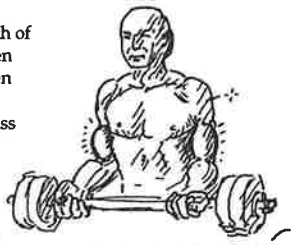
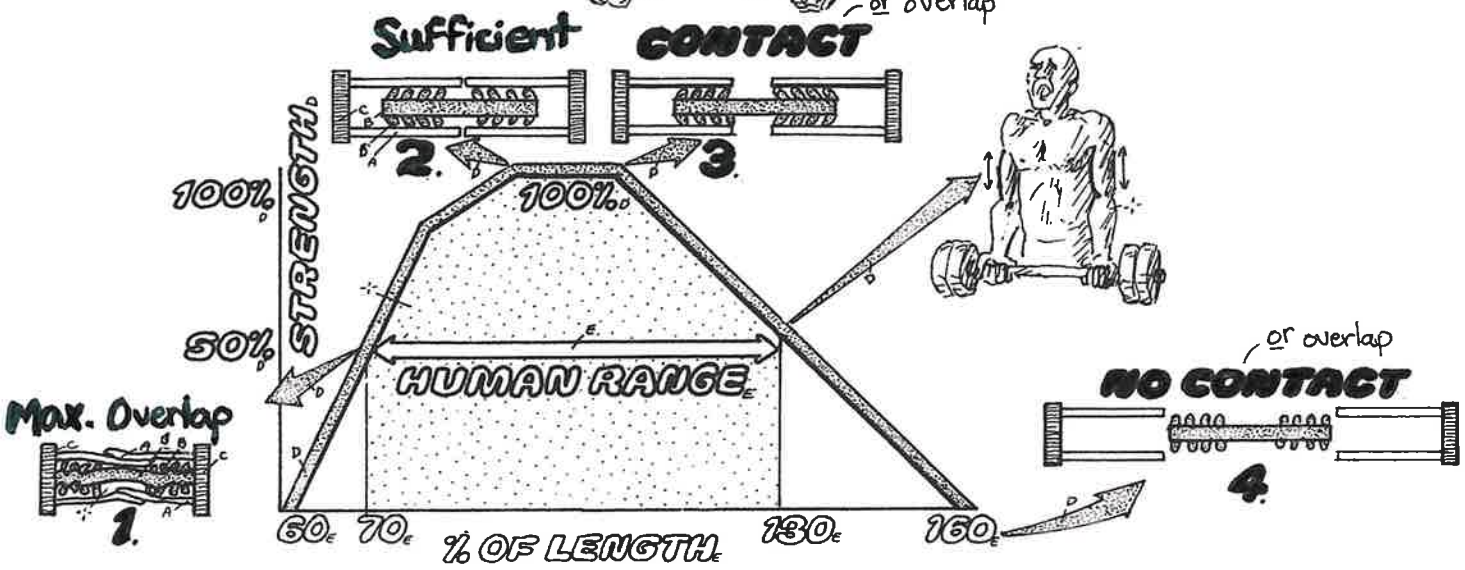
MUSCLE TENSION-LENGTH

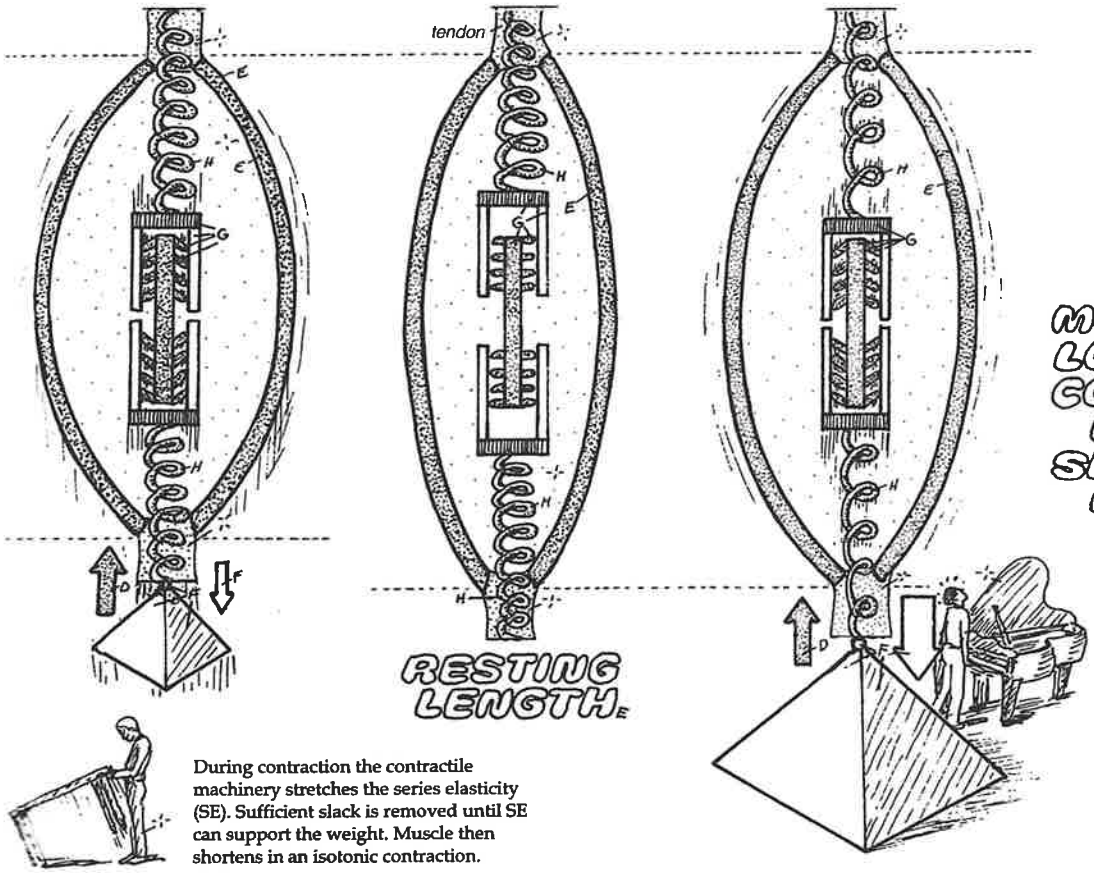
Contractile force (strength) depends on the number of cross bridges that can be recruited for "power strokes." This depends on the length of muscle because cross bridges must contact actin to be effective. When muscle is stretched, contact is poor and contraction is weak (4). When muscle is too short, filaments jam up, interfering with each other's movements (1). Maximal strength of contraction occurs when all cross bridges can contact actin filaments and where there is still room for sliding without interference by actins running into each other (2–3).



ACTIN$_A$
MYOSIN$_B$ or Myosin Head
CROSS BRIDGE$_B$
Z LINE$_C$ or Z disk
MUSCLE TENSION$_D$
MUSCLE LENGTH$_E$



ISOTONIC VS. ISOMETRIC CONTRACTION



MUSCLE LENGTH$_E$
LOAD$_F$
CONTRACTILE ELEMENT$_G$
SERIES ELASTICITY$_H$

During contraction the contractile machinery stretches the series elasticity (SE). Sufficient slack is removed until SE can support the weight. Muscle then shortens in an isotonic contraction.

TENSION$_D$ > LOAD$_F$
(MOVEMENT)
ISOTONIC CONTRACTION
(constant tension)

If the weight is too large, the contractile machinery is incapable of stretching the SE (removing slack) sufficiently so that SE can support weight. Contractile machinery simply stretches SE as much as it can, but no net movement occurs. This is an isometric contraction; increase in length of SE = decrease in length of contractile machinery. (The amount of movement of contractile elements shown in the figure is exaggerated for purposes of illustration.)

TENSION$_D$ < LOAD$_F$
(NO MOVEMENT)
ISOMETRIC CONTRACTION
(constant length)