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🌐 Ultrasound measurement of thoracolumbar fascia deformation

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Fascia-oriented ultrasound examinations



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ABSTRACT

The authors describe a measurement method for recording the deformation of the thoracolumbar fascia in a clinical setting. Since physiological (e.g. lack of activity, overload or delayed onset muscle soreness) or pathological (e.g. acute or chronic low back pain) conditions restrict the shear capacity of the thoracolumbar fascia, the method should detect differences between such conditions and other (e.g. healthy, normal weight-bearing) states.

MATERIALS

Ultrasound: Philips Lumify linear transducer L12-4, 12 MHz; Philips Ultrasound Inc., Bothell, WA

Adhesive tape: CMC Consumer Medical, CMC-Group GmbH, Sontheim, Germany

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Protocol status: Working
We use this protocol and it's working

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Trunk extension task

- 1 The study participants sit on the treatment table with their feet touching the floor.
- 2 Participants are instructed to place their hands lightly on their thighs and keep their elbows close to their body.
- 3 They perform a slow bend of the upper body of 60 degrees without moving the arms. The experimenter stops the movement when the participant is close to the target value (Figure 1).

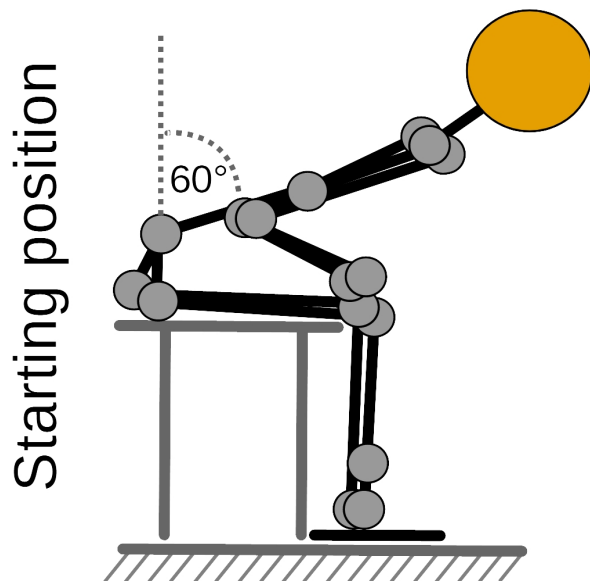


Figure 1. Starting position of the flexion phase of the trunk extension task.

4 A goniometric check of the actual degree of flexion may be carried out in a laboratory test.

5 The participant stretches the trunk to the neutral position (0 degrees; Figure 2).

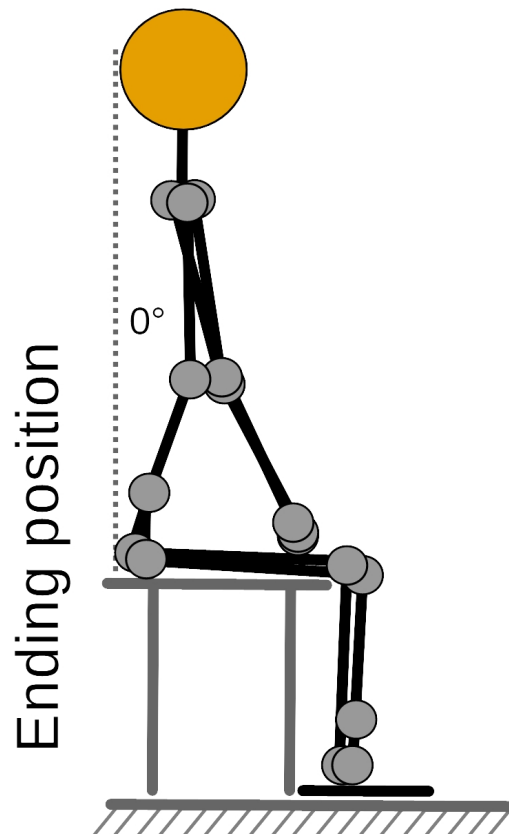


Figure 2. Fully extended position of the trunk extension task (TET).

Ultrasound transducer positioning

6 The transverse process of L1 is recorded sonographically.

7 The transducer is then moved laterally along a horizontal line from the L1 spinous process in sagittal section until the junction of the latissimus dorsi muscle (LD) into the thoracolumbar fascia (TLF) is visible.

- 8 While the junction is still centrally aligned on the image, the transducer is rotated laterally-caudally until the fibers of the LD are aligned in parallel. To make the junction between LD and TLF more visible in the ultrasound image, participants are asked to repeatedly press their arm caudally against the treatment table to activate the LD in isolation.
- 9 The junction between the muscle and fascia is then positioned 10 to 20 mm (depending on transducer width) medial to the center of the image section.
- 10 Using a 2 mm wide plastic adhesive tape, which is stuck to the skin 10 to 20 mm lateral to the center of the image section, an artificial shadow is created in the US image, which serves as a reference for the subsequent measurement. This is necessary to compensate for unintended movements between the skin and the transducer during the torso extension (Figure 3 and 4).

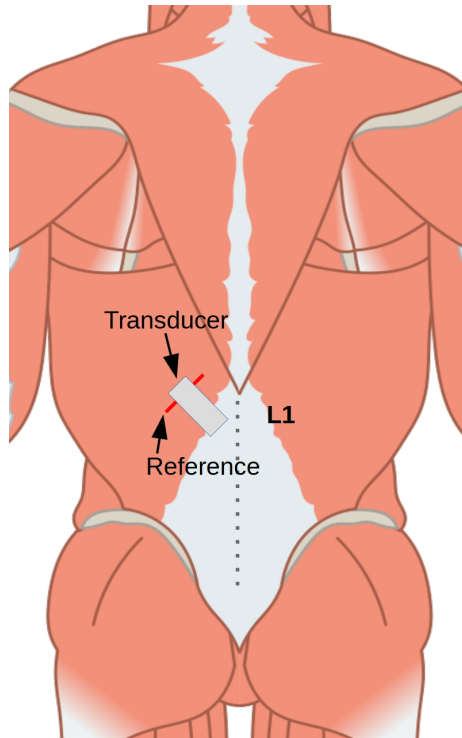


Figure 3. Measurement setup.

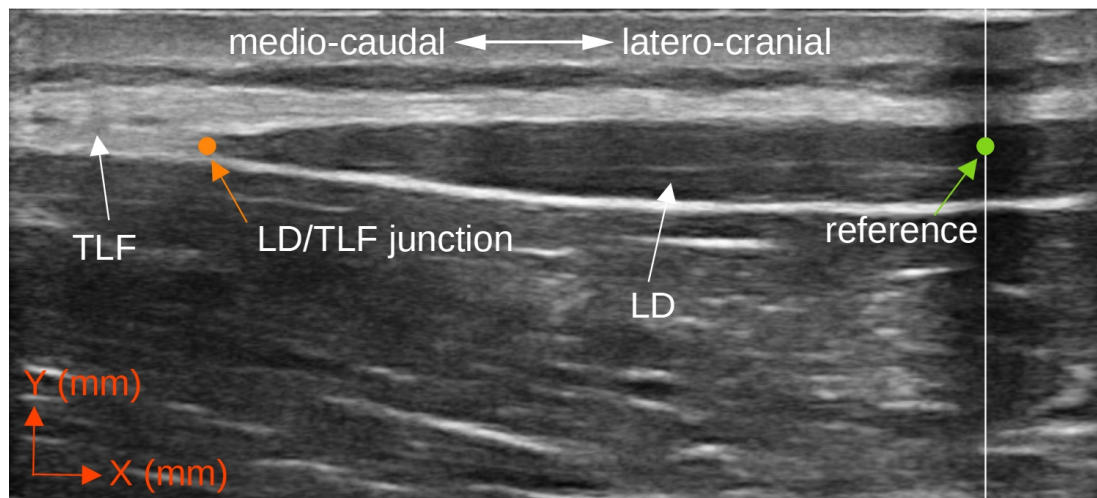


Figure 4. Single image measurement of TLF deformation. LD/TLF, junction of LD and TLF (orange dot); reference (green dot) at the middle of the artificial shadow; LD, latissimus dorsi muscle; TLF, thoracolumbar fascia.

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- 11 Before the measurement, the participants receive information on how to perform the TET. The experimenter demonstrates a complete cycle of the TET (Figures 1 and 2).
- 12 The participants first perform a 60-degree flexion. They then extend the trunk into the neutral position for a period of about 3 s (about 0.1 m/s).
An ultrasonic image is taken at the start position of the TET (t_1) and at the end position of the TET (t_2) and the respective distances between the LD/TLF transition and the reference are measured using the ultrasonic device's built-in measuring tools (Figure 5).

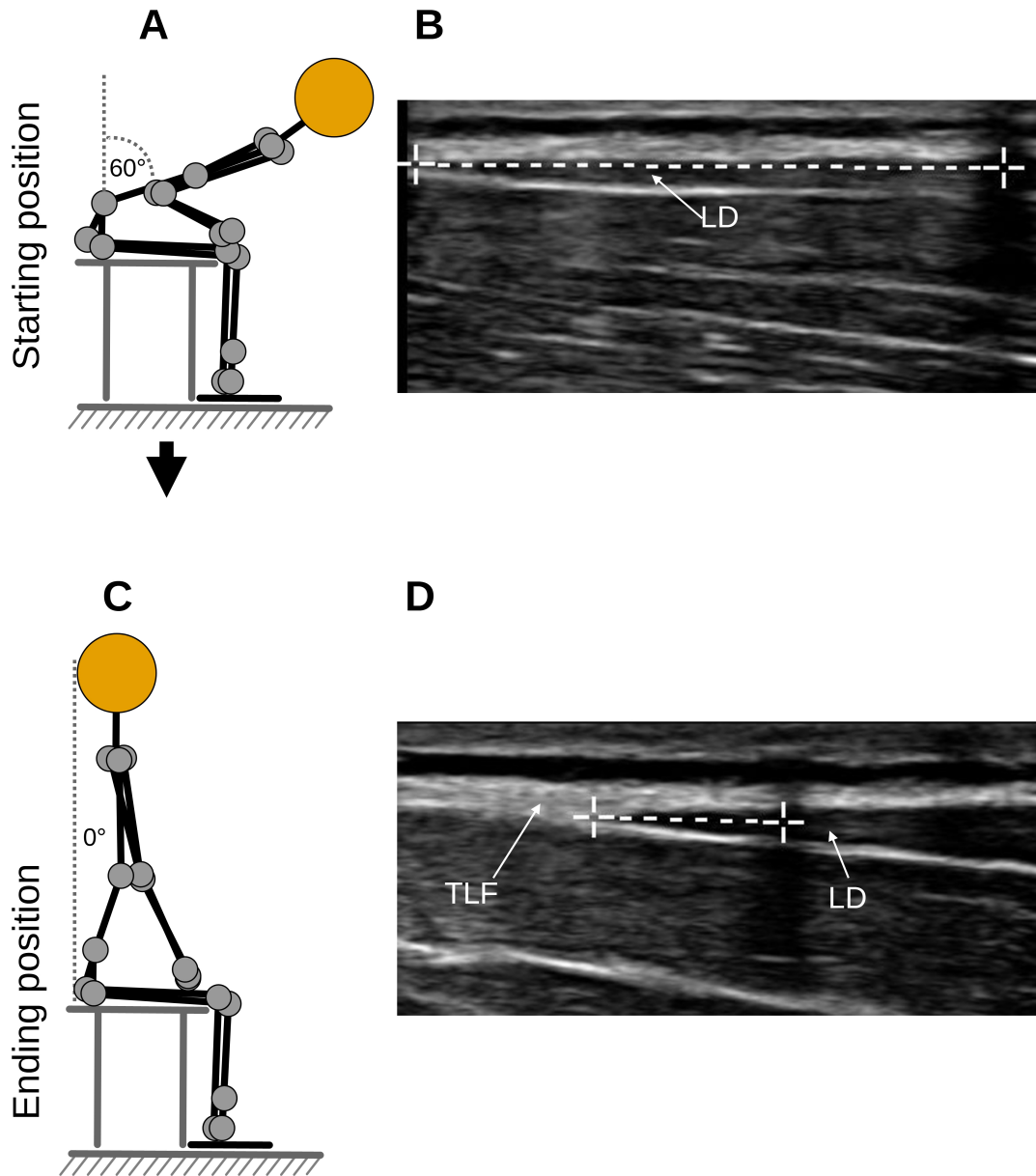


Figure 5. Measurement procedure. (A) Flexion phase trunk extension task. (B) Measurement time point t_1 . (C) Fully extended position of trunk extension task. (D) Measurement time point t_2 . TLF, thoracolumbar fascia; LD, latissimus dorsi muscle.

- 13** The TLF deformation (TLFD) is calculated as follows: $TLFD = t_1 - t_2$ as an absolute value or as $TLFD(\%) = (t_1 - t_2) / t_1 * 100$ as a relative change in percent.