Muscle assessment through ultrasound

Hands-on session

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Content

Work hard

- Role of ultrasound in muscle assessment
- SARCUS1 recommendations
- Future directions

Play hard

- Hands-on session

Content

Role of ultrasound in muscle assessment

SARCUS

Future directions

Hands-on session

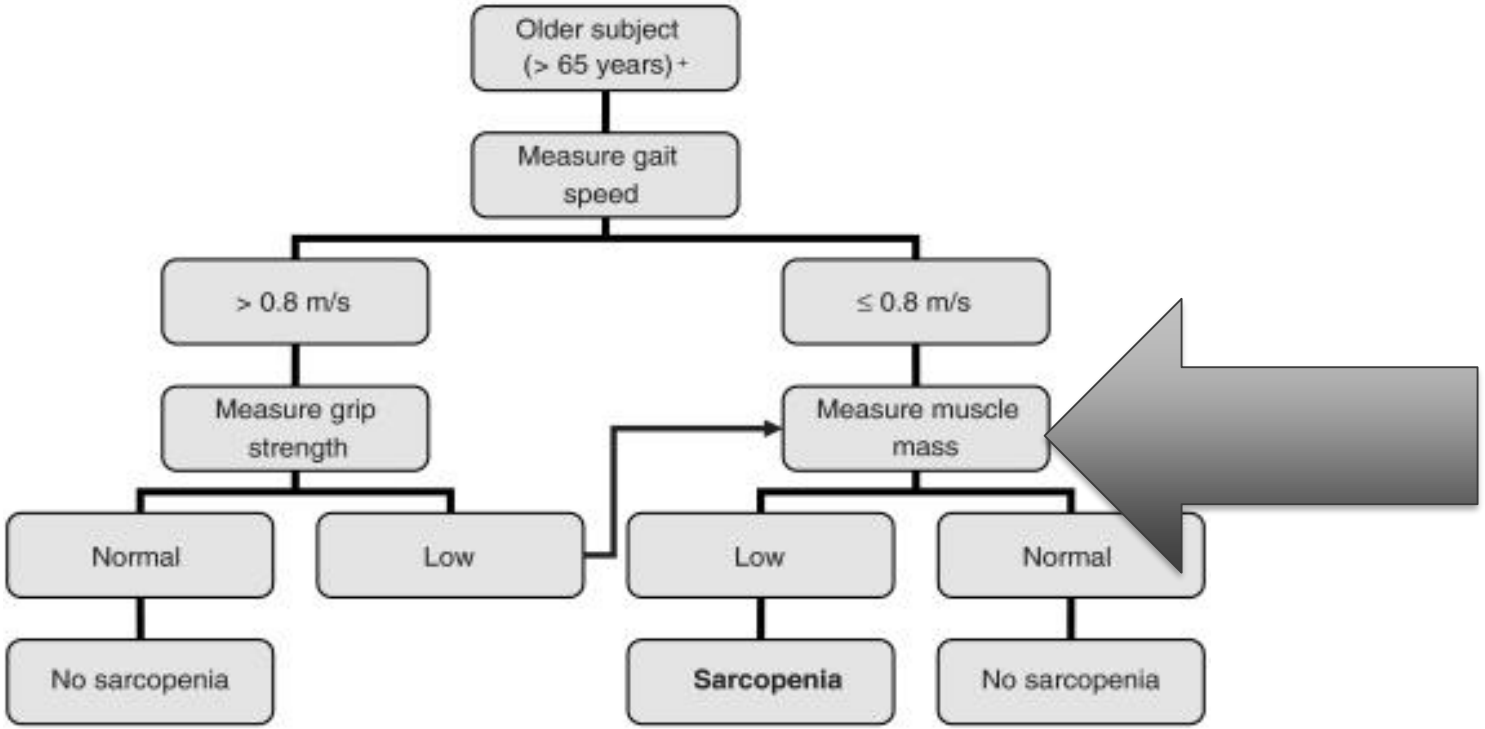
3 questions

Who here is working with geriatric patients?

Who here thinks sarcopenia is a problem?

Who here measures muscle mass?

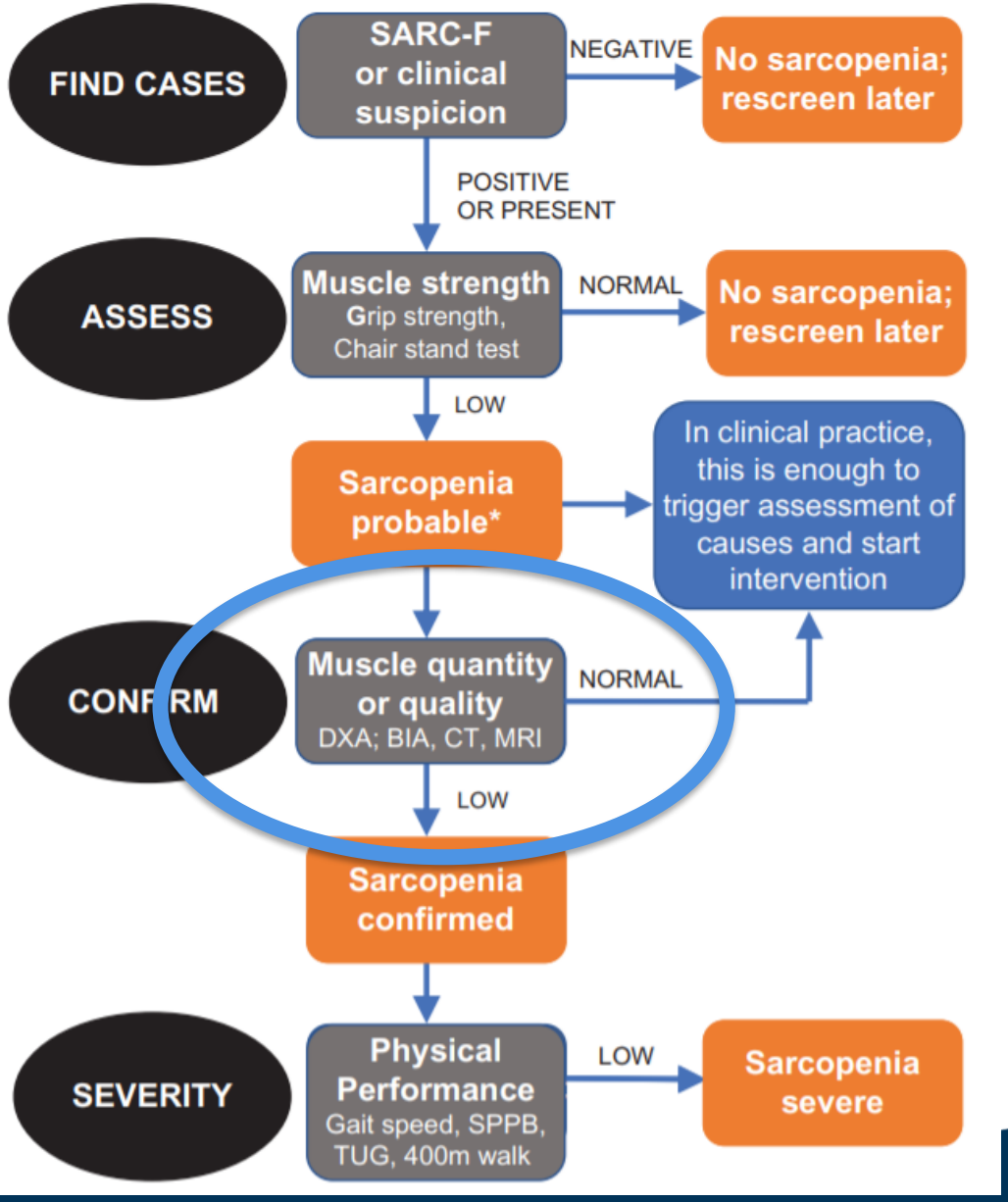
Screening algorithm (2010)



Cruz-Jentoft AJ et al. Sarcopenia: European consensus on definition and diagnosis. Report of the European Working Group on Sarcopenia in Older People. Age Ageing 2010

What to screen in 2018?

Sarcopenia: revised European consensus on definition and diagnosis



Questions

Who has access to DEXA?

- BIA?
- CT?
- MRI?

So who would like to have access to an easy way of assessing/screening muscle mass?

Muscle assessment

Simplified current muscle assessment

	Quantity	Quality	Availability	Standardization	Reference values
DEXA	+	-	+/-	+	+
BIA	+	-	+/-	+	+/-
CT	+	+	+	-	-
MRI	+	+	+/--	-	-

Muscle assessment

Simplified current muscle assessment

	Quantity	Quality	Availability	Standardization	Reference values
DEXA	+	-	+/-	+	+
BIA	+	-	+/-	+	+/-
CT	+	+	+	-	-
MRI	+	+	+/--	-	-
Ultrasound	+	+	+	+/-	-

Ultrasound: what can we measure?

Regional assessment of muscle quantity (size/mass) and quality (echo intensity)

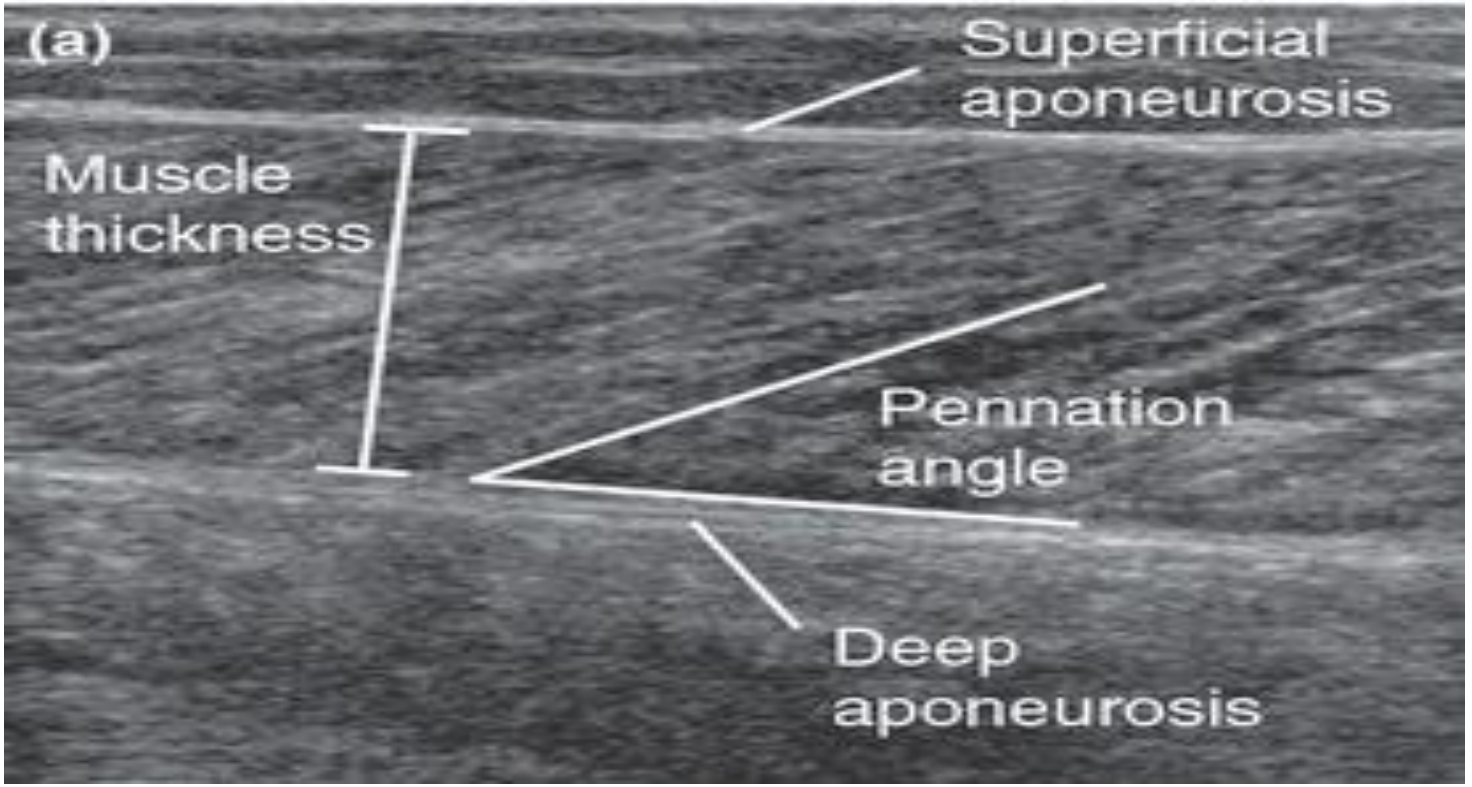
Five main parameters + 1 extra

- Muscle thickness
- Muscle cross-sectional area
- Fascicle length
- Pennation angle
- Echo-intensity

+

- Muscle stiffness

Muscle thickness



Muscle thickness

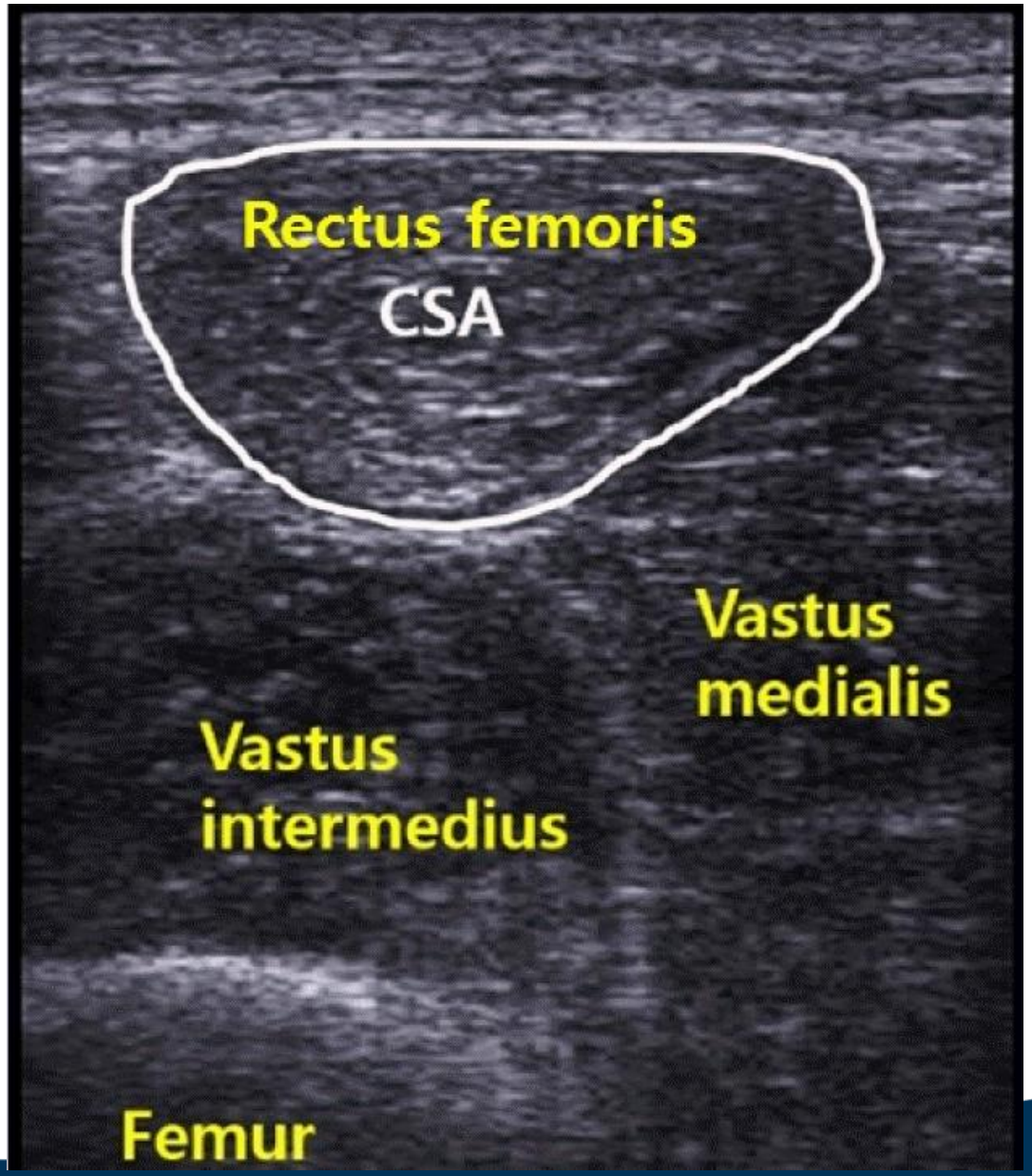
Highly correlated with maximum contractile force

Total skeletal muscle may be estimated

Strong correlation with both MRI and DEXA

Changes can be measured after 6 weeks of training

Muscle cross-sectional area



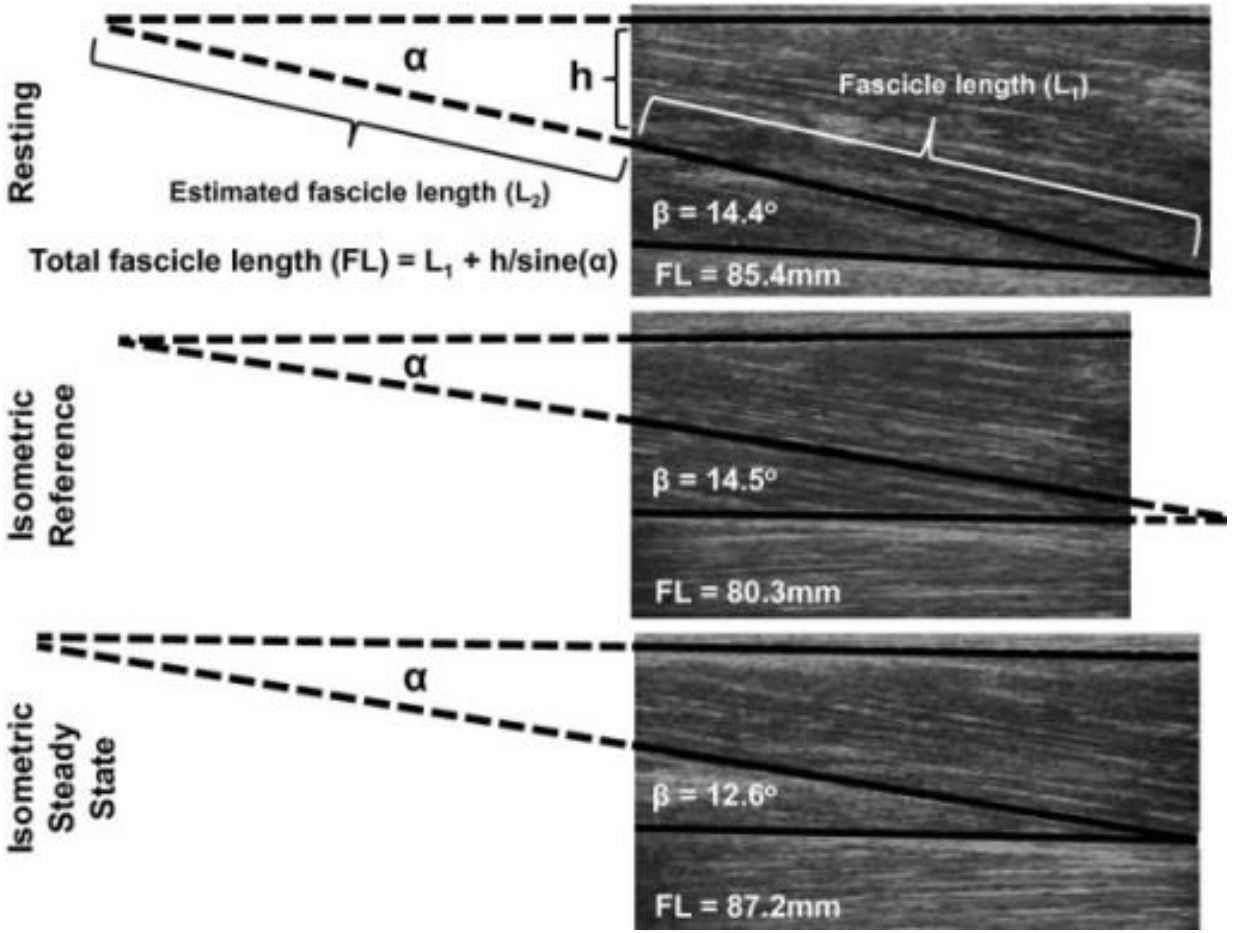
Muscle cross-sectional area

CSA: inter- and intrareader reliability similar to those for MRI

Correlated with postoperative complications

Changes can be measured after 6 weeks of training

Fascicle length



Fascicle length

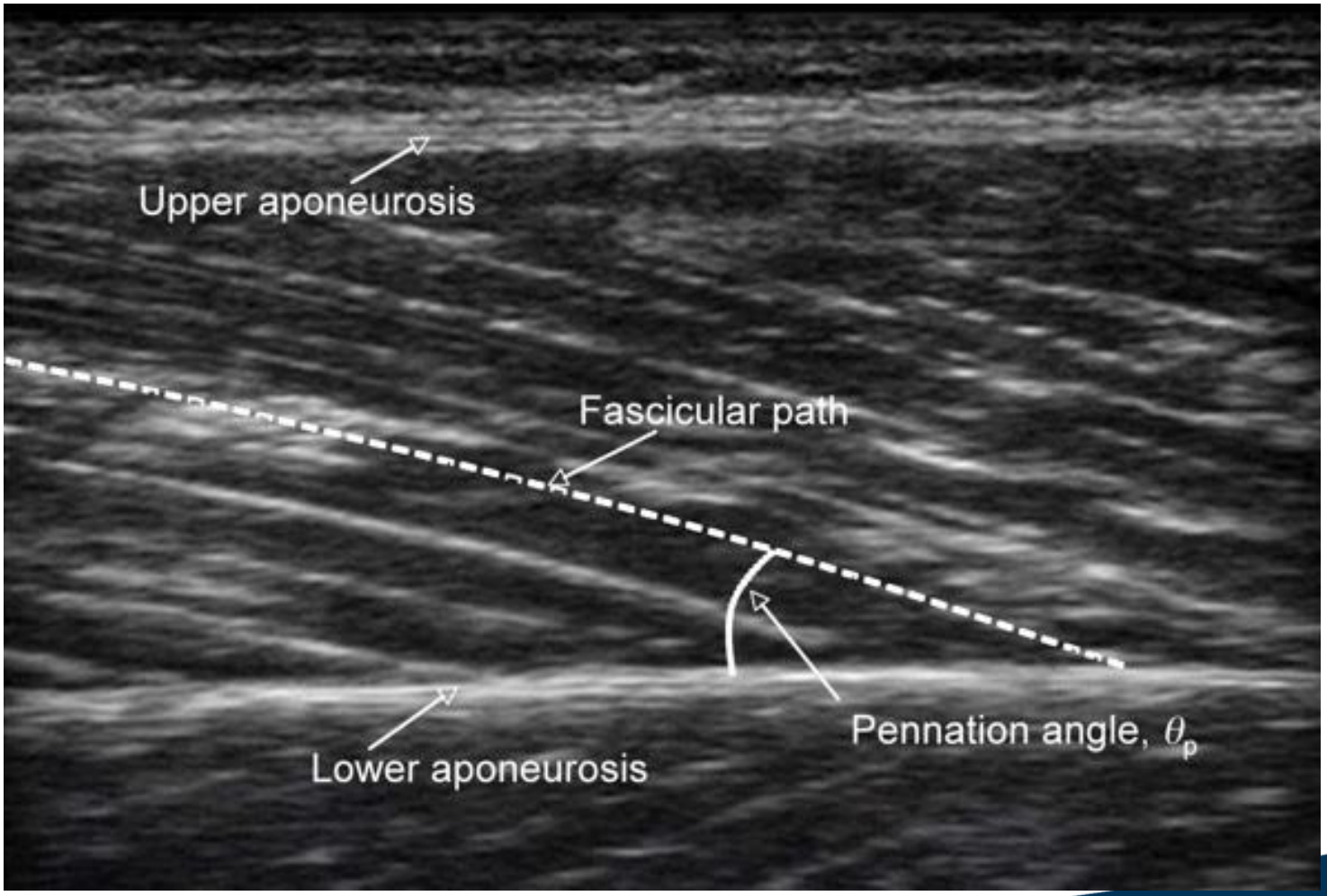
Increases with training (sprint versus endurance)

Fascicle length affects

- Motor-unit recruitment
- Discharge rate
- Central command: contractions at different lengths give different central output

Change in Muscle Fascicle Length Influences the Recruitment and Discharge Rate of Motor Units During Isometric Contractions. Pasquet et al.

Pennation angle



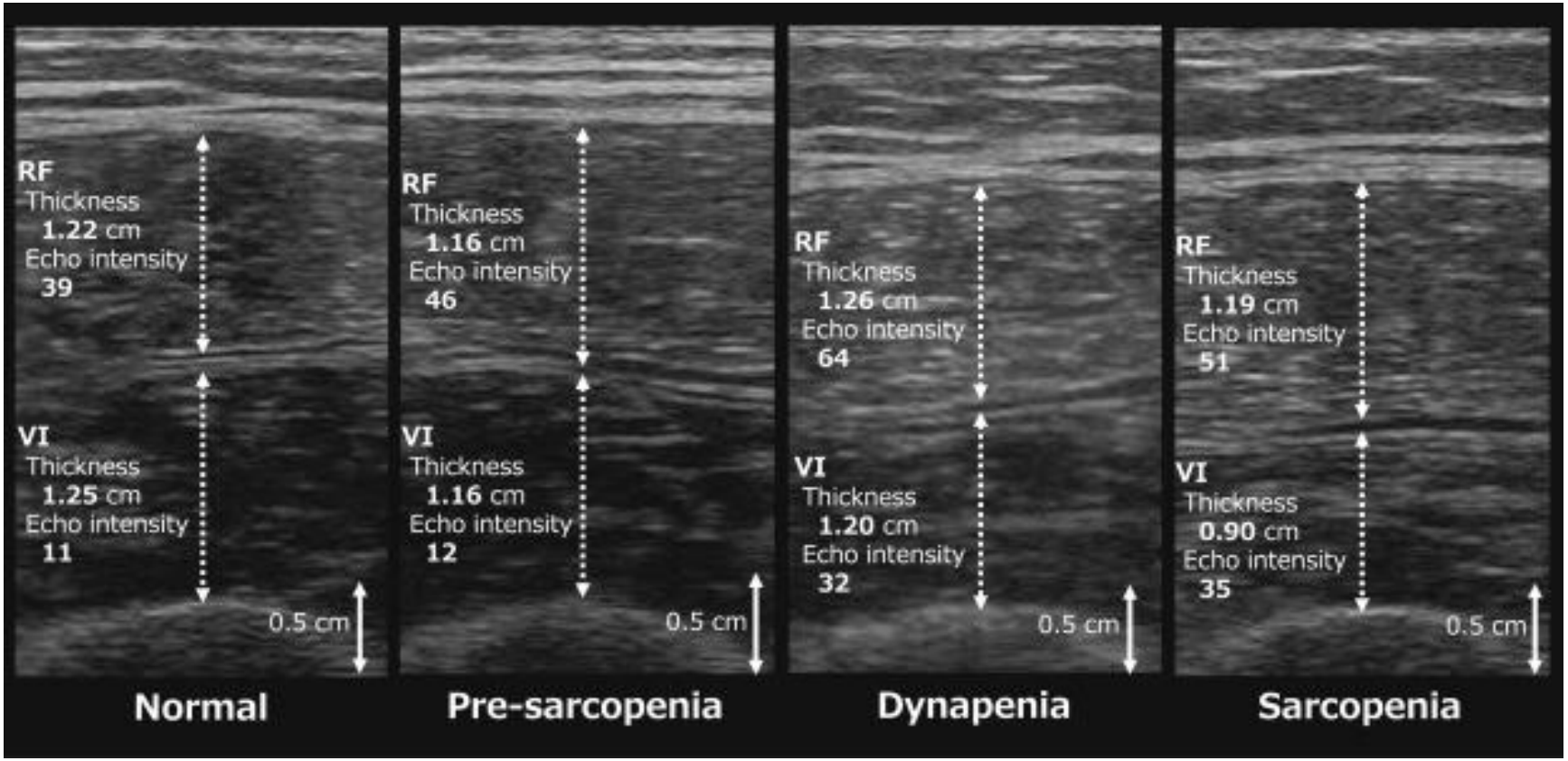
Pennation angle

Pennation angle is linked to the force generating potential of a muscle

Influenced by tendon properties & fat infiltration of the muscle

Is seen in pennate muscles

Echo-intensity



Differential Characteristics of Skeletal Muscle in Community-Dwelling Older Adults. Minoru Y et al. JAMDA September 2017.

Echo-intensity

Quantative gray scale analysis, marker of muscle quality (fat, fibrous)

Negatively correlated with

- Muscle thickness
- Muscle strength (independent of age or muscle thickness)

Content

Role of ultrasound in muscle assessment

SARCUS

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SARCUS1

EuGMS Nice 2017 SIG sarcopenia project call

Use of ultrasound in muscle/sarcopenia assessment

Idea of systematic review and standardizing of technique was launched

Standardization effort!

Application of ultrasound for muscle assessment in sarcopenia: towards standardized measurements

Stany Perkisas[1,18] · Stéphane Baudry[2,18] · Jürgen Bauer[3] · David Beckwée[4,5] · Anne-Marie De Cock[1] · Hans Hobbelen[6,19] · Harriët Jager-Wittenaar[6,20] · Agnieszka Kasiukiewicz[7] · Francesco Landi[8] · Ester Marco[9,10,11] · Ana Merello[12] · Karolina Piotrowicz[13] · Elisabet Sanchez[12] · Dolores Sanchez-Rodriguez[11,14,15,16] · Aldo Scafoglieri[17,18] · Alfonso Cruz-Jentoft[12] · Maurits Vandewoude[1,18]

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SARCUS1

Resulted in recommendations for

Patient positioning pre-investigation

System and system settings

Components

Consensus proposition, shortcomings in knowledge and protocol listings for patient positioning pre-investigation.

Consensus proposition:

- **No exercise 30 minutes before investigation.**
- **Preferably minimum 30 minutes (maximum 60 minutes) in the same position before investigation, for measurements in recumbent position.**
- **Muscle should be assessed in a relaxed state.**
- **If the patient is placed in a recumbent position, it is recommended to use the full extension position (either supine or prone).**

Shortcomings in knowledge:

- **Exact influence of (minor) muscle exercise on measurements**

To be mentioned in the protocol:

- **Preparations in advance of the investigation (amount of minutes rest, in which position).**
- **State of muscle being investigated (relaxed, contracted).**
- **Which position the patient is placed in, including the angles of the relevant joints, clearly describing which angle is meant exactly.**
- **Whether left/right side was taken and whether this was the dominant/non-dominant side.**
- **Sex and age of patient.**

Consensus proposition, shortcomings in knowledge and protocol listings for system and system settings.

Consensus proposition:

- **All types of ultrasound machine can be used, as long as B-mode is present.**
- **Extended field of view is not necessary but recommended.**
- **A linear transducer probe is recommended. A minimum length of 5 cm is advised.**
- **Inclination of the probe should be neutral, which is perpendicular to the skin.**
- **Using a generous amount of transmission gel is recommended.**
- **Maintaining the most minimal pressure possible between transducer and skin is recommended.**

Shortcomings in knowledge:

- **Exact influence of different system settings on measurements of echo-intensity**

To be mentioned in the protocol:

- **Manufacturer and type of US machine**
- **Type of probe, including length of probe**
- **Frequency of beam (other system setting, see "Components and measuring points: echo-intensity")**
- **Any additional software used in post-production of images**

Consensus proposition, shortcomings in knowledge and protocol listings for components.

Consensus proposition:

- **Five components can be measured: muscle thickness, pennation angle, fascicle length, echo-intensity and cross-sectional area.**
- **Measurements are ideally done at maximal muscle bulk.**
- **Depending on muscle anatomy, different techniques are advised for determining maximal muscle bulk.**
- **Panoramic vision and extended-field-of-view software are not absolutely necessary but recommended.**
- **In pennate muscles, measuring physiological CSA rather than anatomical CSA is recommended.**
- **When the fascicle length cannot be directly measured, it can be calculated using the standard formula.**
- **When measuring echo-intensity, all system settings need to be kept the same. Currently, no proposition for specific system settings based upon literature can be done for echo-intensity.**

Shortcomings in knowledge:

- **Exact point of maximal muscle thickness for each muscle.**
- **Changes of the main components (MT, CSA, FL, PA, EI) throughout the muscle bulk.**
- **A good measure for comparing echo intensity between different US machines/systems.**

To be mentioned in the protocol:

- **The muscle that is assessed, with inclusion of the anatomical landmarks that are used and the exact point in between the landmarks. If not the midpoint, clearly describe whether the proximal or distal end is meant.**
- **The components that are measured. If CSA is measured, define if anatomical or physiological CSA is meant.**
- **Total length of muscle (to calculate relative muscle thickness values).**
- **The technique that is used to determine the position of maximal bulk.**

Proposed anatomical landmarks for each muscle discussed.

		Proximal landmark	Distal landmark
Lower limb	Rectus femoris	Greater trochanter	Proximal border of patella
	Vastus lateralis	Greater trochanter	Proximal border of patella
	Vastus medialis	Greater trochanter	Proximal border of patella
	Vastus intermedius	Greater trochanter	Proximal border of patella
	Biceps femoris (long head)	Ischial tuberosity	Proximal head of fibula
	Tibialis anterior	Lateral condyle (anterior) of tibia	US-measurement dependant
	Gastrocnemius (medialis)	Medial condyle (posterior) of the femur	US-measurement dependant
	Gastrocnemius (lateralis)	Medial condyle (posterior) of the femur	US-measurement dependant
	Soleus	Proximal head of fibula (posterior part)	Posterior superior part of calcaneus
Upper limb	Biceps brachii	Anterior part of acromion process (acromioclavicular joint)	Elbow crease where tendon can be palpated
	Triceps brachii	Most lateral distal part of acromion	Tip of olecranon

Disclosure

SARCUS1 is the first attempt to standardize US in muscle assessment

It is probably not perfect

Consider it as a baseline from where to start

SARCUS2

Acute sarcopenia in hospitalized elderly: assessment through ultrasound

Sophie Bastijns [a], Gülistan Bahat [b], Jürgen Bauer [c], Petra Benzinger [c], Alfonso J. Cruz-Jentoft [d], Anne-Marie De Cock [a], Olgun Deniz [e], Jerzy Gasowski [f], Ania Gluszewska [f], Meltem Halil [e], Agnieszka Kasiukiewicz [g], Francesco Landi [h], Ester Marco [i], Anna Maria Martone [h], Ana Merello de Miguel [d], Karolina Piotrowicz [f], Duygu Erbas Saçar [b], Elisabet Sanchez [d], Dolores Sanchez-Rodriguez [j], Sara Salini[h], Giulia Savera[h], Maurits Vandewoude [a,k], Beate Wojszel [g], Stany Perkisas [a,k]

European collaboration

9 centra in 6 countries: Belgium, Germany, Italy, Poland, Spain & Turkey

Content

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Future directions

Strengthening (basic) sarcopenia research in a European setting

Teaching

- international symposia
- online teaching
  - youtube search terms “SARCUS educational video”

Future directions: unknowns

Reference values per age / muscle

Best measuring point per muscle

(Is there a best measuring point per muscle?)

Evolution of different US parameters per age / muscle / measuring point / in sarcopenic proces

Future directions: unknowns

Possibility of comparing echogenicity

Role of elastography

Influence of different kinds of exercise on measurements

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Future directions

Hands-on session

Hands-on session

Measurements are very simple

Everybody can try using US

See one, do one

Hands-on session: let’s get started