MUSCULATURA

Os músculos estão na origem de uma grande variedade de funções vitais ou afetam várias outras:

-Manutenção da postura
-Locomoção
-Contração cardíaca e pressão sanguínea
-Ventilação respiratória
-Captura de alimentos, mastigação e deglutição
-Peristaltismo
-vocalização
-Esfínteres e válvulas dos sistemas digestivo e circulatorio
-Funções ópticas
-Ereção de pelos e plumas…

Tipos de músculos: 3 grandes categorias

Existem 3 grandes categorias de músculos

1. Esqueléticos: associados ao esqueleto

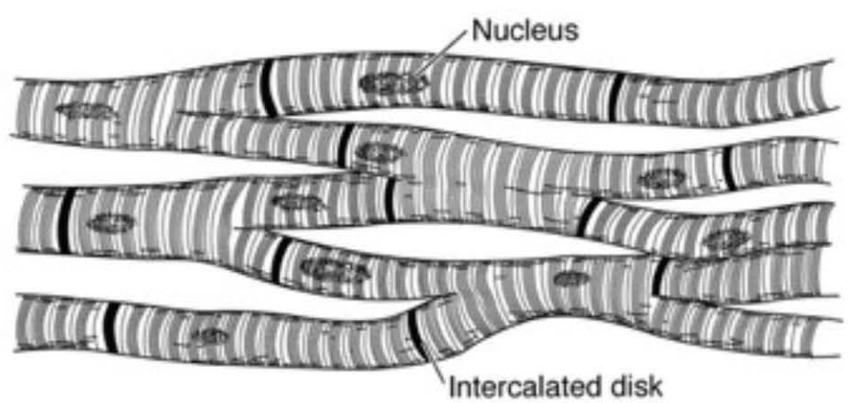
A. Skeletal muscle fibers

Tipos de músculos: 3 grandes categorias

Existem 3 grandes categorias de músculos

1. Esqueléticos: associados ao esqueleto
2. Cardíacos: formam as paredes do coração

A. Skeletal muscle fibers

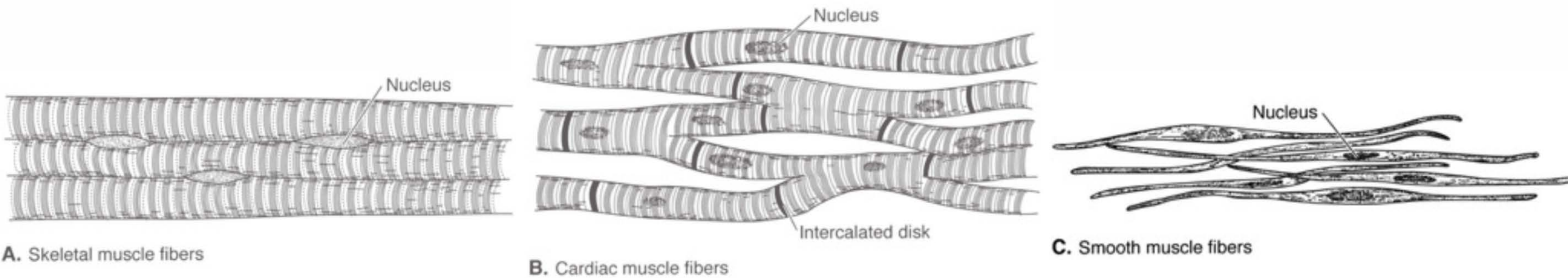


B. Cardiac muscle fibers

Tipos de músculos: 3 grandes categorias

Existem 3 grandes categorias de músculos

1. Esqueléticos: associados ao esqueleto
2. Cardíacos: formam as paredes do coração
3. Lisos: vasos e vísceras

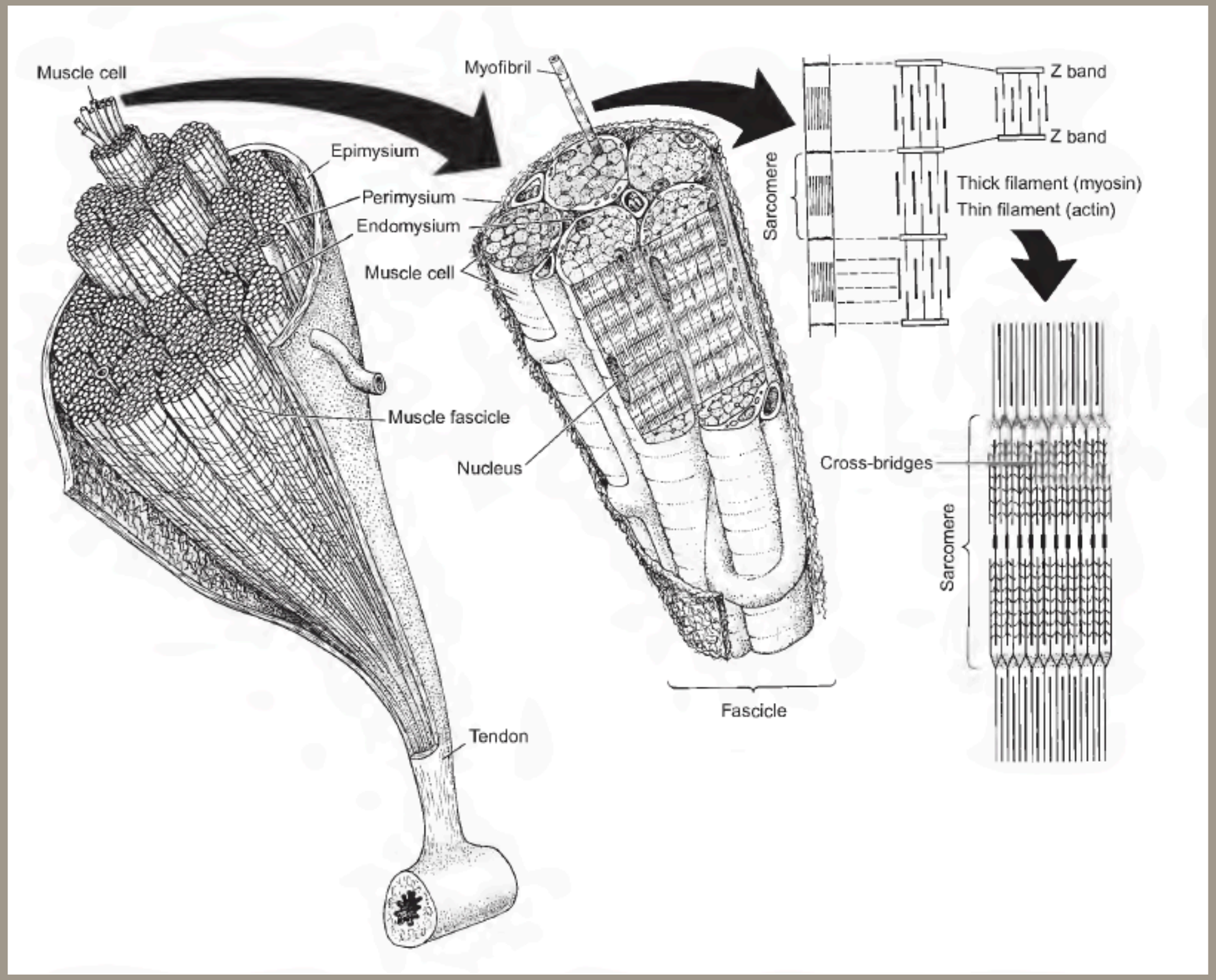


A. Skeletal muscle fibers

B. Cardiac muscle fibers

C. Smooth muscle fibers

ESTRUTURA DA MUSCULATURA ESQUELÉTICA ESTRIADA



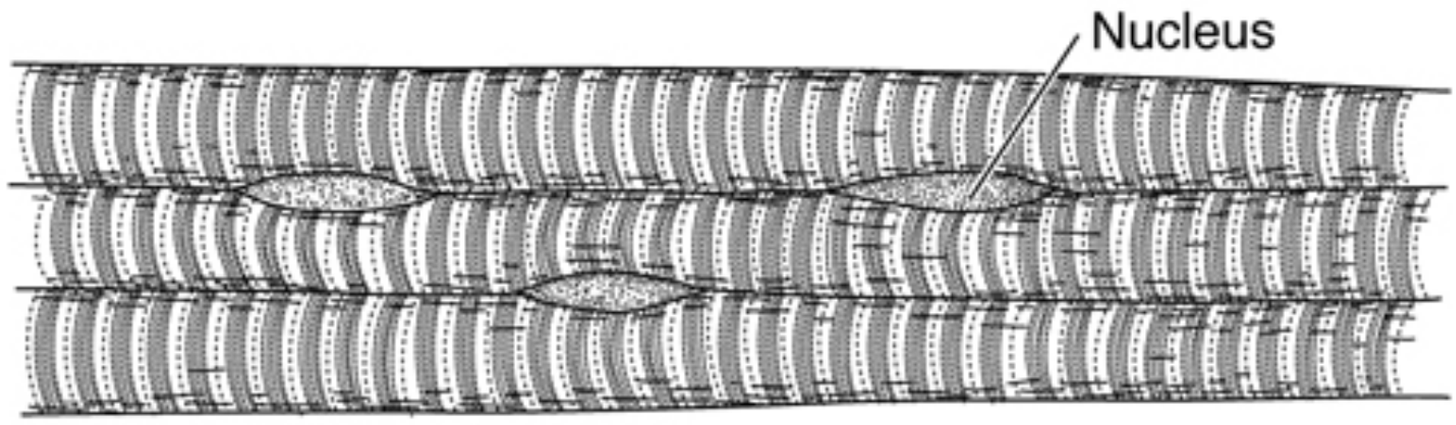
Musculatura estriada
Controle voluntário
Associada ao sistema esquelético

Músculo esquelético: estrutura

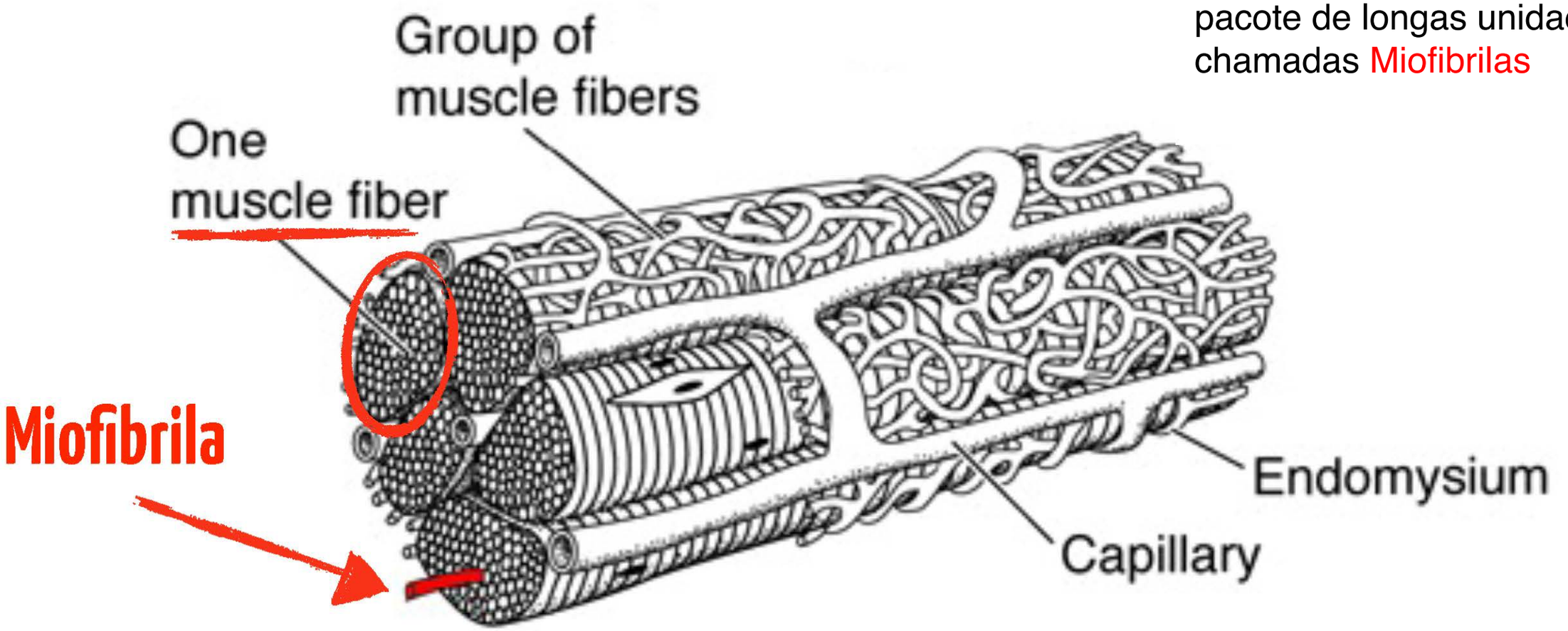
- Celulas estriadas individuais têm menos de 5 cm mas podem se conectar umas às outras formando fibras musculares compostas mais longas

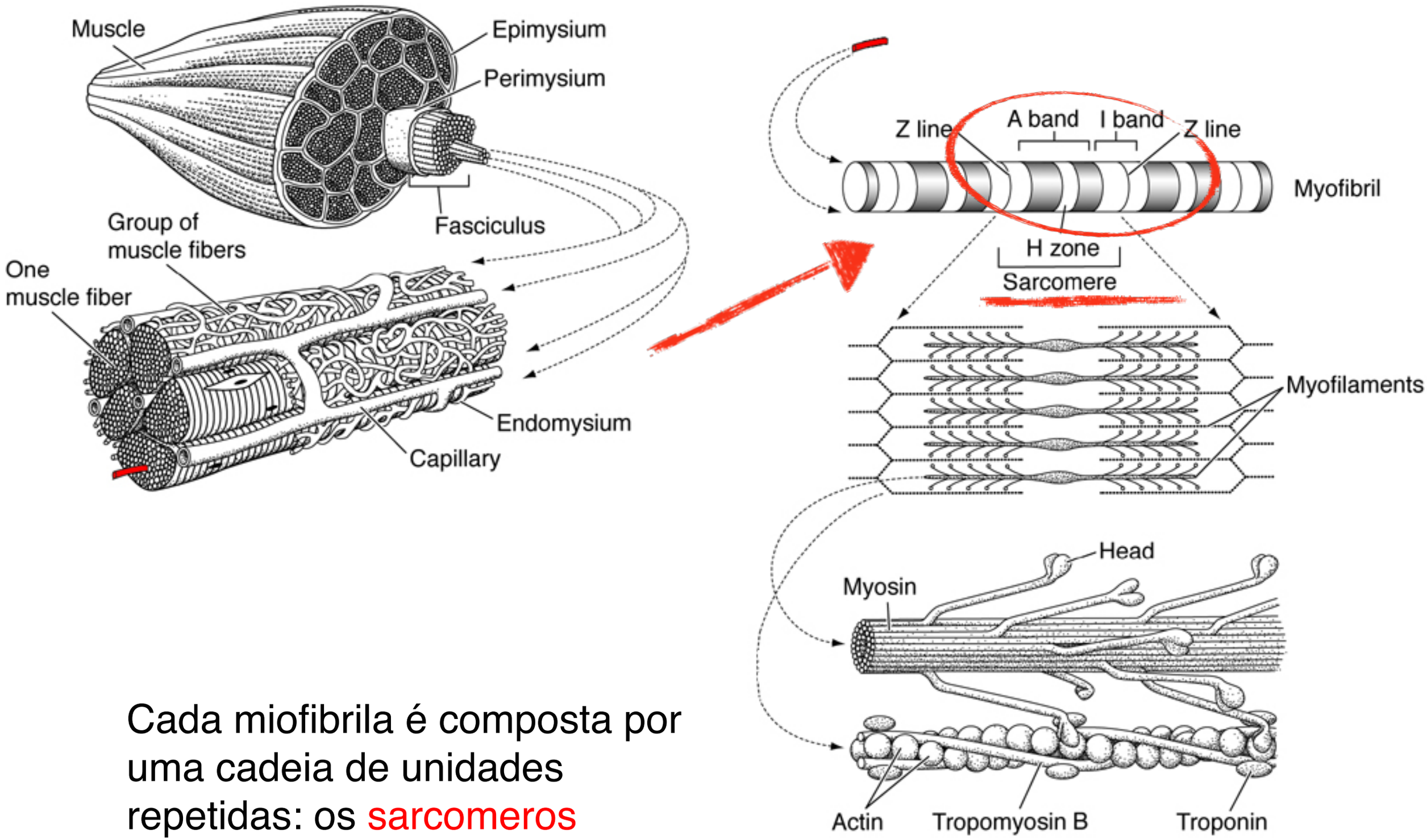
- Células estriadas são multinucleadas, com vários núcleos distribuídos em seu citoplasma, formando fibras musculares

- Cada fibra muscular forma um pacote de longas unidades chamadas Miofibrilas

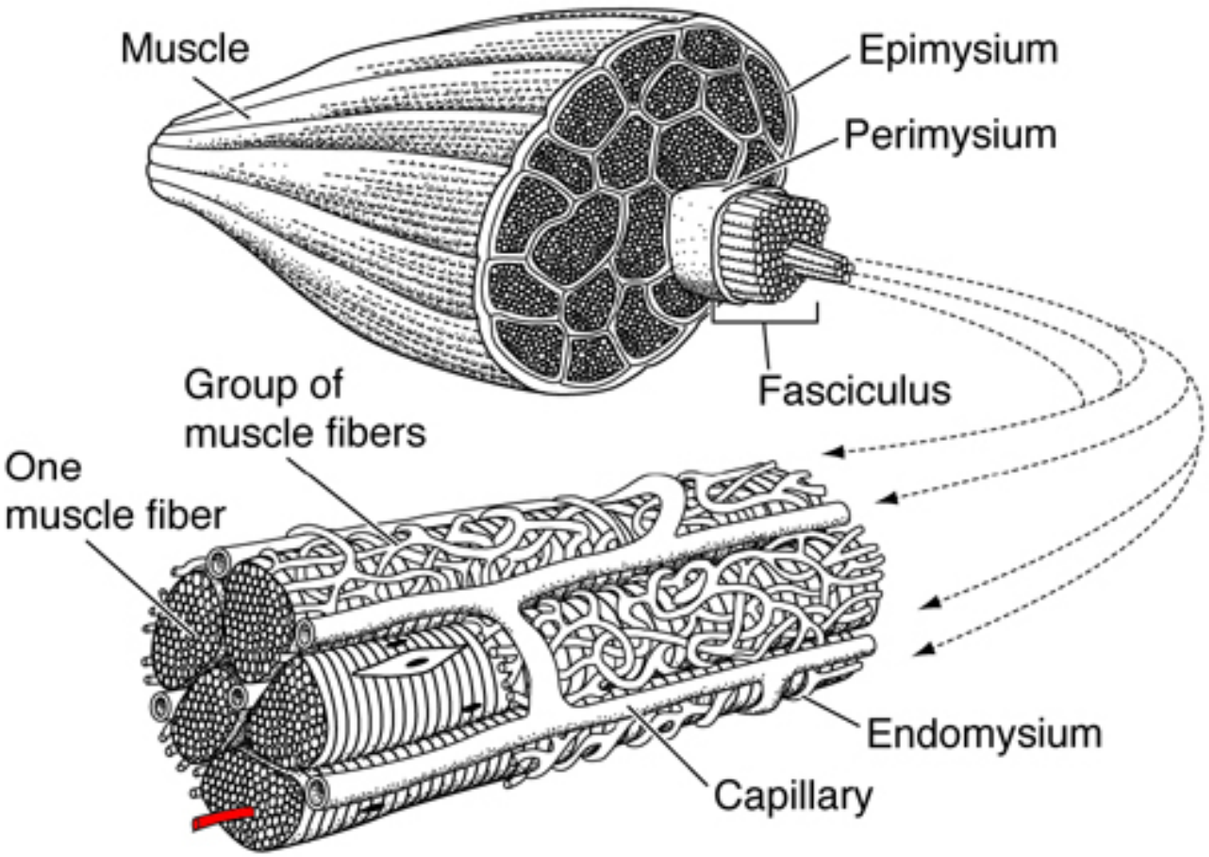


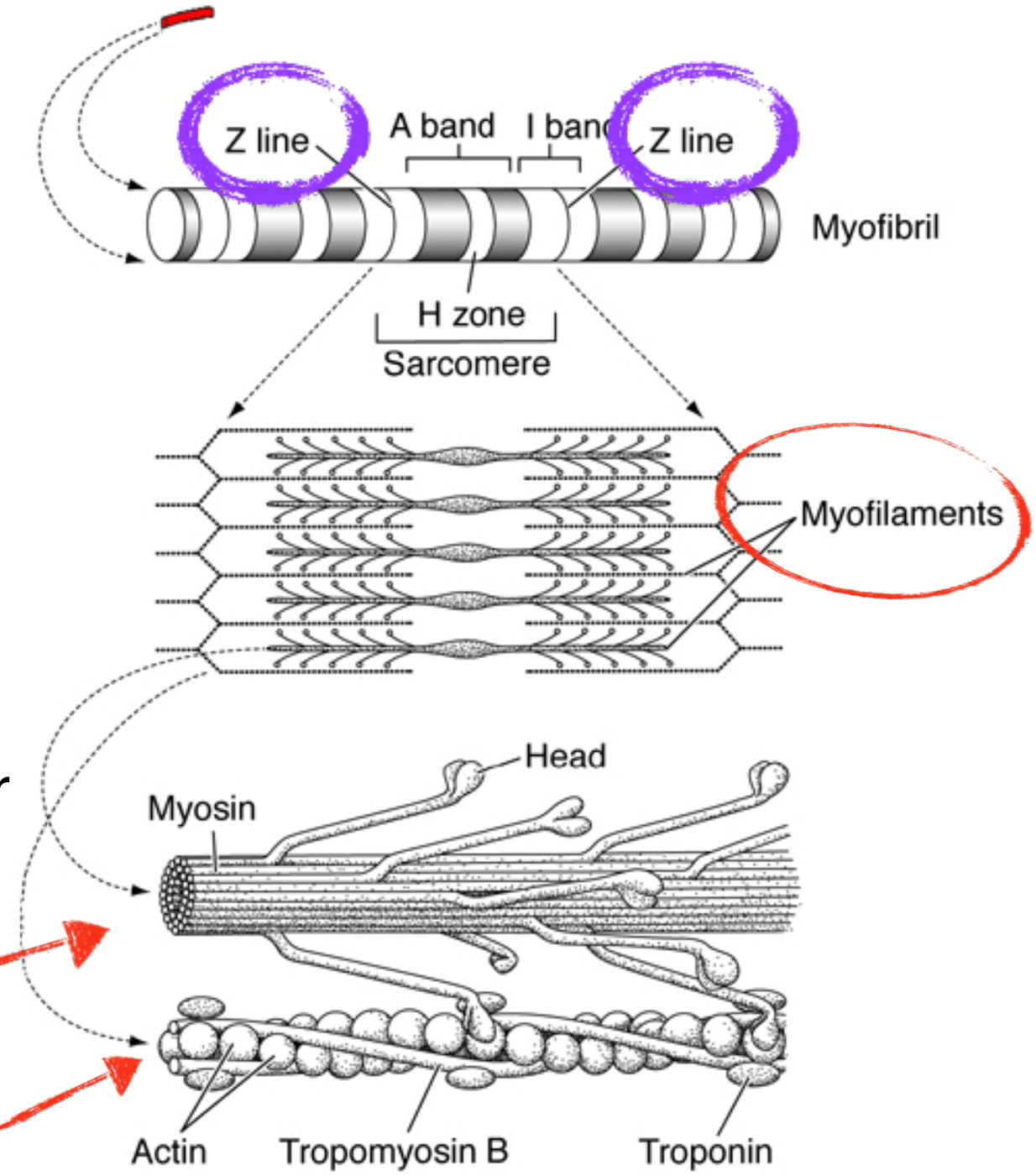
A. Skeletal muscle fibers





Cada miofibrila é composta por uma cadeia de unidades repetidas: os sarcomeros





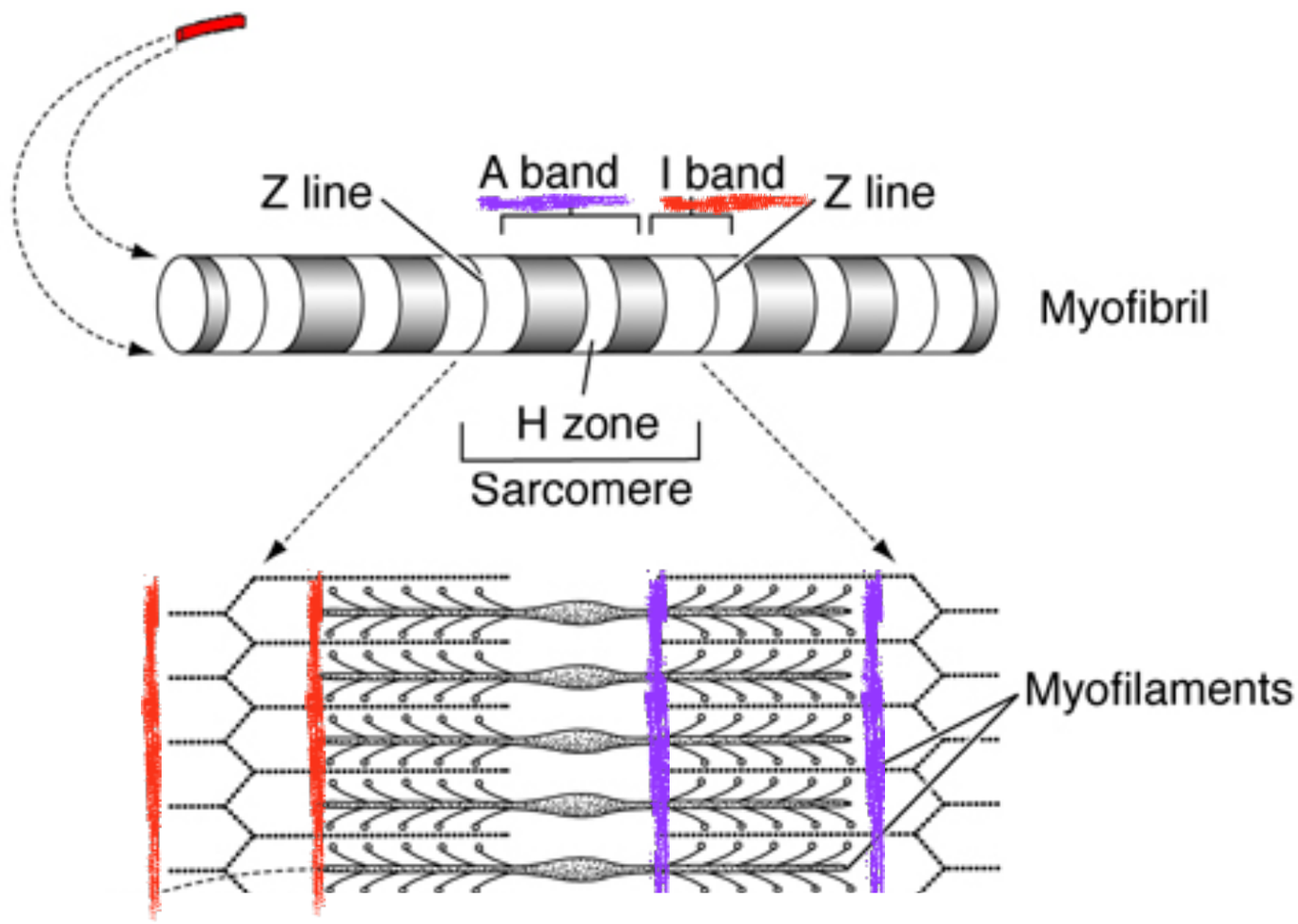
Cada sarcomero é constituído por miofilamentos de dois tipos:

Filamentos finos de Actina

Filamentos grossos de Miosina

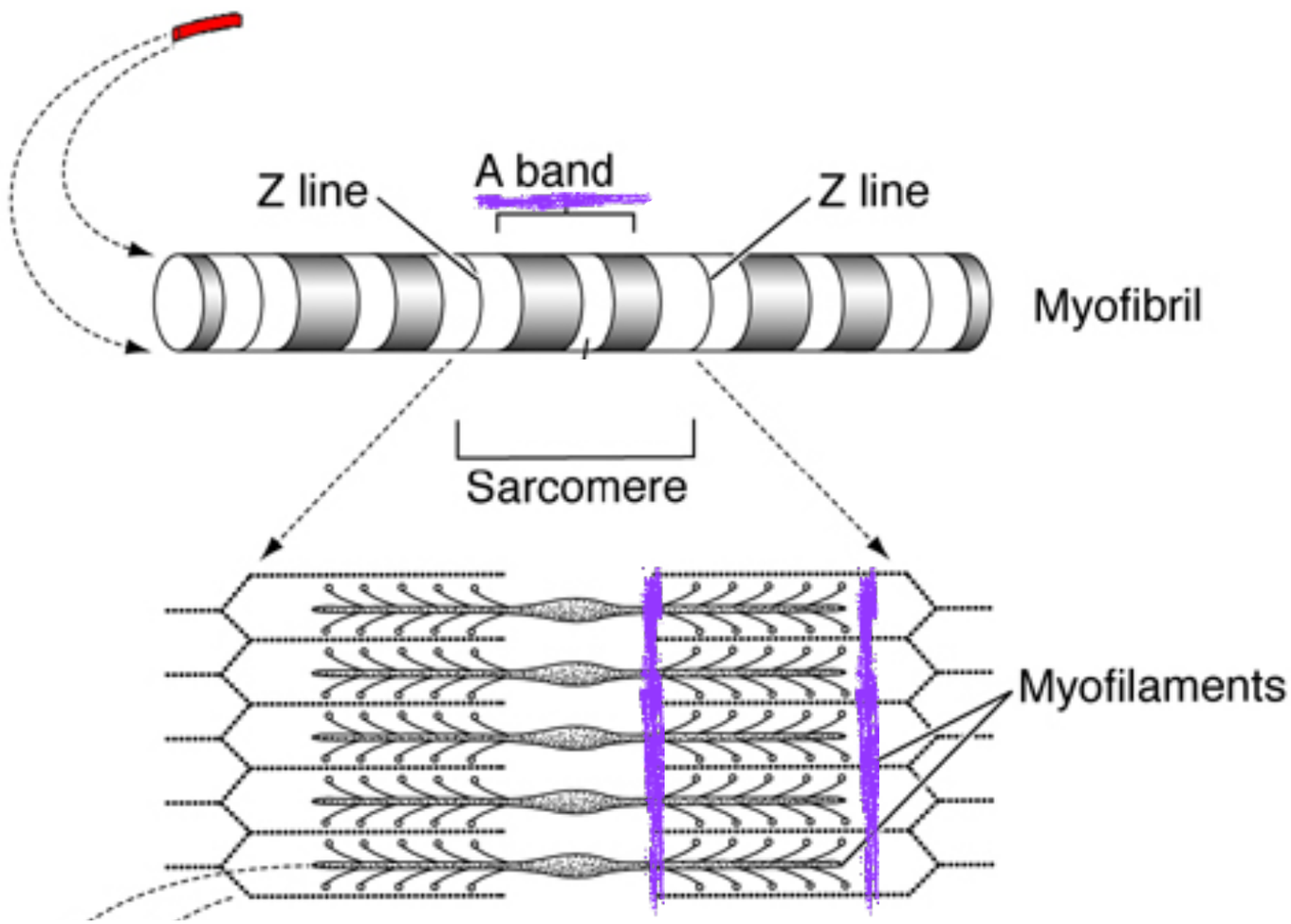
Cada sarcomero é demarcado por linhas escuras chamadas ”Z lines”

Contração muscular



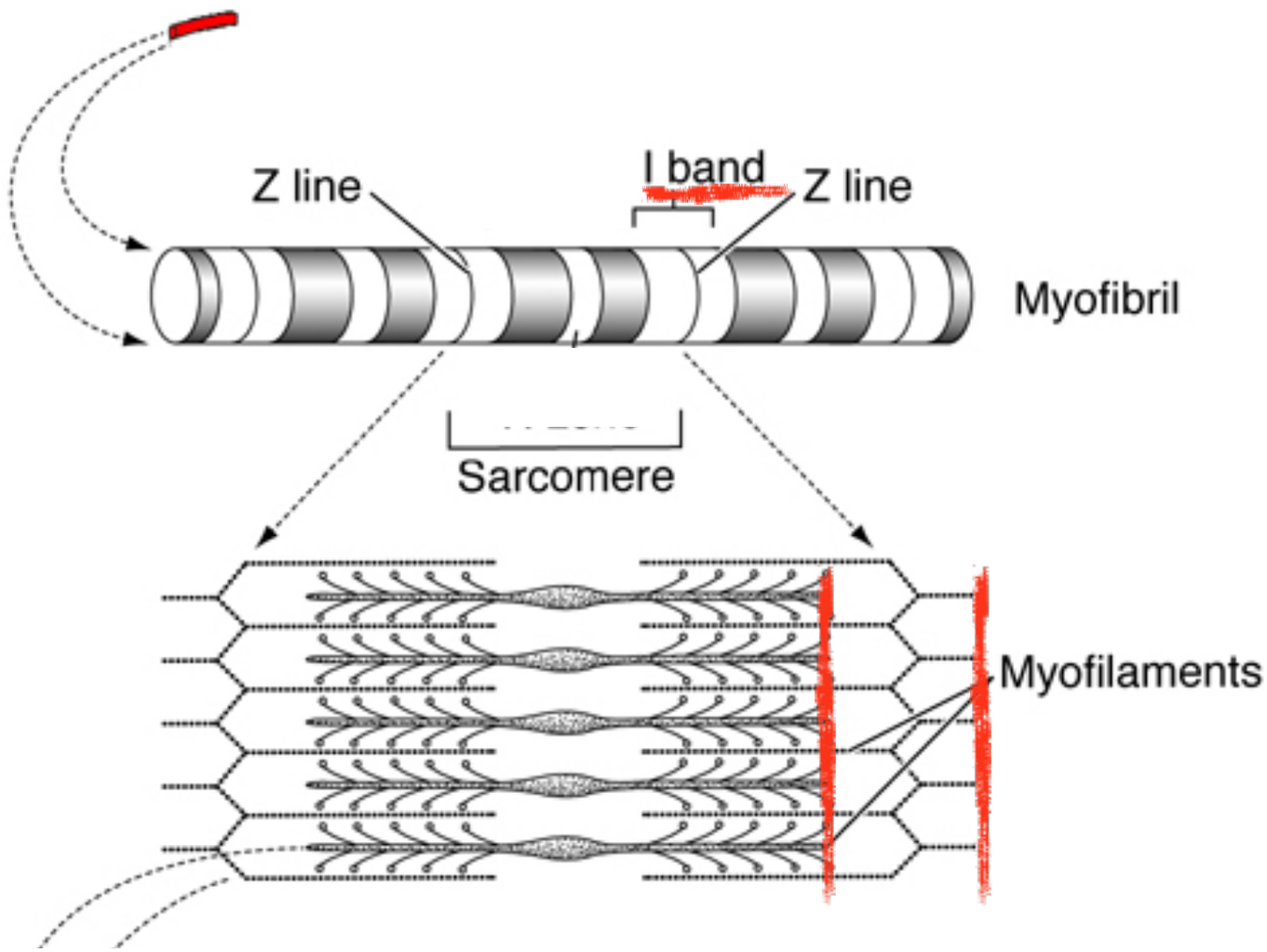
A aparência estriada das fibras é causada pela presença de zonas de distribuição dos miofilamentos, chamadas ”Bandas A” e ”Bandas I” de sarcomeros adjacentes.

Contração muscular



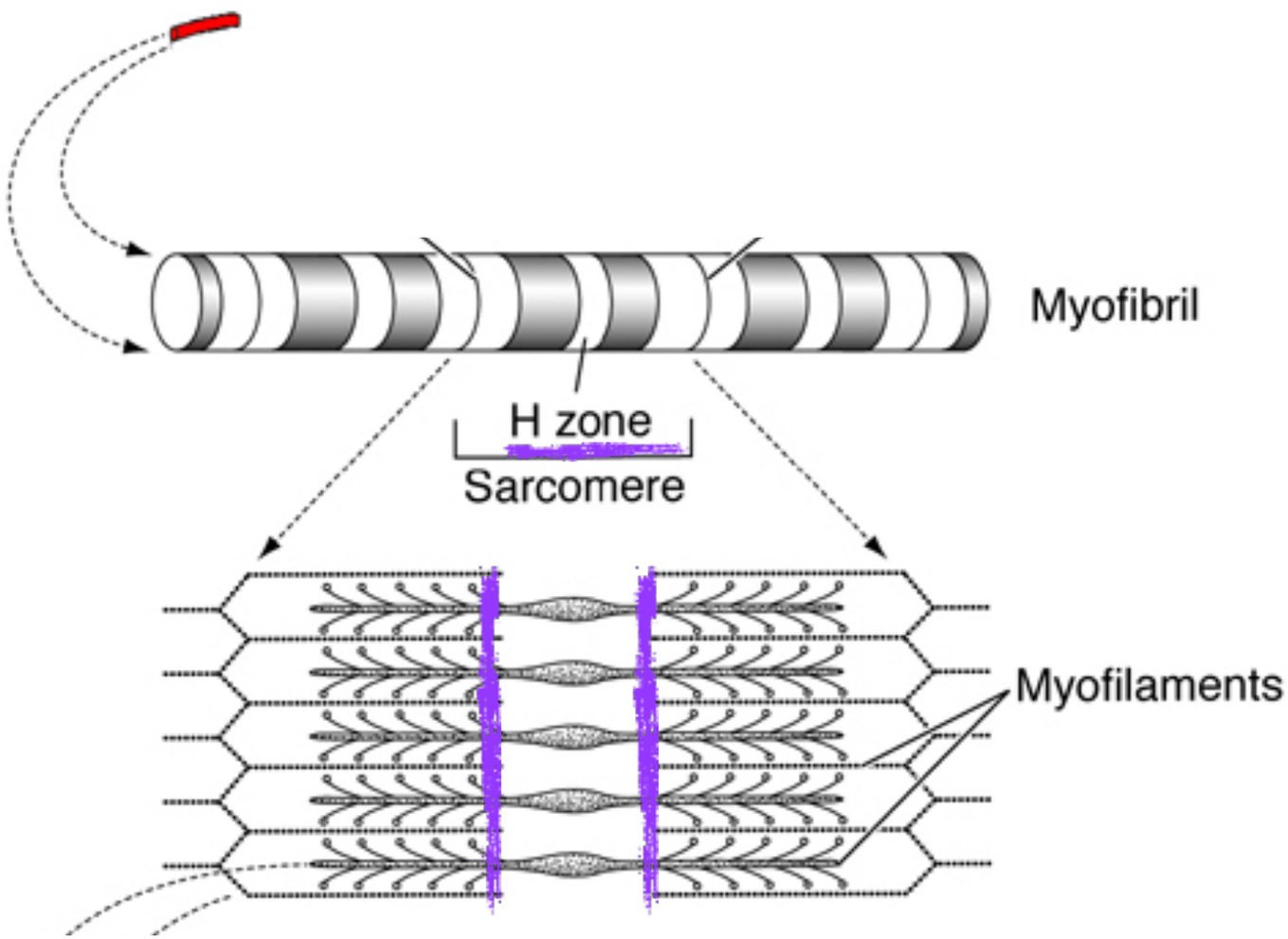
Na zona das Bandas A, filamentos grossos de miosina e finos de actina se sobrepõem

Contração muscular



Na zona das Bandas I, ocorrem apenas os filamentos finos de actina

Contração muscular



Uma outra area clara do miofilamento dentro da Banda A é chamada de ”Zona H”, onde ocorrem apenas filamentos grossos de miosina

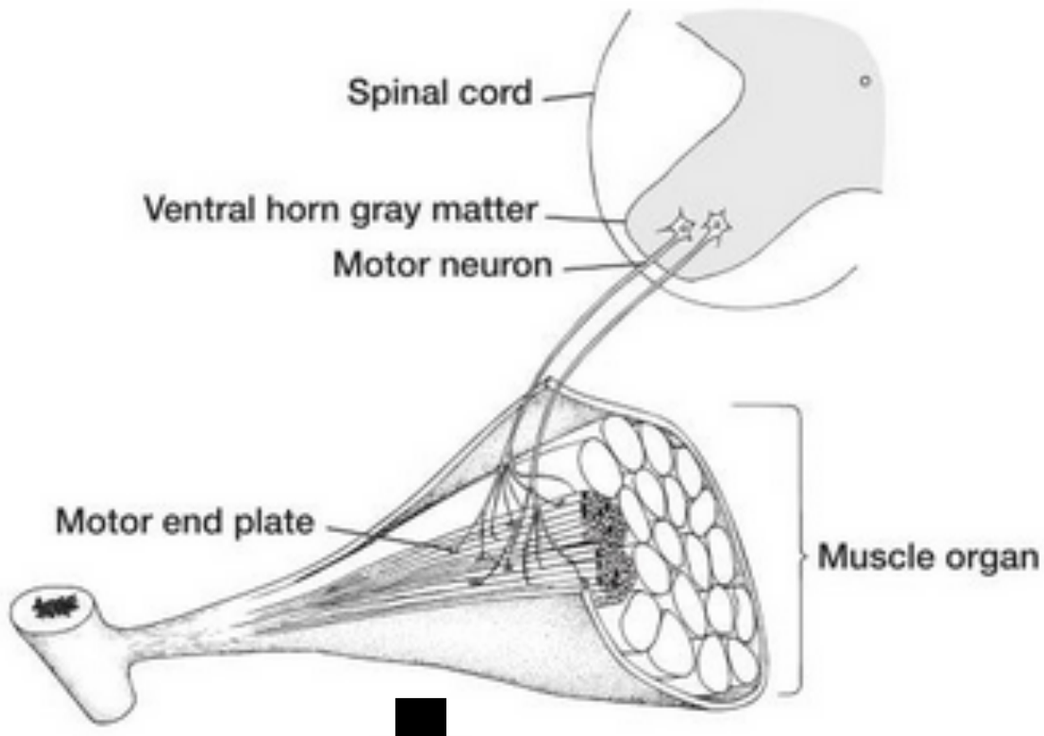
Contração muscular

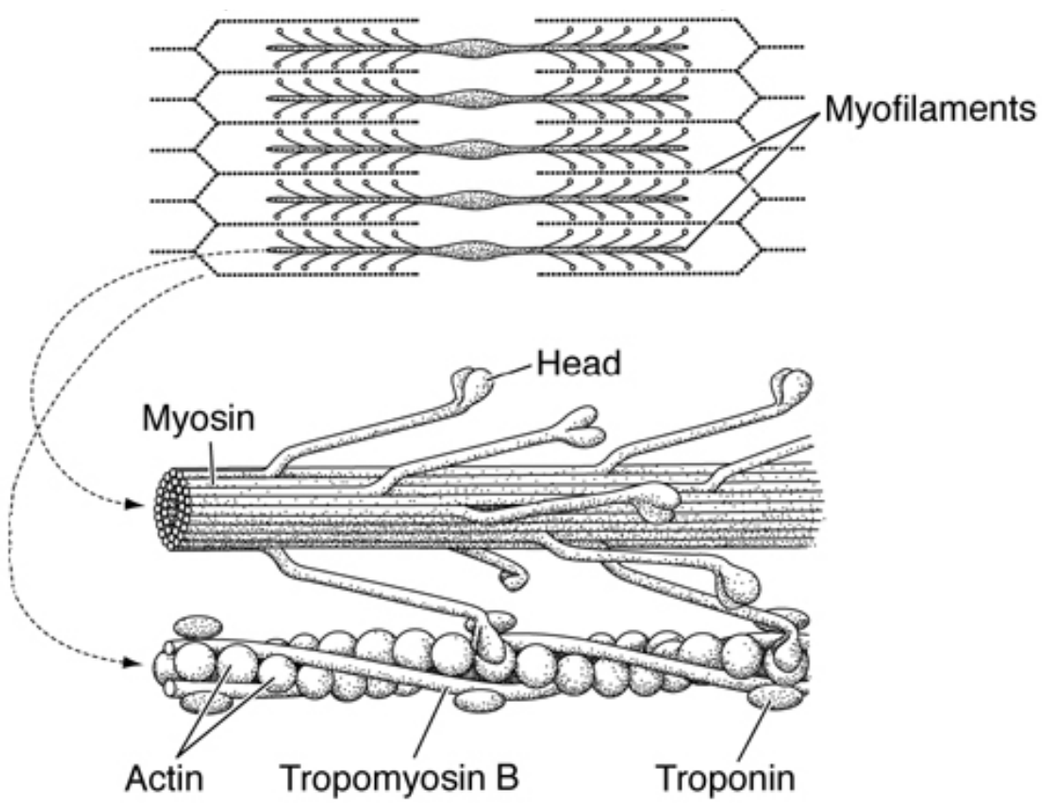
- A ação de contração muscular é estimulada por impulso nervoso na membrana do músculo.

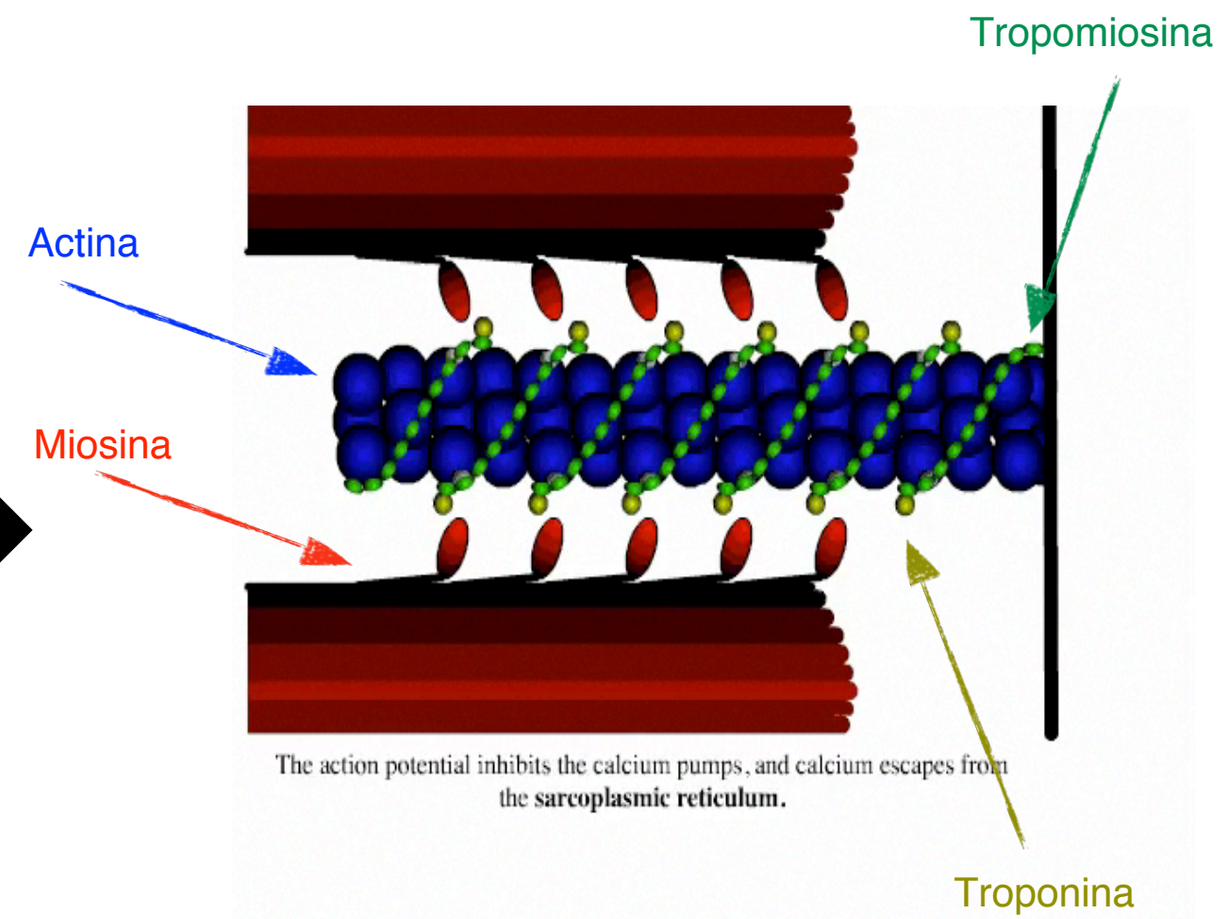
- Inicia uma serie de reações bioquímicas que fazem com que as cabeças dos filamentos de miosina aderem aos sítios ativos do filamento de actina.

- As cabeças giram e puxam o filamento de actina por entre os filamentos de miosina e, em seguida, soltam e aderem novamente em outro ponto, assim sequencialmente, contraindo o músculo como um todo.

- O processo que envolve aderir e soltar a cabeça de miosina requer uma molécula de ATP (adenosina trifosfato) para alimentá-lo

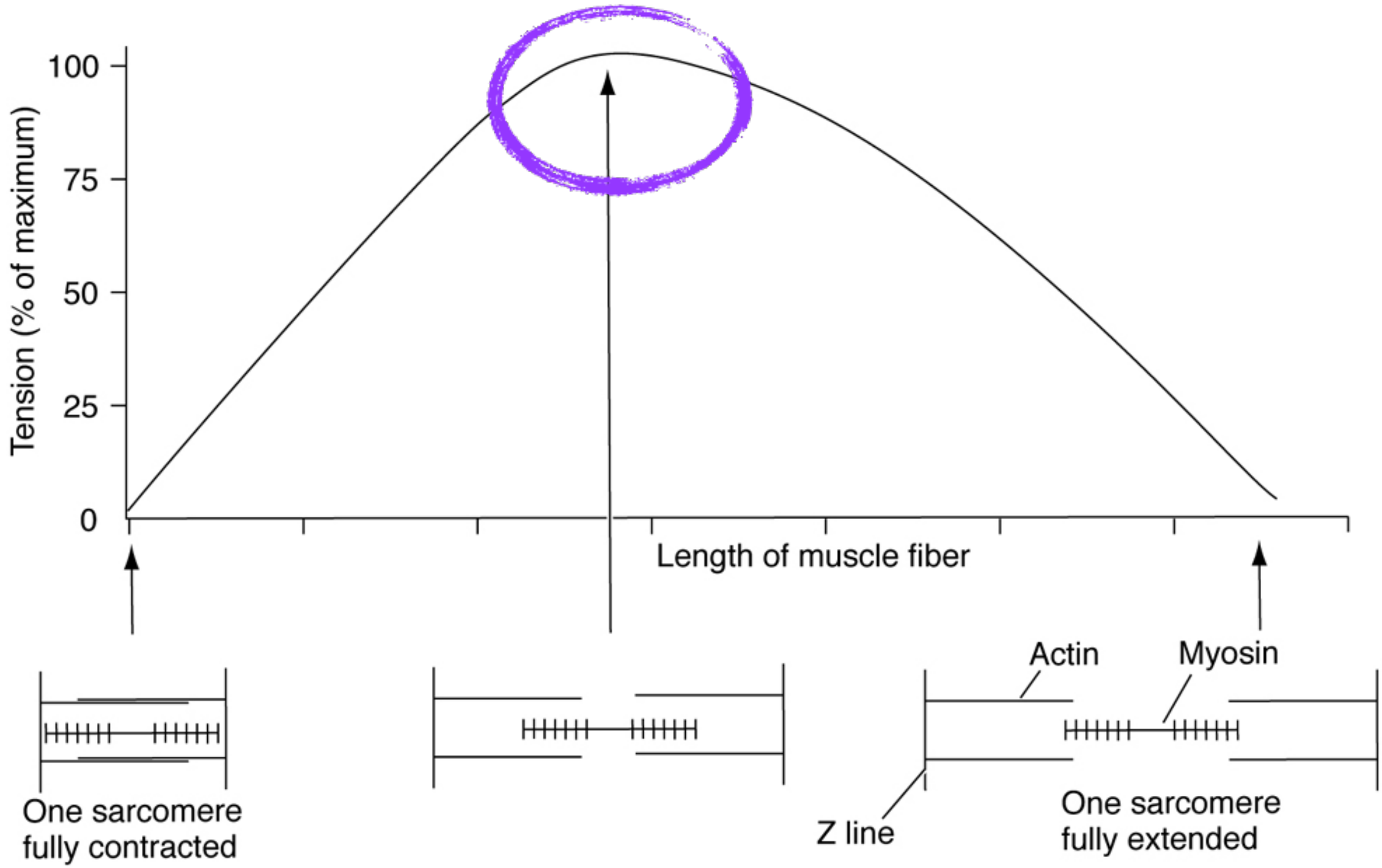






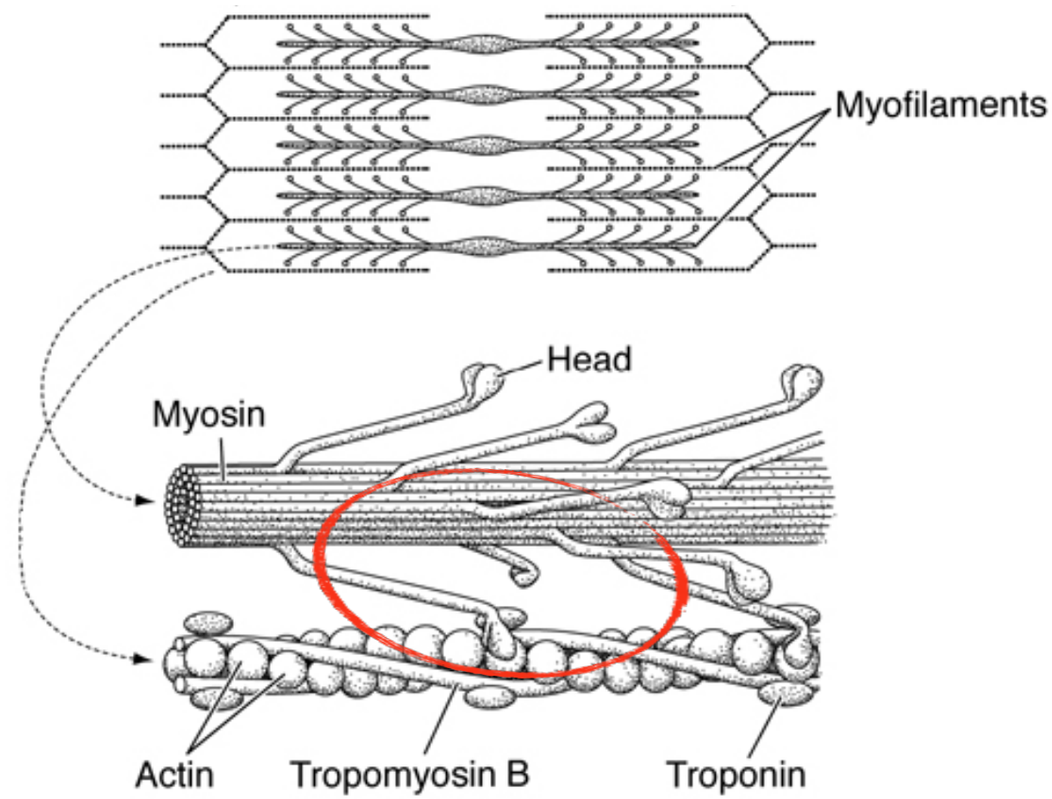
The action potential inhibits the calcium pumps, and calcium escapes from the **sarcoplasmic reticulum.**

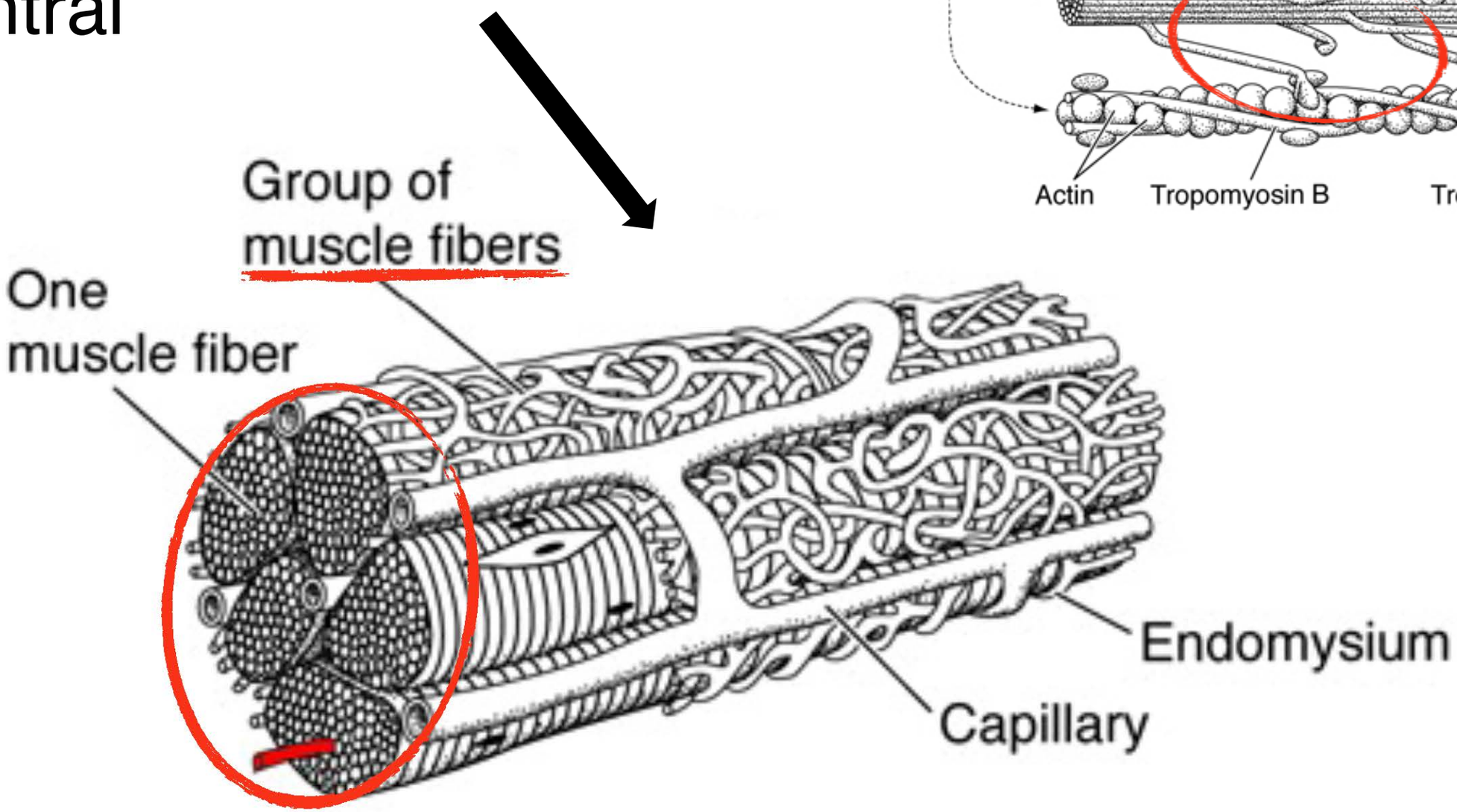
CONTRAÇÃO MUSCULAR: CURVA COMPRIMENTO-TENSÃO



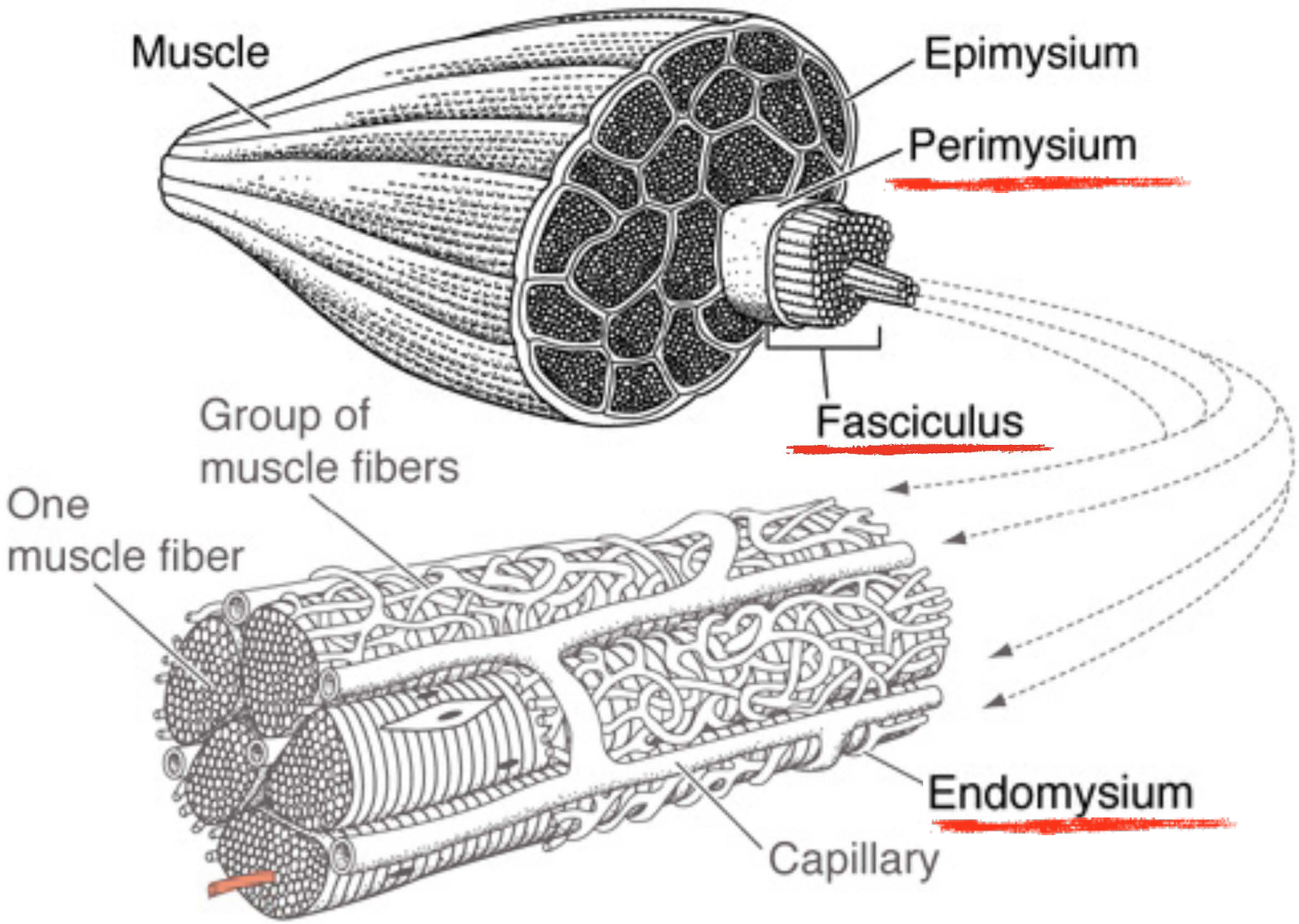
Músculo esquelético: estrutura

Vimos como uma fibra muscular estriada é composta e como ela se contrai





Músculo esquelético: estrutura

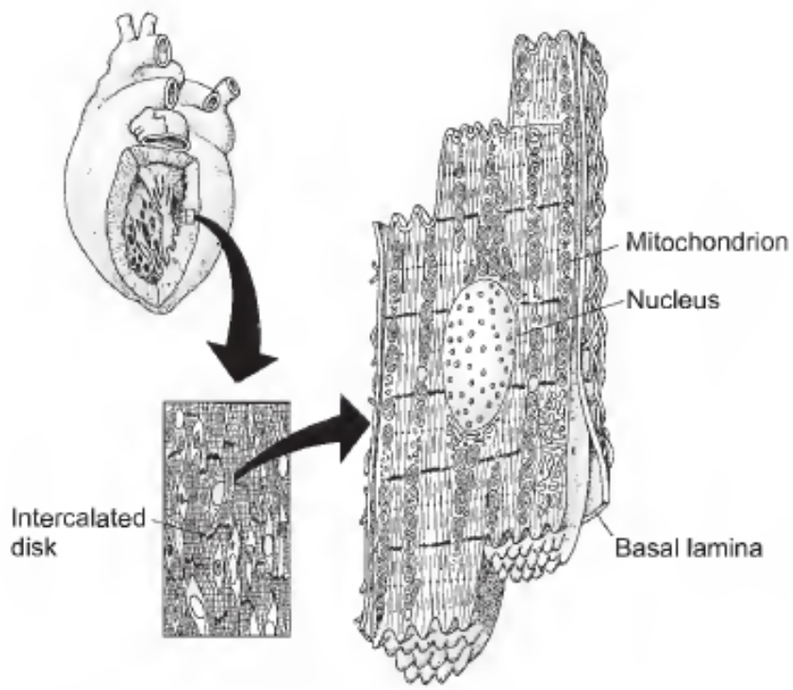


- As fibras individuais são envoltas em tecido conjuntivo chamado Endomísio, por onde passam vasos e nervos associados às fibras.

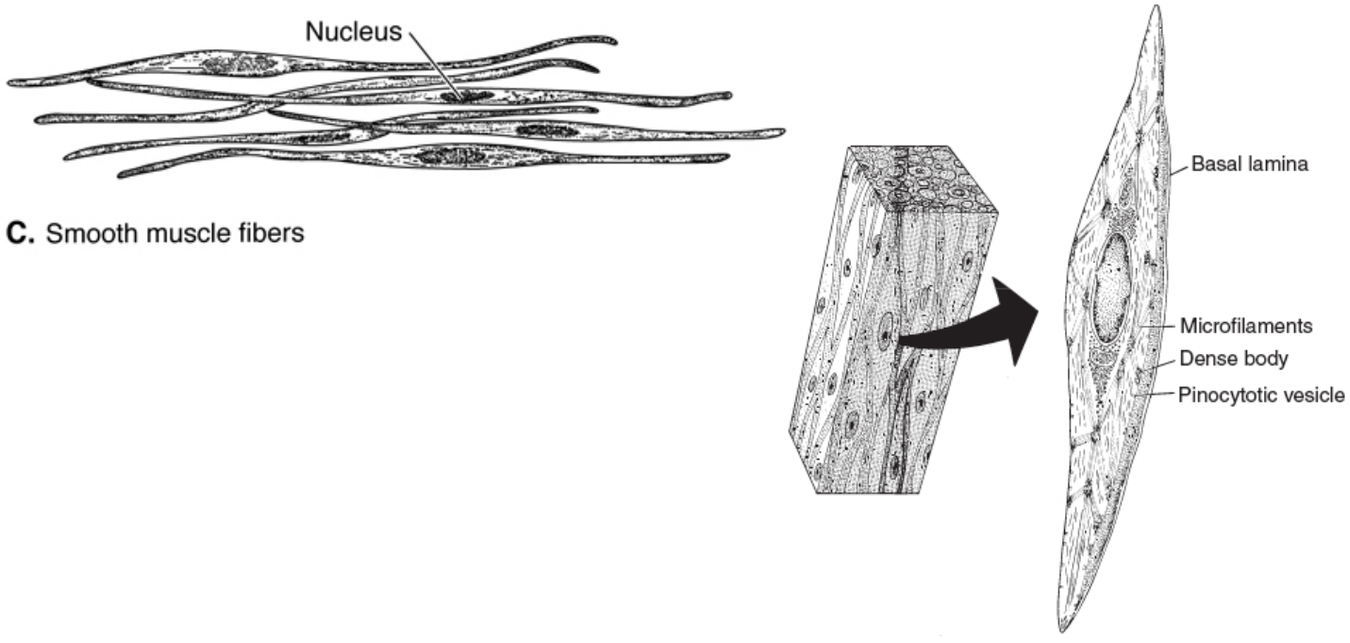
- Grupos de fibras individuais formam fascículos, que são delimitados por uma segunda camada de tecido conjuntivo chamada Perimísio

- Vários fascículos são por sua vez envoltos por uma terceira camada de tecido conjuntivo chamada Epimísio que formam unidades agregadas que reconhecemos como músculos

B. Músculo cardíaco que forma as paredes do coração



C. Músculo Liso que recobre vasos e vísceras

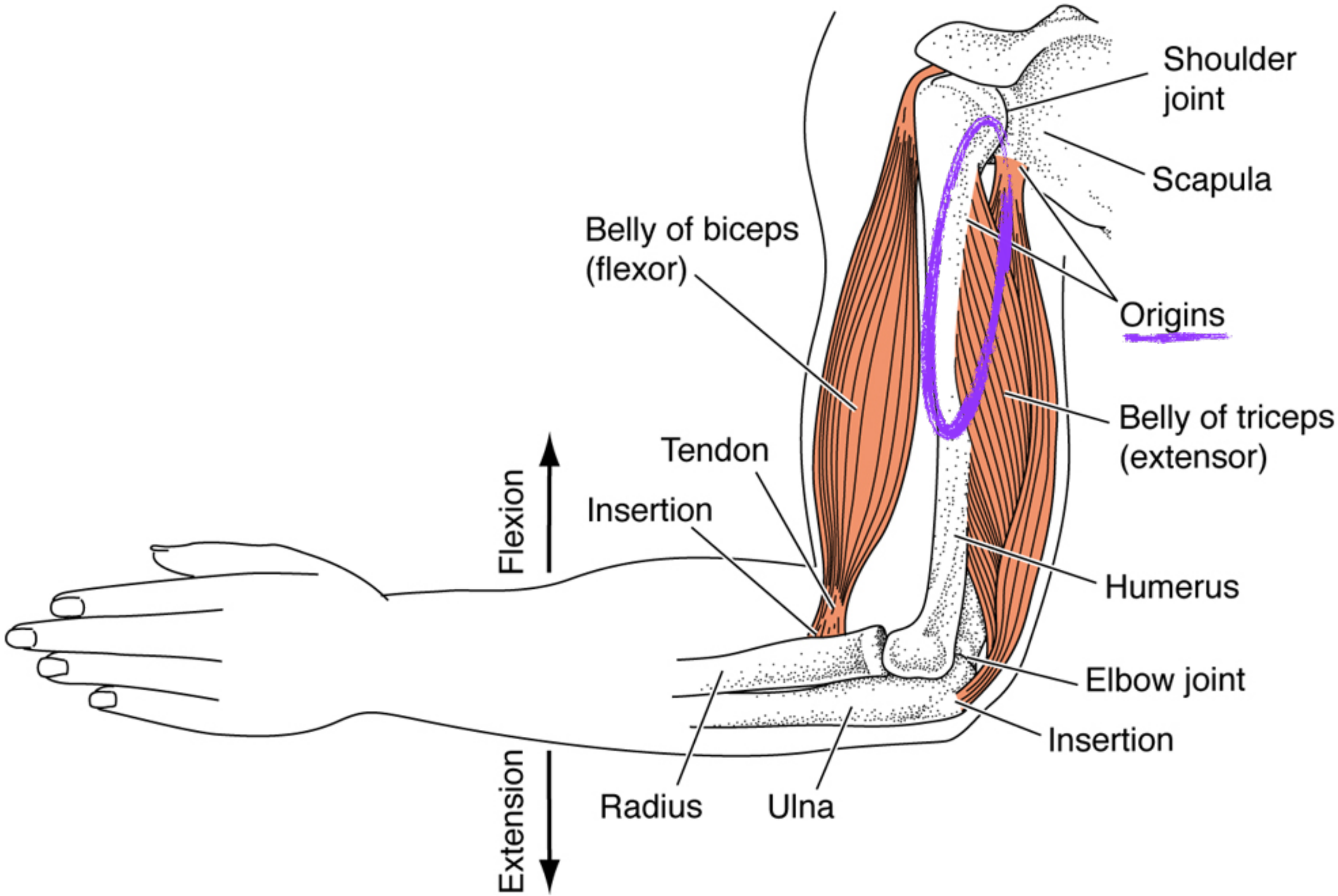


- Os músculos lisos e cardiáco são menos complexos e são organizados em camadas ou ”folhas” dentro da parede dos órgãos viscerais.

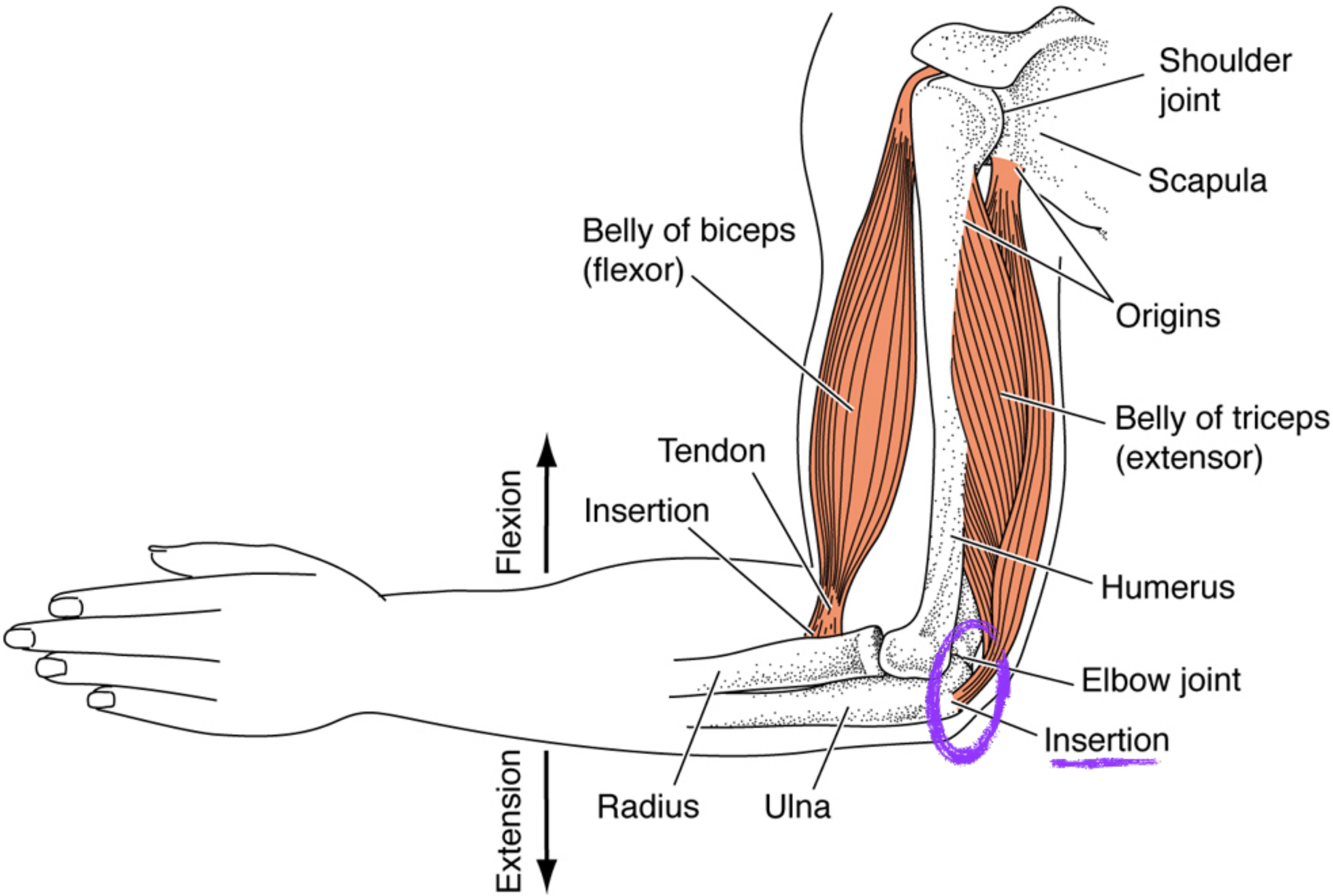
- Suas fibras não têm pontos de conexão bem definidos, mas se ancoram uns aos outros e na parede dos orgãos aos quais estão associados.

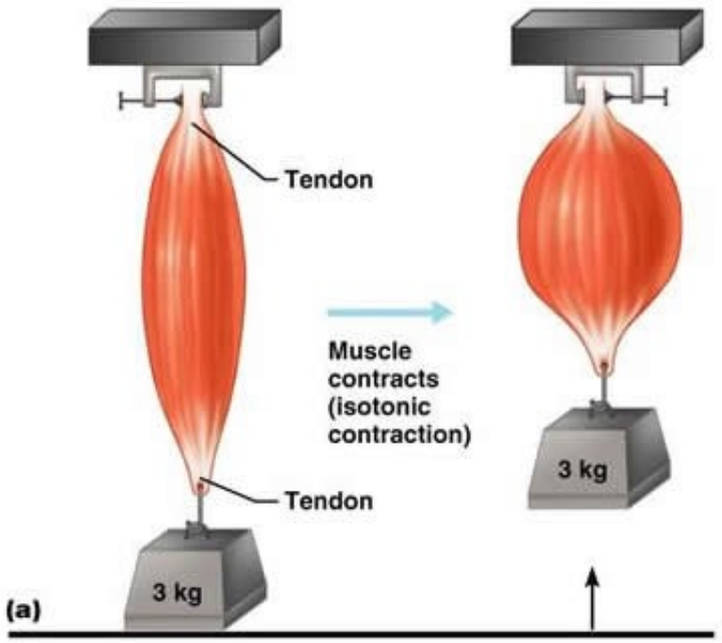
- A ação deles é involuntária e agem em função das mudanças de tamanho e forma (estomago e coração) ou de tensão estrutural (vasos sanguíneos) determinadas pelos próprios orgãos

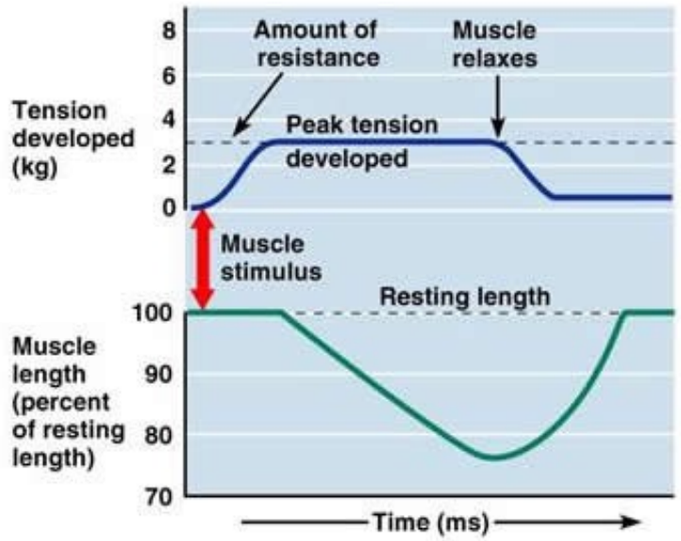
Músculos estriados apresentam uma área de origem ...

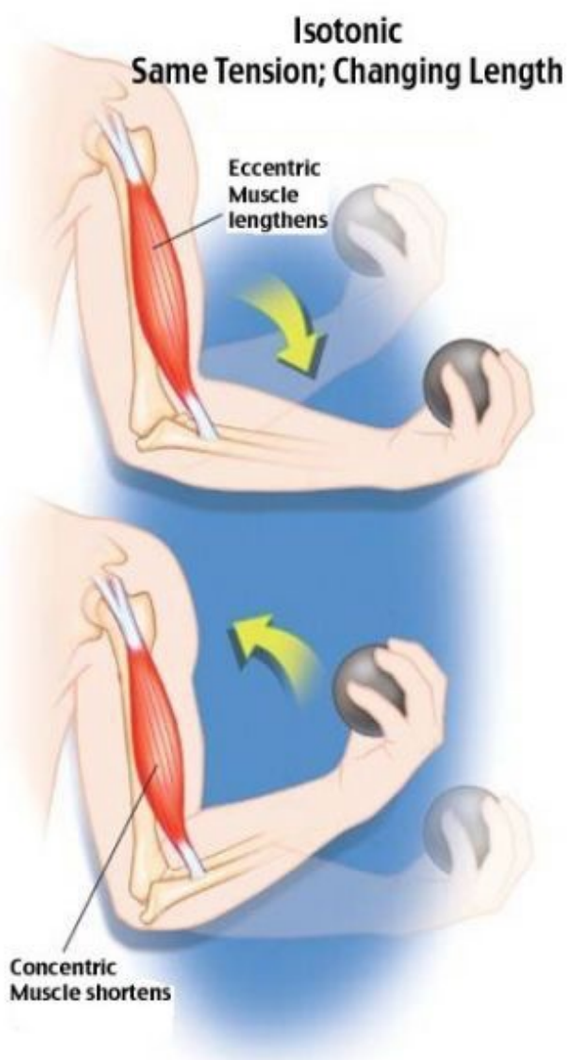


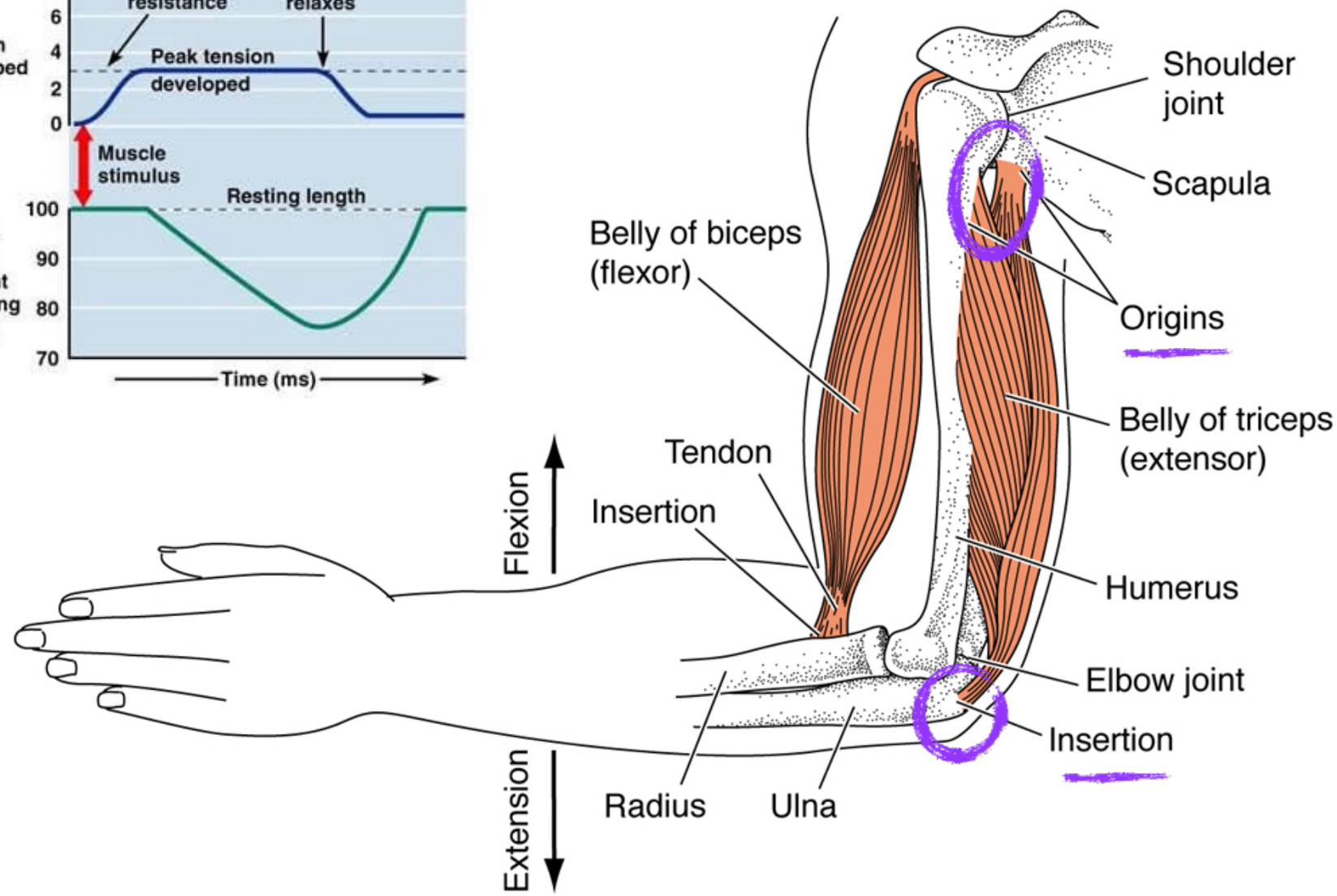
... e de inserção muscular




Tendon
Muscle contracts (isotonic contraction)
Tendon
3 kg
3 kg
(a)


Amount of resistance
Muscle relaxes
Tension developed (kg)
8
6
4
2
0
Peak tension developed
Muscle stimulus
Resting length
Muscle length (percent of resting length)
100
90
80
70
Time (ms)

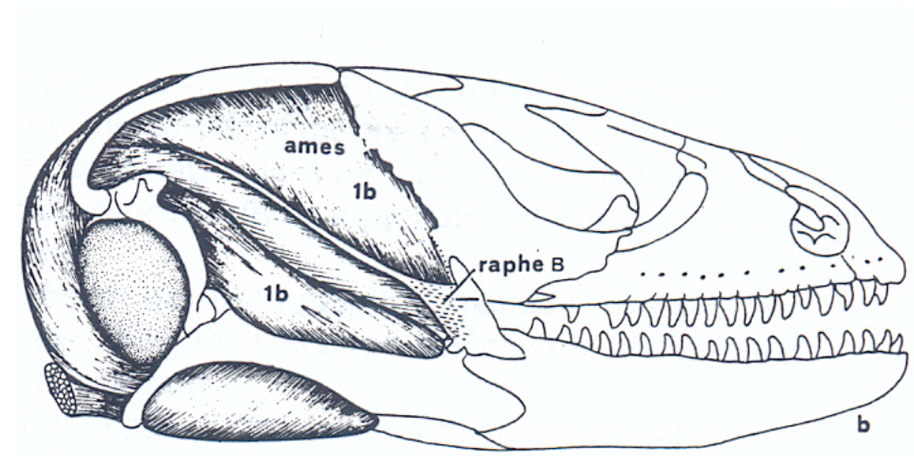

Isotonic
Same Tension; Changing Length
Eccentric Muscle lengthens
Concentric Muscle shortens

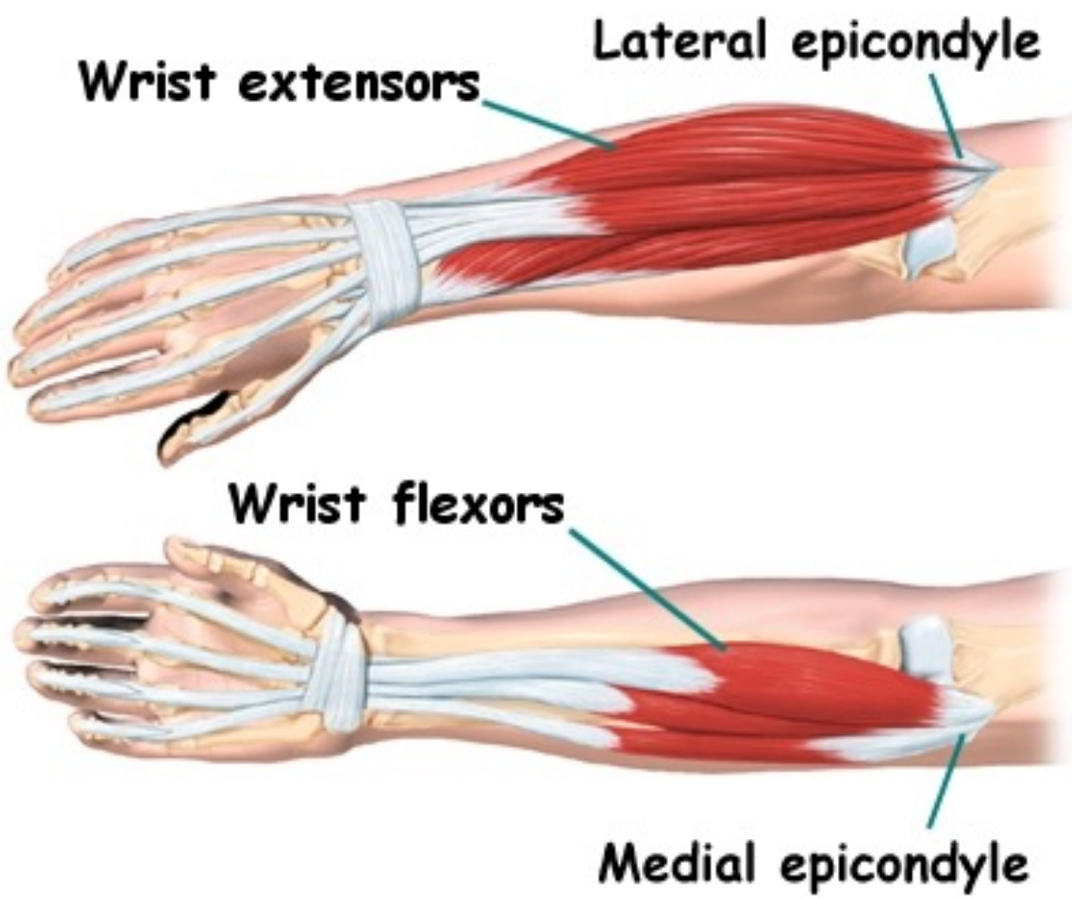

Shoulder joint
Scapula
Belly of biceps (flexor)
Origins
Belly of triceps (extensor)
Tendon
Insertion
Flexion
Humerus
Elbow joint
Insertion
Extension
Radius
Ulna

Os músculos esqueléticos (estriados) se conectam aos elementos do esqueleto dos vertebrados através de **tendões** e **aponeuroses**.

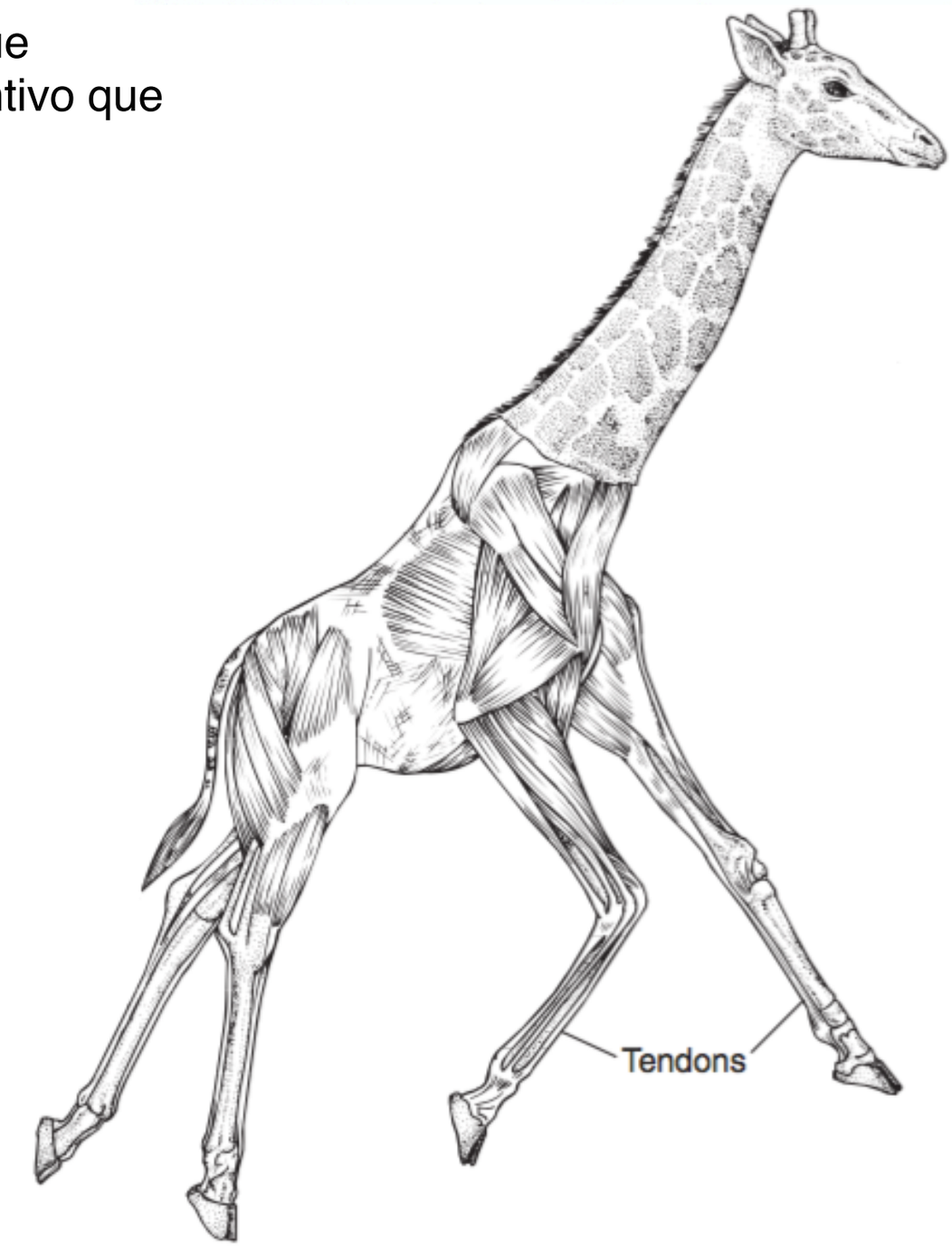
Quando o tecido conjuntivo se condensa para formar estruturas filamentosas longas e rígidas é chamado de tendão, quando se condensa para formar placas ou superficies lisas é chamado de aponeurose.

Tendões são formados pela união dos tecidos conjuntivos que compõem o músculo (endomísio, perimísio e epimísio) e os que envolvem os ossos, o **periósteo** (*periosteum*). O tecido conjuntivo que envolve o músculo frequentemente também penetra o ossos

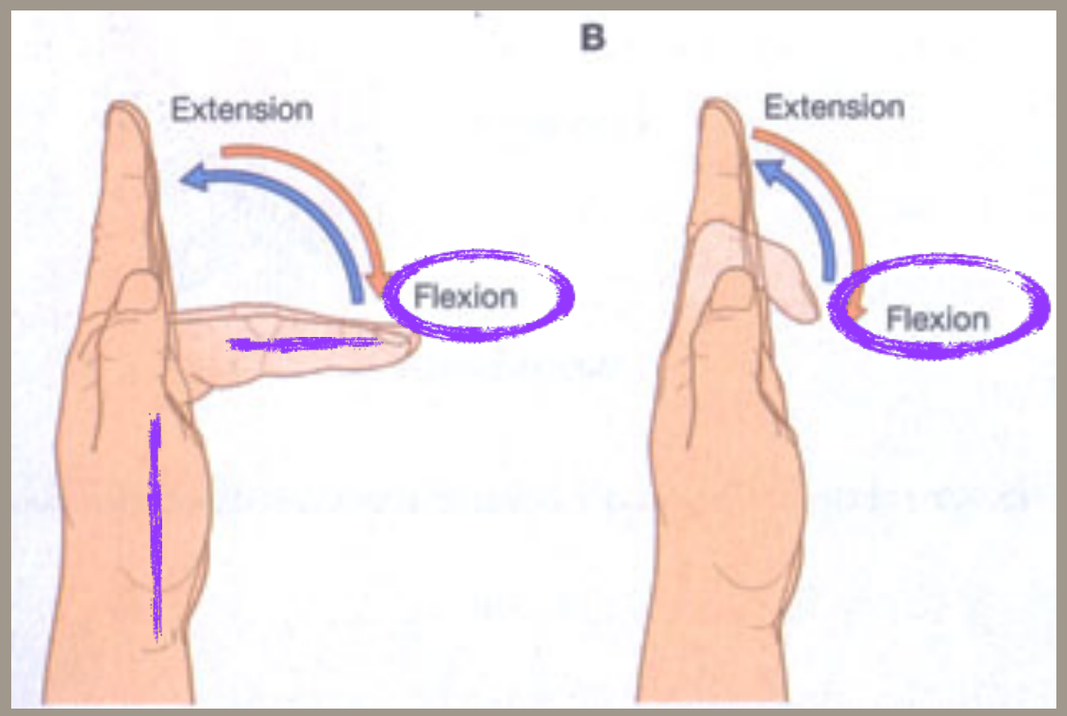




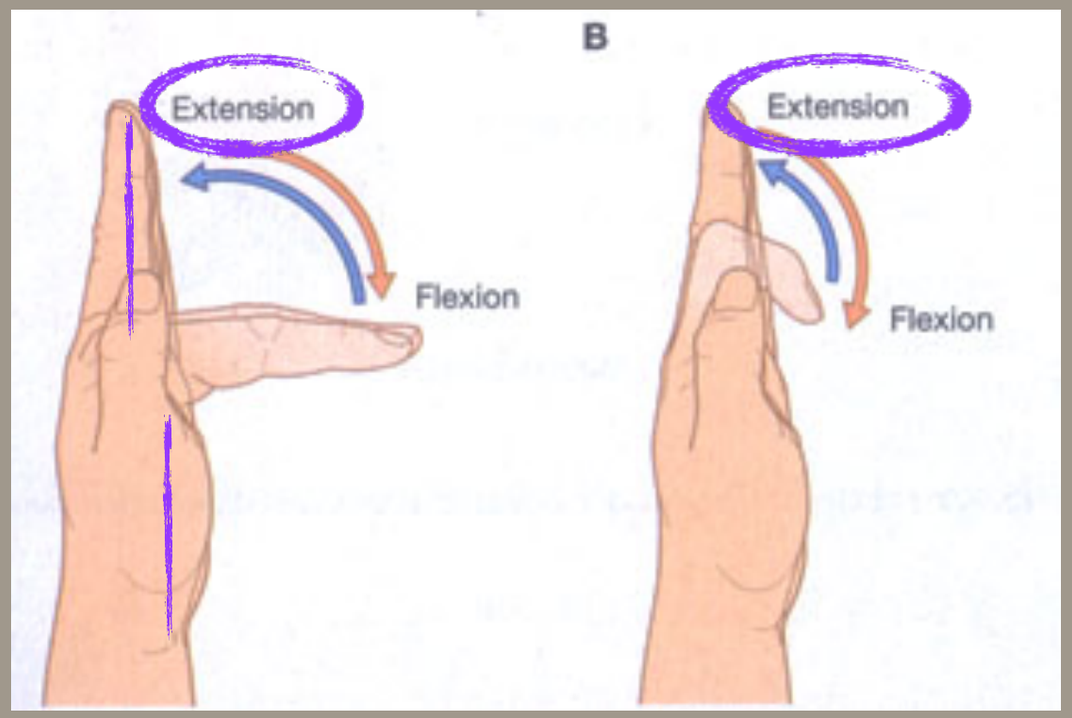
©MMG 2000



TIPOS DE AÇÃO ANTAGÔNICAS: FLEXÃO E EXTENSÃO

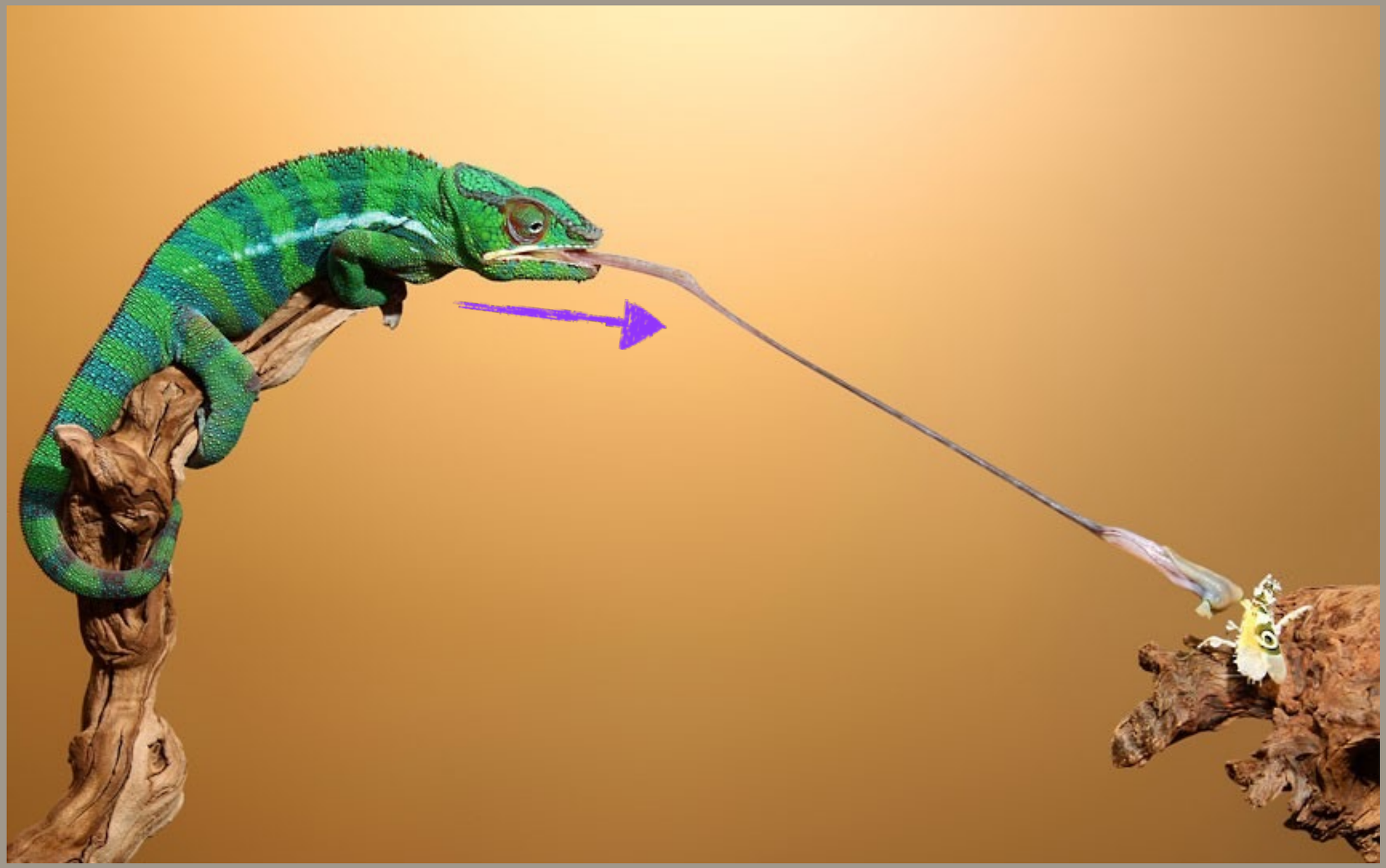


Flexão: Diminui o ângulo



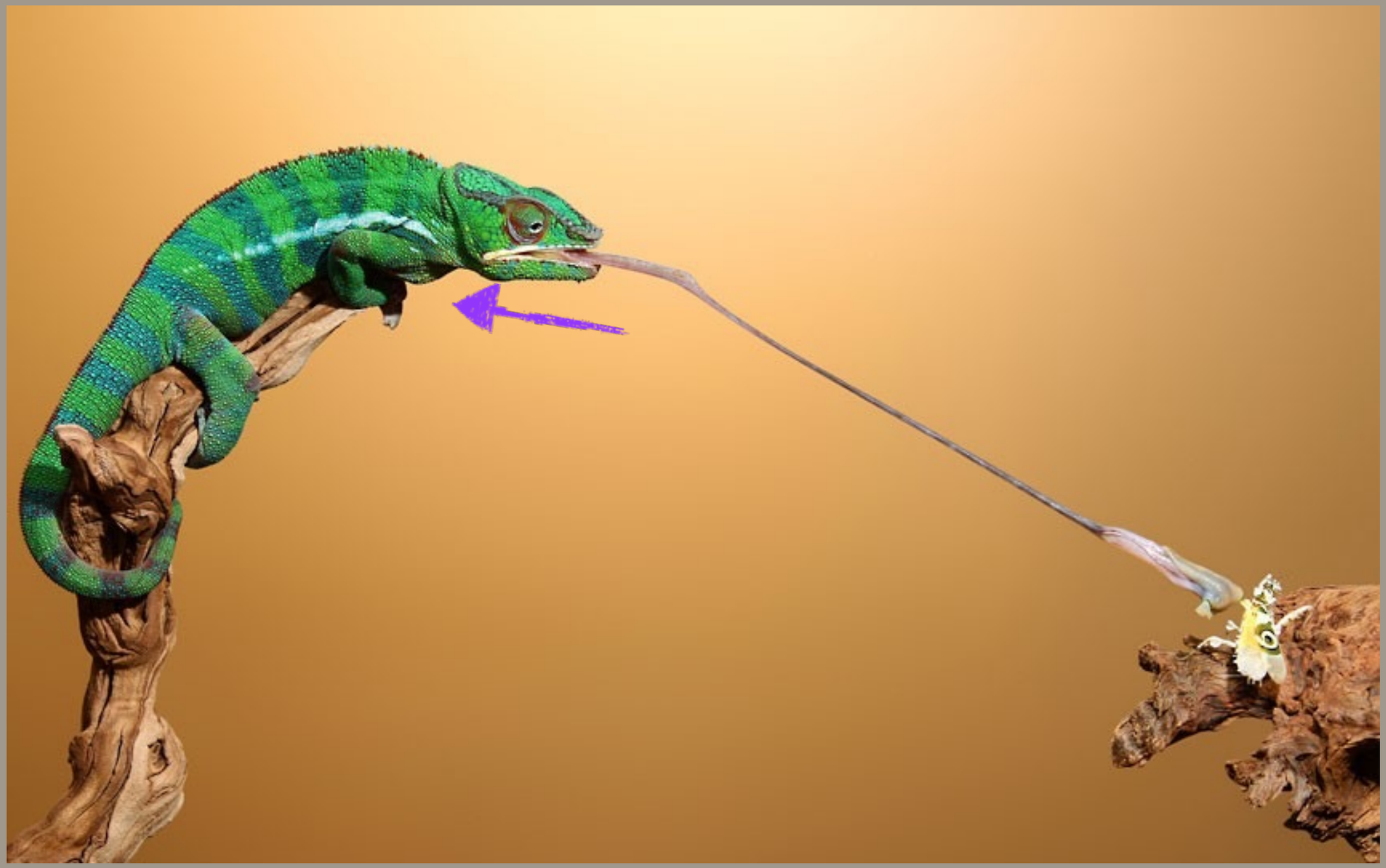
Extensão: Aumenta o ângulo

TIPOS DE AÇÃO ANTAGÔNICAS: PROTRAÇÃO



Empurra

TIPOS DE AÇÃO ANTAGÔNICAS: RETRAÇÃO

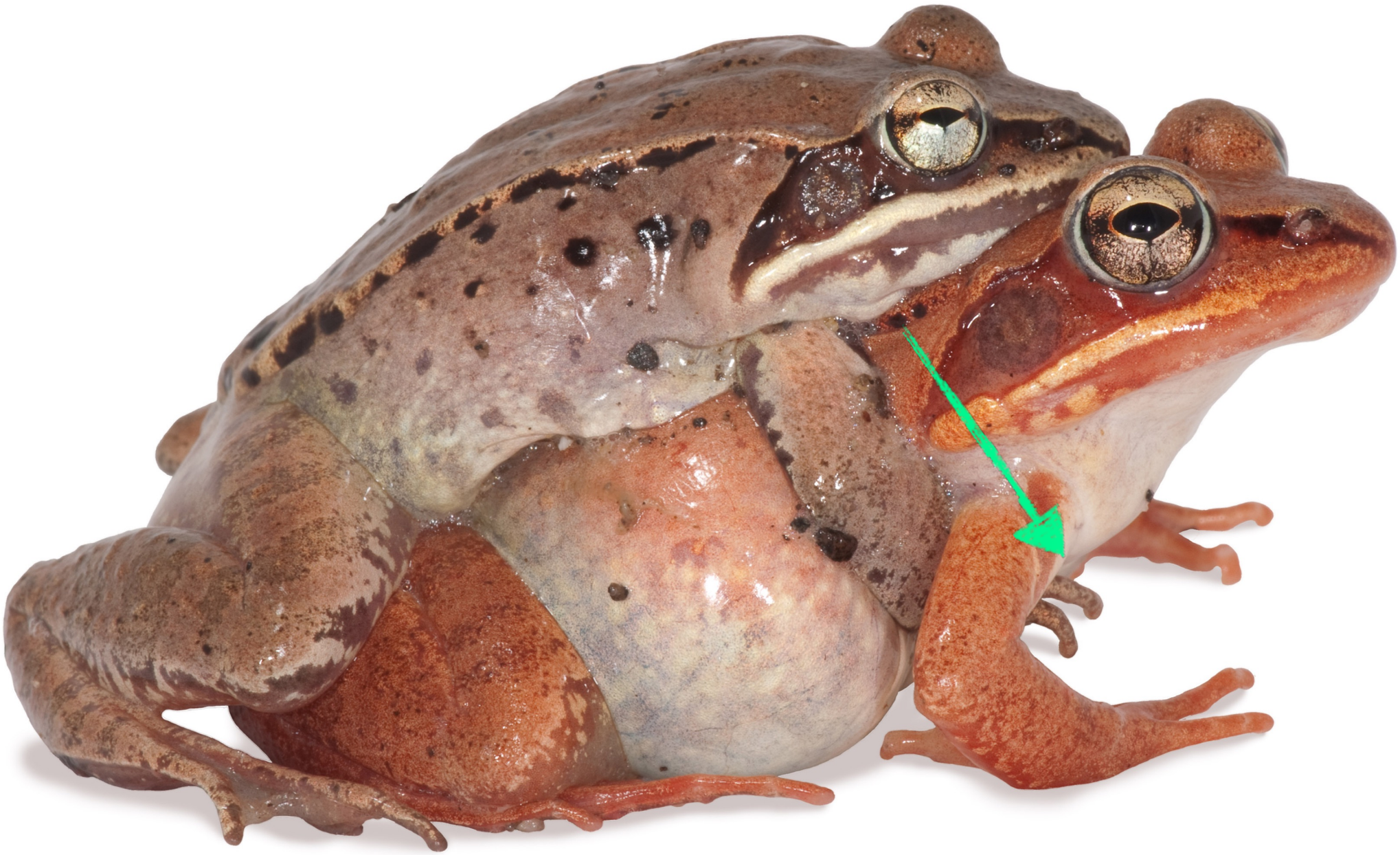


Puxa

TIPOS DE AÇÃO ANTAGÔNICAS: ADUÇÃO

Aproxima ao plano sagital

TIPOS DE AÇÃO ANTAGÔNICAS: ABDUÇÃO



Afasta do plano sagital

TIPOS DE AÇÃO ANTAGÔNICAS: DEPRESSÃO

Abaixa

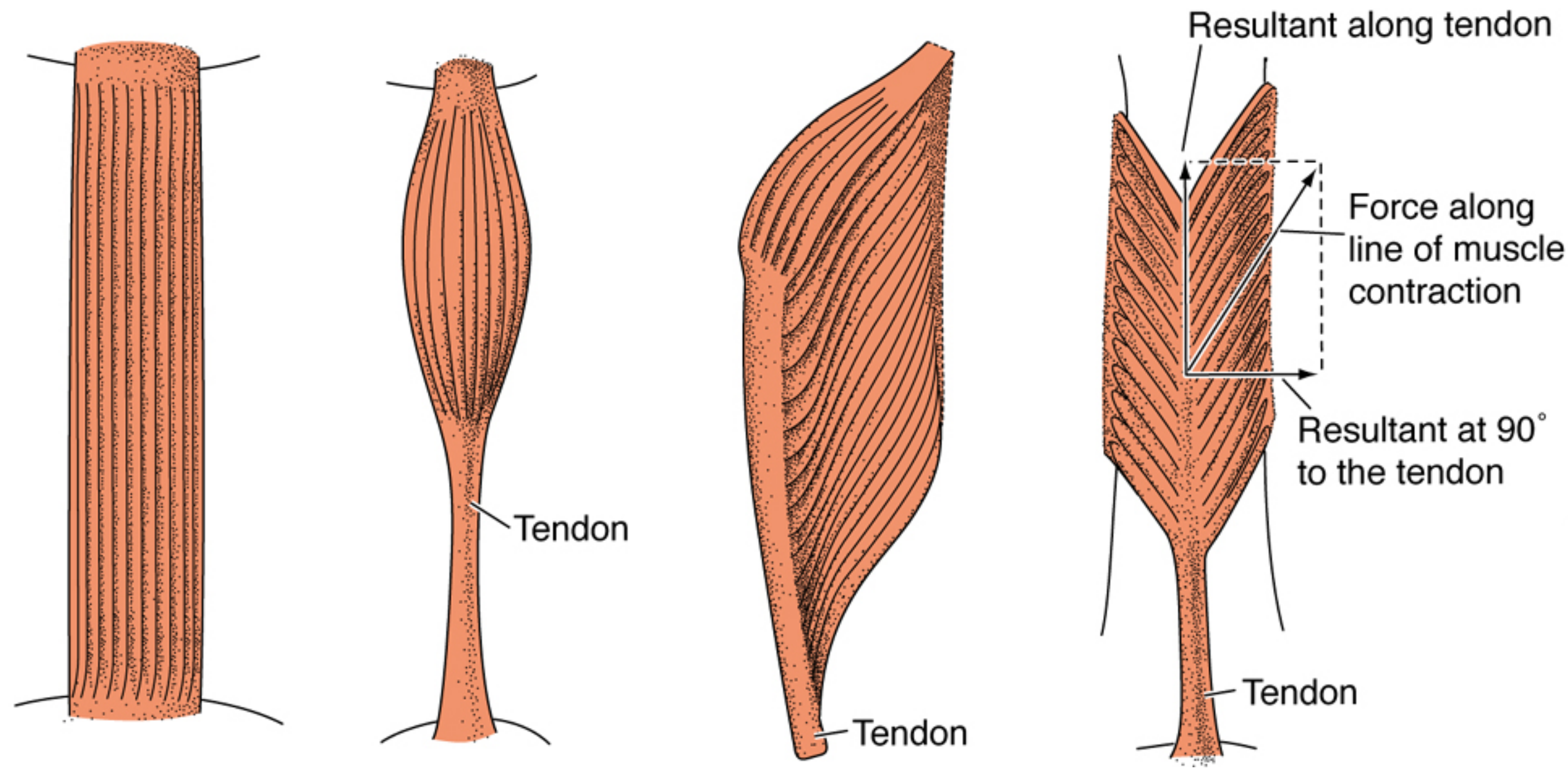
TIPOS DE AÇÃO ANTAGÔNICAS: ELEVAÇÃO

Ergue

Tipos de arranjos das fibras musculares dentro dos músculos

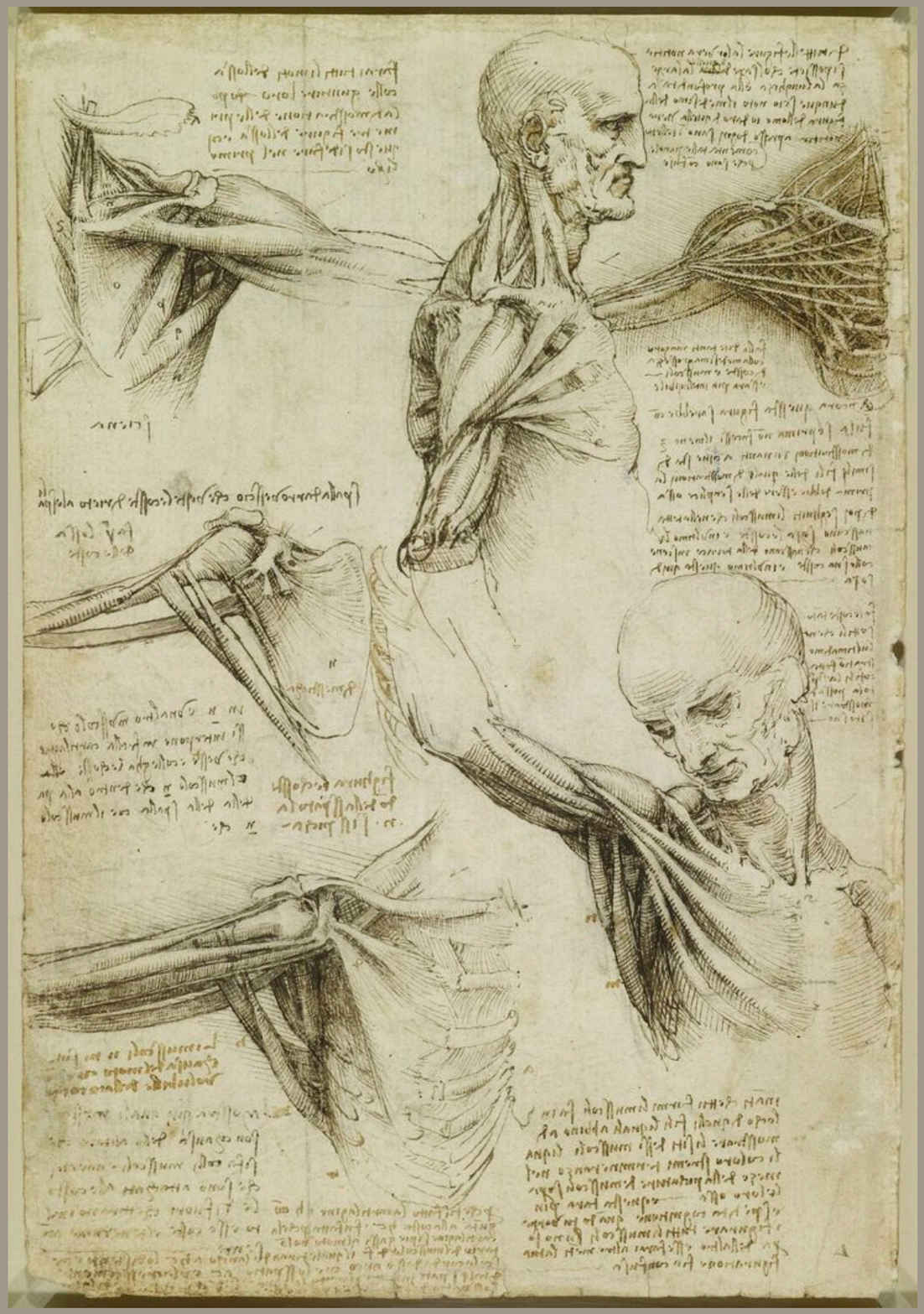
Fibras longas

Fibras curtas

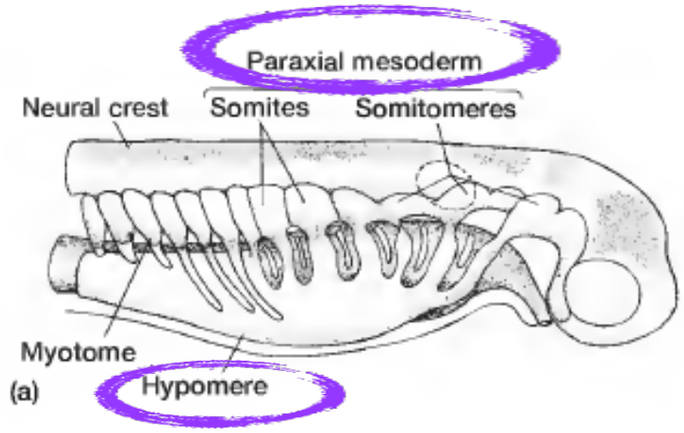


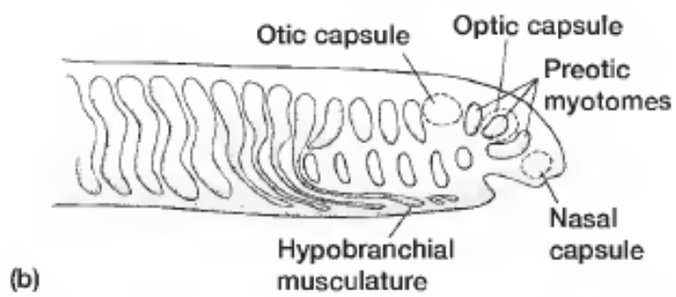
A. Tira **B. Fusiforme** **C. Unipenado** **D. Bipenado**

INTERVALO



ORIGEM EMBRIONÁRIA



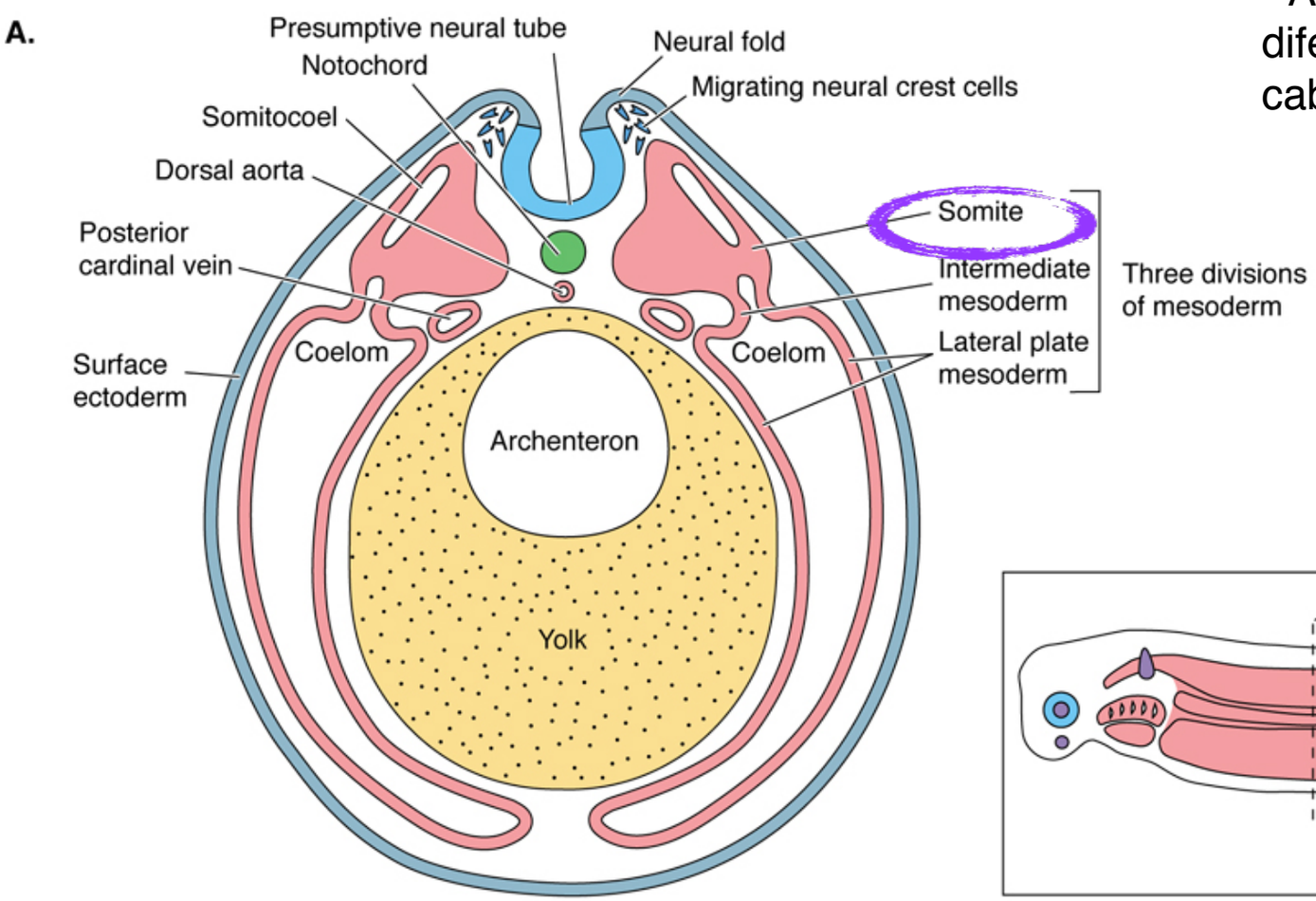


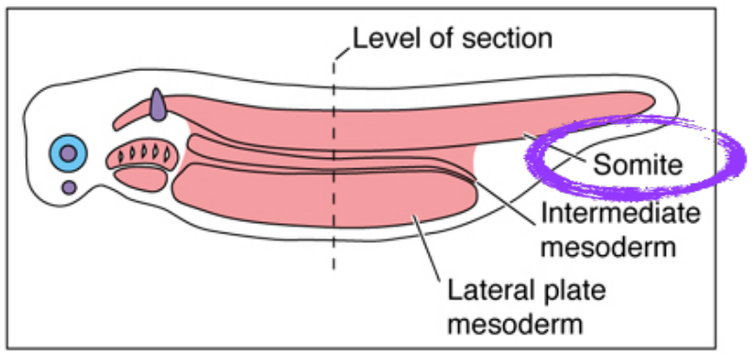
A musculatura tem 3 grandes origens embrionárias a partir de células da Mesoderme

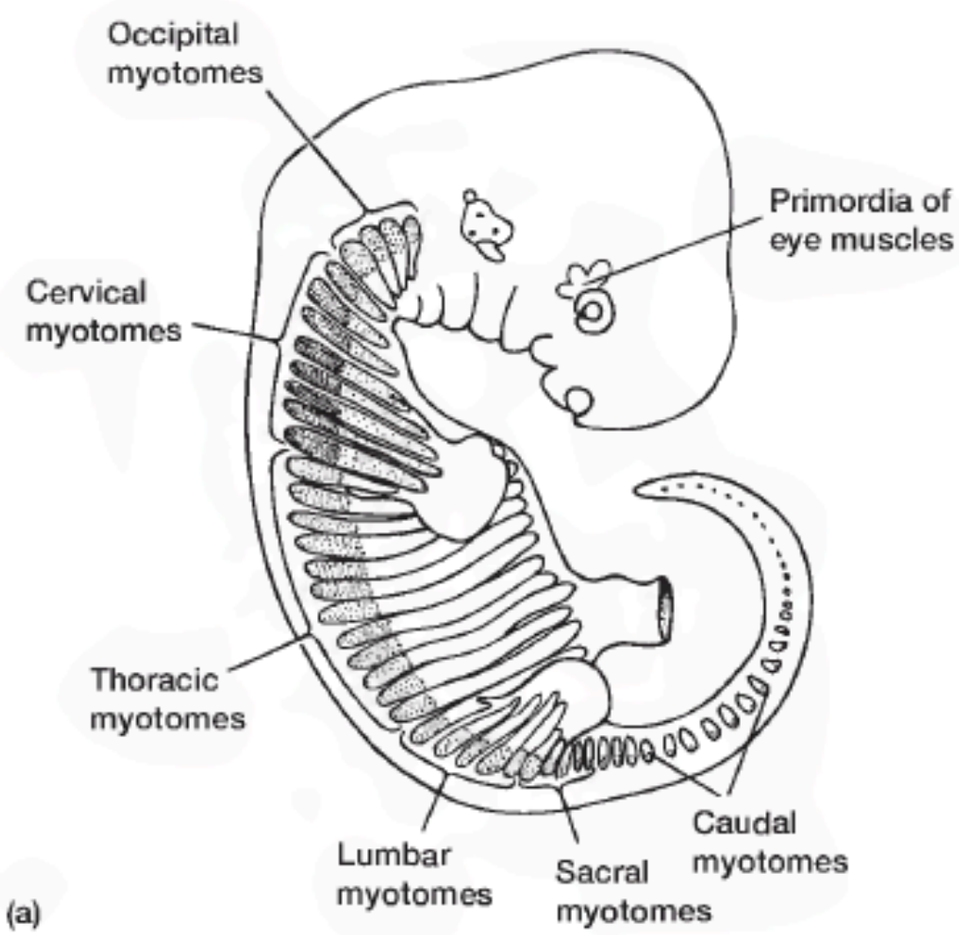
- Através do **mesênquima** de células dispersas no embrião (musculos lisos das paredes de vasos sanguineos e algumas visceras)

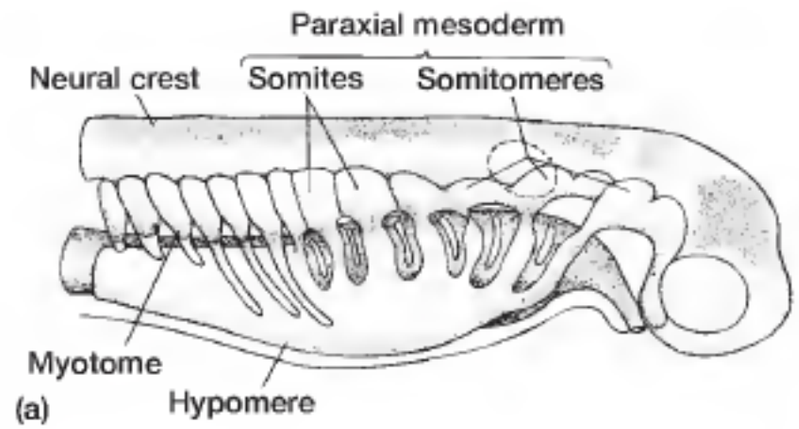
- Através do **hipômero** que se diferencia nos músculos lisos do coração, trato digestório e estruturas associadas

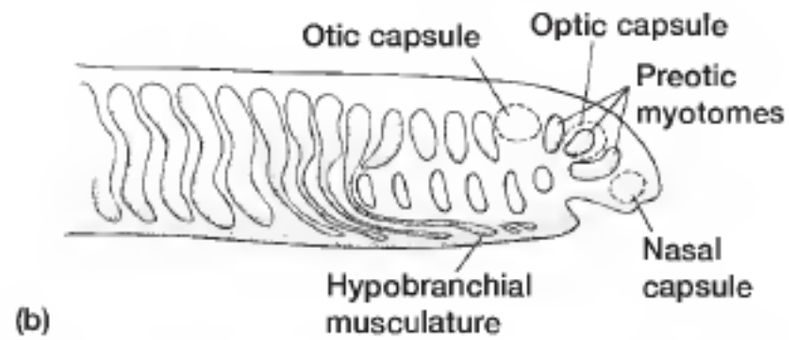
- Através dos **somitos** da Mesoderme Paraxial que se diferenciam para formar os músculos esqueléticos da cabeça (somitômeros) e do corpo (somitos)

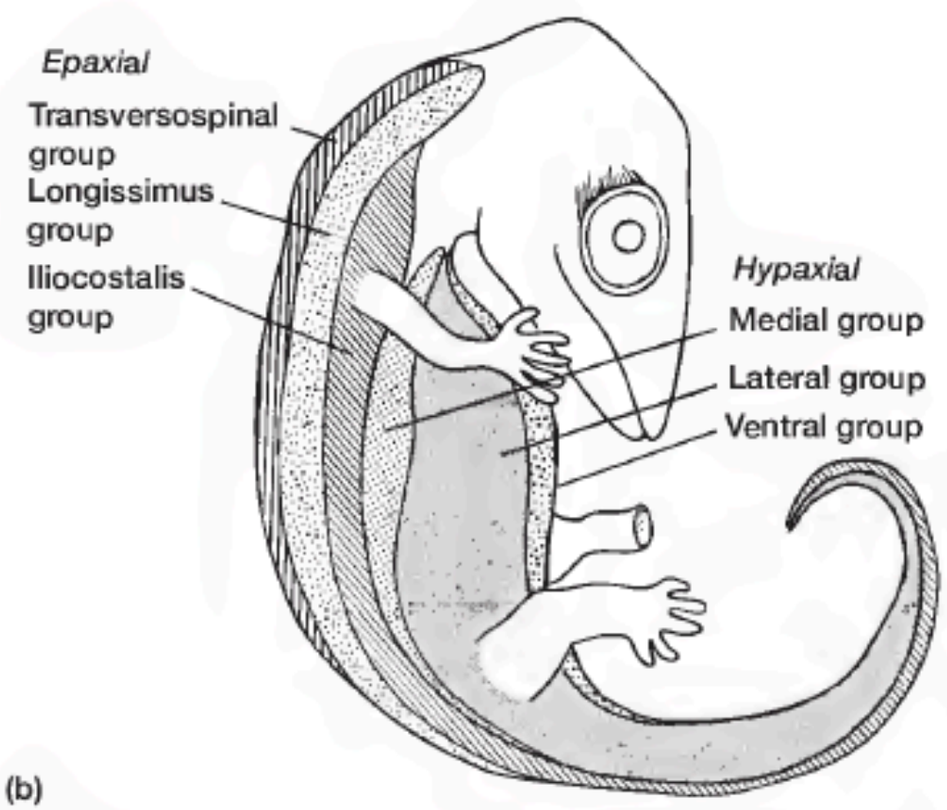










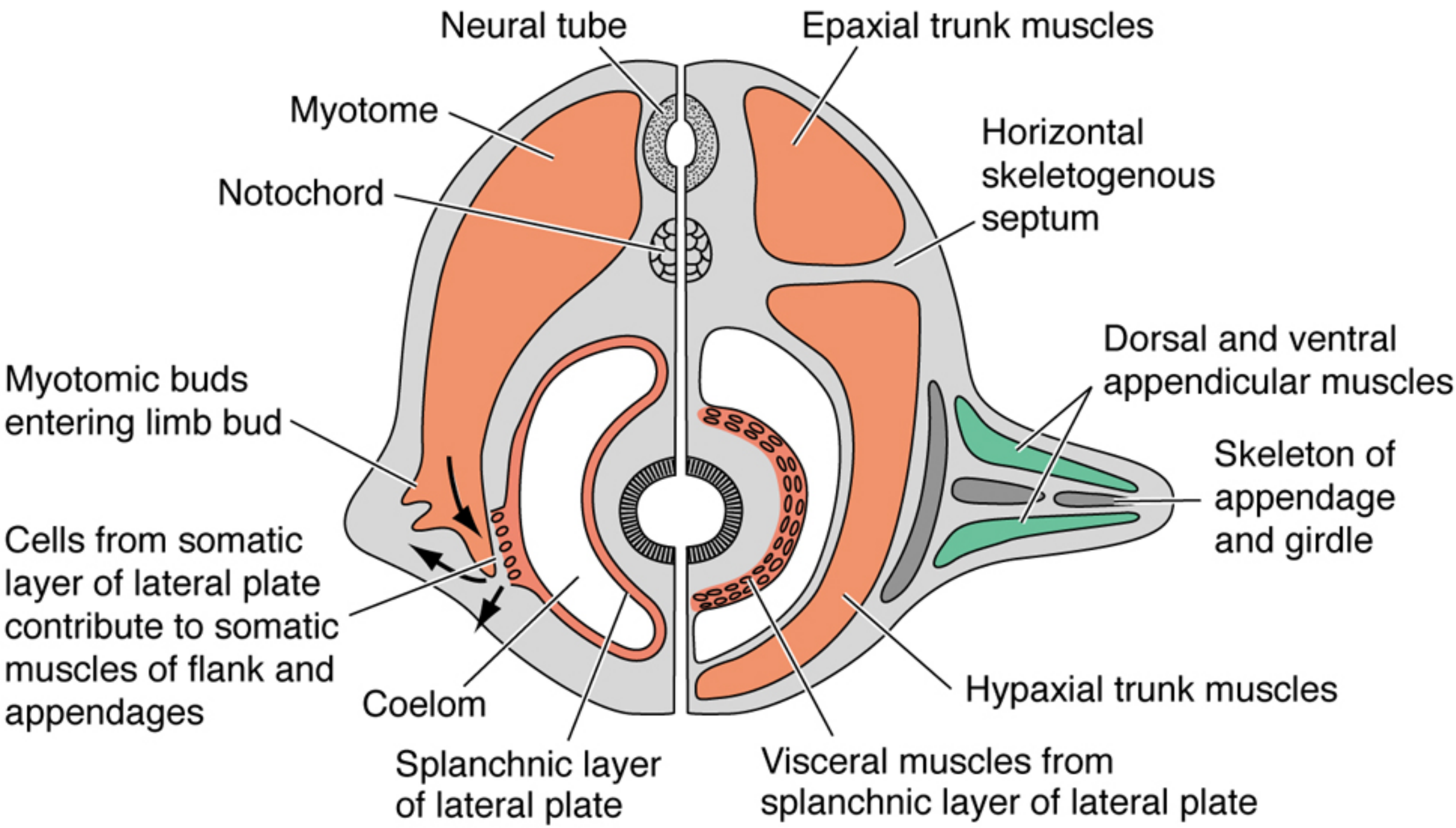


A mesoderme dorsal proxima à notocorda se divide em somitos no tronco mas formam somitomeros na região da cabeça

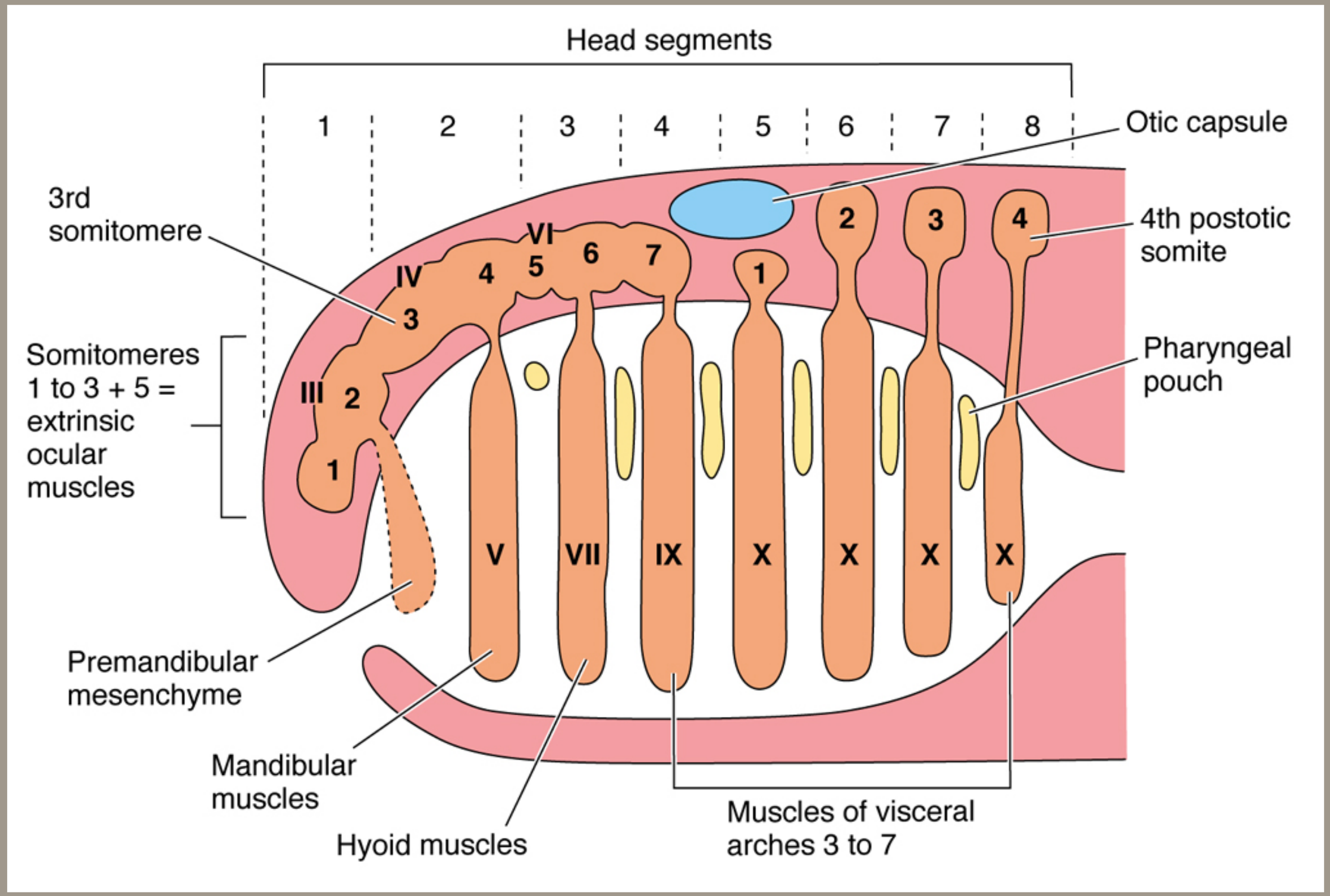
Os Somitomeros contribuem para a formação da musculatura da cabeça e dos arcos branquiais

Os Somitos do tronco se expandem ventralmente durante a embriologia e se dividem em miótomos que formam os grupos musculares do tronco, dos membros e da cauda

GRUPOS DE MÚSCULOS: AXIAIS



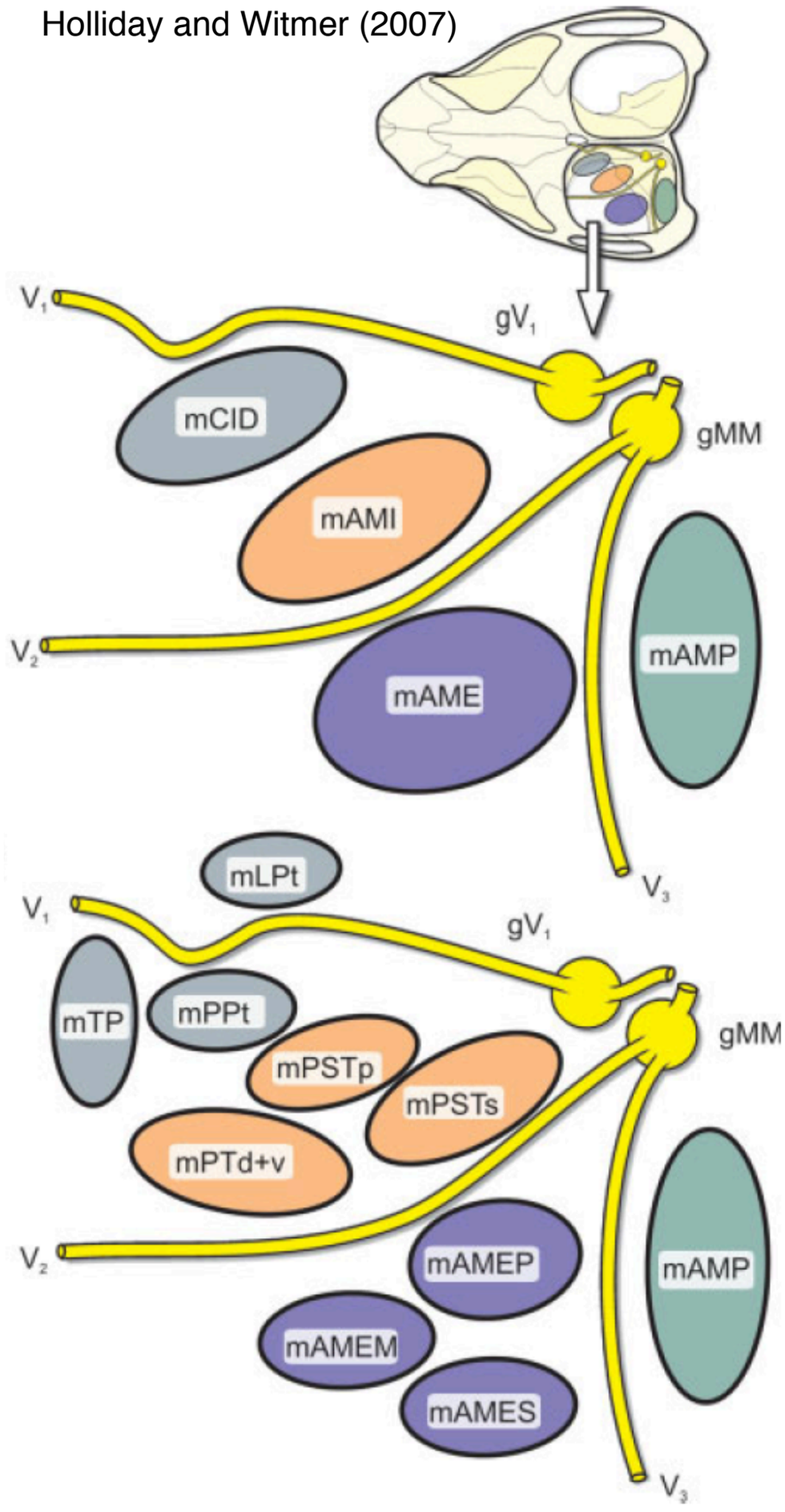
GRUPOS DE MÚSCULOS: CRANIAIS

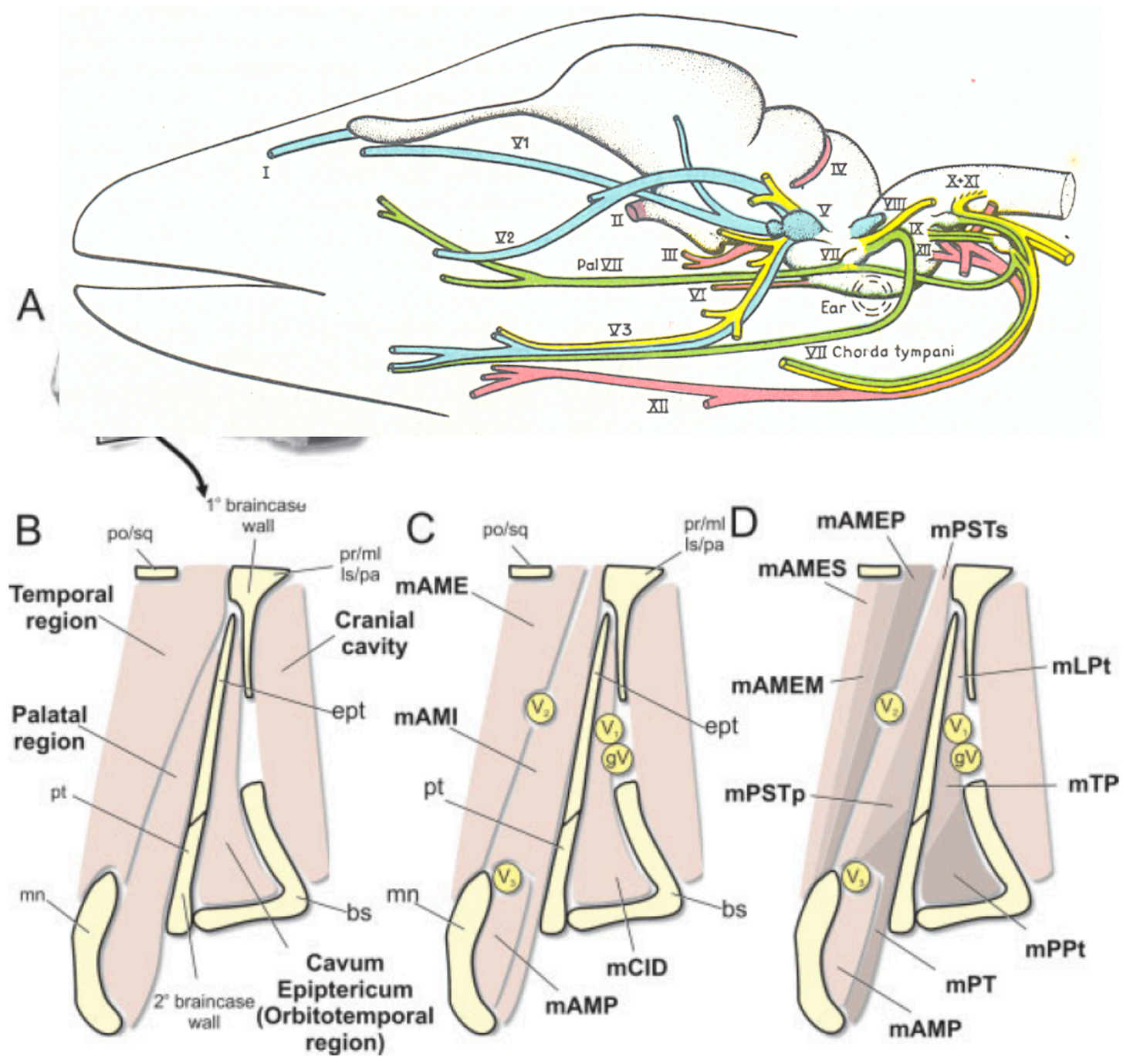


Holliday and Witmer (2007)

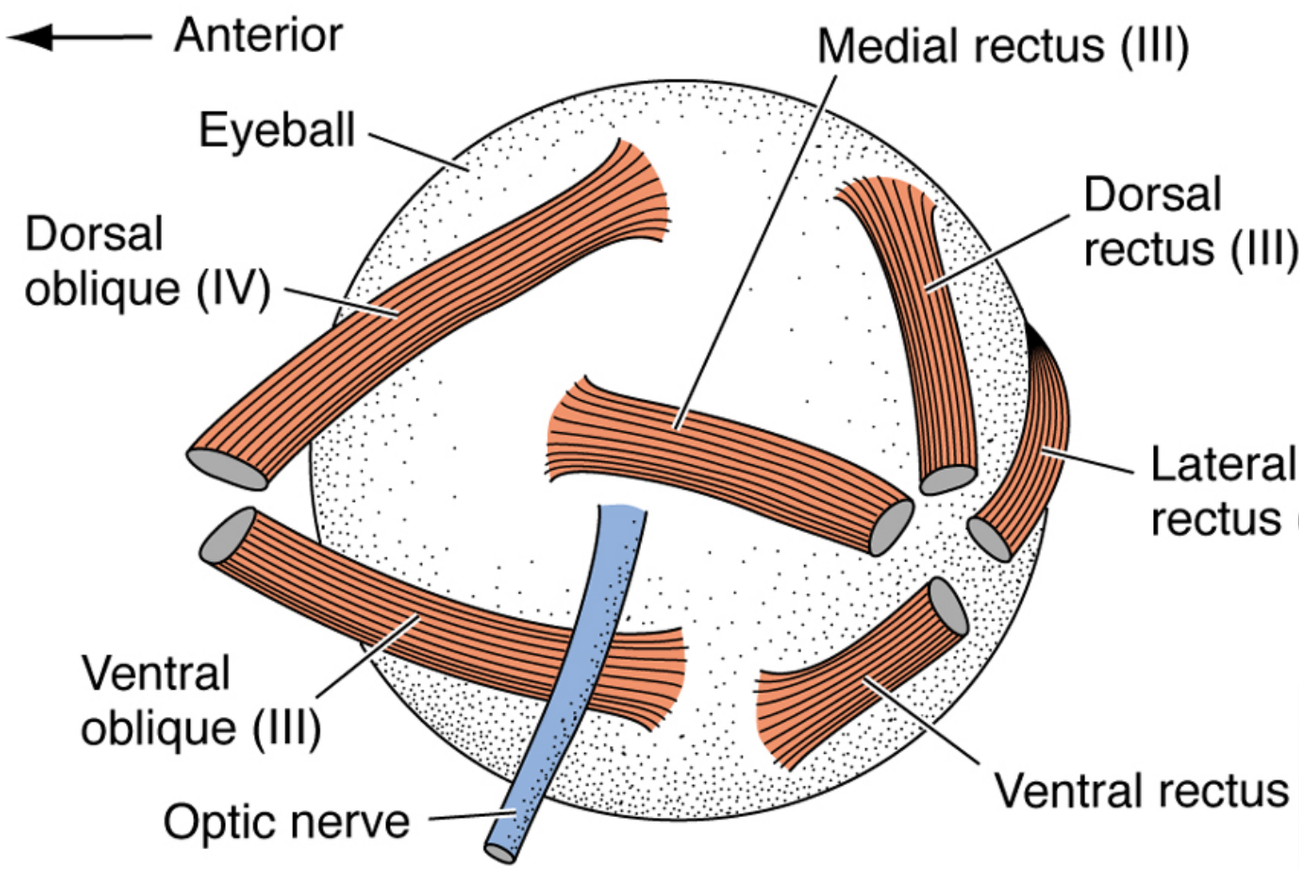
Luther (1913) = Homologias dos pacotes musculares definidos pela sua relação com os nervos trigêmeos

V1- ramo oftámico do trigêmeo
V2- ramo maxilar
V3- ramo mandibular
VII- ramo palatino do facial
XII- nervo hipoglosso



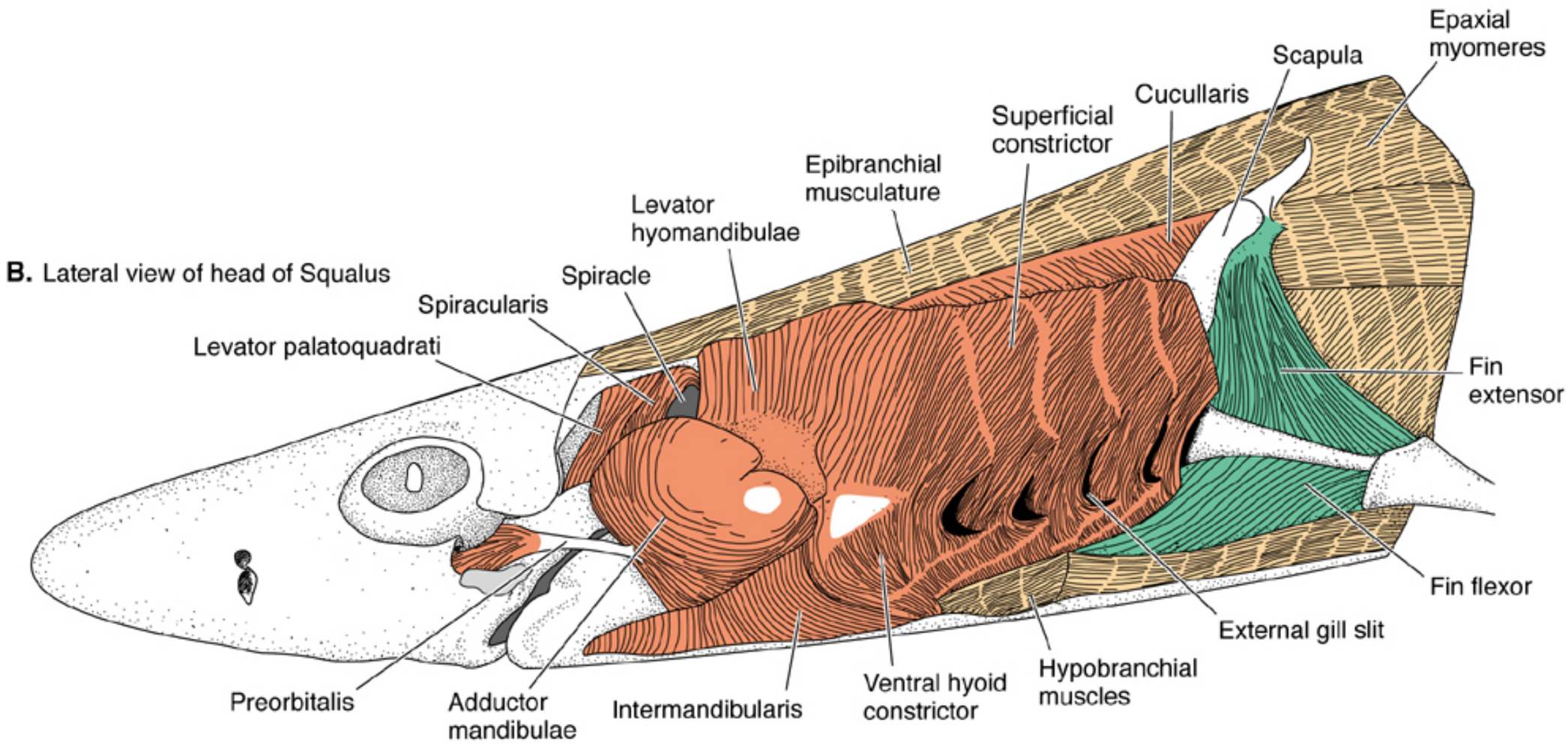


GRUPOS DE MÚSCULOS: OCULARES EXTRÍNSECOS

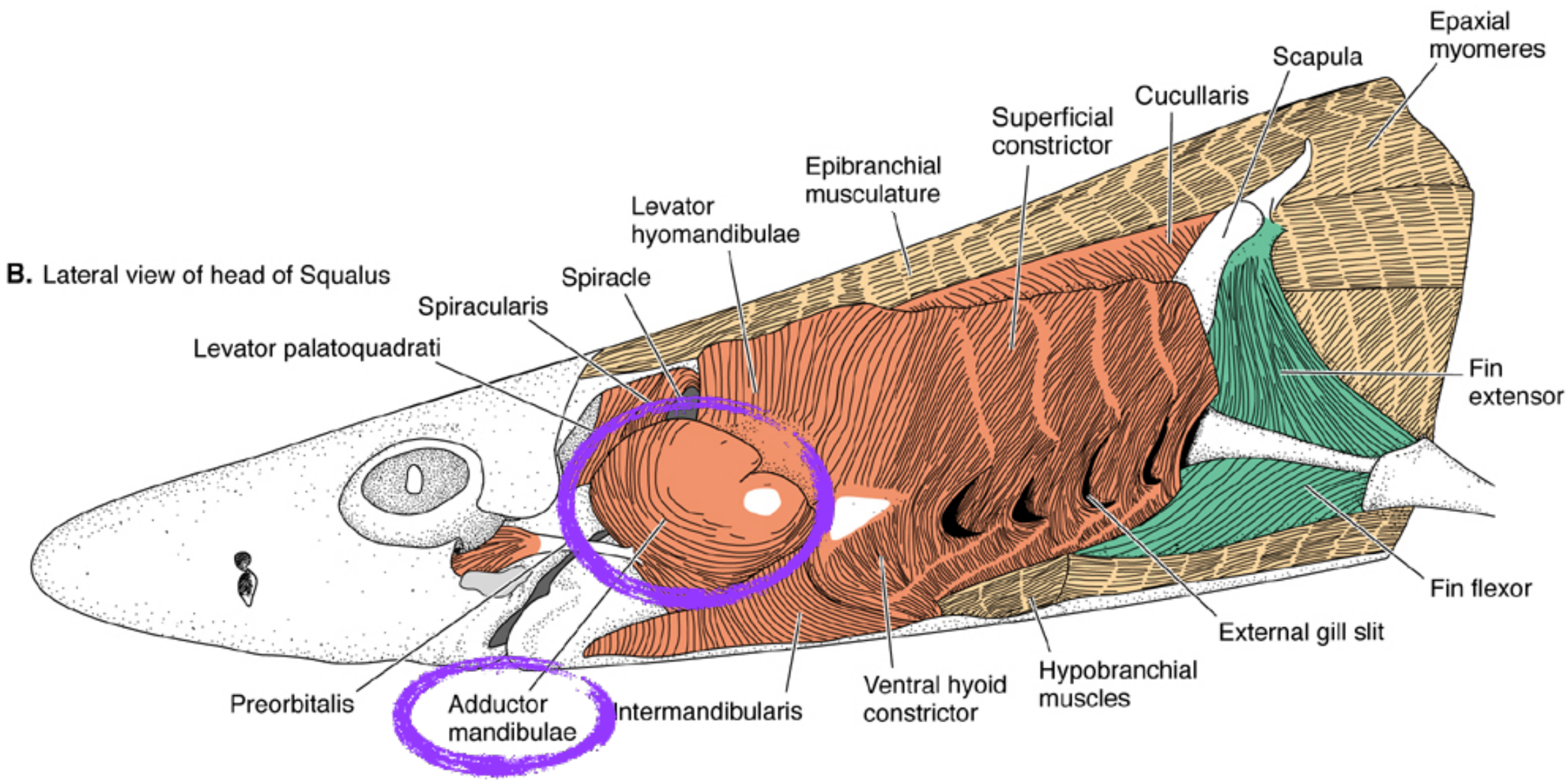


6 pares de musculos derivados de somitomeros distintos movem o globo ocular.

GRUPOS DE MÚSCULOS: BRÂNQUIAIS



GRUPOS DE MÚSCULOS: BRÂNQUIAIS



Fecha a maxila

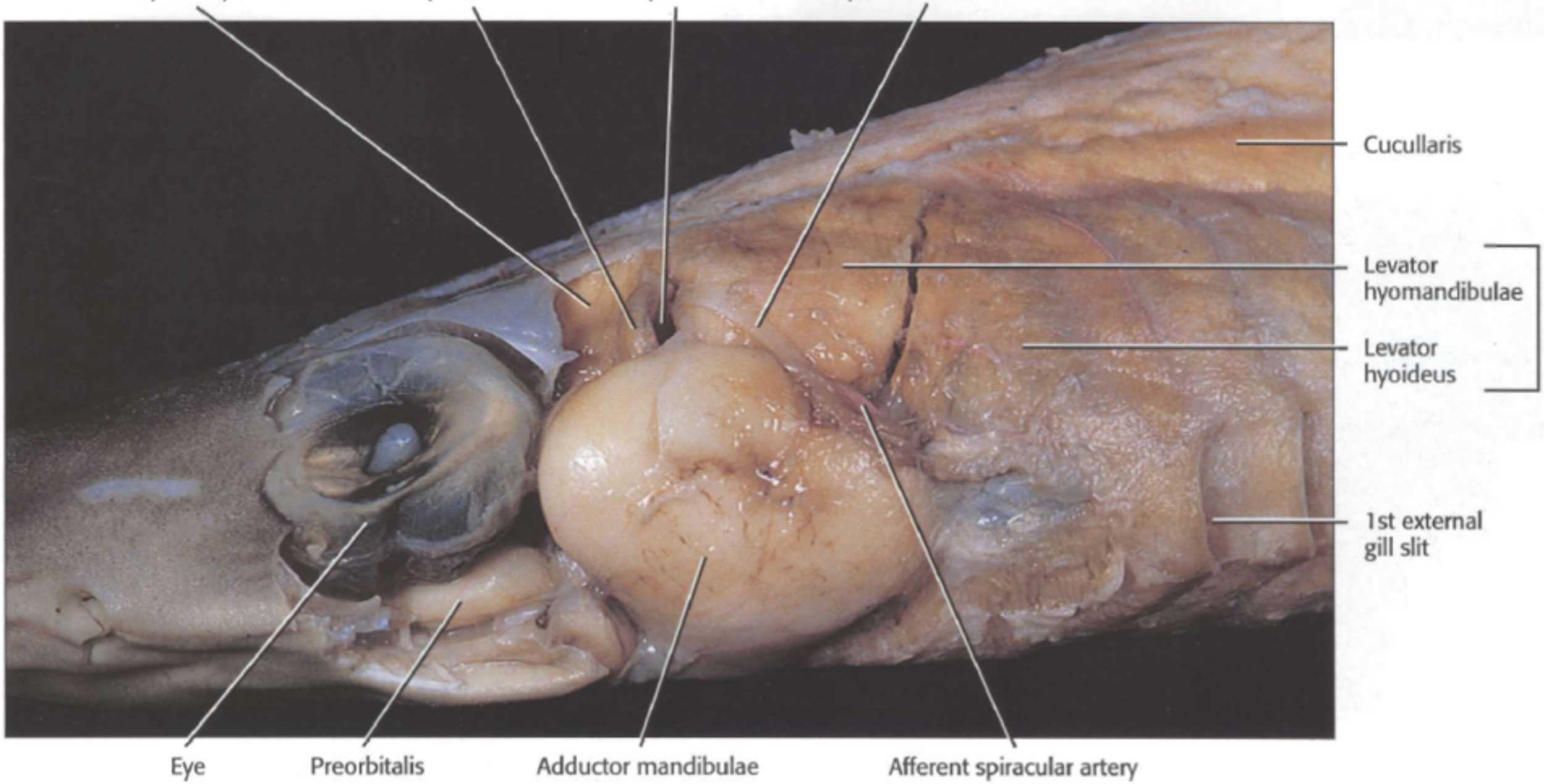
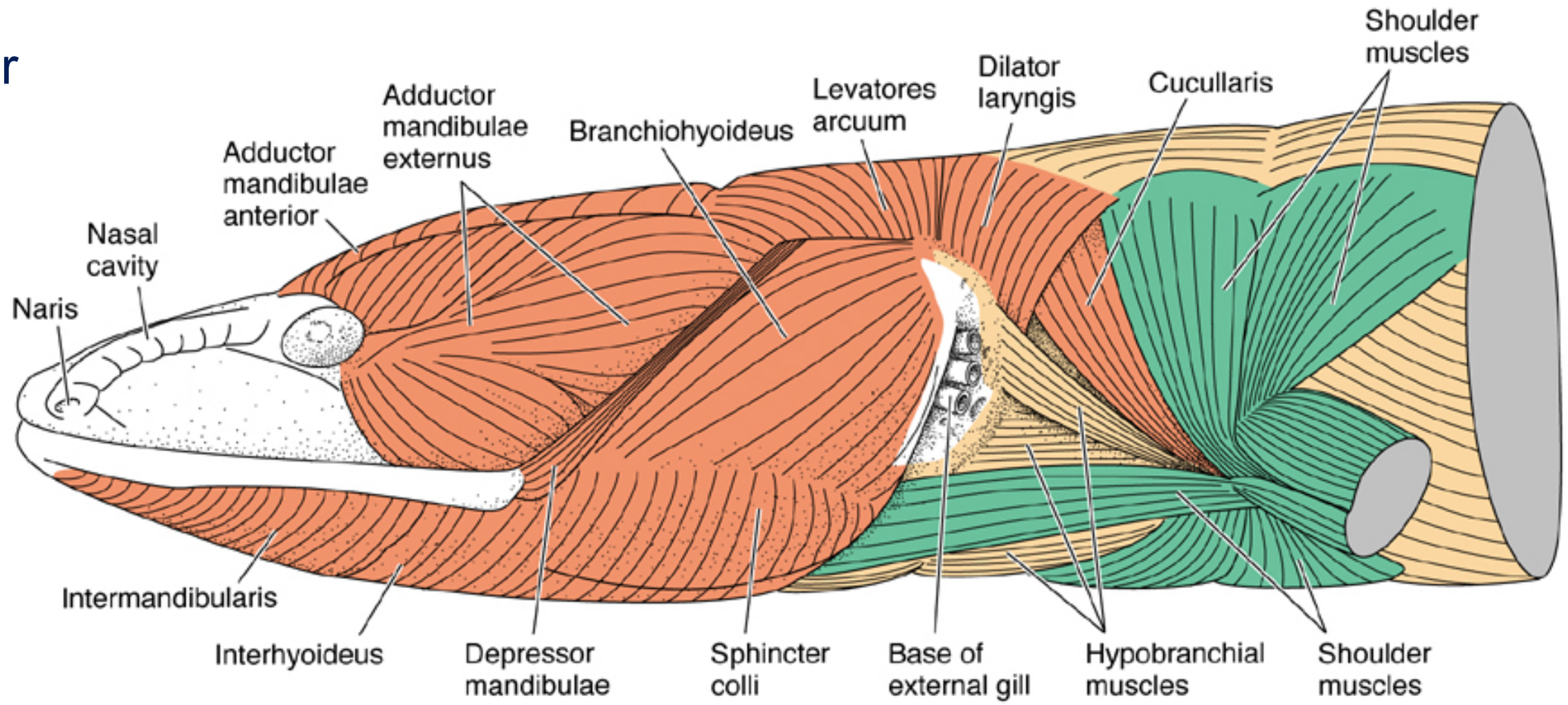


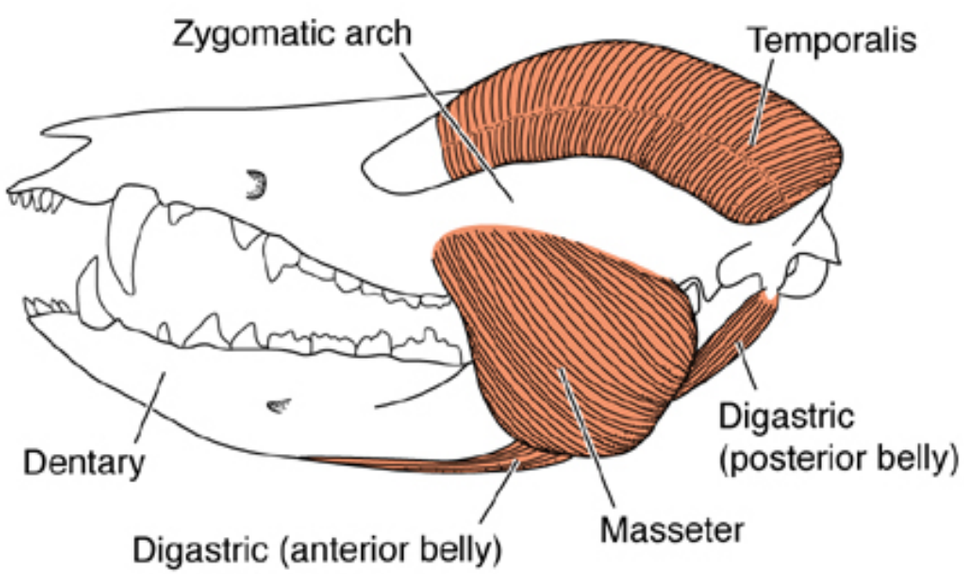
FIGURE 17.11 Muscles of visceral arch I (mandibular).

Musculatura somatica branquiomerica

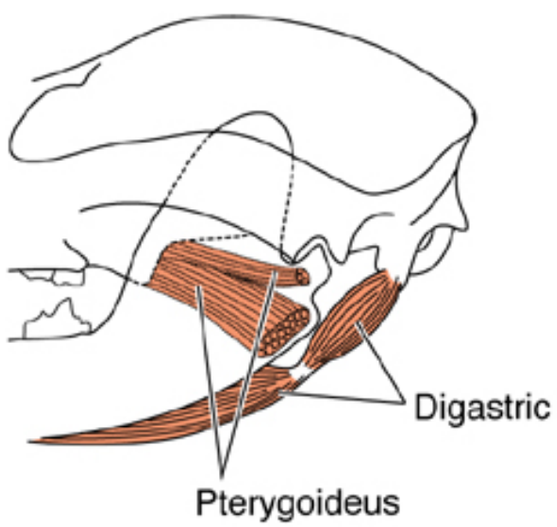
Mandibular
Hioide
Branquial



A. Branchiomeric and shoulder muscles of Necturus



B. Superficial jaw muscle of Didelphis



C. Deeper jaw muscle of Didelphis

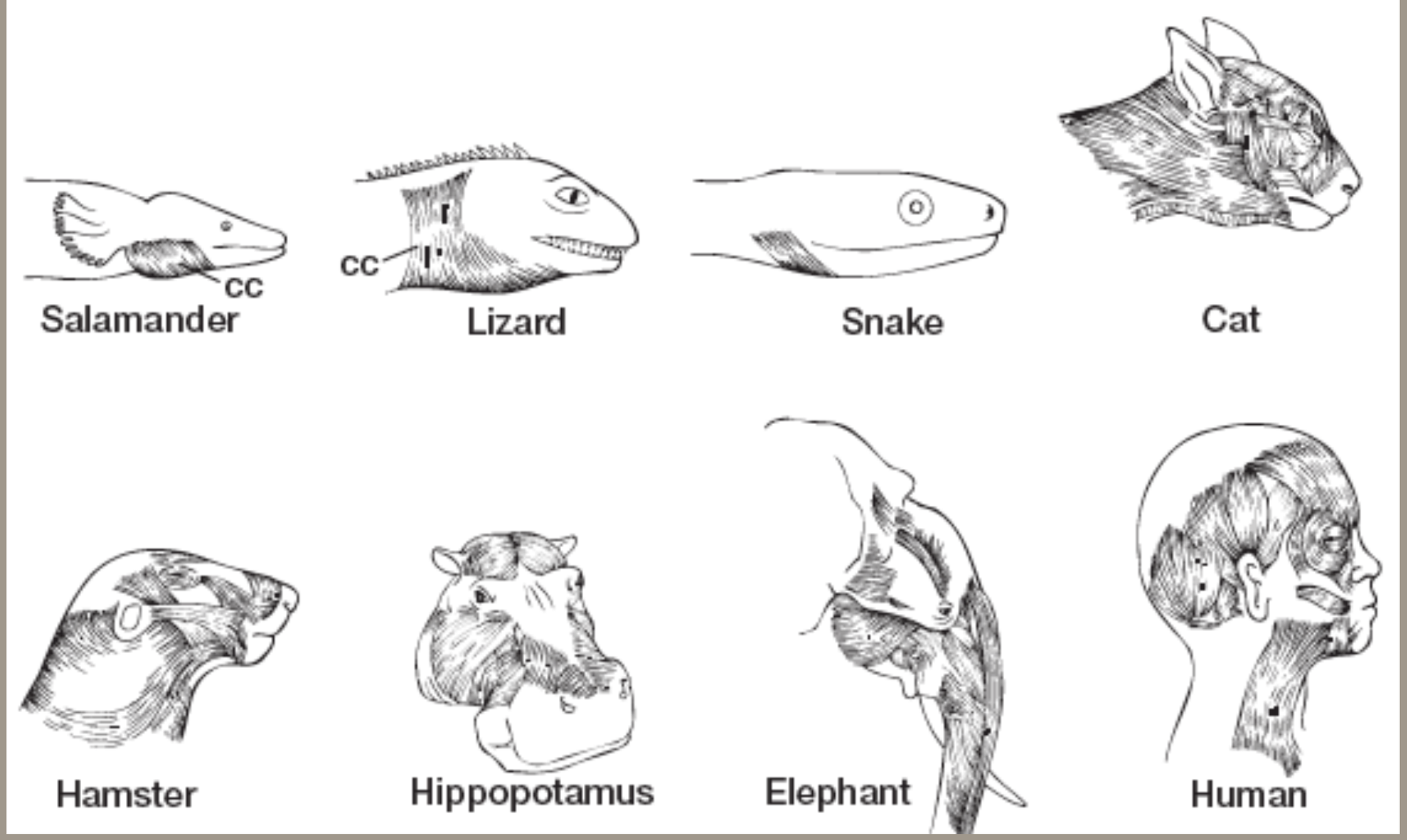
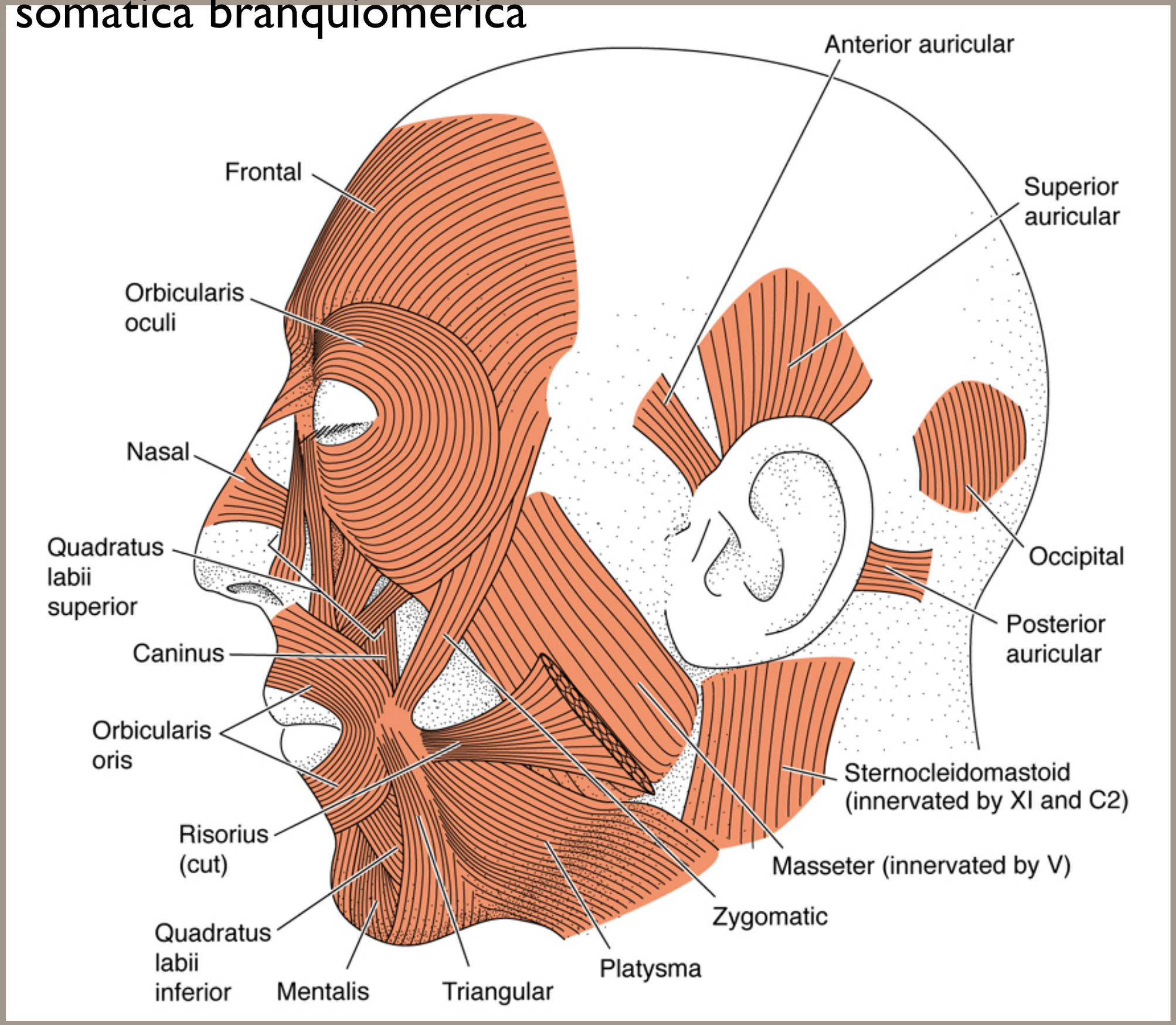
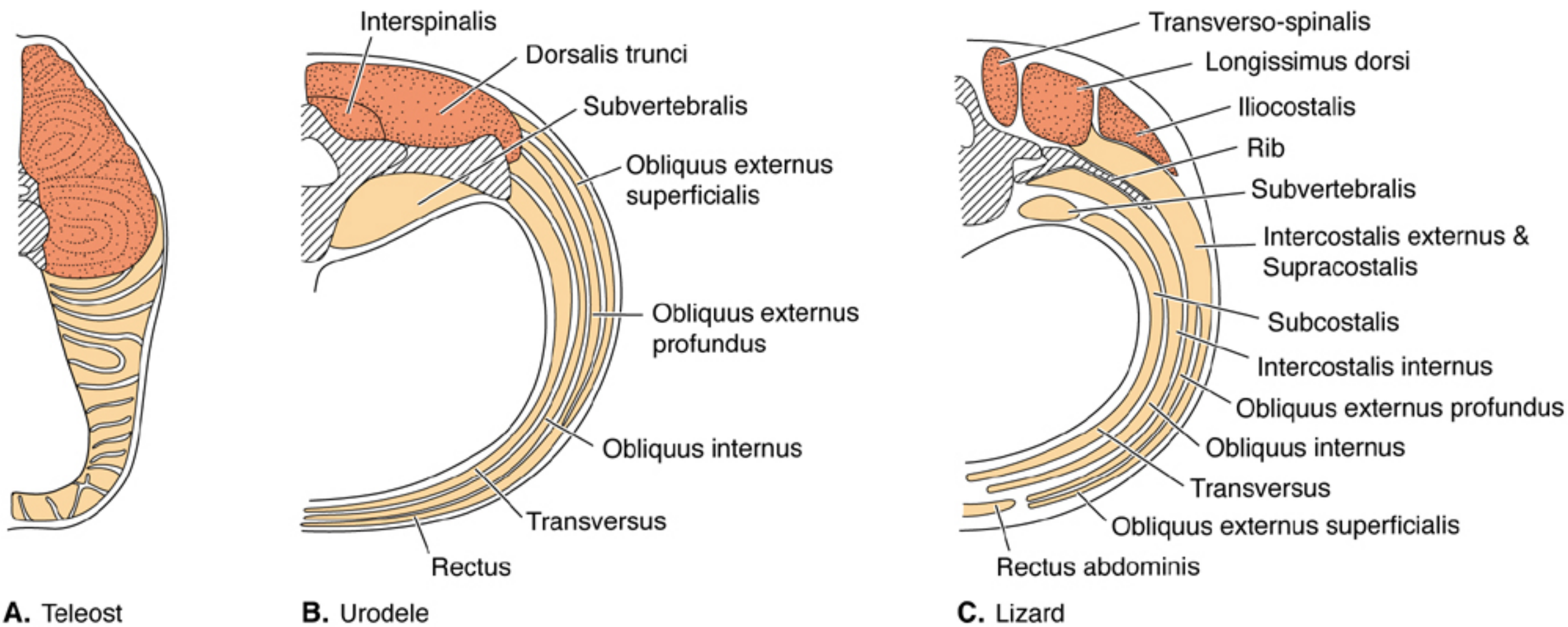


FIGURE 10.40 Evolution of facial muscles. In tetrapods, the hyoid musculature expands over and partially encircles the neck as a thin sheet, the constrictor colli (cc). This muscle also tends to adhere to the dermis of the skin. In mammals, the musculature derived from the hyoid arch expands radically over the head and differentiates into a suite of facial muscles. They are best differentiated around the eyes, lips, and ears, where they serve to accent facial expression.

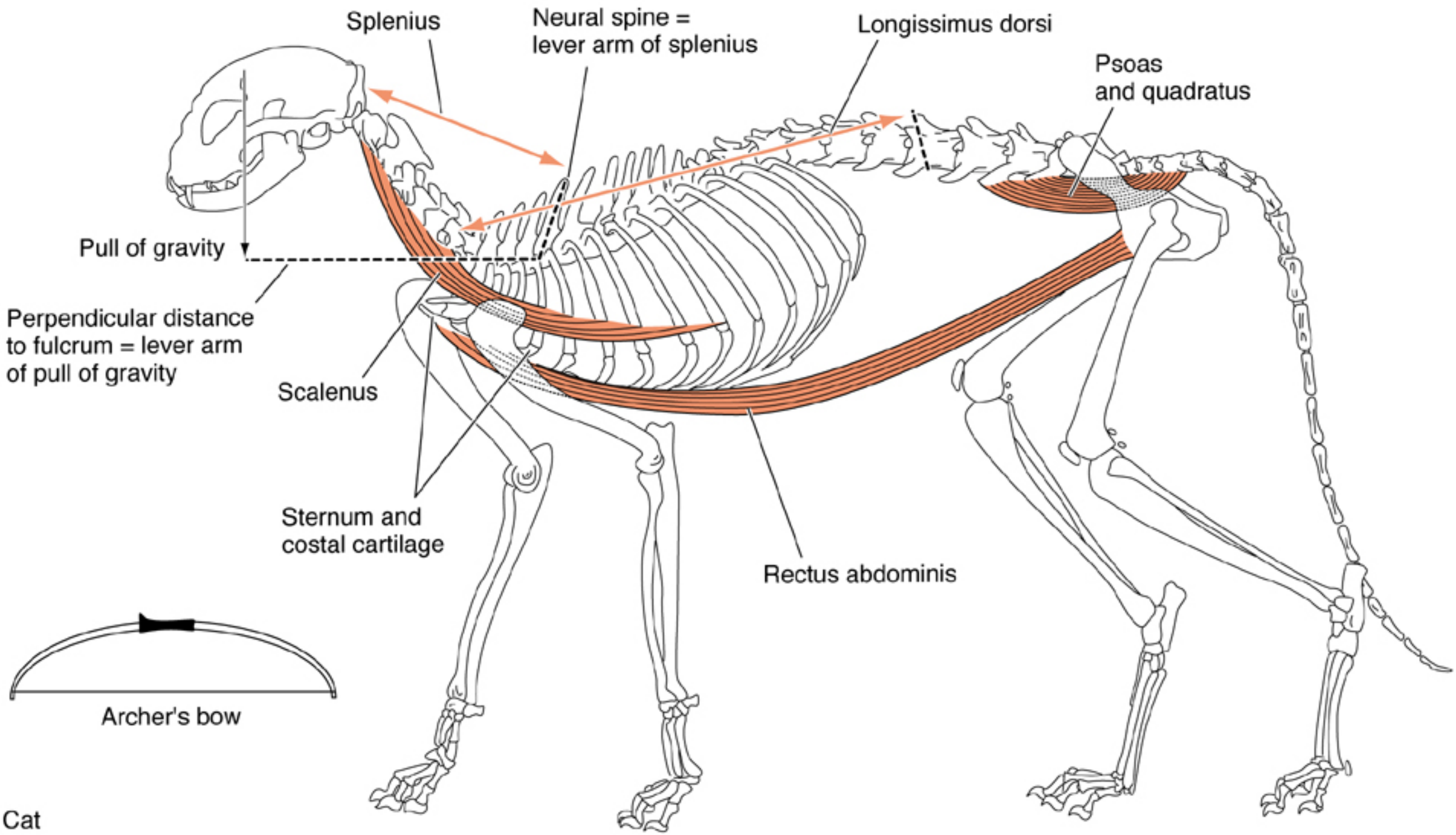
Musculatura somatica branquiomerica



Musculatura somatica axial do tronco e da cauda



Laranja: Musculatura epaxial
amarelo: Musculatura hypaxial

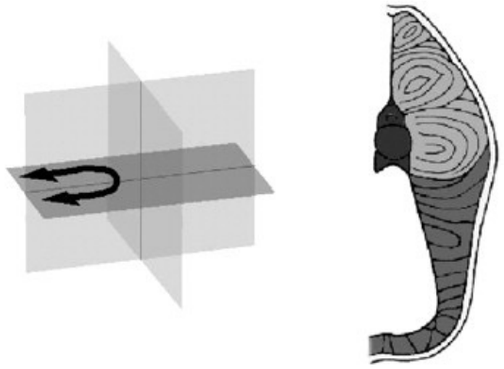

Splenius
Neural spine =
lever arm of splenius
Longissimus dorsi
Psoas
and quadratus
Pull of gravity
Perpendicular distance
to fulcrum = lever arm
of pull of gravity
Scalenus
Sternum and
costal cartilage
Rectus abdominis
Archer's bow

A. Cat

EVOLUÇÃO DE MÚSCULOS: TETRAPODA

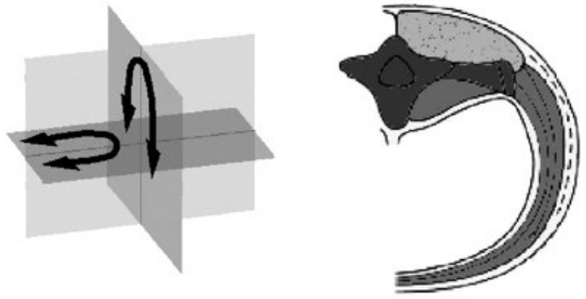
(*a*) fishes,
lower tetrapods

undulation, axial propulsion
trunk and tail regions
myomeres, epaxial and hypaxial separation by horizontal septum



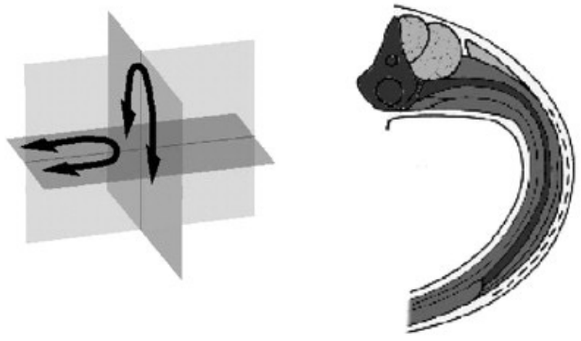
(*b*) higher tetrapods

undulation and torsion, axial and legged body propulsion
cervical, trunk, sacral, and tail region
segmental epaxial musculature
fused hypaxial, polysegmental tracts



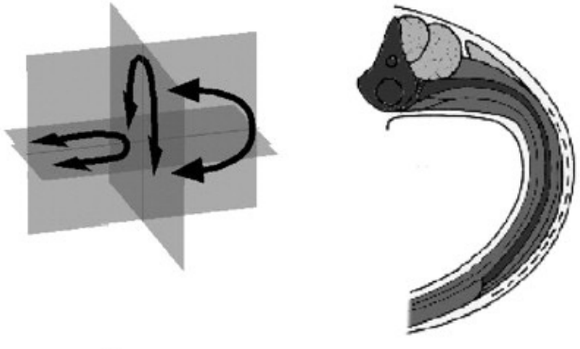
(*c*) amniotes

undulation and torsion, axial and legged body propulsion
cervical, trunk, sacral, and tail region
fused epaxial, polysegmental tracts
further differentiated hypaxial tracts due to ribs

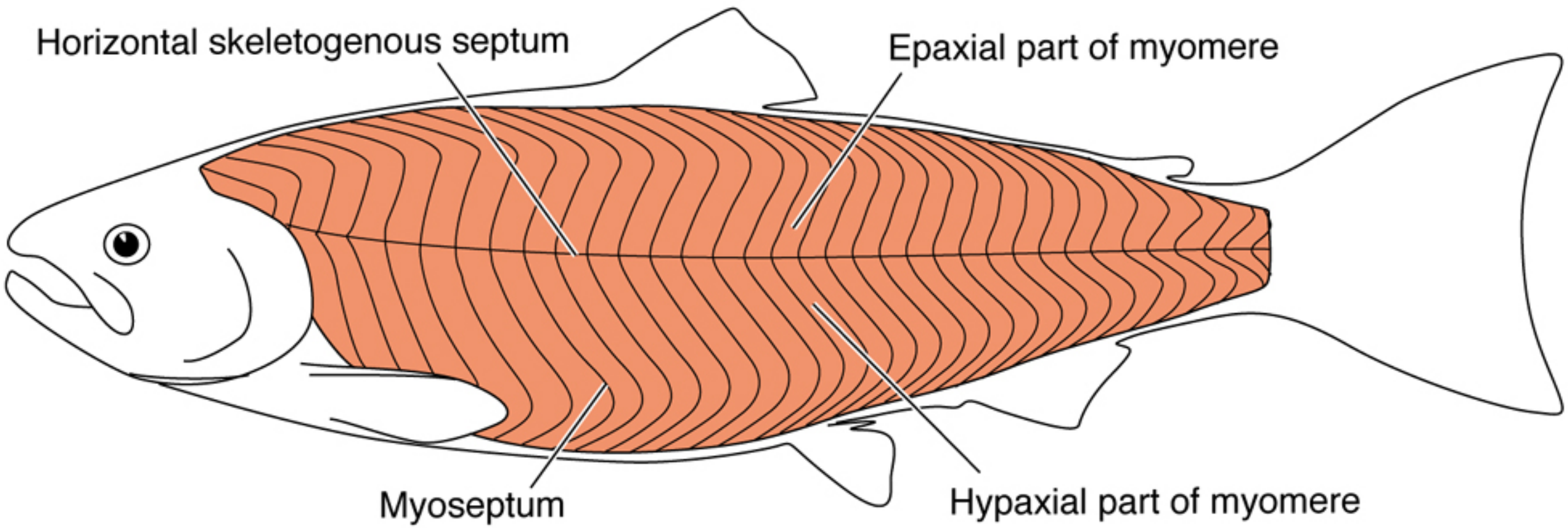


(*d*) mammals

axial and legged body propulsion; undulation and torsion at symmetrical gaits; sagittal bending at asymmetrical gaits
cervical, thoracic, lumbar, sacral, and tail region
strengthening of epaxial muscle tracts



Reflete o papel central da coluna axial na locomoção


Horizontal skeletogenous septum
Epaxial part of myomere
Myoseptum
Hypaxial part of myomere

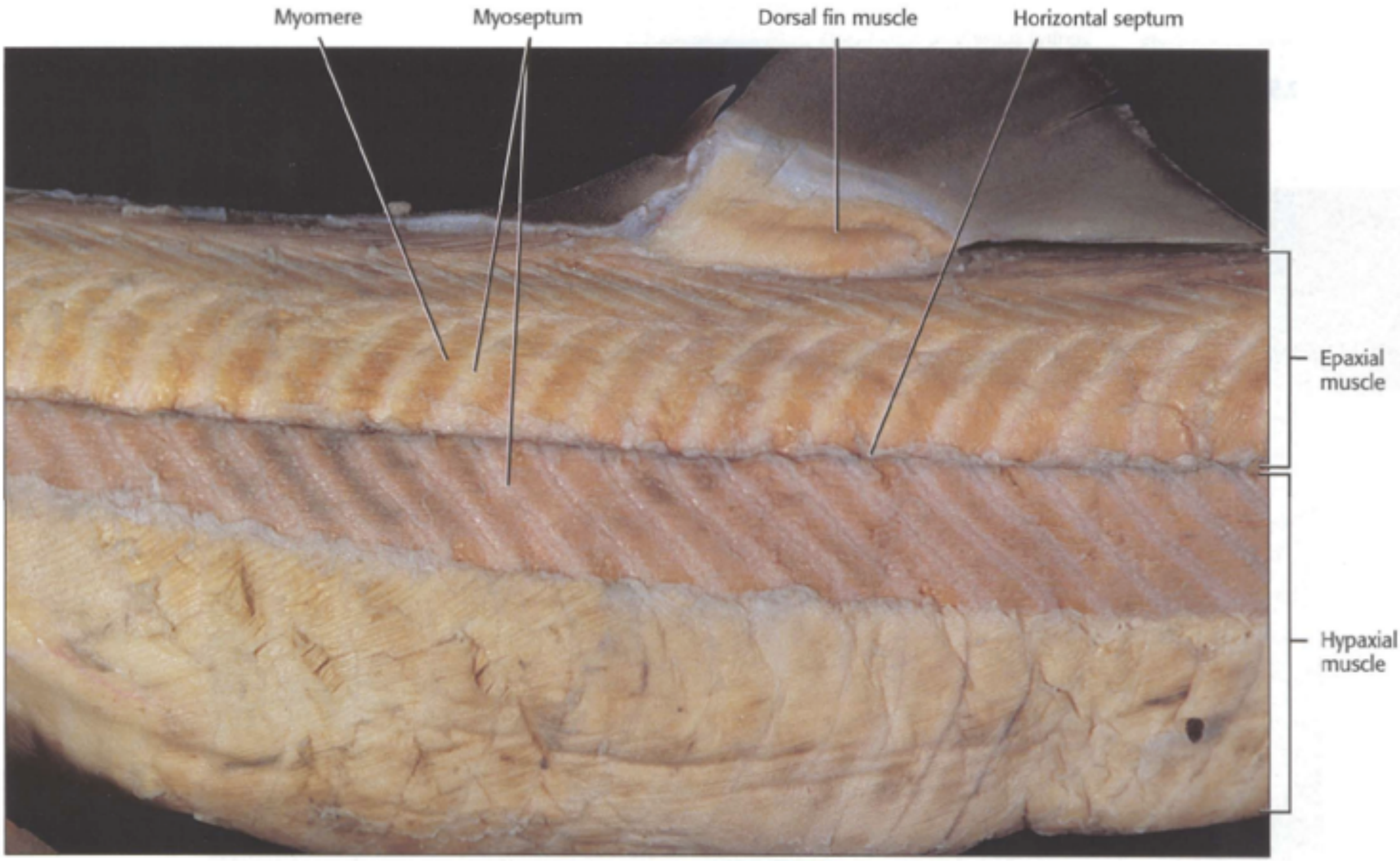
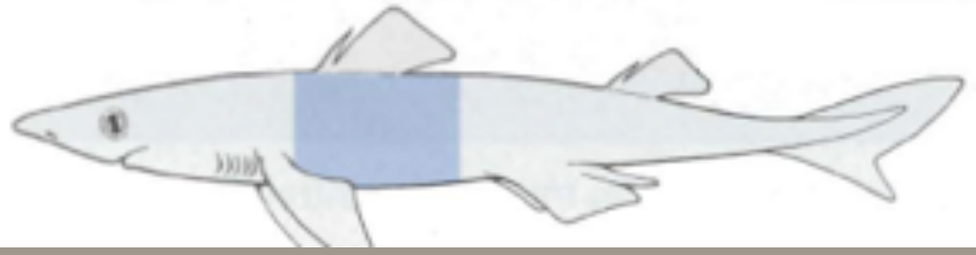
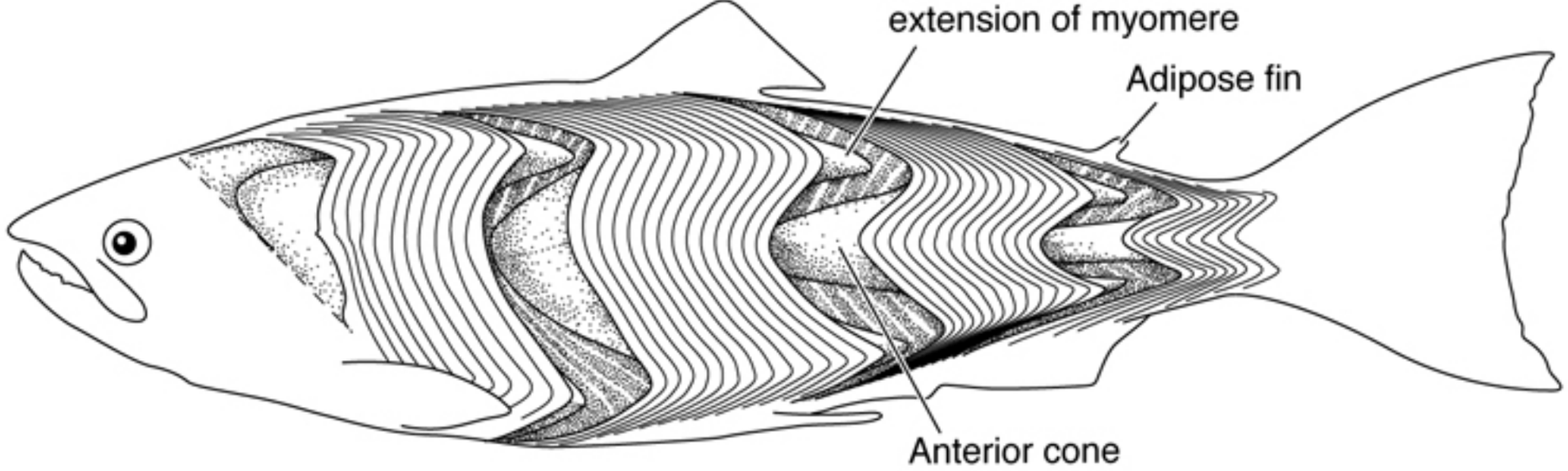
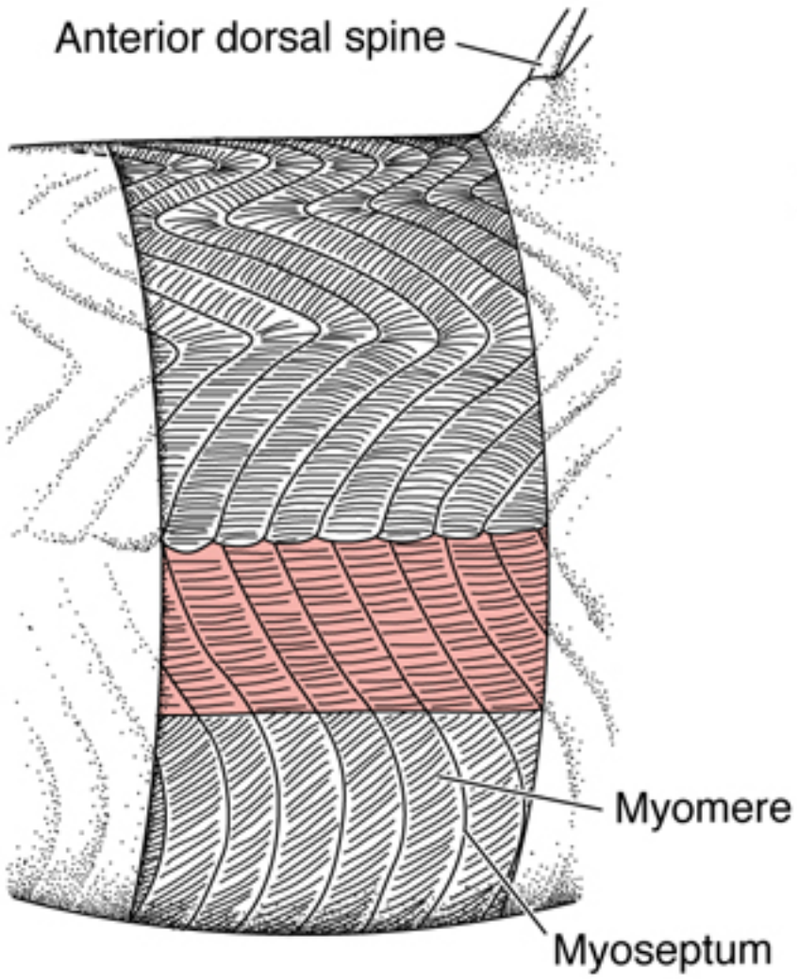


FIGURE 17.4 Trunk muscles: Basic design.

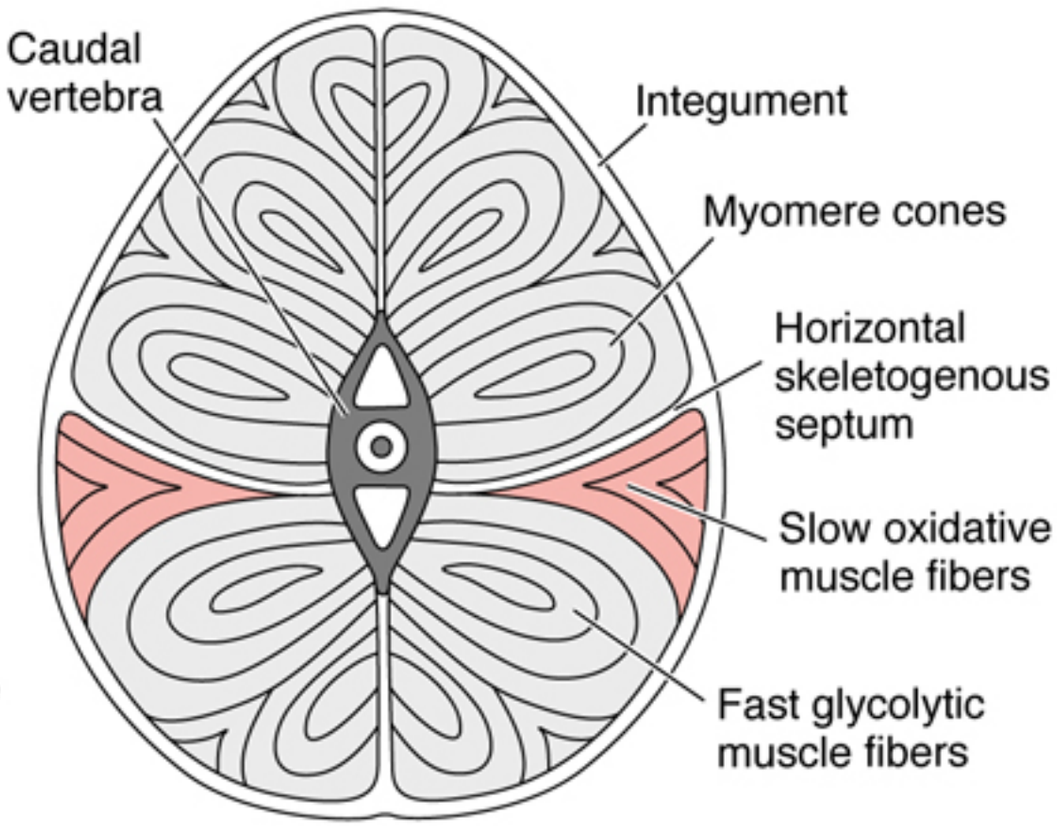




A. Dissection of trunk muscles of a salmonid

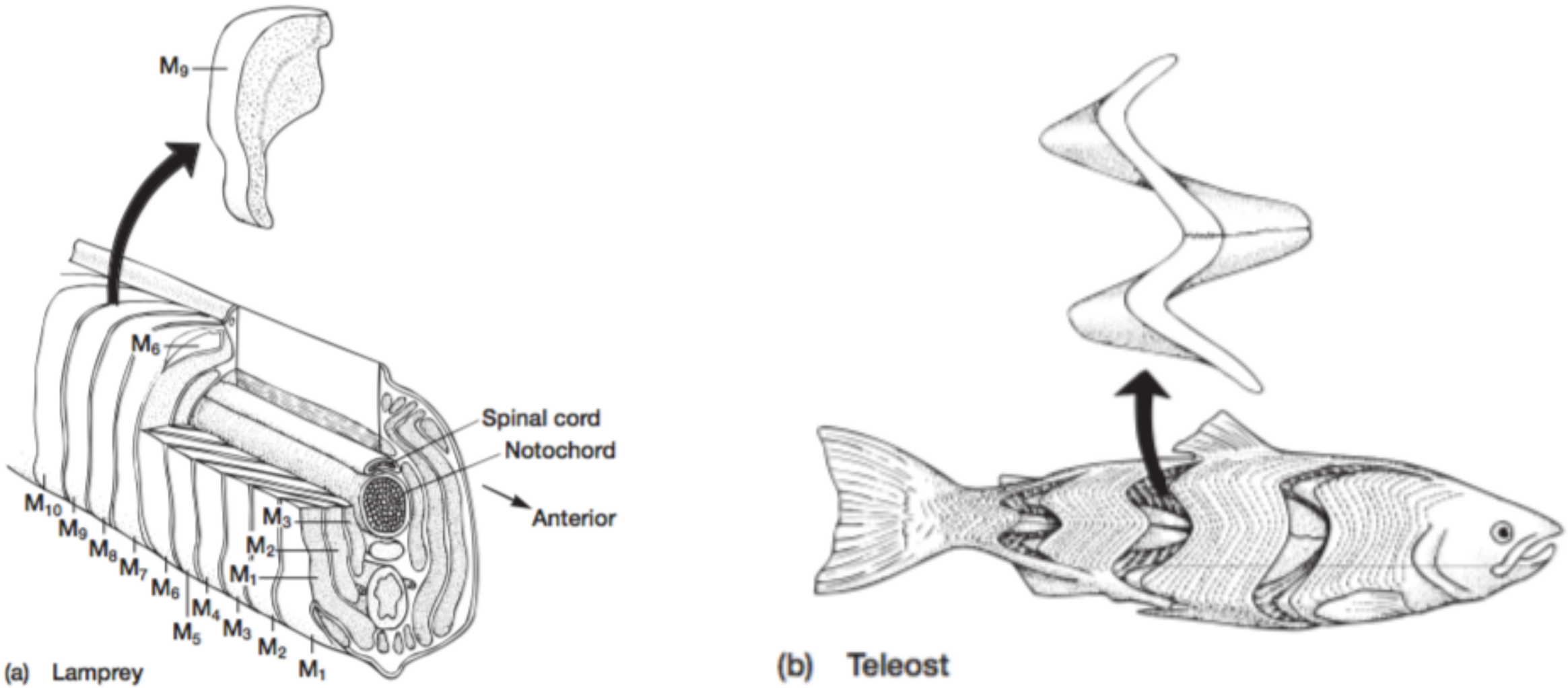


B. Distribution of muscle fiber types



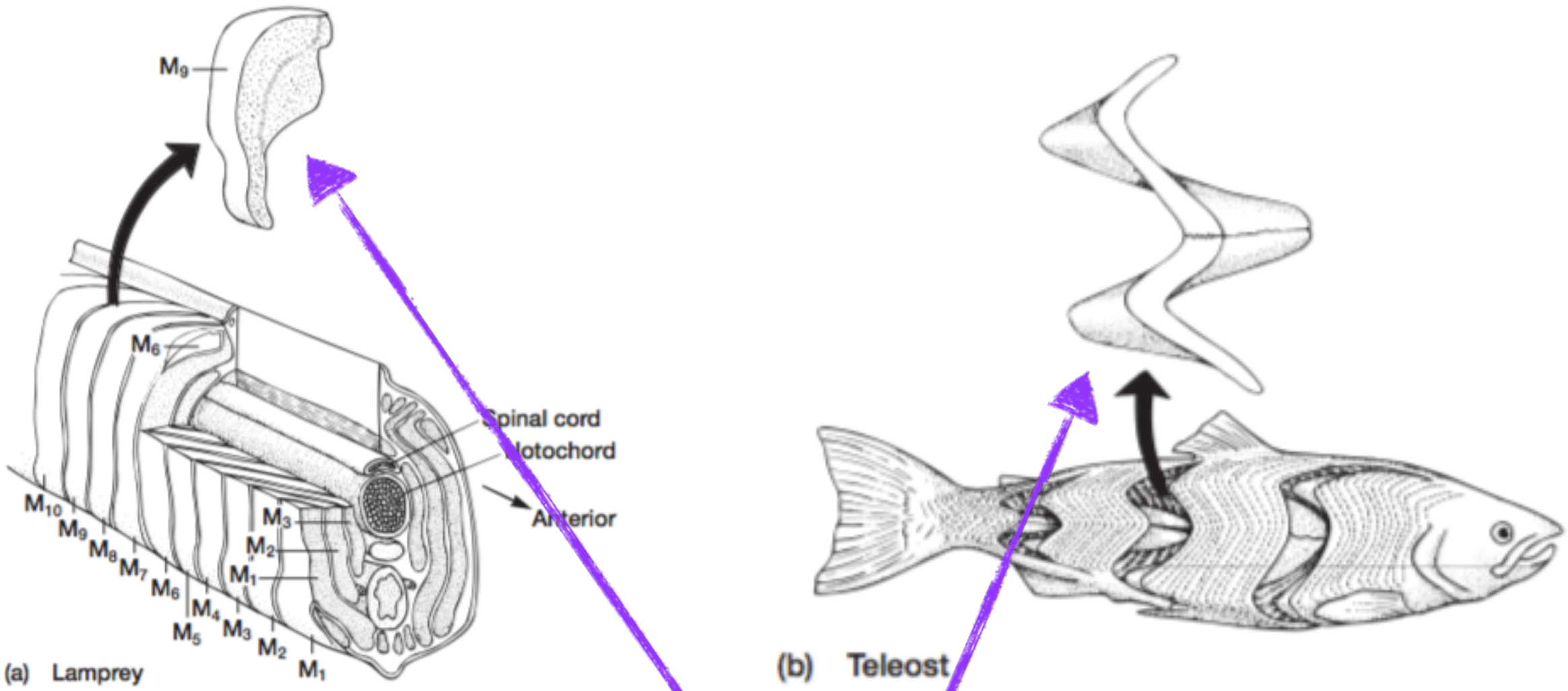
C. Distribution of muscle fiber types in cross section

EVOLUÇÃO DE MÚSCULOS: PEIXES



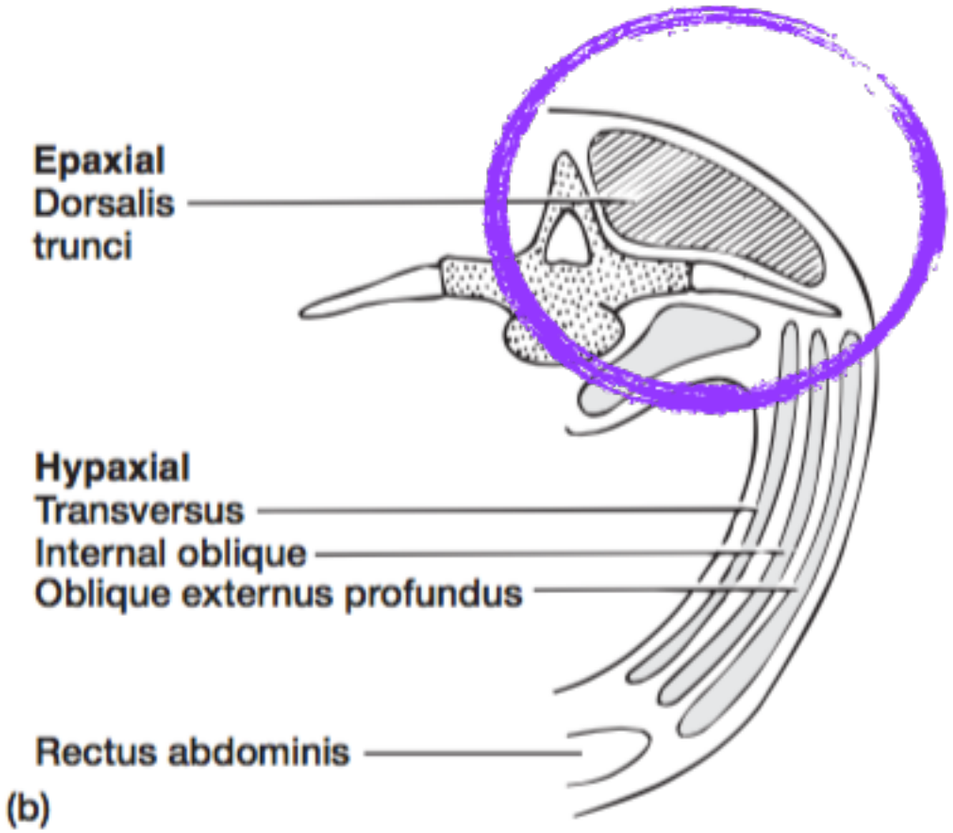
Miômeros

EVOLUÇÃO DE MÚSCULOS: PEIXES



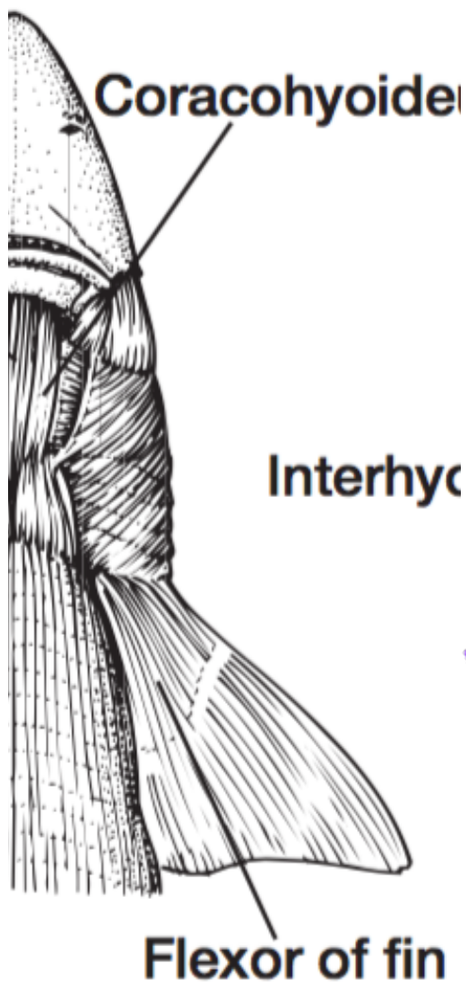
Miômeros

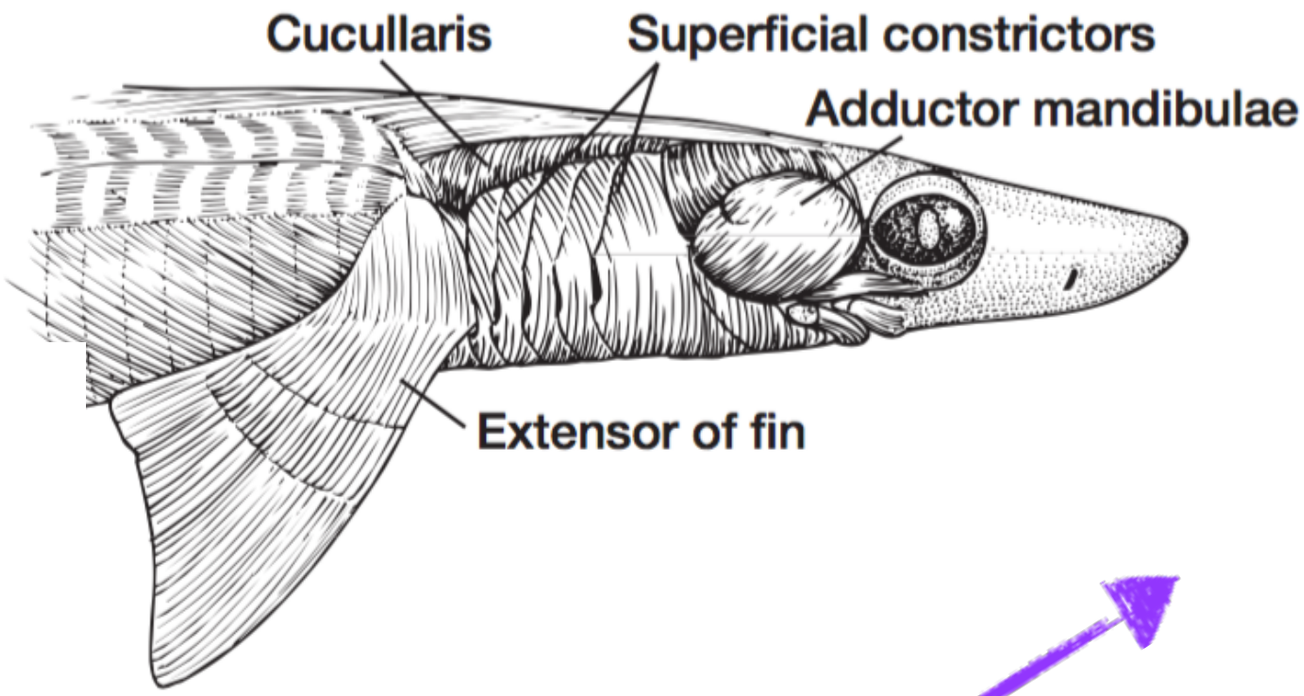
EVOLUÇÃO DE MÚSCULOS: TETRAPODA



Reflete o papel central da coluna axial na locomoção

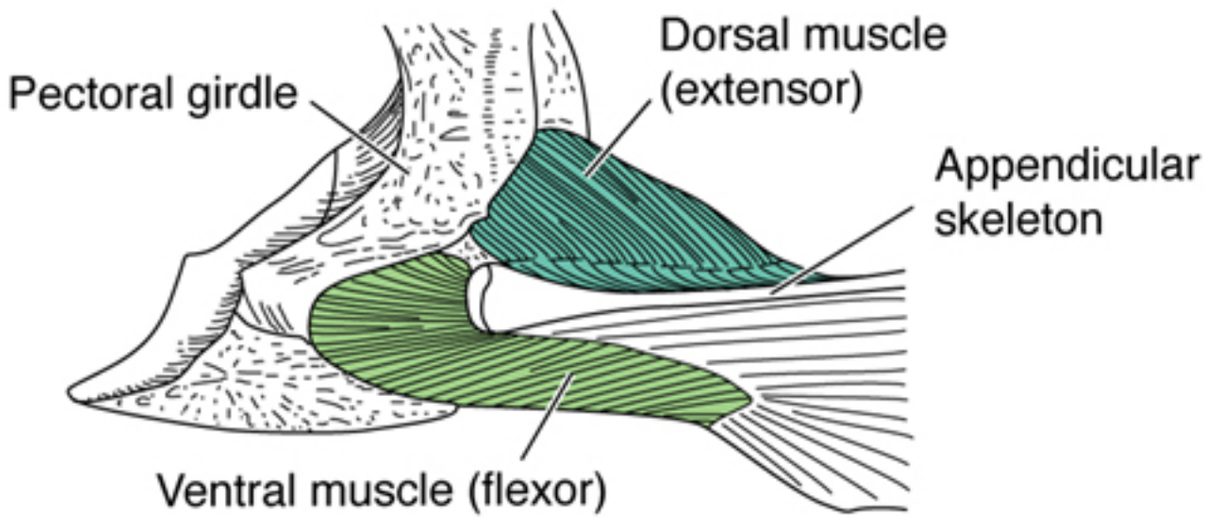
EVOLUÇÃO DE MÚSCULOS: PEIXES



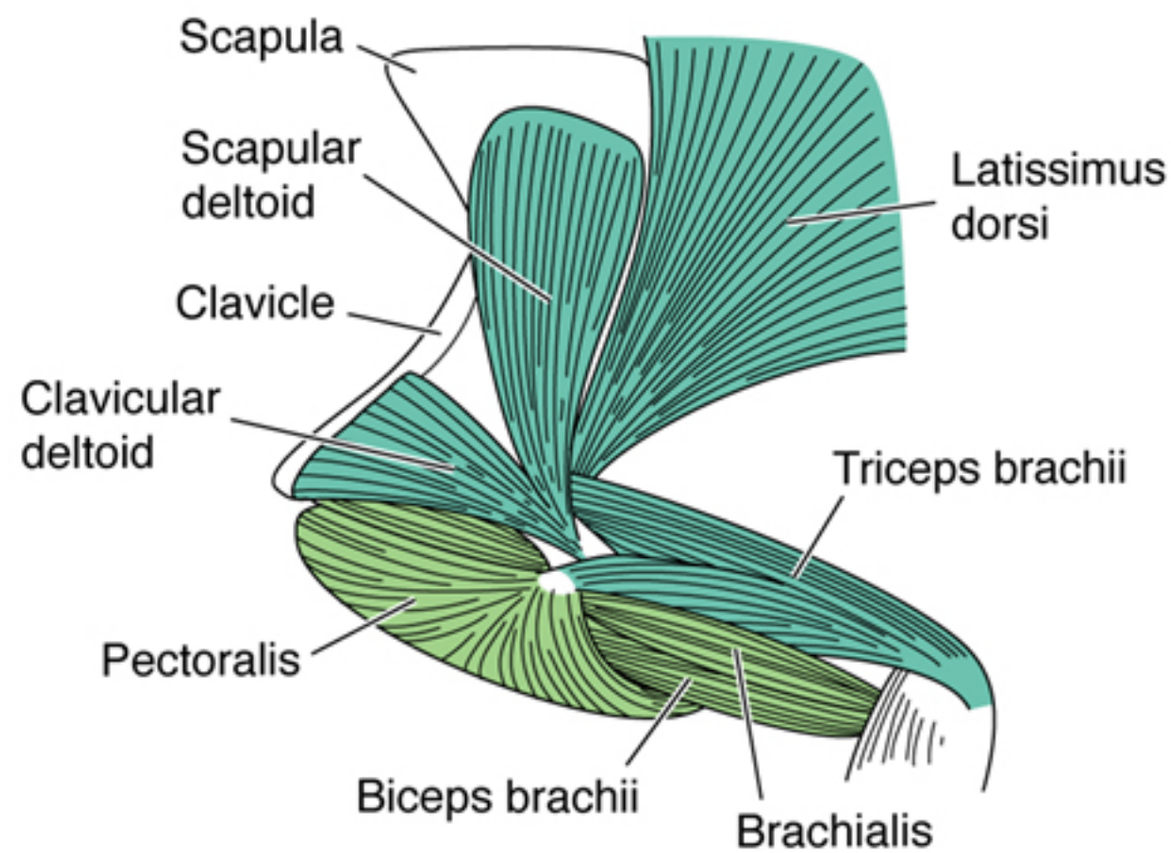


músculos apendiculares

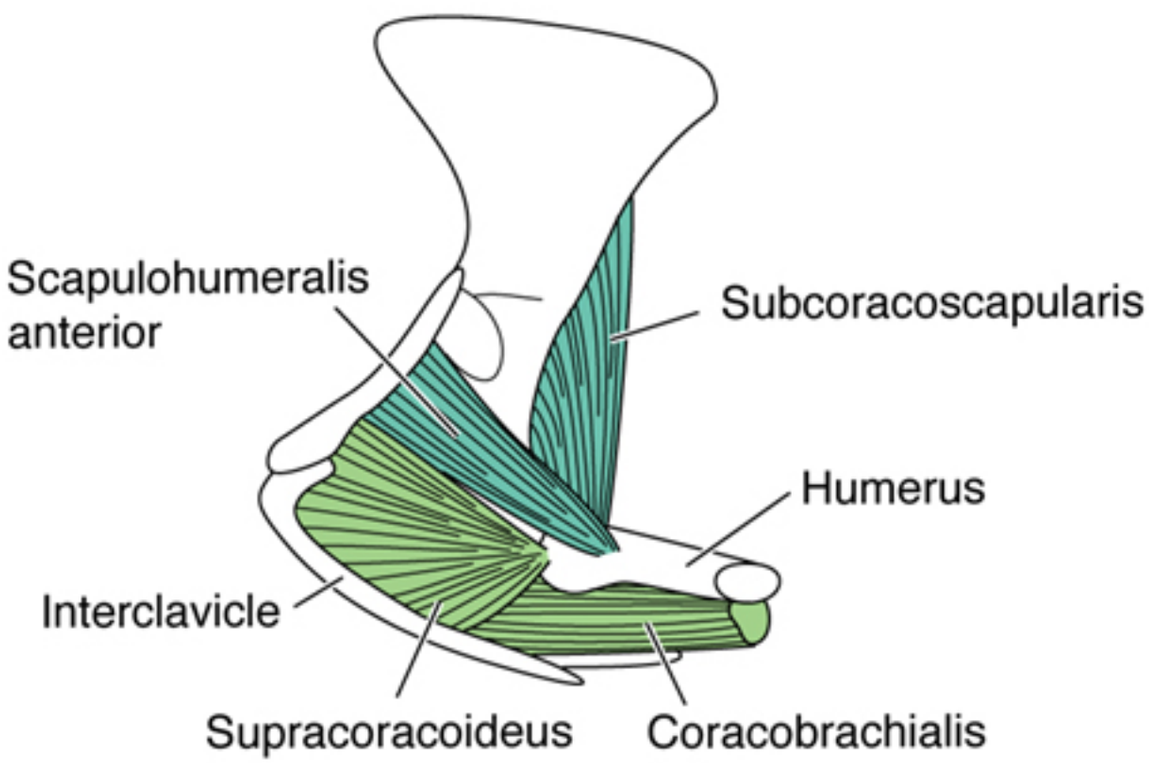
Musculatura somatica apendicular



A. Pectoral fin muscles of a sturgeon

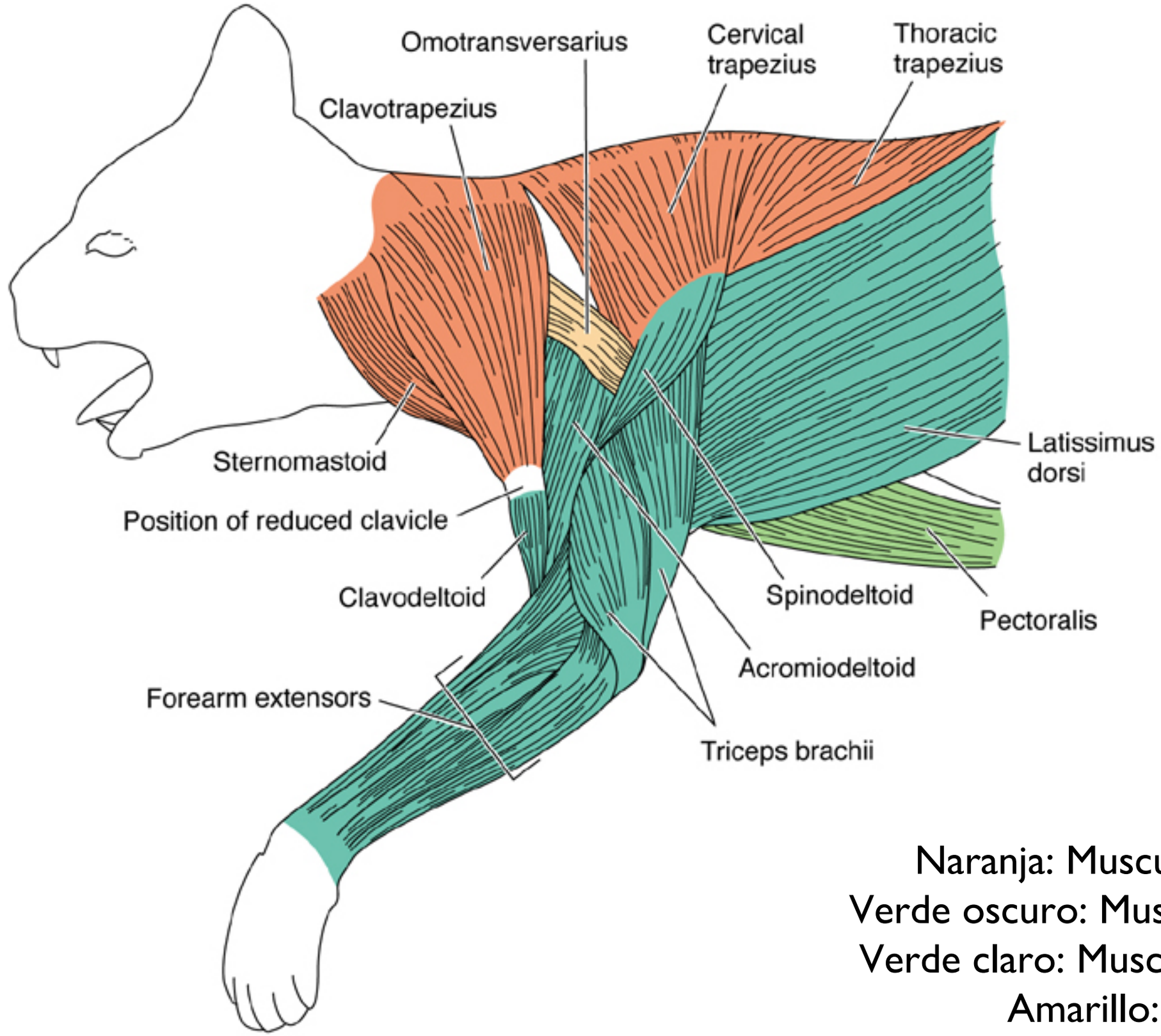


B. Superficial forelimb muscles of a lizard



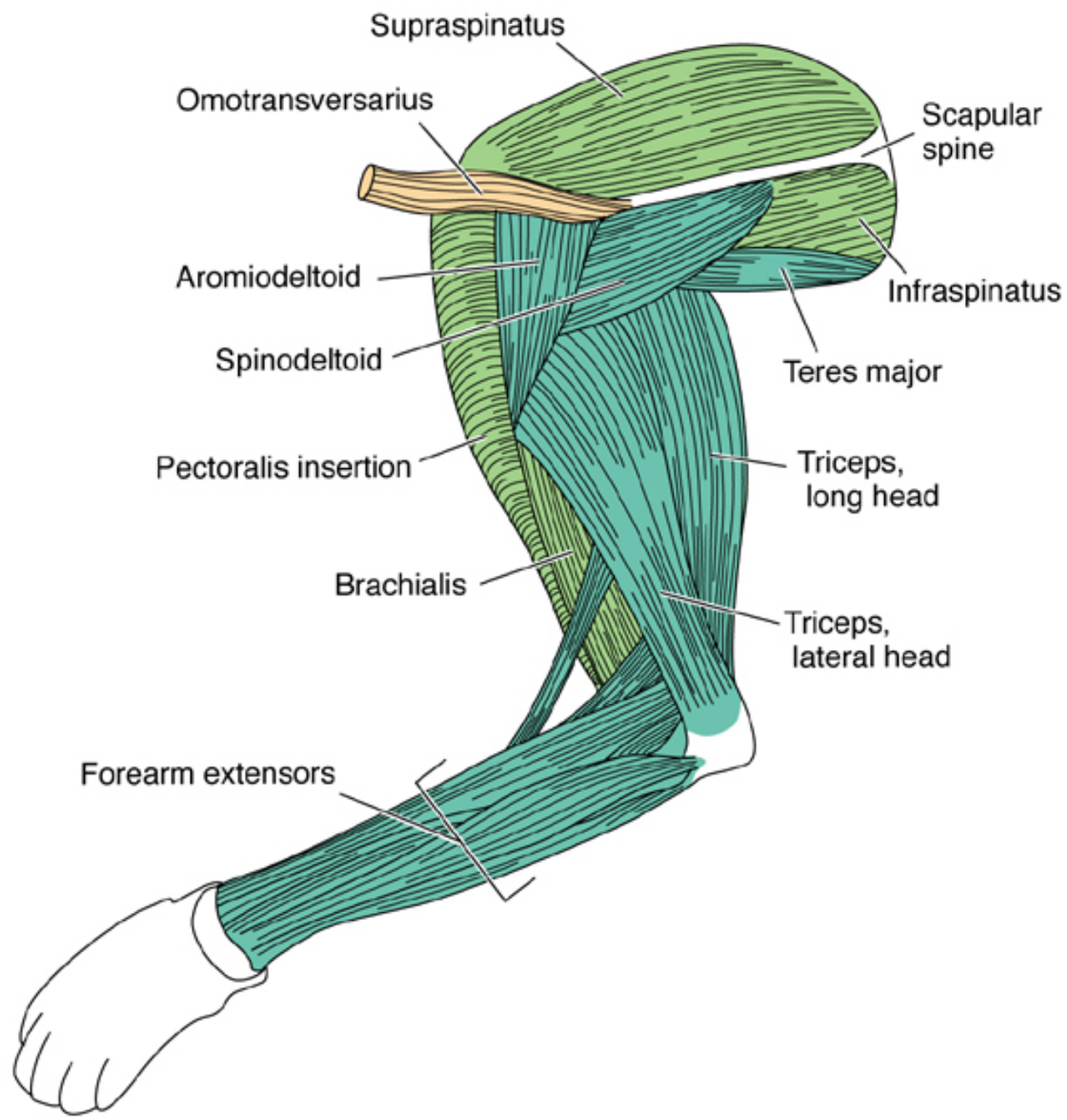
C. Deep forelimb muscles of a lizard

Verde oscuro: Musculatura apendicular dorsa
Verde claro: Musculatura apendicular ventra

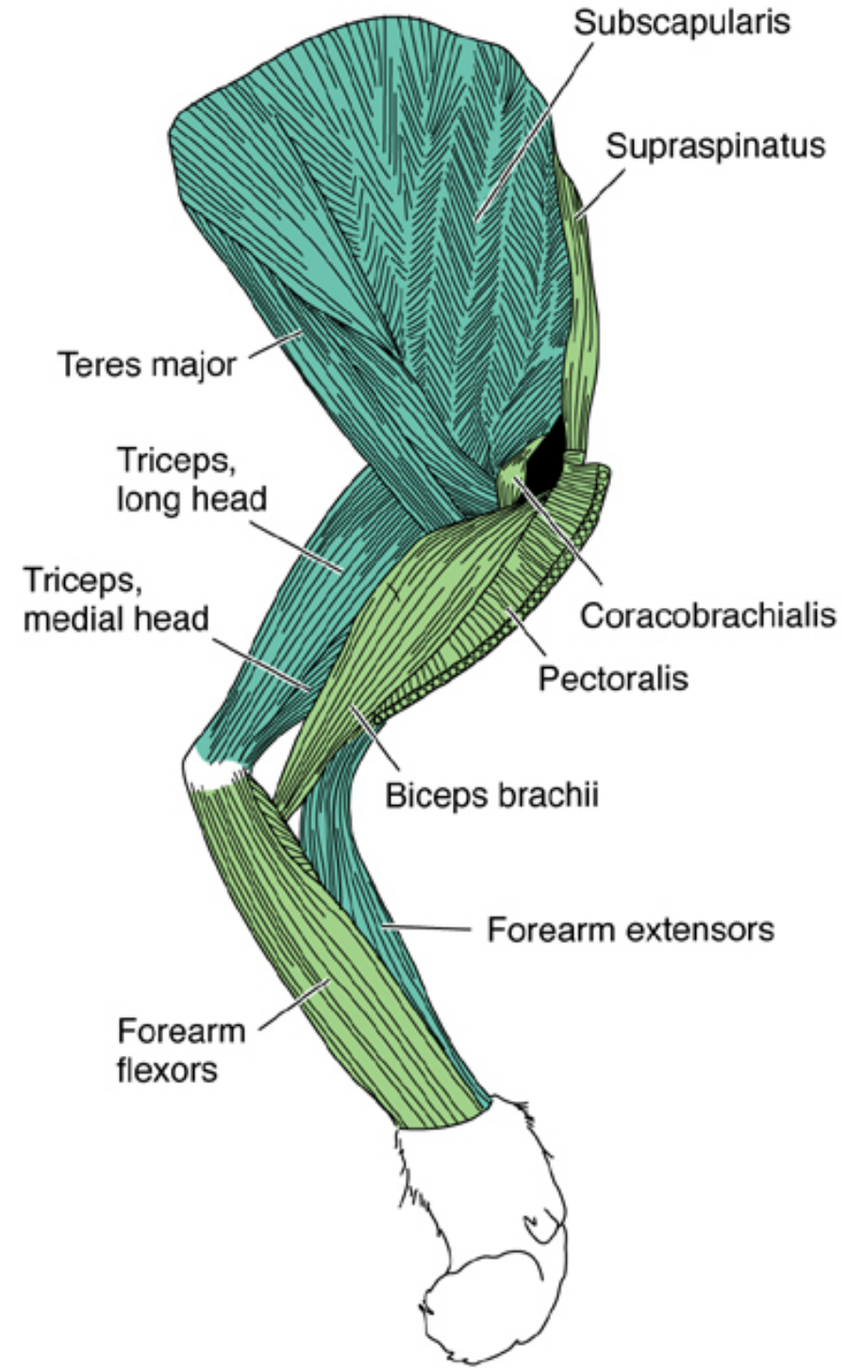


A. Shoulder and foream muscles of Felis

Naranja: Musculatura bramquiomerica
Verde oscuro: Musculatura apendicular dors
Verde claro: Musculatura apendicular ventra
Amarillo: Musculatura axial



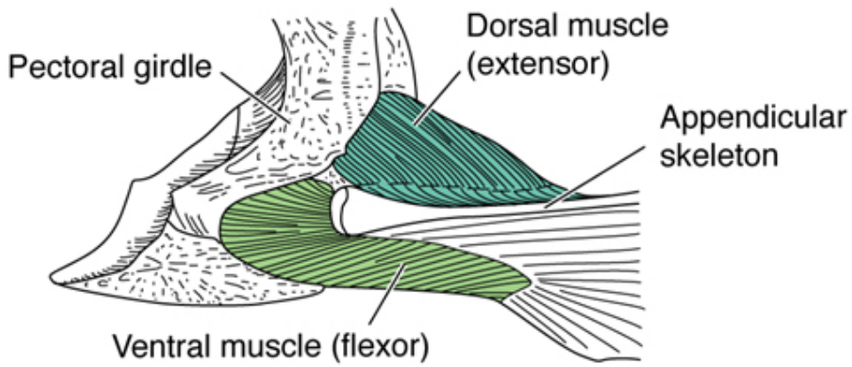
B. Lateral view of deep shoulder and foream muscles of Felis



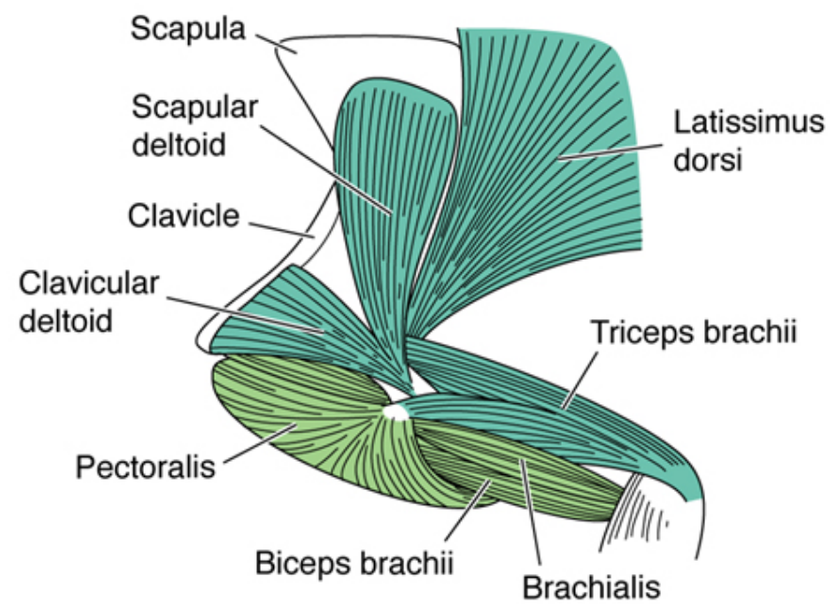
C. Medial view of shoulder and foream muscles of Felis

Verde oscuro: Musculatura apendicular dorsal
Verde claro: Musculatura apendicular ventral
Amarillo: Musculatura axial

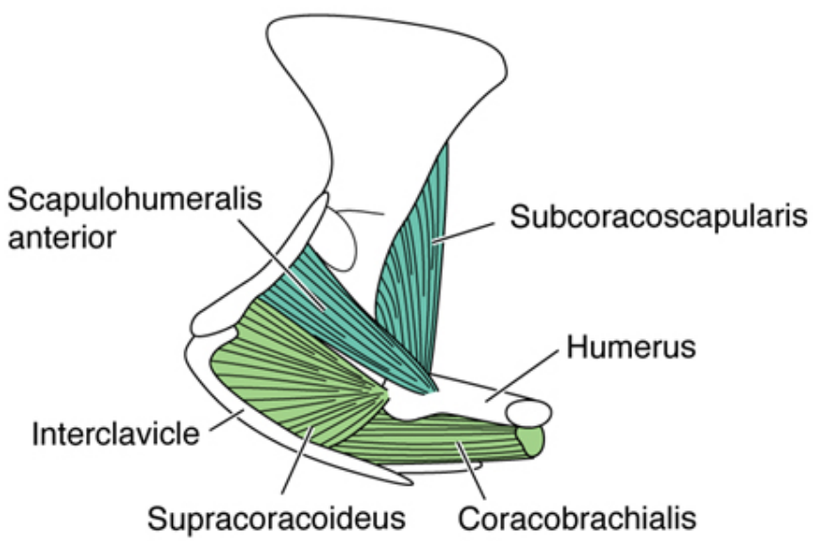
GRUPOS DE MUSCULOS: APENDICULAR



A. Pectoral fin muscles of a sturgeon



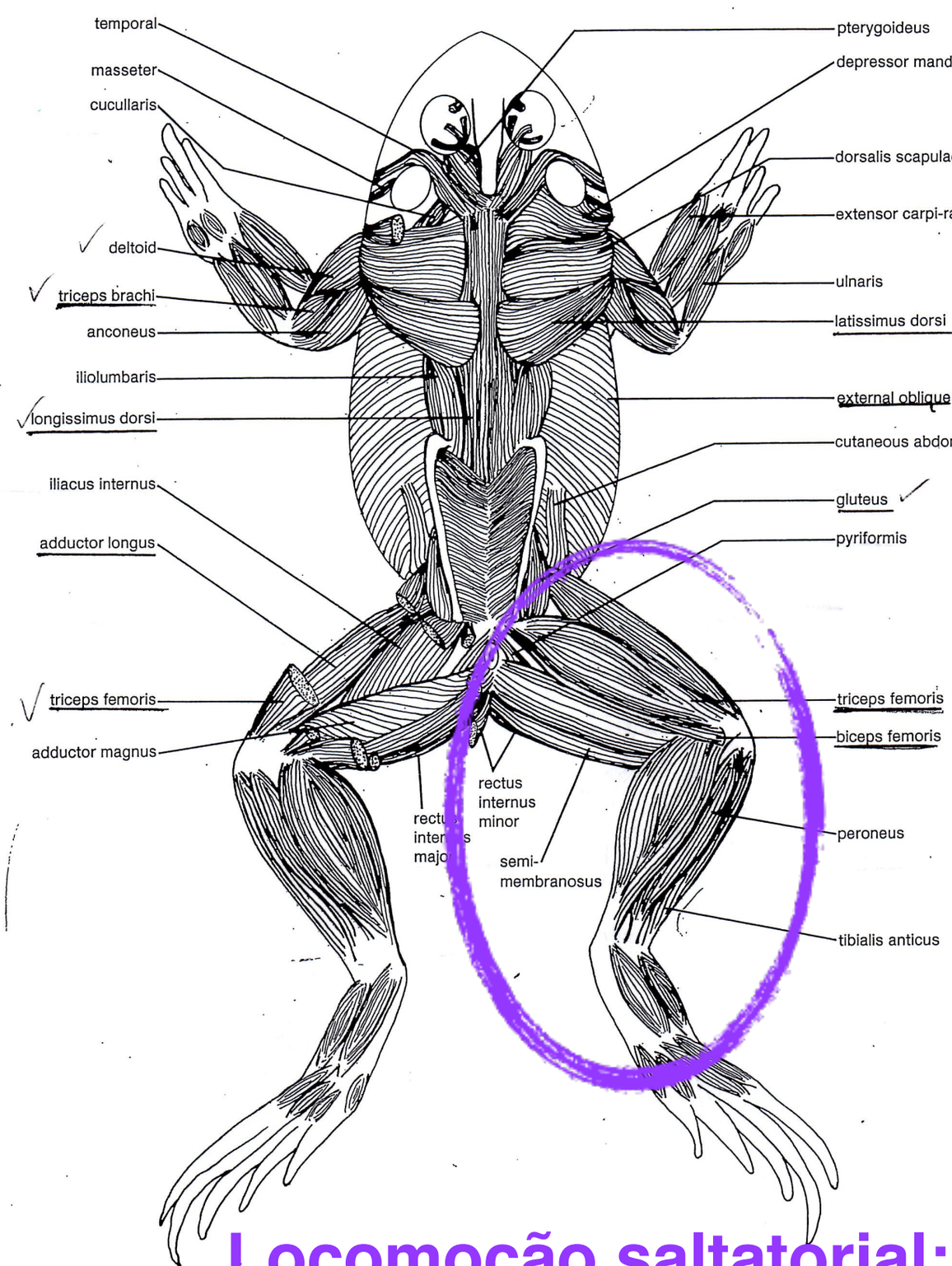
B. Superficial forelimb muscles of a lizard



C. Deep forelimb muscles of a lizard

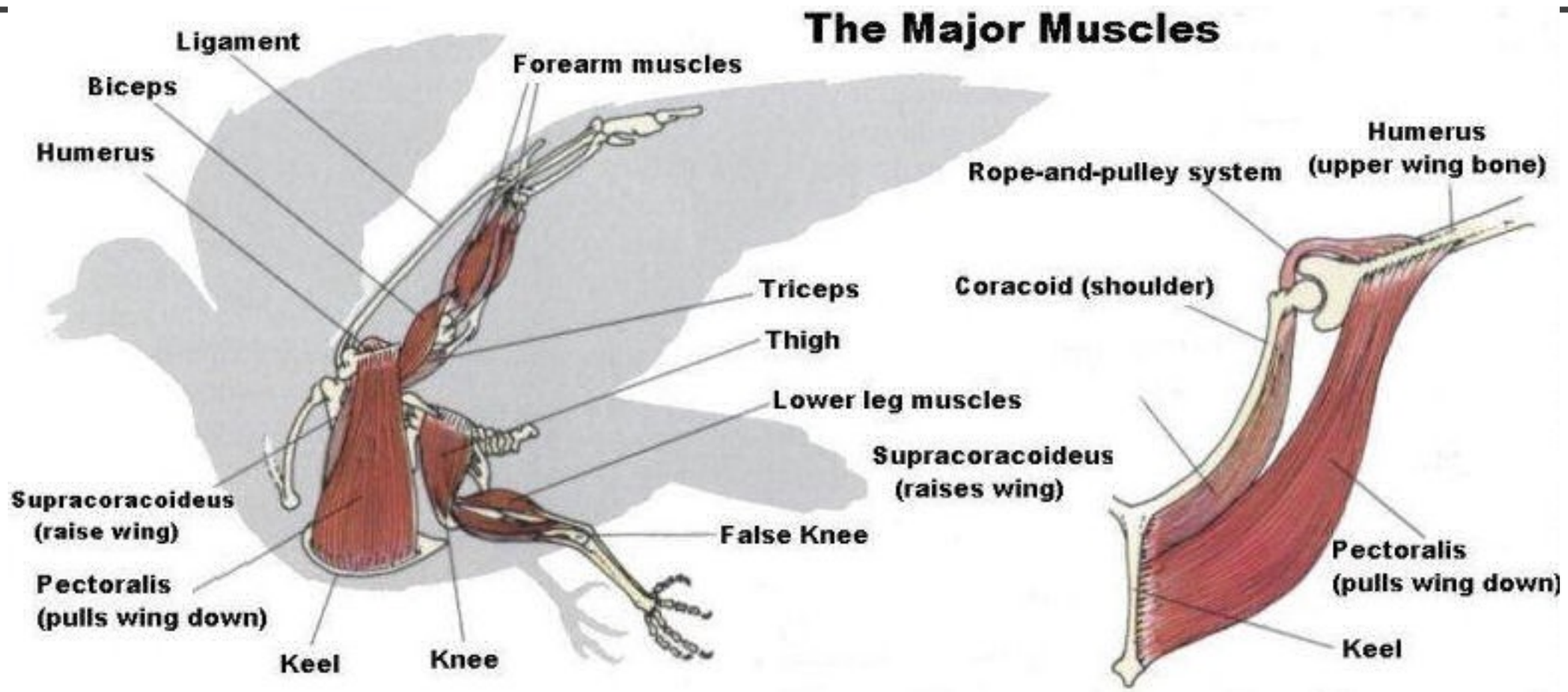
Muito desenvolvidos em Tetrapoda

EVOLUÇÃO DE MÚSCULOS: TETRAPODA



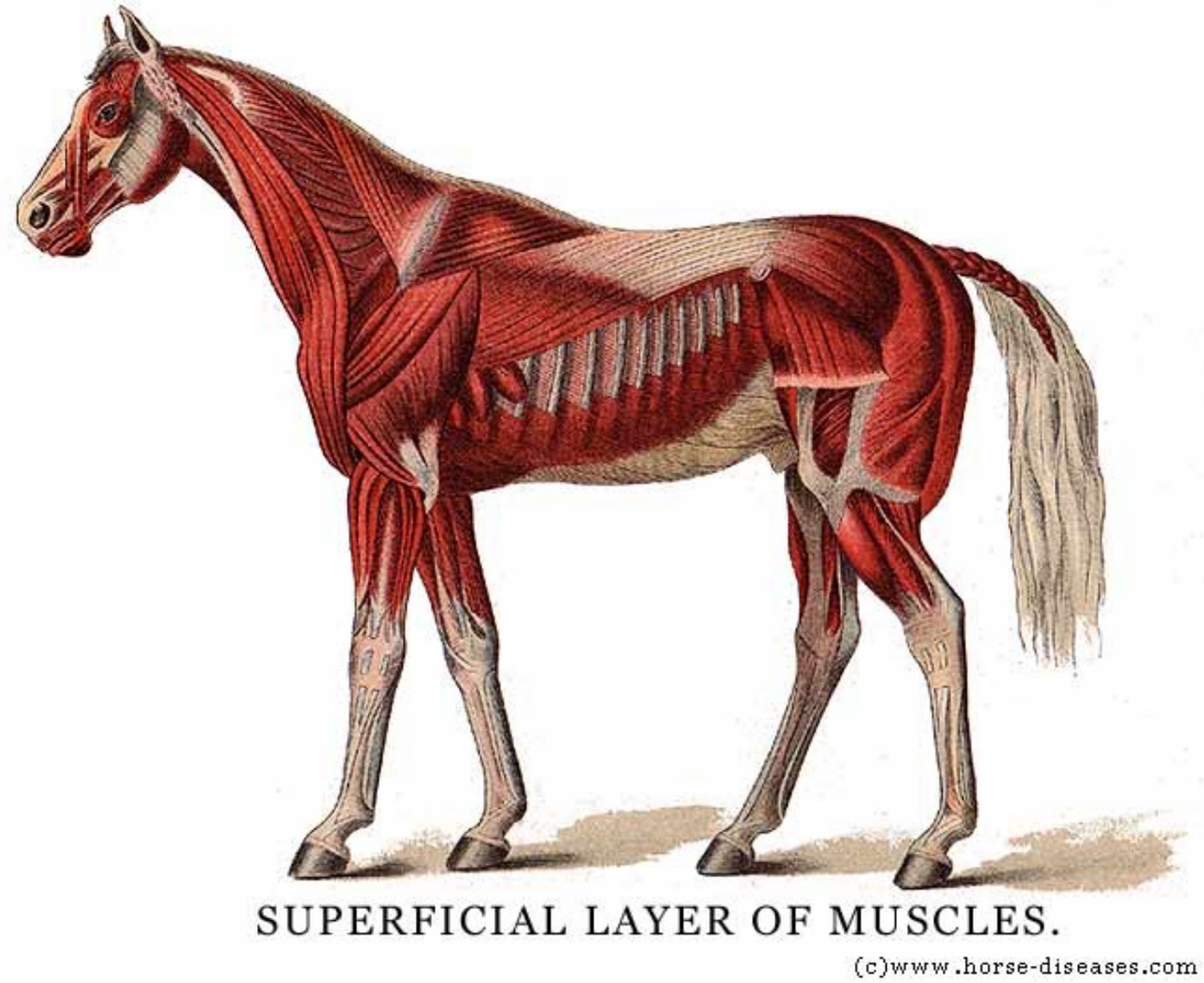
Locomoção saltatorial: músculos apendiculares bem desenvolvidos

EVOLUÇÃO DE MÚSCULOS: TETRAPODA



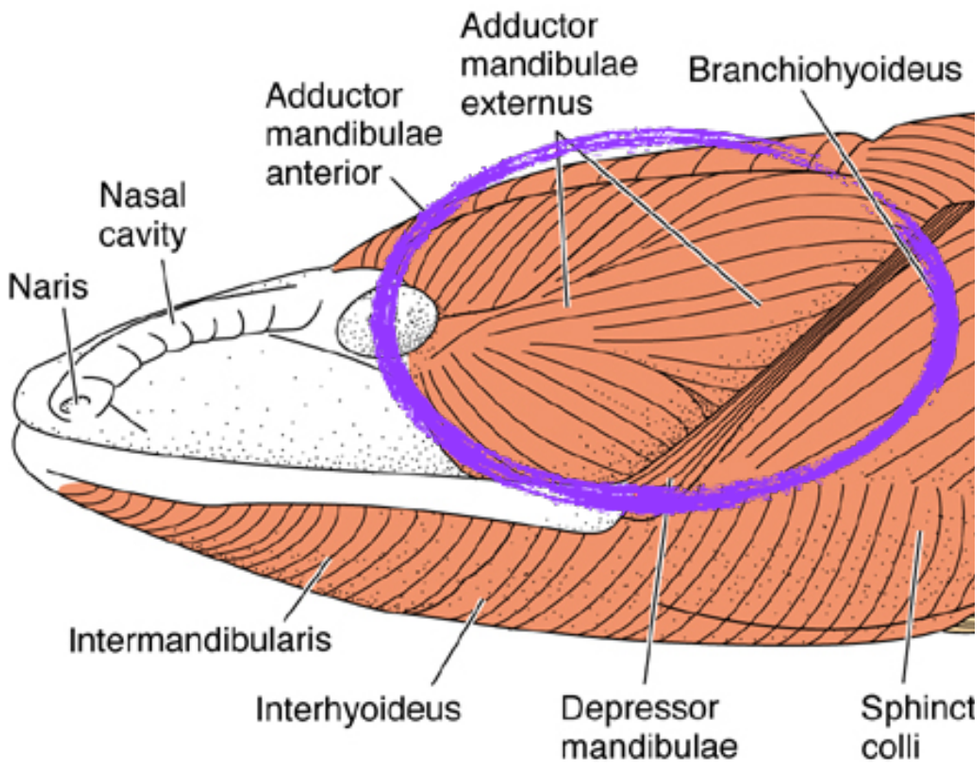
Voo: músculos apendiculares bem desenvolvidos, posição proximal

EVOLUÇÃO DE MÚSCULOS: TETRAPODA

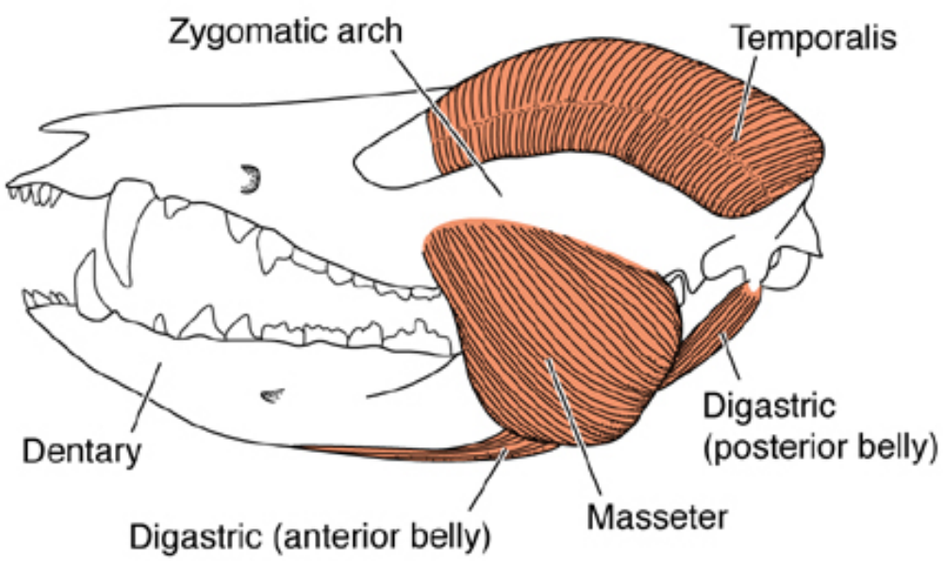


Cursoriais: músculos apendiculares bem desenvolvidos, posição proximal

EVOLUÇÃO DE MÚSCULOS: TETRAPODA



A. Branchiomeric and shoulder muscles of Necturus

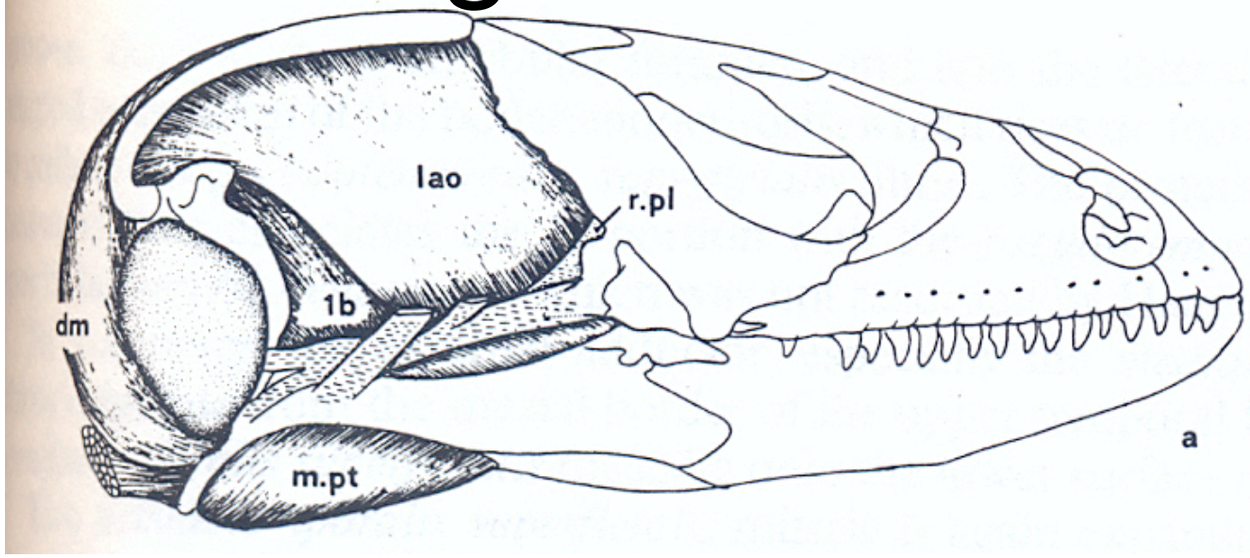


B. Superficial jaw muscle of Didelphis

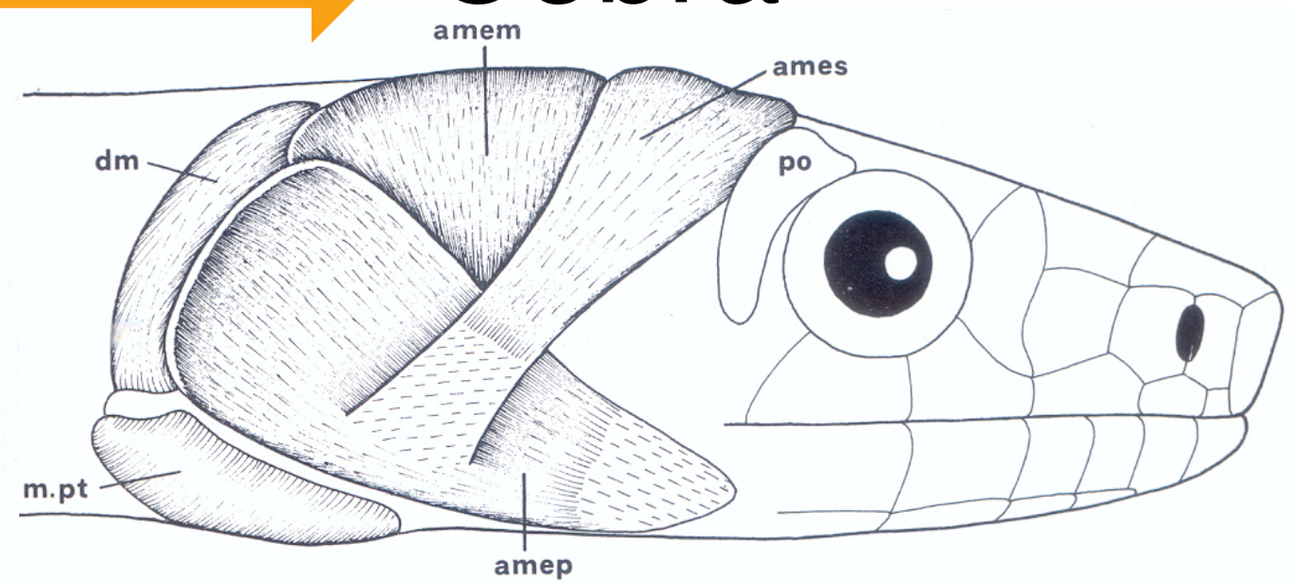
Evolução dos músculos mandibulares: complexidade em Amniota

Rieppel (1980, 1986)

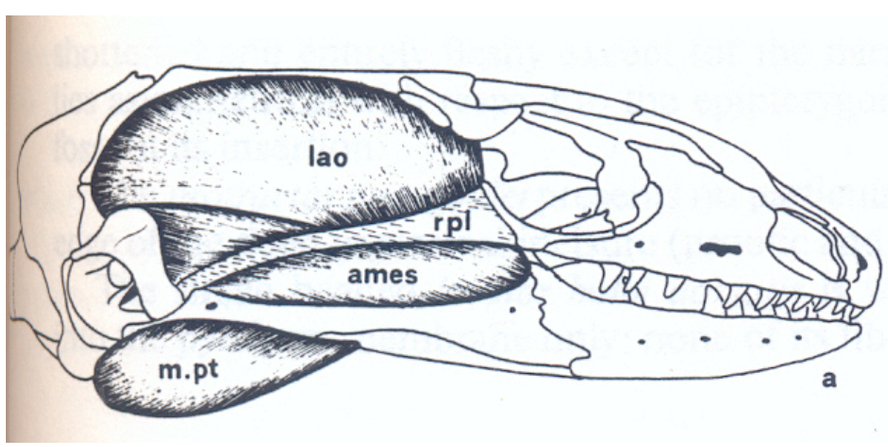
Lagarto → Cobra



Xenosaurus grandis

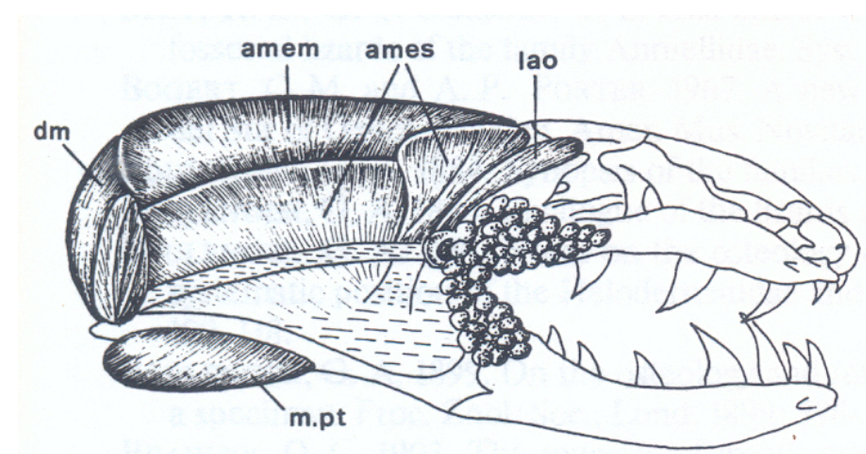


colubrídeo típico



Anniella pulchra

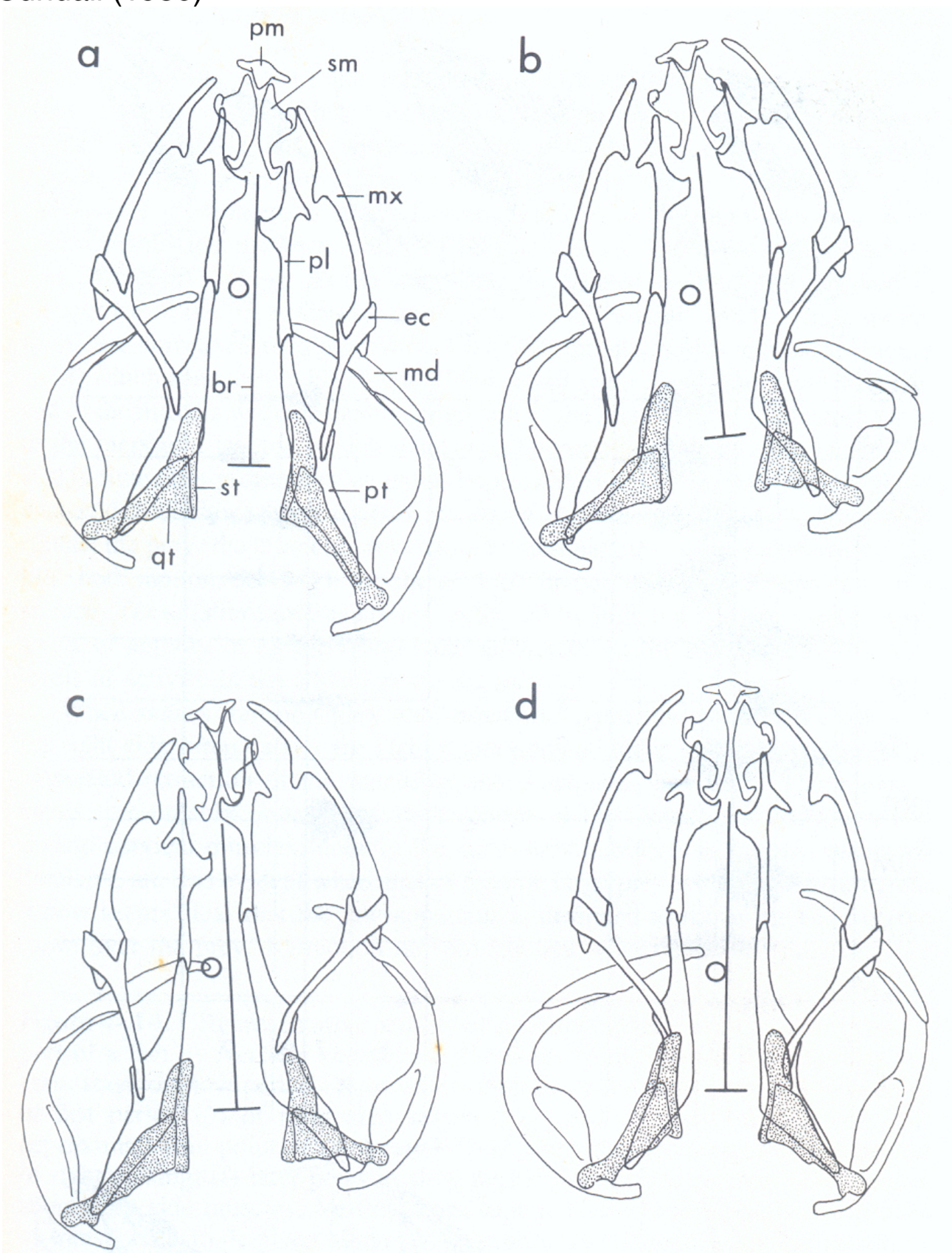
?

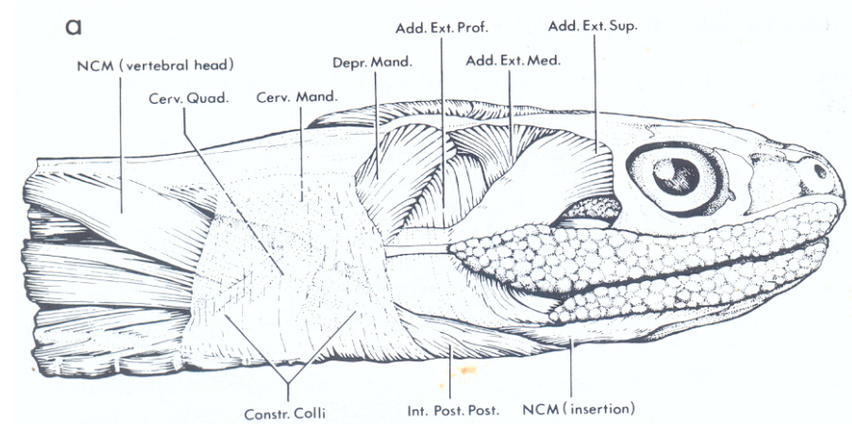


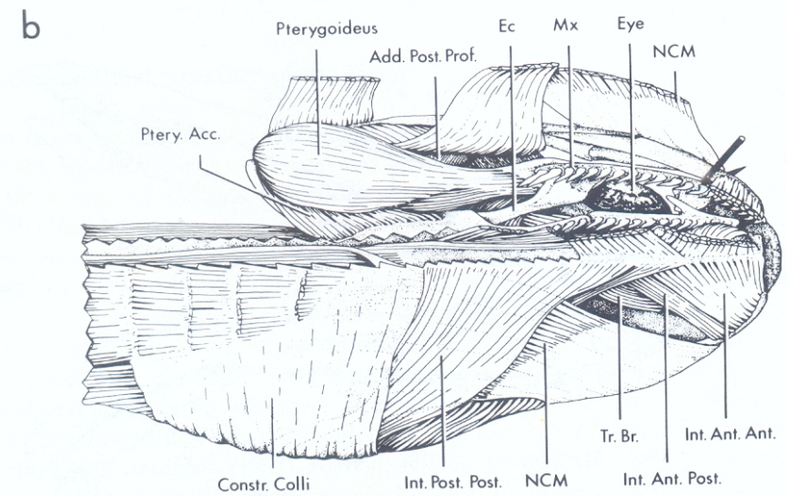
Anilius scytale

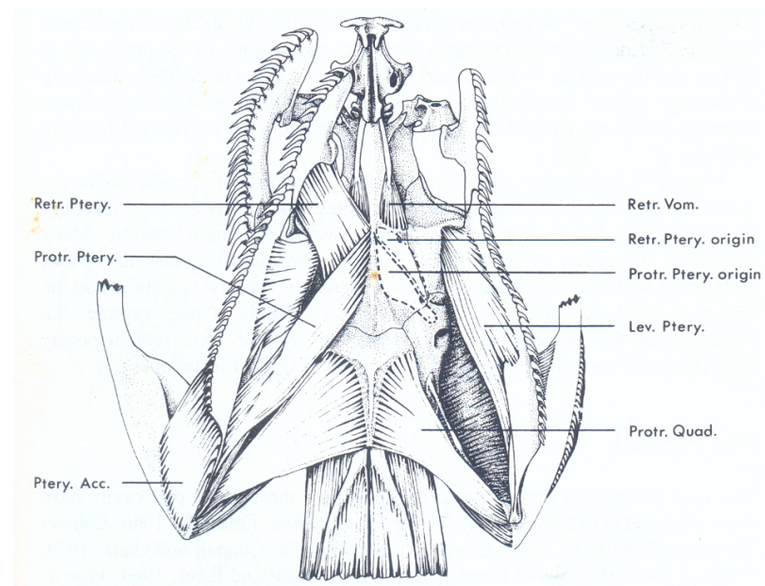
Músculos transformados para uma função especializada na alimentação

Cundall (1986)





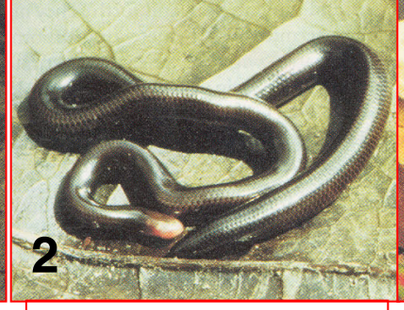




EXTANT SNAKES:
28 families
441 genera
3619 species

Fontes: Vitt (website), Pough et al. (1989)

LEPTOTYPHLOPIDAE (114)



ANOMALEPIDIDAE (18)

TYPHLOPIDAE (281)
GERRHOPILIDAE
XENOTYPHLOPIDAE

CYLINDROPHIIDAE (10)

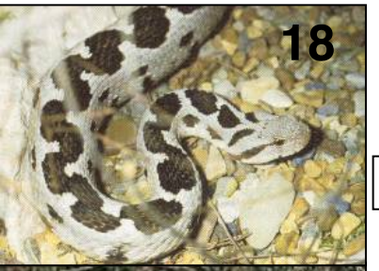
ANILIIDAE (1)

UROPELTIDAE (49)

XENOPELTIDAE (2)

LOXOCEMIDAE (1)

BOIDAE (74)



VIPERIDAE (259)

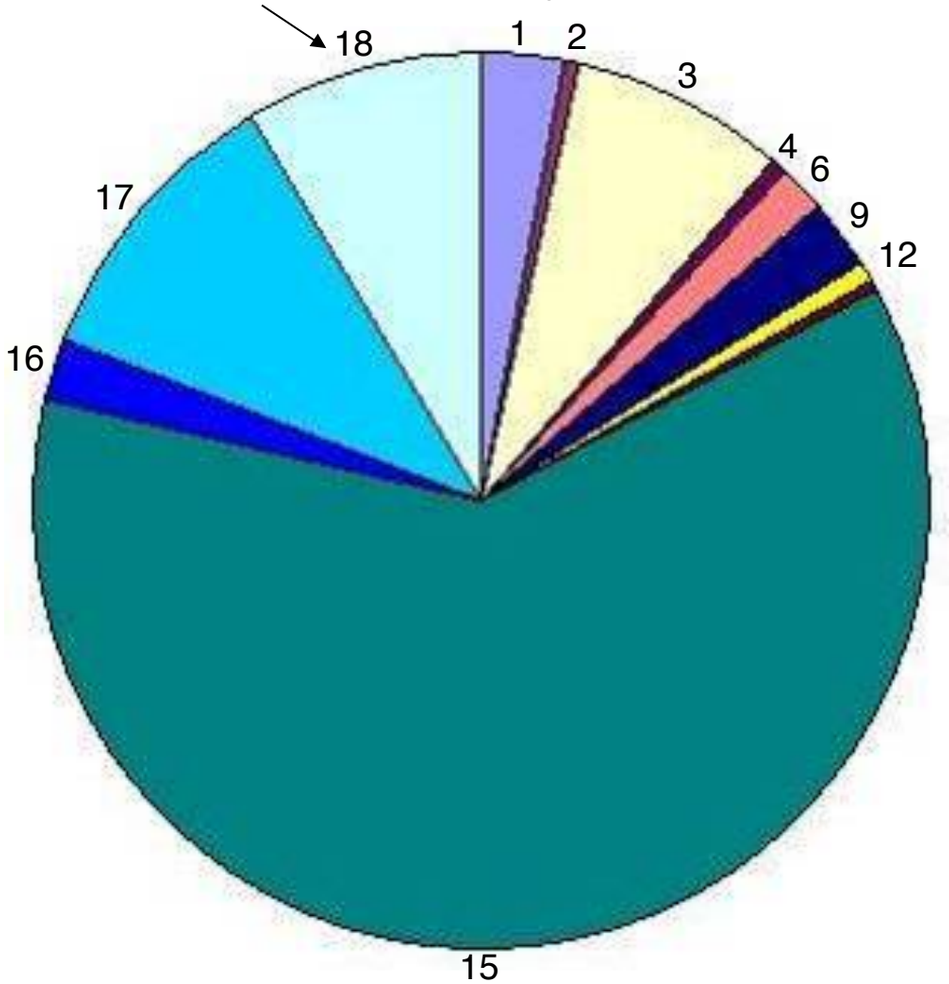
ELAPIDAE (315)

ATRACTASPIDIDAE (66)

COLUBRIDAE
DIPSADIDAE
PSEUDOXENODONTIDAE
NATRICIDAE
LAMPROPHIIDAE
HOMALOPSIDAE
XENODERMIDAE
PAREIDAE
(2409)

ACROCHORDIDAE (3)

Numbers refer to each family



XENOPHIDIIDAE (2)

TROPIDOPHIIDAE (34)

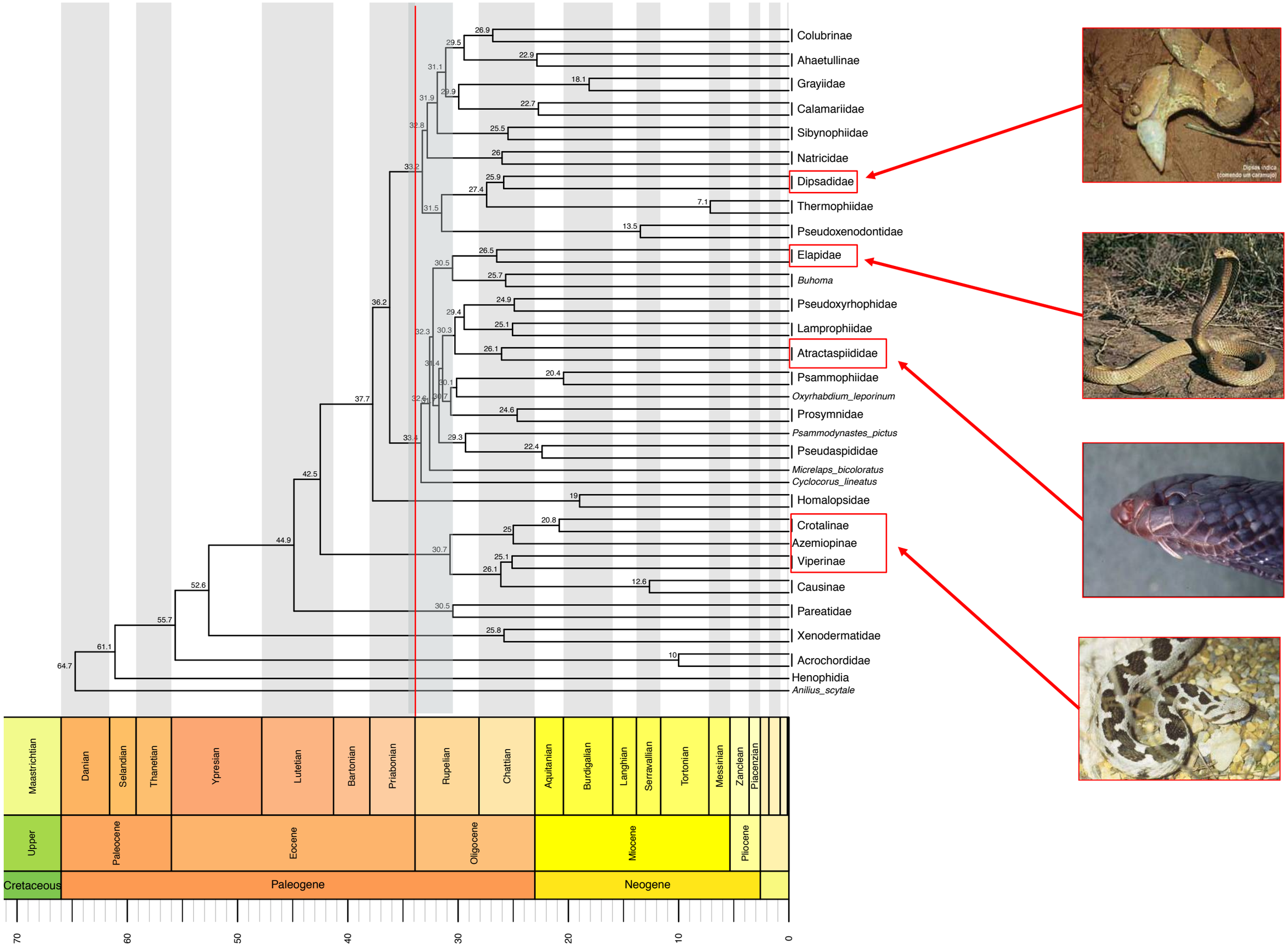
BOLYERIIDAE (2)

UNGALIOPHIIDAE (3)

● = fossorial

● = terrestrial/arboreal

Evolução convergente de um sistema de inoculação de veneno



VIPERIDAE

O compressor da glandula de veneno nos viperídeos se origina do AMEM e não do AMES

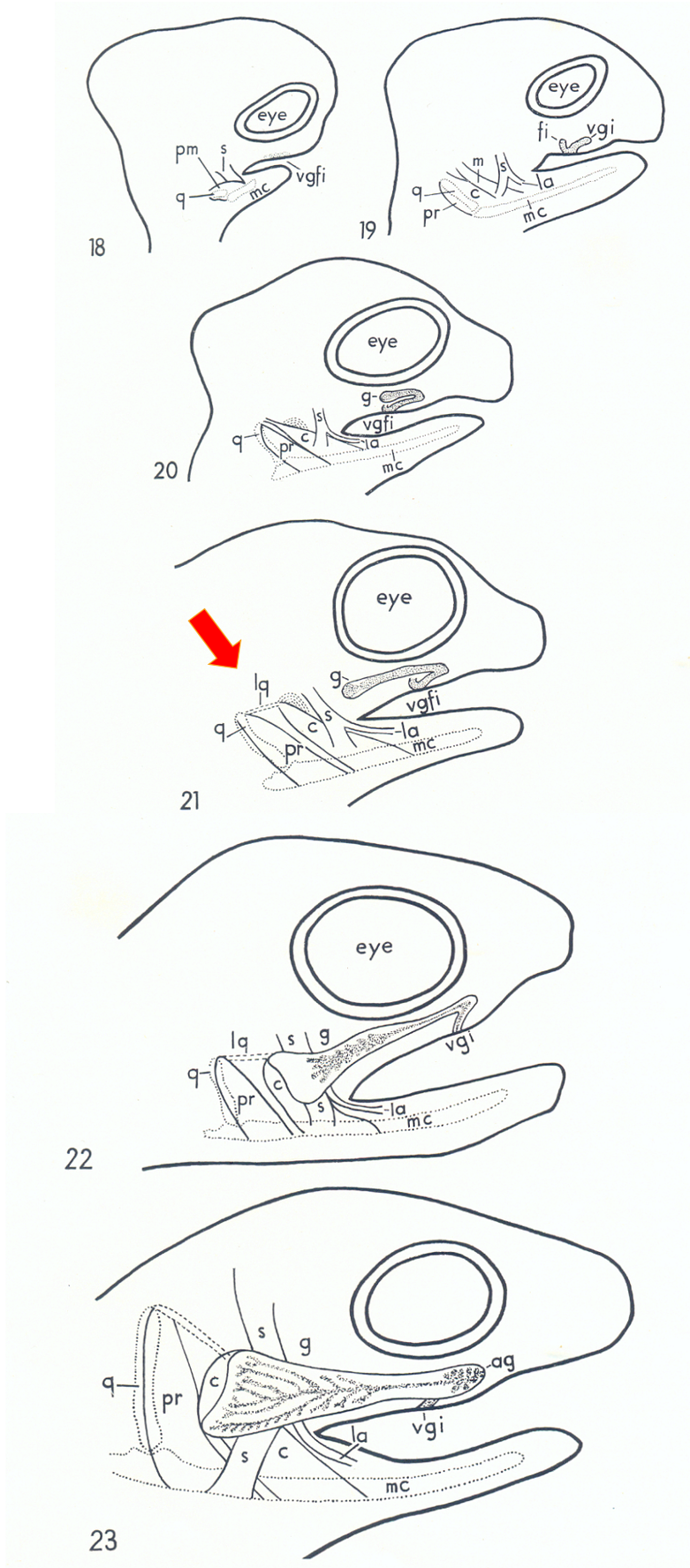
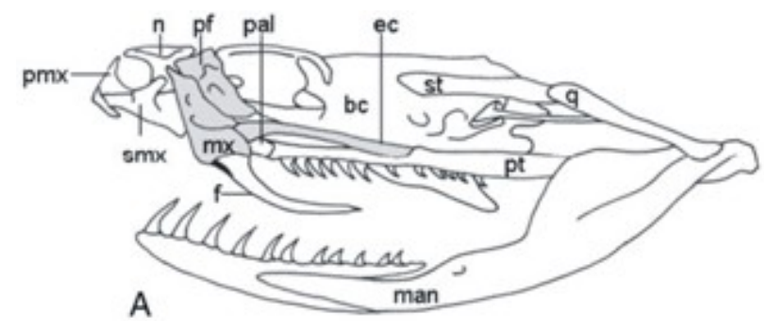
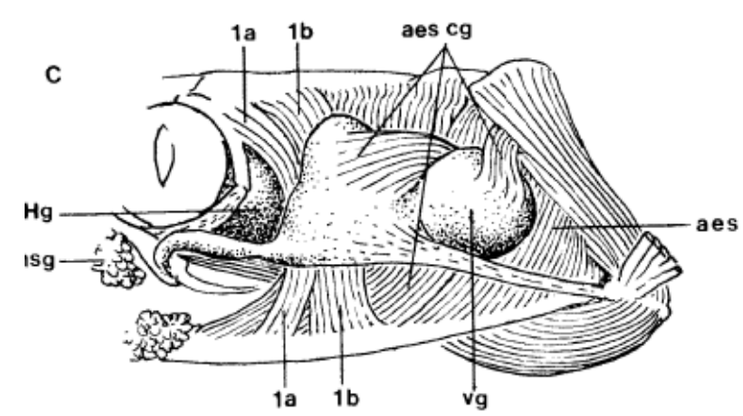


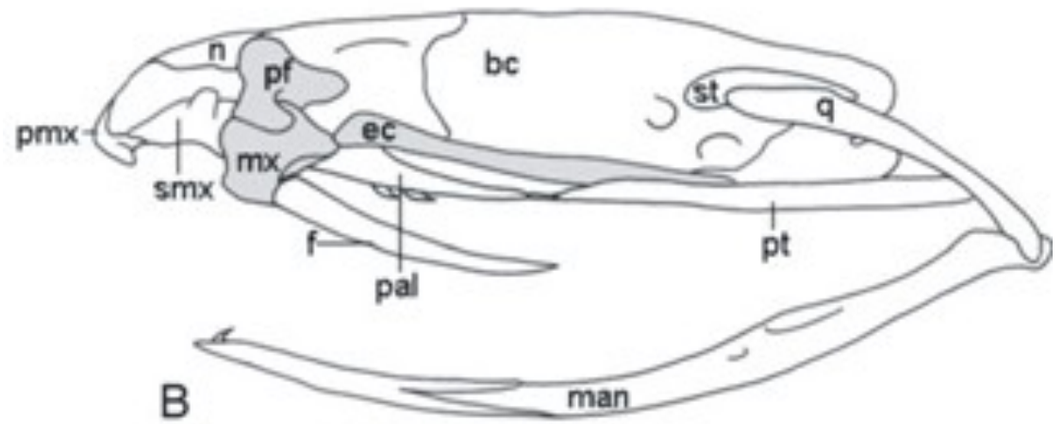
Plate 6.

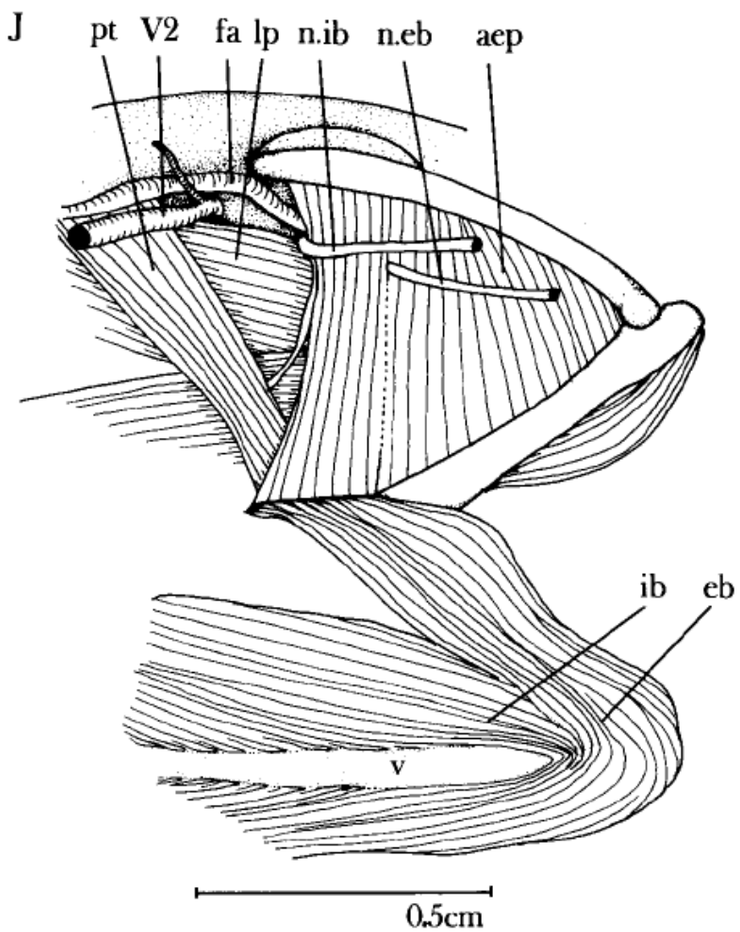




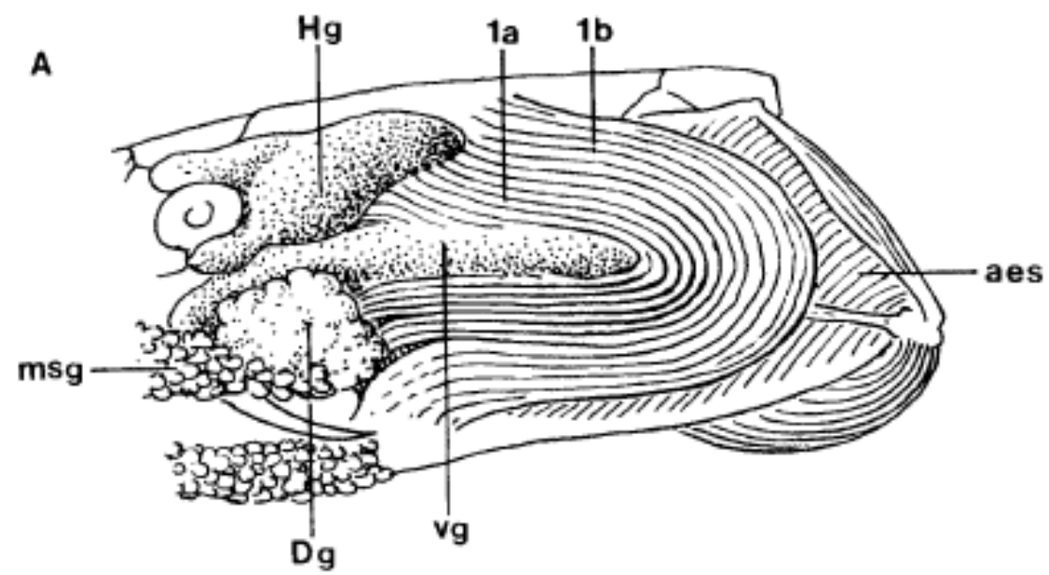
Causus rhombeatus

ATRACTASPIDIDAE



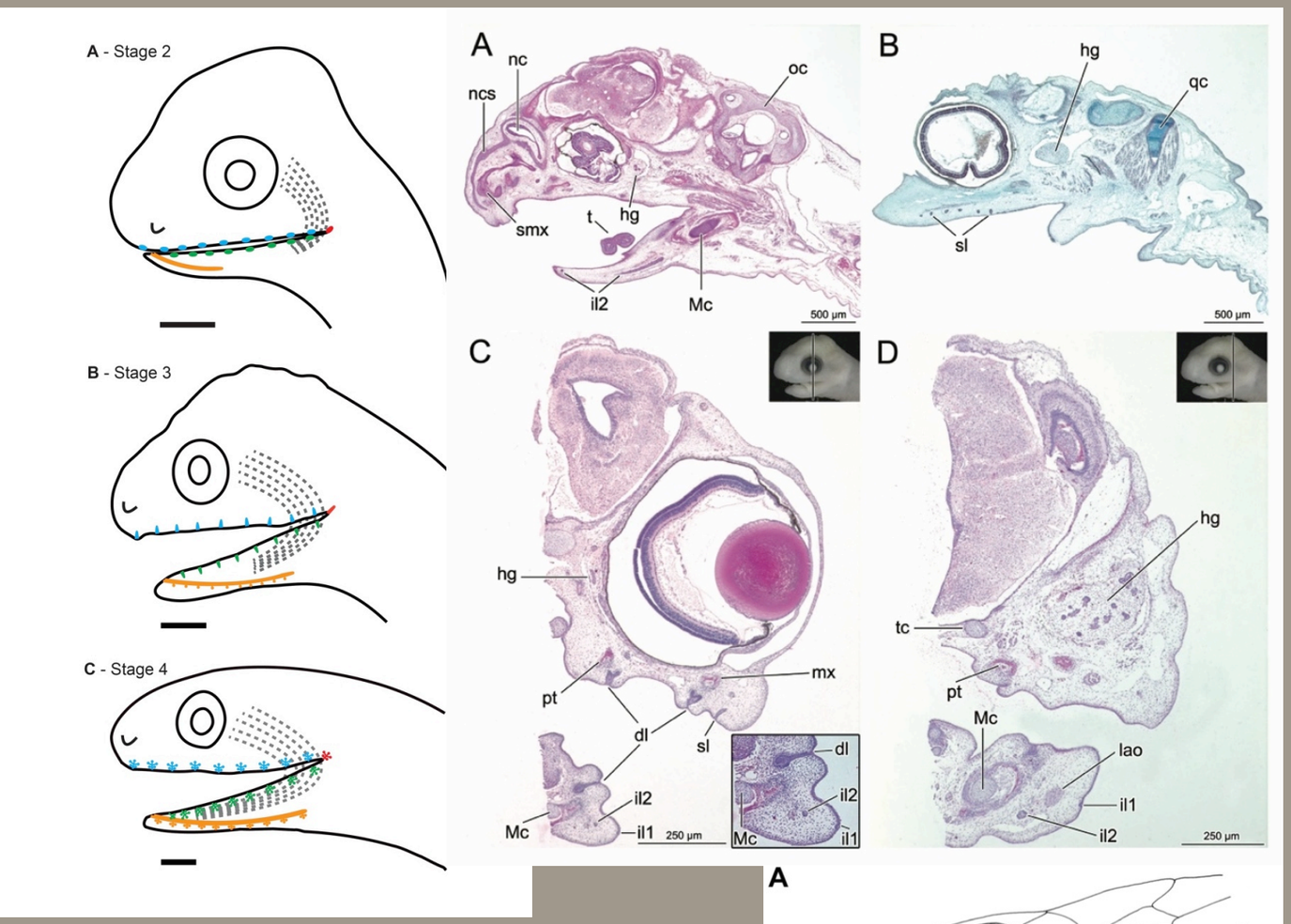
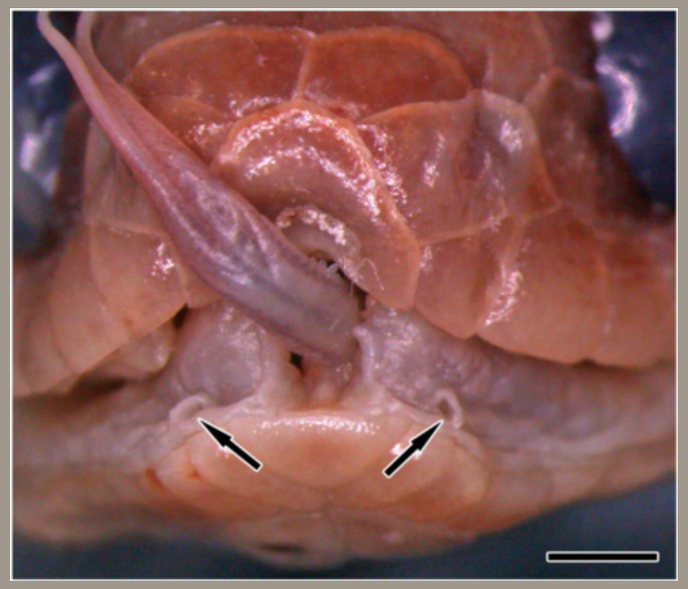
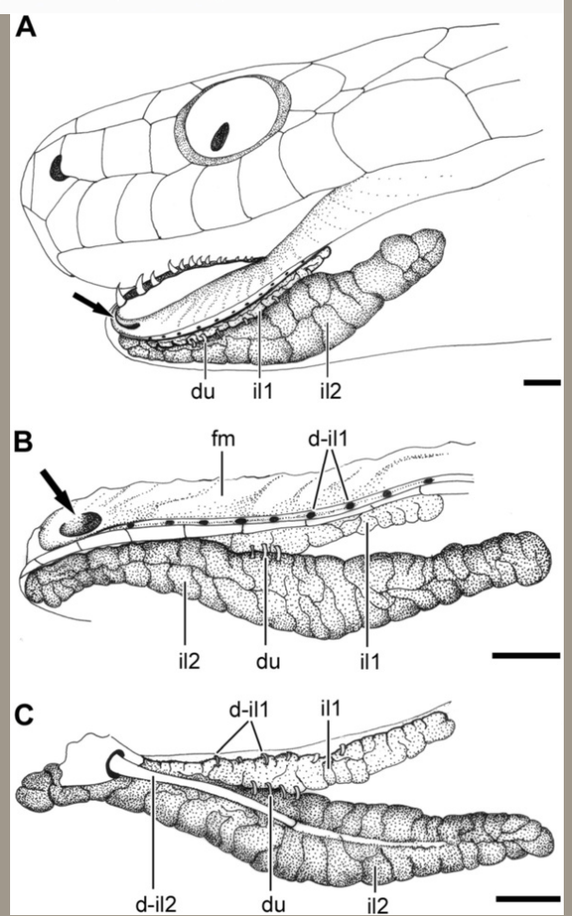
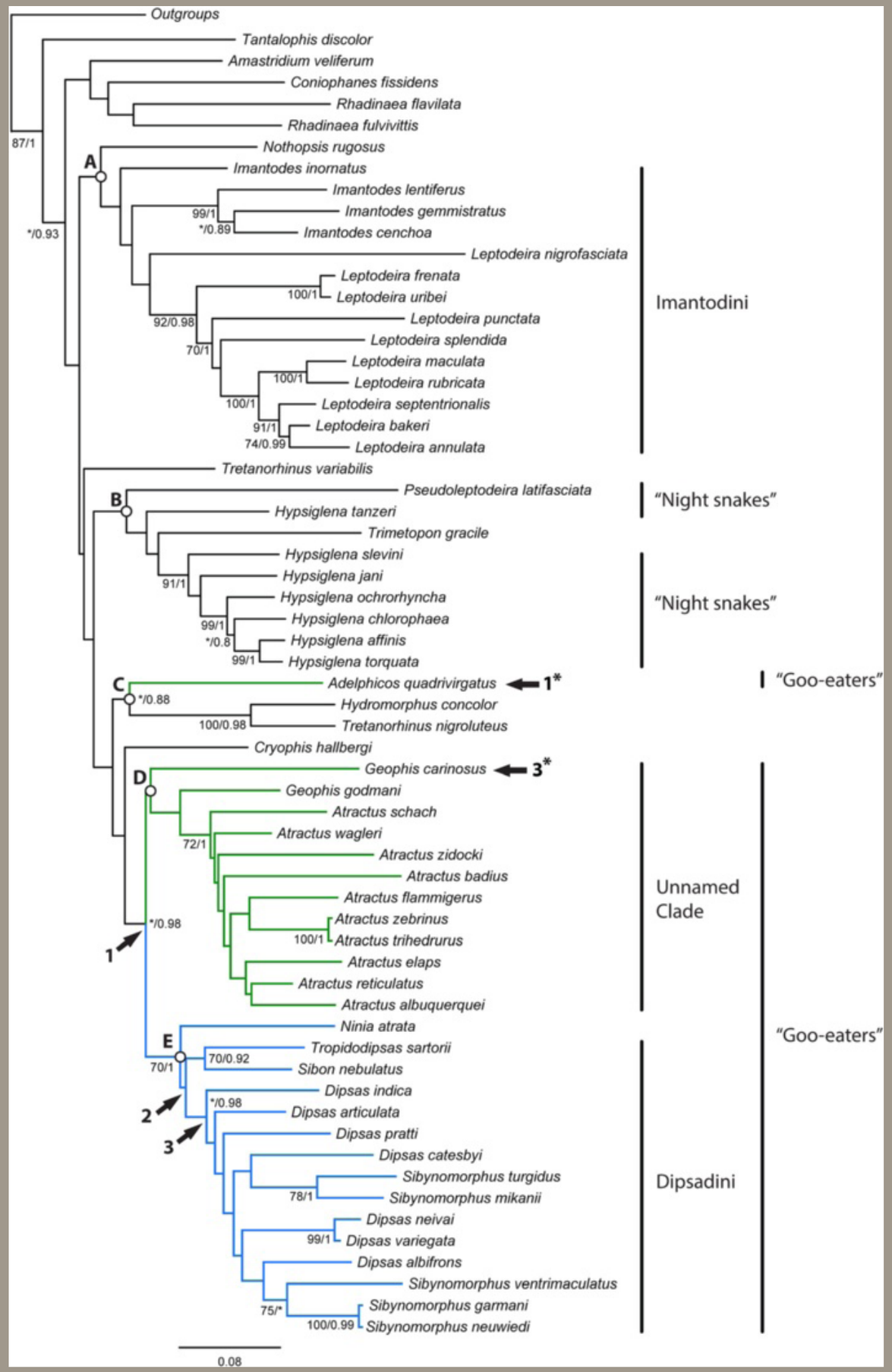


O compressor da glandula de veneno nos atractaspidídeos se origina do AMES



Atractaspis irregularis

DIPSADIDAE: Um novo sistema de inoculação de veneno



Azul, glândula supralabial; Verde, glândula infralabial 1 (il1); Vermelho, glândula rictal; Laranja, glândula infralabial 2 (il2).