

PROTOCOL: Flexion-Relaxation

The Flexion-Relaxation protocol has been developed in order to have a reliable and repeatable instrument to monitor the changes in the flexion and relaxation phenomenon (FRP) of the lumbar paraspinal muscles during a forward flexion movement of the trunk and while maintaining this position during a short time period.

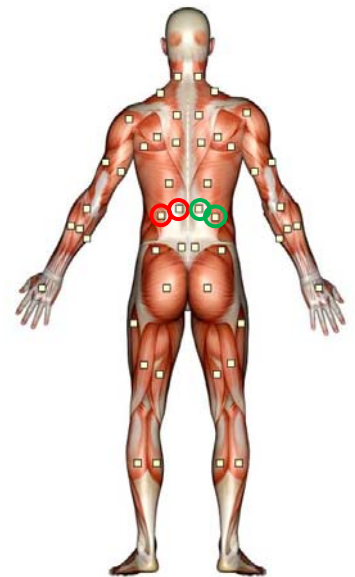
The paraspinal muscles undergo to the relaxation phenomenon when there's the ending of a normal lumbar flexion movement, i.e. when the trunk changes from standing position to flexed position, with a lumbar-pelvic flexion angle between 40° and 70°. This happens because the new position control is made by those muscles that act on the pelvis (gluteal and hamstring). This means that at the paraspinal muscles level it's necessary to obtain an electric "silence" period.



Instead, in those patients who suffer pain in the lumbar spine, this phenomenon is frequently absent and the lack of relaxation phenomenon has been attributed to muscle spasms due to pain, to the voluntary reduction of the lumbar range of movement and to the stretch reflexes amplified in the paraspinal muscles.

The acquisition setup includes 4 muscles:

Right erector spinae ilio-costal
 Left erector spinae ilio-costal
 Right long erector spinae
 Left long erector spinae



Electrogoniometer for the acquisition of the angular movement.

The protocol provides for the acquisition of a static test with a duration of 15 seconds, after to have maintained the subject in orthostatic position for 5 minutes at least. Then a test must be realized in which the subject has to execute a forward flexion and a re-extension of the trunk for 3 times in a row.

It's always very important that the forward flexion and the re-extension phases should last 6 seconds, while the flexed position must be maintained for 1 second.

1. ELABORATION PHASE

At the opening of the protocol it's required to define two time variable input, that represent the starting and the ending of the time window that you want to consider for the calculation within of the offset starting value of the angle with (of) the trunk in standing position, just before the three anterior flexions.

After that, the protocol requires the definition of the following events:

- Starting of the anterior flexion of the trunk (automatically defined)
- Starting of the maintenance phase of the flexed position
- Ending of the maintenance phase of the flexed position



- Ending of the extension of the trunk with a returning to the orthostatic position (automatically defined)

If more than one execution are loaded, there will be opened more windows to define all the described events for each execution.

2. REPORT

The report is organized in the following way

- On the first page there is a comparison between the course of the flex-extension angle of the trunk and the acquired courses of the RMS (Root Mean Square) of the muscles, everything with a reference to the movement cycle (from the starting of the flexion to the end of the trunk extension)
- On the second page there are the average value of the RMS about the static test and the average values of the FRP and FRR indexes about the movement test (Rif. *“The Biomechanical and Clinical Significance of the Lumbar Erector Spinae Flexion-Relaxation Phenomenon”* Colloca et al.; Rif. *“Surface EMG in the identification of chronic low back pain patients: the development of the flexion relaxation ratio”* P J Watson et al.)

LABORATORY of MOTION ANALYSIS

BTS Bioengineering

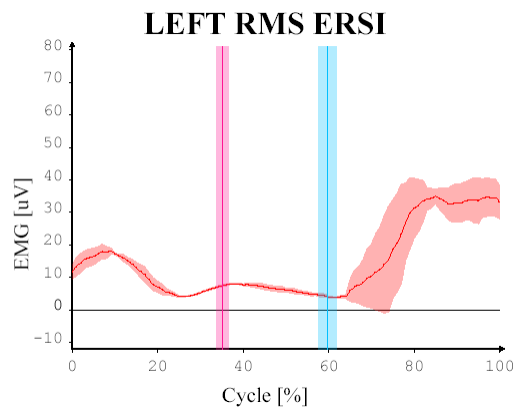
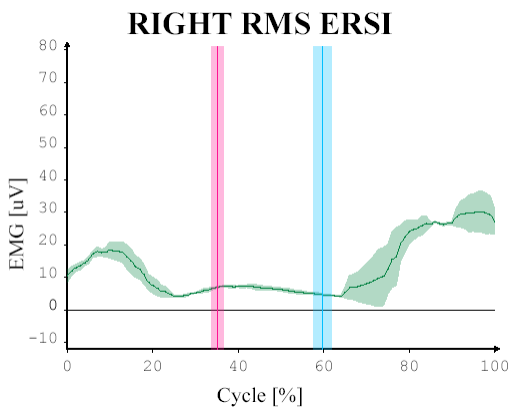
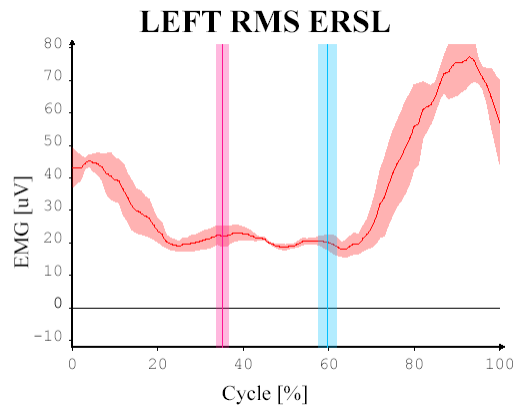
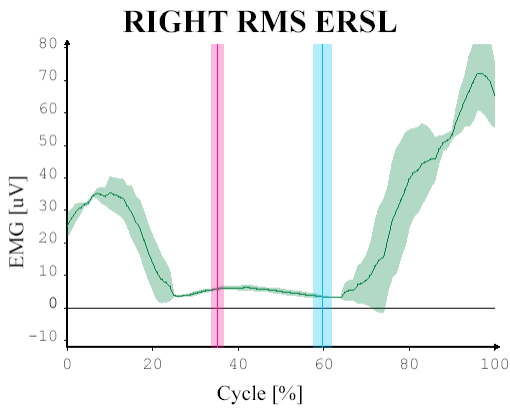
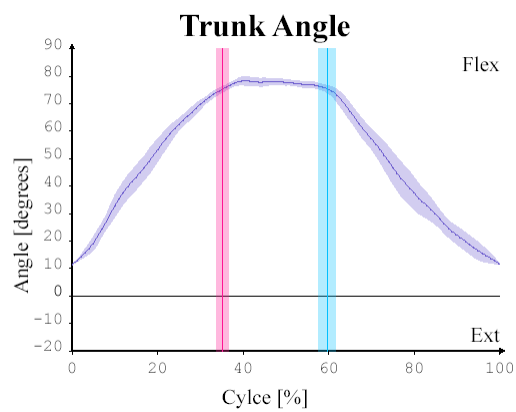
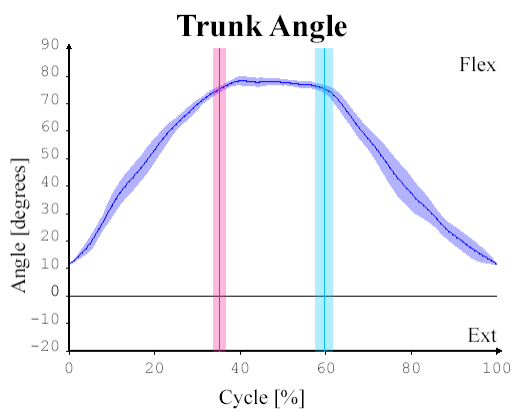
Flexion - Relaxation Test

SURNAME: EMG

NAME: FLEX-RELAX

BIRTHDAY: 24/3/2000

FILE NAME: 0004~EMG FLEX-RELAX



— Starting of the maintenance phase of the trunk flexion

— End of the maintenance phase of the trunk flexion

ERSL = Erector Spinae L1-L2

ERSI = Erector Spinae L4-L5

Static Test

Average RMS (15 sec)	RIGHT	RIGHT Normality	LEFT	LEFT Normality
Erector Spinae L1-L2 [uV]	30.241 ± 11.528	4.05 ± 4.0	19.996 ± 4.676	4.07 ± 3.8
Erector Spinae L4-L5 [uV]	6.471 ± 1.559	3.58 ± 3.7	3.523 ± .944	3.53 ± 3.7

Trunk Flexion Test

Maximum flexion maintenance phase (1 sec)

	FRP	FRP Normality	FRR	FRR Normality
Right Erector Spinae L1-L2 [uV]	5.229 ± .363	2.73 ± 1.5	7.306 ± .99	12.56 ± 8.5
Left Erector Spinae L1-L2 [uV]	20.948 ± .563	2.57 ± 1.2	2.353 ± .074	13.98 ± 11.0
Right Erector Spinae L4-L5 [uV]	6.357 ± .33	3.57 ± 0.7	3.022 ± .381	12.71 ± 5.5
Left Erector Spinae L4-L5 [uV]	6.438 ± .244	2.26 ± 0.9	2.934 ± .097	15.19 7.9

Forward flexion phase (6 sec)

Max RMS	RIGHT	RIGHT Normality	LEFT	LEFT Normality
Erector Spinae L1-L2 [uV]	37.865 ± 2.809	26.69 ± 9.8	49.241 ± .443	28.60 ± 11.7
Erectore Spinae L4-L5 [uV]	19.123 ± 1.936	28.64 ± 11.5	18.912 ± 1.282	28.54 ± 12.4

Re-extension phase (6 sec)

Max RMS	RIGHT	RIGHT Normality	LEFT	LEFT Normality
Erector Spinae L1-L2 [uV]	72.646 ± 11.203	60.40 ± 22.9	80.97 ± 4.485	64.07 ± 23.7
Erector Spinae L4-L5 [uV]	32.39 ± 4.94	51.71 ± 21.8	42.056 ± 1.896	56.10 ± 21.9

FRP = average RMS during maintenance phase of forward flexion

Maximum RMS during forward flexion phase

FRR = -----

FRP