
Glad spierweefsel
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Laboratory of Cell Biology and Histology

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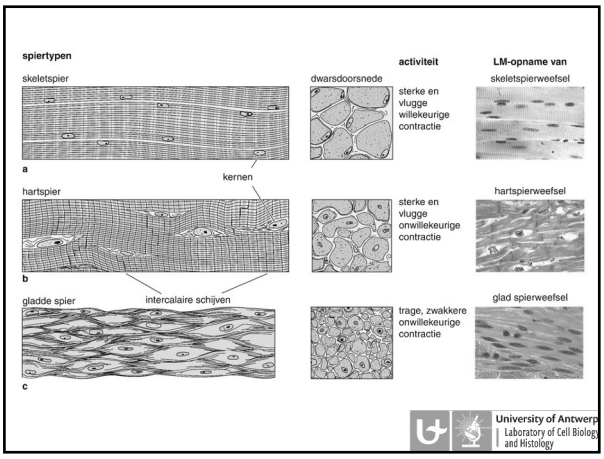
spiertypen
activiteit
LM-opname van
skeletspier
dwarsdoorsnede
sterke en vlugge willekeurige contractie
skeletspierweefsel
a
kernen
hartspier
sterke en vlugge onwillekeurige contractie
hartspierweefsel
b
gladde spier
intercalaire schijven
trage, zwakkere onwillekeurige contractie
glad spierweefsel
c
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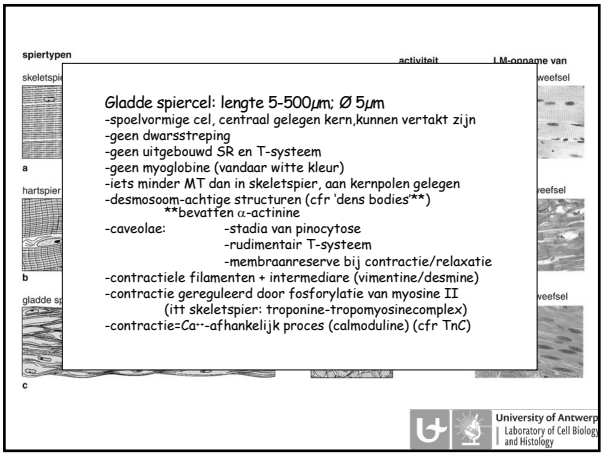
spiertypen
activiteit
LM-opname van
Gladde spiercel: lengte 5-500µm; Ø 5µm
-spoelvormige cel, centraal gelegen kern,kunnen vertakt zijn
-geen dwarsstreping
-geen uitgebouwd SR en T-systeem
-geen myoglobine (vandaar witte kleur)
-iets minder MT dan in skeletspier, aan kernpolen gelegen
-desmosoom-achtige structuren (cfr 'dens bodies'**)
**bevatten α-actinine
-caveolae: -stadia van pinocytose
-rudimentair T-systeem
-membraanreserve bij contractie/relaxatie
-contractiele filamenten + intermediare (vimentine/desmine)
-contractie gereguleerd door fosforylatie van myosine II
(itt skeletspier: troponine-tropomyosinecomplex)
-contractie=Ca++-afhankelijk proces (calmoduline) (cfr TnC)
a
b
c
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Artificiële pellet in stukje dunne darm in petrischaal

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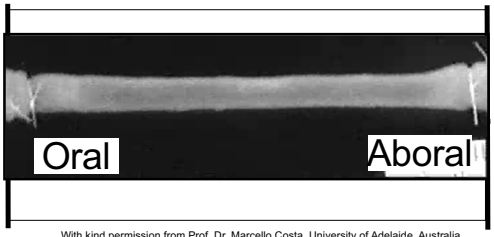
Innervation of the gut is more than extrinsic innervation



With kind permission from Prof. Dr. Marcello Costa, University of Adelaide, Australia.

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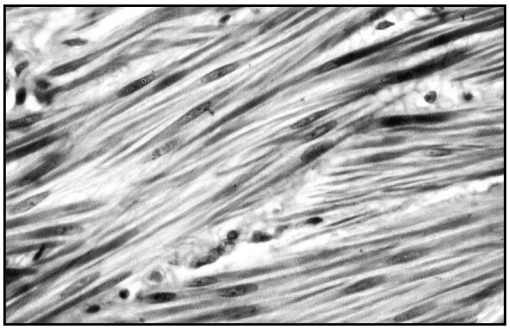

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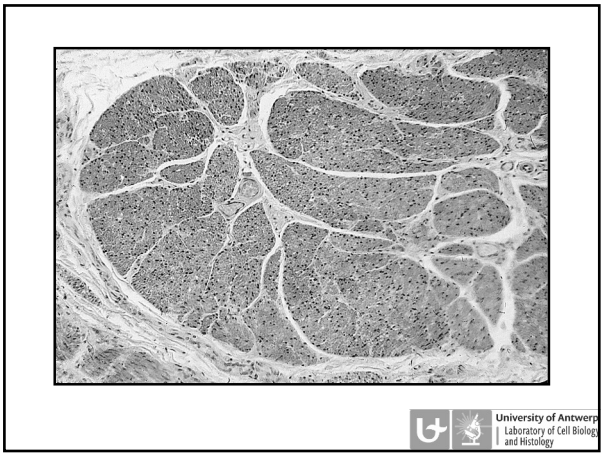

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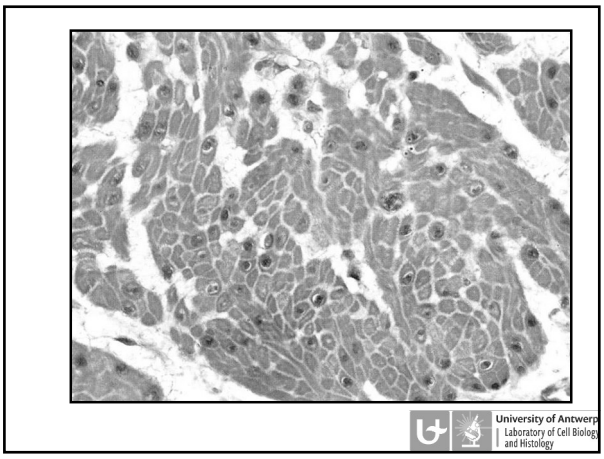

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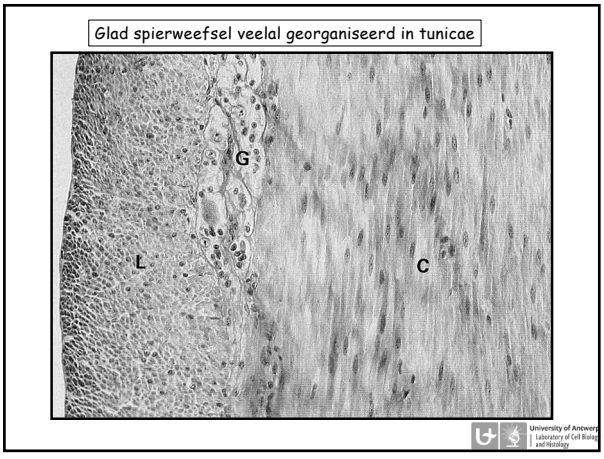

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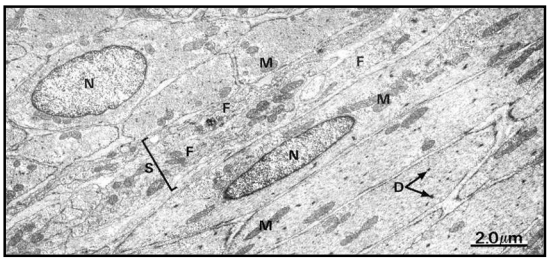

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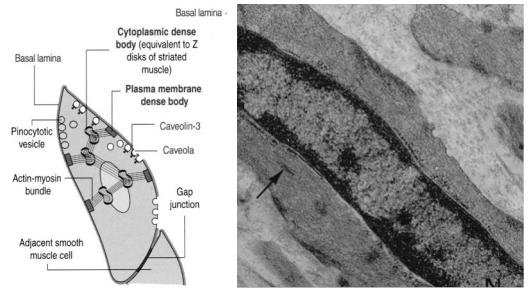
Gladde spiercel

Organisatie actine en myosine



Dense bodies (cfr Z-schijven bij dwarsgestreepte spieren):
bevat <u>α-actinine</u> waaraan actinefilamenten met hun plus-uiteinde gebonden

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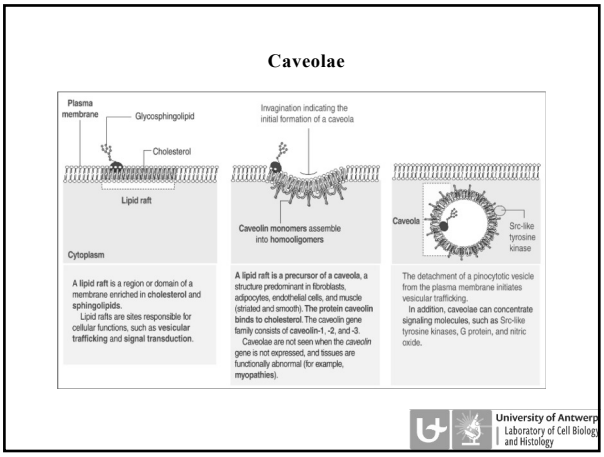
Caveolae
Plasma membrane
Glycosphingolipid
Cholesterol
Lipid raft
Cytoplasm
Invagination indicating the initial formation of a caveola
Caveolin monomers assemble into homooligomers
Caveola
Src-like tyrosine kinase
A lipid raft is a region or domain of a membrane enriched in cholesterol and sphingolipids.
Lipid rafts are sites responsible for cellular functions, such as vesicular trafficking and signal transduction.
A lipid raft is a precursor of a caveola, a structure predominant in fibroblasts, adipocytes, endothelial cells, and muscle (striated and smooth). The protein caveolin binds to cholesterol. The caveolin gene family consists of caveolin-1, -2, and -3.
Caveolae are not seen when the caveolin gene is not expressed, and tissues are functionally abnormal (for example, myopathies).
The detachment of a pinocytotic vesicle from the plasma membrane initiates vesicular trafficking.
In addition, caveolae can concentrate signaling molecules, such as Src-like tyrosine kinases, G protein, and nitric oxide.
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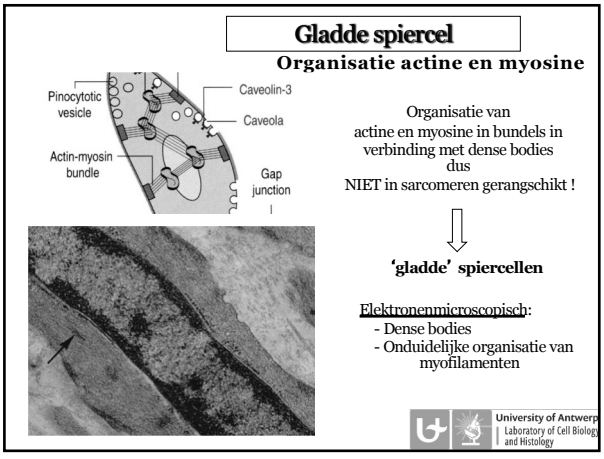
Gladde spiercel
Organisatie actine en myosine
Pinocytotic vesicle
Caveolin-3
Caveola
Actin-myosin bundle
Gap junction
Organisatie van actine en myosine in bundels in verbinding met dense bodies dus NIET in sarcomeren gerangschikt !
'gladde' spiercellen
Elektronenmicroscopisch:
- Dense bodies
- Onduidelijke organisatie van myofilamenten
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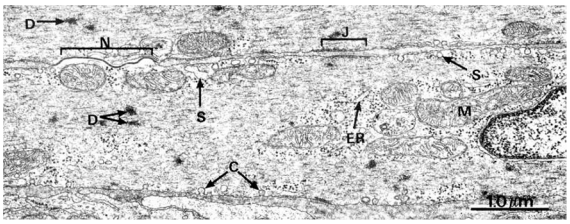
Gladde spiercel



Sarcoplasmatisch reticulum minder ontwikkeld dan bij dwarsgestreepte spier

Rondom de kern: mitochondriën, ribosomen, RER, Golgi-apparaat, geen myoglobine

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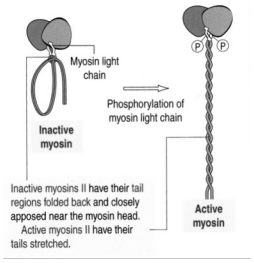
Gladde spiercel

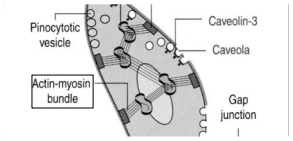
Organisatie actine en myosine



Myosine komt voor in inactieve vorm (geplooid staartdeel)

⇩

Actief myosine II gaat naast actinefilamenten liggen



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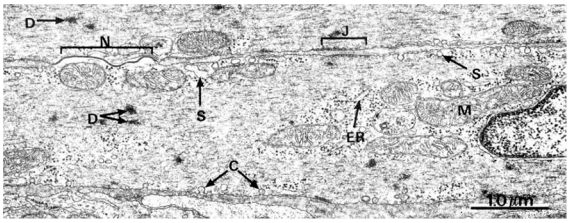
Gladde spiercel

Intracellulaire calciumstijging



Intracellulaire calciumstijging kan op verschillende manieren

Eén manier is vergelijkbaar met dwarsgestreepte spieren:

- -Caveolae (rudimentair T-systeem)
- -Maar ook influx van extracellulair Ca^{2+} (pinocytose van vloeistof met hoge Ca^{2+} -concentratie)

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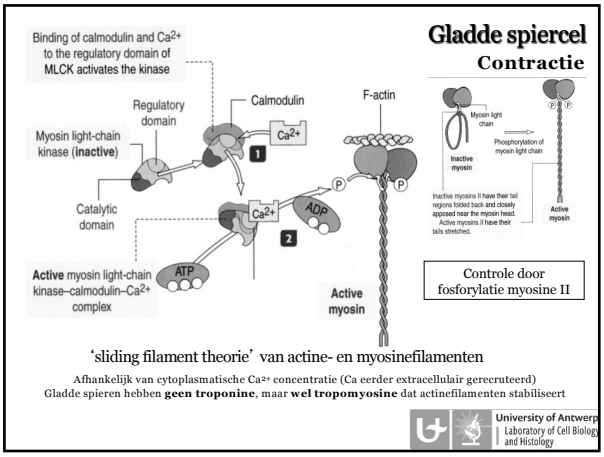
Gladde spiercel
Contractie
Binding of calmodulin and Ca2+ to the regulatory domain of MLCK activates the kinase
Regulatory domain
Calmodulin
F-actin
Myosin light-chain kinase (inactive)
Ca2+
1
Catalytic domain
Ca2+
ADP
2
ATP
Active myosin light-chain kinase–calmodulin–Ca2+ complex
Active myosin
Myosin light chain
Phosphorylation of myosin light chain
Inactive myosin
Active myosin
Inactive myosins II have their tail regions folded back and closely apposed near the myosin head. Active myosins II have their tails stretched.
Controle door fosforylatie myosine II
'sliding filament theorie' van actine- en myosinefilamenten
Afhankelijk van cytoplasmatische Ca2+ concentratie (Ca eerder extracellulair gerecruteerd)
Gladde spieren hebben geen troponine, maar wel tropomyosine dat actinefilamenten stabiliseert
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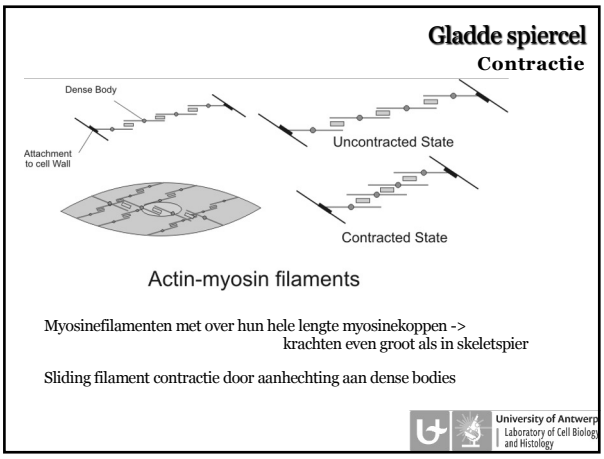
Gladde spiercel
Contractie
Dense Body
Attachment to cell Wall
Uncontracted State
Contracted State
Actin-myosin filaments
Myosinefilamenten met over hun hele lengte myosinekoppen ->
krachten even groot als in skeletspier
Sliding filament contractie door aanhechting aan dense bodies
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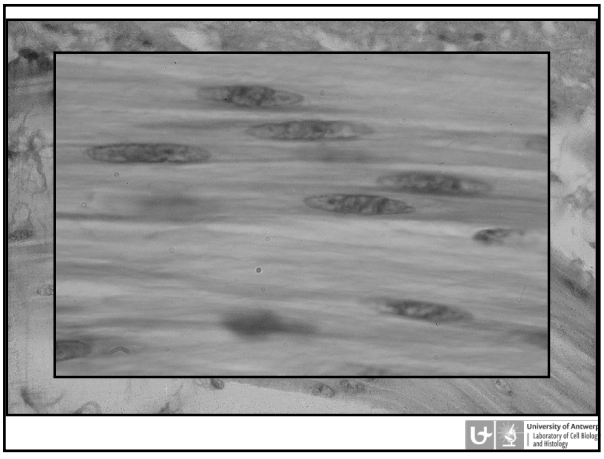
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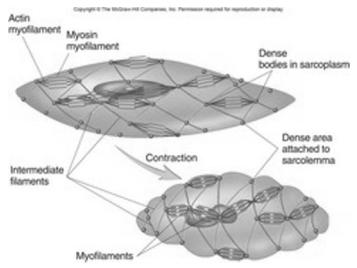
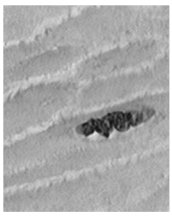
Contractie





Positie dense bodies, myofilamenten en intermediaire filamenten (desmine/vimentine) zorgt voor verwringing gladde spiercel bij contractie

Contractie is trager dan skeletspiercel maar kan langer aanhouden (cfr tonus)

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Gladde spiercel
Controle van de contractie

Autonoom zenuwstelsel:

verschillende transmitters: eindresultaat afhankelijk van transmitter en aanwezigheid receptor

Chemische stoffen:

Beïnvloeding instroom van extracellulair Ca^{2+}
Lokale (chemische) factoren vb histamine, hypoxie
Hormonen (vb oxytocine,…)

Door rekking:

vb tonische contractie door gladde spiercellen van de luchtwegen;
vb oprekking gladde spieren van de blaas

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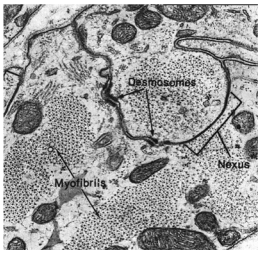
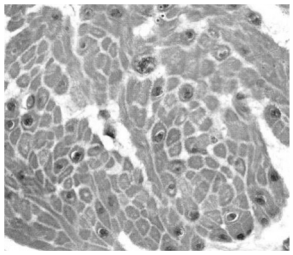
Single unit gladde spieren





Werken als één geheel: gap junctions en desmosomen; minder sterk bezenuwd dan 'multi-unit' gladde spieren
Georganiseerd in tunicae

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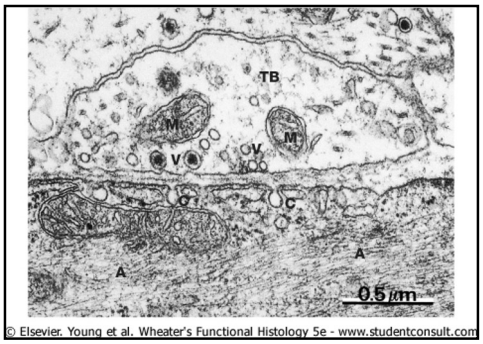

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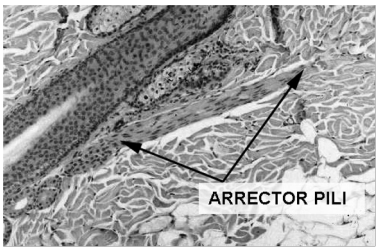
Multi unit gladde spieren



Geen gap junctions, wel goede bezenuwing (eerder 'motorische eenheden' ; ander vb. iris-musculatuur)

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Histogenese, groei & regeneratie van gladde spier

Histogenese, groei:
- mechanismen minder gekend
- hypertrofie (cfr uteruswand tijdens dracht)
- postnataal zou differentiatie van mesenchymale cellen naar gladde spier-cellen nog kunnen voorkomen

Regeneratie:
- regeneratie door mitose mogelijk, meestal echter veel bw-vorming
- dus nooit volledig herstel van oorspronkelijke toestand

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