



SCIENCE FOR
BODY EVOLUTION.

Evaluating Muscle Contraction with Tensiomyography



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What is Tensiomyography?

Diagnostic method

Contractile properties

Superficial skeletal muscle

Application areas



Sport – Performance, Injury prevention

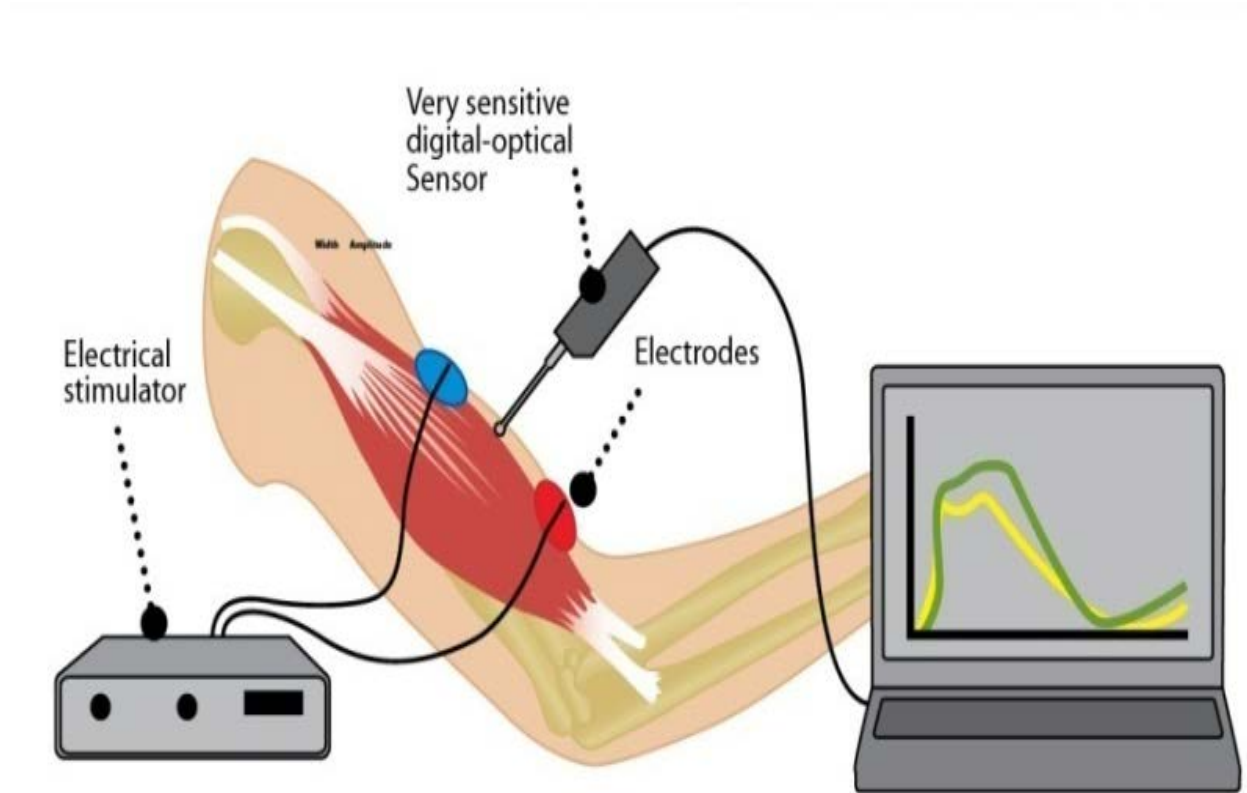
Medicine – Rehabilitation monitoring

Research – Scientific publications



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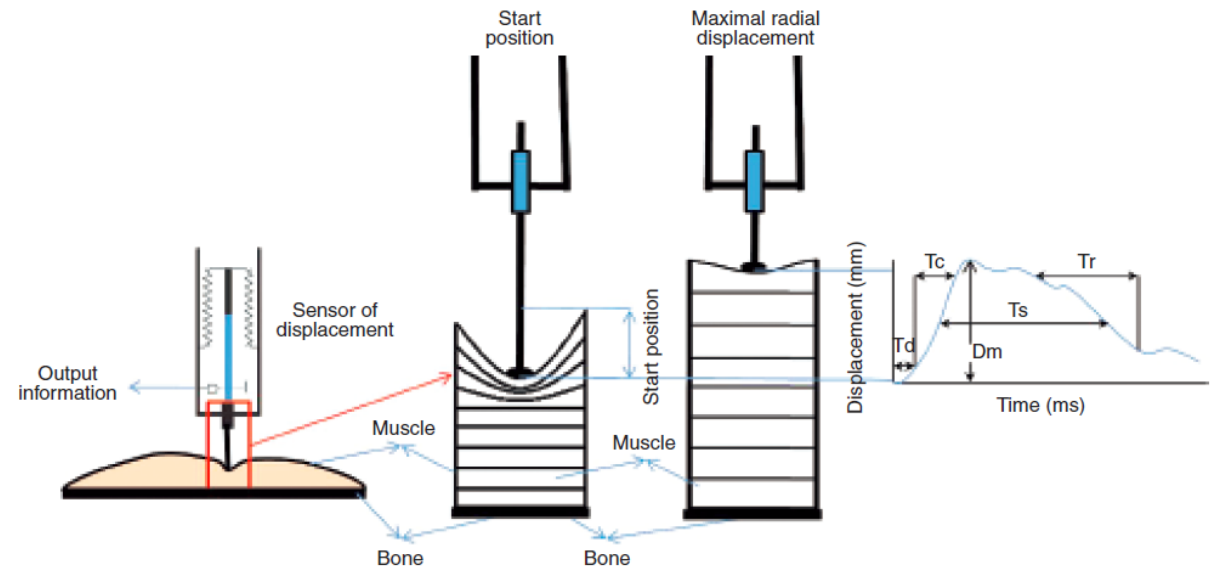
Tensiomyography



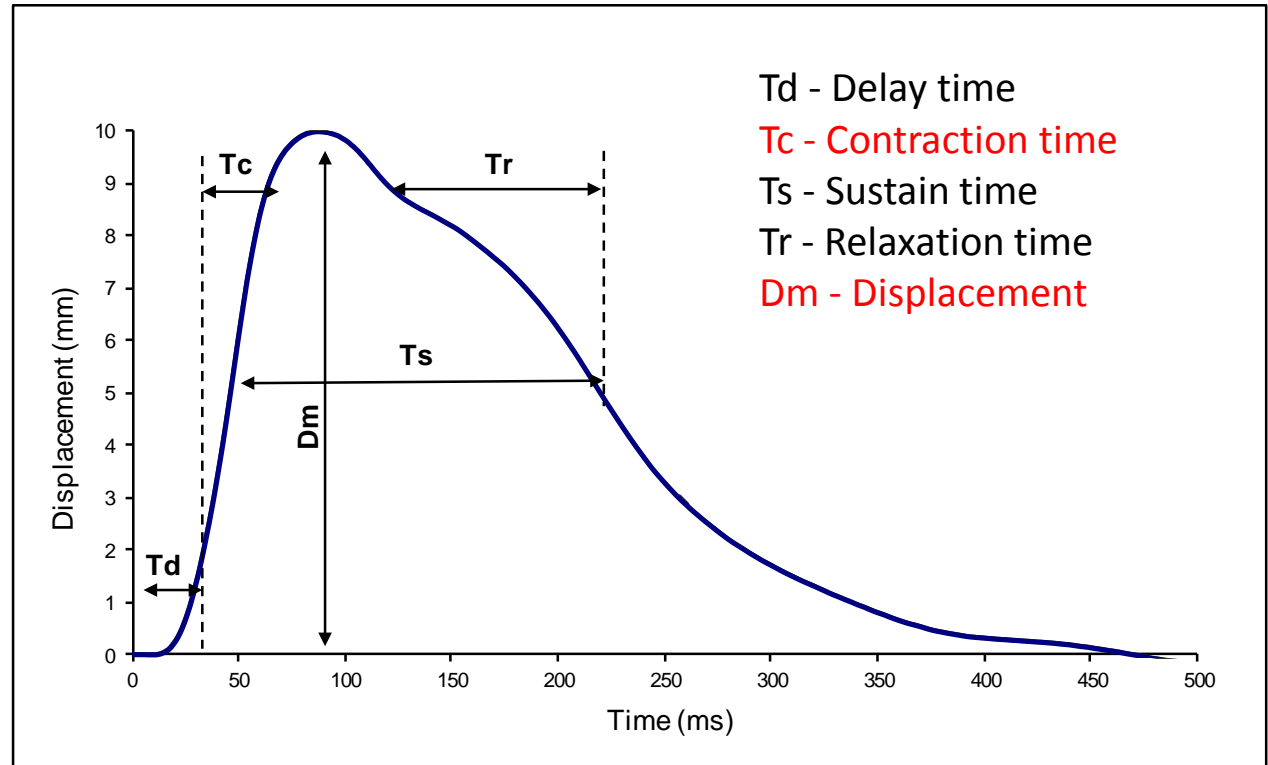


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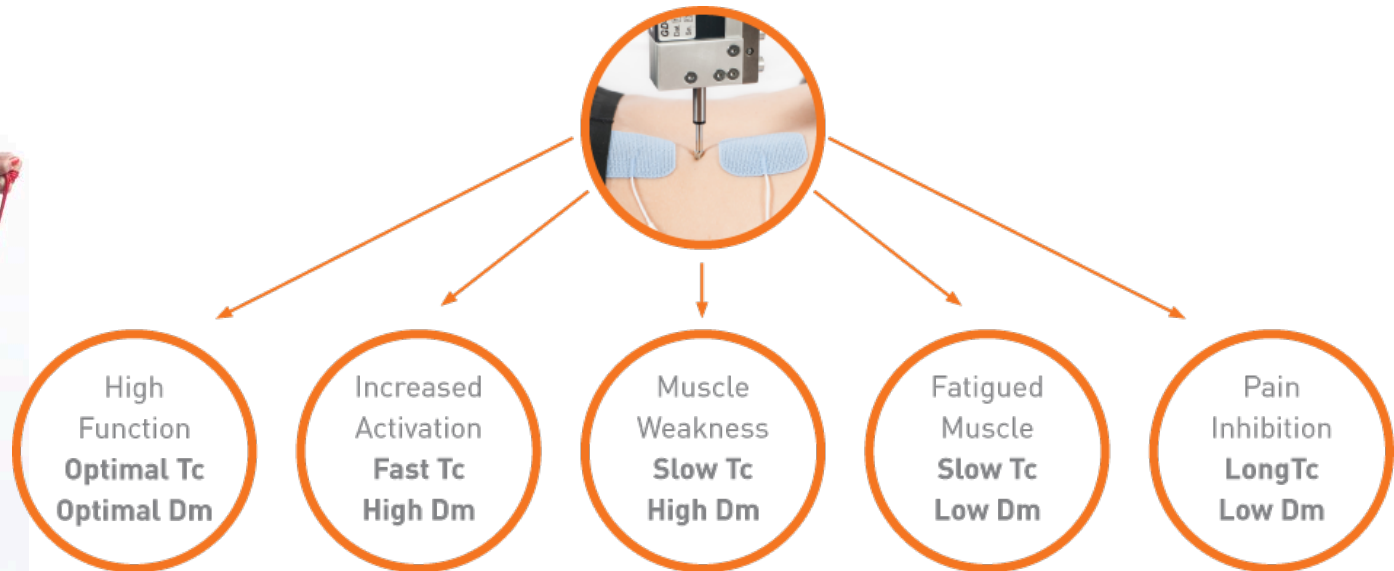
Tensiomyography



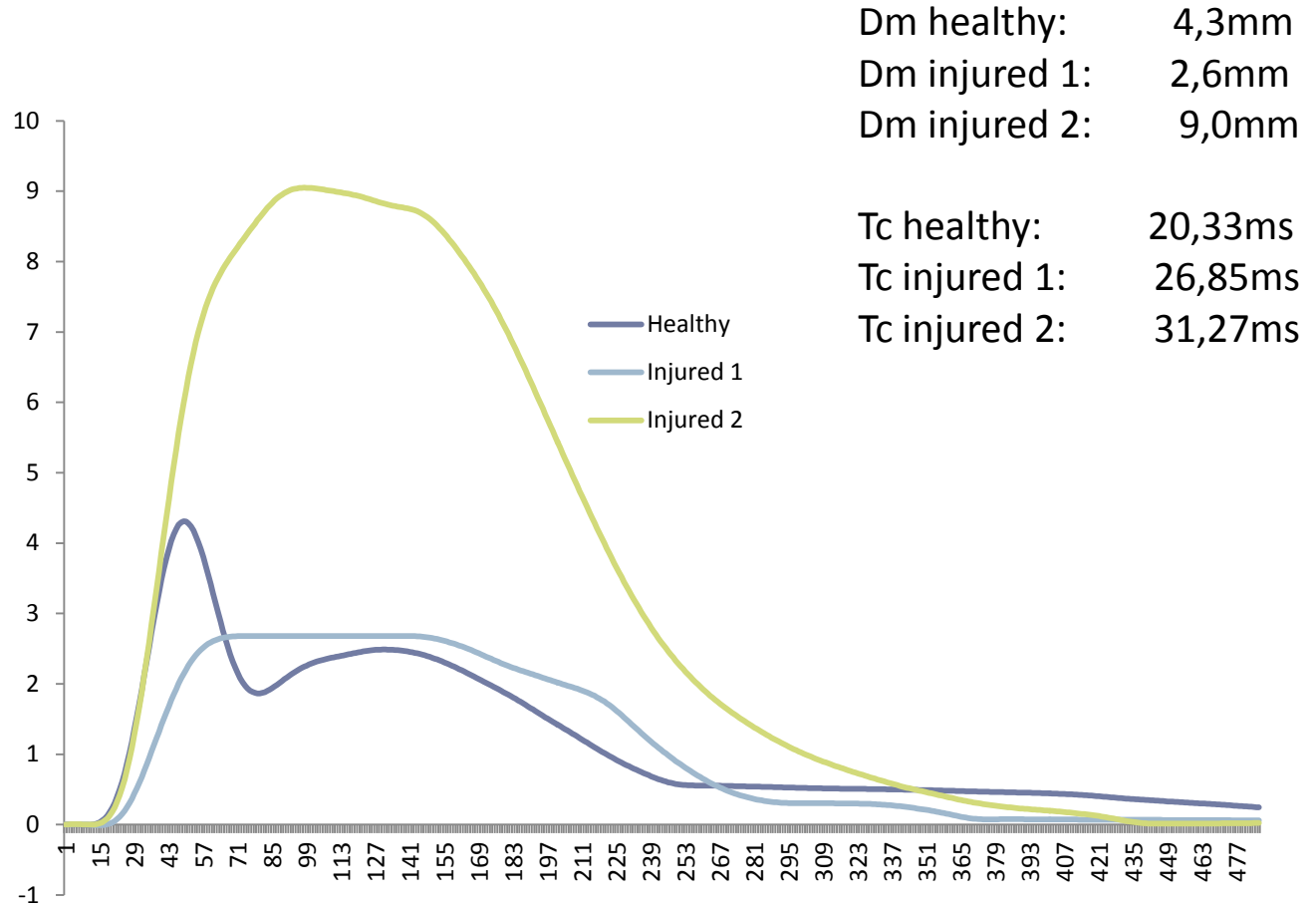
TMG Parameters



Muscle Response Scenarios



Sensitivity: raw data signals



Reference database Male

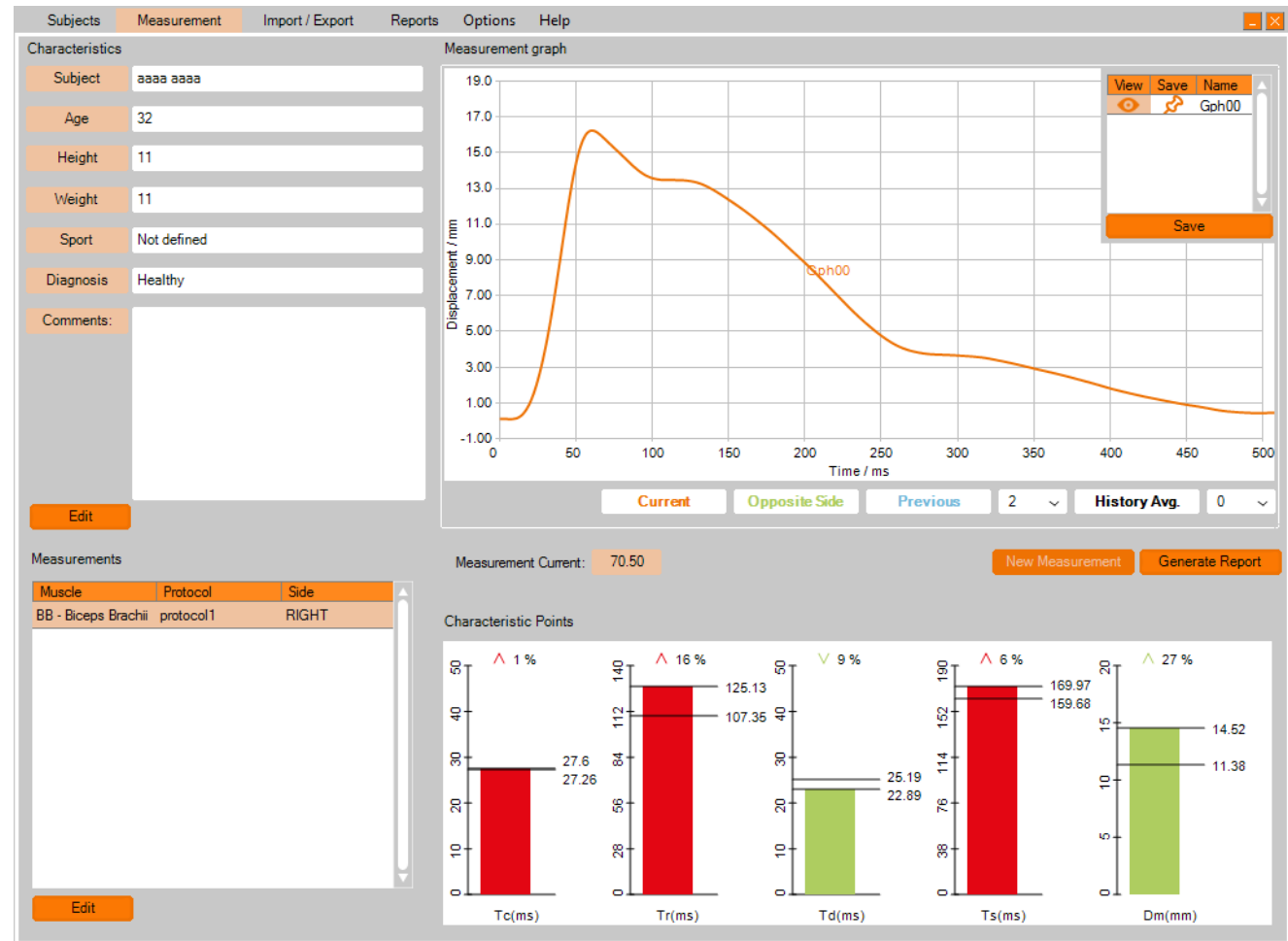


Erector Spinae
Tc= 19,04
Dm= 4,81

Gluteus Maximus
Tc= 46,37
Dm= 8,89

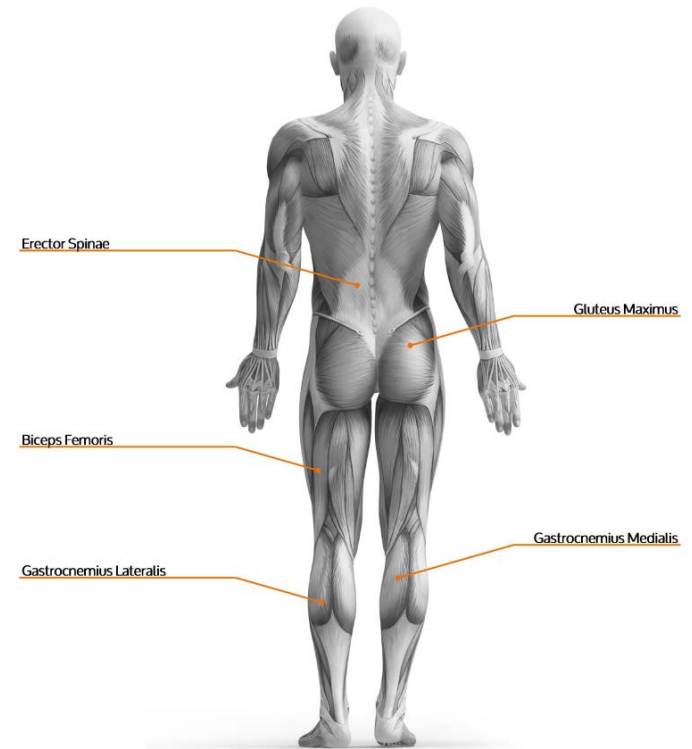
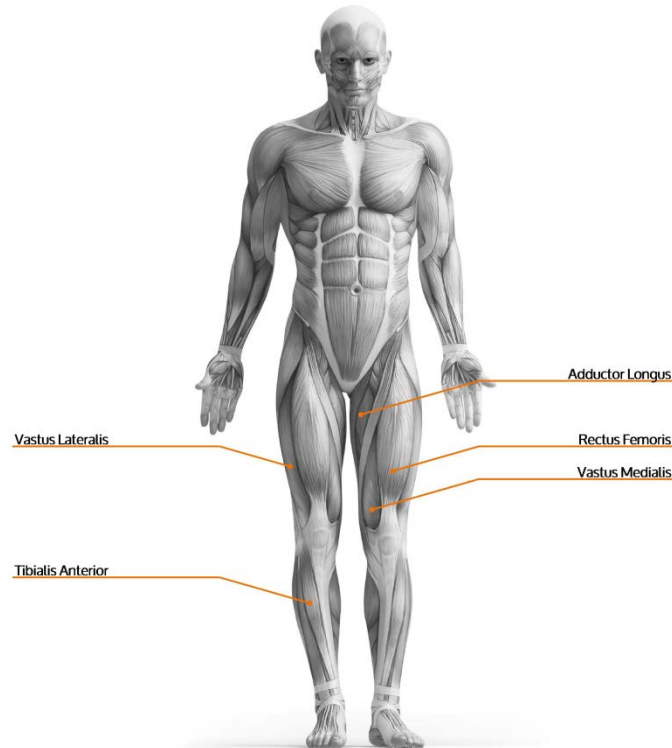
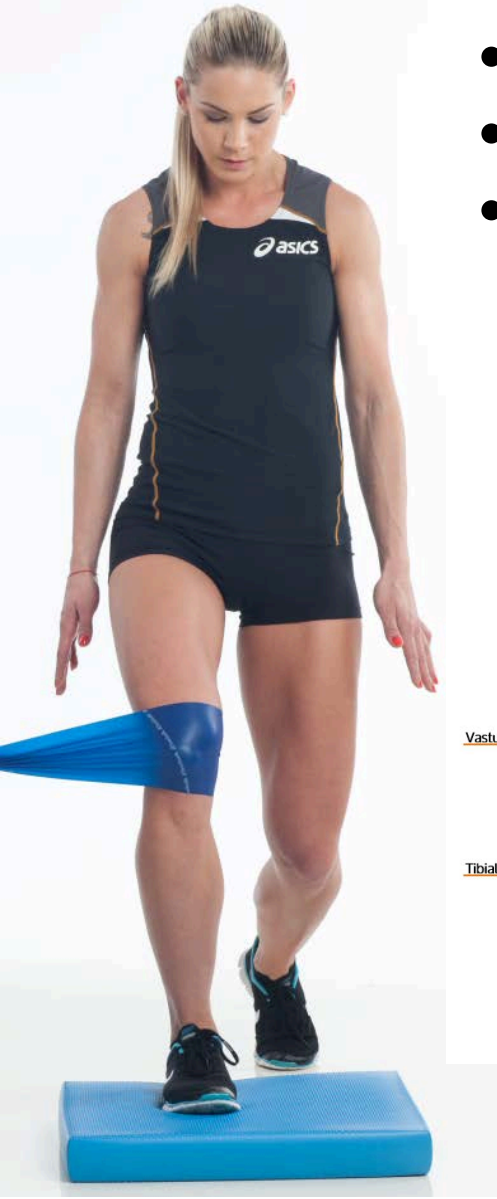
Biceps Femoris
Tc= 28,36
Dm= 4,73

Basic Results



Lateral and Functional Symmetry

- Lateral Symmetry
- Functional Symmetry - Antagonistic Pairs
- Functional Symmetry - Synergistic Pairs



Lateral and Functional Symmetry



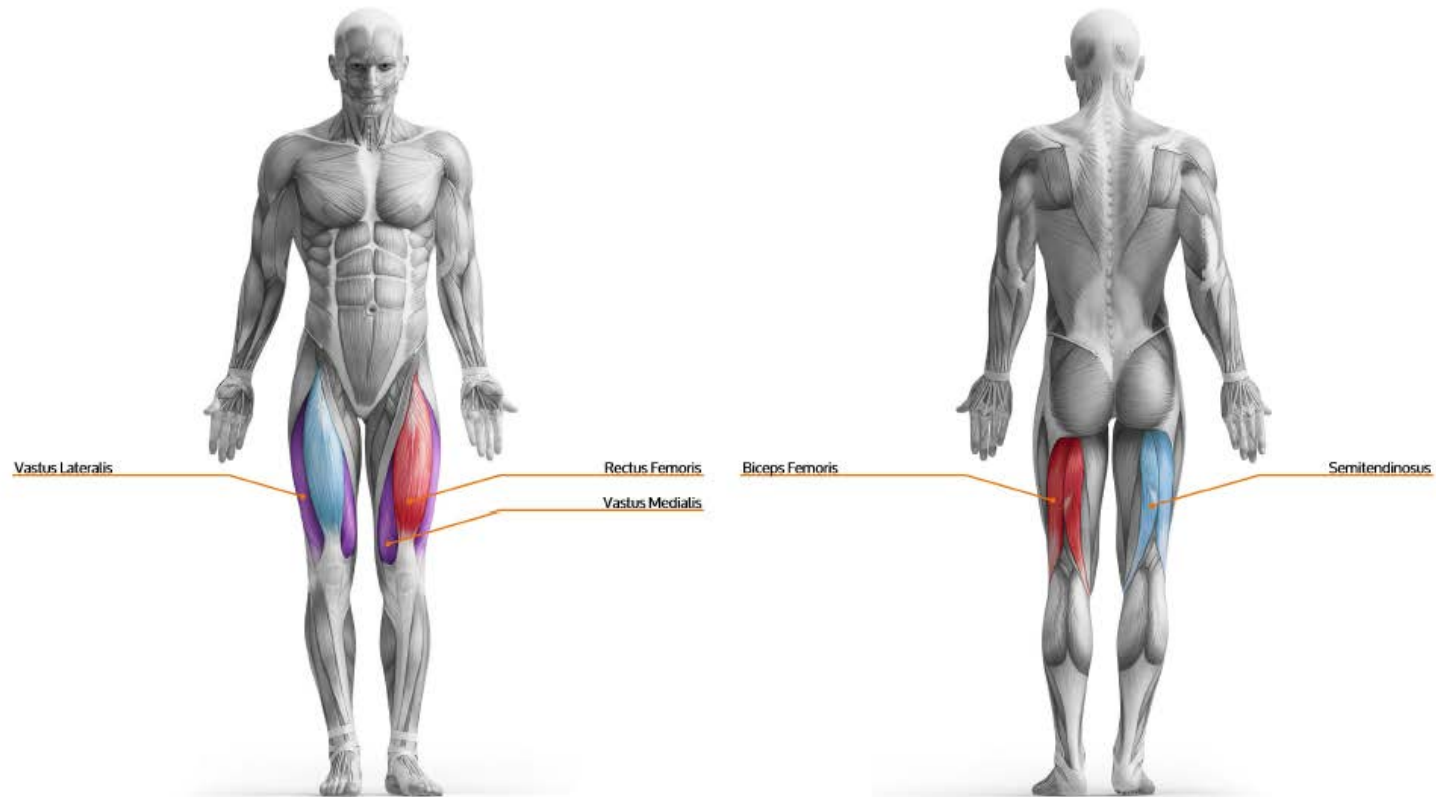
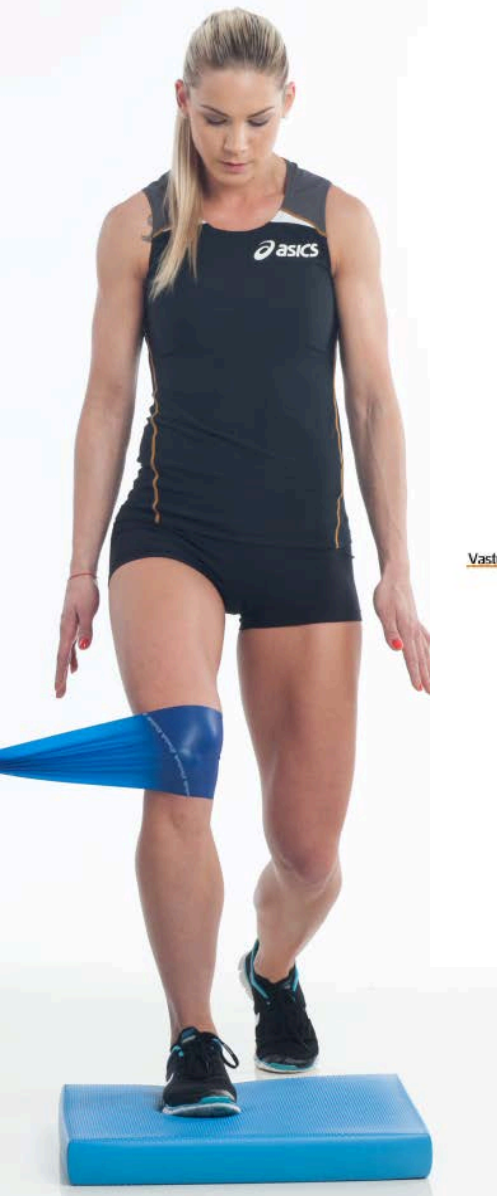
Lateral Symmetry (LS)

Muscle	Side	Tc [ms]	Ts [ms]	Tr [ms]	Dm [mm]	Td [ms]	Sym [%]
m.BF	L	35.14	191.05	74.87	14.62	26.46	66
m.BF	R	24.15	219.19	30.52	5.37	23.23	
m.RF	L	23.44	135.17	65.52	11.25	21.62	79
m.RF	R	20.87	70.67	40.72	6.30	19.97	
m.ST	L	50.55	102.12	38.40	13.89	31.92	78
m.ST	R	42.47	151.20	44.31	8.92	24.52	
m.VL	L	23.72	179.47	152.13	11.00	23.72	89
m.VL	R	22.84	98.90	71.37	9.27	21.69	
m.VM	L	27.09	160.85	54.57	10.65	27.84	94
m.VM	R	28.41	177.89	84.22	10.28	23.14	

Functional Symmetry (FS)

		Sym [%]			Sym [%]
Elbow: (BB/TB)	L	--	Knee: (VL&VM&RF/BF)	L	74
	R	--		R	94
Achilles Tendon: (GL/GM)	L	--	Ankle: (TA/GL&GM)	L	--
	R	--		R	--
Lig.Patellae: (VM/VL)	L	88	Leg: (VL&VM/GL&GM)	L	--
	R	79		R	--

Comments / Recommendations



● Activation exercises ● Strength exercises ● Stretch / Relax

● Tc too slow ● Dm too high ● Dm too low



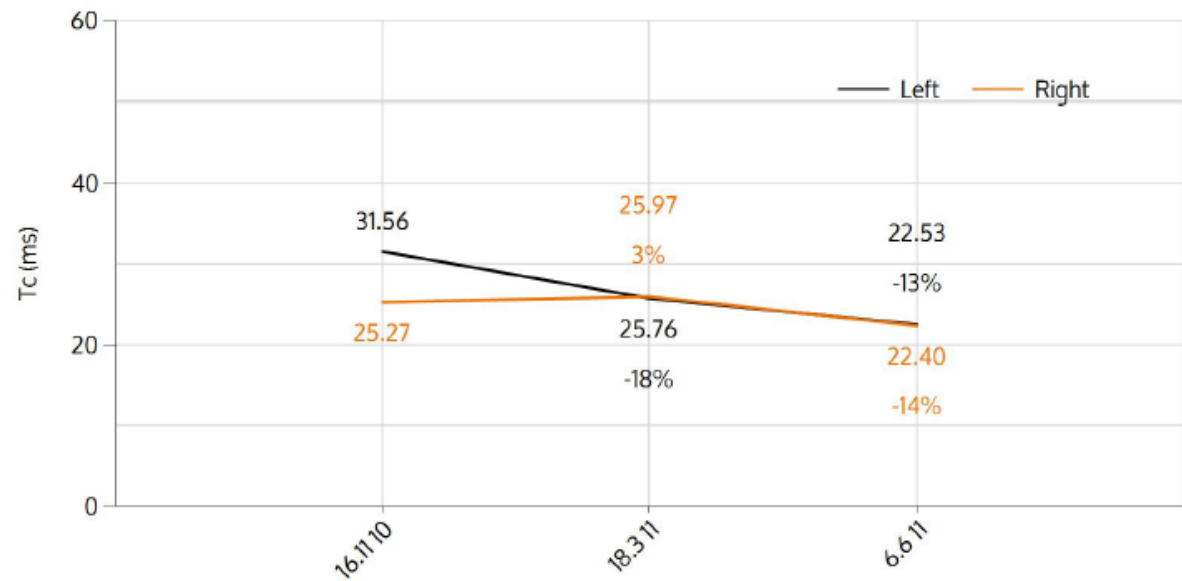
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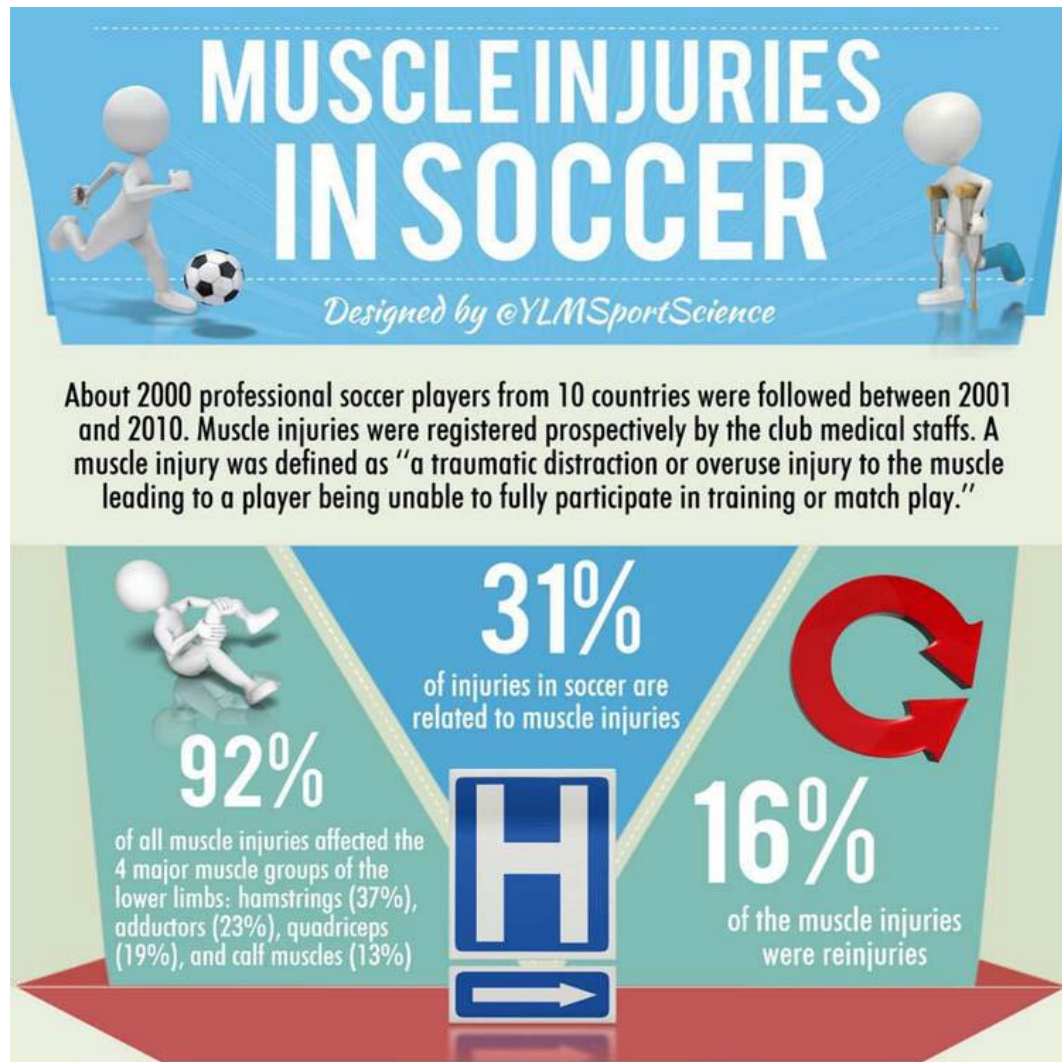
Rehabilitation Process Monitoring

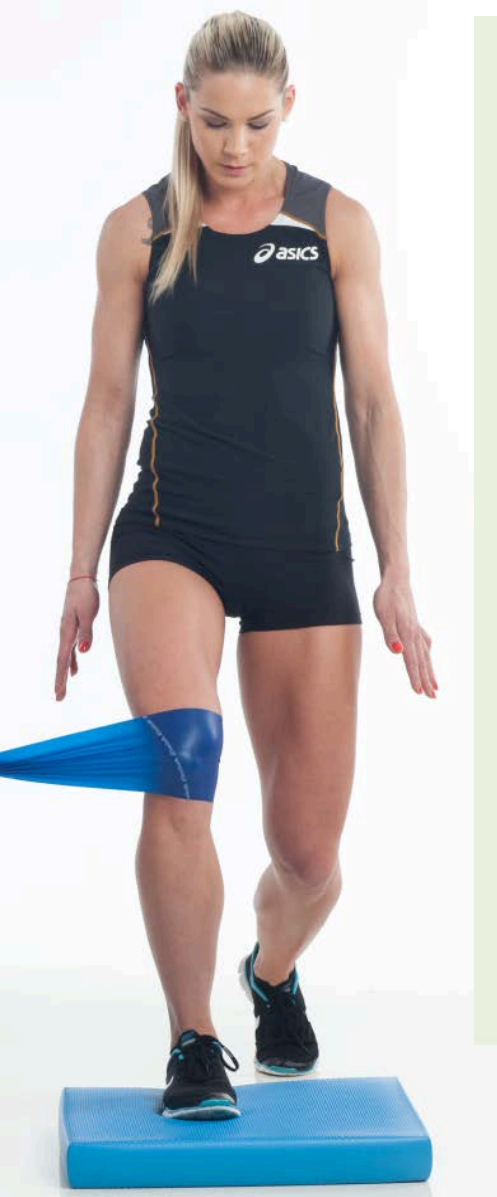


Tc (Contraction time)

Date	Left	%	Right	%	Sym [%]
16.11.2010	31.56	0	25.27	0	80
18.03.2011	25.76	-18	25.97	3	99
06.06.2011	22.53	-13	22.40	-14	99







X2

increased rate of calf injury in older players, but no association was found in other muscle groups



on average, the number of muscle injuries sustained per player per season



15

muscles injuries expected per year for a squad of 25 players



References

Ekstrand et al. Am J Sport Med 2011

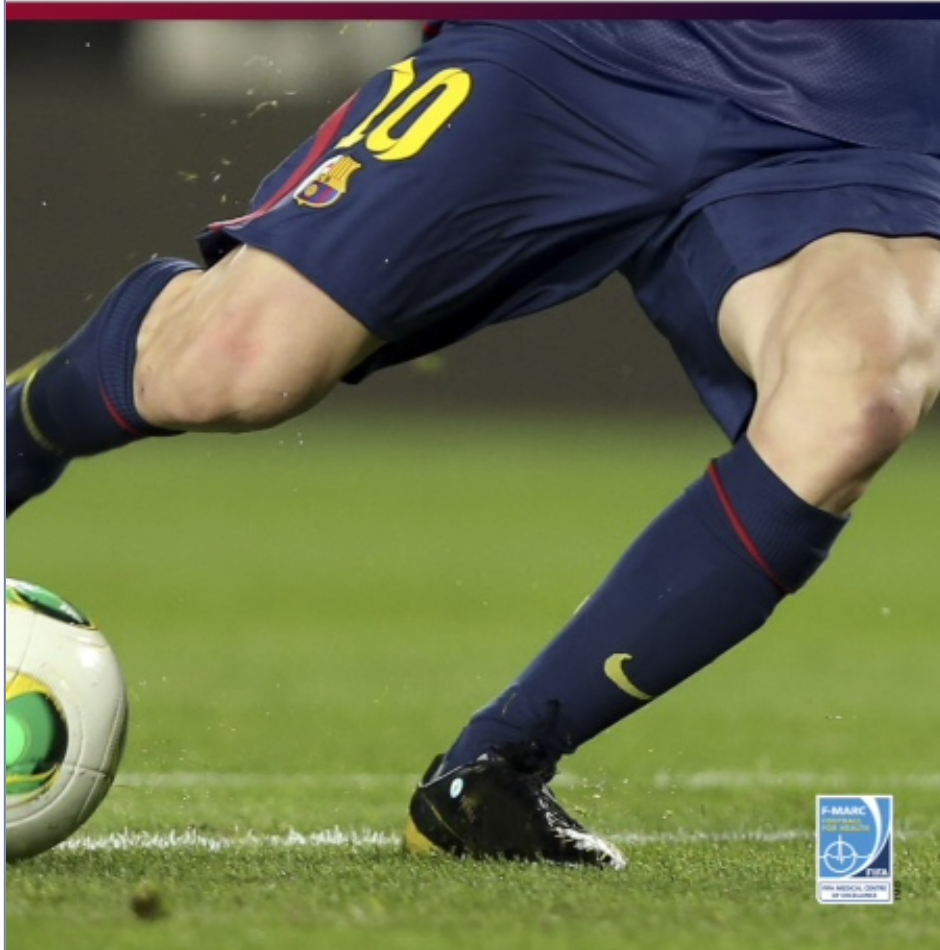
Hägglund et al. Am J Sport Med 2013



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MUSCLE INJURIES CLINICAL GUIDE 3.0

January 2015



“Tensiomyography
is used for
follow-up the
functional recovery
of muscle
and to help decide
return to play”

FC Barcelona & ASPETAR Example :

“Management of a muscle injury”

		Clinical history	Physical exam	US	MRI	Treatment
Initial acute phase	Immediate	X	X		Could be made anytime	Rest Ice Compression Elevation Analgesia
	12 hours		X	X		
	24 hours		X	X		
	48 hours		X	X		
					Functional tests	
Subacute and functional phase	1 st week	Monitorize players feelings	X	x	To evaluate how the progression of loads are assumed	Rehabilitation progressive protocol
	Weekly		X	X		
	Return to play		X	X		

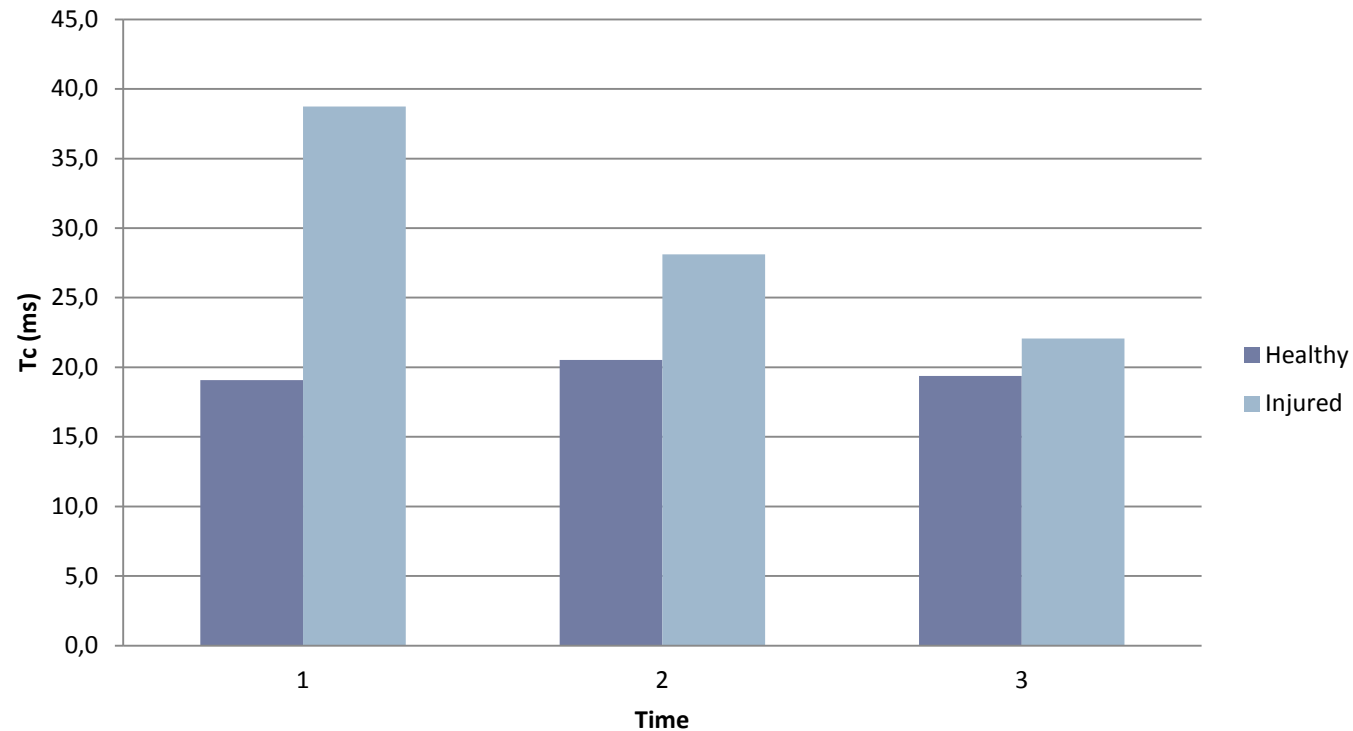
For follow-up the functional recovery and sometimes to help to decide return to play:

- *Muscle:* **Tensiomyography**, electromyography and strength tests.
- *Player:* GPS, HR and self administered scales during and after the rehabilitation sessions on field.

Rehabilitation Monitoring



Hamstring (Biceps Femoris) injury



1st measurement: 4 days after the injury

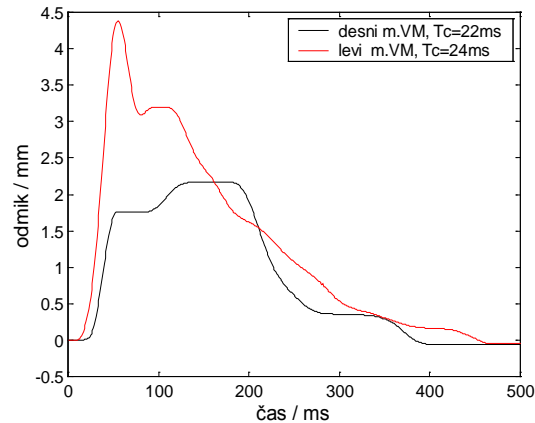
2nd measurement: 10 days after the injury

3rd measurement: 16 days after the injury

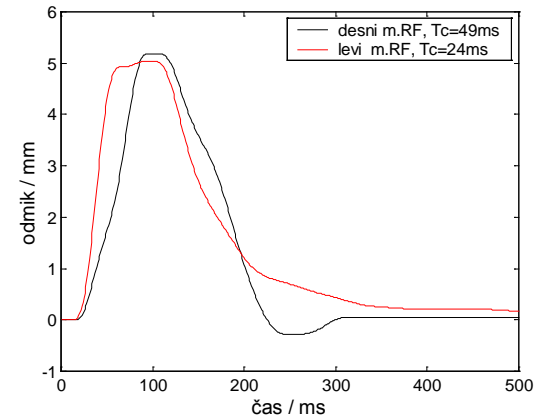
Knee Surgery - ACL



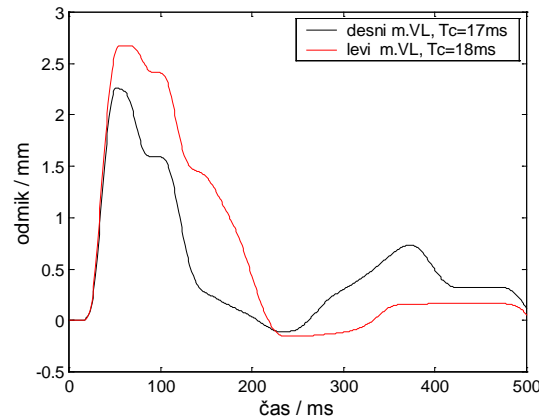
VM = 53 %



RF = 59 %



VL = 79 %

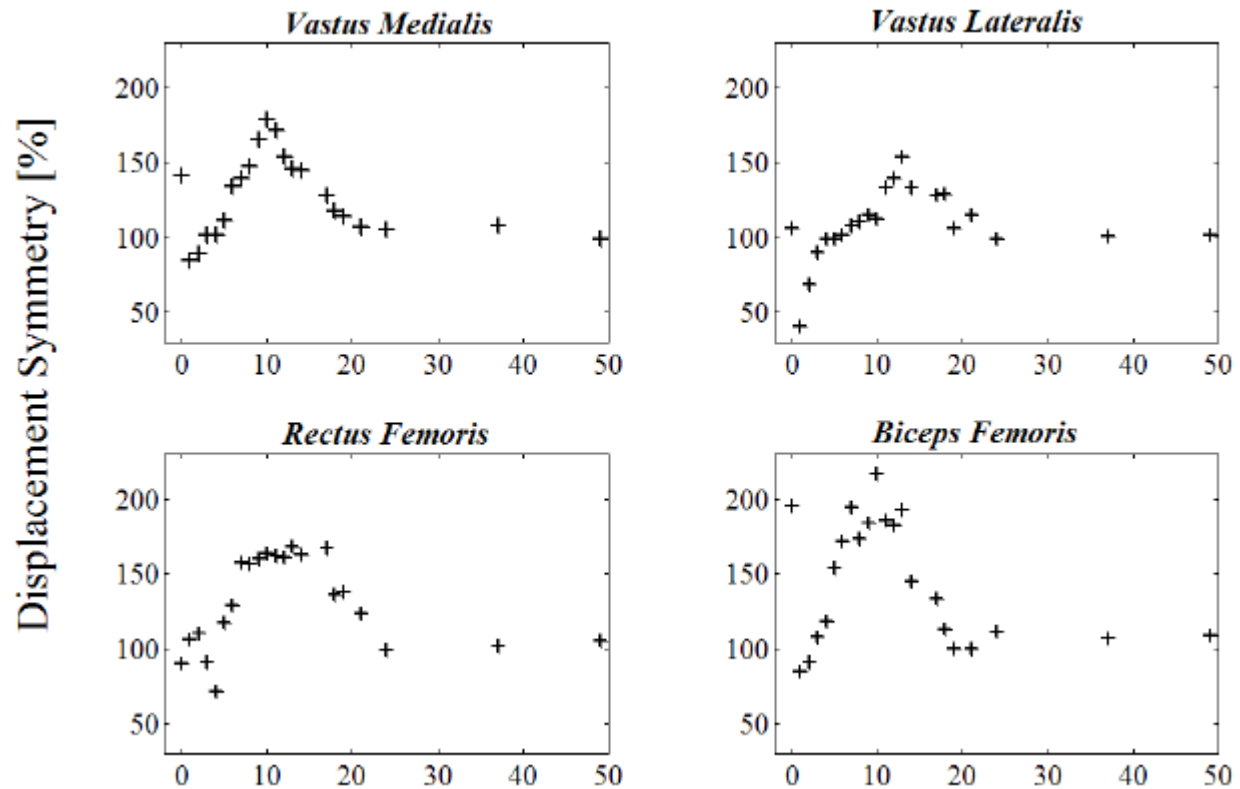


---- Healthy leg

---- Injured leg

4 days after the surgery
Patellar tendon graft

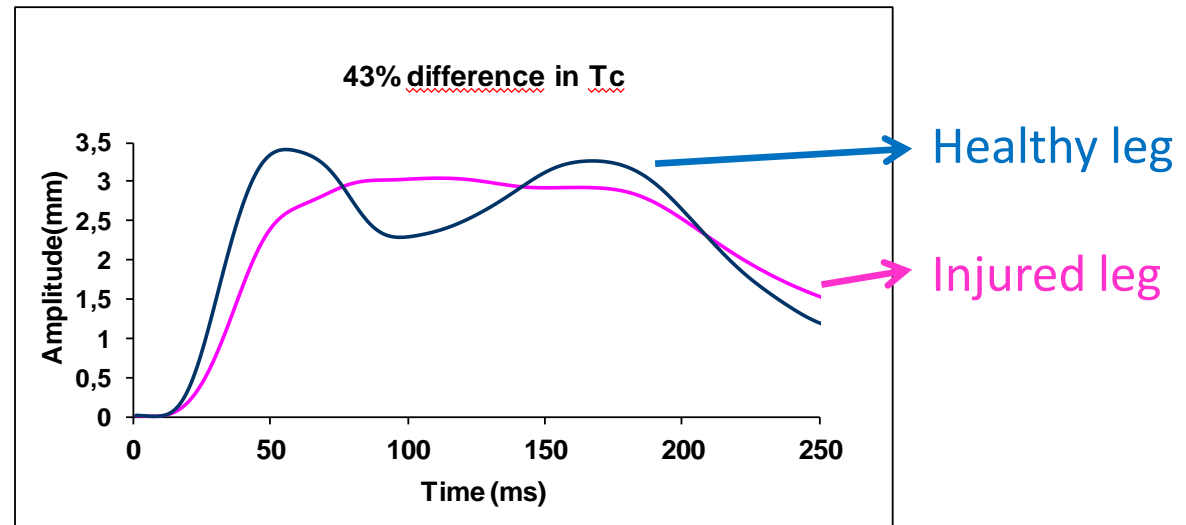
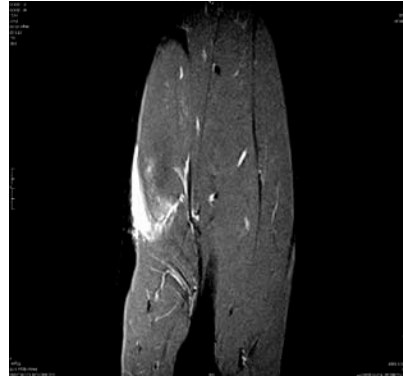
Recovery Monitoring – before/ after ACL surgery



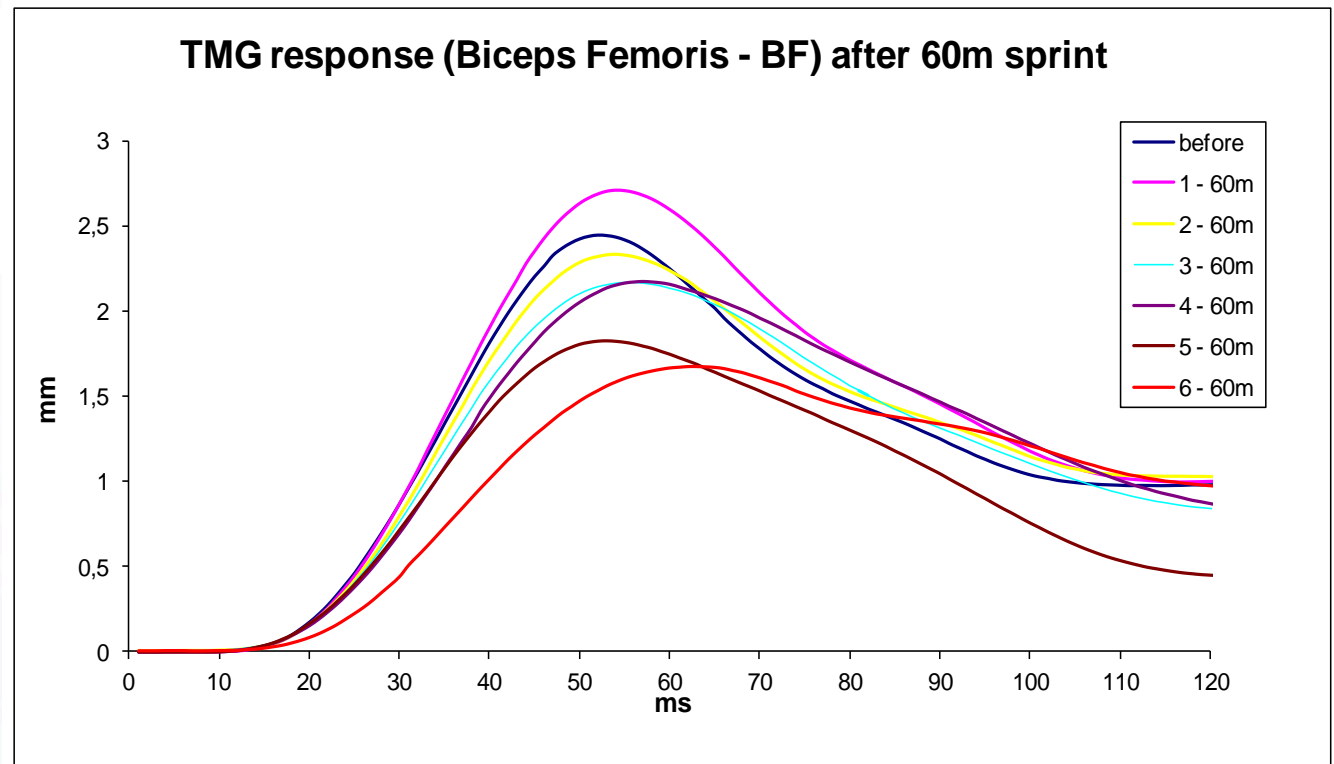
**Adaptation pattern to rehabilitation
Is different for each muscle**

Other Diagnostic Methods

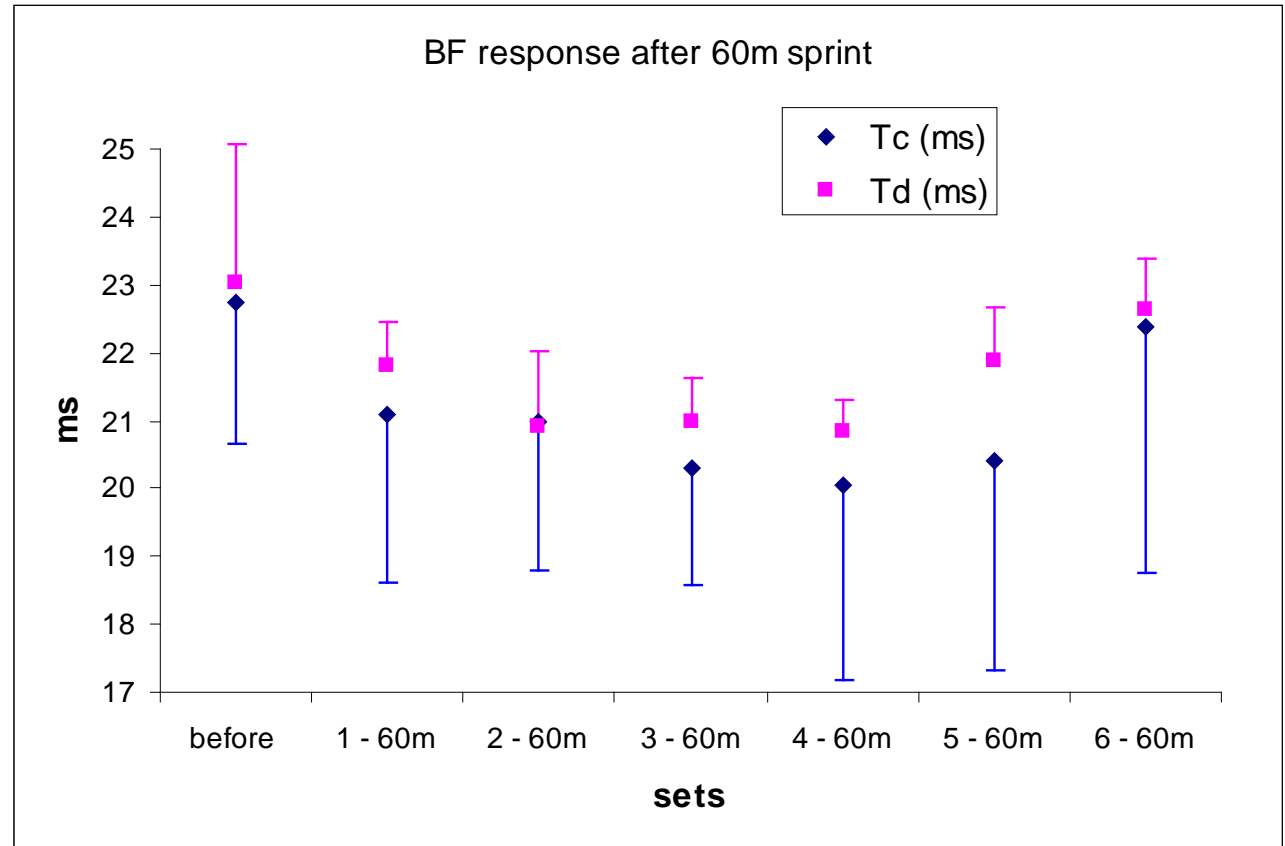
Hamstring (Biceps Femoris) injury



Muscle Fatigue Monitoring



Muscle Fatigue Monitoring

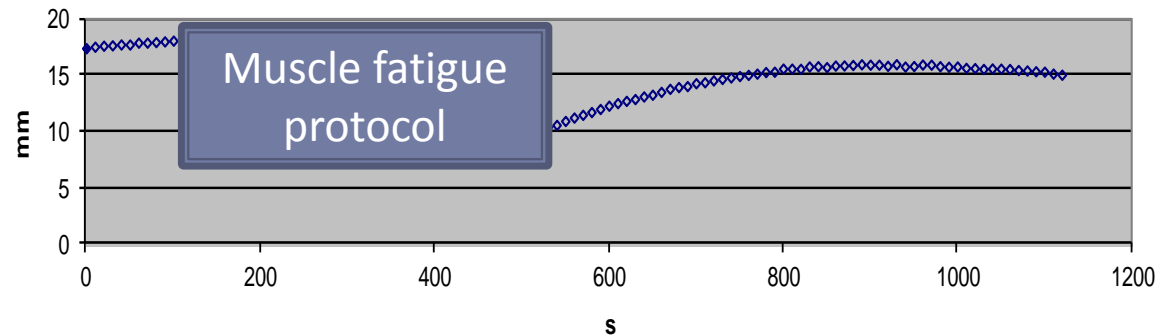


Muscle Recovery Monitoring

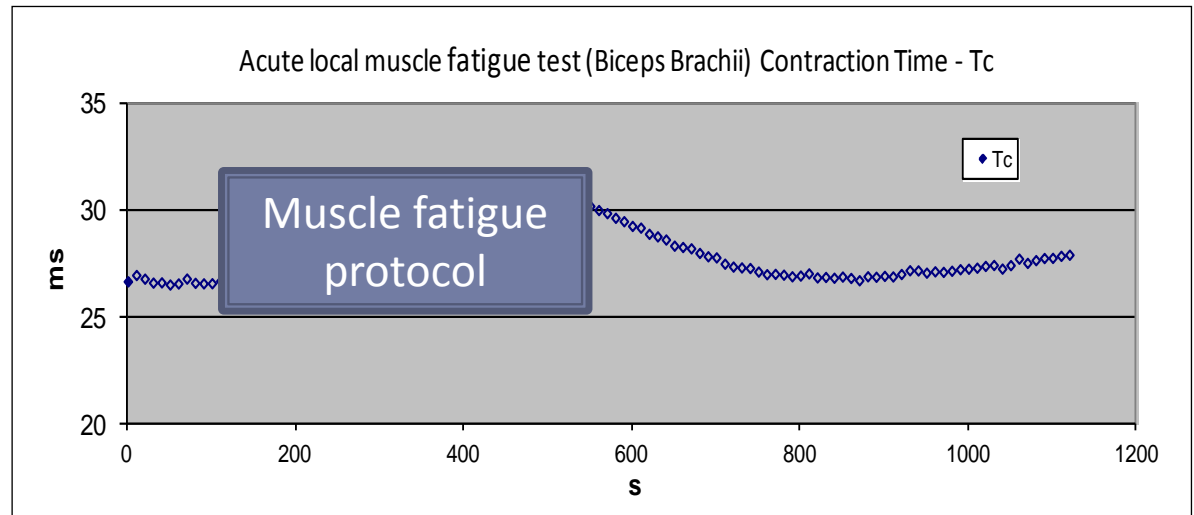


□

Acute local muscle fatigue test (Biceps Brachii) Displacement - D_m



Acute local muscle fatigue test (Biceps Brachii) Contraction Time - T_c



Tensiomyography



Non-invasiveness (No conflict with rehabilitation process)

Selectiveness

Simplicity

High objectivity (no influence of motivation)

Immediate interpretation of results



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