WHAT IS THE SUPERFICIAL FASCIA?

- The Anatomical Terminology [FCAT] suggested that the term fascia could be used to indicate a sheath, sheet or other dissectible connective tissue aggregations.
- The aim of our studies is to demonstrate the constant presence of a sheet of connective tissue inside the subcutaneous tissue.

THE SUPERFICIAL FASCIA OF THE ABDOMEN

A fibrous sheet, corresponding to the Scarpa’s fascia, could be easily isolated inside the subcutaneous adipose tissue.

Computer axial tomography scan

- Superficial fascia
- S. fascia
The superficial fascia of the back

In the dorsum, the superficial fascia appears as a thick fibrous lamina extending in a homogenous manner from the neck to the gluteal region, easily separable from the deep fascia. It adheres to the deeper layers along the spinous processes and along the inferior margin of the scapula.

Superficial fascia

At MRI in T1 weight imaging the superficial fascia is easy to see both in coronal and in sagital planes.

The superficial fascia of the LIMBS

- The SF of the thigh
- The SF of the leg
- The SF of the arm
The SUPERFICIAL FASCIA of the extremities

The superficial fascia adheres to the deep fascia and it is also connected with the skin by thick vertical septa.

WHAT IS THE SUPERFICIAL FASCIA?

- The superficial fascia could be recognized in almost all the human body, even if with regional specialization.
- Vertical/oblique septa connect the superficial fascia to the skin (retinaculum cutis superficialis or skin ligaments) and the deep fascia (retinaculum cutis profundus) forming a 3-D network between the fat lobules.

REGIONAL SPECIALIZATIONS IN THE FACE

- In the face, we can recognize three different patterns.
- Changes in the quantitative and qualitative characteristics of the retinacula cutis and superficial fascia of the face, may contribute to ptosis of facial soft tissues during aging.

The appearance of the SMAS in CT
(Stecco et al, Italian J of Anatomy, 2008)

In axial CT images, the SMAS appears as a relatively hyperdense tortuous line between the hypodense superficial adipose tissue (SAT) and the hypodense deep adipose tissue (DAT).
Histological features of the SUPERFICIAL FASCIA

Superficial fascia of the thigh (azan-Mallory, 25x)

Superficial fascia of the leg (immunohistochemical stain anti-S100 antibody, 100x)

Superficial fascia in the temporal region (van Gieson stain, 100x)

SUPERFICIAL FASCIA AND MUSCLES

- In humans, muscular fibers can be found inside the superficial fascia, particularly in the neck (platysma muscle), in the face (SMAS), in the anal region (external anal sphincter), in the scrotum (dartos).
- The superficial fascia is homologous to the cutaneous muscle layer (panniculus carnosus) found in other mammals.

Resistance to traction in different directions

Mean value of resistance to traction:
SF of the dorsum: 8.5 Kg
SF of the abdomen: 2.8 Kg
SF of the leg: 1.7 Kg

Mean value of resistance to traction:
SF of the dorsum: 6 Kg
SF of the abdomen: 5.5 Kg
SF of the leg: 1.4 Kg

In the dorsum, the superficial fascia shows a great variation in its behaviour, going from a maximum of 10 Kg to a minimum of 0.5 Kg.
In some regions the superficial fascia splits, forming special compartments around major subcutaneous veins and lymphatic vessels. In this way it protects the vessels during movements and maintains the vessels open.

Inside the superficial fascia we can recognize the superficial vascular plexus and numerous lymphatic ducts. Also the perforantes vessels have to cross the superficial fascia to reach the skin.

The terminal fibers of the nerves inside the superficial fascia: could be this a possible site of compression?
The POSSIBLE ROLES OF THE superficial fascia

The features of the SF and its relationships with the surrounding tissues determine:

- The mobility of skin respect to the deep planes (age ptosis and wrinkles, but also it is important for plastic surgery)
- Protection of the superficial vessels and nerves (varicose veins, tired feeling and weakness in the legs...)
- Lymphatic drainage (lymphoedema, fascitis, cellulites...)
- The separation between esteroception (skin) and proprioception (deep fascia)

Normal morphology of Hypodermis

Pathological morphology of Hypodermis

“Densification” of the connective tissue (retinacula cutis).
The retinacula cutis

► The retinacula cutis provide an anchorage of skin to underlying tissues and of the superficial fascia to the deep fascia.
► In this way a flexible and yet resistant mechanism of transmission of the mechanical loads from multi-directional forces could be recognized.
► Regional specializations determine the variations in mobility of the skin with respect to underlying tissues.

Superficial fascia is more adherent to the skin

The septa of the retinaculum cutis superficialis are usually many and vertically oriented, while the septa of the retinaculum cutis profundum are less, thinner and with an oblique direction. In this way the superficial fascia generally is more adherent to the skin than to the deep fascia.

GROSS ANATOMY: the fasciae of the thigh

Subcutaneous adipose tissue after having removed the skin
Isolation of the superficial fascia
Deep fascia of the thigh and epimysium of the quadriceps

GROSS ANATOMY: the fasciae of the leg

Superficial fascia
Deep fascia
Deep and epimysial fasciae
GROSS ANATOMY: fasciae of the upper limb

26/02/2015

GROSS ANATOMY: fasciae of the upper limb

Subcutaneous tissue of the forearm

Deep fascia of the posterior region of the forearm

Deep and epimysial fascia of the biceps brachii muscle

MORPHOMETRIC ANALYSIS: the deep fasciae of the limbs

To understand the resistance of the fascia to tension in 25 upper limbs from 14 subjects, neither embalmed nor frozen, the deep fascia is easily separable from the epimysium of the underlying muscles. It shows aponeurotic features and it is very resistant to traction. It presents different thicknesses according to the evaluated zones.

Fascia is too weak to tension force in the upper limbs

(Stecco et al., Morphologie, 2007)

The deep fascia is easily separable from the epimysium of the underlying muscles and it shows aponeurotic features and it is very resistant to traction. It presents different thicknesses according to the evaluated zones.

HISTOLOGICAL STUDY: the deep fasciae of the limbs

Multiple layers of undulated collagen fibre bundles form the deep fascia. In each layer the bundles are parallel to each other.

A thin layer of loose connective tissue separates the different layers. Adjacent layers of collagen fibers show different orientations.

MORPHOMETRIC ANALYSIS: the deep fasciae of the limbs

The deep fascia is too weak to tension force in the upper limbs. To understand the resistance of the fascia to tension, 25 upper limbs from 14 subjects, neither embalmed nor frozen, were analysed.

31

Fascia is too weak to tension force in the upper limbs

(Stecco et al., Morphologie, 2007)
HISTOLOGICAL STUDY: the deep fasciae of the limbs

In the muscular fascia of the upper limb, few elastin fibers are also present. They form an irregular mesh.

In the deep fascia of the inferior limb, we found very few elastin fibers.

3D RECONSTRUCTION of the collagen fibers

The collagen fibers are disposed parallel to each other to form 2/3 layers (277.6 µm). In adjacent layers, the bundles show different orientations, creating an angle of 78°. The collagen volume fraction is about 18%.

3D RECONSTRUCTION of the elastic fibers

Only a few, short elastic fibers are present, forming an irregular mesh. Their volume is less than 1%. Their concentration increases descending to the deeper layers.

THE DEEP FASCIAE: from an irregular fibrous tissue to a multilayer organization (Stecco et al, 2008)

Thanks to the different orientations of the collagen fibers in the layers, the fascia has strong resistance to traction even when it is exercised in different directions.
The multilayer structure of the deep fasciae of the limbs

Medial region of the elbow

The presence of loose connective tissue interposed between adjacent layers permits local sliding, and so from a mechanical point of view the single layers could be considered independently.

The loose connective tissue permits the different layers to slide one on the other

SLIDING SYSTEM
Presence of HA in the connective tissue

“Hyaluronan is ubiquitously distributed in the extracellular space of higher animals; the highest concentrations are found in soft connective tissues”
TC Laurent and JR Fraser; Hyaluronan; The FASEB Journal, 1992 Vol 6, 2397-404.

HA is present in most connective tissues and abundant in loose connective tissue.”

Presence of HA under deep fascia

“Hyaluronic acid is localized to the deep or muscular surface (arrow) of the deep fascia”

Deep fascia produces HA

“The deep fascia is a simple structure of connective tissue, which produces a gliding interface in conjunction with the epimysial capsule of the muscle and the intervening areolar tissue plane.”

“Three distinct layers are identified in the retinaculums of both the ankle and wrist: the inner gliding layer, with hyaluronic acid-secreting cells.”

“The inner gliding surface, characterized by modified fibroblasts secreting hyaluronic acid”

“The inner layer contained a hyaluronic acid-like substance. The majority of the inner layer cells had the appearance of modified (In fresh unembalmed elderly cadavers)”
Deep layer of extensor retinaculum
Calcaneal tendon
Tibial anterior tendon
Superficial layer of flexor retinaculum

MRI of the ankle retinacula

“The retinacula are thickening of the deep fascia”

“They are formed of 2–3 layers of parallel collagen fibre bundles, densely packaged with a little loose connective tissue, without elastic fibres but many nervous fibres and corpuscles”.
The capacity of the different collagen layers to glide one on the other could be altered in cases of overuse syndrome, trauma or surgery.

Male, 65 ys, diabetic, amputation after 10 months of immobility following trauma.

Normal Pathological

Control Male, 65 ys, diabetic, amputation after 10 months of immobility following trauma

The pectoral fascia is a thin lamina, enveloping the pectoralis major muscle. It strongly adheres to the muscle, thanks to many intramuscular septa.

This close relationship allows selective spatial stretching of the fascia according to the muscular contraction.

The pectoral fascia

It appears as a thin lamina of collagen fibers, with a structure similar to a single layer of limb fasciae.

Many elastic fibers (~15%) are present, forming an irregular mesh.
The pectoralis major, latissimus dorsi, trapezius, deltoid and gluteus maximus muscles are comprised within the superficial lamina of the deep fascia, and are not separable from the same. The continuity given by this fascia permits the connection among these muscles and the muscles of limbs.

**DISCUSSION: THE DEEP FASCIAE OF THE LIMBS**
- Thicker (0.5-1.8 mm)
- Partially separated from the underlying muscles
- Few elastic fibers
- Multilayer structure
- Scarcely adaptable
- Perfect for the force transmission

**DISCUSSION: THE DEEP FASCIAE OF THE TRUNK**
- Thinner (apart from the thoracolumbar region)
- Strongly adherent to the underlying muscles
- The superficial layer of the muscles of the trunk are developed inside the superficial layer of the fasciae
- The roles of the fasciae of the trunk in the movements cannot be separated from the actions of the muscles
Thank you

Venice