TMG - BMC LTD.

Mirje 6

1000 Ljubljana

Slovenia

Europe (EU)

Tel: (00 386 1) 4210 037

Fax: (00 386 1) 2425 382

Email: info@tmg.si

Web: www.tmg.si

TENSIOMYOGRAPHY (TMG)

MEASUREMENT RESULTS

TENSIOMYOGRAPHY

Tensiomyography (TMG) is measuring method for detecting skeletal muscles' contractile properties. It enables selective measurements of radial muscle belly enlargements in single muscle. Muscle is stimulated with single electrical stimulus or train of electrical stimuli (tetanic stimulation). Measurements are carried out under isometric conditions.

METHOD

Radial displacement of skeletal muscle belly is proportional to relative muscle force. TMG provides selective information on contractile properties of neuro-muscular system. Measuring method is non-invasive.

PROTOCOL

Measured subject is sitting or laying on one side, on the back or on the front, depending on measured muscle. Joints are put in natural physiognomic position – flexed for 5 – 20 degrees. Both electrodes are placed symmetric to sensor; positive electrode (anode) is placed proximal and negative electrode (cathode) distal, 50 – 60 mm from measuring point. Electrodes are self-adhesive. In portable measuring system the cathode can be integrated part of a sensor.

Measuring tool – the displacement sensor is pressed to the skin above measured muscle belly, radial to the surface. Positioning of the sensor is performed in voluntary contracted or electrically stimulated muscle by palpation. Initial displacement of the sensor is set manually or automatic with servo system.

ELECTRICAL STIMULATION

Electrical stimulation consists of single DC electrical stimuli of 1 ms duration. Their amplitude is of supramaximal value. Tetanic stimulation is a set of 0.1 ms DC stimuli. Pulse amplitude is adjusted to measured subjects, pulse frequency ranges from 10 to 40 Hz – depending on the process observed. For electrical stimulation mainly current impulse generator is used. It is powered by installed batteries.

Stimuli are repeated three to five times with at least 5 s pauses between them. Muscle responses are stored and analyzed with a PC.

PARAMETERS OF MUSCLE BELLY RESPONSE

TMG signals are analyzed in order to determine the following parameters: delay time, contraction time, sustain time, relaxation time and maximal amplitude. Additionally also statistical analysis, differences between agonistic pairs, synergistic pairs and lateral pairs can be calculated.

RESULTS AND MEASUREMENT ANALYSIS S

Standard output of TMG measurement is table of results, which is included in this report. Extended report contains also graphs of measured muscles' responses.

It is possible to request for additional analyses on the basis of TMG measurement database.

Discussion on measuring results is based on comparison between measured subject data and database of average responses (with standard deviation) for each muscle or database on specific sport.
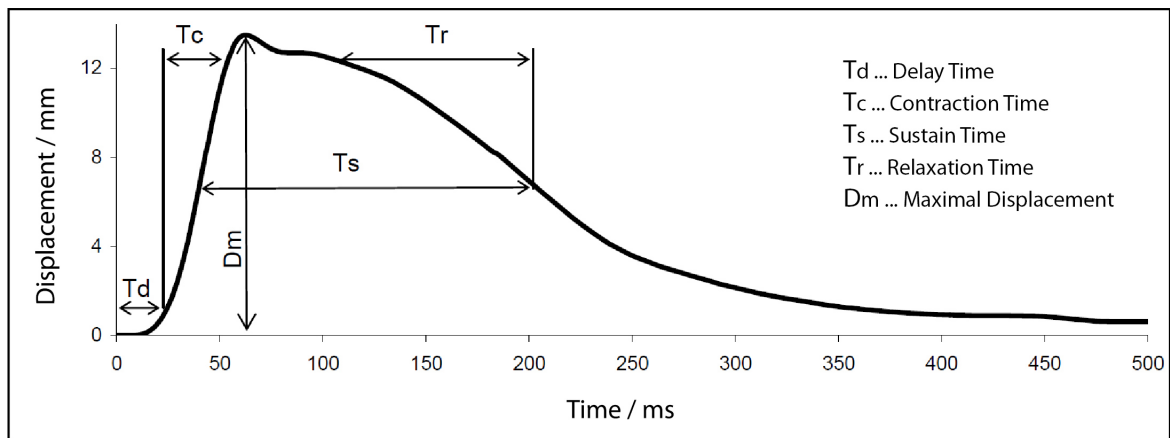
AGREEMENT

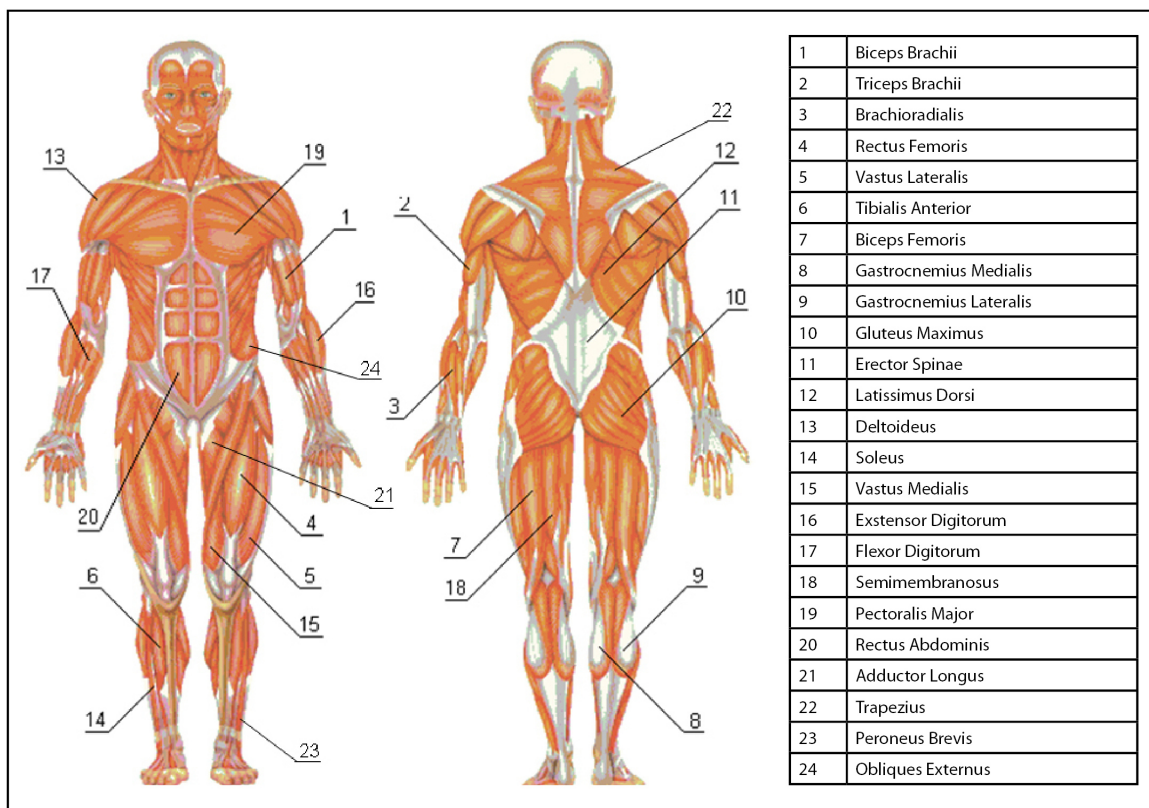Measured person, measurement performer and applicant are informed about the test (TMG) and its objective.

Measured person agrees that test results can/will be used for sport training technology planning, for diagnostics and rehabilitation with patients with neuro-muscular diseases and injuries.

Measurement performer may use test results for research of contractile properties of skeletal muscles according to medical and sports ethics and protection of personal data.

PARAMETERS DEFINITIONS

Td ... Delay Time
Tc ... Contraction Time
Ts ... Sustain Time
Tr ... Relaxation Time
Dm ... Maximal Displacement

MUSCLE LEGEND

1	Biceps Brachii
2	Triceps Brachii
3	Brachioradialis
4	Rectus Femoris
5	Vastus Lateralis
6	Tibialis Anterior
7	Biceps Femoris
8	Gastrocnemius Medialis
9	Gastrocnemius Lateralis
10	Gluteus Maximus
11	Erector Spinae
12	Latissimus Dorsi
13	Deltoideus
14	Soleus
15	Vastus Medialis
16	Exstensor Digitorum
17	Flexor Digitorum
18	Semimembranosus
19	Pectoralis Major
20	Rectus Abdominis
21	Adductor Longus
22	Trapezius
23	Peroneus Brevis
24	Obliques Externus

		Age:	18	**Diagnosis:**	Healthy
		Height:	172	**LoadType:**	Not defined
Sex:	Male	**Weight:**	68	**Sport:**	Football - center

Reference database: Basic Reference Database

Lateral Symmetry (LS):

Muscle	Side	Tc [ms]	Ts [ms]	Tr [ms]	Dm [mm]	Td [ms]	Sim [%]
m.BF	R	22.19	205.93	42.87	6.00	20.83	
m.BF	L	22.11	184.33	43.68	4.82	21.72	**94**
m.RF	R	20.38	46.15	23.69	7.29	22.30	
m.RF	L	22.85	213.34	183.58	9.62	23.93	**80**
m.VL	R	20.64	30.89	9.41	5.66	20.22	
m.VL	L	22.03	78.57	53.69	8.04	21.57	**84**
m.VM	R	24.09	216.81	187.35	9.06	21.28	
m.VM	L	19.58	222.78	197.64	7.83	20.24	**85**

Functional Symmetry (FS):

		Sim [%]			Sim [%]
Elbow: (BB/TB)	R		**Knee: (VL&VM&RF/BF)**	R	93
	L			L	97
Achilli Tendon: (GL/GM)	R		**Ankle: (TA/GL&GM)**	R	
	L			L	
Lig.Patellae: (VM/VL)	R	79	**Leg: (VL&VM/GL&GM)**	R	
	L	84		L	

BF Biceps Femoris

BF Biceps Femoris RIGHT Ref	
X	Tc(ms)
X	Tr(ms)
X	Td(ms)
	Dm(mm)

BF Biceps Femoris LEFT Ref	
X	Tc(ms)
X	Tr(ms)
X	Td(ms)
	Dm(mm)

RF Rectus Femoris

RF Rectus Femoris RIGHT Ref	
X	Tc(ms)
X	Tr(ms)
X	Td(ms)
X	Dm(mm)

RF Rectus Femoris LEFT Ref	
X	Tc(ms)
X	Tr(ms)
X	Td(ms)
X	Dm(mm)

VL Vastus Lateralis

VL Vastus Lateralis RIGHT Ref	
X	Tc(ms)
X	Tr(ms)
X	Td(ms)
X	Dm(mm)

VL Vastus Lateralis LEFT Ref	
X	Tc(ms)
X	Tr(ms)
X	Td(ms)
X	Dm(mm)

VM Vastus Medialis

VM Vastus Medialis RIGHT Ref	
X	Tc(ms)
X	Tr(ms)
X	Td(ms)
X	Dm(mm)
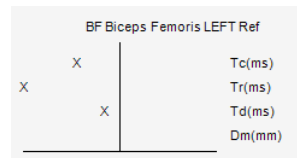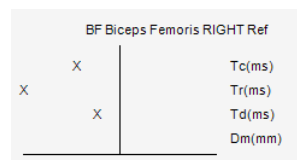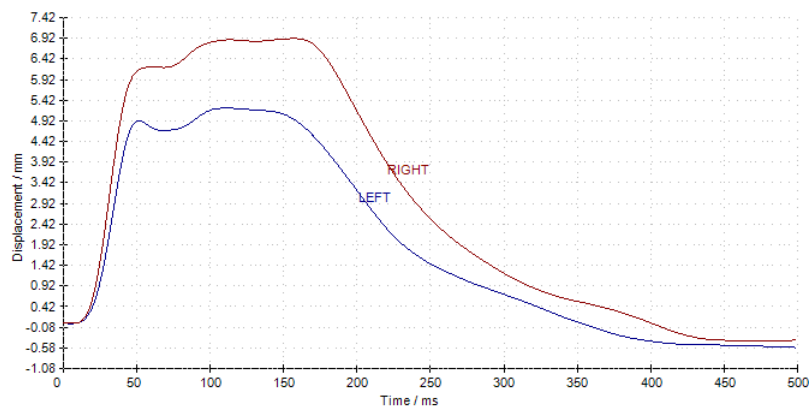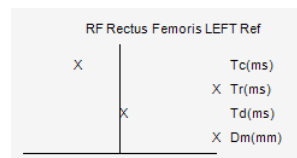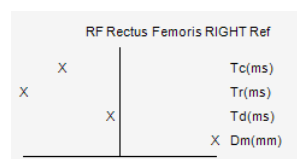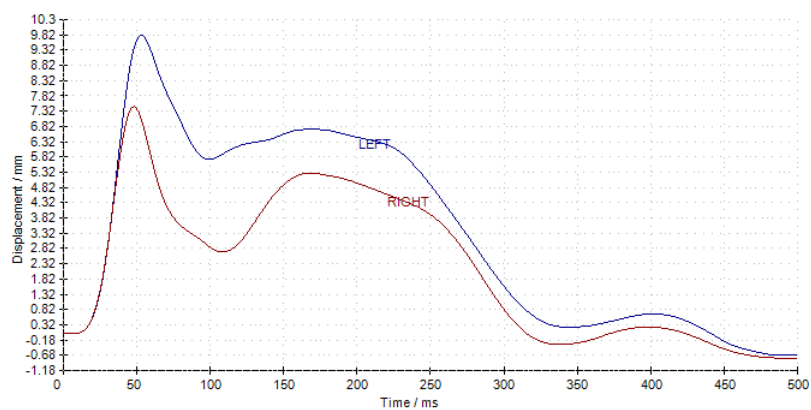
VM Vastus Medialis LEFT Ref	
X	Tc(ms)
X	Tr(ms)
X	Td(ms)
X	Dm(mm)
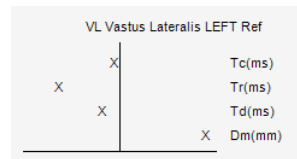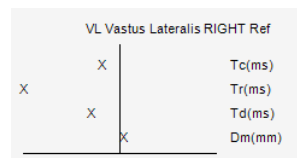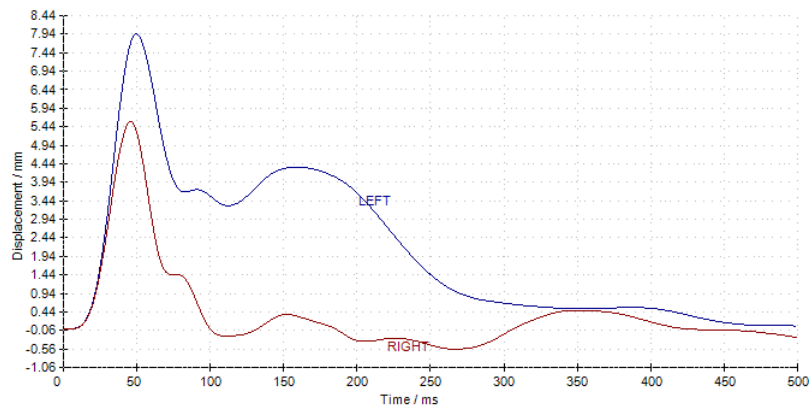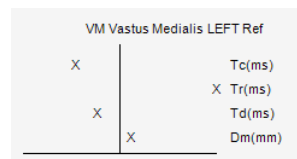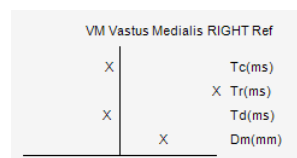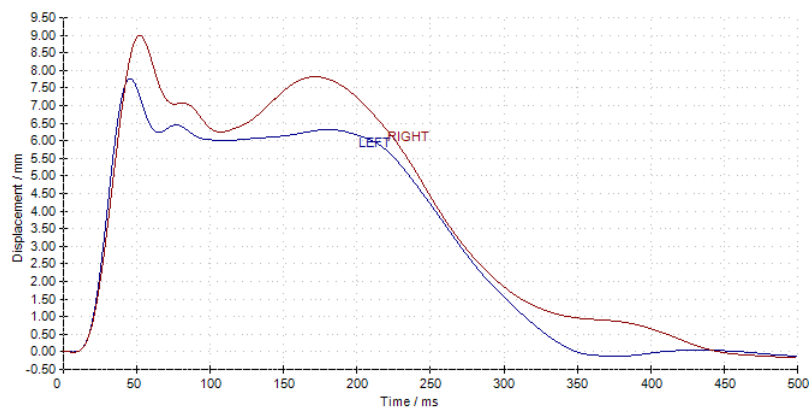
INTERPRETATION

LATERAL SYMMETRY (LS):

BF Biceps Femoris

General Biceps Femoris (BF) muscle LS is very high 94%.

The muscle is slightly faster than selected sport average.

RF Rectus Femoris

General Rectus Femoris (RF) muscle LS is sufficiently high 80%.

The muscle is significantly faster than selected sport average.

VL Vastus Lateralis

General Vastus Lateralis (VL) muscle LS is sufficiently high 84%.

The muscle is significantly faster than selected sport average.

VM Vastus Medialis

General Vastus Medialis (VM) muscle LS is sufficiently high 85%.

LS of contraction time is significantly lower than recommended. Slower is the muscle on the right side.

The muscle is significantly faster than selected sport average.

We recommend activation exercises for right side.

FUNCTIONAL SYMMETRY (FS):

R Knee

General FS of the right Knee is very high 93%.

L Knee

General FS of the left Knee is very high 97%.

R Lig.Patellae

General FS of the right Lig.Patellae is sufficiently high 79%.

Muscle VM is the slower one. We recommend activation exercises.

L Lig.Patellae

General FS of the left Lig.Patellae is very high 84%.