% of diabetic patients with diabetic foot infection will develop infection in the other foot in 18 months
DIABETIC FOOT INFECTIONS – THE DEVELOPMENT

• Usually precipitated by trauma
• Infection may start superficially in an ulcer or crack of the skin but can rapidly progress to involve deeper structures including tendons and bones
• The anatomical structures of various compartments of the foot, tendon sheaths, ligaments, fascia and neurovascular bundles tends to facilitate proximal spread of the infection
• Inflammation and infection in the foot compartments can cause compartment syndrome – vascular thrombosis
DIABETIC FOOT INFECTIONS - PRESENTATIONS

• Redness, swelling, discharging sinus/ulcer, gangrene, pain
• Diabetic patient may or may not mount a fever, even in the presence of severe infection
• 50% of patients with a limb-threatening infection do not manifest systemic signs or symptoms leading to underestimation of the presence and severity of infection
• The signs and symptoms are masked by neuropathy
• Hypotension, tachycardia and severe unexplained hyperglycaemia are however often noted
DIABETIC FOOT INFECTIONS - PROGRESSION

- Coexisting metabolic derangements, peripheral arterial disease, poor immune response \(\Rightarrow\) poor delivery of antibiotics to the infected tissues, reduced access & functions of phagocytic cells to the infected area \(\Rightarrow\) rapid progression of infection in hours or days & quickly become limb- or life-threatening
These wounds are usually more severe and more complicated to treat than do equivalent infections in persons without diabetes.
DIABETIC FOOT INFECTIONS - BACTERIA INVOLVED

- Aerobic Gram +ve cocci, esp (Staphylococcus aureus) are the predominant pathogens

- In chronic ulcers or in patients who have recently received antibiotic therapy may be infected with Gram –ve rods

- In those with foot ischaemia and gangrene may have obligate anaerobic organisms
- Staphylococcus aureus 45%
- Streptococcus sp. 35%
  - Enterococcus sp. 29%
  - Staphylococcus epidermidis
- Proteus mirabilis 26%
- Pseudomonas aeruginosa 16%
- Peptostreptococcus 22%
- Diphtheroids 19%
- Bacteroides 16%
Limb-threatening infections are often polymicrobial.
MULTIRESISTANT BACTERIAL INFECTIONS

Diabet Met 2004 Jul;21(7) : 710-5

Diabetic foot ulcer and multidrug-resistant organisms: risk factors and impact.


- Detected in 1/3 of patients with previous history of hospital admission for the same wound

- Detected in 25% of patients with osteomyelitis
Clinical Microbiology & Infection - October 2005
Prevalence of methicillin-resistant Staphylococcus aureus in infected and uninfected diabetic foot ulcers

- ALMOST 50% of Staph aureus isolated are MRSA!
TIMELINE OF STAPHYLOCOCCAL RESISTANCE

Penicillin-resistance

Sporadic MRSA

Epidemic MRSA

GISA

CA-MRSA

VRSA

DIABETIC FOOT INFECTIONS – TREATMENT STRATEGIES

Require attention to both local & systemic issues
DIABETIC FOOT INFECTIONS - COMPREHENSIVE MANAGEMENT

LOCAL ISSUES

TREAT THE ULCER & INFECTION, GET THE WOUND TO HEAL, PREVENT RECURRENCE

SYSTEMIC ISSUES

TREAT THE DIABETES, ASSOCIATED SYSTEMIC PROBLEMS & OVERCOME THE UNDERLYING PATHOLOGY

AT THE SAME TIME
Comprehensive management of these patients requires care of a finely-tuned multidisciplinary team for medical stabilization, surgical debridement, antibiotic selection, vascular reperfusion, wound care, podiatric care, orthotic care, nutrition support, rehabilitation and delayed reconstruction to achieve functional limb salvage.
EVALUATION AT 3 LEVELS

1. The patient as a whole
2. The affected limb or foot
3. The infected wound

To determine:
- presence, type, extent and severity of infection
- pathogens involved
- presence of any systemic consequences of infection
- contribution of vascular disease / neuropathy
- altered foot biomechanics that contributes to the cause of the wound (and thus, its ability to heal)
BLOOD INVESTIGATIONS:

- Full blood count
- Erythrocyte Sedimentation Rate (ESR)
- C- Reactive Protein (CRP)
- Random / Fasting Sugar Levels
- Glycosylated Haemoglobin
- Renal Profile
- Serum Albumin
EXAMINE THE FOOT:

- Palpation/probing for fluctuance & tunneling wounds/ ulcer (deep infection)
- a clinically infected ulceration probes to bone – 89-95% osteomyelitis

- Blood supply: Dorsalis Pedis, Posterior Tibialis & Popliteal pulses. Ankle-Brachial Systolic Index (ABSI), Doppler, Evidence of ischaemia & gangrene
- the degree of impaired limb perfusion significantly reduce the chances of wound healing, increases the overall severity of infection and risk of amputations

- Sensation --- Neuropathy
  – pain in an insensate foot means severe infection

- Deformities & Abnormal Pressure Points
DIABETIC FOOT INFECTIONS - INITIAL ASSESSMENT AND INVESTIGATIONS

**TAKE AN X-ray:**
- Osteomyelitis
- Gas Gangrene
- Presence of Foreign Body
- Osseous deformities / fractures / dislocations

**MRI** is more sensitive and specific, especially for extent of soft tissue involvement
IDENTIFY THE ORGANISMS INVOLVED:
- Send appropriately obtained specimens for culture before starting empirical antibiotic therapy
- Soft tissue or bone specimens obtained by biopsy, curettage, or aspiration are preferable
- Superficial swab cultures of infected ulcers often complicate evaluation of the infection
- Definitive antibiotic therapy will be based on C&S results from intra-op cultures
DIABETIC FOOT INFECTIONS – INITIAL MANAGEMENT

ANTIBIOTIC SELECTION

Characteristic odours or history of resistant bacterial infections – affect initial antibiotic choices

**Initial treatment in a previously untreated patient with a non-limb-threatening infection is focused on** *Staphylococcus* and *Streptococcus sp*

**Initial treatment of limb-threatening infections requires broad-spectrum antibiotics covering Staph aureus, group B Streps, other Streptococcus sp., enterobacteriaceae & anaerobes**

Antibiotic vary in how well they achieve effective concentration in the infected diabetic foot – affected by the arterial blood supply to the foot & pharmacodynamic properties of the drug
The degree of end organ dysfunction affects multiple aspects of medical and surgical management.

Antibiotic dosing adjustment issues, poor cardiac function, hyperglycaemia, ketoacidosis, dehydration, hyperosmolality, electrolyte imbalance, renal insufficiency, anaemia, poor limb perfusion, immunosuppression, poor nutrition, poor healing potential often coexist.

The goal of medical management is to regulate and normalize the metabolic and haemodynamic derangements and to prevent further decompensations.
STABILIZE / RESUSCITATE THE PATIENT

• Restore fluid and electrolyte balances, correct anemia, hyperglycaemia, hyperosmolarity, acidosis & treat other exacerbating disorders

• Optimize treatment of other medical illnesses: ischaemic heart disease, heart failure, renal impairment etc

• May need resuscitation eg sepsis, ketoacidosis
When a non-healing infected diabetic foot ulcer is worsening despite adequate wound care and cultured-directed antibiotics, urgent surgery is needed.

Emergency surgical intervention:

- Life- or limb-threatening infection
  - Necrotising fasciitis
  - Gas gangrene
  - Critical limb ischaemia
  - Deep abscess
OVERVIEW OF SURGICAL MANAGEMENT OF INFECTED DIABETIC FOOT

To achieve a healed wound & prevent major amputation of the leg:

- Drainage of pus, remove necrotic soft tissue & bone + creating a healthy wound bed
- Limb reperfusion
- Soft Tissue Cover

SUCCESSFUL SALVAGE

- Correct deformity, relieve pressure areas
- Restore stability, alignment & function
- Reduce risk of reulceration & subsequent amputation

Incision & drainage
Debridement
Sequestrectomy
Disarticulation
Ray Amputation
DIABETIC FOOT INFECTIONS – INITIAL SURGICAL DEBRIDEMENT

- After patient is medically stabilised
- Must be timely and aggressive
- Remove all sloughs, necrotic and marginal-looking tissues, dead bones, drain all pus, explore all sinus tracts
- Exposed tendons should be excised if proximal migration of infection is suspected
- Exploration is done to determine involvement of fascial planes
- The degree of intra-operative bleeding must be assessed
- Aims to reduce the bacterial load in the wound, create a healthy environment to restore the physiologic processes of tissue repair and healing
- Changes stubborn non-healing chronic wounds into acute wounds
- Deep tissue & bone: C&S ± HPE (if osteomyelitis suspected)
- Crucial to successful control of infection and must be done as soon as possible
- In severe infections, general anaesthesia is often needed as the depth of infection and fascial spread may be extensive
ANTIBIOTICS THERAPY

Based on culture & sensitivity results, depth and severity of infection
CONTINUED UNTIL RESOLUTION OF INFECTION, NOT UNTIL THE WOUND HAS HEALED

Often insufficient without appropriate wound care

TREAT THE INFECTION, DO NOT STERILISE THE WOUND
DIABETIC FOOT INFECTIONS --- WOUND BED PREPARATION

- Converting a chronic wound into a wound with the potential to heal
- Involves debridement, control of infection and inflammation, moisture control, excision of wound edges and callus

"TIME"
- "T" refers to the need to remove necrotic and diseased Tissue
- "I" indicates the need to control bacterial burden and Infection
- "M" refers to restoration of Moisture balance
- "E" stands for the healing Edge, which is the point at which the wound is optimally primed for healing
Repeated sharp debridement is done until all necrotic tissues and bone + biofilms are removed.
• Stimulates production of growth factors and proliferation of collagen and fibroblasts.
• A healthy wound bed is created for granulation tissue to grow and wound to heal.
REPEATED DEBRIDEMENT - ULTRASONIC DEBRIDEMENT

- Use of low frequency cavitational ultrasound to debride away dead tissues, leaving healthy and granulation tissue intact
- Also removes bacteria and biofilms
- Sterile saline solution transfer the ultrasonic energy to the wound where tiny vibrating gas bubbles and cellular level fluid movement separates dead from healthy tissues
- Safe, cost effective, painless alternative to painful sharp debridements

Low-frequency ultrasound has been shown to have cellular-level physical effects, known as cavitation and microstreaming, that can promote healing.

Cavitation is the formation and oscillation of microscopic bubbles, which expand and collapse as they resonate with the ultrasound frequency.

Acoustic microstreaming is the physical force of sound pressure waves that can displace small molecules and move fluids along and/or through cell membranes.
REPEATED DEBRIDEMENT - HYDROSURGICAL DEBRIDEMENT

Versajet Hydrosurgery System (Smith & Nephew)
- utilises a high-pressure jet of sterile saline that travels parallel to the wound surface
- This high-speed jet creates a Venturi effect that enables the surgeon to simultaneously hold, cut and remove tissue, while irrigating and aspirating the wound, with a single instrument

- Enables rapid debridement, likely to result in shorter procedure times
- Clean wounds potentially reduce the number of required debridement procedures
- Single device technique - combining lavage and sharp debridement instrumentation
- Multiple tip configurations enhance procedural flexibility
REPEATED DEBRIDEMENT -
Maggots Debridement Therapy

- Sterile larva of the greenbottle fly is applied to the wound for 2-3 days
- Necrotic tissues are eaten away
- In late 1920s, William Baer from Johns Hopkins University, used maggots to treat children with osteomyelitis and soft tissue infections
- Successfully performed by thousands of physicians throughout 1930’s, but was supplanted by the new antibiotics and surgical techniques during World War II
- In 2004, FDA allowed the production and marketing of the *Phaenicia sericata* larvae
- In 2006, approx 50,000 treatments were applied to wounds using maggots
- Low cost, simple, safe, ideal when surgical debridement is not the optimal choice
Involves application of a cream or ointment to the wound. The action of the chemicals or enzymes contained in the cream work to loosen the dead tissue, which is then manually removed.

Fast acting
Minimal or no damage to healthy tissue with proper application.

May be used as the primary technique for debridement in some cases when surgical debridement is not feasible owing to bleeding disorders or patient is not fit for surgery.

Combined therapy, such as initial surgical debridement followed by serial debridement using an enzymatic agent is effective for many patients with chronic, indolent, or nonhealing wounds.
POST-DEBRIDEMENT SOFT TISSUE COVER

- Presence of large soft tissue defect after surgical debridement often makes primary closure difficult.

- When possible, the least invasive methods of coverage are employed, e.g., Delayed primary closure, Vacuum assisted closure.

- However, many wounds are not amenable to delayed primary closure and require plastic surgical techniques:
  - Split Skin Graft
  - Local and Pedicle Flaps
  - Free Flaps
Using a vacuum source to draw fluid out of the wound to accelerate debridement and promote healing

Not for acutely ischaemic foot, tumour wound

Special precaution: patient on anticoagulant

Wound bed preparation prior to initiation of treatment

Optimal level of negative pressure ~125mmHg

Most effective if applied in a cyclical pattern – 5 mins on, 2 mins off

**Advantage:**
- cheap
- Ideal for difficult-to-heal wounds

**Disadvantages:**
- restricts patient mobility
DIABETIC FOOT INFECTIONS -- CELLULITIS

• 9 times more frequent in diabetic compared to nondiabetic patients
• Infection is confined to the dermal and subcutaneous layers
• Commonly caused by Group A Streps & Staph
• Entry: skin cracks, fissures, blister, insect bites
• Antibiotics
DIABETIC FOOT INFECTIONS - OSTEOMYELITIS

• A difficult problem to treat & heal
• The combined effects of peripheral vascular disease, neuropathy, and repetitive trauma produce complex lesions with exposed bone, surrounding cellulitis, and soft tissue gangrene
• Plain x-rays, gallium scan, MRI
• Bone culture
A Clinico-microbiological Study of Diabetic Foot Ulcers in an Indian Tertiary Care Hospital

Ravisekhar Gadepalli, MSC, Benu Dhawan, MD; Vishnubhatla Sreenivas, PHD, Arti Kapil, MD; A.C. Ammini, MD; Rama Chaudhry, MD

All patients had Wagner 3-5 ulcers
62.5% had associated osteomyelitis
DIABETIC FOOT INFECTION - OSTEOMYELITIS

• If osteomyelitis is confirmed from initial deep cultures or histopathology, further aggressive resection of all affected bone is warranted

• DEBRIDE ALL DEAD BONE & SOFT TISSUE till viable, bleeding bone & soft tissue

• Staph aureus penetrates and survives in bone cells

  * BONE PENETRATION OF ANTIBIOTICS *

Fluoroquinolones (ciprofloxacin, ofloxacin, moxifloxacin), Fucidic acid
NECROTISING FASCIITIS IN DIABETIC

- Incidence on the rise
- 70% of patients are diabetic
- **MEDICAL & SURGICAL EMERGENCY!**
- Highly fatal (overall morbidity & mortality: 70-80%)
- Group A hemolytic streptococci (Strep pyogenes) and Staph aureus, alone or in synergism, are frequently the initiating infecting bacteria.
- However, other aerobic and anaerobic pathogens may be present, including Bacteroides, Clostridium, Peptostreptococcus, Enterobacteriaceae, coliforms, Proteus, Pseudomonas, and Klebsiella.
- Poor prognostic factors: advanced age, poor glycaemic control, long duration of diabetes & delayed referral.
NECROTISING FASCIITIS
• Progressive, rapidly spreading infection along the deep fascia plane & extensive necrosis of the subcutaneous tissues & muscle without a corresponding necrosis of the overlying skin until much later

• **Early features**: Fever, pain, tachycardia, swelling, induration, cellulitis

• **Late features**: Severe pain & tenderness disproportionate to skin changes, skin discoloration (purplish black), blister or bullae, crepitus, septicaemic shock, multiorgan failure

• X-rays: subcutaneous gas

• Antibiotics

• Extensive surgical debridement & fasciotomy: delay for 24 hours ↑↑ mortality
THE ISCHAEMIC DIABETIC FOOT

UNLESS THERE IS ADEQUATE REPERFUSION OF THE FOOT / LEG, ANTIBIOTICS TREATMENT AND SURGERY WILL FAIL & AMPUTATION WILL BE NEEDED
Historically, diabetic foot surgery was largely done in the presence of acute infection or when in need of amputation.

With better understanding of the pathophysiology of diabetic foot disease, we have began to recognize the importance of elective diabetic foot surgery in helping patients to stay active and ulcer free.
# CLASSIFICATION OF SURGERY IN THE DIABETIC FOOT

<table>
<thead>
<tr>
<th>CLASS</th>
<th>PURPOSE</th>
<th>EXAMPLES</th>
</tr>
</thead>
<tbody>
<tr>
<td>I ( Elective )</td>
<td>For painful deformities in patients without neuropathy or open wounds</td>
<td>Realignment osteotomies, tendon balancing procedures, arthrodeses &amp; Charcot reconstructions</td>
</tr>
<tr>
<td></td>
<td>For prevention of ulceration in patients with neuropathy but no open wounds</td>
<td>Partial or complete removal of bone such as metatarsal head, sesamoid, accessory bone, exostosis, calcanectomy, soft tissue cover / reconstructions</td>
</tr>
<tr>
<td>II ( Prophylactic )</td>
<td>To assist healing of ulcers in patients with neuropathy</td>
<td>Amputations, debridements, incision and drainage</td>
</tr>
<tr>
<td>III ( Curative )</td>
<td>To arrest / limit progression of acute infection, eliminate infected and necrotic tissue</td>
<td></td>
</tr>
<tr>
<td>IV ( Emergent / Ablative )</td>
<td>To arrest / limit progression of acute infection, eliminate infected and necrotic tissue</td>
<td></td>
</tr>
</tbody>
</table>

GOALS:
1) Stability
2) Realignment
3) Platigrade foot amendable to bracing or accommodation
4) Reduction of pressure points / “surgical offloading”
ELECTIVE / PROPHYLACTIC SURGERY

FOREFOOT:

HALLUX and FIRST METATARSAL PHALANGEAL JOINT:
- SESAMOIDECTOMY / EXOSTECTOMY
- HALLUX INTERPHALANGEAL ARTHROPLASTY / ARTHRODESIS
- RESECTION OF FIRST METATARSAL HEAD
- OSTEOTOMIES OF THE PHALANX AND FIRST METATARSAL

LESSER DIGITS:
- LESSER METATARSAL OSTEOTOMIES: Shortening osteotomy, Elevating osteotomy
- LESSER METATARSAL HEAD RESECTION
ELECTIVE / PROPHYLACTIC SURGERY

MIDFOOT:
- EXOSTECTOMY
- REALIGNMENT MIDFOOT OSTEOTOMIES + ARTHRODESIS
  - single plane vs multiplane
REARFOOT:
- TRIPLE ARTHRODESIS
- REALIGNMENT CALCANEAL OSTEOTOMIES
- TALECTOMY + TIBIAL-CALCANEAL ARTHRODESIS
- CALCANEECTOMY (partial / total)
Correct and reverse all correctable negative factors on wound healing:

- Anemia
- Diabetes
- Heart Failure
- Malnutrition
- Smoking
- Steroid
- Vitamin deficiency
- Uraemia
Optimal wound care is crucial for healing but it is not the only way to treat the diabetic foot ulcer.

Infection complicates treatment of a diabetic foot ulcer, making a more aggressive wound care strategy necessary.

One particular dressing should not be used for all stages of wound care.

- **A long process** – time, patience, perseverance
  -- Dedicated team of doctors and nurses

- **Problems to be addressed in DFU**:  
  -- Exudate, bacterial load, slough, granulation
CHOOSING THE APPROPRIATE DRESSING

- **INFECTED**: surgical debridement + silver dressing
- **EXUDATIVE**: absorptive dressing
  - eg. Hydrofibres, Alginates, Composite dressings, Foam dressings
- **SLOUGHY**: surgical / enzymatic / maggot debridement
- **DRY**: Hydrogels
• Reducing the number of lower extremity amputations is a goal for all doctors caring for patients with diabetes

• However, the numbers of limb-threatening infections continue to rise each year

• Failures in limb salvage attempts do occur

• These failures result in multiple trips to the operating room, significant potential morbidity, and prolonged disability
“THE GOOD NEWS IS WE WERE ABLE TO SAVE YOUR LEG ...”
Somewhere in the world, a leg is lost to diabetes every 30 seconds.

Diabetics are 40x more likely to undergo amputation of the leg than non-diabetics.

>85% of amputation begins with a foot ulcer.

Those who undergo a lower limb amputation have up to 30% chance of undergoing similar amputation on the contralateral limb within 3 years and up to 50% chance in 5 years.

Mortality rate post amputation:
- 11-41% after 1 year
- 20-50% after 3 years
- 39-68% after 5 years

Two goals: **ABLATION + RECONSTRUCTION**

“refashioned” the viable residual limb so that an appropriate prosthesis may be fitted to assist functional mobility.
## STRAUSS WOUND GRADING SCORE

<table>
<thead>
<tr>
<th>VARIABLES</th>
<th>2</th>
<th>1.5</th>
<th>1</th>
<th>0</th>
</tr>
</thead>
<tbody>
<tr>
<td>PERFUSION DEPTH</td>
<td>Warm</td>
<td>Cool</td>
<td>Cold</td>
<td></td>
</tr>
<tr>
<td>SIZE</td>
<td>Skin &amp; sub-Q</td>
<td>Musc &amp; tendons</td>
<td>Bone &amp; Joint</td>
<td></td>
</tr>
<tr>
<td>INFECTION</td>
<td>&lt; thumb</td>
<td>Thumb – fist</td>
<td>&gt; fist</td>
<td></td>
</tr>
<tr>
<td>WOUNDBASE</td>
<td>Clean &amp; contam.</td>
<td>Cellulitis</td>
<td>Septic</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Red</td>
<td>Yellow-white</td>
<td>Black</td>
<td></td>
</tr>
</tbody>
</table>

- **<=3**  70% amputation
- **4-7**  20% amputation
- **>=8**  0% amputation
MINOR AMPUTATIONS:
- Disarticulation
- Ray amputation
- Midfoot amputation
- Syme amputation

MAJOR AMPUTATIONS:
- Below knee amputation
- Above knee amputation
- Hip disarticulation
<table>
<thead>
<tr>
<th>AMPUTATION LEVEL</th>
<th>% ENERGY BEYOND BASELINE</th>
</tr>
</thead>
<tbody>
<tr>
<td>Long BKA</td>
<td>10</td>
</tr>
<tr>
<td>Medium BKA</td>
<td>25</td>
</tr>
<tr>
<td>Short BKA</td>
<td>40</td>
</tr>
<tr>
<td>Bilateral medium BKA</td>
<td>41</td>
</tr>
<tr>
<td>Average AKA</td>
<td>65</td>
</tr>
</tbody>
</table>

Miller; Orthopaedic Review: Pg. 218.
AFTER AMPUTATION ......
CHALLENGE: PREVENTING RECURRENCE

- **Specialty diabetic foot clinic**: recurrence rate 25-80%/year
- **Self-monitoring**
  - to identify signs of disease and precursors to injury
  - many diabetic patients with a high risk for ulceration cannot see their feet! (obesity, limited joint mobility, visual impairment)
  - by the time patients in this study were able to visualize areas of concern, it was too late, and an ulceration had already developed
- **Self-care**
CHALLENGE - PATIENTS

EDUCATION & SUPPORT
PERCEPTION & BEHAVIORAL CHANGE

Overcoming:
- Ignorance / Misconception
- Fear
- Denial
- Uncooperativeness
- Social problems

Increase awareness of:
- DM & its many consequences
- Methods of care & support available
CHALLENGE – THE OLD DIABETIC PATIENTS

DIFFERENT FROM THE YOUNGER PATIENTS:

- Poorer limb perfusion
- Poorer healing / tissue regeneration
- Weaker immune defence
- Comorbidities ++
- Soft tissue fragility / osteoporosis
- Poor nutrition
- Poor vision / memory / senility
- Limited mobility
- Social and financial support problems
- Dependant, poor self care, neglect
- NURSING HOME PROBLEMS

Two-thirds of elderly patients undergoing amputation do not return to independent life
**CHALLENGE – HEALTHCARE PERSONNEL**

- **Organisation**: WOUND CARE TEAM
  - 70% of wound dressings are applied by the bedside nurse, NOT the wound care specialists

- **Training (Knowledge & Skills)**:
  - Train more people
  - Keep in touch with the latest development
  - Learn what to do, what not to do, how to do it

- **Early detection & referral**:
  - Educate & build a positive working relationship with primary health care providers

- **Budget & allocation**
Although there have been many advances in the management of the diabetic foot, it remained a major global public health problem.

Where have we failed?
- Health Care Policy?
- Health Care Budgeting?
- Health Care Organisation?
- Policy Implementation?

What needs to be done?
- Present?
- Future?

What about the poorer countries and their people?
CHALLENGE - RESEARCH

FROM THE BENCH TO THE BEDSIDE

- integration of resources into a coordinated effort and monitoring pathway to bring products of research and technology to the patients
FUTURE OF DIABETIC WOUND CARE

• Narrowing gap between basic science and clinical application
• Necessary to understand the complex interactions of various physiologic components in wound healing

• “SMART BIOACTIVE DRESSING” -- that responds to the needs of the wound by releasing factors needed for healing

• “STEM CELLS” – as a potentiator of healing by replacing or activating senescent cells in the wound eg. Bioengineered skin
OVERALL MANAGEMENT

• PREVENTION ! PREVENTION ! PREVENTION !

• Early detection and intervention

• Medical management of diabetes and comorbid conditions

• Targeted antibiotic coverage of infection

• TEAM EFFORT

• Wound care and dressing, off-loading / pressure relief

• Adjuvant therapies (eg. Hyperbaric O2) & Nutrition

• Post-op follow-up, podiatric care / foot wear and orthoses

• PREVENT RECURRANCE !
THANK YOU

Doctor treating a foot ulcer: 17th Century, after David Teniers the younger