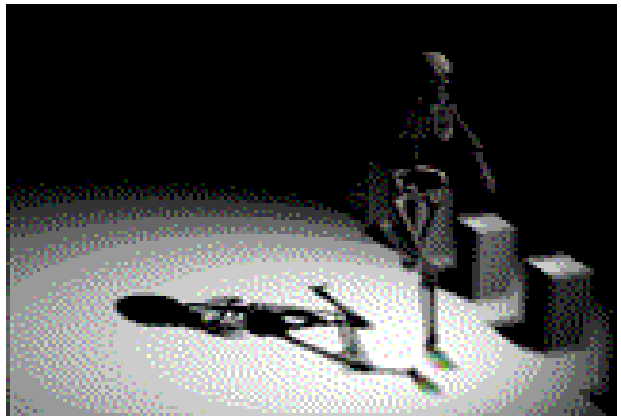
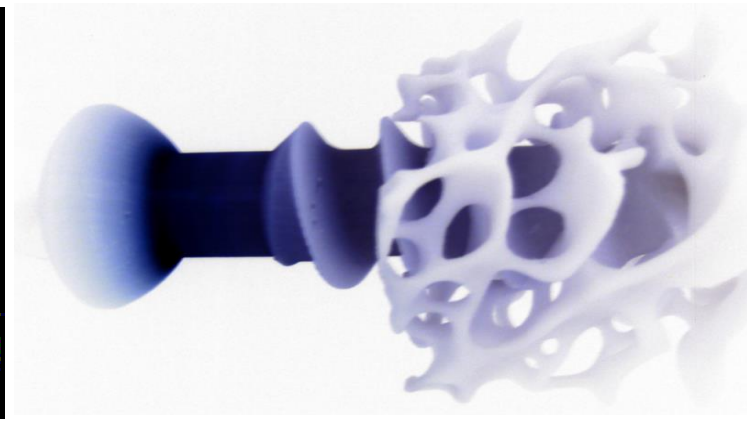
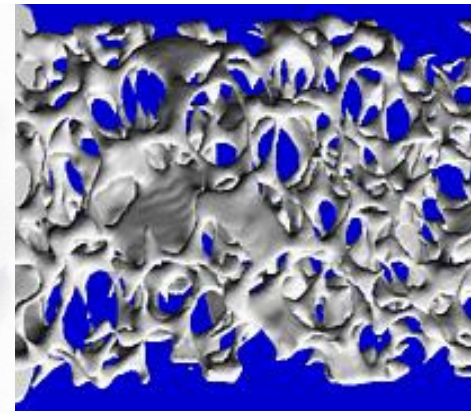

Orthopaedic Implants - The basics of design

A look into biomaterials - present and future

Eur Ing Prof Philip Procter PhD CEng, CSci,
Consultant, Medical Device Industry,
Divonne les Bains, FRANCE

What I will cover today

MY BACKGROUND

A QUIZ

HIP FRACTURES

- Biomechanics of the proximal femur
- Implants & materials for the proximal femur

THE FUTURE

What I will cover today

MY BACKGROUND

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HIP FRACTURES

- Biomechanics of the proximal femur
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THE FUTURE

My background

Based

France/Sweden

Mech Eng/Biomedical Eng/Marketing

Commercial

30 years+ Ortho Implant industry 3 multinational companies

Founder Irish start-ups GPBio Ltd, Biomimetic Innovations Ltd

Self employed medical device consultant France CPP SARL

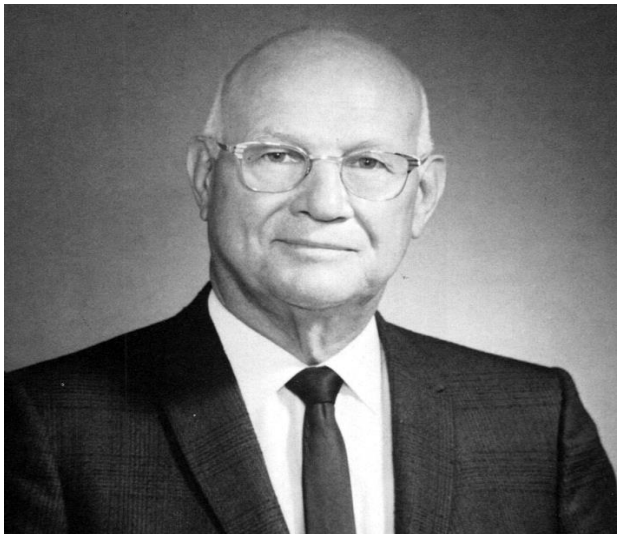
Academic (Pro bono)

Direct Applied Research/Translation

EPFL Lausanne Switzerland

Adj Prof Angstrom U Uppsala Sweden

Last Company - Stryker Corporation (1997-2011)

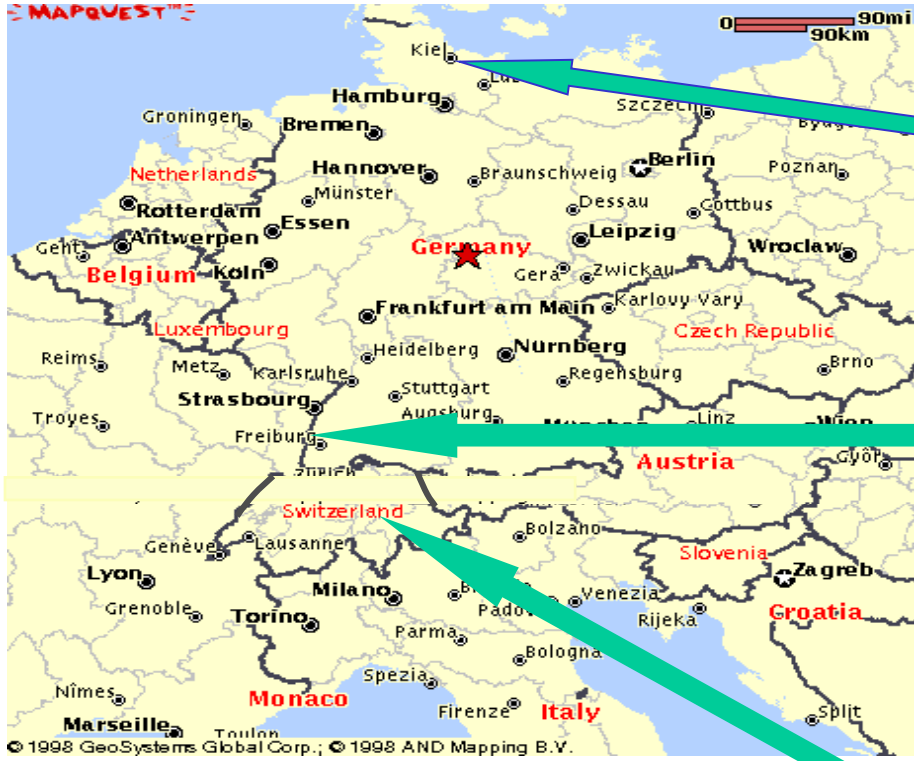


Dr. Homer Stryker
4. 11.1894 – 5.5.1980

1941 The origin of the company

A practicing orthopedic surgeon and brilliant inventor, **Dr. Homer Stryker** developed the **Turning Frame**, a special bed for handling orthopedic patients. Beside practicing as a doctor, he assembled the Turning Frame in a basement and sold it on his own.

Stryker Osteosynthesis in Europe

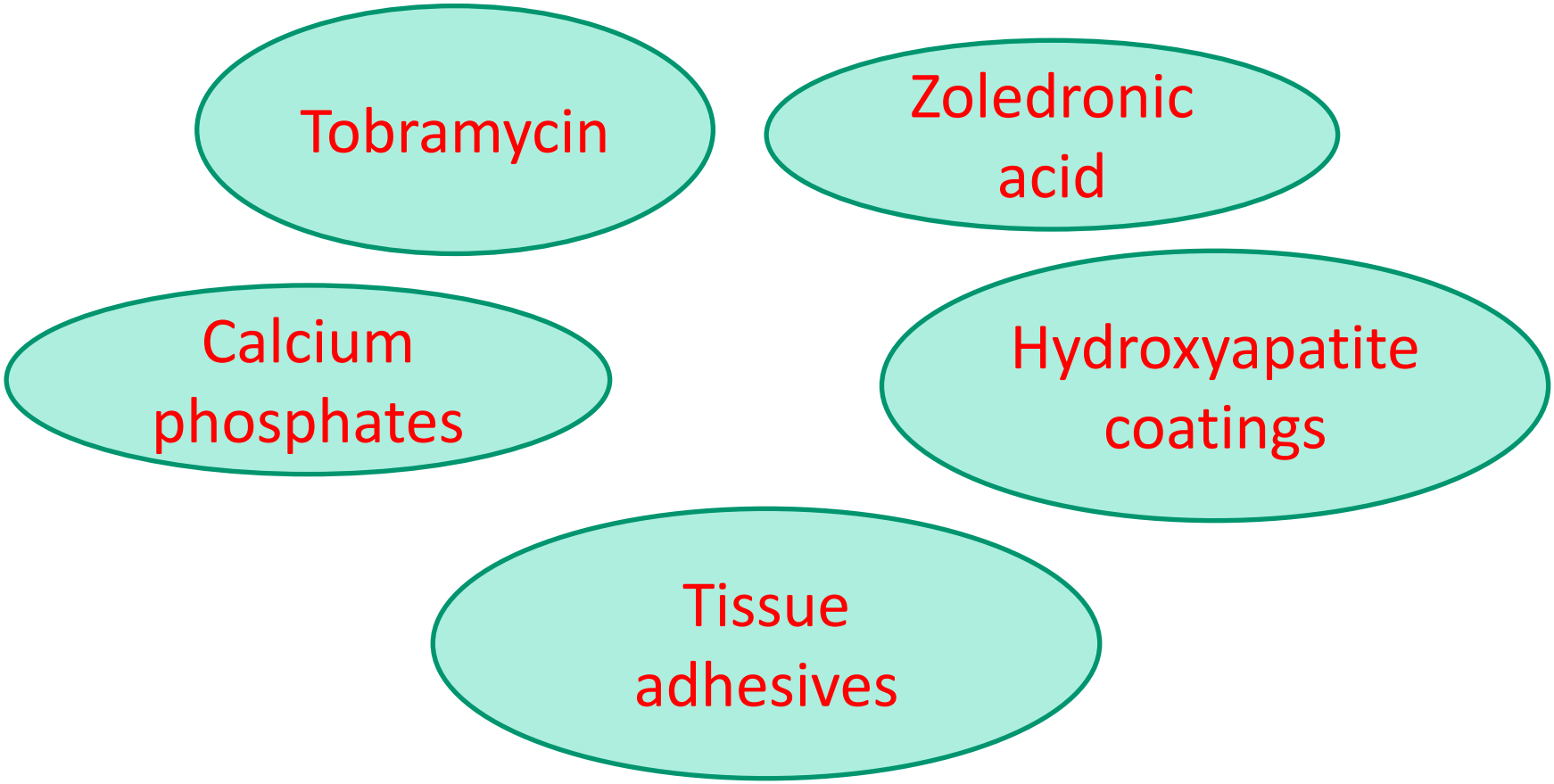


Stryker Osteosynthesis GmbH
Kiel, Germany
IM Nails

Stryker Osteosynthesis AG
Freiburg, Switzerland
CMF Implants

Stryker Osteosynthesis AG
Selzach, Switzerland
Plate & Screw/External Fixation

My applied research: Bone screws combined with biomaterials,tissue changing drugs and adhesives



What I focus on today

Understanding how
to improve fixation of
implants in poor quality
cancellous bone

Something I have
been working on
For a very long time

ACCIDENTS HAPPEN ALL THE TIME

And the associated medical devices …..

Note: most connect to bone with screws…..

What I will cover today

MY BACKGROUND

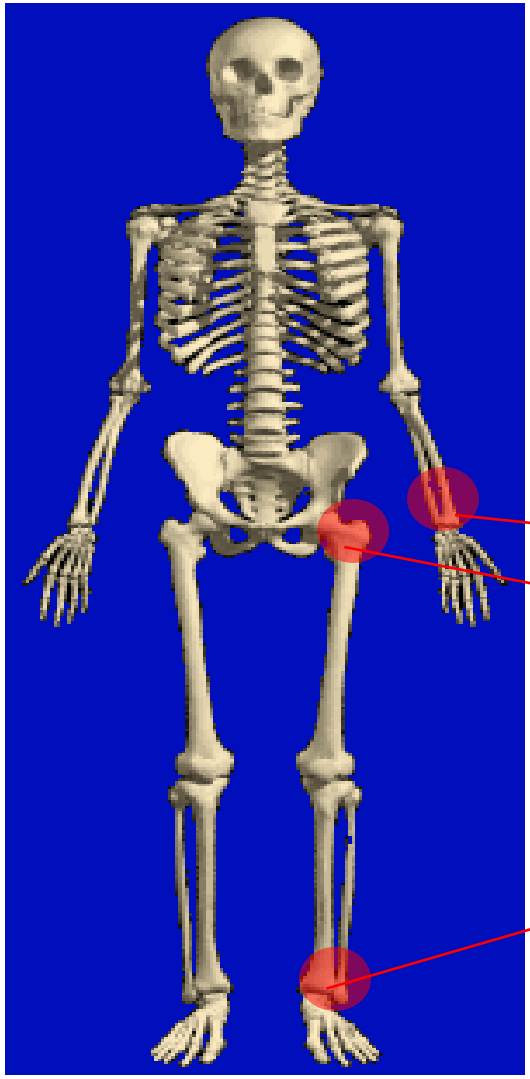
A QUIZ

HIP FRACTURES

- Biomechanics of the proximal femur
- Implants & materials for the proximal femur

THE FUTURE

Fracture Prevalence Quiz 1



Put which you think is most often broken 1st,2nd,3rd

Wrist =

_____

Hip =

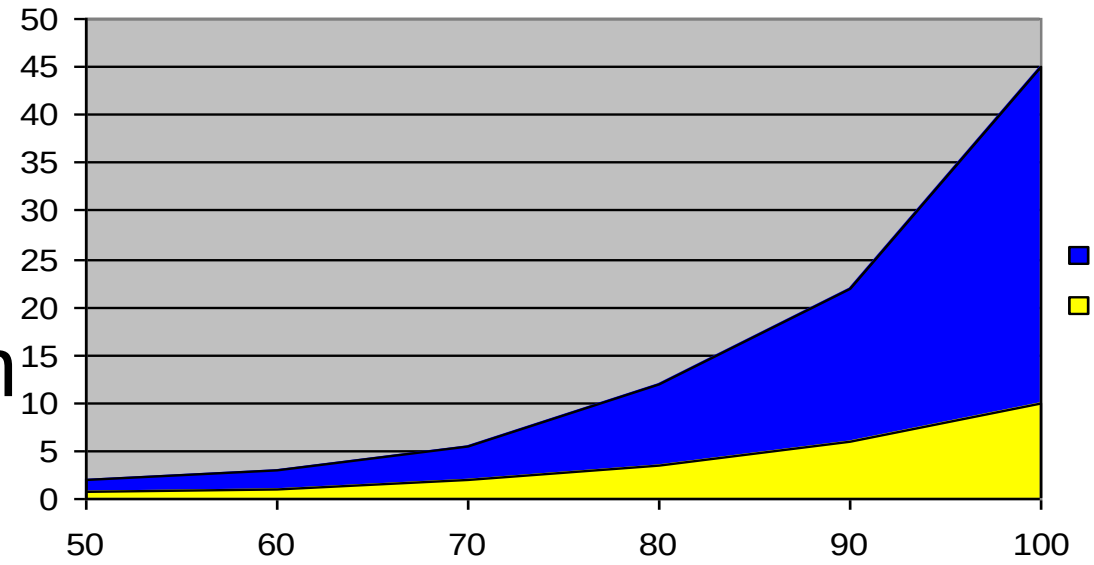
_____

Ankle =

_____

Fracture Prevalence Quiz 2

Hip Fx per 1000 population



Age in Years

Which graph is male? _____

Which graph is female?_____

Fracture Prevalence Quiz 3

Which continent will have the most hip fractures by 2050

1) Asia
2) Europe
3) America

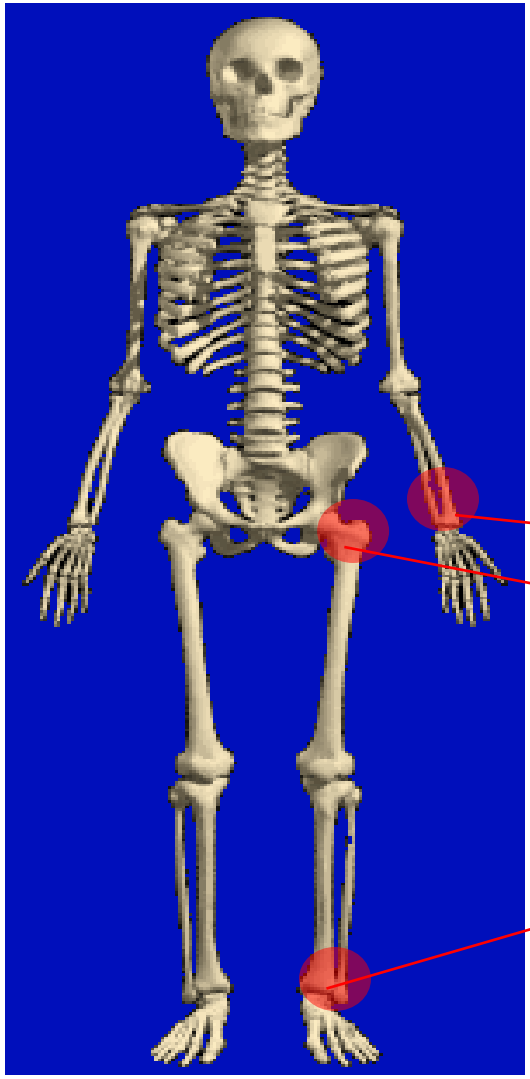
Which bone has the highest value in skeletal implants?

1) Tibia
2) Femur
3) Humerus

What is the most common cause of fractures in the elderly?

1) Road Traffic Accidents
2) Falls at home
3) In line skating

Fracture Prevalence Quiz 1



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_____

Ankle =

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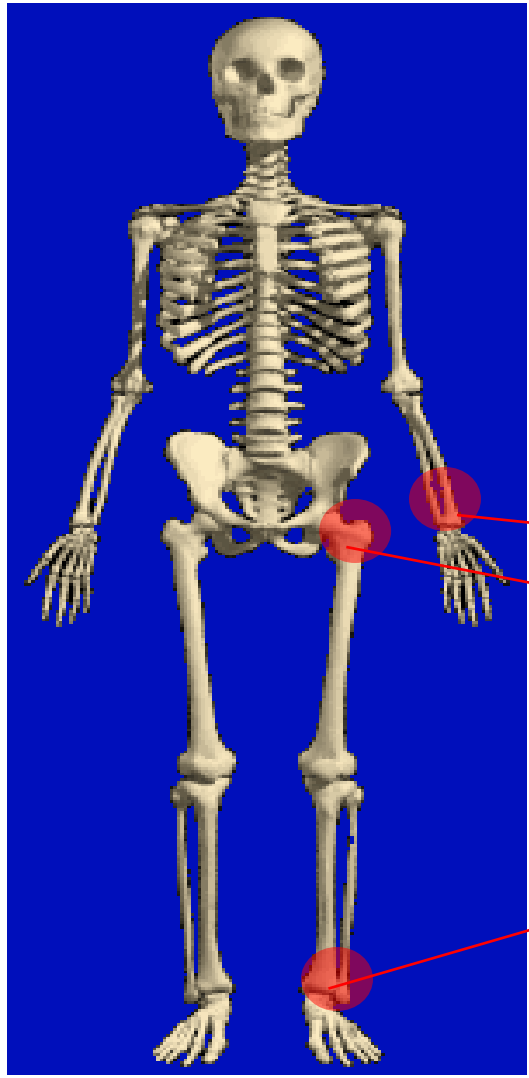
Fracture Prevalence Quiz 1



Put which you think is most often broken 1st,2nd,3rd

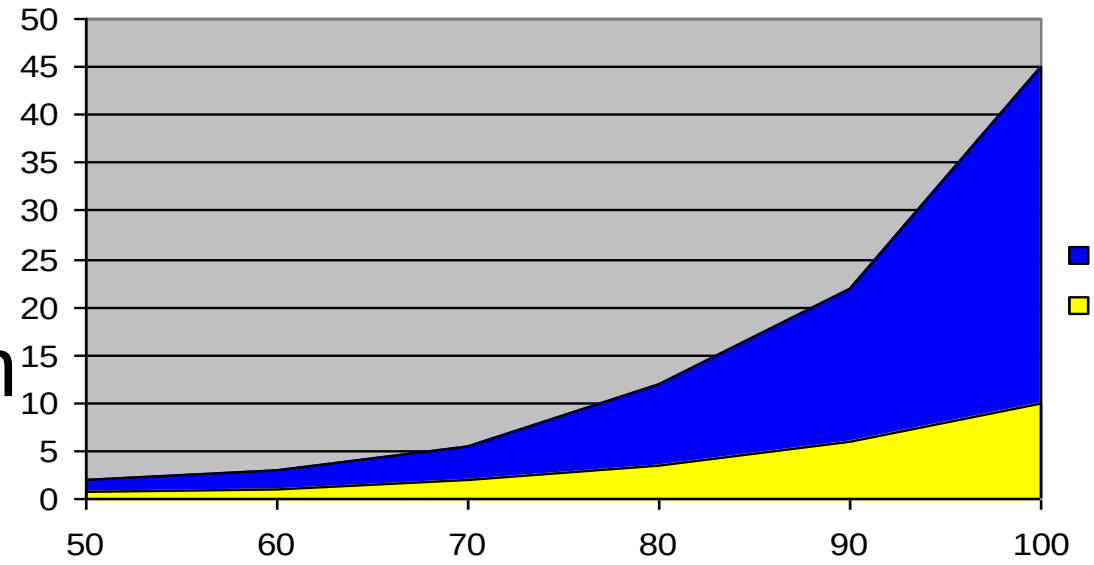
Wrist = _1_____

Hip = _2_____

Ankle = _3_____

Fracture Prevalence Quiz 2

Hip Fx per 1000 population



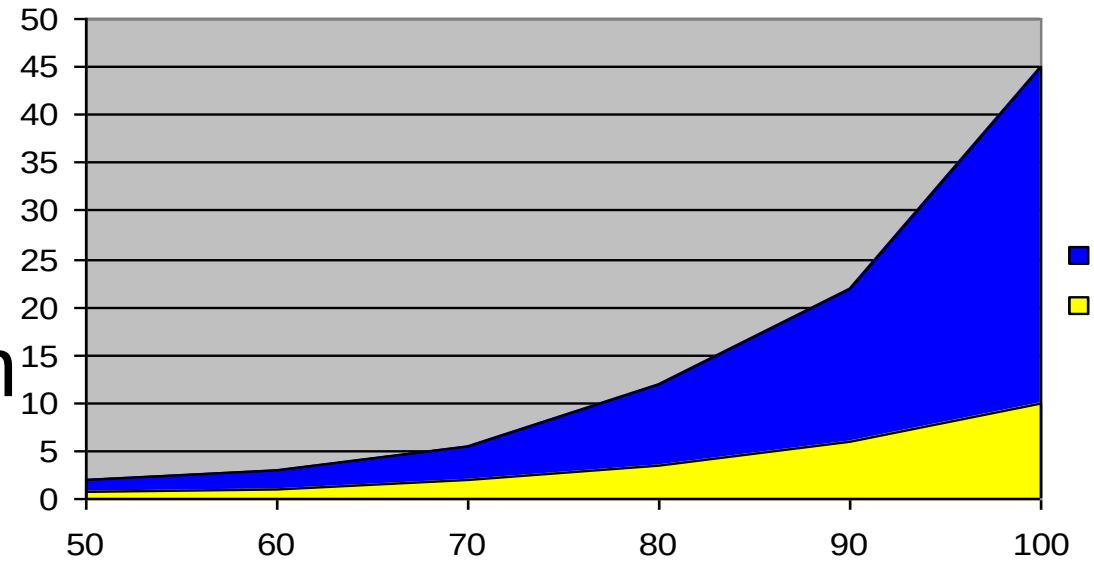
Age in Years

Which graph is male? _____

Which graph is female?_____

Fracture Prevalence Quiz 2

Hip Fx per 1000 population



Age in Years

Which graph is male? __Yellow__

Which graph is female?__Blue____

Fracture Prevalence Quiz 3

Which continent will have the most hip fractures by 2050

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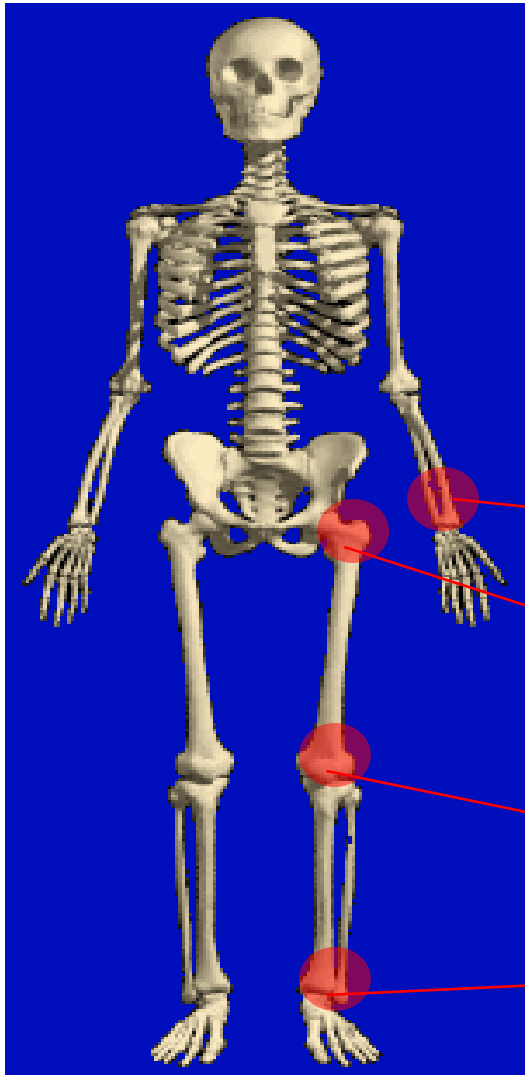
What is the most common cause of fractures in the elderly?

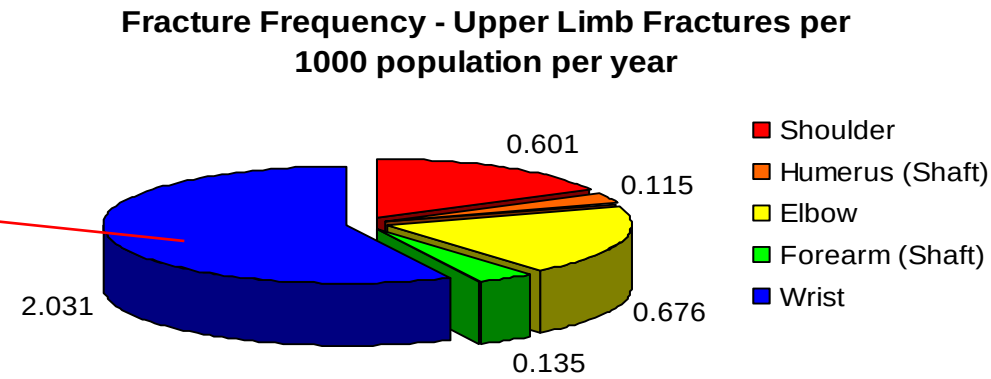
1) Road Traffic Accidents
2) Falls at home
3) In line skating

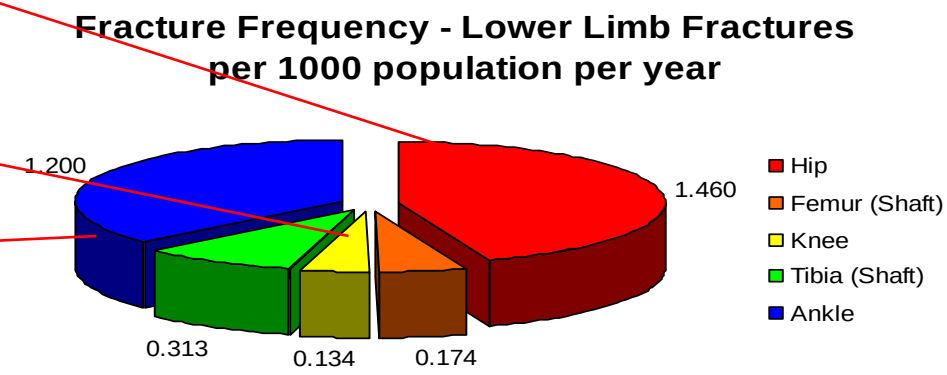
How often do bones break?



1st Wrist	2.031 per 1000 pop
2nd Hip	1.460 per 1000 pop
3rd Ankle	1.200 per 1000 pop

95% of hip fractures get an implant





Note: North European Population

What I will cover today

MY BACKGROUND

A QUIZ

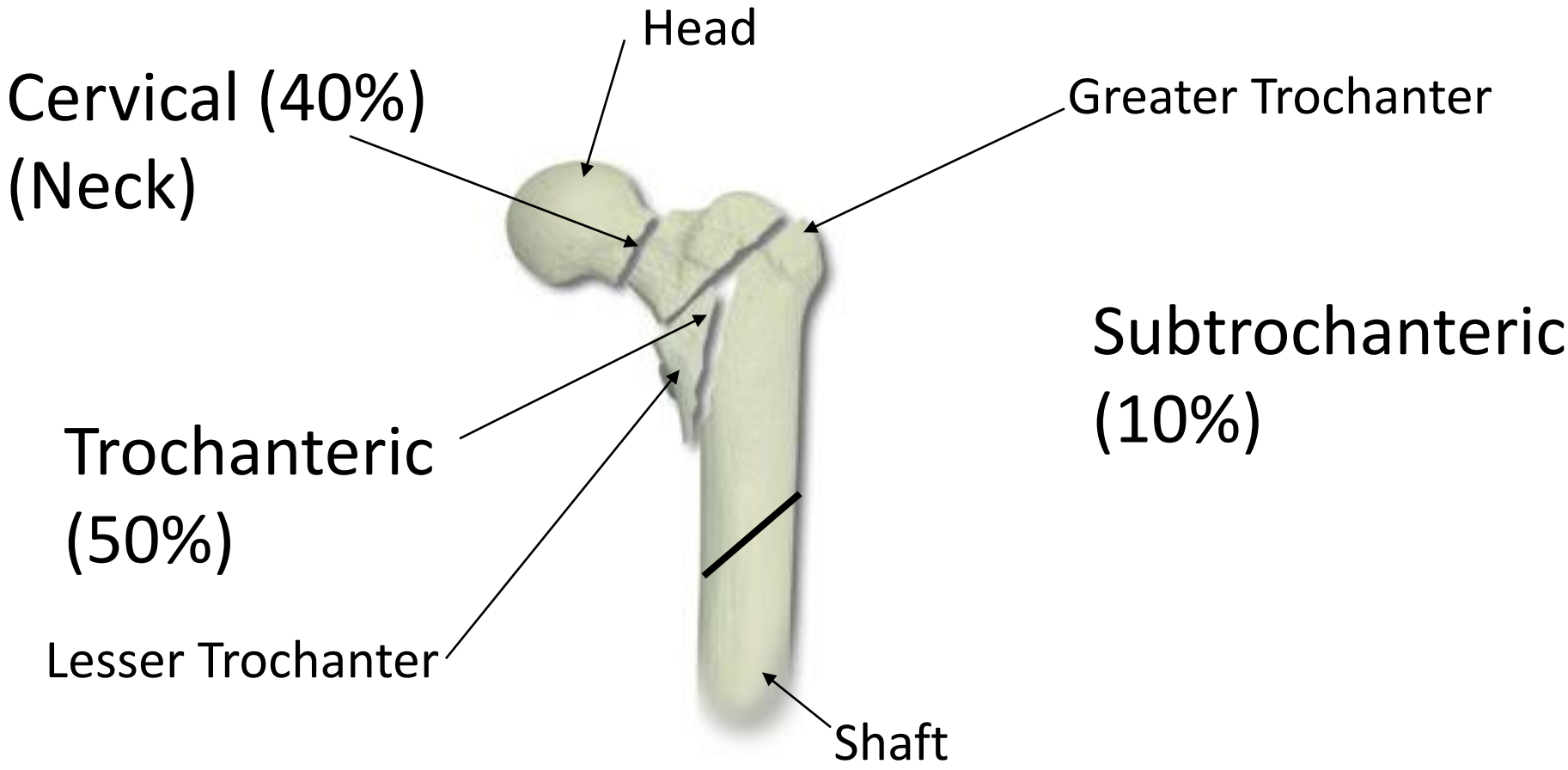
HIP FRACTURES

- Biomechanics of the proximal femur
- Implants & materials for the proximal femur

THE FUTURE

Introduction

Types of Hip Fracture

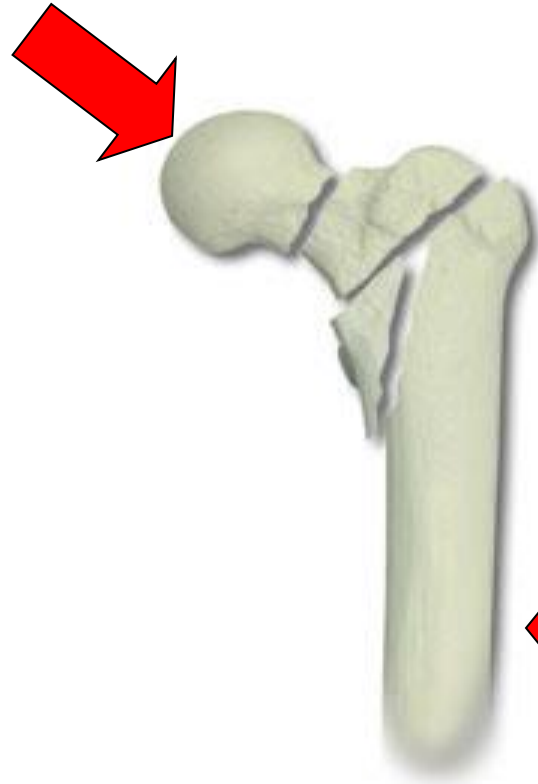


Each fracture type has different biomechanics

Introduction

The Biomechanical Problem

How to connect this

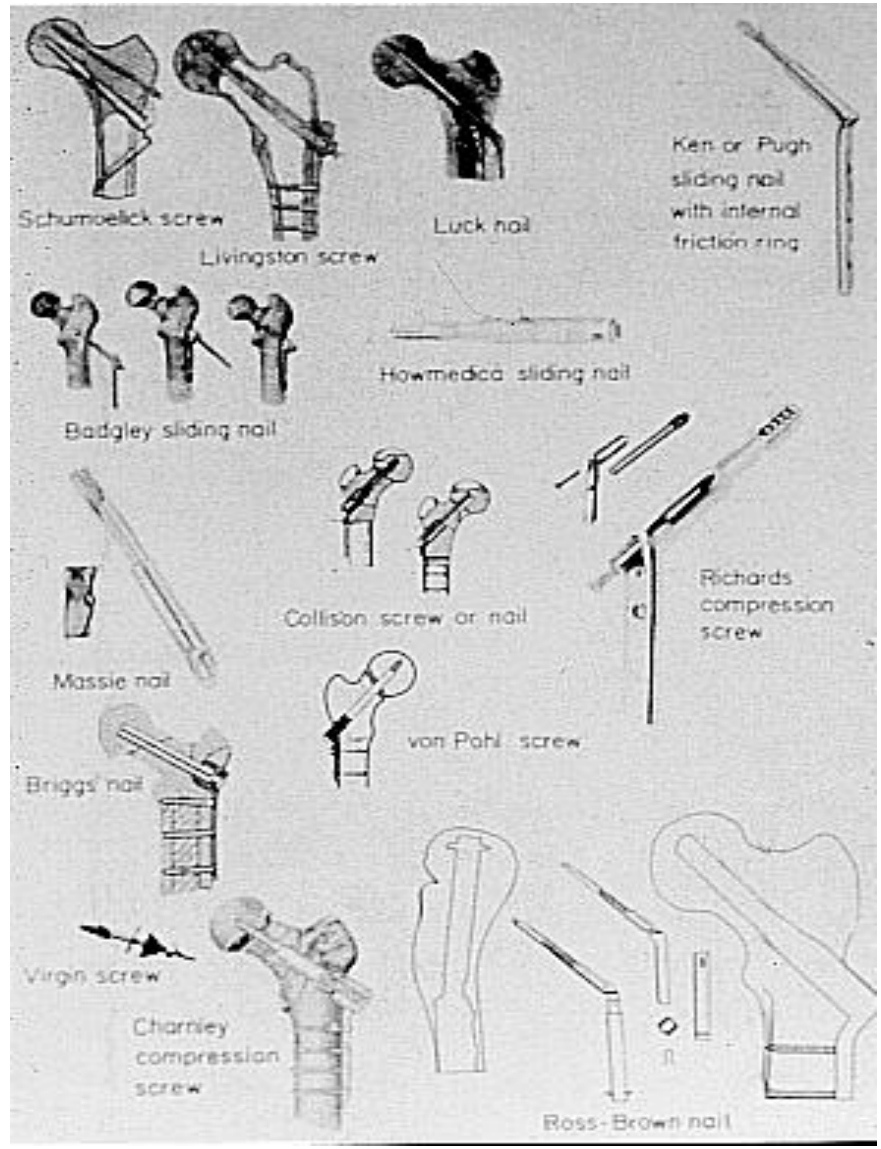


To this

Introduction

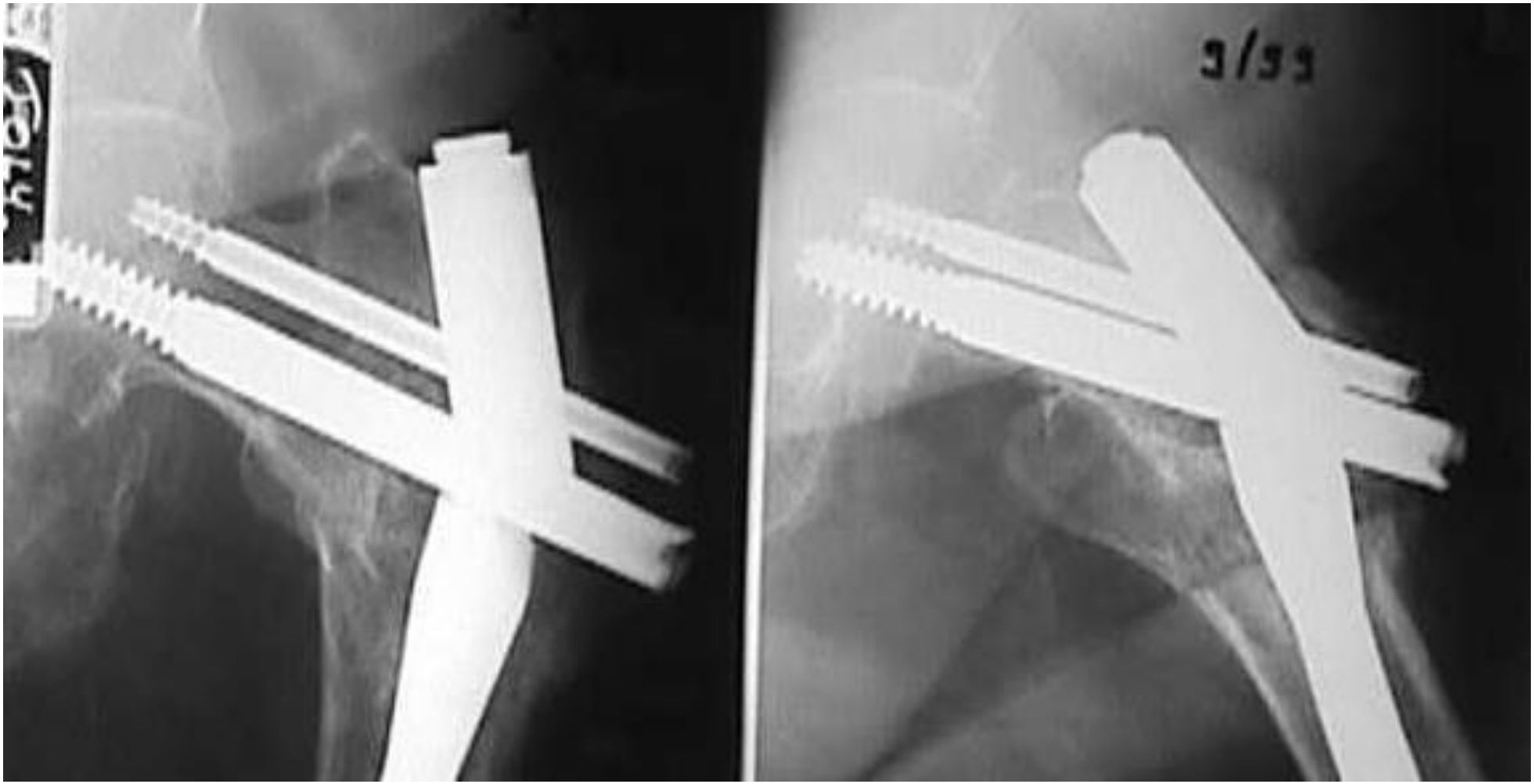
Up to 1990's Hip fractures were treated mainly by screw and plate devices

There were 2 types of failure



Implant Failure

Implant Failure



Bone Failure

Screw Cuts Out Through Bone

+

=

?

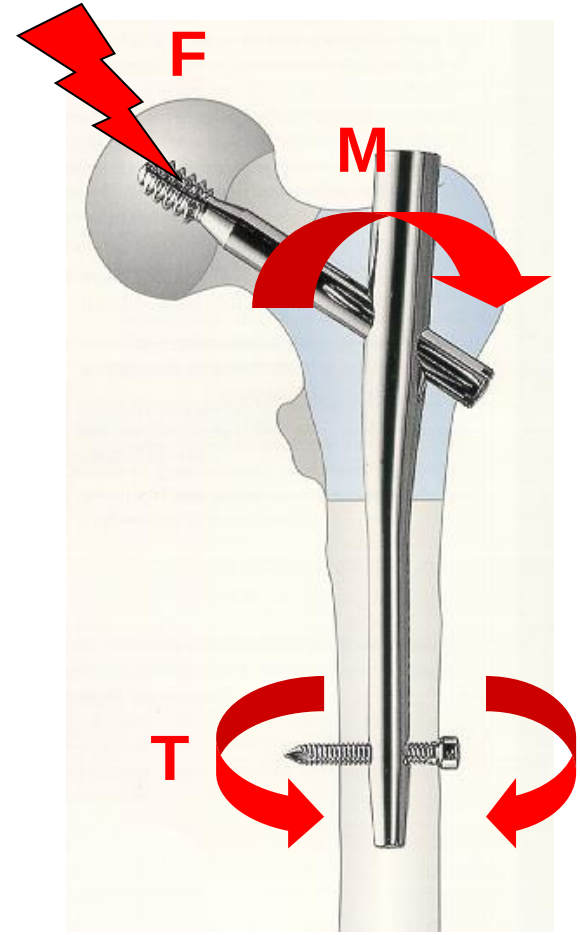
Compression Hip Screw - Gold Standard

Worked well in stable uncomplicated fx

Worked less well in unstable complex fx

Biomechanical Goal 1990

To combine biomechanical advantages of an axial weight bearing device with those of a compression hip screw.



Forces & Moments Exercise

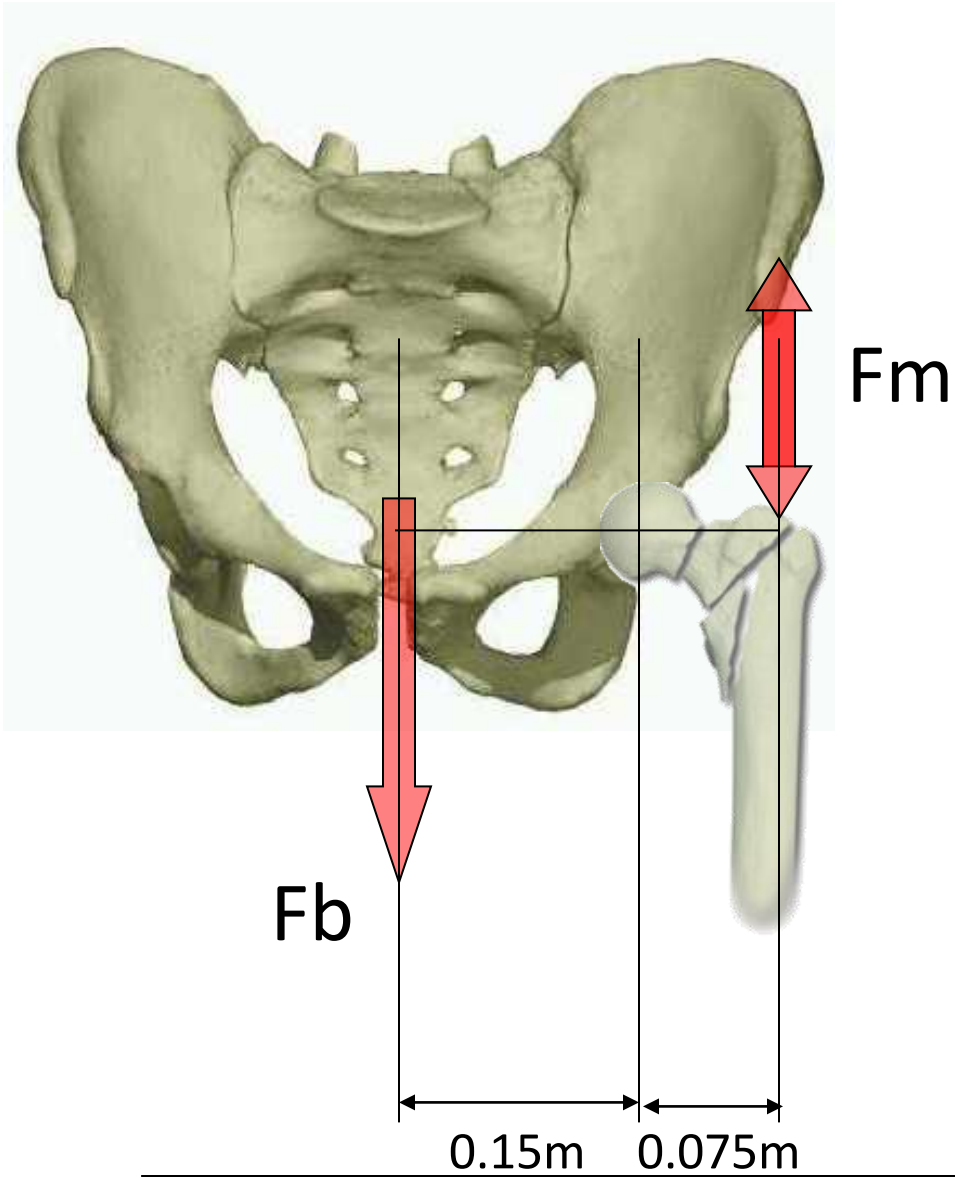
Forces

- Measurement Newton
  - » 1kg equivalent 10N

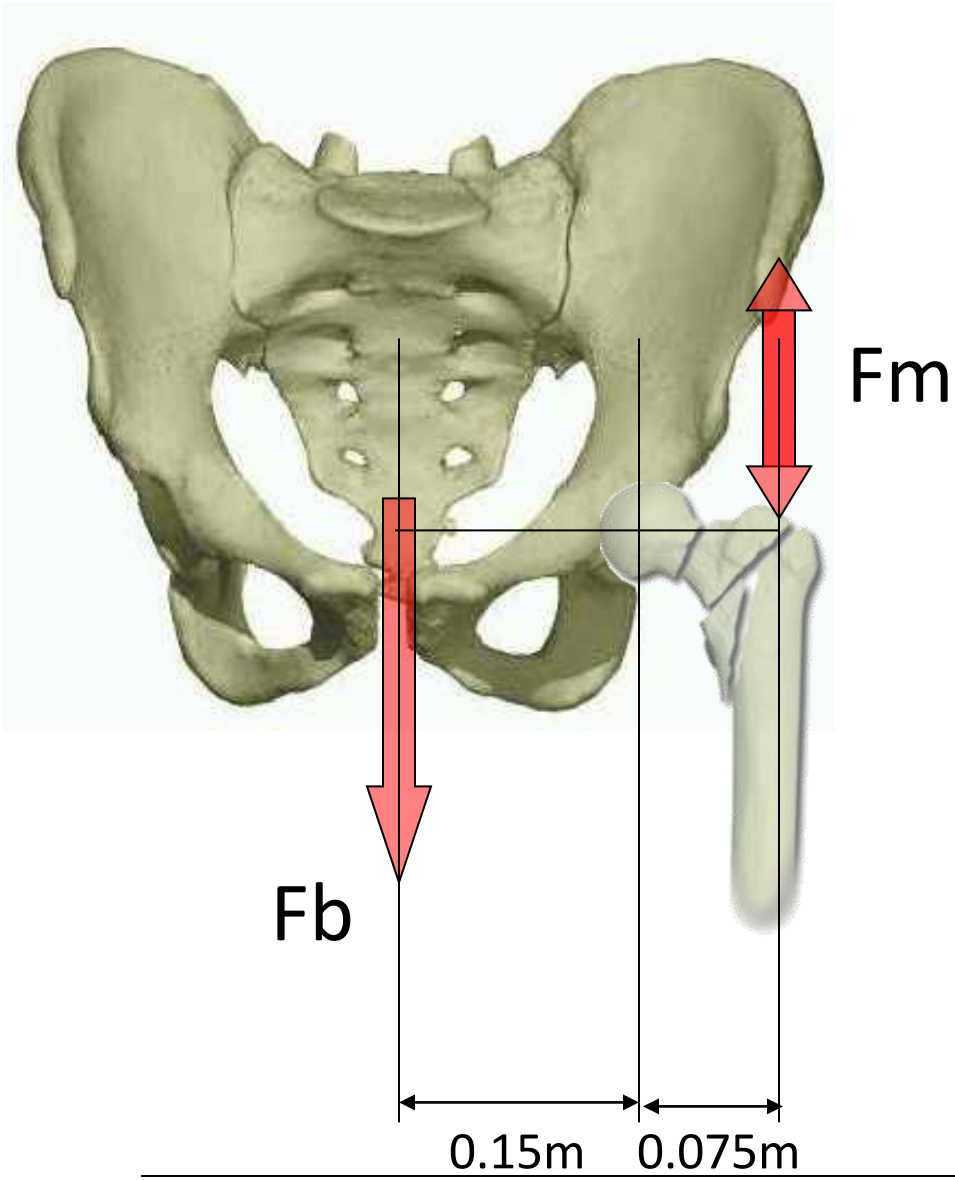
Moments

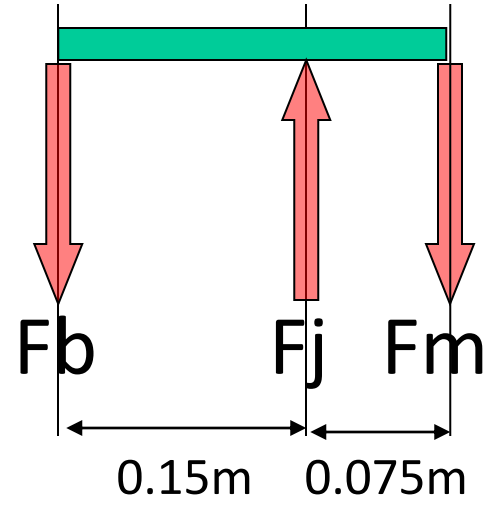
- Measurement Newton metre
  - » 1 kg held at 1metre equivalent to 10Nm

Hip Force Example

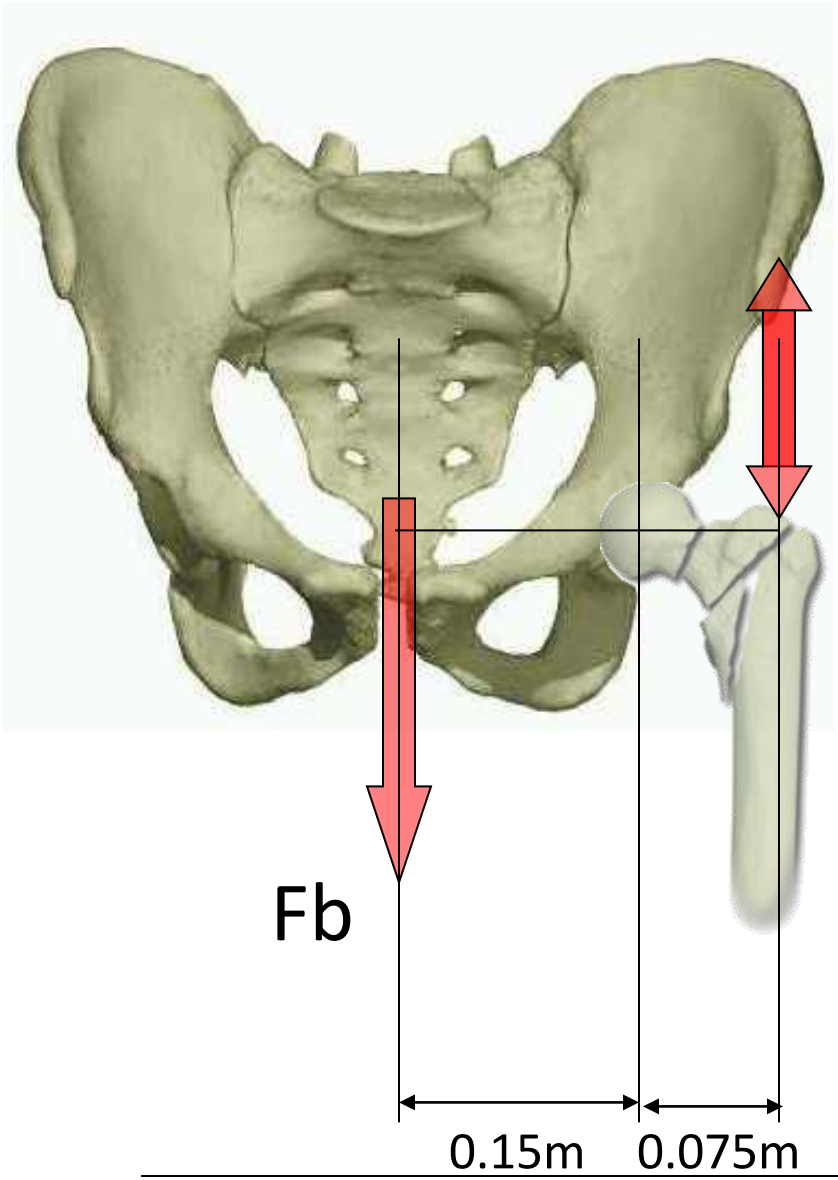


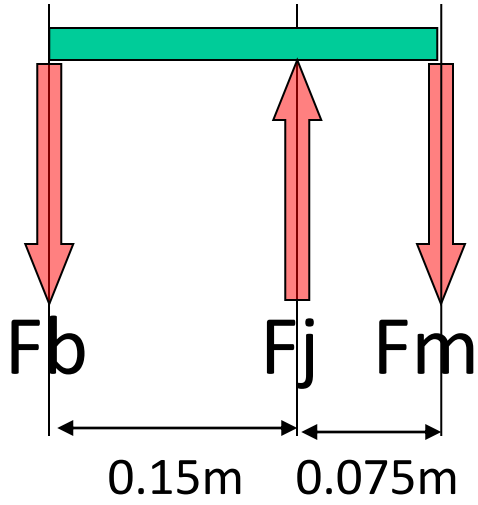
Hip Force Example





Hip Force Example





$\Sigma M \quad Fm \times 0.075 = Fb \times 0.15$

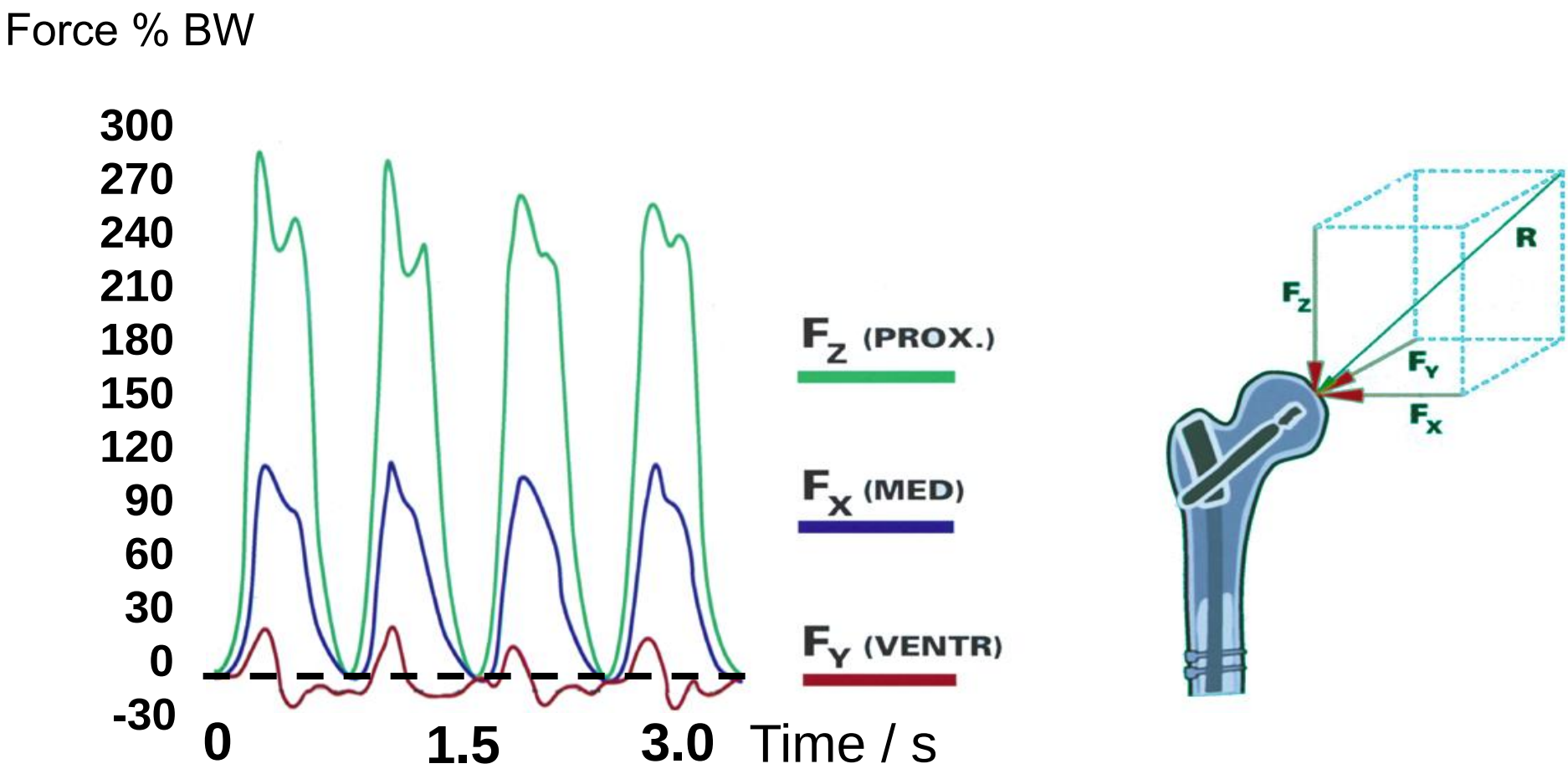
$Fm = 2\,Fb$

$\Sigma F \quad Fj = Fb + Fm$

$Fj = Fb + 2Fb$

Hip force is 3 times Body Weight

Hip Joint Force (Bergmann)



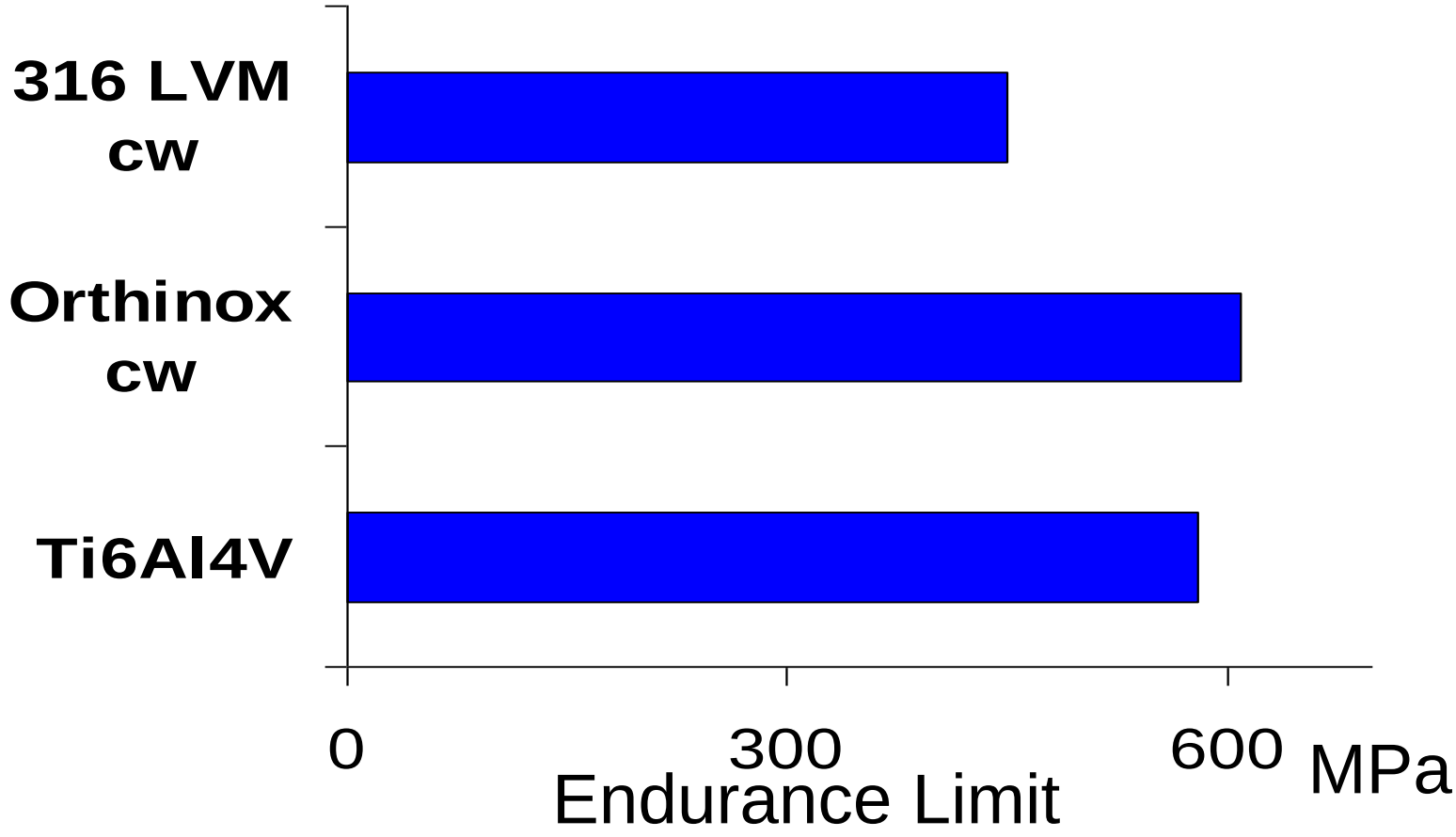
Implant Materials

Type	Composition									
	C	Mn	N	Cr	Ni	Mo	Fe	Al	V	Ti
316 LVM ISO 5832-1	0.03	2.0	0.1	18	13	3	bal.	-	-	-
Orthinox ISO 5832-9	0.06	3.0	0.4	21	10	2.5	bal.	-	-	-
Ti 6Al 4V ISO 5832-3	-	-	-	-	-	-	0.25	6	4	bal.

Other $\leq$ 0.5%

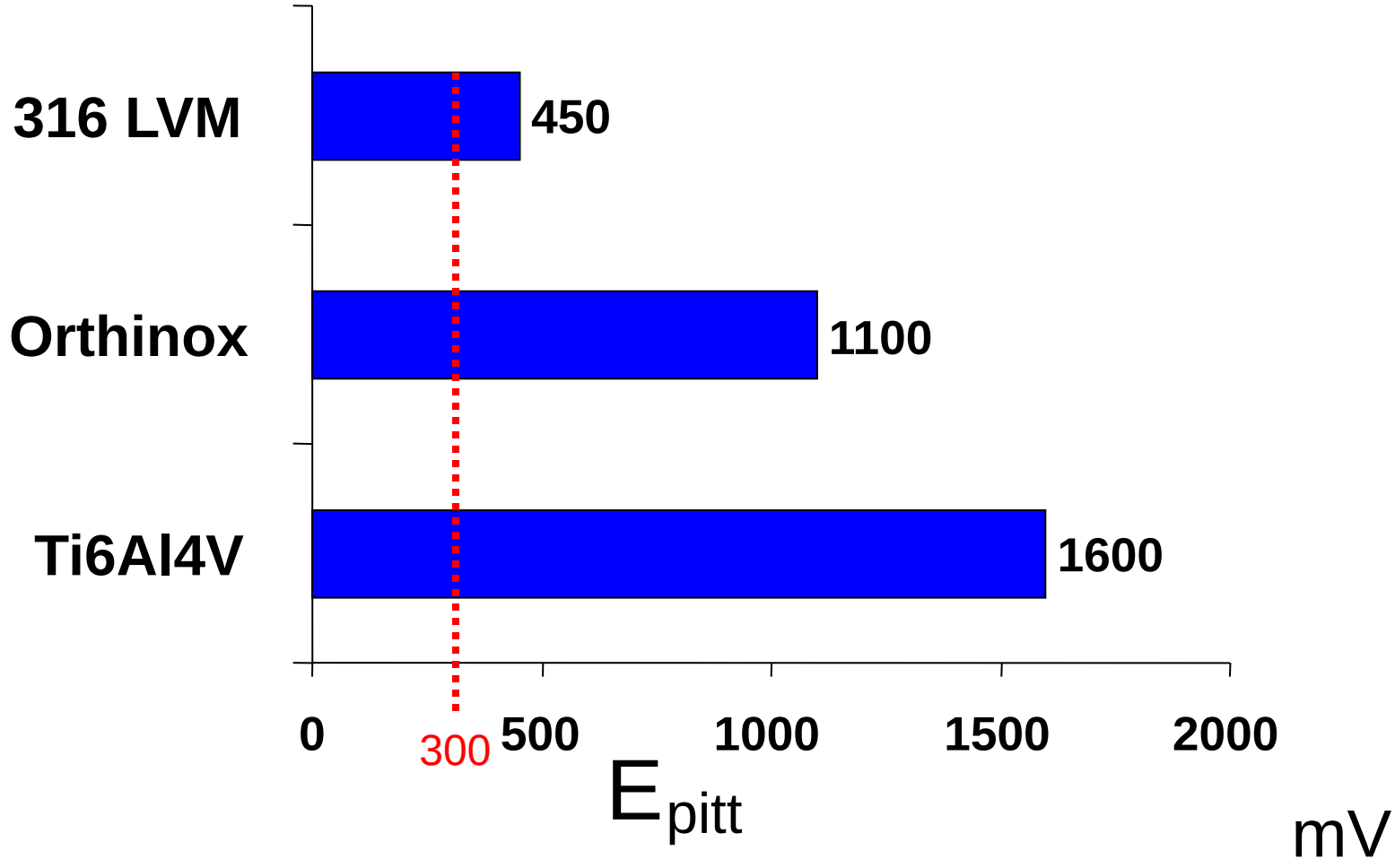
Fatigue Strength

Rotating bending, smooth surface



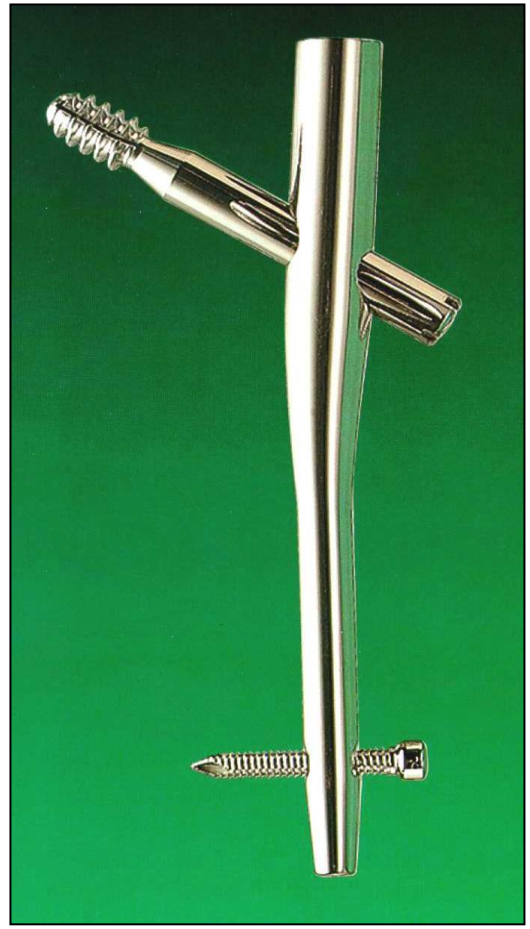
Corrosion

Pitting Potentials



Implant options today

Compression Hip Screw



IM Nail

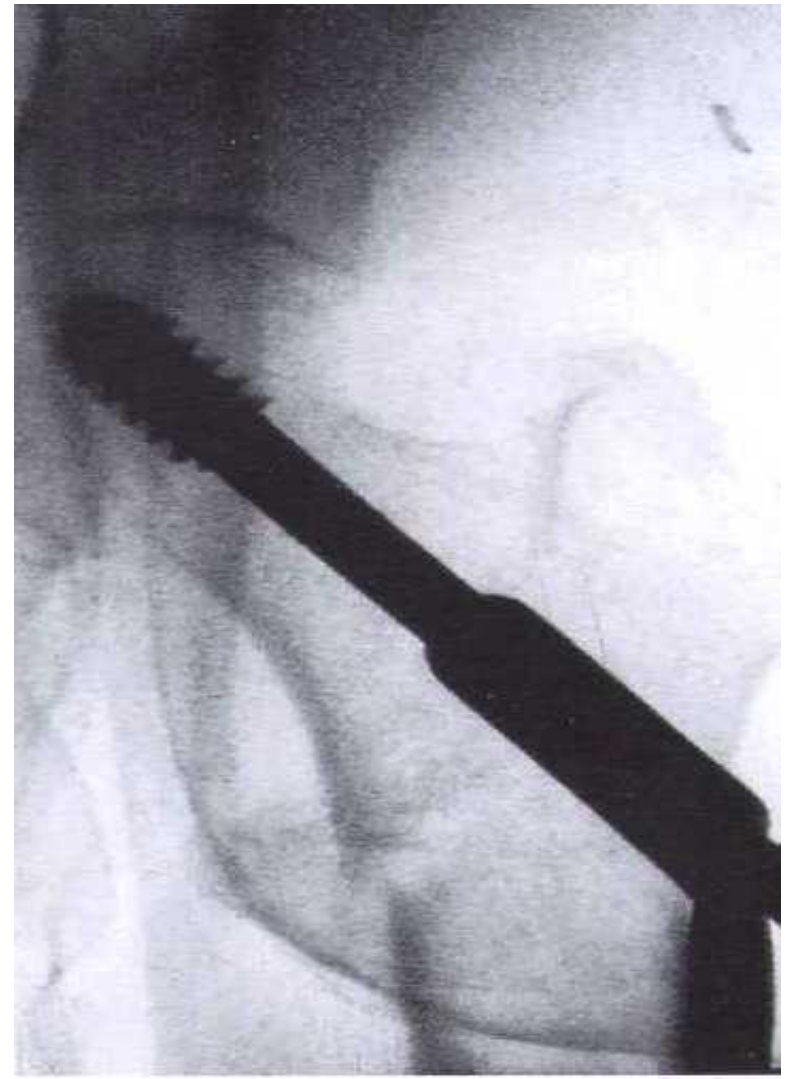
Cannulated Screw

Fracture of femoral Neck

Garden II

Pertrochanteric Fracture

Stable

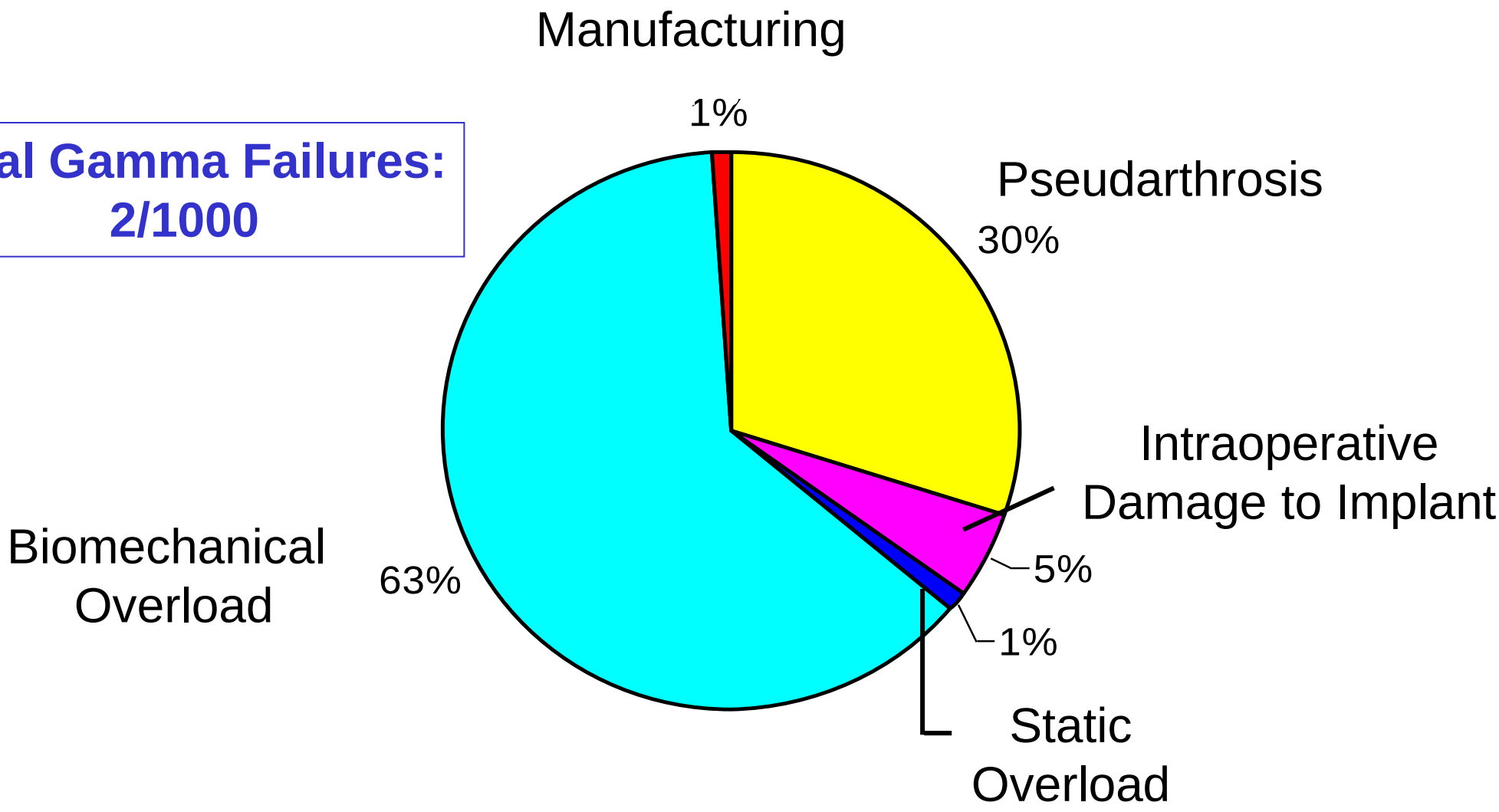


Segmented prox. femoral Fracture

Unstable

Implant Failure

Total Gamma Failures: 2/1000



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