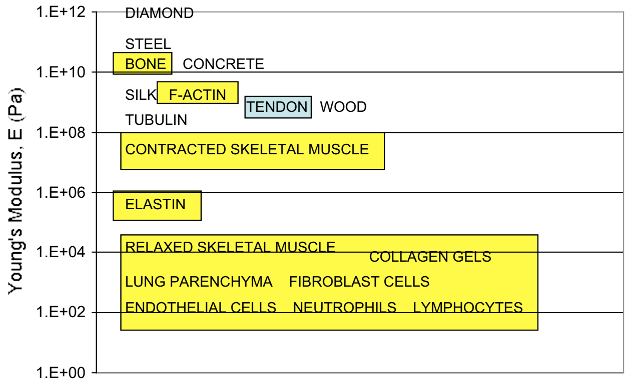
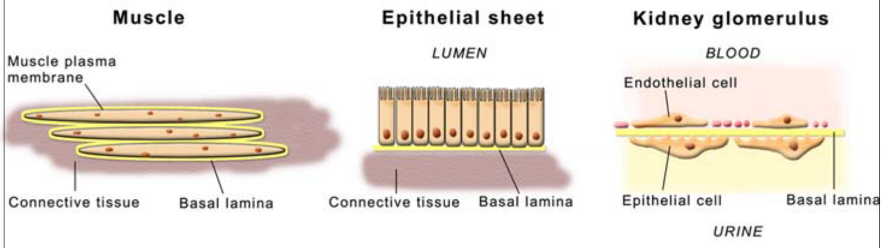
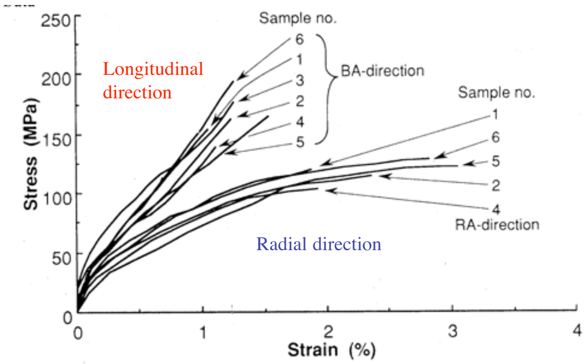
Values of the elastic or Young's modulus for various materials





Basal laminae (the yellow lines) are organized in three ways.

Right tibia (somewhat non-isotropic and nonlinear)



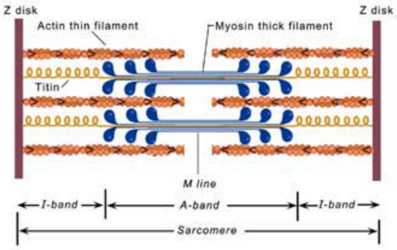
Comments

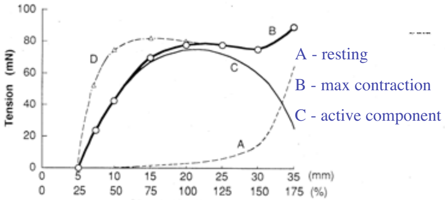
None.

Reference(s)

Kobayashi K, Tanabe Y, Koga Y, Hara T (1993) Identification of the dynamic properties of human compact bone. Theor Appl Mech 42:313–318

Striated muscle





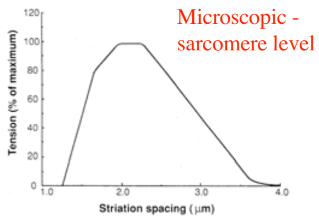
Macroscopic view

Comments

- Caption:
  A, resting tension; B, maximum tension produced by the optimum stimulus; C, active tension (= B – A); D, potentiated tension produced by successive stimuli.
- The slightest resting tension was produced at 75% of the in situ length (20 mm).
- The optimum length, at which the active tension became maximum, is between 100% and 125% of the in situ length.
- The active tension declines almost symmetrically on either side of the optimal length.
- The maximum tension potentiated by successive stimuli was attained at 75% of the in situ length.

Reference(s)

Mashima H, Yoshida T (1965) Effect of length on the development of tension in guinea-pigs *Taenia coli*. Jpn J Physiol 15:463–477



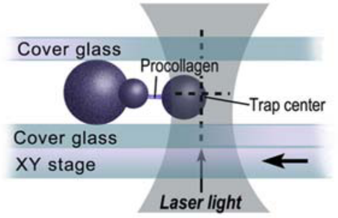
Comments

- Many features of the length–tension relation are simply explained by the sliding-filament theory.
- The peak of the curve consists of a plateau between sarcomere lengths of 2.05 and 2.2 μm.

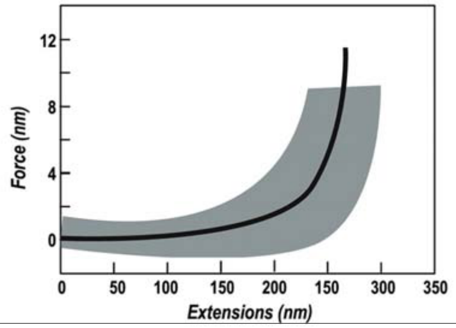
Reference(s)

Gordon AM, Huxley AF, Julian FJ (1966) The variation in isometric tension with sarcomere length in vertebrate muscle fibres. J Physiol 184:170–192 (with permission)

Stretching a procollagen II molecule with an optical tweezers



The force-extension curve of a single collagen II



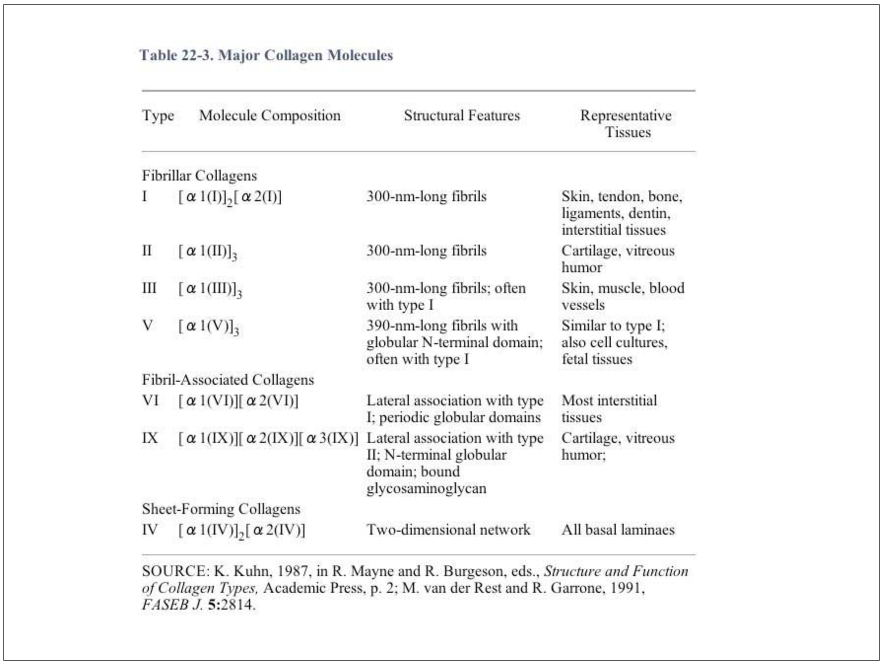


Table 22-3. Major Collagen Molecules

Type	Molecule Composition	Structural Features	Representative Tissues
Fibrillar Collagens			
I	$[\alpha 1(\text{I})]_2[\alpha 2(\text{I})]$	300-nm-long fibrils	Skin, tendon, bone, ligaments, dentin, interstitial tissues
II	$[\alpha 1(\text{II})]_3$	300-nm-long fibrils	Cartilage, vitreous humor
III	$[\alpha 1(\text{III})]_3$	300-nm-long fibrils; often with type I	Skin, muscle, blood vessels
V	$[\alpha 1(\text{V})]_3$	390-nm-long fibrils with globular N-terminal domain; often with type I	Similar to type I; also cell cultures, fetal tissues
Fibril-Associated Collagens			
VI	$[\alpha 1(\text{VI})][\alpha 2(\text{VI})]$	Lateral association with type I; periodic globular domains	Most interstitial tissues
IX	$[\alpha 1(\text{IX})][\alpha 2(\text{IX})][\alpha 3(\text{IX})]$	Lateral association with type II; N-terminal globular domain; bound glycosaminoglycan	Cartilage, vitreous humor;
Sheet-Forming Collagens			
IV	$[\alpha 1(\text{IV})]_2[\alpha 2(\text{IV})]$	Two-dimensional network	All basal laminaes

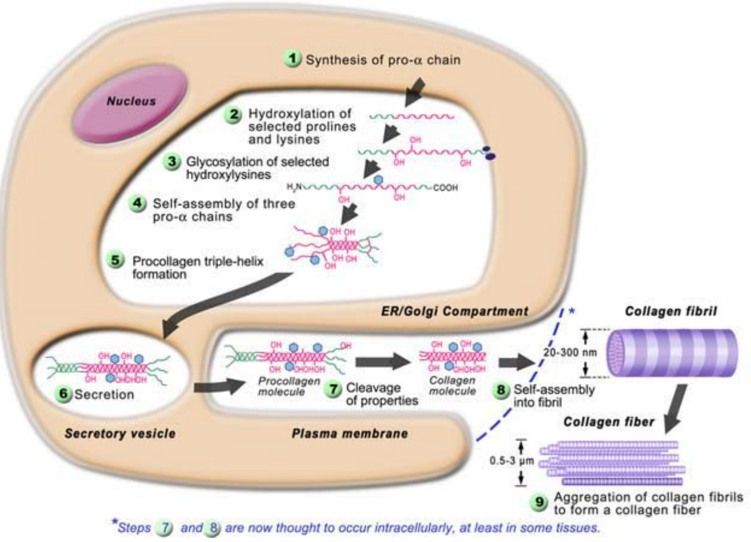
SOURCE: K. Kuhn, 1987, in R. Mayne and R. Burgeson, eds., *Structure and Function of Collagen Types,* Academic Press, p. 2; M. van der Rest and R. Garrone, 1991, *FASEB J.* **5:**2814.

Image removed due to copyright considerations.

See Figure 19-41 in: Alberts, Bruce, et al. *Molecular Biology of the Cell*. 4th ed. New York: Garland Publishing, 2002.

Image may be viewed online at the NIH's PubMed Bookshelf.

http://www.ncbi.nlm.nih.gov/entrez/query.fcgi?db=Books



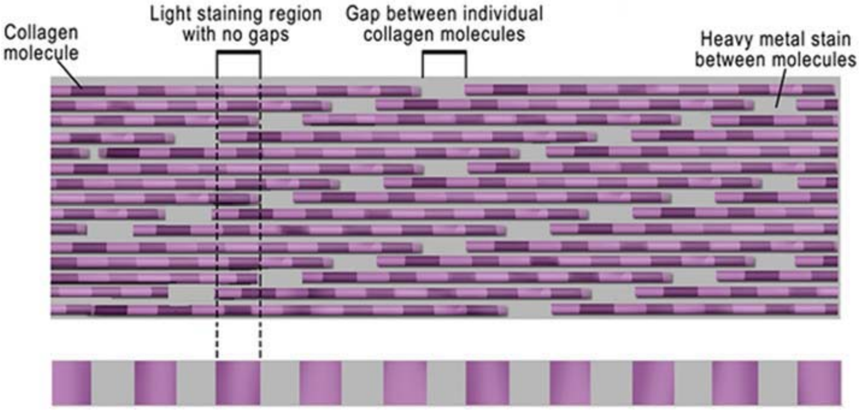
*Steps 7 and 8 are now thought to occur intracellularly, at least in some tissues.

Events involved in the formation of a collagen fibril.

Image removed due to copyright considerations.

See Figure 7.3:4 in: Fung, Y. C. *Biomechanics: Mechanical Properties of Living Tissues*. New York: Springer-Verlag, 1993.

Striated appearance of collagen fibrils



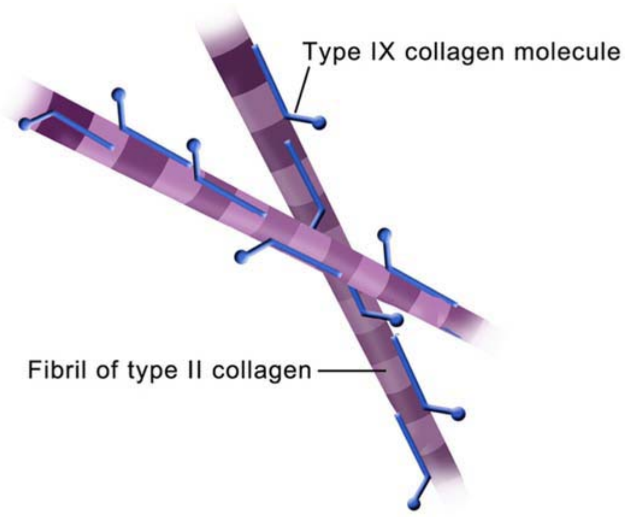
Collagen fiber arrangement in skin
and cornea with alternating directions

Image removed due to copyright considerations.

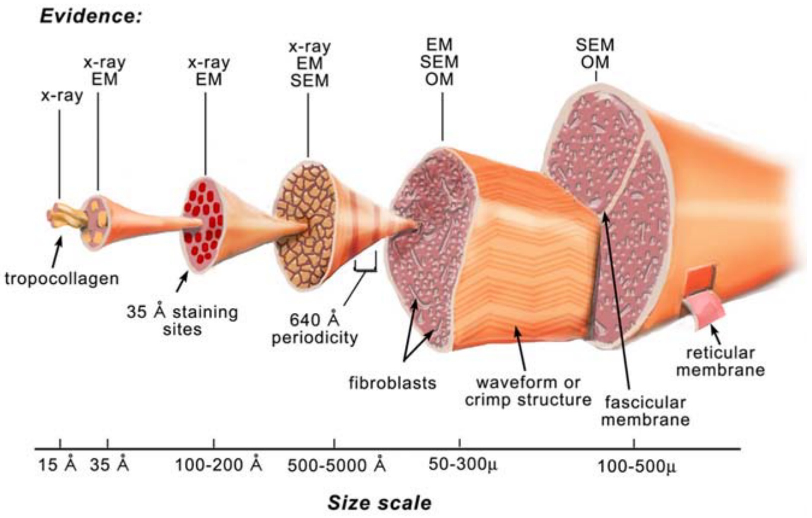
See Figure 19-46 in: Alberts, Bruce, et al. *Molecular Biology of the Cell*. 4th ed. New York: Garland Publishing, 2002.

Image may be viewed online at the NIH's PubMed Bookshelf.

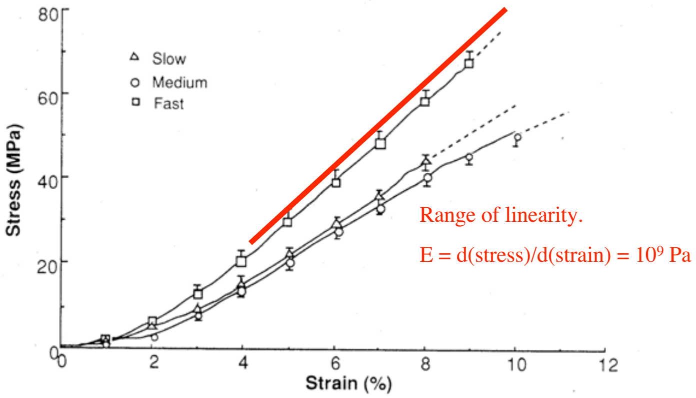
http://www.ncbi.nlm.nih.gov/entrez/query.fcgi?db=Books



Tendon Hierarchy



ACL -- different strain rates



Range of linearity.

E = d(stress)/d(strain) = 10^9 Pa

Comments

- Ninety percent of the ACL specimens failed by avulsion at the insertion site (72% at the tibial insertion and 18% at the femoral insertion), and 10% failed in the midsubstance.

Reference(s)

Danto MI, Woo SL-Y (1993) The mechanical properties of skeletally mature rabbit anterior cruciate ligament and patellar tendon over a range of strain rates. J Orthop Res 11:58–67 (with permission)

Collagen derives its stiffness, not from the single molecule characteristics of collagen, but rather from the straightening of “wavy” collagen fibers

Image removed due to copyright considerations.

Cornea, M.
Johnson, J. Ruberti