

The Stapedio-vestibular joint – "How to be fixed and movable at the same time".

The explanation lies in the architecture
of the stapedio-vestitubular joint.

Prof. Claude Laurent will explain



The stapedio-vestibular connection looks different in different species



Syndesmosis or diarthrosis?

Syndesmosis – is a fibrous connection.

It is found in all children up to the age of 13 years.

Is also found in cats, dogs, sheep, rabbits and rats.

Diarthrosis is a synovial joint-cavity.

Is found in 30% of adult humans.

Is also present in guinea pigs, chinchillas and in monkeys.

How does the oval window look in the majority of humans?

- The stapedio-vestibular connection is usually (in 70% of the cases) a half-joint with a small joint cavity in the rear part facing the "processus pyramidalis" and a syndesmosis in the rest of the insertion of the stapes.
- In the human there is never a true annular ligament!

Connective tissue components in the middle ear (studies in the rat)

- A discovery of a high accumulation of hyaluronic acid around the stapes in the oval window



Histological examinations

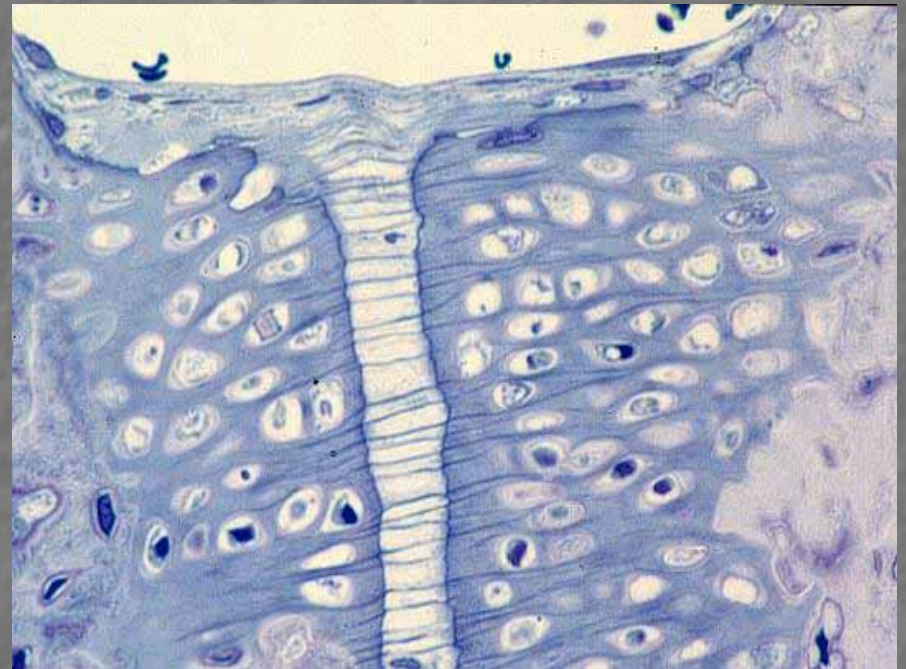
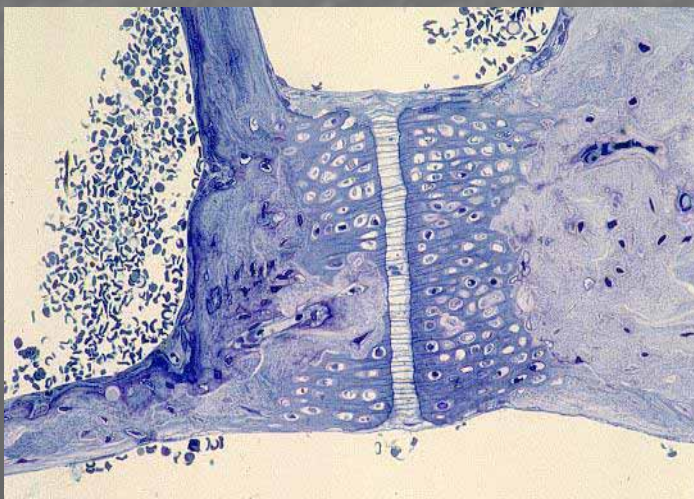
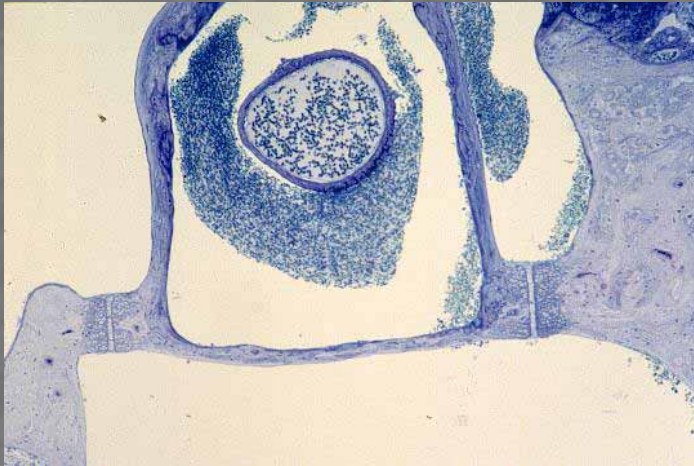
- Paraffin sections stained with

- 1) A hyaluronic acid binding protein probe
- 2) Haematoxylin-Van Gieson
- 3) Mallory stain
- 4) Weigert's elastin staining

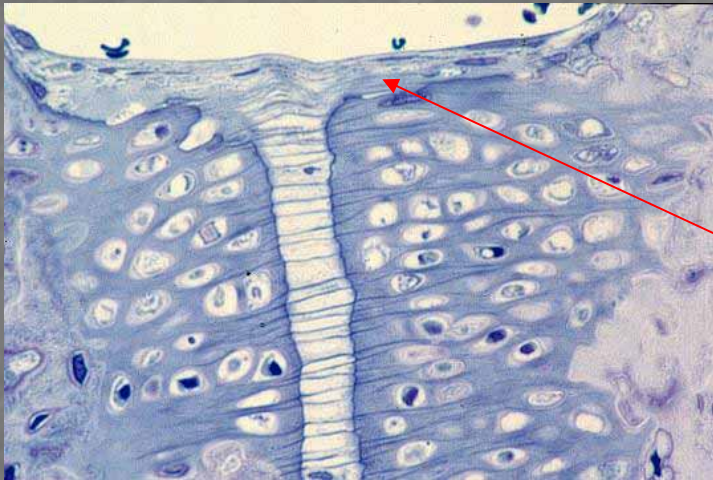
- Plastic sections stained with

- 1) Toluidine blue and contrasted for electron microscopy

The stapedio-vestibular connection – toluidine blue

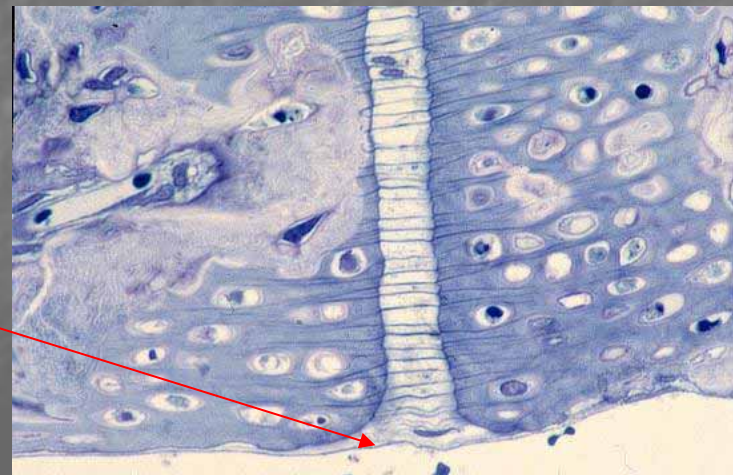


Ligaments are present on both sides – facing the middle ear and the vestibulum

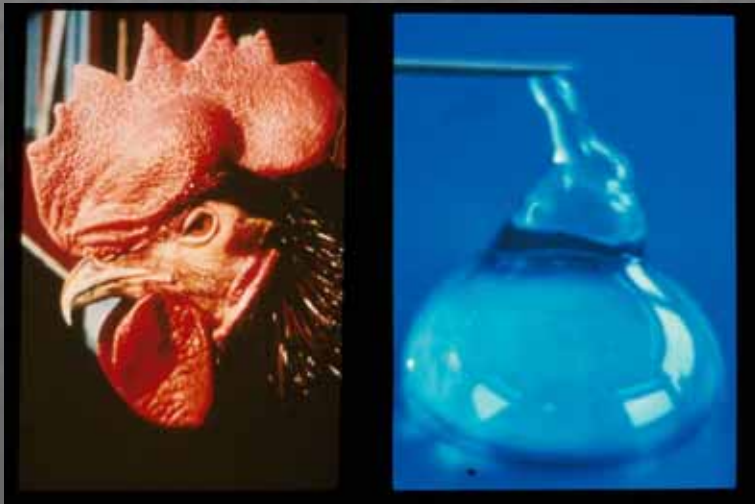
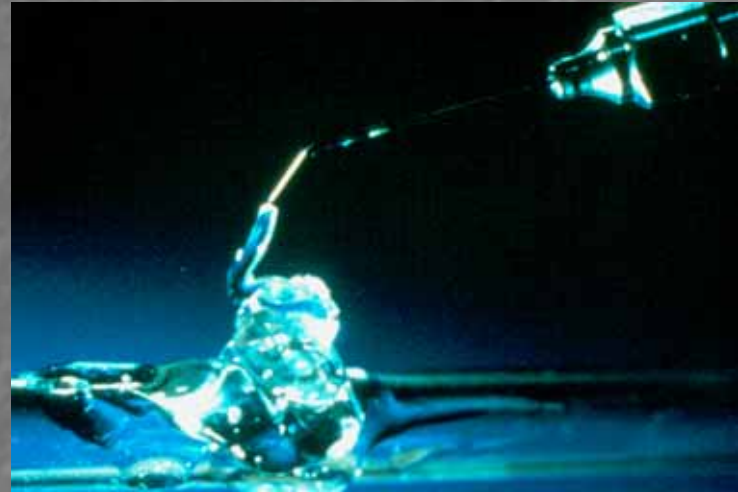


The ligament facing the middle ear is thick

The ligament facing the vestibulum is thinner than the one above



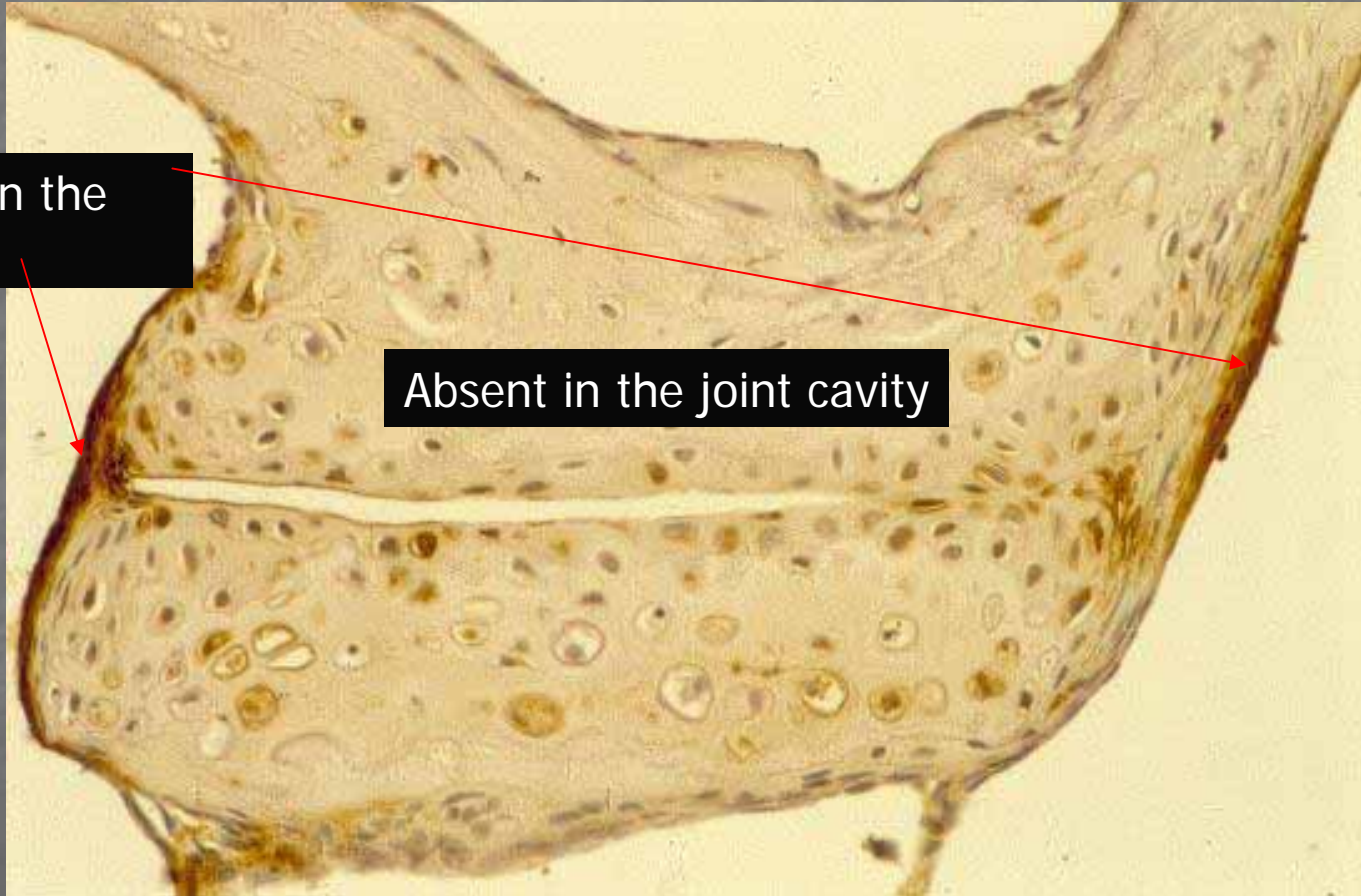
Hyaluronic acid – our best shock absorber, lubricant and a “bounce-trampoline”



Hyaluronic acid in the incudo-stapedial joint

Abundant in the ligaments

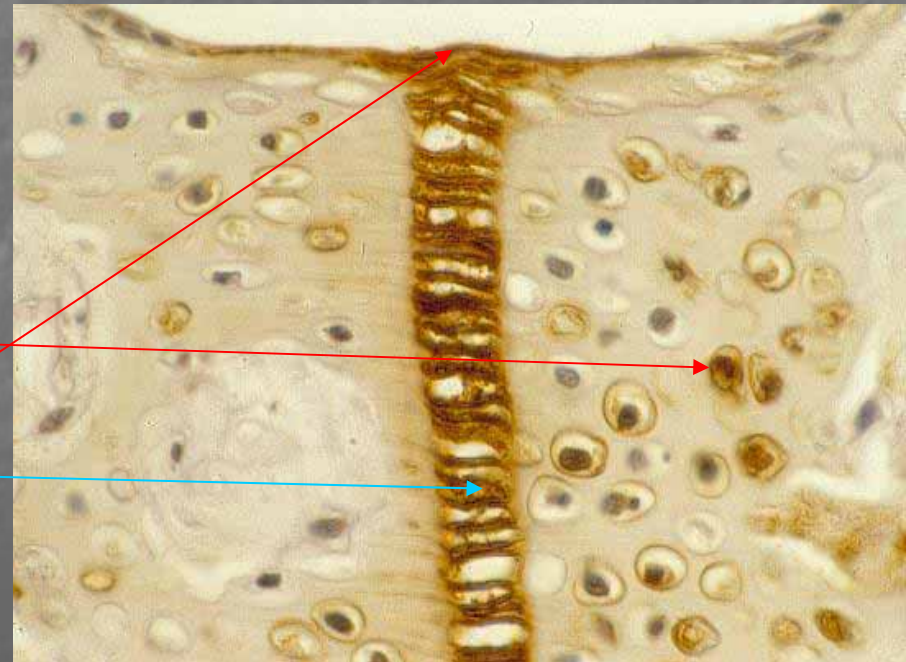
Absent in the joint cavity



Hyaluronic acid in the oval window

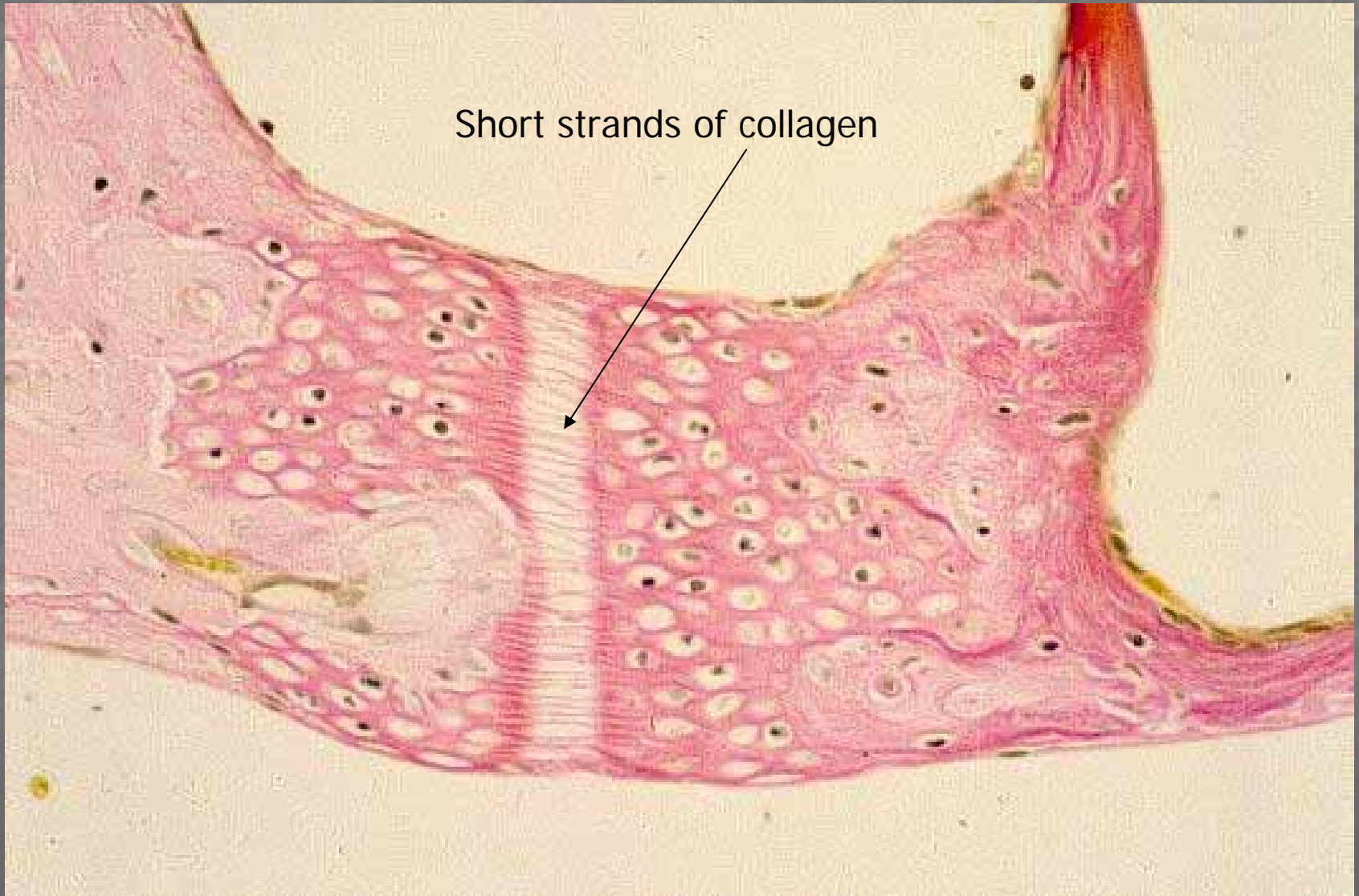


Scattered between the fibres in the gap between the cartilages



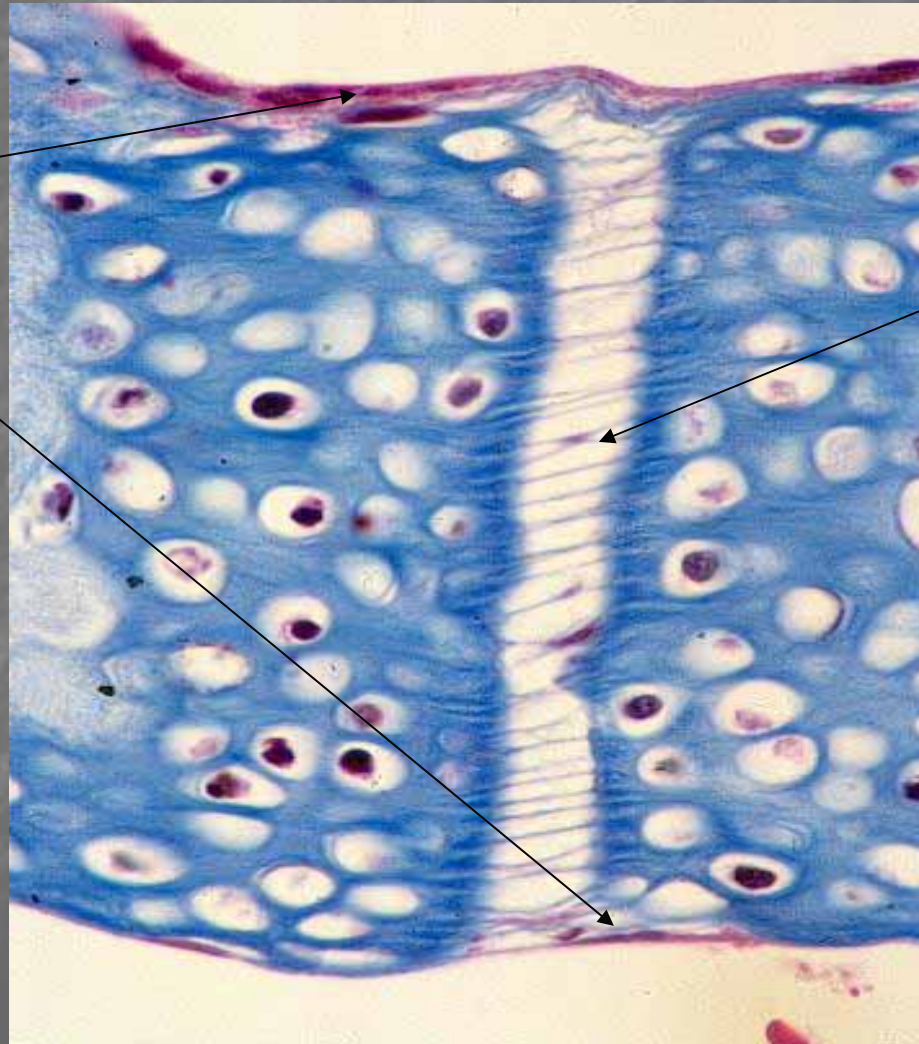
Present around chondrocytes in the cartilage and in the ligaments - but "most abundant in the gap"

Van Gieson – mature collagen is red



Mallory – collagen is blue and elastin is stained in weak red

The ligaments are elastic



Short collagen fibres stabilize the stapes

Weigert's elastin staining

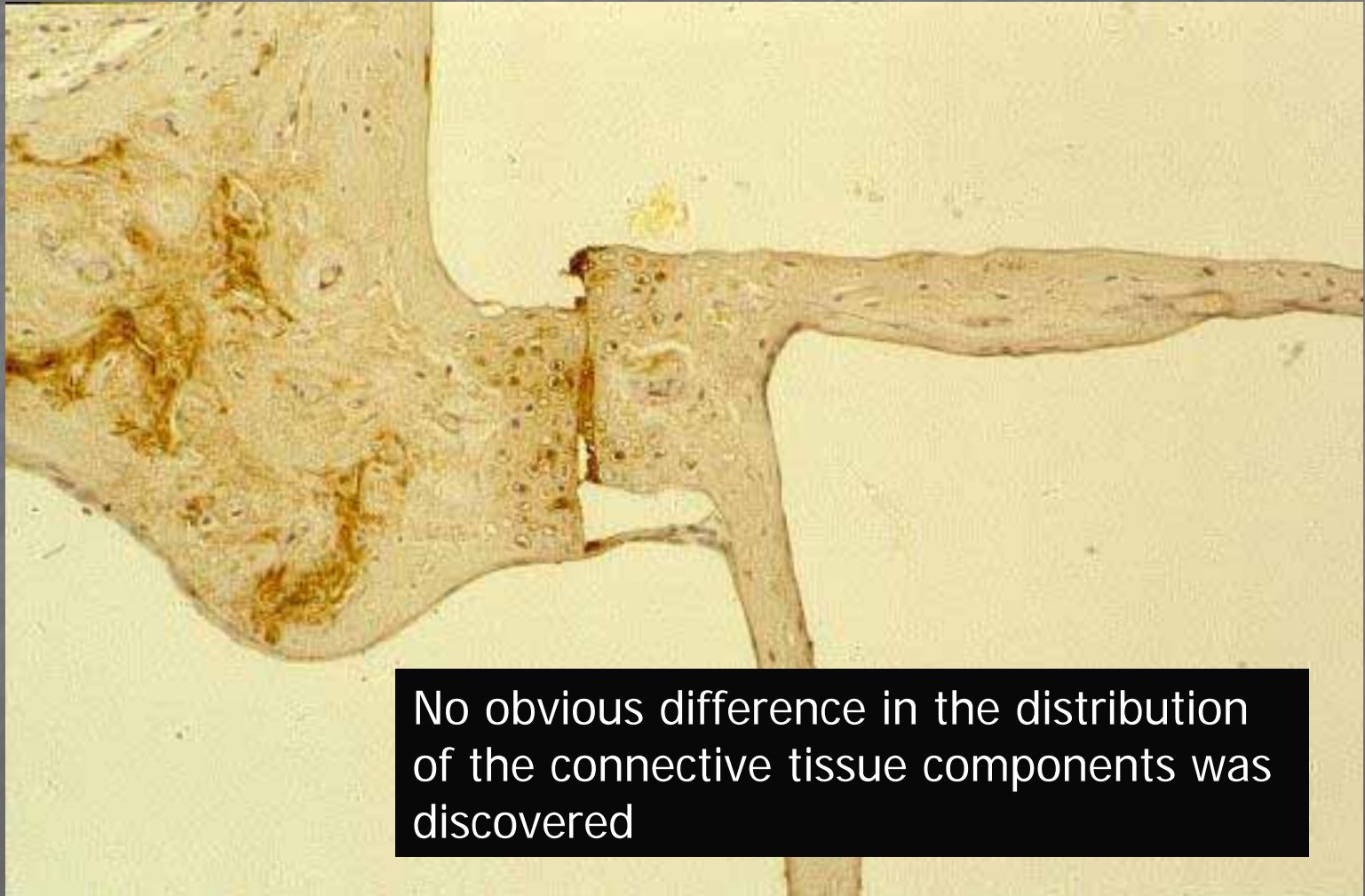


Elastin fibres have black or brown staining

It is notable how far into the cartilages that the elastic fibres extend – almost as a network with deep anchoring sites between the chondrocytes

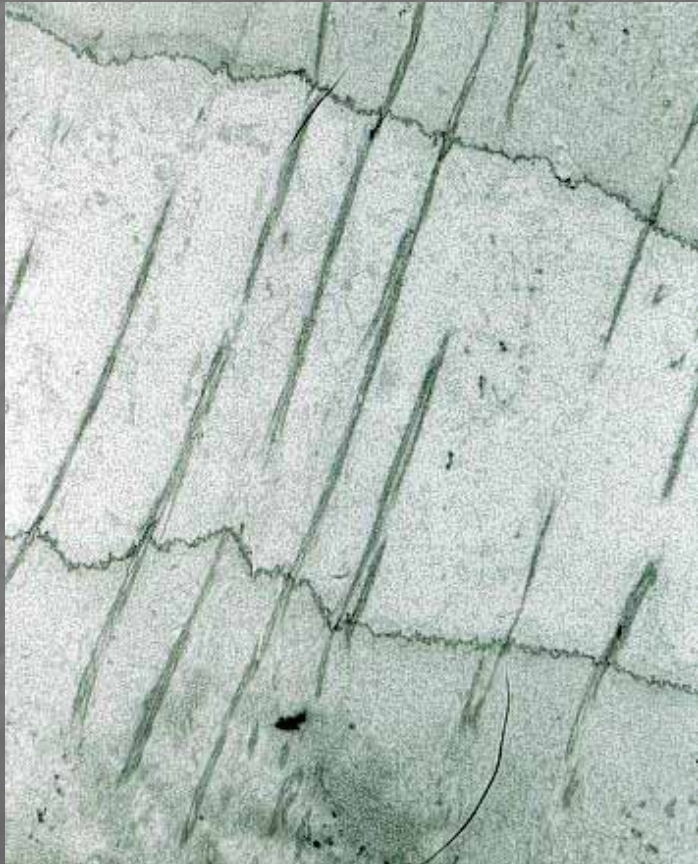


Dis-articulated and luxated stapes with 1 - 3 months observation time



No obvious difference in the distribution of the connective tissue components was discovered

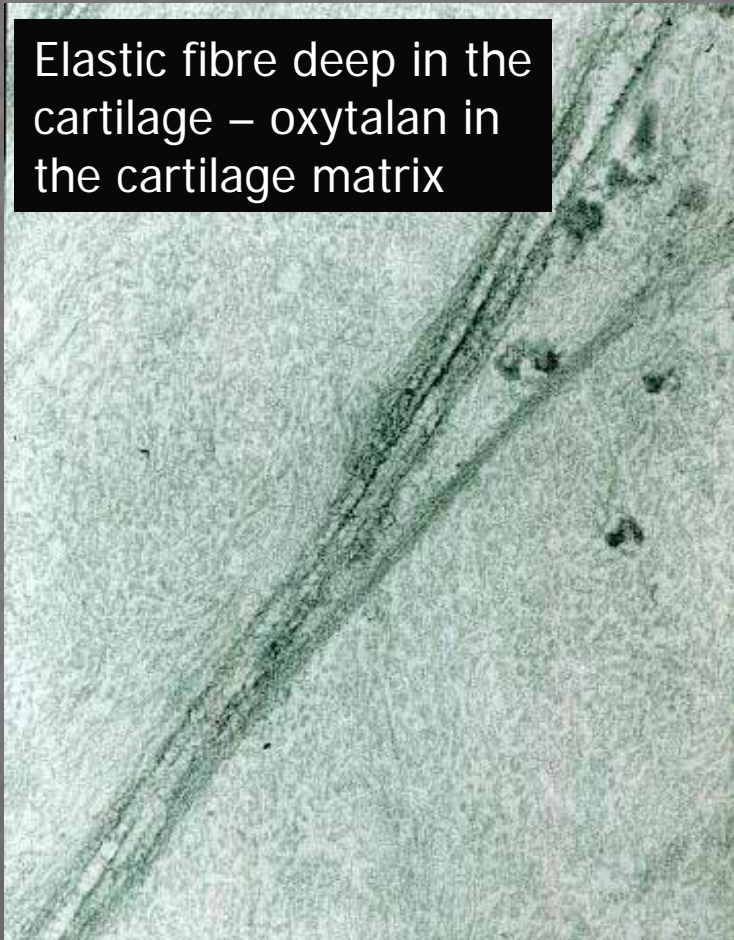
Electron microscopy for studies of the elastic fibres



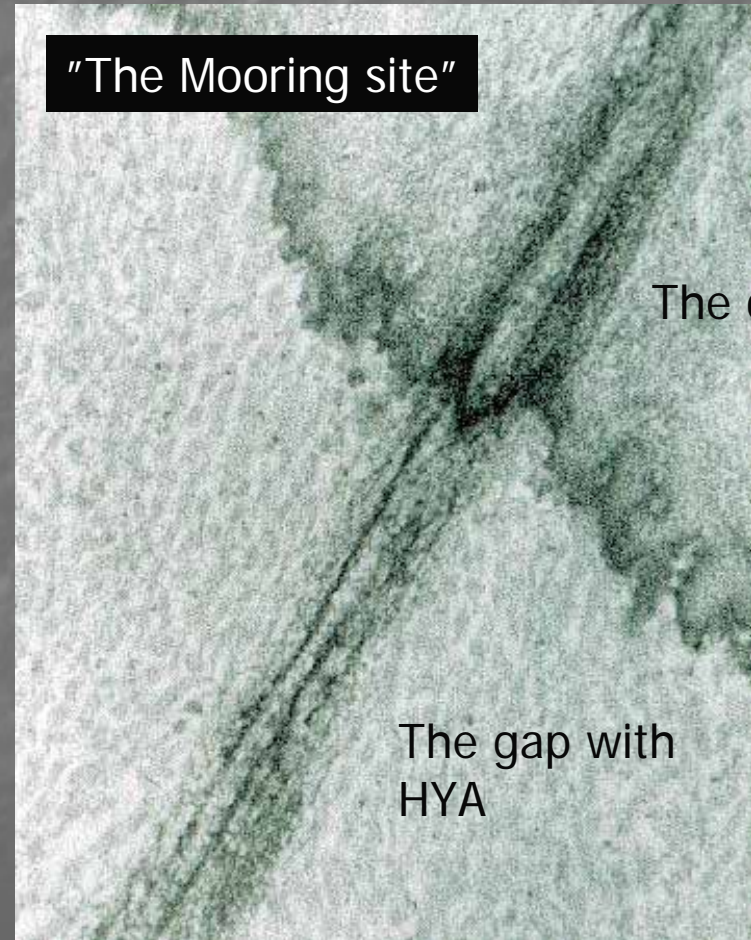
Elaunin fibre in the
HYA rich - gap

More electron microscopy

Elastic fibre deep in the cartilage – oxytalan in the cartilage matrix



"The Mooring site"



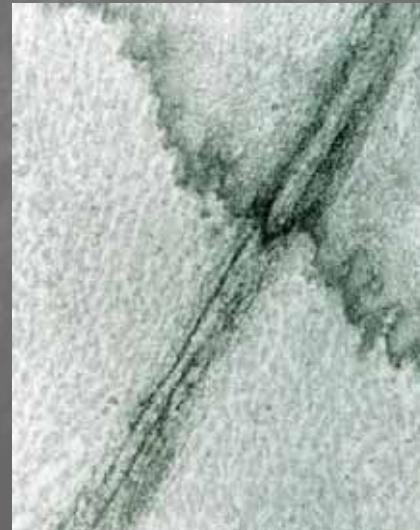
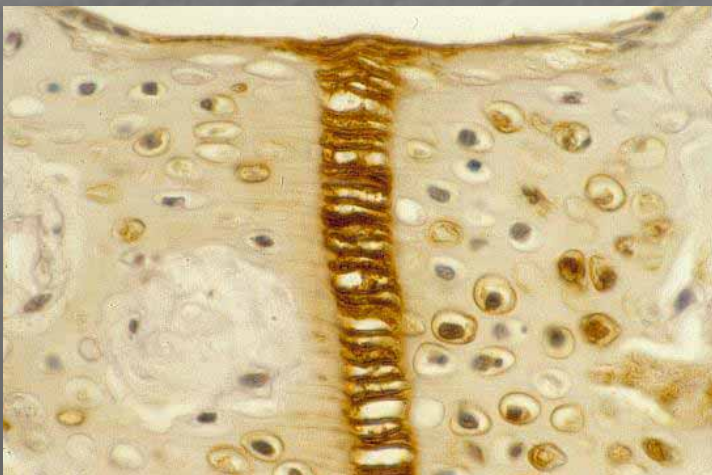
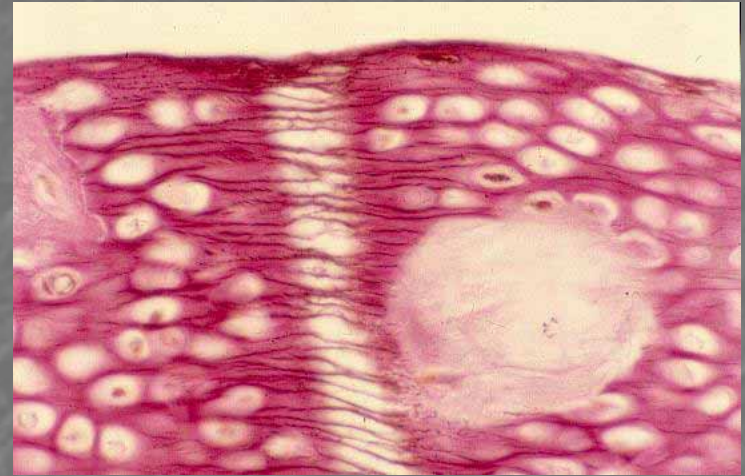
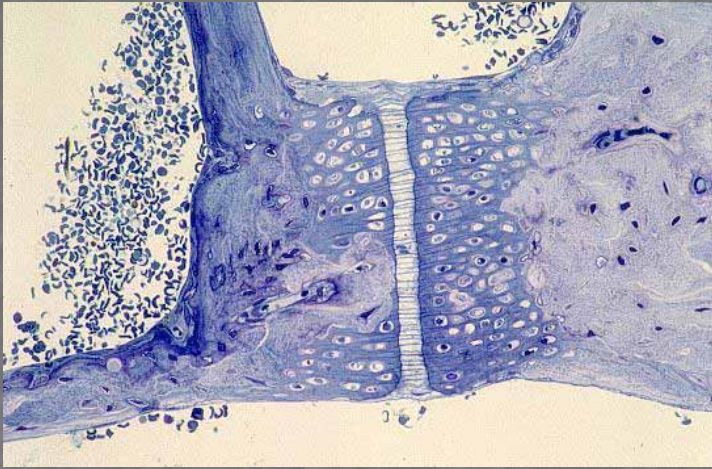
The cartilage

The gap with
HYA

The key to the "mystery of the stapes insertion"

- A hanging mooring with long elastic fibres
- A stabilization by short collagen fibres
- An anchoring deep into the cartilage on both sides of the gap
- "A floating situation" due to a visco-elastic positioning of the stapes with abundant hyaluronic acid in the gap between the fibres
- Two stabilizing ligaments on the inner and outer surfaces
- Most probably there is a continuous turn-over of the different connective tissue components in relation to the actual needs

The most important findings



Thanks for the attention –
and for not falling asleep!

