



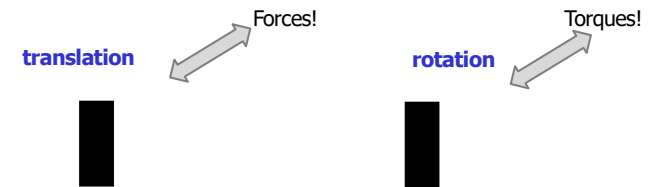
Biomechanics



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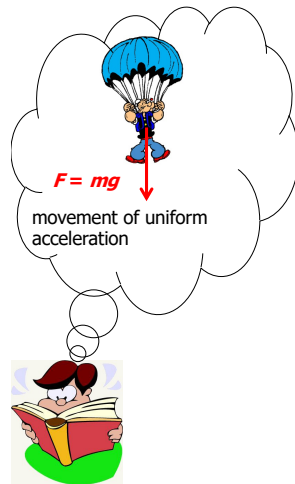
Types of motion

translation + rotation



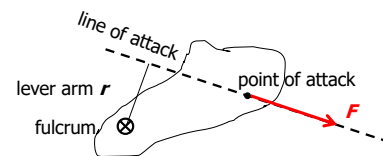
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Force and torque



For rigid bodies: rotation occurs if torque is present (even without translation)

$\sum \vec{F}_i = 0$



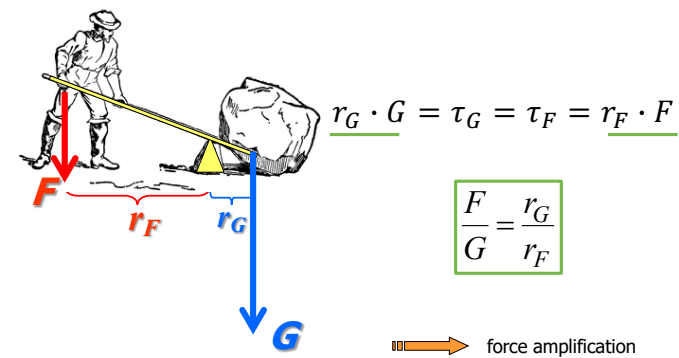
Torque (τ):

$$\tau = F \cdot r \quad (\text{Nm})$$

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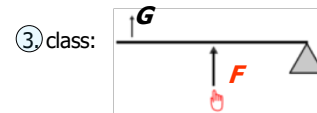
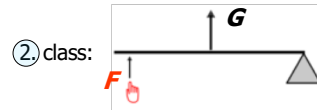
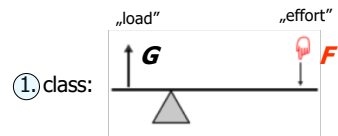
The concept of a lever

$$\text{equilibrium} \Leftrightarrow \sum F_i = 0 \text{ and } \sum \tau_i = 0$$



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Types of levers



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Levers



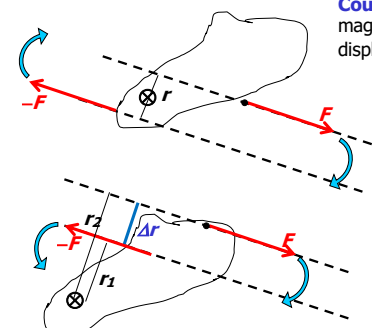
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Dental levers



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Force couple



Couple: a pair of forces, equal in magnitude, oppositely directed, and displaced by perpendicular distance.

Resultant force: 0

Resultant torque (τ):

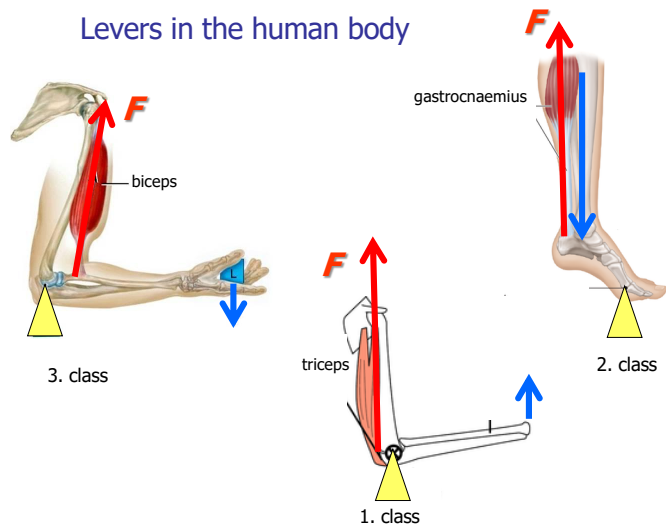
$$\tau = F \cdot (r_2 - r_1) = F \cdot \Delta r$$

➡ „couple = torque“

Any set of forces on a body can be replaced by a single force and a single couple.

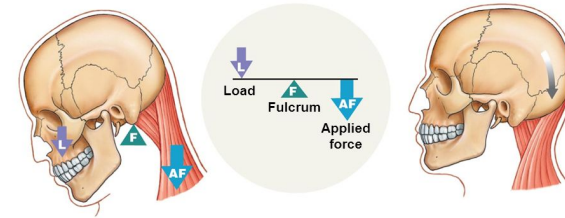
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Levers in the human body



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A first-class lever

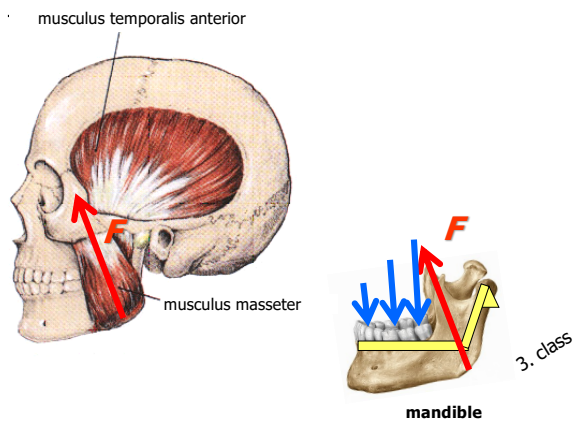


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Figure 10.1 6

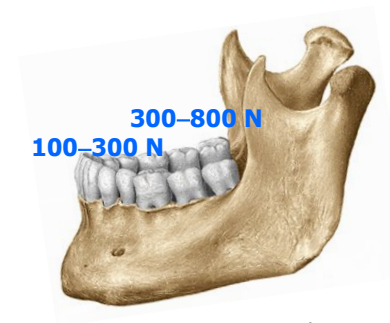
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The mandible as a lever



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Masticatory forces

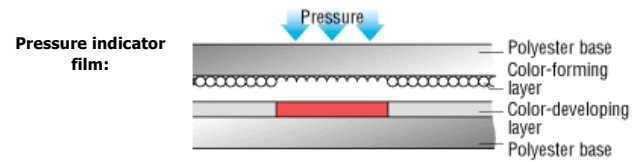


(Guinness: human - 4000 N)

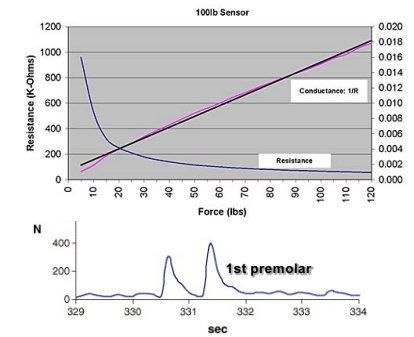
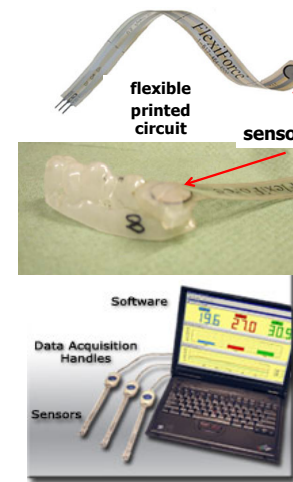


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Measuring masticatory forces



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other
(subjective)
methods:



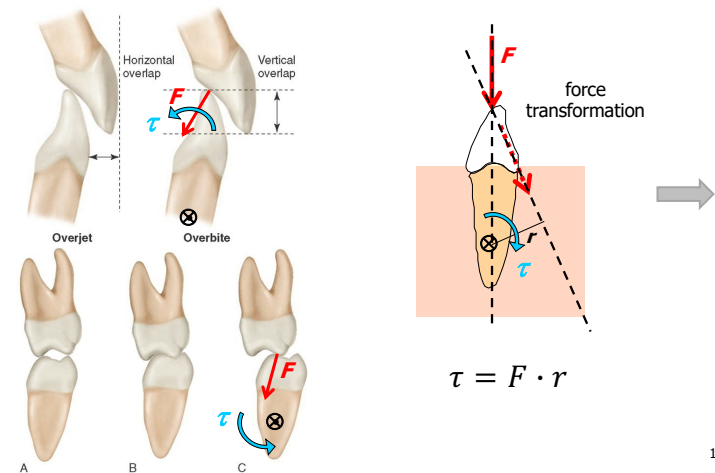
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Pressure values of mastications



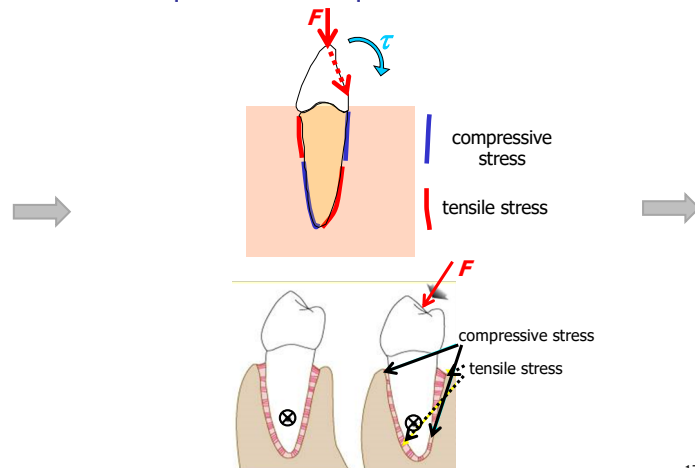
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Torque of mastication



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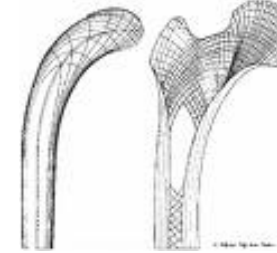
Consequences of torque



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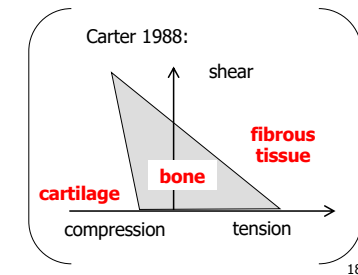
Bone remodeling

Wolff's law 1870



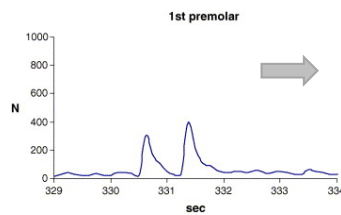
Every change in the function of a bone is followed by certain definite changes in its internal architecture and its external conformation.

compressive stress \Rightarrow resorption
tensile stress \Rightarrow formation



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Masticatory forces



$F = 100-800 \text{ N}$
 $t \leq 1 \text{ s}$

If the force would be constant

3-5 seconds \Rightarrow pain
 \approx hours \Rightarrow tissue damage
7-14 days \Rightarrow loosening of teeth

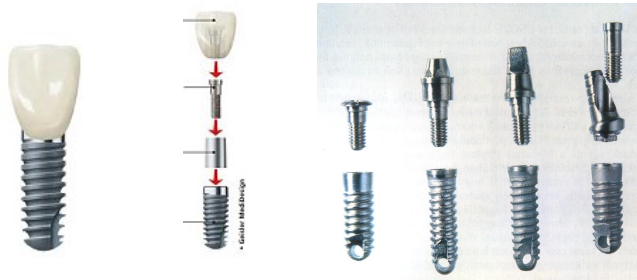
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Physical bases of implantology





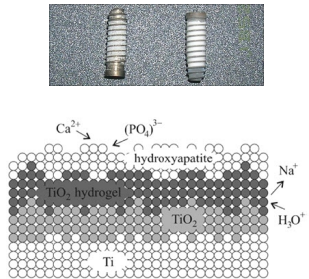
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Dental implants



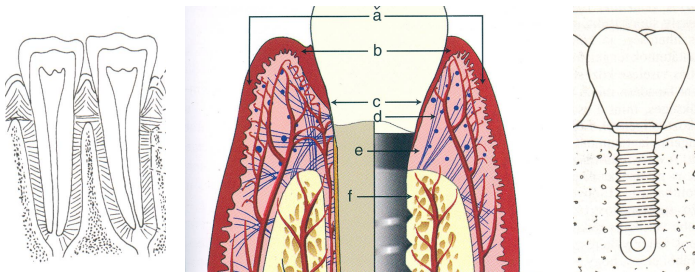
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Implant materials

metals	ceramics	metals with ceramic coating
<ul style="list-style-type: none"> titanium (Ti) 	<ul style="list-style-type: none"> aluminium-oxide zirconia (zirconium-dioxide) HAP bioglasses 	
<ul style="list-style-type: none"> titanium alloys (Ti-6Al-4V) Cobalt alloys (Co-Cr-Mo) 		

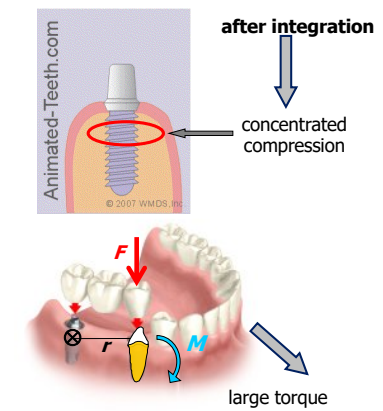
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Tooth vs. implant



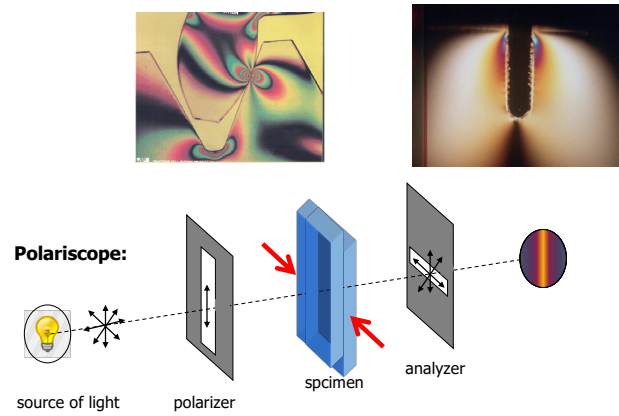
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Force transition of implant



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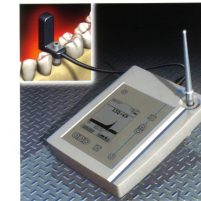
Optical method for stress analysis



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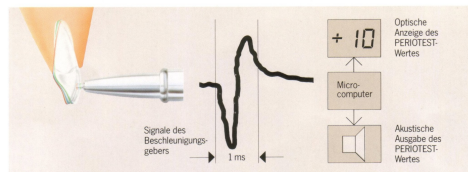
Methods for testing implant stability

- Resonant Frequency Analysis (RFA)



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- Periotest



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