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**Clinica Ortopedica Ferrara**



# ***APPARATO LOCOMOTORE***

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- **OSSA**
- **MUSCOLI**
- **ARTICOLAZIONI**



# ***APPARATO LOCOMOTORE***

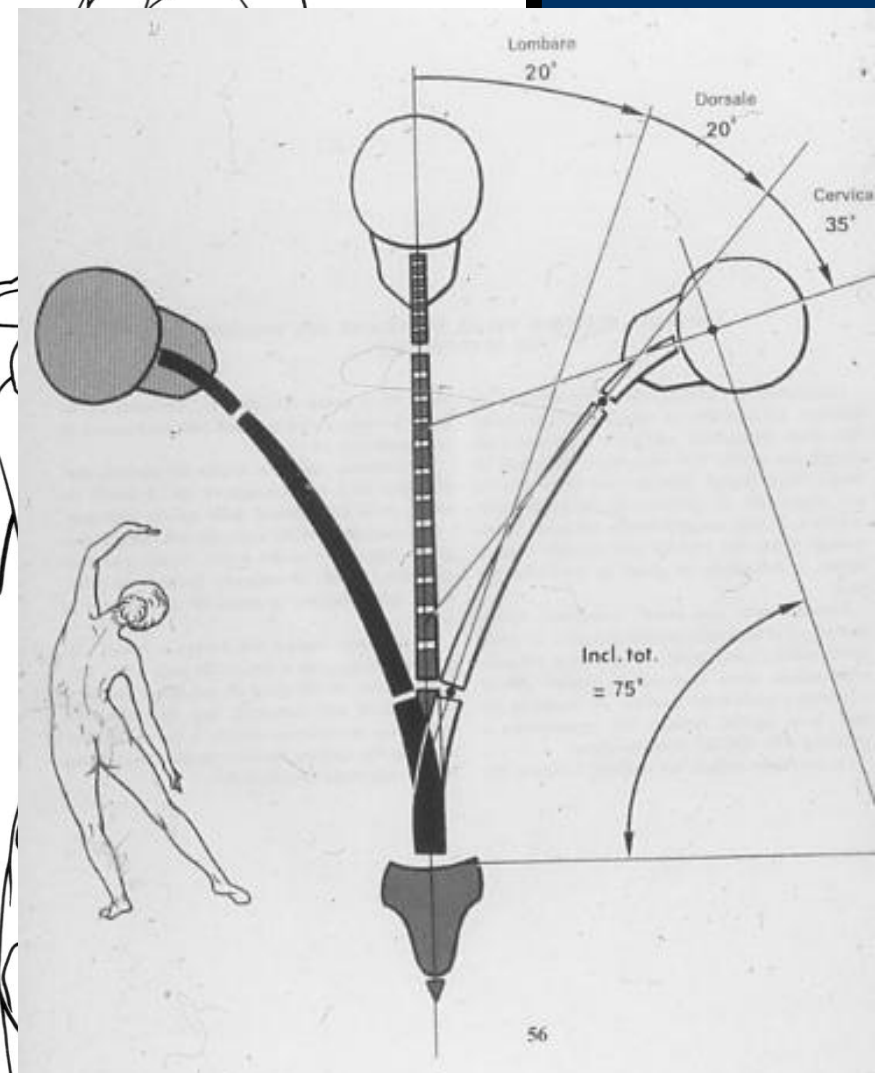
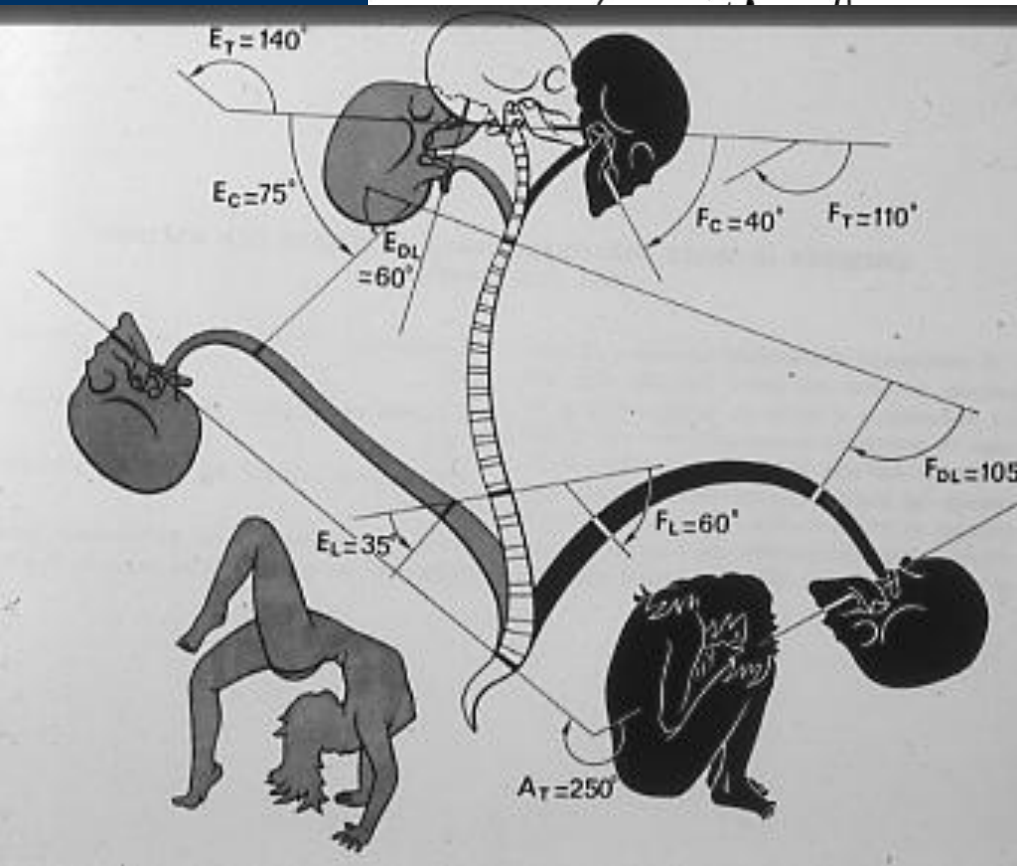
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- **SOSTEGNO**
- **MOVIMENTO**
- **PROTEZIONE ORGANI INTERNI**

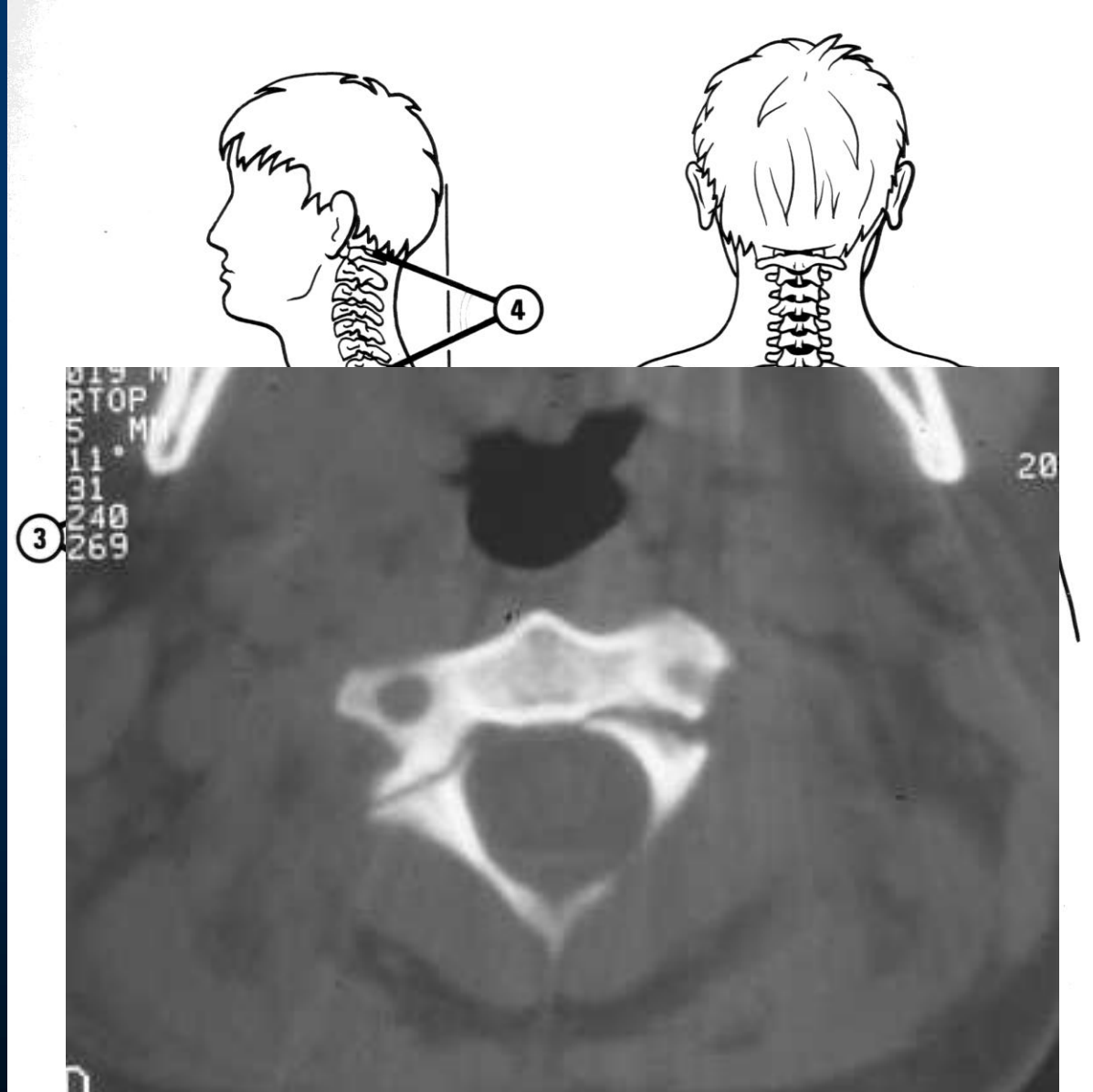








# COLONNA VERTEBRALE MOVIMENTO



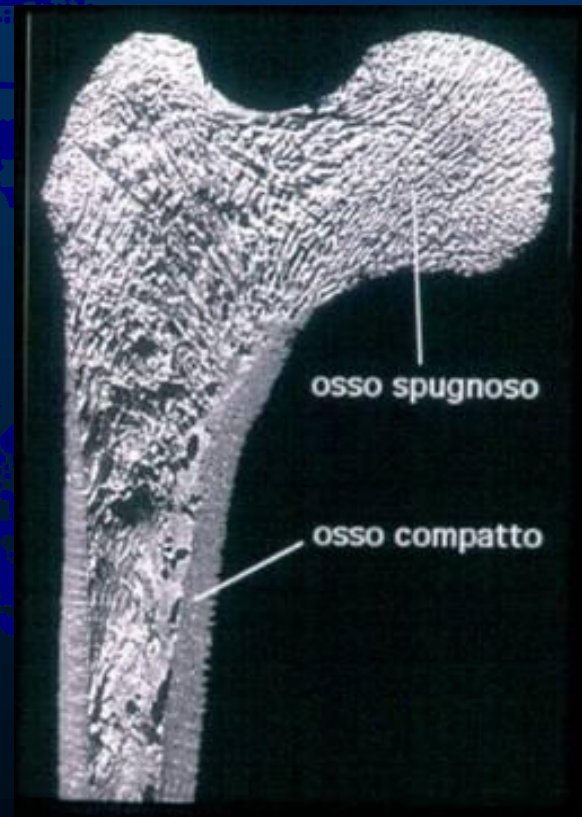
***COLONNA VERTEBRALE SOSTEGNO***



# ***COLONNA VERTEBRALE PROTEZIONE***



# OSSO

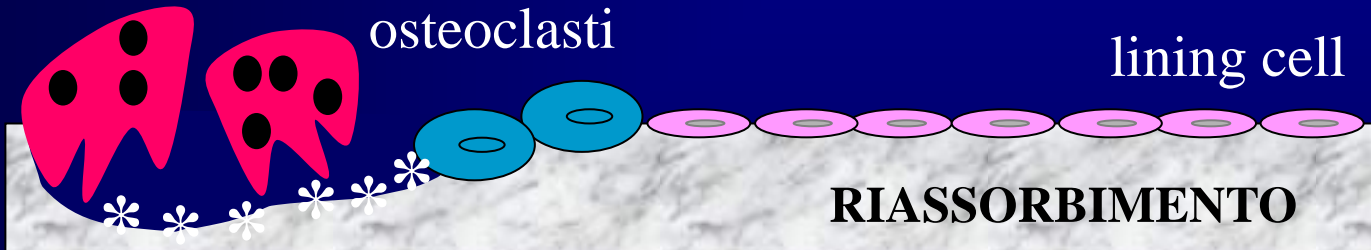


# TESSUTO OSSEO

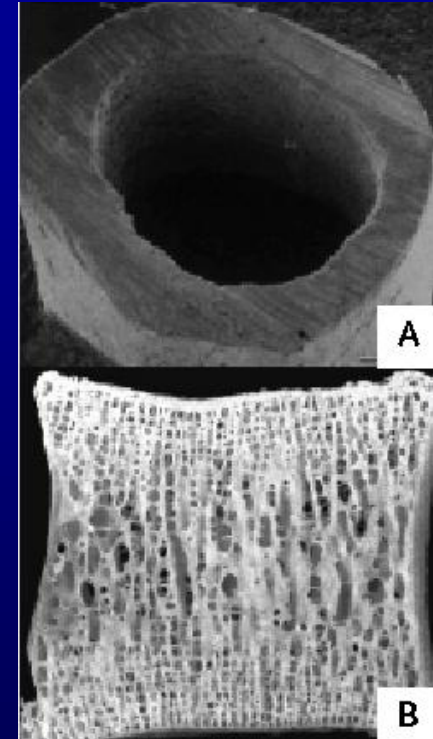
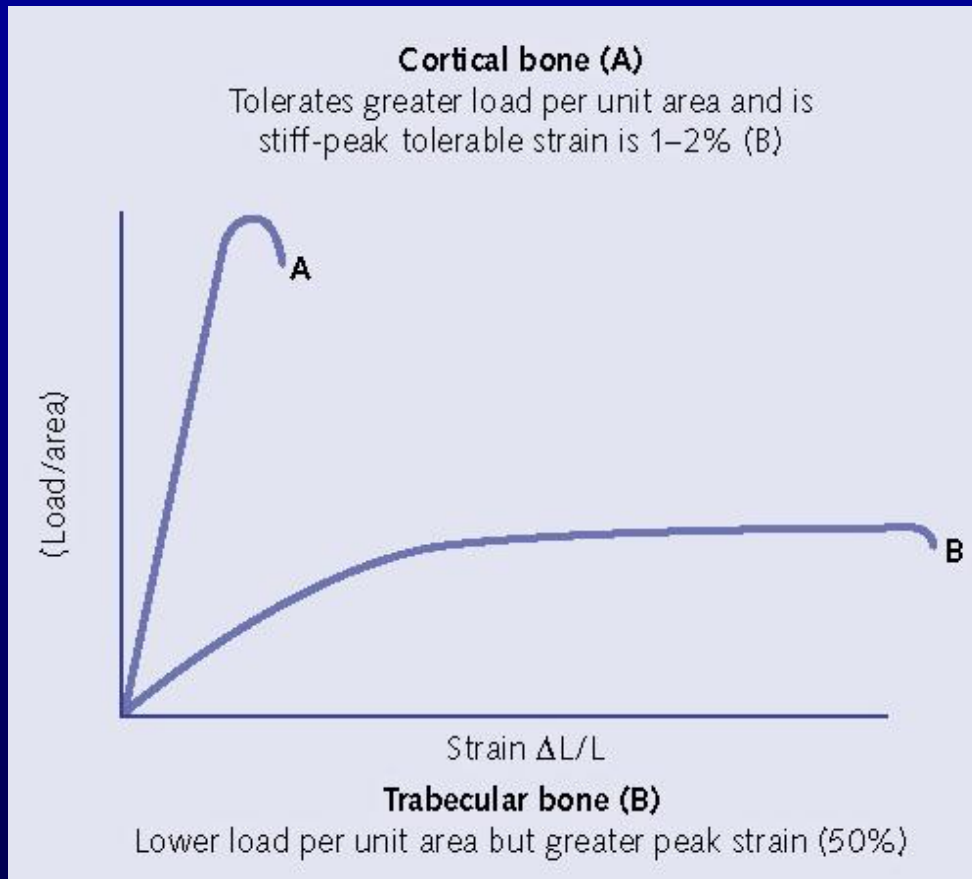
- Tessuto in continuo “**Turn-over**”: ci sono cellule che formano osso (**OSTEOBLASTI**) e cellule che distruggono osso (**OSTEOCLASTI**).



# RIMODELLAMENTO DELL'OSSO



# x Elasticità *versus* Rigidità



Reproduced with permission from Seeman E *Advances in Osteoporotic Fracture Management* 2:2-8; 2002 and Currey JD *J Biomechanics* 12: 459-469; 1979









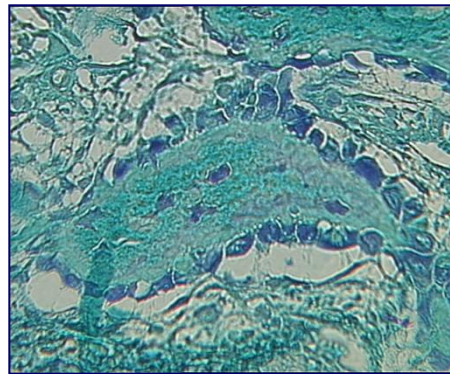
# OSTEOINDUZIONE

**FISICA**

**CHIMICA**

**CELLULARE**

**ATTIVITA' BIOLOGICA**

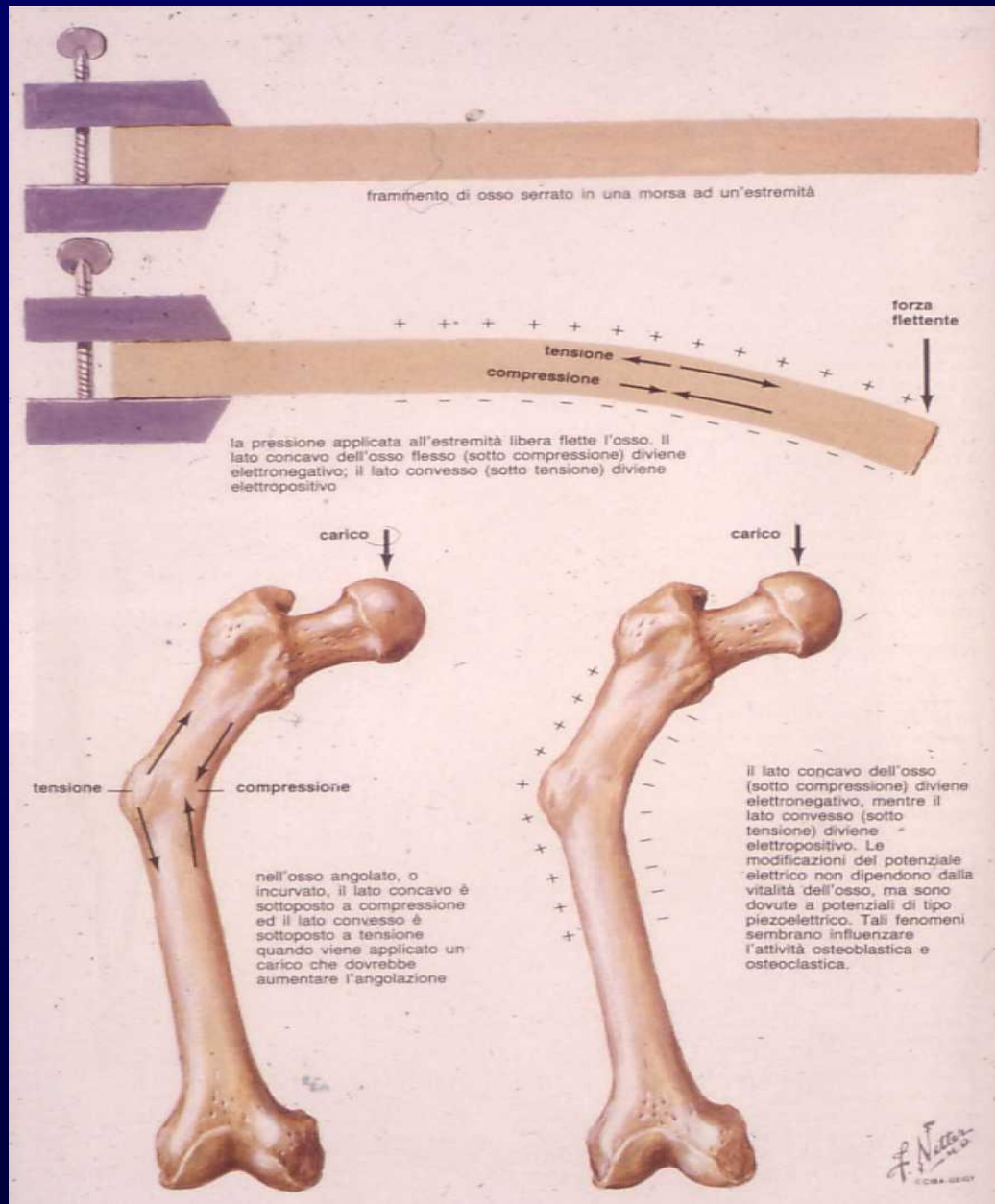


# L'ATTIVITÀ ELETTRICA DEL TESSUTO OSSEO

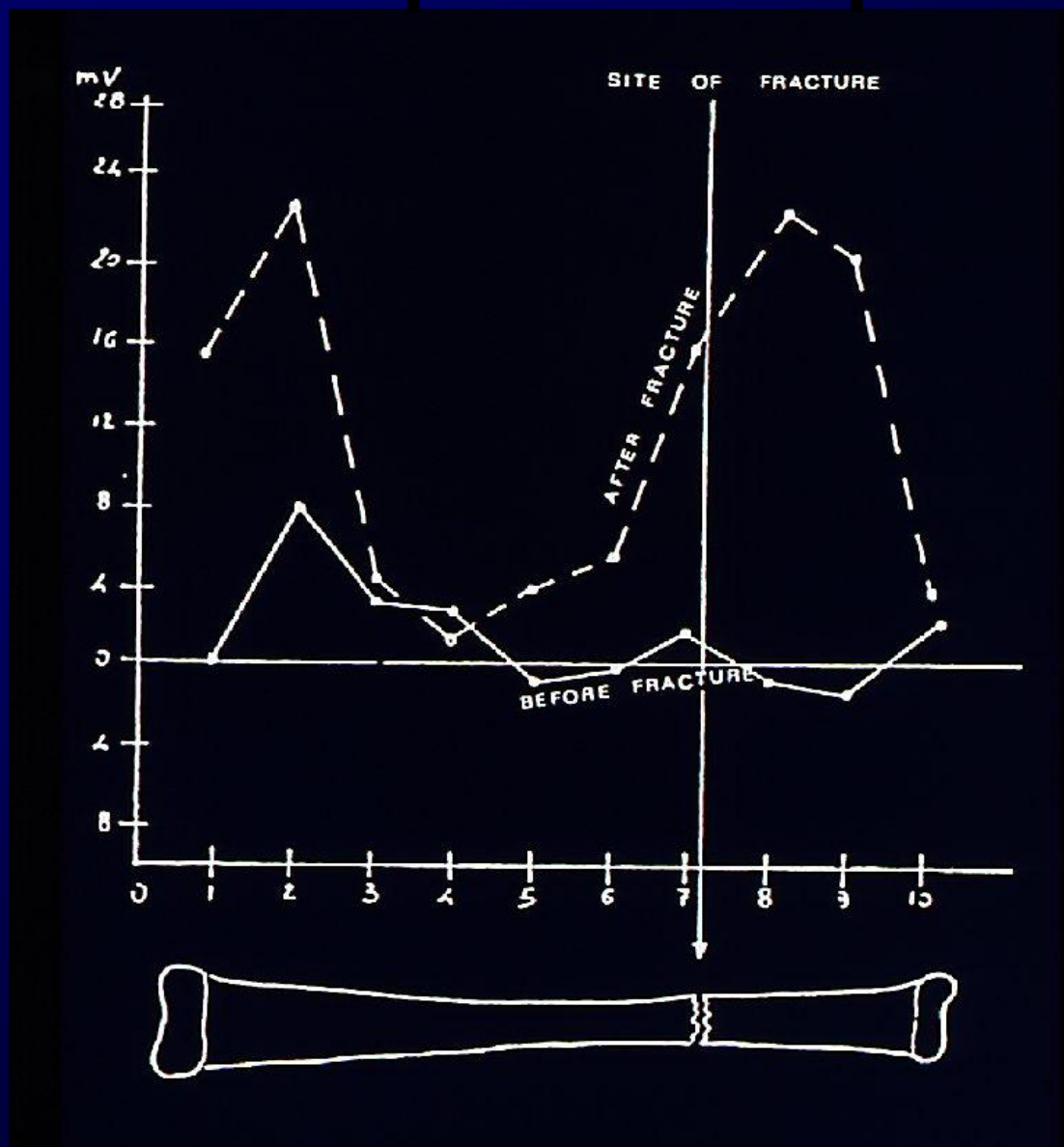
# L'osso genera due tipi di segnale elettrico:

- *in risposta alla deformazione meccanica (I)*
- *a riposo, in assenza di deformazione meccanica (II)*

# Effetto Piezoelettrico Diretto



# Biopotenziali prima e dopo una frattura





# **ENERGIA FISICA**

```
graph TD; A[ENERGIA FISICA] --> B[Energia elettromagnetica]; A --> C[Energia meccanica];
```

**Energia elettromagnetica**

**Faradica: DC - AC**

**Elettrica**

**Elettromagnetica**

**Energia meccanica**

**Diretta: carico**

**Irradiata: ultrasuoni**

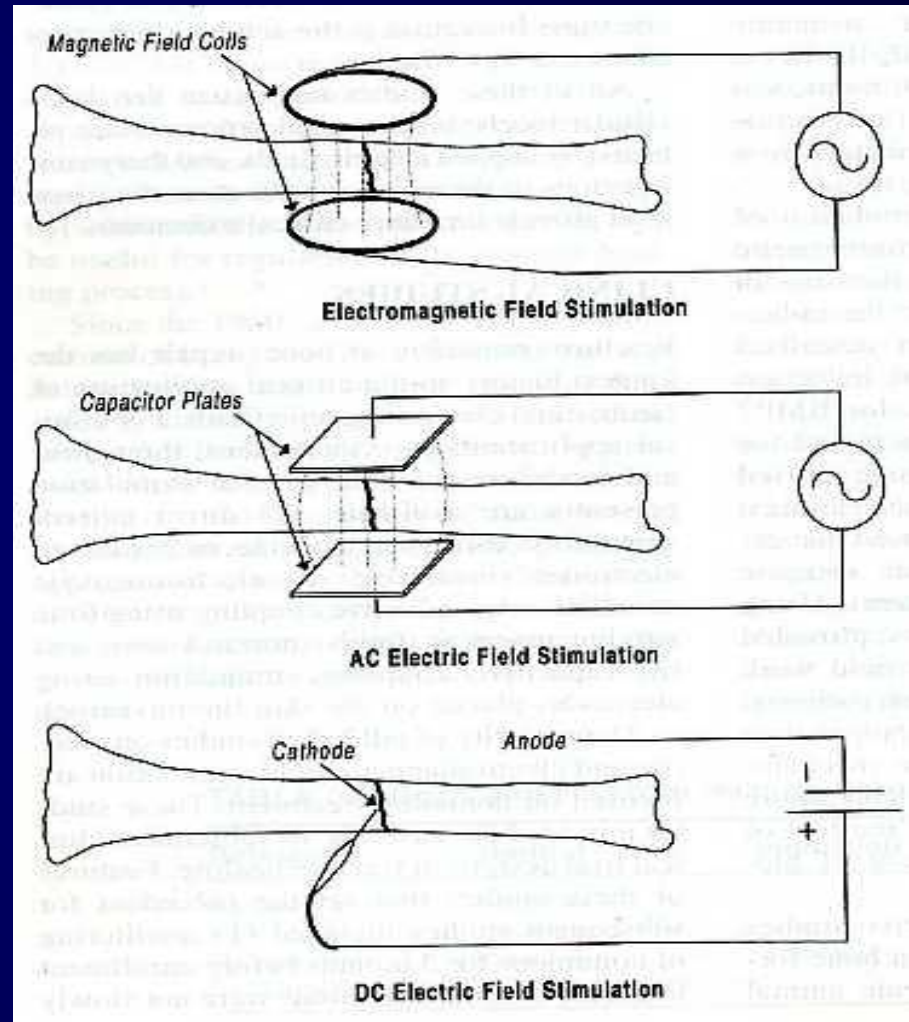
# Rappresentazione schematica delle metodiche di stimolazione elettrica e magnetica dell'osteogenesi

X

Induttiva

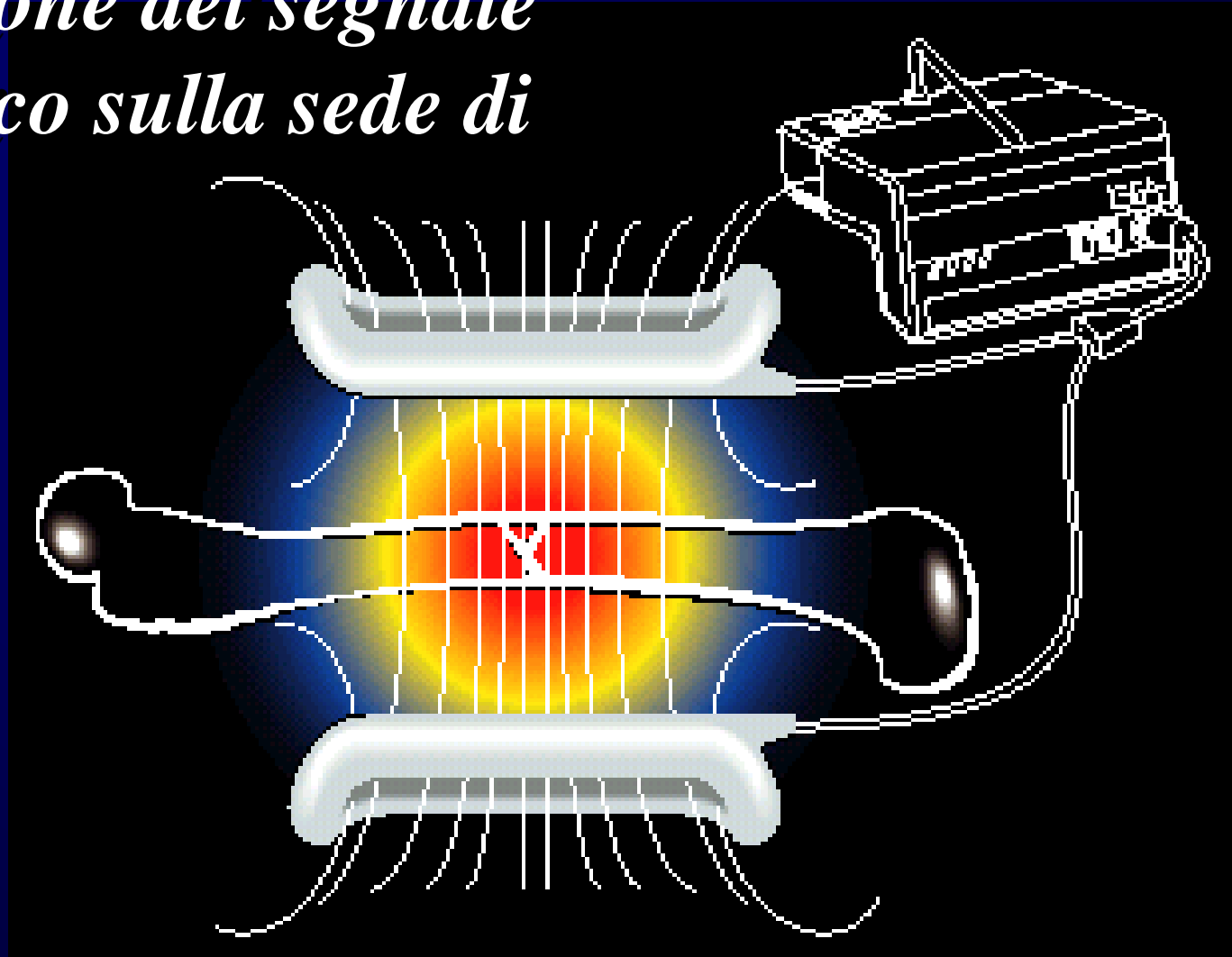
Capacitiva

Faradica

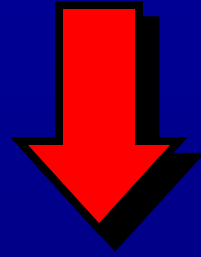


# Sistemi Induttivi

*Focalizzazione del segnale osteogenetico sulla sede di frattura.*

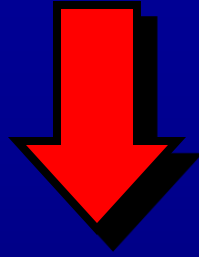


# MUSCOLO

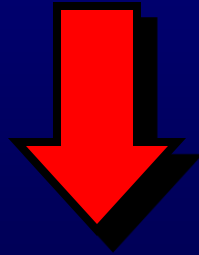


Elemento terminale cui spetta  
la realizzazione della fase  
esecutiva del movimento.

NERVO SOMATICO



PLACCA NEUROMUSCOLARE

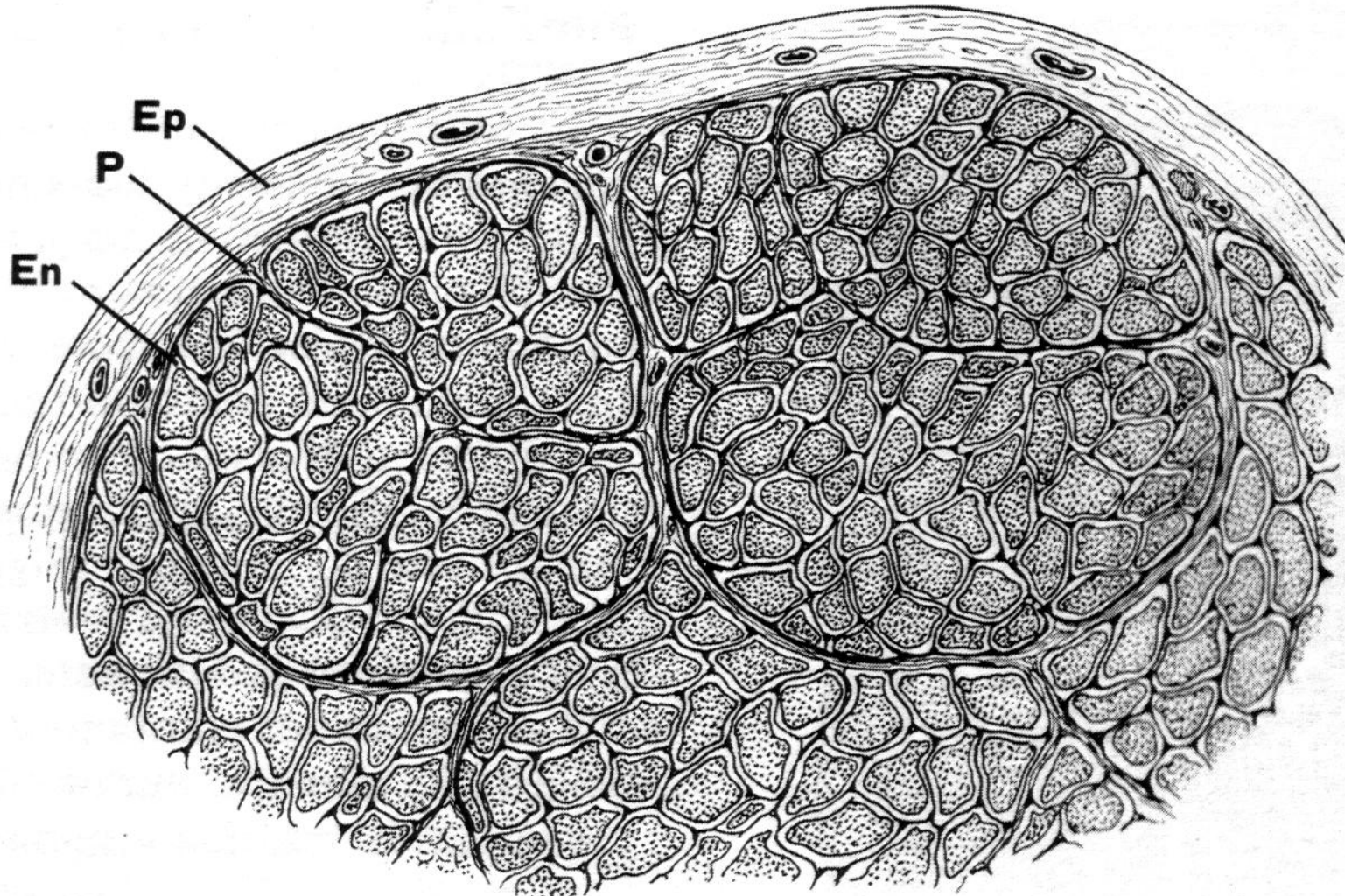


MUSCOLO



# ANATOMIA DEL MUSCOLO

- fibre muscolari: il numero dipende dal diametro trasverso del muscolo;
- fasce di origine connettivale che avvolgono il muscolo (divisione in gruppi e sottogruppi):  
*Epimisio, Perimisio, Endomisio.*

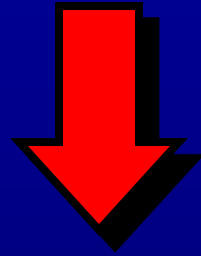


Ep

P

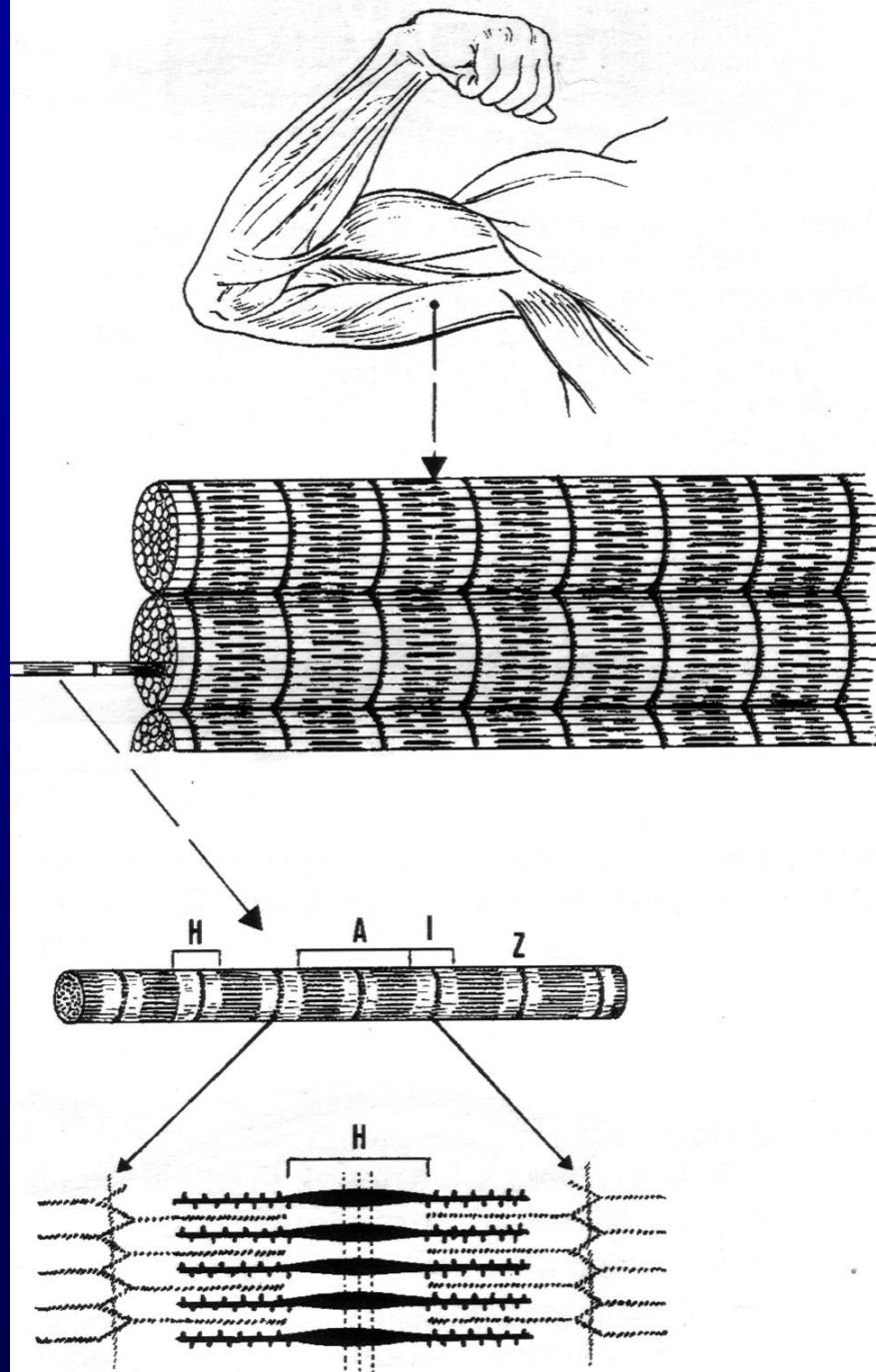
En

# Perimisio, Epimisio, Endomisio

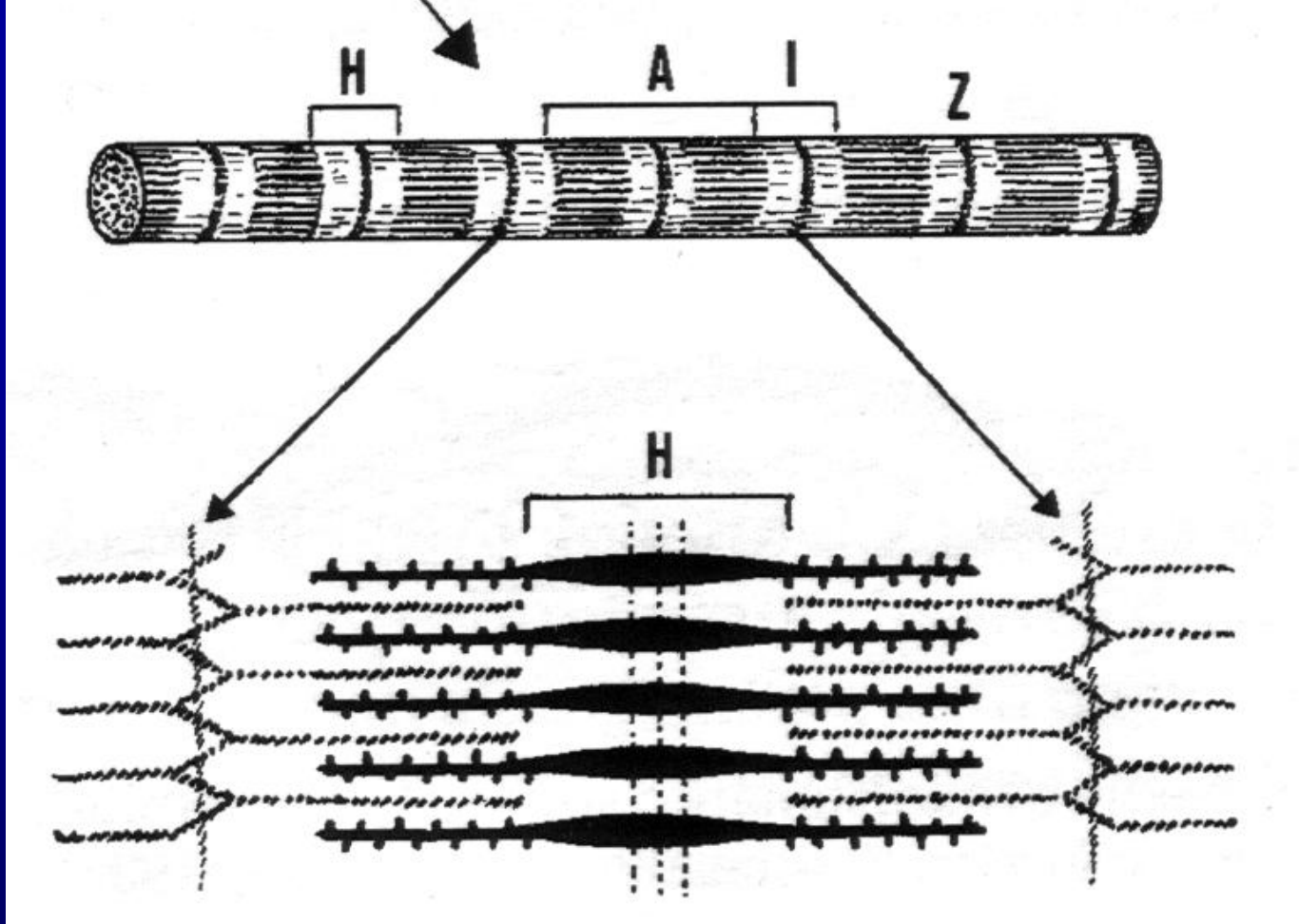


- danno elasticità alle fibre muscolari;
- proteggono da insulti esterni;
- compattano le fibre muscolari;
- mantiene il tono-trofismo muscolare.





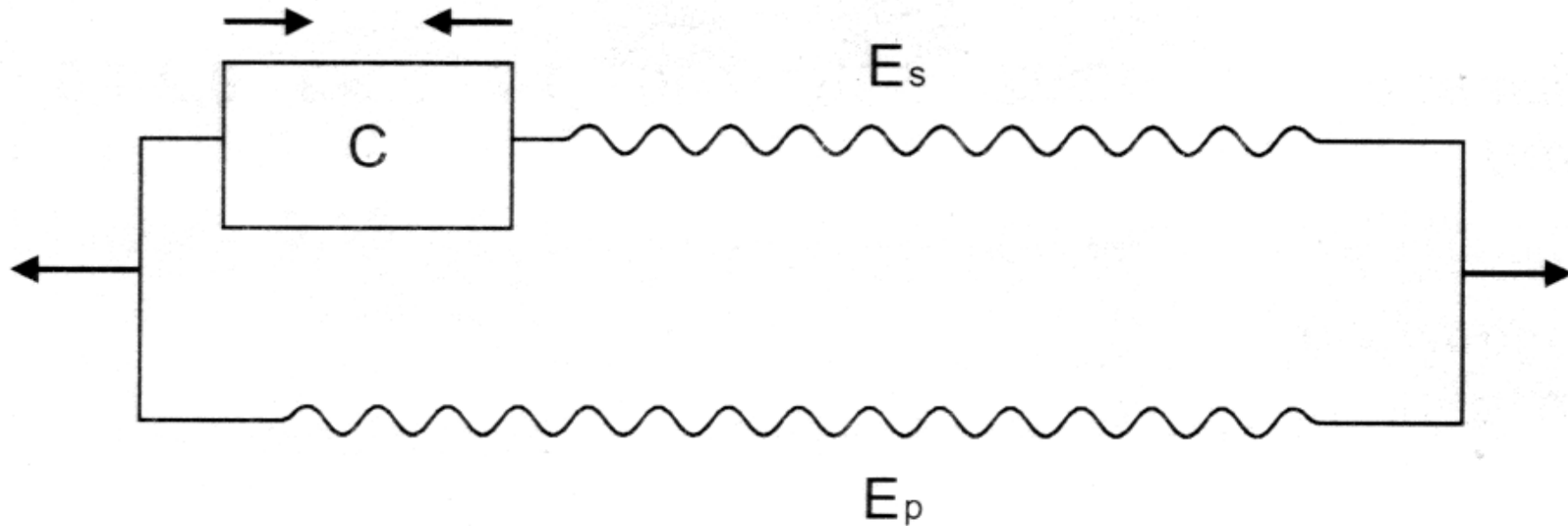
- la funzione contrattile avviene per il movimento dei filamenti di actina e di miosina.



SARCOMERO: unità funzionale  
contrattile del muscolo

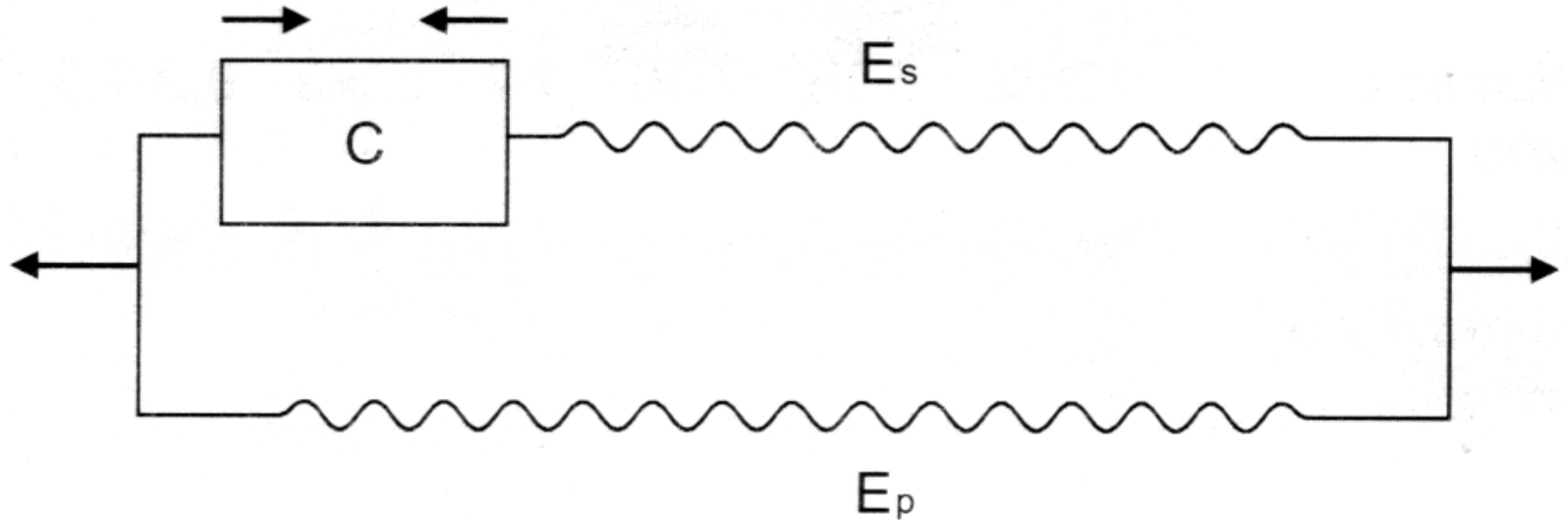


# Relazione tra le fibre muscolari e le componenti elastiche



- strutture elastiche in serie:  
tendini;

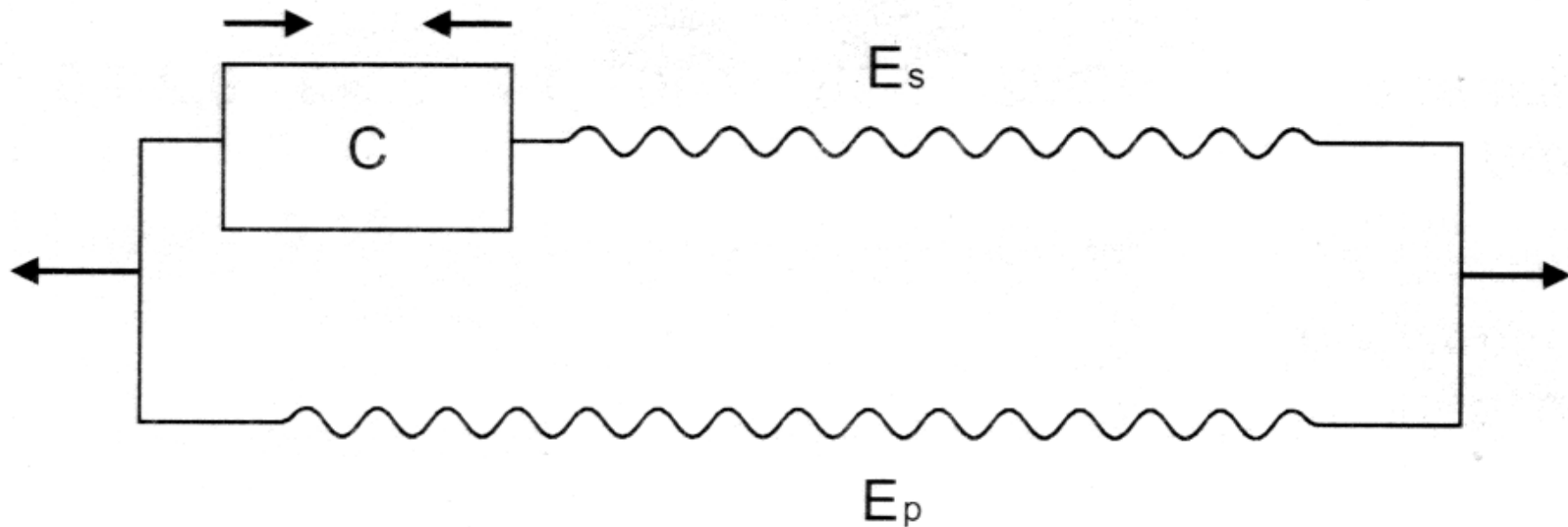
- strutture elastiche in parallelo



- strutture elastiche in serie:  
tendini;
- strutture elastiche in parallelo
- la funzione dei tendini, durante l'attività contrattile, è quella di ridurre le sollecitazioni prodotte sia dagli stiramenti che dalle contrazioni.

- strutture elastiche in serie:  
tendini;
- strutture elastiche in parallelo

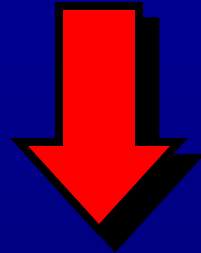
*- sarcolemma e tessuto connettivo  
interposto: attenuano solamente le  
sollecitazioni prodotte da  
stiramenti, riducendo le resistenze.*



- protezione interna;

- risparmio di energia contrattile

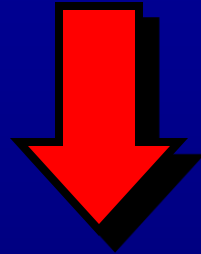
# Tipi di contrazione muscolare



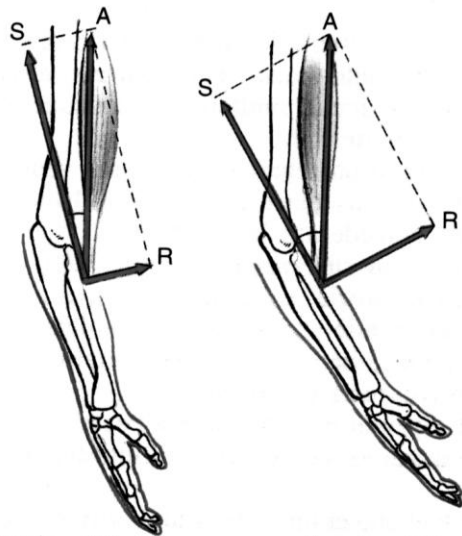
- isotonica concentrica;
- isotonica eccentrica;
- isometrica;
- (*isocinetica*).



# Tipi di leve

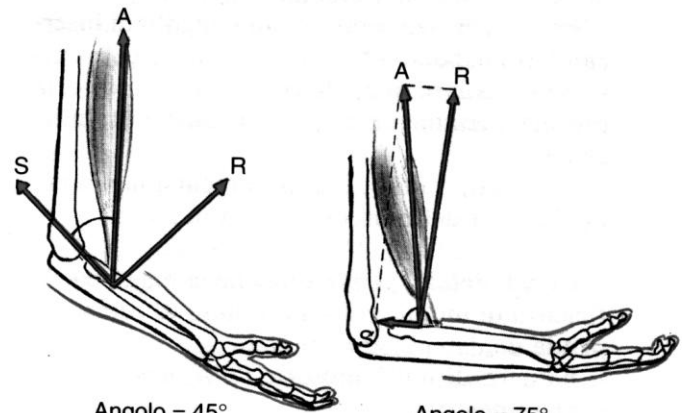


- primo tipo (interfulcrali) o neutre;
- secondo tipo (interresistenti) o vantaggiose;
- terzo tipo (interpotenti) o svantaggiose.



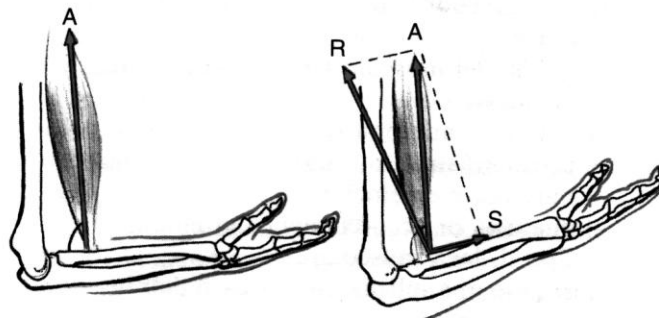
Angolo = 15°  
 S = 95,6 N  
 R = 25,9 N

Angolo = 30°  
 S = 86,6 N  
 R = 50 N



Angolo = 45°  
 S = 70,7 N  
 R = 70,7 N

Angolo = 75°  
 S = 25,9 N  
 R = 96,6 N



Angolo = 90°  
 S = 0  
 R = A = 100 N

Angolo = 120°  
 S = 50 N  
 R = 86,6 N

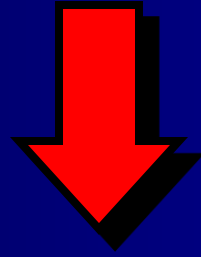
# ***APPARATO LOCOMOTORE***

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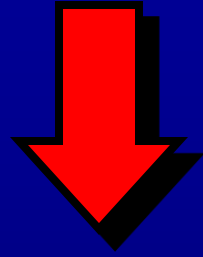


# ARTICOLAZIONE



Giunto di connessione tra  
strutture ossee che possono  
muoversi reciprocamente.

# Classificazione delle articolazioni



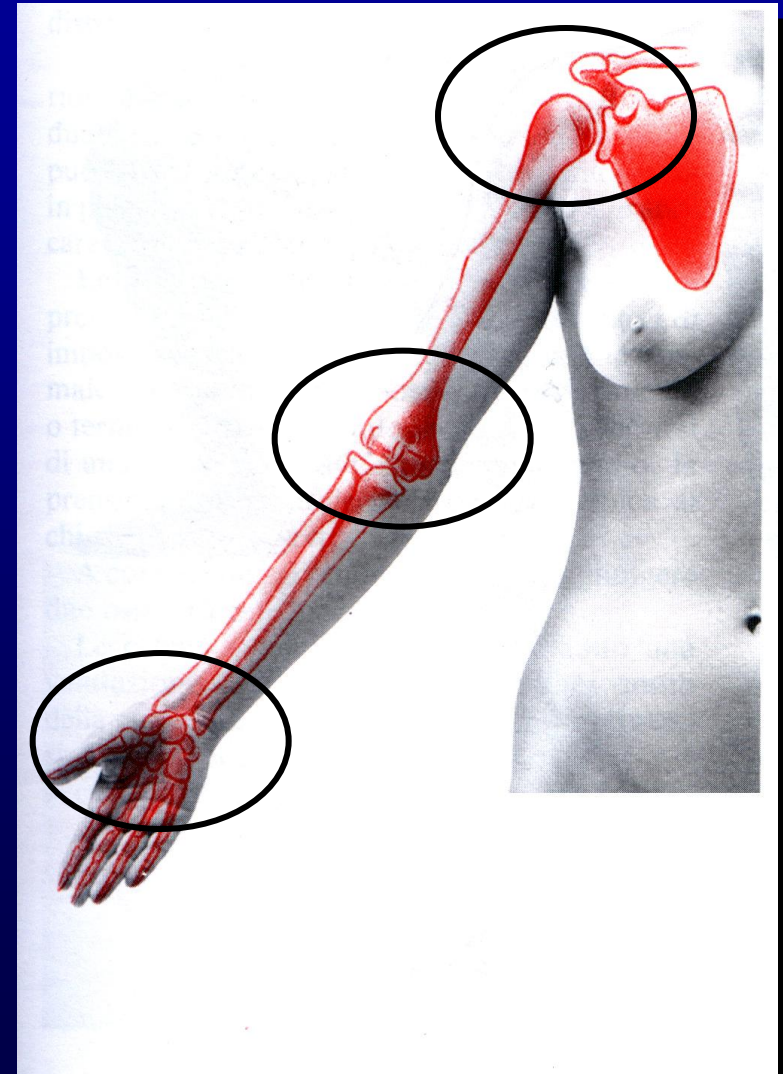
- Sinartrosi;
- Diartrosi;
- Enartrosi.

S

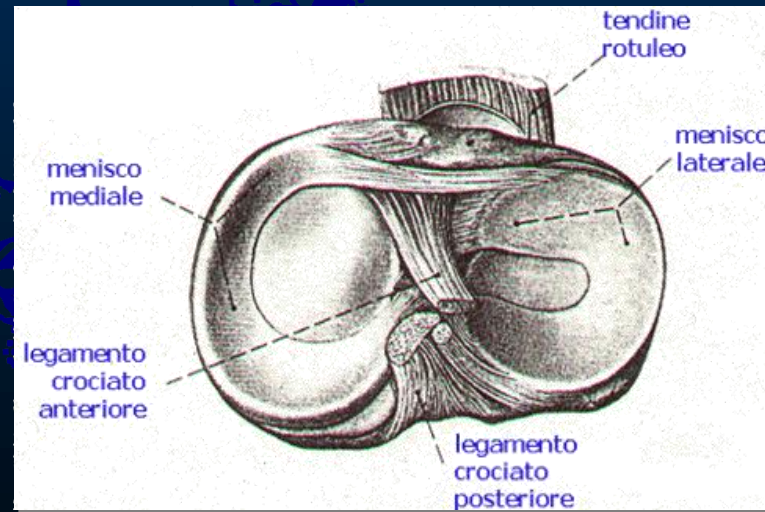
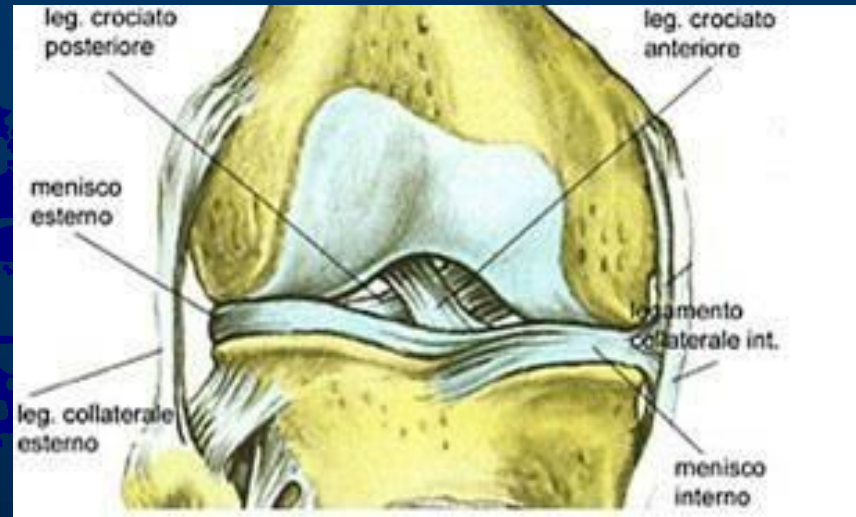
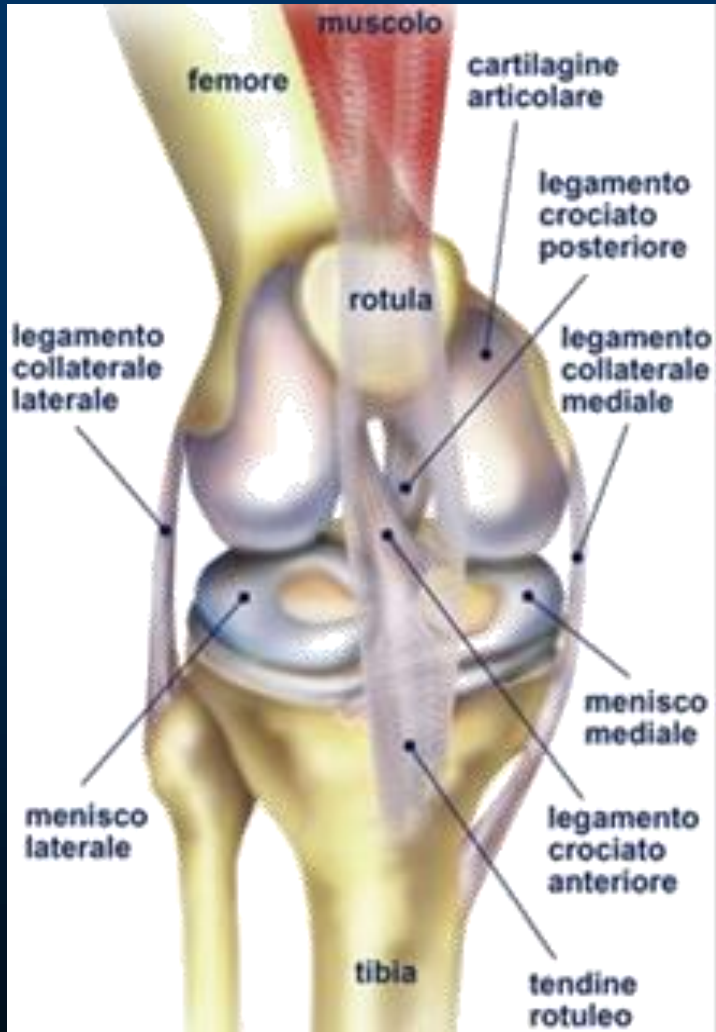


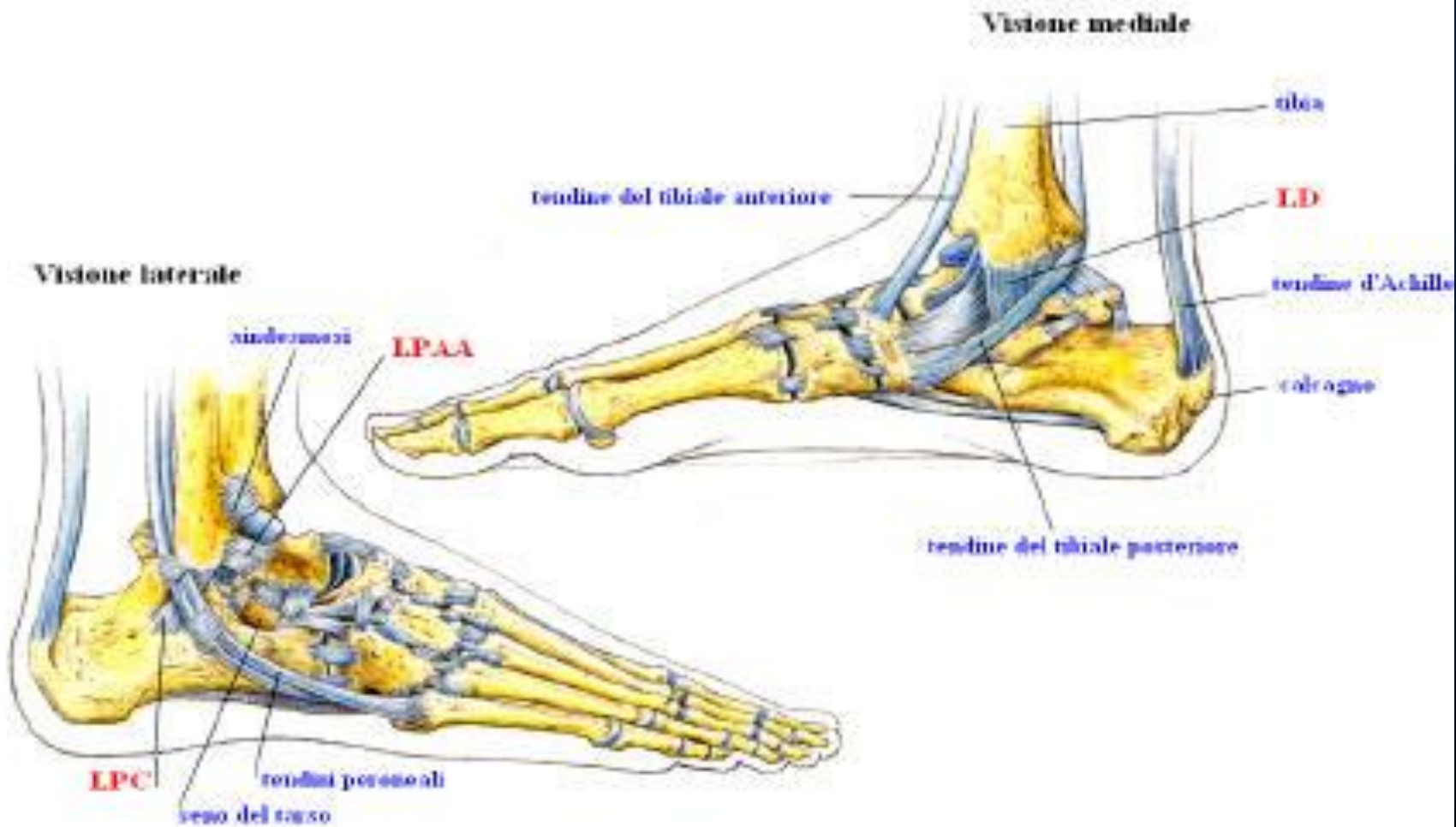


# - Enartrosi.

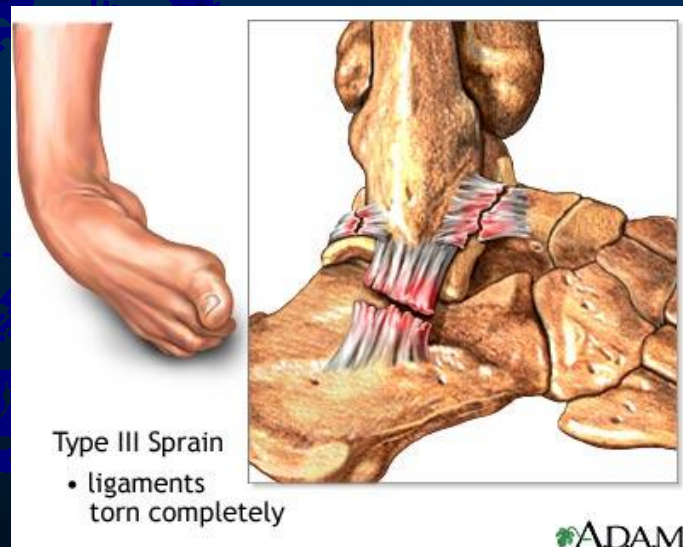
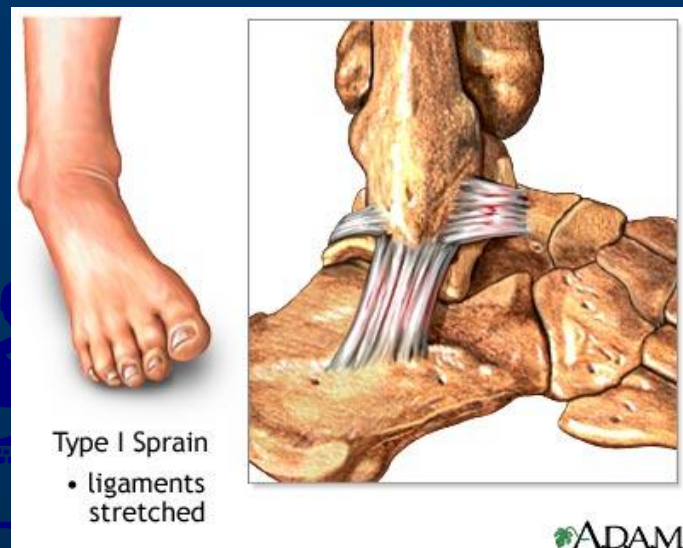
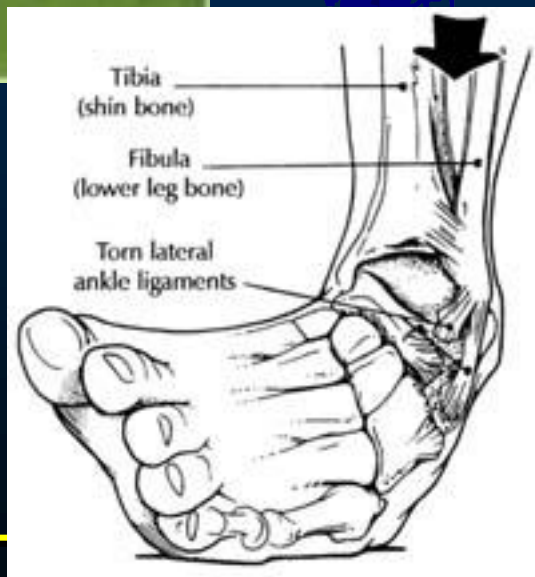


# Anatomia del ginocchio

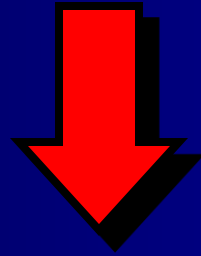








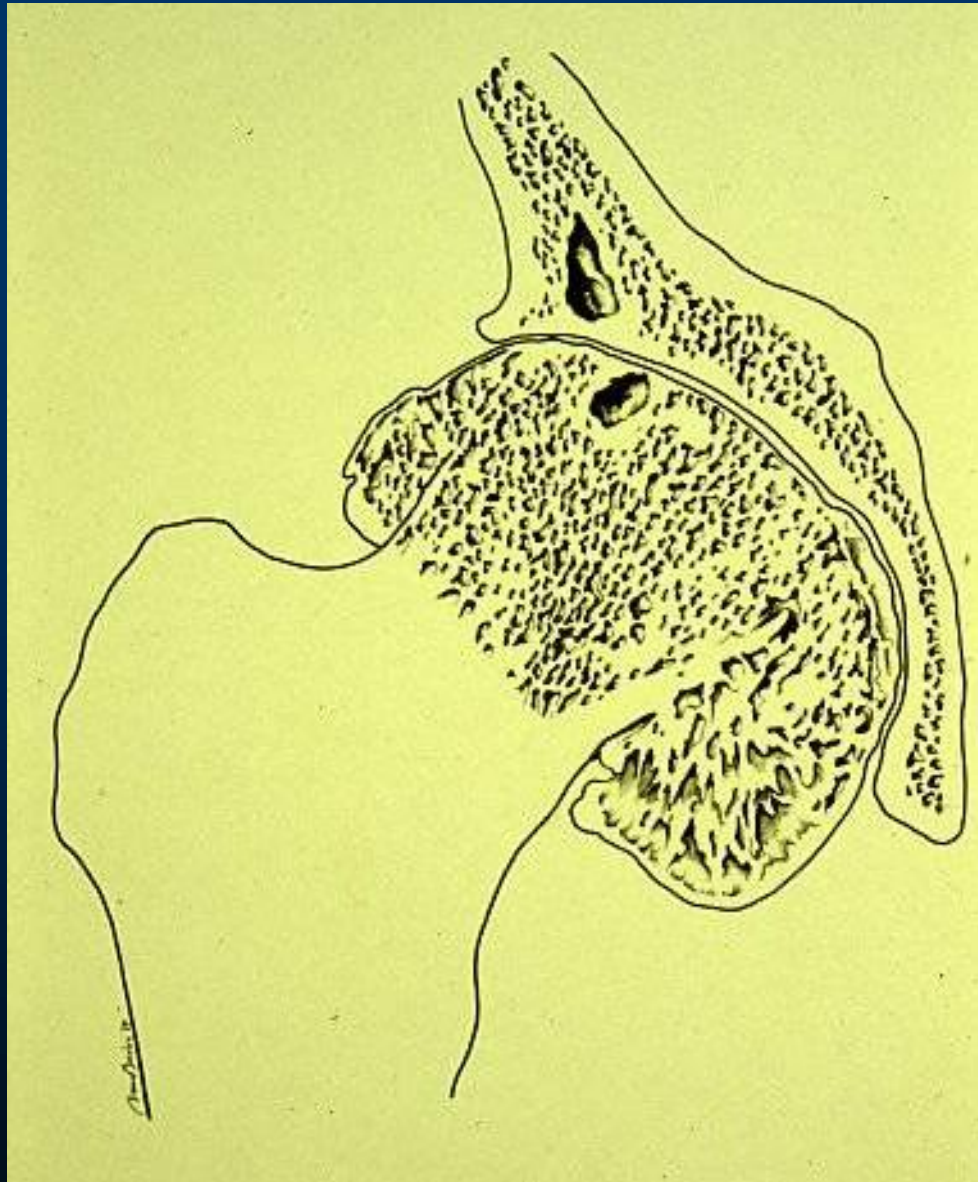
# Funzioni della cartilagine articolare

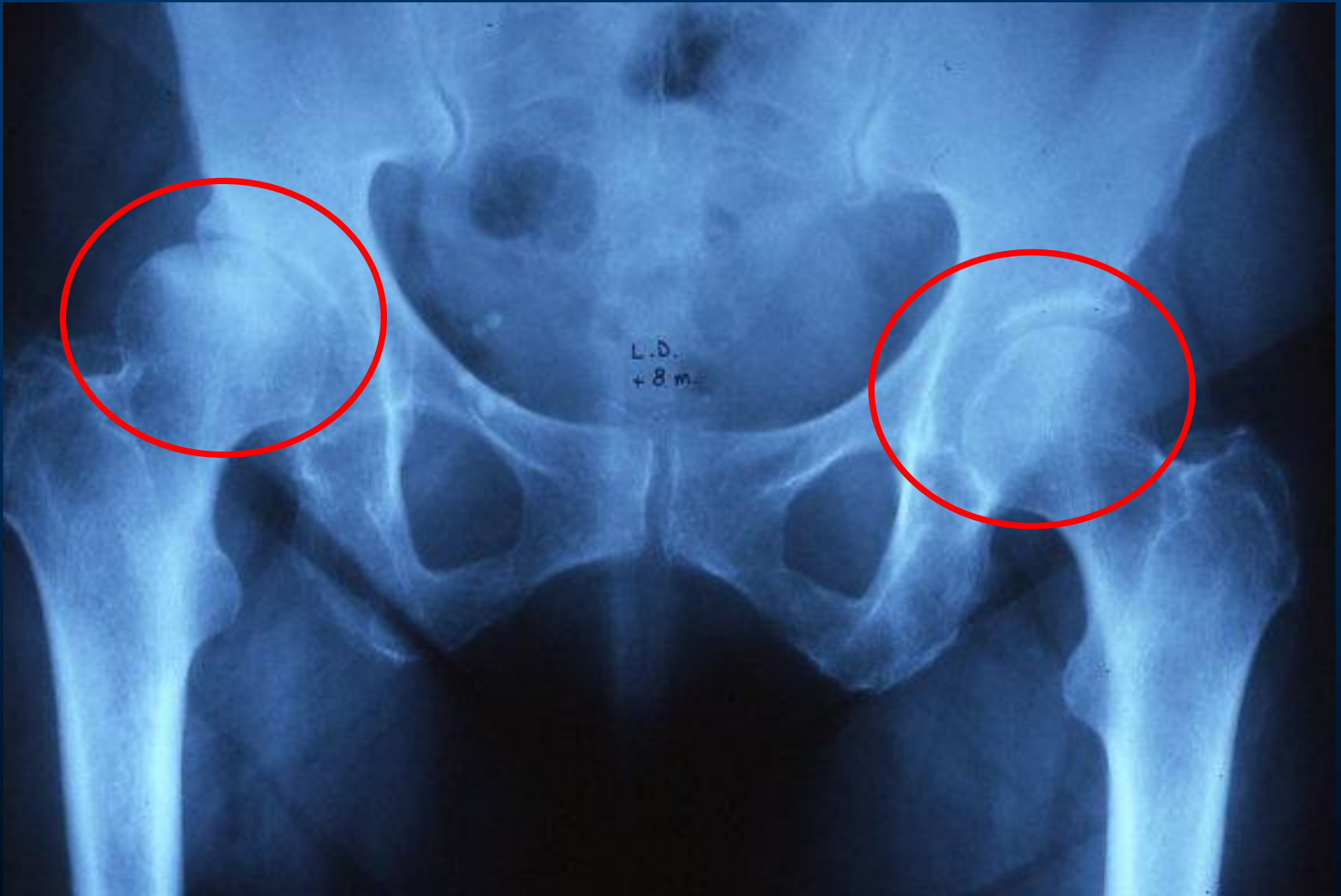


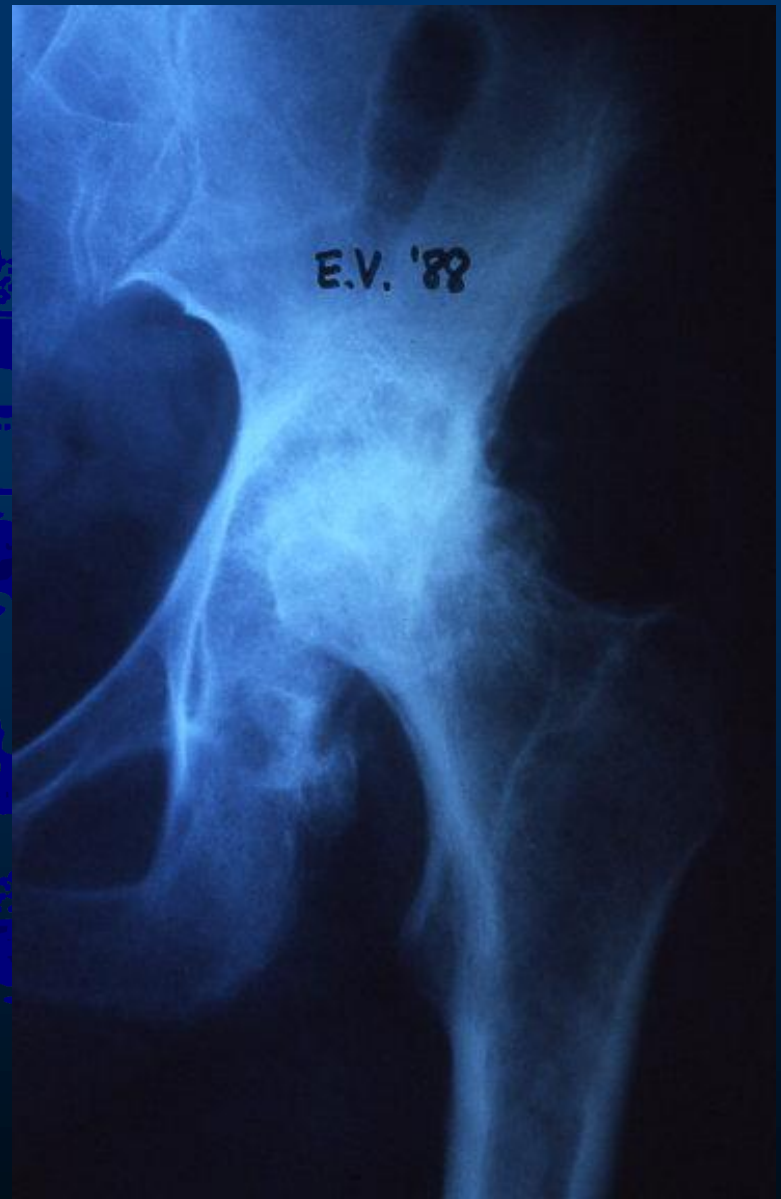
- movimento senza attrito;
- "shock adsorber", distribuzione dei carichi.















"There probably remains an unexpected and poorly measured pandemic of perceptive mortality, which is an unappreciated public health concern."



## Review

## The operation of the century: total hip replacement

*Ian D Learmonth, Claire Young, Cecil Rorabeck*

*Lancet* 2007; 370: 1508–19

Published Online

March 29, 2007

DOI:10.1016/S0140-

6736(07)60457-7

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Cumberland Infirmary,  
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University of Western Ontario,  
London Health Services  
Centre, London, Ontario,  
Canada (Prof C Rorabeck FRCS)

Correspondence to:  
Prof Ian D Learmonth

In the 1960s, total hip replacement revolutionised management of elderly patients crippled with arthritis, with very good long-term results. Today, young patients present for hip-replacement surgery hoping to restore their quality of life, which typically includes physically demanding activities. Advances in bioengineering technology have driven development of hip prostheses. Both cemented and uncemented hips can provide durable fixation. Better materials and design have allowed use of large-bore bearings, which provide an increased range of motion with enhanced stability and very low wear. Minimally invasive surgery limits soft-tissue damage and facilitates accelerated discharge and rehabilitation. Short-term objectives must not compromise long-term performance. Computer-assisted surgery will contribute to reproducible and accurate placement of implants. Universal economic constraints in healthcare services dictate that further developments in total hip replacement will be governed by their cost-effectiveness.

Palaeopathologists have diagnosed osteoarthritis of the hip in ancient skeletons,<sup>1</sup> and prevalence and distribution of the disease then seems no different from today.<sup>2</sup> However, little more than 100 years ago, the first attempt was made to treat hip arthritis surgically. Interpositional arthronasty, offered in the late 19th and early 20th

fracture of the implant,<sup>13</sup> aseptic loosening as a result of mechanical failure of the fixation interface,<sup>14</sup> infection,<sup>15</sup> polyethylene wear,<sup>16</sup> and dislocation.<sup>17</sup> Furthermore, high failure rates were reported in young patients.<sup>18–20</sup>

Indications for total hip replacement were initially largely restricted to either elderly and infirm people or

# Protesi articolari

## "cementate"



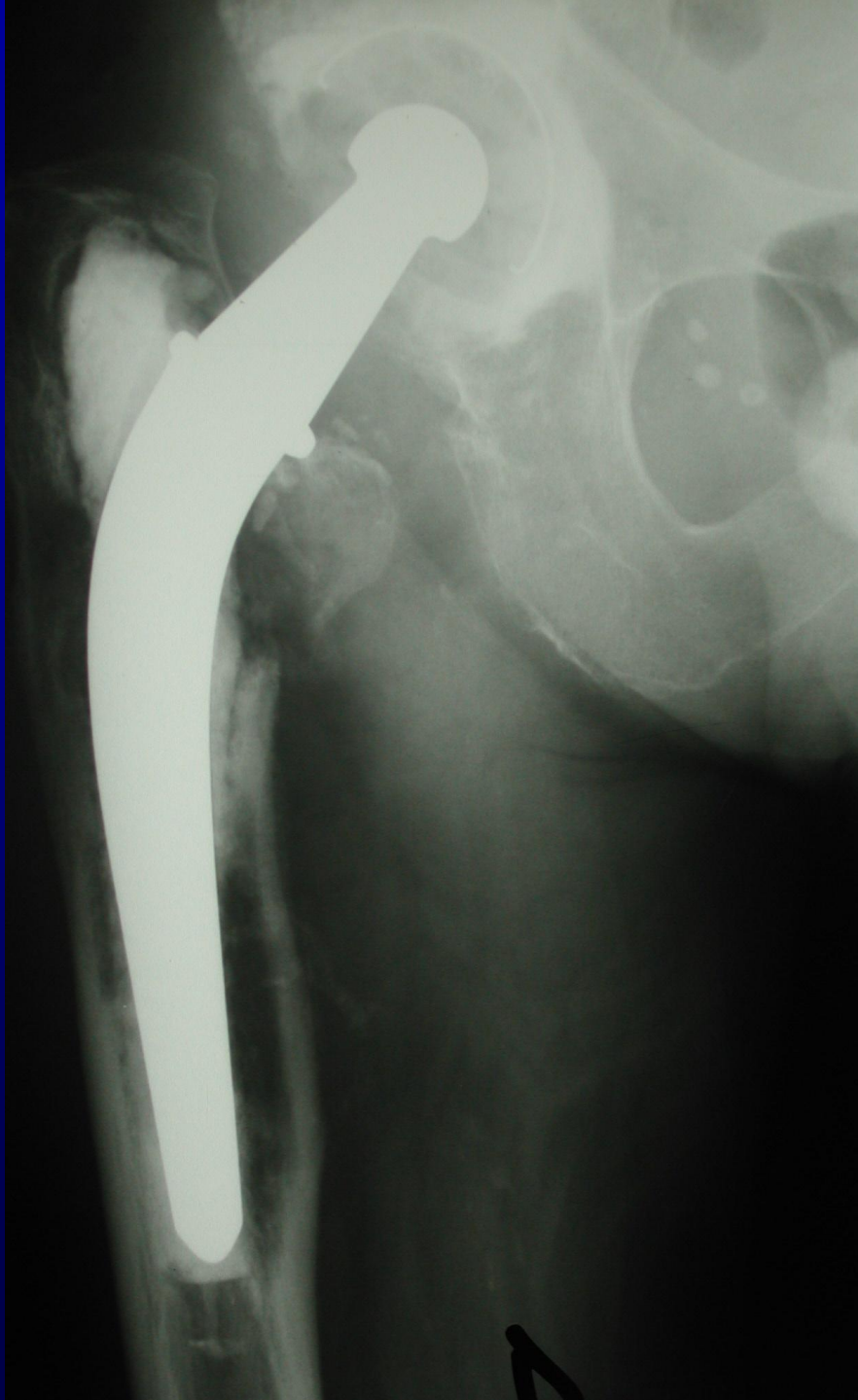




# I materiali

- Il cemento è polimetilmetacrilato
- Viene preparato estemporaneamente in sala operatoria mescolando il metacrilato, liquido, con polimetilmetacrilato.
- La polimerizzazione avviene in qualche minuti (5-8), tempo utile per interporlo tra protesi ed osso.
- Quando è polimerizzato è un solido e vincola la protesi all'osso





# Protesi articolari

## "non cementate"





X

# Caratteristiche Bio-Fisiche dei materiali per protesi articolari

- ✓ *Resistenza al carico;*
- ✓ *Rigidezza ed elasticità;*
- ✓ *Biocompatibilità.*

# **BIOMATERIALI più in uso in Chirurgia Ortopedica:**

***ACCIAIO***

***TITANIO (Ti-6Al-4V)***

***CROMO-COBALTO (Cr-Co-Mo)***



# YOUNG's modulus

$$\lambda = \frac{\textit{stress}}{\textit{strain}} = \frac{F/A}{x/l} = \frac{Fl}{Ax}$$



Material	Young's modulus (E) in <u>GPa</u>	Young's modulus (E) in <u>lb/in<sup>2</sup> (psi)</u>
<u>Rubber</u> (small strain)	0.01-0.1	1,500-15,000
<u>Low density polyethylene</u>	0.2	30,000
<u>Polypropylene</u>	1.5-2	217,000-290,000
<u>Polyethylene terephthalate</u>	2-2.5	290,000-360,000
<u>Polystyrene</u>	3-3.5	435,000-505,000
<u>Nylon</u>	2-4	290,000-580,000
<u>Oak wood</u> (along grain)	11	1,600,000
<u>High-strength concrete</u> (under compression)	30	4,350,000
<u>Magnesium metal</u>	45	6,500,000
<u>Aluminium alloy</u>	69	10,000,000
<u>Glass</u> (all types)	72	10,400,000
<u>Brass and bronze</u>	103-124	17,000,000
<u>Titanium (Ti)</u>	105-120	15,000,000-17,500,000
<u>Carbon fiber reinforced plastic</u> (unidirectional, along grain)	150	21,800,000
<u>Wrought iron and steel</u>	190-210	30,000,000
<u>Tungsten (W)</u>	400-410	58,000,000-59,500,000
<u>Silicon carbide (SiC)</u>	450	65,000,000
<u>Tungsten carbide (WC)</u>	450-650	65,000,000-94,000,000
<u>Single Carbon nanotube</u> [1]	approx. 1,000	approx. 145,000,000
<u>Diamond</u>	1,050-1,200	150,000,000-175,000,000



L= SE1 EHT= 20.0 KV WD= 16 mm MAG= X 48.6 PHOTO= 14 R= OFF  
ZOOM= X8 500 µm |  
CONTROLLO

**Controllo 72h**



L= SE1 EHT= 20.0 KV WD= 16 mm MAG= X 172. PHOTO= 12  
200 µm |  
CROMO/COBALTO

**Cr-Co 72h**

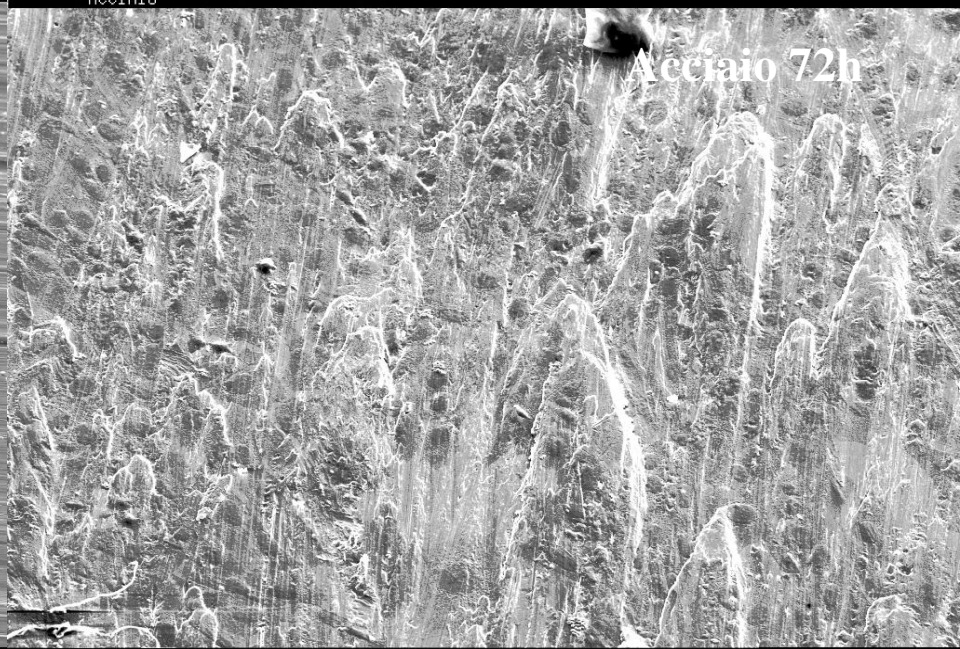
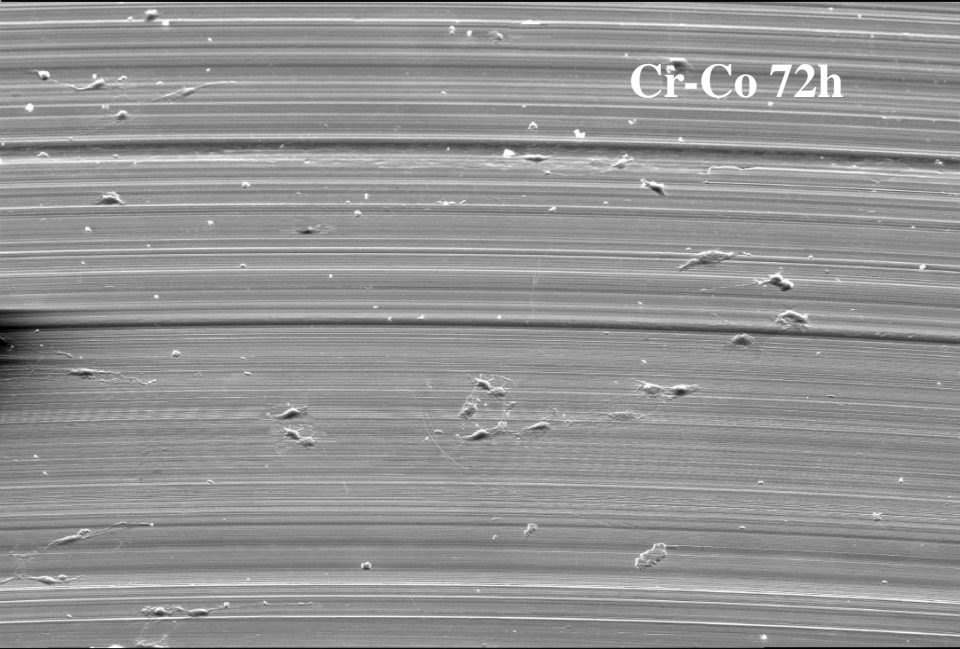
L= SE1 EHT= 20.0 KV WD= 20 mm MAG= X 62.1 PHOTO= 18 R= OFF  
ZOOM= X8 500 µm |  
TITANIO

**Titanio 72h**



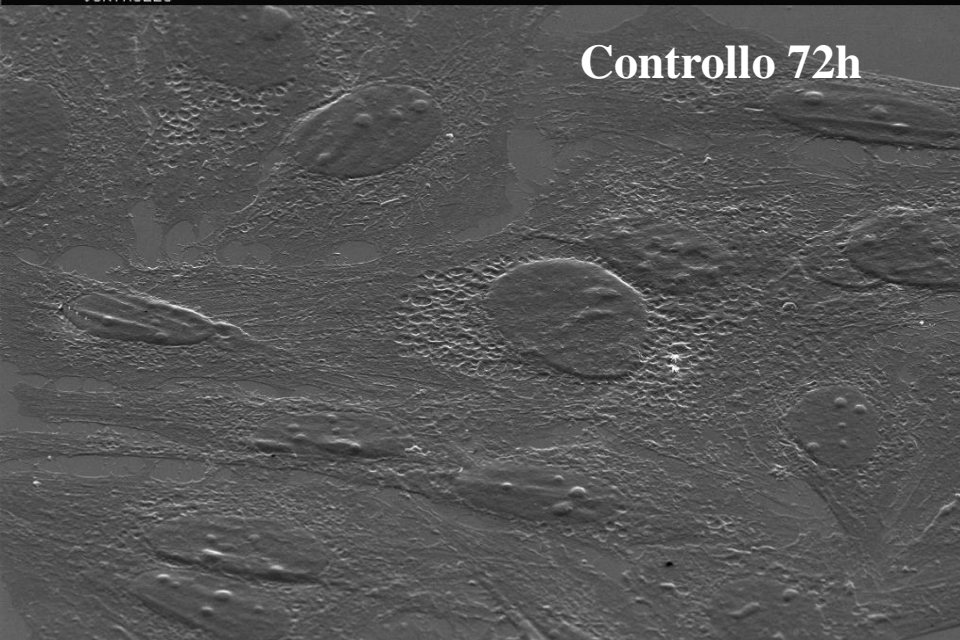
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200 µm |  
ACCIAIO

**Acciaio 72h**



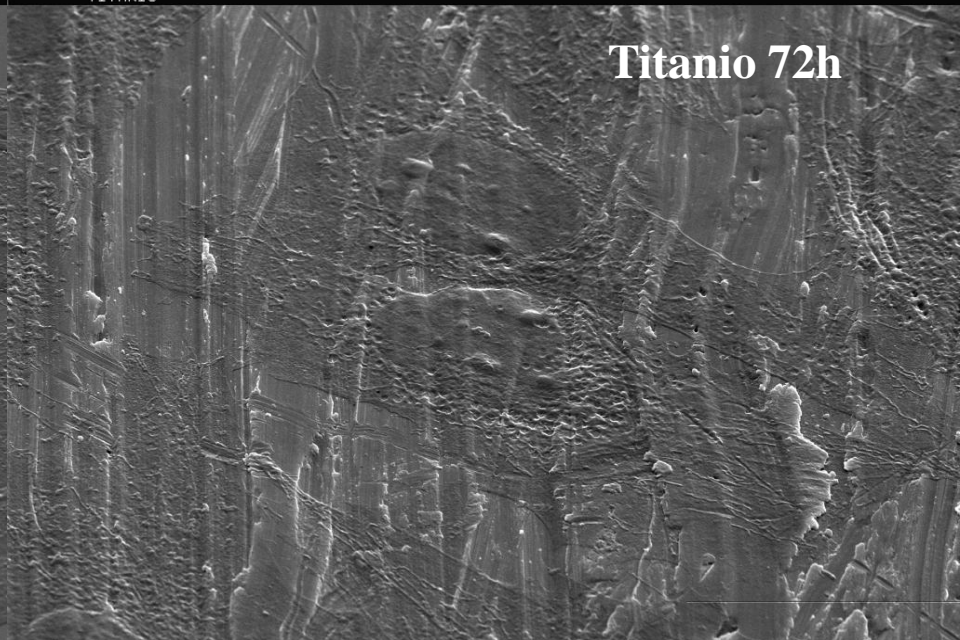
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CONTROLLO

**Controllo 72h**



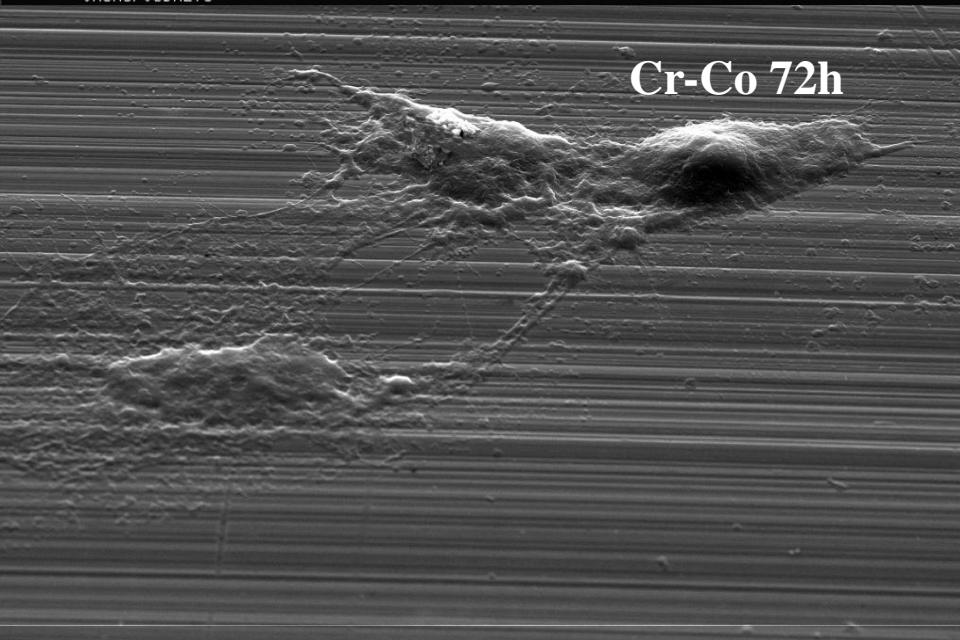
L= SE1 EHT= 20.0 KV WD= 18 mm MAG= X 1.35 K PHOTO= 17  
TITANIO

**Titanio 72h**



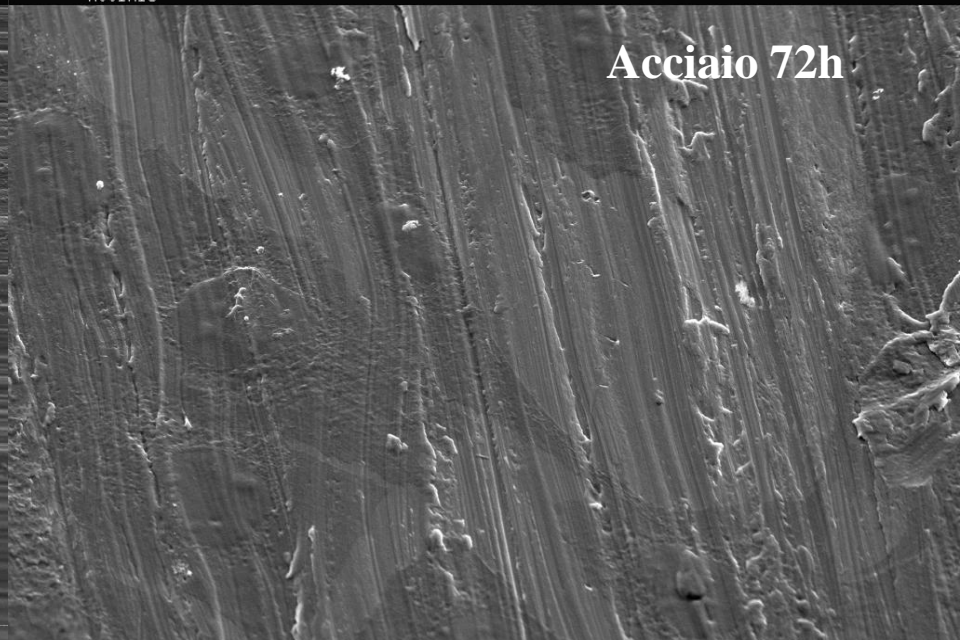
L= SE1 EHT= 20.0 KV WD= 16 mm MAG= X 1.44 K PHOTO= 11  
CROMO/COBALTO

**Cr-Co 72h**



L= SE1 EHT= 20.0 KV WD= 20 mm MAG= X 901. PHOTO= 8  
ACCIAIO

**Acciaio 72h**







## The Definitive Implant Design

### ZIMMER<sup>®</sup> Anatomic Hip Prosthesis<sup>®</sup>

The ZIMMER Anatomic Hip Prosthesis incorporates practical design considerations that impact the ultimate function of the hip.

Remodeling and stress shielding are minimized by aligning the centroidal and medial bending axes of the prosthetic stem with those of the natural femur.

- The anatomic center of rotation for the joint is restored through an anteverted femoral neck and an anterior head-neck offset.
- Load transfer from stem to bone is maximized through the use of TITANIUM<sup>®</sup> Ti-6Al-4V Alloy.
- Modular sizing promotes an optimal fit.
- Commercially pure titanium fiber-metal<sup>®</sup> circumferential pads enhance fixation.
- System specific instrumentation facilitates precise, reproducible implantation.

These are some of the design features that make the Anatomic Hip Prosthesis a valuable addition to THE TOTAL SYSTEM<sup>®</sup>—an exacting and practical choice in restoring natural function and eliminating pain.

Complete information concerning this product including relevant contraindications, warning precautions and adverse effects, is available by contacting Zimmer, Inc., P.O. Box 798, Warsaw, IN 46580. Full disclosure is also contained in the package insert accompanying the device.

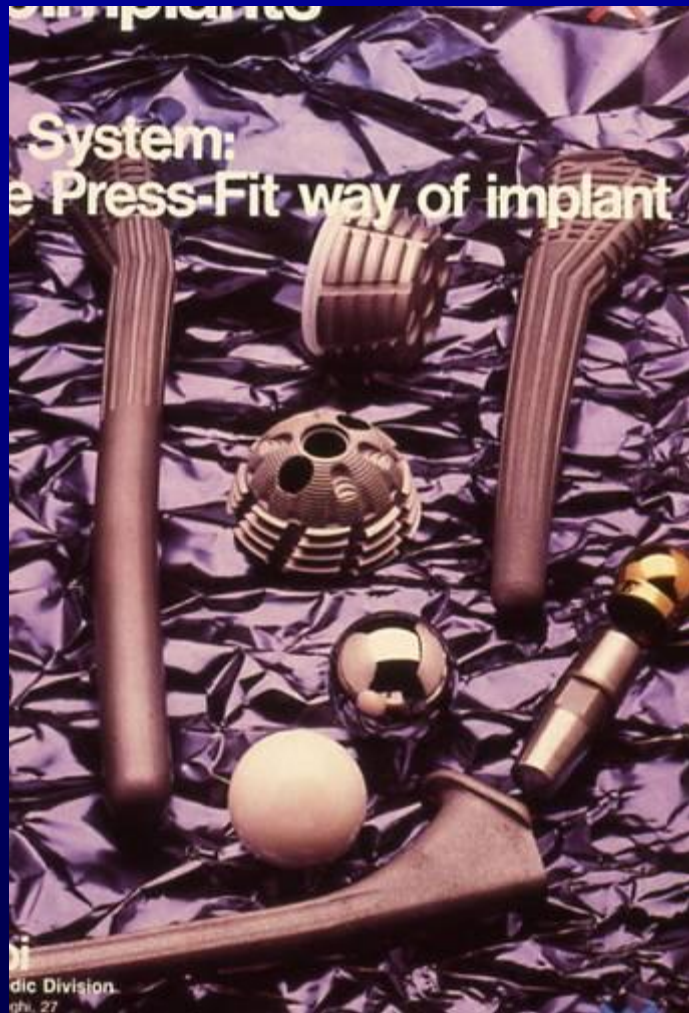
The Anatomic Hip Prosthesis is marketed for use only in the United States.  
\*U.S. Patent No. 4,739,912/Other Patents Pending  
\*\*U.S. Patent No. 4,865,421





Orthopédie

# System: The Press-Fit way of implant



Medic Division  
ghl, 27



## DES SOLUTIONS

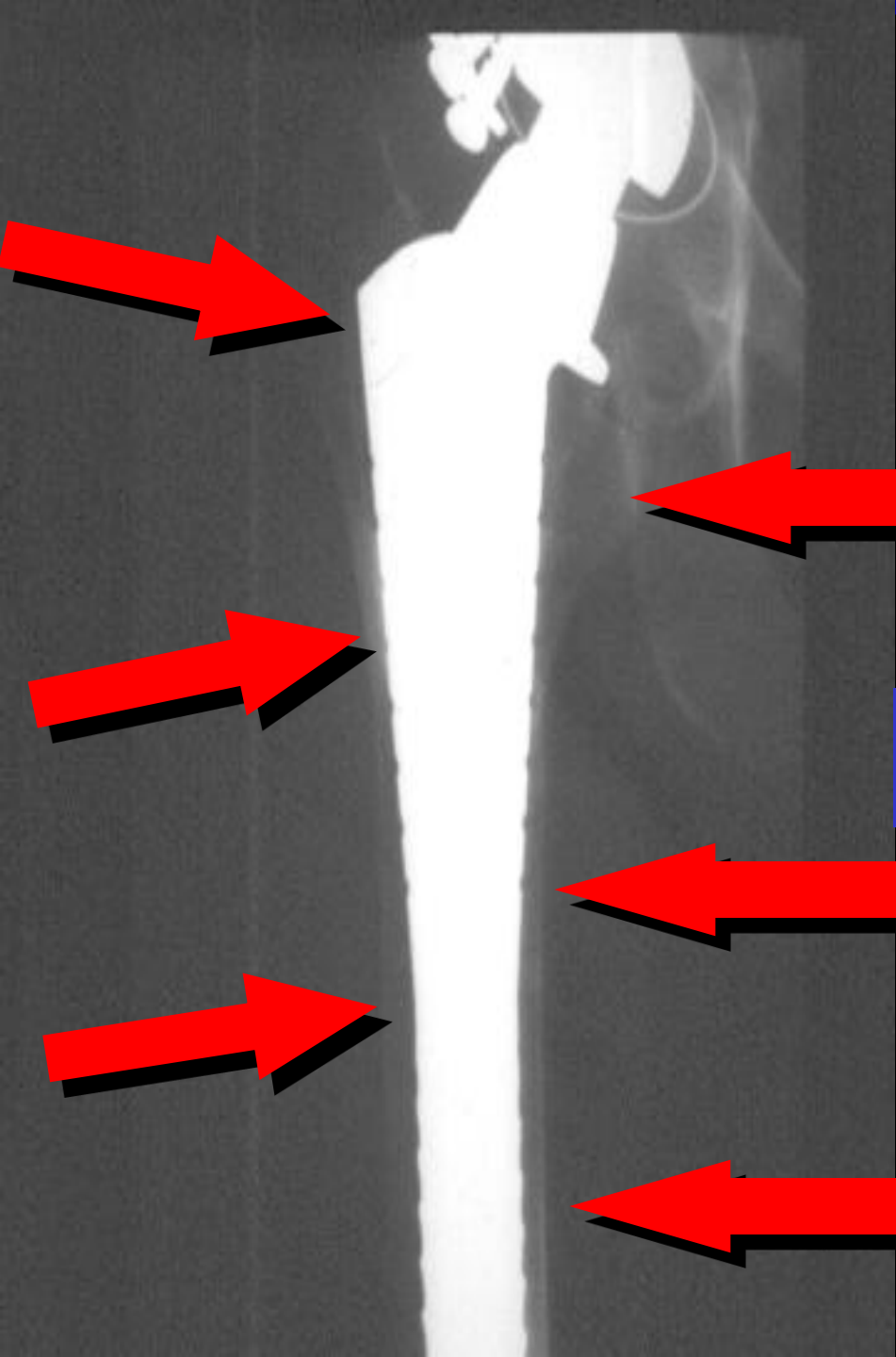
implant fémoral sans ciment  
craque métaphysaire  
stabilité immédiate  
cillaire réduit  
compatible avec tête de 22,  
28 et 32 mm

## UNE SOLUTION AU RÉGLAGE DE L'ANGLE

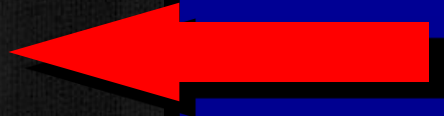
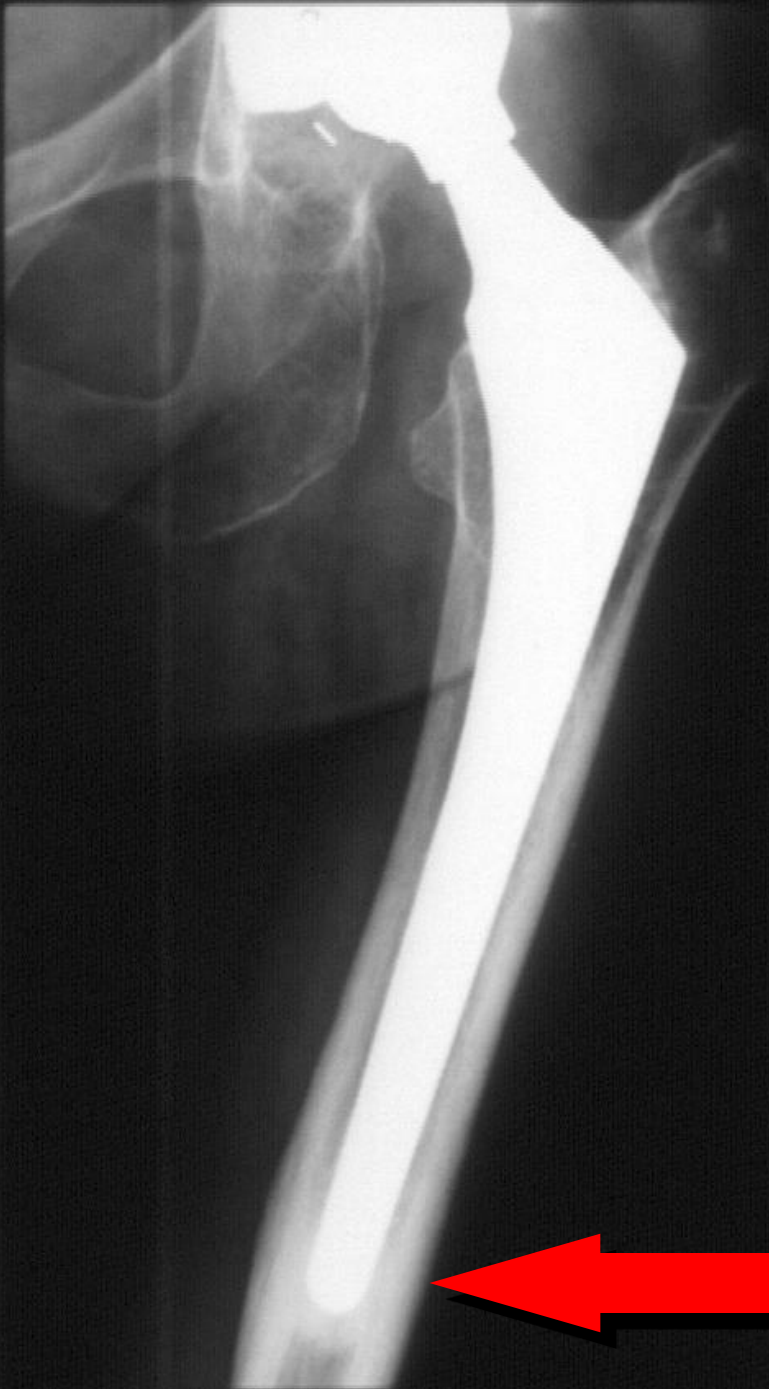
Docteurs BEDOUCHA et

1 - Office Médico Chirurgical International - 6 rue Nobel - Z.I. de Kernévez 29000  
Tél. (33) 98 55 68 95 - Fax. (33) 98 53 42 13 - Téléx. 940 062 F

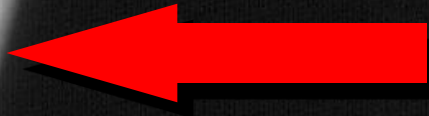




*Bone Remodeling*

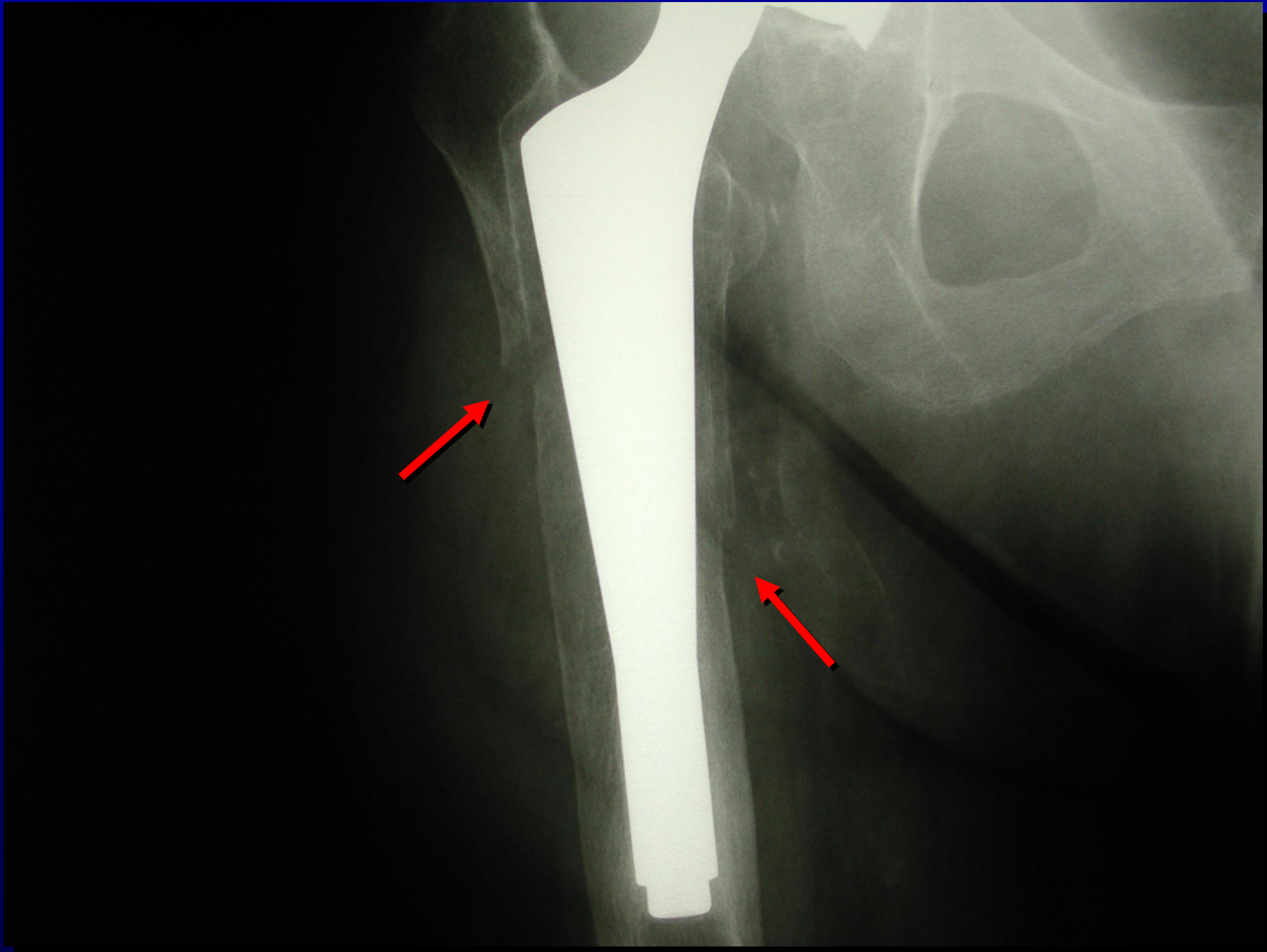


*Bone Remodeling*



*Bone Modeling*







# *IDROSSIAPATITE* $Ca_5(PO_4)_3(OH)$

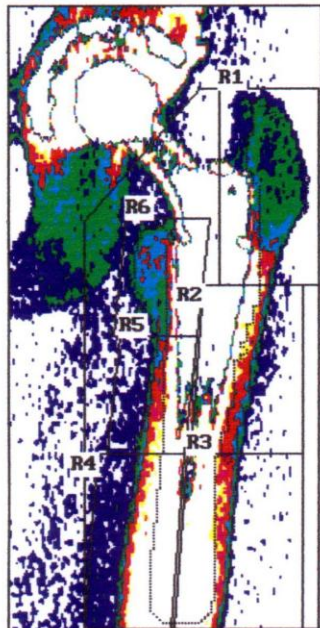


# ***IDROSSIAPATITE*** $\text{Ca}_5(\text{PO}_4)_3(\text{OH})$

***Costituisce il maggiore componente delle ossa.***

***Il 99% del calcio presente nell'organismo umano è immagazzinato nel tessuto osseo***

AZIENDA OSPEDALIERA S. ANNA - FERRARA



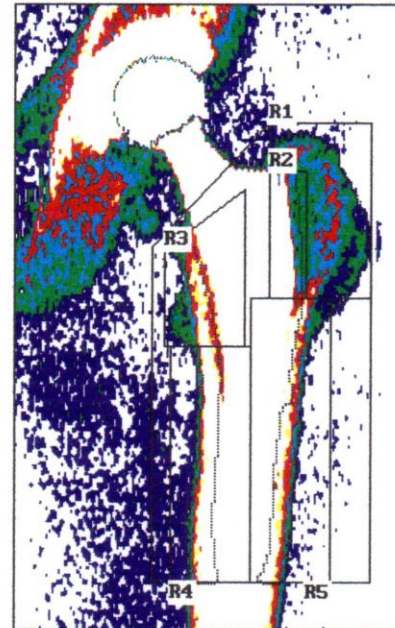
A08310013  
 Name:  
 Comment: PROT. G 1997 A SM  
 I.D.: HIP-PRO.. Sex: F  
 S.S.#: - - Ethnic: C  
 ZIPCode: Height: 172.00 cm  
 Scan Code: Weight: 72.00 kg  
 BirthDate: Age: 66  
 Physician: MASSARI  
 Image not for diagnostic use

	C.F.	1.006	1.035	1.000
Region	Area (cm2)	BMC (grams)	BMD (gms/cm2)	
GLOBAL	25.20	28.67	1.138	
R1	7.19	4.67	0.649	
R2	3.18	4.30	1.353	
R3	3.91	5.88	1.505	
R4	5.66	9.27	1.639	
R5	2.23	2.45	1.097	
R6	3.23	2.34	0.723	
NETAVG	25.18	28.63	1.137	

[74 x 1801]  
 Hologic QDR 1000 (S/N 287)



AZIENDA OSPEDALIERA S. ANNA - FERRARA



A05119915  
 Name:  
 Comment: ABGDG 6.10.92SN12.10.94  
 I.D.: HIP PROT. Sex: M  
 S.S.#: - - Ethnic: C  
 ZIPCode: Height: 174.00 cm  
 Scan Code: Weight: 105.00 kg  
 BirthDate: 20.Oct.22 Age: 76  
 Physician: MASSARI  
 Image not for diagnostic use

	C.F.	1.006	1.035	1.000
Region	Area (cm2)	BMC (grams)	BMD (gms/cm2)	
GLOBAL	26.45	31.61	1.195	
R1	10.69	7.39	0.692	
R2	1.51	0.94	0.622	
R3	3.20	3.71	1.159	
R4	5.82	10.86	1.868	
R5	6.79	9.80	1.444	
NETAVG	26.30	31.54	1.199	

[72 x 153]  
 Hologic QDR 1000 (S/N 287)

