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Trattamento delle Osteomieliti in età pediatrica. Ruolo della F.E.

F.M. Pezzoli, A. Krzysztofiak*,
G. Mastantuoni, F. Falciglia

UOC Ortopedia e Traumatologia
Dir. Francesco Falciglia

**UOC Pediatria e Malattie Infettive*
Resp. L.Lancella

OSPEDALE PEDIATRICO
Bambino Gesù

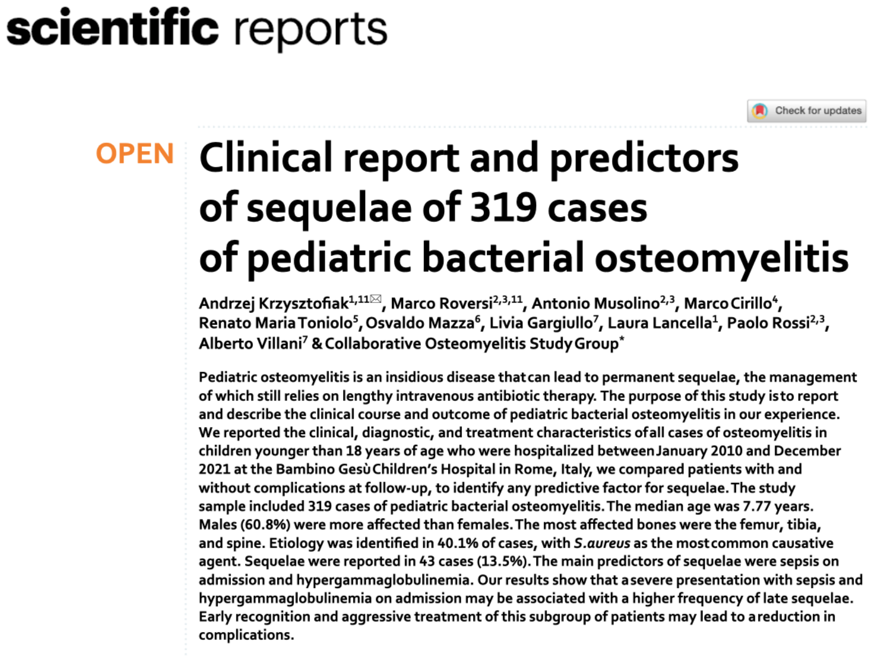
OSTEOMIELITI

Significativa causa di morbilità nei bambini in tutto il mondo (2-13/100.000 bambini/anno)
Possono avere alto tasso di sequele anche gravi e di lunga durata.
La diagnosi tempestiva ed un trattamento adeguato rimangono sempre di primaria importanza

Diagnosi differenziale con patologie tumorali !

Gruppo di studio multidisciplinare

Infettivologi, Ortopedici, Radiologi,
Reumatologi, Microbiologi,
Chirurghi Plastici



scientific reports

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OPEN

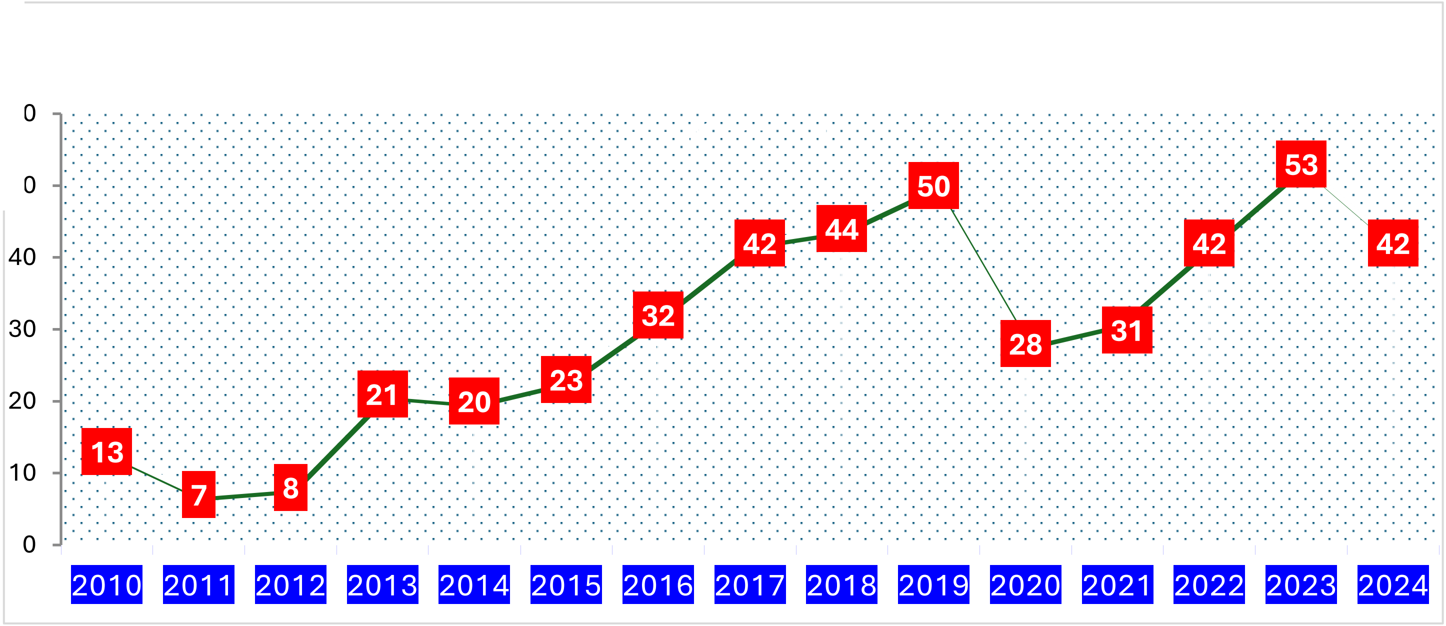
Clinical report and predictors of sequelae of 319 cases of pediatric bacterial osteomyelitis

Andrzej Krzysztofiak[1,11]✉, Marco Roversi[2,3,11], Antonio Musolino[2,3], Marco Cirillo[4], Renato Maria Toniolo[5], Osvaldo Mazza[6], Livia Gargiullo[7], Laura Lancella[1], Paolo Rossi[2,3], Alberto Villani[7] & Collaborative Osteomyelitis Study Group*

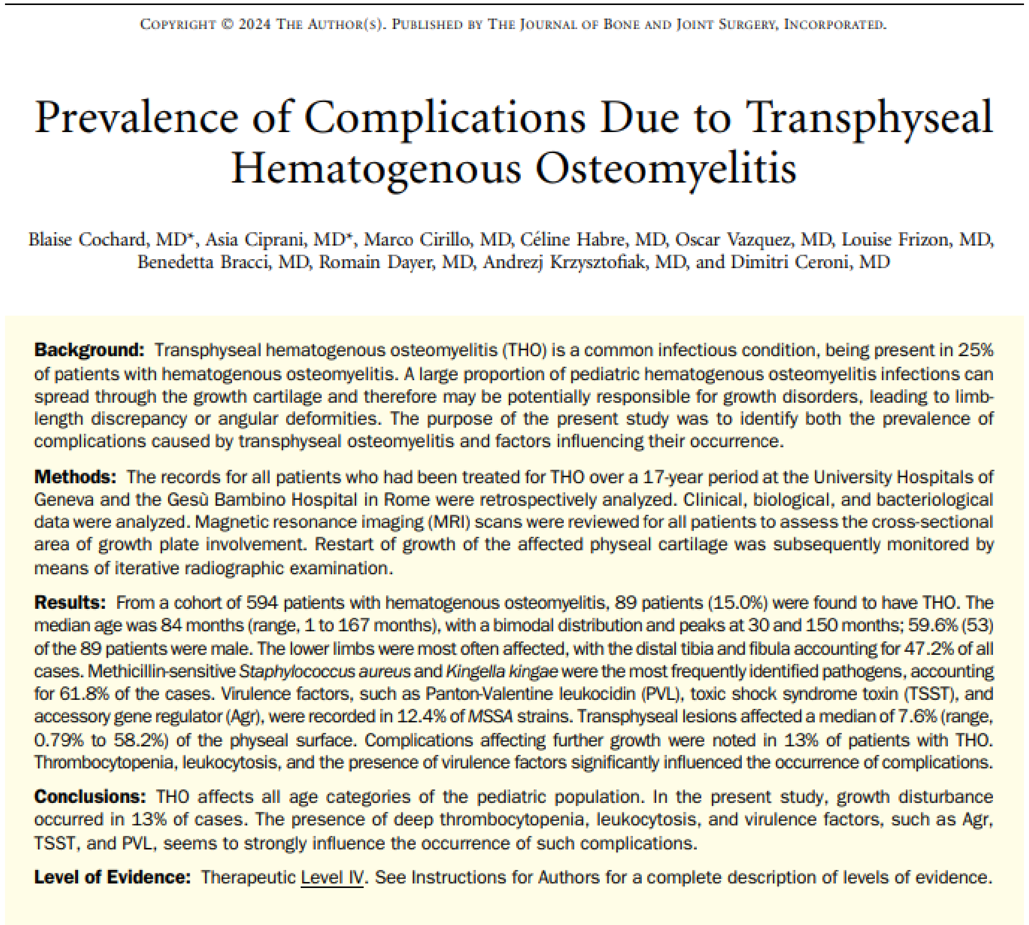
Pediatric osteomyelitis is an insidious disease that can lead to permanent sequelae, the management of which still relies on lengthy intravenous antibiotic therapy. The purpose of this study is to report and describe the clinical course and outcome of pediatric bacterial osteomyelitis in our experience. We reported the clinical, diagnostic, and treatment characteristics of all cases of osteomyelitis in children younger than 18 years of age who were hospitalized between January 2010 and December 2021 at the Bambino Gesù Children's Hospital in Rome, Italy, we compared patients with and without complications at follow-up, to identify any predictive factor for sequelae. The study sample included 319 cases of pediatric bacterial osteomyelitis. The median age was 7.77 years. Males (60.8%) were more affected than females. The most affected bones were the femur, tibia, and spine. Etiology was identified in 40.1% of cases, with *S.aureus* as the most common causative agent. Sequelae were reported in 43 cases (13.5%). The main predictors of sequelae were sepsis on admission and hypergammaglobulinemia. Our results show that a severe presentation with sepsis and hypergammaglobulinemia on admission may be associated with a higher frequency of late sequelae. Early recognition and aggressive treatment of this subgroup of patients may lead to a reduction in complications.

Gruppo di studio multidisciplinare

Casistica Osteomieliti OPBG 2010-2024



2022-2024 Gruppo di studio internazionale



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Prevalence of Complications Due to Transphyseal Hematogenous Osteomyelitis

Blaise Cochard, MD*, Asia Ciprani, MD*, Marco Cirillo, MD, Céline Habre, MD, Oscar Vazquez, MD, Louise Frizon, MD, Benedetta Bracci, MD, Romain Dayer, MD, Andrzej Krzysztofiak, MD, and Dimitri Ceroni, MD

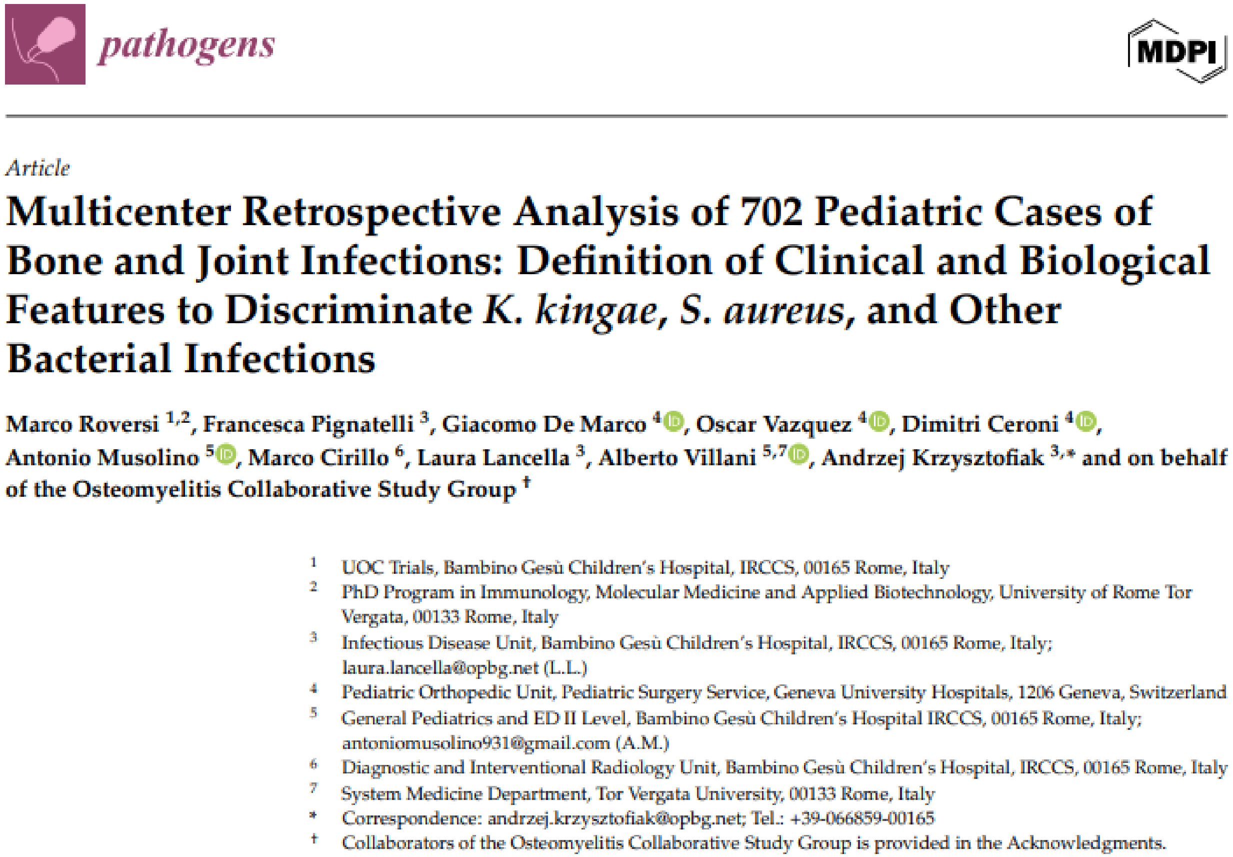
Background: Transphyseal hematogenous osteomyelitis (THO) is a common infectious condition, being present in 25% of patients with hematogenous osteomyelitis. A large proportion of pediatric hematogenous osteomyelitis infections can spread through the growth cartilage and therefore may be potentially responsible for growth disorders, leading to limb-length discrepancy or angular deformities. The purpose of the present study was to identify both the prevalence of complications caused by transphyseal osteomyelitis and factors influencing their occurrence.

Methods: The records for all patients who had been treated for THO over a 17-year period at the University Hospitals of Geneva and the Gesù Bambino Hospital in Rome were retrospectively analyzed. Clinical, biological, and bacteriological data were analyzed. Magnetic resonance imaging (MRI) scans were reviewed for all patients to assess the cross-sectional area of growth plate involvement. Restart of growth of the affected physeal cartilage was subsequently monitored by means of iterative radiographic examination.

Results: From a cohort of 594 patients with hematogenous osteomyelitis, 89 patients (15.0%) were found to have THO. The median age was 84 months (range, 1 to 167 months), with a bimodal distribution and peaks at 30 and 150 months; 59.6% (53) of the 89 patients were male. The lower limbs were most often affected, with the distal tibia and fibula accounting for 47.2% of all cases. Methicillin-sensitive *Staphylococcus aureus* and *Kingella kingae* were the most frequently identified pathogens, accounting for 61.8% of the cases. Virulence factors, such as Panton-Valentine leukocidin (PVL), toxic shock syndrome toxin (TSST), and accessory gene regulator (Agr), were recorded in 12.4% of *MSSA* strains. Transphyseal lesions affected a median of 7.6% (range, 0.79% to 58.2%) of the physeal surface. Complications affecting further growth were noted in 13% of patients with THO. Thrombocytopenia, leukocytosis, and the presence of virulence factors significantly influenced the occurrence of complications.

Conclusions: THO affects all age categories of the pediatric population. In the present study, growth disturbance occurred in 13% of cases. The presence of deep thrombocytopenia, leukocytosis, and virulence factors, such as Agr, TSST, and PVL, seems to strongly influence the occurrence of such complications.

Level of Evidence: Therapeutic Level IV. See Instructions for Authors for a complete description of levels of evidence.



pathogens

MDPI

Article

Multicenter Retrospective Analysis of 702 Pediatric Cases of Bone and Joint Infections: Definition of Clinical and Biological Features to Discriminate *K. kingae*, *S. aureus*, and Other Bacterial Infections

Marco Roversi [1,2], Francesca Pignatelli [3], Giacomo De Marco [4], Oscar Vazquez [4], Dimitri Ceroni [4], Antonio Musolino [5], Marco Cirillo [6], Laura Lancella [3], Alberto Villani [5,7], Andrzej Krzysztofiak [3,*] and on behalf of the Osteomyelitis Collaborative Study Group [†]

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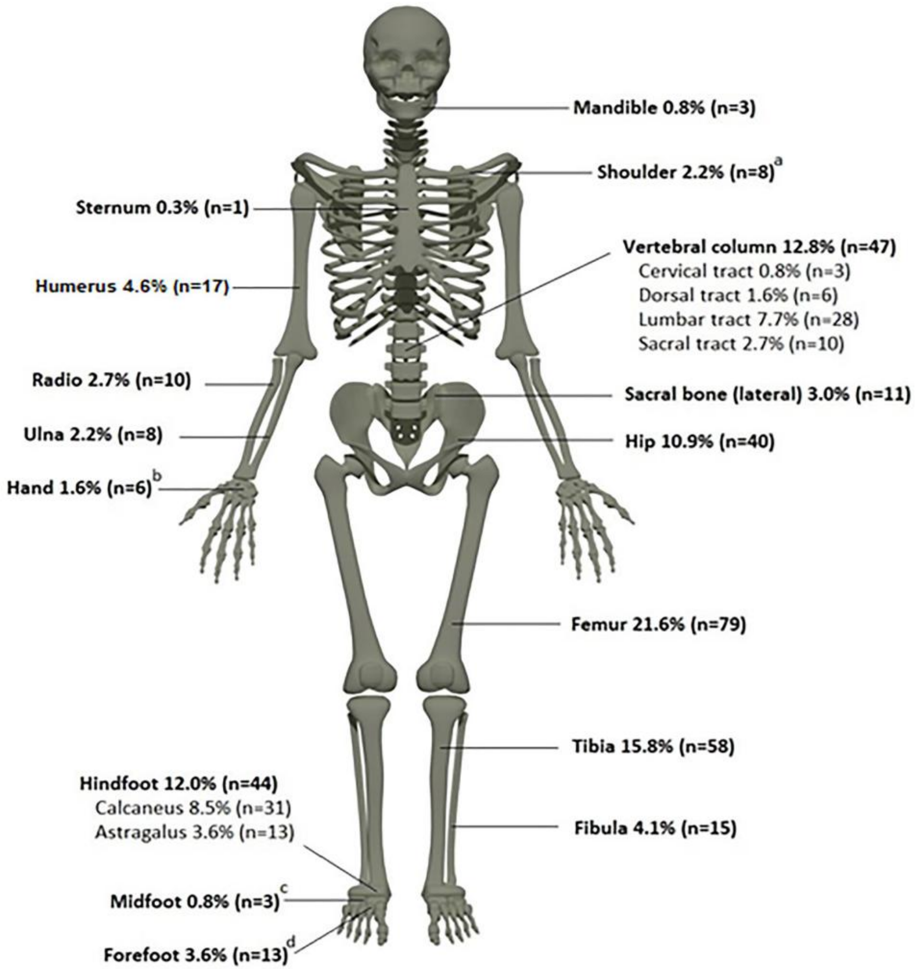
[†] Collaborators of the Osteomyelitis Collaborative Study Group is provided in the Acknowledgments.

Casistica gruppo di studio multidisciplinare


Mandible 0.8% (n=3)
Shoulder 2.2% (n=8)a
Sternum 0.3% (n=1)
Vertebral column 12.8% (n=47)
Cervical tract 0.8% (n=3)
Dorsal tract 1.6% (n=6)
Lumbar tract 7.7% (n=28)
Sacral tract 2.7% (n=10)
Humerus 4.6% (n=17)
Radio 2.7% (n=10)
Sacral bone (lateral) 3.0% (n=11)
Ulna 2.2% (n=8)
Hip 10.9% (n=40)
Hand 1.6% (n=6)b
Femur 21.6% (n=79)
Tibia 15.8% (n=58)
Hindfoot 12.0% (n=44)
Calcaneus 8.5% (n=31)
Astragalus 3.6% (n=13)
Fibula 4.1% (n=15)
Midfoot 0.8% (n=3)c
Forefoot 3.6% (n=13)d

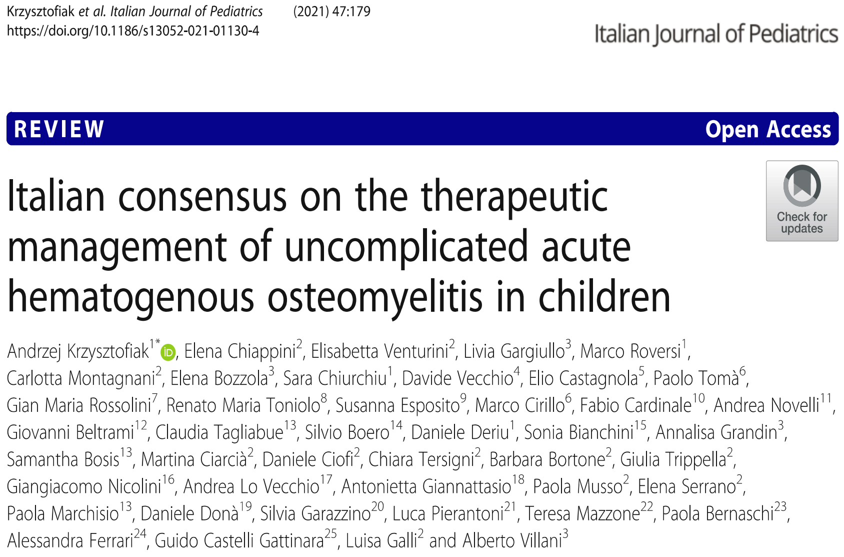
Le localizzazioni

Femore	*21.6%*	*79 pz*
Tibia	*15.8%*	*58 pz*
Colonna	*12.8%*	*47 pz*

OSPEDALE PEDIATRICO
Bambino Gesù

Linee Guida

Osteomieliti non complicate



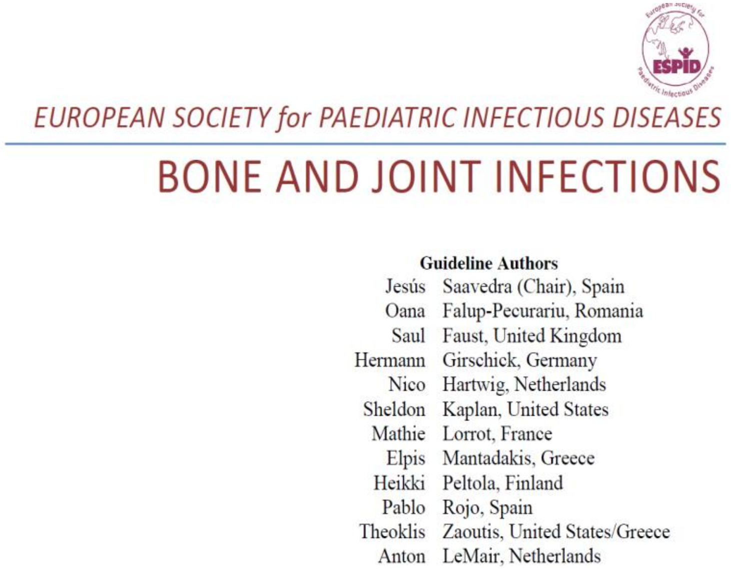
Krzysztofiak *et al. Italian Journal of Pediatrics* (2021) 47:179
https://doi.org/10.1186/s13052-021-01130-4

Italian Journal of Pediatrics

REVIEW **Open Access**

Italian consensus on the therapeutic management of uncomplicated acute hematogenous osteomyelitis in children

Andrzej Krzysztofiak[1*], Elena Chiappini[2], Elisabetta Venturini[2], Livia Gargiullo[3], Marco Roversi[1], Carlotta Montagnani[2], Elena Bozzola[3], Sara Chiurchiu[1], Davide Vecchio[4], Elio Castagnola[5], Paolo Tomà[6], Gian Maria Rossolini[7], Renato Maria Toniolo[8], Susanna Esposito[9], Marco Cirillo[6], Fabio Cardinale[10], Andrea Novelli[11], Giovanni Beltrami[12], Claudia Tagliabue[13], Silvio Boero[14], Daniele Deriu[1], Sonia Bianchini[15], Annalisa Grandin[3], Samantha Bosis[13], Martina Ciarcià[2], Daniele Ciofi[2], Chiara Tersigni[2], Barbara Bortone[2], Giulia Trippella[2], Giangiacomo Nicolini[16], Andrea Lo Vecchio[17], Antonietta Giannattasio[18], Paola Musso[2], Elena Serrano[2], Paola Marchisio[13], Daniele Donà[19], Silvia Garazzino[20], Luca Pierantoni[21], Teresa Mazzone[22], Paola Bernaschi[23], Alessandra Ferrari[24], Guido Castelli Gattinara[25], Luisa Galli[2] and Alberto Villani[3]



EUROPEAN SOCIETY for PAEDIATRIC INFECTIOUS DISEASES

BONE AND JOINT INFECTIONS

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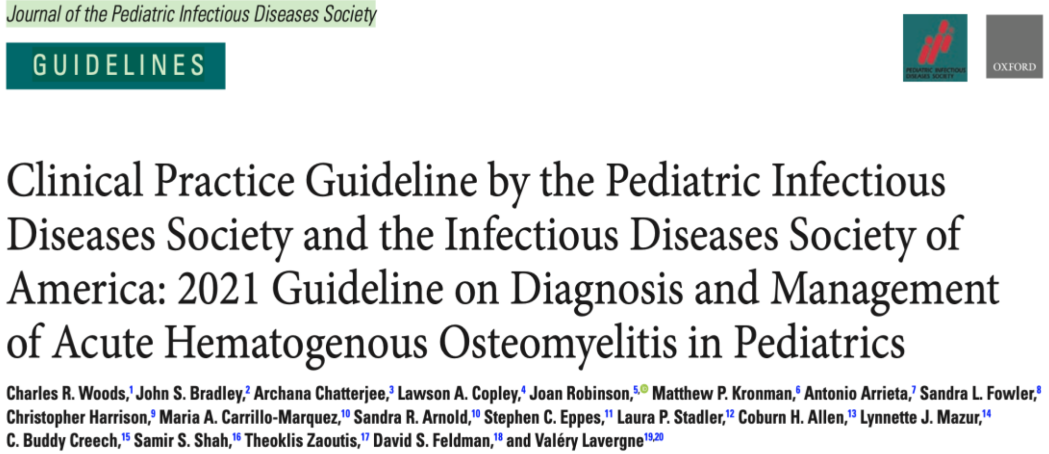


Journal of the Pediatric Infectious Diseases Society

GUIDELINES

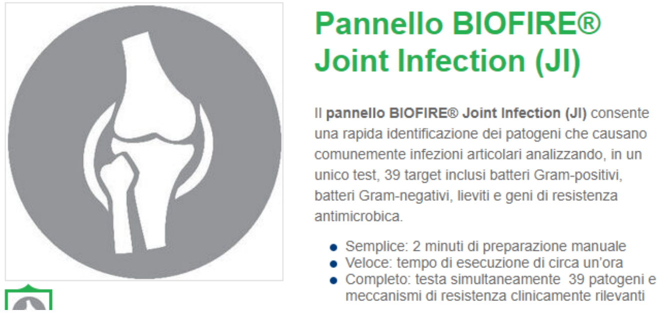
Clinical Practice Guideline by the Pediatric Infectious Diseases Society and the Infectious Diseases Society of America: 2021 Guideline on Diagnosis and Management of Acute Hematogenous Osteomyelitis in Pediatrics

Charles R. Woods,[1] John S. Bradley,[2] Archana Chatterjee,[3] Lawson A. Copley,[4] Joan Robinson,[5] Matthew P. Kronman,[6] Antonio Arrieta,[7] Sandra L. Fowler,[8] Christopher Harrison,[9] Maria A. Carrillo-Marquez,[10] Sandra R. Arnold,[10] Stephen C. Eppes,[11] Laura P. Stadler,[12] Coburn H. Allen,[13] Lynnette J. Mazur,[14] C. Buddy Creech,[15] Samir S. Shah,[16] Theoklis Zaoutis,[17] David S. Feldman,[18] and Valéry Lavergne[19,20]

Importanza della diagnosi precoce

- La diagnostica molecolare deve essere utilizzata per identificare i batteri, utili per un'appropriata terapia antibiotica.
- È necessario un approccio multidisciplinare.

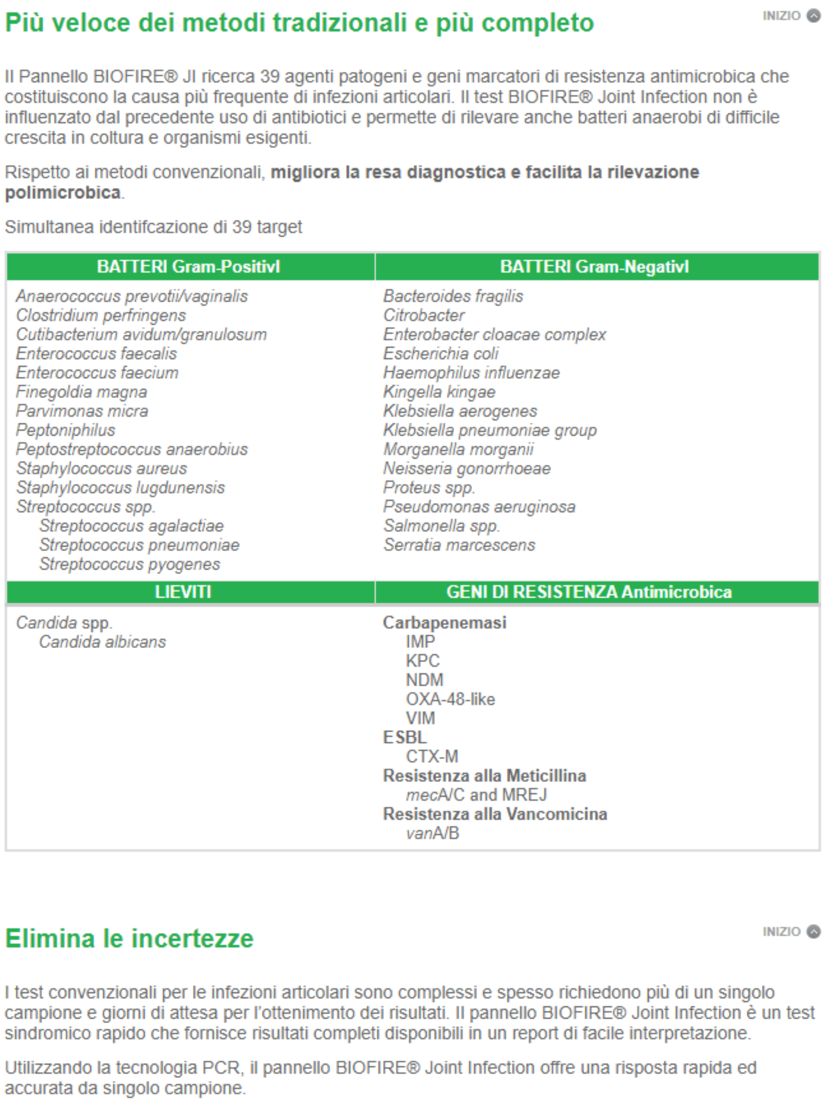
La diagnostica molecolare ha un ruolo sempre più importante nella diagnosi e gestione dell'osteomielite, offrendo strumenti per una identificazione più precisa dell'agente infettivo e per la valutazione dell'efficacia della terapia.



Pannello BIOFIRE® Joint Infection (JI)

Il **pannello BIOFIRE® Joint Infection (JI)** consente una rapida identificazione dei patogeni che causano comunemente infezioni articolari analizzando, in un unico test, 39 target inclusi batteri Gram-positivi, batteri Gram-negativi, lieviti e geni di resistenza antimicrobica.

- Semplice: 2 minuti di preparazione manuale
- Veloce: tempo di esecuzione di circa un'ora
- Completo: testa simultaneamente 39 patogeni e meccanismi di resistenza clinicamente rilevanti



Più veloce dei metodi tradizionali e più completo

Il Pannello BIOFIRE® JI ricerca 39 agenti patogeni e geni marcatori di resistenza antimicrobica che costituiscono la causa più frequente di infezioni articolari. Il test BIOFIRE® Joint Infection non è influenzato dal precedente uso di antibiotici e permette di rilevare anche batteri anaerobi di difficile crescita in coltura e organismi esigenti.

Rispetto ai metodi convenzionali, **migliora la resa diagnostica e facilita la rilevazione polimicrobica**.

Simultanea identifcazione di 39 target

BATTERI Gram-Positivi	BATTERI Gram-Negativi
Anaerococcus prevotii/vaginalis	*Bacteroides fragilis*
Clostridium perfringens	*Citrobacter*
Cutibacterium avidum/granulosum	*Enterobacter cloacae complex*
Enterococcus faecalis	*Escherichia coli*
Enterococcus faecium	*Haemophilus influenzae*
Finegoldia magna	*Kingella kingae*
Parvimonas micra	*Klebsiella aerogenes*
Peptoniphilus	*Klebsiella pneumoniae group*
Peptostreptococcus anaerobius	*Morganella morganii*
Staphylococcus aureus	*Neisseria gonorrhoeae*
Staphylococcus lugdunensis	*Proteus spp.*
Streptococcus spp.	*Pseudomonas aeruginosa*
Streptococcus agalactiae	*Salmonella spp.*
Streptococcus pneumoniae	*Serratia marcescens*
Streptococcus pyogenes	
LIEVITI	**GENI DI RESISTENZA Antimicrobica**
Candida spp.	**Carbapenemasi**
Candida albicans	IMP
	KPC
	NDM
	OXA-48-like
	VIM
	ESBL
	CTX-M
	Resistenza alla Meticillina
	mecA/C and MREJ
	Resistenza alla Vancomicina
	vanA/B

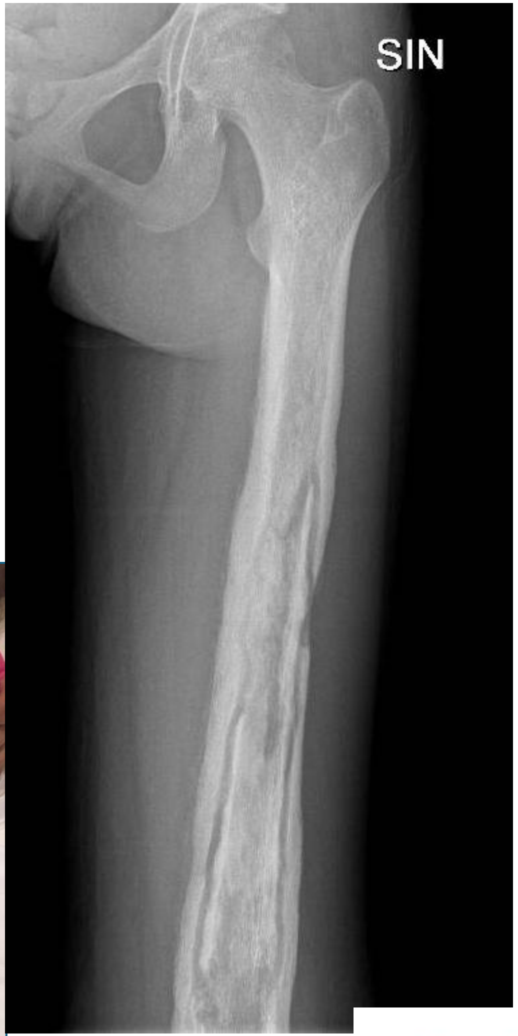
Elimina le incertezze

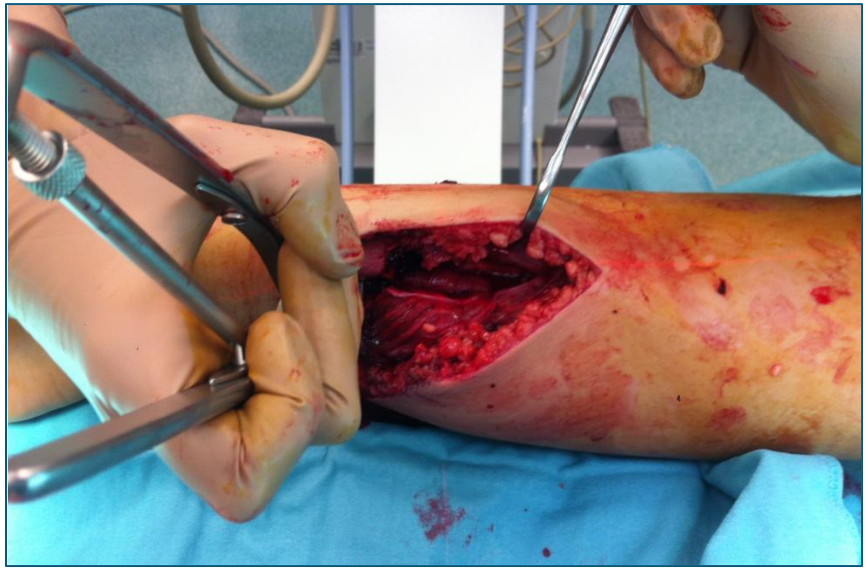
I test convenzionali per le infezioni articolari sono complessi e spesso richiedono più di un singolo campione e giorni di attesa per l'ottenimento dei risultati. Il pannello BIOFIRE® Joint Infection è un test sindromico rapido che fornisce risultati completi disponibili in un report di facile interpretazione.

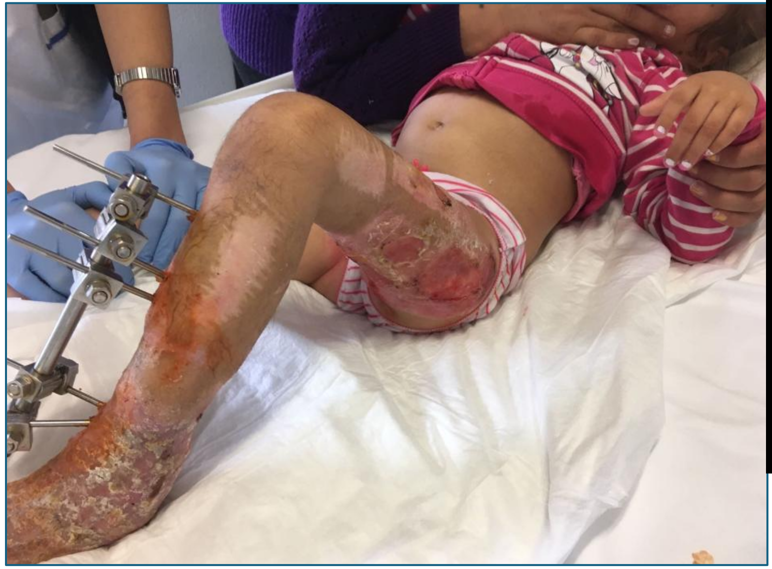
Utilizzando la tecnologia PCR, il pannello BIOFIRE® Joint Infection offre una risposta rapida ed accurata da singolo campione.

Osteomieliti complicate

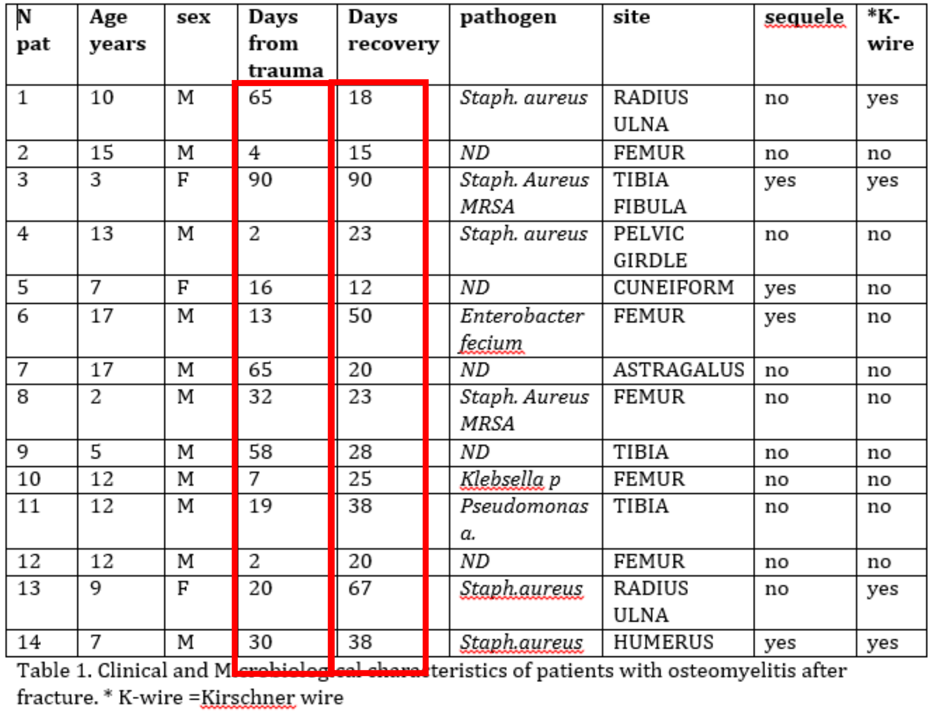
Via ematica
Fratture esposte
Fratture conseguenti a traumi ad alta energia
Mezzi di sintesi





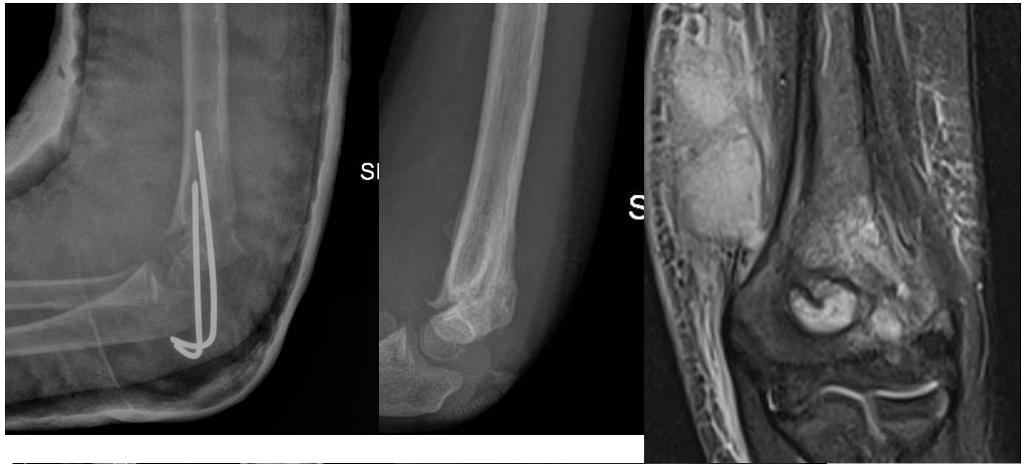


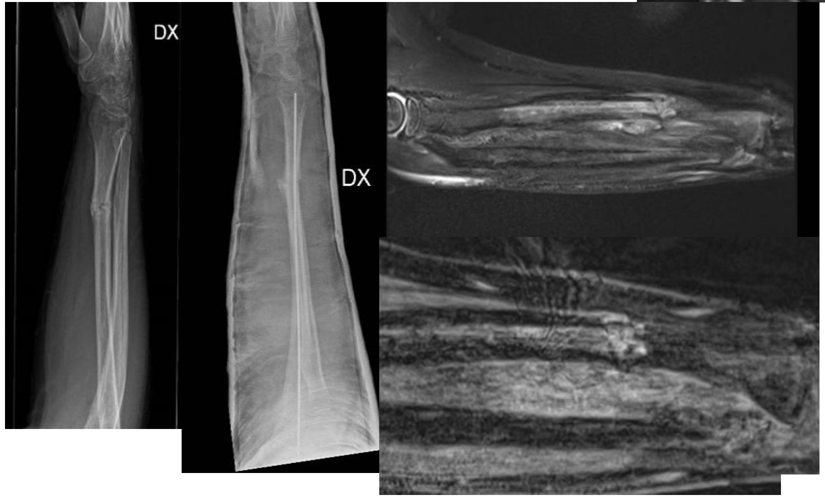
Casistica osteomieliti su fratture



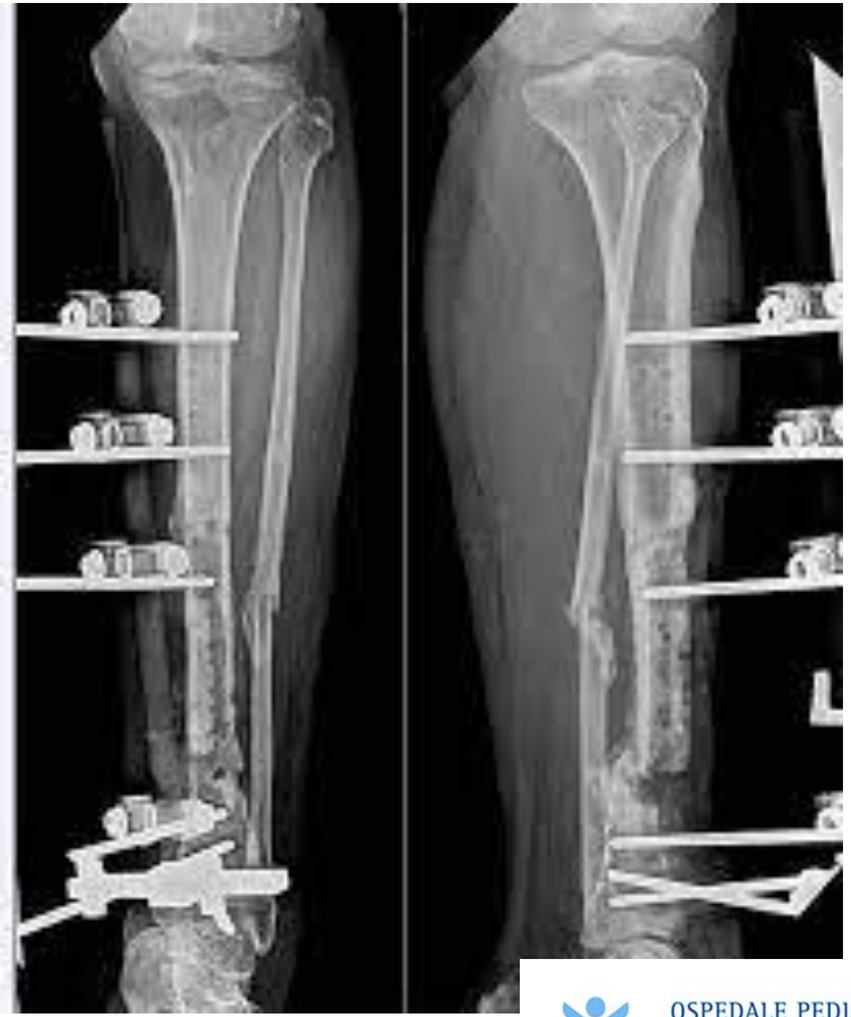
N pat	Age years	sex	Days from trauma	Days recovery	pathogen	site	sequele	*K-wire
1	10	M	65	18	*Staph. aureus*	RADIUS ULNA	no	yes
2	15	M	4	15	*ND*	FEMUR	no	no
3	3	F	90	90	*Staph. Aureus MRSA*	TIBIA FIBULA	yes	yes
4	13	M	2	23	*Staph. aureus*	PELVIC GIRDLE	no	no
5	7	F	16	12	*ND*	CUNEIFORM	yes	no
6	17	M	13	50	*Enterobacter fecium*	FEMUR	yes	no
7	17	M	65	20	*ND*	ASTRAGALUS	no	no
8	2	M	32	23	*Staph. Aureus MRSA*	FEMUR	no	no
9	5	M	58	28	*ND*	TIBIA	no	no
10	12	M	7	25	*Klebsella p*	FEMUR	no	no
11	12	M	19	38	*Pseudomonas a.*	TIBIA	no	no
12	12	M	2	20	*ND*	FEMUR	no	no
13	9	F	20	67	*Staph.aureus*	RADIUS ULNA	no	yes
14	7	M	30	38	*Staph.aureus*	HUMERUS	yes	yes

Table 1. Clinical and Microbiological characteristics of patients with osteomyelitis after fracture. * K-wire =Kirschner wire





Osteomieliti post - traumatiche



E' un problema mondiale nel campo dei traumi ortopedici.

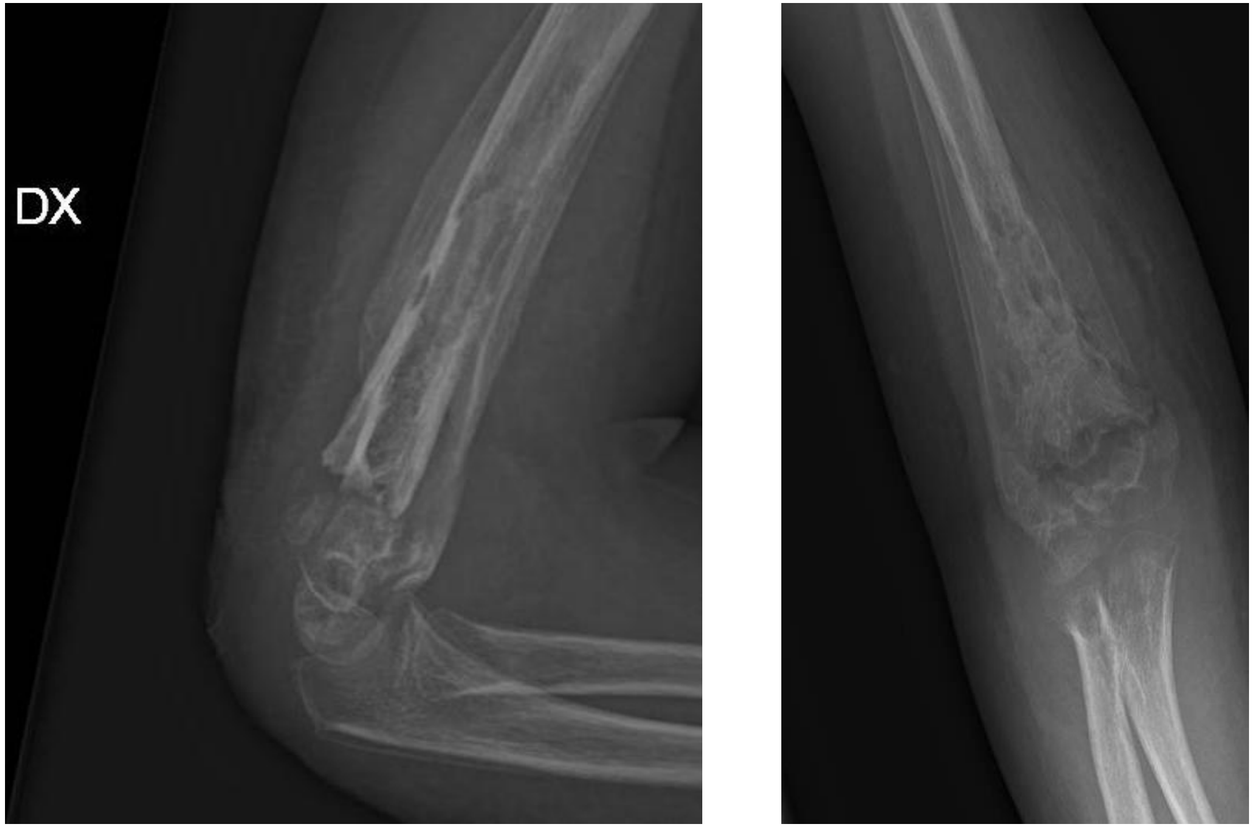
Non esiste un trattamento ideale per la sua gestione.

Questioni aperte:

- ✓ **il meccanismo fisiopatologico**
- ✓ **classificazione clinica, eziologica, istologica, anatomica**
- ✓ **diagnosi di imaging**
- ✓ **strategie terapeutiche**

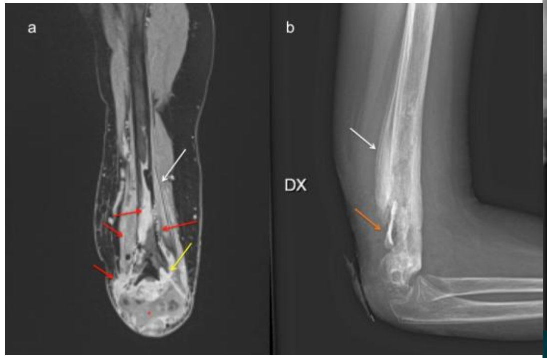
Osteomieliti post - traumatiche

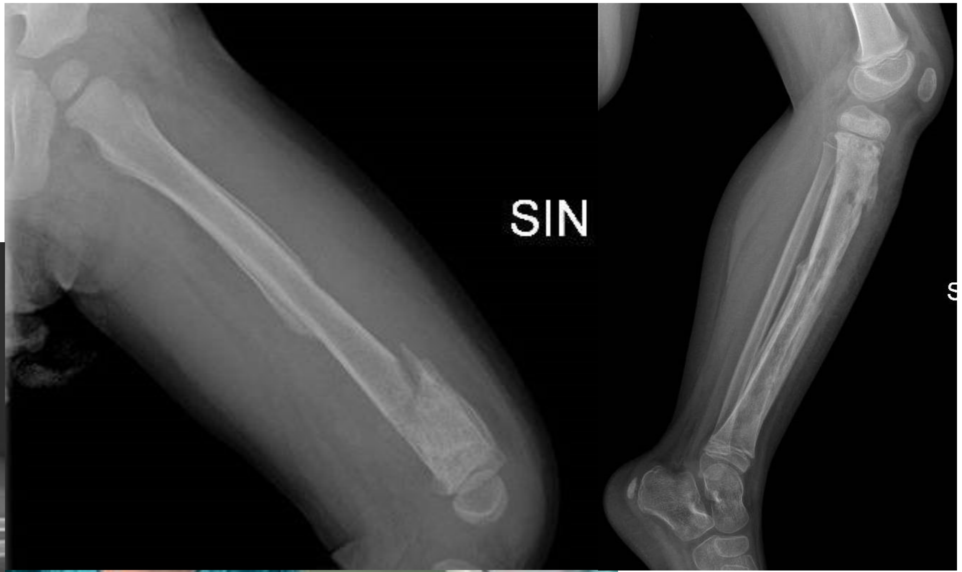
- rara nei bambini ma potenzialmente devastante con esiti invalidanti
- La diagnosi spesso difficile (anamnesi, clinica, microbiologia, dati di laboratorio, radiografia standard, TC, RM o scintigrafia ossea)
- Patogeni: *Staphylococcus Aureus* (incluso MRSA)

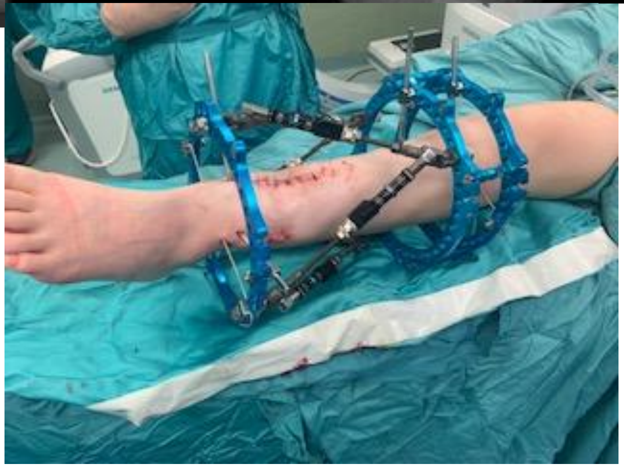


C. M. 7 aa - Frattura sovracondiloidea omero destro
Alterazione della struttura ossea diffusa del terzo diafisario e della metafisi distale dell'omero dx con apposizione periostale da osteomielite.

Ruolo della Fissazione Esterna





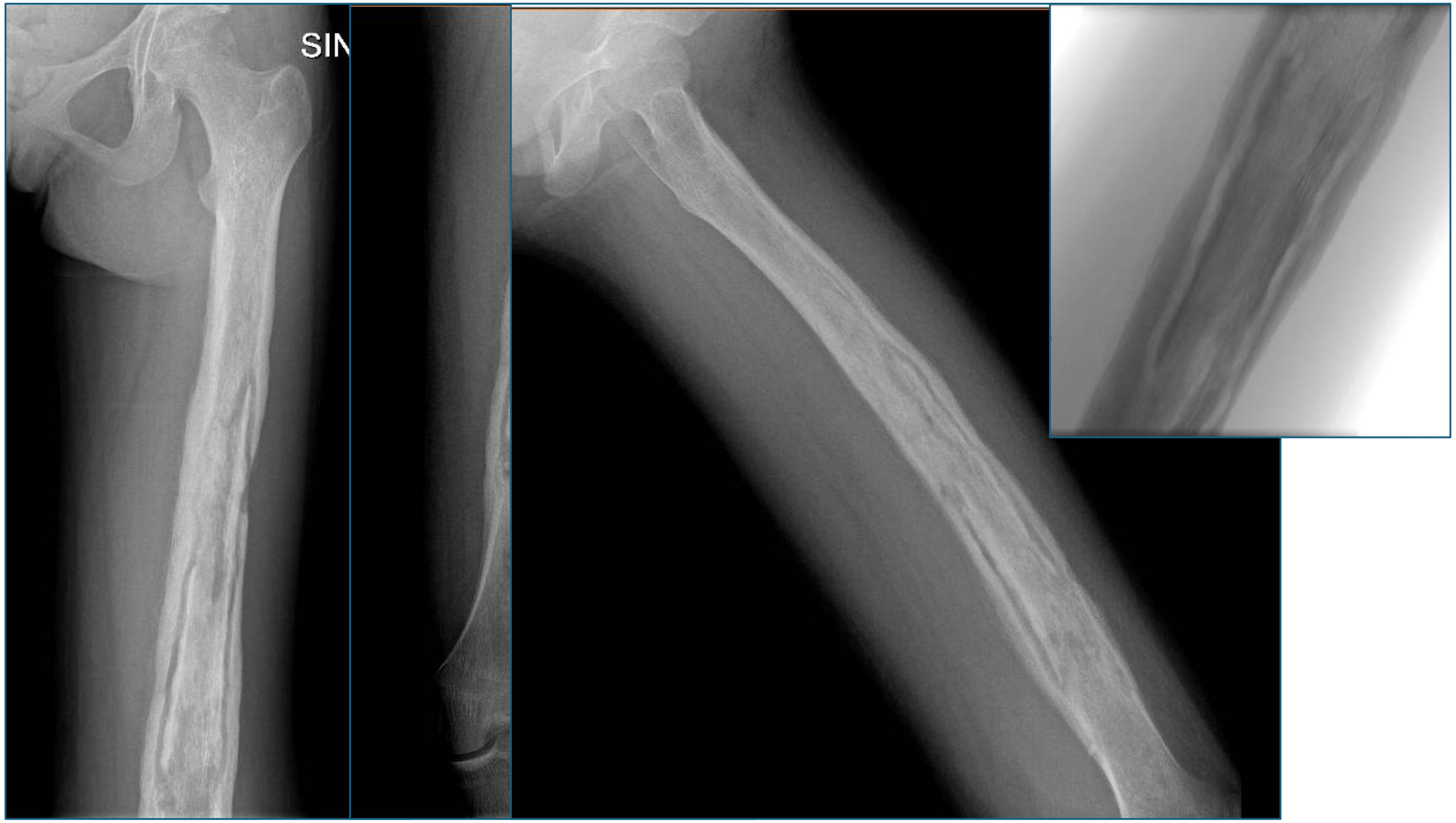


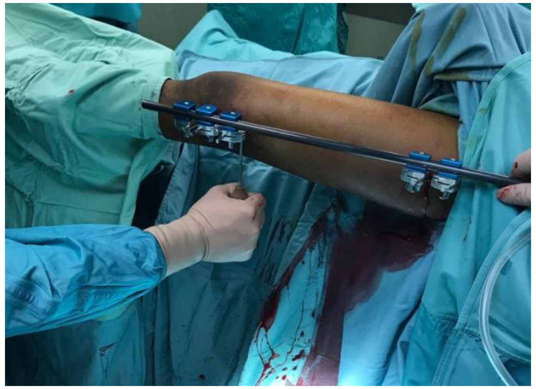
Stabilita'
Non invasivo

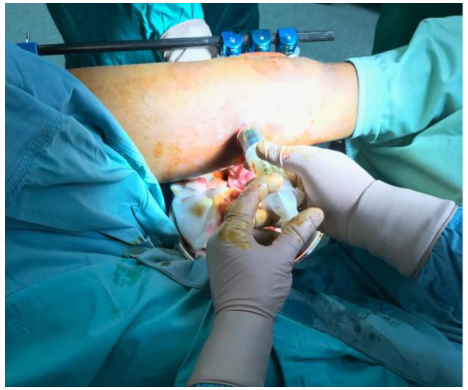
Versatilita'
Pulizia del focolaio

Terapia medica adeguata

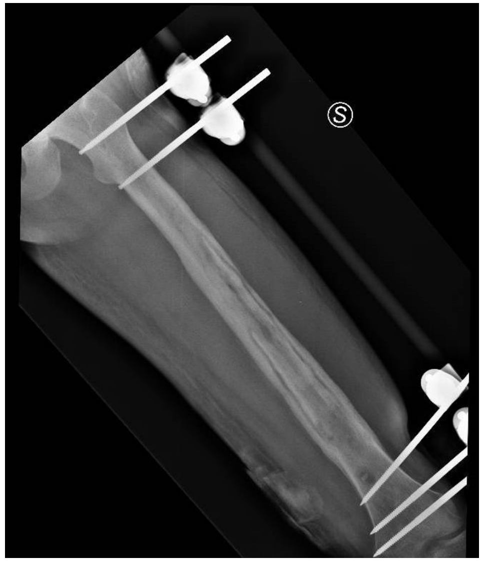
Paziente 17 aa osteomielite da *Salmonella in Talassemia*

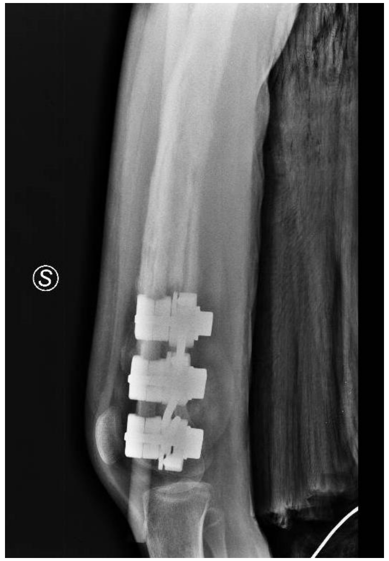


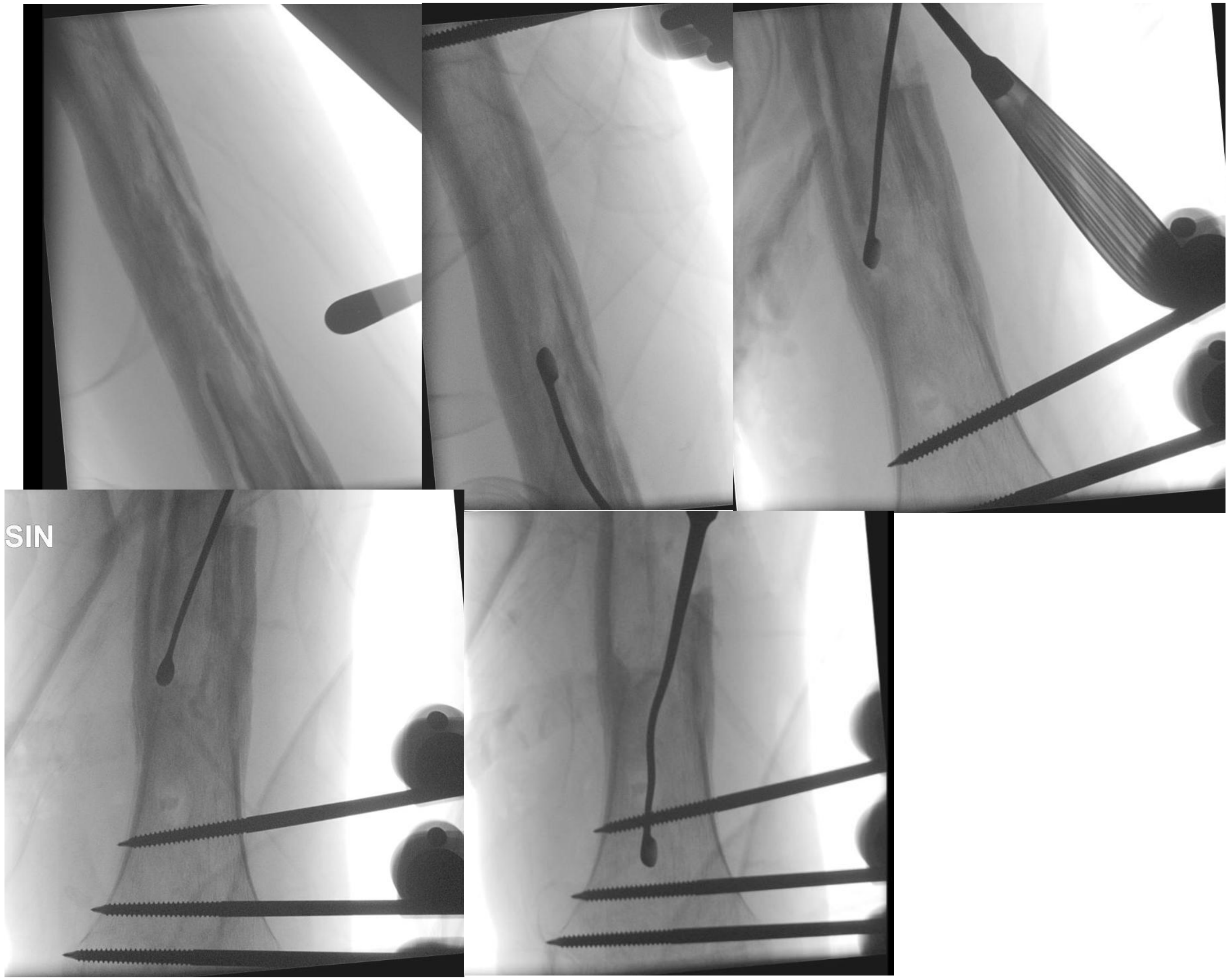




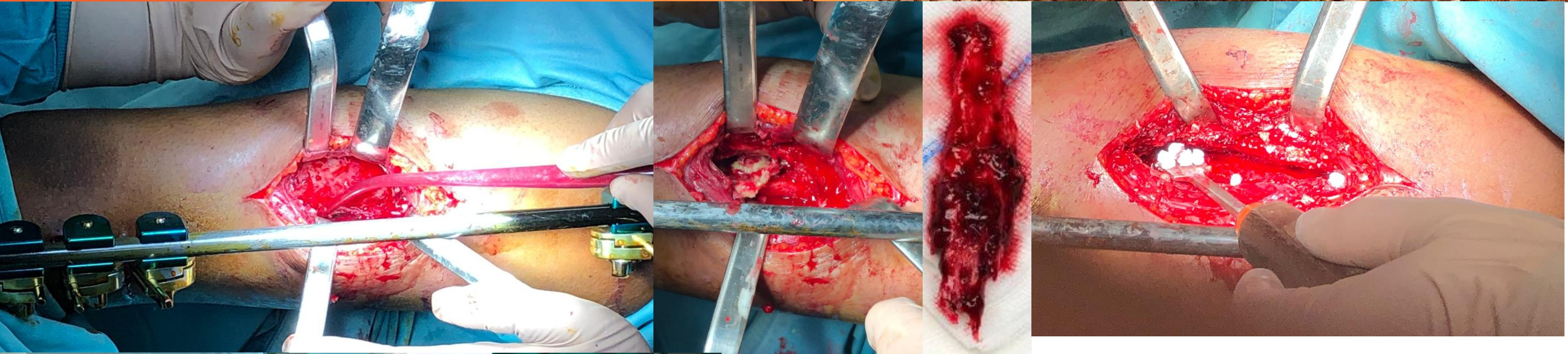
stabilita' meccanica

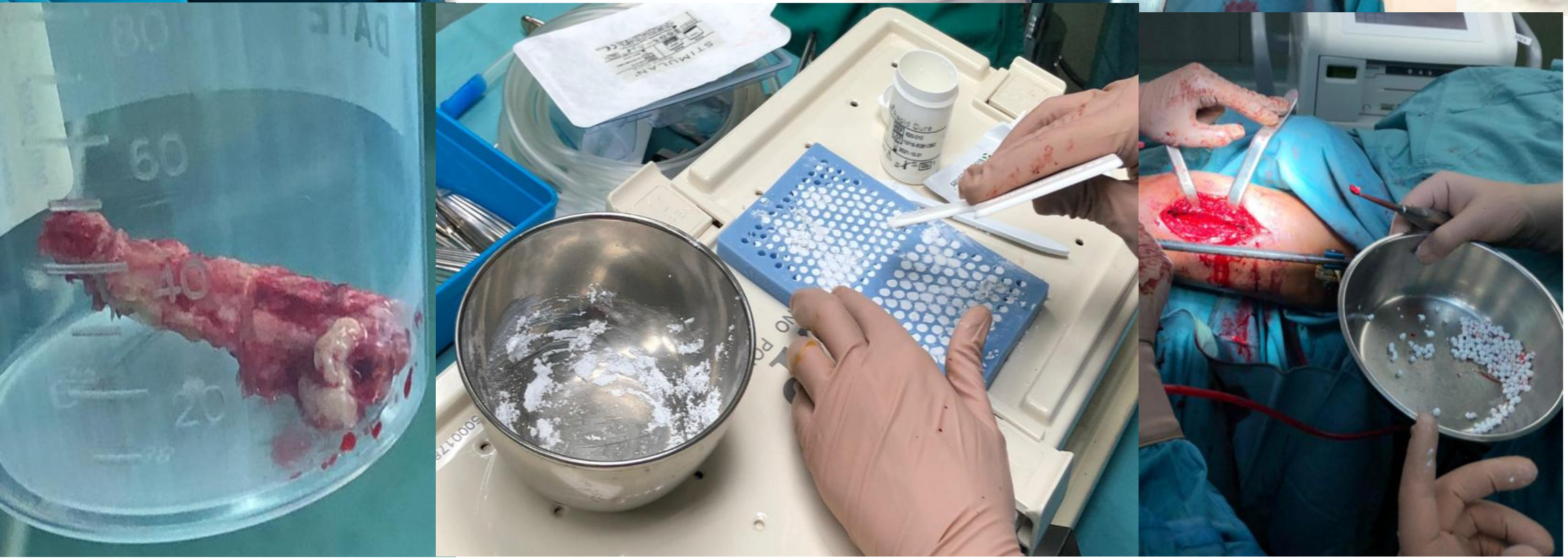






**Sequestrotomia
pulizia del focolaio,
pervieta' del canale**

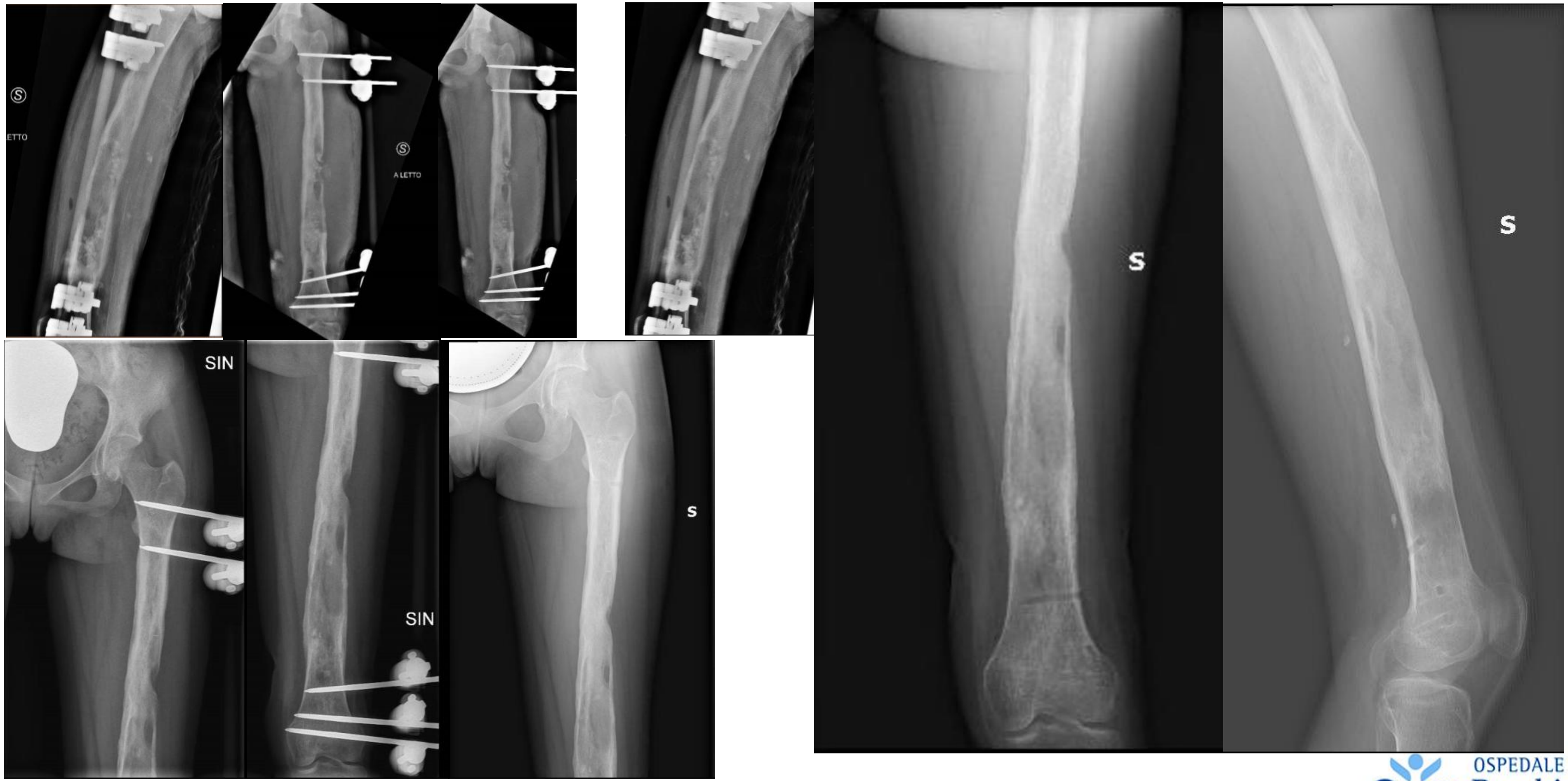




Invio del materiale asportato per istologia e microbiologia

Introduzione di preparato antibiotato

FUP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ETTO
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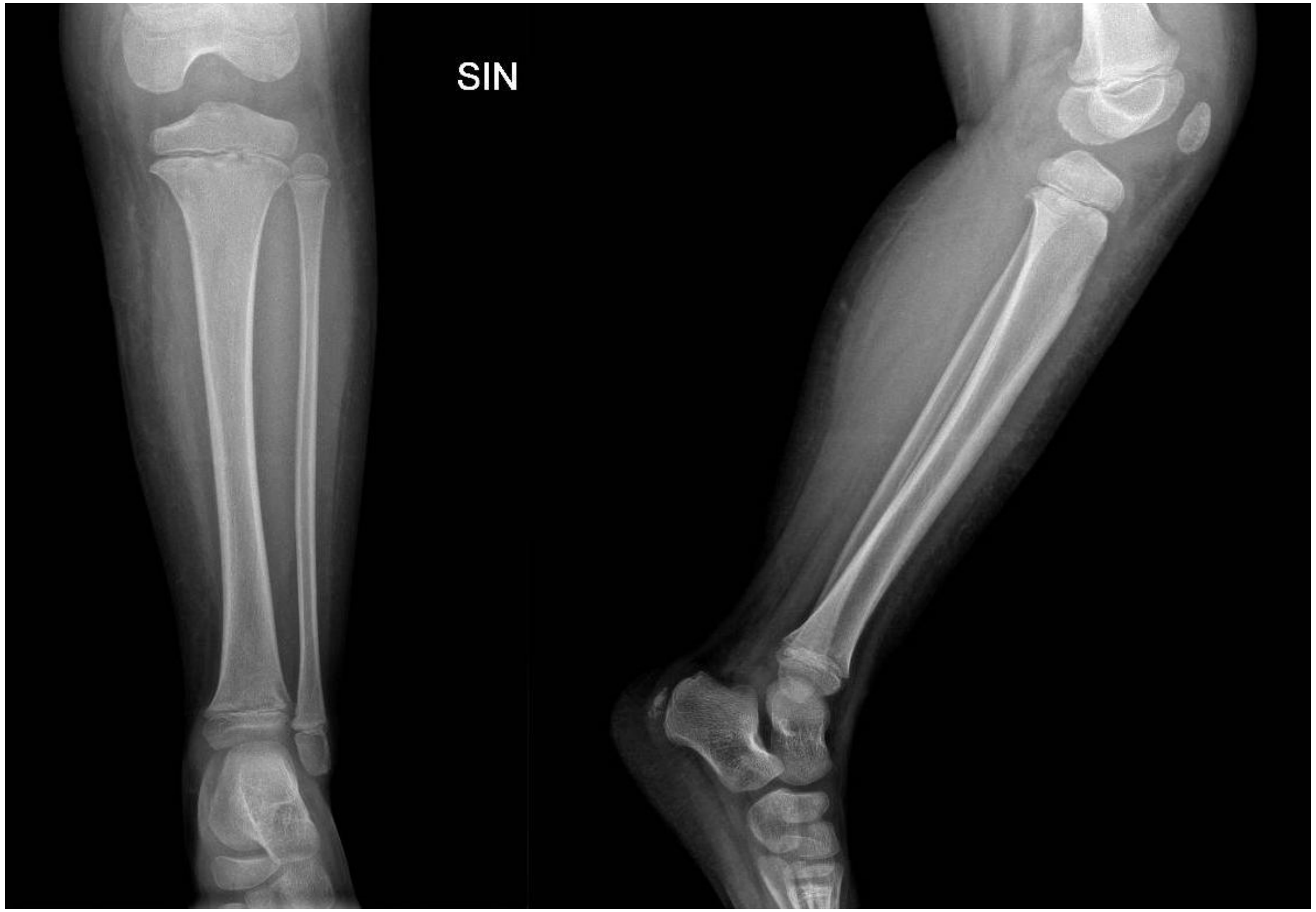
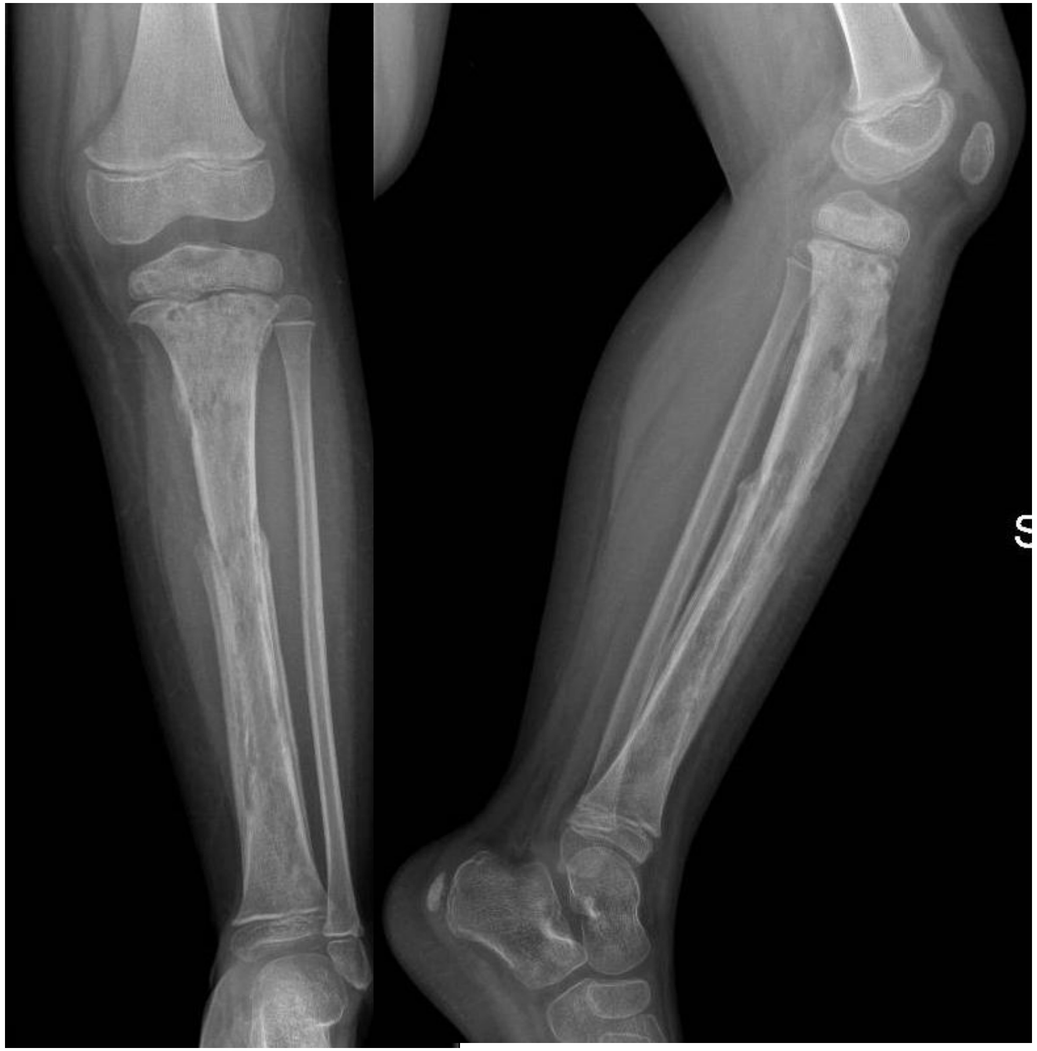
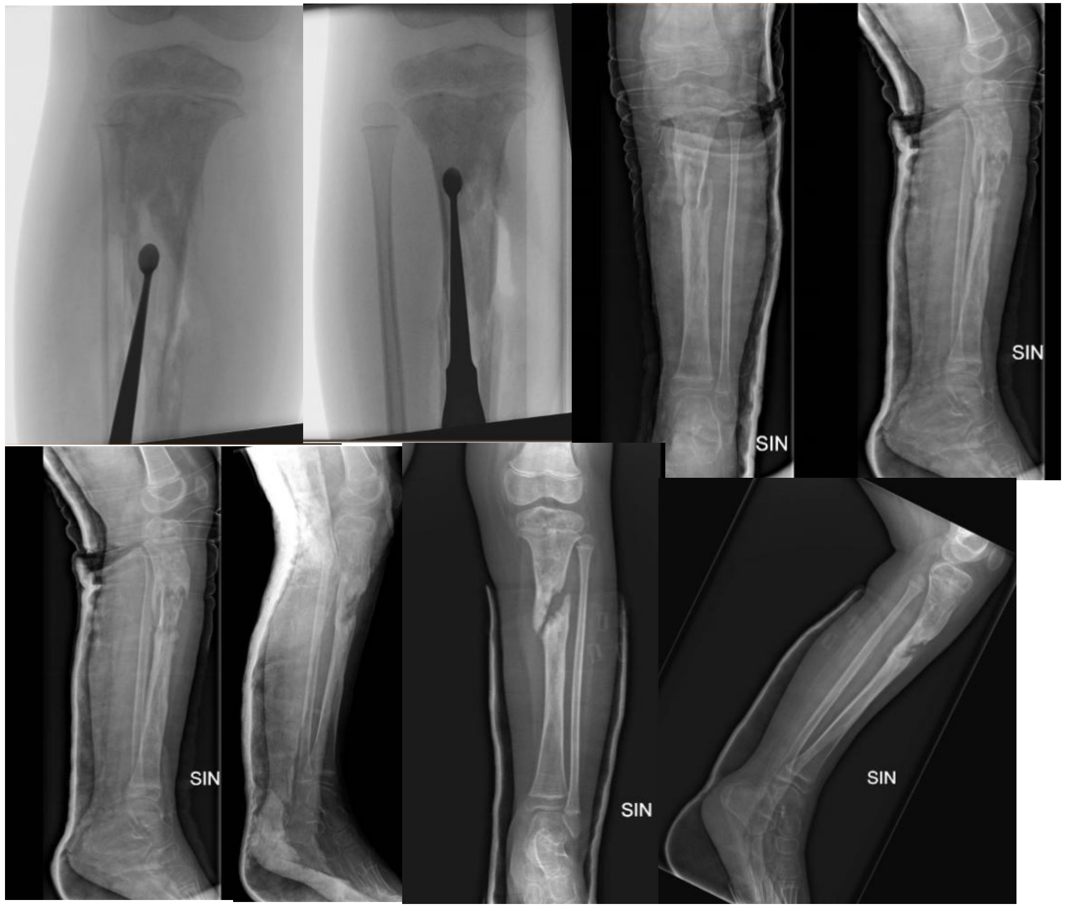
Pz 6 aa ricoverata per polmonite presenta successivamente tumefazione gamba sinistra





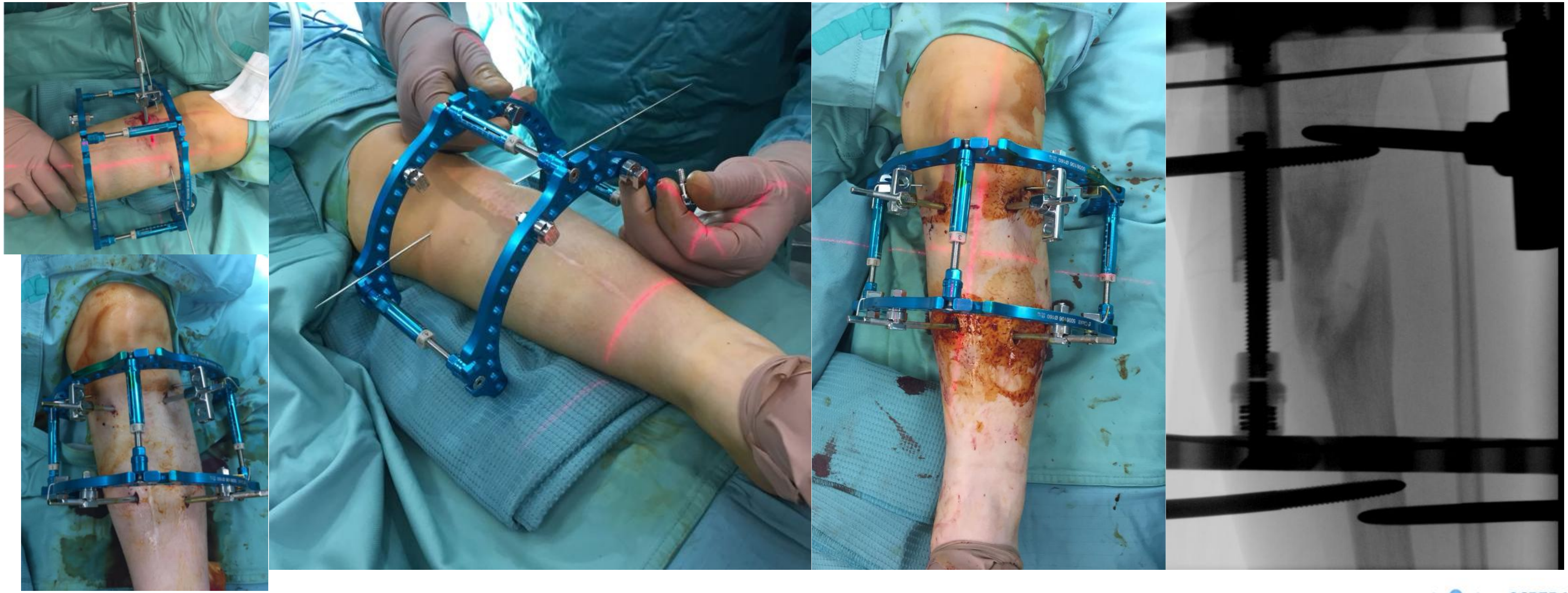
RX dopo un mese

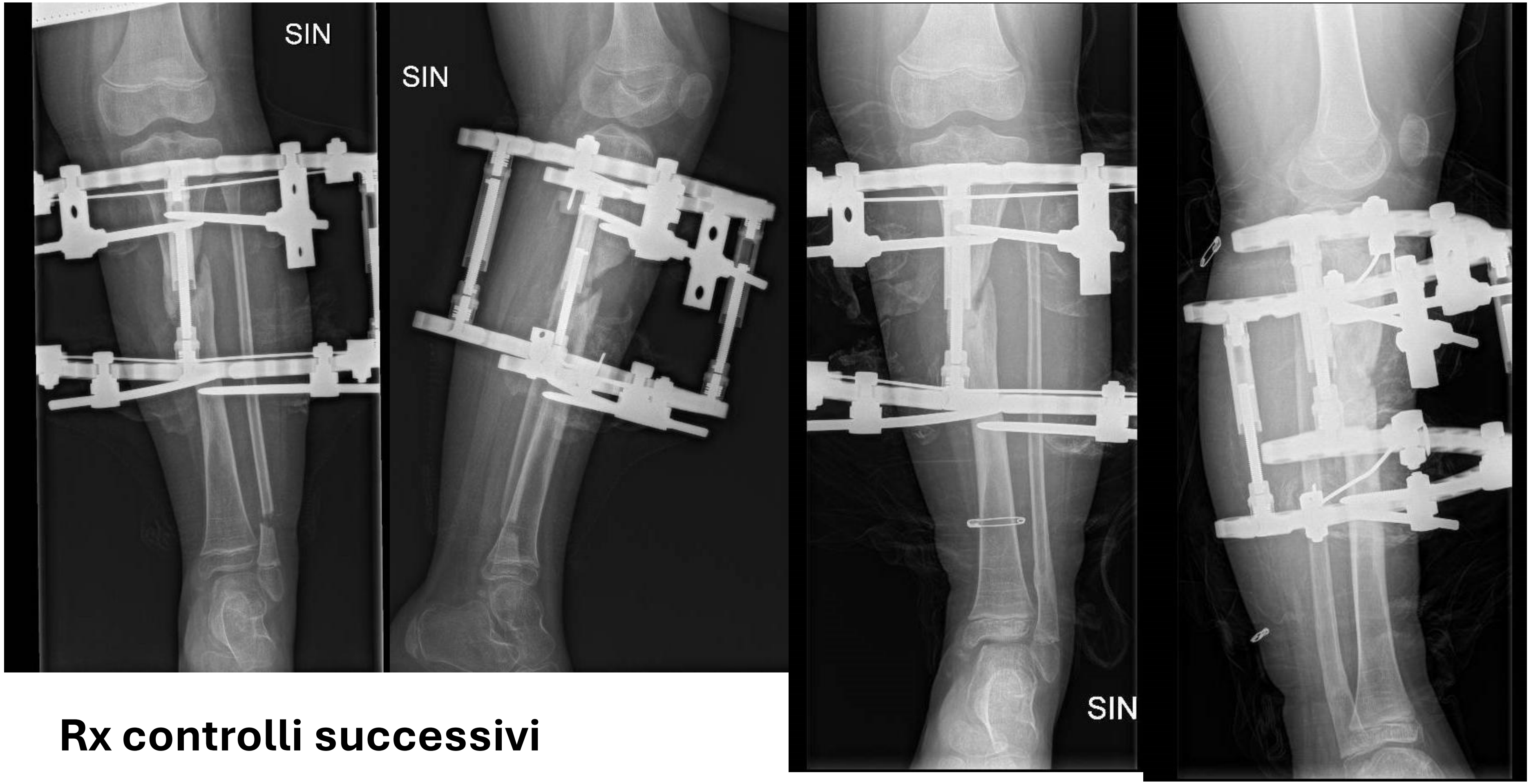
Primo intervento chirurgico



Peggioramento del quadro clinico
Trattamento non efficace

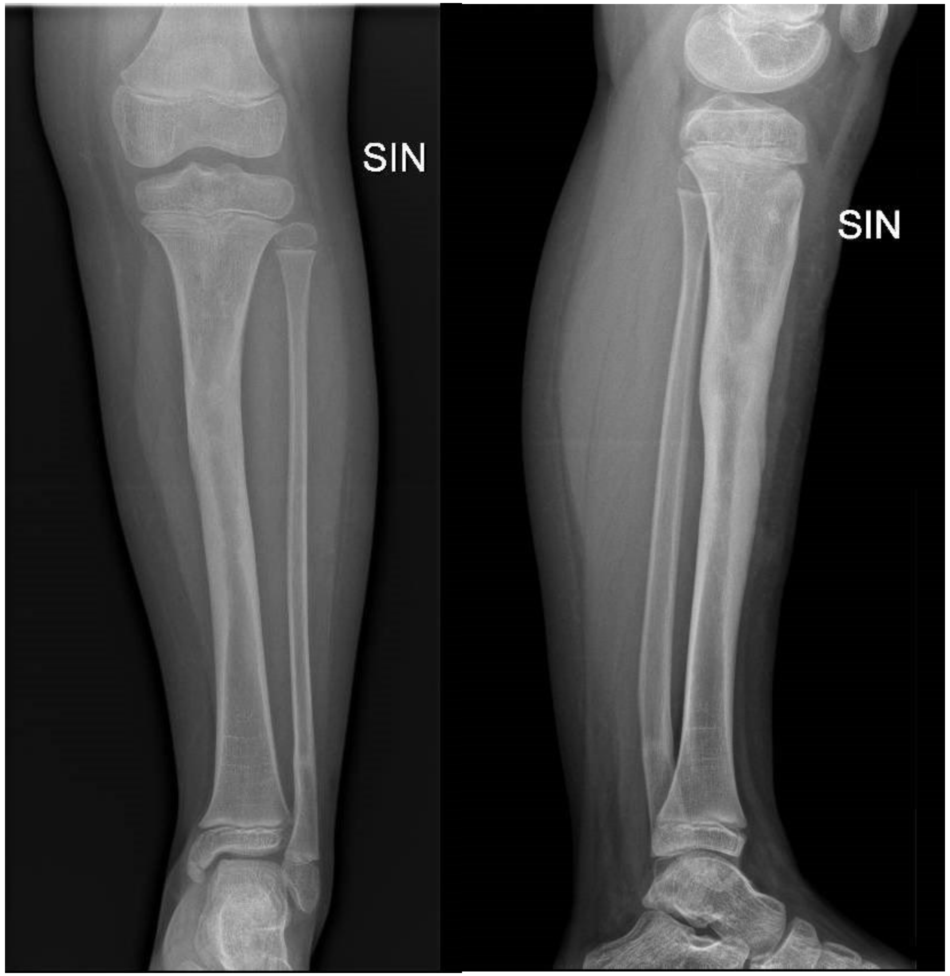
secondo intervento montaggio fissatore esterno

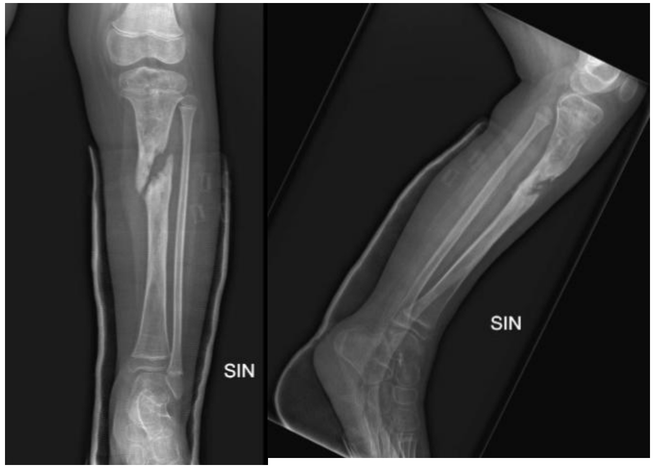




Rx controlli successivi

RX dopo rimozione del fissatore esterno

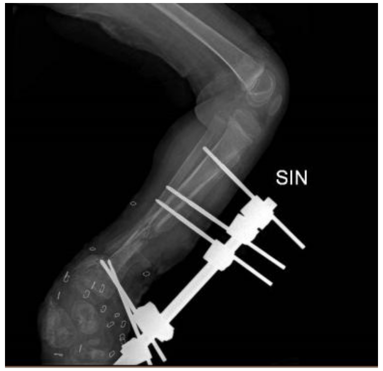


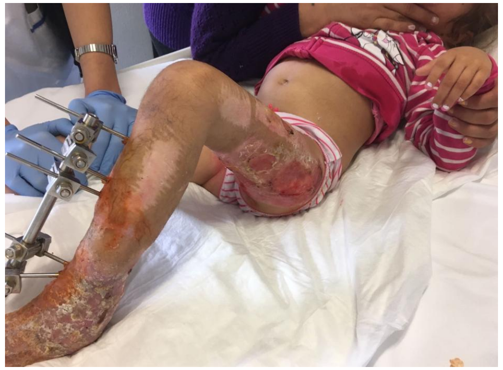


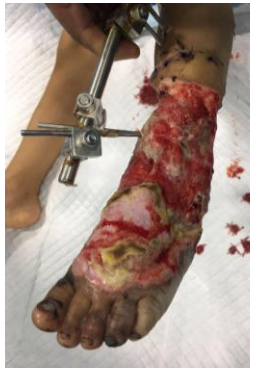
prima

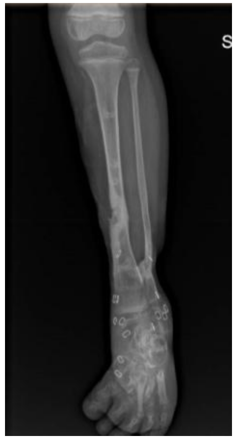
Osteomielite in trauma ad alta energia

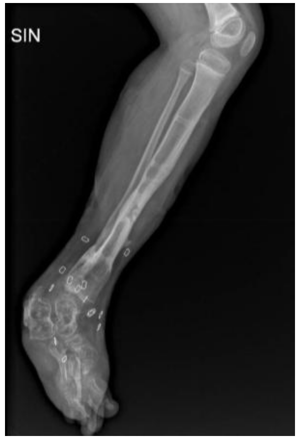
Bambina di 4 aa infezione cute e tessuti molli associata a frattura pluri frammentaria scomposta della gamba e del piede.

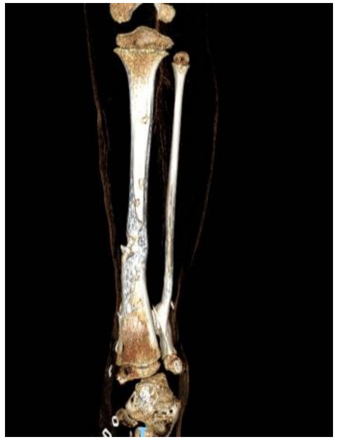




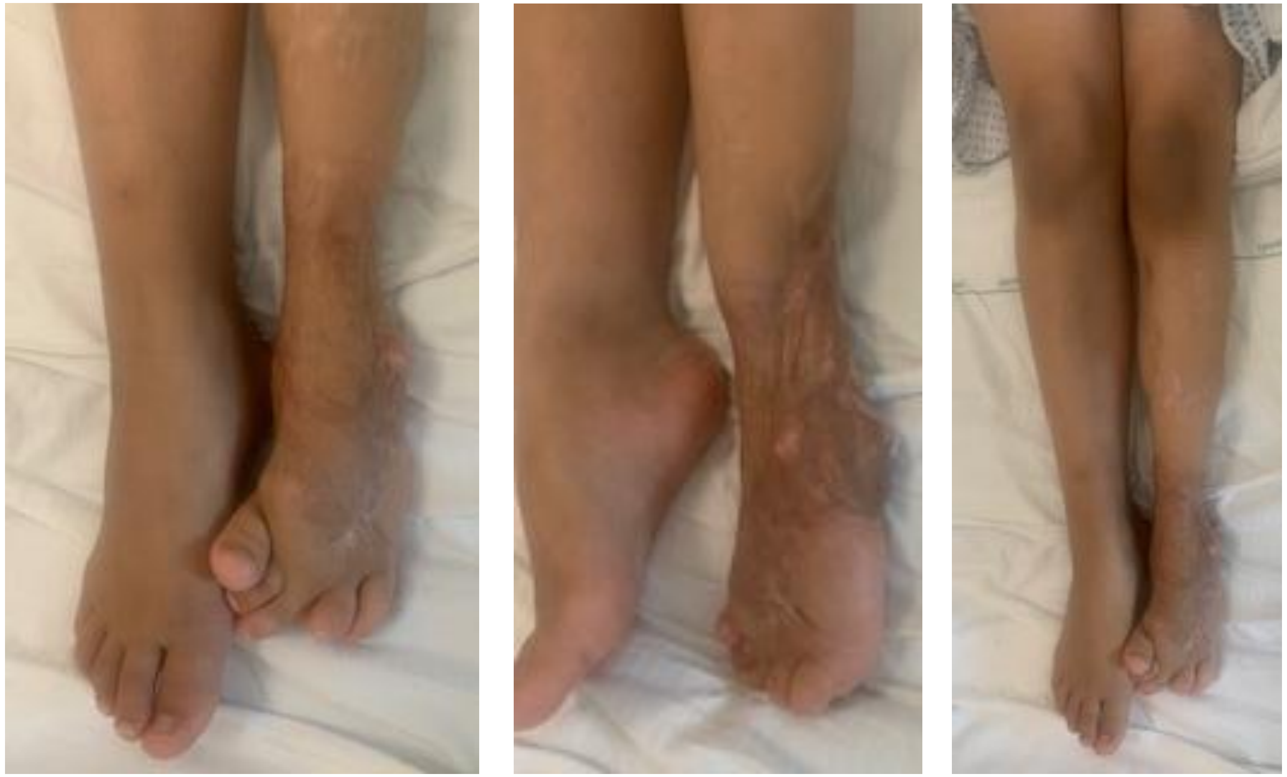




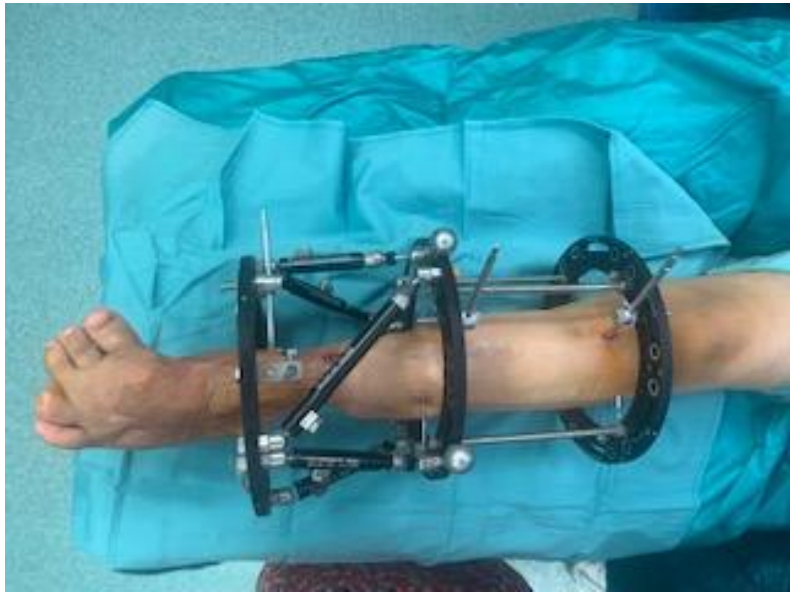




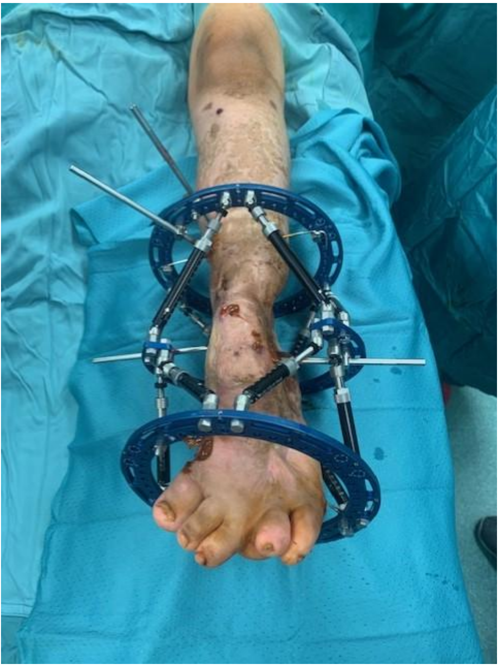
Accorciamento, rotazione, appoggio plantare in equinismo e supinazione



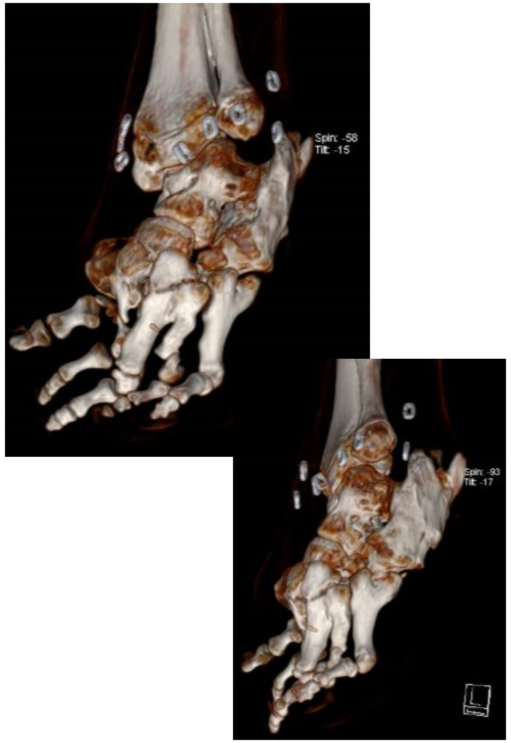
Intervento chirurgico con Fissatore Esterno Esapodalico



Prima fase



Seconda fase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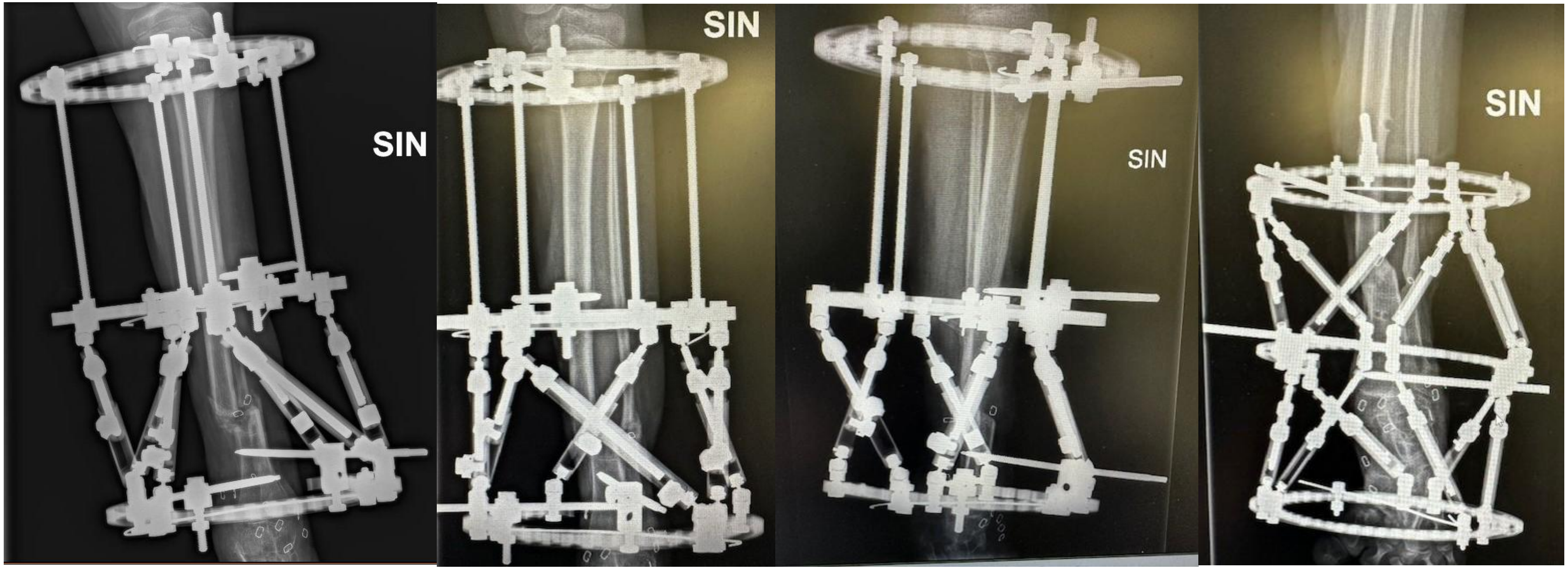
Tilt: -15
Spin: -93
Tilt: -17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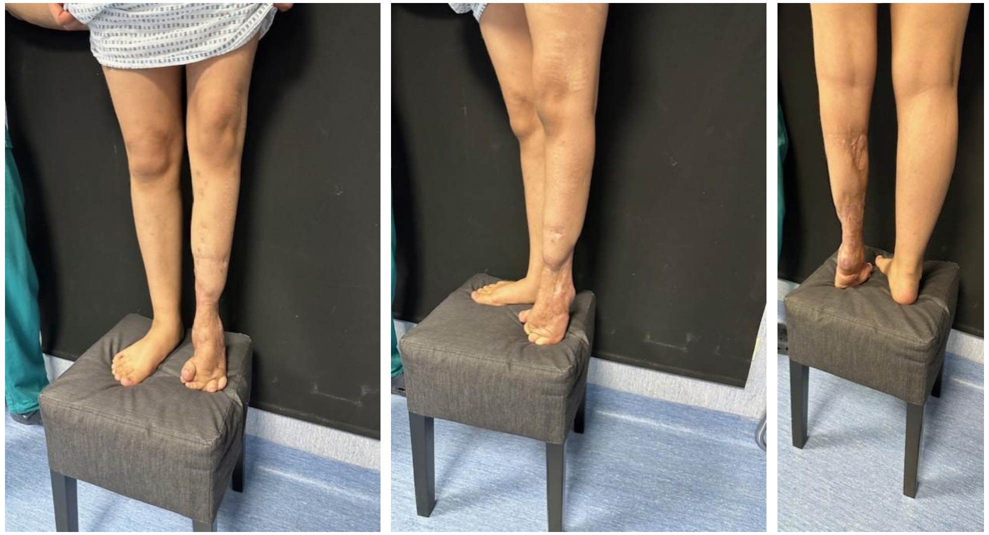
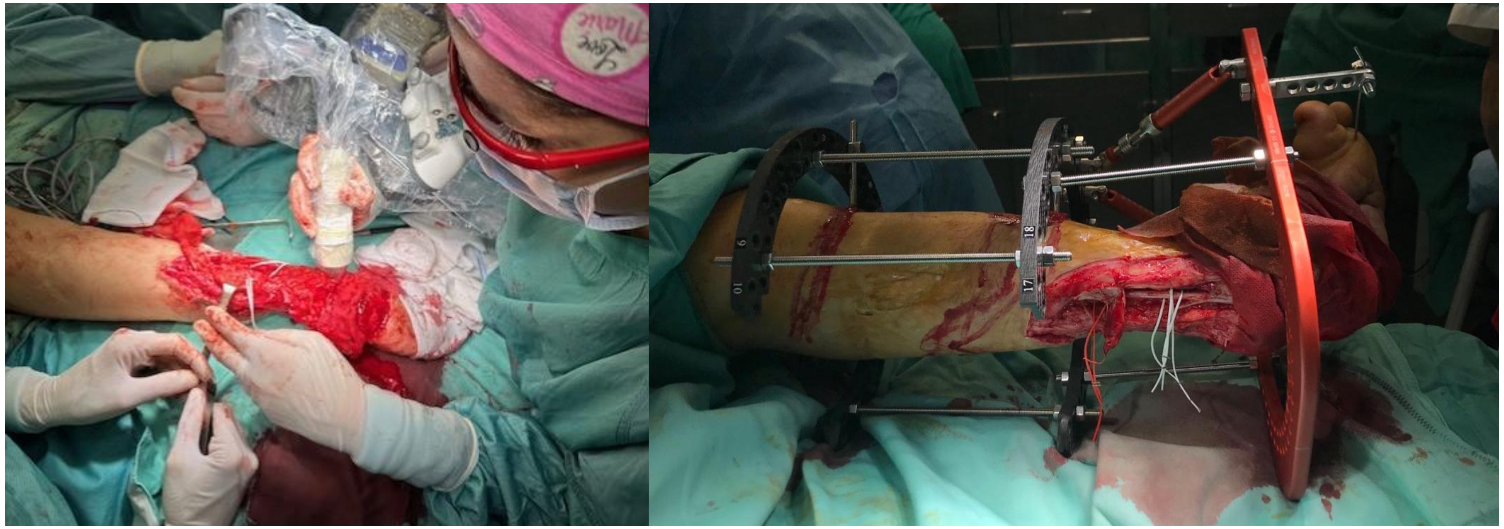
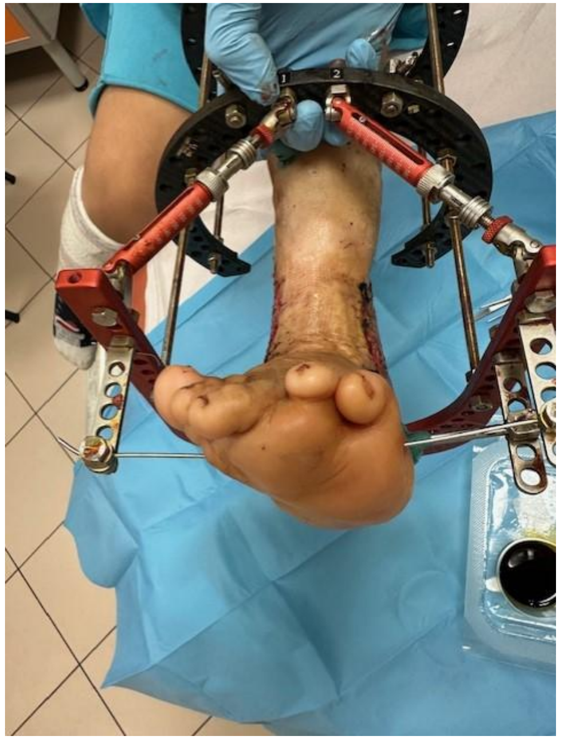
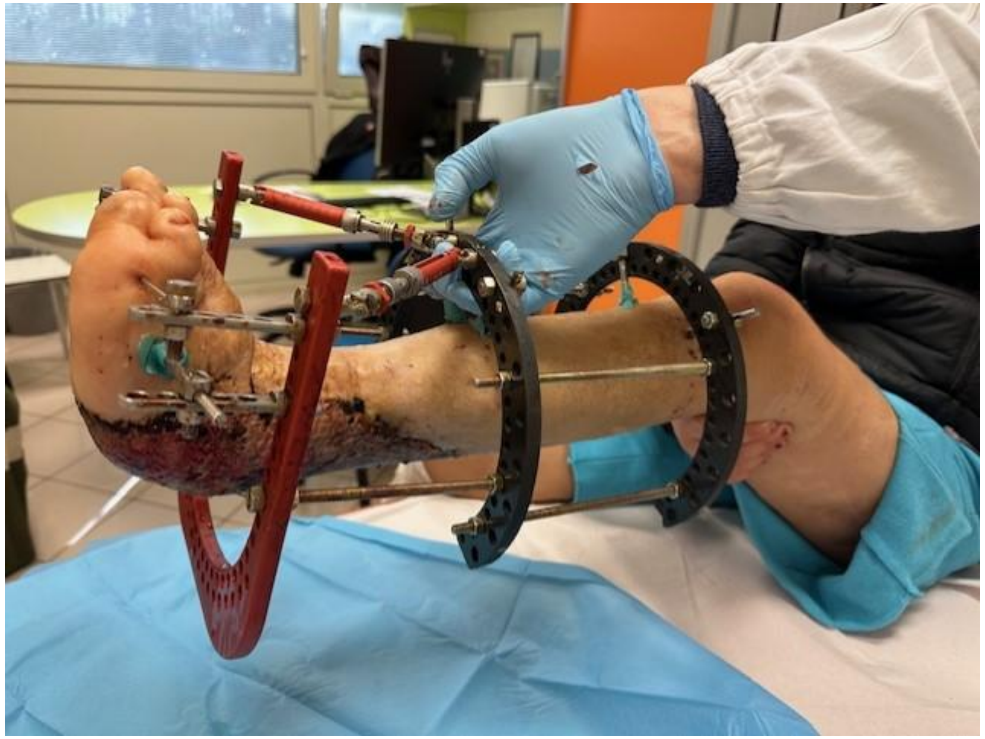
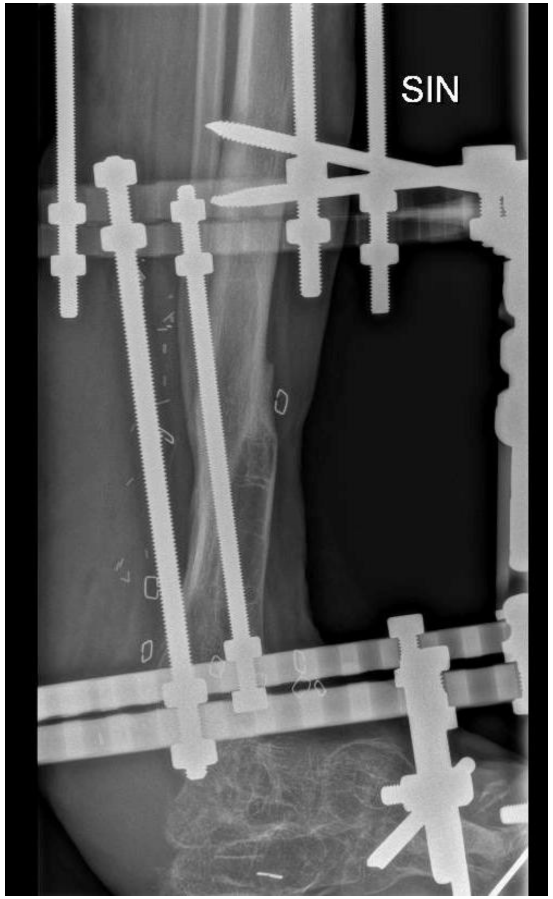
intervento di ortoplastica
lembo vascolarizzato F.E. esapodalico







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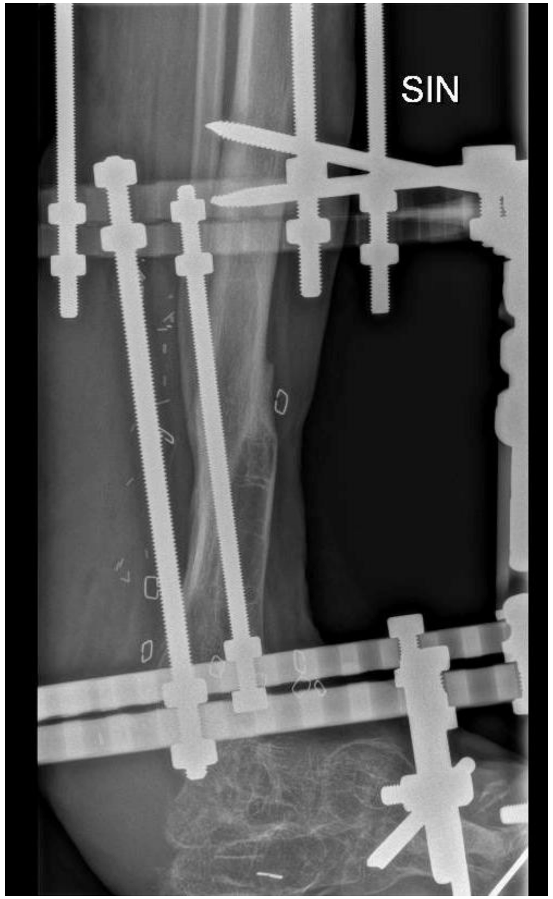
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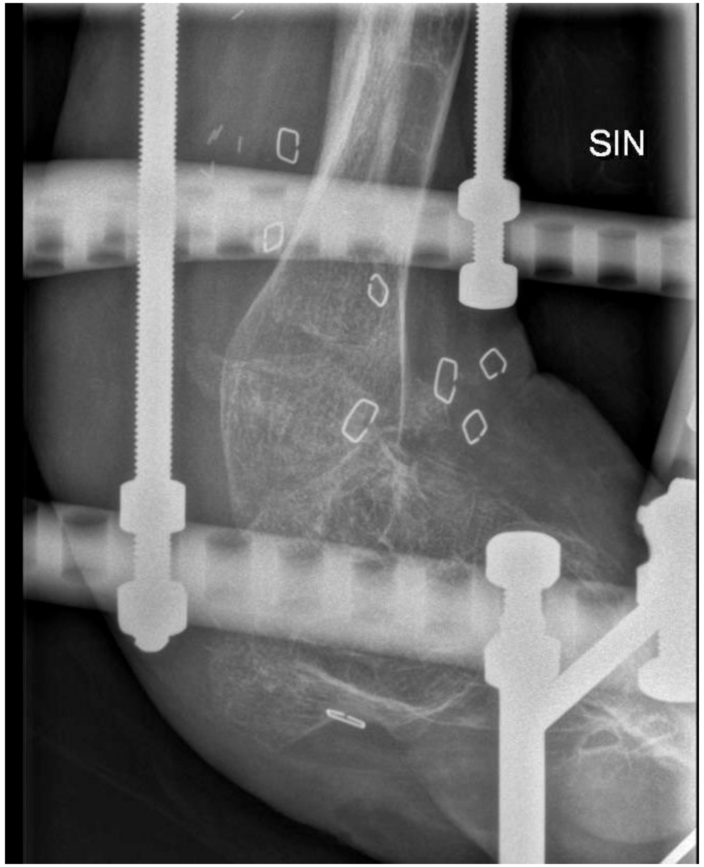
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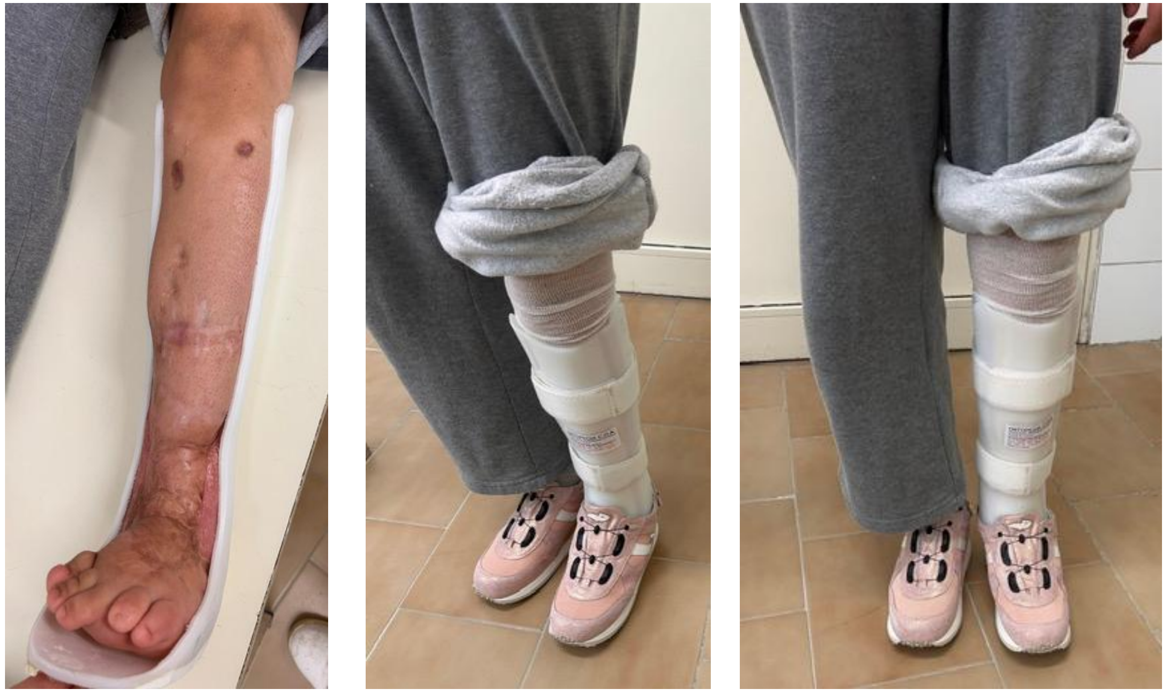
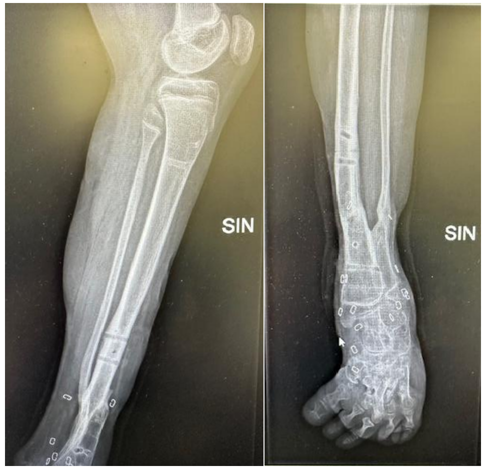
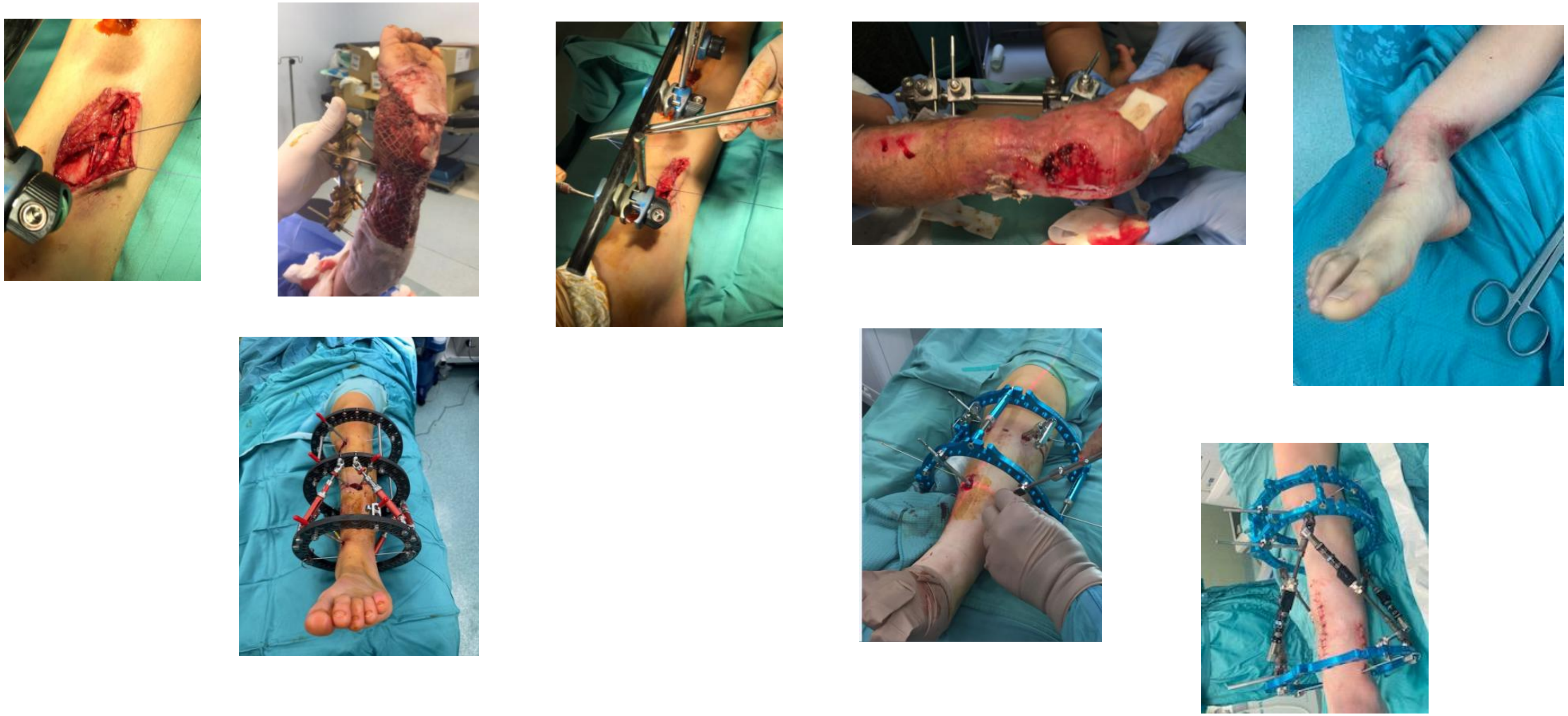


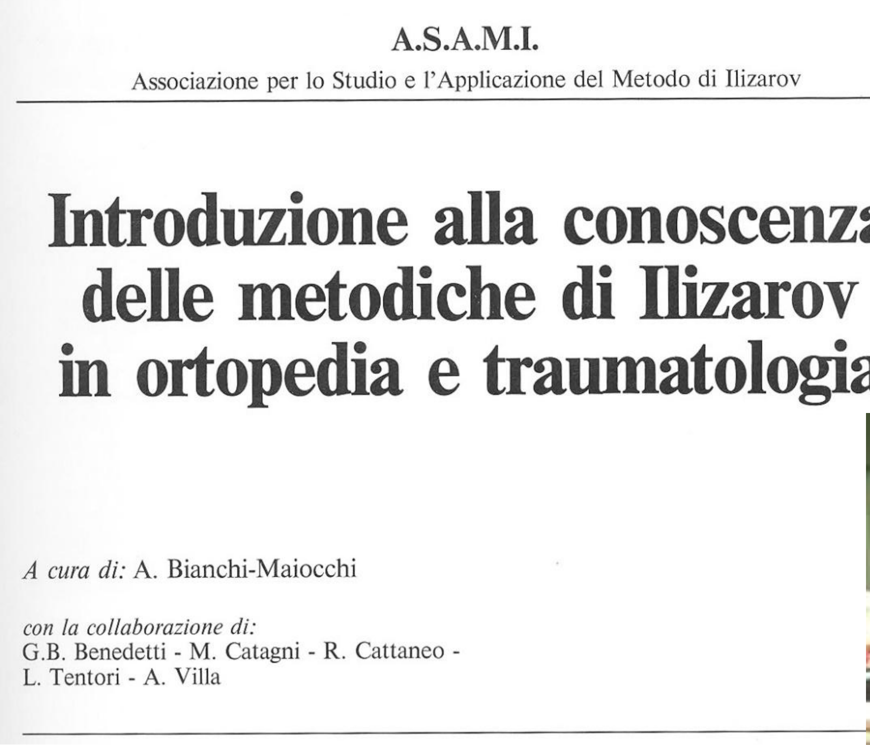
rimozione F.E.





La fissazione esterna (monolaterale-ibrida-circolare-esapodalica) risulta un valido aiuto nel trattamento delle osteomieliti in eta' pediatrica

L'approccio multidisciplinare e' importante per il risultato finale



A.S.A.M.I.

Associazione per lo Studio e l'Applicazione del Metodo di Ilizarov

Introduzione alla conoscenza delle metodiche di Ilizarov in ortopedia e traumatologia

A cura di: A. Bianchi-Maiocchi

con la collaborazione di:
G.B. Benedetti - M. Catagni - R. Cattaneo -
L. Tentori - A. Villa

GRAZIE

OSPEDALE PEDIATRICO
Bambino Gesù