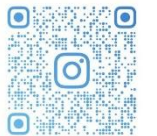


Pro and contra of limb lenghtening with external fixators and internal nails



Daniele Pili
Centro Ilizarov Lecco
Director Maurizio Catagni



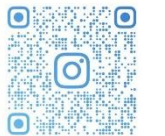
DRPILIORTOPEDICO

Evolution of the Ilizarov system and presentation of new configurations



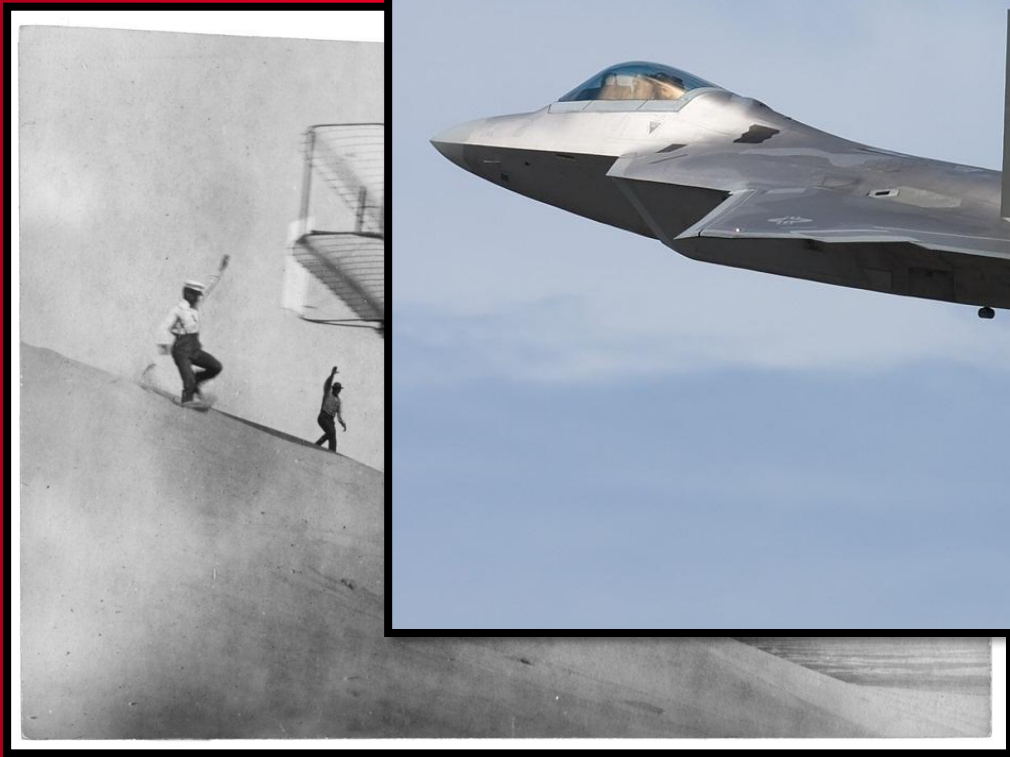
Ospedale Lecco

Ilizarov Unit



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Progresso



DRPILIORTOPEDICO



Progress
is gained by the continuous
learning of our's and other's
experiences



Ospedale Lecco

Ilizarov Unit



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Why in Lecco, Italy

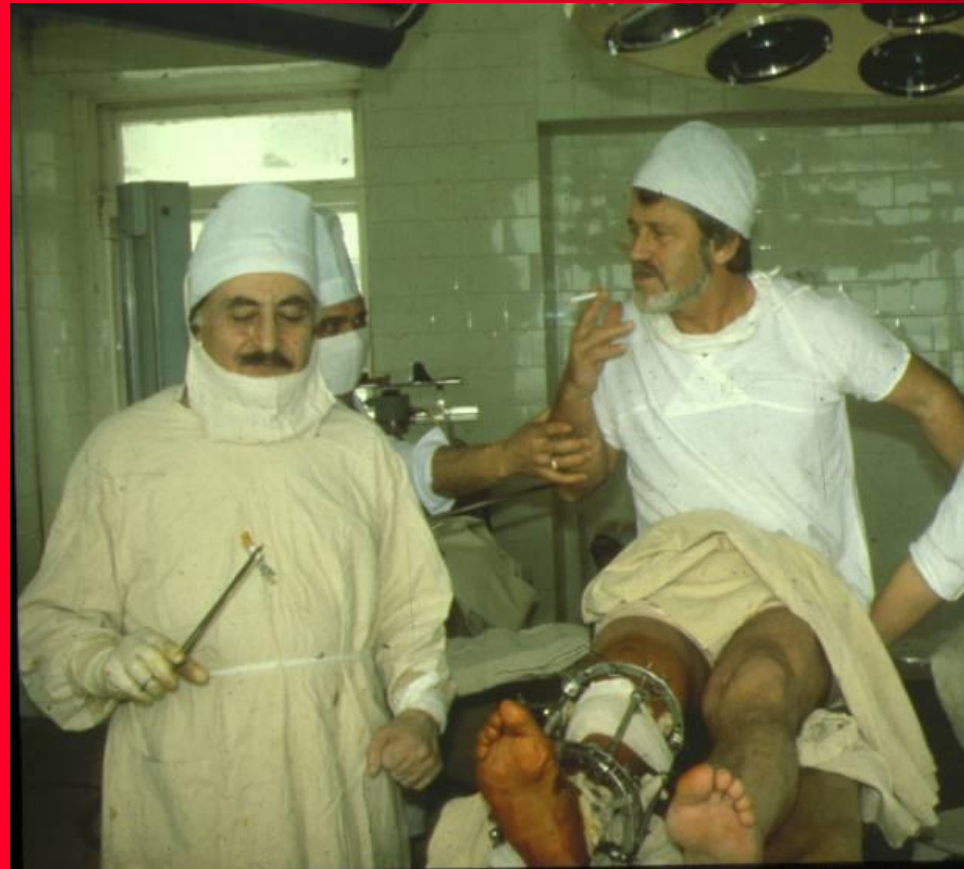
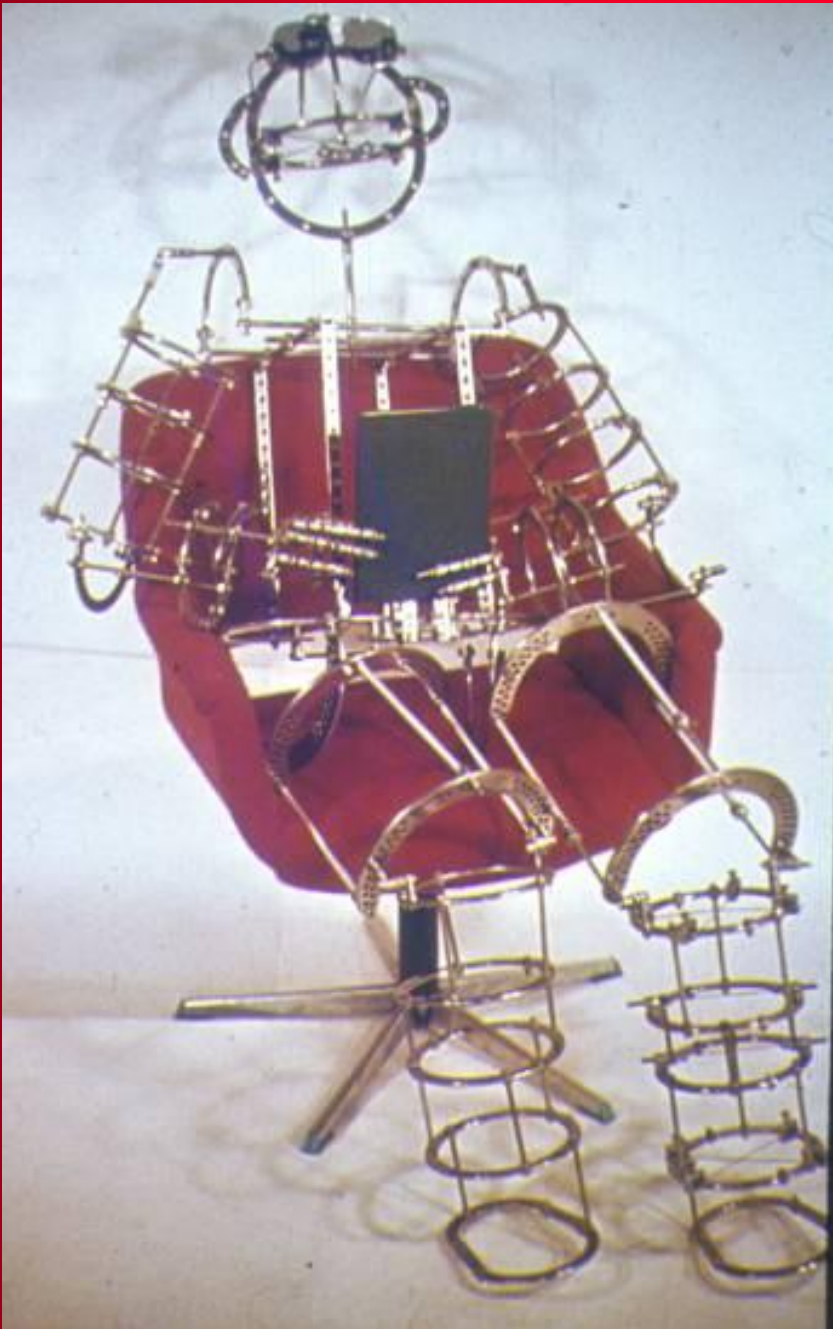


Ospedale Lecco

Ilizarov Unit



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Gavril and
Carlo

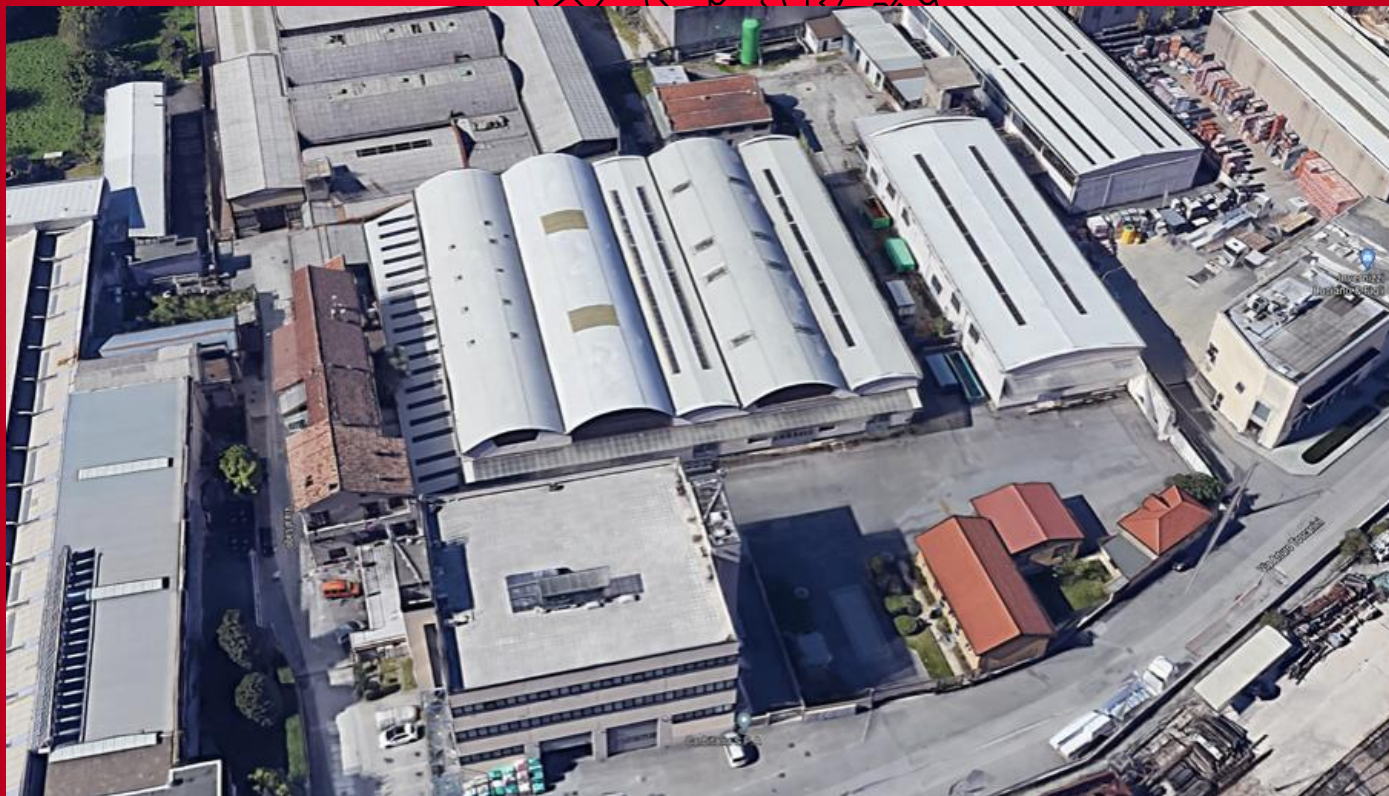


M. A. Catagni



DRPILIORTOPEDICO

Why in Lecco, Italy



Ospedale Lecco

Iliizarov Unit



DRPILIORTOPEDICO



Catagni and Cattaneo

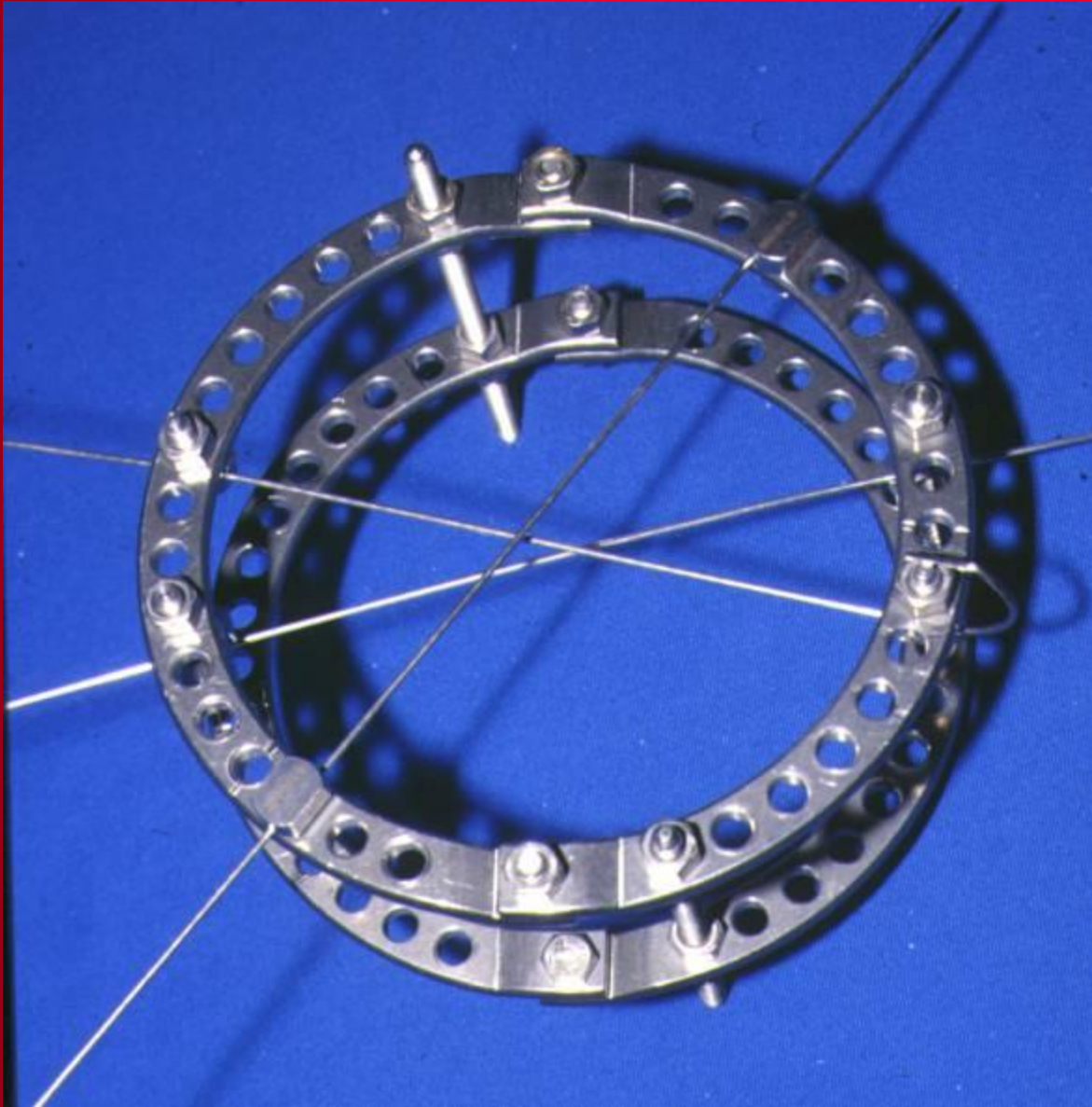


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Ilizarov Unit

The bridge between conventional orthopaedics



M. A. Catagni



DRPILIORTOPEDICO

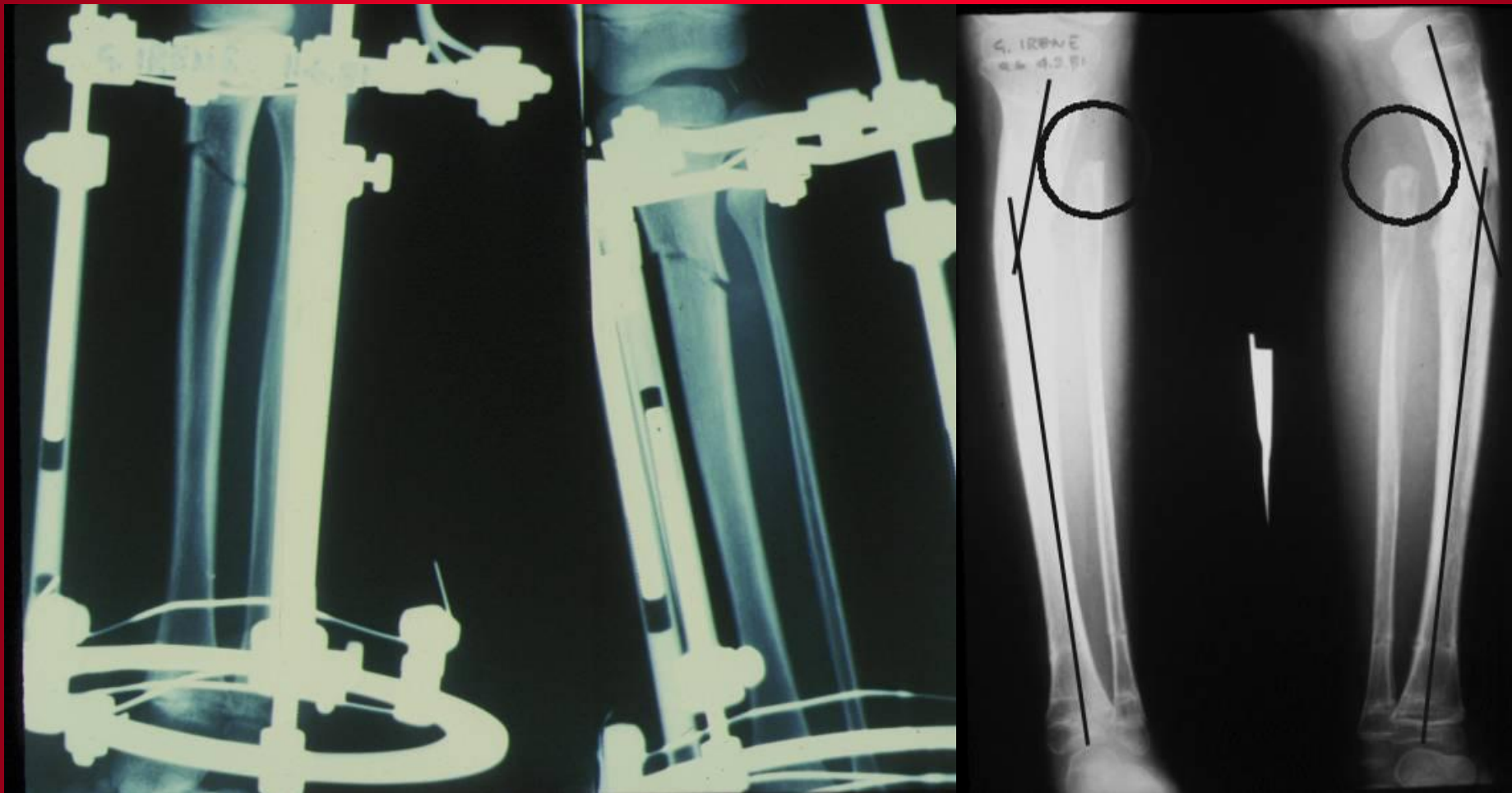
Ilizarov Upgrade:

- Frame construct
- Biology
- New parts



M. A. Catagni





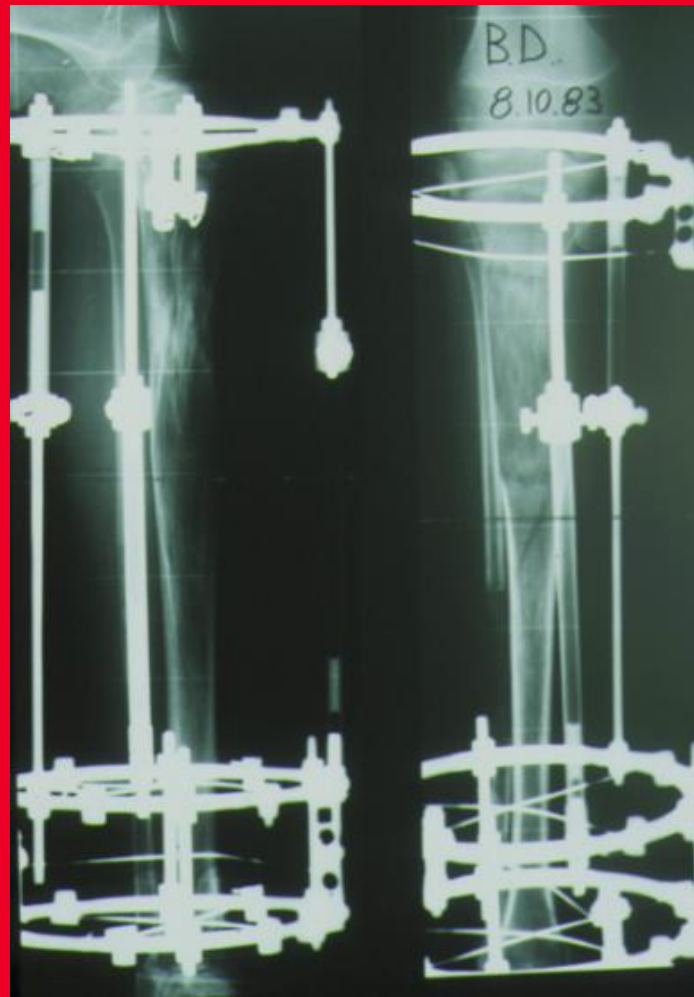
Tibia: Axial deviation



M. A. Catagni

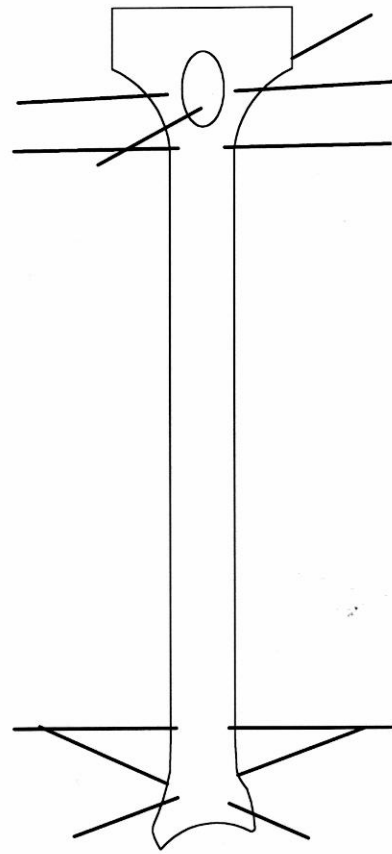


DRPILIORTOPEDICO



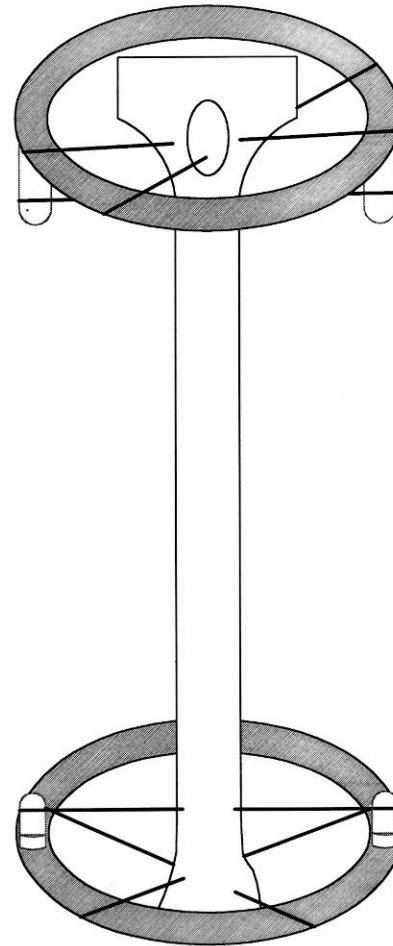
1982 First modification:
More stability, less axial deviation



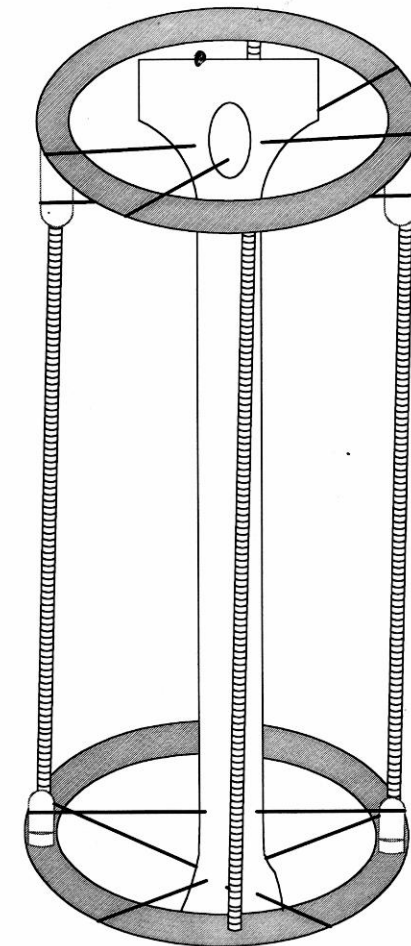


1 Wires Insertion

1981



2 Rings Application

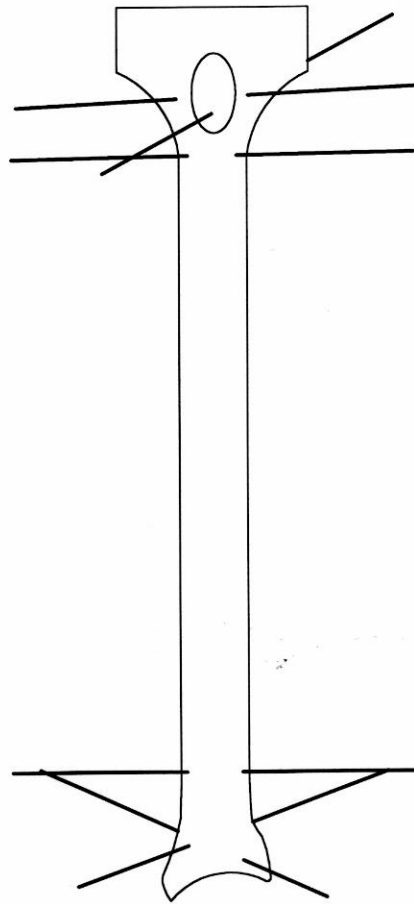


3 Rings Connection

Evolution of frame application

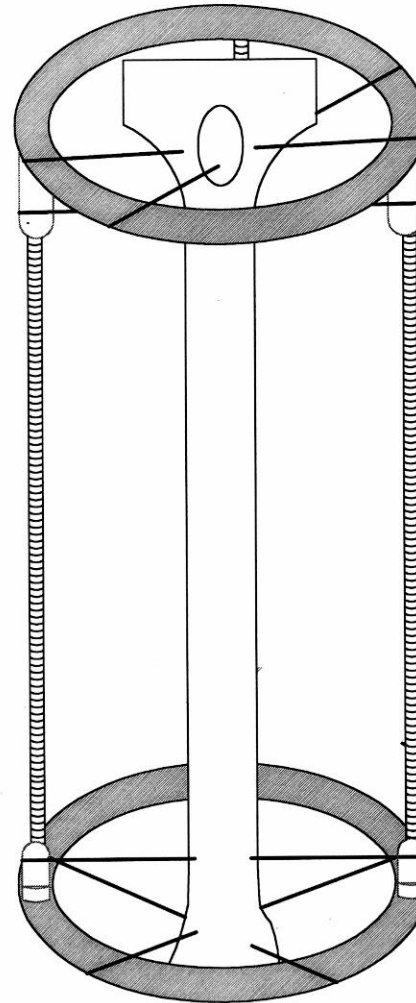


M. A. Catagni



1 Wires Insertion

1982

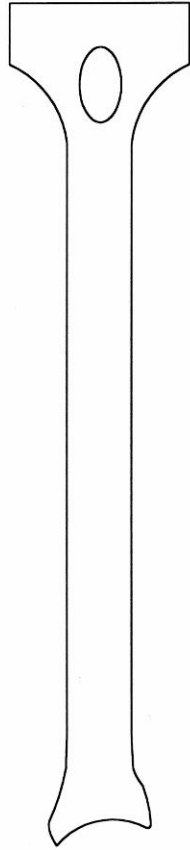


2 Frame Assembling
With Connections

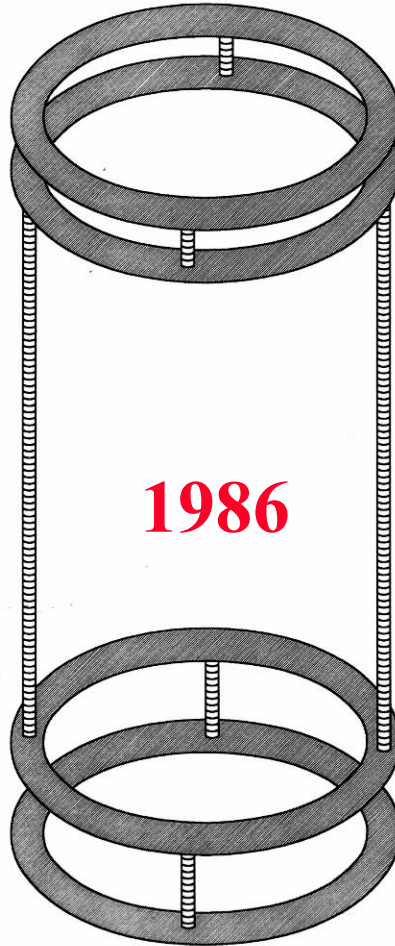
Evolution of frame application



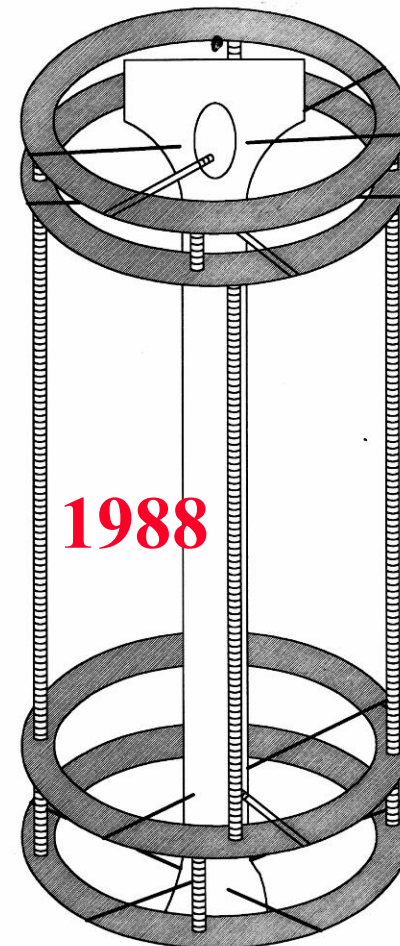
M. A. Catagni



Segment
to be Treated



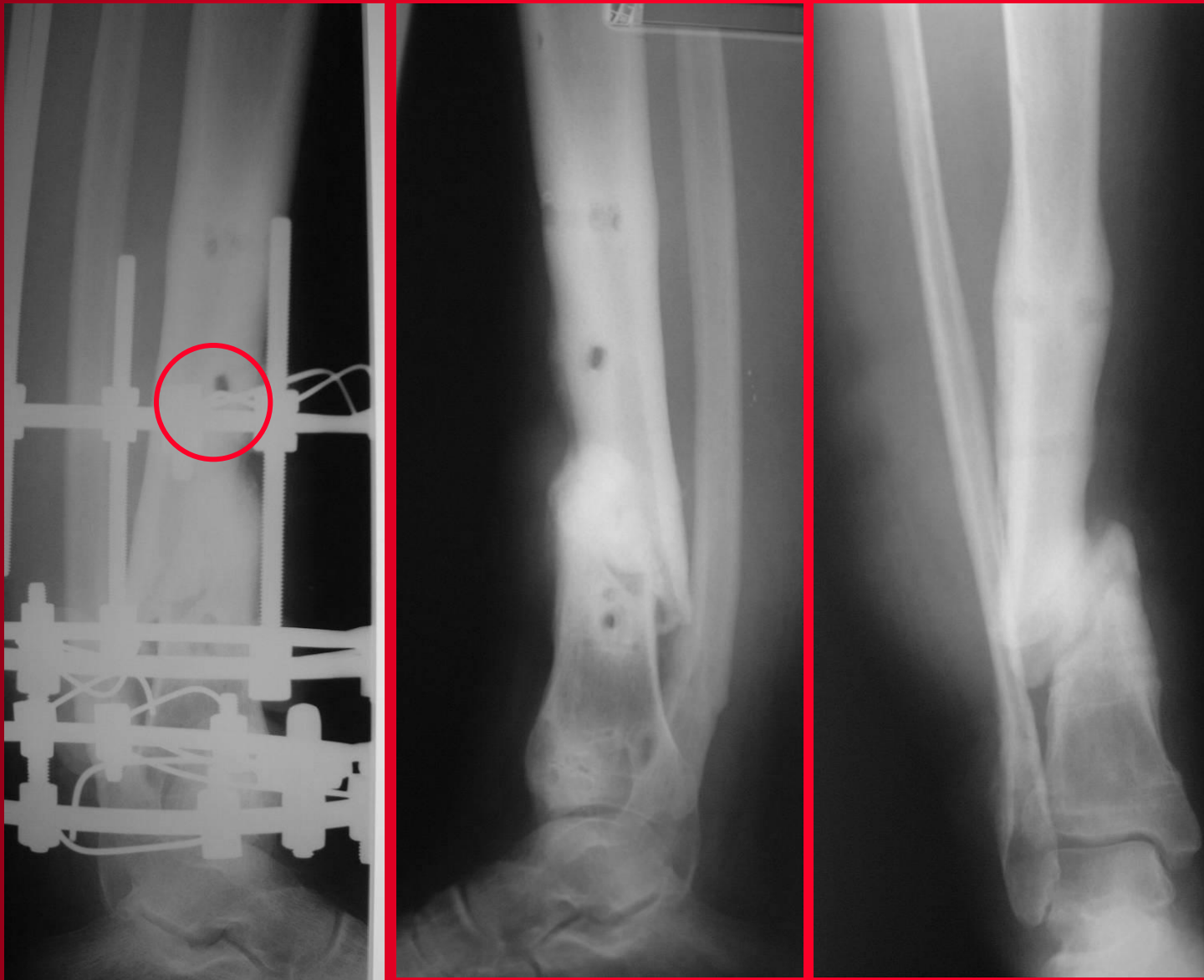
Preassembled
Frame



Wires and
Pin Fixation

Evolution of frame application





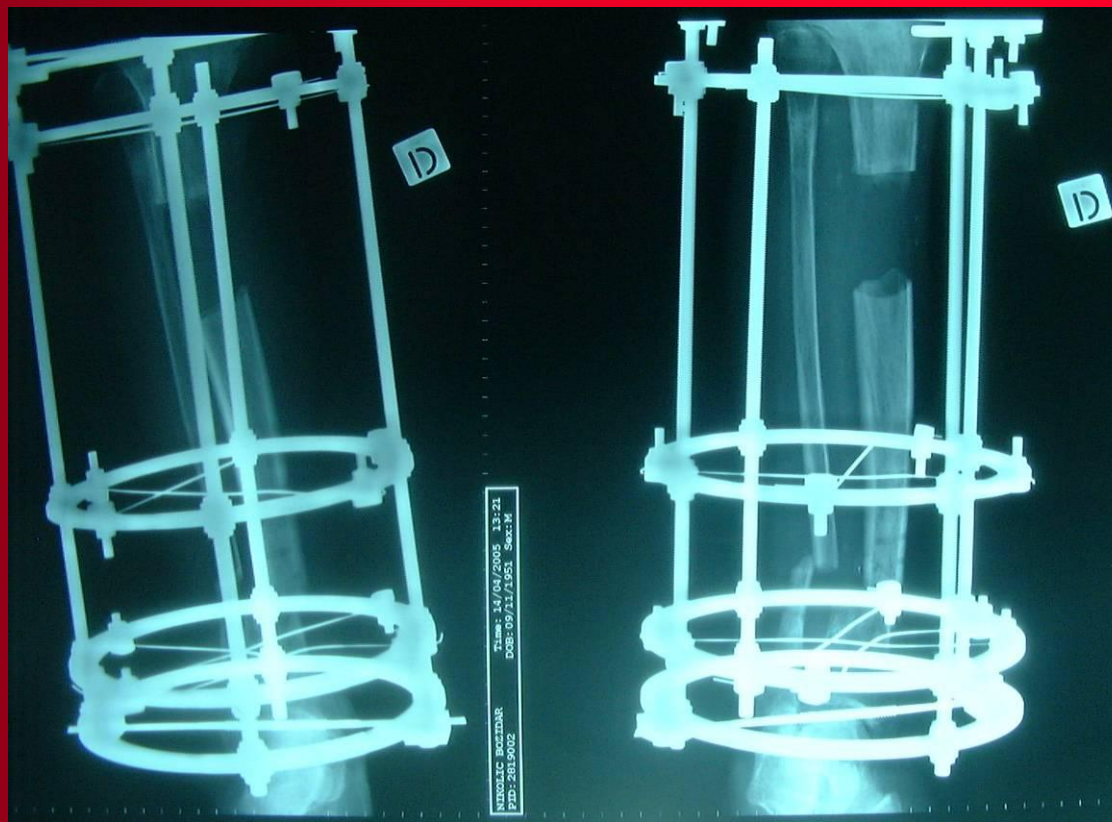
Wires complication: osteolysis and instability



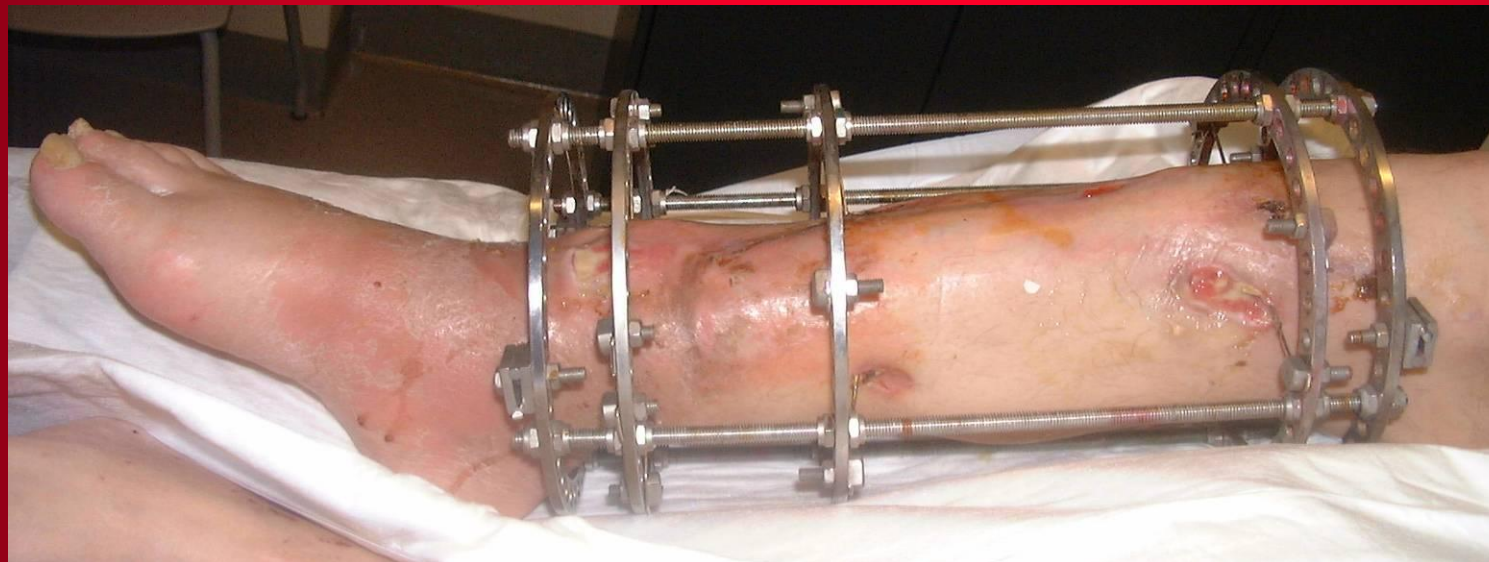
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M. A. Catagni



Unstable frame;
delay of new bone
formation,
infection and lack
of alignment

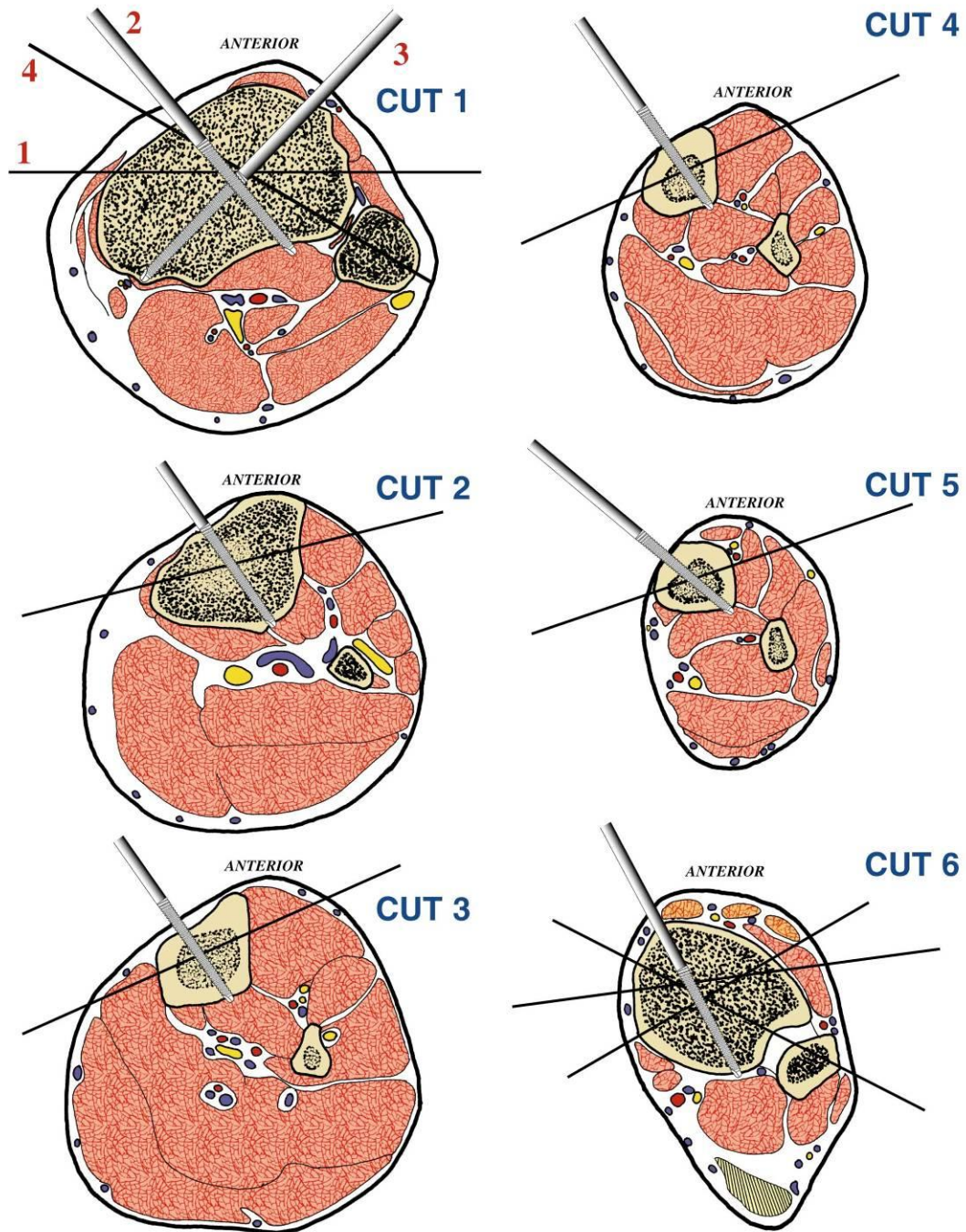


DRPILORTOPEDICO



M. A. Catagni

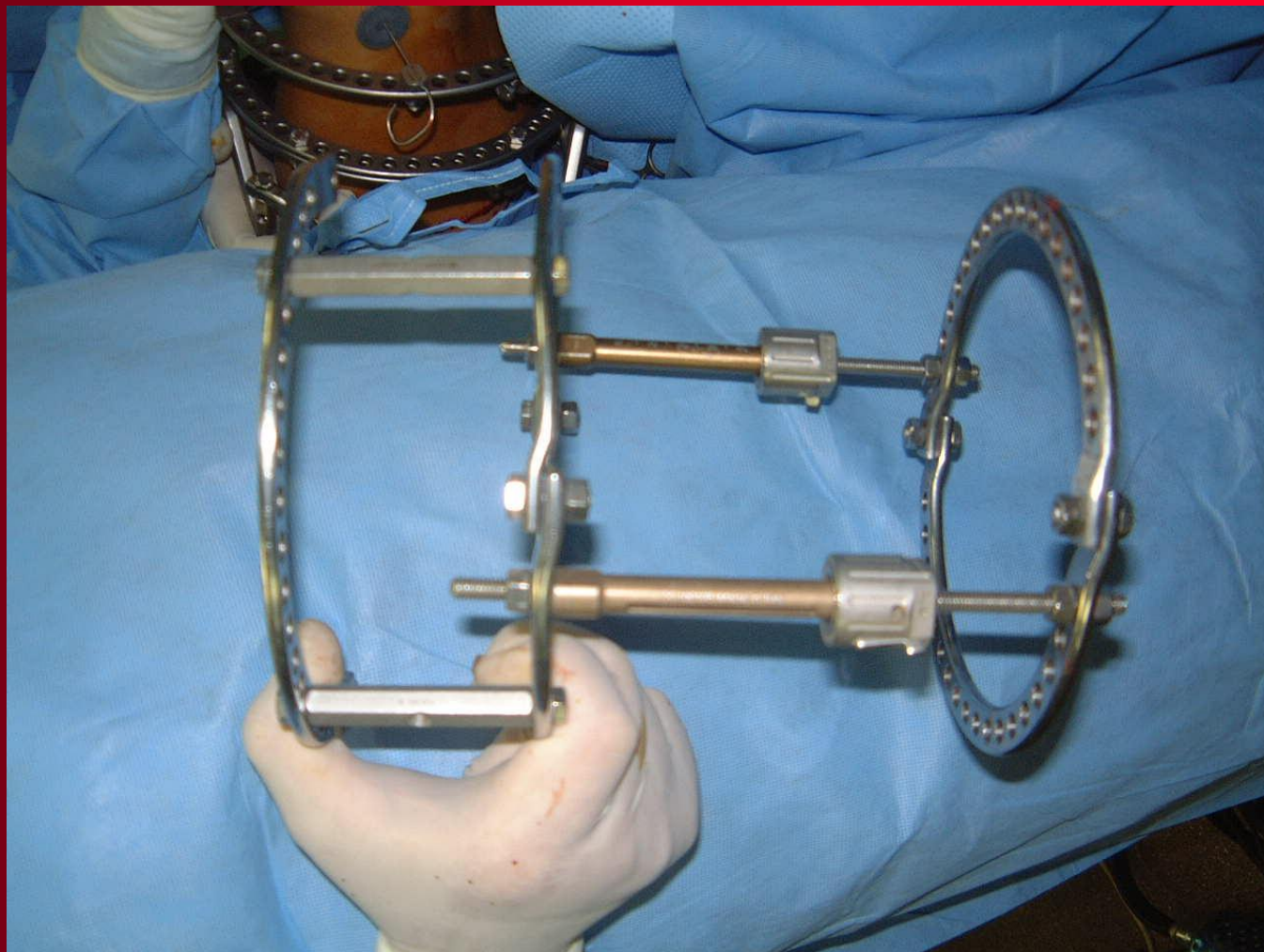
INSERTION WIRES AND HALF-PINS - LEFT



Wires and half pins in the leg



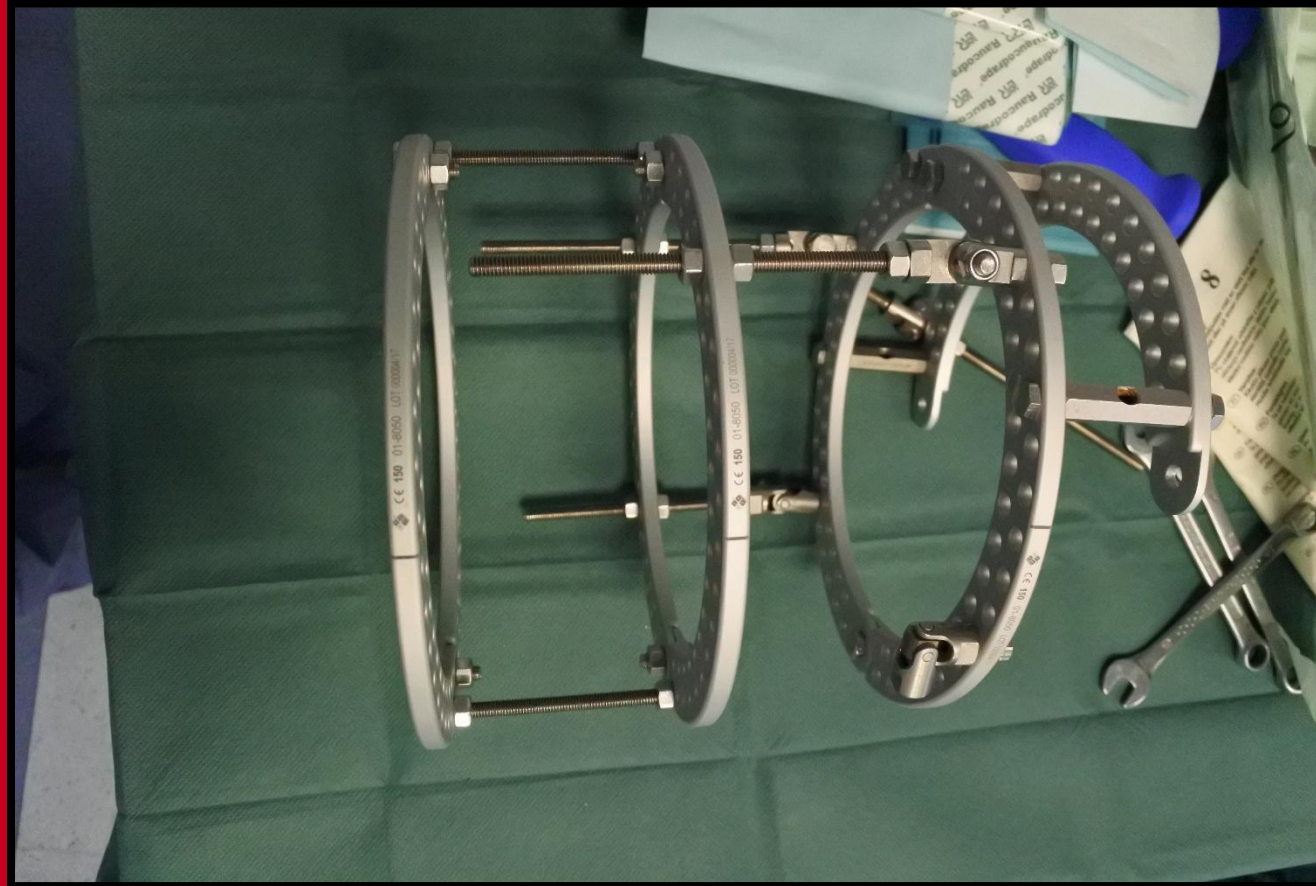
DRPILIORTOPEDICO



Preassembled frame

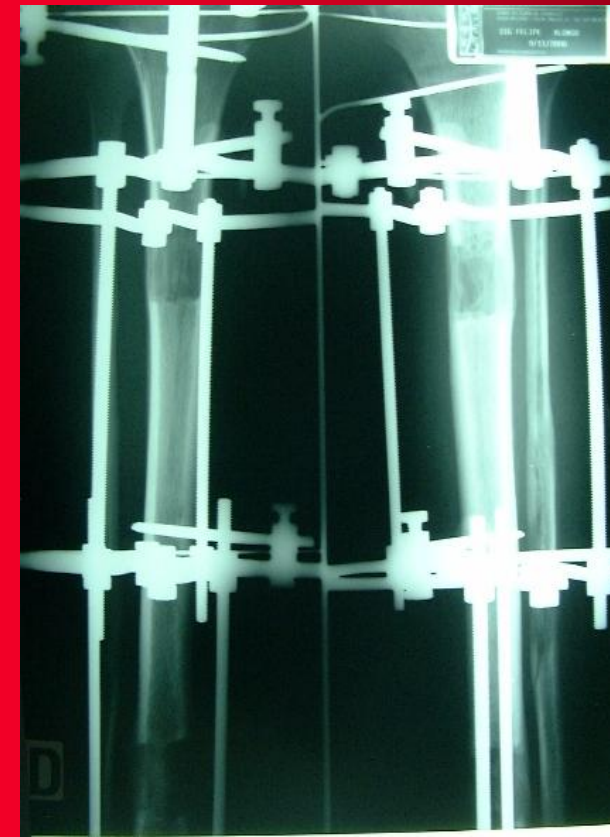
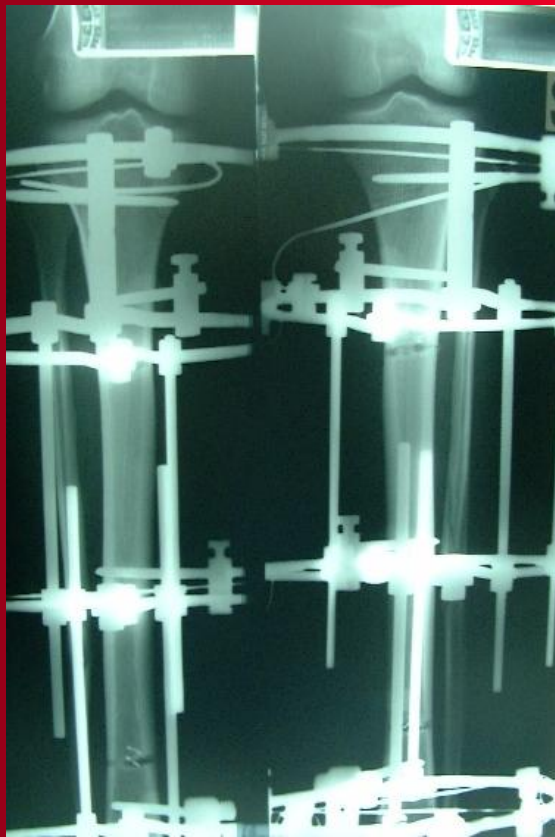


Pre-assembled frame



Pre-assembled frames





During treatment



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M. A. Catagni



Final
clinical
result



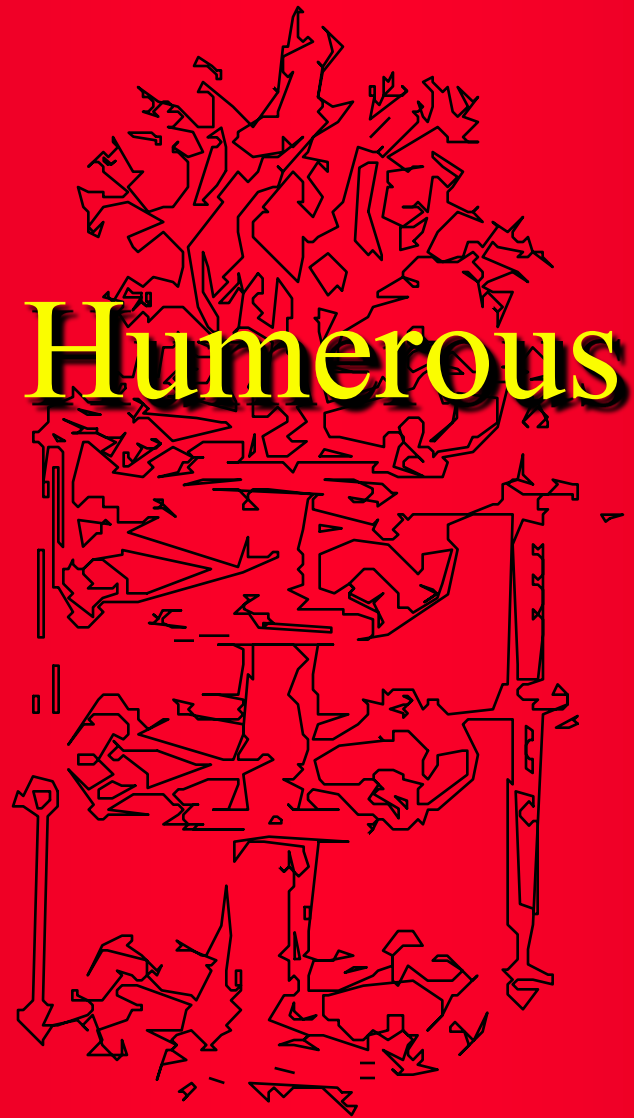
M. A. Catagni



Function



M. A. Catagni



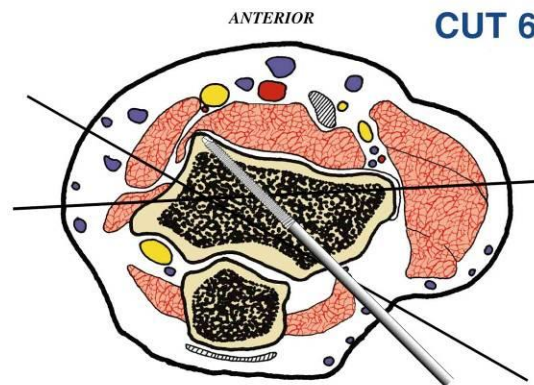
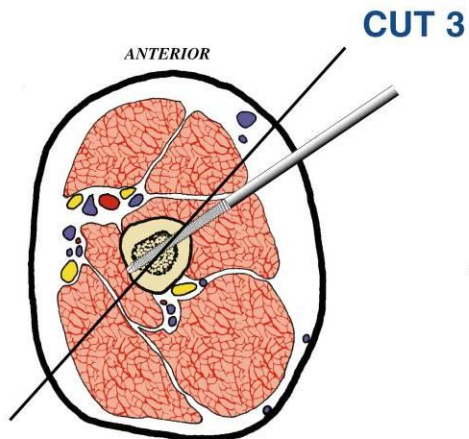
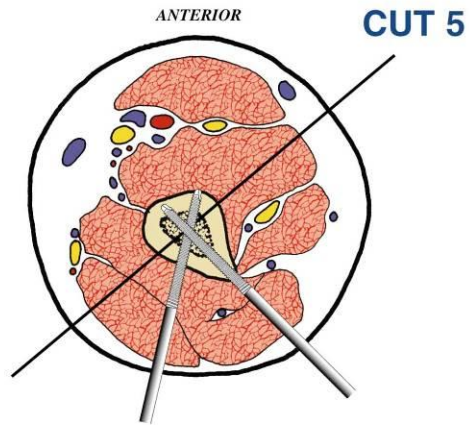
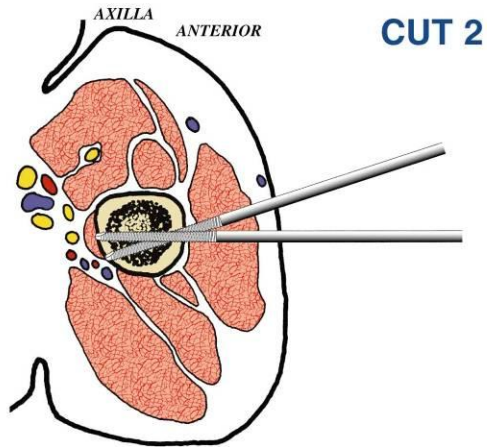
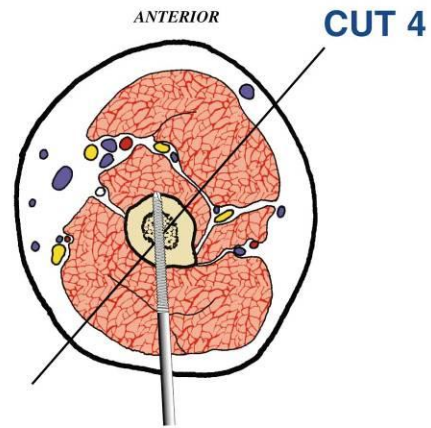
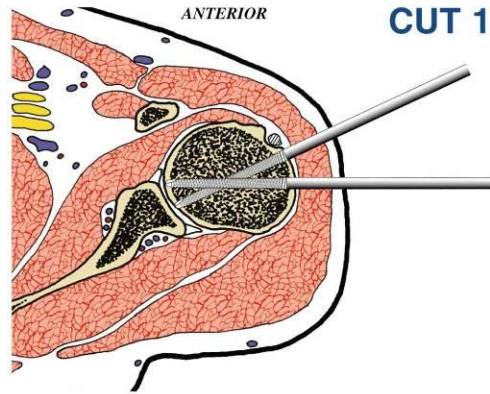
Humorous



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Ilizarov Unit

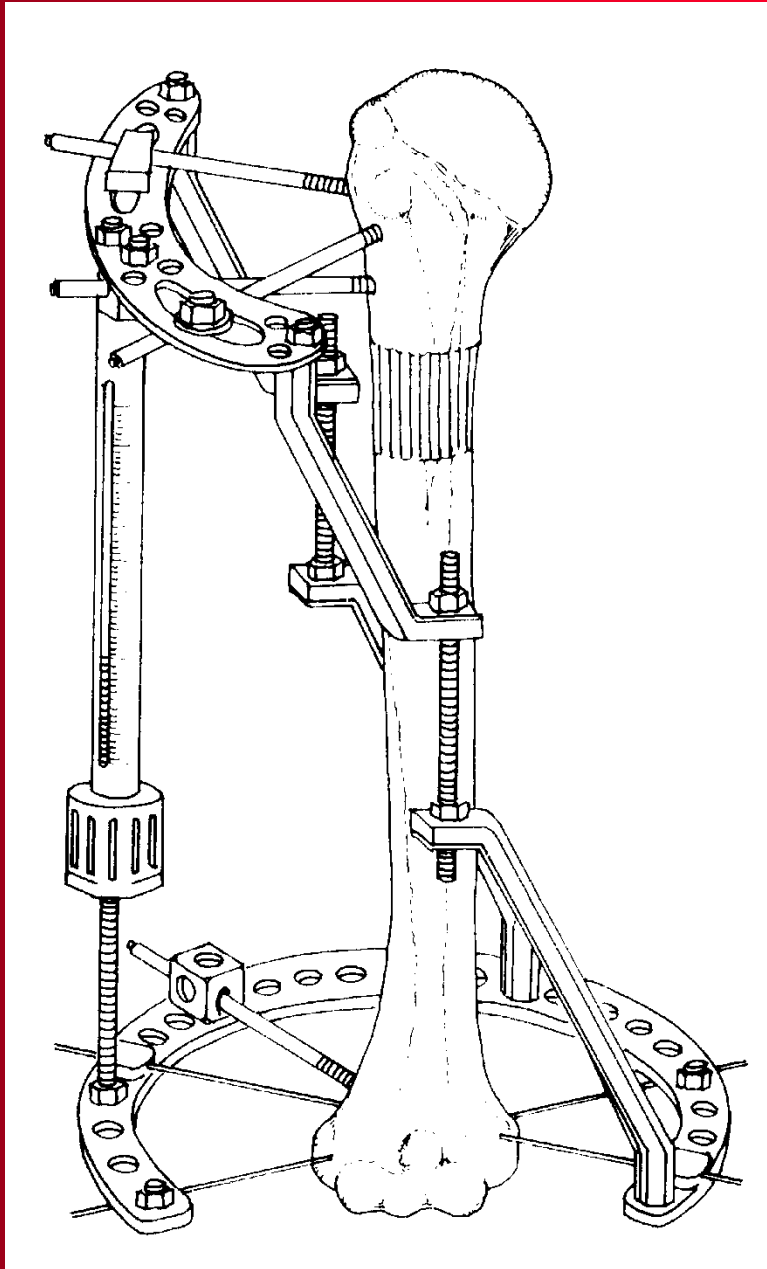
INSERTION WIRES AND HALF-PINS - LEFT



Wires and half pins in the humerus



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New configuration

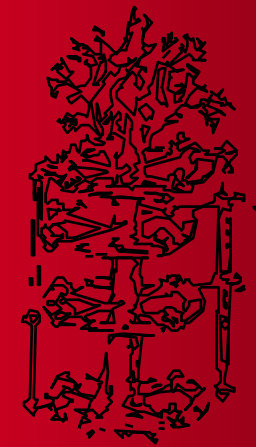
**Proximal Fixation:
Three half pins)
(from 1987)**

**Distal Fixation:
Wires and half pins
(from early 90)**

M. A. Catagni



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One or two distal half pins

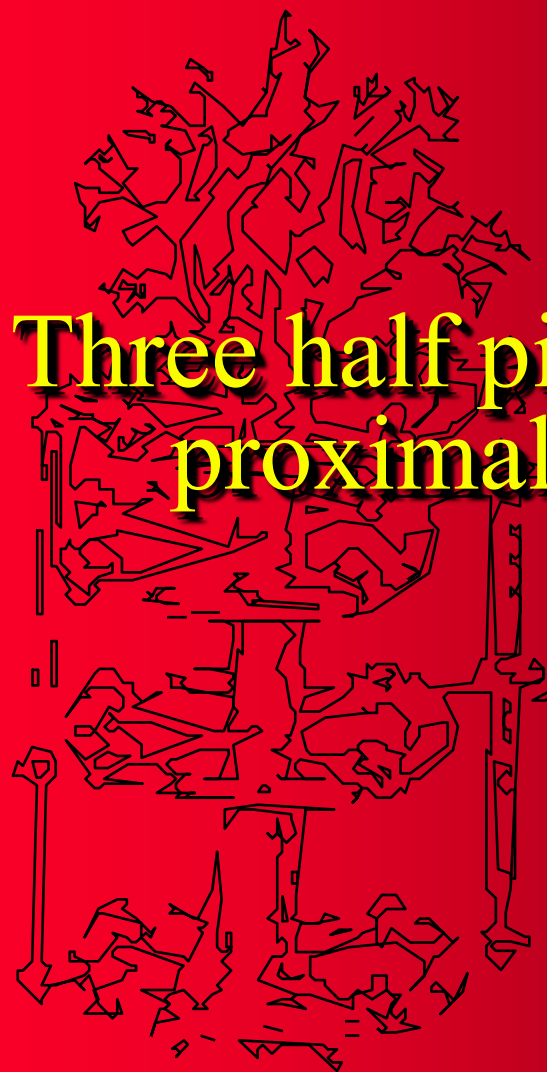


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M. A. Catagni
M. A. Catagni

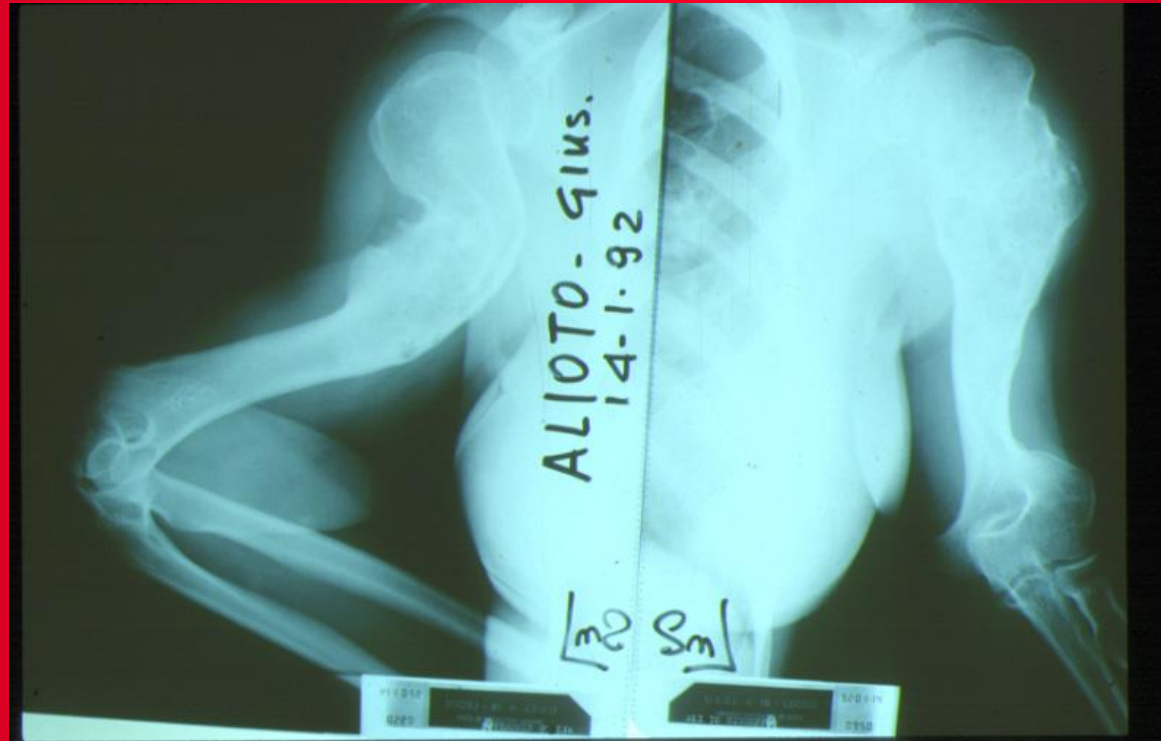


**Three half pins
proximal**



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M. A. Catagni
M. A. Catagni



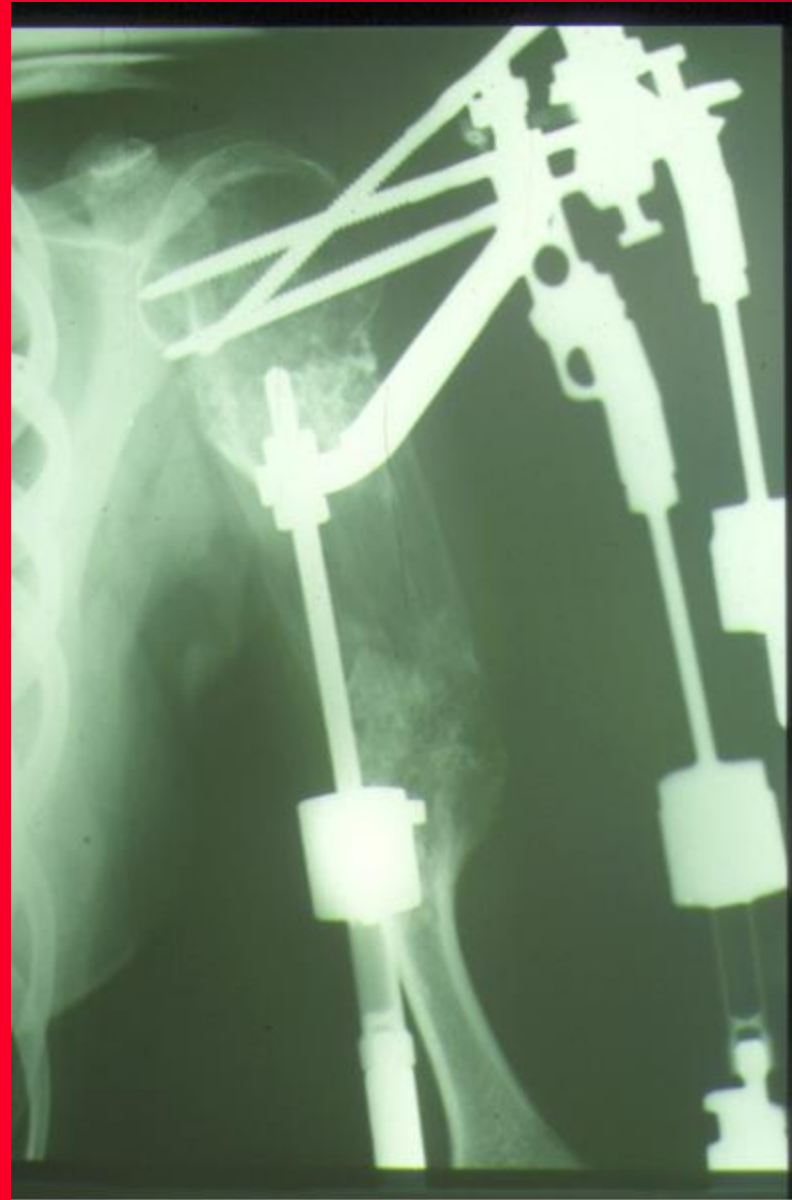
**Ollier with 90° deformity:
a stable fixation is needed and the half
pins guarantee more grip in to the
soft bone**



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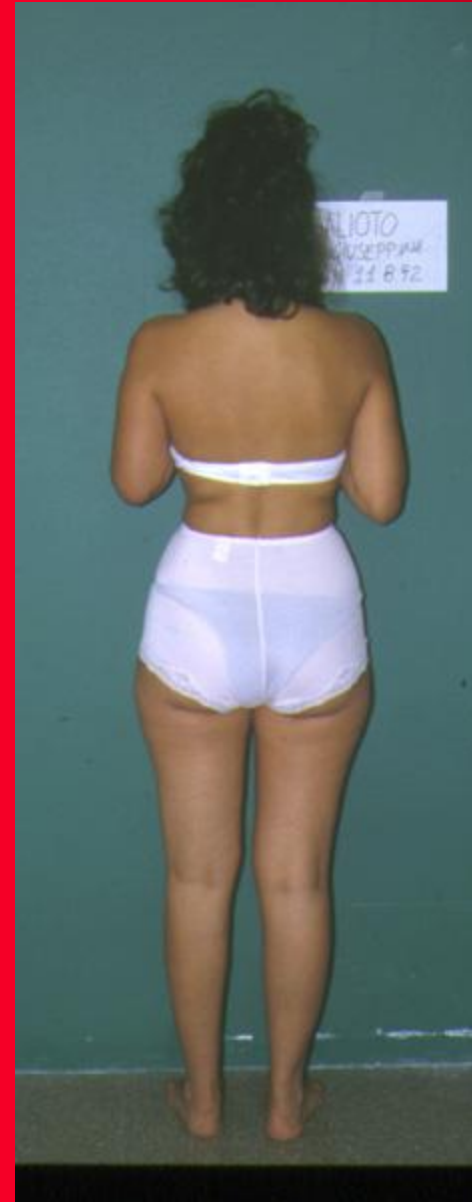


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Stable frame for correction

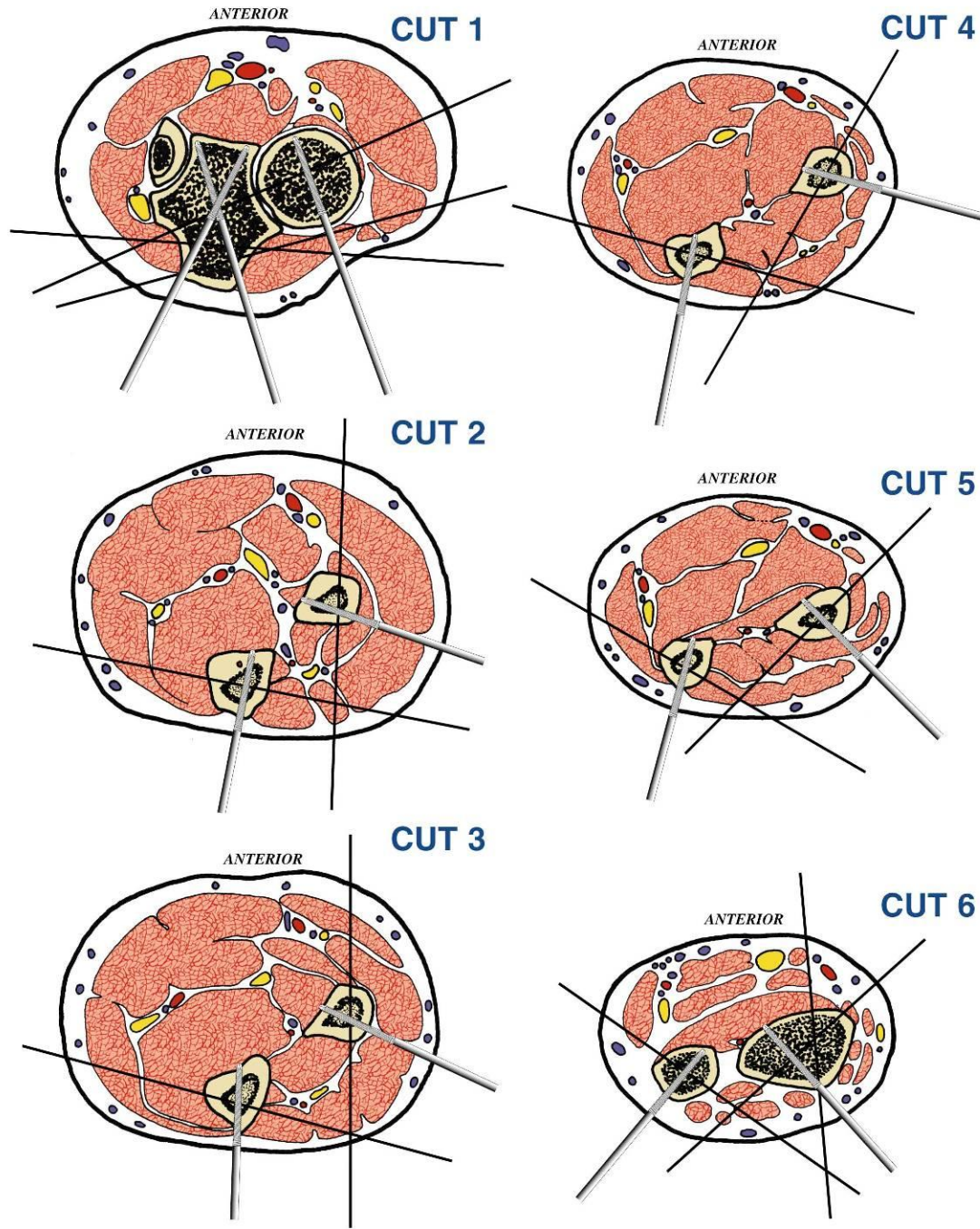




**Final result without any stability problem
in the frame despite a soft bone**



INSERTION WIRES AND HALF-PINS - LEFT



**Wires and half pins in the forearm:
Every level
one safe wire
and one safe
pin**



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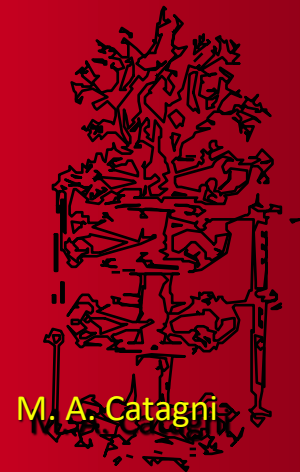




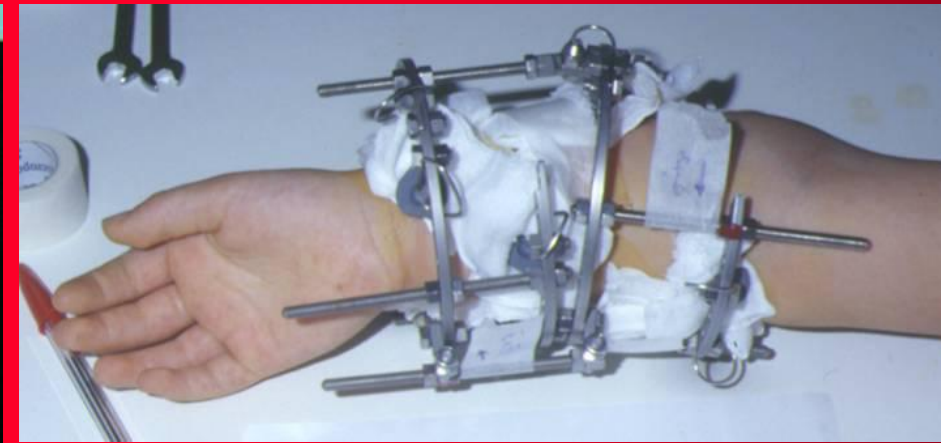
Short ulna and radial head dislocation (exostosis)



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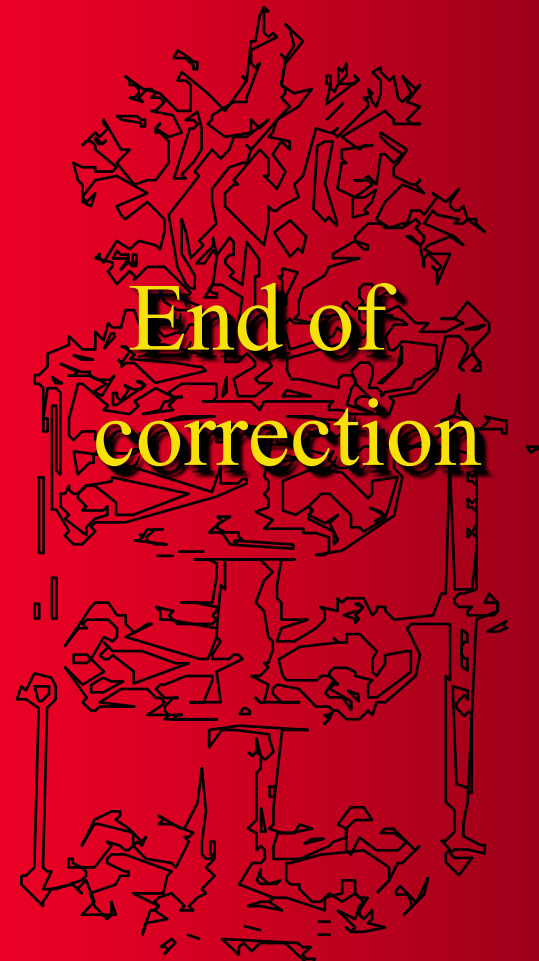


M. A. Catagni



**Ulnar lengthening and
reposition of the
radius with translation
by hinges**





End of
correction

M. A. Catagni



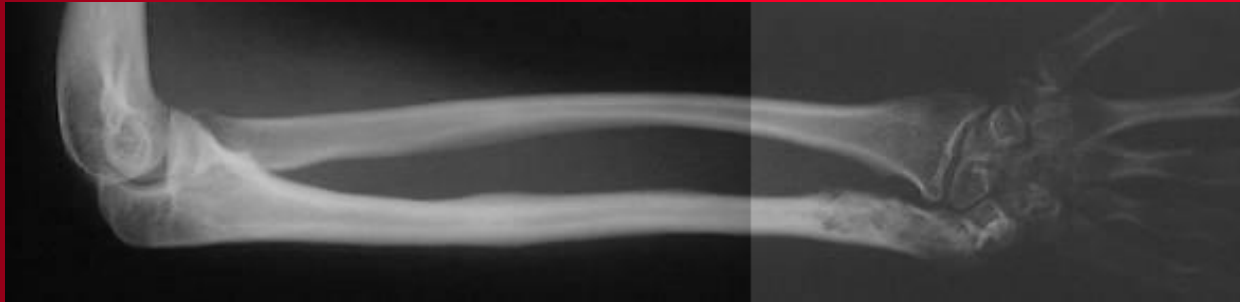
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Radiological
result



M. A. Catagni
M. A. Catagni



Two years Follow-up



M. A. Catagni
M. A. Catagni



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Forearm ulnar deviation of the radius with short ulna

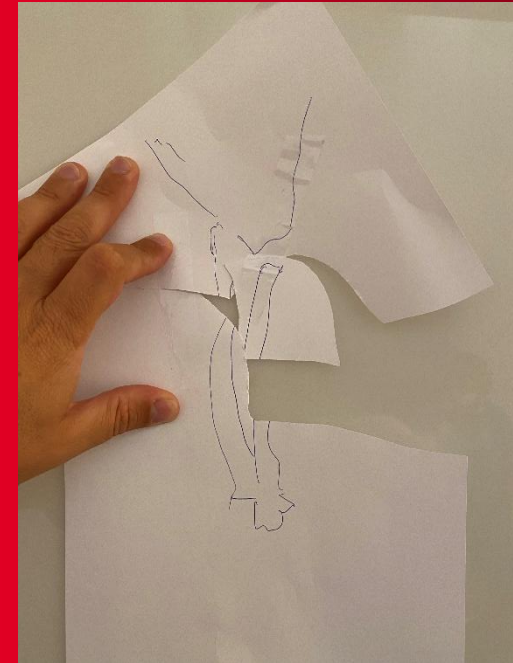




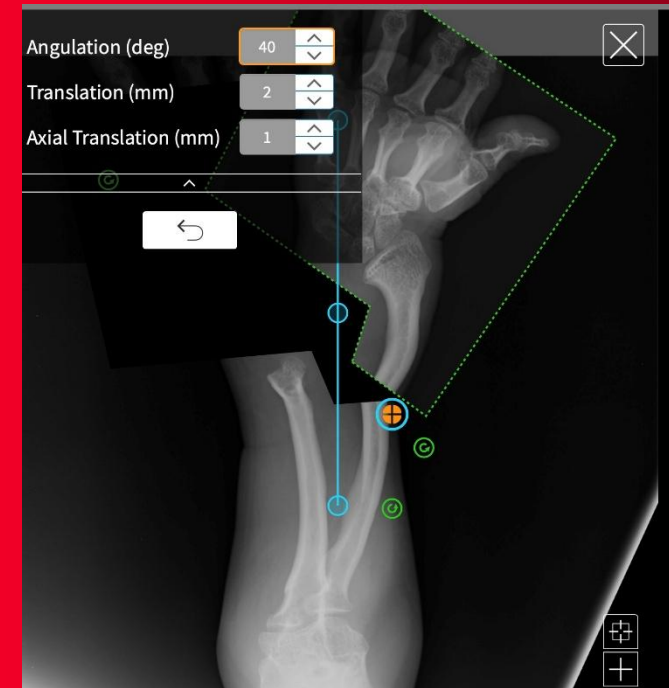
**Forearm ulnar deviation
of the radius with short
ulna**



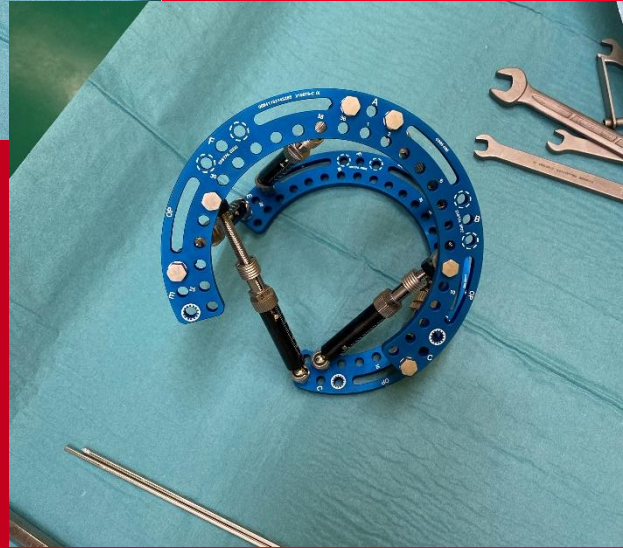
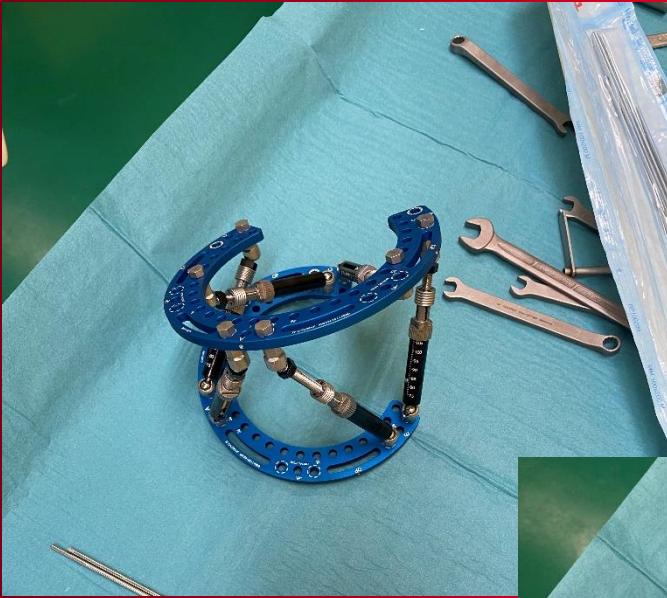
Forearm ulnar deviation of the radius with short ulna

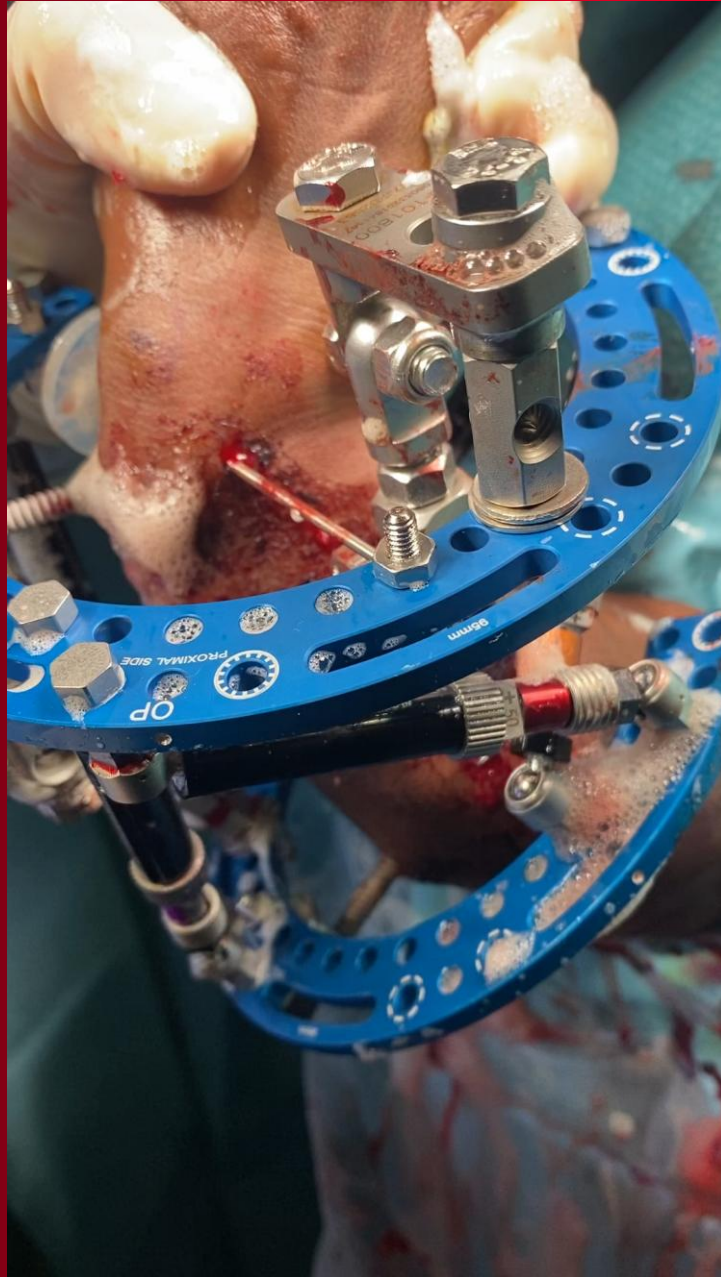


Forearm ulnar deviation of the radius with short ulna



Forearm ulnar deviation of the radius with short ulna





Forearm ulnar
deviation of the
radius with short
ulna



Forearm ulnar deviation of the radius with short ulna





Forearm ulnar
deviation of the
radius with short
ulna





Final Xrays

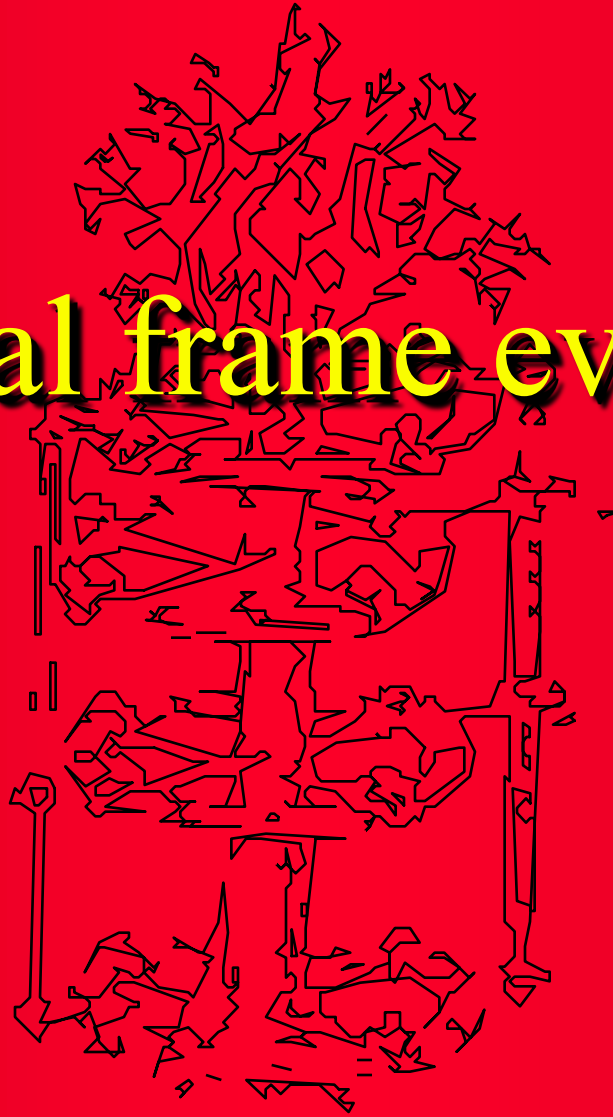




Final result

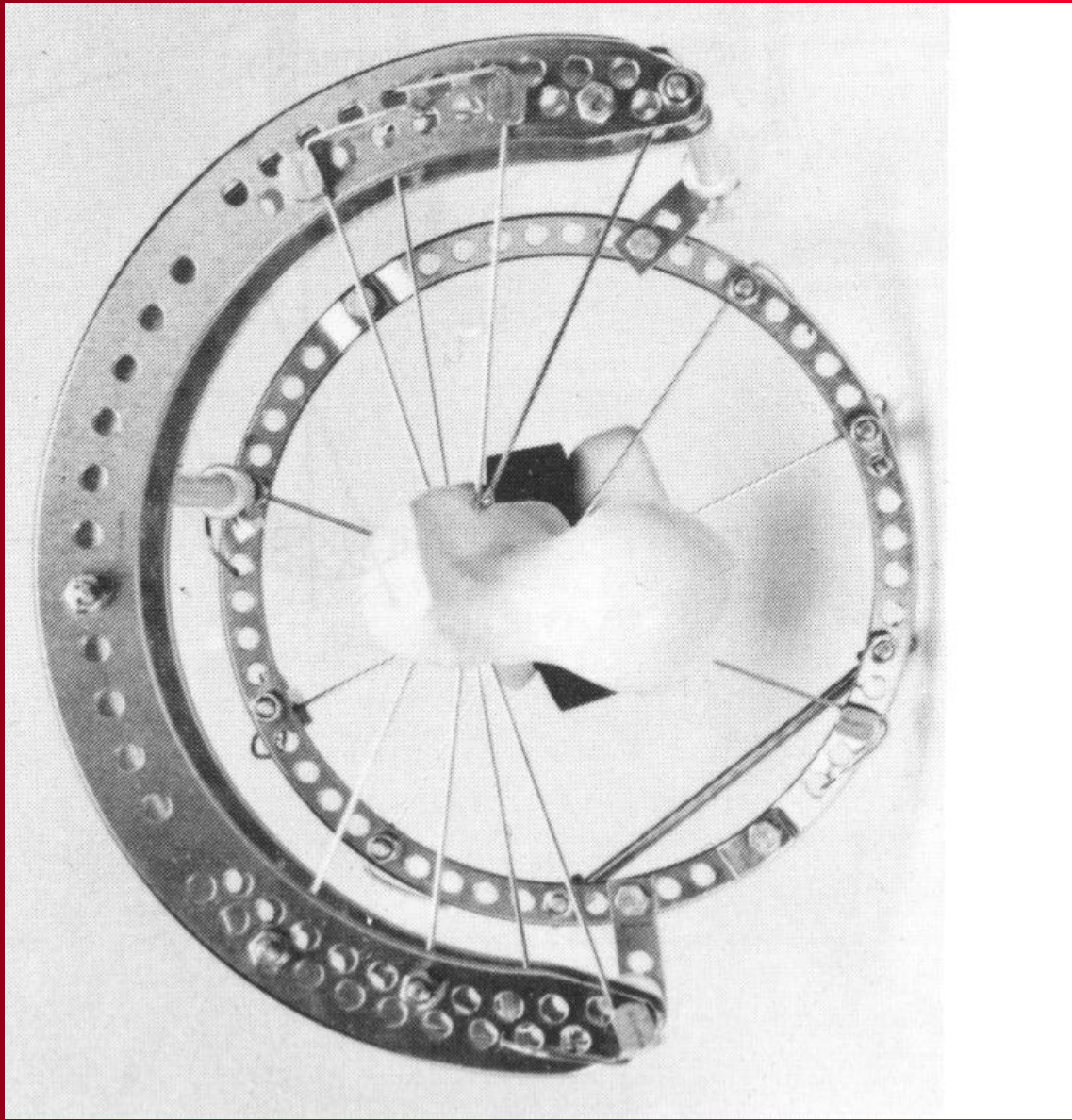


Femoral frame evolution



Ospedale Lecco

Ilizarov Unit



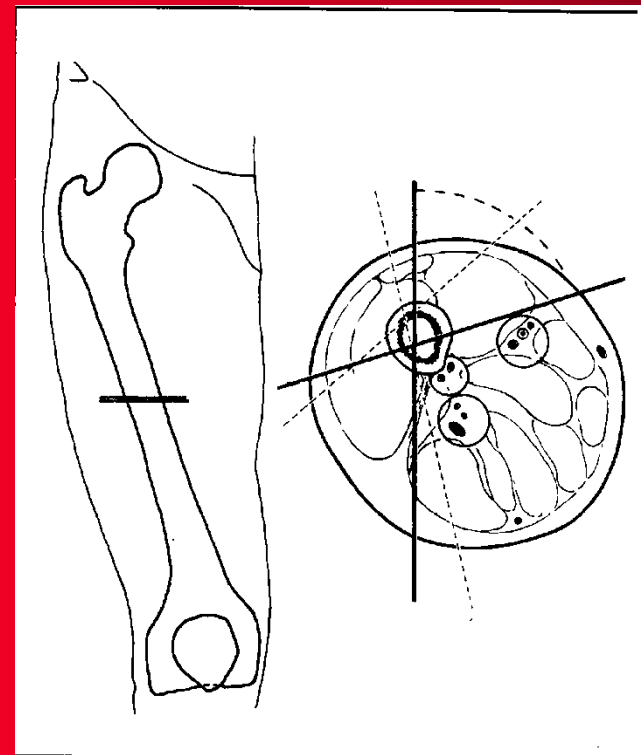
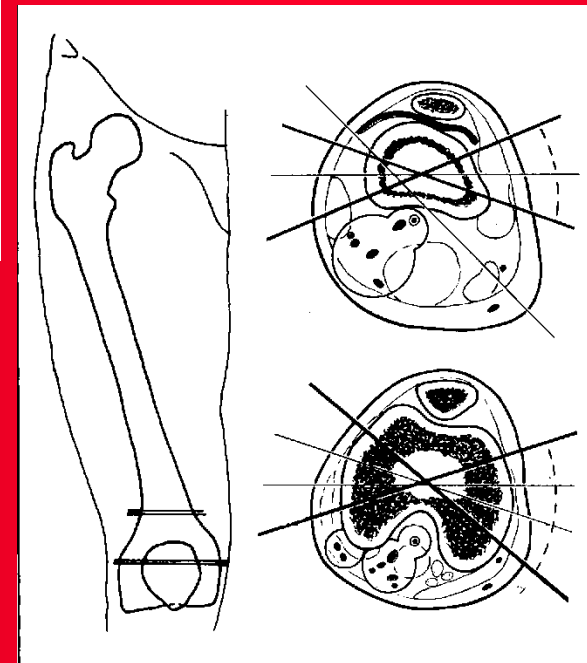
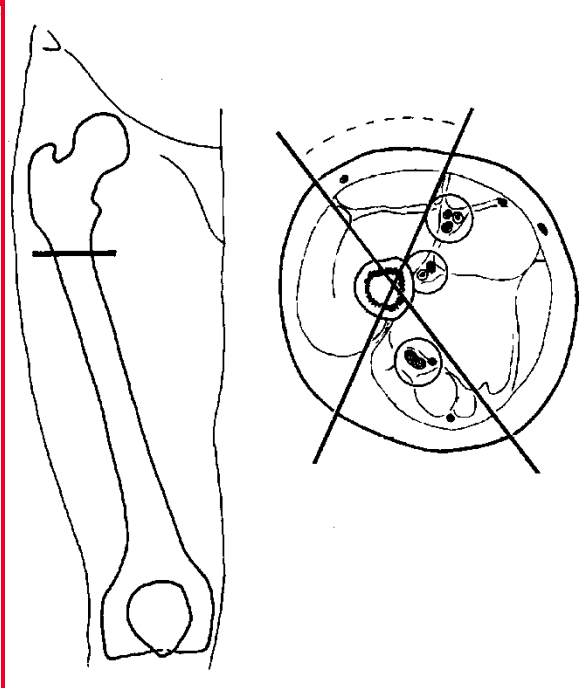
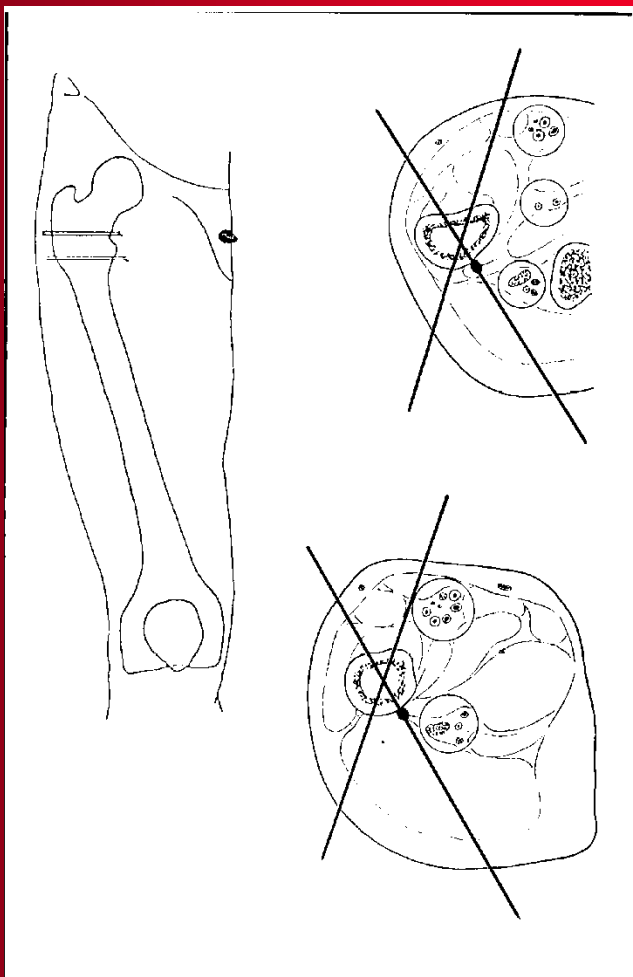
Original femoral fixation



Ilizarov Unit



Ospedale Lecco



**Wire
placement**

Ilizarov Unit





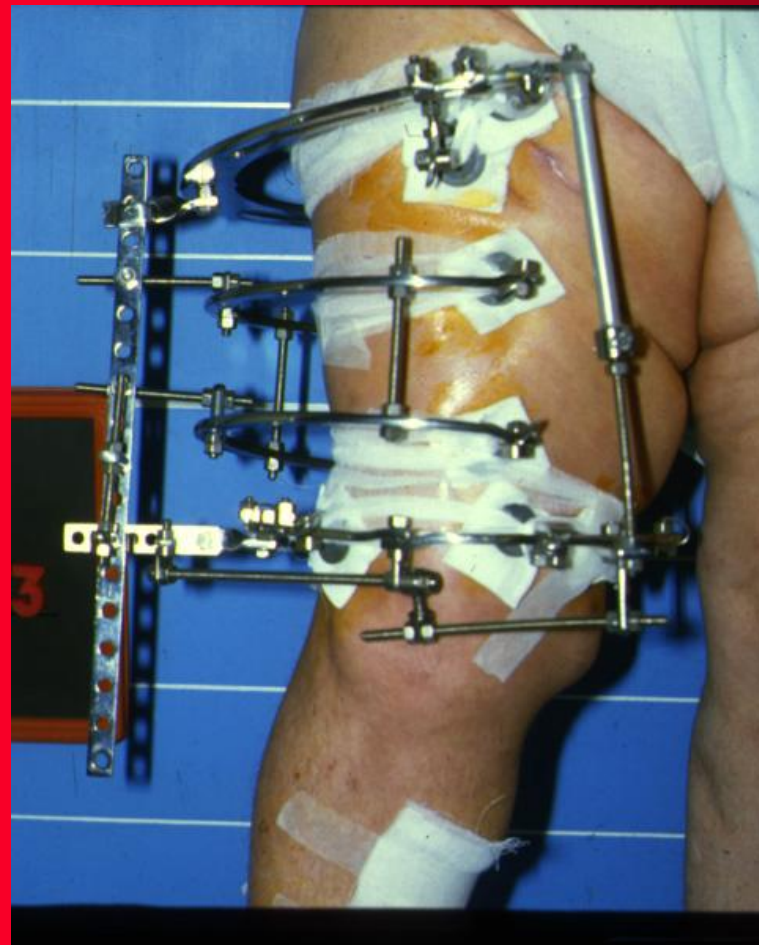
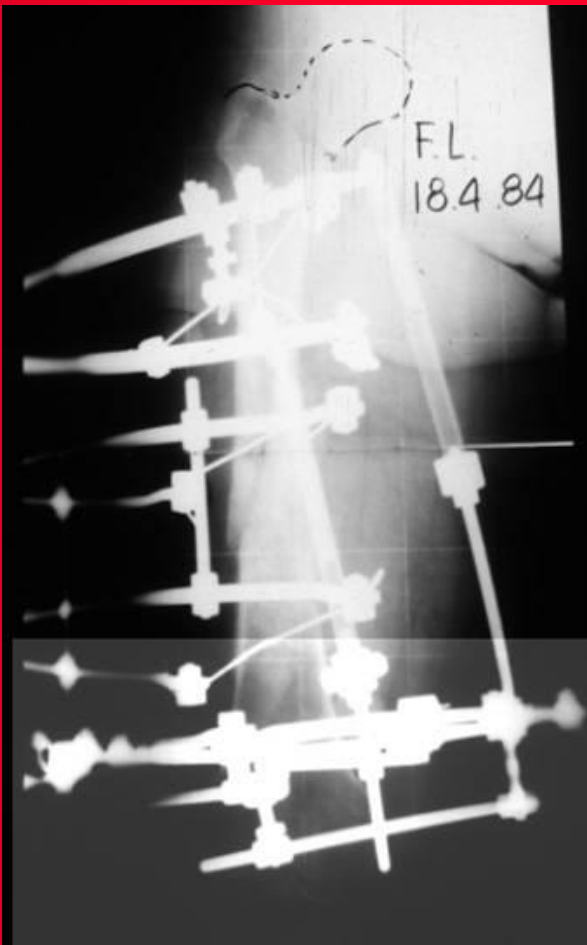
Ospedale Lecco

Original femoral fixation

Ilizarov Unit



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Infected nonunion treated with original Ilizarov



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Ospedale Lecco



Ilizarov Unit



Good result but stiffness of the knee and same sufferance



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Ospedale Lecco

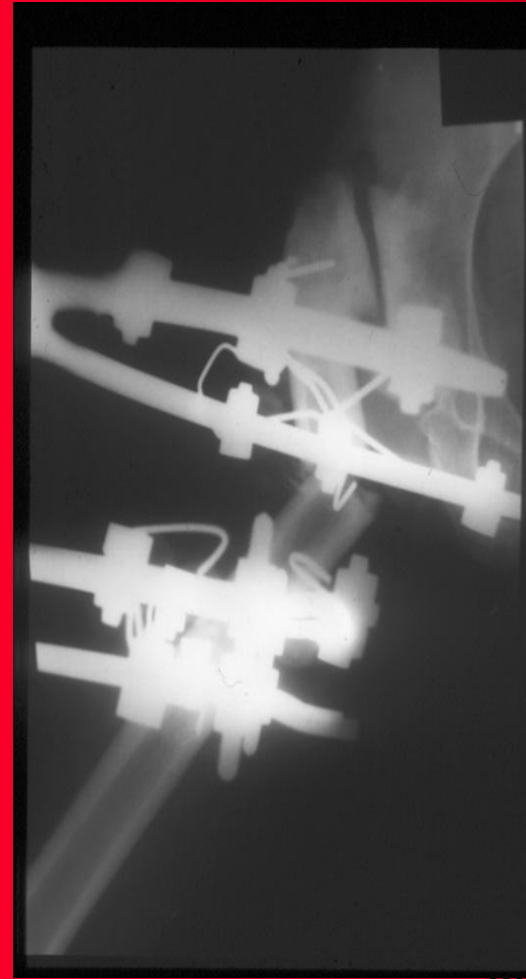
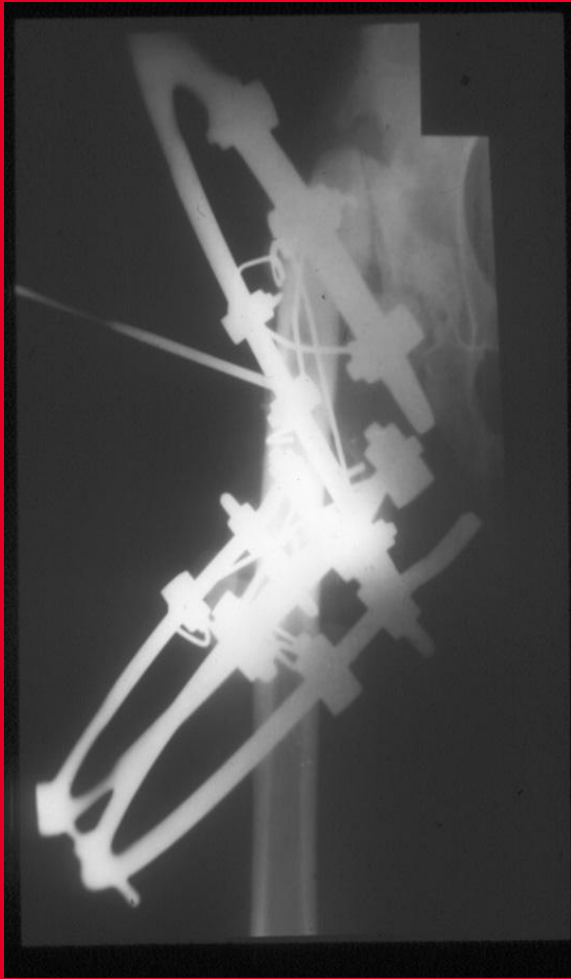


Experientia Magistra Vitae



Ospedale Lecco

Ilizarov Unit



1986 Drama: complete sciatic nerve palsy!!



DRPILIORTOPEDICO



Ospedale Lecco



Ilizarov Unit

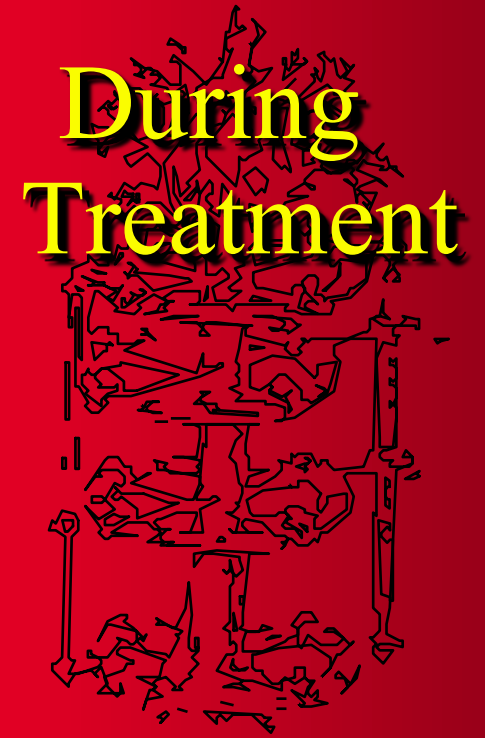


Removal of the proximal wires and application of half pin



Ospedale Lecco





During
Treatment



Ospedale Lecco

Ilizarov Unit

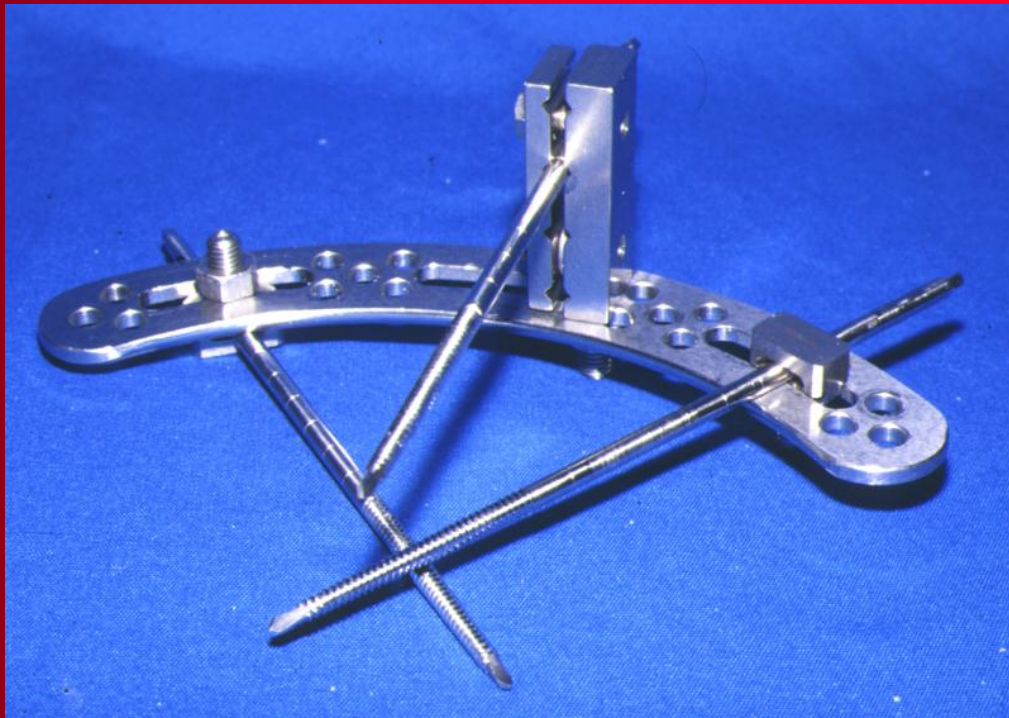


After nerve inspection



Ospedale Lecco





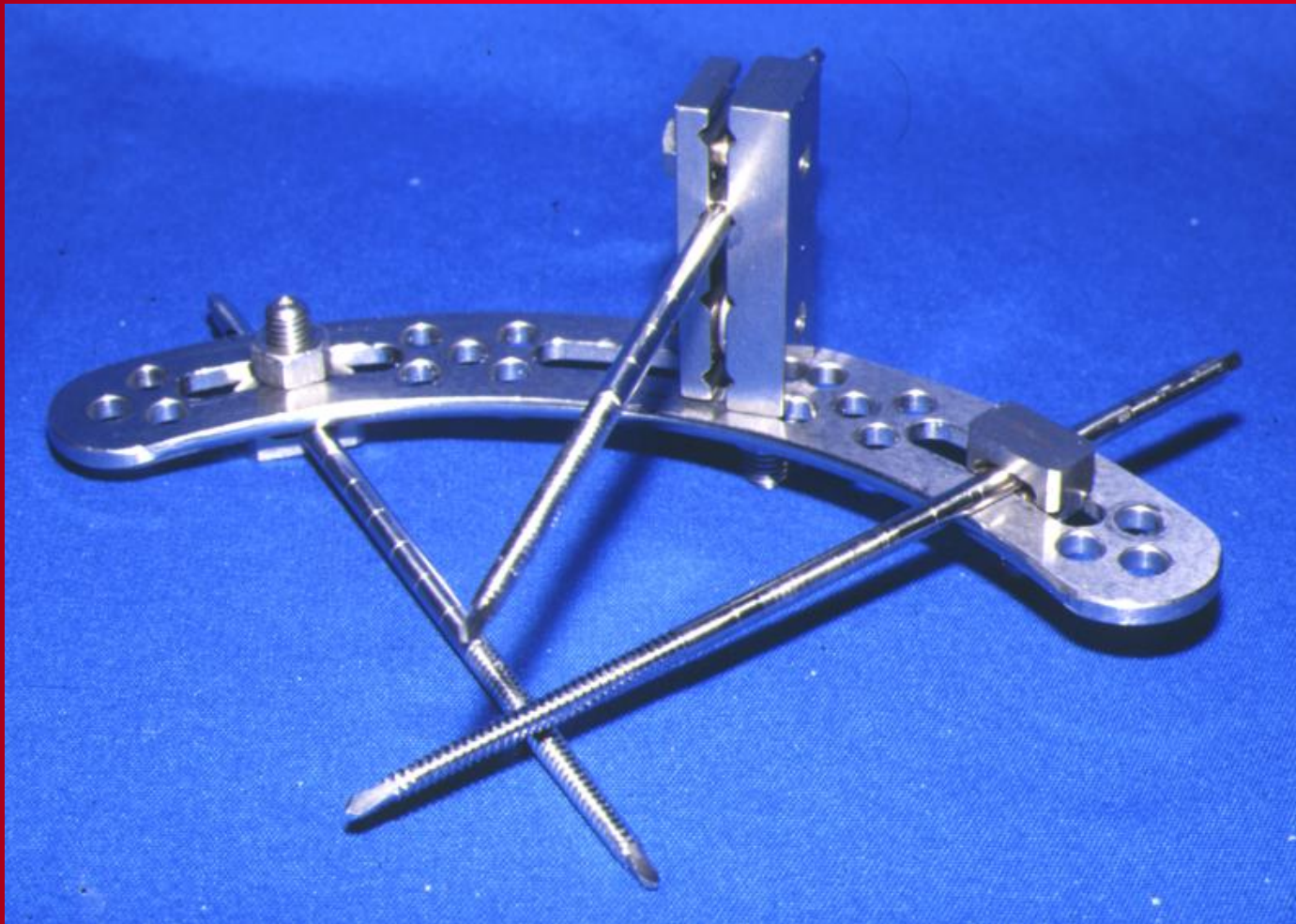
New femoral arch and devices for half pins fixation developed in Lecco on 1986 and 1998



Ospedale Lecco



Ilizarov Unit



**New femoral arch and devices for half pins
fixation developed in Lecco on 1986**



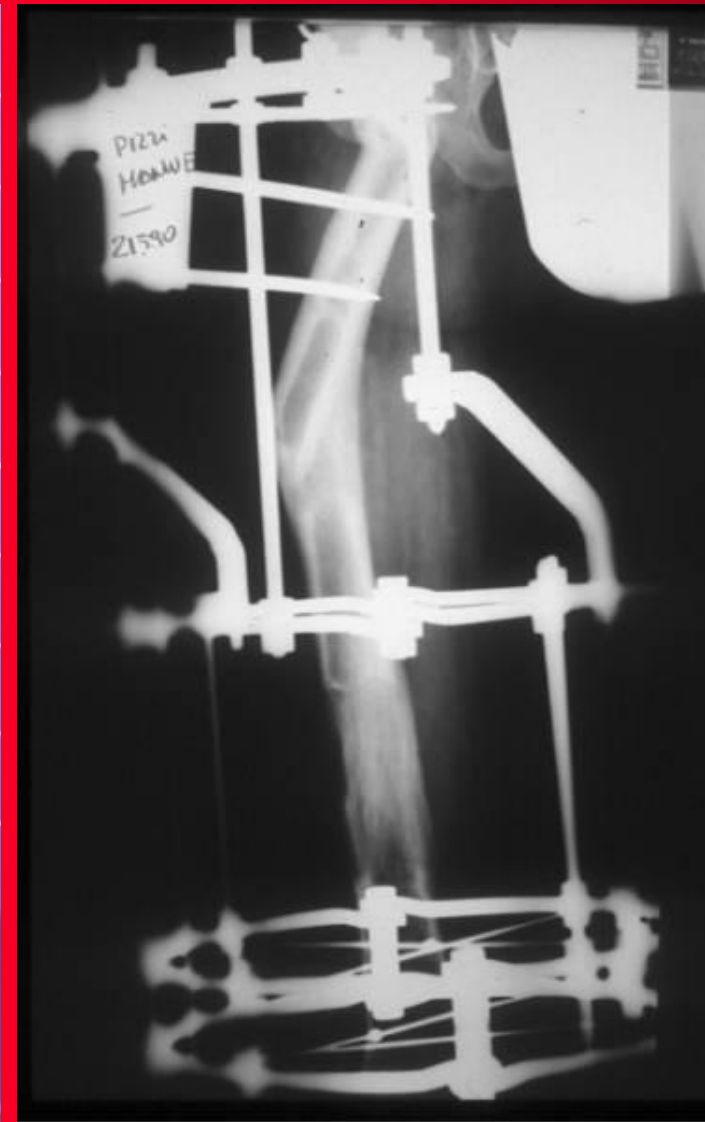
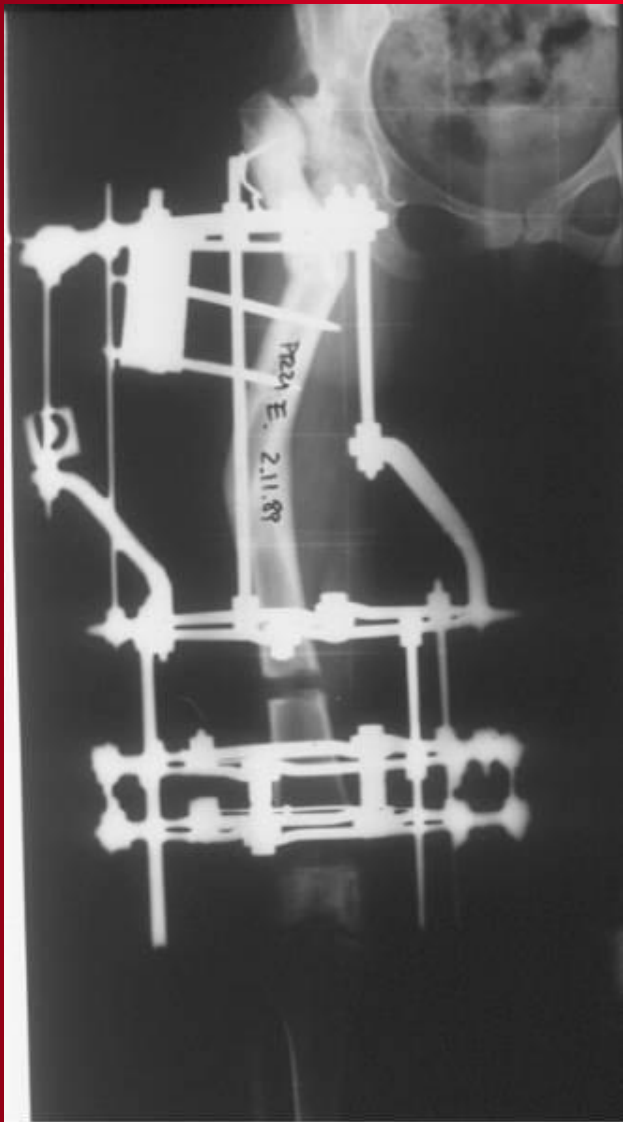
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Ospedale Lecco



Ilizarov Unit



New lengthening after 3 years



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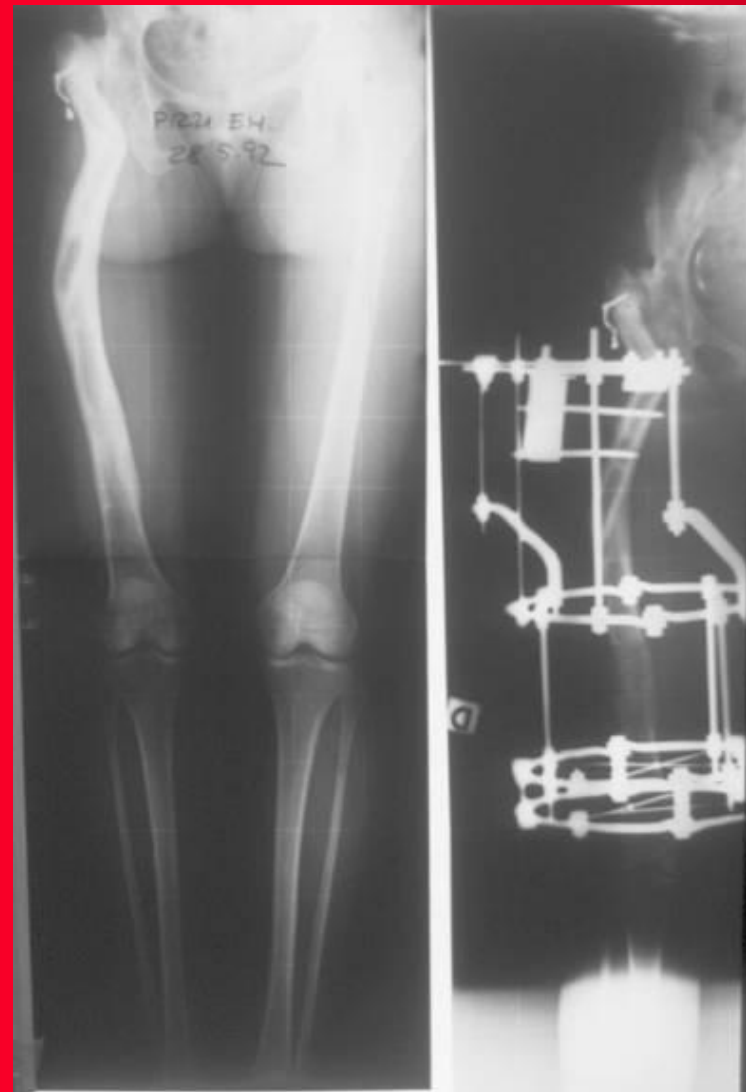


Ospedale Lecco



Ilizarov Unit

More comfort!!

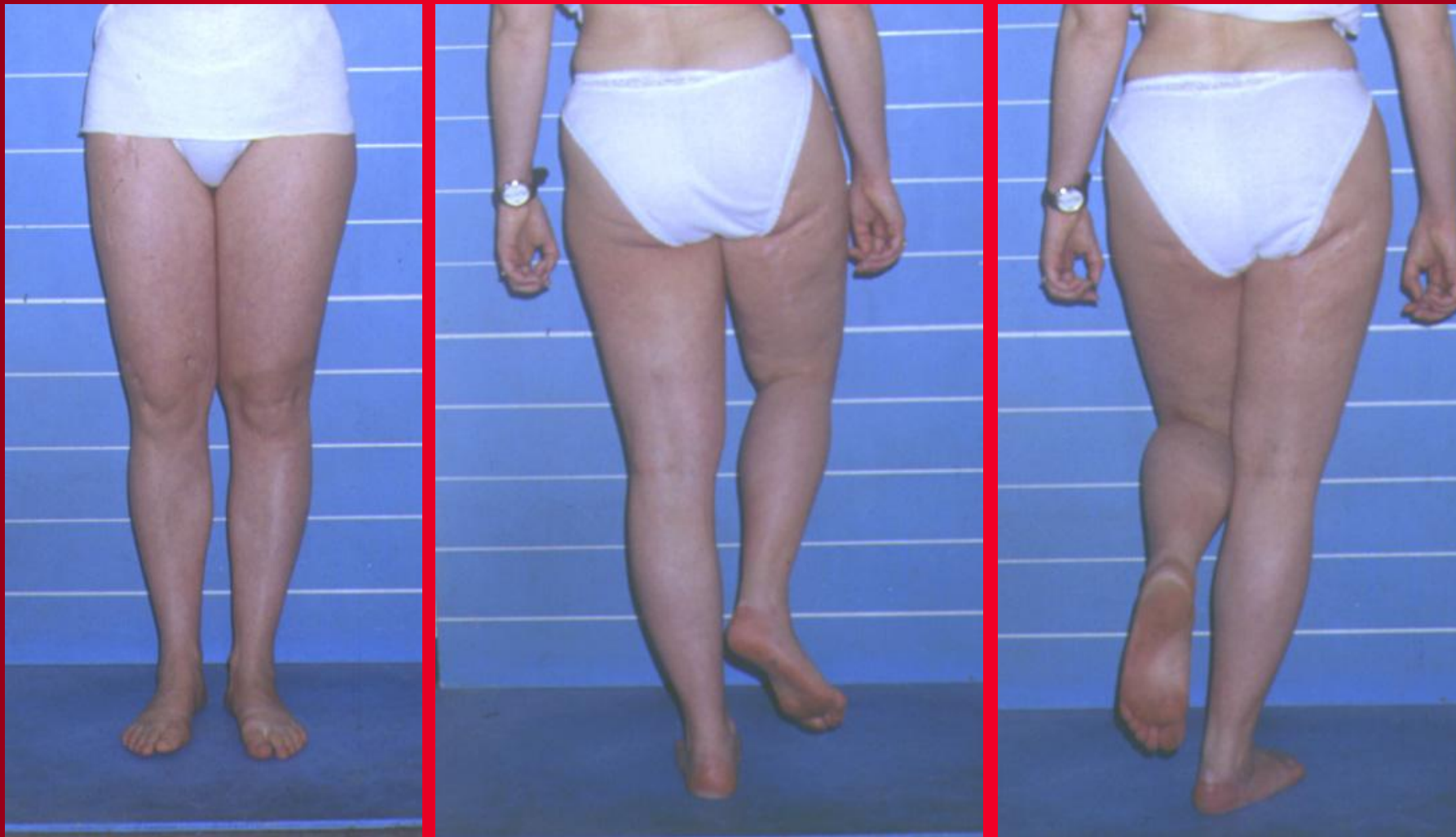


During and after lengthening



Ospedale Lecco





**Clinical result with great satisfaction for
the patient and for the Surgeon**



DRPILIORTOPEDICO



Ospedale Lecco



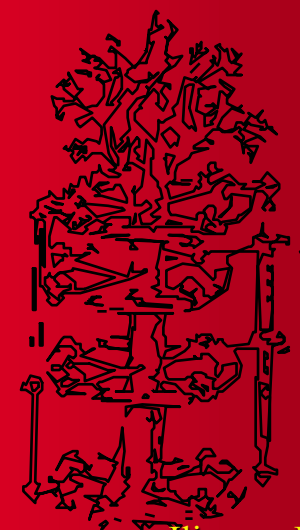
Ilizarov Unit



Function

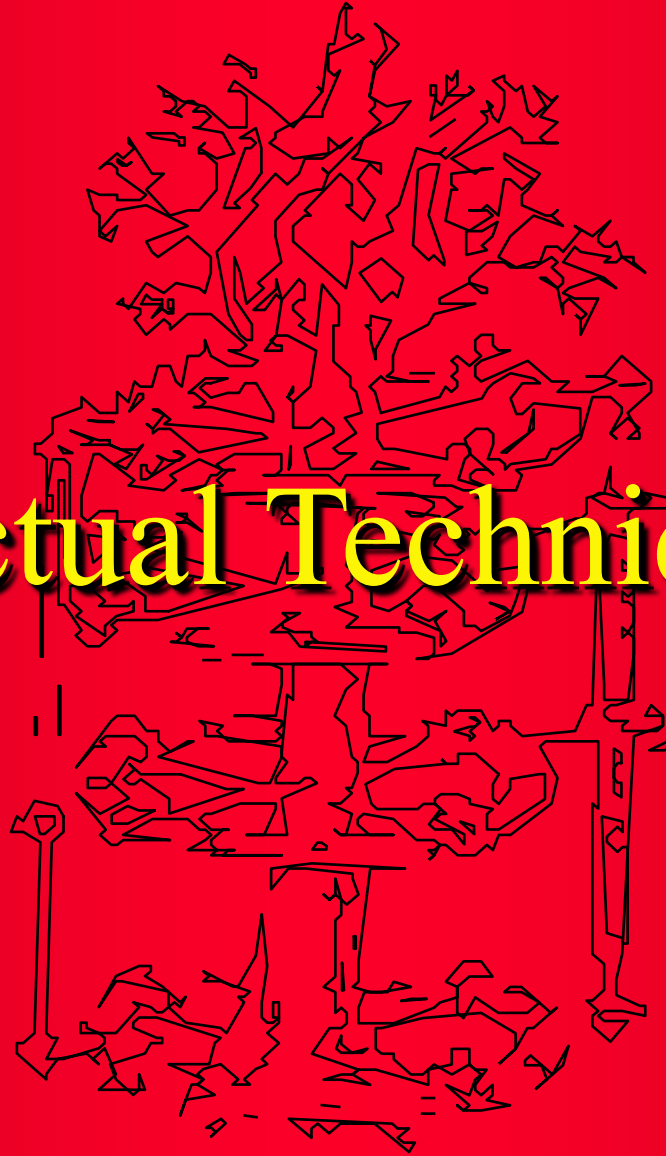


Ospedale Lecco



Ilizarov Unit

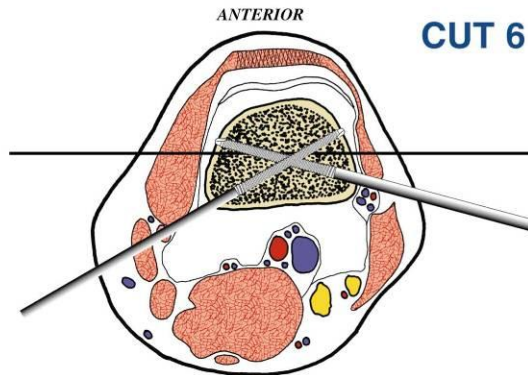
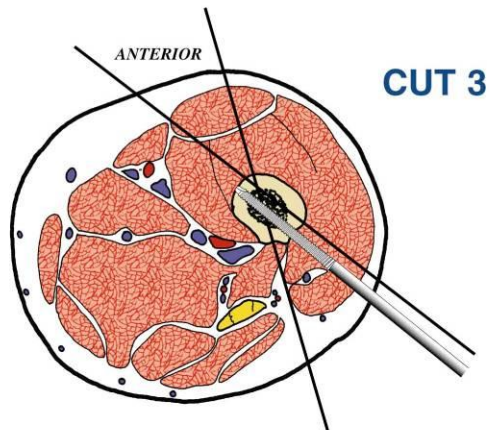
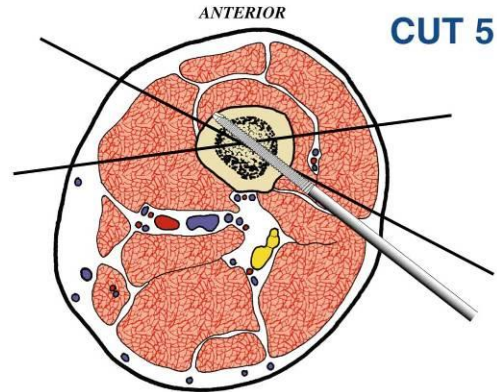
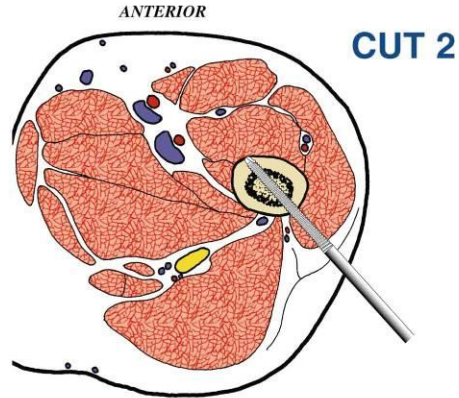
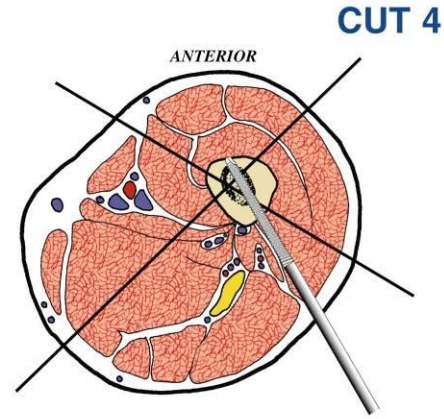
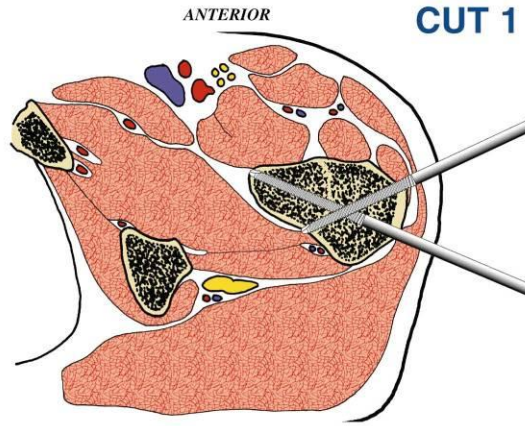
Actual Technique



DRPILIORTOPEDICO

Ilizarov Unit - Lecco

INSERTION WIRES AND HALF-PINS - LEFT

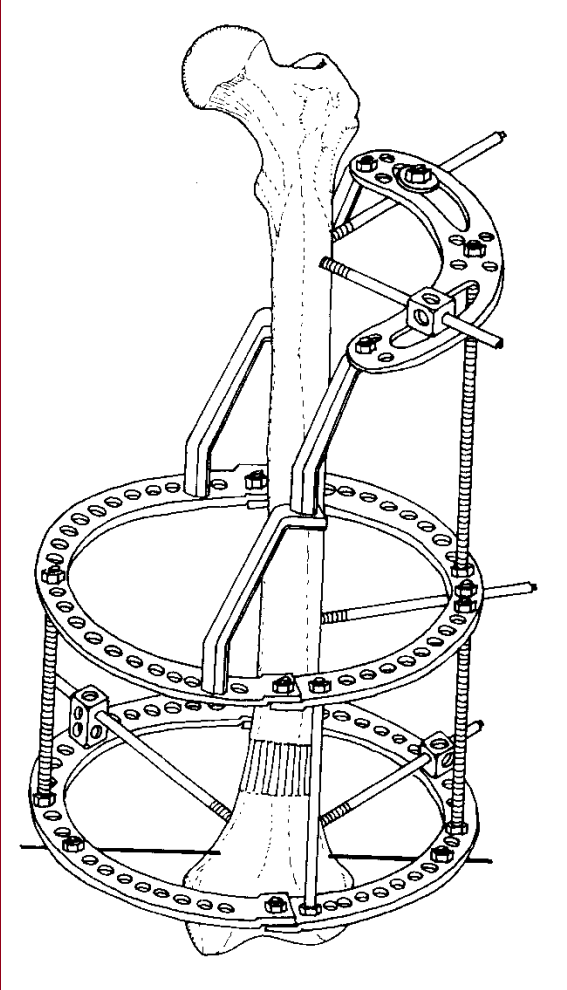


Ospedale Lecco

Wires and half pins in the femur



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**Configuration
1990**

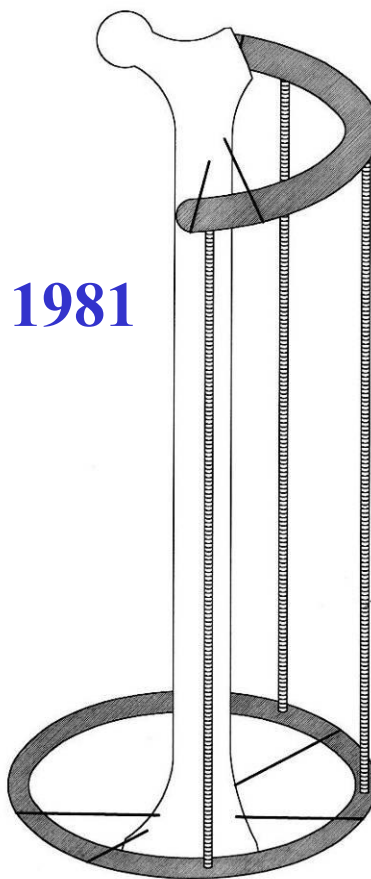


**Configuration
1992**



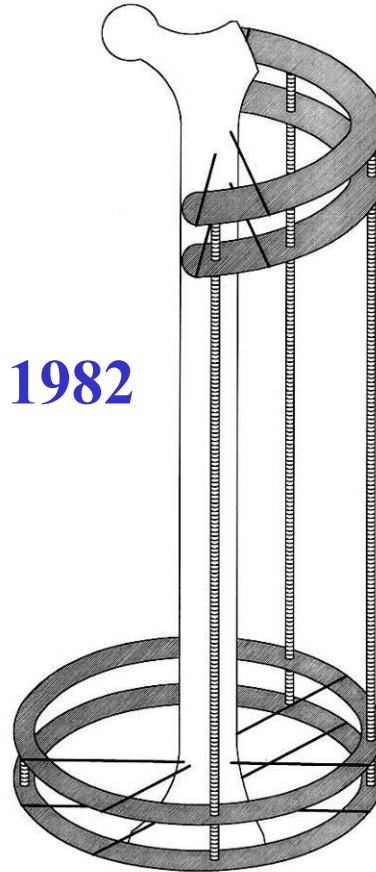
DRPILIORTOPEDICO

Evolution of Ilizarov femoral frames



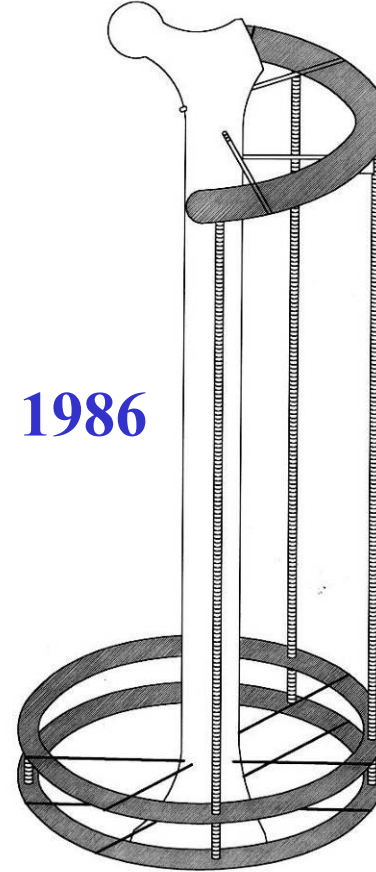
1981

Femoral Frame Evolution
A



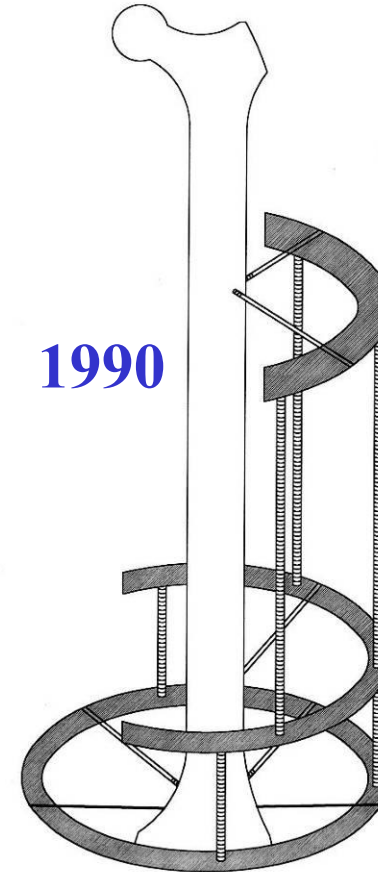
1982

Femoral Frame Evolution
B



1986

Femoral Frame Evolution
C



1990

Femoral Frame Evolution
D



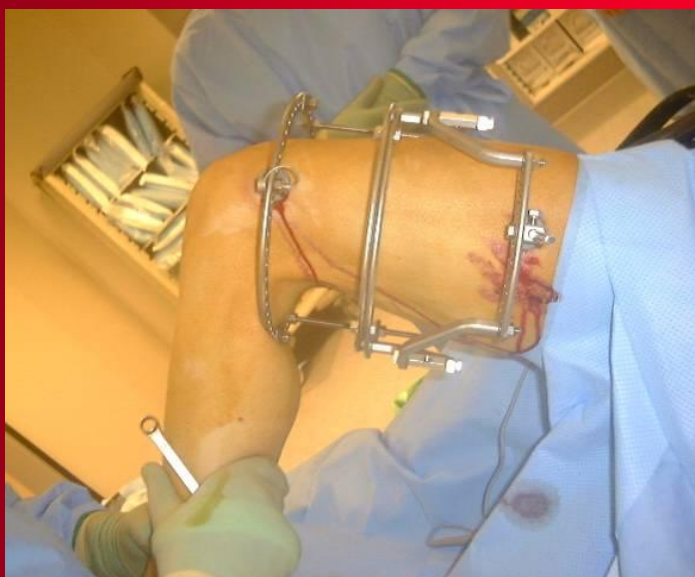
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Ilizarov Unit - Lecco



Ospedale Lecco

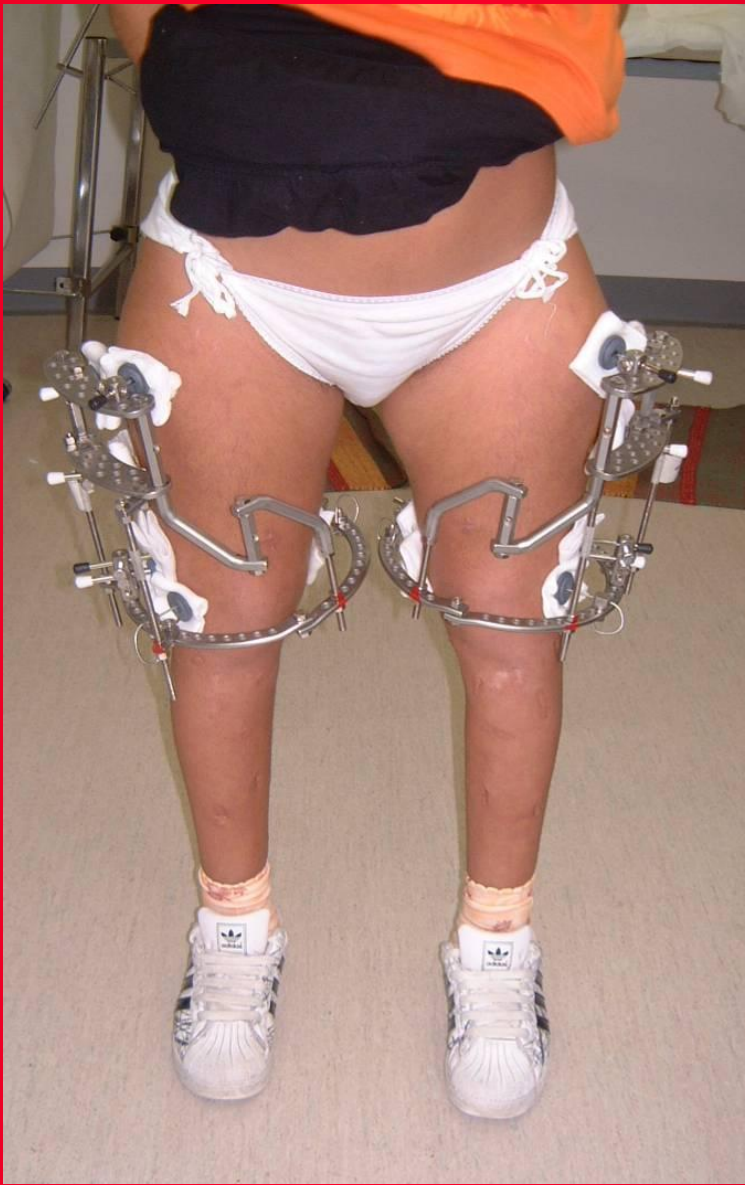


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Frame application 1992



M. A. Catagni



Bilateral femoral lengthening





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Ospedale Lecco

Bilateral femoral lengthening



Ilizarov Unit



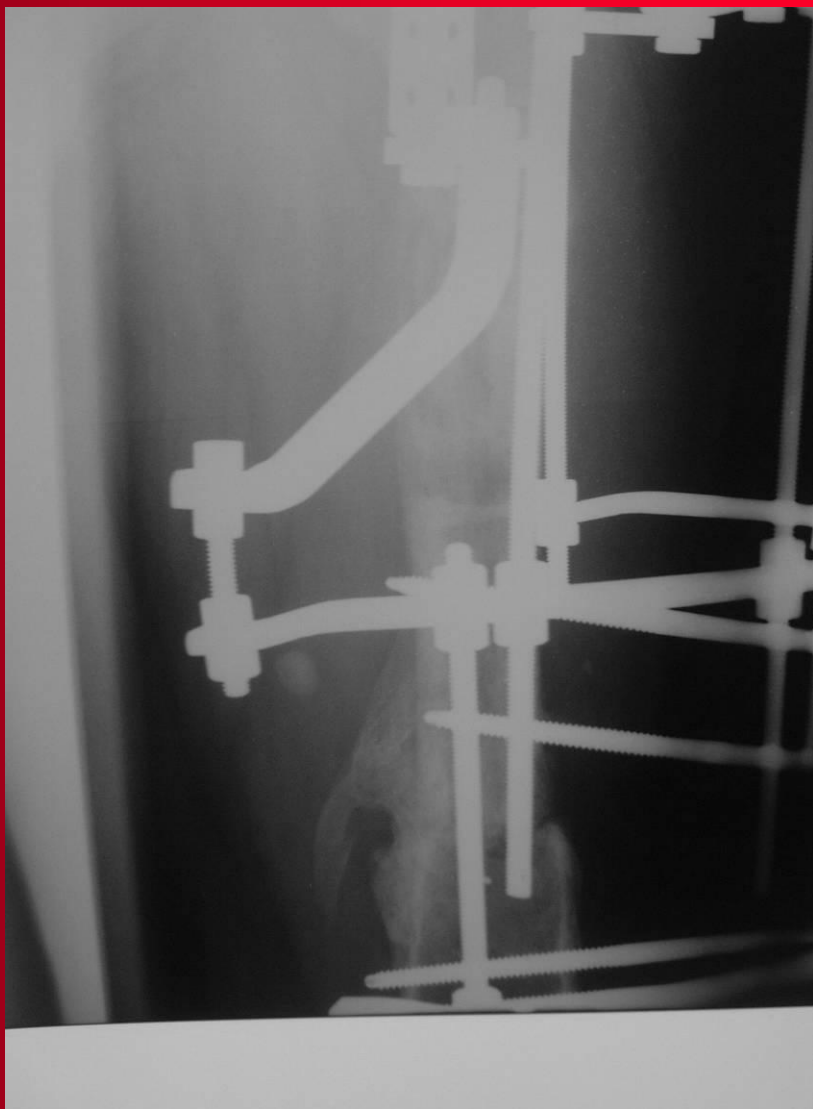
Bifocal in the femur



Ospedale Lecco

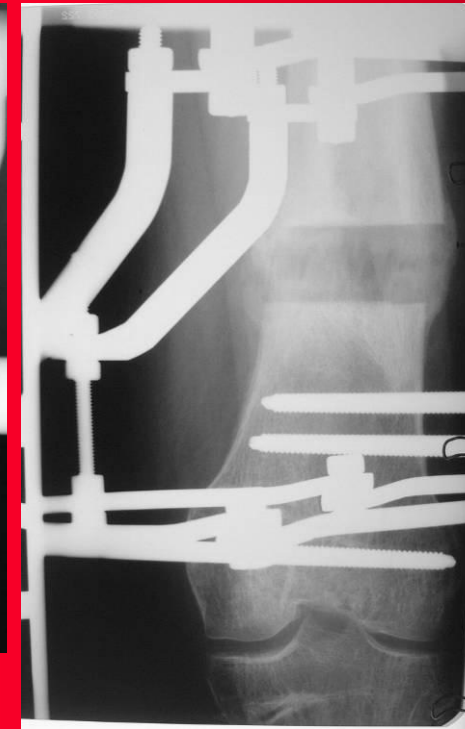
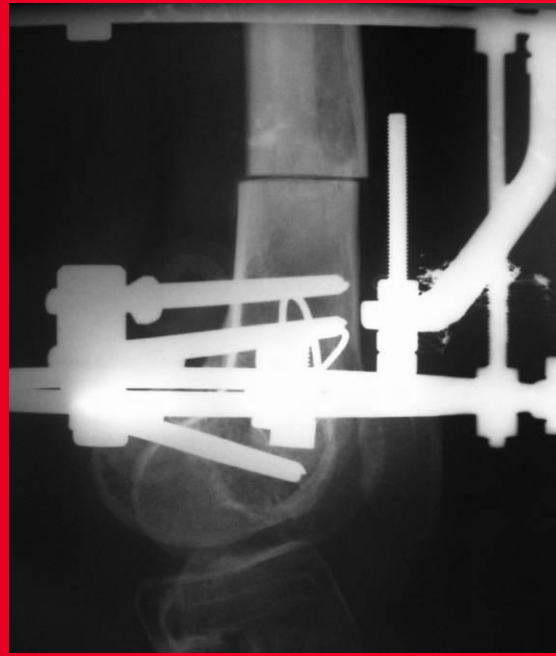


Ilizarov Unit



Bifocal in the femur





..but with e circular is easier to do rotation, angular correction etc





We develop a new
femoral frame



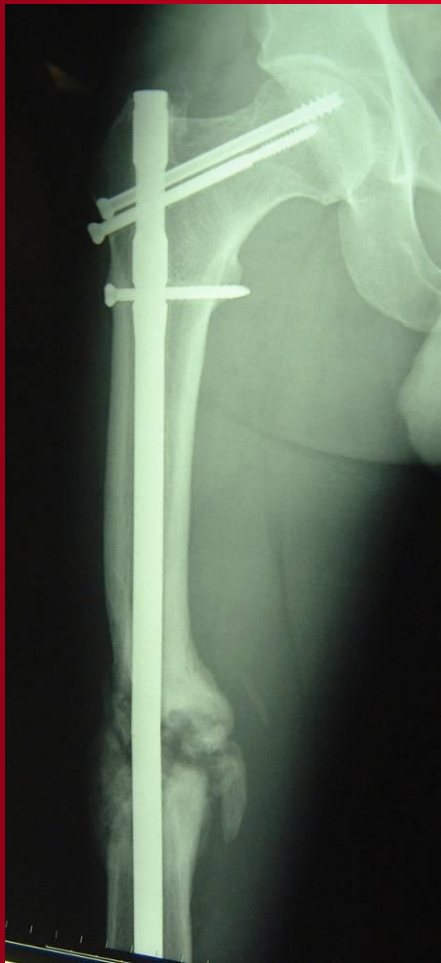
Ospedale Lecco





At the end of the
lengthening or correction
period, a great part can be
removed





Lax femoral nonunion: bifocal treatment



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Dynamization



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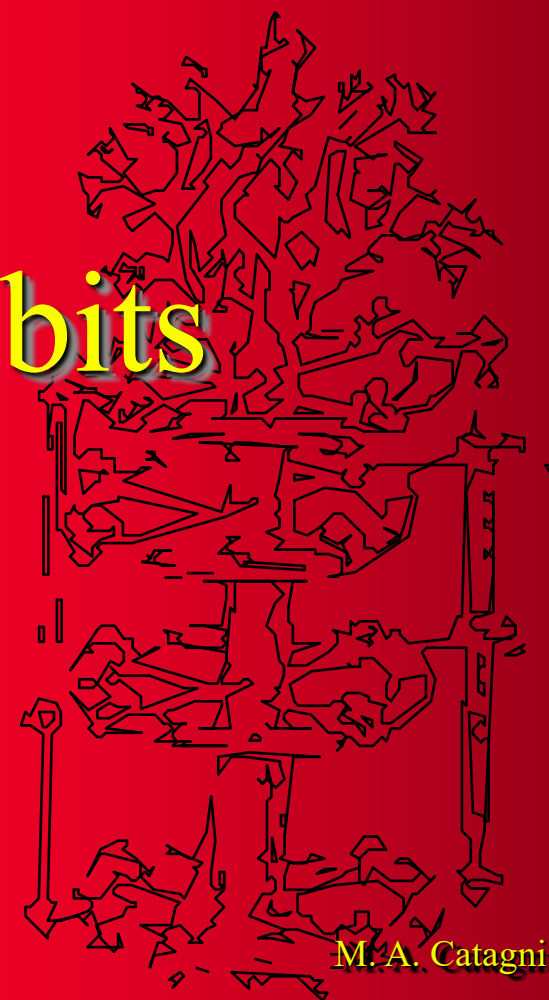
Ilizarov Unit



**Rapid function
recovery**



New devices and bits



M. A. Catagni

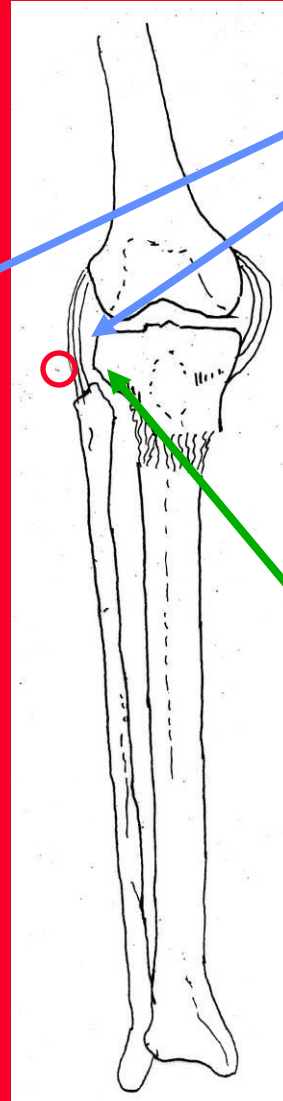
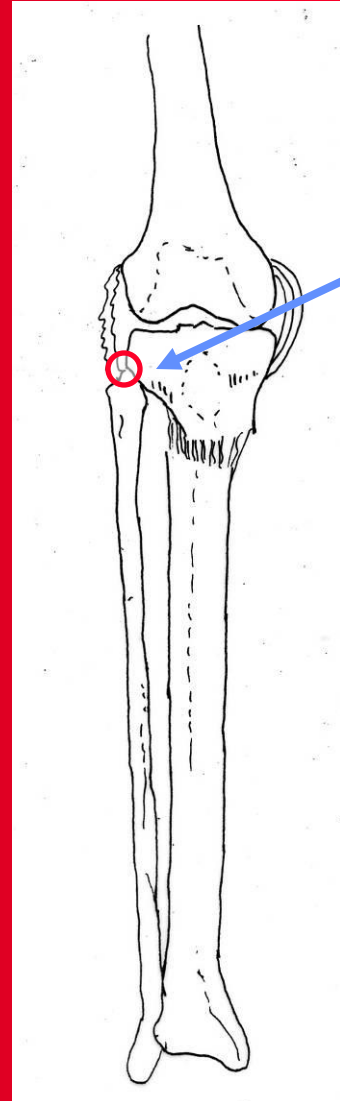
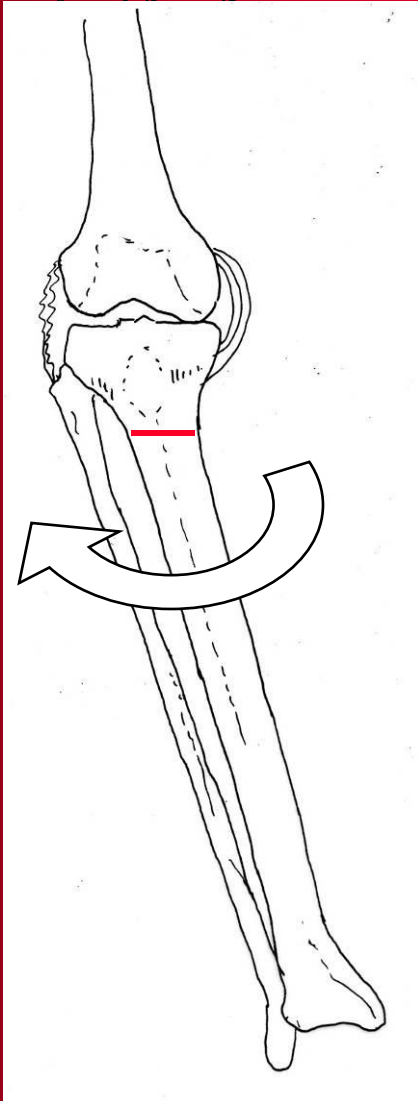


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From 1990: Iuxta articular
hinges and universal for
correction of tibia vara
without fibular osteotomy



Without fibular osteotomy



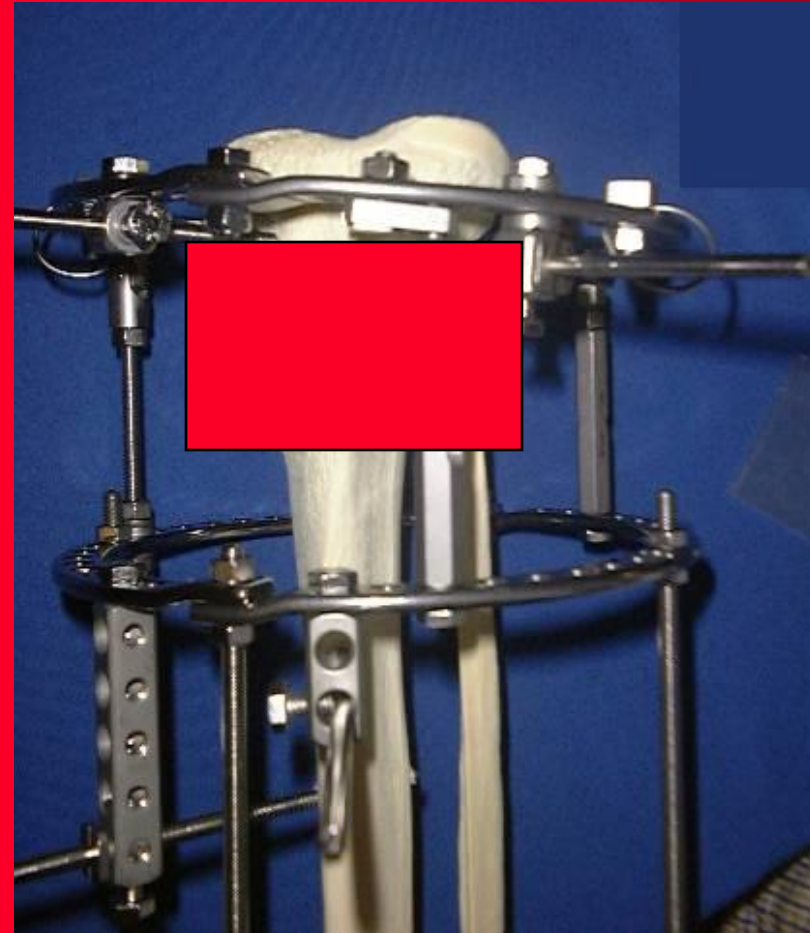
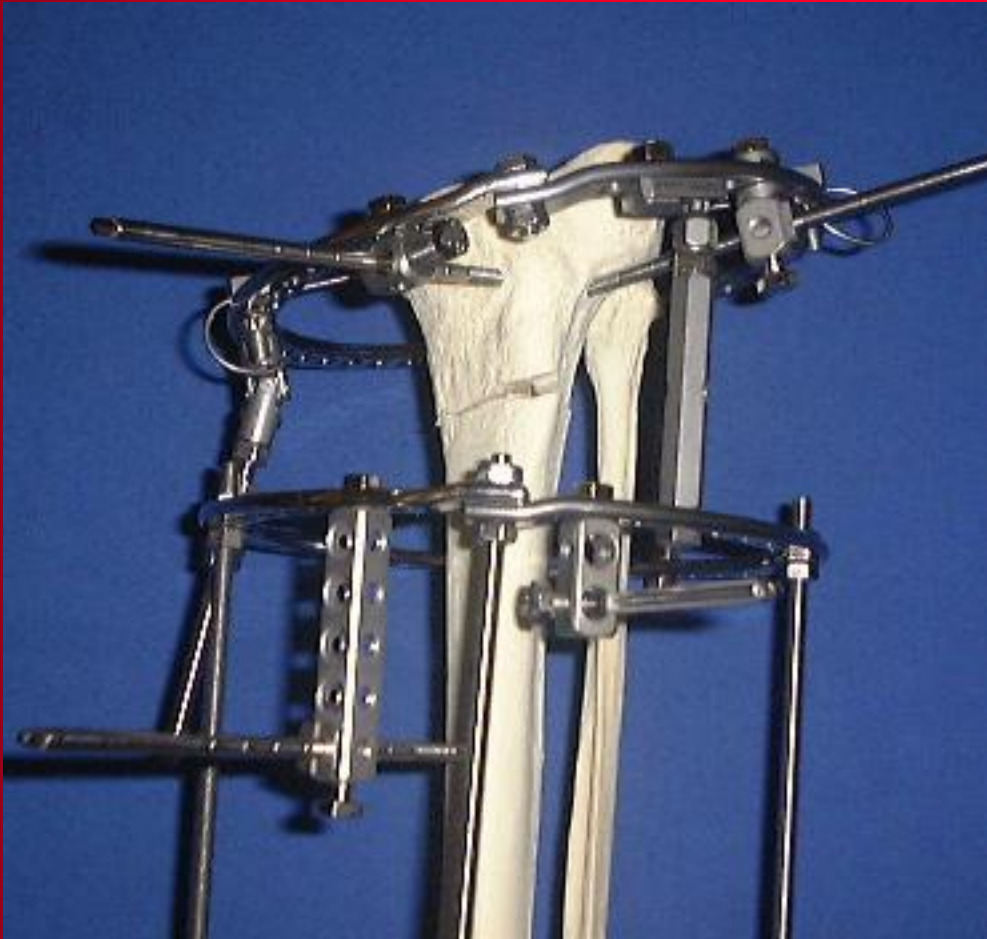
Center of rotation

Retention of LCL





Iuxta articular hinges



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Exapodalic frames



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Use of the intramedullary nail for femoral lengthening Experience in Lecco - Italy



First femoral lengthening in
Lecco 1995 using Albizia Nail
(mechanic nail)
For 3 achondroplastic patient
(6 femora)



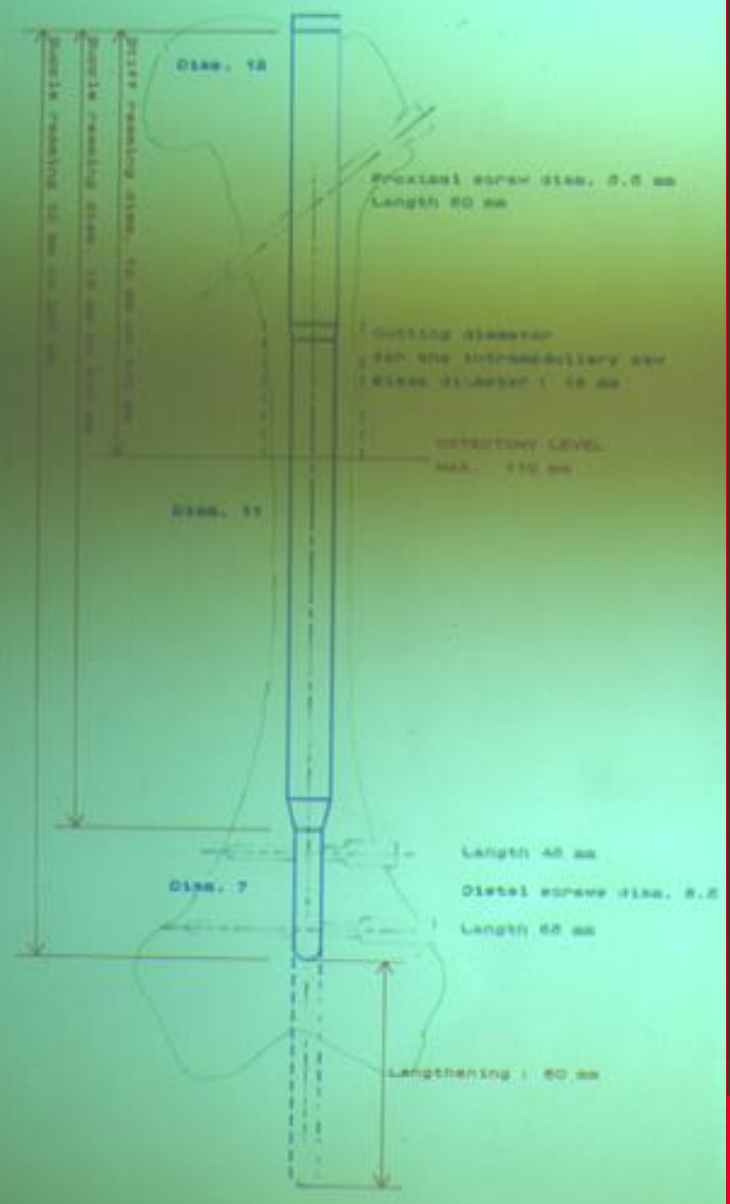


First femoral
lengthening
with “Albizia”

16 y.o. after
tibial and
humeral
lengthening
(13+9)



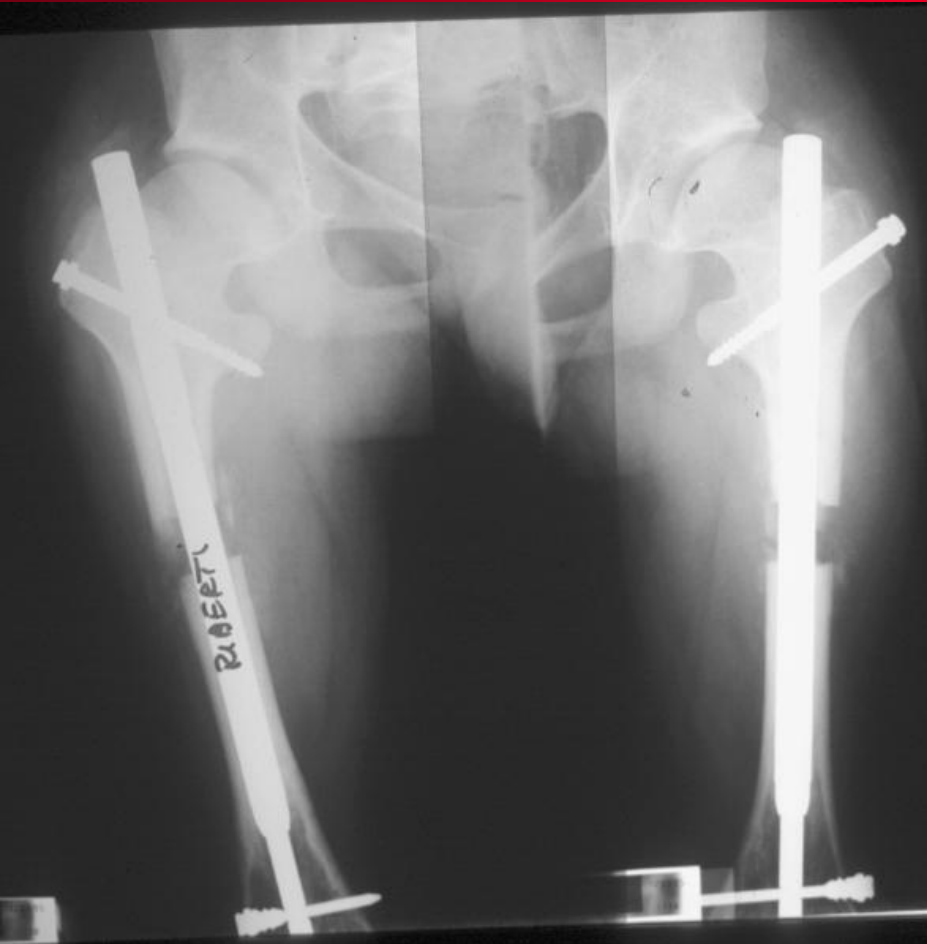
MEDINOV SPINAL LENGTHENING SYSTEM
 ALBERTI PRANDERCO
 OPERATING DATE : 1995-01
 SIDE : LEFT
 MATERIAL : STAINLESS
 DATE : 1995
 SURGEON DR. CARLONE
 PAT. : 4415/14/174
 8-9-95 1. 4.38
 27 rue L. Longueville 40.000 MOULIN (FR) 79.72.04.5



Pre op plan



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6 cm lengthening
250 days of treatment



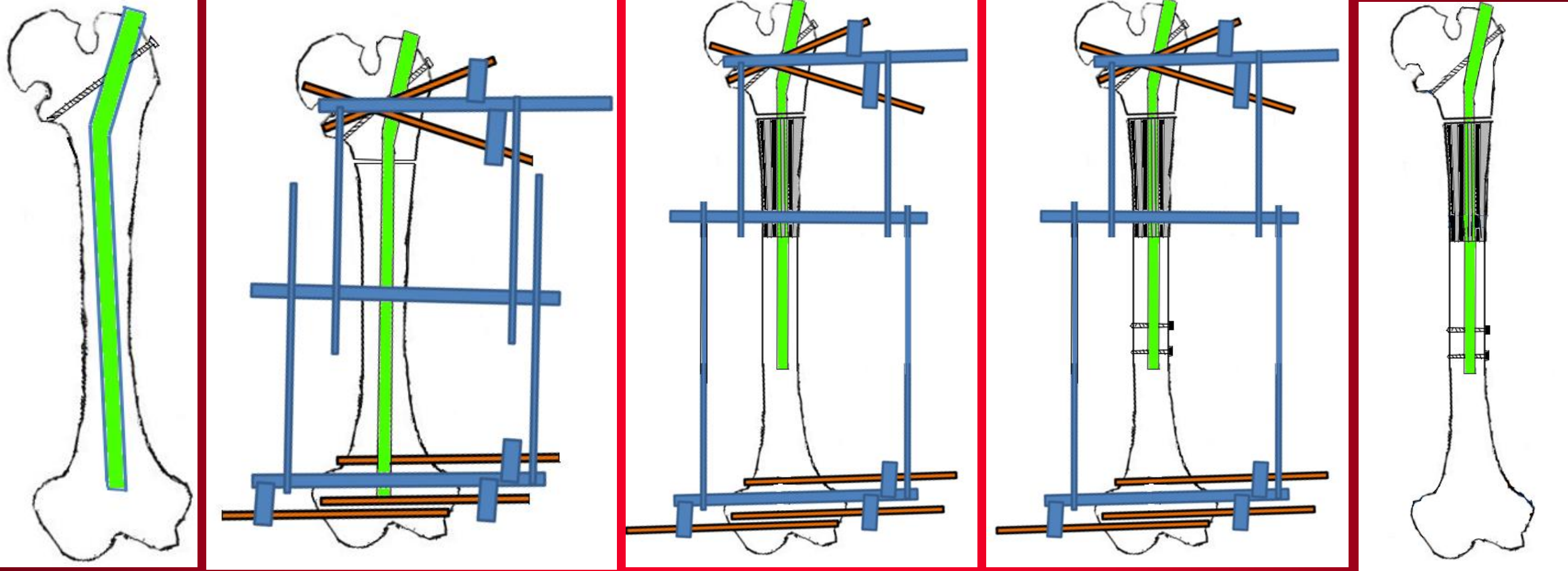
ASAMI Lecco



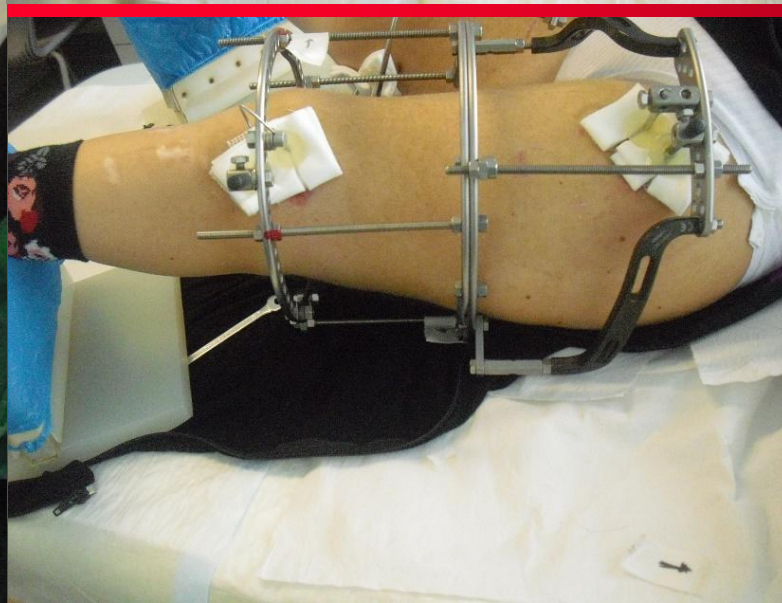
The patient asked for further lengthening
At that time the limit with the “Albizia” was only 6 cm



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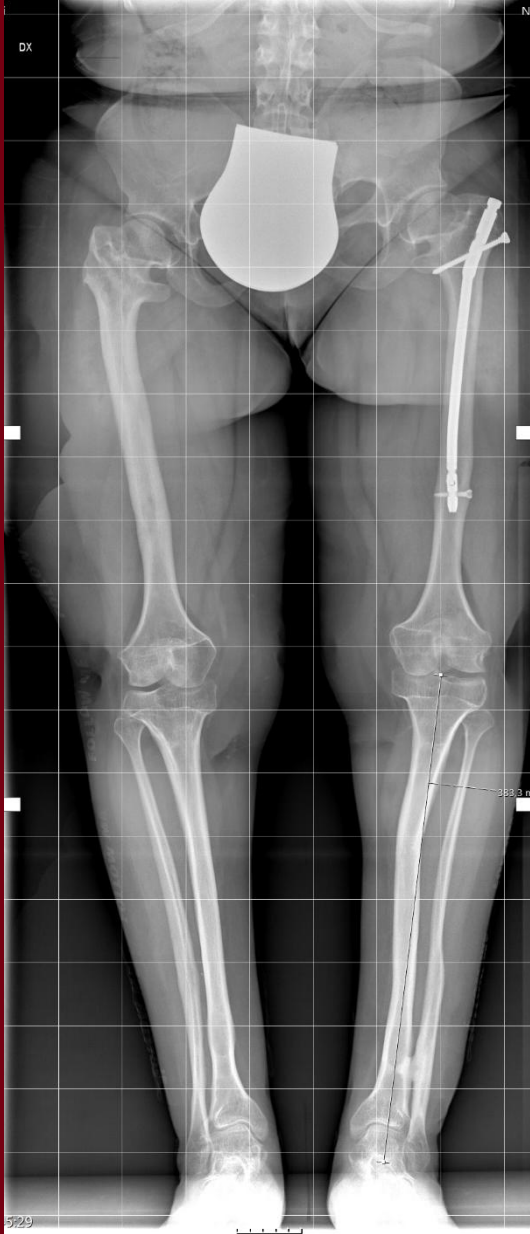
Pediatric nail insertion, proximal fixation, circular fixator application, osteotomy, fixator lengthening, distal nail fixation, fixator removal



First case with traditional external circular fixator



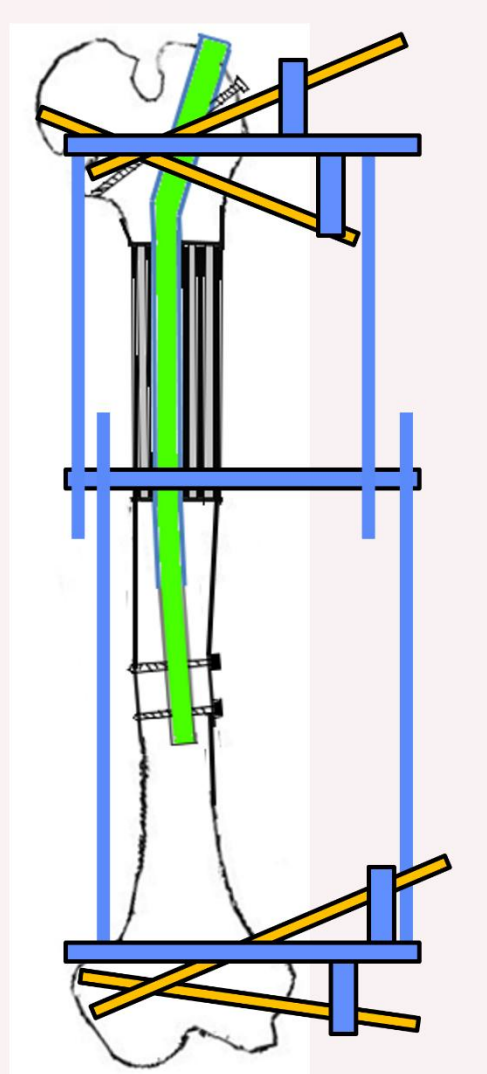
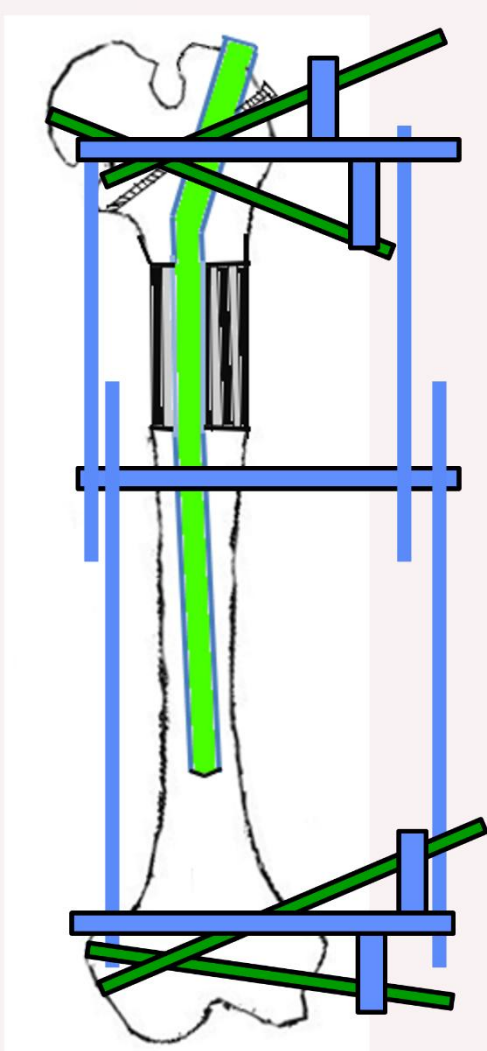
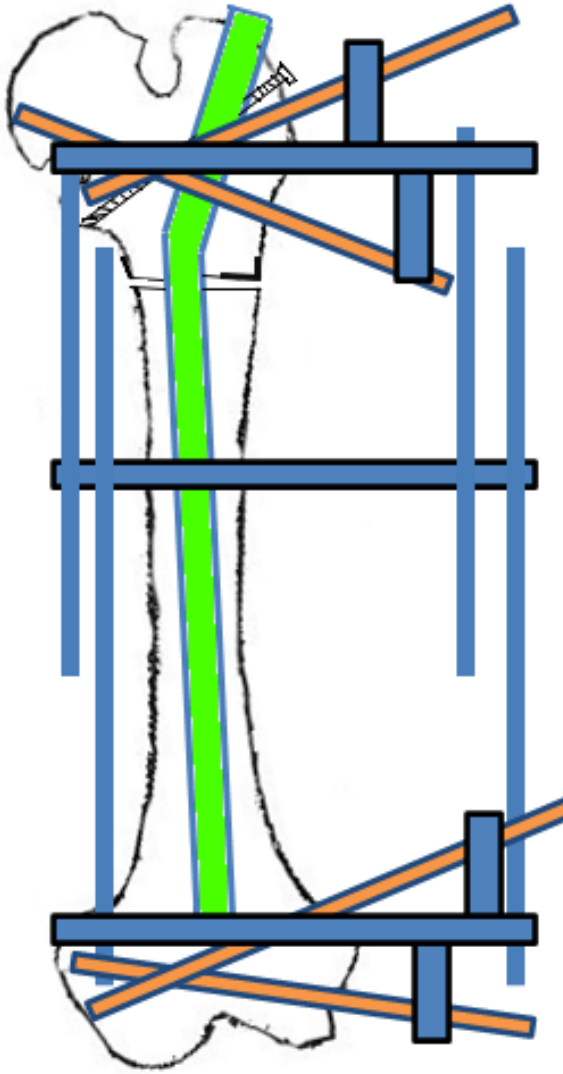
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After frame removal

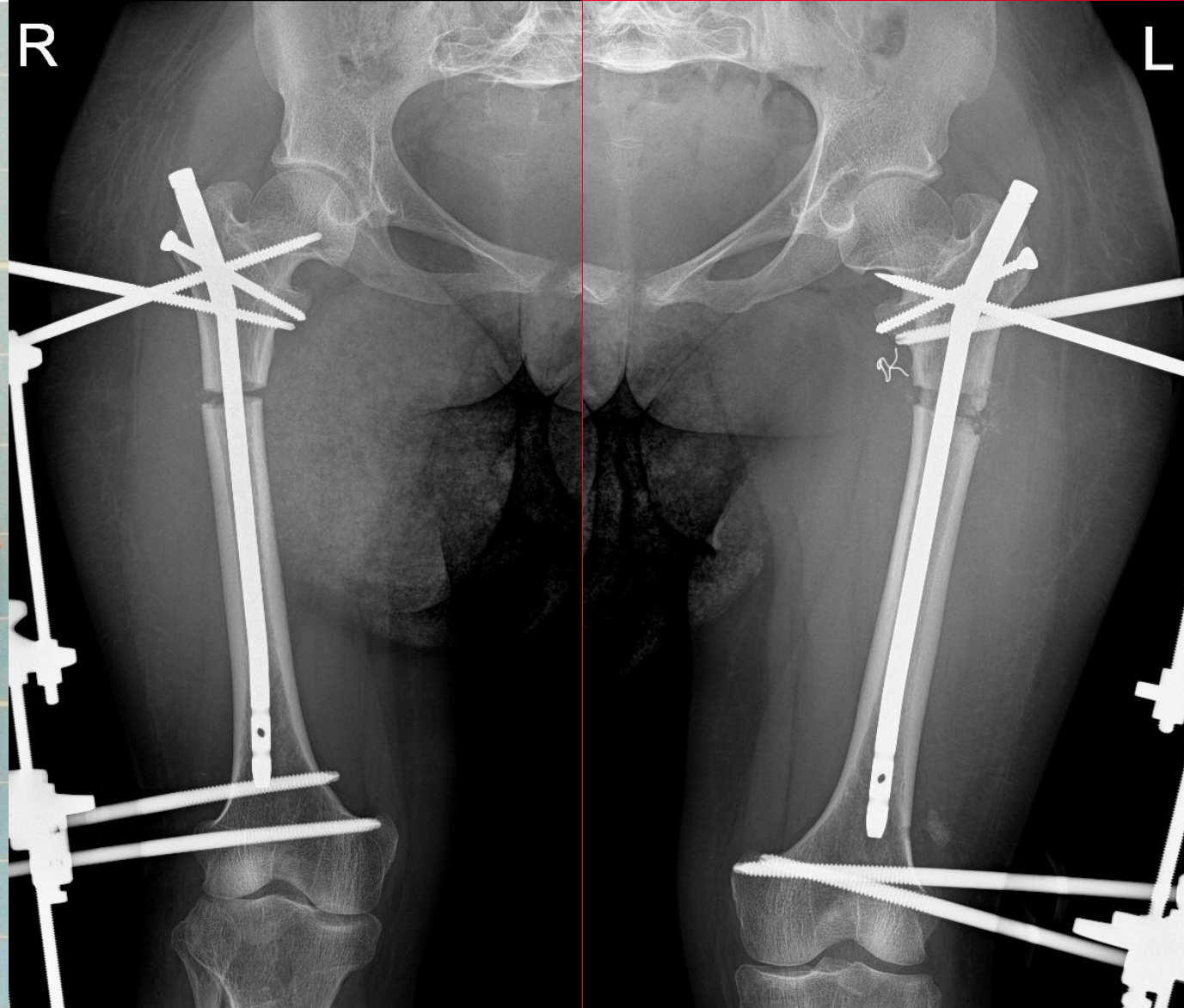


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Second case: monolateral ex-fix





Second case: monolateral ex-fix



Second case: monolateral ex-fix



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Third case: monolateral ex-fix





Normal knee function



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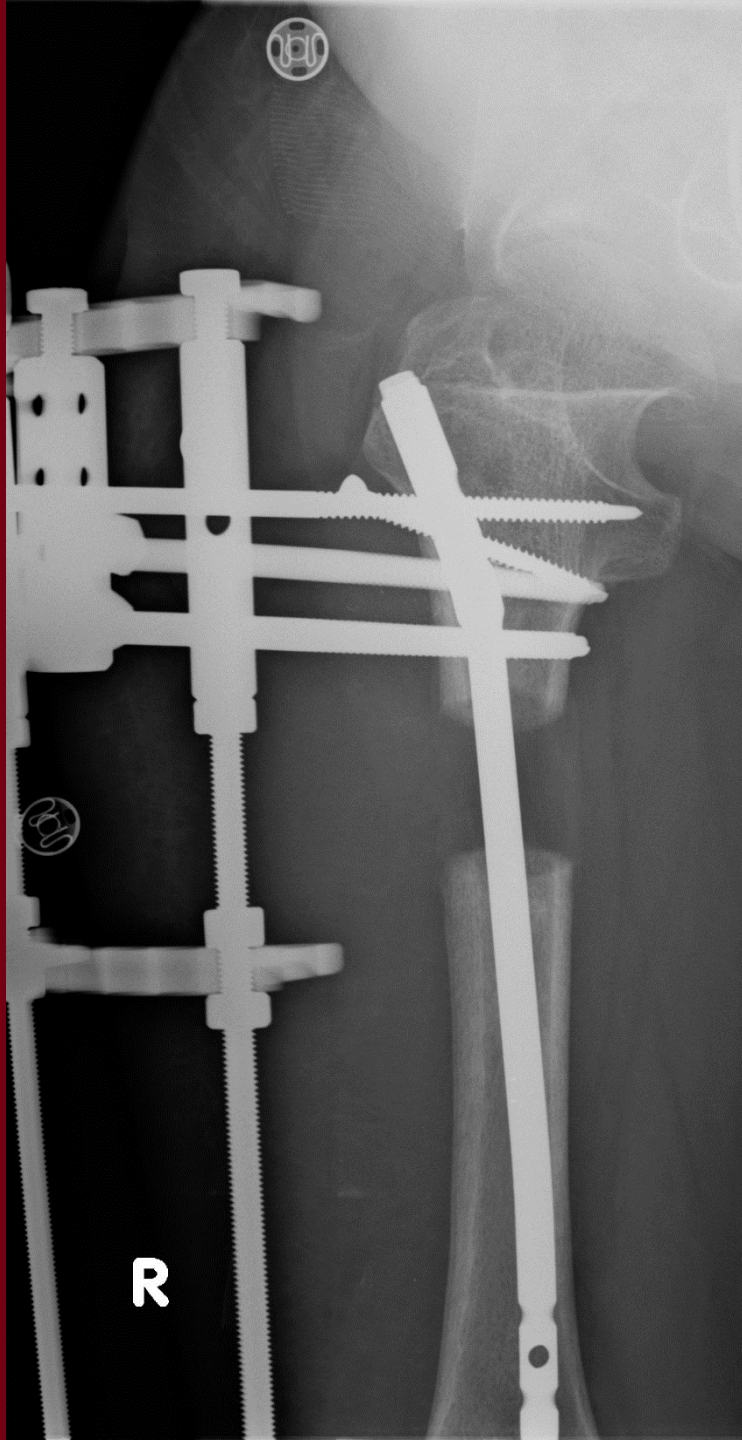


**Last case done 2019 at
Mangioni Hospital Lecco**

**After tibial and humerus
lengthening in 2014 and
2015**



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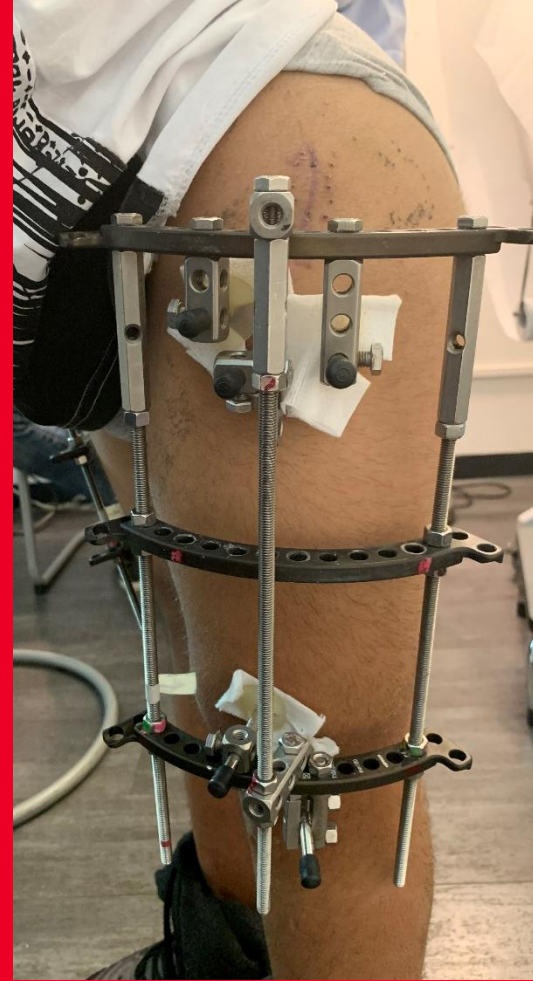
Nail 20 cm
Ø 8.5 mm

Proximal and distal
pins Ø 6 mm
Hydroxyapatite

Frame Aluminum
arcs 200 mm
diameter



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Frame mounting



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Distal locking at the end
of lengthening period

10 cm lengthening



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**After frame
removal
In total 7 months
in the frame**



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One year FU



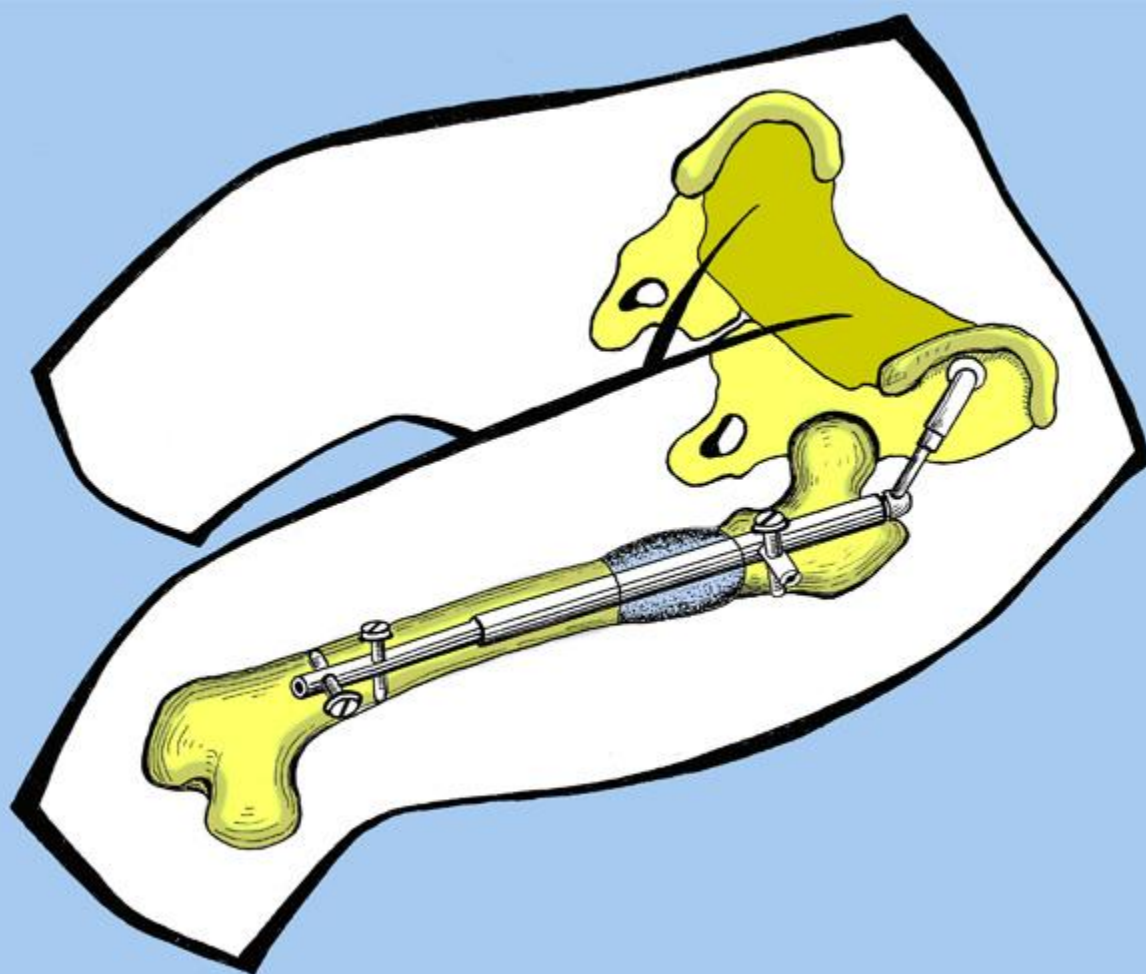
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The difficulties we encountered in using the first "Albizzia" model were:

- Invasive surgery with conspicuous blood loss
- Difficulty performing rotational movements due to pain and muscle contractures which, in two cases, forced anesthesia to be performed twice a week to complete the lengthening
- The 6 cm limit in elongation with the "Albizzia" nail was the reason why the nail was dropped and we went back to using the external fixator



Lengthening with medullary nail: One of the first mechanical nails for lengthening was the Bliskunov nail, where the lengthening mechanism was controlled by a lever attached to the iliac crest.



In the 90s. the Albizzia nail (now Guichet nail) represented a good system for femoral lengthening, unfortunately associated with a certain difficulty, by the patients, to tolerate the relatively painful maneuvers to perform the daily lengthening (rotation of the femur by leveraging the leg)



An evolution was introduced with the ISKD (Intramedullary Skeletal Kinetic Distractor) nail in which the elongation occurred with the movement of the knee only, without control by the patient and with the risk of hyper-elongation and poor bone regeneration. (out of market from 2015)



Dong Hoon Lee 1, Keun Jung Ryu, Hae Ryong
Song, Soo-Hong Han
Complications of the Intramedullary Skeletal
Kinetic Distractor (ISKD) in distraction
osteogenesis

Comparative Study Clin Orthop Relat Res. 2014
Dec;472(12):3852-9. doi: 10.1007/s11999-014-3547-4.

Conclusions: Rate control was difficult to achieve with the ISKD nail for femoral and tibial lengthening, complications were relatively common, and among patients in whom rate control was not achieved, pain levels were high. Based on our findings, we believe that surgeons should avoid use of this nail.



Since 1988 the Fitbone nail has been introduced where the energy to move the nail is transmitted by a transducer placed under the skin

A fully implantable distraction nail was used clinically successfully for the first time by Baumgart and Betz in 1988



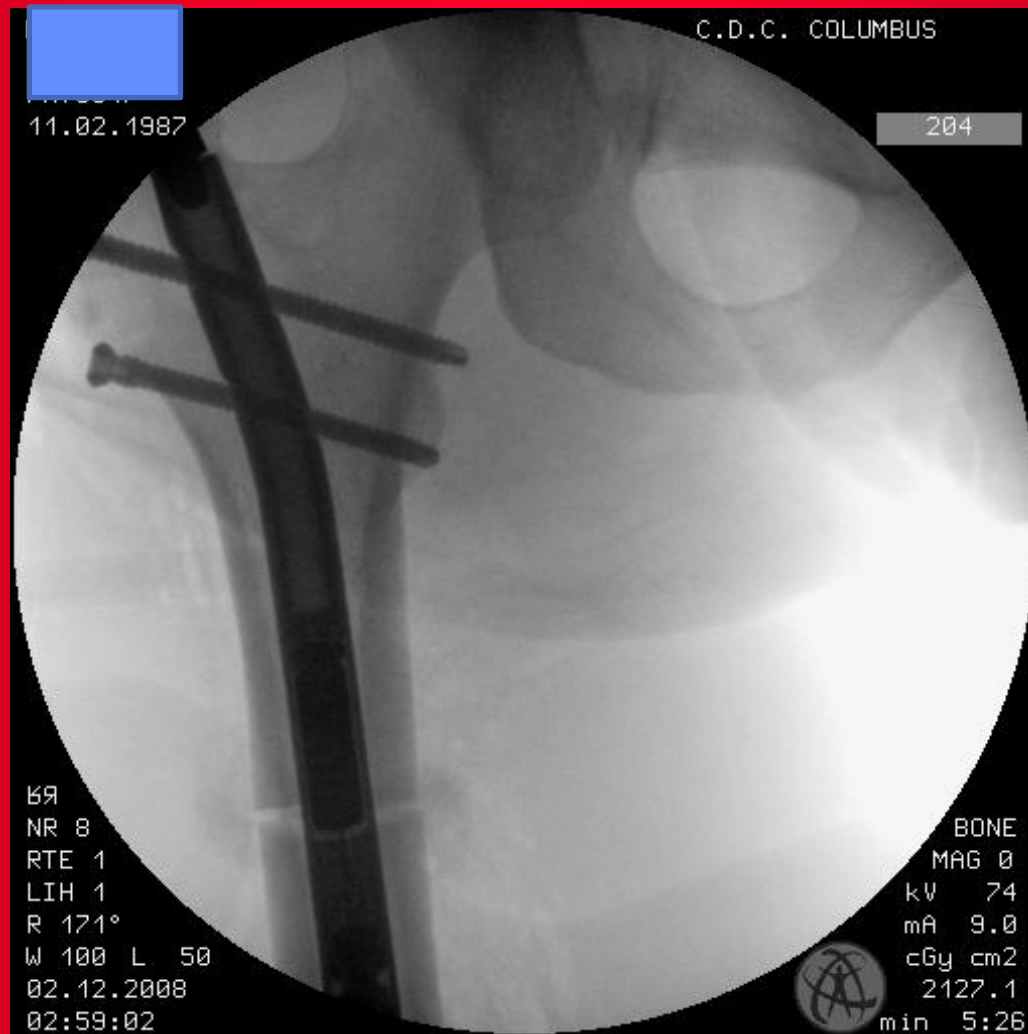
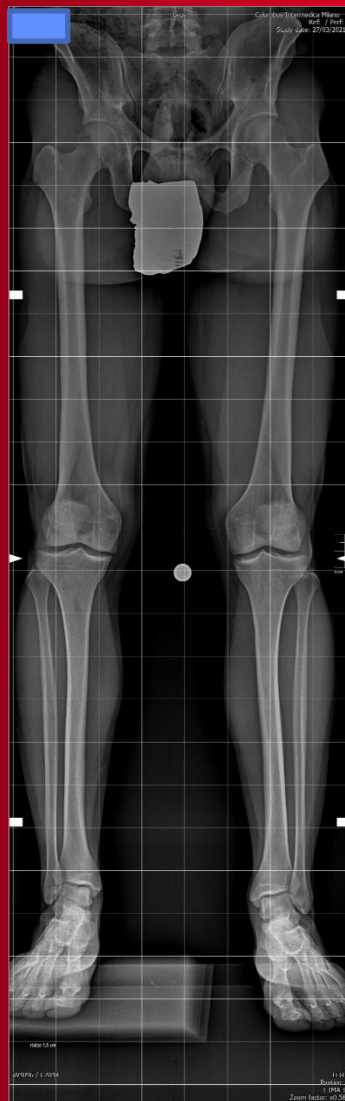
All previous nails have a problem: in case of poor bone regeneration, it is not possible to perform a shortening to stimulate the formation of callus



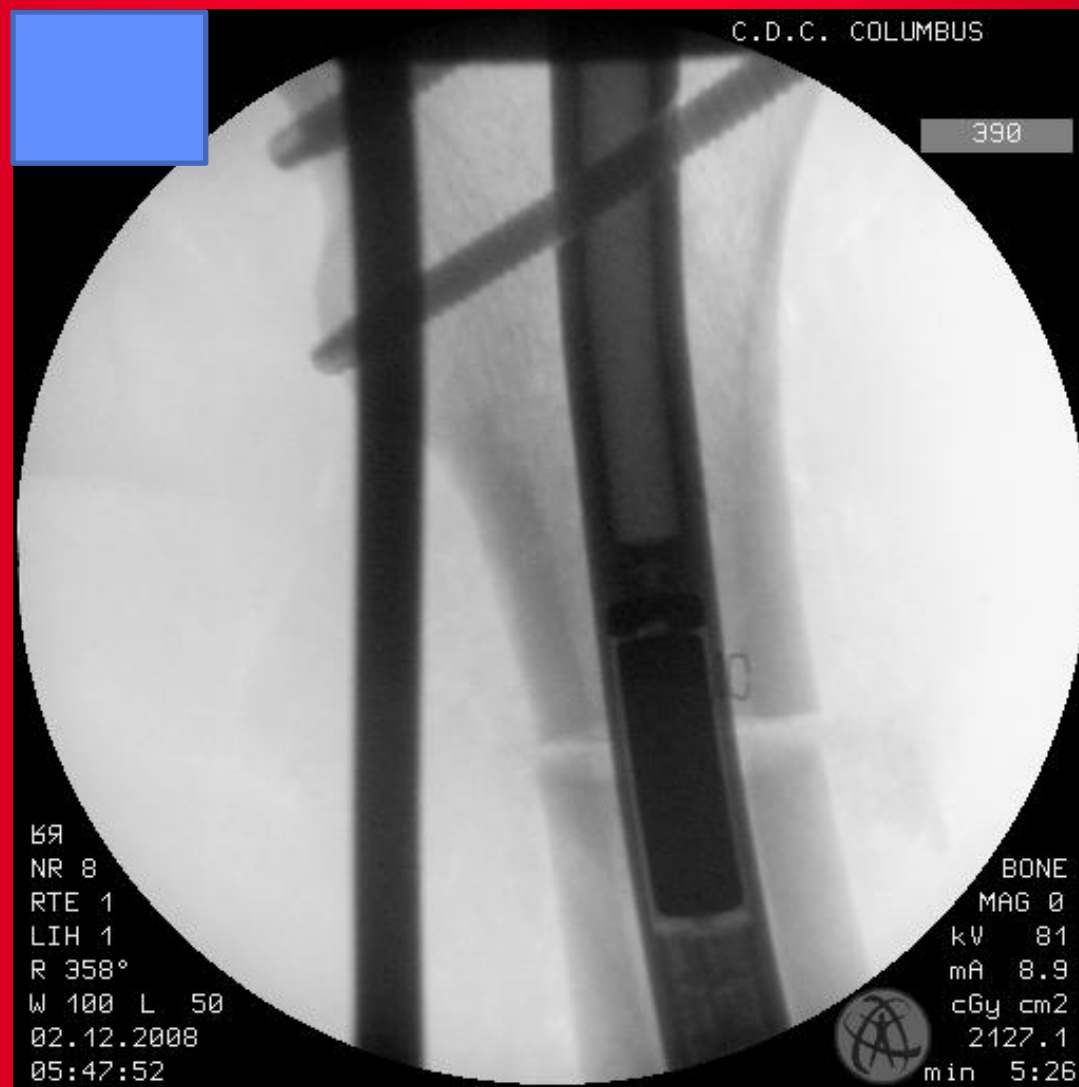
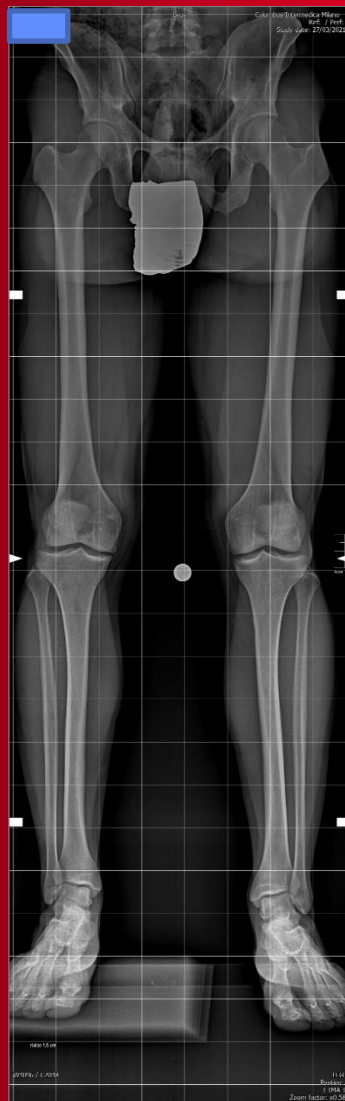
Precice and Stryde nails introduced by Pili



Precice and Stryde nails



Precice and Stryde nails



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Precice and Stryde nails



Precice and Stryde nails



Precice and Stryde nails



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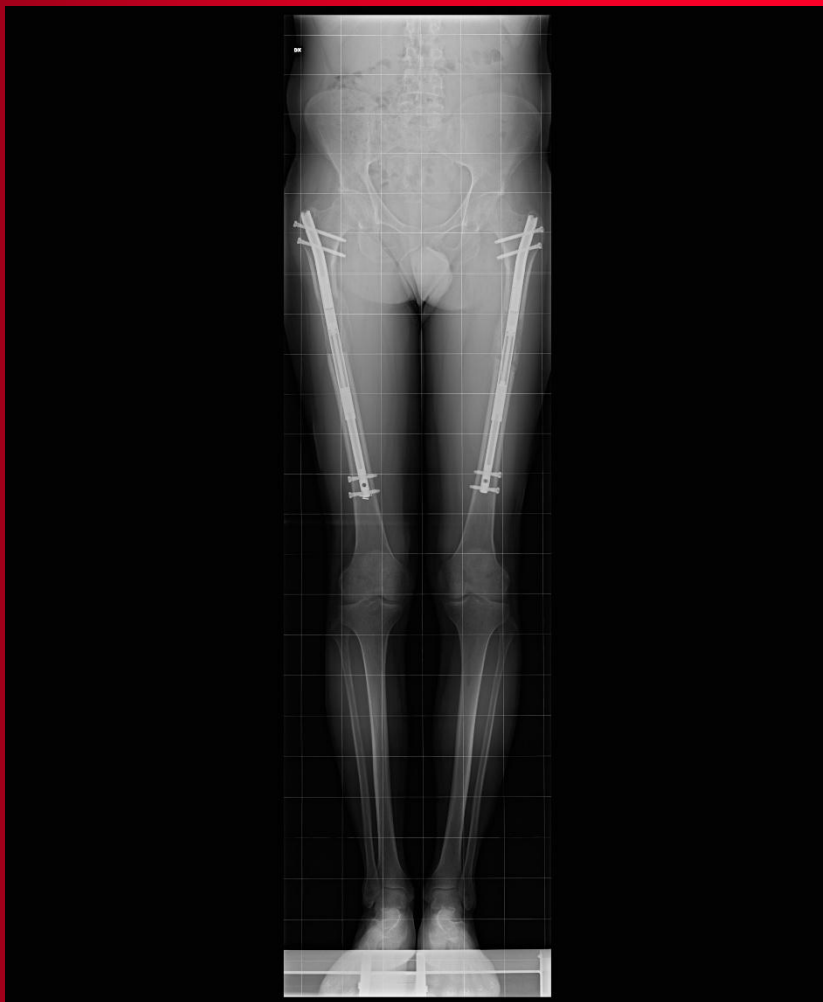


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Precice and Stryde nauils



Precice and Stryde nails



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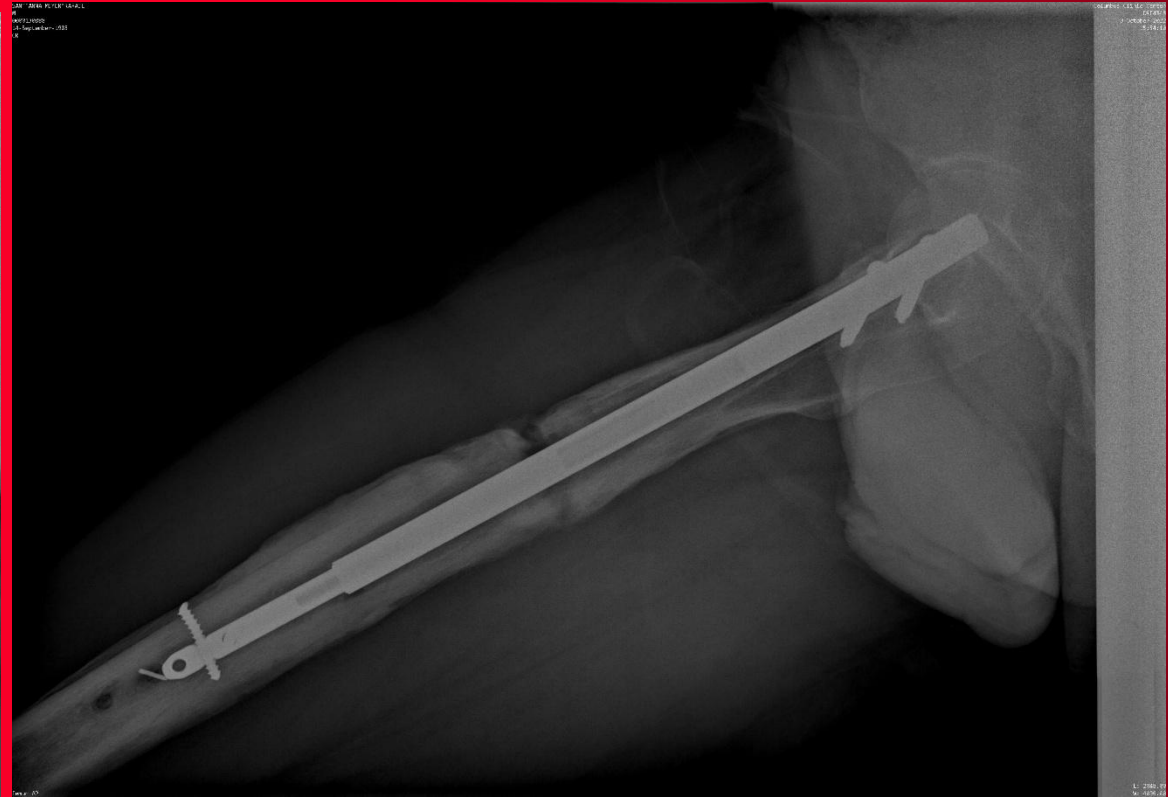
Precice and Stryde nails



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Stryde



Guerreschi started (in 2017) using the lengthening system with support of an intramedullary nail.

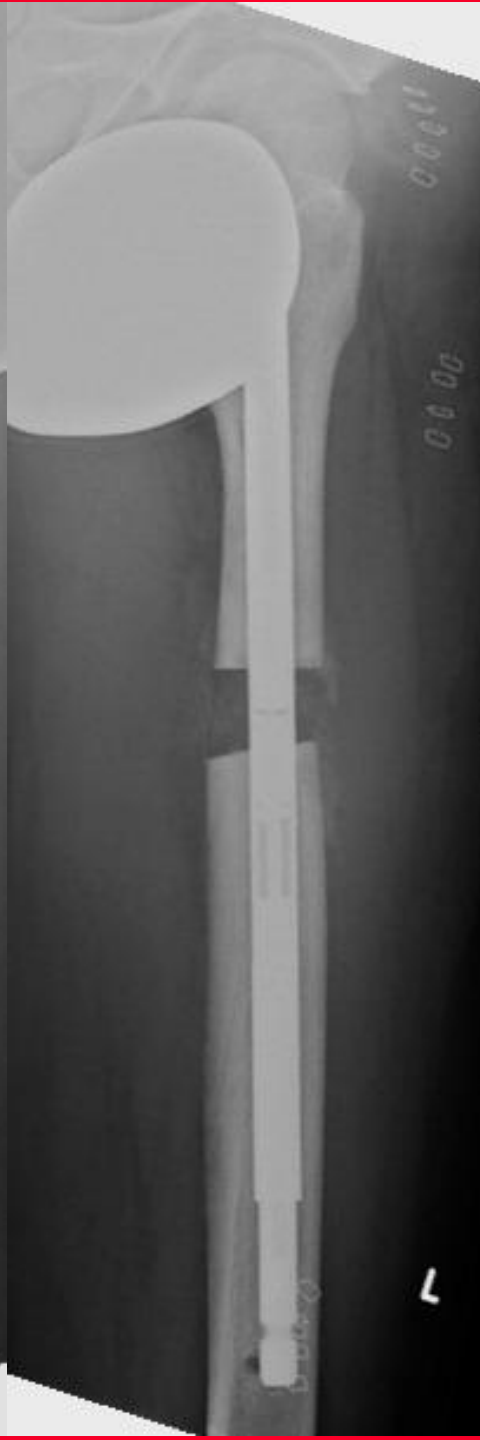


Certainly, for the femur, in cases of severe deformity, the external fixator represents a safe and well-tested system, but, for a simple femoral lengthening, the intramedullary nail is certainly a solution better tolerated by patients.



The introduction of the Precice nail obviates this problem because the transcutaneous magnetic control allows to reverse the movement of the nail producing a shortening, if necessary





**Femoral
lengthening with
magnetic nail
One mm per day**



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**Very rapid
consolidation**



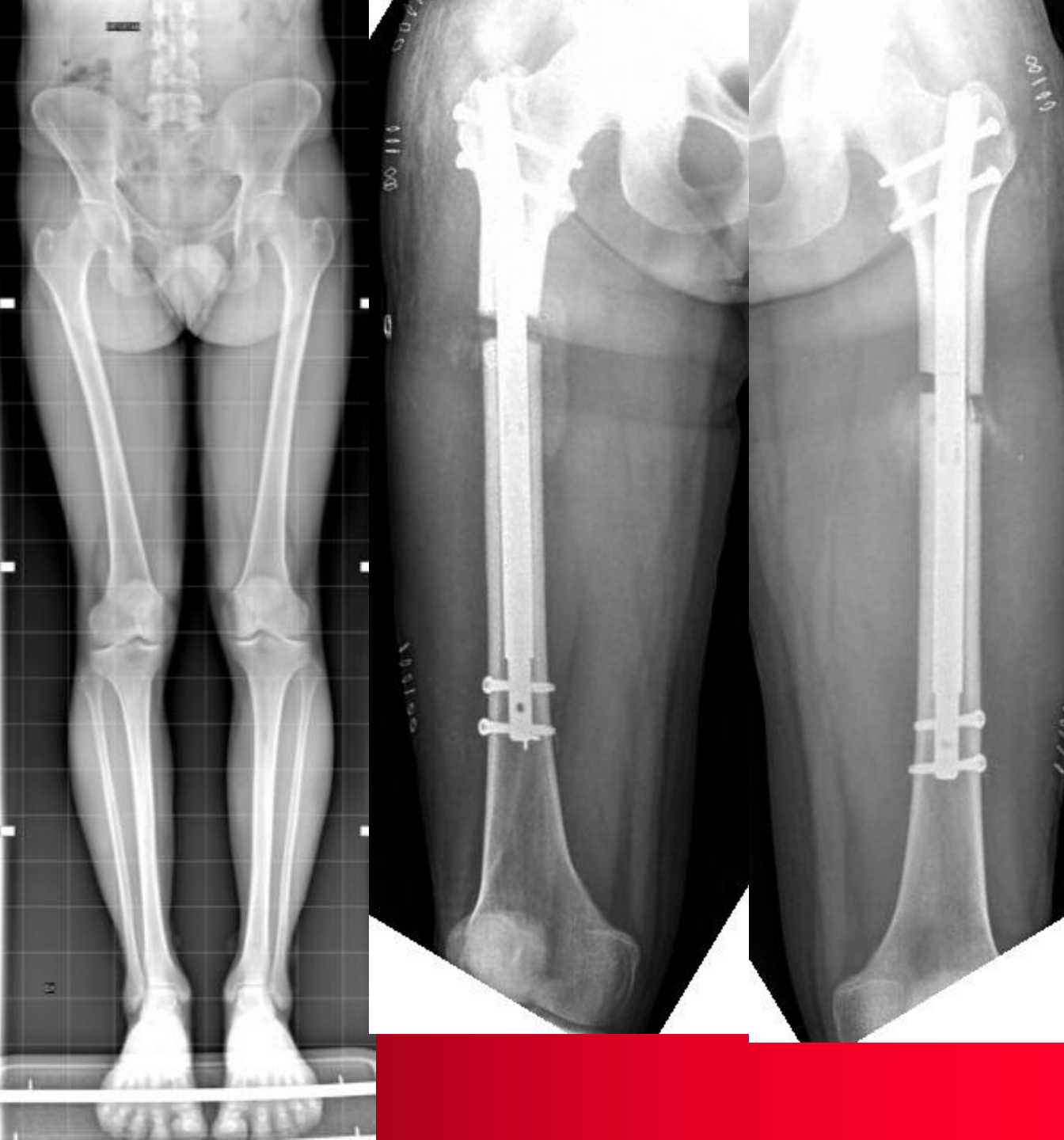
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Minimum scare



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**Initial lengthening
at the time of
surgery**



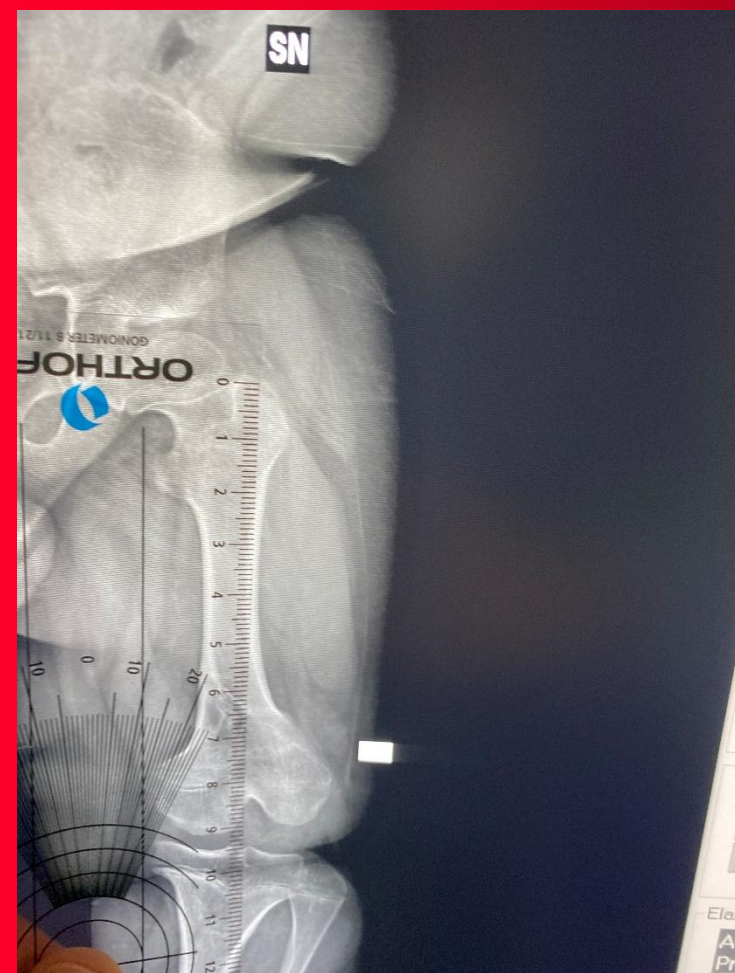
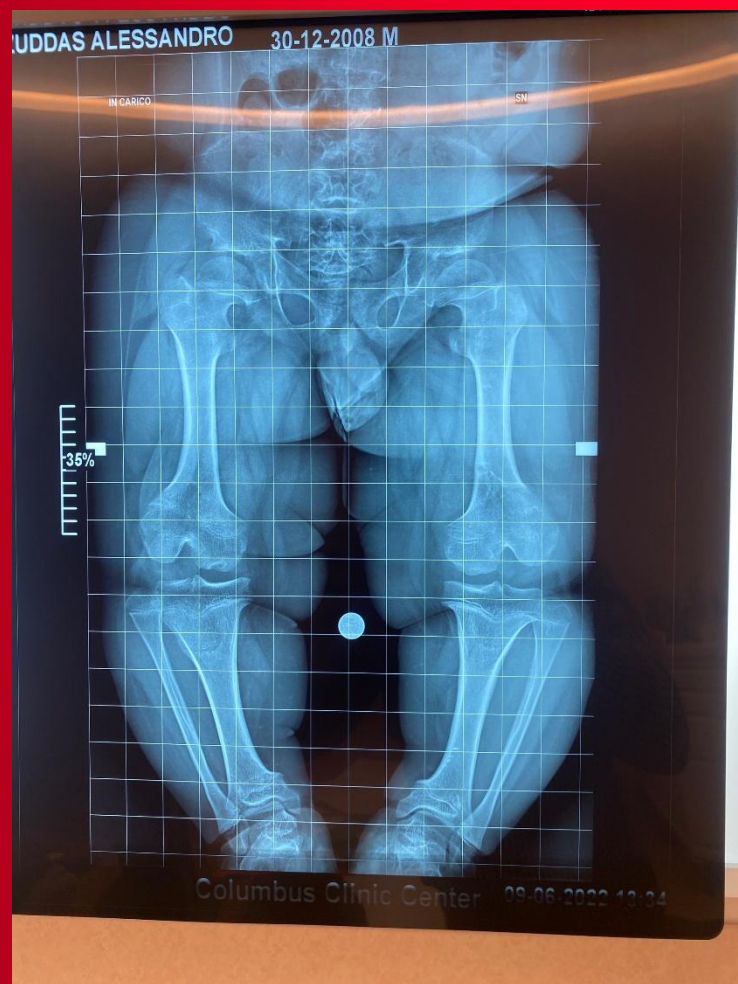
ASAMI Lecco

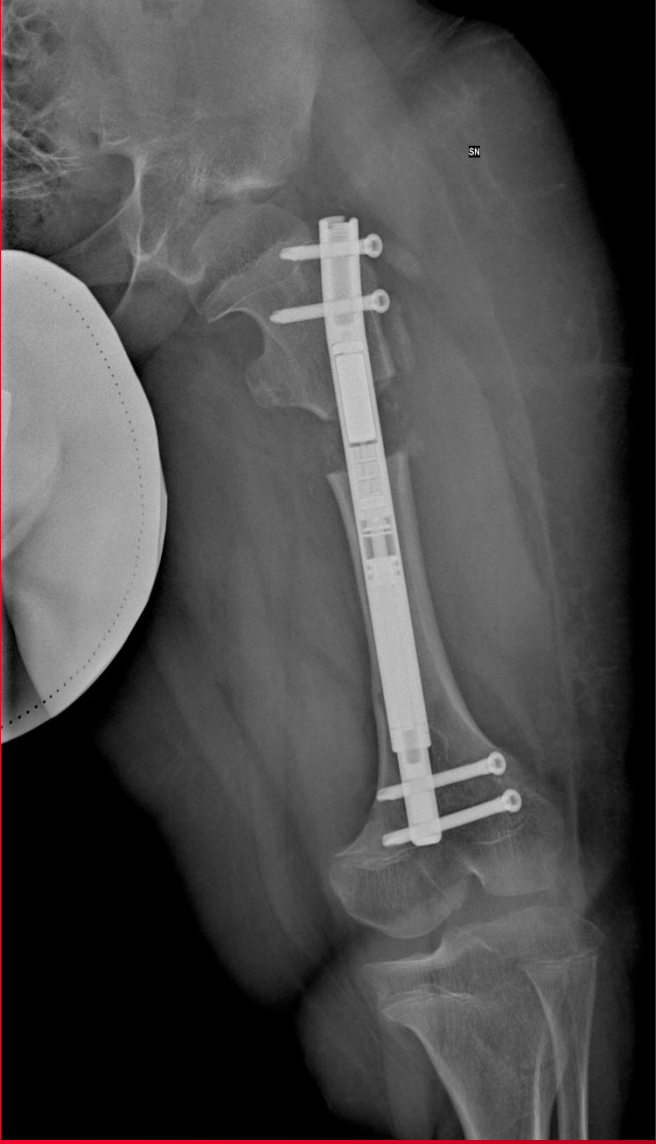


**Rapid consolidation
and recovery of the
function in 6 months**



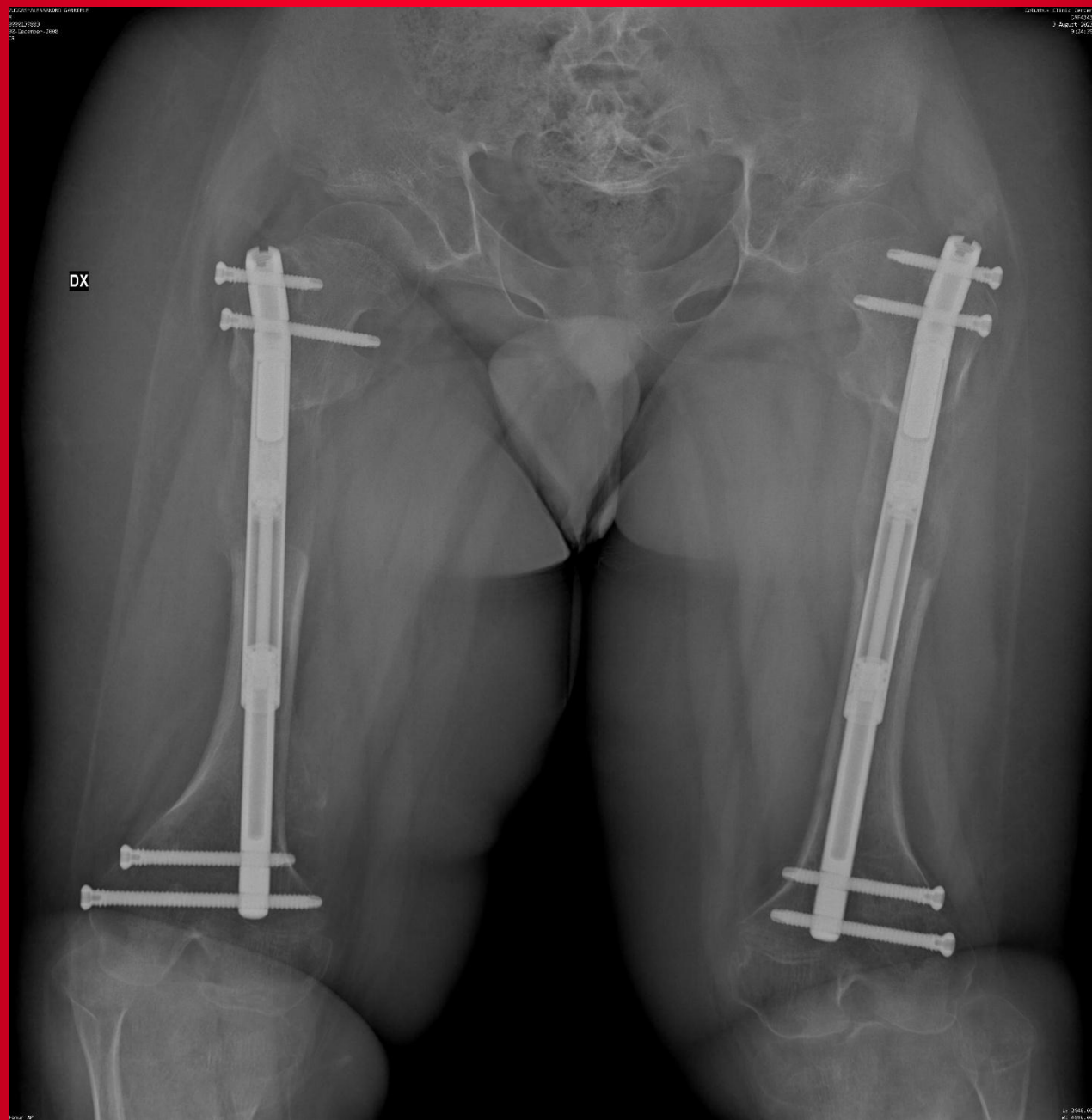
















M. A. Catagni

Thank you



Daniele Pili
info@drpiliortopedico.it



[drpiliortopedico](https://www.instagram.com/drpiliortopedico)

Thank you



Daniele Pili
info@drpiliortopedico.it



[drpiliortopedico](https://www.instagram.com/drpiliortopedico)