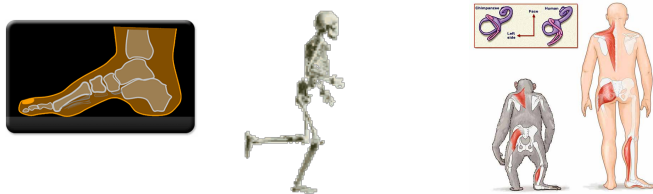




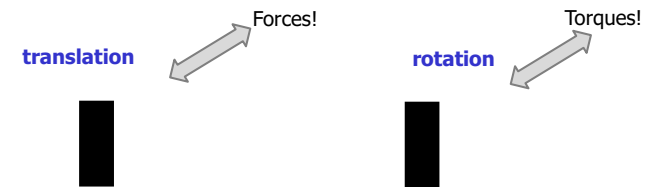
## Biomechanics



1

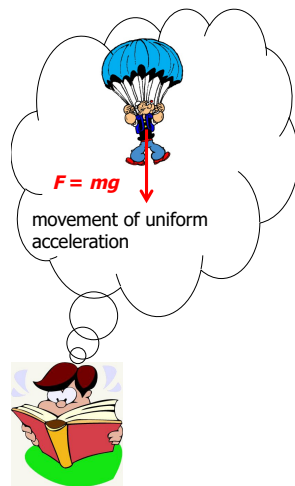
## Types of motion

translation + rotation



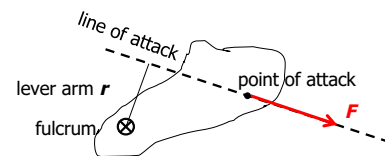
2

## Force and torque



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

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



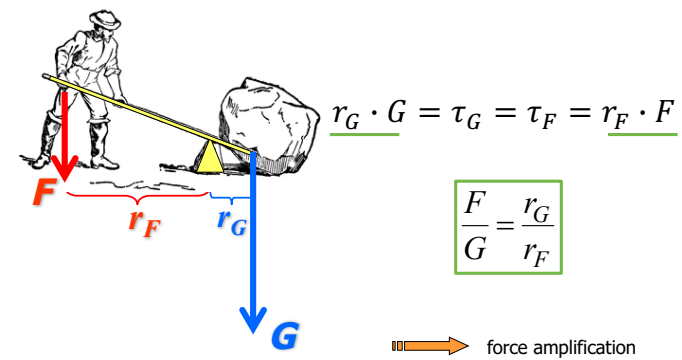
Torque ( $\tau$ ):

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

3

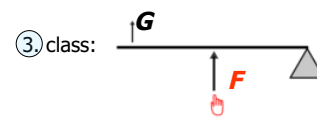
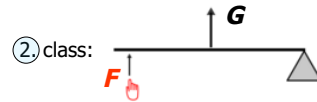
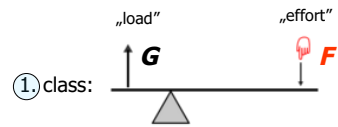
## The concept of a lever

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



4

## Types of levers



5

## Levers



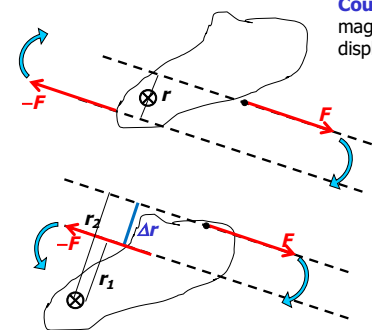
6

## Dental levers



7

## Force couple



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

Resultant force: 0

Resultant torque ( $\tau$ ):

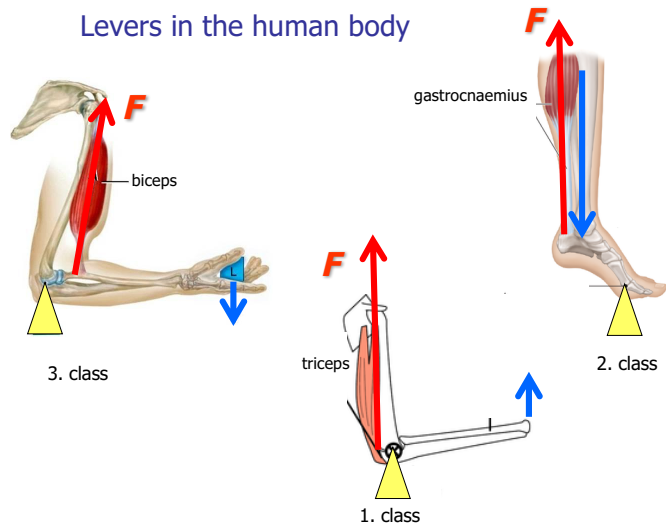
$$\tau = F \cdot (r_2 - r_1) = F \cdot \Delta r$$

➡ „couple = torque“

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

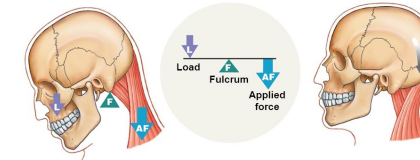
8

## Levers in the human body



9

A first-class lever

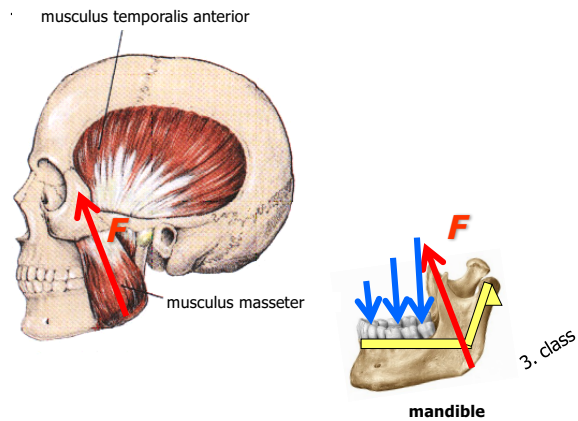


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Figure 10.1

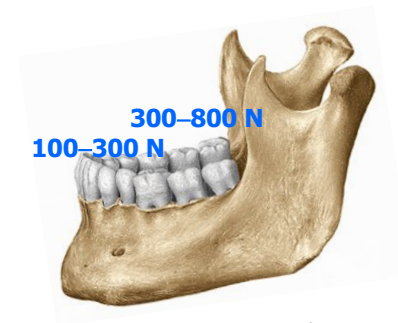
10

## The mandible as a lever



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## Masticatory forces

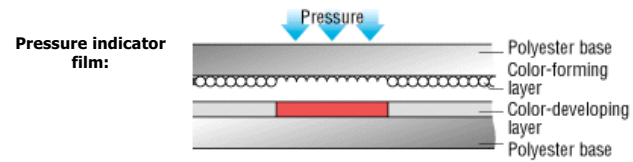


(Guinness: human - 4000 N)

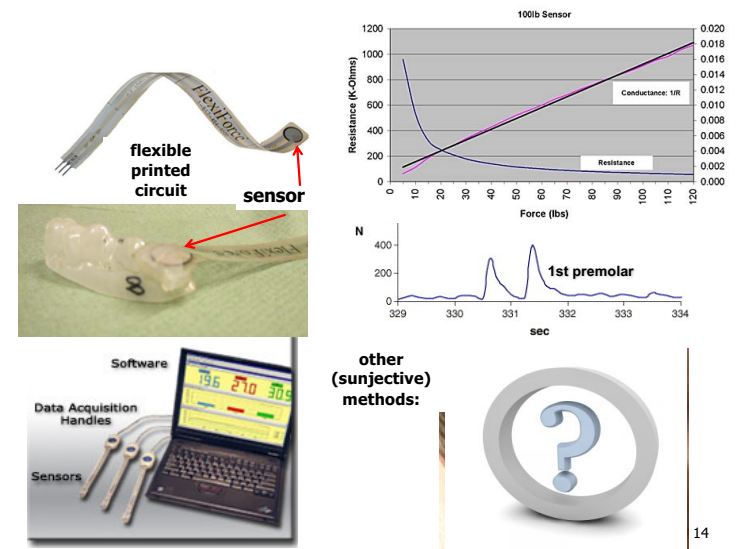


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## Measuring masticatory forces



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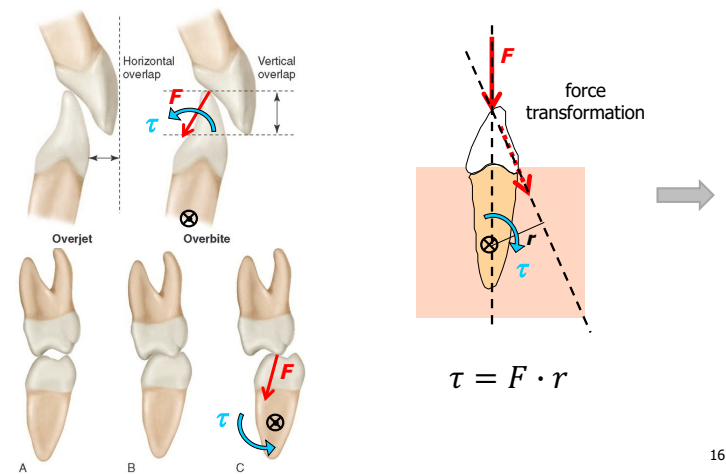
14

## Pressure values of mastications



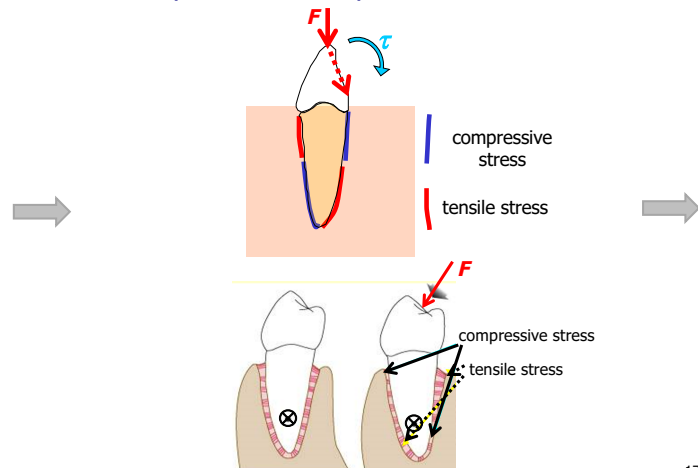
15

## Torque of mastication

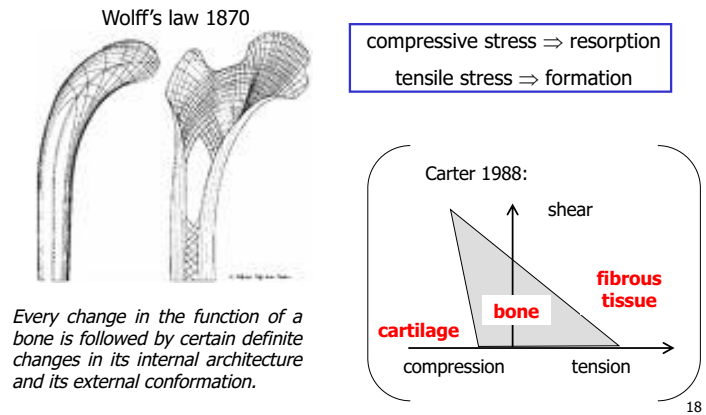


16

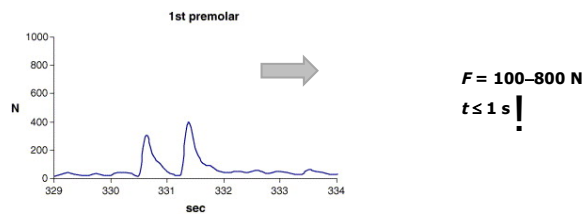
## Consequences of torque



## Bone remodeling



## Masticatory forces

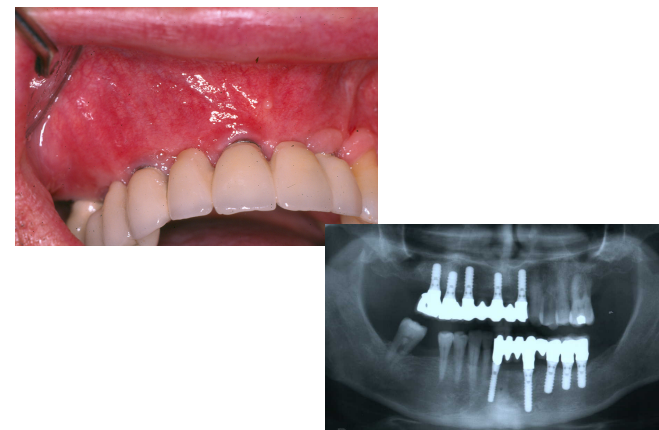


If the force would be constant

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

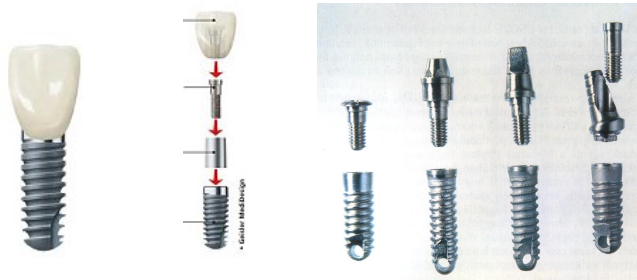
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## Physical bases of implantology



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## Dental implants




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## Implant materials

**metals**


- titanium (Ti)




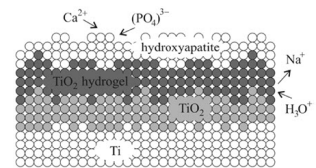
- titanium alloys (Ti-6Al-4V)
- kCobalt alloys (Co-Cr-Mo)

**ceramics**

- aluminium-oxide
- zirconia (zirconium-dioxide)
- HAP
- bioöglasses

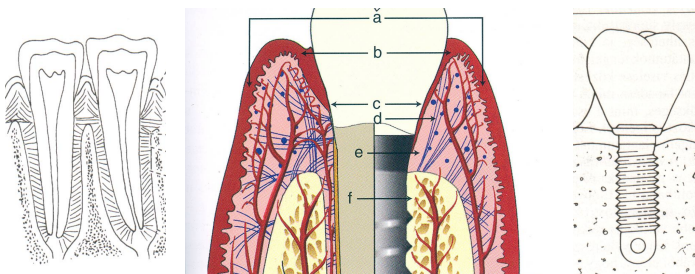


**metals with ceramic coating**

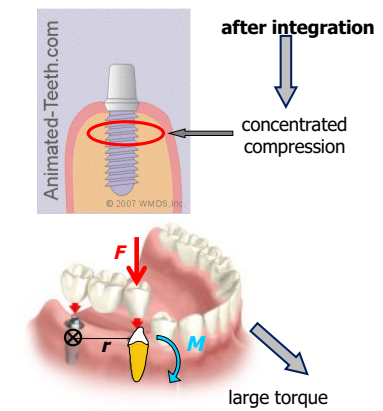
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## Tooth vs. implant



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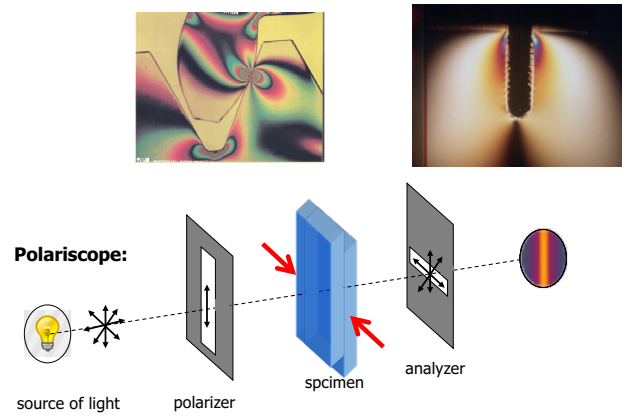
## Force transition of implant



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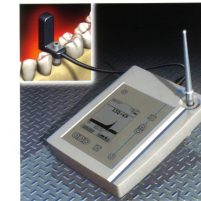
## Optical method for stress analysis



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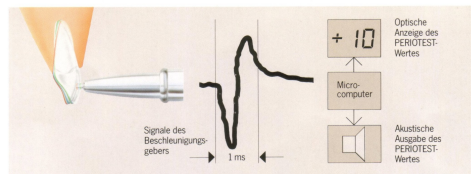
## Methods for testing implant stability

- Resonant Frequency Analysis (RFA)



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- Periotest



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