

CONGRESSO NAZIONALE SOCIETÀ ITALIANA FISSAZIONE ESTERNA

Fissazione esterna nel trattamento
delle emergenze e traumi militari,
tecniche di ricostruzione degli arti e
trattamento degli esiti posttraumatici

ROMA

2025

16-17 MAGGIO 2025

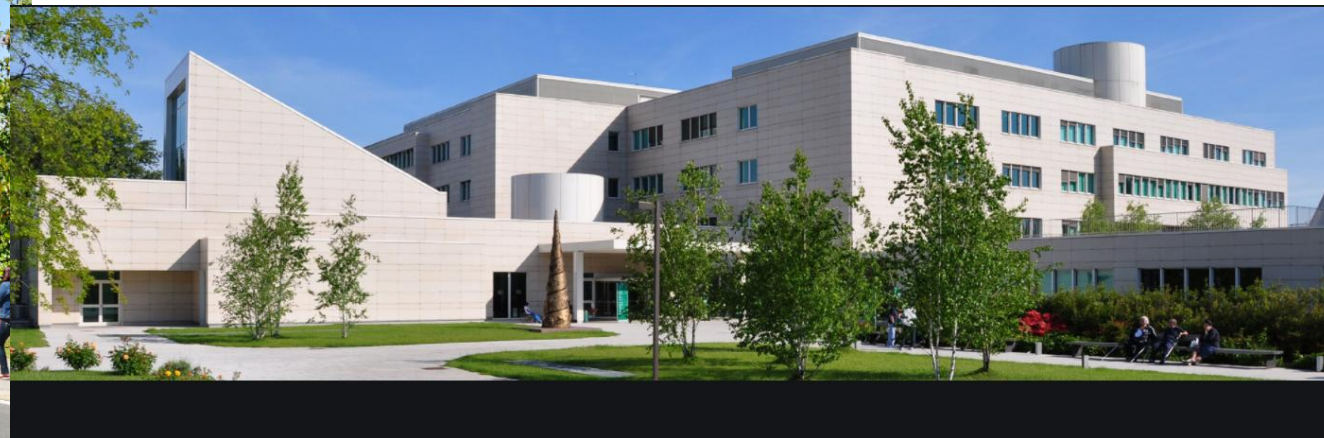


SALVATAGGIO DI CAVIGLIA NEI POSTUMI POSTRAUMATICI TIBIA E PERONE DISTALE

ANKLE SALVAGE IN POST-TRAUMATIC SEQUELAE OF DISTAL TIBIA E FIBULA

Kirienko Alexander

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Ankle Salvage Following Nonunion of Distal Tibia Fractures

Giovanni Lovisetti, MD¹, Alexander Kirienko, MD², Charles Myerson, BA³, and Ettore Vulcano, MD⁴

Abstract

Background: Nonunions of the distal tibia in close proximity to the ankle joint can be a challenge to treat. The purpose of this study was to evaluate radiographic and clinical outcomes of patients who underwent ankle-sparing bone transport for periarticular distal tibial nonunions.

Methods: Twenty-one patients underwent ankle-sparing bone transport between January 2006 and July 2016. The mean age of the patients was 48.6 years, and 71% (15/21) were male. Patients were followed for an average of 14.6 months (range, 10.6-17.7 months), with an average of 8.6 months in-frame. Thirteen of 21 patients had infected nonunions. Primary endpoints included time to union and American Orthopaedic Foot & Ankle Society (AOFAS) score.

Results: All fractures achieved union. Mean time to union was 37.4 weeks. Mean AOFAS score was 86.3 points (range, 37-100). A score of 37 was observed in 1 patient with preexisting Charcot foot. Radiographic evaluation at 6 months revealed a mean lateral distal tibial angle of 89.2 degrees and a mean anterior distal tibial angle of 76 degrees. Leg length discrepancy was less than 1.2 cm in all patients. Superficial pin infection was observed in 7 patients, and operative wound infection at the level of bone resection was observed in 3 patients.

Conclusion: The ankle-sparing bone transport technique was an effective alternative to bone graft and arthrodesis for the treatment of periarticular nonunions of the distal tibia and was safe for use in patients with infected nonunions in close proximity to the ankle joint.

Level of Evidence: Level IV, case series.

Keywords: ankle sparing, distal tibia, nonunion, bone transport

Nonunions of the distal tibia in close proximity to the ankle joint can be a challenge to treat. Restoration of functional status relies on adequate bone union, resolution of any discrepancy in limb length, and alignment of the tibial plafond.^{21,22} The poor quality of bone at the site of nonunion, the proximity to the joint space, and the complexity of the operative approach make achieving functionality difficult regardless of the operative technique or type of fixation used.^{13,33} Given the complexity of the pathology and the frequent presence of a comorbid infection of the nonunion, revision surgery with ankle fusion is frequently pursued.^{5,7-9,40} This joint-sacrificing technique, although effective, is not without consequence. Fusion of the tibio-talar joint causes significant changes in gait and increased loading of nearby joints.^{39,41} Internal fixation and bone grafting offer promising results, but few studies have been done on this technique.^{14,26}

Bone transport techniques, while complex, offer an alternative to bone grafting and ankle fusion.^{29,31} An ankle-salvage approach by means of bone transport has been presented in several clinical cases.^{15,16,28,34} Kabata et al¹⁶ were among

the first to report on successful preservation of the tibial plafond using a bone transport technique. The authors described one patient with an infected distal periarticular tibial nonunion successfully treated with acute segmental shortening at the nonunion site.¹⁶ In more recent years, an ankle-sparing technique involving en bloc resection of pathologic bone and staged distraction osteogenesis of the proximal tibia has been reported with good clinical results.³⁴

The aim of this retrospective study was to present radiographic and clinical outcomes of periarticular distal tibial nonunions managed with ankle-sparing bone transport. Our

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21 patients

Foot & Ankle International 00(0)

Table 1. Preoperative Demographics.

Patient Characteristic	Result
Male:female	15:6
Age, mean (range), y	48.6 (17-79)
Local infection, n (%)	13 (61.9)
Previous surgery, n (%)	21 (100)
Current smoker, n (%)	2 (9.5)
Diabetic, n (%)	2 (9.5)

Table 2. Operative, Radiographic, and Clinical Outcomes Data.

Operative Endpoint	Mean (Range)
Bone resected, mm	47.8 (22-80)
Distance from articular surface, mm	27.3 (11-50)
Time in frame, wk	37.4 (20-51)
Complete bone consolidation, n (%)	20 (95.2)
Lateral distal tibial angle, degrees	89.2 (85-101)
Anterior distal tibial angle, degrees	76 (64-84)
American Orthopaedic Foot & Ankle Society score	86.3 (37-100)

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1211

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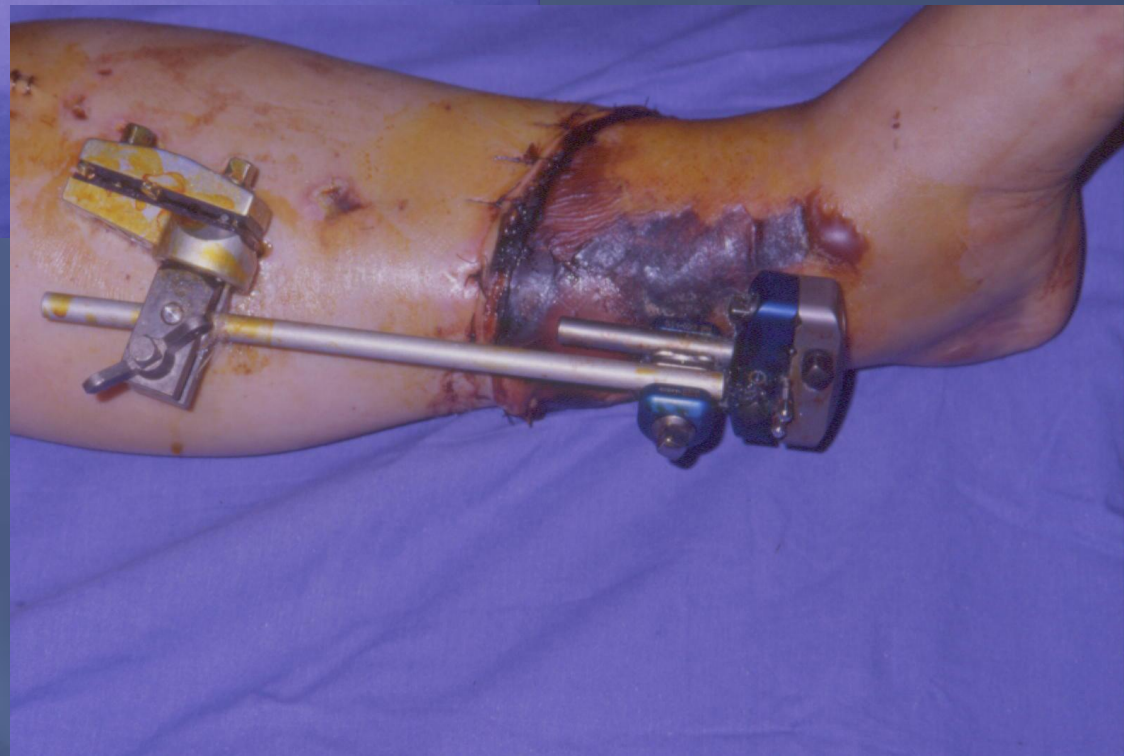


42 y.o.female. 43B,
Gustilo IIIB fracture.
Subamputation of the
distal leg, fracture of
the distal diaphysis of
the femur, distal
humerus, radius and
ulna on the left site.





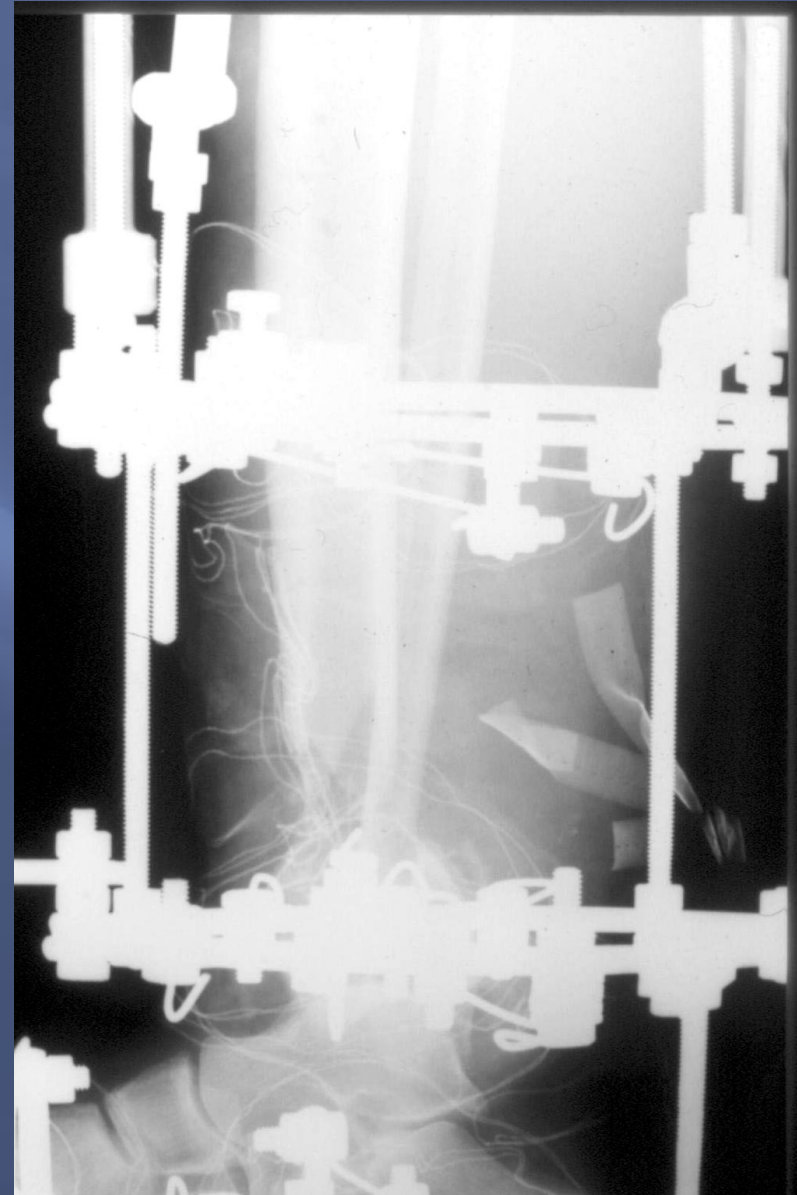
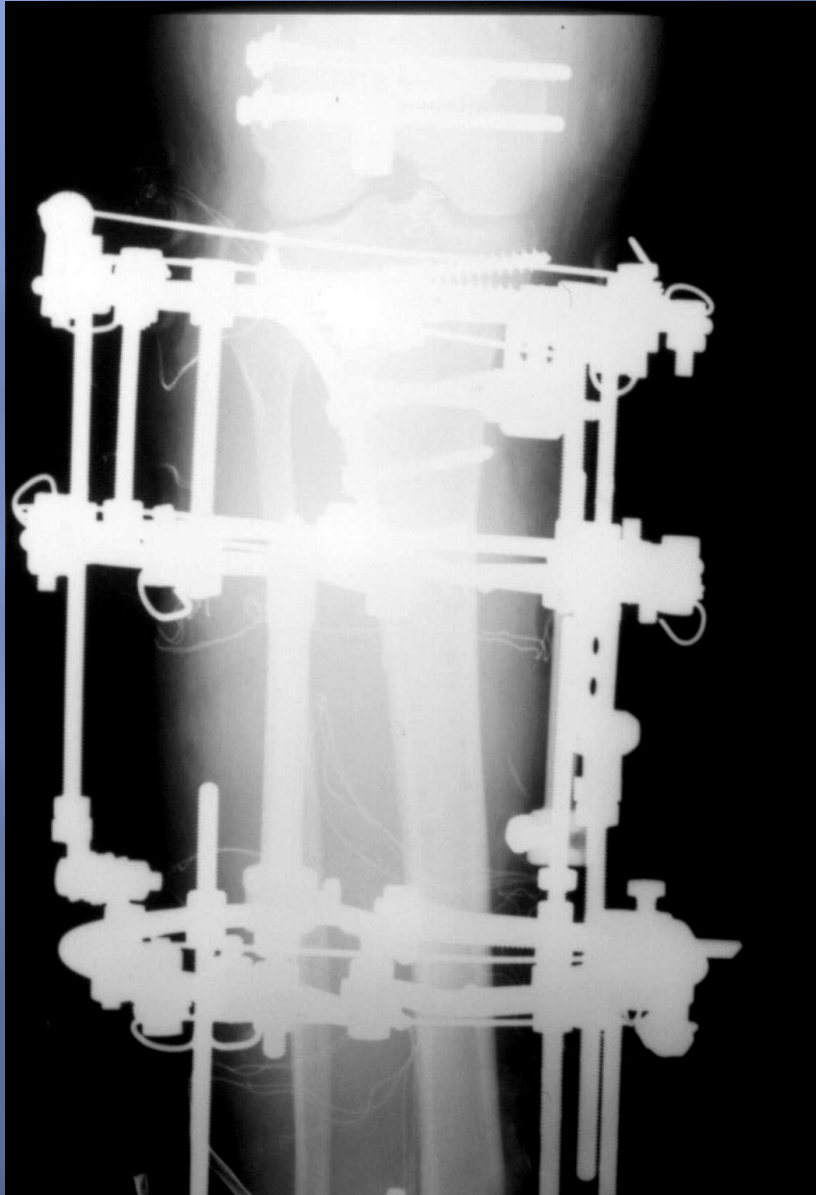
Ex Fix on
the bridge
in
emergency



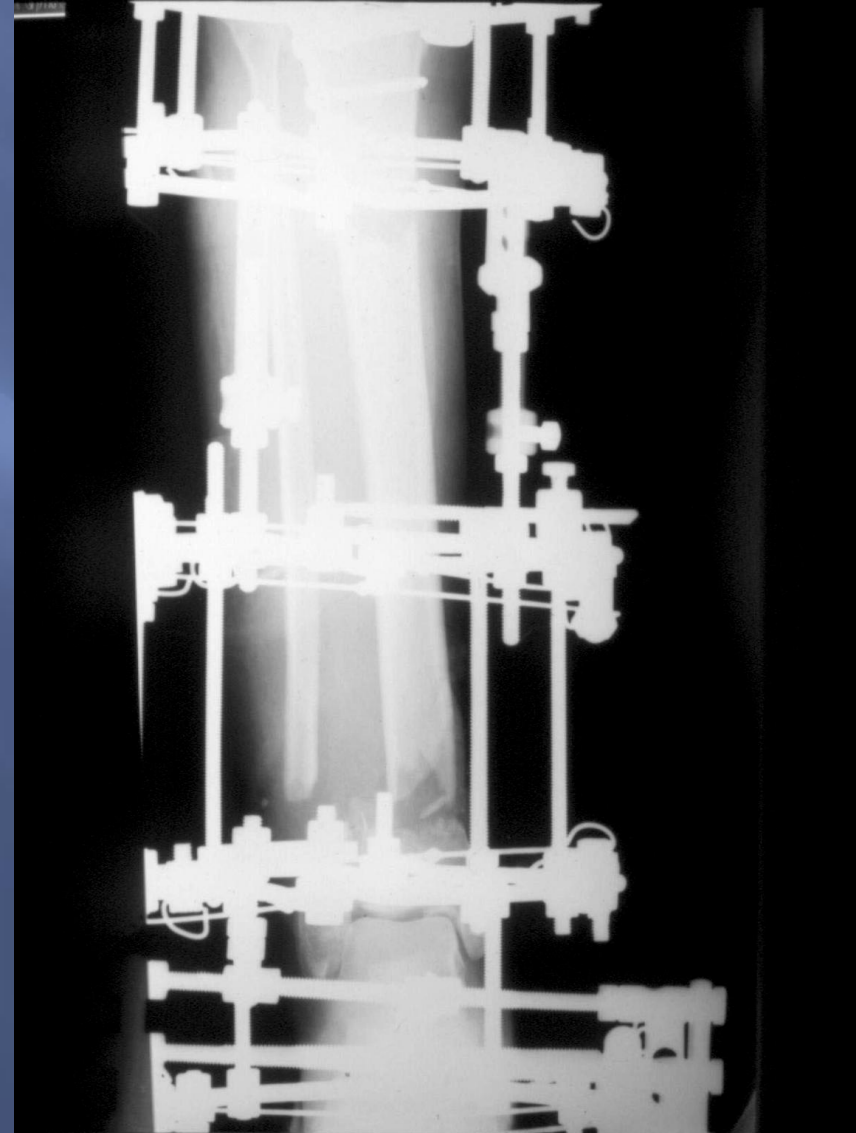
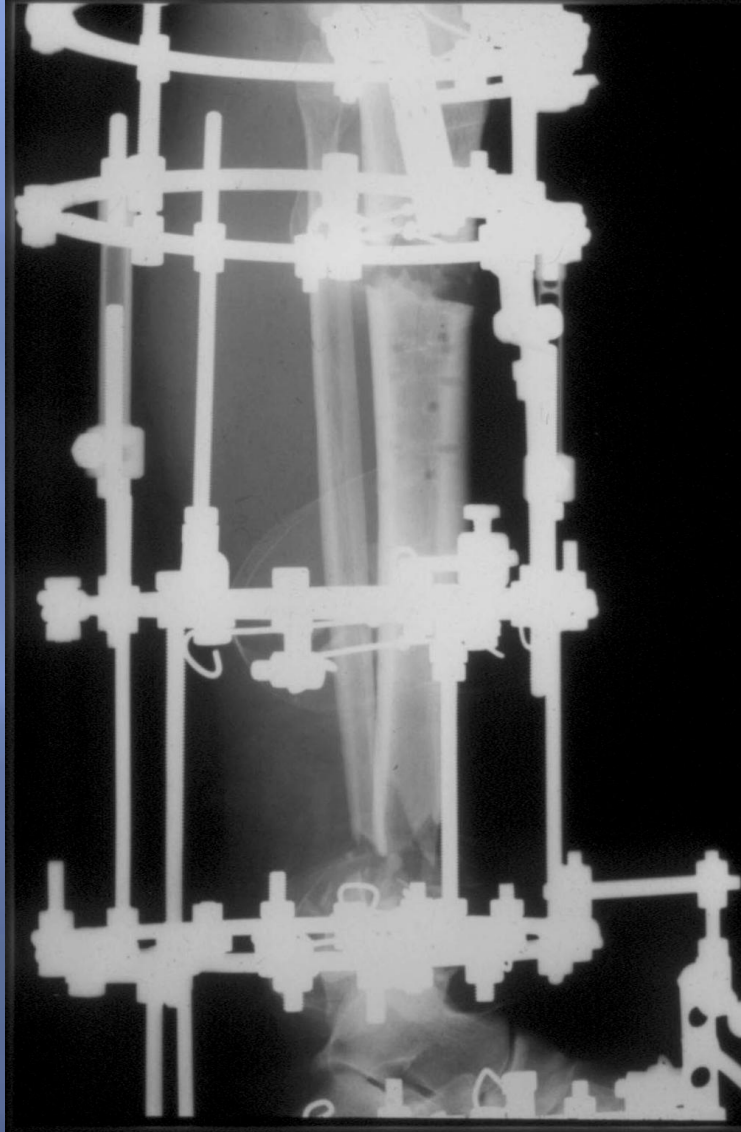
X-ray after surgery



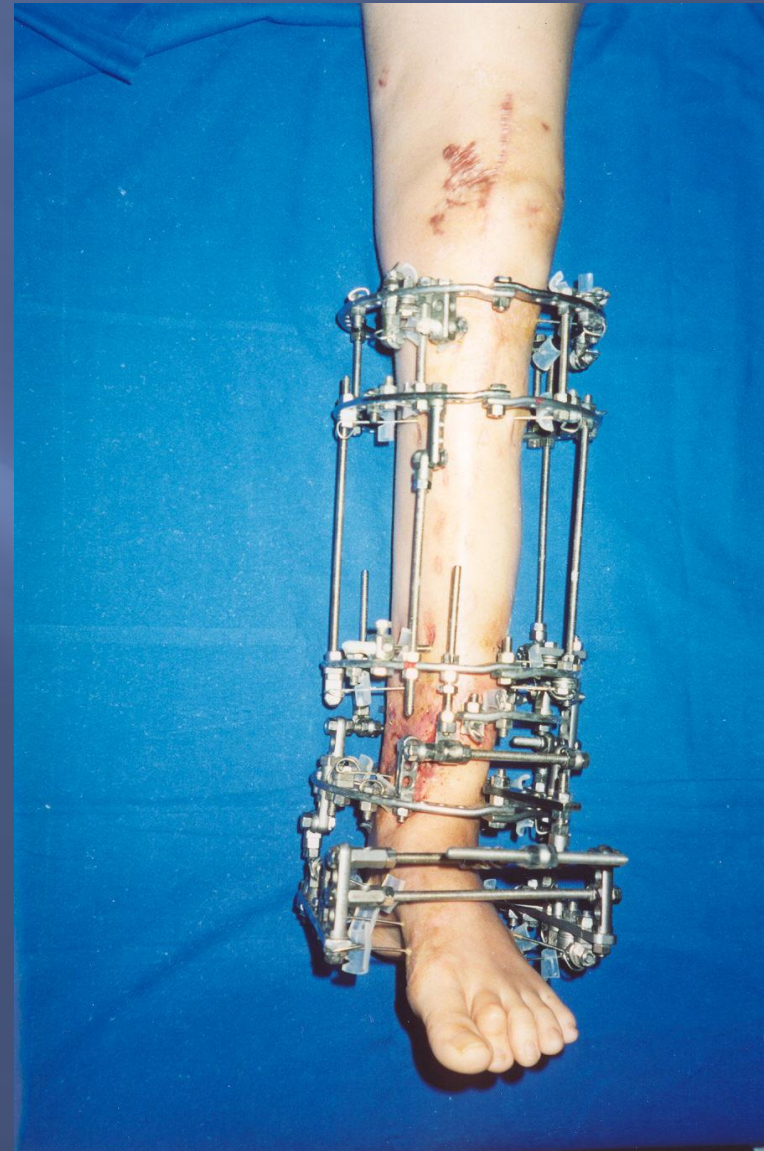
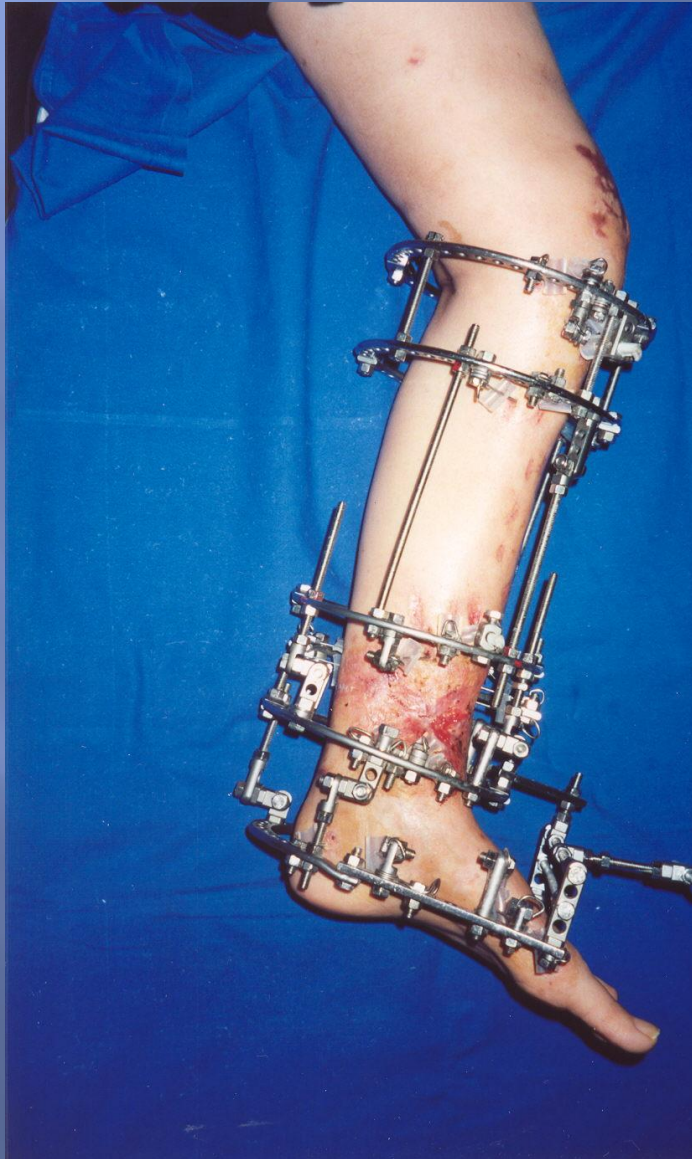
X-rays after definitive osteosynthesis with circular frame, proximal osteotomy for bone transport



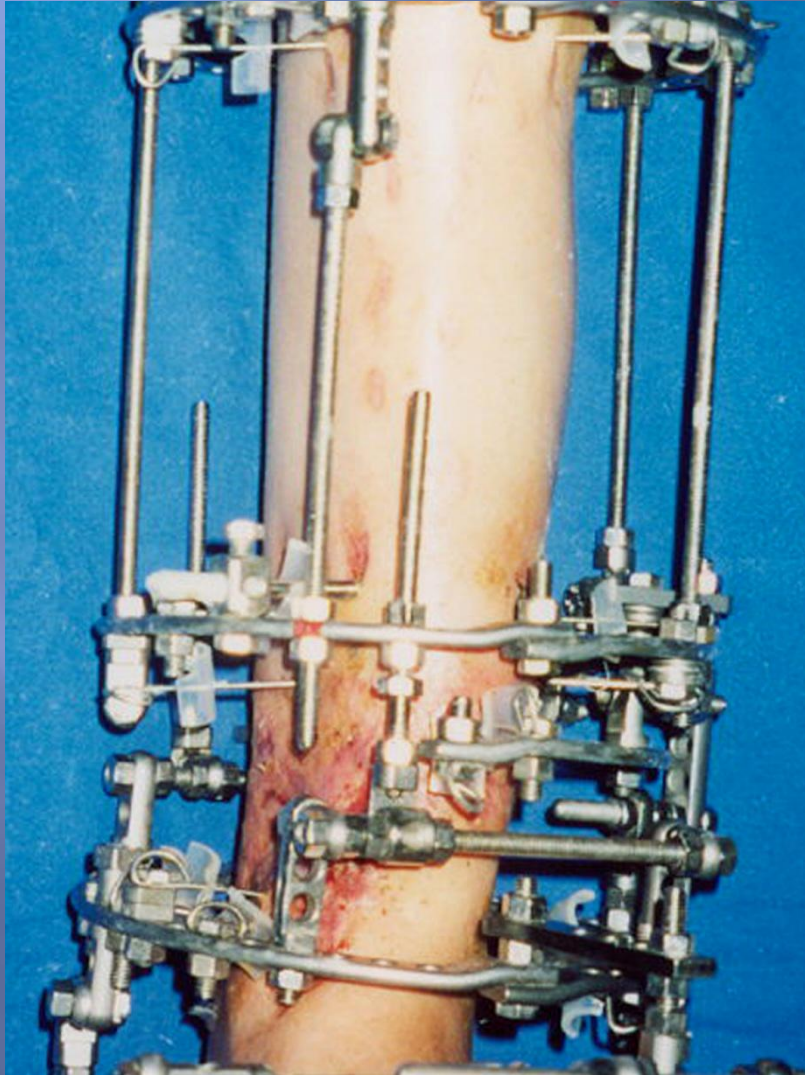
Proximal lengthening and distal compression.



Clinical view.



Wound healing



Iron woman





At work, she was
anesthesiologist in our
hospital Humanitas

19 y.o. Female with posttraumatic infected non union of the distal tibia

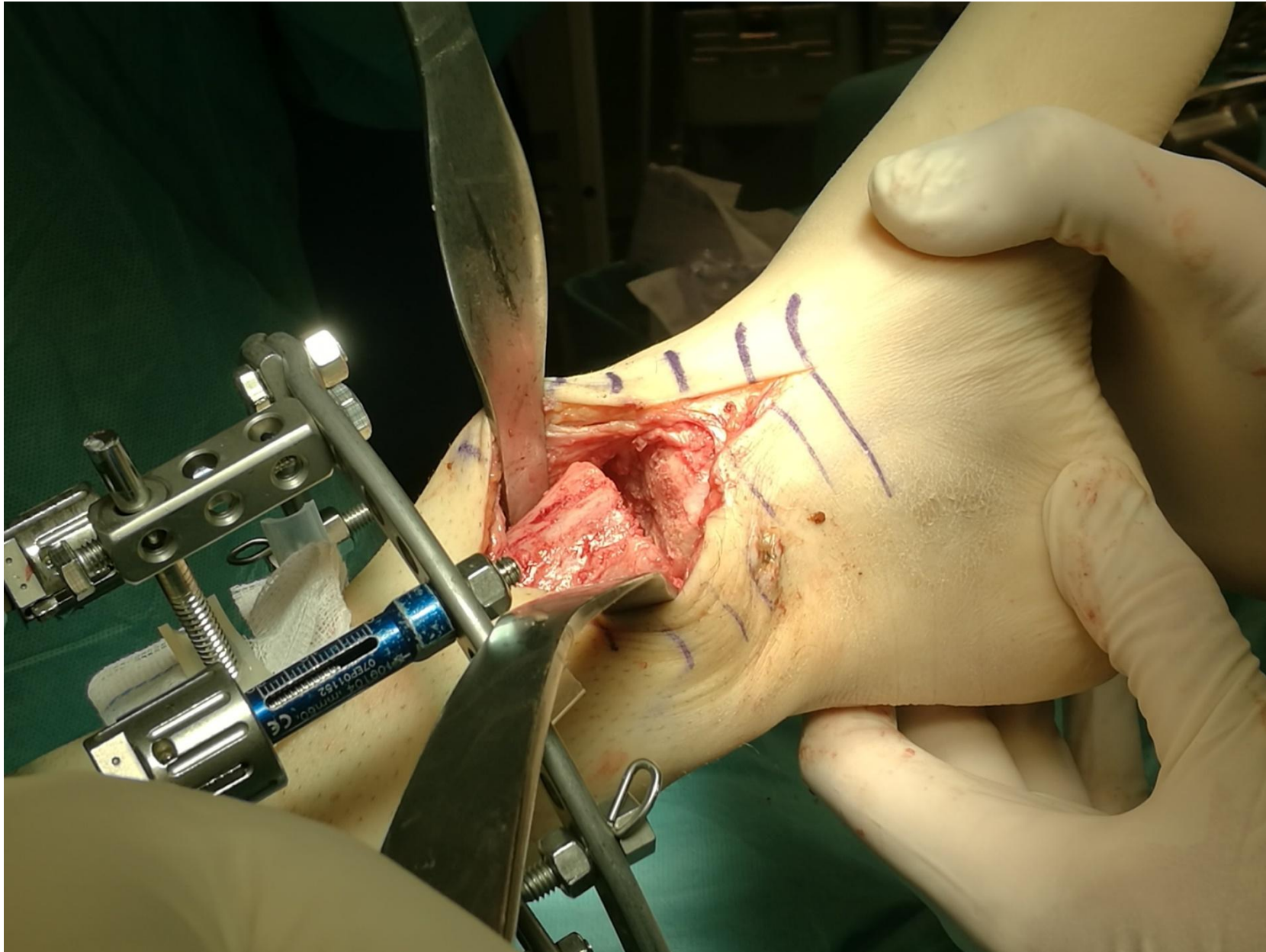


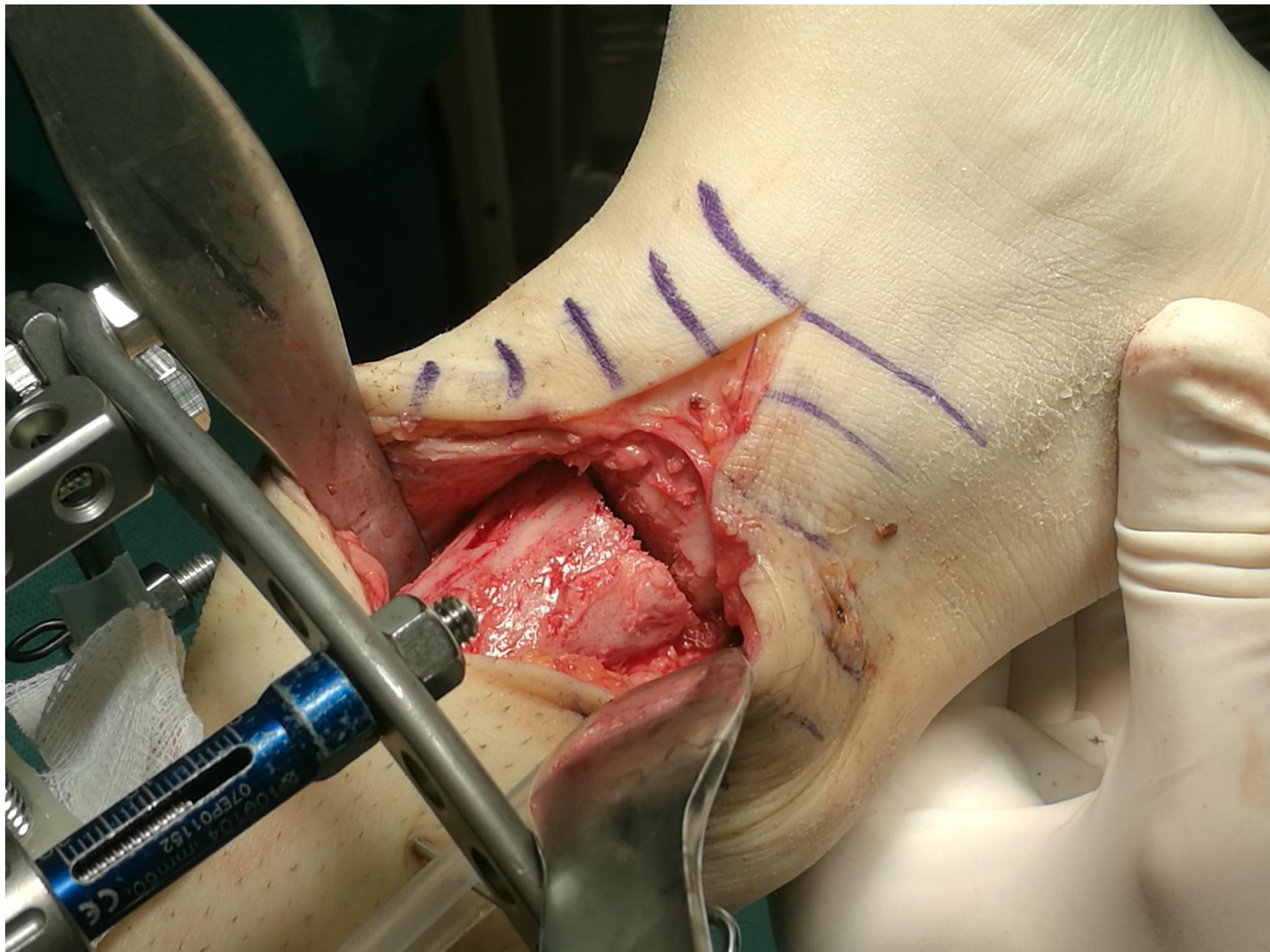




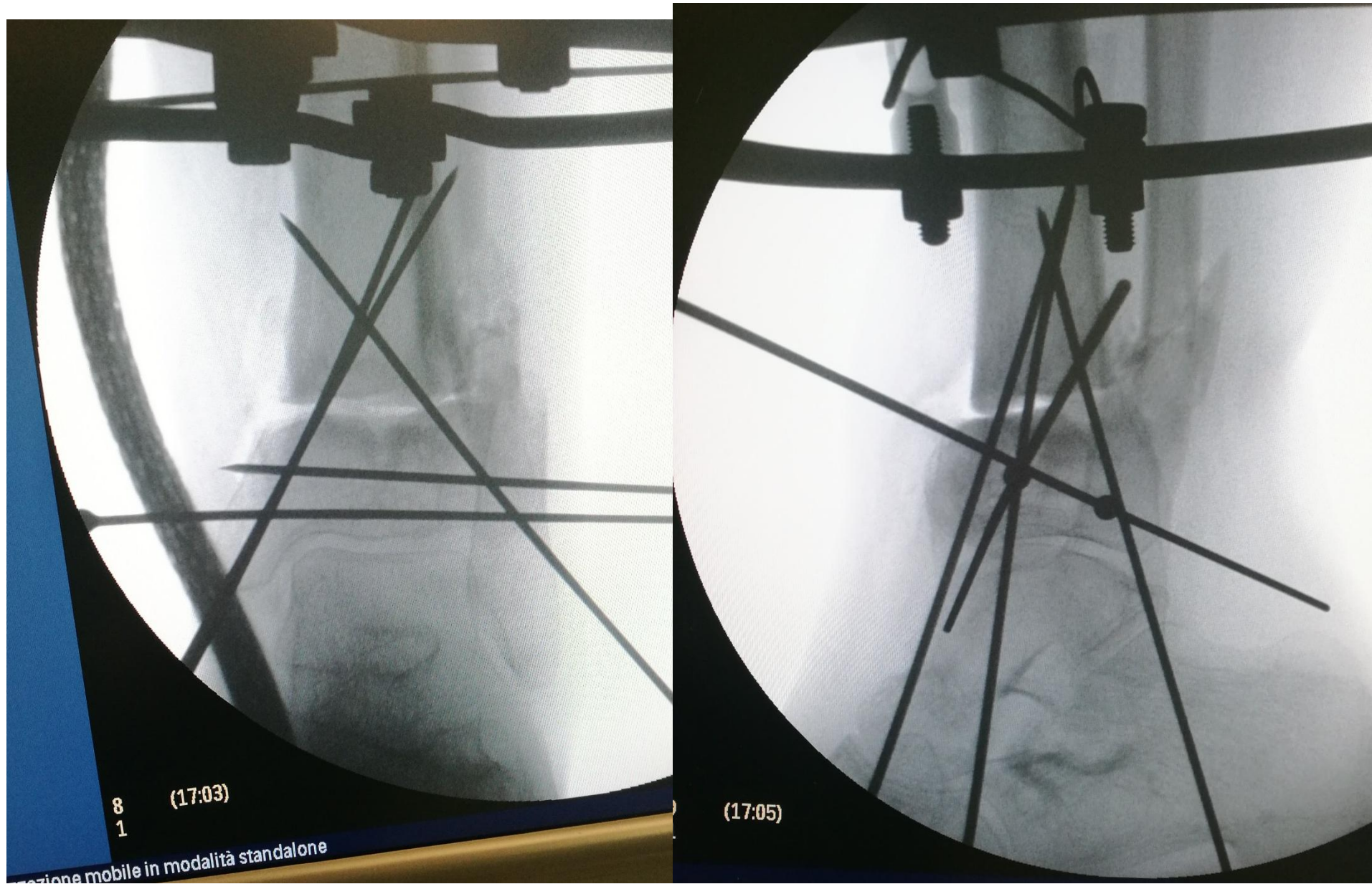


Resection of the infected bone



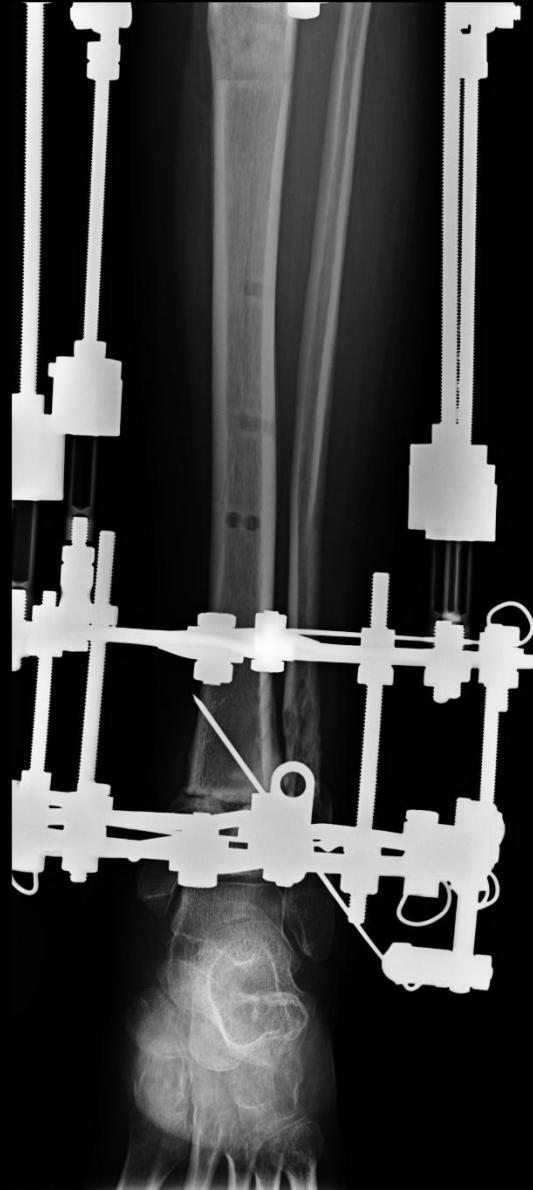


Osteotomy of the distal fibula permits acute shortening and compression of the distal tibia



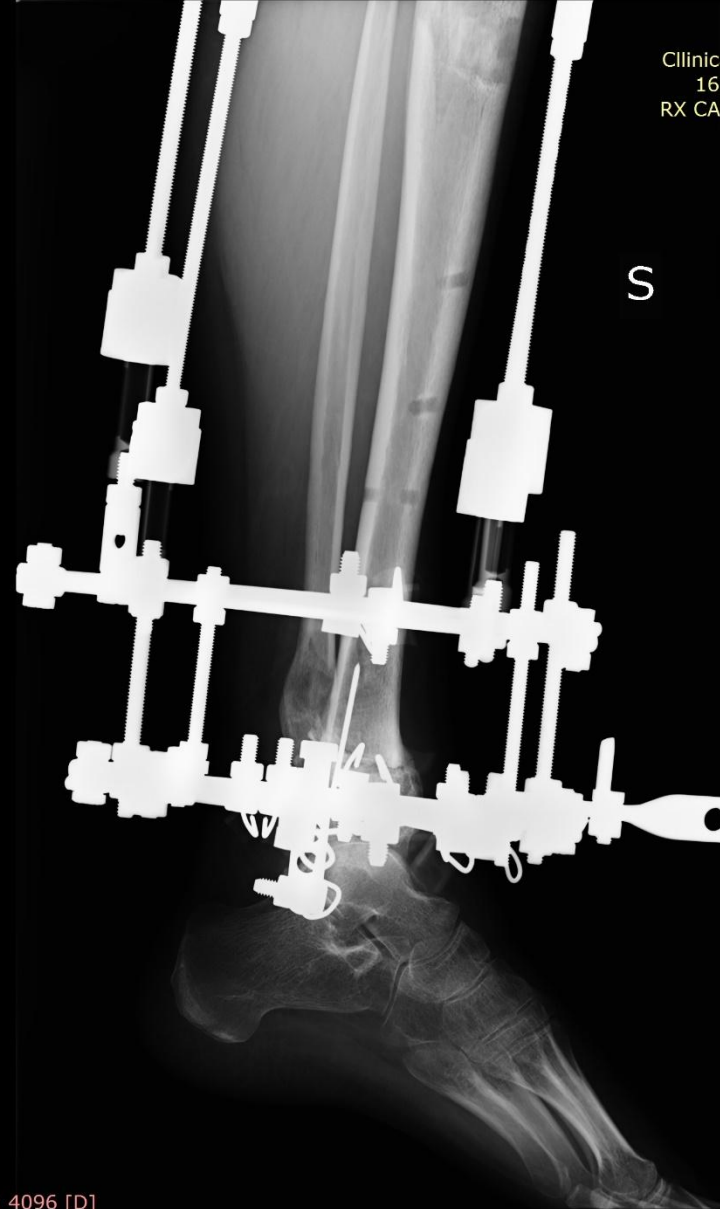
Simultaneous lengthening of the proximal tibia

Im: 1/1
Se: 1



WL: 2047 WW: 4096 [D]

RAGNI FRANCESCA LAURA
Im: 1/1
Se: 3



WL: 2047 WW: 4096 [D]

RAGNI FRANCESCA LAURA
2096276
19/02/2000 F
Clinica San Rocco Ome
1631117071824531
RX CAVIGLIA SINISTRA
L LAT

18/07/2017 10:59:34

Im: 1/1
Se: 1

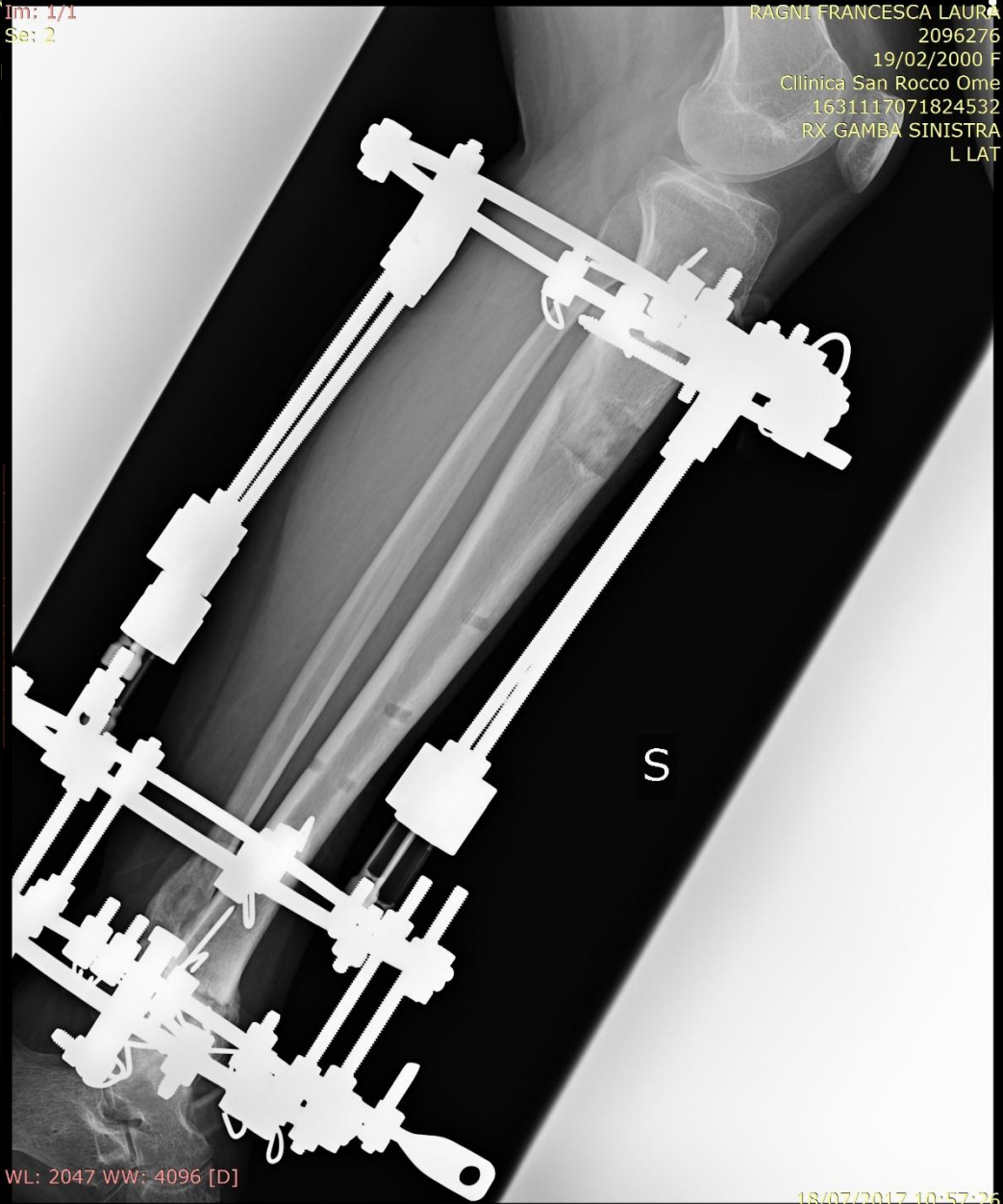
S



WL: 2047 WW: 4096 [D]

RAGNI FRANCESCA LAURA
Im: 1/1
Se: 2
CI

RAGNI FRANCESCA LAURA
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19/02/2000 F
Clinica San Rocco Ome
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RX Gamba SINISTRA
L LAT

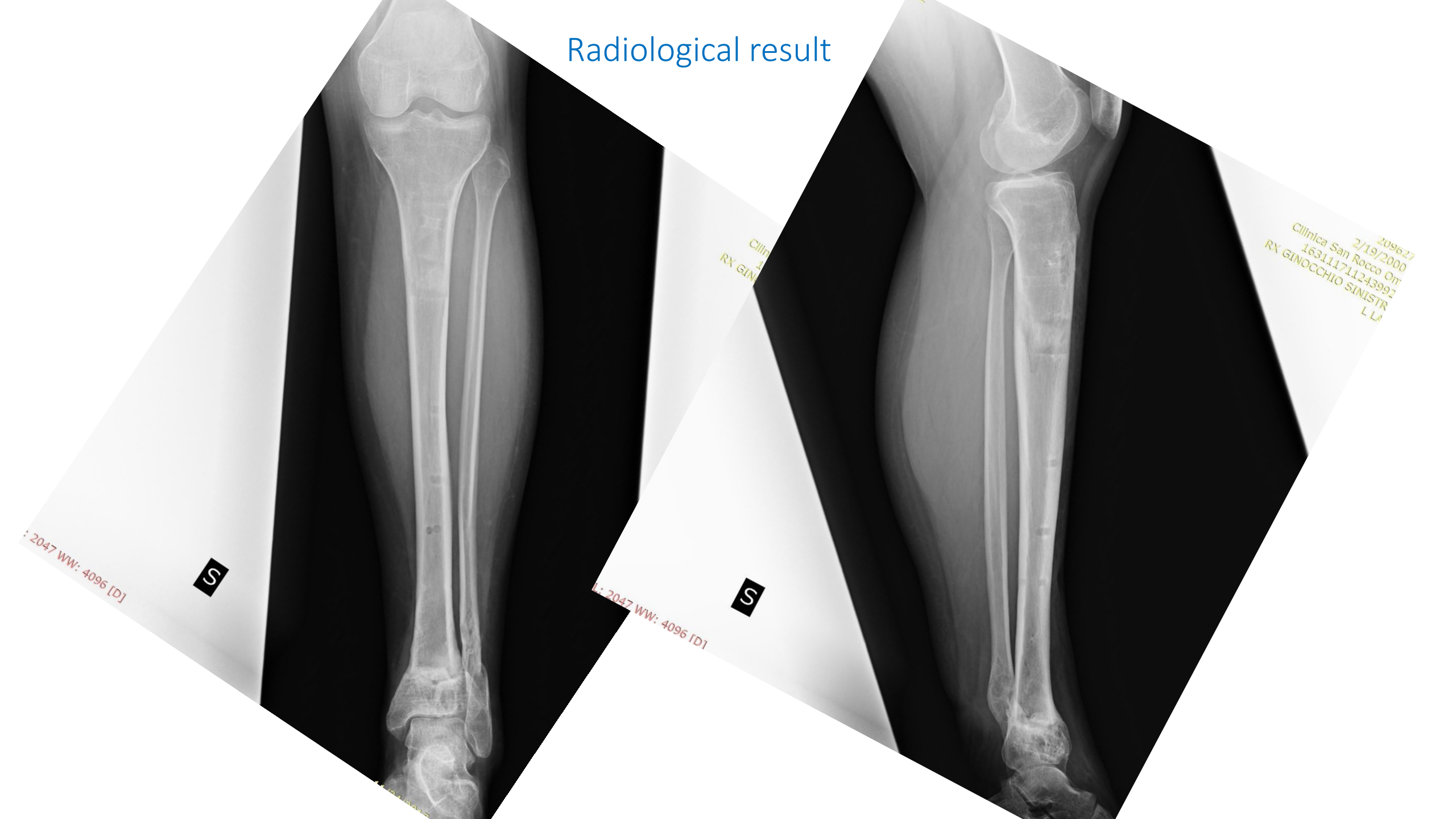


S

WL: 2047 WW: 4096 [D]

18/07/2017 10:57:26

Radiological result



42 y.o. male with postraumatic pseudoarthrosis of the distal tibia



PET SCAN with FDG



Im: 27/47
Se: 650

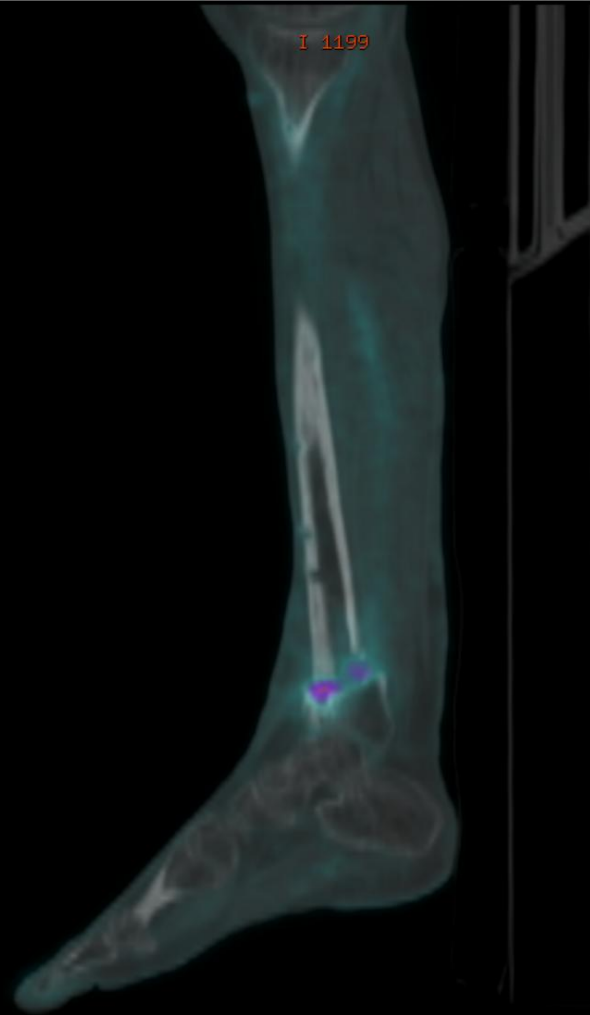
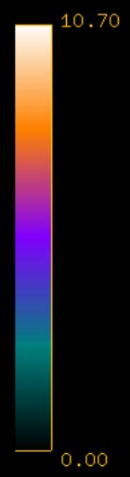
Reformat Volume 2/Volume 1
Ex: 50% 10956 / 50% 10956

Se: 6 / 3
L: 60.5

DFOV 70.0 cm

GIORIA MICHELE
ISTITUTO CLINICO HUMANITAS
M 45 1708083
DoB: Jan 17 1970
Ex: Dec 04 2015

GIORIA MICHELE
1708083
17/01/1970 M
ISTITUTO CLINICO HUMANITAS
10956
PET GLOBALE CORPOREA
Processed Images



P
4
1
4

50 % PET

2.73

3.3mm /3.3sp

X: 187 Y: 379 Val: 0,00
WL: 128 WW: 256 [D]

I 1899

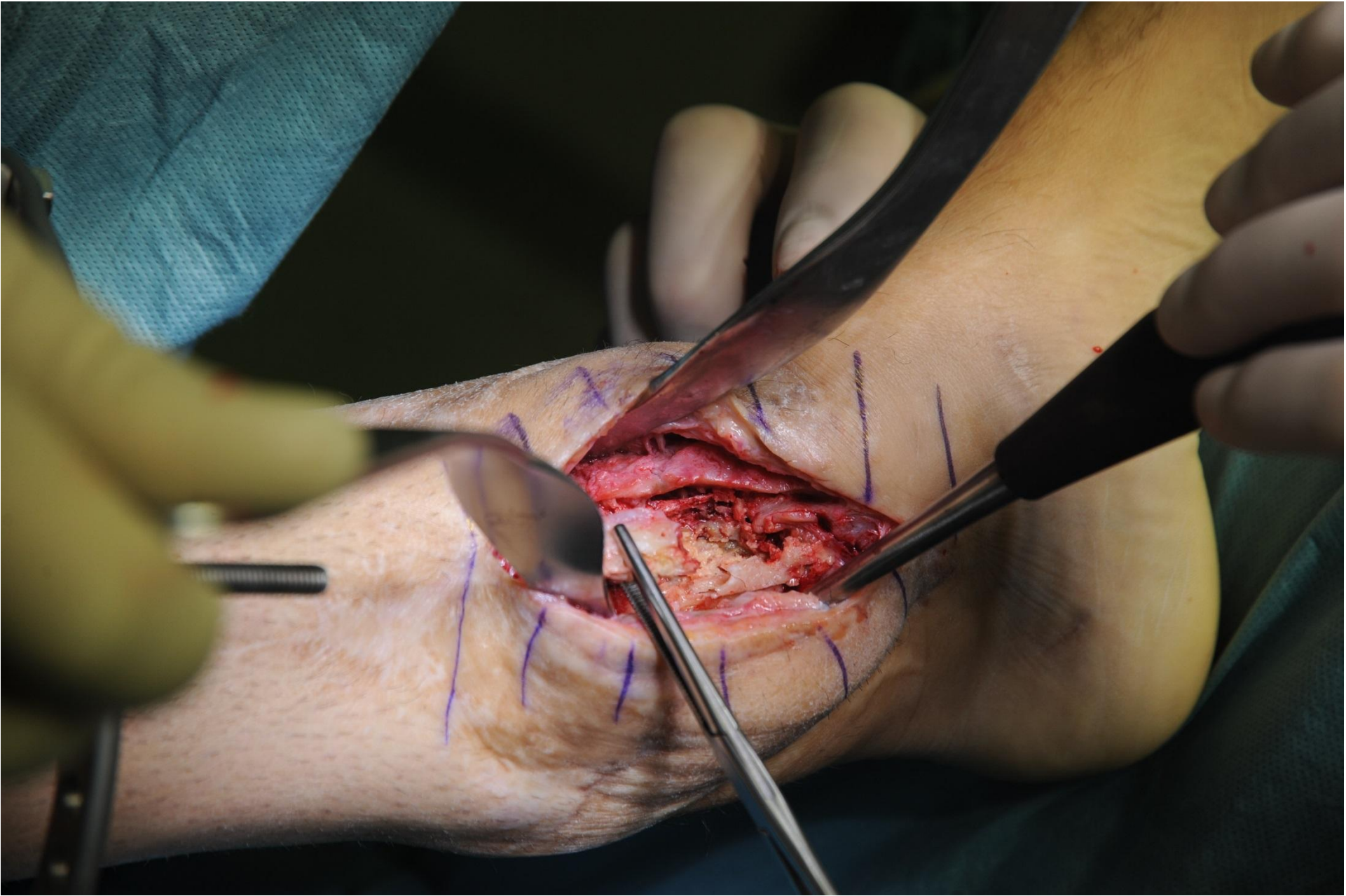
650/27

V=3.81

04/12/2015 13:15:36

Surgery 13 January 2017

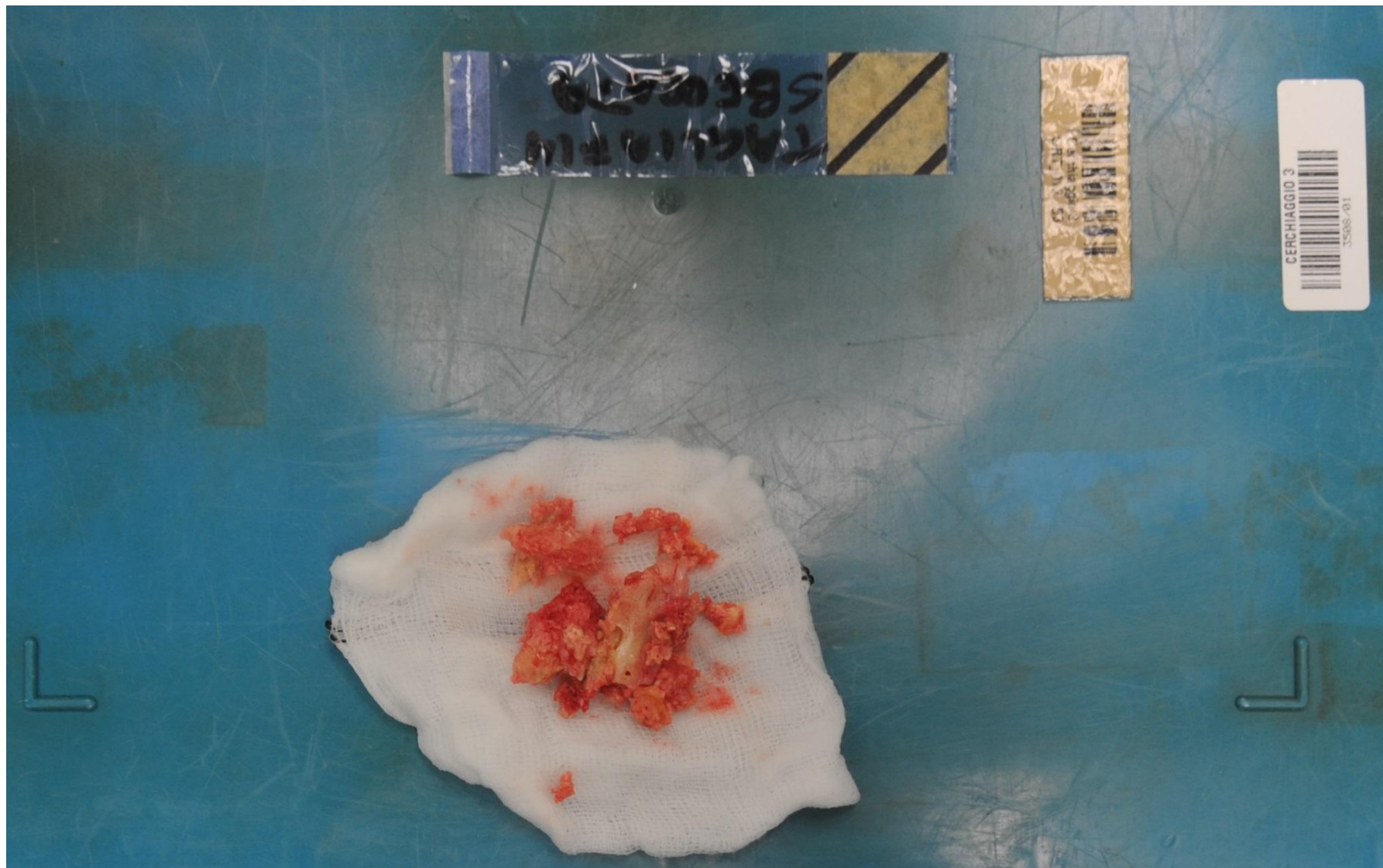




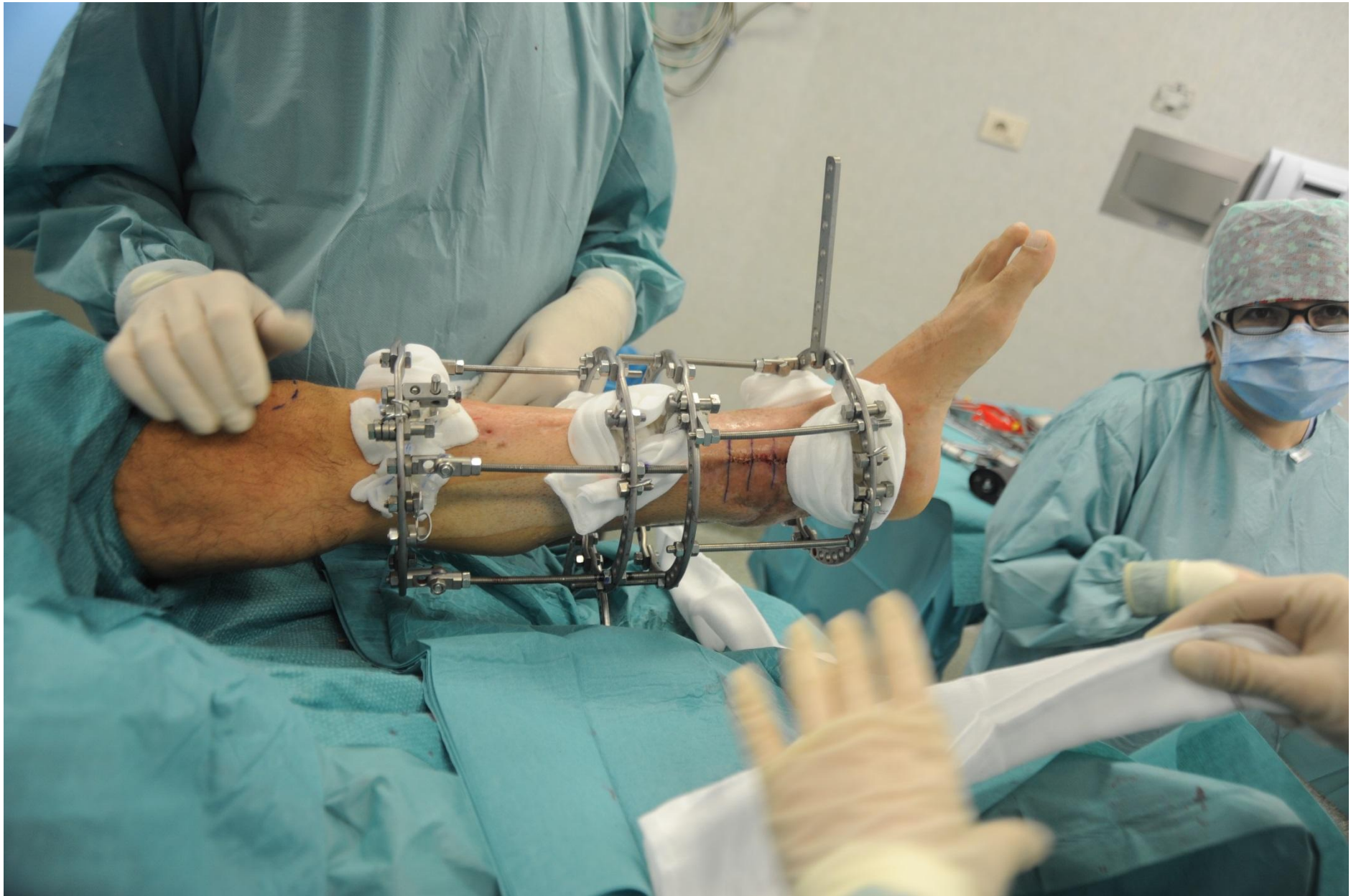
Infected bone



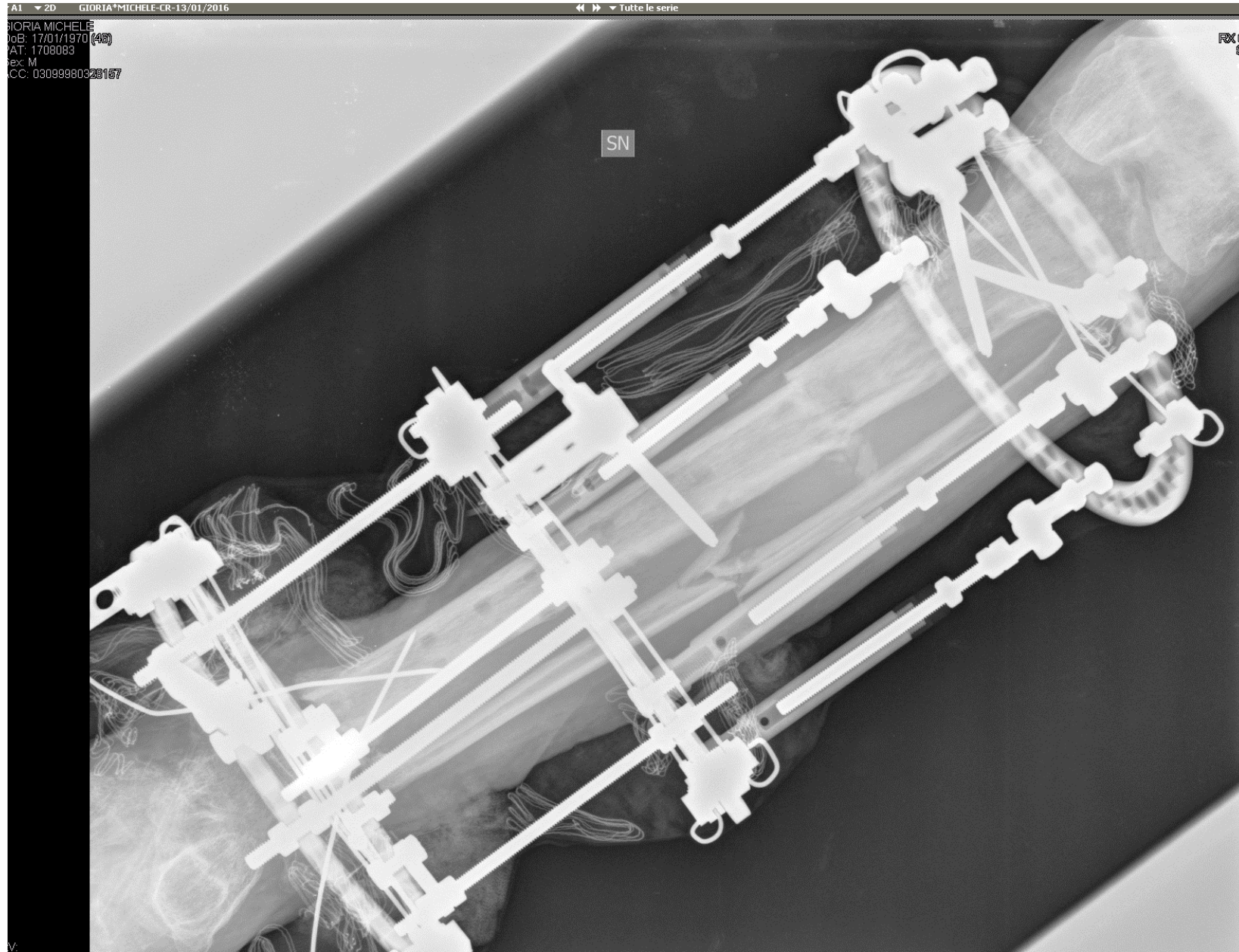
Bone resected





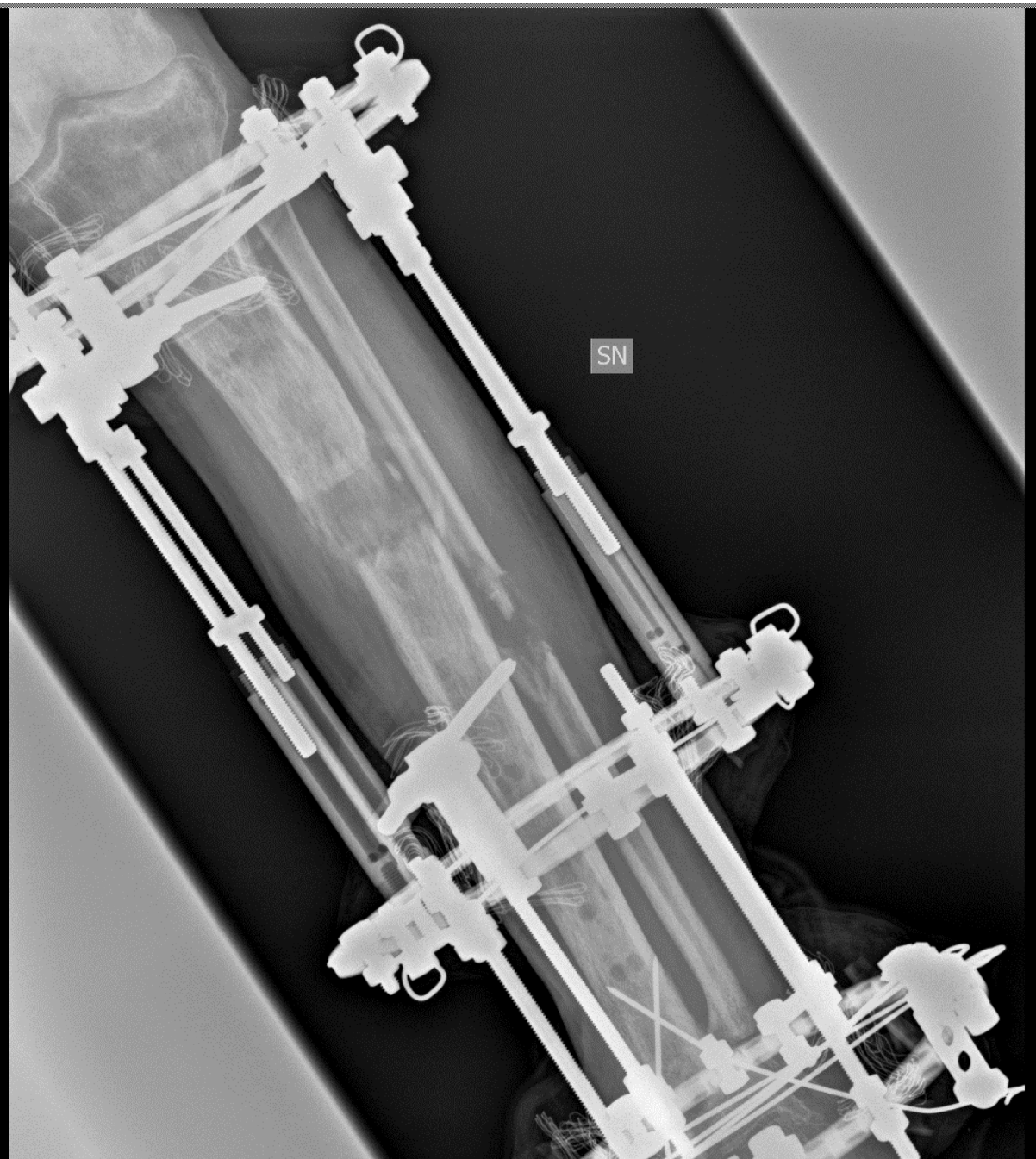


After surgery 13.01.2017

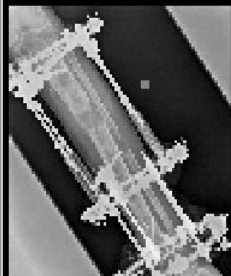


17.03.2016

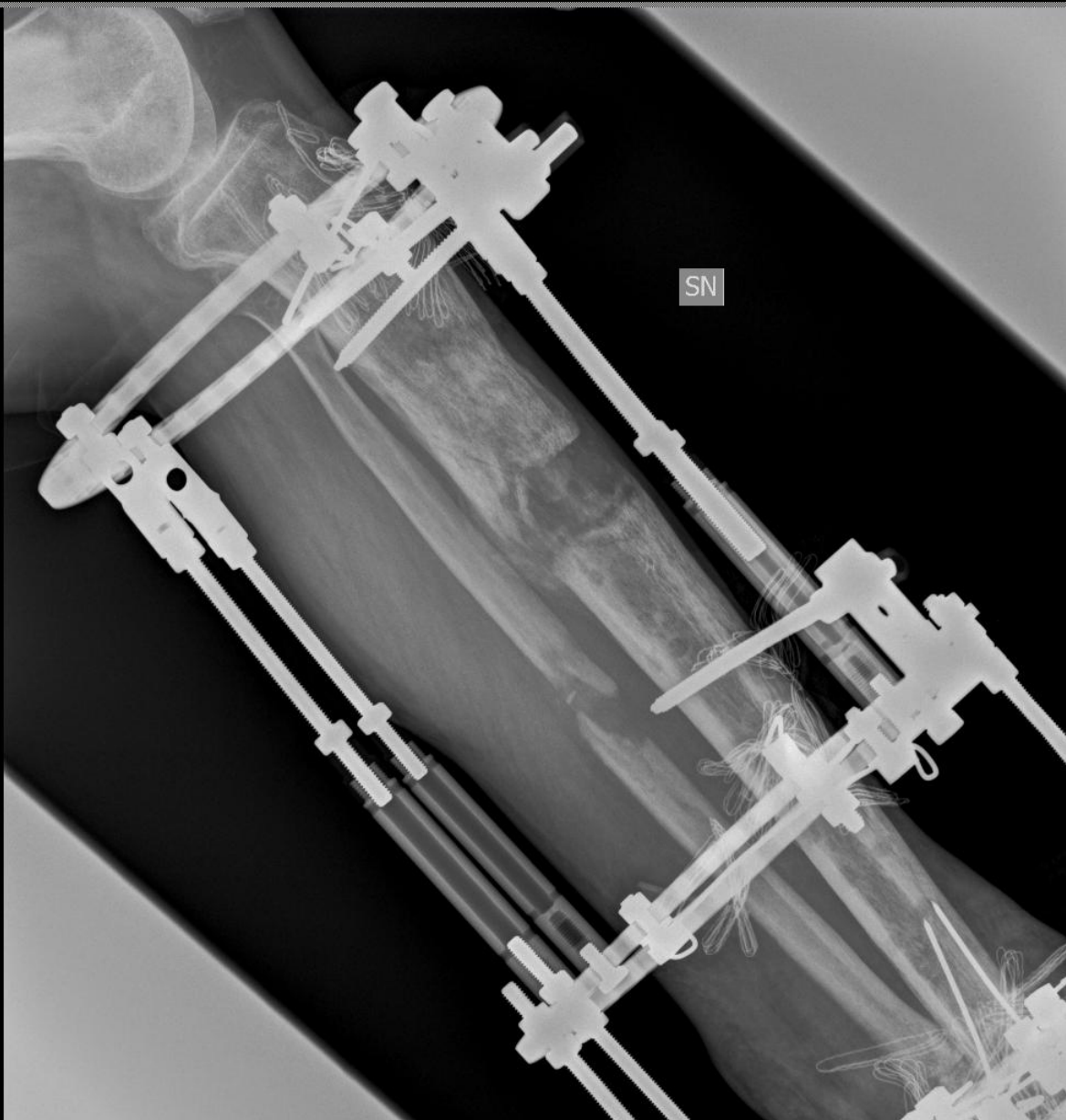
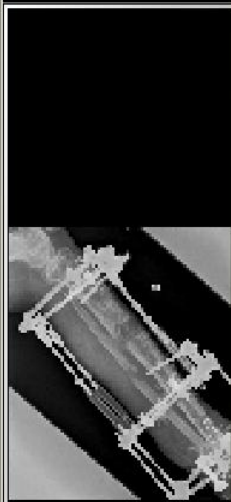
GIORGIA MICHELE
DoB: 17/01/1970 (46)
PAT: 1708083
Sex: M
ACC: 03099981278992



GIORIA MICHELE
DoB: 17/01/1970 (46)
PAT: 1708083
Sex: M
ACC: 03099981278992



1.1





Pet Scan
02 March
2016

2/Volume 1

50% 11629

I 1211

ISTITUTO CLINICO HUMANITAS

M 46 1708083

DoB: Jan 17 1970

Ex:Mar 02 2016

L
3
5
0

Volume 1

% 11629

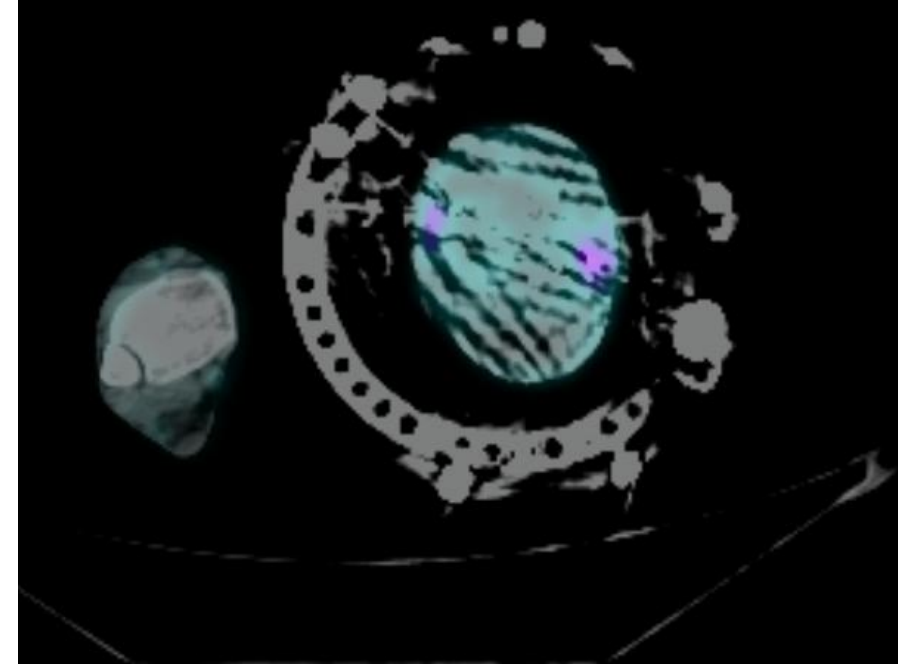
A 350 ISTITUTO CLINICO HUMANITAS

GIORIA MICHELE

M 46 1708083

DoB: Jan 17 1970

Ex:Mar 02 2016



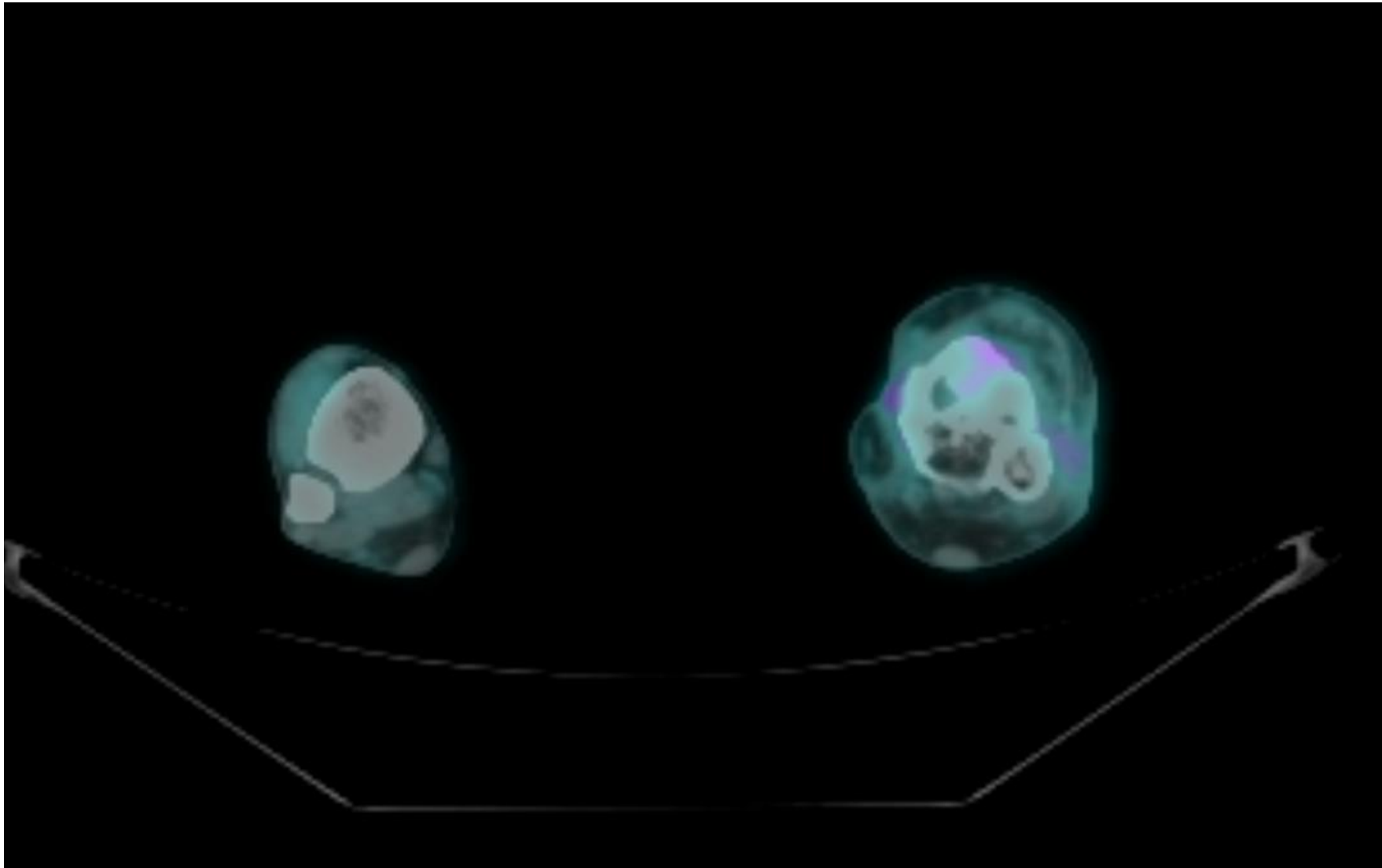
L
3
5
0

651/36

Healing 26 October 2017



17.01.2018 Pet Scan negative



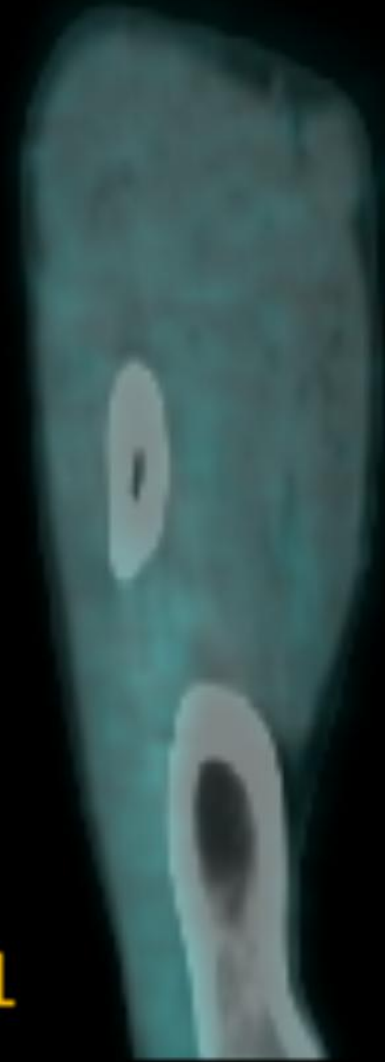
GIORGIA MICHELE
DoB: 17/01/1970 (47)
PAT: 1708083
Sex: M
ACC: 03099986847715

ISTITUTO CL
PET GLO

sp

73 g/ml

I 1624



Patient is walking now
with his son that was
born during the
treatment with the frame.



Compartment syndrom

15 y.o. girl. Vascular lesion of the popliteal arteri, equinus foot







19 5 2008





28 5 2008



Late complication, osteomyelitis of the V-th metatarsal, asportation.





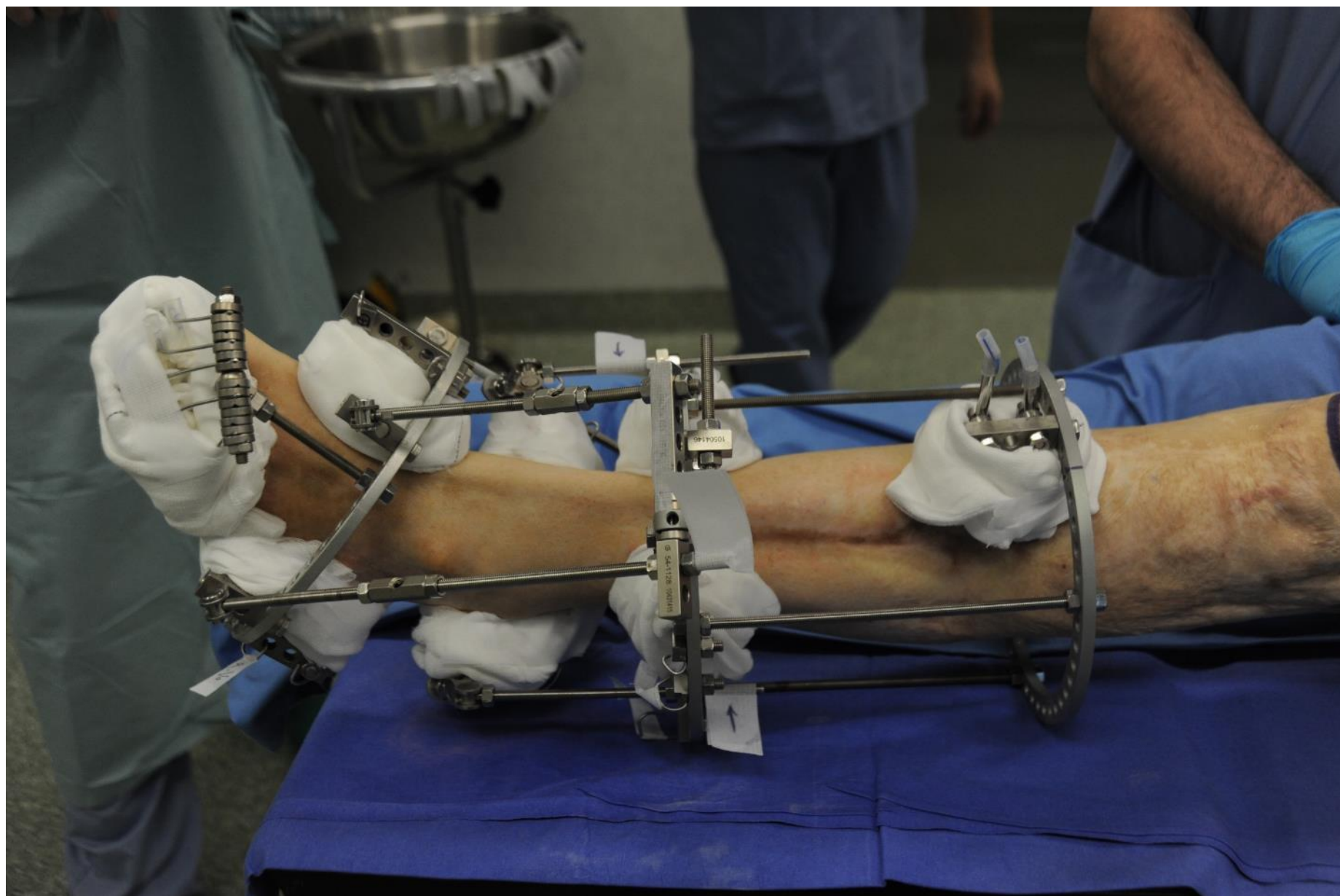


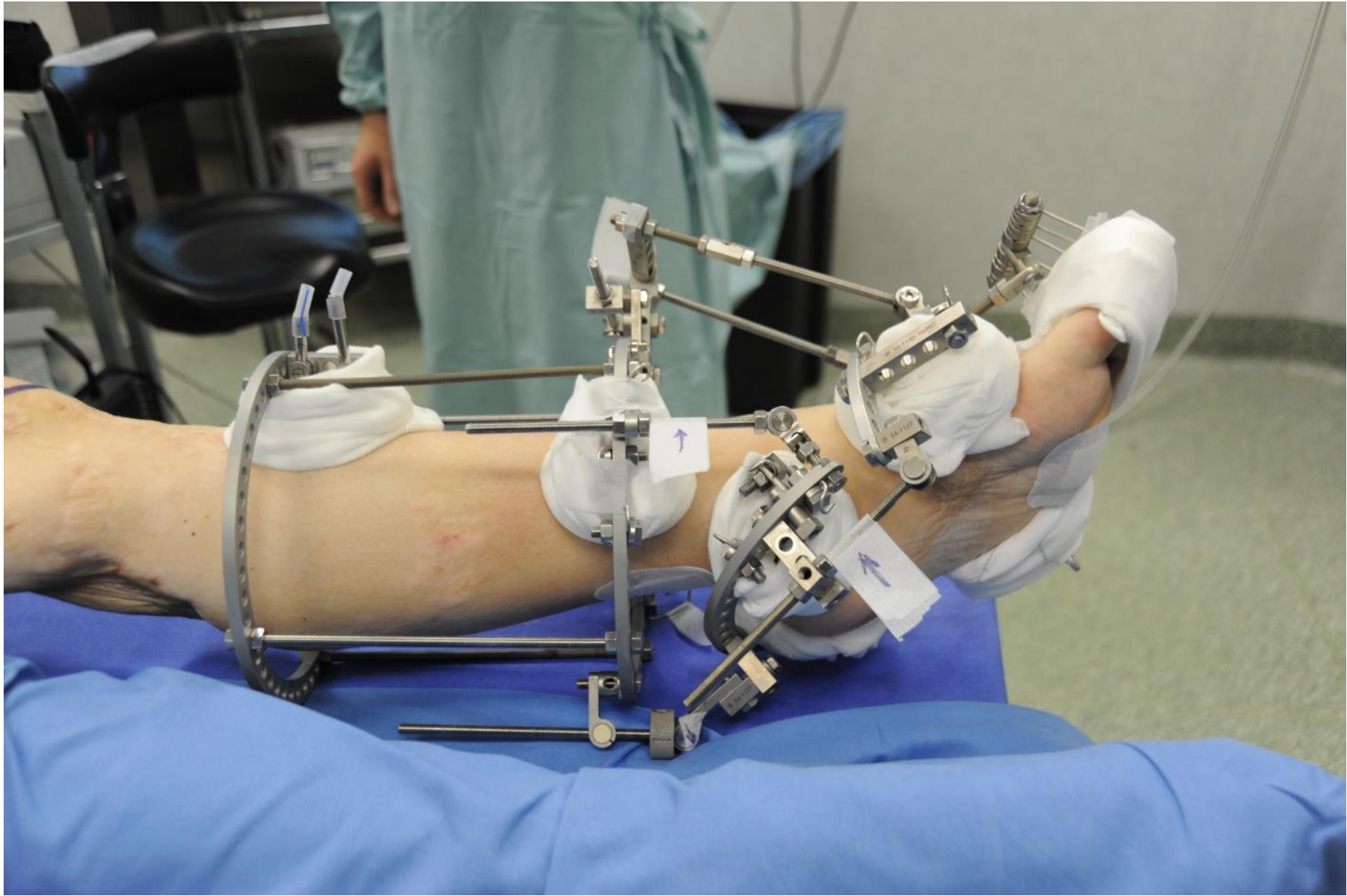
Cromic ulcer



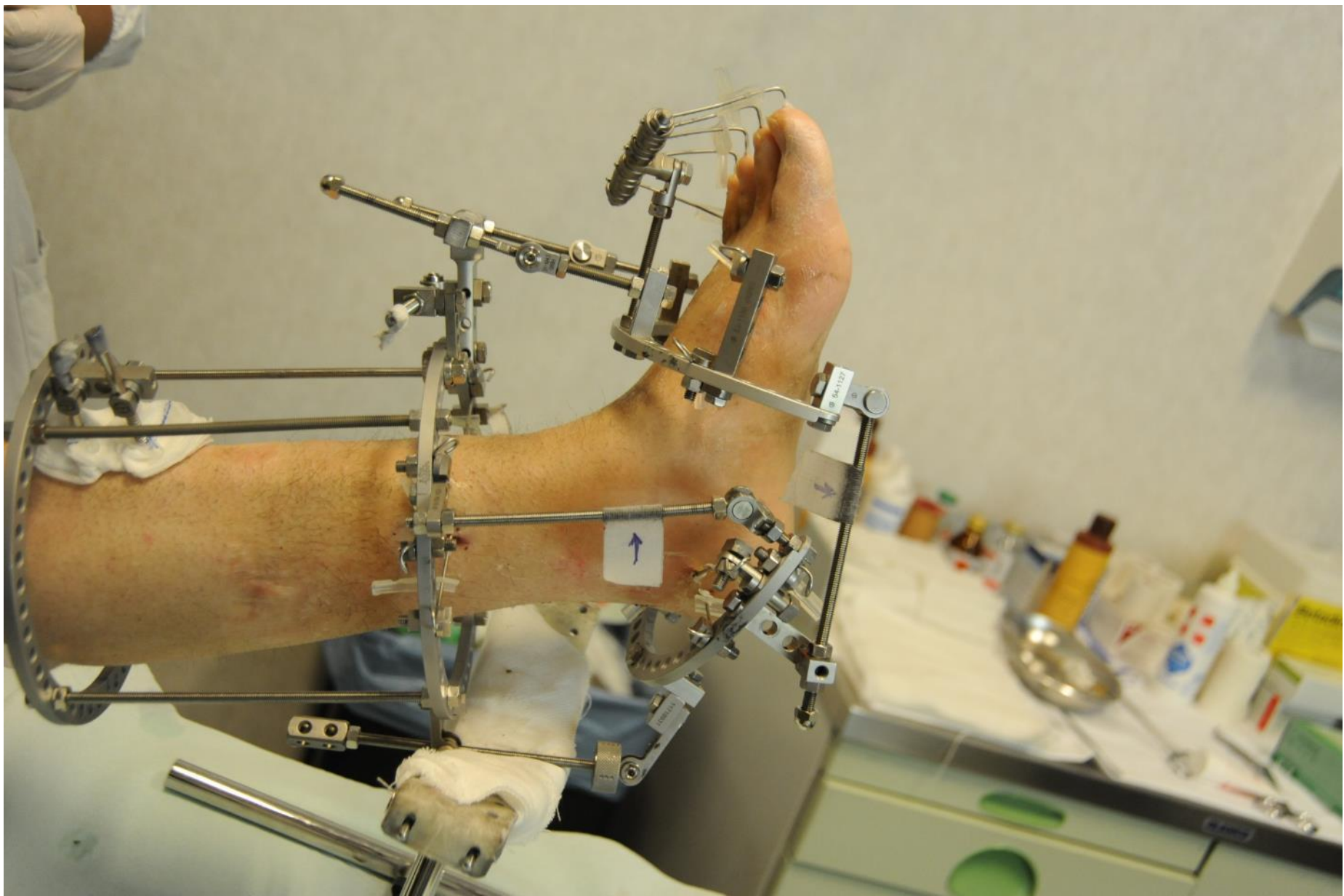


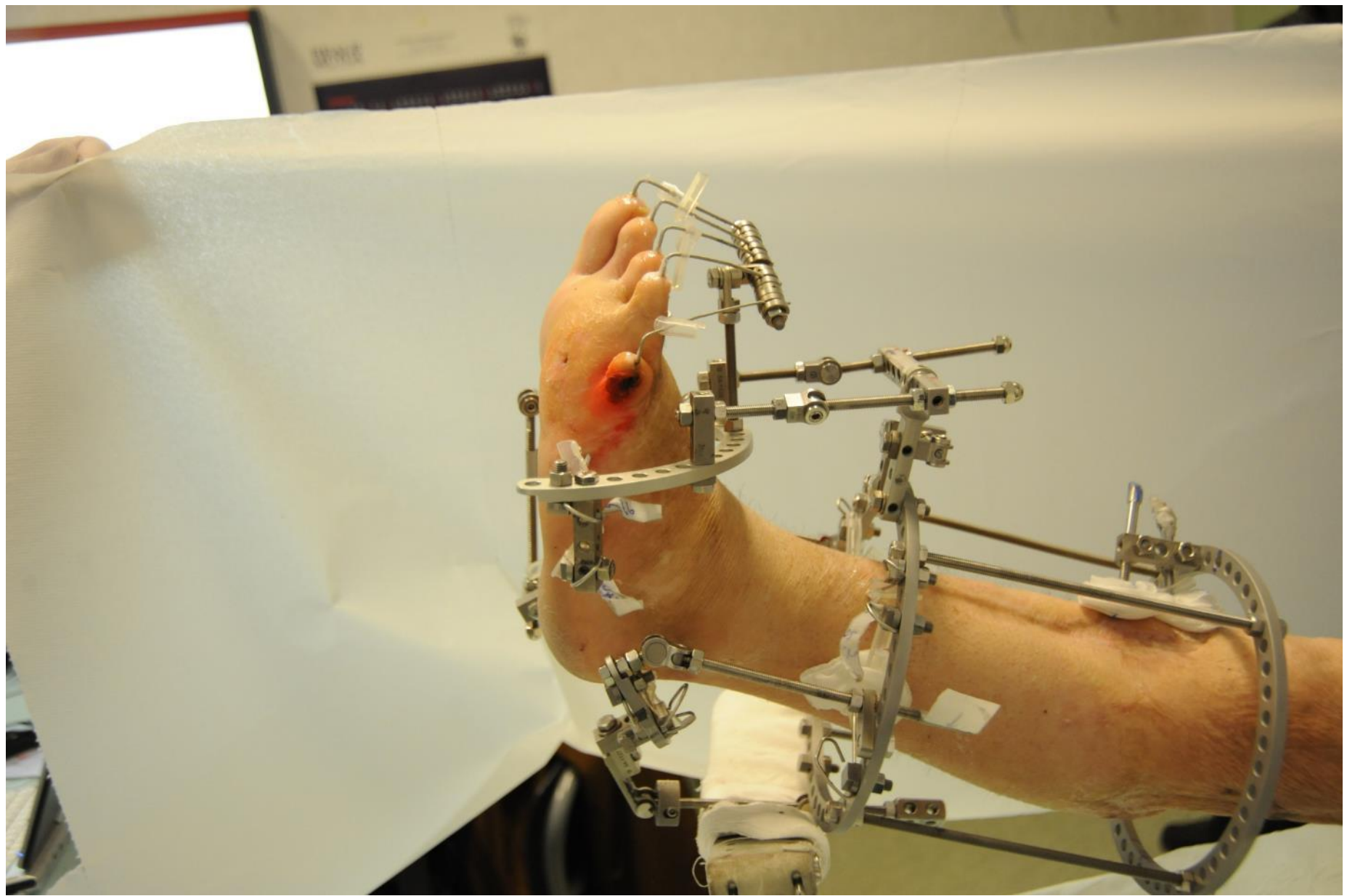






















Ospedale di Saronno - Saronno
B731752
RX PIEDE SINISTRO -
piede AP

S



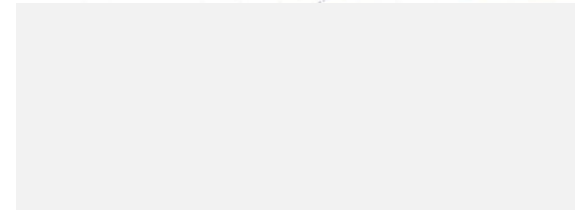
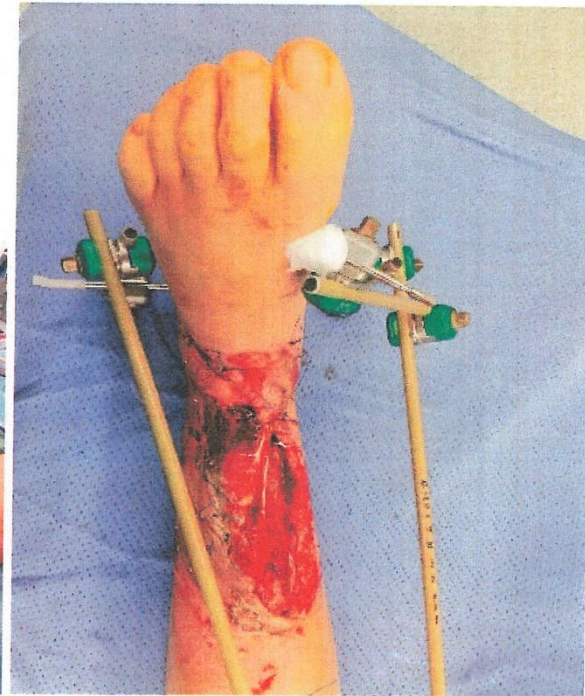
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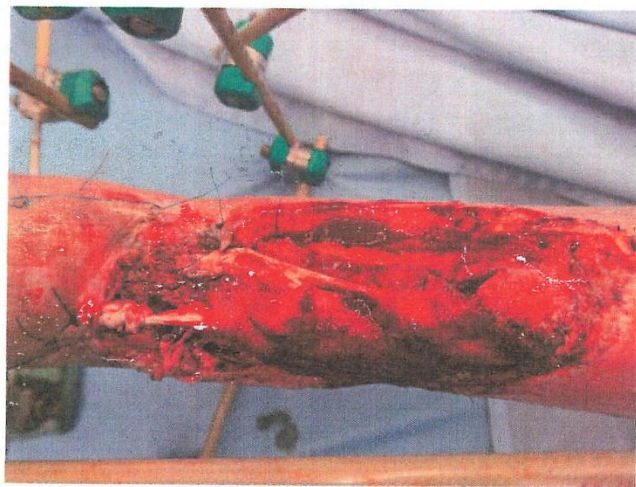
22 y.o. Girl

- 27.01.2019 CAR ACCIDENT WITH TIBIA OPEN FRACTURE GUSTILLO IIIB
- DAMAGE CONTROL PERFORMED PLUS GRANDORSAL FLAP AND APPLICATION OF ANTIBIOTIC CEMENT



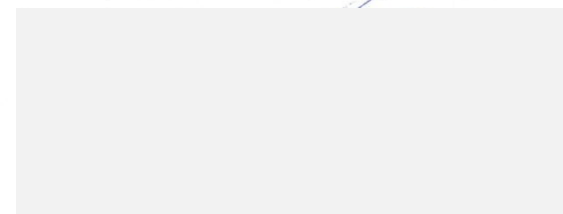
Immagini post operatorie relative a salvataggio di arto eseguito in urgenza.
Paziente:

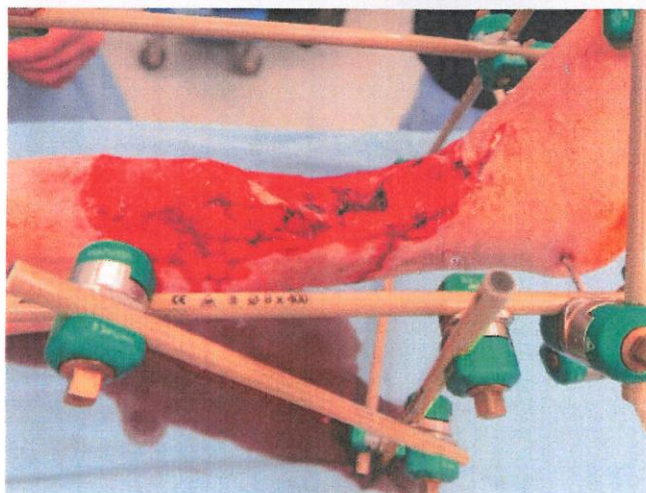
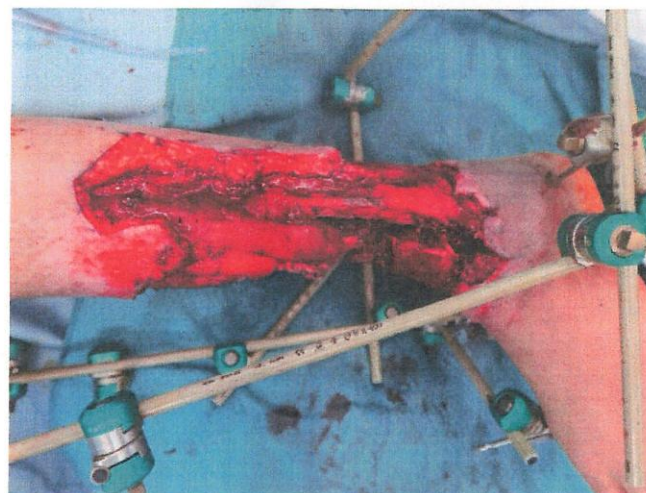




Ulcera traumatica con infezione ed
osteomielite prima di radicale toilte e
pulizia. (06/02/2019)

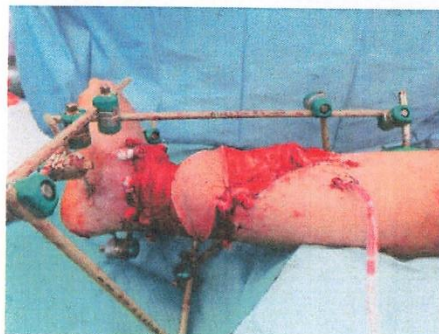
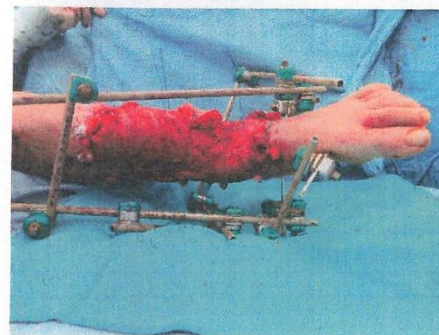
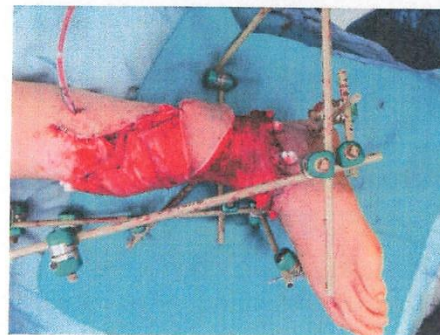
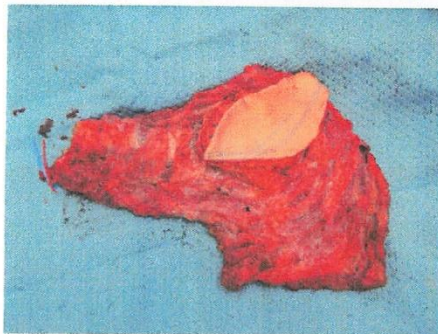
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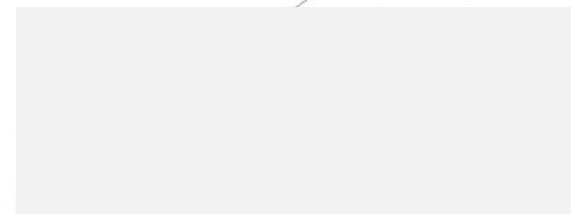


Immagini del fondo
dell'ulcera traumatica
con esposizione e PDS
ossea e tendinea.

Paziente:

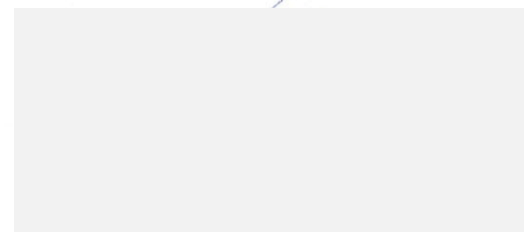


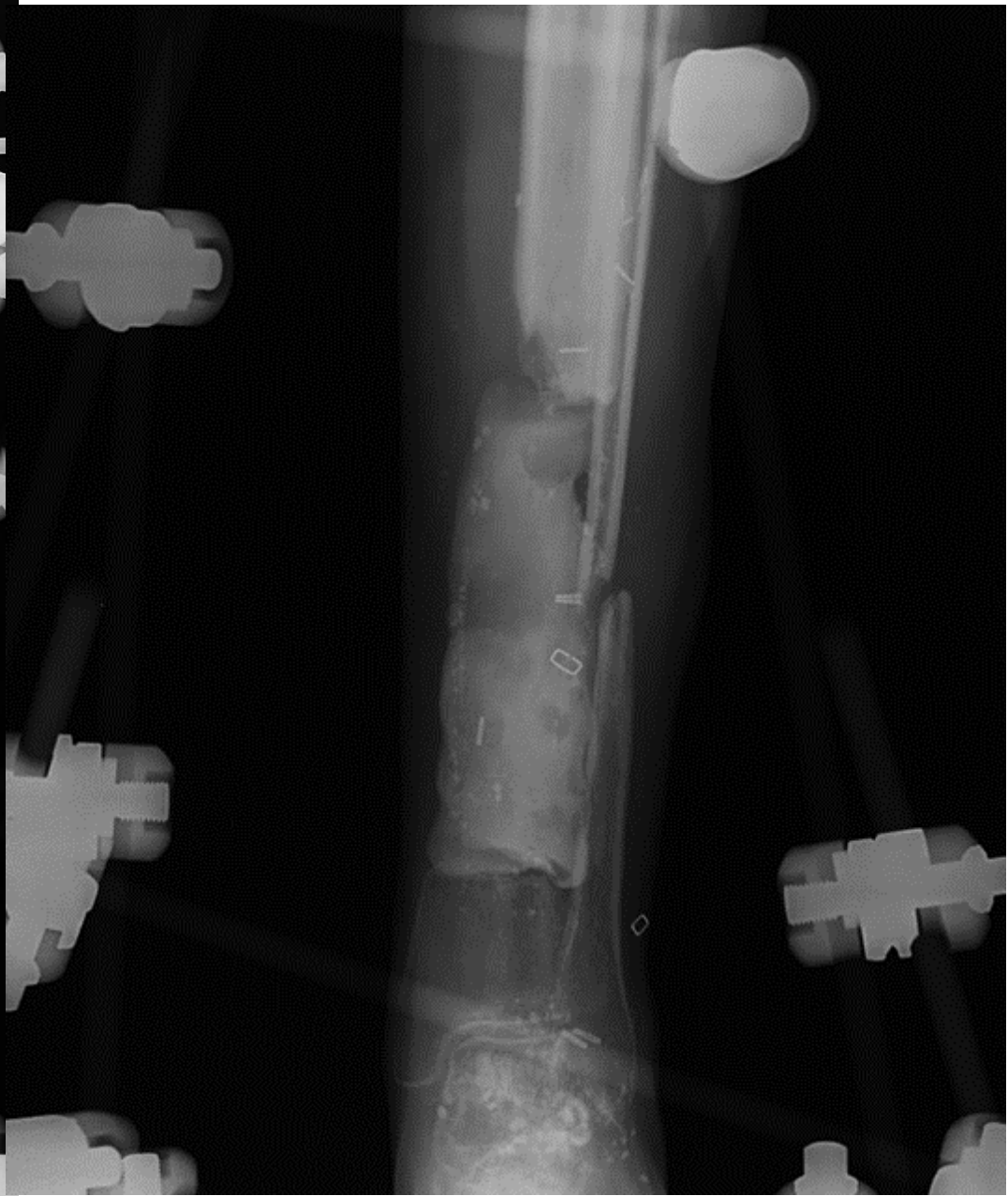
Immagini del tempo
ricostruttivo con
spaziatore di cemento
antibiotato e lembo
libero microchirurgico di
muscolo grandorsale.
Paziente:





Controllo della copertura tegumentaria
stabile
e trofica a 3 mesi dell' intervento.
Paziente: [REDACTED]

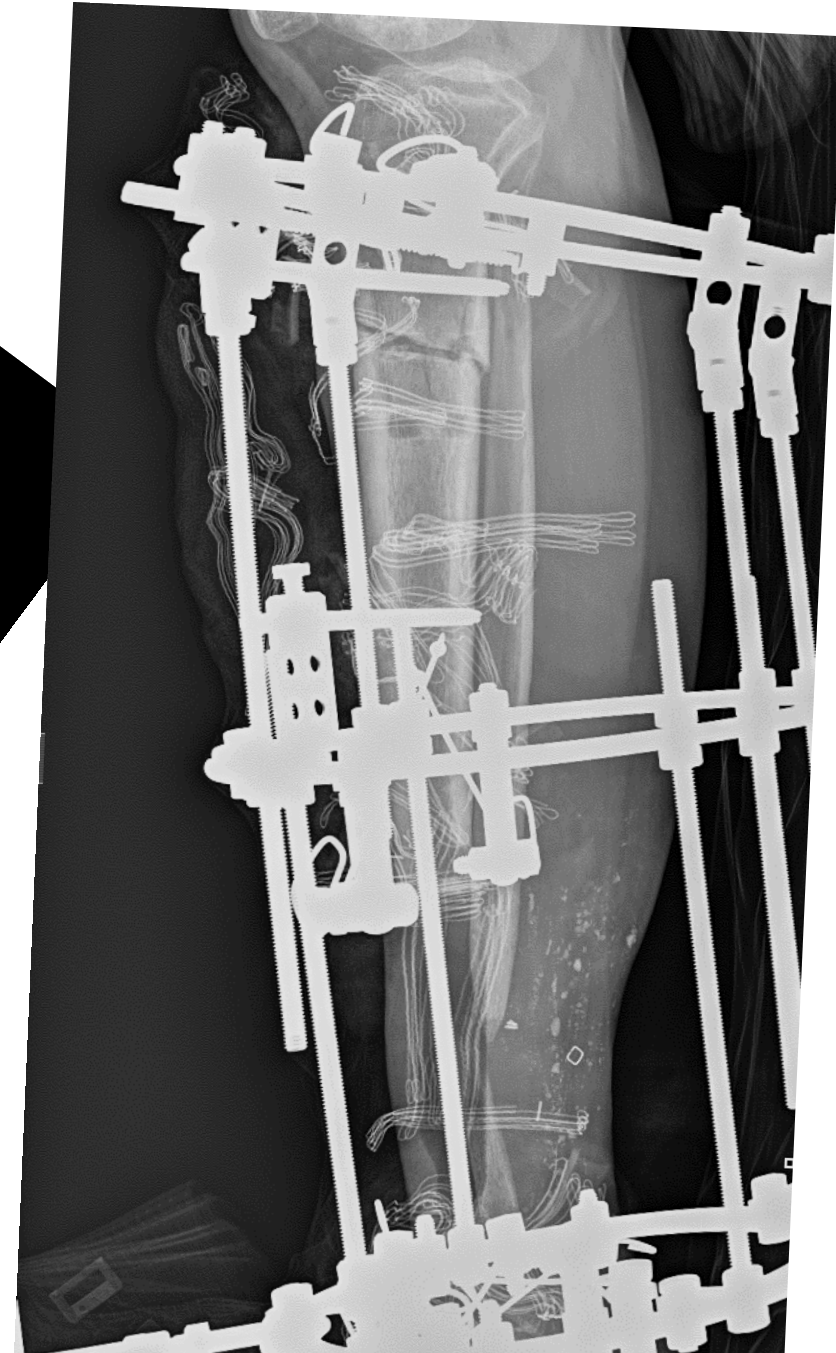
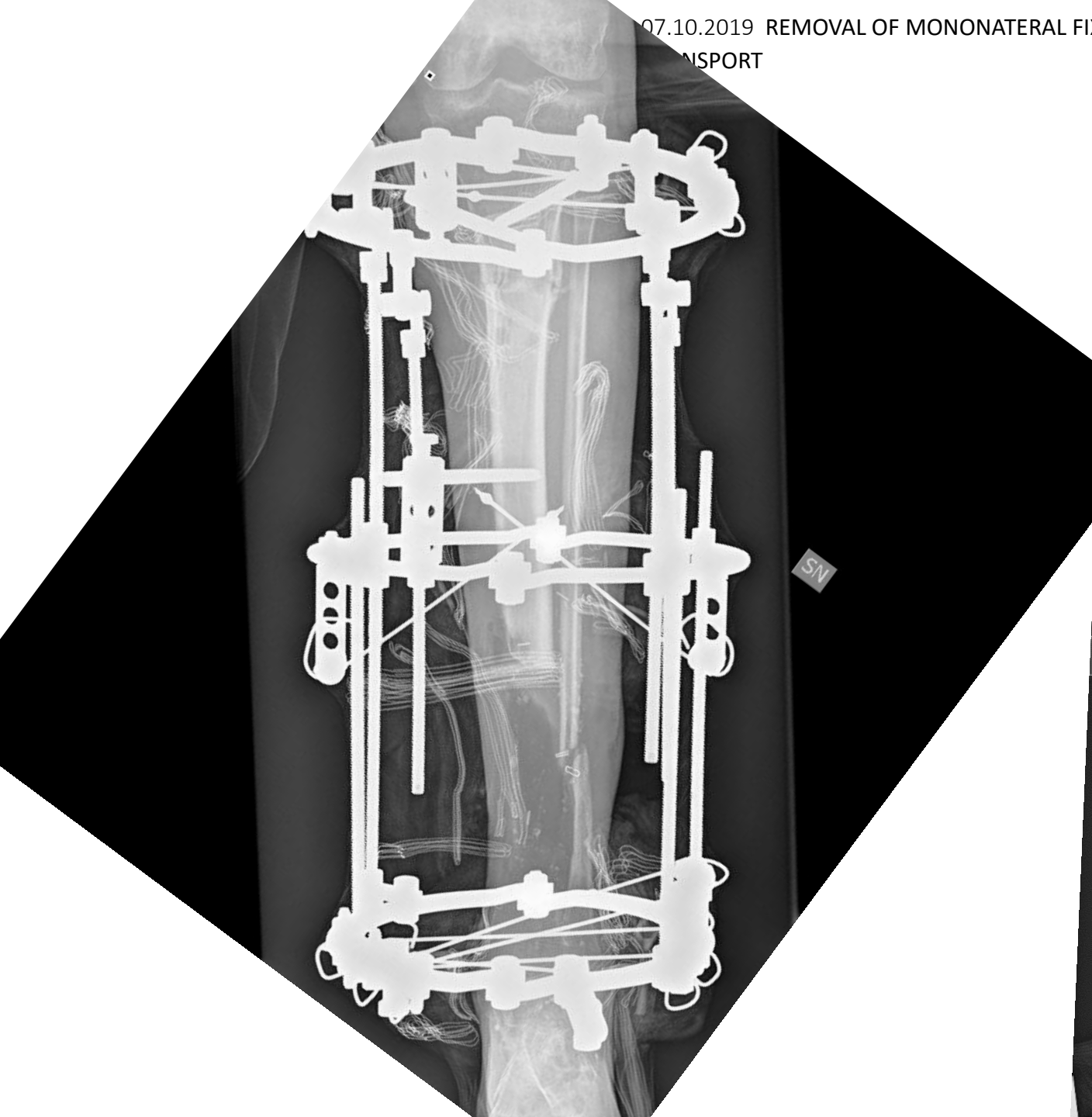


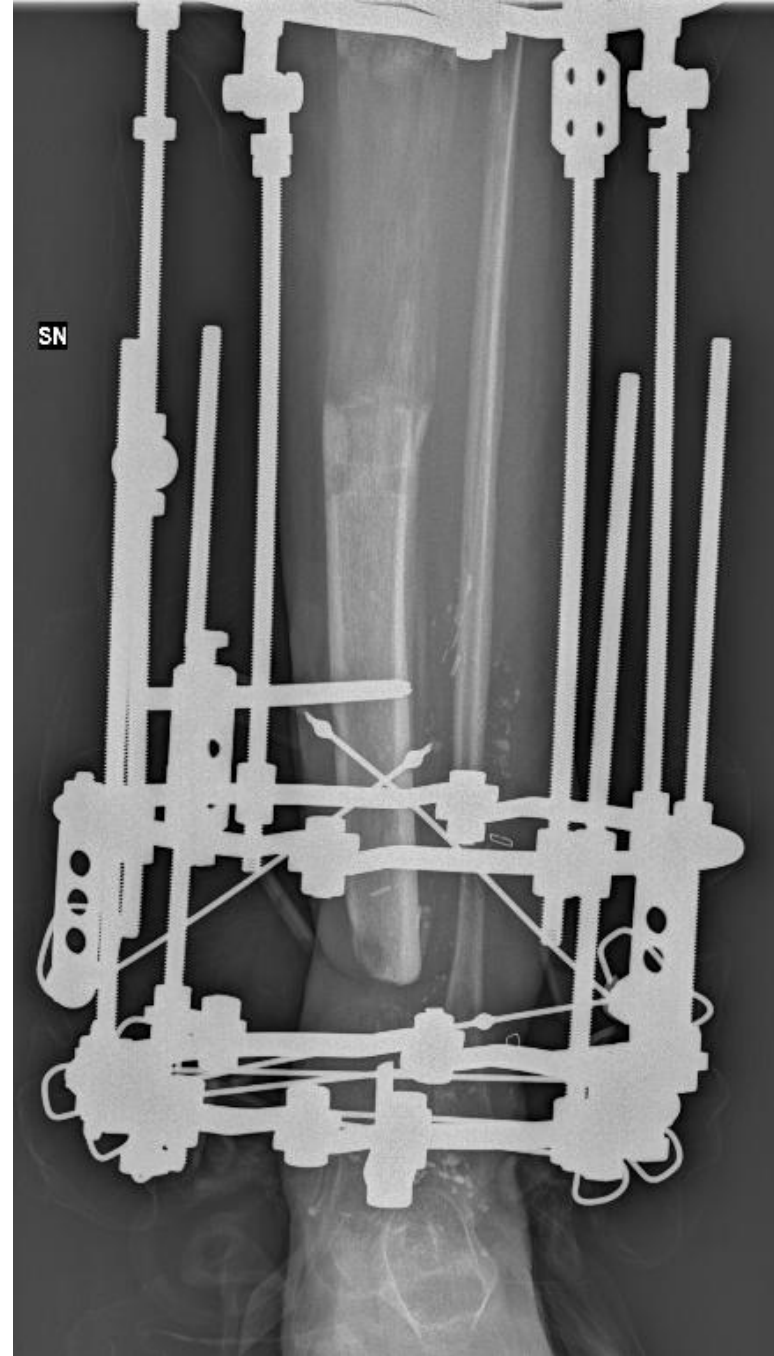


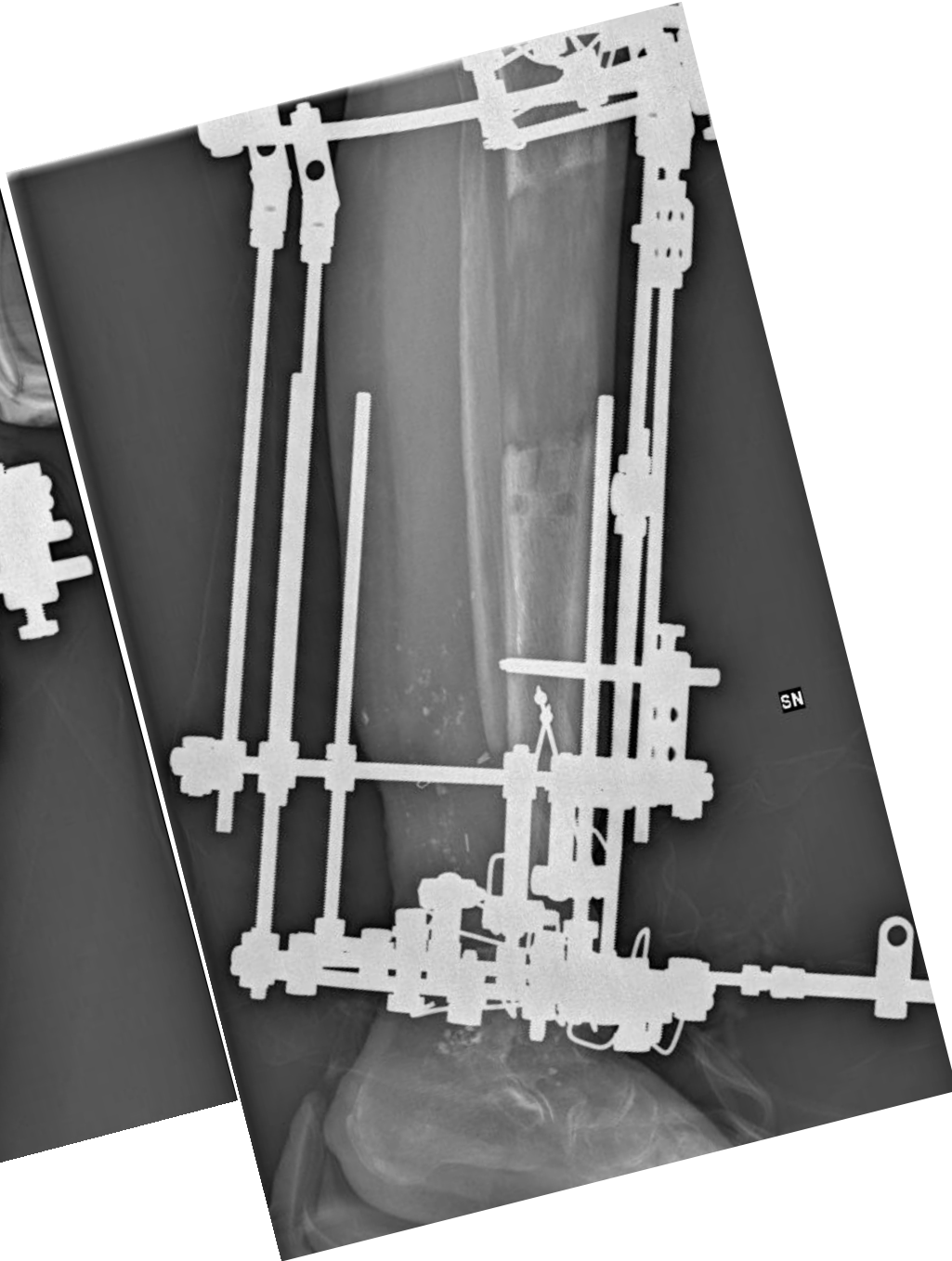
12.07.2019



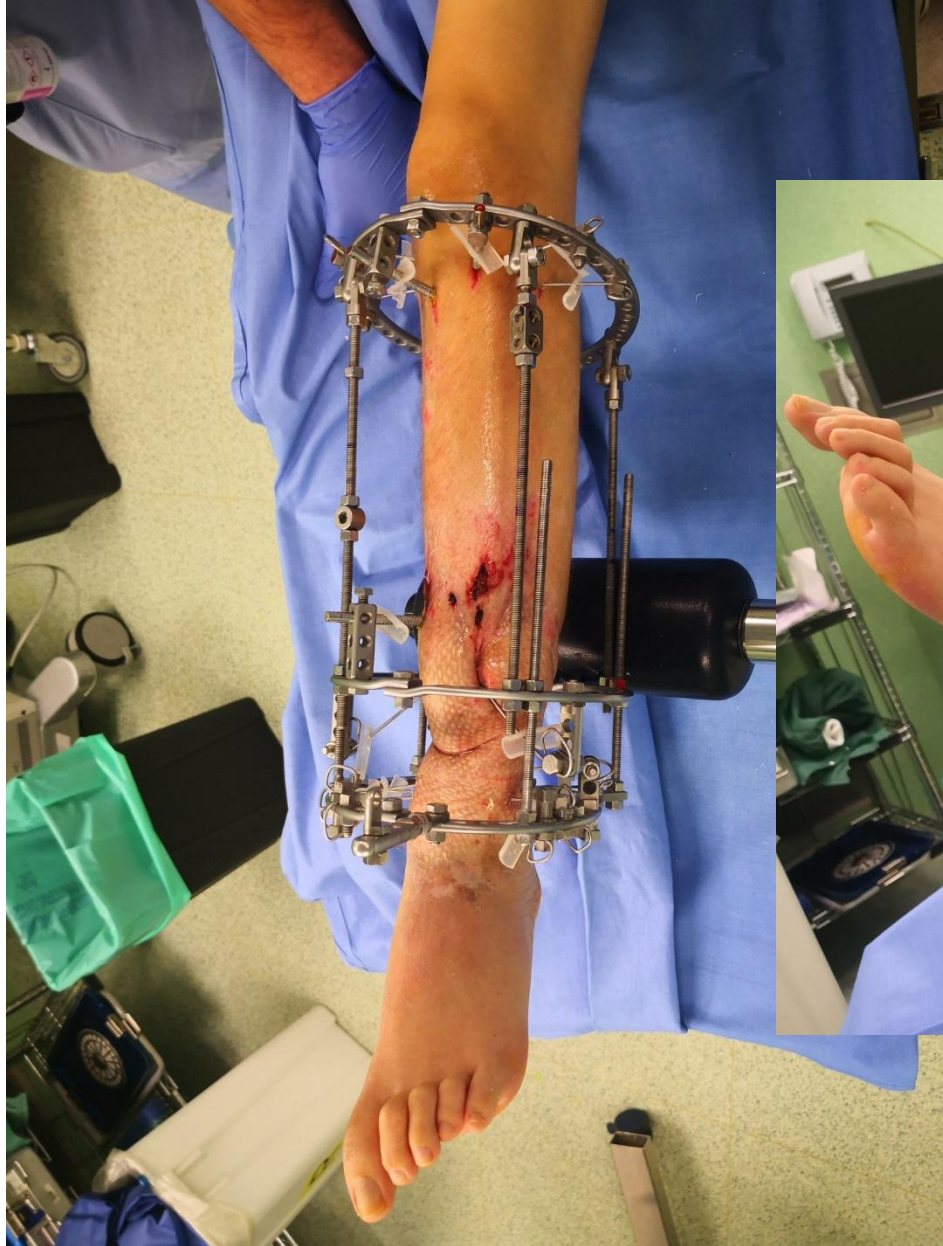


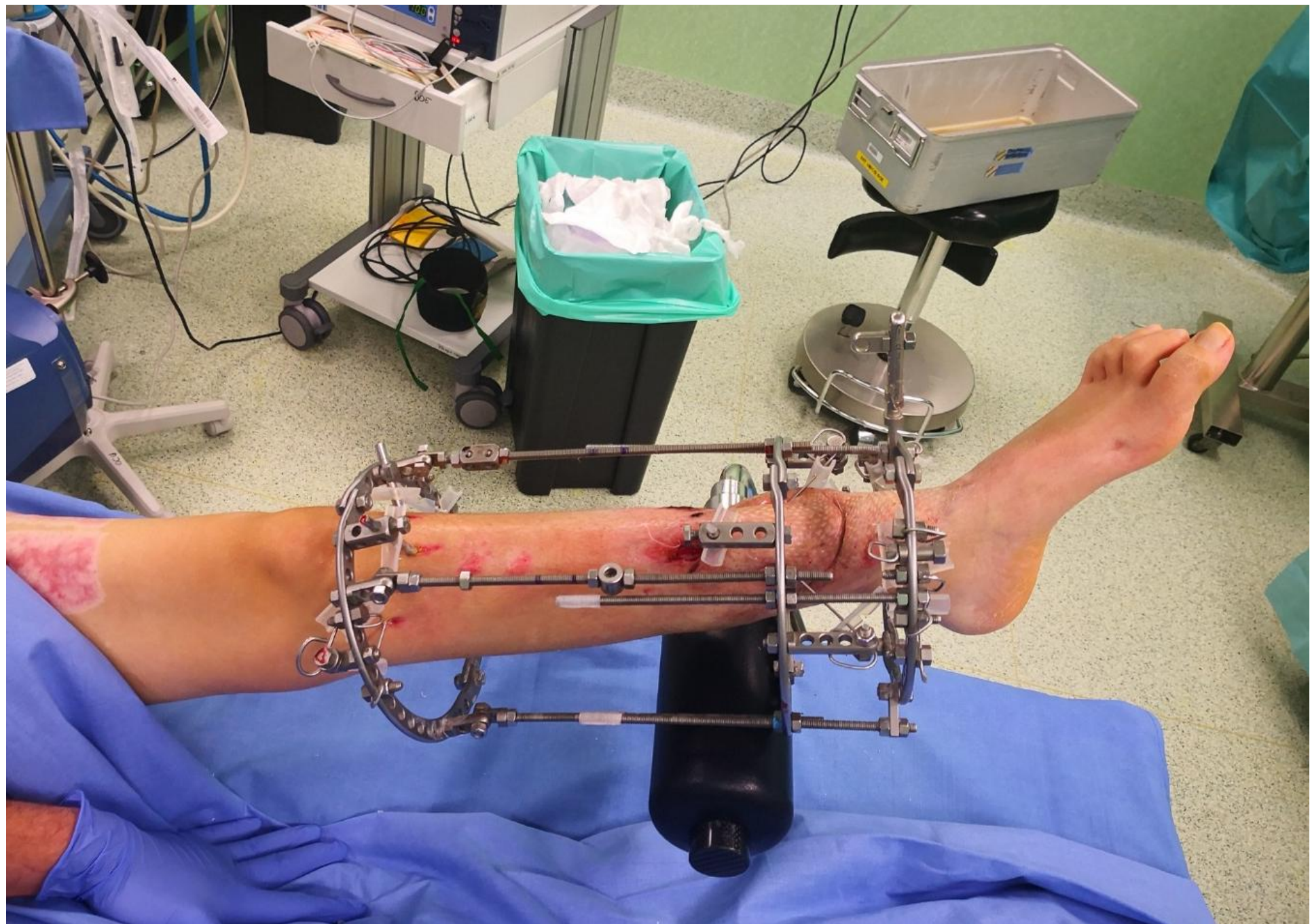


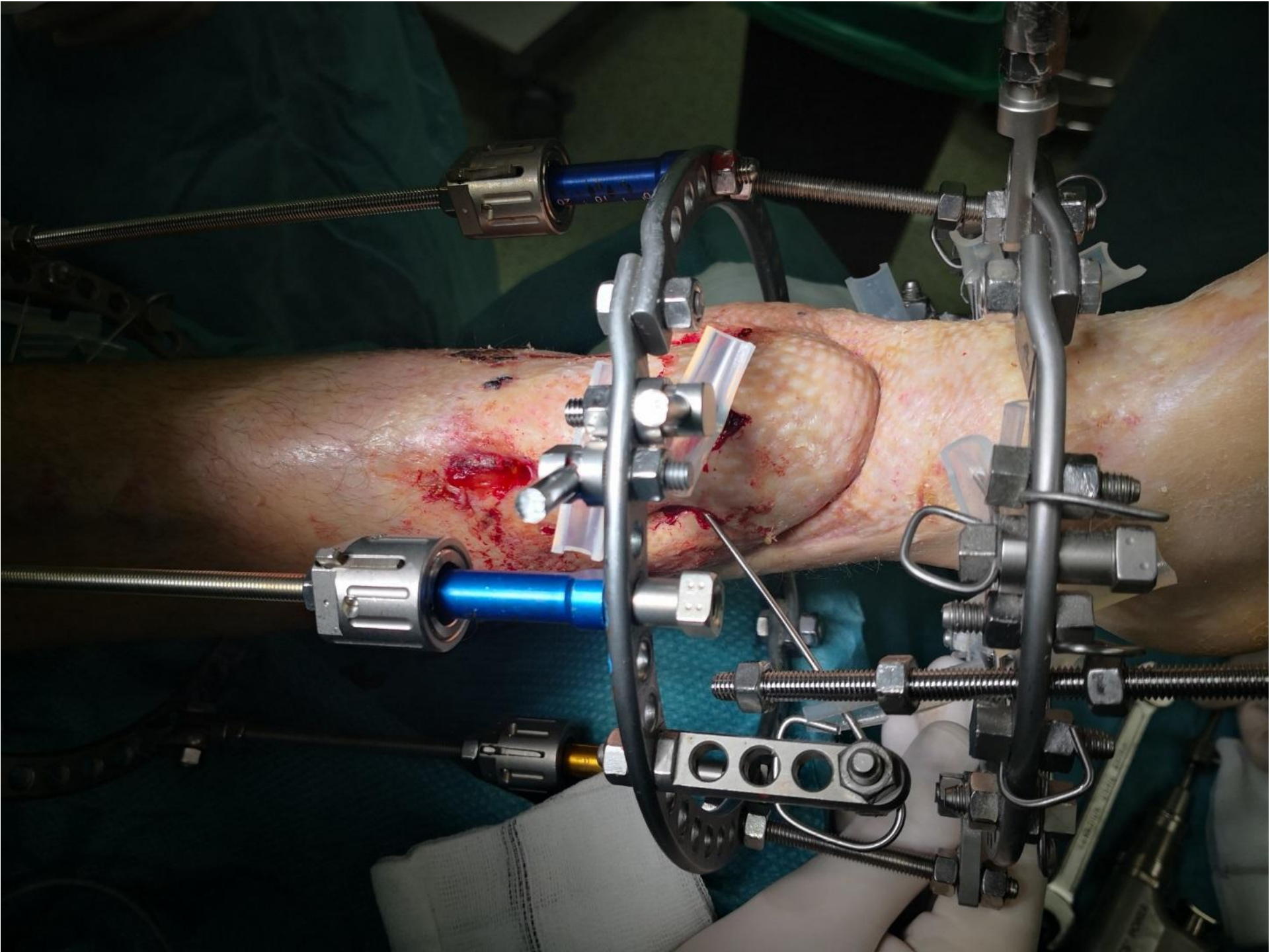


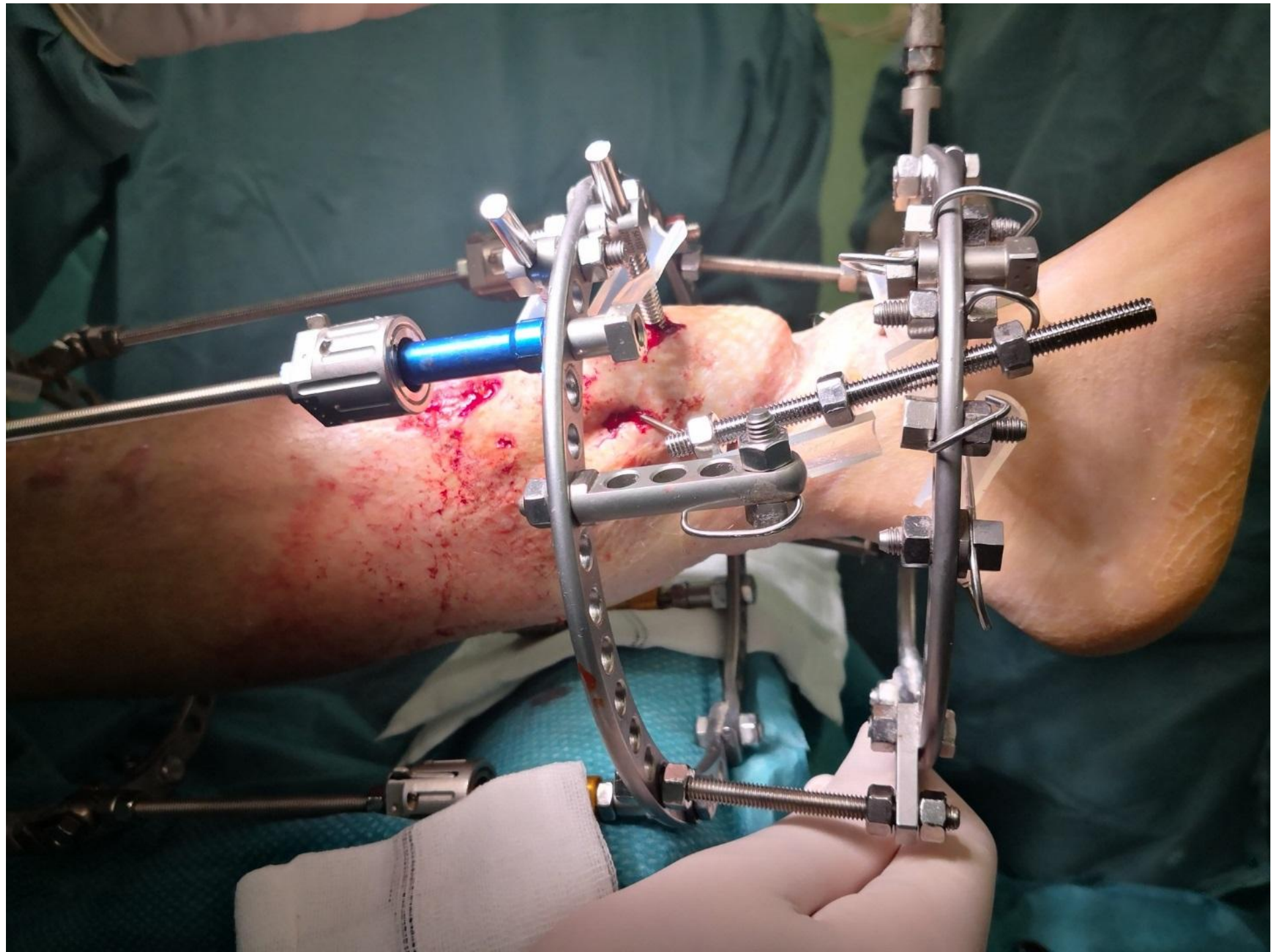


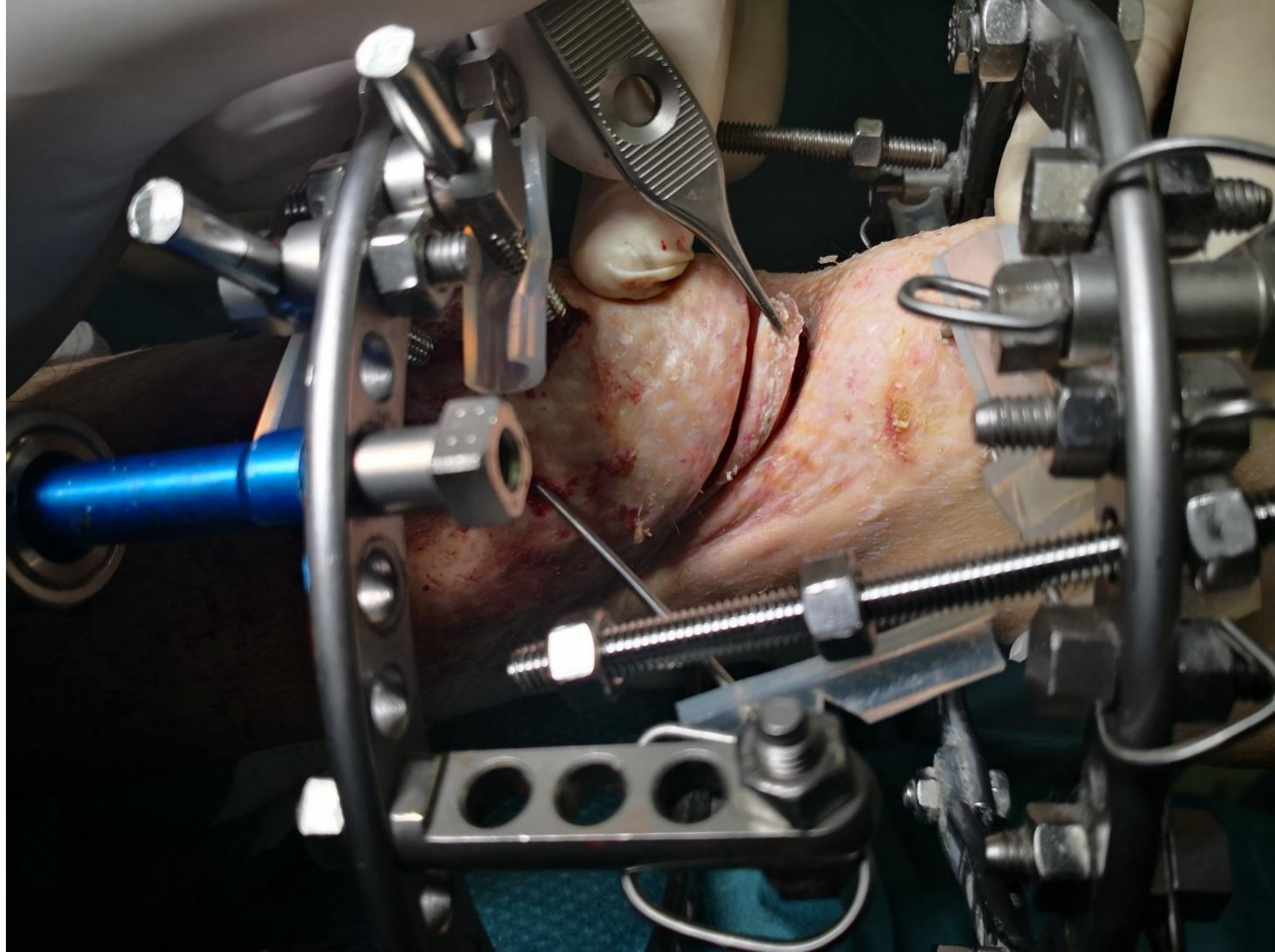
05/02/20 TRANSPORT FINISHED, DOCKING SIDE REVIEW MORE CONTINUED LENGTHENING

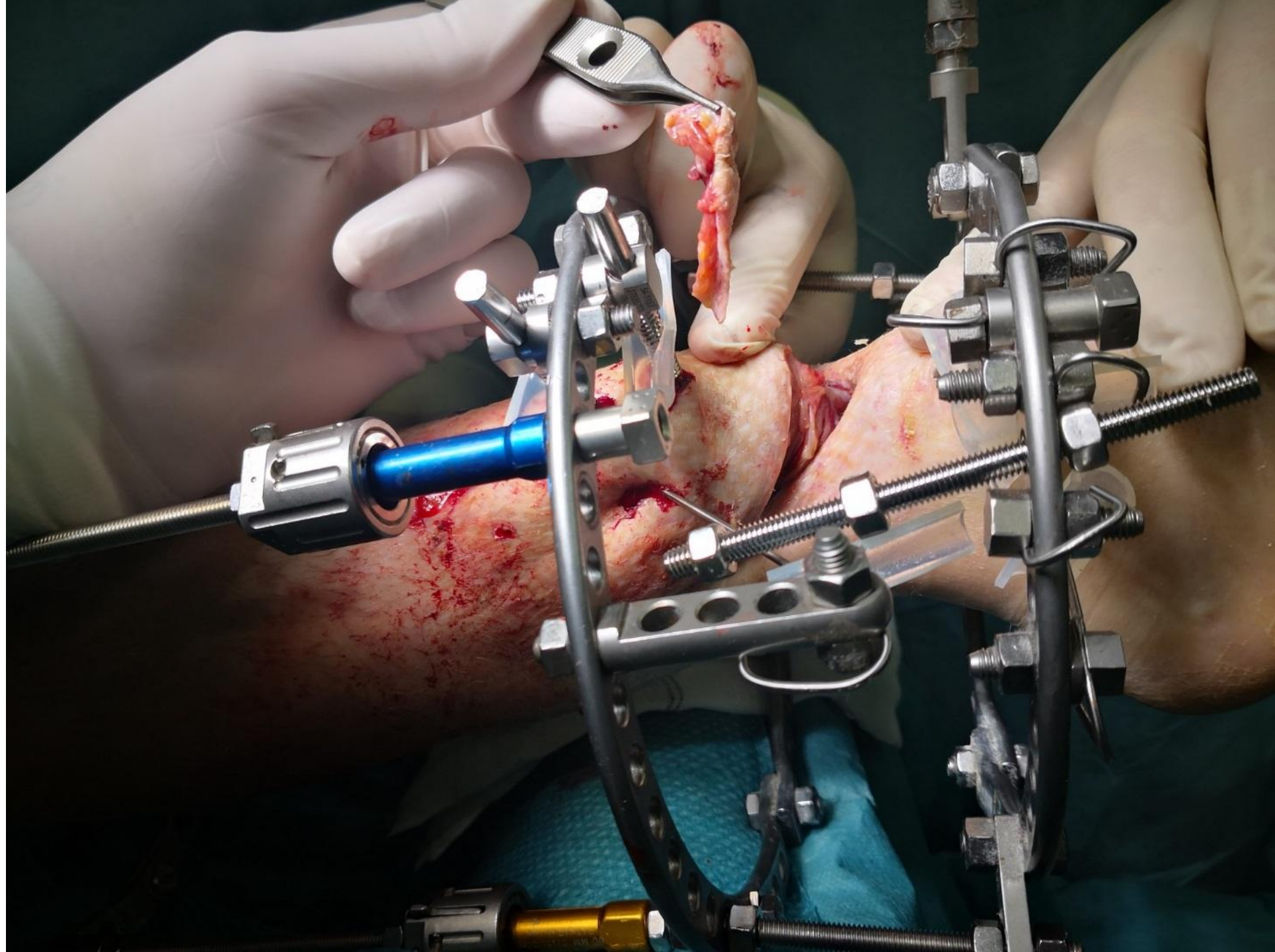


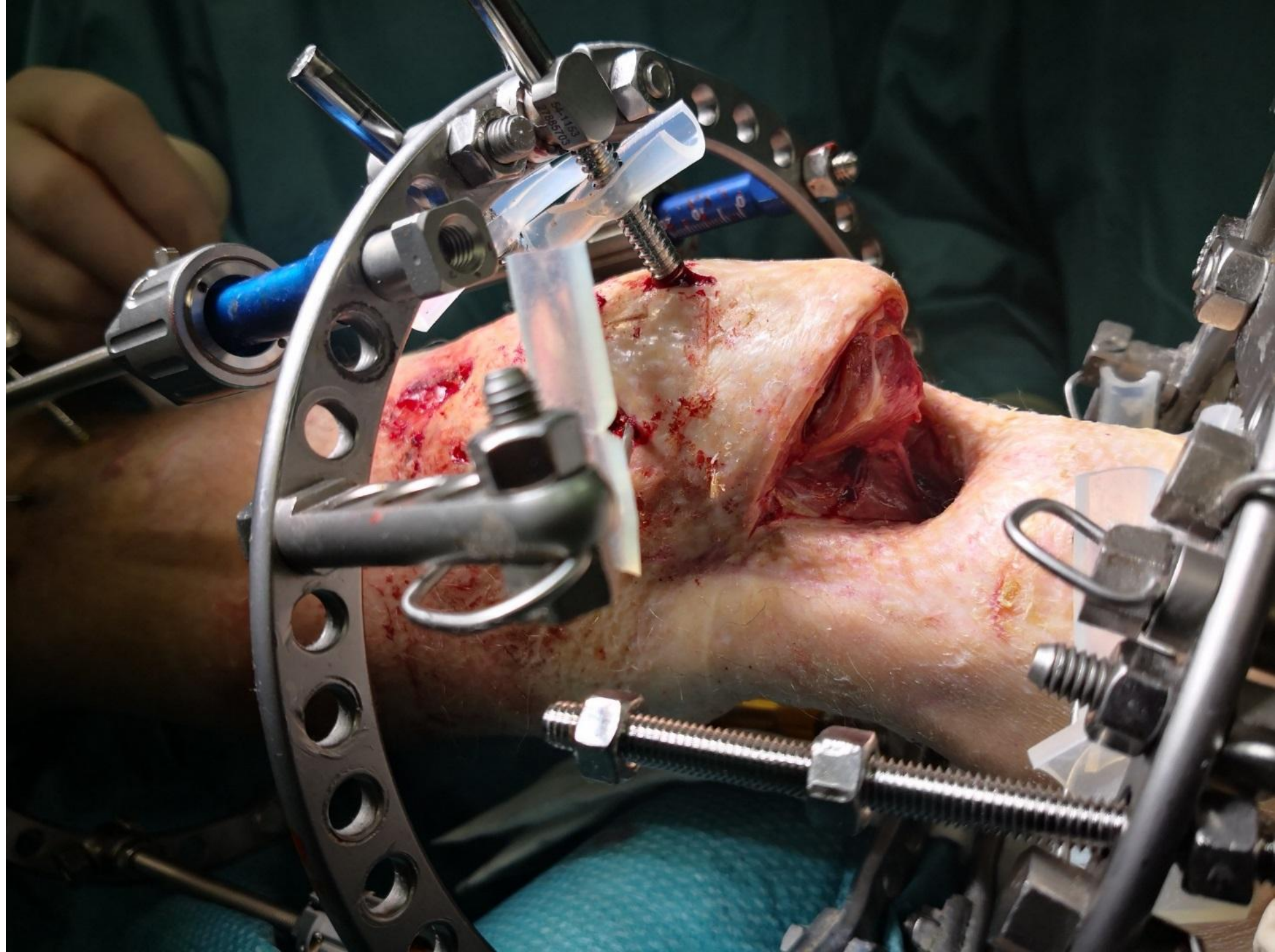


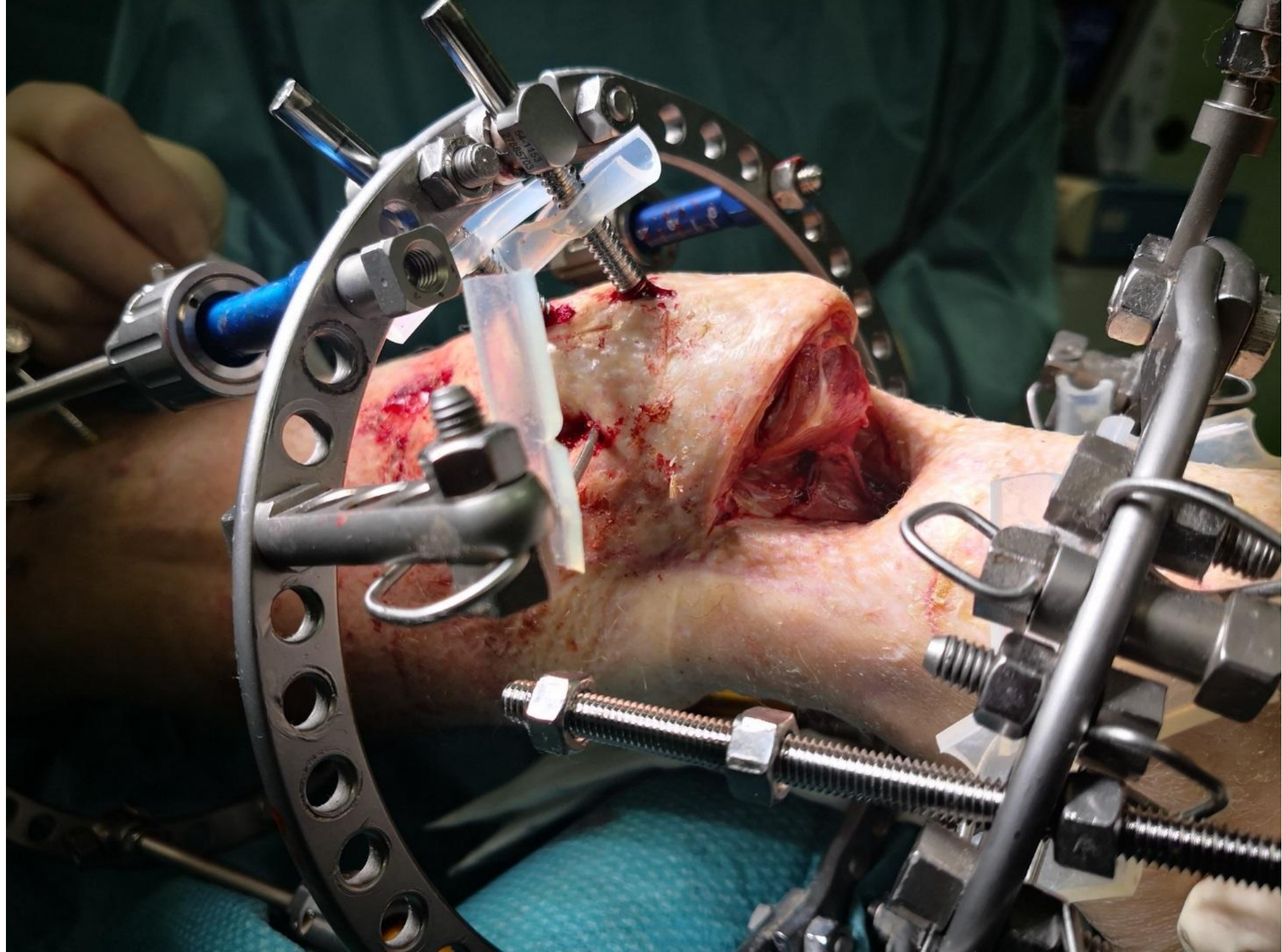


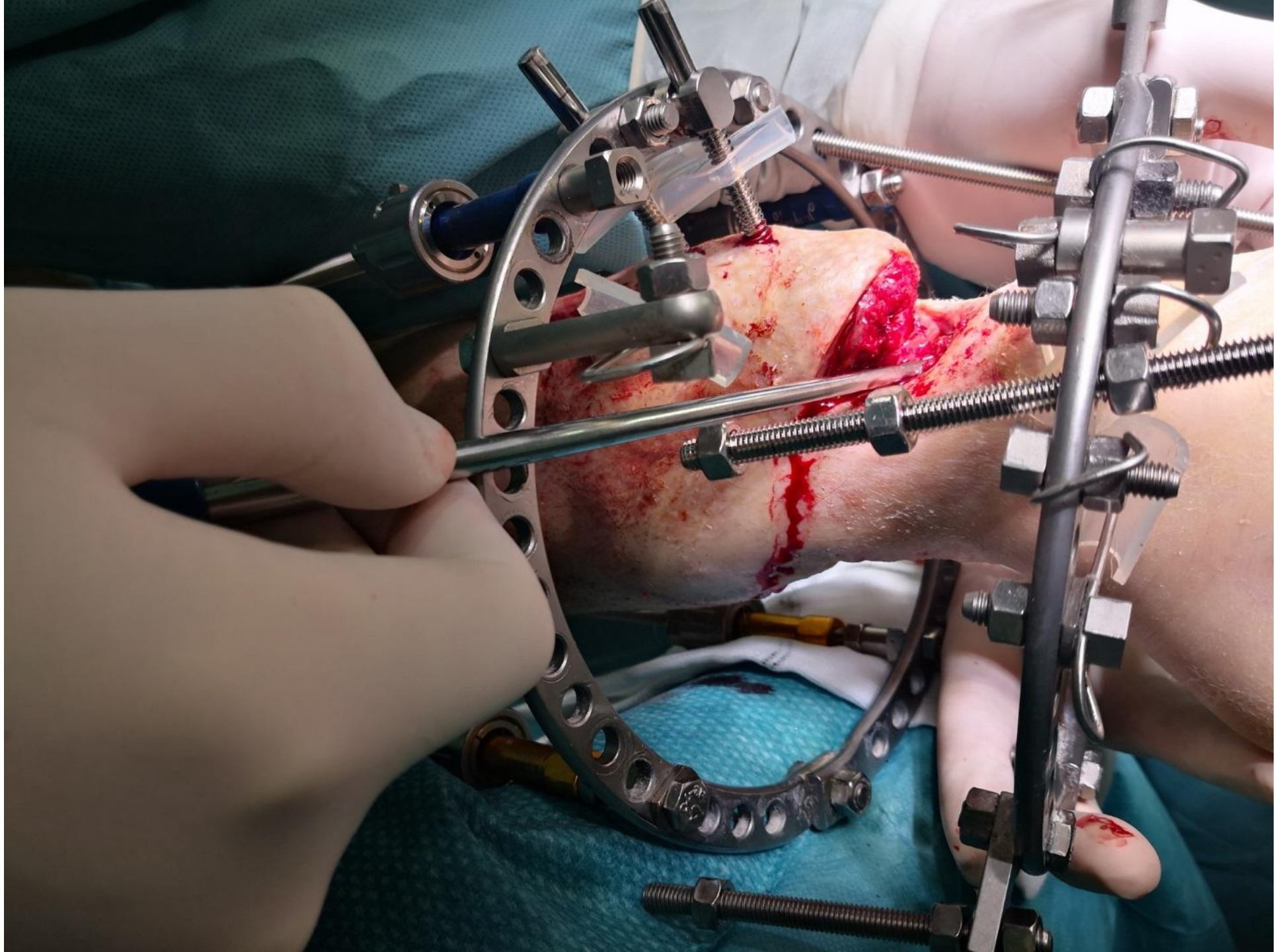


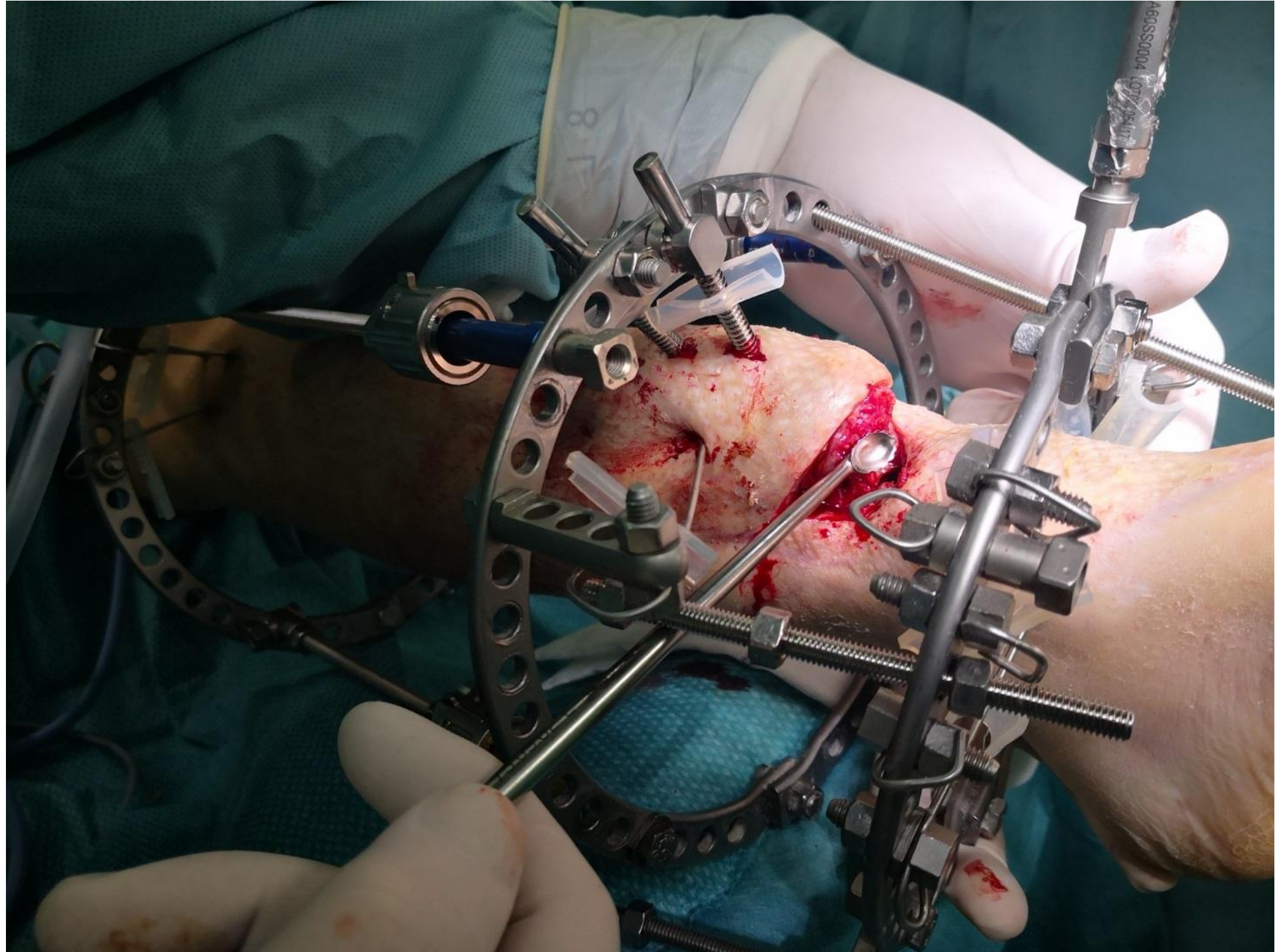


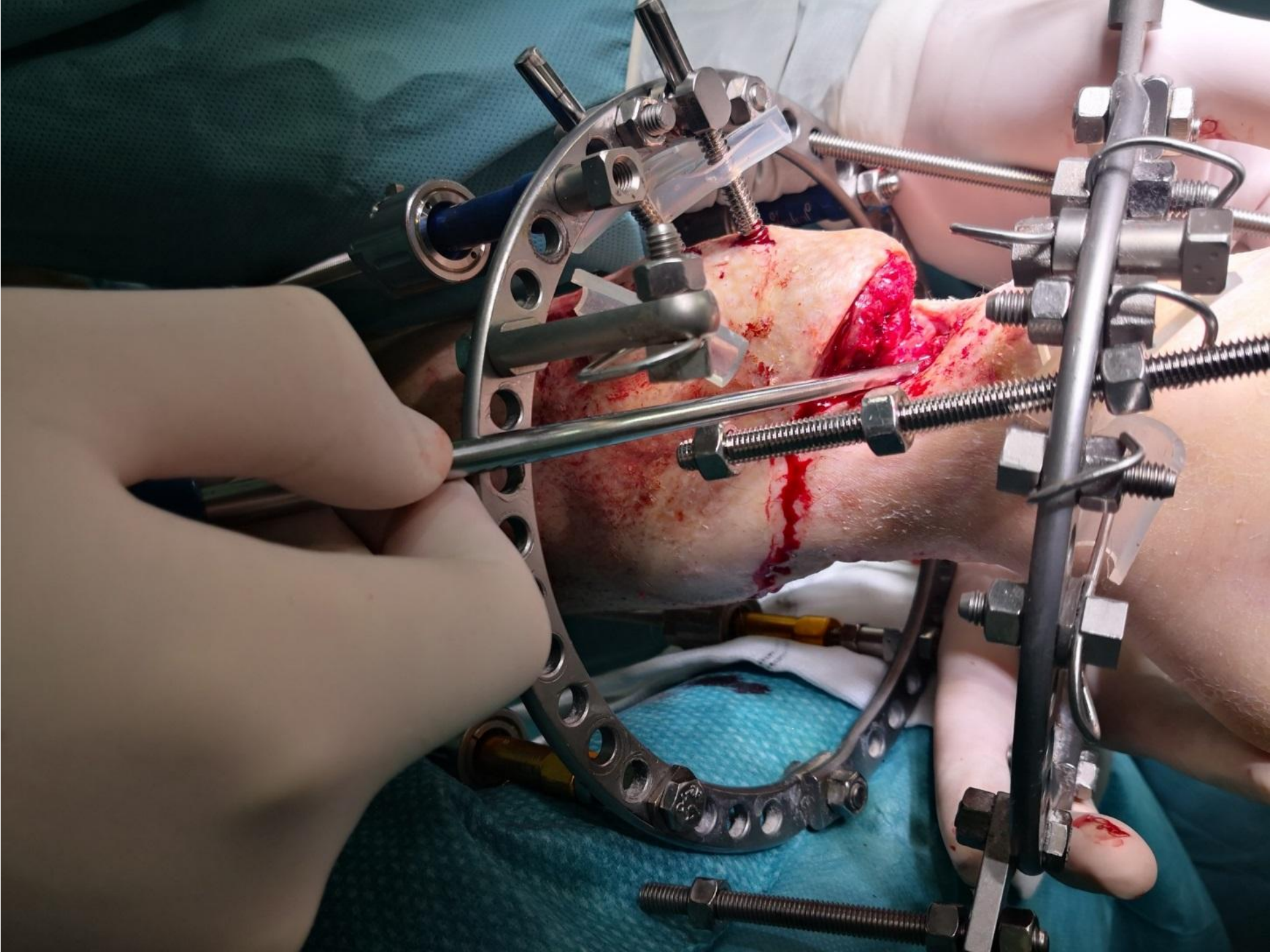


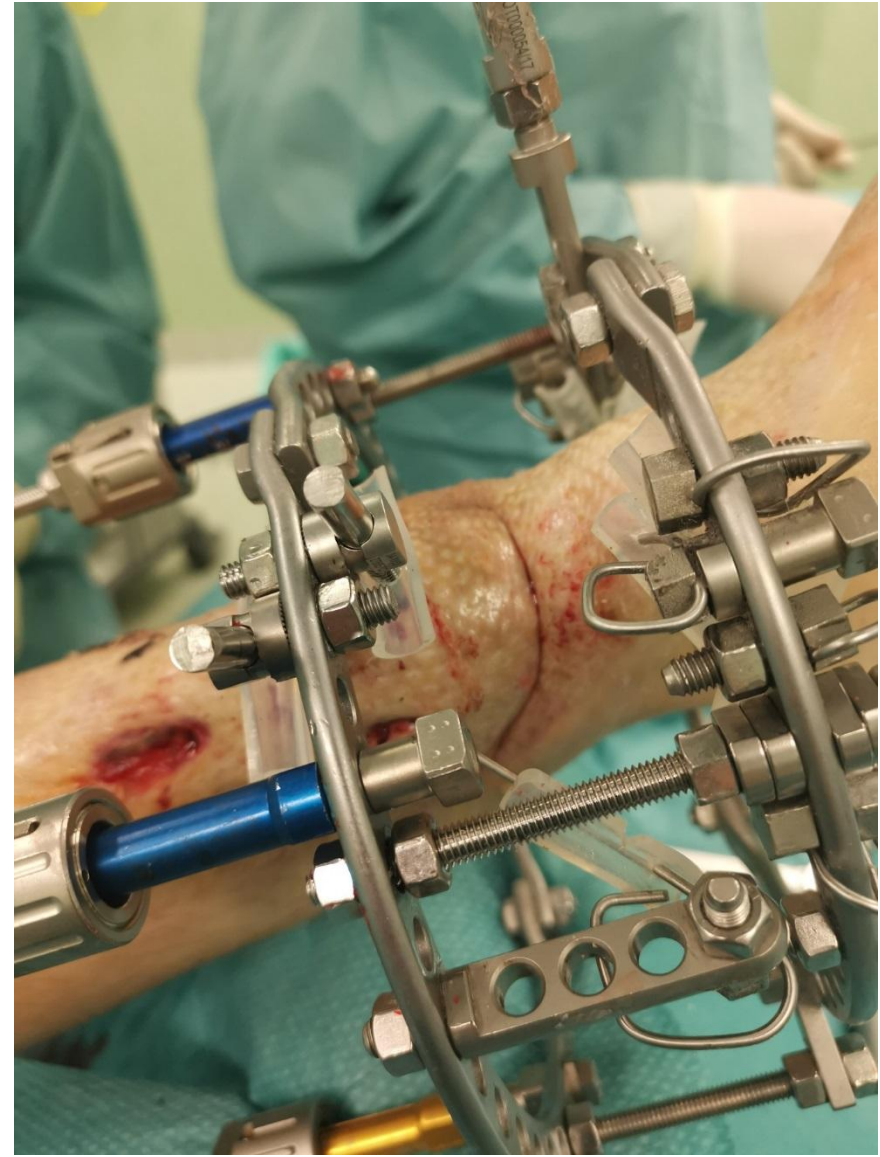




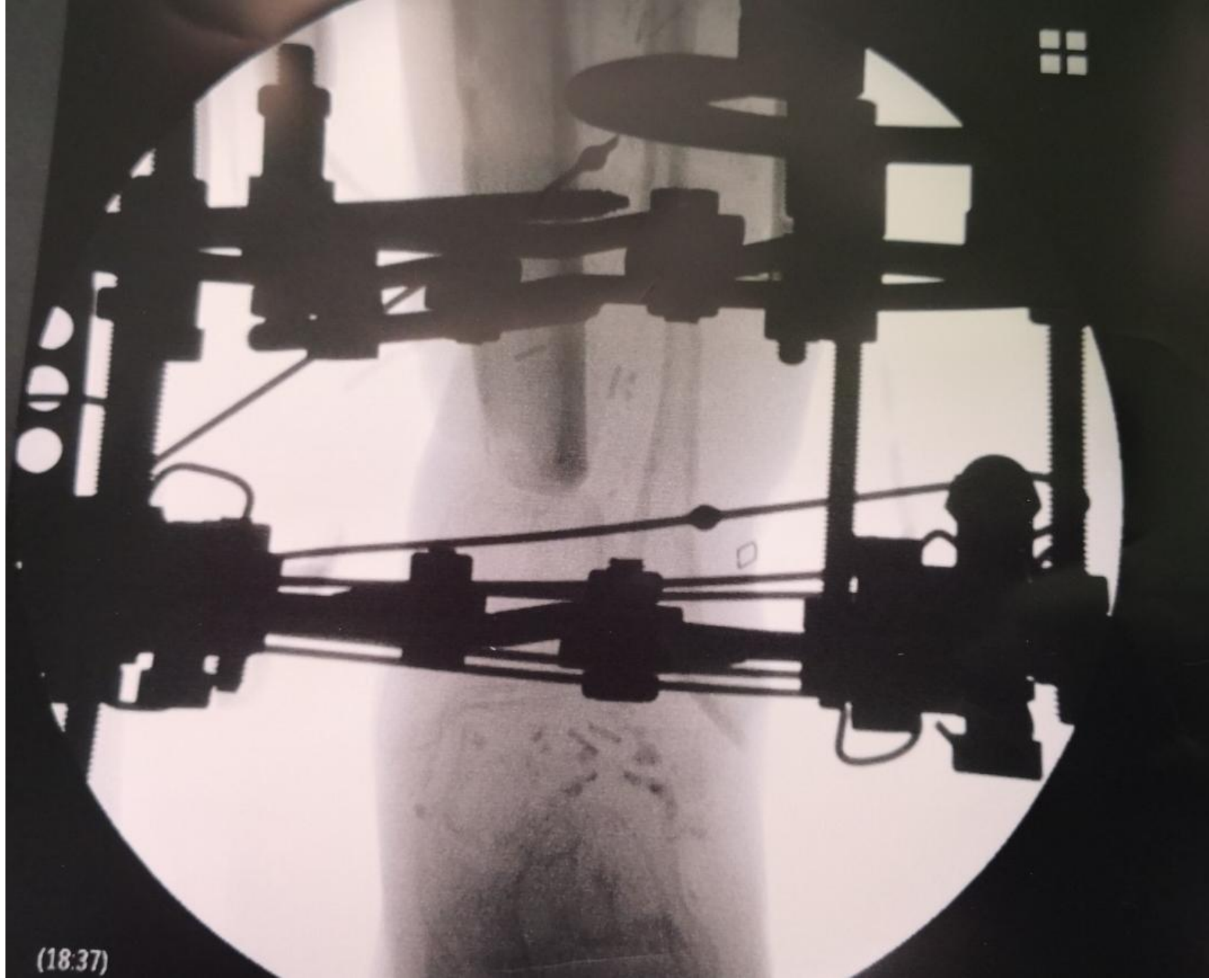


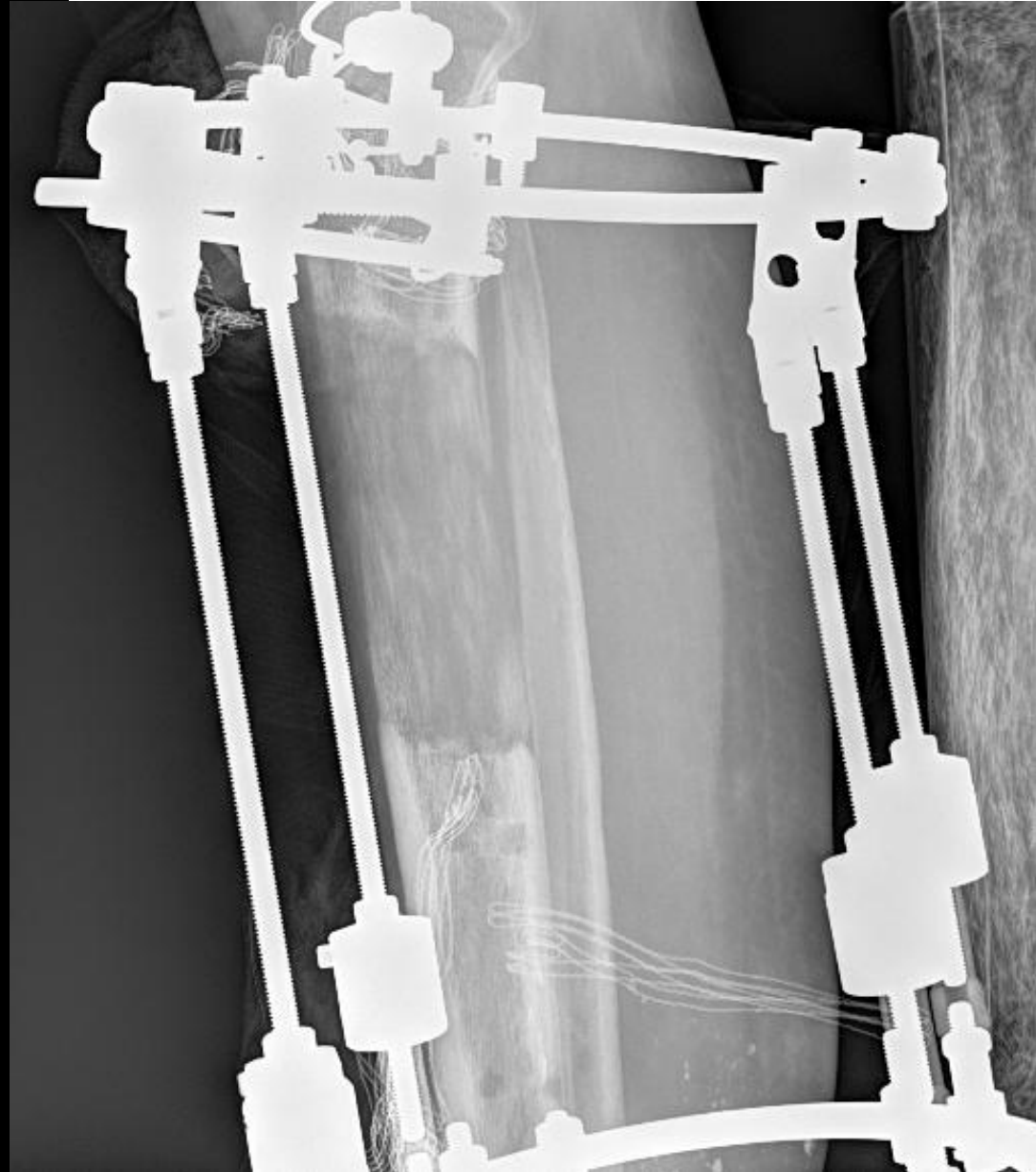


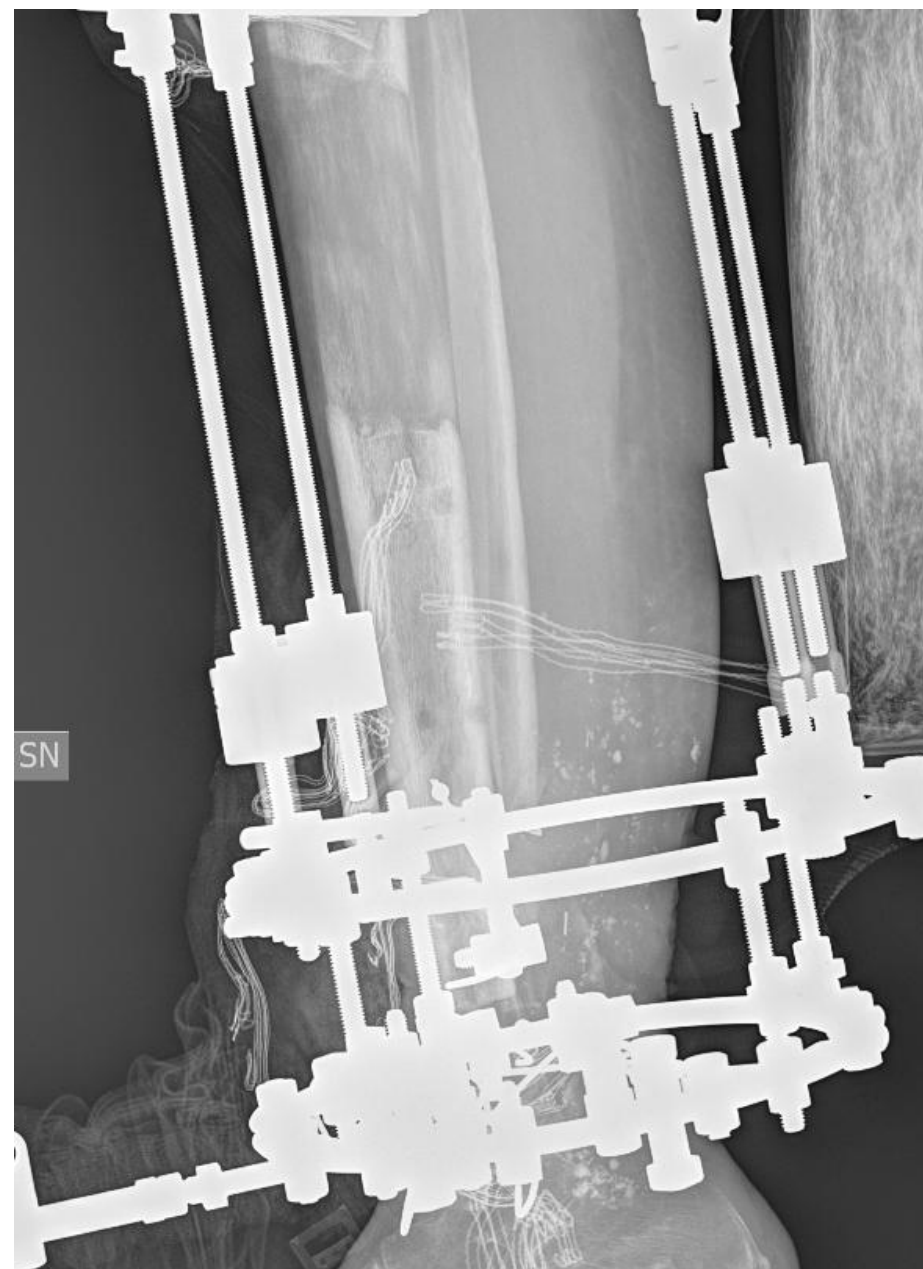
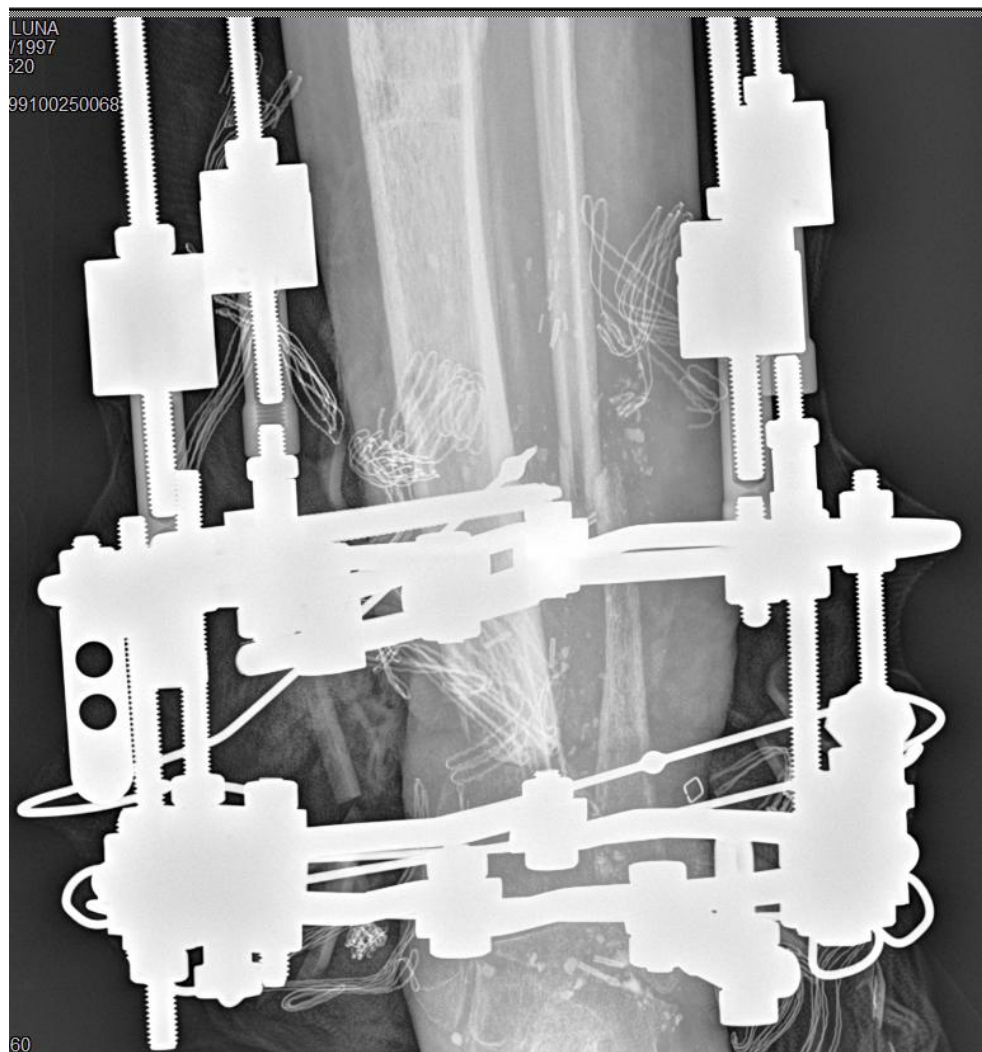










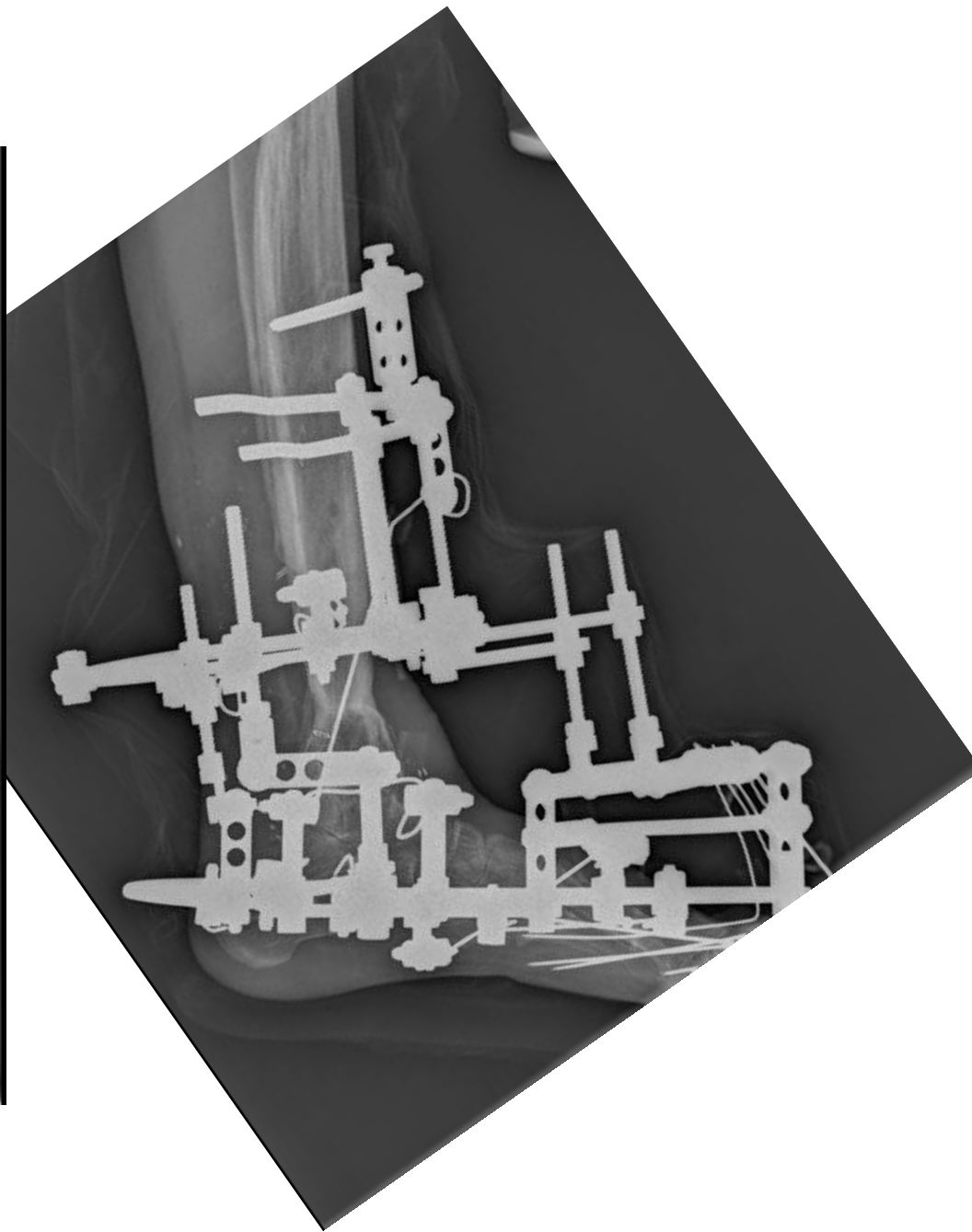
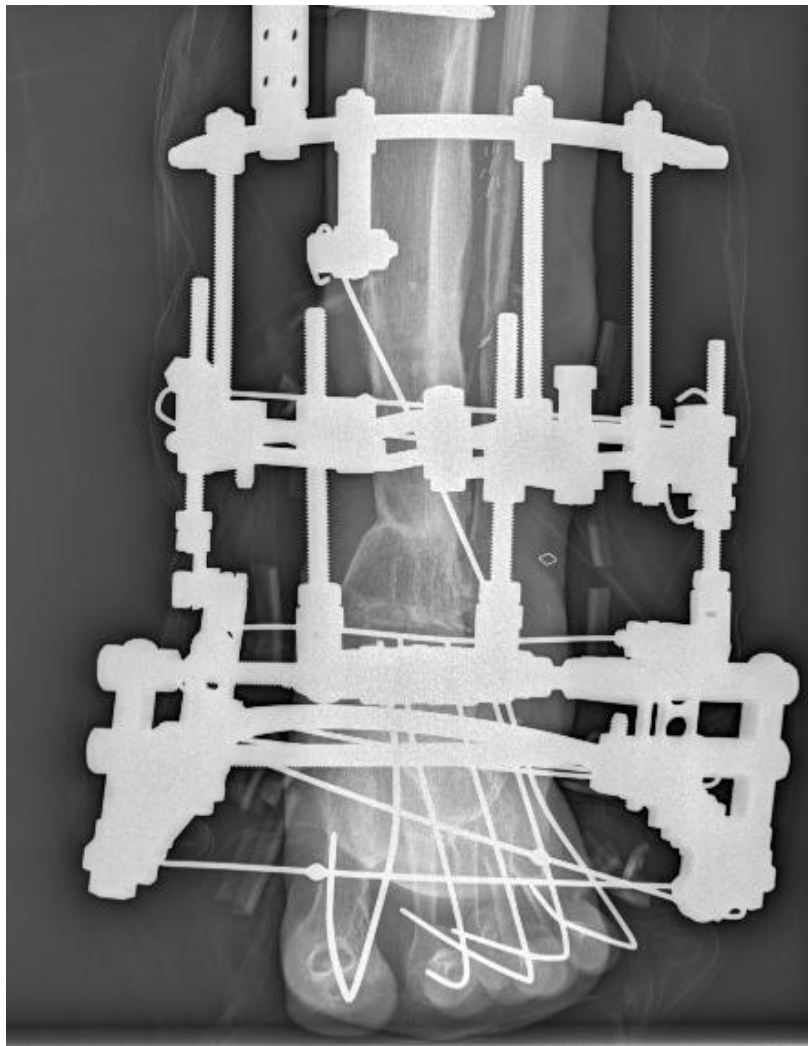




30.09.2021



Ankle arthrodesis done 01.10.2021



Removal 12.01.2021









7/15/16, 58y.o. man , driver, time of entrapment in the car more then 1 hour, intubated on the scene for anesthesia for facilitation of extraction from the van

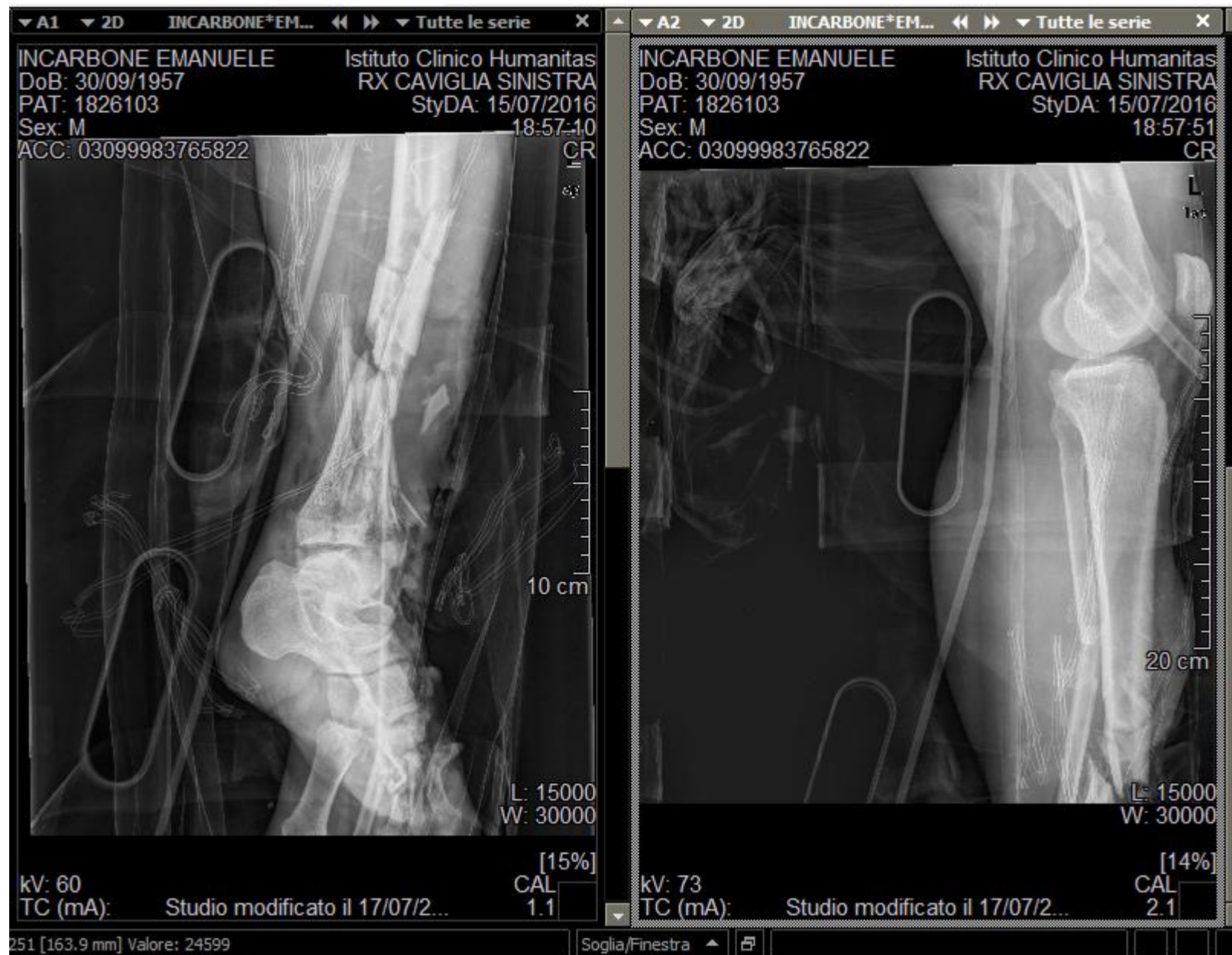


After abdominal surgery go in the radiology and do Bone scan of the brain and X-rays of the bilateral ankle, open dislocation at the right and subamputation on the left.

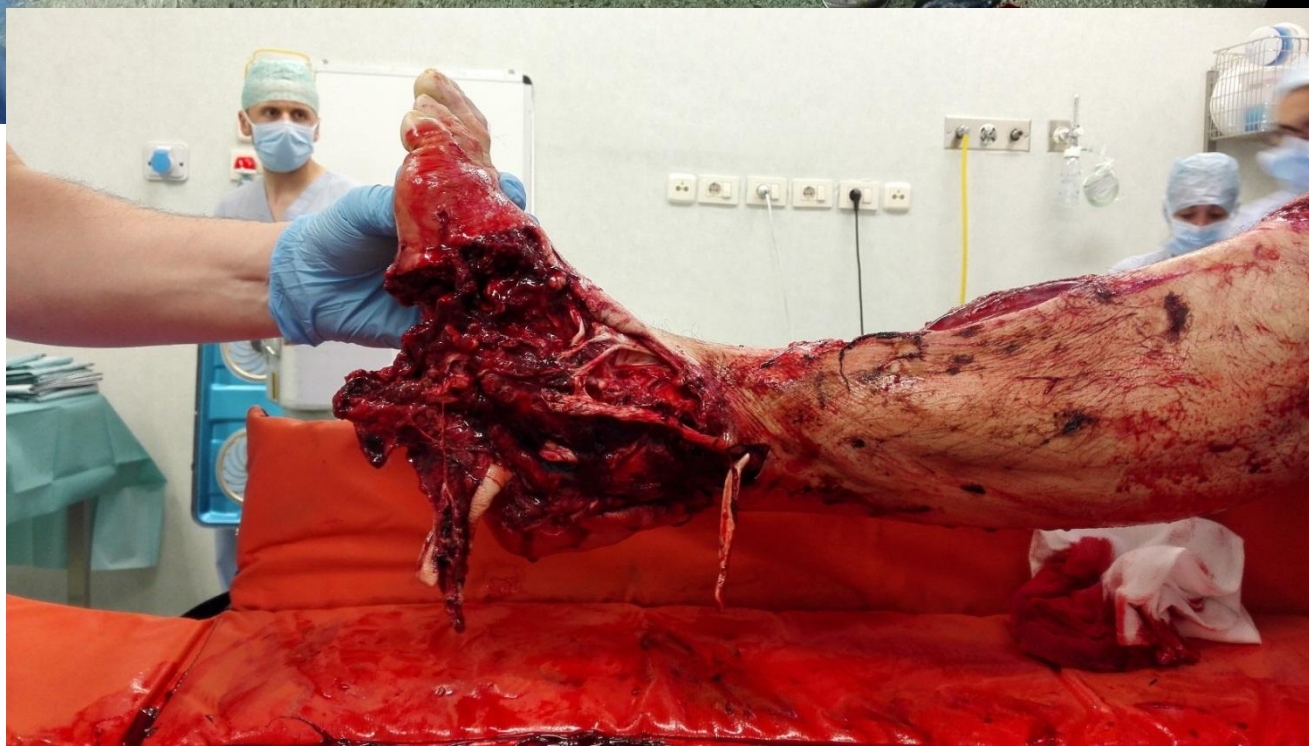


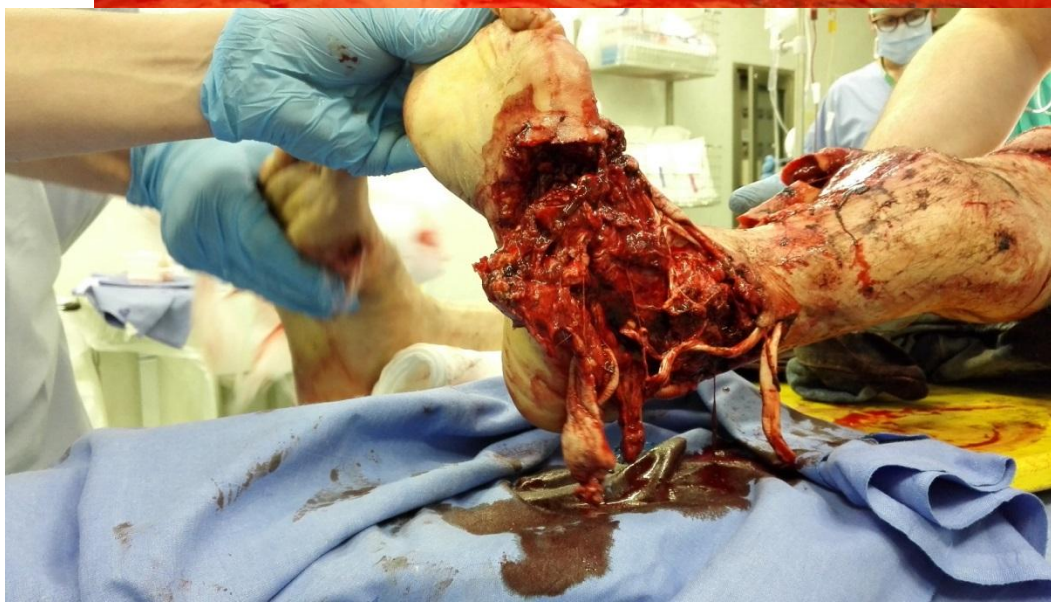
Right
foot





Left side

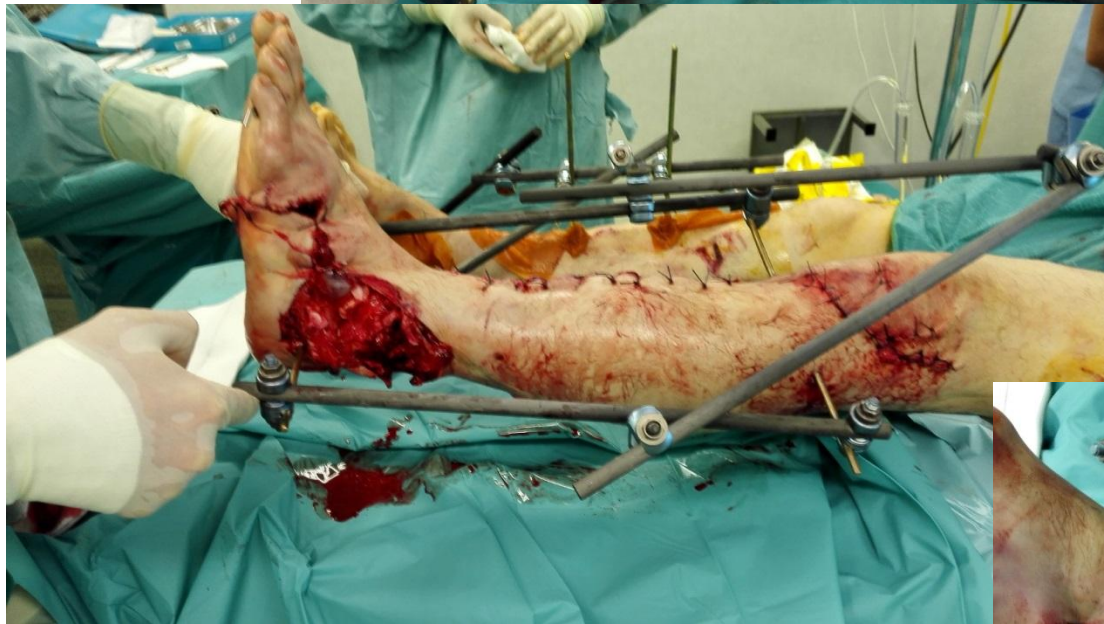




**In operation room EcoDoppler,
evaluation of the vascular surgeon:
NO BLOOD SUPPLY BELOW THE
POPLITEAL ARTERY.**

**See the concomitant fracture of the
distal femur, for avoiding femur level
amputation, attempt for wound care
(DCO) and ExFix**



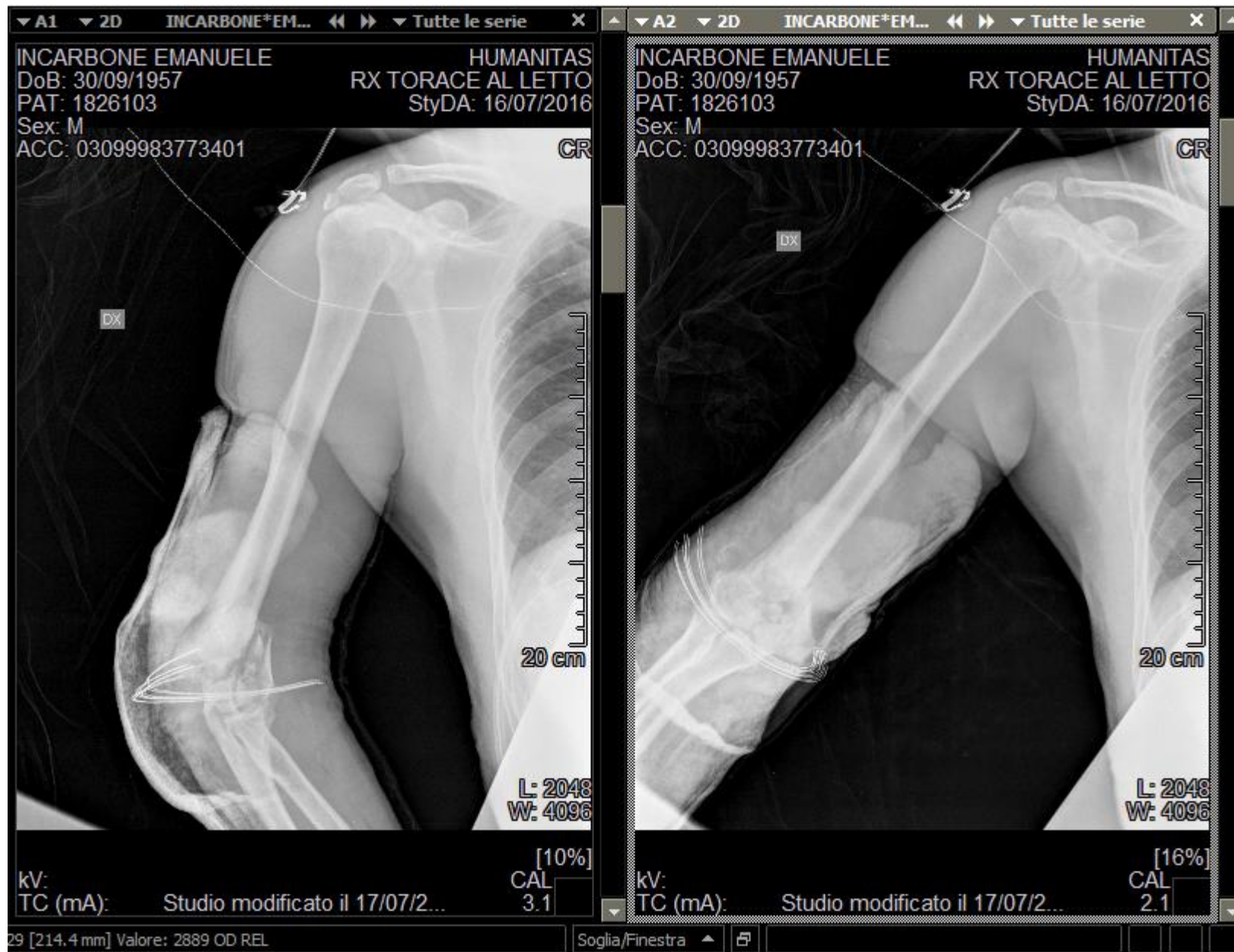


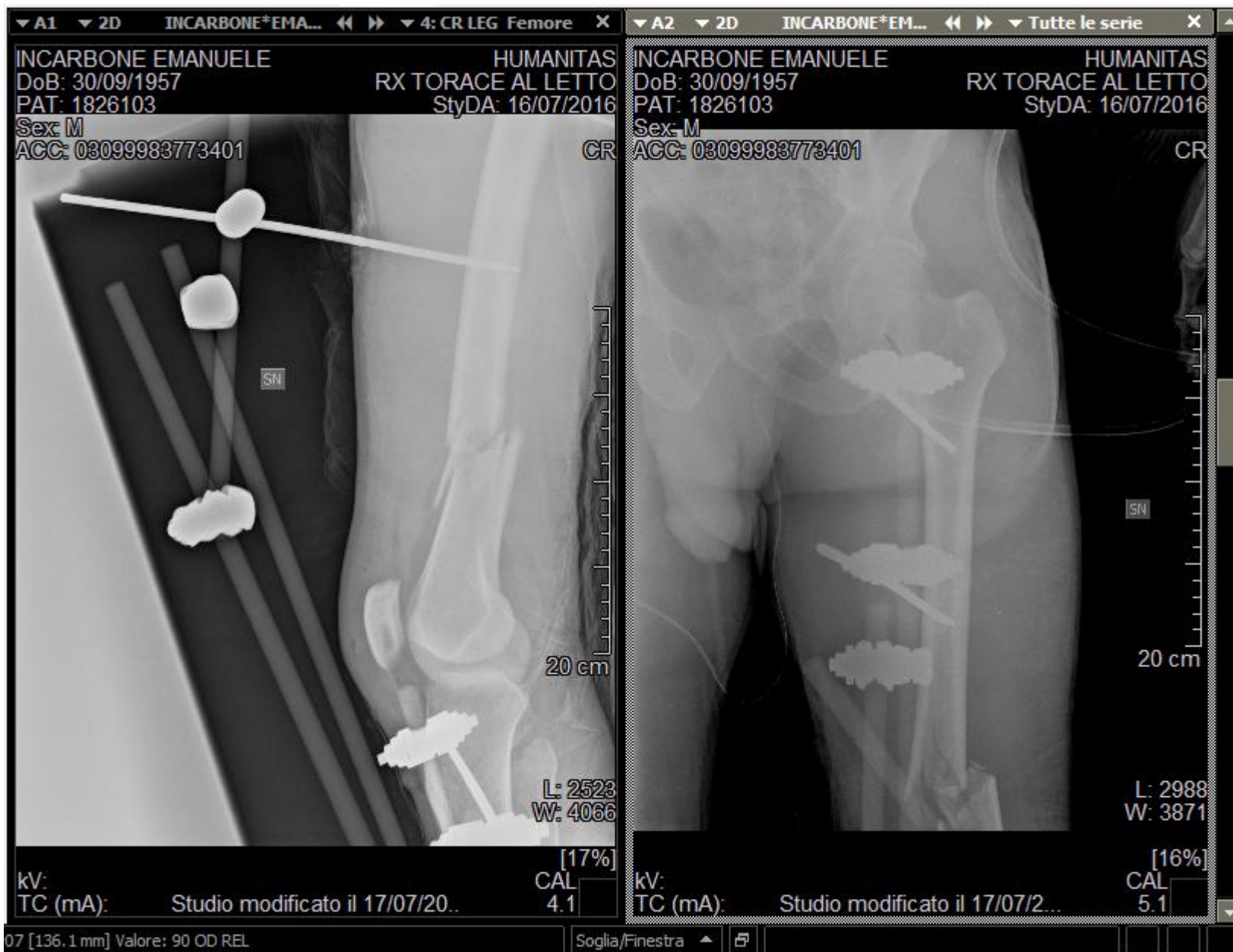






Arteriography and evaluation of vascular surgeon on the intensive care room, trifasic flow till the left foot

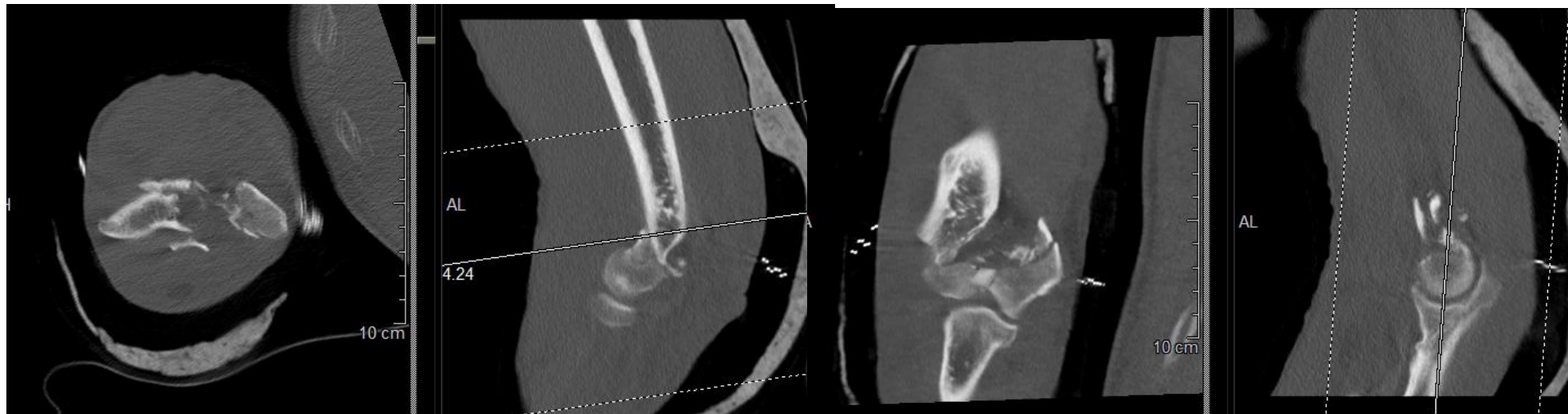
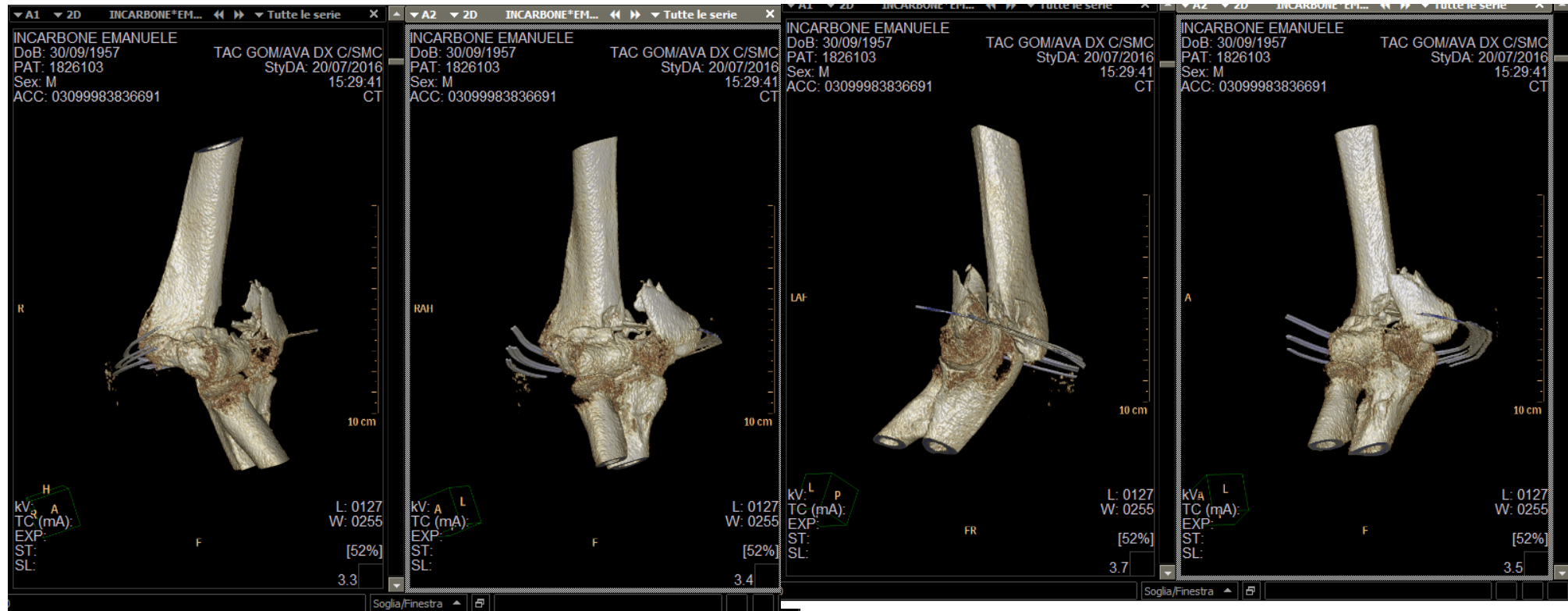












No infection on 4 Arts after 2 weeks





Pus from pancreas with local infection of *Acinetobacter Baumanii*



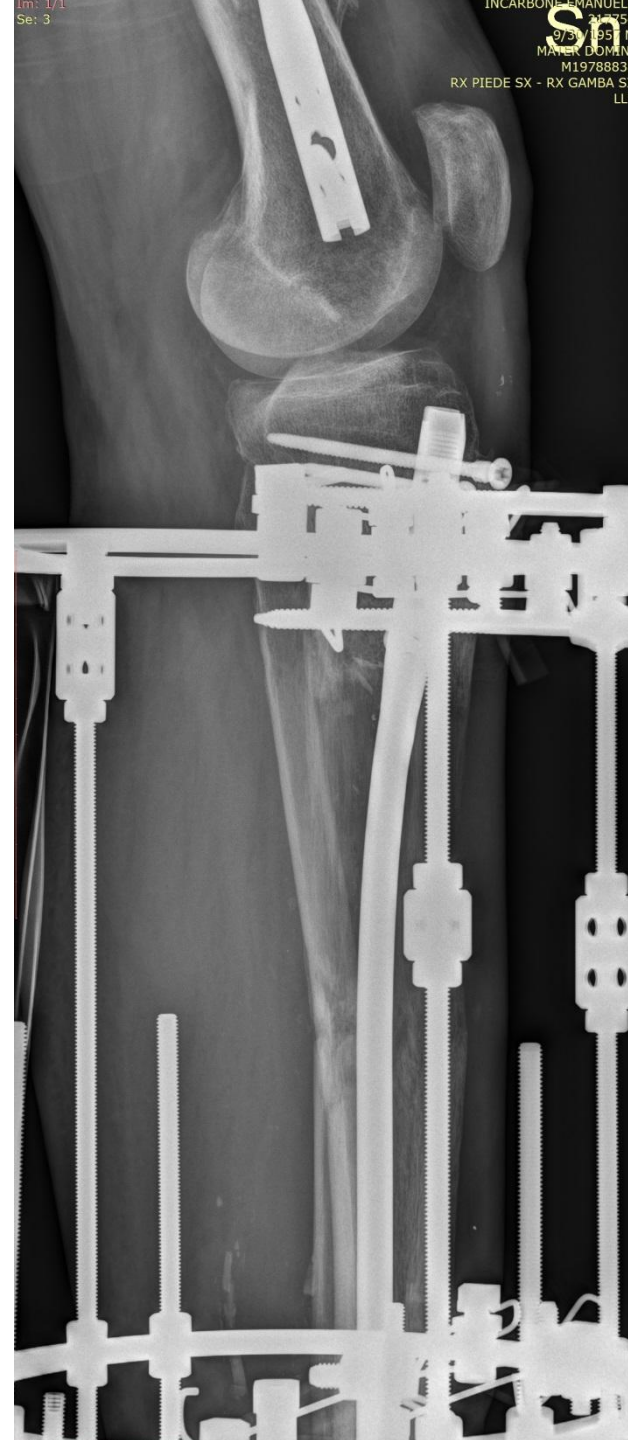
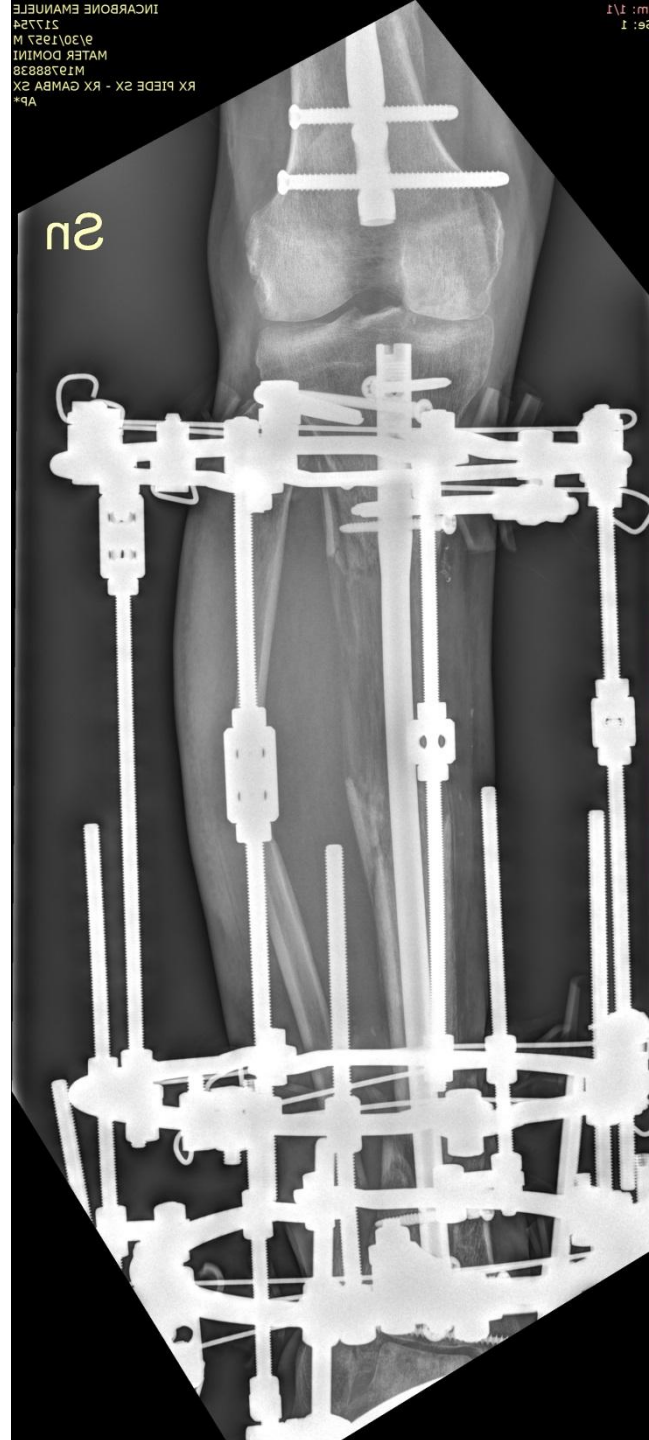






LON

Lengthening
over the
nail

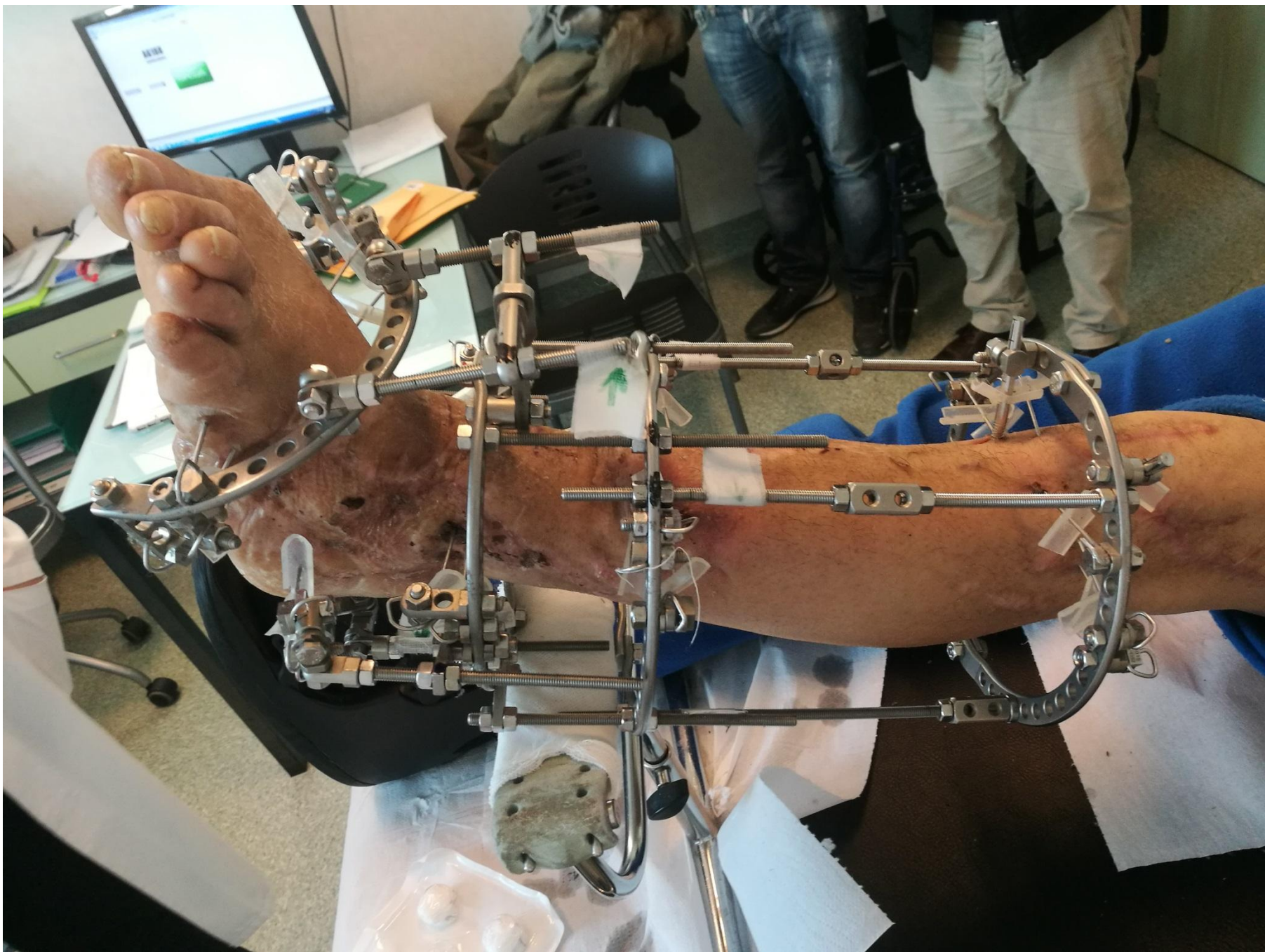


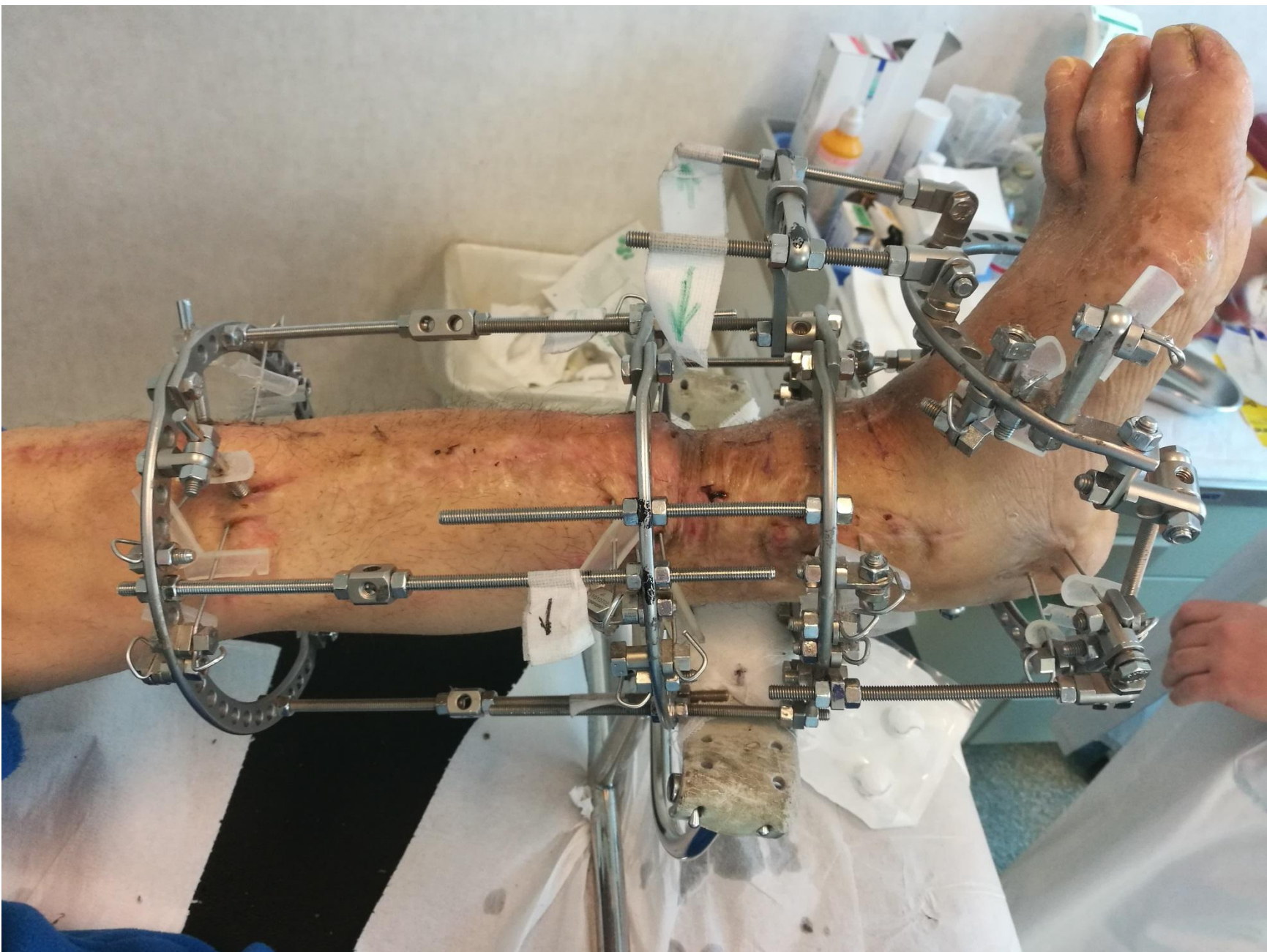
Im: 1/1
Se: 2



Closed foot correction









10 month after trauma



1 year and 4 month after trauma.





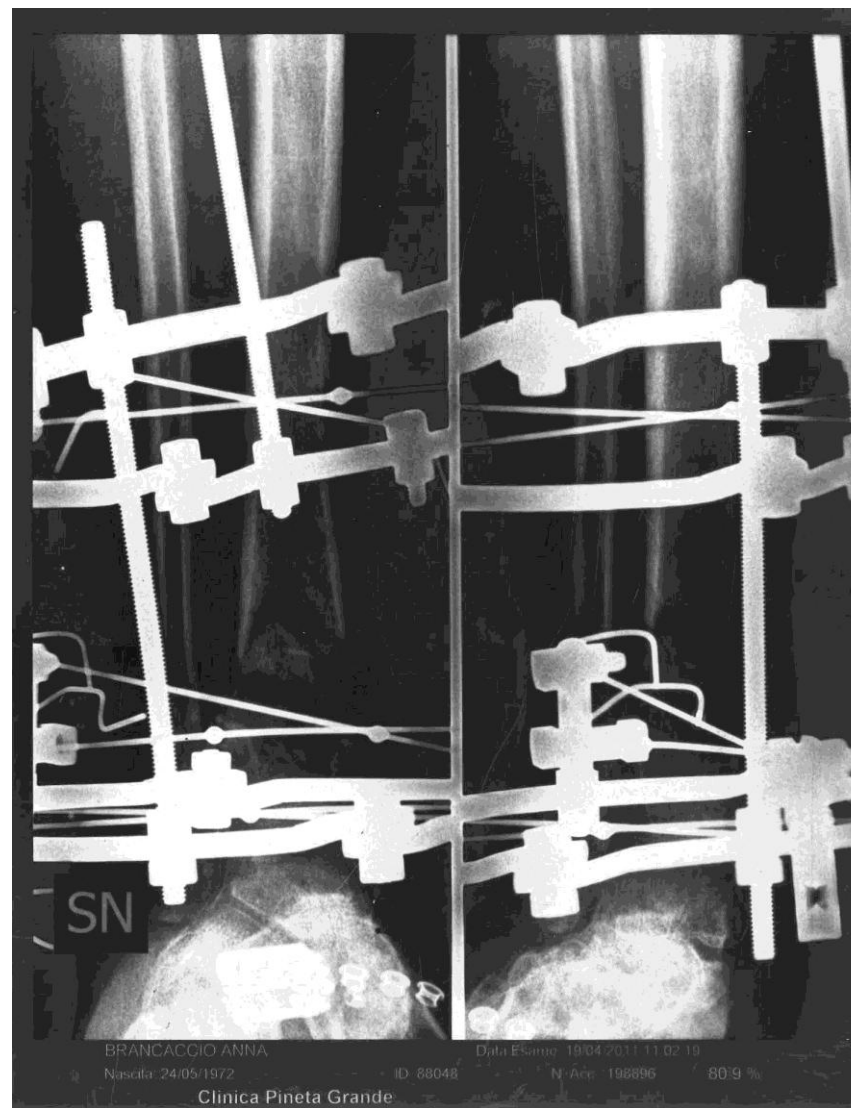
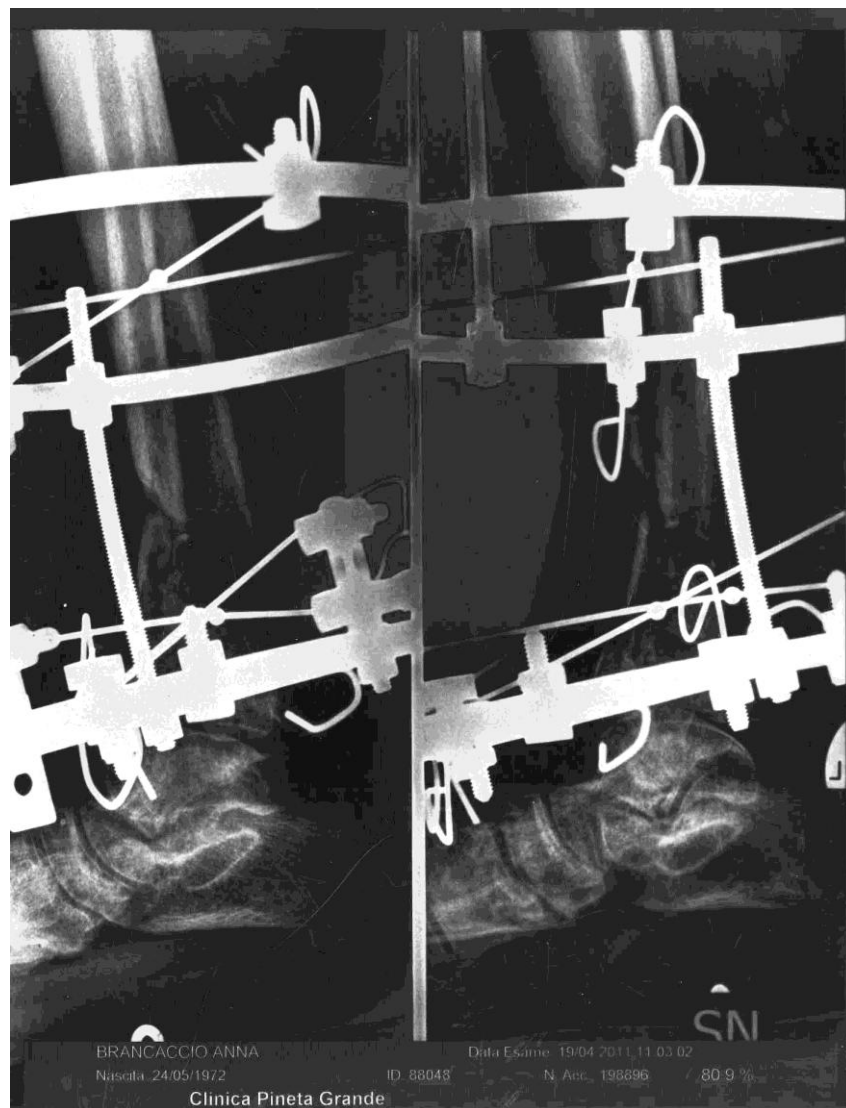
Bone scan 27.10.17



47 y.o. Female

- TRIMALLEOLAR FRACTURE OF THE LEFT ANKLE IN A MOTORCYCLE ACCIDENT 8 YEARS AGO (APRIL 2011). TREATMENT WITH THE ILIZAROV FIXATOR, PSEUDOARTROSIS AND THEN ANOTHER ILIZAROV FOR 12 MONTHS.
- FRACTURE HAS BEEN CONSOLIDATED, BUT THERE IS A 3.5 CM SHORTENING OF THE LEG, A VOLUMINOUS ANKLE, AND MEDIALY TRANSLATED.

19.04.2011





20.12.2012 AFTER 8
MONTH

26.09.2013



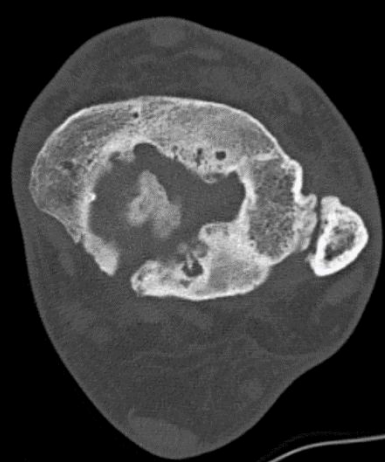
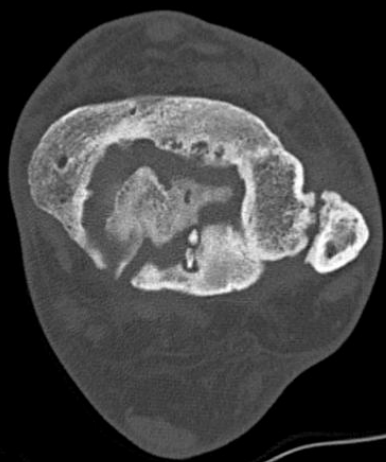
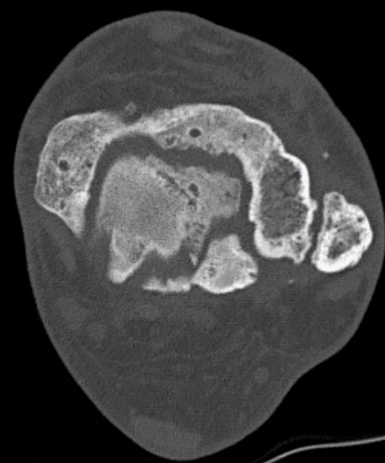
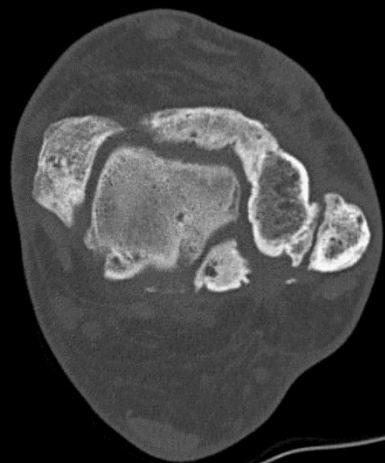
09.01.2020





ANKLE RX SHOWS VERY
SEVERE ARTHROSIS, HUGE
CALLUS OF AROUND TALUS.







09.01.2020



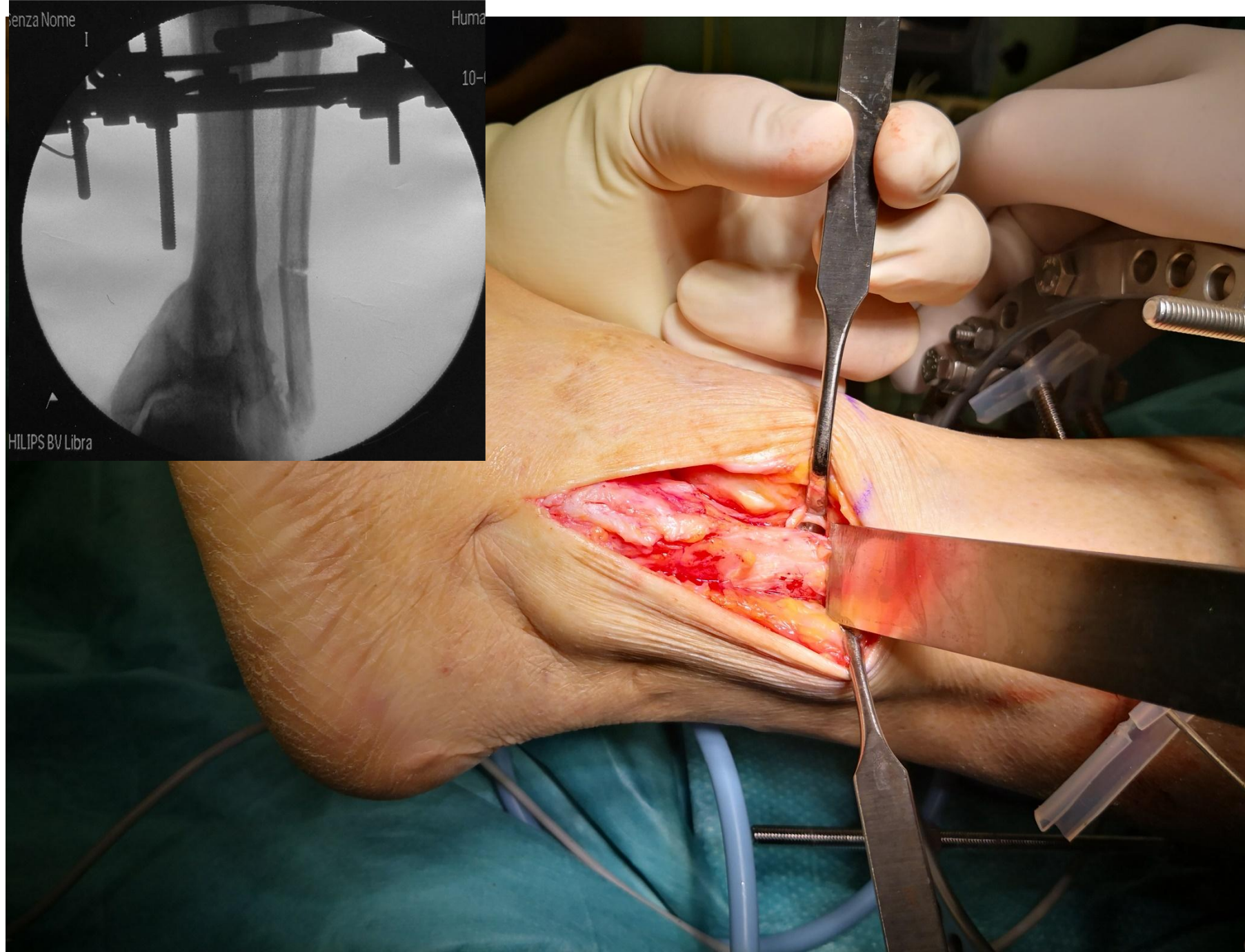


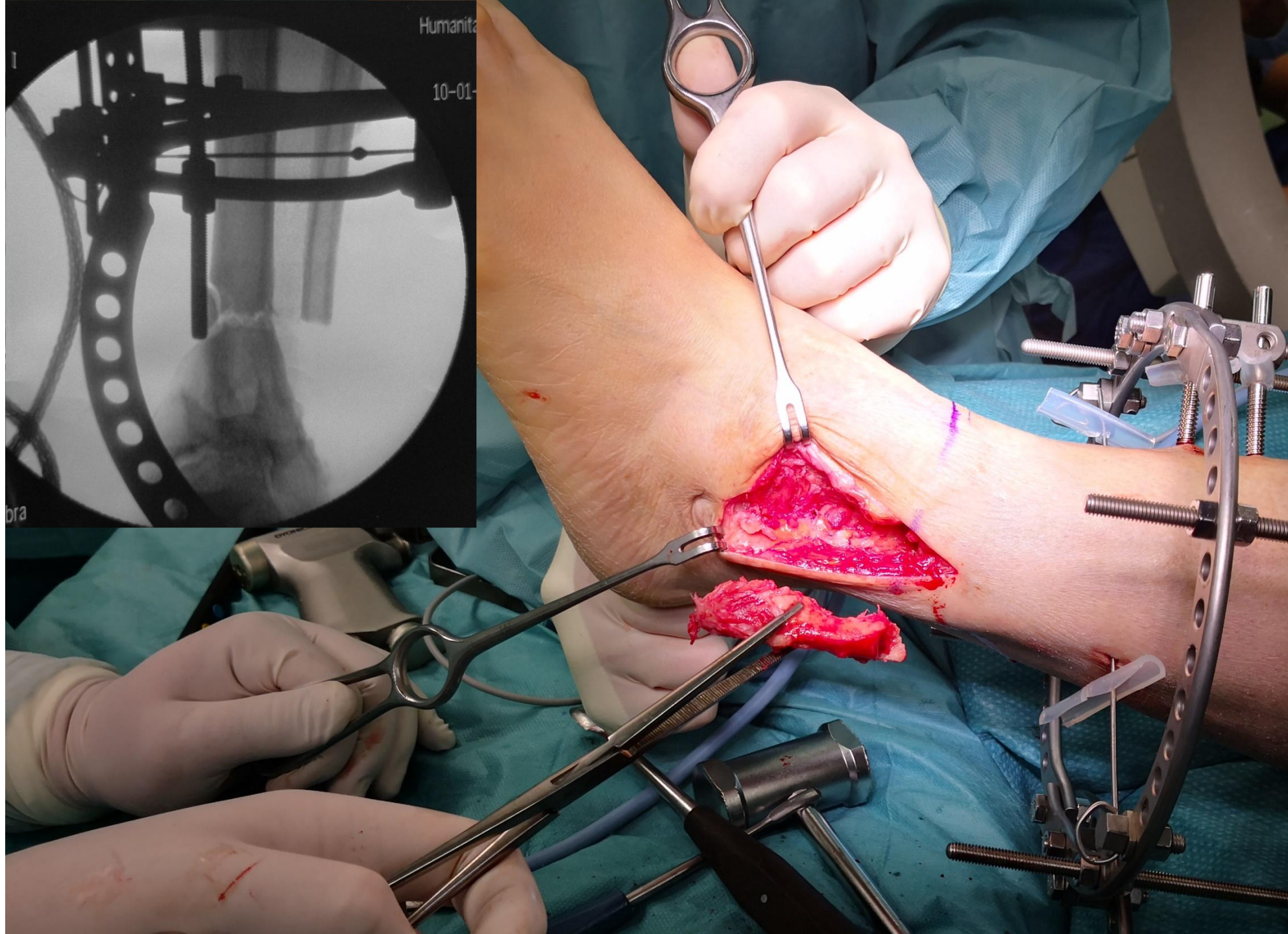
OUR **PLAN** WAS TO DO ARTHRODESIS OF THE ANKLE JOINT WITH TRANSLATION AND REALINEMENT AND LENGTHENING OF THE LEG.

BUT

- SHE DOESN'T HAVE PERMANENT PAIN,
- WALKS WITHOUT NOTICE CLAUDICATION IN NORMAL SHOES,
- ALWAYS DRESSES WITH TROUSERS
- CLINICALLY STILL PRESERVED ANKLE MOVEMENT GOOD ENOUGH.

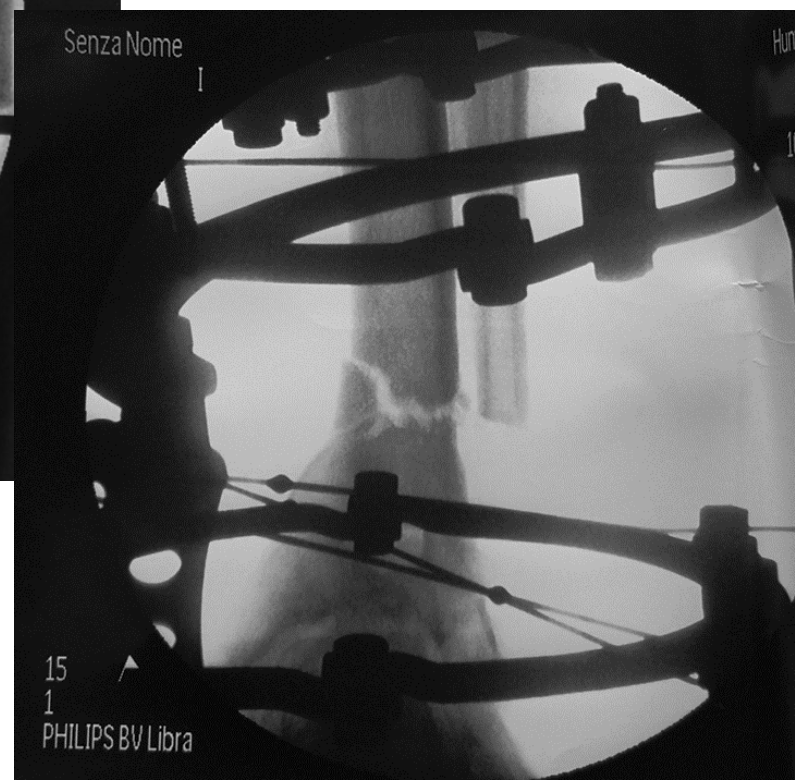
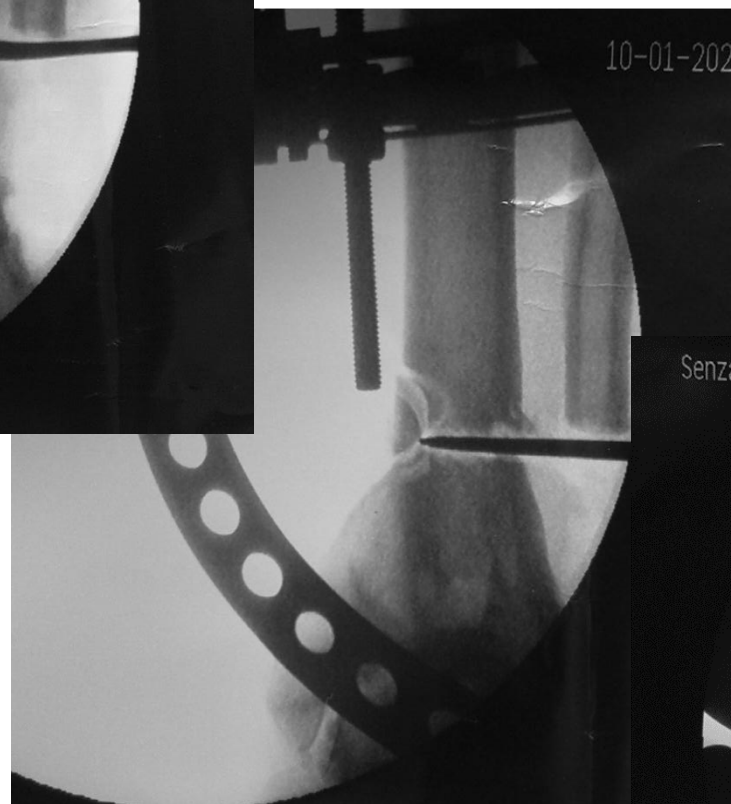




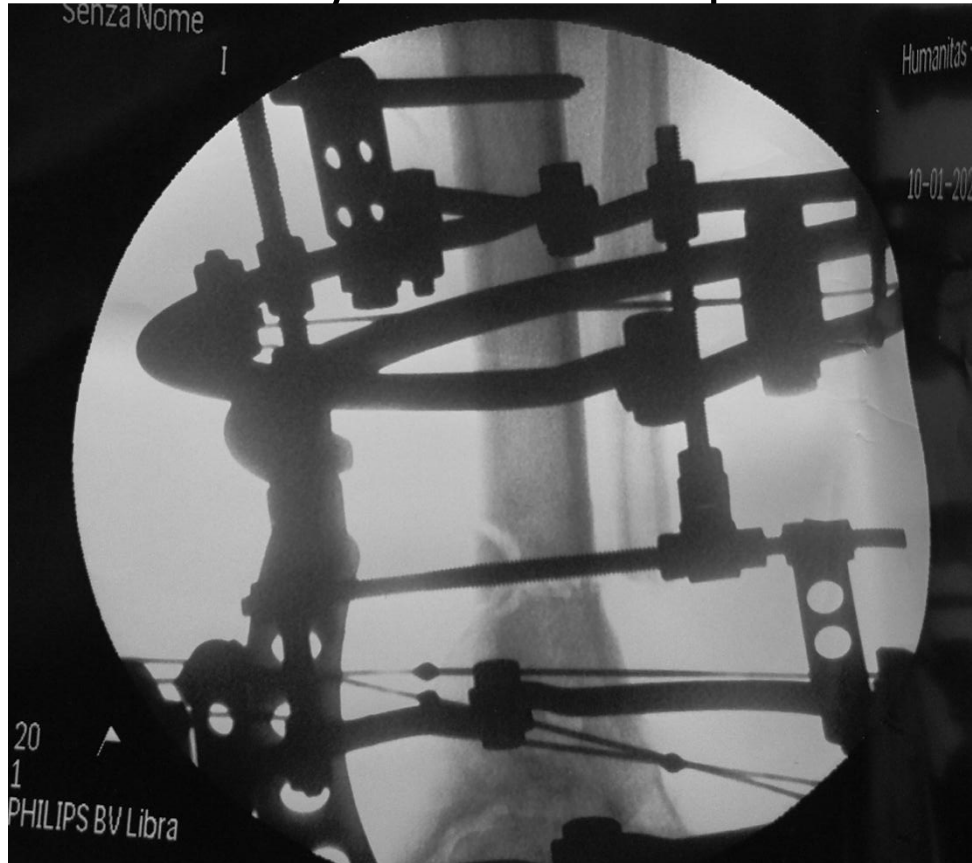




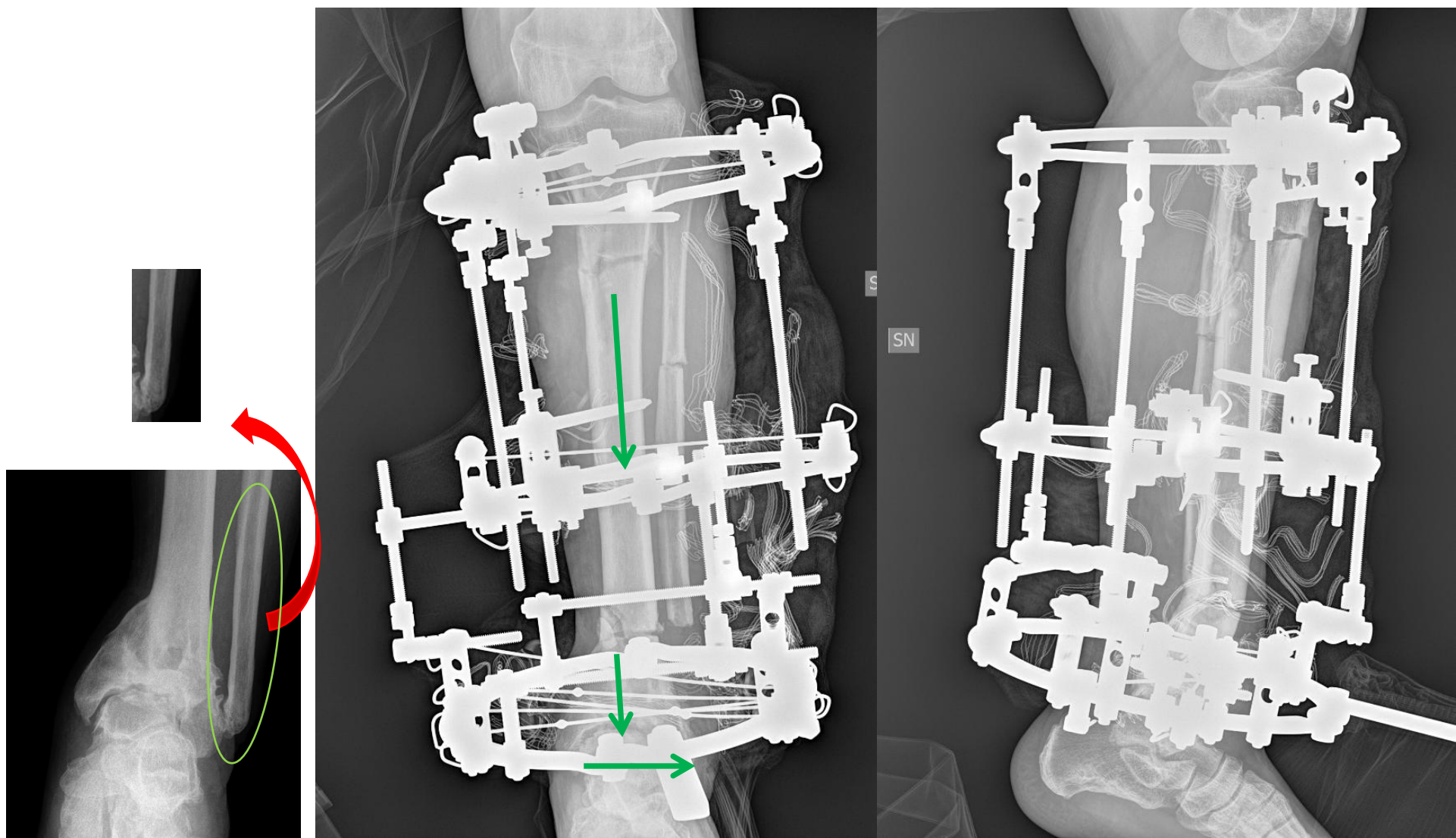
TIBIAL OSTEOTOMY



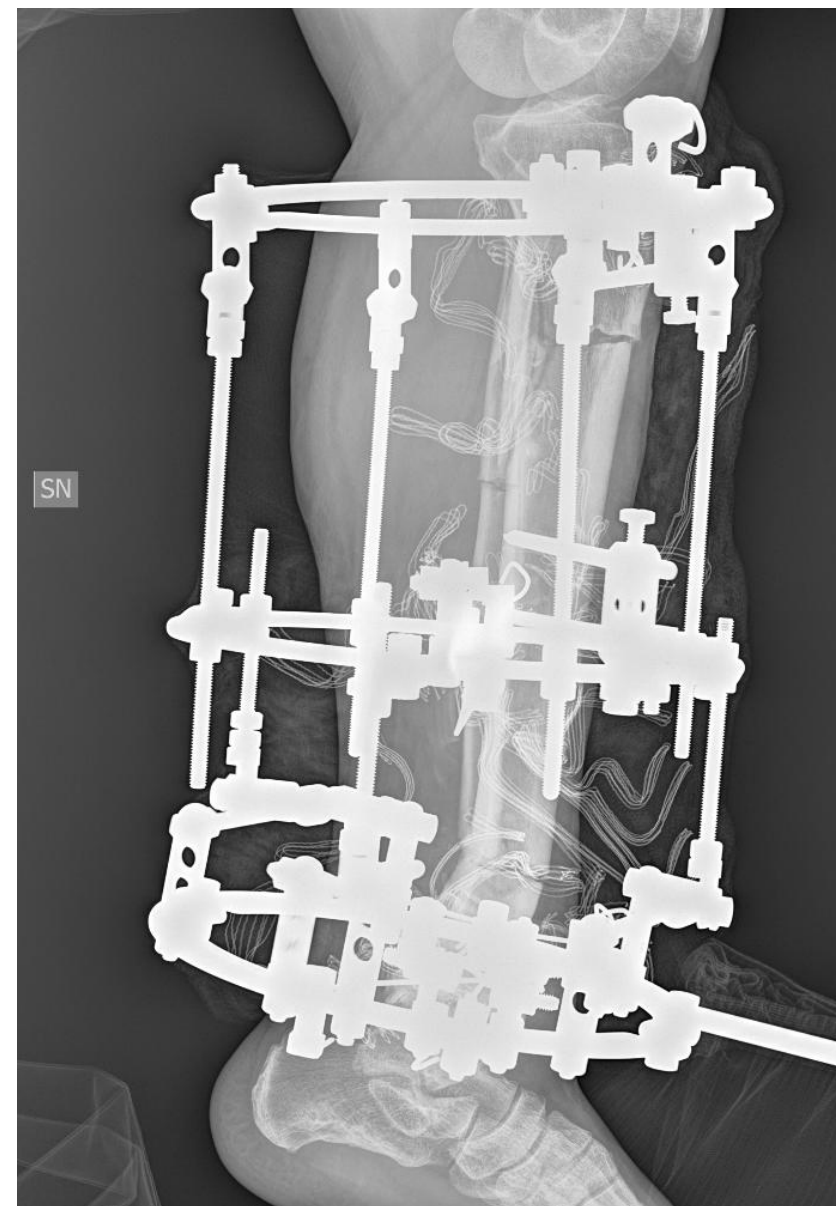
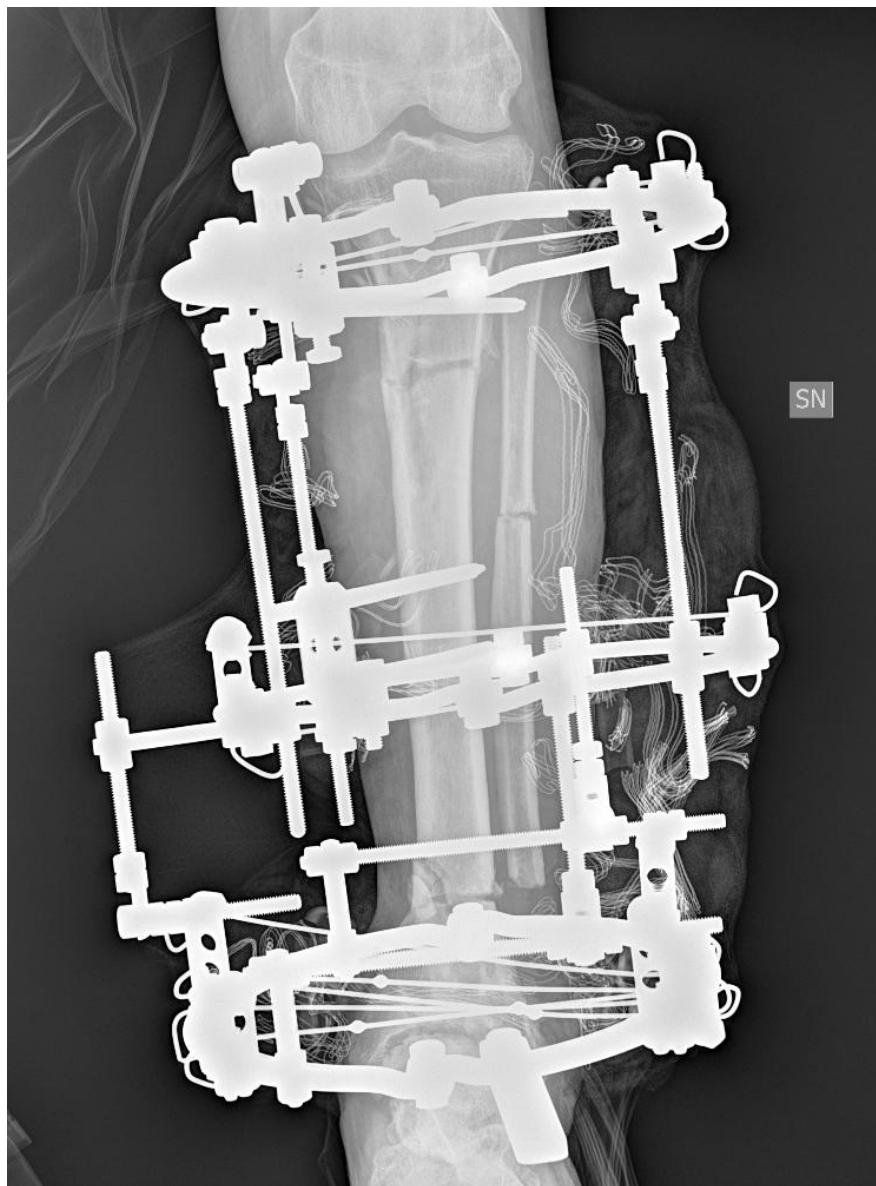
Translation system and proximal lengthening



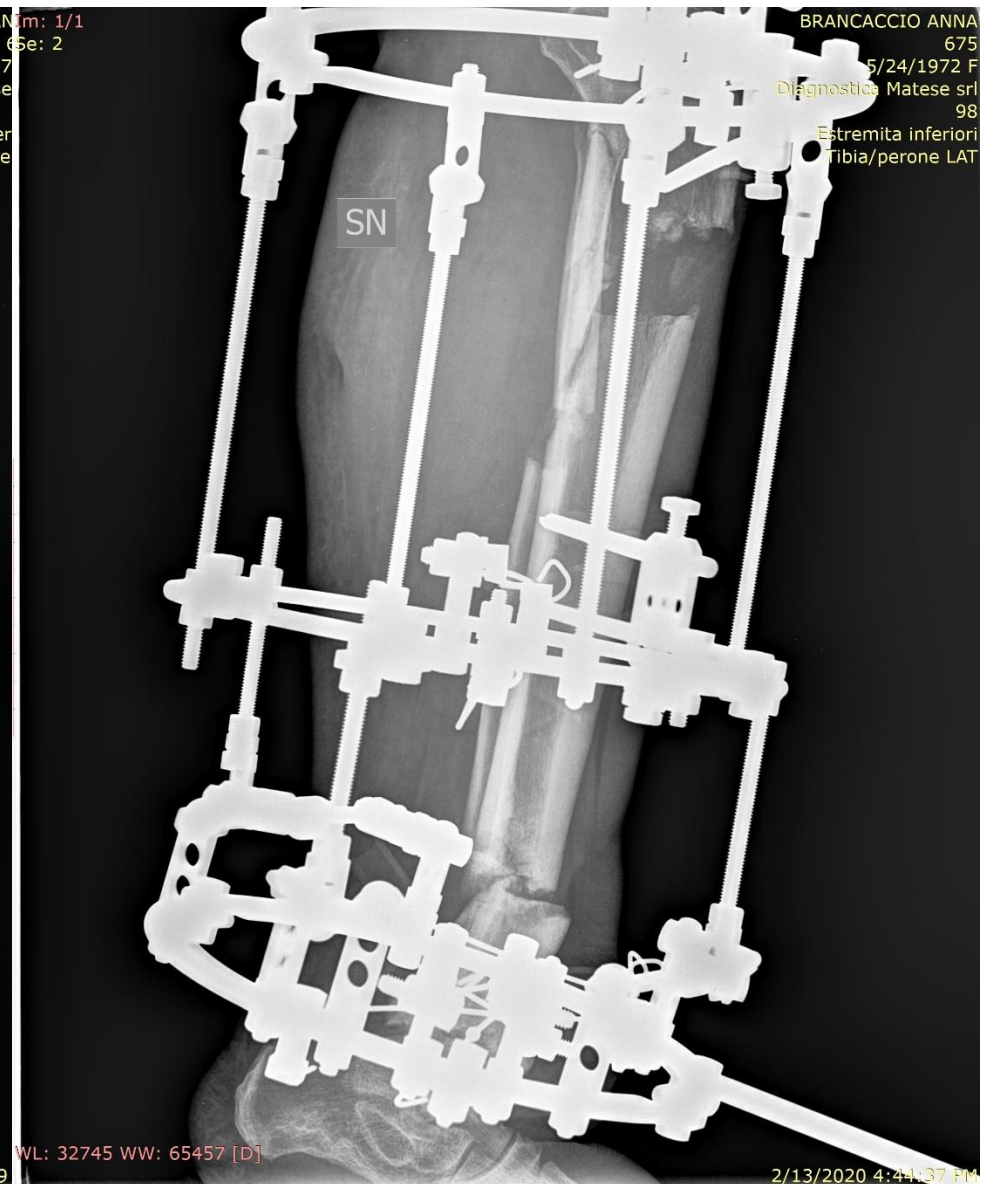
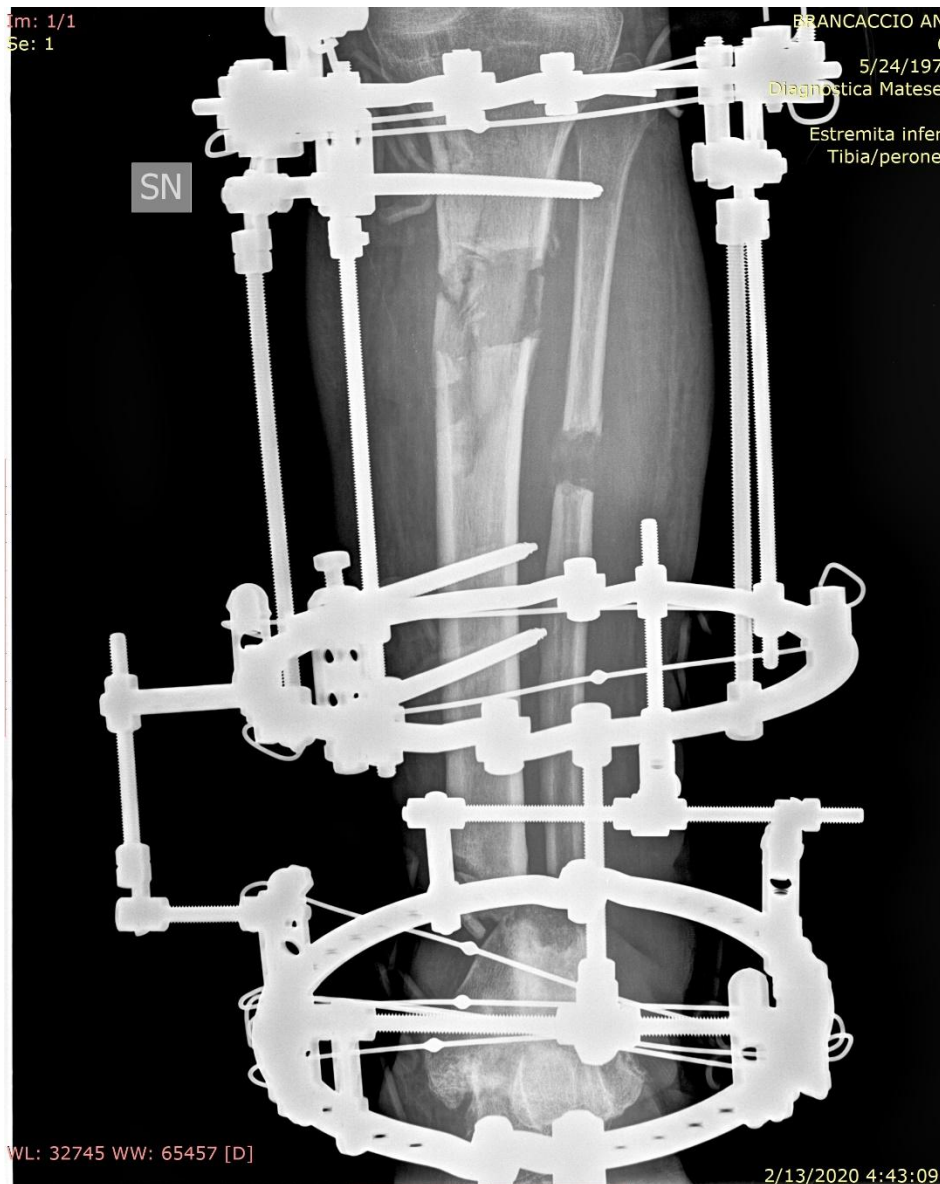
10.01.2020



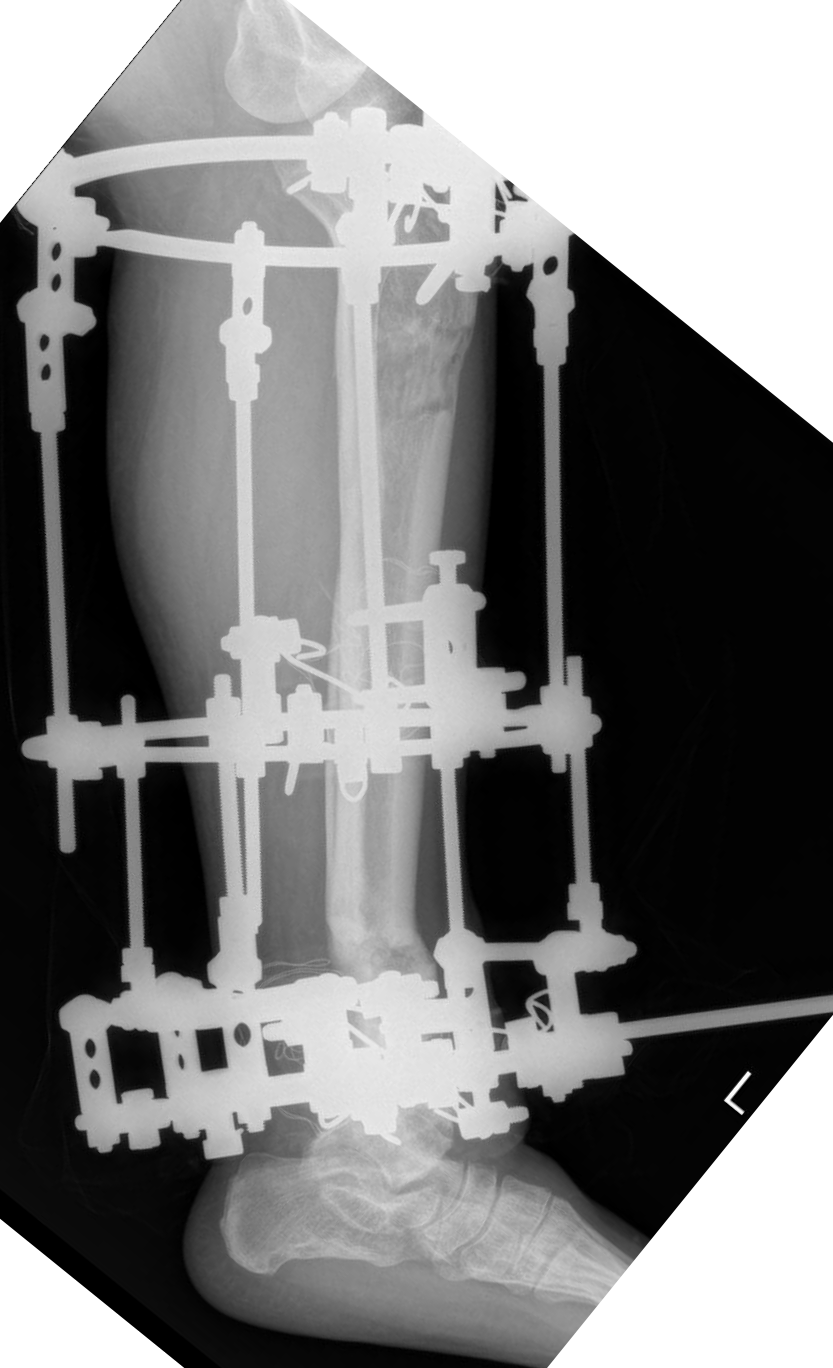
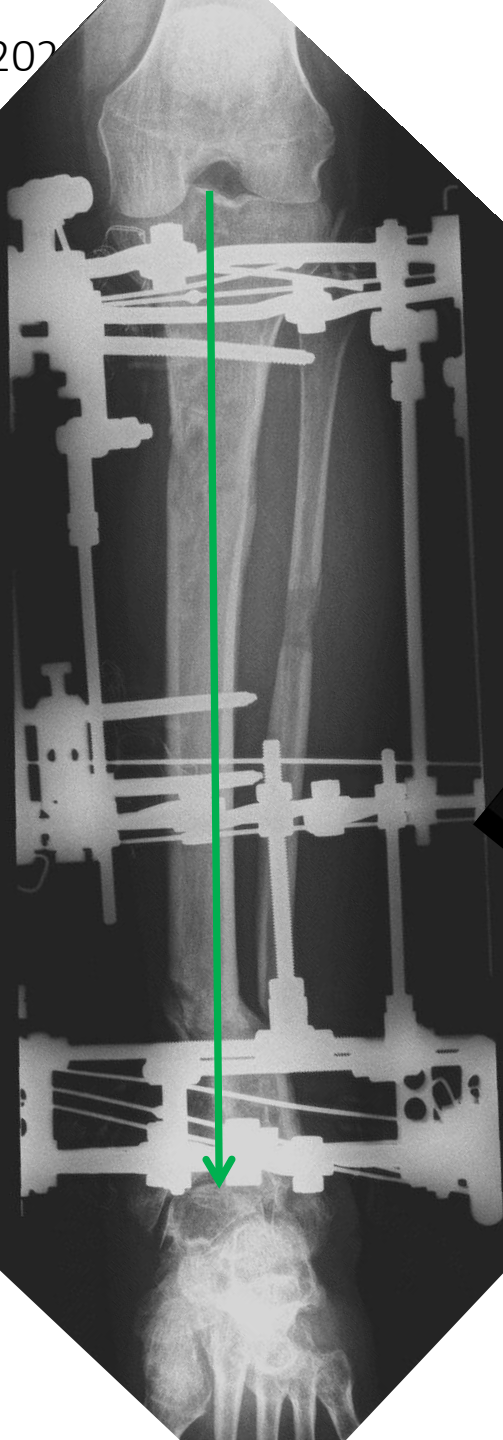
10.01.2020



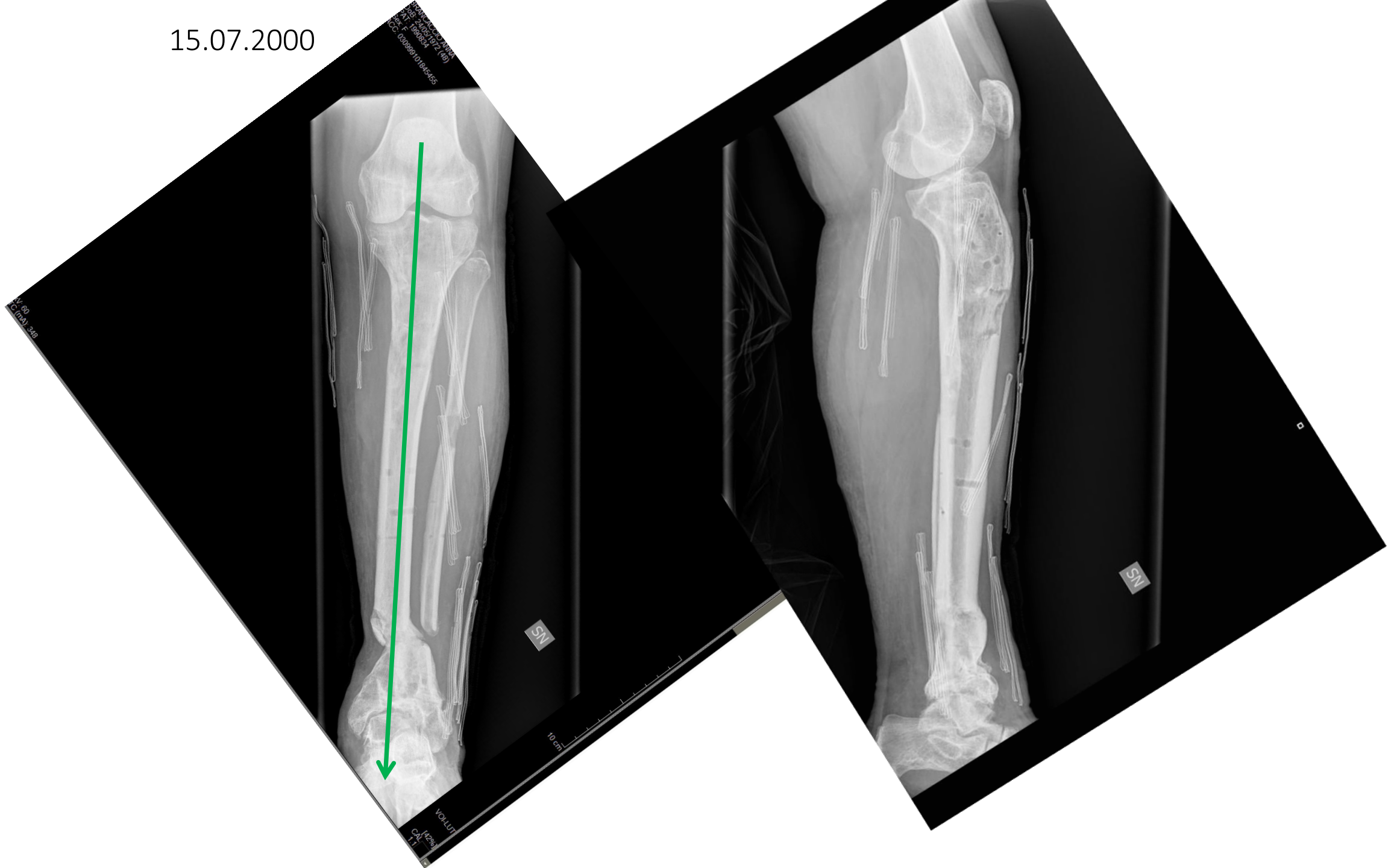
13.02.2020



14.07.202



15.07.2000





29.10.2020

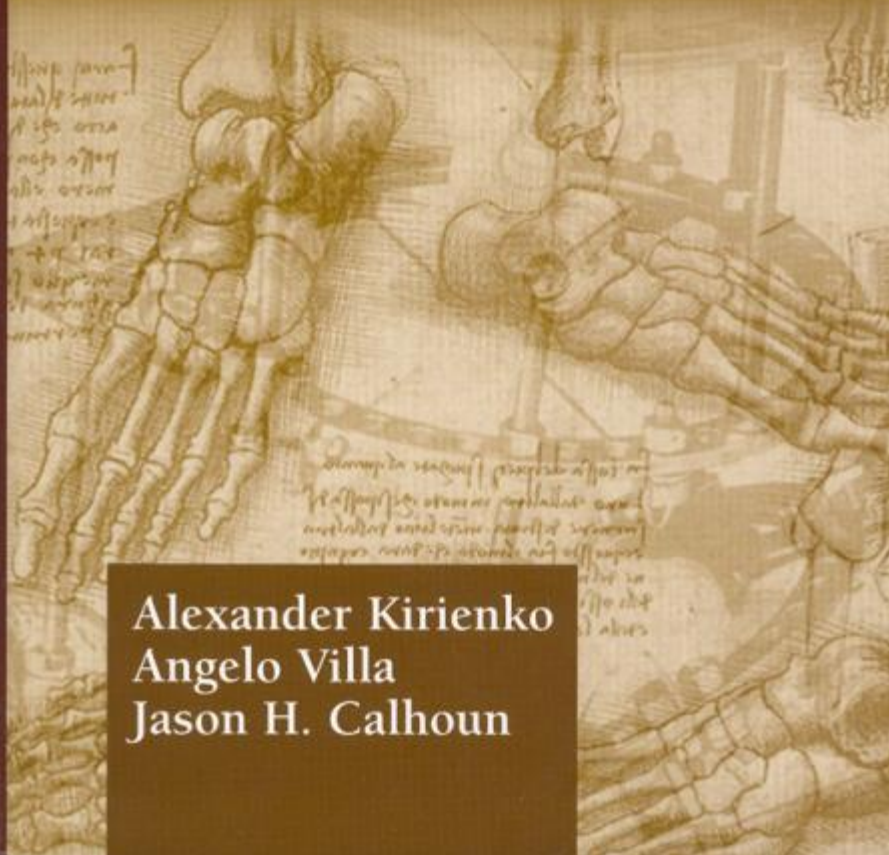






Ilizarov Technique for Complex Foot and Ankle Deformities

[Amazon.com](https://www.amazon.com)



Alexander Kirienko
Angelo Villa
Jason H. Calhoun

https://app.tlhex.com/Cases/CreateCaseWizard.aspx

tlhex.com

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TRUELOK HEXAPOD SYSTEM

Welcome Dr. Samchukov!



Home Page

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Patients

Account

Case Data

Deformity Parameters

Frame Parameters

Postoperative

End of Correction

Schedule

Prescription

Report

Checkup

Case Number: CopyOf_001

Case Name: Fracture tibia_Copied on 8/13/2012

Patient Number: 6400

Side Selection: Left

All the corrections in this section are under/over corrections relative to biomechanically aligned segment

AP Over/Under Correction (deg)

0

☒ Valgus☐ Varus

AP Over/Under Translation (mm)

0

☒ Medial☐ Lateral

ML Over/Under Correction (deg)

0

☒ Apex Anterior☐ Apex Posterior

ML Over/Under Translation (mm)

0

☒ Anterior☐ Posterior

Over/Under Rotation (deg)

0

☒ External☐ Internal

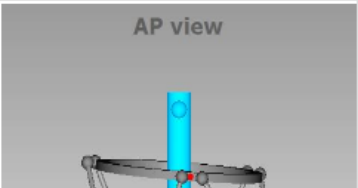
Bone Length (mm)

0

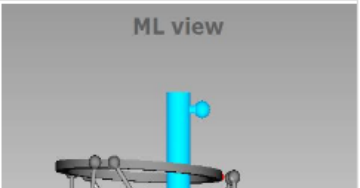
☐ Shortening☒ Lengthening

Update Views

AP view



ML view



Axial view



Speed up browsing by disabling add-ons.

Choose add-ons

Ask me later



EN 5:50 AM 8/14/2012