

Omurgada Hareket Segmenti

Normal Omurga Biyomekaniđi

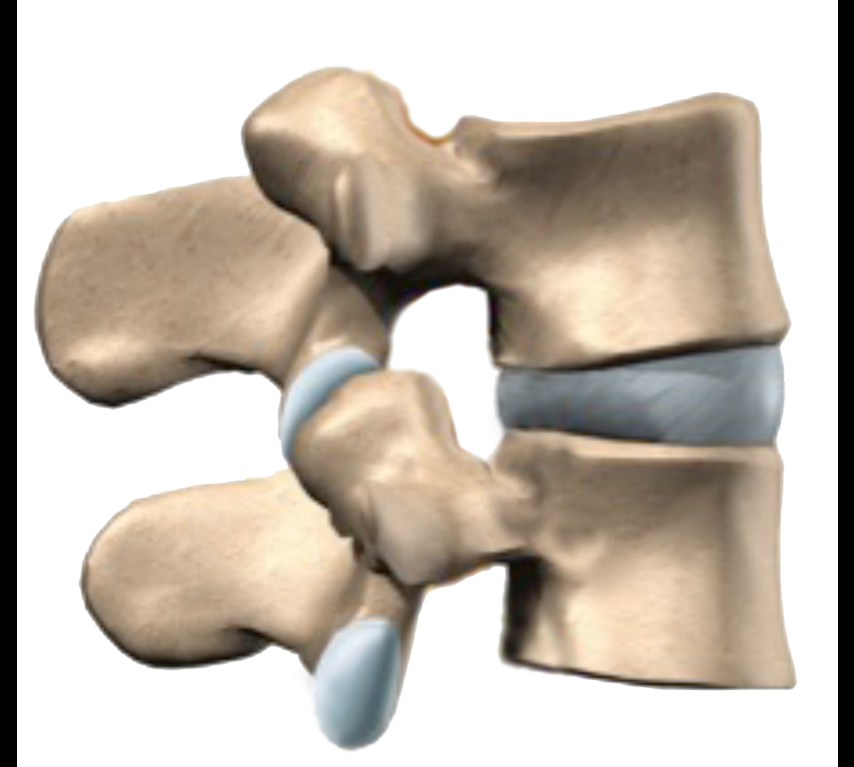
Dr. Hakan BOZKUŞ

Konuşma Konusu

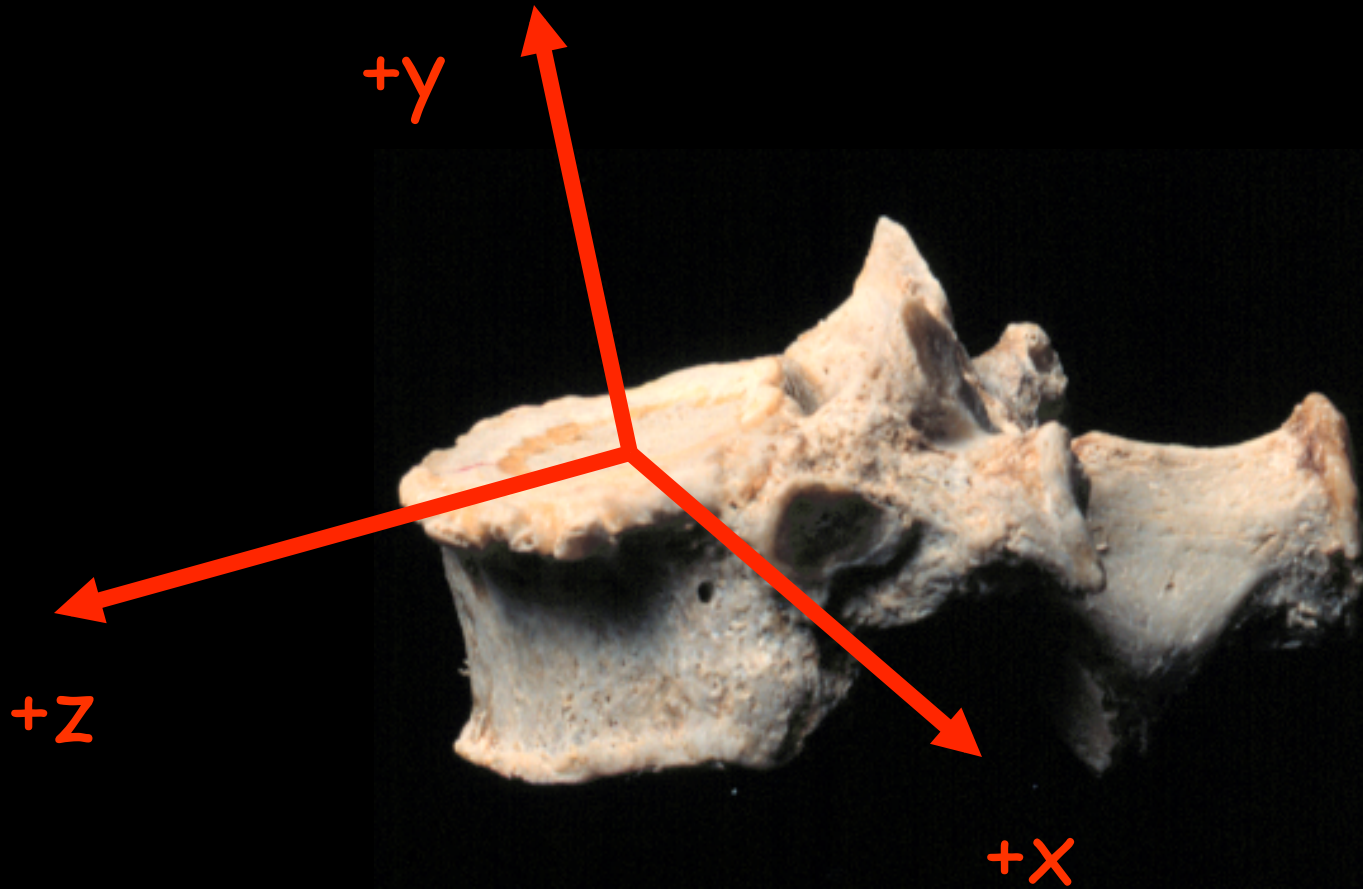
- Fonksiyonel Spinal Ünite (FSU)
- Rotasyonun Anlık Eksenini (RAE)
- Hareket Aralığı (ROM)
- Biyomekanik Kavramlar
- Biyomekanik Davranış

Fonksiyonel Spinal Ünite (FSU)

- İki komşu omur
- Bir disk mesafesi
- Faset eklemleri
- Ligamanlar ve faset kapsülü



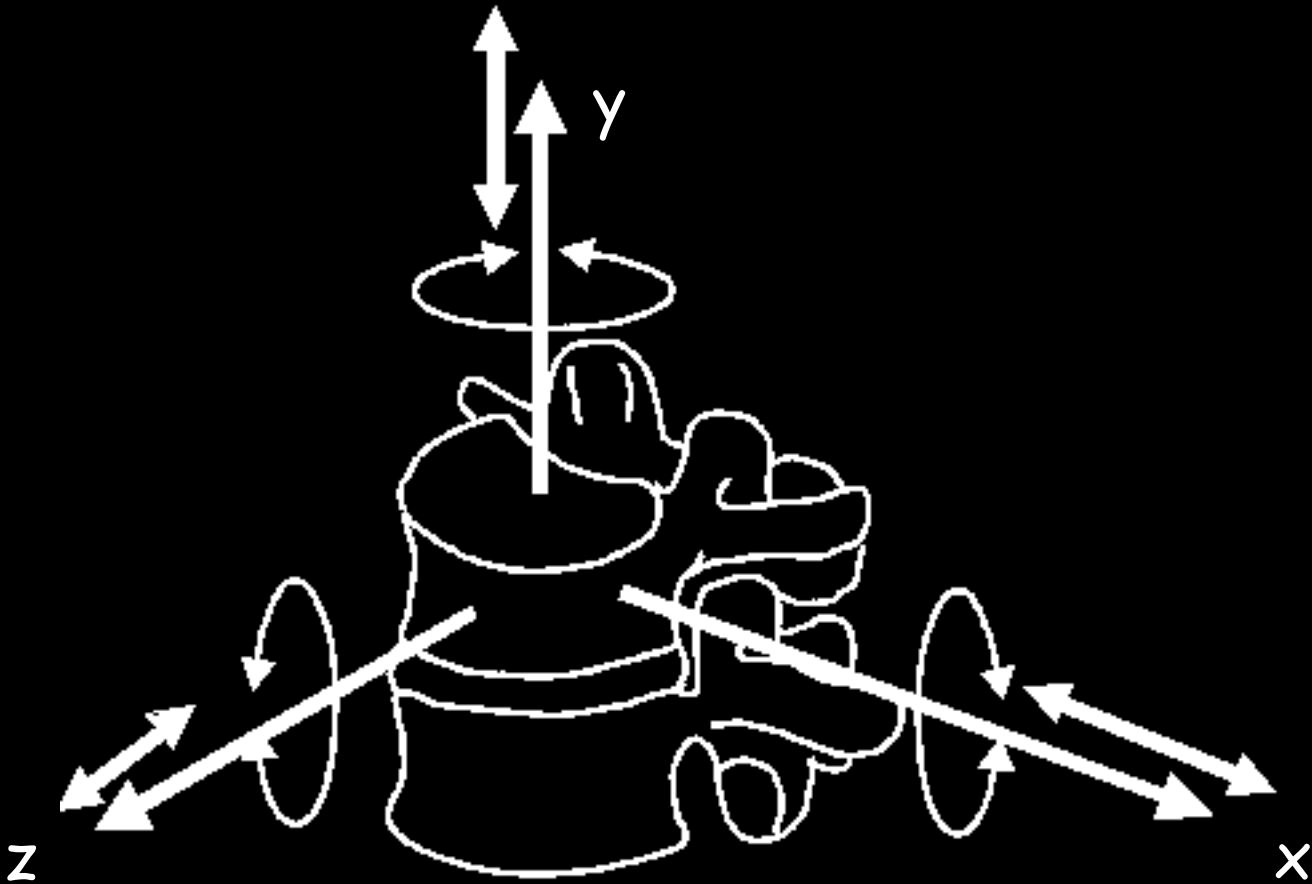
Pozitif Eksen Takımı

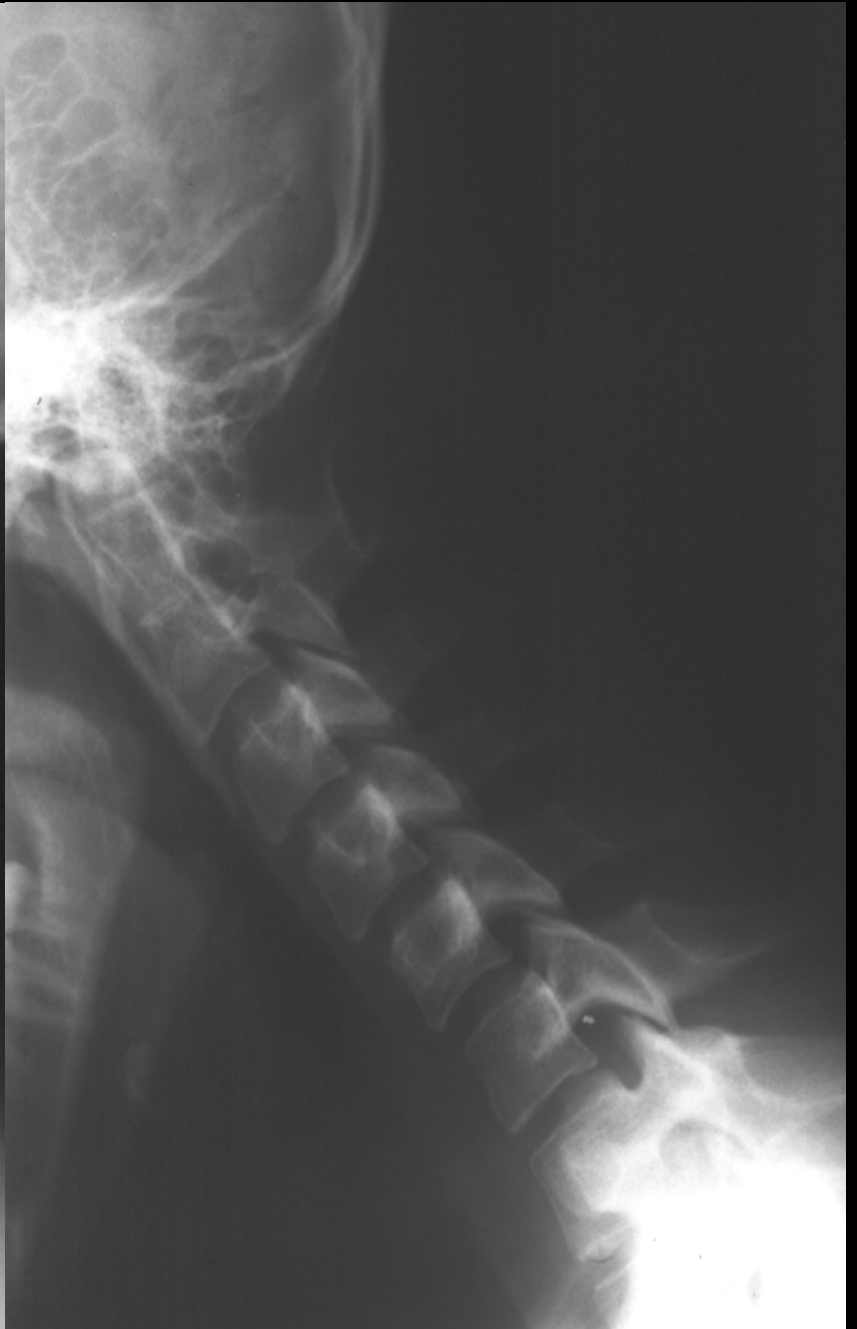


Panjabi, 1978

Hareket Serbestliđi

6 yönde hareket serbestliđi





Tek Planda RAE Doğruluğu ?

GERÇEK KATI CİSİM HAREKETİNİ GÖSTERMİYOR !

A1A2 ve B1B2 noktalarının translasyonu tek bir doğrultuda olmayabilir.

İstatistiksel olarak aynı translasyon vektörlerinin kullanılması gerçekçi değil.

YAKINSAMA OLABİLİR !

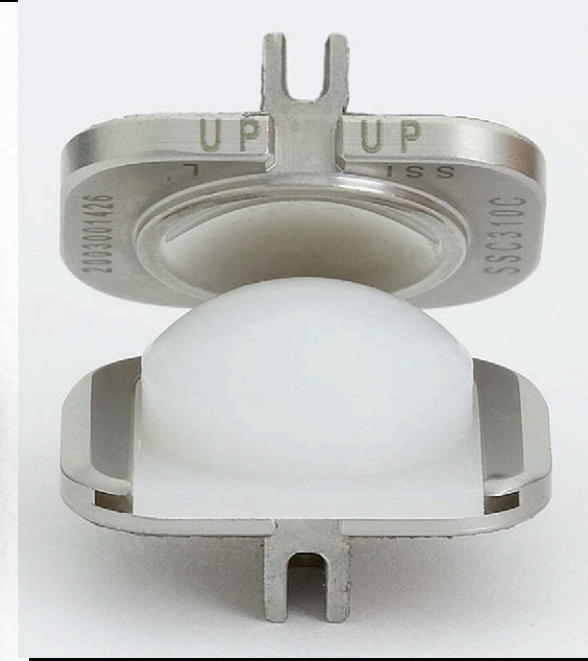
Gerçekçi RAE Çözümü ?

En az 3 noktanın,

Translasyon vektörü ve rotasyon matriksinin bilinmesi

ÜÇ BOYUTLU RAE !

Helikal Rotasyon Ekseni



eksen

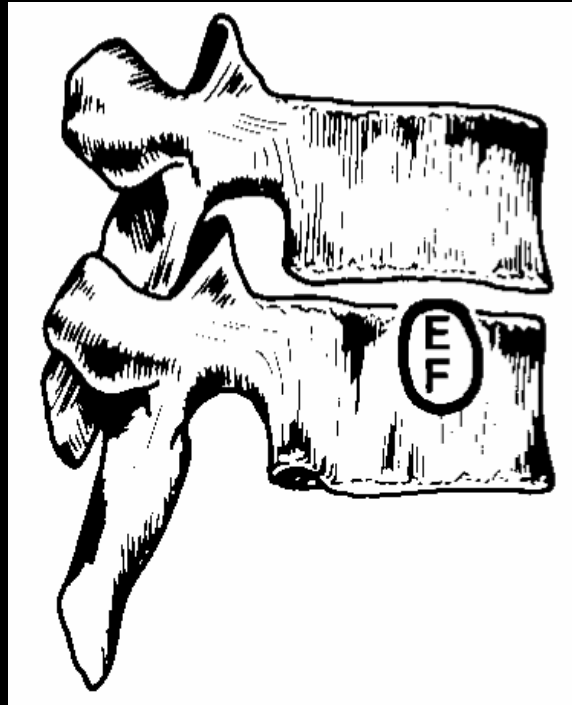
Spoor ve Veldpaus, J Biomech 1980

Rotasyonun Anlik Ekseni (RAE)

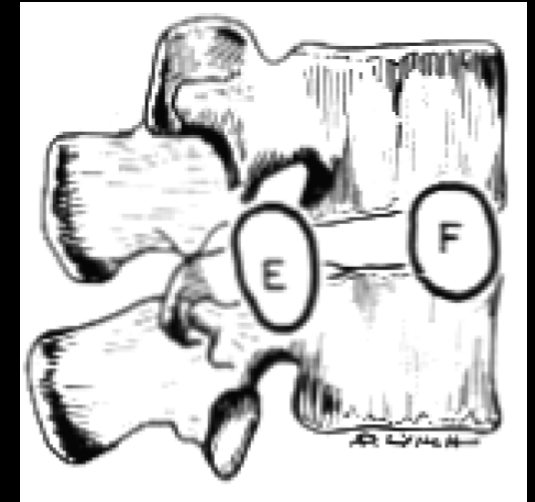
Sagittal plan



servikal

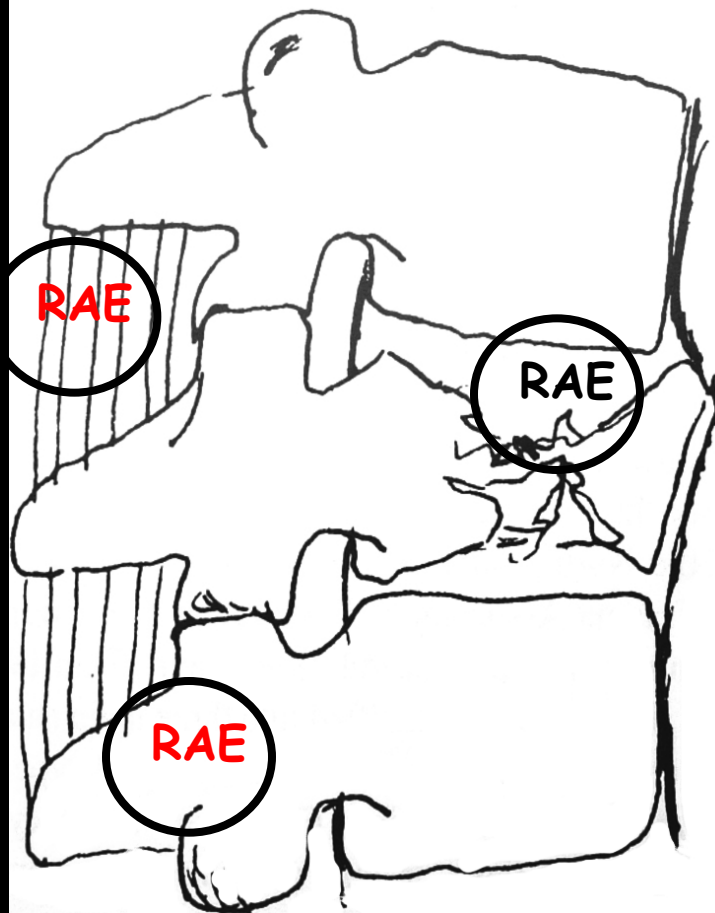


torasik



lomber

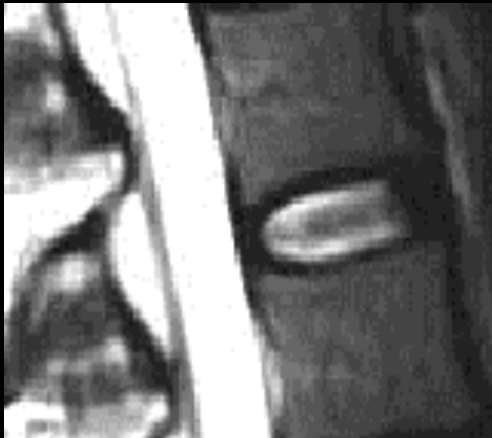
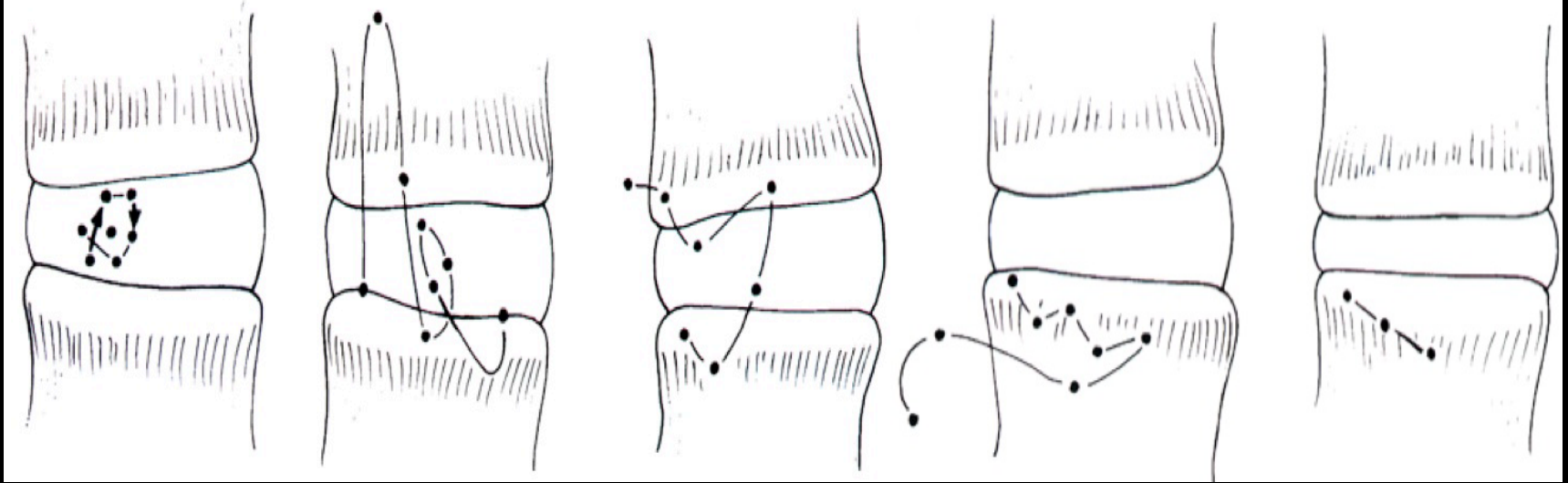
RAE yer deęiřtirir mi ?



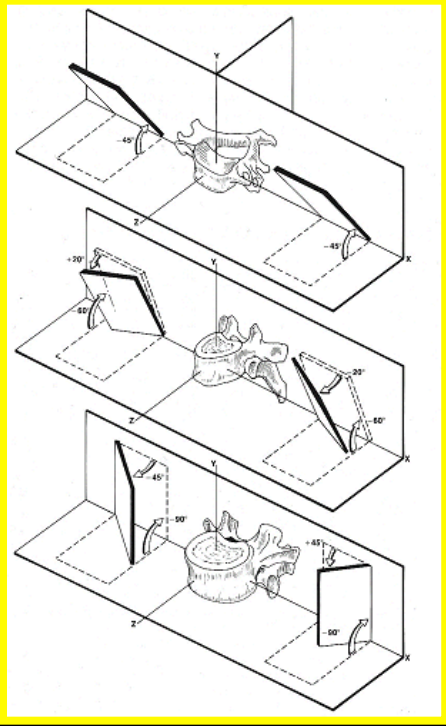
Stabilizasyon
bozulması

RAE yer deđiřtirir mi ?

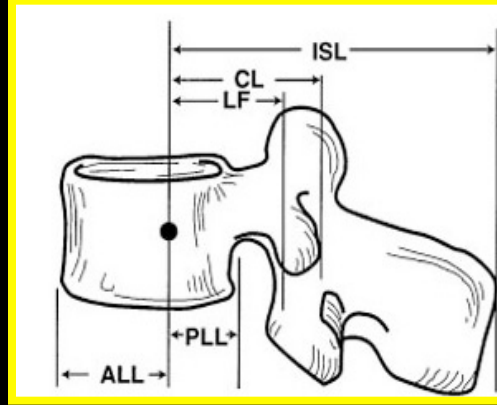
Lomber sagittal plan



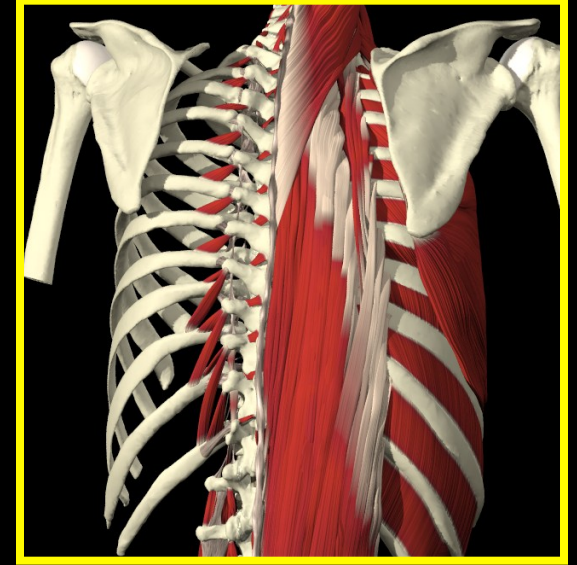
Hareketi Saęlayan Yapılar



Fasetler



Ligamanlar

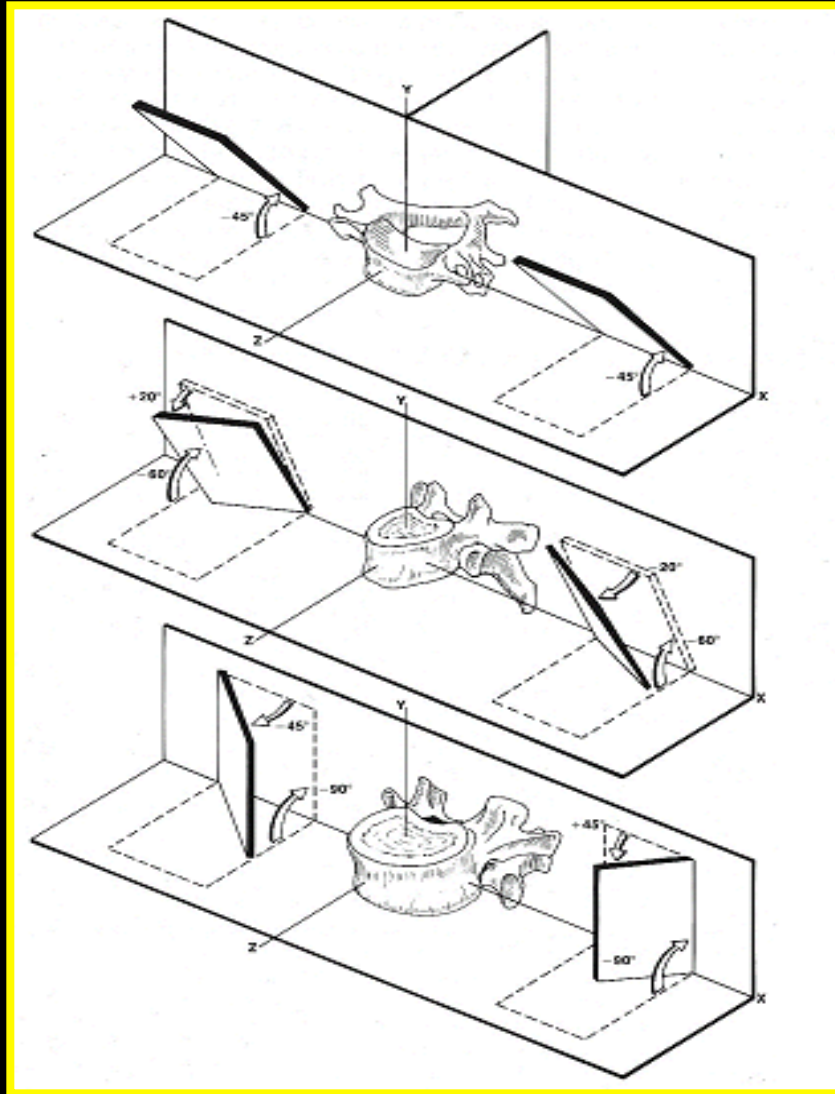


Adaleler



İntervertebral disk

Fasetler



koronal

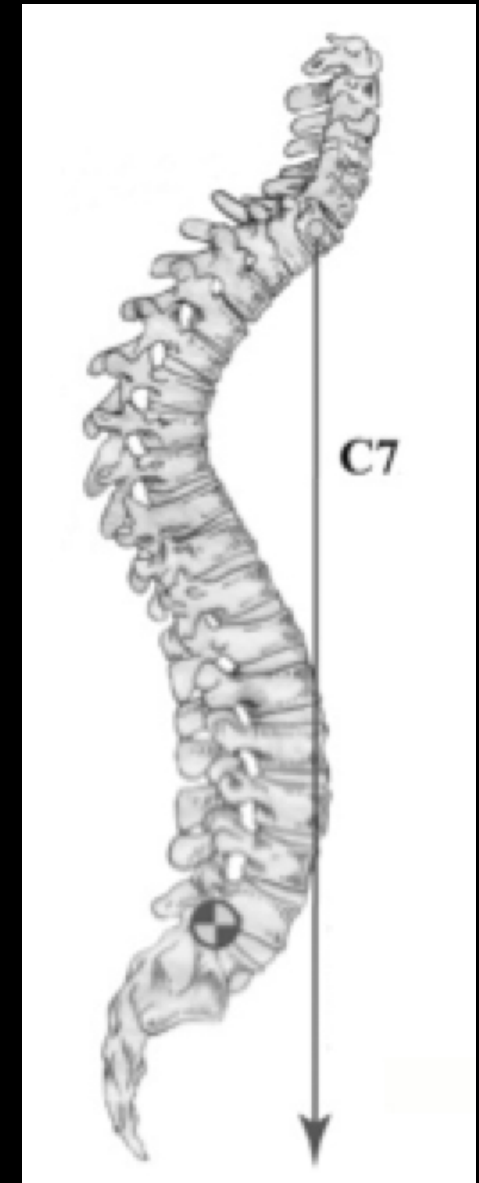
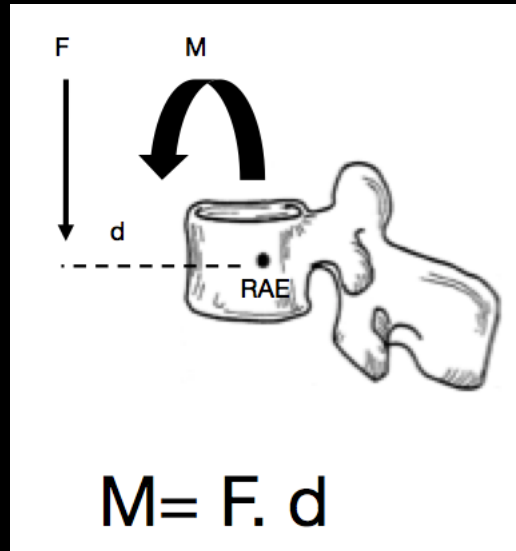
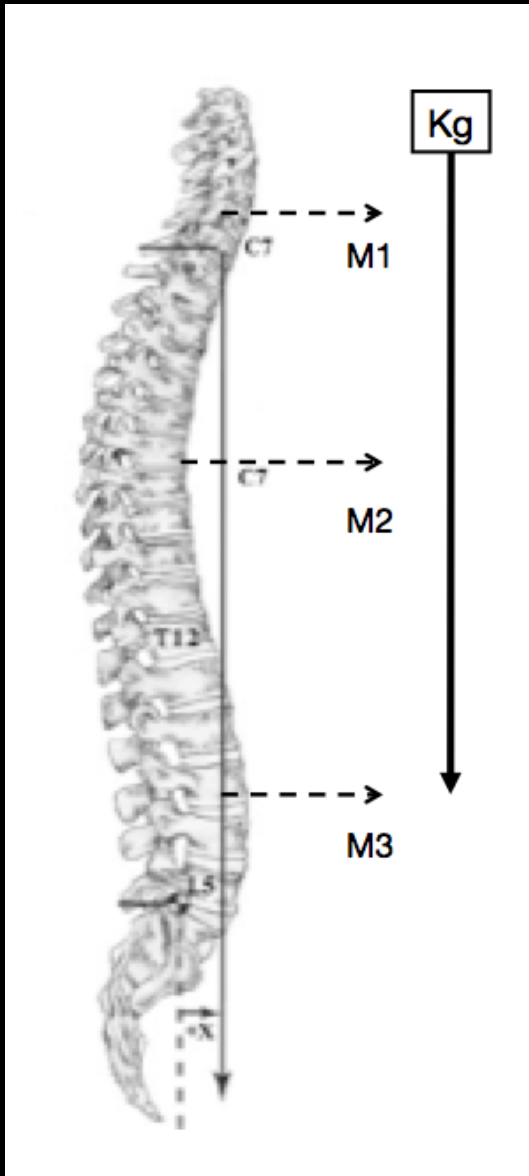


Koronal
+
sagittal

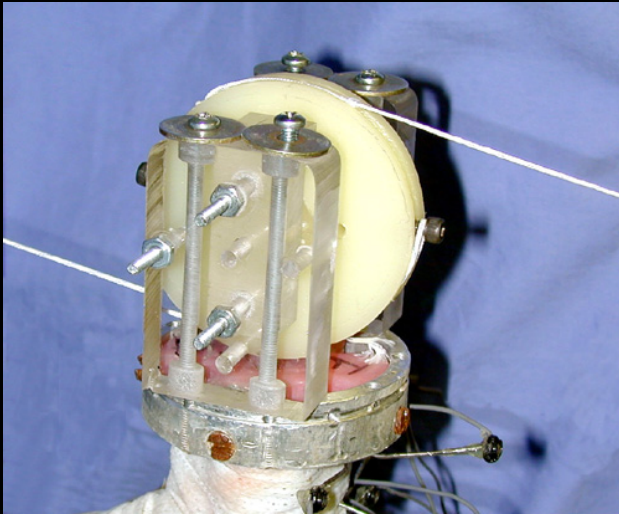
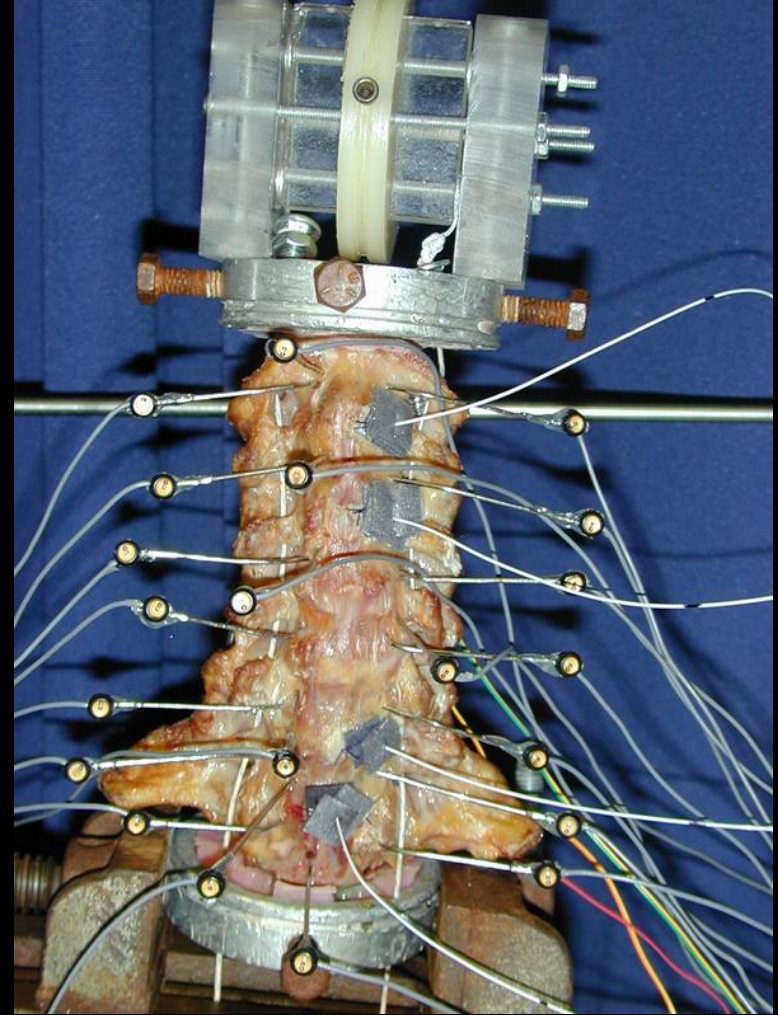
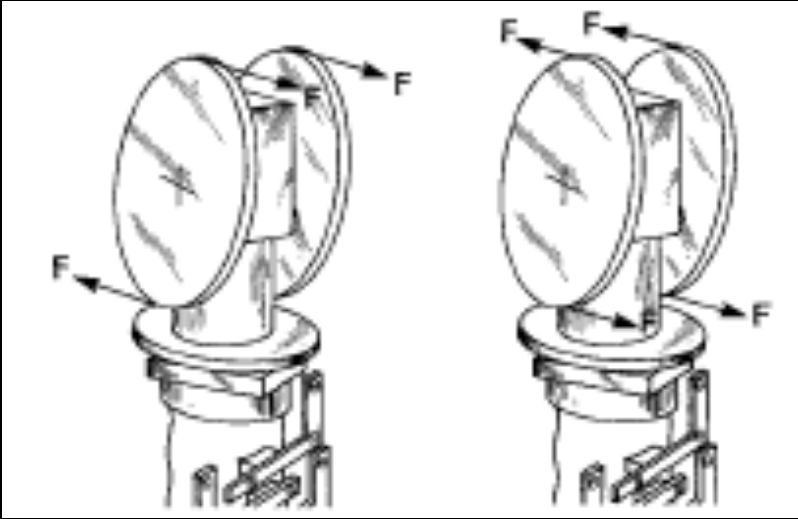


sagittal

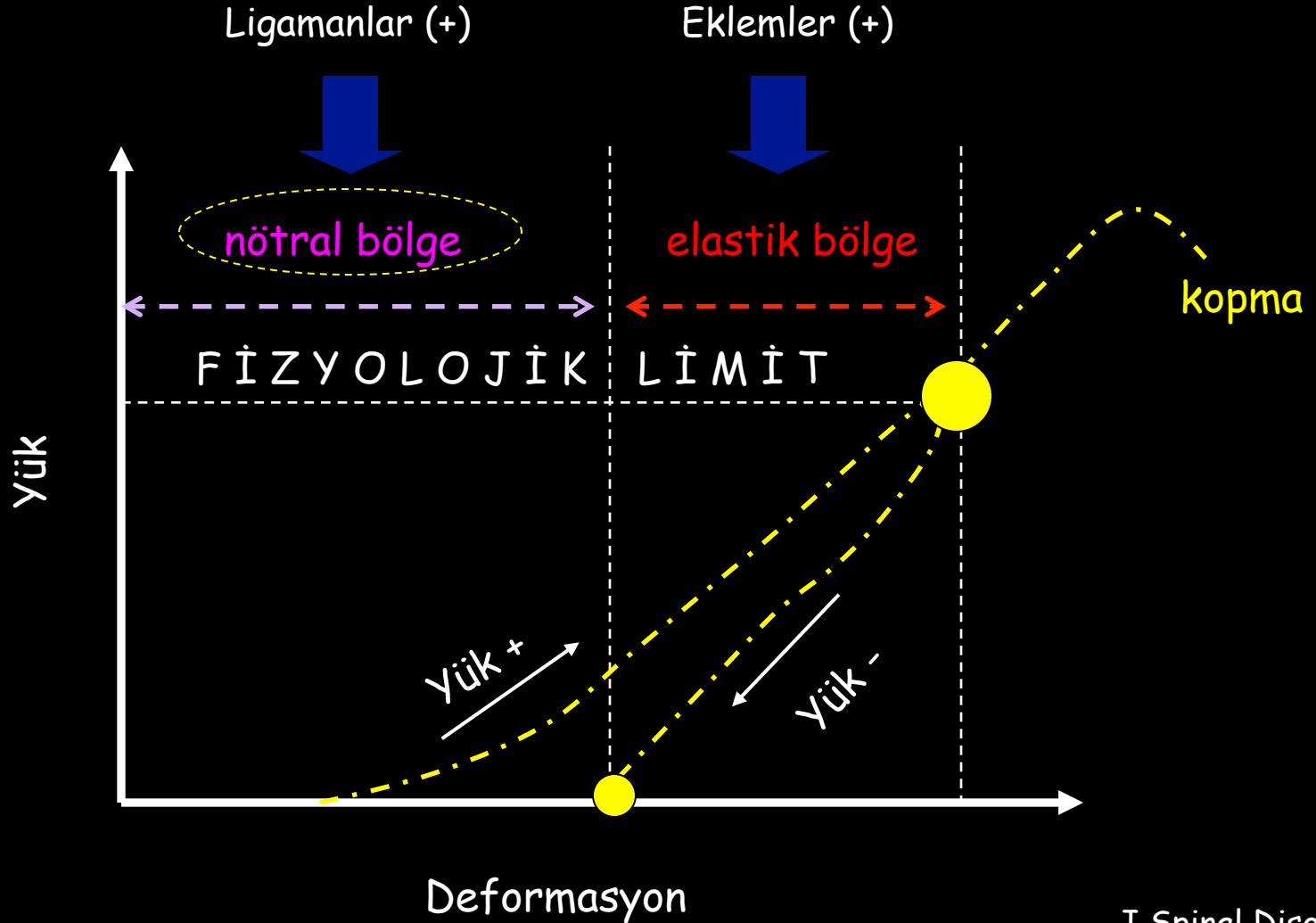
Moment



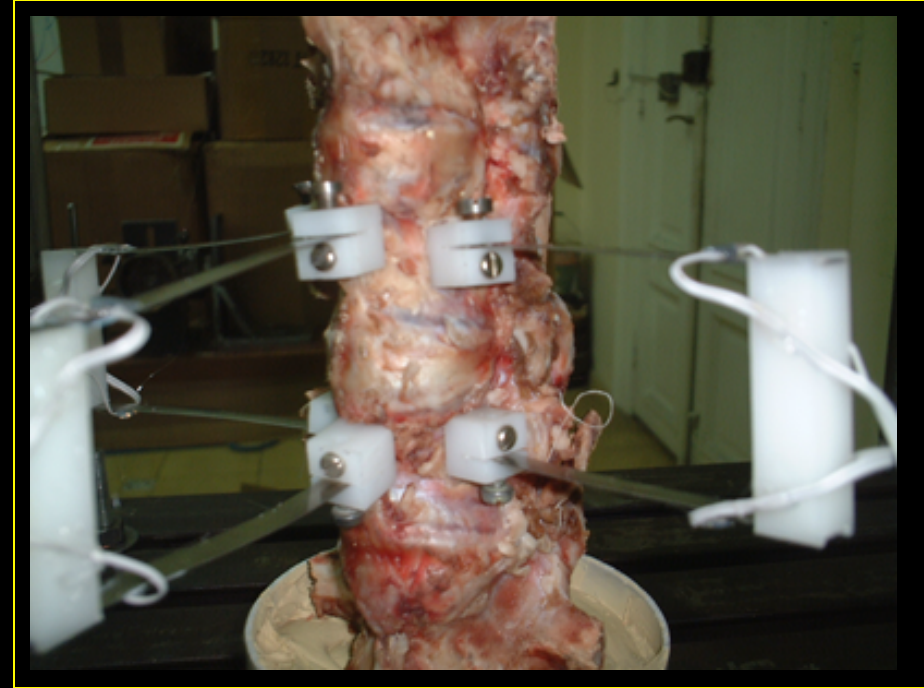
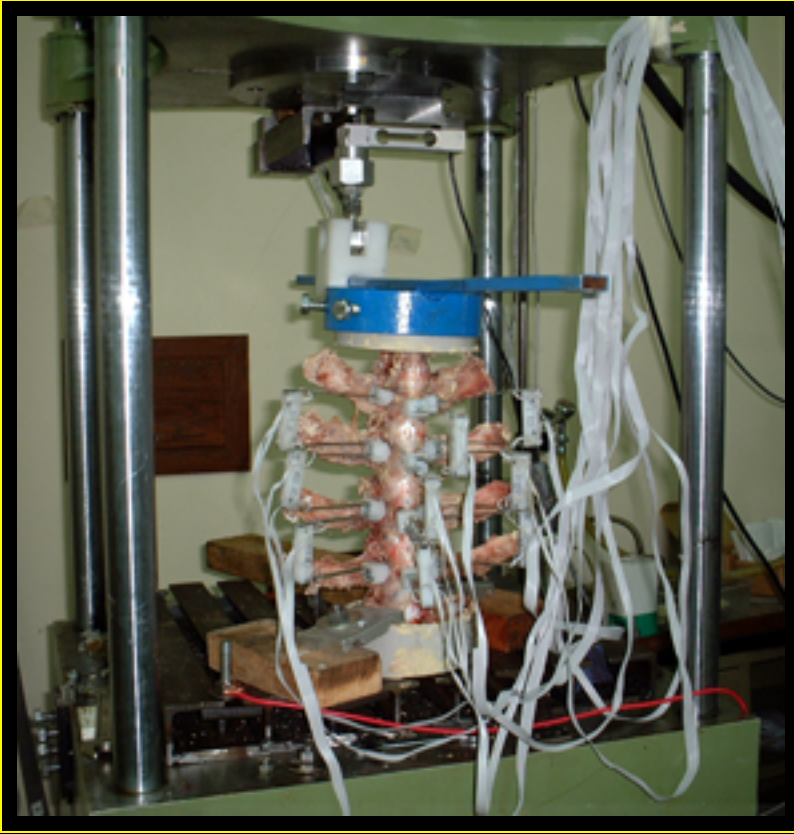
Moment Yüklemesi



Hareket Aralığı (ROM)

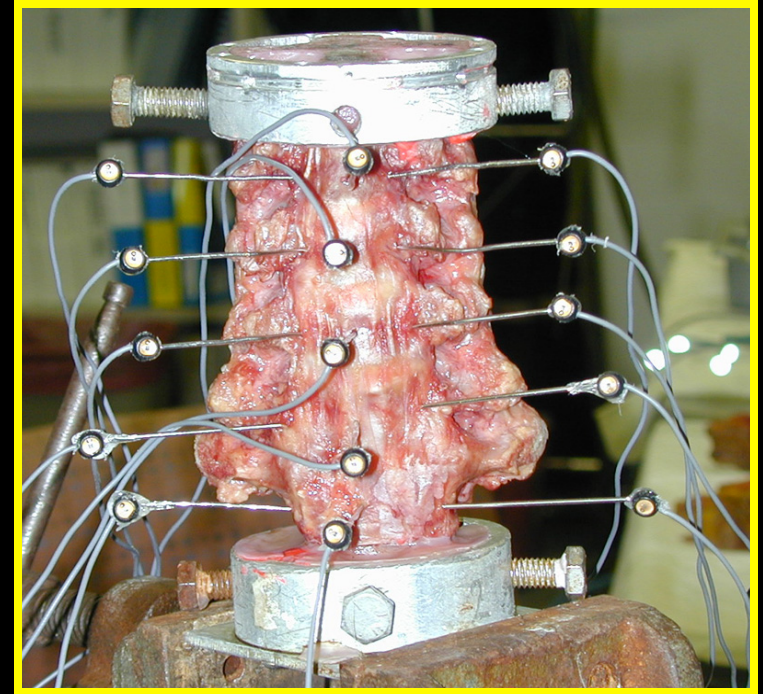
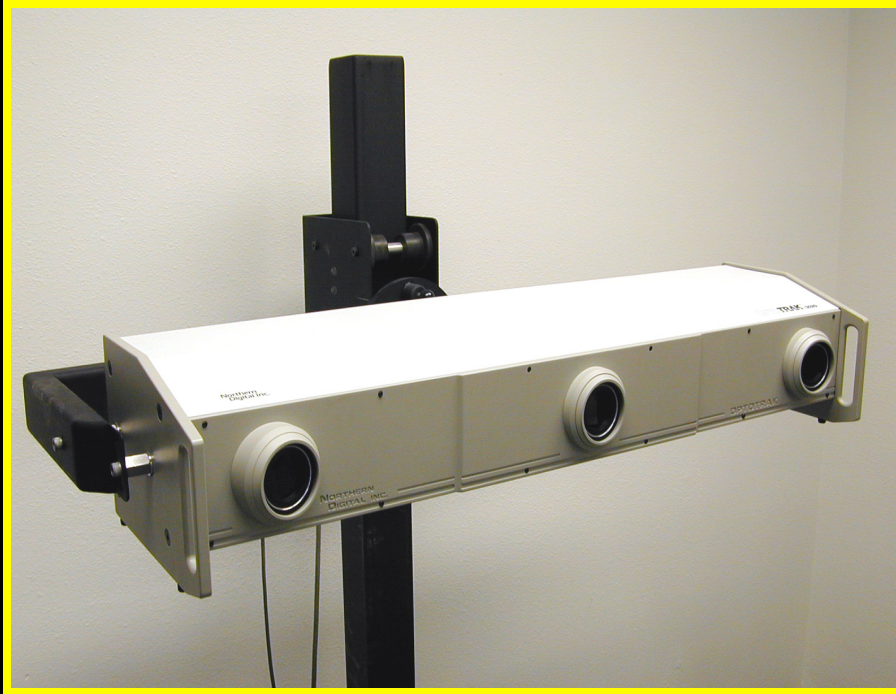


Hareket Aralığı Ölçümü



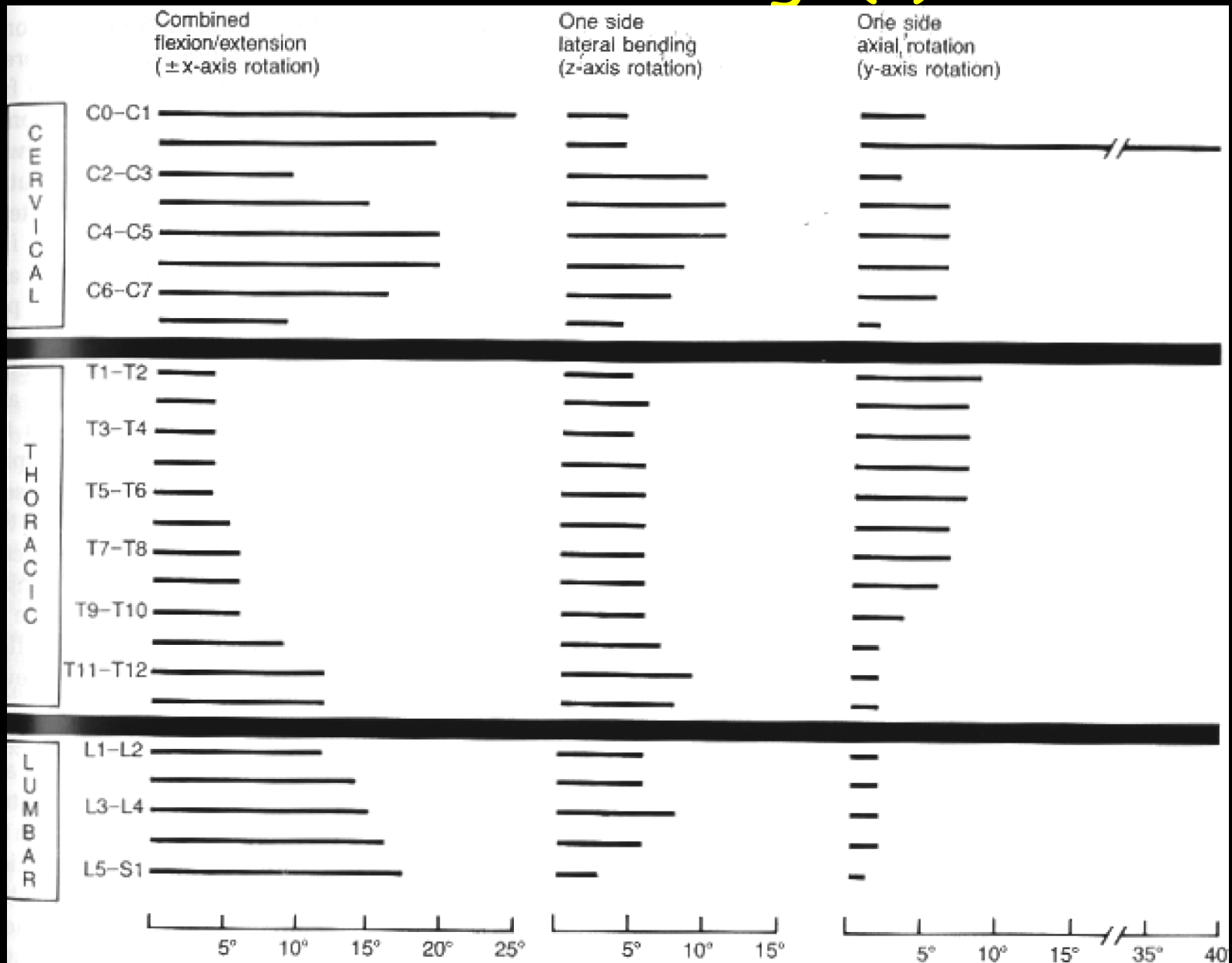
Ekstansometre

Hareket Aralığı Ölçümü



Sterofotogrametri

Hareket Aralığı (°)



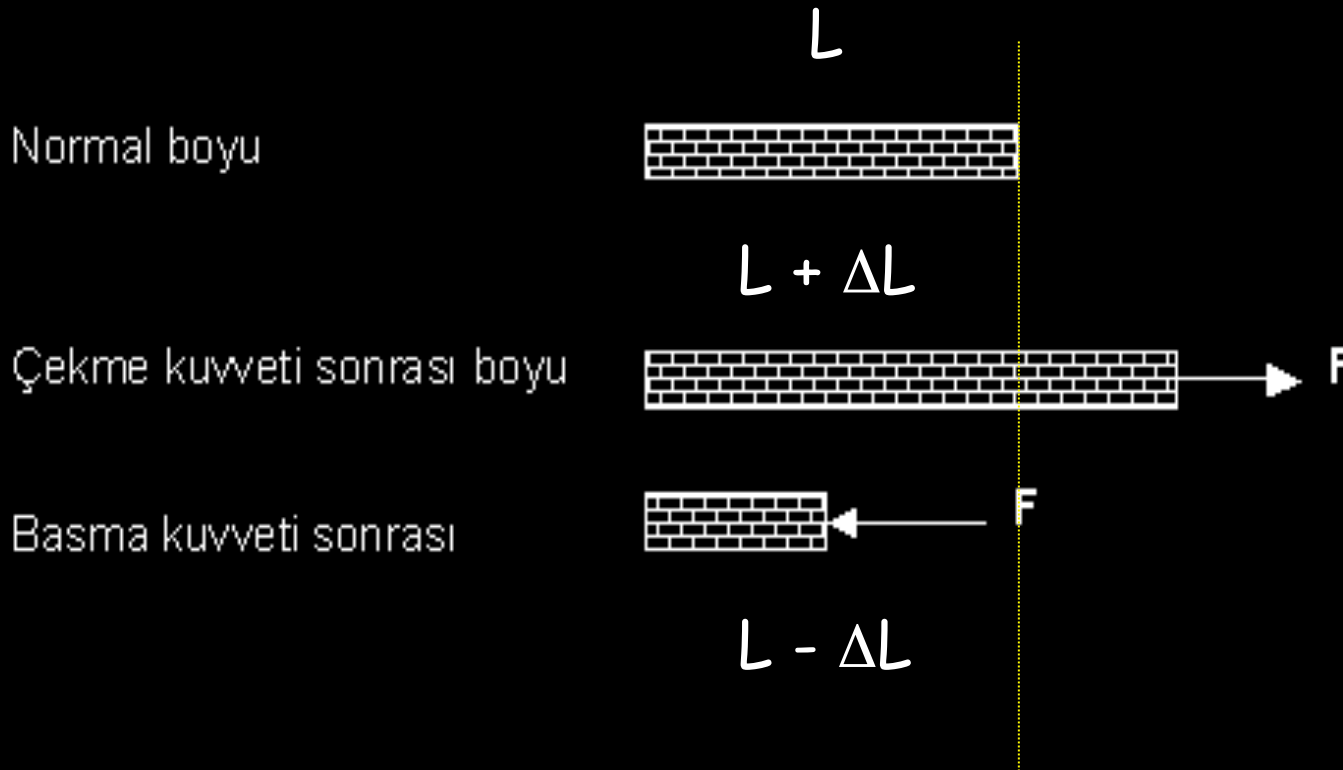
Mekanik Terimler

Strain= Birim Şekil değişikliği

Stress= Gerilme

Young Modülü= Elastisite modülü

Strain= Birim Şekil Değişimi (ϵ)



- Basma (compressive)
- Çekme (tensile)
- Kayma (shear)

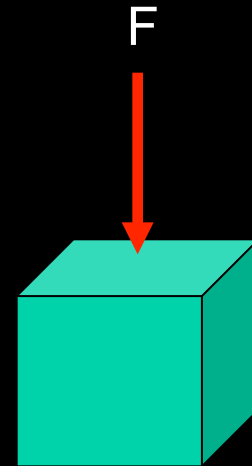
$$\epsilon = \Delta L / L$$

Stress= Gerilme

- Birim alana gelen kuvvet ($\text{Pa} = \text{N}/\text{m}^2$)

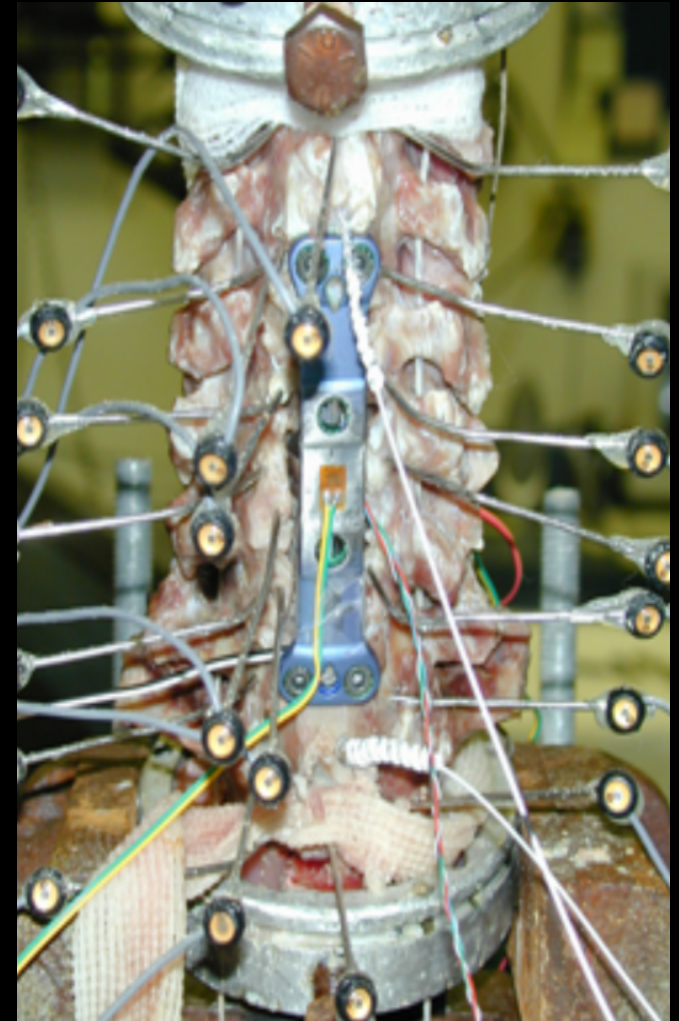
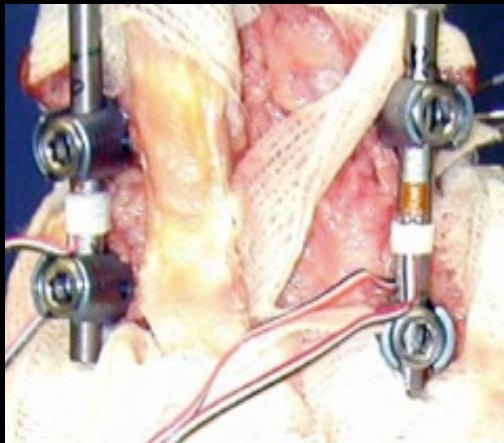
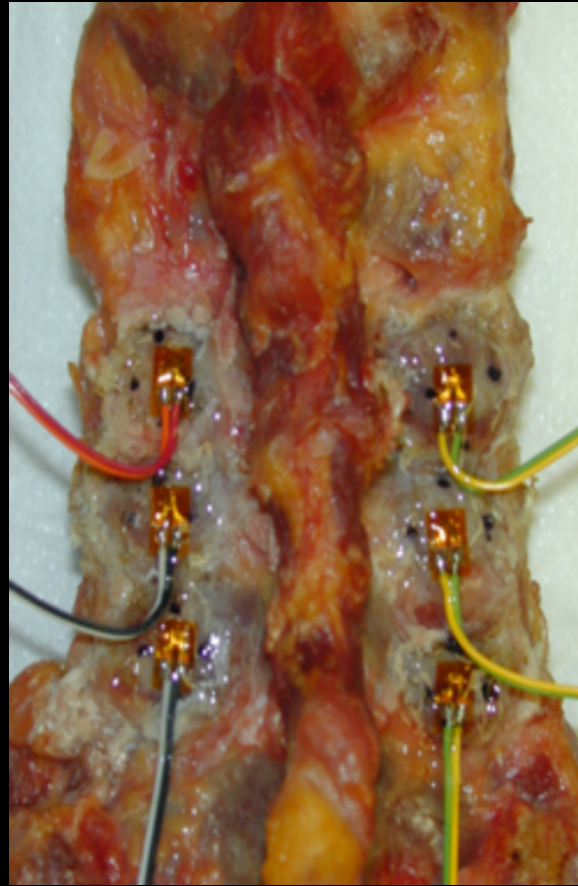
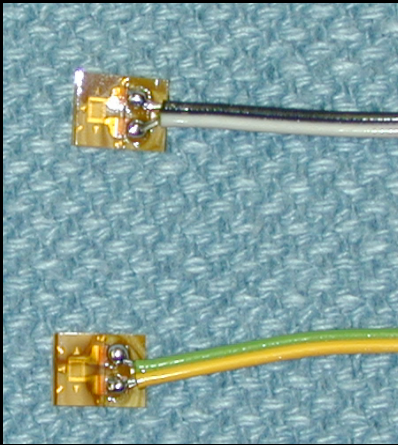
Gerilme= Kuvvet/Alan

- Basma (compressive)
- Çekme (tensile)
- Kayma (shear)



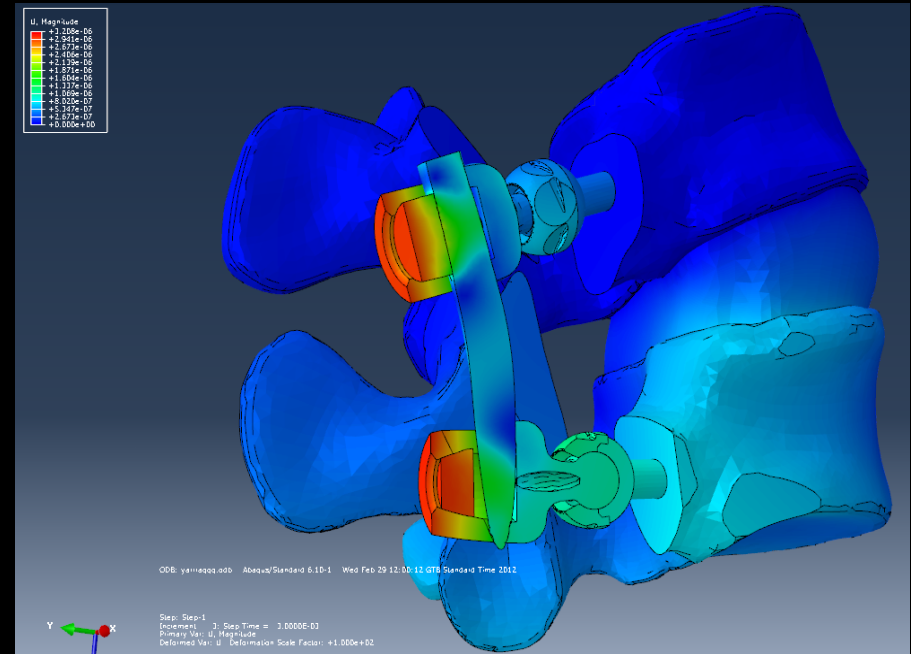
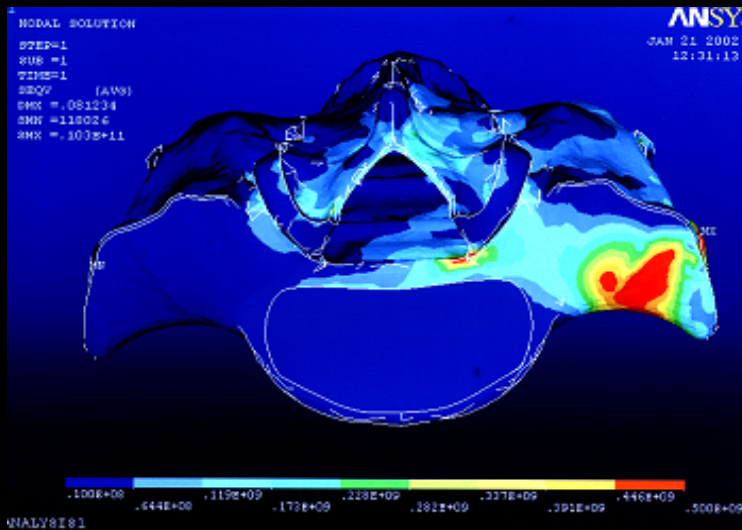
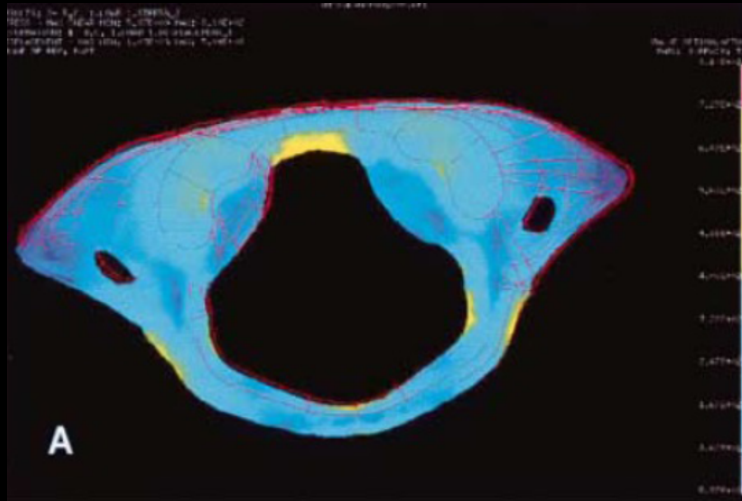
Strain ve Stress ölçümü

Strain gage



Strain ve Stress ölçümü

FEM



Elastisite Modülü

Gerilmenin birim şekil değişikliğine oranıdır.

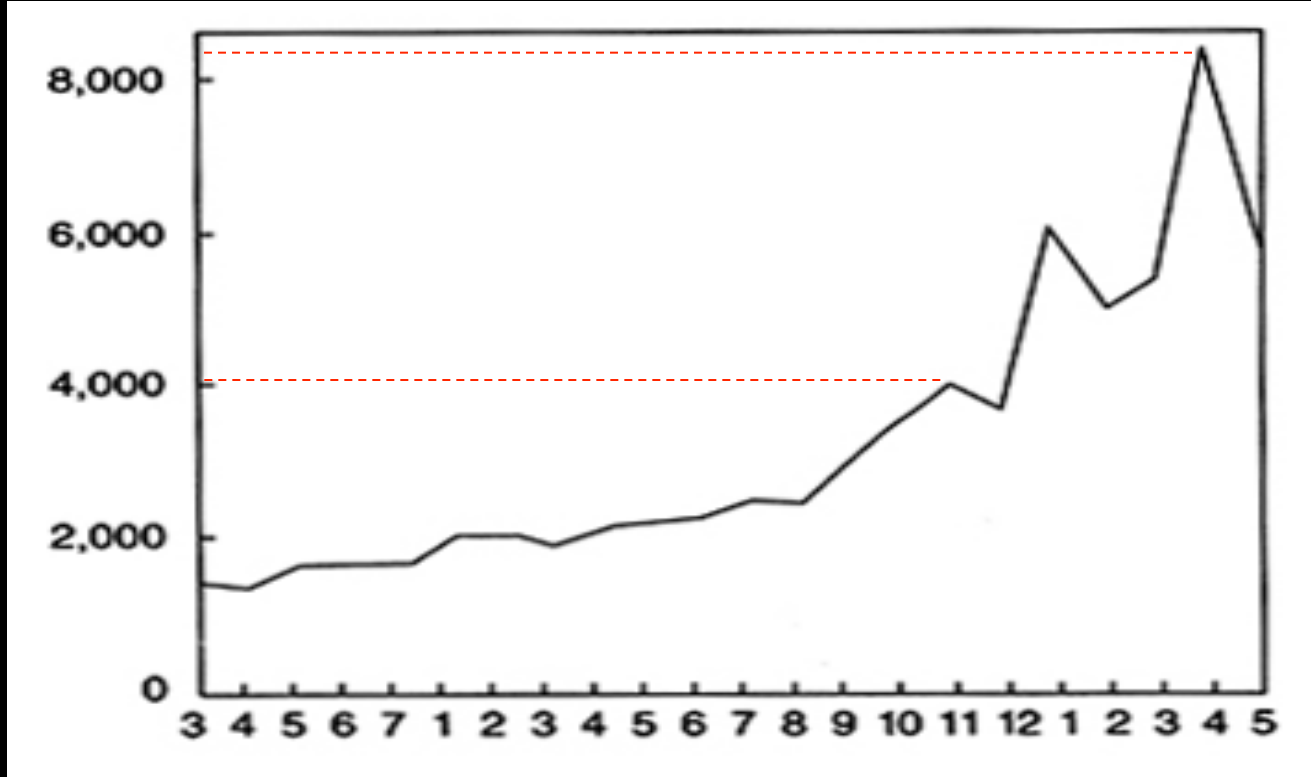
Elastisite modülü yüksekse cisim daha fazla dayanımlıdır.

$$E = \sigma / \varepsilon$$

Vertebra Korteks Dayanımı

Basma yüklemesi

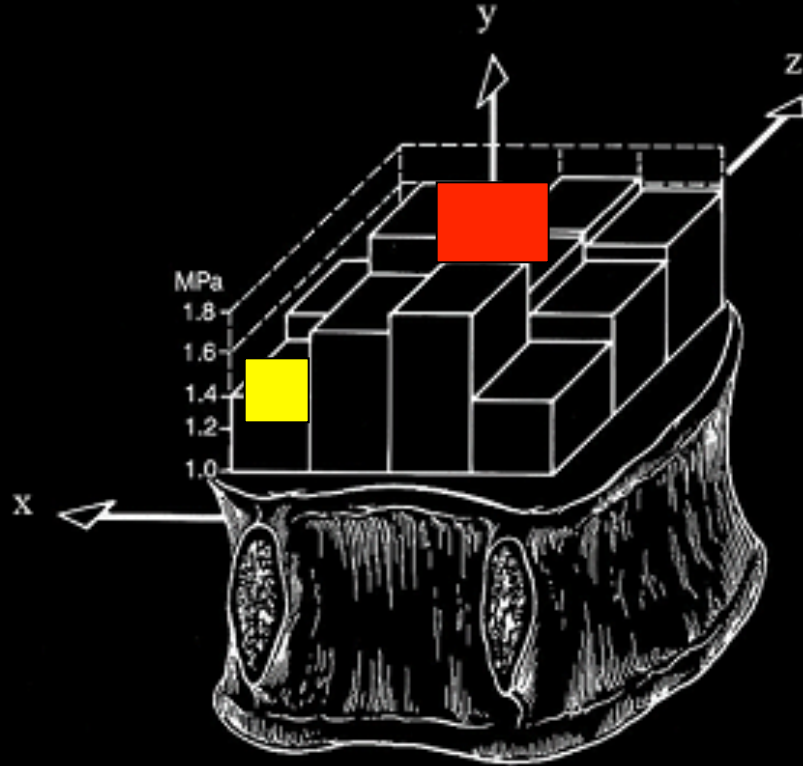
Dayanım (N)



Mesafeler

Vertebra Spongioz Dayanımı

Basma yüklemesi



Basma yüklemesine dayanım;

En fazla → ORTA

En az → ARKA YAN

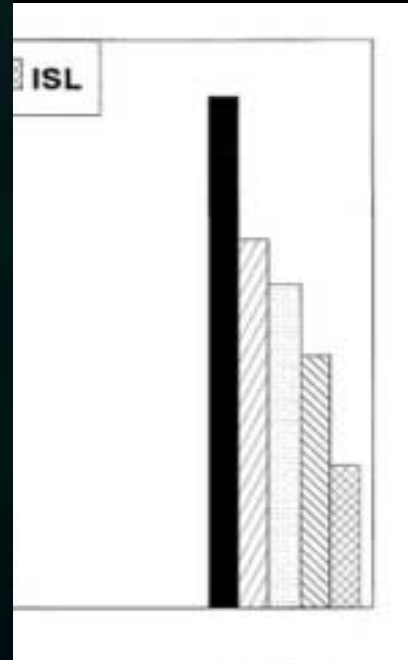
1 MPa = 10 kg/cm²

Kazarian, 1977

in Dayanımı



mesi



Lomber bölge

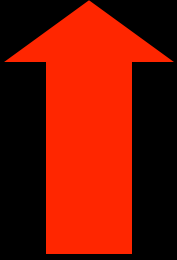
Servikal
CL > LF > ALL > PLL > ISL

Torakal
ALL > LF > CL > PLL > ISL

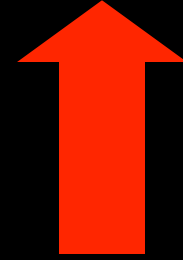
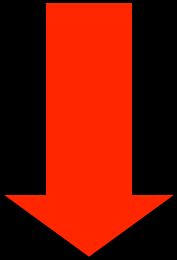
Lomber
ALL > PLL > LF > CL > ISL



Disk Davranışı



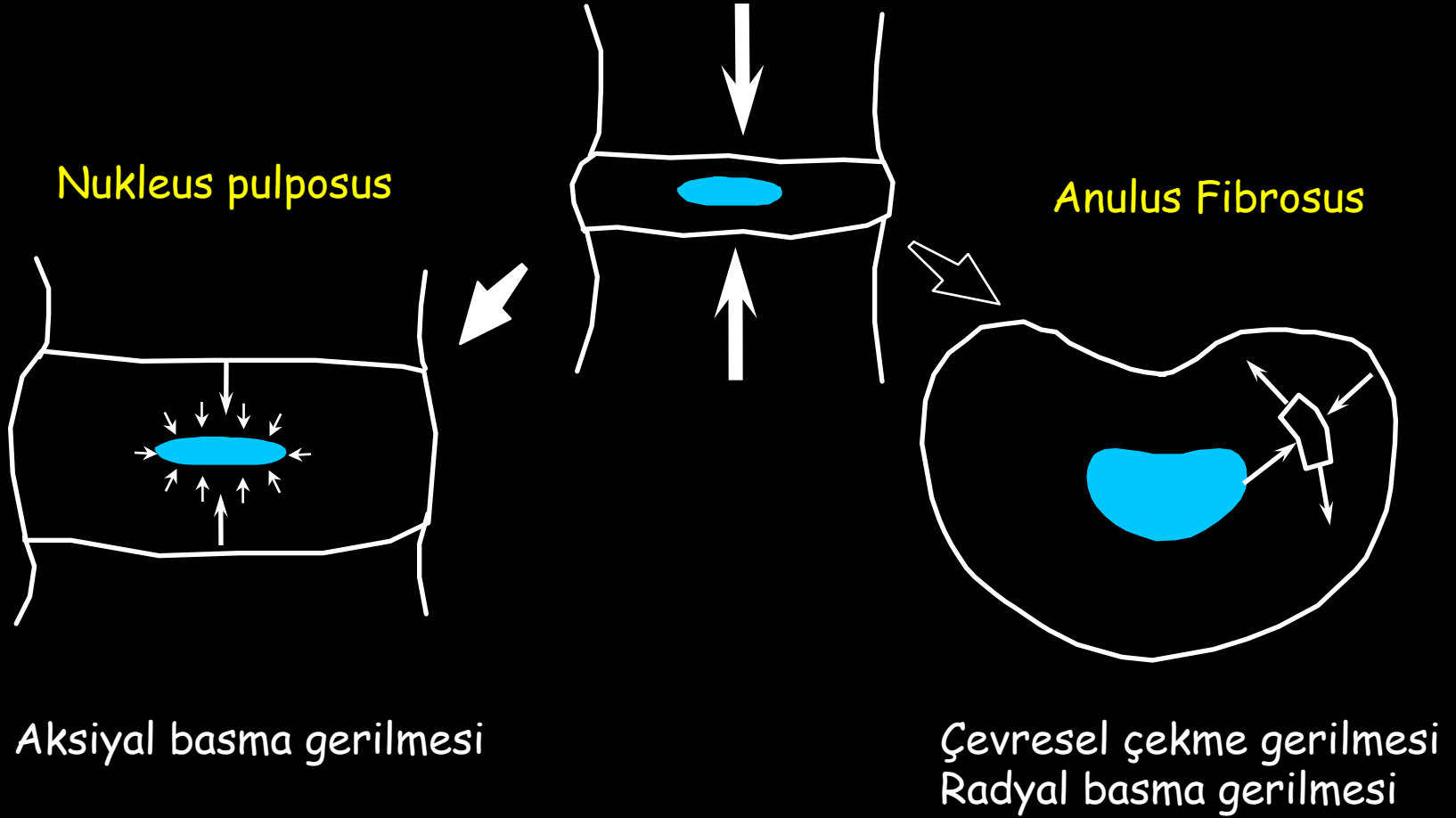
YÜK



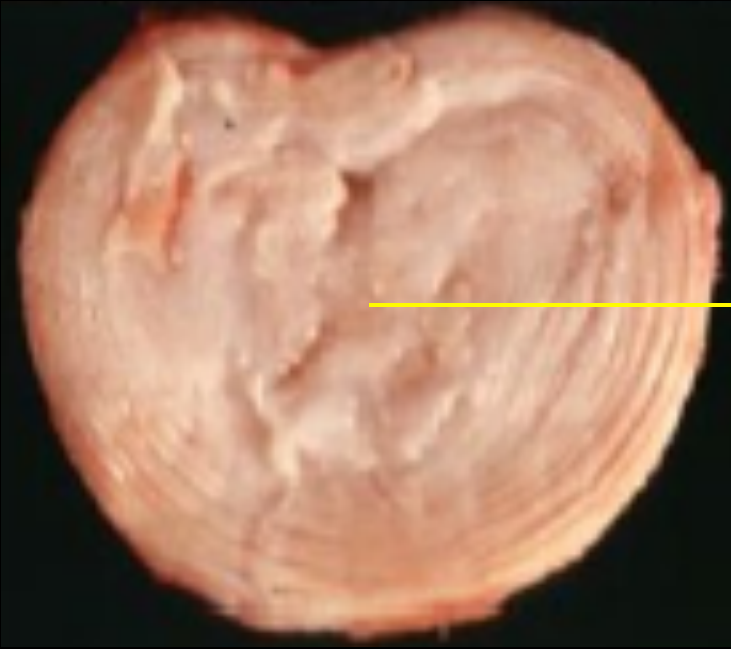
DİSK SERTLİĞİ



Disk İçerisinde Statik Basma Yüklemesi



Nukleusun Dayanım Gücü



Yüksek Basma
Gerilmesi Dayanımı

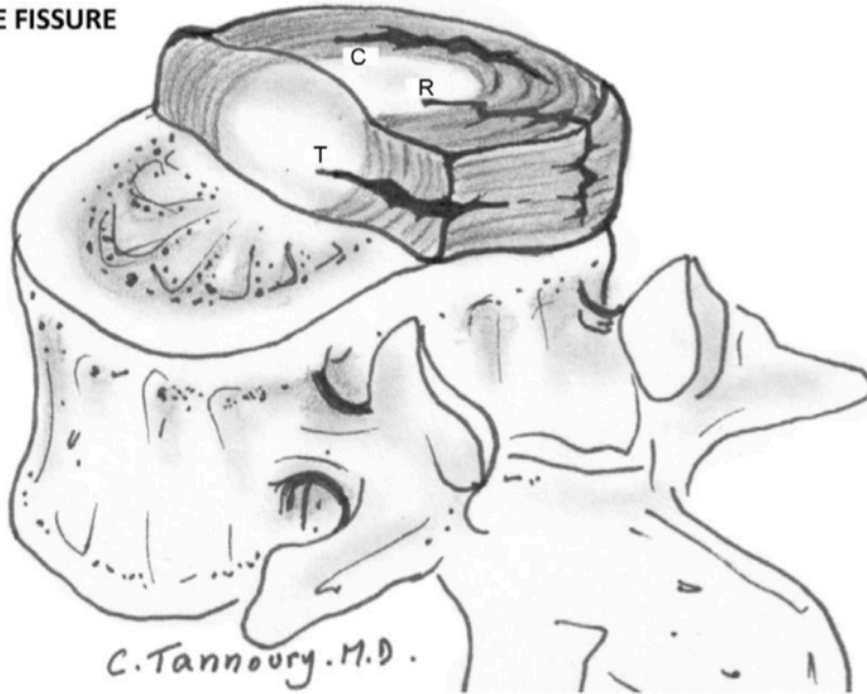
0.7-2.5 MN/m

Düşük Çekme
Gerilmesi Dayanımı

0-0.3 MPa

Anulusun Dayanım Gücü

C: CONCENTRIC FISSURE
R: RADIAL FISSURE
T: TRANSVERSE FISSURE



Düşük Çekme
Gerilmesi Dayanımı

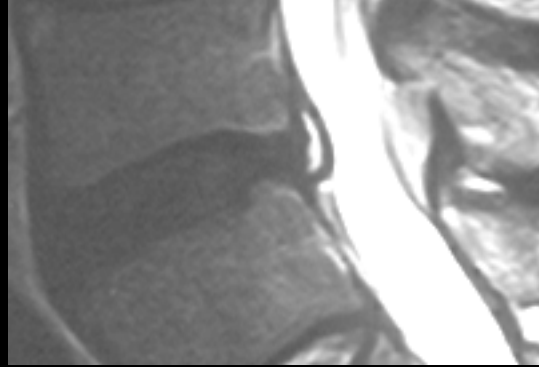
0.3- 0.7 MPa

Yüksek Çekme
Gerilmesi Dayanımı

0.7- 1.4 MPa

Annuler Yırtık

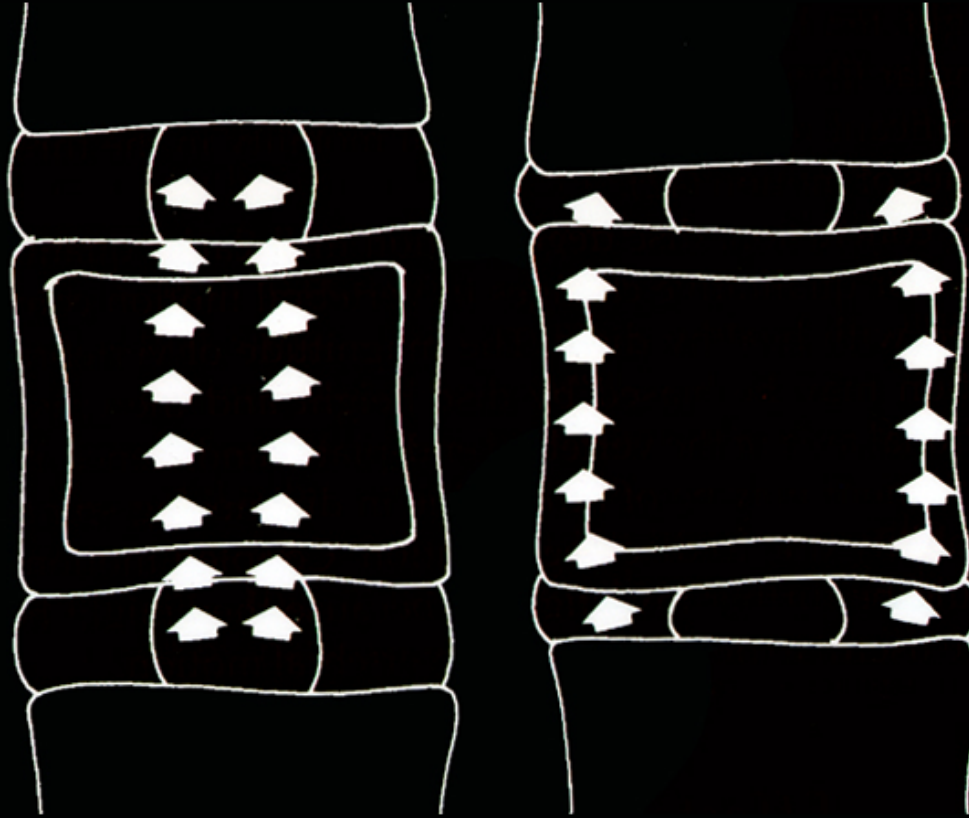
Düşük Çekme Gerilmesi Dayanımı



Yüksek Kayma Gerilmesi



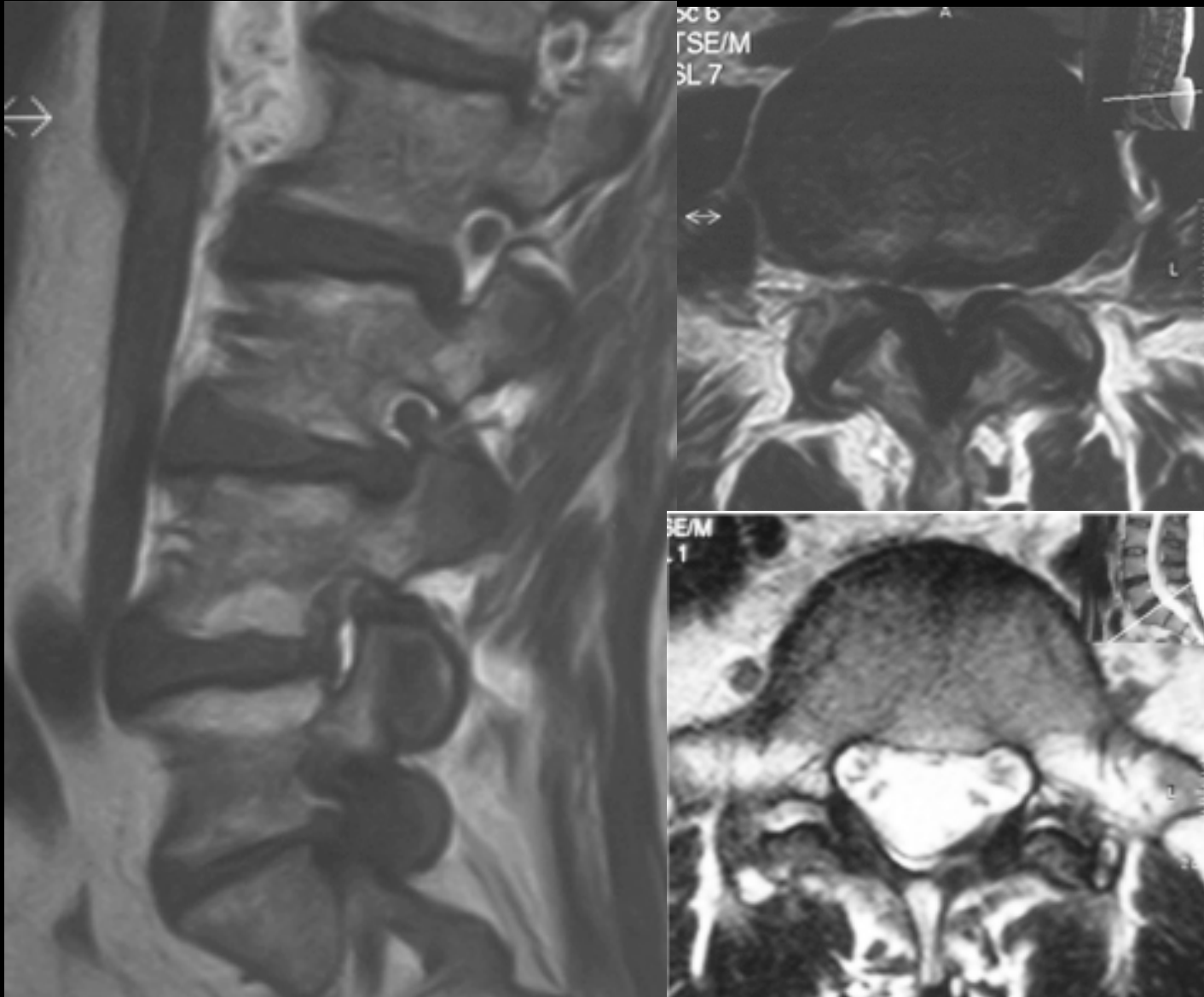
Yük Geçişi



Normal

Dejenere

Yük Geçişi



Sunum Slaytları
www.hakanbozkus.com.tr
alınabilir

Teşekkür ederim