





Diabetic Foot Italy
Gruppo interassociativo AMD - SID
podopatia diabetica



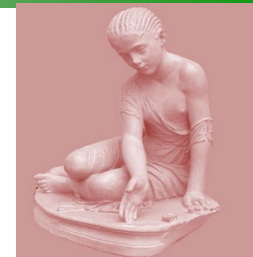
6° Congresso Nazionale del Gruppo di Studio della Podopatia Diabetica

Il Piede Diabetico in Italia nel terzo millennio: discipline diverse,
professionalità integrate in un percorso unitario con
il paziente diabetico al centro

Presidente del Congresso: Dr. Roberto Da Ros
Responsabile Scientifico: Dr. Roberto Anichini



Starhotels Savoia Excelsior Palace
Trieste, 31 gennaio / 2 febbraio 2019



Piede Diabetico Acuto
Dott. R De Giglio



Legnano H nuovo



Legnano H storico



Cuggiono



Magenta



Abbiategrasso

Dipartimento Medico

UOC Medicina Interna – Piede Diabetico

Ospedale di Abbiategrasso

Dr. R. De Giglio

Dipartimento Medico
Direttore UOC Medicina - Piede Diabetico
Ospedale di Abbiategrasso
ASST Ovest Milanese



**IL RELATORE di questa sessione
DICHIARA
l'ASSENZA di situazioni,
anche potenziali, di
CONFLITTO DI INTERESSE**

Consapevole che chiunque rilascia dichiarazioni mendaci è punito ai sensi del Codice Penale e delle Leggi speciali in materia

Dr. Ezio Faglia

GRANDE RIFERIMENTO del PIEDE DIABETICO ITALIANO





Effectiveness and Safety of a Nonremovable Fiberglass Off-Bearing Cast Versus a Therapeutic Shoe in the Treatment of Neuropathic Foot Ulcers

A randomized study

CARLO CARAVAGGI, MD
EZIO FAGLIA, MD
ROBERTO DE GIGLIO, MD
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Neuropathic ulcers result when causative factors occur together in the presence of a peak in plantar pressure. This normally causes the onset of a neuropathic plantar ulcer (1,2).

The relief of pressure from the



Piede diabetico

Definizione

"Condizione di infezione, ulcerazione e/o distruzione di tessuti profondi associate ad anomalie neurologiche e a vari gradi di vasculopatia periferica degli arti inferiori"

(Criteri stabiliti dall'OMS)

Documento di consenso internazionale sul piede diabetico

"Piede con alterazioni anatomico-funzionali determinate dall'arteriopatia occlusiva periferica e/o dalla neuropatia diabetica"



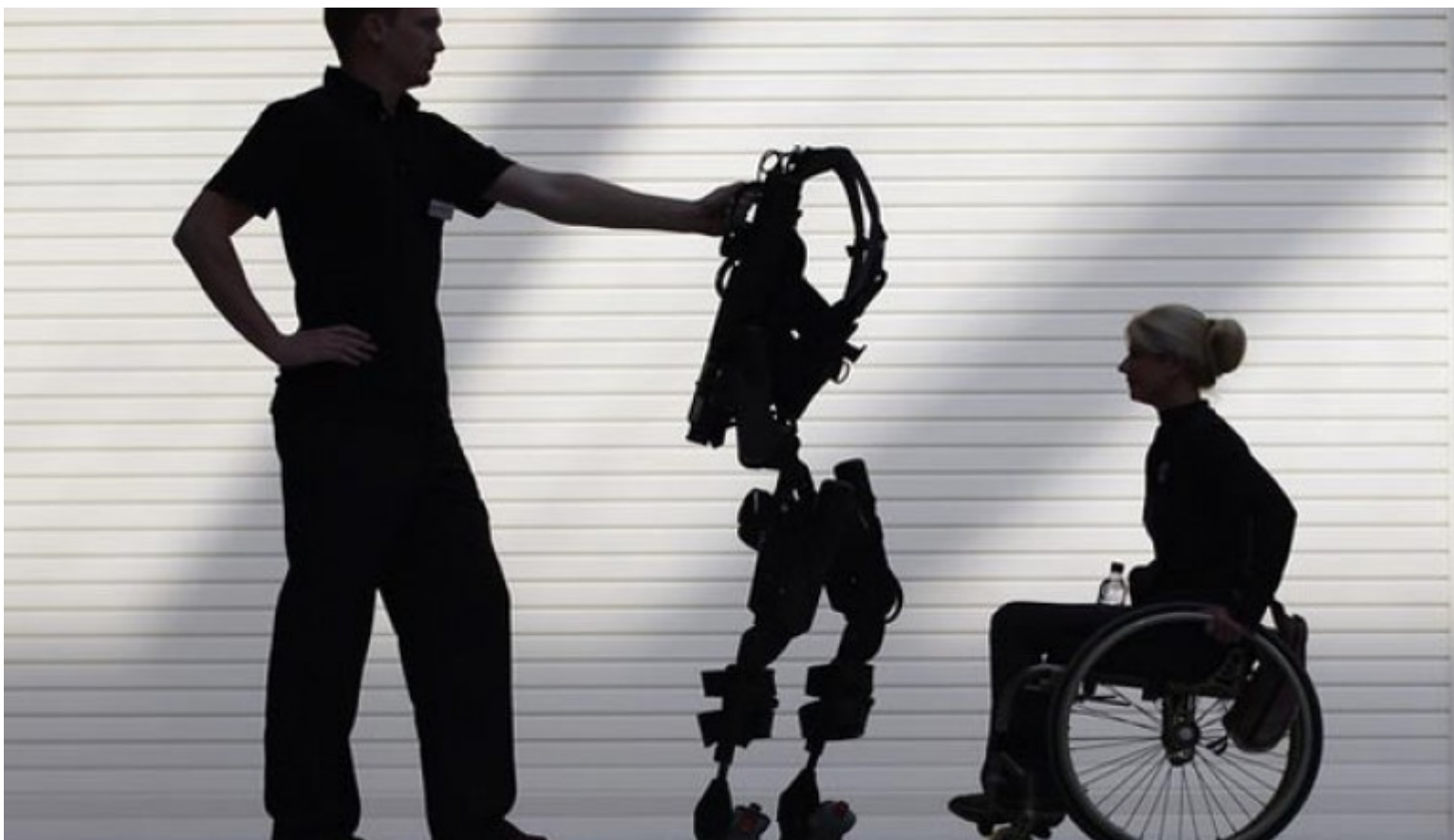
Obiettivo

Obiettivo del trattamento del piede diabetico è la conservazione dell'integrità anatomica e funzionale del piede.

Quando ciò non è possibile, si mira a ridurre al minimo la disabilità provocata dalla malattia e dalle manovre terapeutiche.

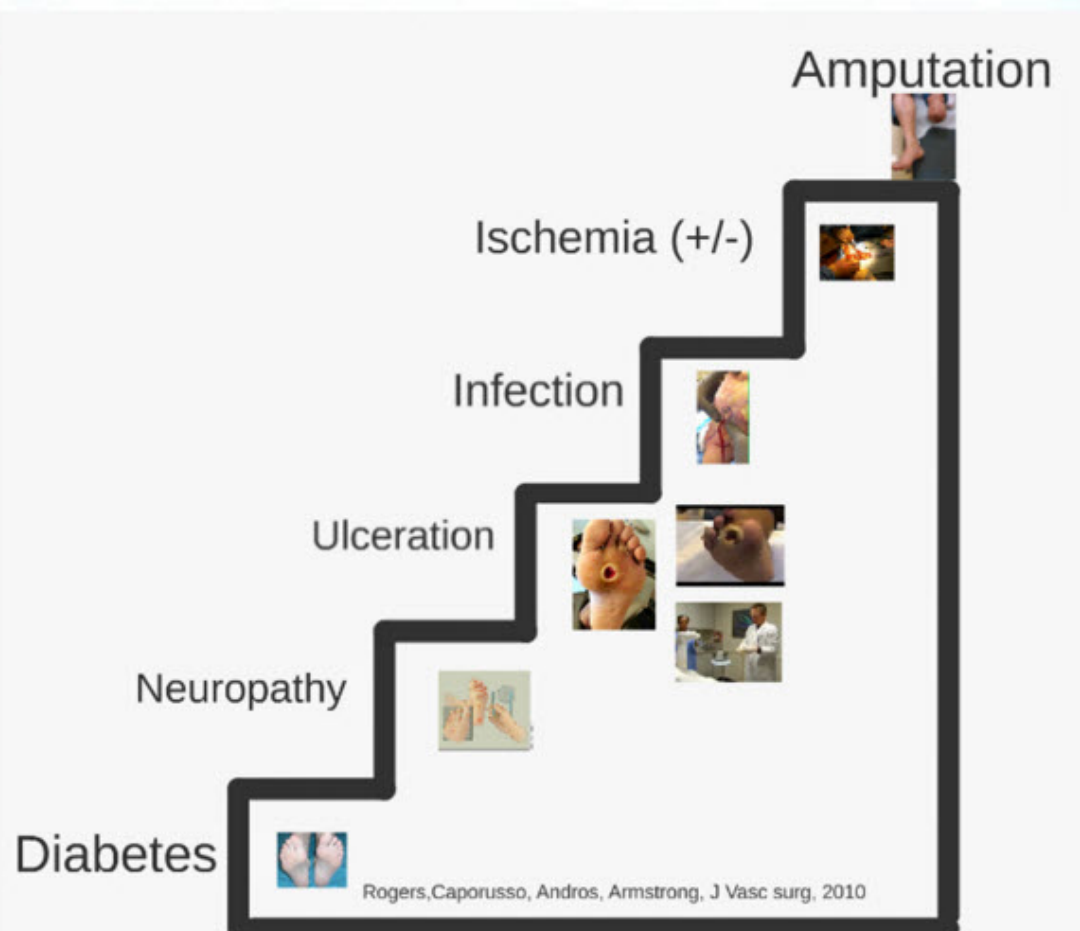


BACK TO WALK





STAIRWAY TO AMPUTATION





PIEDE DIABETICO





Figure 3. Longitudinal view of compartments of the foot

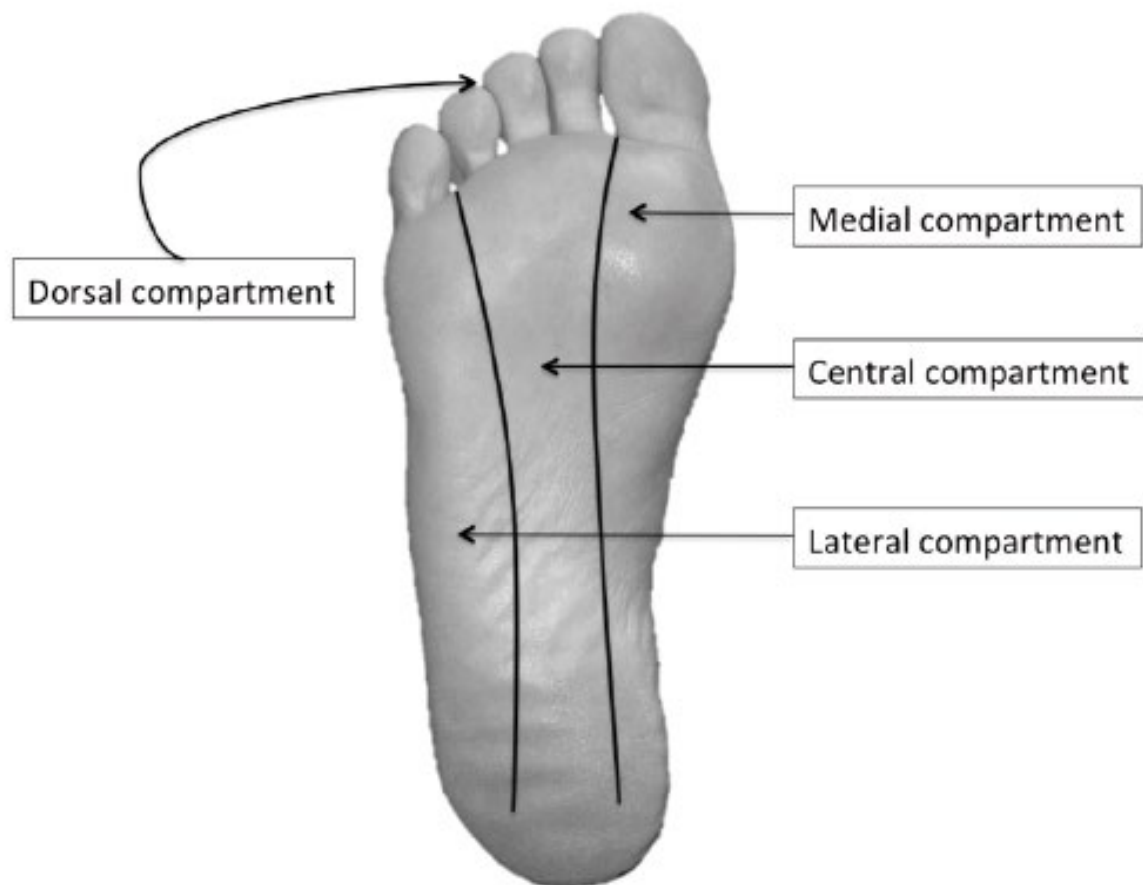
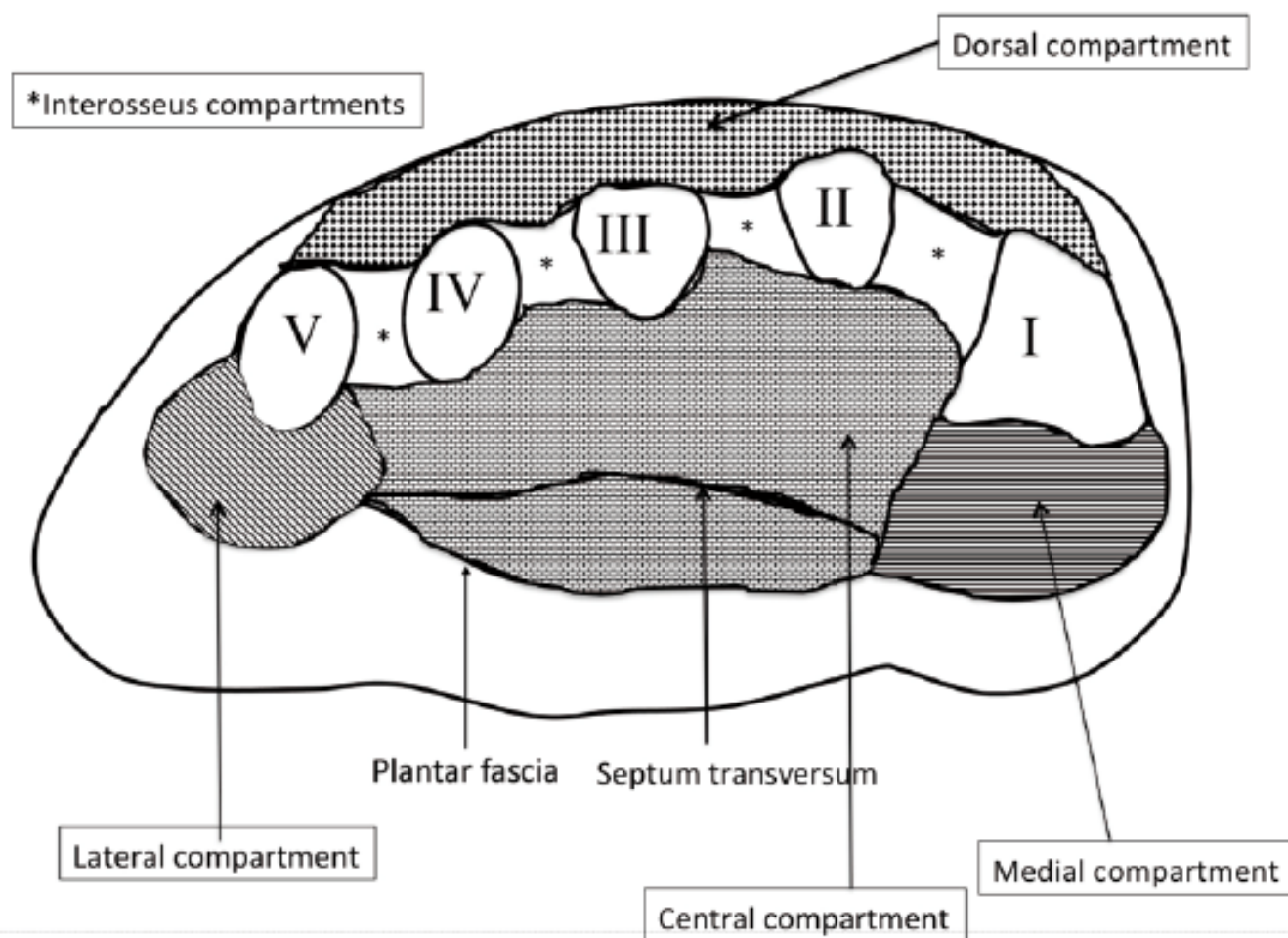
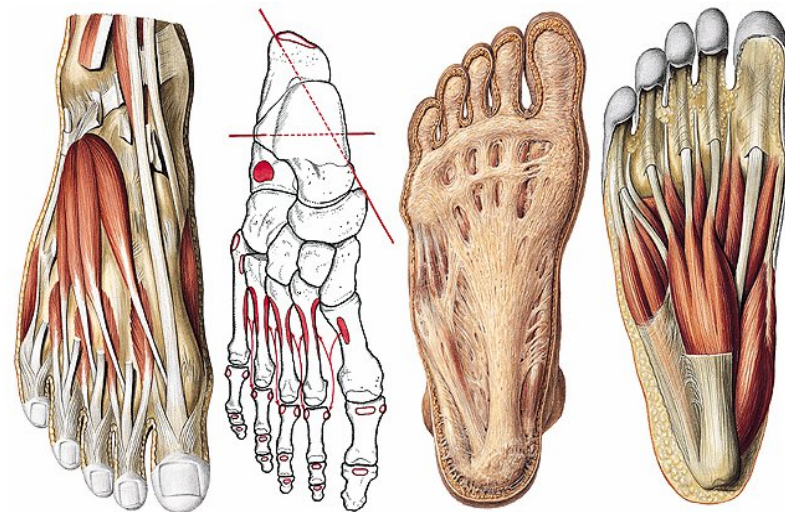


Figure 4. Transversal view of compartments of the foot



CONDIZIONI LOCALI FAVORENTI LE INFEZIONI

- Caratteristiche circolo arterioso - tipo terminale :
"sindrome delle dita blu"
- Organo osteo-muscolo-tendineo organizzato in logge separate da setti fibrosi che dividono **compartimenti anatomici inespansibili**
- Spazi articolari e segmenti ossei in prossimità della superficie cutanea : **velocità di diffusione profonda del processo infettivo**



Classificazione clinica dell'infezione (IDSA), con definizioni IDSA = Infectious Diseases Society of America IWGDF = International Working Group on the Diabetic Foot	Gradi IWGDF classificazione IDSA
Non infetto : assenza di sintomi o segni locali o sistemici d'infezione	1 (non infetto)
Infetto • Almeno 2 dei seguenti punti sono presenti : ◦ gonfiore o indurimento locale ◦ eritema > 0.5 cm intorno all'ulcera ◦ indolenzimento locale o dolore ◦ calore locale ◦ secrezione purulenta • Dovrebbero essere escluse altre cause di una risposta infiammatoria della cute (es. trauma, gotta, neuroartropatia di Charcot acuta, frattura, trombosi, stasi venosa) • Infezione coinvolgente la cute o solo il tessuto sottocutaneo (senza coinvolgimento dei tessuti più profondi e senza segni sistemici come descritti sotto). Qualsiasi eritema esteso < 2 cm intorno alla lesione • Nessun segno o sintomo sistemico d'infezione (vedi sotto)	2 (infezione lieve)
• Infezione coinvolgente strutture più profonde della cute e del tessuto sottocutaneo (es. ossa, articolazioni, tendini) o eritema esteso > 2 cm dai margini della lesione • Nessun segno o sintomo sistemico d'infezione (vedi sotto)	3 (infezione moderata)
• Qualsiasi infezione del piede con i seguenti segni di una sindrome da risposta infiammatoria sistemica (SIRS): questa risposta si manifesta con 2 o più delle seguenti condizioni : ◦ Temperatura > 38° o < 36° Celsius ◦ Frequenza cardiaca > 90 batt/min ◦ Frequenza respiratoria > 20 atti resp./min o PaCO₂ < 32 mmHg ◦ Conta dei globuli bianchi > 12.000 o < 4000 /mL o il 10% di forme immature	4a (infezione severa)



**Questo sistema di classificazione,
insieme ad una valutazione vascolare,
aiuta a discriminare, quali pazienti :**

- dovrebbero essere ospedalizzati***
- quali dovrebbero richiedere speciali indagini diagnostiche***
- quali richiederanno amputazione***

2012 Infectious Diseases Society of America
Clinical Practice Guideline for the Diagnosis
and Treatment of Diabetic Foot Infections^a

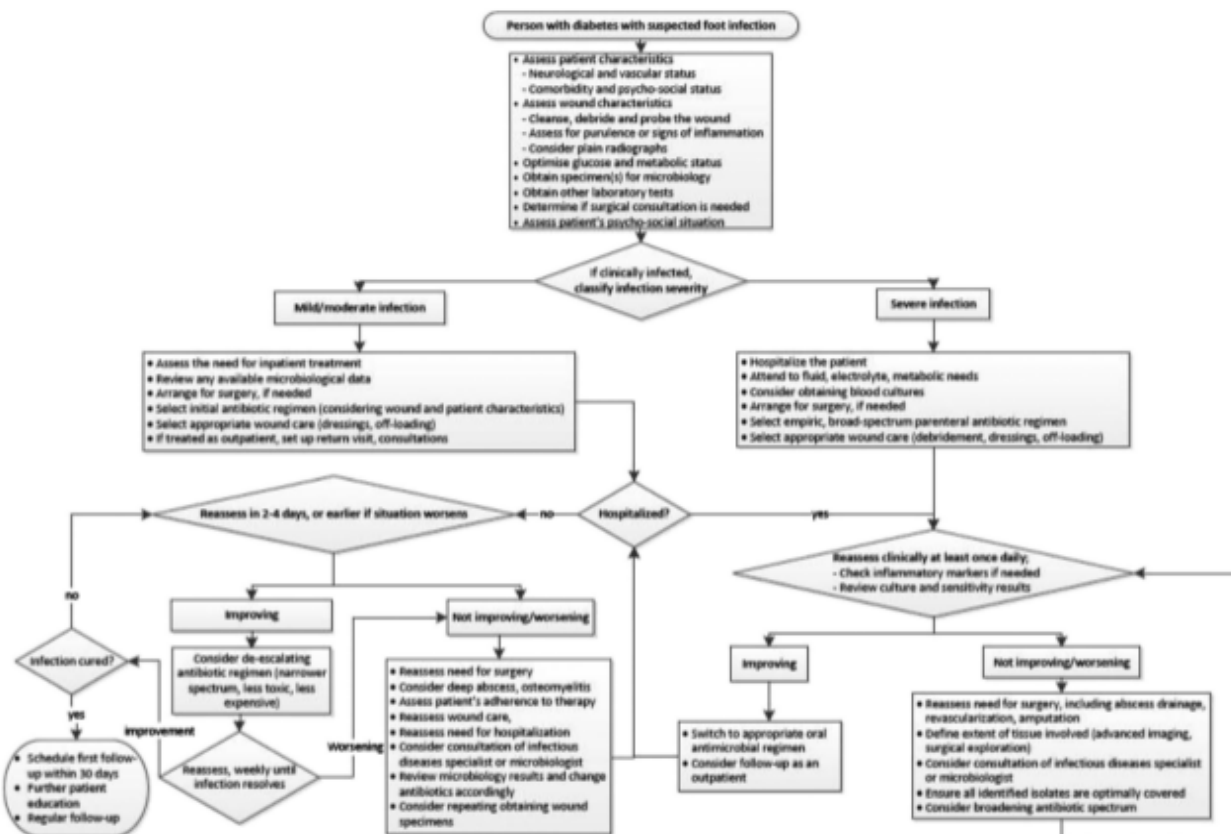


Figure 2. Algorithm overview of the approach to the patient with diabetes and a foot infection

La figura mostra un algoritmo sull'approccio al trattamento di un paziente diabetico con infezione al piede



DIABETES/METABOLISM RESEARCH AND REVIEWS

Diabetes Metab Res Rev 2016; 32(Suppl. 1): 45–74

Published online in Wiley Online Library (wileyonlinelibrary.com) DOI: 10.1002/dmrr.2699

SUPPLEMENT ARTICLE

IWGDF guidance on the diagnosis and management of foot infections in persons with diabetes

Benjamin A. Lipsky^{1,2*}

Javier Aragón-Sánchez³

Mathew Diggle⁴

John Embil⁵

Shigeo Kono⁶

Lawrence Lavery⁷

Éric Senneville⁸

Vilma Urbančič-Rovan⁹

Suzanne Van Asten^{7,10}

Edgar J. G. Peters¹⁰

Recommendations

Classification/diagnosis

1. Diabetic foot infection must be diagnosed clinically, based on the presence of local or systemic signs or symptoms of inflammation (strong; low).
2. Assess the severity of any diabetic foot infection using the Infectious Diseases Society of America/International Working Group on the Diabetic Foot classification scheme (strong; moderate).

Osteomyelitis



Surgical treatment

- 16. Consult a surgical specialist in selected cases of moderate, and all cases of severe, DFI (Weak; Low)
- 17. Perform urgent surgical interventions in cases of deep abscesses, compartment syndrome and virtually all necrotizing soft tissue infections (Strong; Low)
- 18. Consider surgical intervention in cases of osteomyelitis accompanied by: spreading soft tissue infection; destroyed soft tissue envelope; progressive bone destruction on X-ray, or bone protruding through the ulcer (Strong; Low)

Surgical treatment

17. Perform urgent surgical interventions in cases of deep abscesses, compartment syndrome and virtually all necrotizing soft tissue infections.

B. A. Lipsky et al.

Diabetes Metab Res Rev 2016; 32(Suppl. 1): 45-74 DOI: 10.1002/dmrr



Chirurgia d'urgenza nel piede diabetico

È necessaria in specifiche circostanze:

- **Ascesso e Flemmone**
- **Gangrena umida e gassosa**
- **Fascite necrotizzante**
- **Sindrome compartimentale**
- **Sepsi sistemica**

Aragon-Sanchez J: Seminar review: a review of the basis of surgical treatment of diabetic foot infections. Int J Low Extrem Wounds 10:33-65, 2011

CHIRURGIA D'URGENZA

Sono tutti gli interventi volti a eliminare o a ridurre la progressione delle infezioni acute o della gangrena.

- **Drenaggio di ascessi o flemmoni**
- **Fasciotomie decompressive del piede e della gamba**
- **Bonifiche dei focolai osteomielitici**

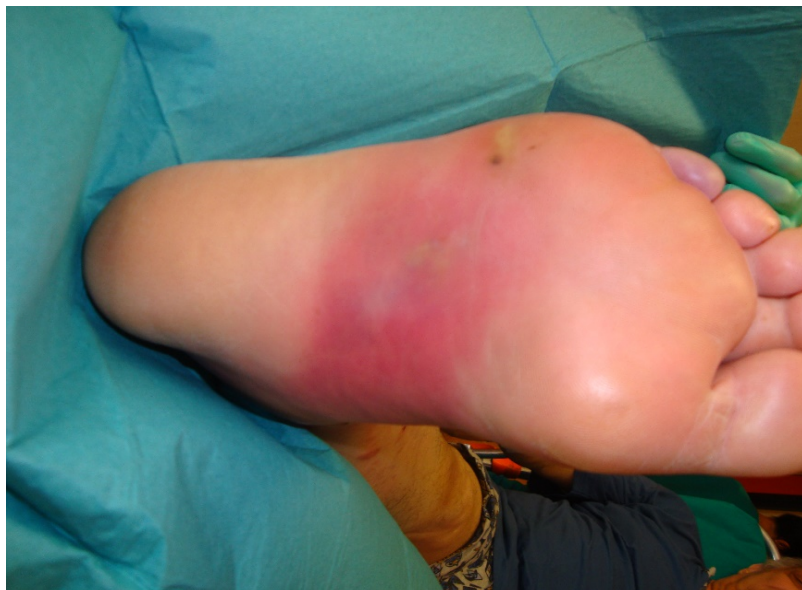
Caratteristica comune è quella di essere drastica e tempestiva perché in queste condizioni ogni giorno di ritardo nell'esecuzione dell'intervento si associa a un aumento del rischio di amputazione





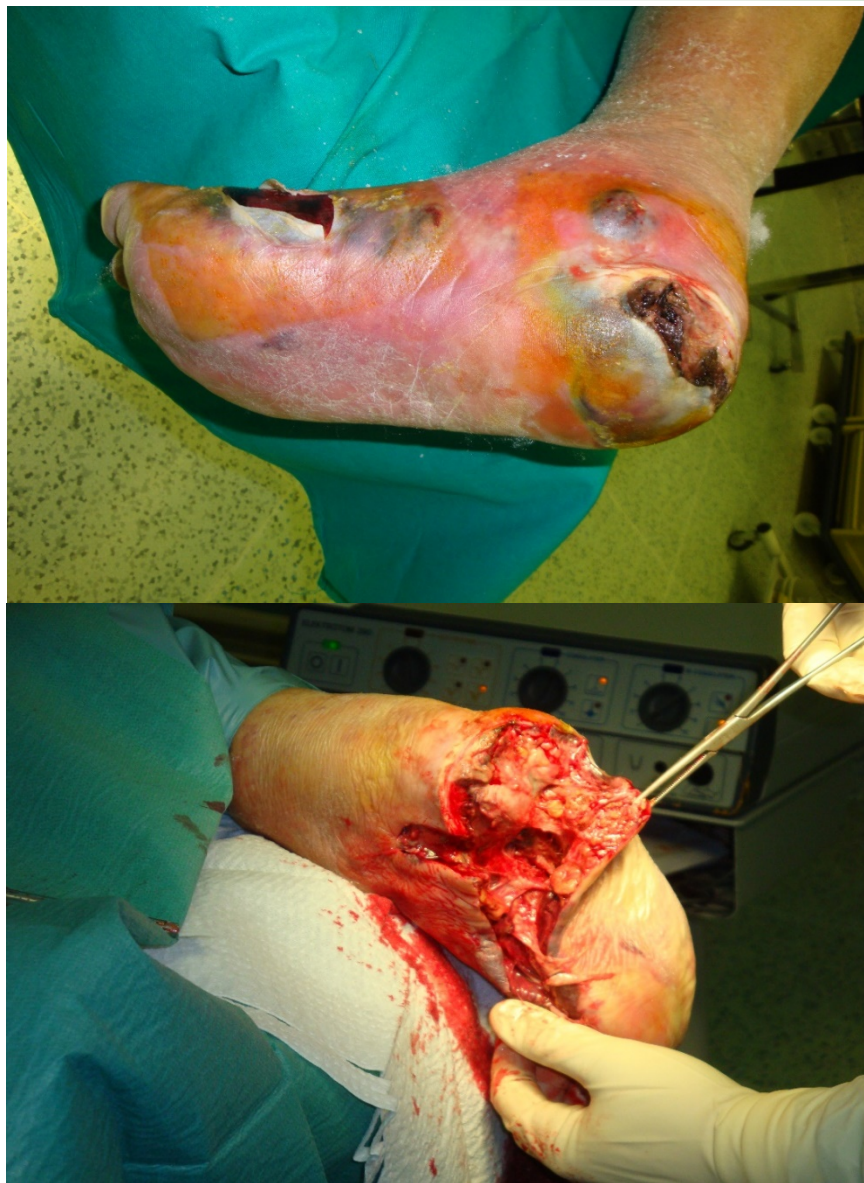
Ascesso e Flemmone

- Le raccolte ascessuali e i flemmoni sono le sacche di pus che si formano a livello dei tessuti interni e possono rendersi:
 - evidenti spontaneamente (fistole superficiali)
 - nascondersi in profondità (sacche purulente)









Piede
ischemico
con
flemmone



- Il trattamento di un'infezione del piede diabetico dovrebbe essere portato a termine da un chirurgo esperto conoscitore dell'anatomia del piede e delle modalità con le quali una infezione si diffonde attraverso i piani fasciali.
- Lo scopo del trattamento chirurgico è drenare ogni raccolta profonda di pus e ridurre al minimo il tessuto necrotico e decomprimere i compartimenti del piede, rimuovendo tutto il tessuto devitalizzato e infetto.

Armstrong DG, Lipsky BA: Diabetic foot infections: stepwise medical and surgical management. Int Wound J 1:123-132, 2004

Aragon-Sanchez J: Seminar review: a review of the basis of surgical treatment of diabetic foot infections. Int J Low Extrem Wounds 10:33-65, 2011









GANGRENA

È la necrosi a tutto spessore dei tessuti molli e può coinvolgere falangi, dita ed estendersi a tutto il piede



Gangrena secca

- È un'urgenza relativa
- Può trasformarsi da secca ad umida
- La rimozione è chirurgica
- È indicata la rivascolarizzazione preoperatoria



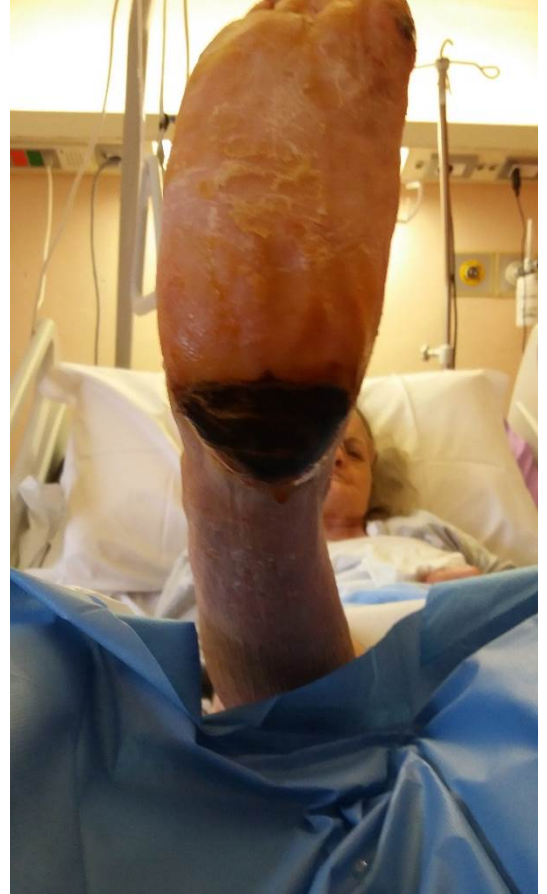
Gangrena secca

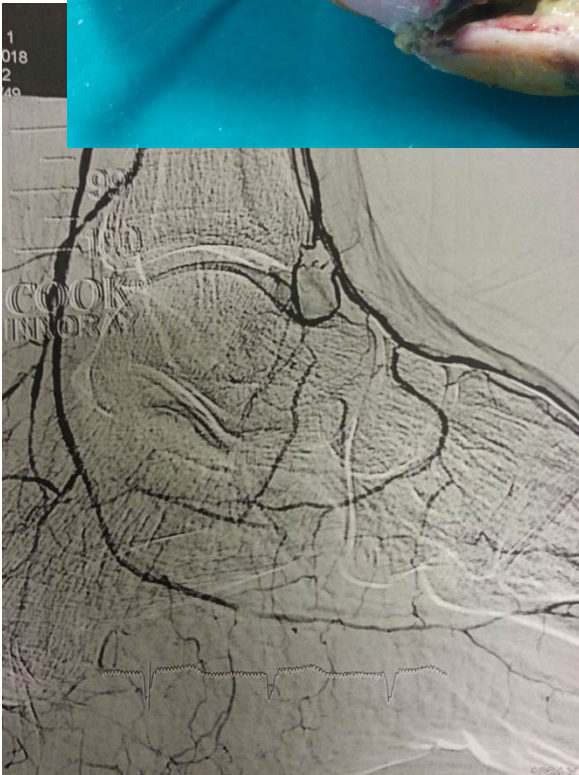




Gangrena secca









Gangrena umida e gassosa

- È un' urgenza assoluta
- Trattamento chirurgico con rimozione dei tessuti necrotici e infetti
- Terapia antibiotica
- Eventuale OTI



Gangrena umida





Gangrena umida





FASCITE NECROTIZZANTE

L'infezione può estendersi in poche ore o pochi giorni tramite la fascia che ricopre i muscoli.

La fascia appare grigia e necrotica e il tessuto sottocutaneo risulta scollato e necrotico.

Obbligatorio:

- Intervento immediato (rimozione dei tessuti necrotici infetti)
- Terapia antibiotica

In presenza di germi anaerobi può essere utile l' OTI.

Fascite necrotizzante



Fascite necrotizzante



Fascite necrotizzante





Fascite necrotizzante



OTI





Fascite necrotizzante

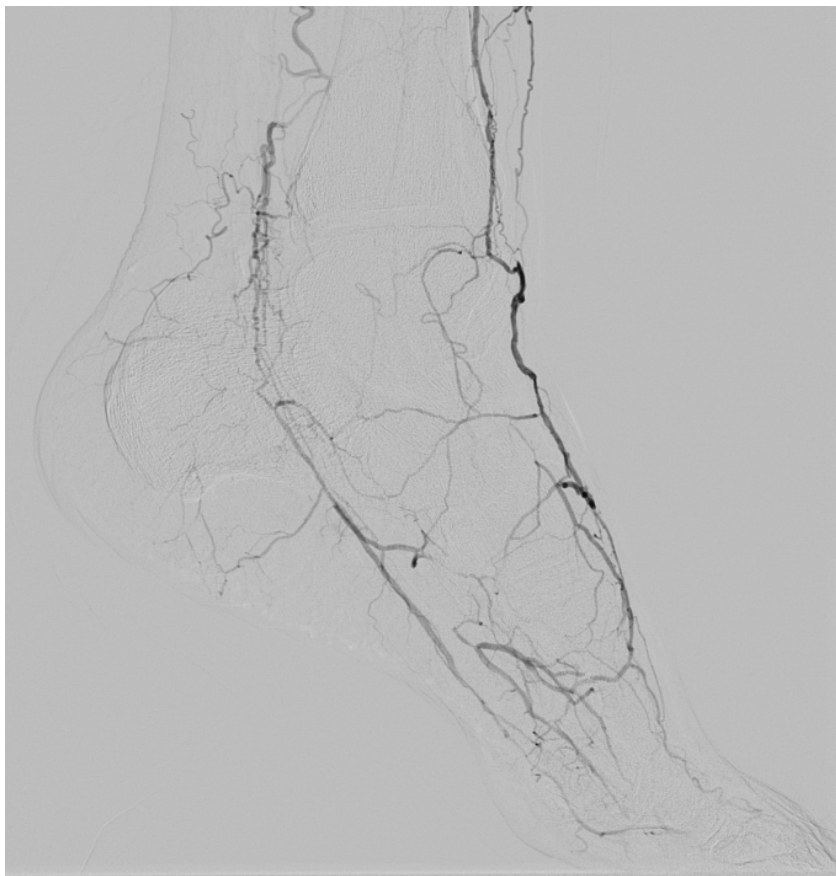




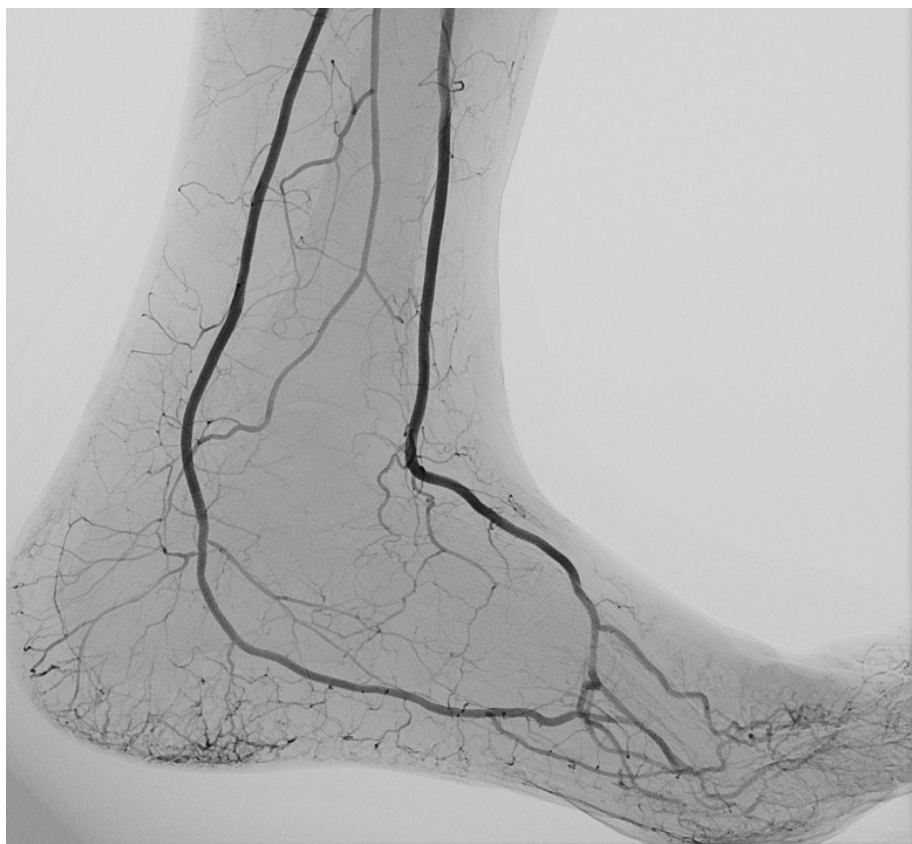
Cosa è importante nella chirurgia del piede diabetico infetto ?

1. Timing
2. Adeguata vascolarizzazione
3. Livello di amputazione
4. Rapida chiusura o riepitelizzazione
(concetto di « *clean and close* »)
5. Gestione post-operatoria
6. Prevenzione di recidive





per gentile concessione del dr. Ferraresi



per gentile concessione del dr. Ferraresi





The Role of Early Surgical Debridement and Revascularization in Patients With Diabetes and Deep Foot Space Abscess: Retrospective Review of 106 Patients With Diabetes

Ezio Faglia, MD,¹ Giacomo Clerici, MD,² Maurizio Caminiti, MD,³
Antonella Quarantiello, MD,⁴ Michela Gino, MD,⁵ and Alberto Morabito, PhD⁶

The Journal of Foot & Ankle Surgery, 2006

TABLE 4 Final outcome of surgical treatment of patients directly hospitalized (group A) and referred from other hospitals (group B)

Surgical intervention	Group A	Group B	
Drainage without amputation	9	4	
One or more ray amputation	21	21	$\chi^2 = 24.4$
Transmetatarsal amputation	12	10	$P < .001$
Chopart amputation	1	23	
Above-the-ankle amputation	—	5	

IWGDF Guidance on the diagnosis and management of foot infections in persons with diabetes

Prepared by the IWGDF Working Group on Foot Infections

Recommendations

Introduction

Pathophysiology

Diagnosis and Classification

Soft tissue infection

Osteomyelitis

Assessing severity

Microbiological considerations

Treatment

Key Controversies

References

Systematic review

Recommendations

Classification/Diagnosis

1. Diabetic foot infection must be diagnosed clinically, based on the presence of local or systemic signs or symptoms of inflammation (Strong; Low).
2. Assess the severity of any diabetic foot infection using the Infectious Diseases Society of America/International Working Group on the Diabetic Foot classification scheme (Strong; Moderate)

Osteomyelitis

3. For an infected open wound, perform a probe-to-bone test; in a patient at low risk for osteomyelitis a negative test largely rules out the diagnosis, while in a high risk patient a positive test is largely diagnostic (Strong; High)
4. Markedly elevated serum inflammatory markers, especially erythrocyte sedimentation rate, are suggestive of osteomyelitis in suspected cases (Weak; Moderate)
5. A definite diagnosis of bone infection usually requires positive results on microbiological (and, optimally, histological) and examinations of an aseptically obtained bone sample, but this is usually required only when the diagnosis is in doubt or determining the causative pathogen's antibiotic susceptibility is crucial (Strong; Moderate)
6. A probable diagnosis of bone infection is reasonable if there are positive results on a combination of diagnostic tests, such as probe-to-bone, serum inflammatory markers, plain X-ray, MRI or radionuclide scanning (Strong; Weak)
7. Avoid using results of soft tissue or sinus tract specimens for selecting antibiotic therapy for osteomyelitis as they do not accurately reflect bone culture results (Strong; Moderate)
8. Obtain plain X-rays of the foot in all cases of non-superficial diabetic foot infection. (Strong; Low)





Surgical treatment

16. Consult a surgical specialist in selected cases of moderate, and all cases of severe, DFI (Weak; Low)
17. Perform urgent surgical interventions in cases of deep abscesses, compartment syndrome and virtually all necrotizing soft tissue infections (Strong; Low)
18. Consider surgical intervention in cases of osteomyelitis accompanied by: spreading soft tissue infection; destroyed soft tissue envelope; progressive bone destruction on X-ray, or bone protruding through the ulcer (Strong; Low)





Probing to Bone in Infected Pedal Ulcers

A Clinical Sign of Underlying Osteomyelitis in Diabetic Patients

M. Lindsay Grayson, MD; Gary W. Gibbons, MD; Karoly Balogh, MD; Elaine Levin; Adolf W. Karchmer, MD

JAMA. 1995;273(9):721-723. doi:10.1001/jama.1995.03520330051036.

Text Size: **A** A A

Article

References

ABSTRACT

[ABSTRACT](#) | [REFERENCES](#)

Objective. —To assess a bedside technique for diagnosing osteomyelitis.

Design. —We prospectively assessed infected pedal ulcers for detectable bone by probing with a sterile, blunt, stainless steel probe. We then examined the relationship between detection of bone and the presence or absence of osteomyelitis that was defined histopathologically and/or clinically.

Setting. —A tertiary care center.

Patients. —Seventy-five hospitalized diabetic patients with a total of 76 infected foot ulcers were studied.

Results. —Osteomyelitis was diagnosed in 50 instances (66%) and was excluded in 26 instances.

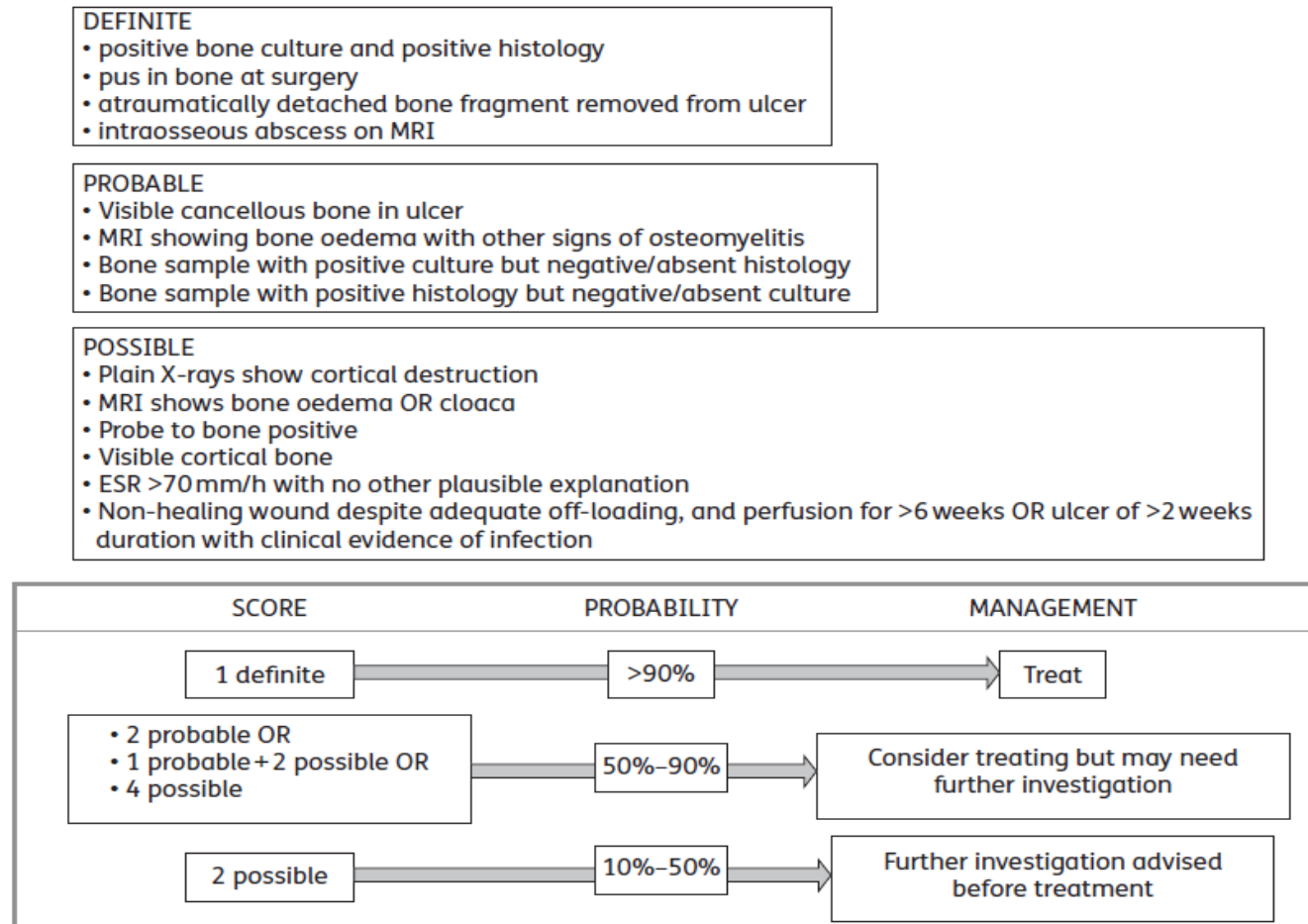


Figure 2. Diagnostic criteria to guide the management of osteomyelitis in patients with diabetic foot disease (modified from Berendt *et al.*²⁴).

CLINICAL RESEARCH ARTICLE

Consensus on surgical aspects of managing osteomyelitis in the diabetic foot

Sachin Allahabadi, BS, BA¹, Kareem B. Haroun, BS¹,
Daniel M. Musher, MD², Benjamin A. Lipsky, MD^{3,4,5} and
Neal R. Barshes, MD, MPH^{6*}

¹Baylor College of Medicine, Houston, Texas; ²Division of Infectious Diseases, Department of Medicine, Baylor College of Medicine, Houston, Texas; ³Department of Medicine, University of Washington, Seattle; ⁴Department of Medicine (Infectious Diseases), University of Geneva, Geneva, Switzerland; ⁵Department of Medicine, Green Templeton College, University of Oxford, Oxford, United Kingdom; ⁶Division of Vascular Surgery and Endovascular Therapy, Michael E. DeBakey Department of Surgery, Baylor College of Medicine / Michael E. DeBakey Veterans Affairs Medical Center, Houston, Texas

Background: The aim of this study was to develop consensus statements that may help share or even establish 'best practices' in the surgical aspects of managing diabetic foot osteomyelitis (DFO) that can be applied in appropriate clinical situations pending the publication of more high-quality data.

Methods: We asked 14 panelists with expertise in DFO management to participate. Delphi methodology was used to develop consensus statements. First, a questionnaire elicited practices and beliefs concerning various

**Table 2.** Consensus statements for *initial diagnosis* and *selection of patients* for operative management of diabetic forefoot osteomyelitis

Item	Statement	Mean rating
A-1	Identifying visible, chronically exposed trabecular bone visible within a forefoot ulcer is sufficient for establishing the diagnosis of DFO.	7.77
A-2	MRI and/or bone biopsy are preferred second-line diagnostic modalities to confirm the presence of DFO when X-rays and clinical exam alone are suspicious but not sufficient to diagnose DFO.	7.93
A-3	Systemic toxicity in the presence of DFO with associated soft tissue infection, represents an absolute indication for surgical resection of bone.	7.93
A-4	Bone resection is recommended when substantial cortical destruction, osteolysis, macroscopic bone fragmentation (sequestra), or necrotic bone is seen on X-ray.	7.69
A-5	Débridement/resection of bone is recommended when visible, chronically exposed trabecular bone is identified within a forefoot ulcer.	7.31
A-6	An open or infected joint space represents an absolute indication for surgical resection of bone.	7.29
A-7	DFO in patients with prosthetic heart valves represents an absolute indication for surgical resection of bone.	7.00

DFO, diabetic foot osteomyelitis.

	Item	Statement	Mean rating
A	B-1	Concomitant deep soft tissue infection (i.e. abscess, joint space infection) or soft tissue necrosis should be drained/debrided and controlled prior to the definitive bone resection and soft tissue closure/reapproximation over remaining bone.	7.50
	B-2	Negative pressure wound therapy dressings with instillation may be considered for use during the intervals between serial operations done for soft tissue infection with DFO.	7.21
	B-3	Whenever feasible, bone resection should continue until grossly healthy bone is seen (specifically, bone with normal caliber, smooth cortical contour, firm density, and punctate bleeding).	8.29
	B-4	The extent of bone resection should include all areas of significant cortical destruction seen on plain X-ray and any grossly infected, necrotic or fragmented bone.	8.21
	B-5	Grossly abnormal or infected bone should be sent for microbiology.	8.64
	B-6	Operative bone specimens sent for microbiology should include microscopic examination of a gram-stained smear as well as aerobic and anaerobic cultures.	7.50
	B-7	Grossly abnormal or infected bone should be sent for histopathology.	7.93
	B-8	A sample of the proximal-most bone resected (i.e. a bone margin specimen) should be labeled separately and sent for histopathology.	7.29
	B-9	A sample of the proximal-most bone resected (i.e. a bone margin specimen) should be labeled separately and sent for microbiology.	7.50
	B-10	A power saw is the preferred instrument for transecting bone.	7.00
	B-11	The definitive (final) bone resection and any attempted delayed primary closure of skin and soft tissue should be done 3–7 days after soft tissue infection or necrosis has been addressed and appropriate antibiotic therapy has been begun.	7.57
	B-12	It is preferable that grossly normal-appearing bone margins are obtained at the time of final planned operative debridement.	8.14
	B-13	Partial ostectomy of the distal metatarsal and/or proximal phalanx is an acceptable alternative to ray amputation for selected patients with osteomyelitis if the remaining bone was not radiographically involved and looks normal at surgery, and if abnormal biomechanics of the residual forefoot are not anticipated.	7.93
	B-14	Adjunctive tendo-achilles lengthening should always be considered when significant ankle equinus deformity (inability to dorsiflex ankle past neutral) is present.	7.50
	B-15	Podiatric/orthopedic procedures should always be considered to address significant forefoot biomechanical issues (e.g. hallux valgus and hammer toe deformities) when these pose risk of reulceration or new ("transfer") ulcers.	7.14



OSTEOMIELEITE ?





FONDAMENTALE DETERMINARE LA SEVERITÀ DELL'INFEZIONE





Table 2. Infectious Diseases Society of America and International Working Group on the Diabetic Foot Classifications of Diabetic Foot Infection

Clinical Manifestation of Infection	PEDIS Grade	IDSA Infection Severity
No symptoms or signs of infection	1	Uninfected
Infection present, as defined by the presence of at least 2 of the following items:		
• Local swelling or induration • Erythema • Local tenderness or pain • Local warmth • Purulent discharge (thick, opaque to white or sanguineous secretion)		
Local infection involving only the skin and the subcutaneous tissue (without involvement of deeper tissues and without systemic signs as described below). If erythema, must be >0.5 cm to ≤2 cm around the ulcer. Exclude other causes of an inflammatory response of the skin (eg, trauma, gout, acute Charcot neuro-osteopathy, fracture, thrombosis, venous stasis).	2	Mild
Local infection (as described above) with erythema > 2 cm, or involving structures deeper than skin and subcutaneous tissues (eg, abscess, osteomyelitis, septic arthritis, fasciitis), and No systemic inflammatory response signs (as described below)	3	Moderate
Local infection (as described above) with the signs of SIRS, as manifested by ≥2 of the following: • Temperature >38°C or <36°C • Heart rate >90 beats/min • Respiratory rate >20 breaths/min or PaCO₂ <32 mm Hg • White blood cell count >12 000 or <4000 cells/μL or ≥10% immature (band) forms	4	Severe ^a

Abbreviations: IDSA, Infectious Diseases Society of America; PaCO₂, partial pressure of arterial carbon dioxide; PEDIS, perfusion, extent/size, depth/tissue loss, infection, and sensation; SIRS, systemic inflammatory response syndrome.

^a Ischemia may increase the severity of any infection, and the presence of critical ischemia often makes the infection severe. Systemic infection may sometimes manifest with other clinical findings, such as hypotension, confusion, vomiting, or evidence of metabolic disturbances, such as acidosis, severe hyperglycemia, and new-onset azotemia [29, 43, 44].



Per tutte le :

- INFEZIONI SEVERE
- INFEZIONI MODERATE

è consigliato il trattamento chirurgico urgente

nelle INFEZIONI LIEVI

si potrà proseguire con terapia antibiotica per lungo tempo (6-8 settimane)

Lipsky BA: Treating diabetic foot osteomyelitis primarily with surgery or antibiotics: have we answered the question? Diabetes Care 37:593-595, 2014



Recommendation 24:

For diabetic foot osteomyelitis we recommend 6 weeks of antibiotic therapy for patients who do not undergo resection of infected bone and no more than a week of antibiotic therapy if all infected bone is resected. (Strong; Moderate)

CONTROVERSIE

**Per quanto tempo proseguire
la terapia antibiotica mirata
dopo l'asportazione chirurgica
del focolaio osteomielitico ??**

**Table 9. Suggested route, setting, and durations of antibiotic therapy, by clinical syndrome.**

Site, by severity or extent, of infection	Route of administration	Setting for therapy	Duration of therapy
Soft-tissue only			
Mild	Topical or oral	Outpatient	1–2 Weeks; may extend up to 4 weeks if slow to resolve
Moderate	Oral (or initial parenteral)	Outpatient/inpatient	2–4 Weeks
Severe	Initial parenteral, switch to oral when possible	Inpatient, then outpatient	2–4 Weeks
Bone or joint			
No residual infected tissue (e.g., post-amputation)	Parenteral or oral	...	2–5 Days
Residual infected soft tissue (but not bone)	Parenteral or oral	...	2–4 Weeks
Residual infected (but viable) bone	Initial parenteral, then consider oral switch	...	4–6 Weeks
No surgery, or residual dead bone postoperatively	Initial parenteral, then consider oral switch	...	>3 Months



BIOVETRI

Il professor **Larry Hench** li scoprì nel 1969 presso l'Università della Florida a Gainesville.
Il biovetro è una ceramica vetrosa composta da :

- Biossido di silicio (45%)
- Ossido di sodio (24.5%)
- Ossido di calcio (24.5%)
- Pentossido di fosforo (6%)





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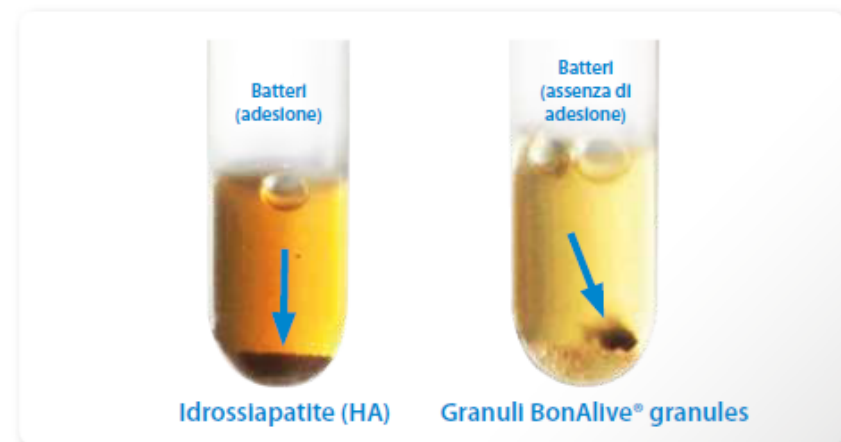
Batteri Gram-positivi

*Bacillus cereus**Bifidobacterium adolescentis**Clostridium difficile**Clostridium perfringens**Clostridium septicum**Corynebacterium ulcerans**Enterobacter cloacae**Enterococcus faecalis**Enterococcus faecium**Eubacterium lentum**Listeria monocytogenes**Micrococcus sp.**Mycobacterium tuberculosis**Peptostreptococcus anaerobius**Peptostreptococcus magnus**Propionibacterium acnes**Propionibacterium propionicus**Staphylococcus aureus**Staphylococcus epidermidis**Staphylococcus hominis**Staphylococcus lugdunensis**Streptococcus agalactiae**Streptococcus mutans**Streptococcus pneumoniae**Streptococcus pyogenes**Streptococcus sanguis*

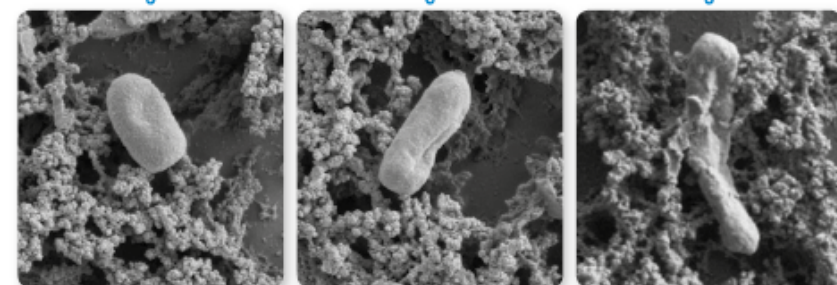
Batteri Gram-negativi

*Acinetobacter baumannii**Bacteroides fragilis**Bacteroides thetaiotaomicron**Chryseobacterium* (in precedenza *Flavobacterium*) *meningosepticum**Enterobacter aerogenes**Enterobacter amnigenus**Escherichia coli**Fusobacterium necrophorum**Fusobacterium nucleatum**Haemophilus influenzae**Klebsiella pneumoniae**Monaxella cavaarthalis**Neisseria meningitidis**Pasteurella multocida**Porphyromonas gingivalis**Prevotella intermedia**Prevotella melaninogenica**Prevotella mirabilis**Pseudomonas aeruginosa**Salmonella typhimurium**Shigella sonnei**Veillonella parvula**Yersinia enterocolitica*

Batteri resistenti alla meticillina

*Pseudomonas aeruginosa**Staphylococcus aureus* (MRSA)*Staphylococcus epidermidis* (MRSE)

I test batteriologici eseguiti utilizzando ceppi di *Porphyromonas gingivalis* pigmentati mostrano che i batteri non riescono ad aderire e proliferare sulla superficie dei granuli BonAlive® granules.



Le immagini illustrano l'effetto del cristallo bioattivo S53P4 sui batteri *Staphylococcus aureus*, *Klebsiella pneumoniae* e *Acinetobacter baumannii*, resistenti alla meticillina. L'inibizione della proliferazione batterica è rilevabile tramite variazioni morfologiche dei batteri quali deformazione delle cellule e comparsa di fori nelle membrane cellulari.



Uso di BIOACTIVE GLASS S53P4 nel trattamento della Osteomielite del Piede Diabetico: STUDIO RETROSPETTIVO - COMPARATIVO

- Studio comparativo retrospettivo 44 pazienti diabetici affetti da osteomielite localizzata a livello del piede
- Debridement del focolaio osteomielitico e applicazione locale di bioactive glass S53P4 (gruppo A) di 22 pz
- Abbiamo osservato lo stesso numero di pazienti con le stesse caratteristiche (gruppo B) sottoposti a trattamento tradizionale (debridement e/o ad amputazione)



Uso di BIOACTIVE GLASS S53P4 nel trattamento della Osteomielite del Piede Diabetico: STUDIO RETROSPETTIVO - COMPARATIVO

Entrambi i gruppi erano stati trattati con :

- terapia antibiotica sistemica sulla base del risultato di esami colturali microbiologici
- in tutti i pazienti era stato valutato il grado di vascolarizzazione periferica e se non sufficiente erano stati sottoposti a rivascolarizzazione mediante angioplastica endoluminale



Uso di BIOACTIVE GLASS S53P4 nel trattamento della Osteomielite del Piede Diabetico: STUDIO RETROSPETTIVO - COMPARATIVO RISULTATI (1) :

dopo lo stesso periodo di follow up (15 ± 6 mesi) :
la risoluzione della osteomielite era significativamente
aumentata nel gruppo A trattato con Bioactive glass
confrontato con il gruppo B (90% vs. 61,9%,
rispettivamente $p = 0.03$)

	Overall	Bioglass	Controls	P
Percutaneous transluminal angioplasty (%)	70.5	72.7	68.2	0.74
Hospitalization (days)	13.1 $\pm$ 10.1	12.9 $\pm$ 10.2	13.2 $\pm$ 10.3	0.94
Antibiotic therapy (%)	28.6	13.6	45.0	0.07
Wound healing (days)	145.6 $\pm$ 77.7	162.6 $\pm$ 82.1	120.8 $\pm$ 65.8	0.14
Osteomyelitic focus recurrence (%)	12.5	5.5	21.4	0.18
Osteomyelitis resolution (%)	75.6	90.0	61.9	0.03



Uso di BIOACTIVE GLASS S53P4 nel trattamento della Osteomielite del Piede Diabetico: STUDIO RETROSPETTIVO - COMPARATIVO

RISULTATI (2) :

La probabilità del gruppo trattato con Bioactive glass di raggiungere la risoluzione dell'osteomielite era 5.54 volte più grande rispetto al gruppo trattato con trattamento tradizionale (OR 5.54, 95% CI 1.10-30.5)

	Overall	Bioglass	Controls	P
Percutaneous transluminal angioplasty (%)	70.5	72.7	68.2	0.74
Hospitalization (days)	13.1±10.1	12.9±10.2	13.2±10.3	0.94
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Uso di BIOACTIVE GLASS S53P4 nel trattamento della Osteomielite del Piede Diabetico: STUDIO RETROSPETTIVO - COMPARATIVO

RISULTATI (3) :

L'uso del Bioactive glass era associato all'81% di minore probabilità di terapia antibiotica rispetto al gruppo B trattato con solo debridement chirurgico (OR 0.19, 95% CI 0.04-0.87)

	Overall	Bioglass	Controls	P
Percutaneous transluminal angioplasty (%)	70.5	72.7	68.2	0.74
Hospitalization (days)	13.1±10.1	12.9±10.2	13.2±10.3	0.94
Antibiotic therapy (%)	28.6	13.6	45.0	0.07
Wound healing (days)	145.6±77.7	162.6±82.1	120.8±65.8	0.14
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Uso di BIOACTIVE GLASS S53P4 nel trattamento della Osteomielite del Piede Diabetico: STUDIO RETROSPETTIVO - COMPARATIVO

I nostri risultati dimostrano che il debridement dell'osteomielite seguito dall'applicazione di Bioactive glass può essere considerata una valida opzione nel trattamento dell'osteomielite del piede diabetico



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Letter to the Editor

BIOACTIVE GLASS S53P4: a new opportunity for the treatment in the diabetic foot osteomyelitis

ARTICLE INFO

Keywords:

Diabetes
Diabetic foot
Internal medicine

Diabetes mellitus is one of the major public health problems worldwide. With the aging of the population, improvements in living standards, and changes in lifestyle, the prevalence of the disease is growing rapidly. There have been many studies regarding high prevalence of diabetes and diabetes complication among patients admitted to Internal Medicine Wards and costs for diabetic patients, both in North America and Europe. Most have shown that the medical costs of diabetes are responsible for a very high proportion of total healthcare expenditure, with the proportion of costs increasing year by year [1,2].

Although diabetic foot complications occurred in only a small portion of hospitalized diabetic patients the associated hospitalization costs were the highest, and twice that of patients without foot damage. The high cost of diabetic foot damage was associated primarily with a longer LOS because of a relapse of foot ulcers and expensive surgical and rehabilitation costs [3].

Approximately 33% of diabetes-related costs have been linked to the treatment of foot ulcers, the majority of which are related to inpatient hospital admissions, frequently in Internal Medical Wards for the treatment of related diabetic foot infection and osteomyelitis, that require a multidisciplinary approach [4].

Osteomyelitis is a bone infectious process and represents one of the most challenging conditions in diabetic foot; it is usually due to non-healing ulcers and it is associated with high risk of major amputation [5]. Osteomyelitis diagnosis (optimally defined by bone culture and histology) and treatment can be difficult [6]. The surgical debridement of the osteomyelitis process often requires a resection or loss of bone substance that forms an unfilled cavity with repercussions on the firmness, function and strength of the bone. With debridement you cannot be sure that you have removed all the bone involved in the infectious process. The rate of recurrence of osteomyelitis is high, in some cases relapse after some months. It is mandatory an adequate blood flow in the area of the infection, otherwise a distal revascularization is required [7]. Gram positive bacteria as *Staphylococcus aureus* are the most involved in diabetic foot infections. The ulcers complicated by osteomyelitis often require a long antibiotic therapy too, which can induce the development of methicillin-resistant *Staphylococcus aureus* (MRSA) [8]. Often prolonged antibiotic therapy is easily characterized

by side effects that may require interruption. Non-healing, prolonged treatment times and relapses result in high health costs.

Bioactive glass (BAG-S53P4 - BonAlive® granules, Bon Alive Biomaterials Ltd. Finland) is an antibacterial synthetic bone substitute. The BAG-S53P4 received EU approval for the indication of treatment of osteomyelitis in 2011. The antibacterial properties of the glass is ascribed to an elevation of pH and also of osmotic pressure that are caused by the chemical reactions at the glass surface, which take place as soon as the glass is implanted into the body. The antibacterial, osteostimulative and osteoconductive bone substitute BAG-S53P4, is suitable as bone void filler in the treatment of chronic osteomyelitis. The treatment of osteomyelitis can be performed in a one-stage procedure with excellent results. This makes the treatment protocol cost-effective with a trend towards a reduction in the length of the hospital stay as well [9,10].

In our experiences we have treated 25 patients from March 2017 to March 2018 affected by osteomyelitis in diabetic foot and after debridement and antibiotic therapy we have used bioactive glass. The application of the product, after the due debridement of the bone plane affected by the infectious process, was easy and fast. At a mean follow-up of 12 months (6 to 12), all patients showed no sign of recurrence of infection. At latest follow-up, the radiographs showed partial incorporation of all bone substitutes; the biomaterial were still seen on the plain radiographs, although there were no signs of osteolysis or periosteal reactions. These preliminary results seem to be promising for the surgical treatment of chronic osteomyelitis in patients with diabetic foot.

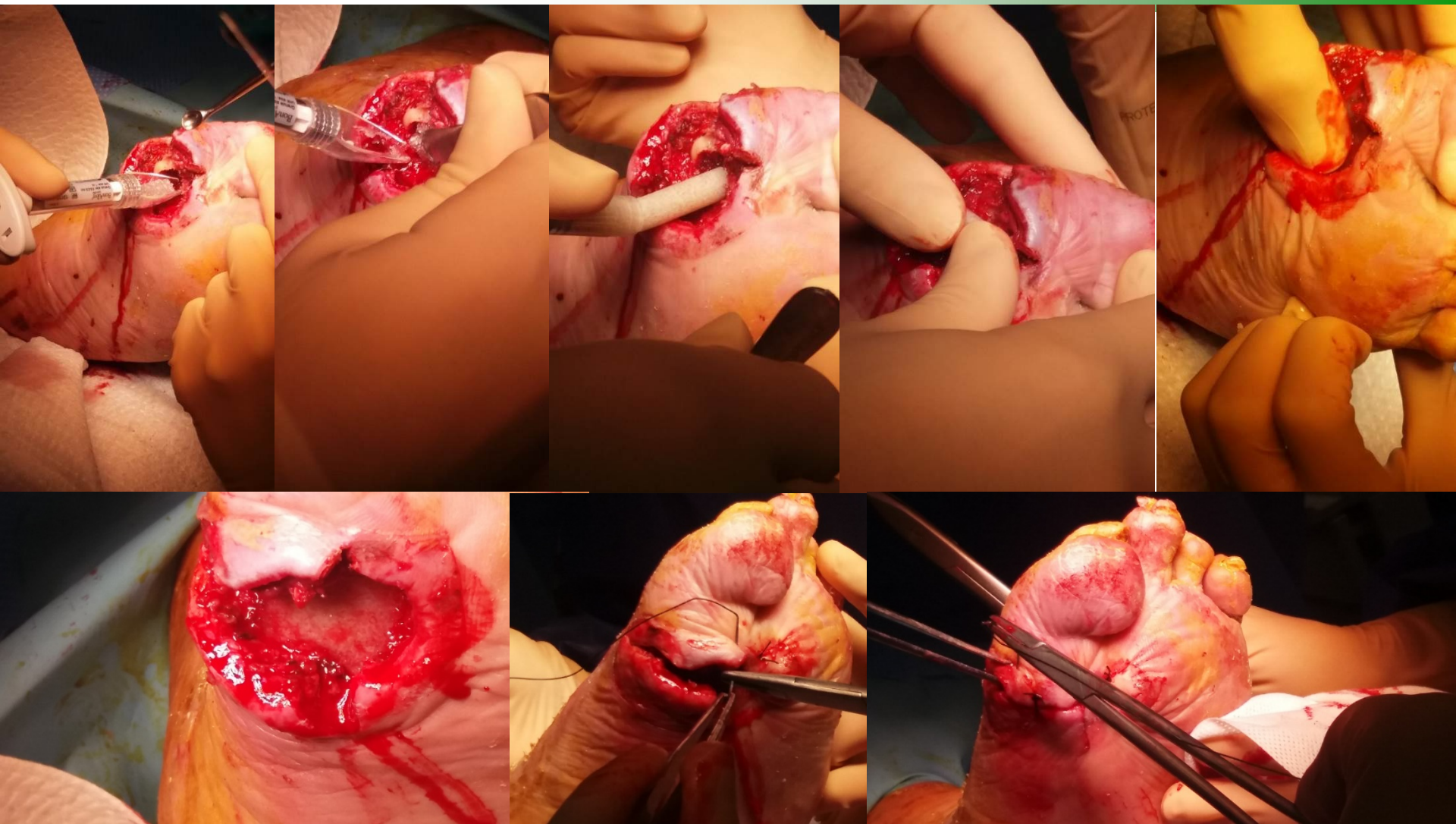
References

- [1] Solli O, Jonsson T, Kristiansen S. Diabetes: cost of illness in Norway. *BMC Endocrinol* 2010;10:15.
- [2] Tunceli O, et al. Cost of diabetes: comparison of disease attributable and matched subject cost estimation methods. *Curr Med Res Opin* 2010;26:3827–34.
- [3] Xiaoyuan BAO, et al. Hospitalization costs and complications in hospitalized patients with type 2 diabetes mellitus in Beijing, China. *J Diabetes* 2017;9:405–11.
- [4] Hilde CW, et al. 15h burden of infected diabetic foot ulcers on hospital admissions and costs. *Ann Vasc Surg* 2016;33:149–54.
- [5] Ezenich M, Larson J, Apollonio J. Deep foot infections in patients with diabetes and

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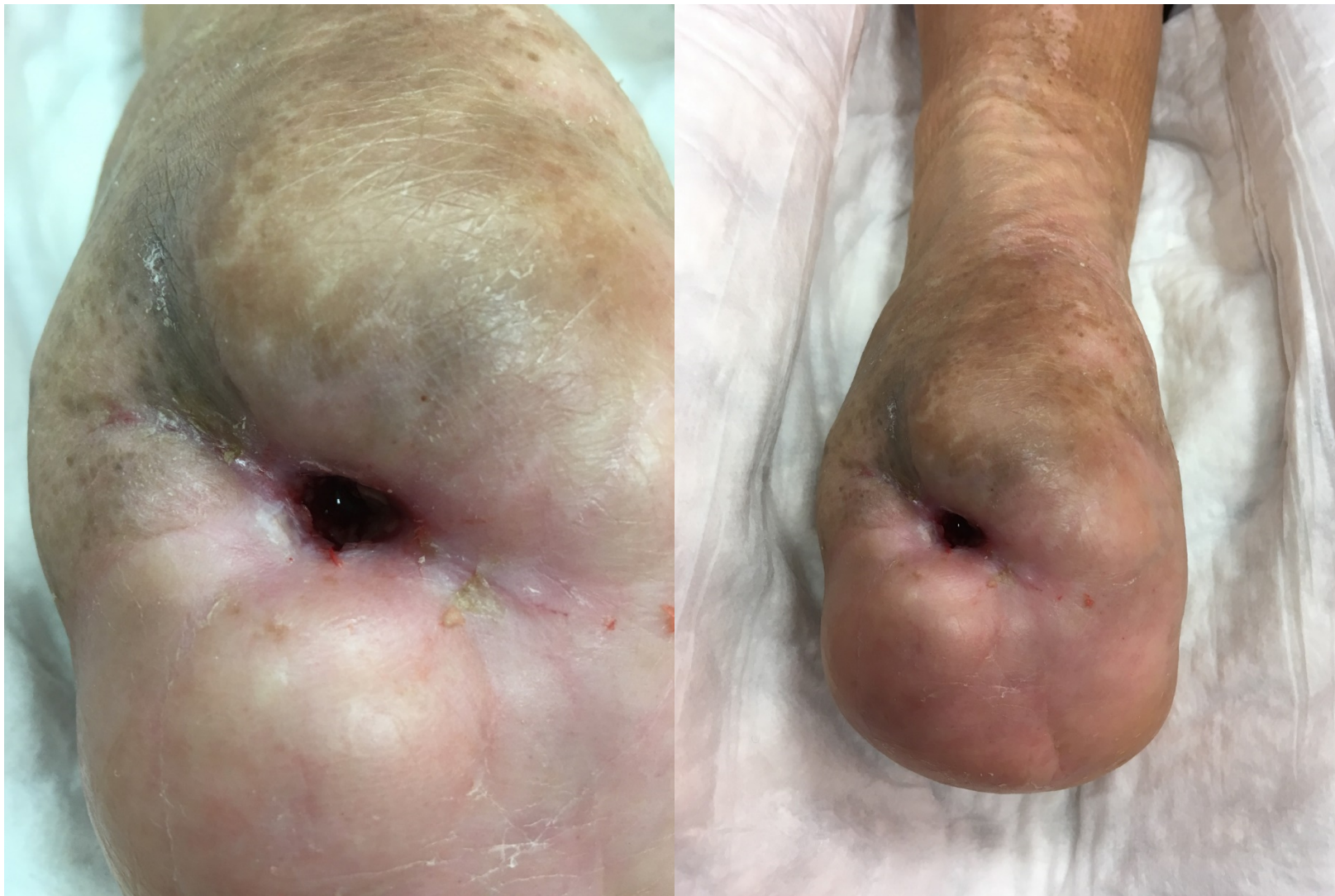
0953-6205/ © 2018 Published by Elsevier B.V. on behalf of European Federation of Internal Medicine.











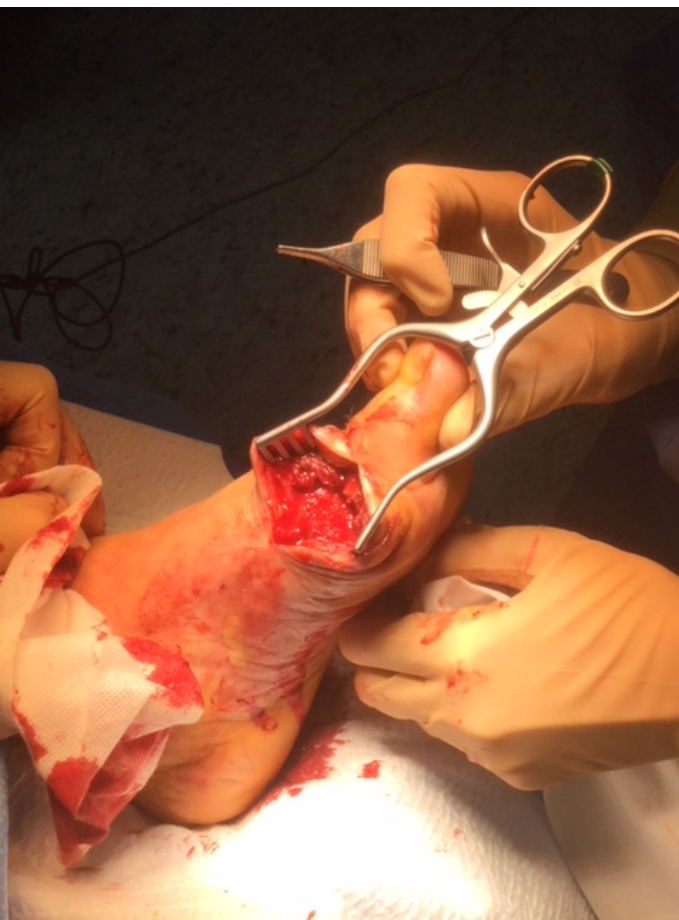




CLINIC CASE

- Female, aged 68
- Type 2 diabetic since 2000
- Thyroidectomy for nodules, in substitutive therapy with LT4
- Smoker: 10 /die
- Three months before start of lesion to the first metatarsal of the right foot
- Comes to our attention for the first time with ulcer I metatarsal ray and positive test probe to bone, previously treated with different therapies without healing.





**Surgical bone
debridement : on
December 21°, 2017**

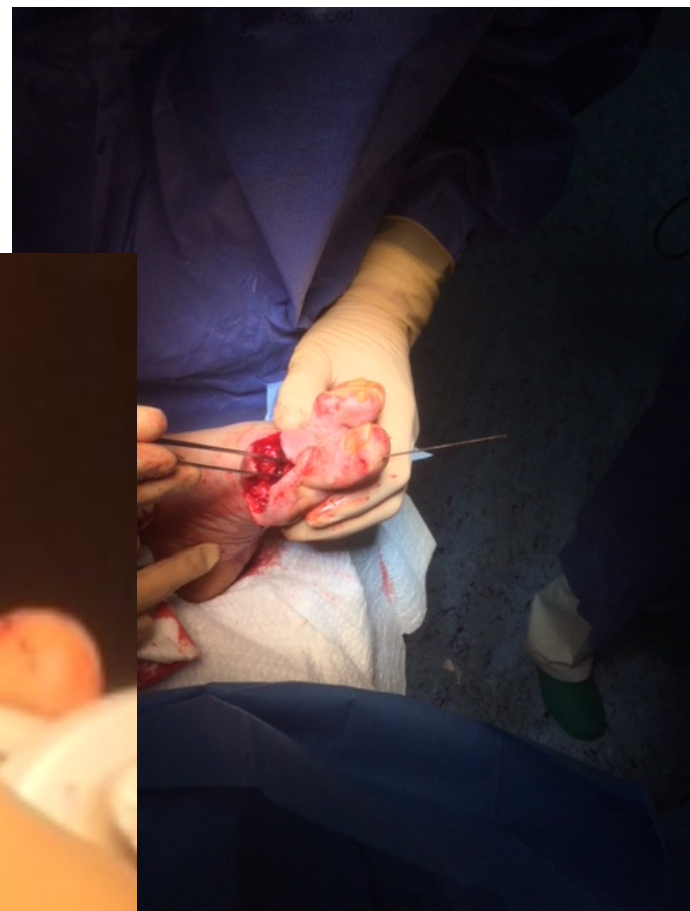
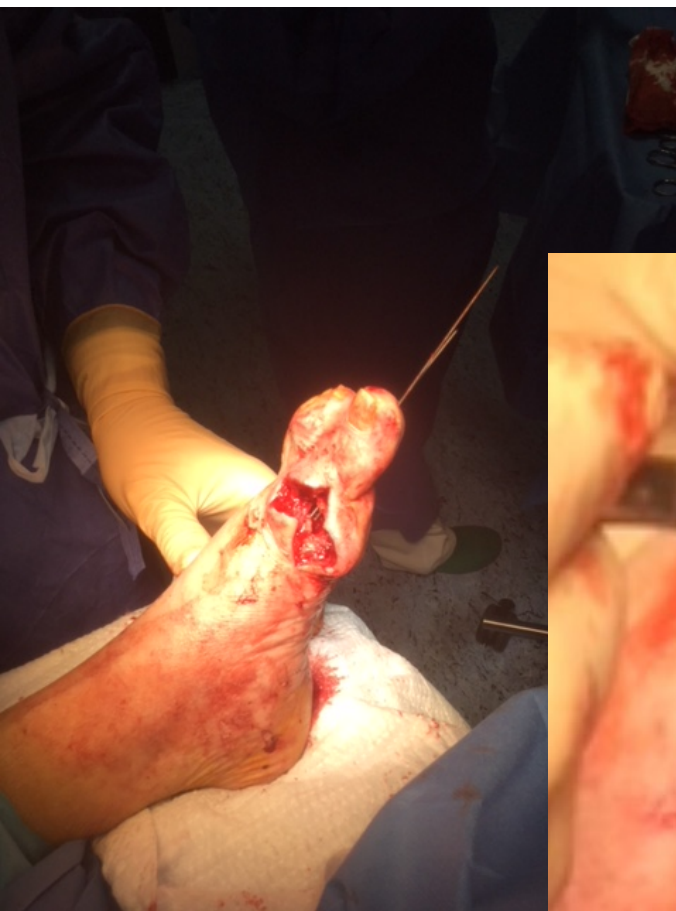
**Antibiotic therapy with
Piperacillin/tazobactam
4,5 gr x 3/die**

No vascular problem





Surgical debridement of the osteomyelitis and stabilization of the metatarsal ray with K-wires arthrodesis



one week after



7 weeks after





9 weeks after





20 weeks after



Neuroartropatia di Charcot: storia naturale

Charcot **ACUTO** → Charcot **CRONICO**

Fase di sviluppo

Fase di coalescenza

Fase di
consolidamento

tempo



Piede di Charcot: diagnosi differenziale

- **Cellulite**
- **Erisipela**
- **TVP**
- **insuffic.venosa**
- **Artrite riacutizzata**
- **Frattura**
- **Artrite settica o gottosa**
- **Osteomielite**
- **Artrite reumatoide**
- **Neuroalgodistrofia**

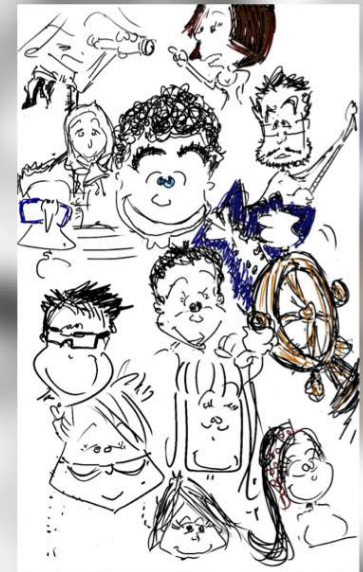


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Dr. De Giglio is forming a DF user group with 8 leading Italian clinics and first meeting is expected to be on the 18th of April. Dr. De Giglio in the middle of the picture.



GRAZIE



