

Model for measure the kinematic behavior of the "Stiff knee"

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The role of the knee



Stability during the stance phase

Forward movement during the swing phase



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The demands over the knee



The total flexion movement of the knee during the swing phase is near 60° to 65°

This amount of movement requires three different elements:

- Previous flexion of 40 degrees in pre-swing phase
- Hip flexor moment and plantar flexor moment at the ankle
- Active knee flexion generated by the short head of the Biceps femoris



Muscle influence on peak knee velocity

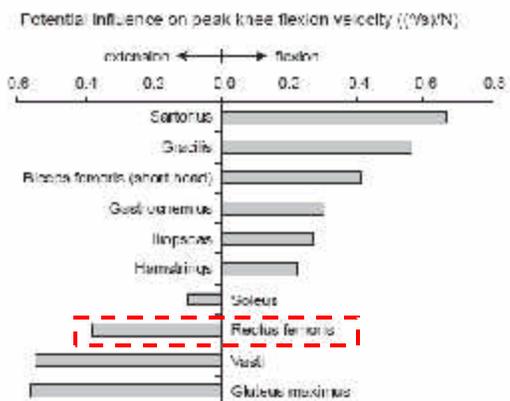


Fig. 5. The potential influence of selected muscles on the peak knee flexion velocity during double support. The values characterize the change in peak flexion velocity (ΔV) due to a 1 N change in muscle force (ΔF) throughout the period of double support and were calculated as shown in Fig. 4. Muscles not shown had potential influences of less than 0.05 (%/N).

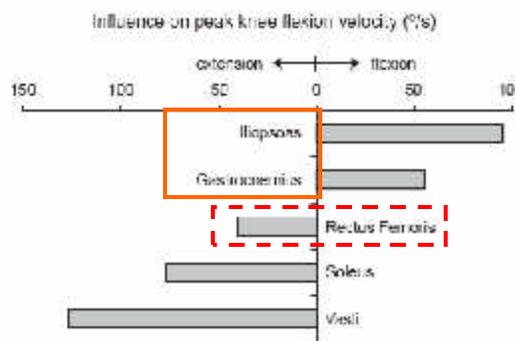
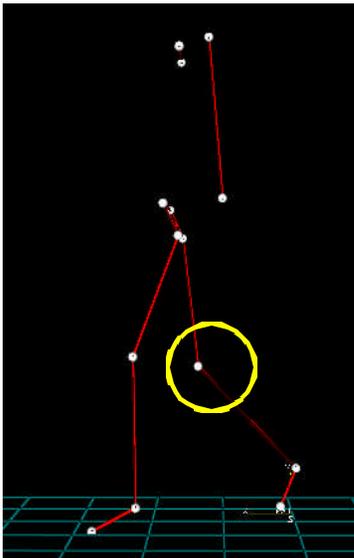


Fig. 6. The influence of selected muscles on the peak knee flexion velocity during double support. The influence was calculated as the slope of plots of change in peak knee flexion velocity vs. perturbation size as a percentage of unperturbed muscle force. All other muscles had influences of less than 26%/s.

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Control of the knee flexion movement



🇧🇪 In the specific time when the knee flexion occurs

🇧🇪 In the amount of movement

Control the hiperflexion

Rectus Femoris activation

The Rectus Femoris



🇪🇺 Cross over two different joints. Acting like hip flexor **and** knee extensor

🇪🇺 It's active almost exclusive during the **pre-swing** phase (*Nene et al. 1999 y 2004*)

🇪🇺 His activation it's well related with the gait velocity (*Nene et al. 1999 and 2004; Annaswamy et al. 1999*). Been very low (near 0 activation) at slow speeds (0.5 m/s)

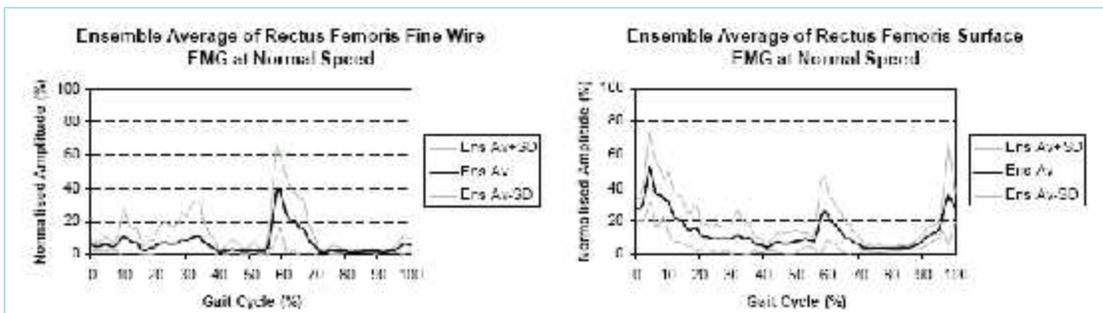


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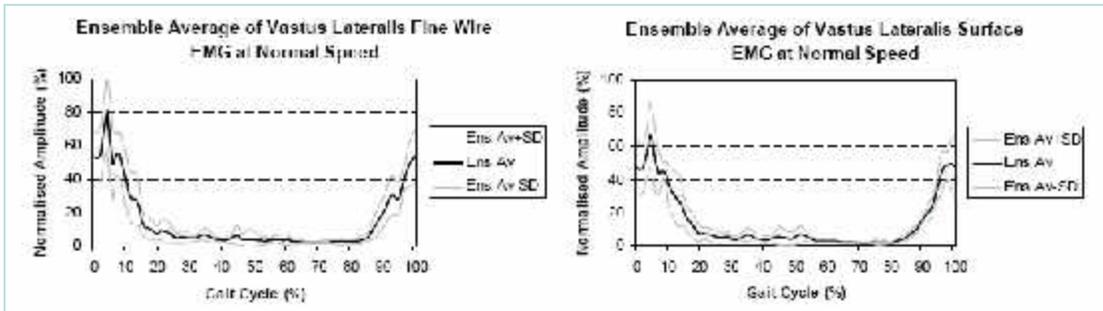
Rectus Femoris ? Vasti normal speed



Rectus femoris



Lateral Vasti



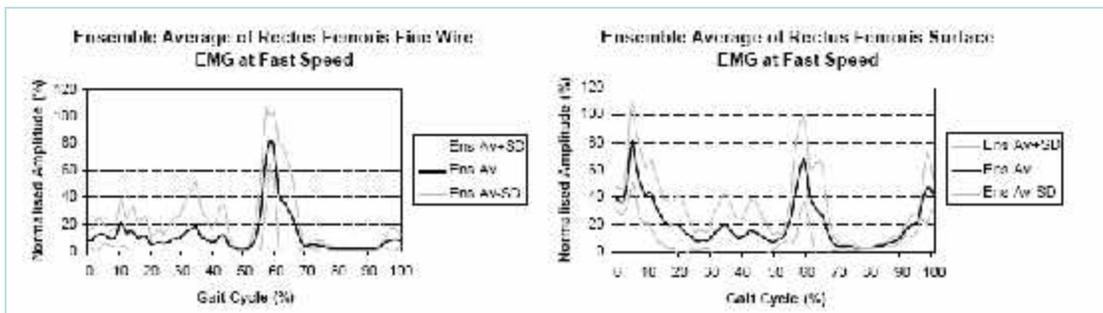
Nene et al. 2004

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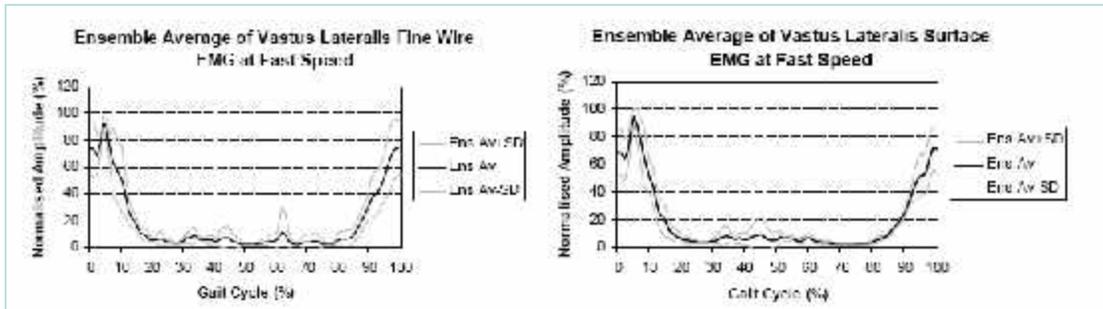


Recto Femoral ? Vasti high speed

Rectus femoris



Lateral Vasti



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STIFF KNEE Definition



Characterized for the lack of flexion during the swing phase. It's very common problem in hemiplegic patients and compromised the ability to move the foot forward during gait (foot clearance).

Then may occur a drag foot (the foot never left the ground), The gait becomes more unstable or generate different compensatory movements like hip abduction or pelvis elevation



Increase the energetic cost of the gait (Stoquart, 2008)

Creation of a protocol for the measurement of the Stiff Knee



Objetives

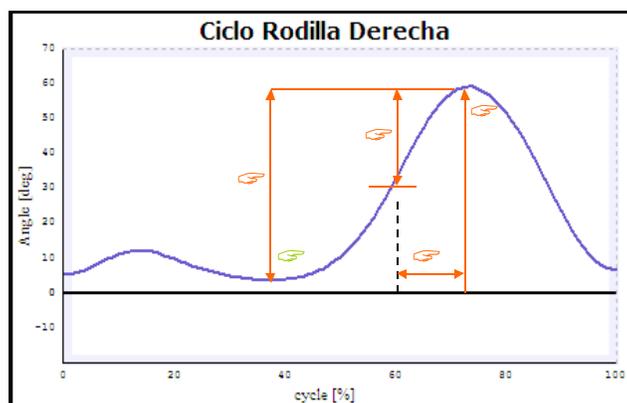
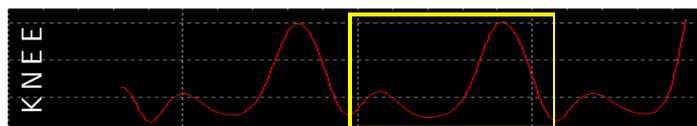
Create a tool for objective evaluation of the kinematic behavior of the knee in the "Stiff-knee" gait.

Obtain normal values of the cinematic values of the knee (normal reference).

Compare the results obtained with different therapies (Surgery, Botox, physical therapy) on the behavior of the knee using this tool.



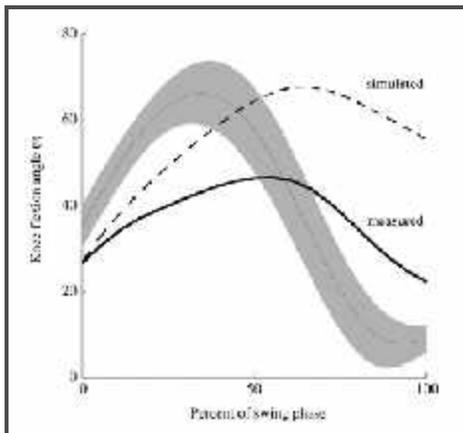
Protocol for the evaluation of the "Stiff Knee"



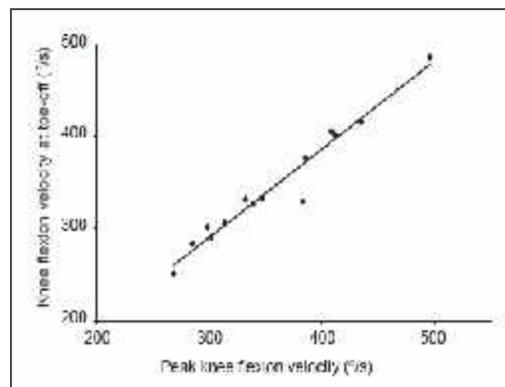
1. Peak of flexion during swing (deg)
2. Difference between peak of flexion and Toeoff (deg)
3. Difference between peak of flexion and peak of extensión (deg)
4. Proportion between Toeoff/peak of flexion - swing (%)
5. Knee velocity at Toeoff (deg/s)

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Knee velocity at Toeoff



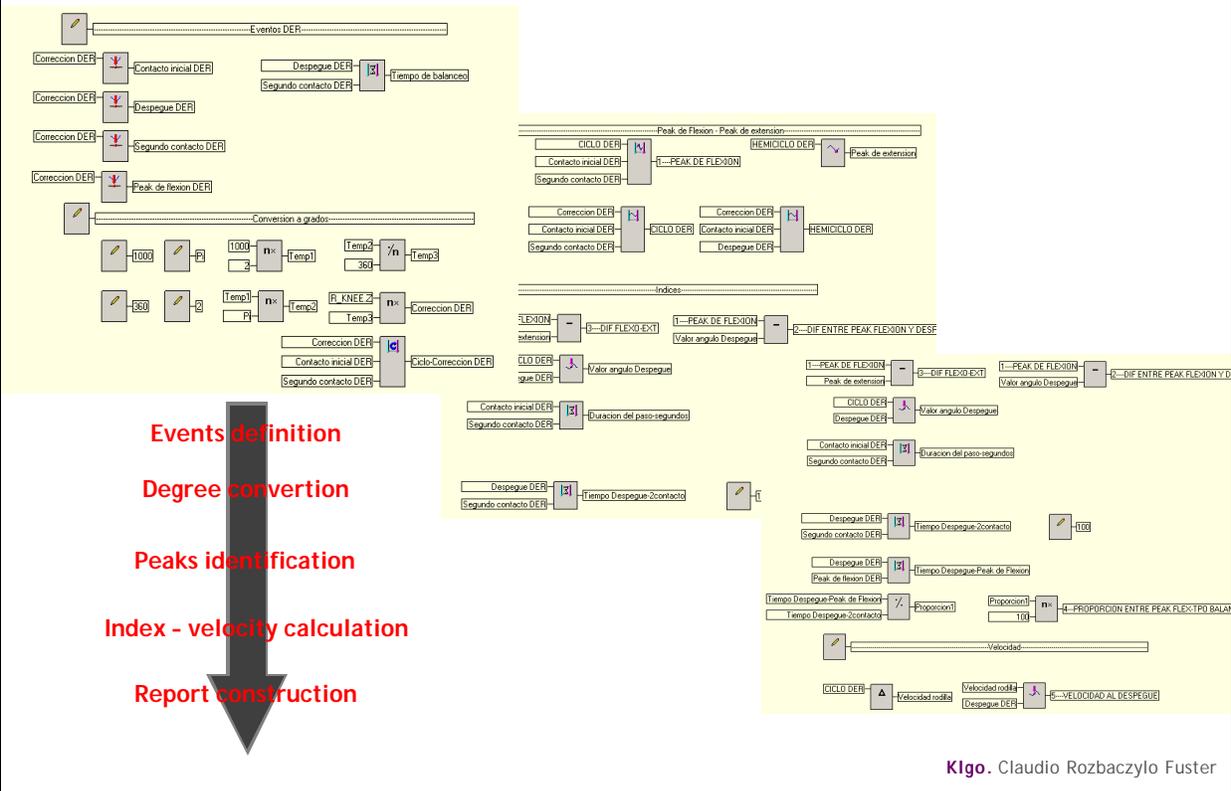
Goldberg et al



Goldberg et al

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Protocol - SmartAnalyzer[©]



Data base – Normal subjects (Adults)



Número de examen	Género	Talla	Edad	Consentimiento
2132xa04	H	1.74 m.	25	No
2141xa03	M	1.65 m.	24	No
2154xa06	M	1.54 m.	24	No
2263xa05	M	1.60 m.	25	No
2344xa04	M	1.60 m.	22	No
2385xa04	M	1.50 m.	23	No

Peak of flexion during swing (deg)	54.3 ± 4.6
Difference between peak of flexion and Toeff (deg)	31.7 ± 4
Difference between peak of flexion and peak of extensión (deg)	51.2 ± 3.9
Proportion between Toeff/peak of flexion - swing (%)	37.7 ± 1.2
Knee velocity at Toeff (deg/s)	227 ± 27.7

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Example – Normal subject (Adulto)



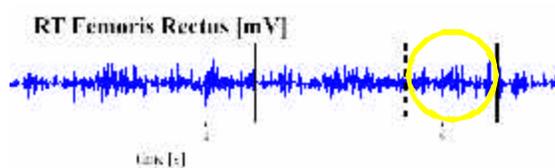
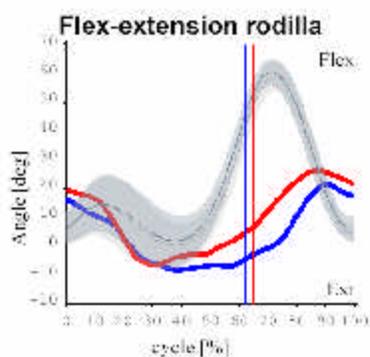
ÍNDICES	DER	NORMS
1. PEAK DE FLEXION [deg]	59.1	54.3 ± 4.6
2. DIFERENCIA ENTRE PEAK FLEXION Y DESPEGUE [deg]	33	31.7 ± 4
3. DIFERENCIA ENTRE PEAK DE FLEXION Y EXTENSION [deg]	55.5	51.2 ± 3.9
4. PROPORCIÓN Despegue/Peak Flex - 1 po Balanceo [%]	35.585	37.778 ± 1.239
5. VELOCIDAD AL DESPEGUE [deg/s]	272.536	227.089 ± 27.799

Example – Clinical case (Adult)



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Example – Clinical case (Adult)



	Right side	Norms
Peak of flexion during swing (deg)	12.6	54.3 ± 4.6
Difference between peak of flexion and Toeff (deg)	7.1	31.7 ± 4
Difference between peak of flexion and peak of extensión (deg)	8	51.2 ± 3.9
Proportion between Toeff/peak of flexion - swing (%)	69.5	37.7 ± 1.2
Knee velocity at Toeff (deg/s)	19.8	227 ± 27.7

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Example – Clinical case (Adult)



ÍNDICES	DER	NORMS
1. PEAK DE FLEXION [deg]	12.6	54.3 ± 4.6
2. DIFERENCIA ENTRE PEAK FLEXION Y DESPEGUE [deg]	7.1	31.7 ± 4
3. DIFERENCIA ENTRE PEAK DE FLEXION Y EXTENSION [deg]	8	51.2 ± 3.9
4. PROPORCION Despegue/Peak Flex - Tpo Balanceo [%]	69.565	37.778 ± 1.239
5. VELOCIDAD AL DESPEGUE [deg/s]	19.897	227.089 ± 27.799

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