

The background of the slide is a light gray gradient with several realistic water droplets of various sizes scattered across it. The droplets have highlights and shadows, giving them a three-dimensional appearance.

CHRONIC POST-TRAUMATIC OSTEOMYELITIS: A MULTIDISCIPLINARY APPROACH TO COMPLEX CASES

MODERATOR: DAVID W. LOWENBERG, MD

PANELISTS: SAAM MORSHED, MD, DAVID SHEARER, MD, SCOTT HANSEN, MD

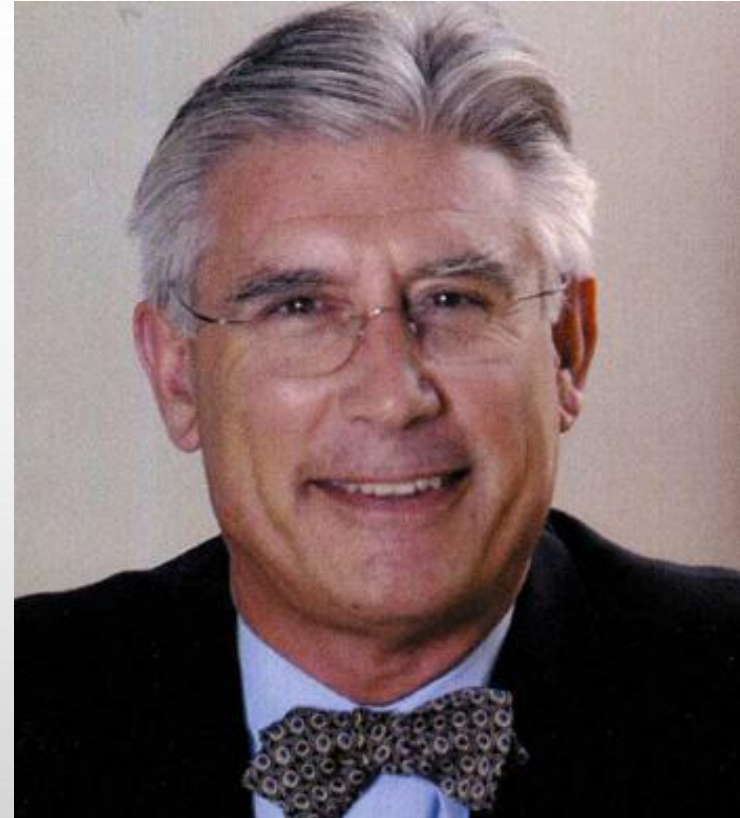
DR. HARRY J. BUNCKE
(1922 – 2008)

*“THE FATHER OF
MICROSURGERY”*

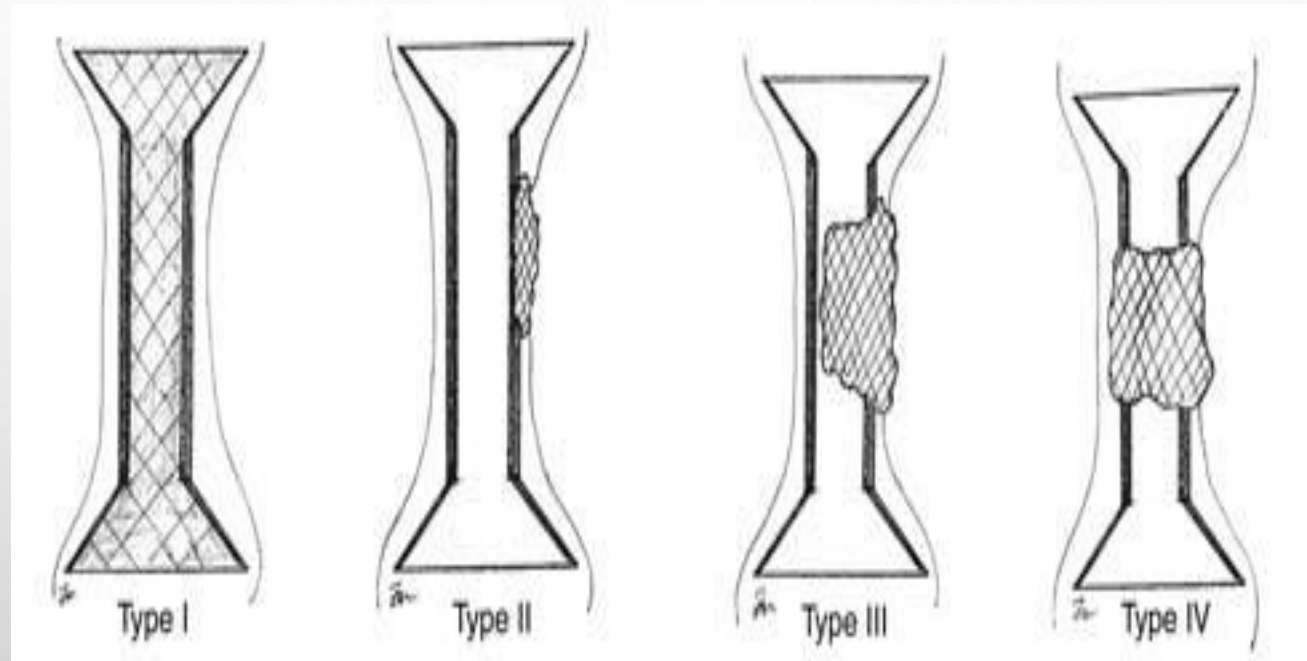


DR. GEORGE CIERNY, III
(1947 – 2013)

*“The Father of
Osteomyelitis
Surgery”*

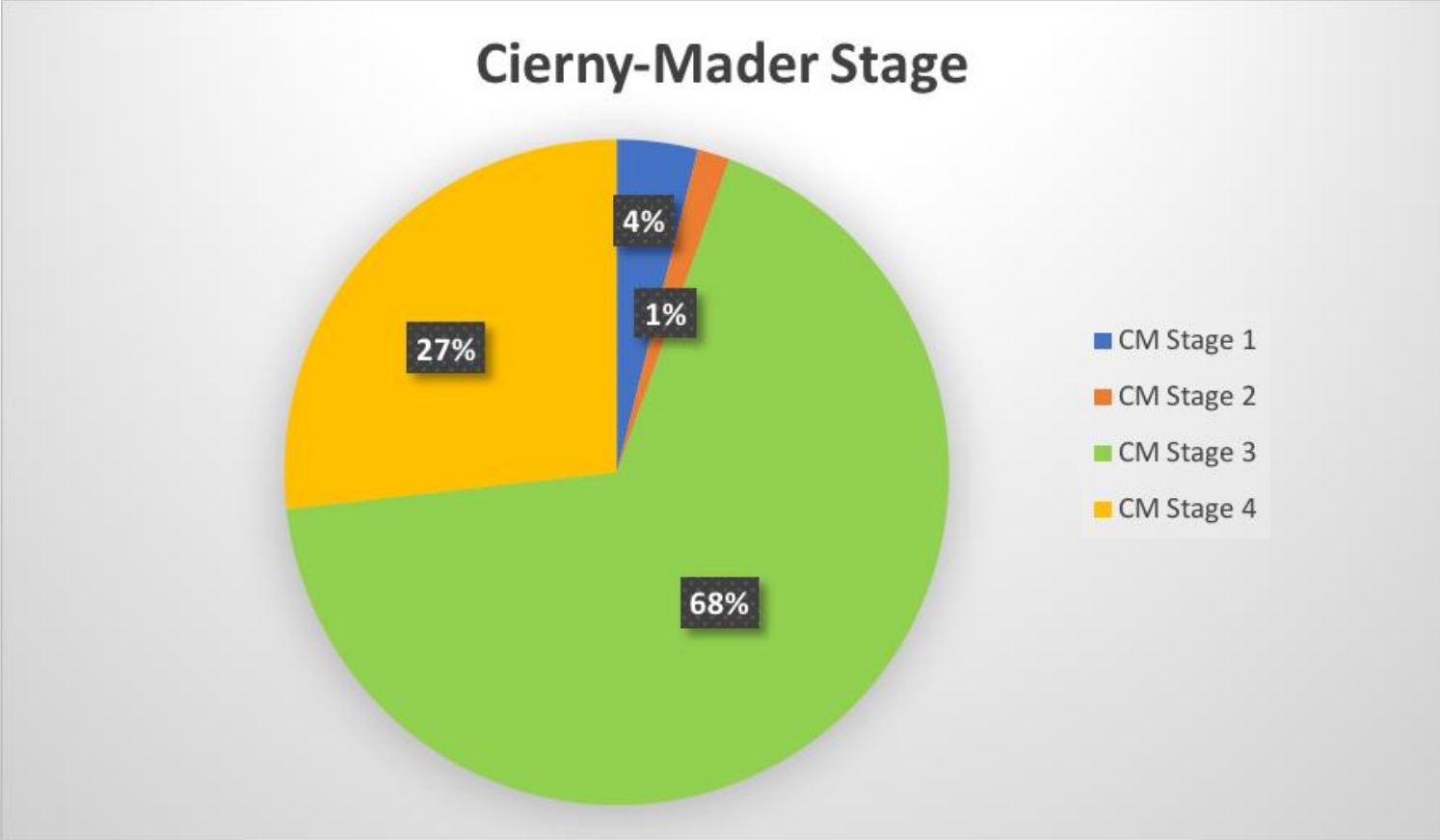


CIERNY-MADER CLASSIFICATION



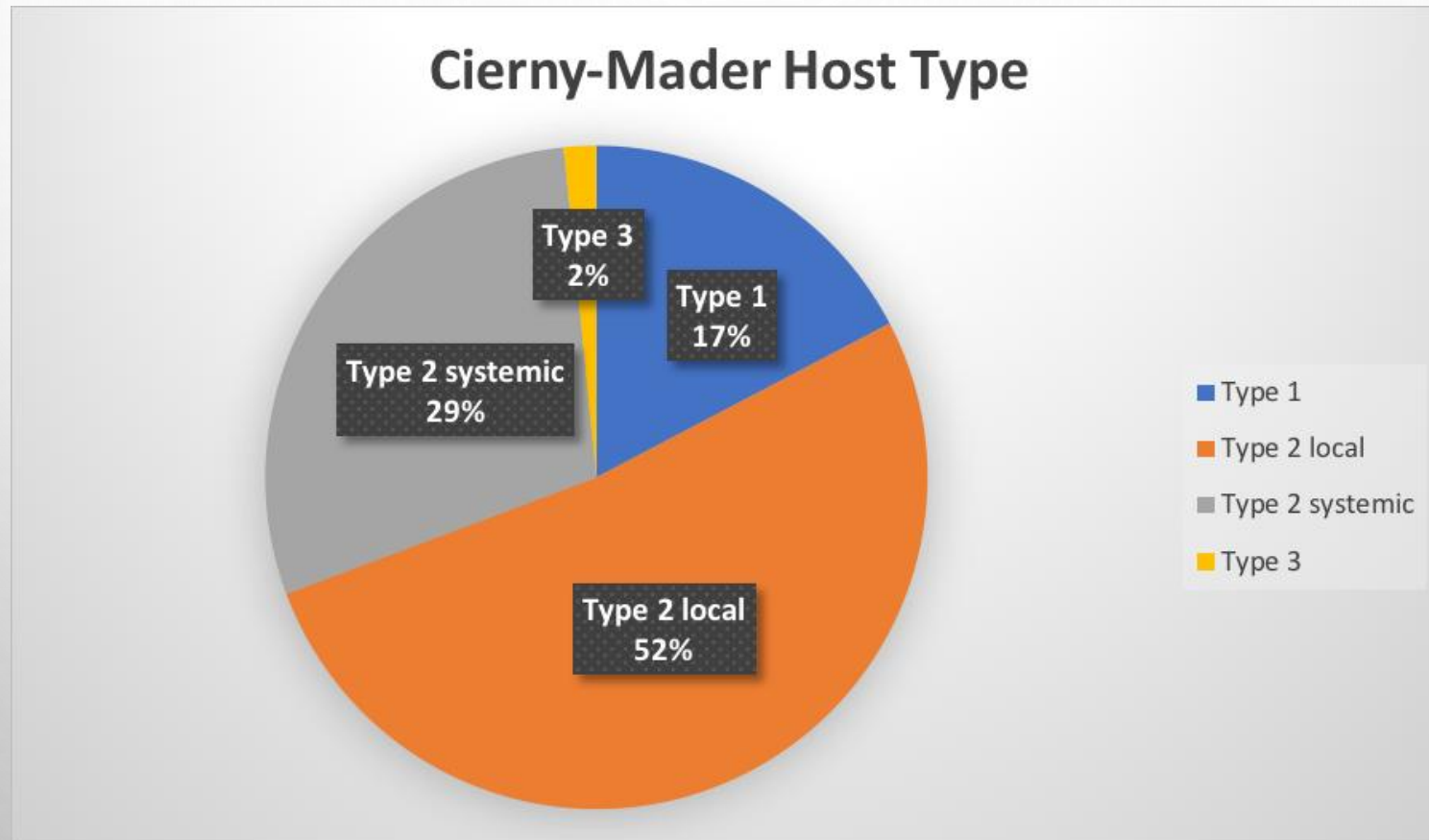
(Reproduced from Ziran BH, Rao N: Infections, in Baumgaertener MR, Tornetta P III [eds]: Orthopaedic Knowledge Update: Trauma 3. American Academy of Orthopaedic Surgeons, Rosemont, IL, 2005, p 132.)

CIERNY-MADER STAGE



Type	Infection Status	Perpetuating Factors	Treatment
A	Normal physiologic response	Little or no systemic or local compromise	No contraindications to surgical treatment
B (local)	Locally active Impairment of response	Prior trauma, or surgery to area; chronic sinus; free flap; impaired local vascular supply	Consider healing potential of soft tissues and bone, consider adjunctive measures
B (systemic)	Systemically active Impairment of response	Diabetes, immunosuppression, vascular, or metabolic disease	Treat correctable metabolic/nutritional abnormalities first
C	Severe infection	Severe systemic compromise and stressors	Suppressive treatment or amputation

CIERNY-MADER HOST TYPE



TREATMENT

Temporal Order	Reconstruction Step Performed
1	Excise <i>ALL</i> devitalized/infected bone and soft tissue.
2	Manage the dead space.
3	Obtain a healed soft tissue envelope.
4	Reconstruct the bone defect.

Liberal use of free tissue transfers for soft tissue envelope reconstruction.

***HOW MUCH DO YOU CUT OUT?
WHAT'S DEAD AND WHAT'S ALIVE?***



70 Y/O M NOW 40 YEARS FOLLOWING BLAST INJURY

- SUFFERED AN OPEN TIBIA FRACTURE WHICH HEALED WITH DEFORMITY.
- HAS HAD A CHRONIC SINUS TRACT WITH ATROPHIC SOFT TISSUE ENVELOPE SINCE THEN.
- NOW WITH KNEE PAIN.



70 Y/O M WITH 40 YEAR SINUS TRACT



CLASSIFY THE CIERNY-MADER STAGE?

- STAGE 3
- LOOK AT THE POSTERIOR CORTEX.



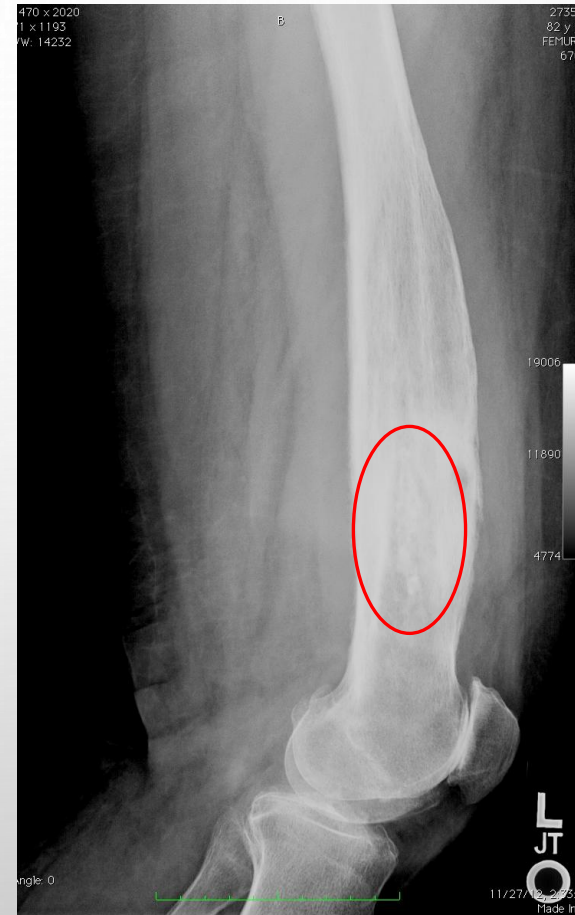
RR: 26 Y/O FOLLOWING MCA, POLYTRAUMA



79 Y/O F WITH NEW ONSET DRAINING SINUS TRACT AT LATERAL LEFT THIGH

- AT AGE 15 DEVELOPED HEMATOGENOUS OSTEOMYELITIS TO THE LEFT DISTAL FEMUR.
- UNDERWENT AND EXCISIONAL DEBRIDEMENT.
- ONE OF THE FIRST PATIENTS IN THE U.S. TO RECEIVE PCN AS A COMPASSIONATE USE.
- DID JUST FINE UNTIL ~ 7 WEEKS AGO WHEN DEVELOPED A COMMON FLU.
- 1 WEEK LATER DEVELOPED LEFT DISTAL THIGH AND SWELLING FOLLOWED BY MALAISE AND A WEEK LATER A DRAINING SINUS.

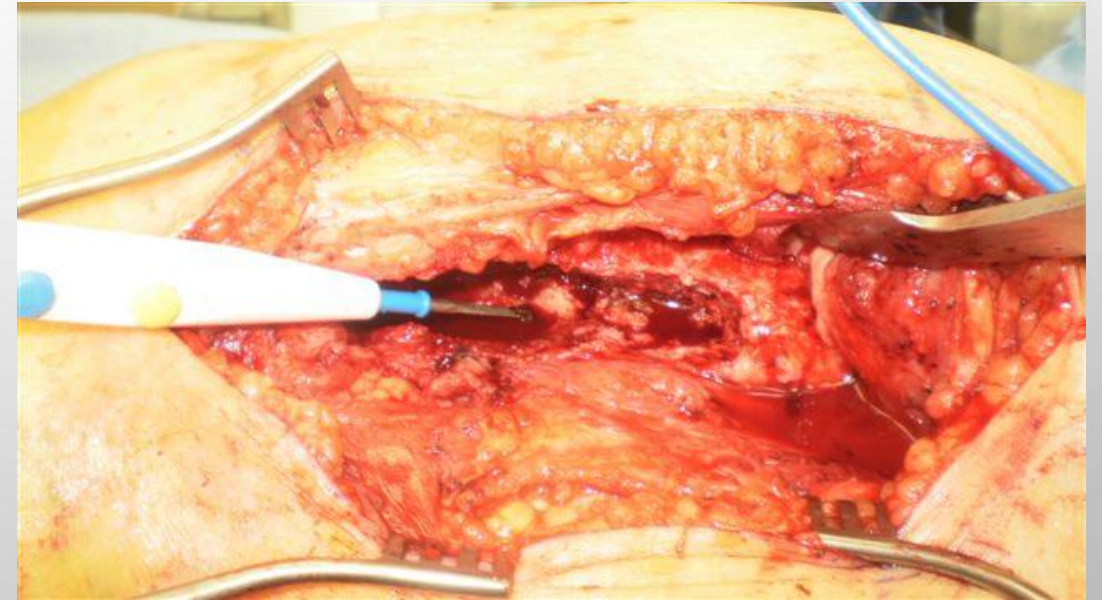
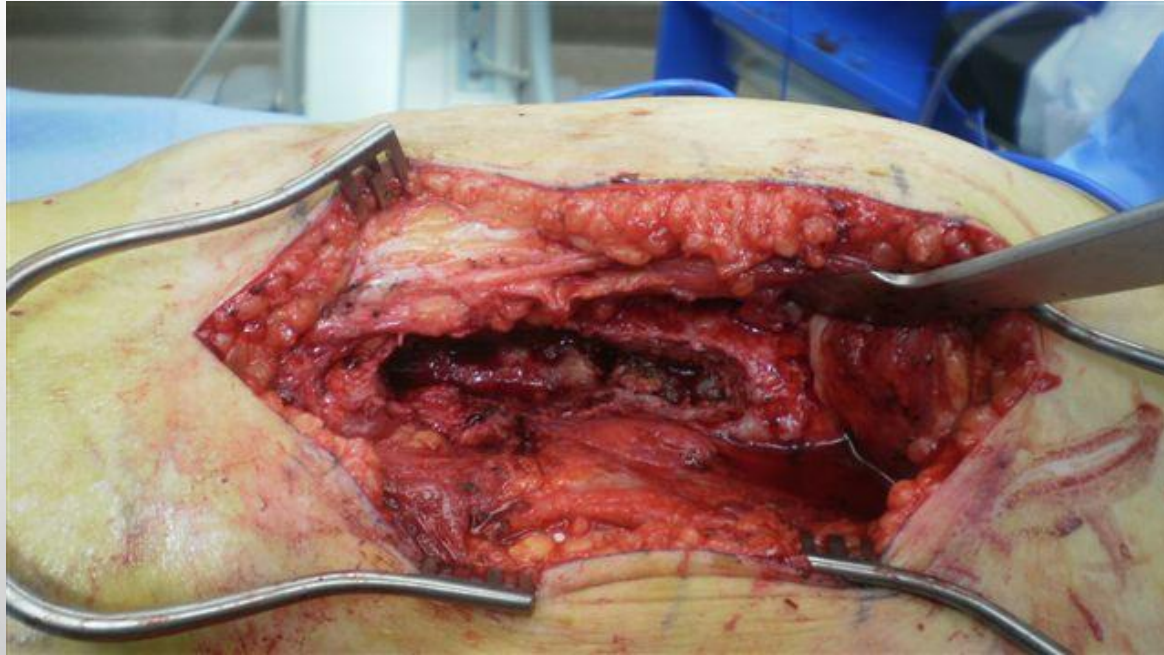
79 Y/O F WITH LEFT FEMORAL SINUS TRACT



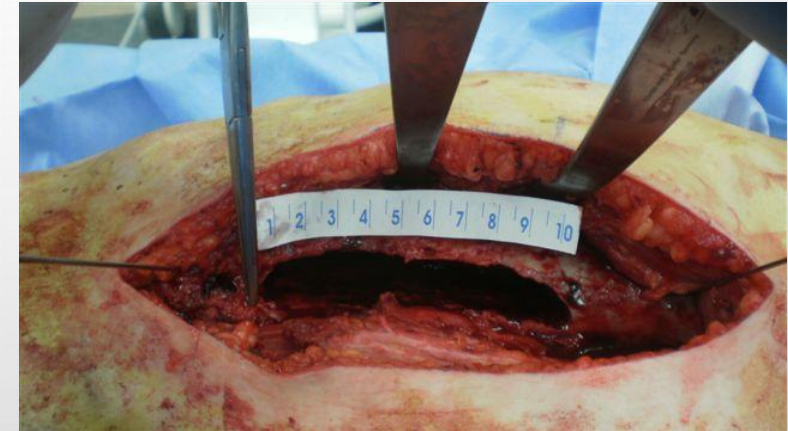
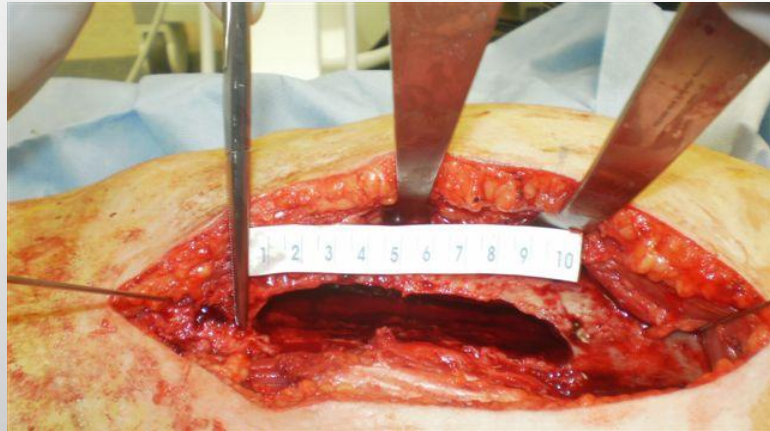
LATERAL THIGH SINUS TRACT *



SEQUESTRUM IN C-M STAGE 3



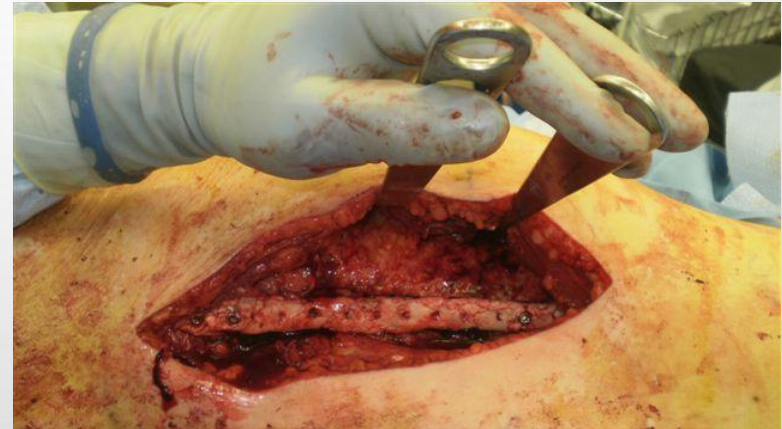
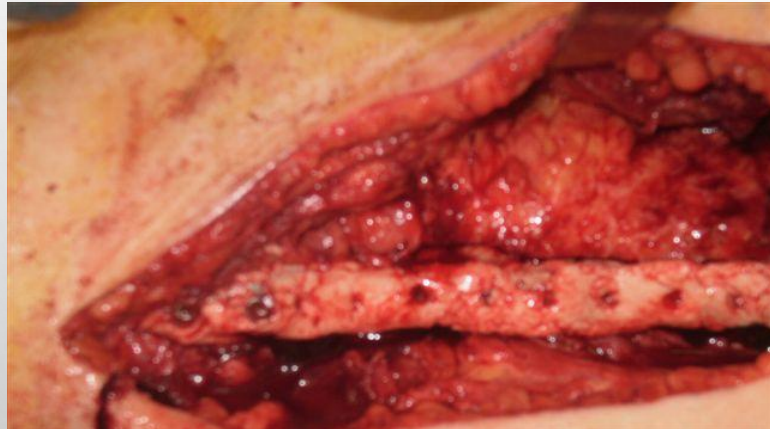
FOLLOWING DEBRIDEMENT AND SEQUESTRECTOMY



SEQUESTRUM



ANTIBIOTIC BEAD PLACEMENT FOR LOCAL DELIVERY AND DEAD SPACE MANAGEMENT WITH ANTIBIOTIC BRIDGE PLATING



FOLLOWING SAUCERIZATION AND COMPLETE DEBRIDEMENT OF C-M STAGE 3 OSTEOMYELITIS



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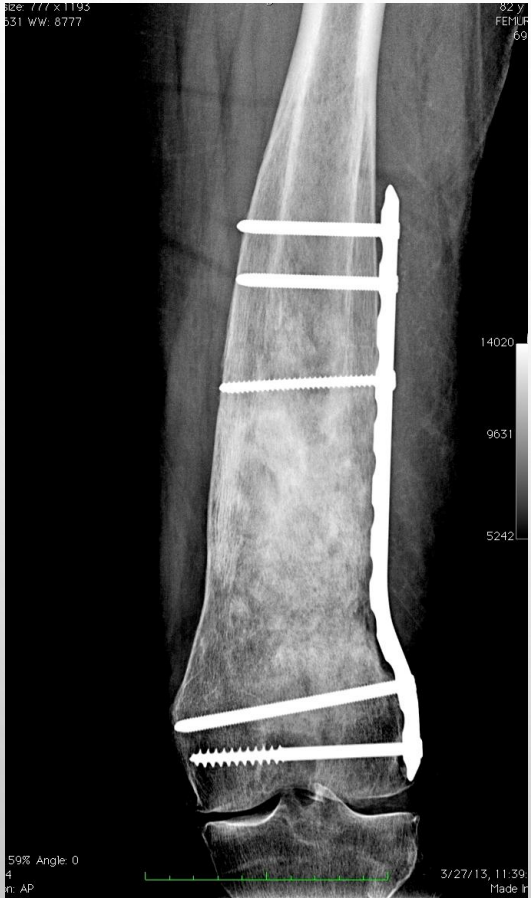
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1 MONTH FOLLOWING BONE GRAFTING WITH AUTO/ALLOGRAFT MIXTURE



2 MONTHS FOLLOWING BONE GRAFTING WITH AUTO/ALLOGRAFT



5 MONTHS FOLLOWING BONE GRAFTING WITH AUTO/ALLOGRAFT



1-1/2 YEARS FOLLOWING GRAFTING, REMAINS ASYMPTOMATIC



3 YEARS POST-GRAFTING. PHONE CONTACT FOR F/U

- THE PATIENT STATED SHE WAS DOING WELL.
- ADMITTED TO SOME MEMORY FAILURE.
- STILL WALKING INDEPENDENTLY.
- NO PAIN.
- NO DRAINAGE OR SWELLING.

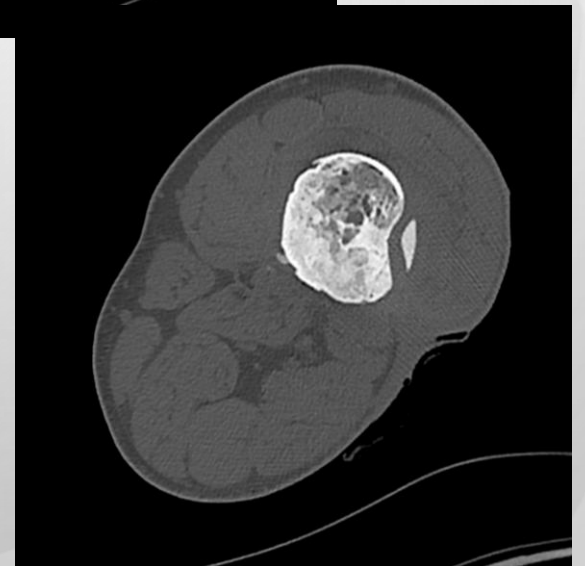
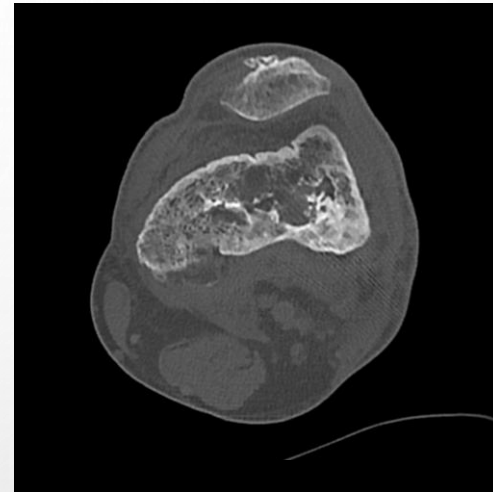
S.L.: 68 Y/O M FOLLOWING SURGERY IN MEXICO 10+ YEARS AGO

- LEFT DISTAL FEMUR FRACTURE > 10 YEARS PRIOR TREATED WITH ORIF.
- GOT INFECTED, REMAINED INFECTED AND EVENTUALLY HE HEALED.
- HARDWARE REMOVED AND A CEMENT BLOCK PLACED.
- HAS BEEN DRAINING FROM 5 SINUS TRACTS EVER SINCE.
- OTHERWISE HEALTHY AND CAN WALK ON HIS LEG.

S.L.: 5 SINUS TRACTS AT THE DISTAL FEMUR MEDIALLY AND Laterally



S.L.: 5 SINUS TRACTS AT THE DISTAL FEMUR MEDIANLY AND LATERALLY

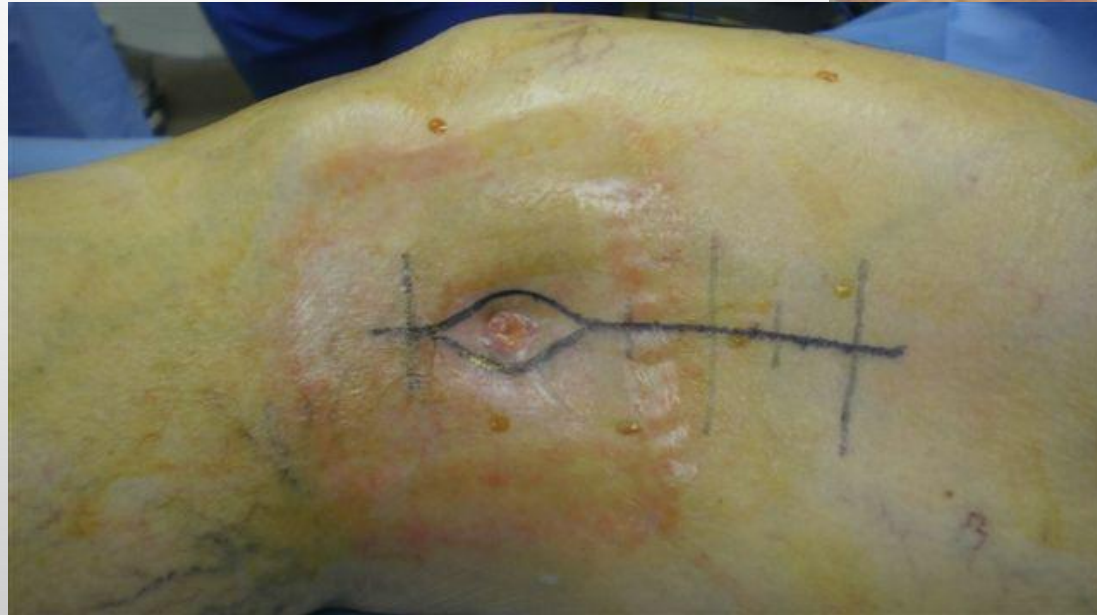


Question?

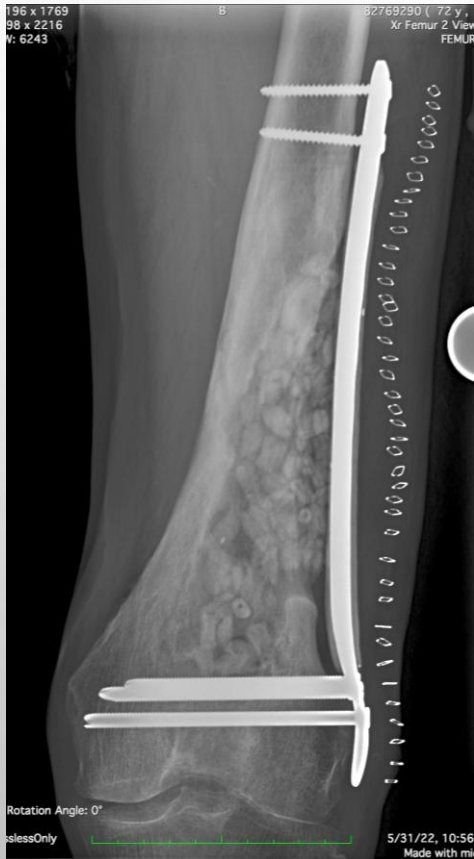
- **WHAT IS THE TYPE/STAGE OF OSTEOMYELITIS?**
- **WHAT IS THE HOST TYPE?**

Question?

- WHAT ABOUT THE SINUS TRACTS??



S.L.: ESSENTIALLY A TYPE 3 CM OSTEO EXCISE
ALL INFECTED NECROTIC BONE AND SOFT TISSUE,
DEAD SPACE MANAGEMENT



S.L. 6 WEEKS POST-OP



S.L.: AFTER REDEBRIDE, CX'S, BEAD EXCHANGE... NO GROWTH



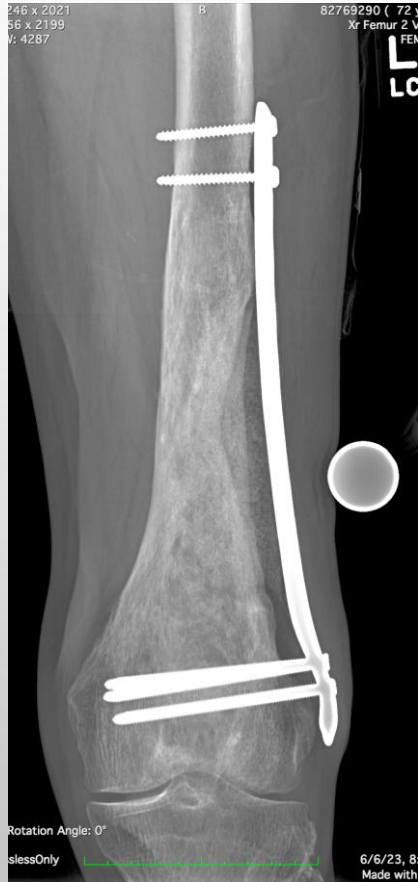
S.L.: POST-OP DISTAL DEFECT ICBG AND BEAD MANAGEMENT FOR DIAPHYSEAL DEAD SPACE



S.L.: 3 MONTHS FOLLOWING DISTAL GRAFTING



S.L. FOLLOWING DIAPHYSEAL GRAFTING



S.L.: 3 MONTHS S/P DISAPHYSEAL GRAFTING



S.L.: 1 YEAR AFTER LAST SURGERY. NO RECURRENCE,
NO PAIN, BACK TO FULL ACTIVITY



J.E.: 32 Y/O F DROVE OFF THE ROAD, EJECTED, AND FOUND IN A RIVERBED

- WAS UNCONSCIOUS AND SUFFERED A CLOSED HEAD INJURY AND A MIDSHAFT OPEN RIGHT FEMUR FRACTURE.
- THE ACCIDENT OCCURRED IN THE MIDDLE OF THE NIGHT AND SHE WAS NOT FOUND FOR > 8 HOURS WITH HER FEMUR IN THE WATER OF A NONFLOWING RIVERBED (STAGNANT WATER).

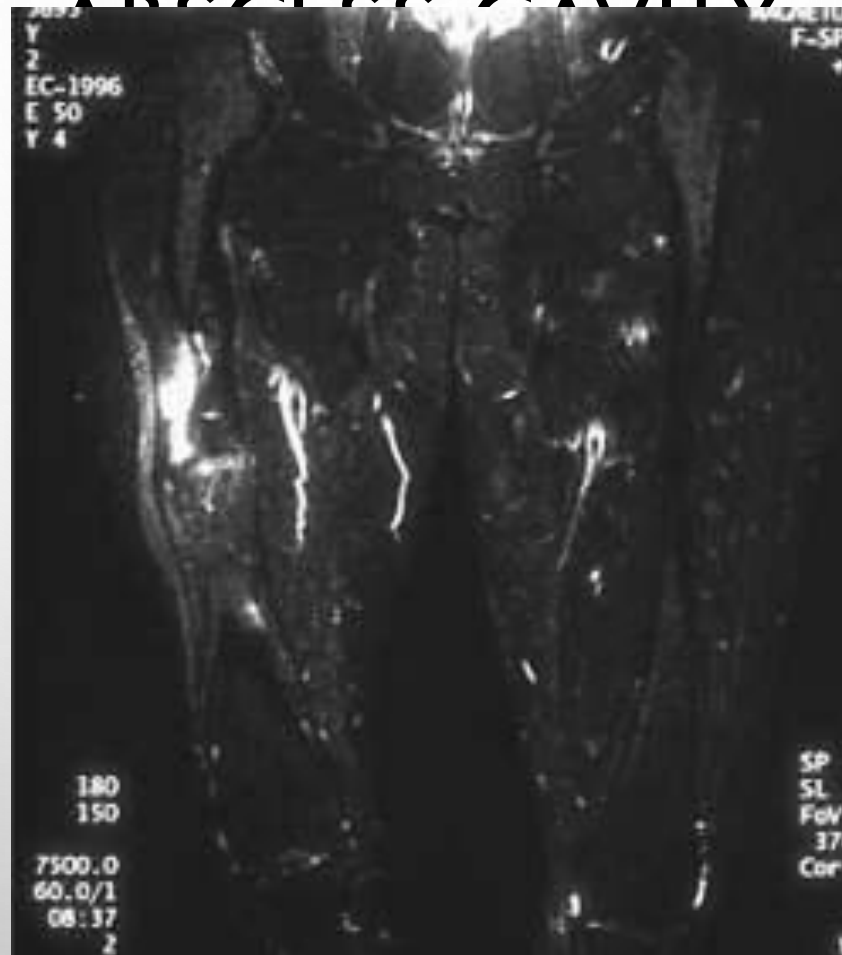
FEMUR TREATED WITH TRACTION, DRESSING CHANGES THEN CASTING



FOLLOWING CASTING WITH CHRONIC ANTIBIOTIC SUPPRESSION



MRI DELINEATING EXTENT OF OSTEOMYELITIS & ABSCESS CAVITY



FOLLOWING RESECTION WITH ANTIBIOTIC NAIL & BEAD POUCH PLACEMENT, & TRANSPORT FRAME



10 CM BONE TRANSPORT OVER A LOCKED FEMORAL ROD



COMPLETION OF BONE TRANSPORT



GRAFTING AT DOCKING SITE



NONUNION AT DOCKING SITE



EXCHANGE RODDING WITH REAMING



HEALED WITH EQUAL LIMB LENGTH AND
RESOLUTION OF OSTEOMYELITIS, RETURNED TO FULL
ACTIVITIES, RESUMED WORK AS AN ACCOUNTANT



12 YEAR FOLLOW UP, NO FUNCTIONAL LIMITATIONS, NO MEDS



22 YEARS POST TREATMENT

- NO LIMITATIONS IN FUNCTION OR ACTIVITY.
- TAKES NO PAIN MEDICATIONS.
- WORKS FULL TIME AS AN ACCOUNTANT WITHOUT ISSUES.

B.K.: 60 Y/O F WITH CLOSED PATELLA FRACTURE FOLLOWING A FALL

- Initially treated with a conventional ORIF using tension band wiring one day after injury.
- 7 days post-op developed swelling and pain. Aspirated and pyarthrosis found. Taken to OR for I&D.

B.K.: 60 Y/O F WITH CLOSED PATELLA FRACTURE FOLLOWING A FALL

- Infection persisted, brought back to OR POD #6/13 for repeat I&D with attempted closure.
- *Began HBO treatment.*
- Developed massive wound breakdown and continued infection. Transferred for care POD #20 from index surgery.

HERESY: HYPERBARIC O₂

SHANDLEY, S, MATTHEWS, KP, COX, J, ROMANO, D, ABPLANALP, A, KALNS, J; J
ORTHOP RES, FEB;30(2), 203-8, 2012.

■ **I THINK WE HAVE FINALLY PUT THE NAIL
IN THE COFFIN.**

■ NO EFFICACY FOUND IN THE TREATMENT OF IMPLANT-
ASSOCIATED OSTEOMYELITIS FOR METHICILLIN-RESISTANT
STAPHYLOCOCCUS AUREUS AND PSEUDOMONAS
AERUGINOSA IN AN ANIMAL MODEL.

B.K.: 3 WEEKS OUT WITH LARGE OPEN WOUND



B.K.: 3 WEEKS OUT WITH LARGE OPEN WOUND

- Taken to OR for debridement and staging.
- Had been treated with a Wound Vac.
- Patella and Patellar Tendon now necrotic.



B.K.: WITH CHRONIC OPEN WOUND

- **Necrotic Patella.**
- **Necrotic patellar Tendon.**
- **Joint infection.**

What do you want to do??

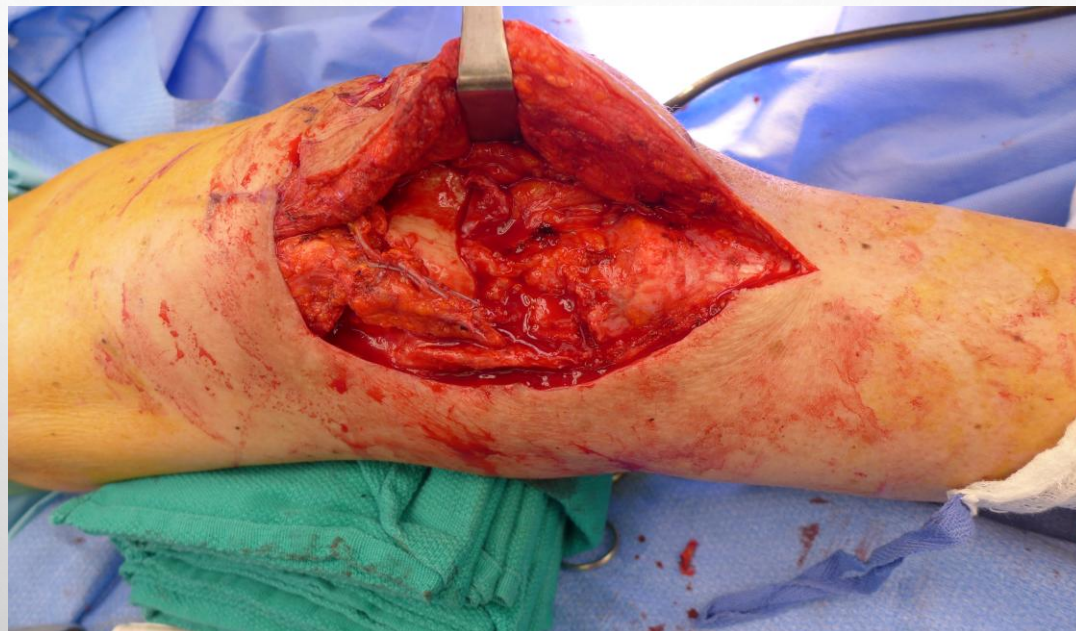
B.K.: TREATMENT... DEBRIDEMENT, OPEN ANTIBIOTIC BEAD POUCH

- Free tissue transfer (partial latissimus with skin paddle) over beads when clean (6 days later).
- Then late reconstruction.

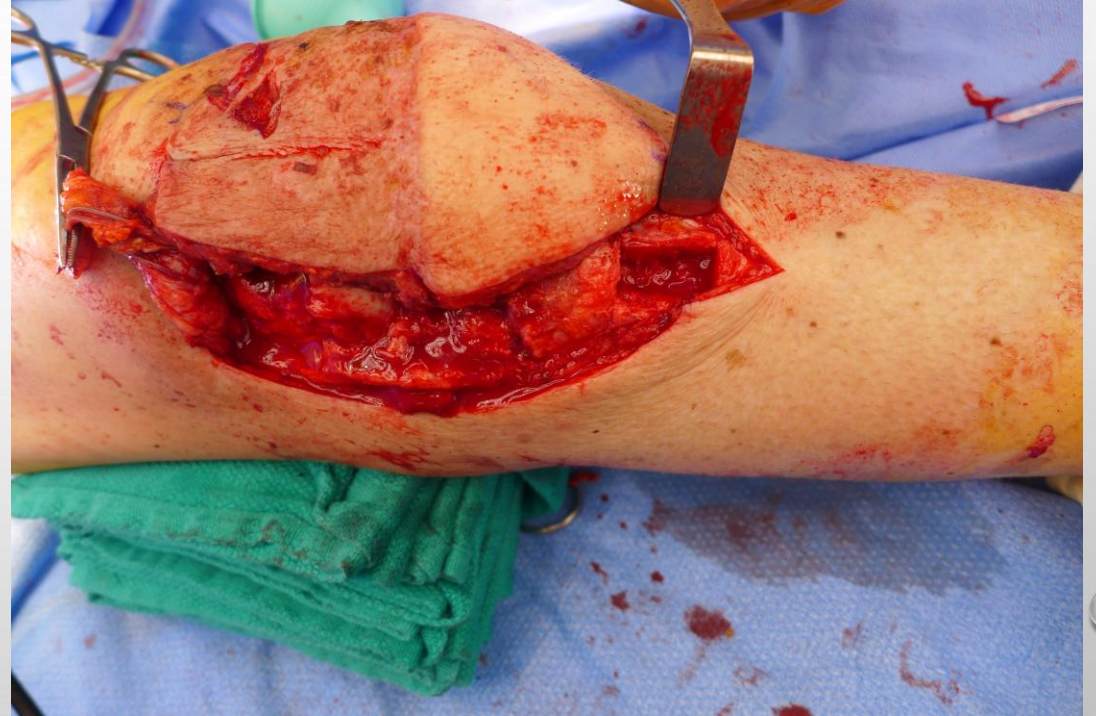
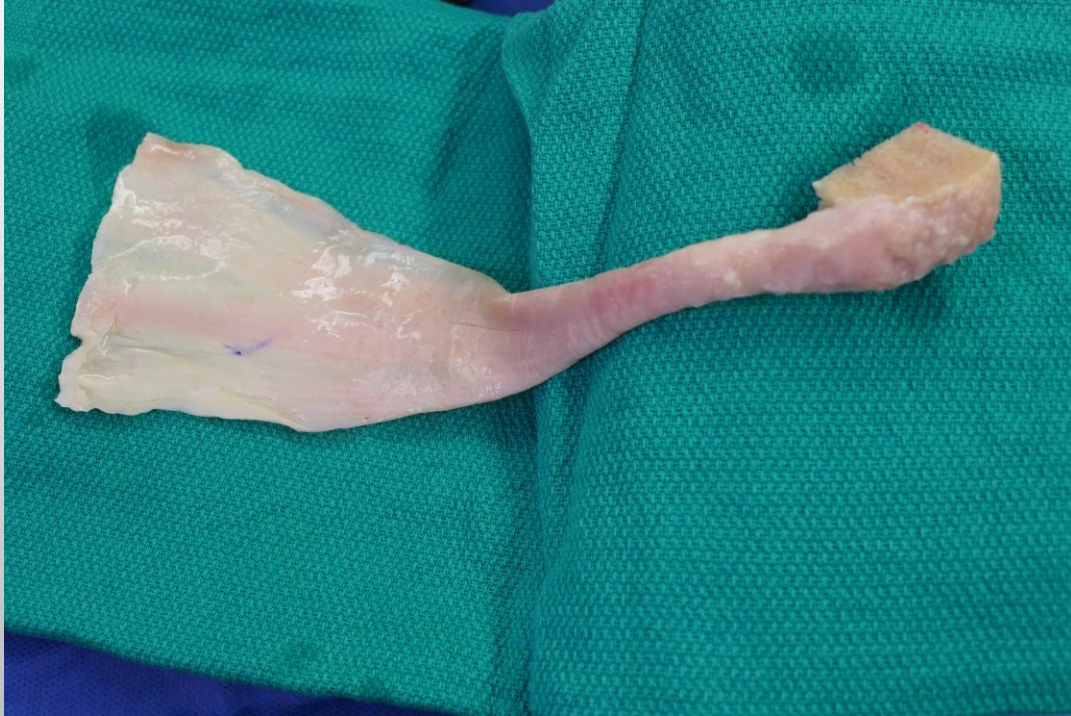
B.K.: FREE FLAPPED ALLOWED TO REST



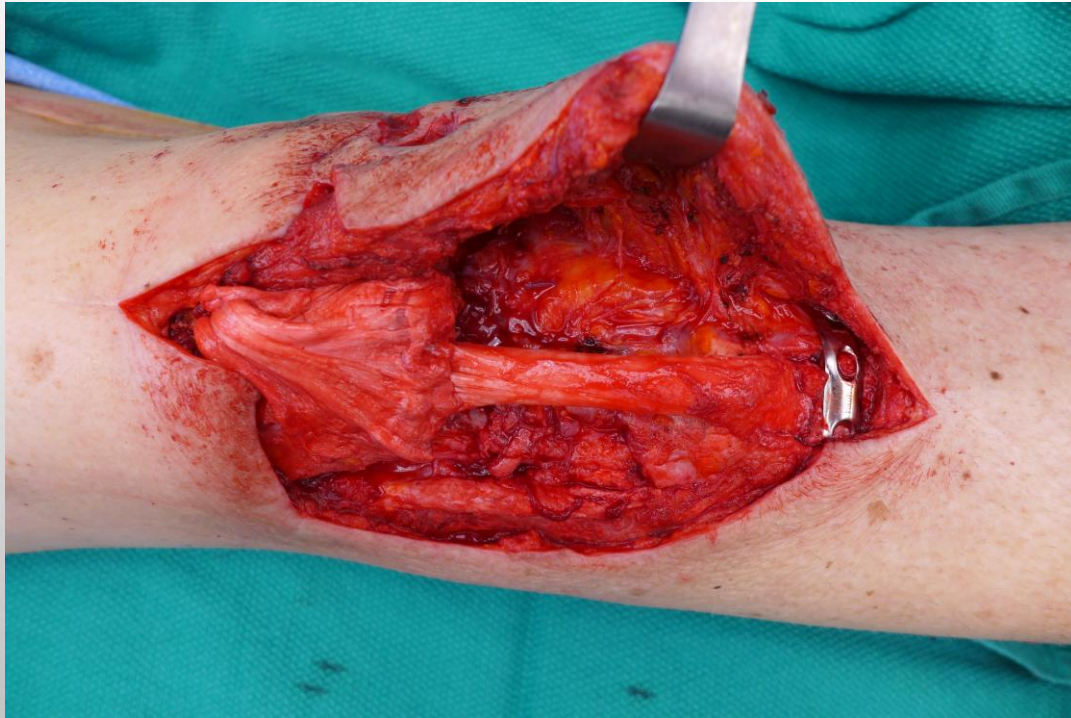
B.K.: FLAP THEN ELEVATED FOR RECONSTRUCTION



B.K.: FLAP THEN ELEVATED FOR RECONSTRUCTION



B.K.: FLAP THEN ELEVATED FOR RECONSTRUCTION



B.K.: 6 MONTHS FOLLOWING RECONSTRUCTION



B.K.: 5 YEARS FOLLOWING FRACTURE (“PHONE CALL” FOLLOW UP)

- SHE IS A COMMUNITY AMBULATOR WALKING WITHOUT AN AMBULATORY AID.
- TAKES OCCASIONAL NSAID’S FOR PAIN.
- SHE HAS SOME KNEE PAIN AND HAS NEVER RETURNED TO THE ACTIVITY LEVEL SHE HAD BEFORE THE FRACTURE.

A.G.: 22 Y/O M S/P ACHILLES TENDON RUPTURE

- HEALTHY U.C. BERKELEY STUDENT WHO SUFFERED A CLOSED ACHILLES TENDON RUPTURE WHILE PLAYING LACROSSE.
- TREATED BY PRIMARY REPAIR AT A HOSPITAL WHERE HIS FATHER (AN OB/GYN) IS CHIEF OF STAFF.

A.G.: 22 Y/O M S/P ACHILLES TENDON RUPTURE

- PLACED IN A SHORT LEG CAST POST-OPERATIVELY.
- ~2 WEEKS LATER NOTED A BAD SMELL FROM THE CAST.
- CAST REMOVED WITH COMPLETE BREAKDOWN OF WOUND.
- SERIAL DEBRIDEMENTS LED TO COMPLETE LOSS OF ACHILLES TENDON.

**A.G.: 22 Y/O M, COMPLETE LOSS OF
ACHILLES TENDON & SOFT TISSUE ENVELOPE**



A.G.: 22 Y/O M, COMPLETE LOSS OF
ACHILLES TENDON & SOFT TISSUE ENVELOPE

WHAT DO YOU DO?

A.G.: 22 Y/O M, COMPLETE LOSS OF
ACHILLES TENDON & SOFT TISSUE ENVELOPE

HOT DOG IN A BUN PROCEDURE

HOT DOG IN A BUN



HOT DOG IN A BUN



HOT DOG IN A BUN



A.G.: 2 MONTHS POST FLAP & FRAME



**A.G.: 3 MONTHS POST FLAP & FRAME,
WALKING NORMALLY WITHOUT AN
AMBULATORY AID**



A.G.: 4 MONTHS AFTER ACHILLES RECONSTRUCTION



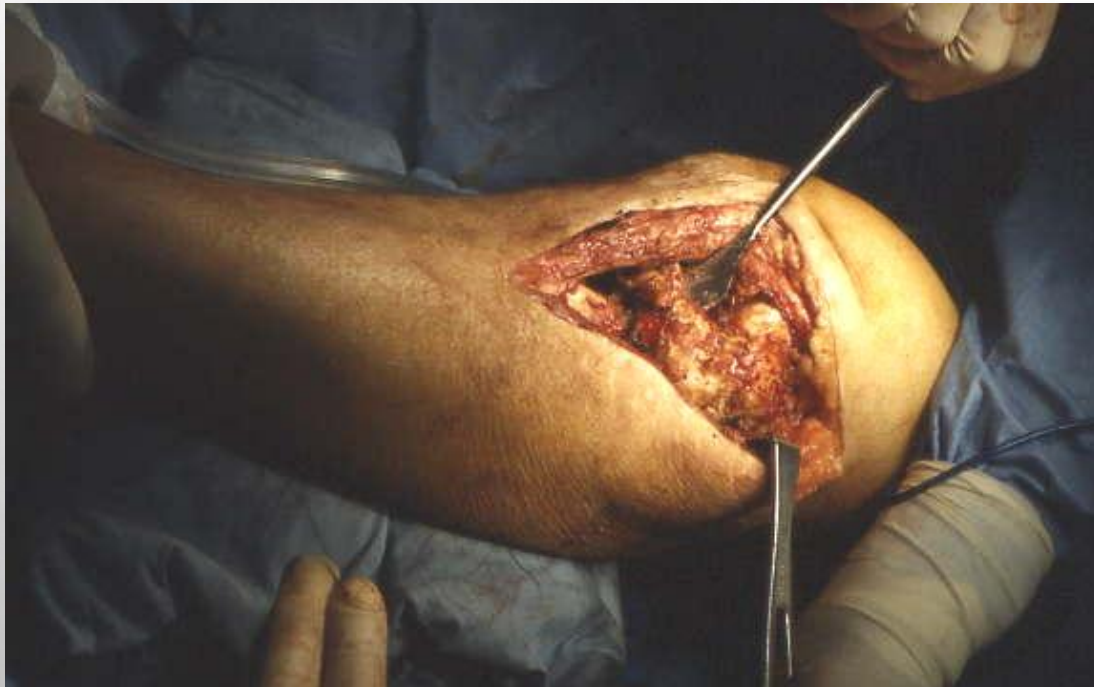
M.P.: PATIENT WITH SINUS TRACT AT ANTERIOR KNEE

- 60 year old female with diabetes mellitus, s/p tibial plateau fracture repaired in Central America 4 years prior.
- Came to California and worked her way up the cost hitting the Academic Medical Centers.
- With a chronic draining sinus tract that shot out pus with each step she took.
- Told her only option was an AKA.

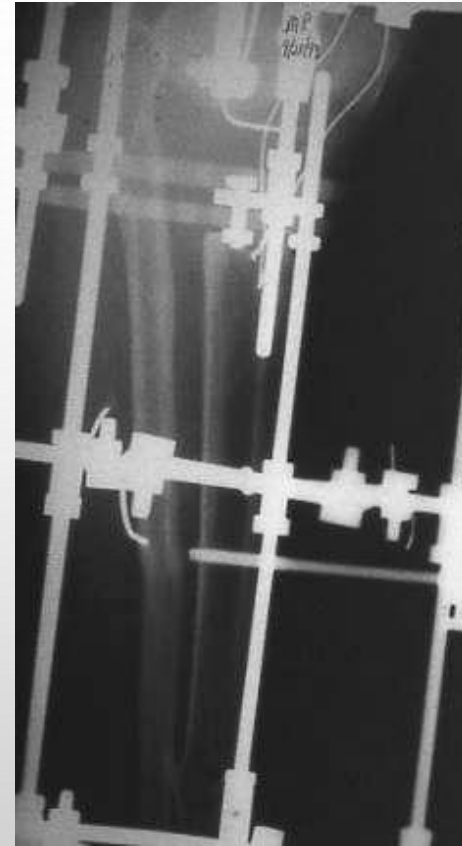
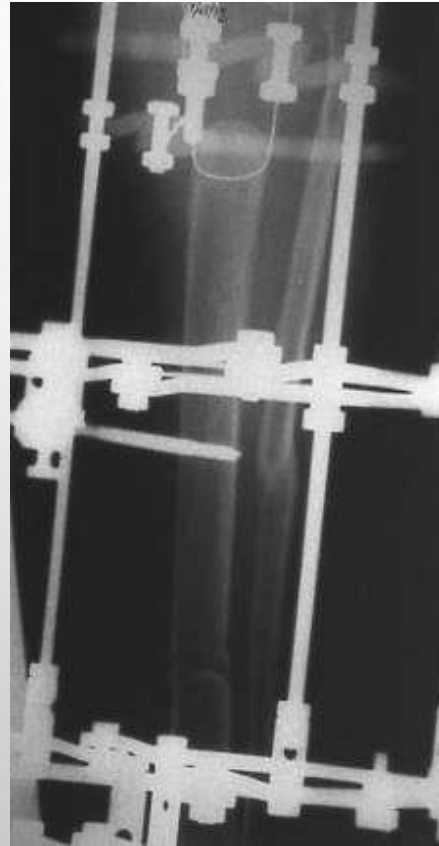
4 YEAR DRAINING SINUS TRACT



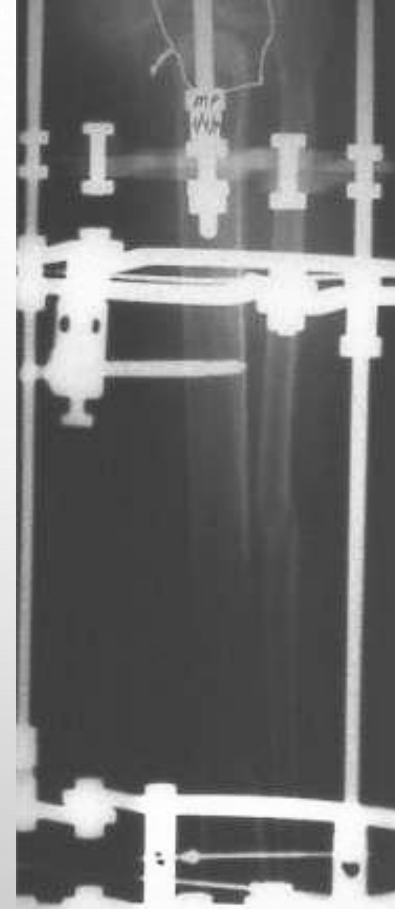
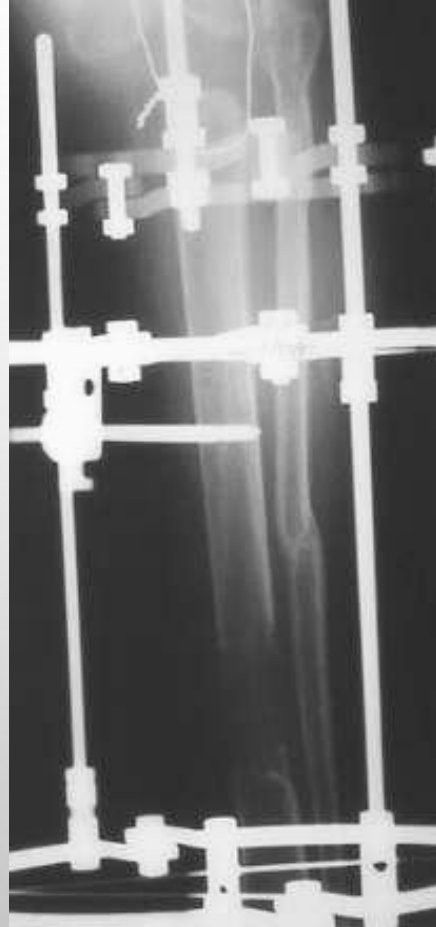
C-M STAGE 4 OSTEOEN BLOC RESECTION OF TIBIAL PLATEAU



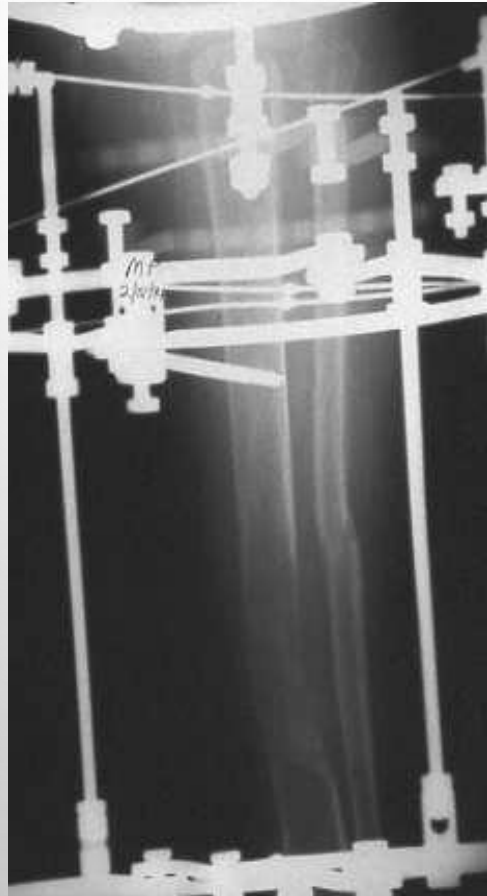
DISTAL TIBIAL CORTICOTOMY & TRANSPORT



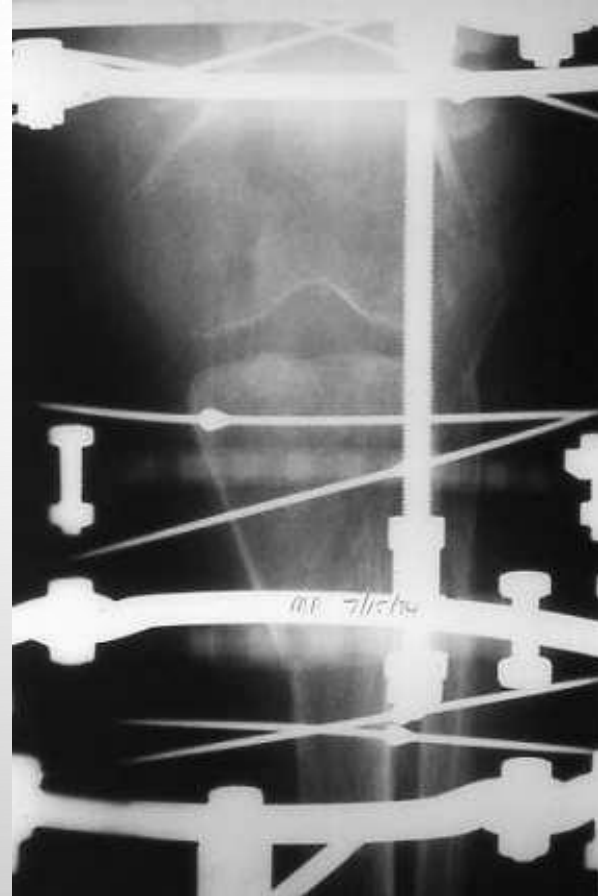
DURING BONE TRANSPORT



SAGITAL PLANE CORTICOTOMY WITH PROXIMAL TIBIAL WIDENING



CREATION OF A TIBIAL PLATEAU



ALLOW 6 MONTHS FOR PIN TRACTS TO FULLY HEAL



PLACEMENT OF SEMICONSTRAINED TOTAL KNEE ARTHROPLASTY

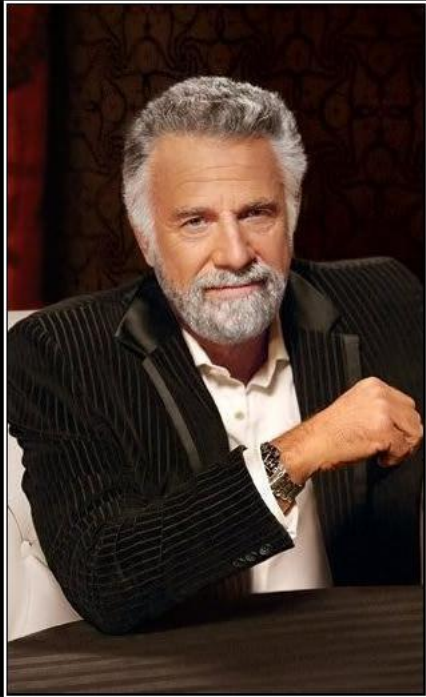


M.P.: FOLLOW UP AT 5 YEARS POST TKA

- Walking independently with out pain.
- Using a cane for assisted ambulation.
- No infection.
- Taking no pain medications.

THANKS TO THOSE BEFORE ME

My Mentors & Teachers



**STAY THIRSTY
MY FRIENDS**

- ROBERT B. GORDON, MD
- HARRY J. BUNCKE, MD
- GEORGE CIERNY, MD
- STEVEN MATHES, MD
- LEONEL SAENZ, MD
- RICHARD MAURER, MD
- WILLIAM MURRAY, MD
- JAMES O. JOHNSTON, MD
- LORRAINE DAY, MD
- MICHAEL W. CHAPMAN, MD

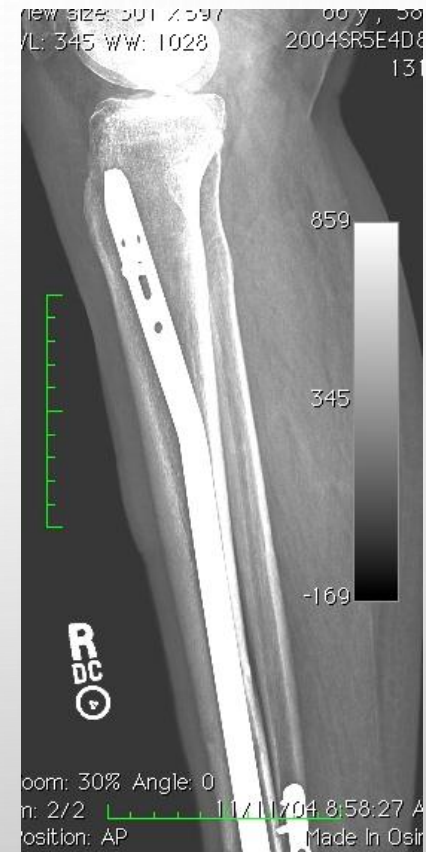
THE FUTURE

- BETTER UNDERSTANDING OF MICROBIOMES THROUGHOUT THE BODY
- BETTER APPRECIATION OF THE HOST'S DIRECT ROLE IN INFECTION
- BETTER BIOMARKER PREDICTORS FOR RECURRENCE *THE MACROPHAGE*
- CREATION OF A *"PURPOSEFUL MICROBIOME"*

G.N.: 58 Y/O F WITH CLOSED DISTAL TIB/FIB FX

- REPORTED AS A CLOSED INJURY.
- TREATED WITH CLOSED IM RODDING AND DISTAL FIBULAR PLATING.

G.N.: S/P RODDING AND FIBULAR PLATING



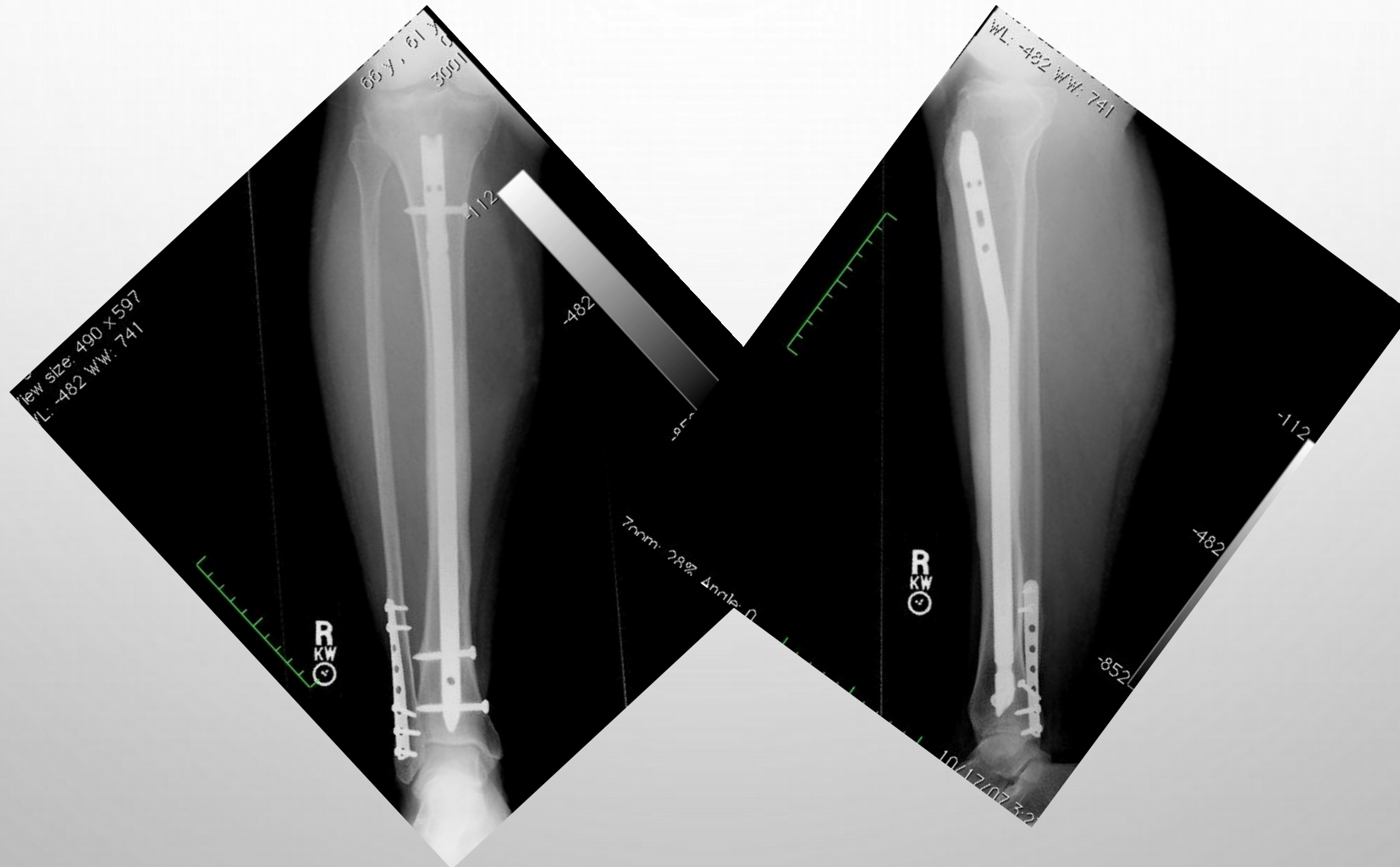
G.N.: S/P RODDING AND FIBULAR PLATING



G.N. FRACTURE & WOUNDS HEALED

- SHE COMPLAINED OF CHRONIC RIGHT LEG SWELLING AND PAIN.
- TOLD THERE WAS NOTHING WRONG AND THIS WOULD GET BETTER.
- LIMITED TO <2 BLOCKS AMBULATION.

G.N.: 3 YEARS POST-OP WITH CHRONIC LEG PAIN



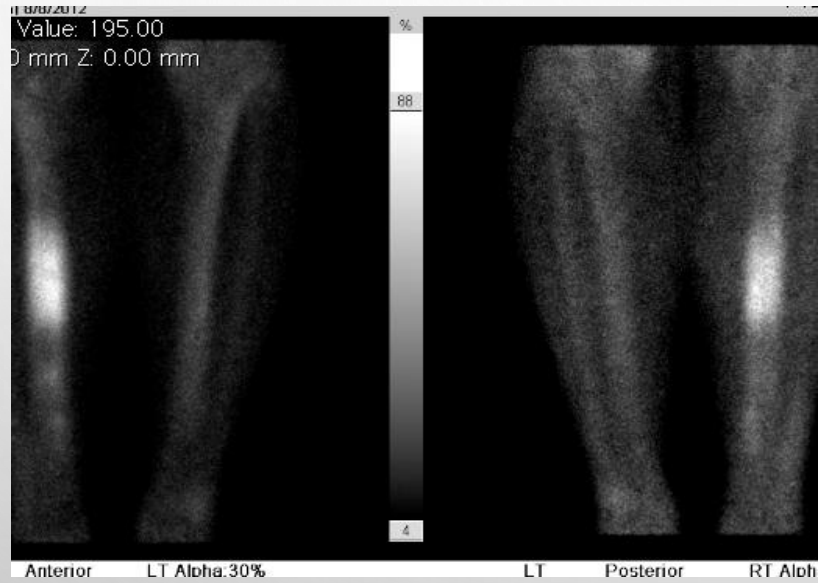
G.N.: 8 YEARS POST-OP, CONTINUED PAIN & SWELLING



WHAT OTHER STUDIES WOULD YOU CONSIDER OBTAINING?

- A. TC⁹⁹ BONE SCAN
- B. MRI OF LEG
- C. CT SCAN OF LEG
- D. SERUM ALKALINE PHOSPHATASE, CA⁺⁺, AND VITAMIN D LEVELS
- E. INFLAMMATORY INDICES

G.N.: TC⁹⁹ PERFORMED (NOW 2012)

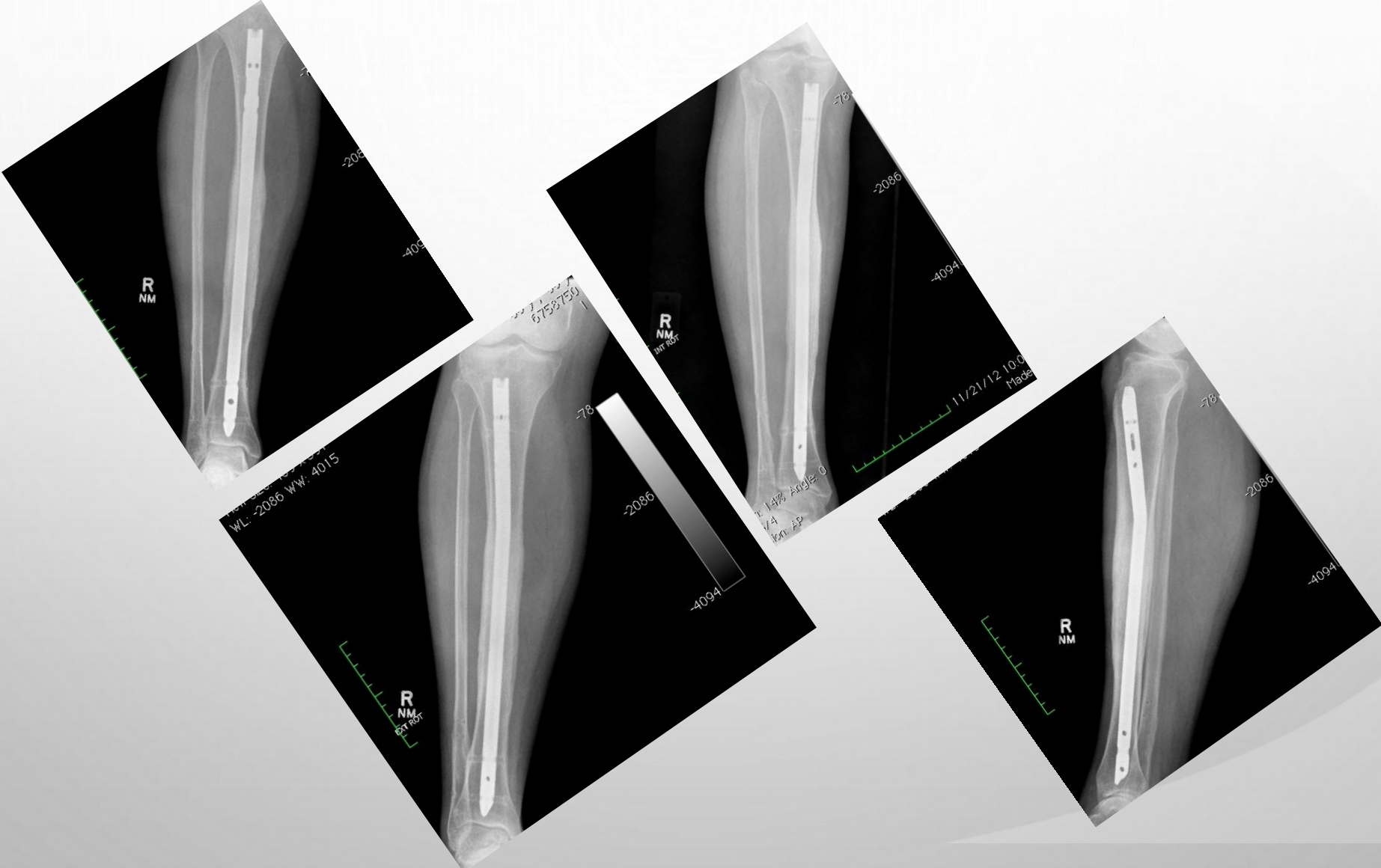


G.N.: NOW 66 Y/O

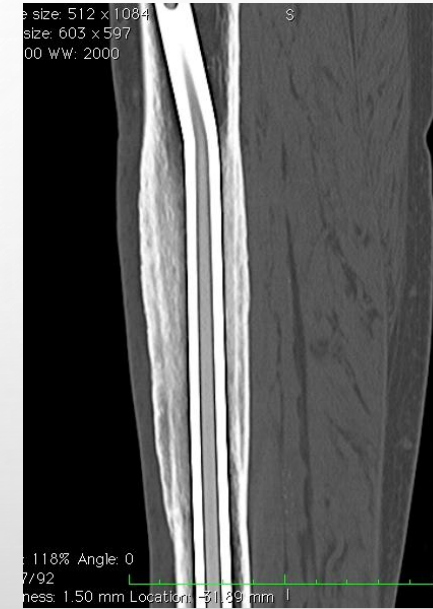
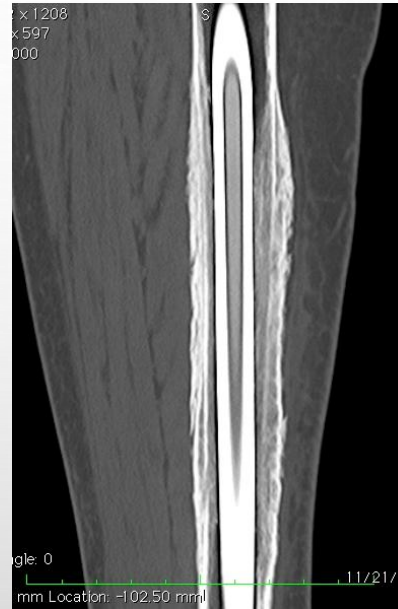
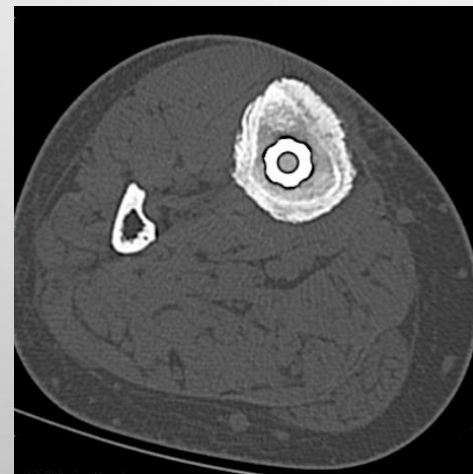
- TREATING SURGEON PERFORMED INTERLOCKING SCREW REMOVAL.
- NO CHANGE IN PATIENT'S COMPLAINTS.
- NORMAL INFLAMMATORY INDICES.



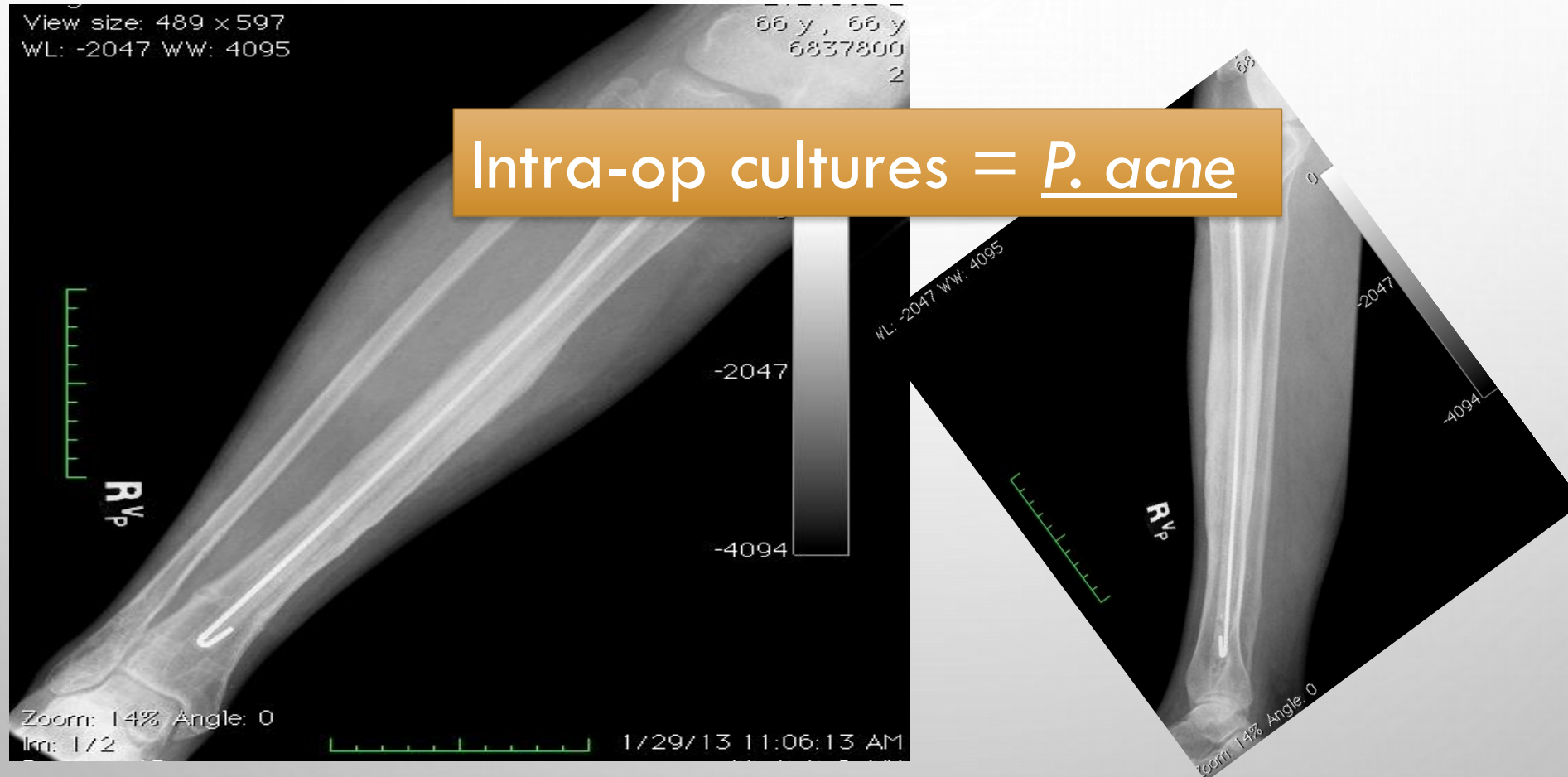
G.N.8 YEARS POST-OP



G.N.: CT OF RIGHT LEG



G.N.: TAKEN TO OR, ROD REMOVED, CANAL REAMED UP, ANTIBIOTIC NAIL PLACED.



G.N.: 6 WEEKS LATER ANTIBIOTIC NAIL REMOVED, X-RAYS 7 MONTHS FOLLOWING REMOVAL, REMAINS ASYMPTOMATIC 2 YEARS LATER, 9 YEAR PHONE CALL NO PAIN AND NO LIMITATIONS.

