Análise do movimento na avaliação dos déficits neuromotores.

Marcos Crespo
Jefe de Ingeniería en Rehabilitación
Coordinador del Laboratorio de Análisis de Marcha y Movimiento

VII COBRAFIN FORTALEZA-CE
CONGRESSO BRASILEIRO DE FISIOTERAPIA NEUROFUNCIONAL
III CONGRESSO INTERNACIONAL DA ASSOCIAÇÃO BRASILEIRA DE FISIOTERAPIA NEUROFUNCIONAL
II SIMPÓSIO INTERNACIONAL DE SAÚDE FUNCIONAL

21.000 M2

430 Empleados

80 Camas operativas

6 Dormis

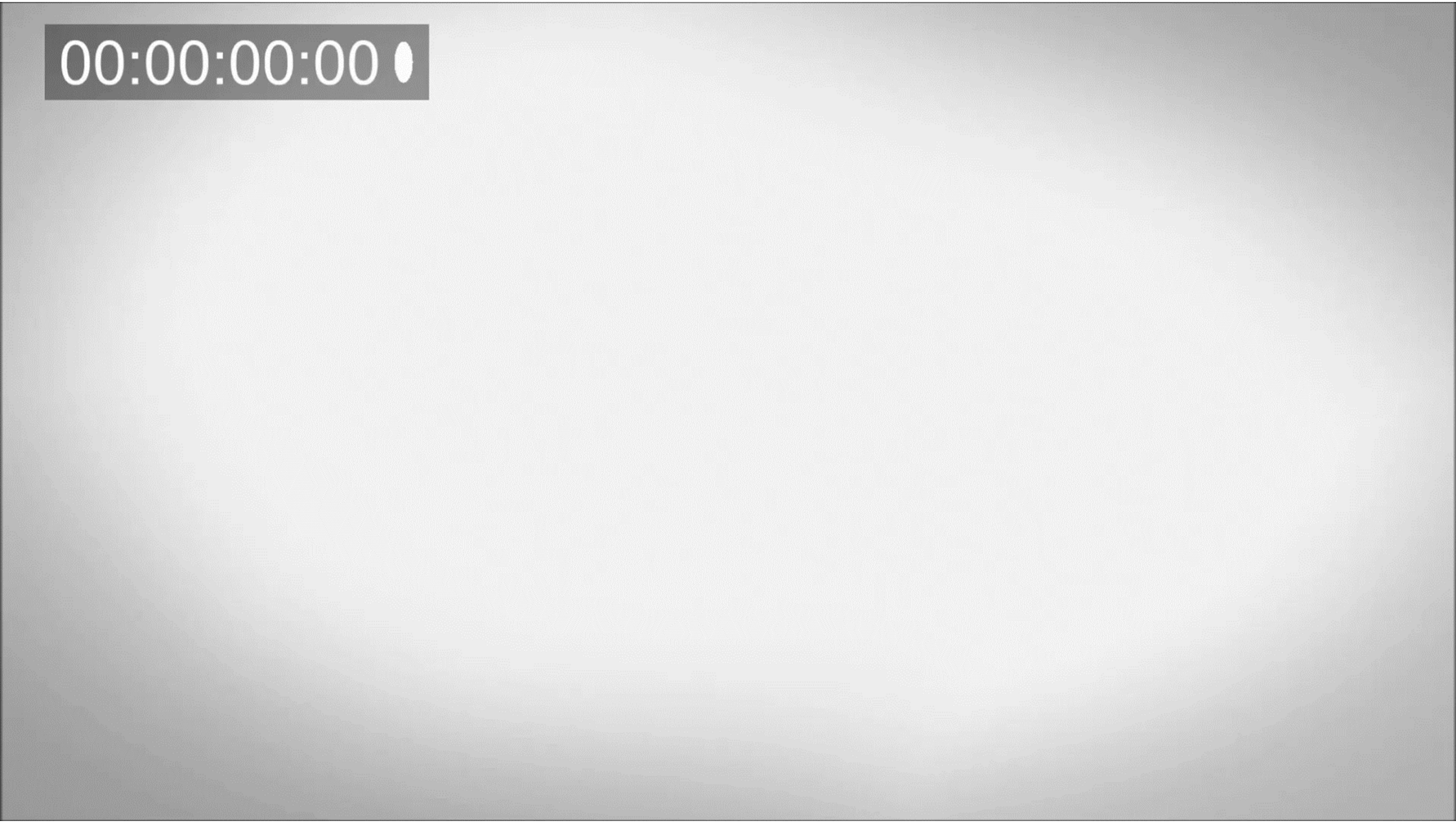
6 Gimnasios

Unidad de Tecnología Asistiva y Tecnología en Rehabilitación

Simulador de Manejo

1 Piscina

Laboratorio de Marcha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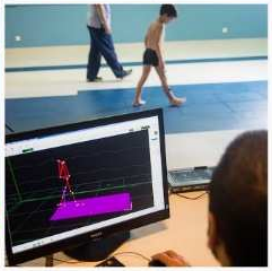
The Gaitlab in numbers

20 years of experience

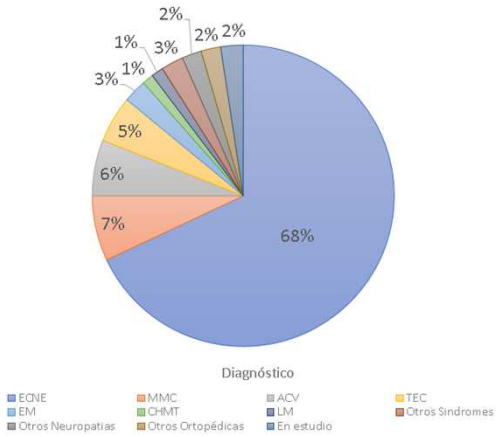
+4000 analysis

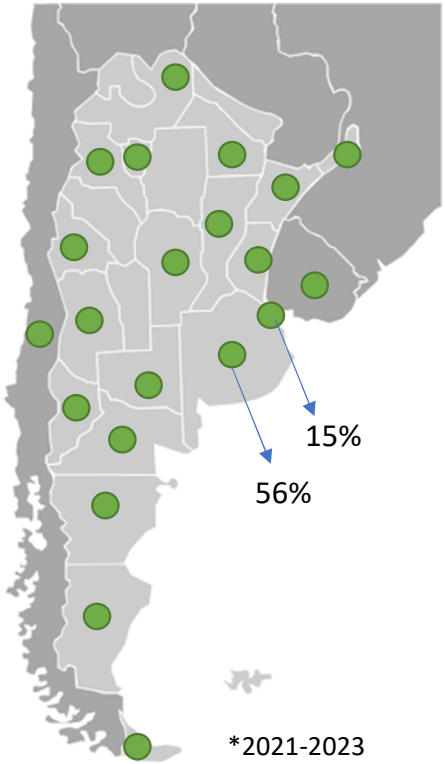
+3000 Patients



250 Eval/year

84% <18 years old





*2021-2023

Assessment and treatment of gait dysfunctions in children with Cerebral Palsy

Primary problems (Injury)

SMC, weakness, balance, muscle tone

Secondary problems (growth)

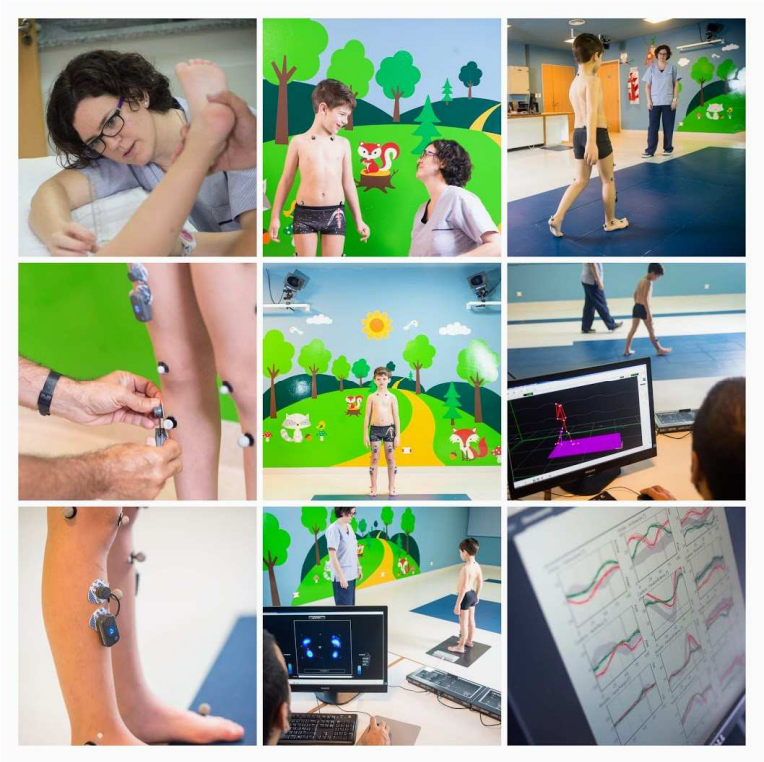
Muscle contractures. Bone deformities

Tertiary problems

Compensation

Multifactorial – Multilevel – Three-dimensional

Instrumented Clinical Gait Analysis (CGA)



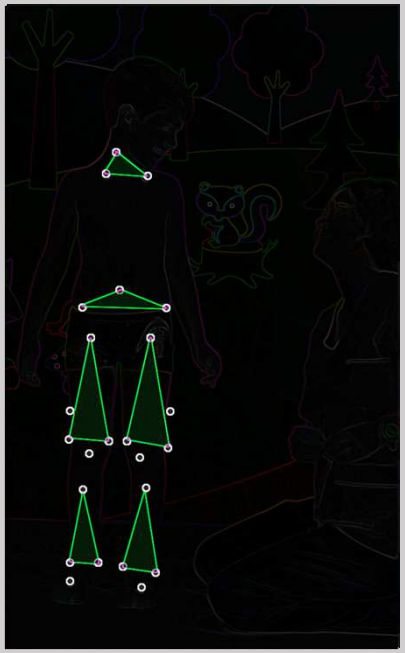
Physical exam
Kinematics
Kinetics
Dynamic electromyography

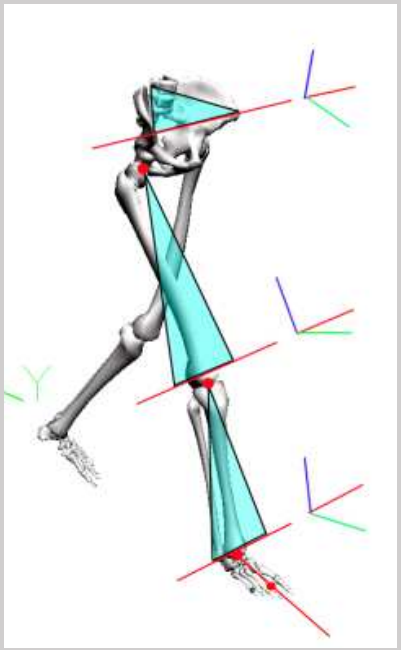
Conventional video, images, baropodometry, muscle dynamics.

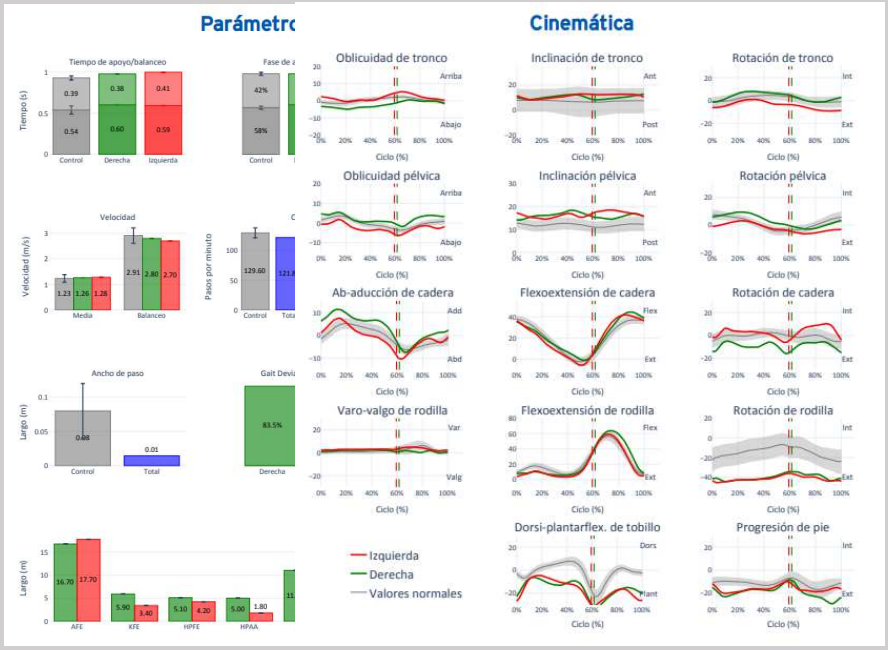
Instrumented Measurement
Biomechanical interpretation


SMART DX

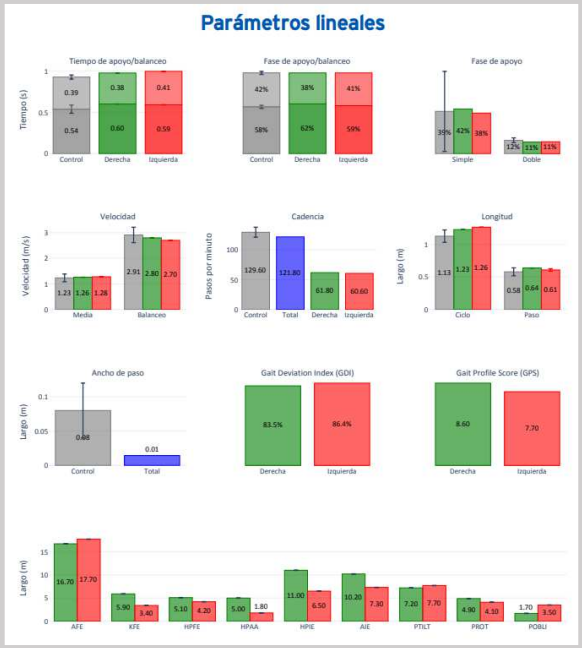
Kinematics

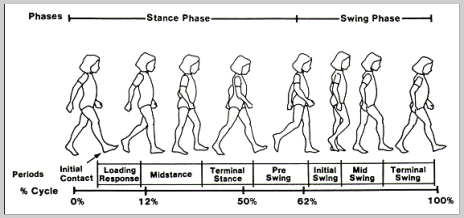





Parámetro
Cinemática
Tiempo de apoyo/balanceo
Tiempo (s)
Control
Derecha
Izquierda
Velocidad
Velocidad (m/s)
Media
Balanceo
Ancho de paso
Largo (m)
Total
Largo (ml)
AFE
KFE
HPFE
HPAA
Oblicuidad de tronco
Inclinación de tronco
Rotación de tronco
Oblicuidad pélvica
Inclinación pélvica
Rotación pélvica
Ab-aducción de cadera
Flexoextensión de cadera
Rotación de cadera
Varo-valgo de rodilla
Flexoextensión de rodilla
Rotación de rodilla
Dorsi-plantarflex. de tobillo
Progresión de pie
Ciclo (%)
Izquierda
Derecha
Valores normales

Kinematics

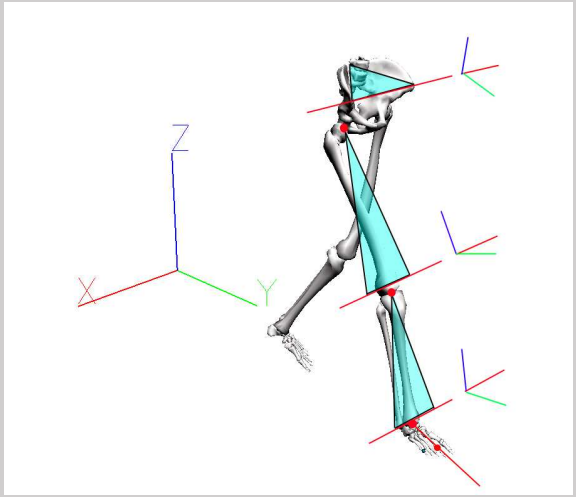


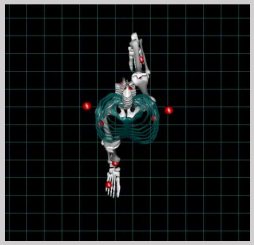


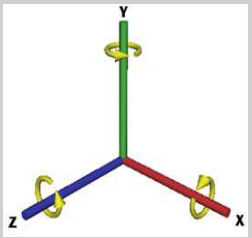
Gait cycle
Time distance parameters

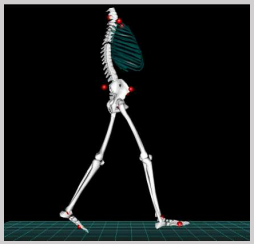
Support				Swing		
SD	Simple support		SD			
LR	Medial Support	Terminal Support	Pre Swing	Initial Swing	Medial Swing	Terminal Swing
0	10	30	50	60	70	85	100

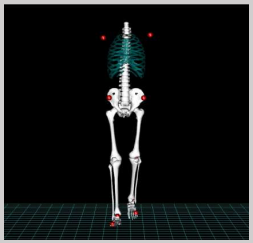
Cinemática

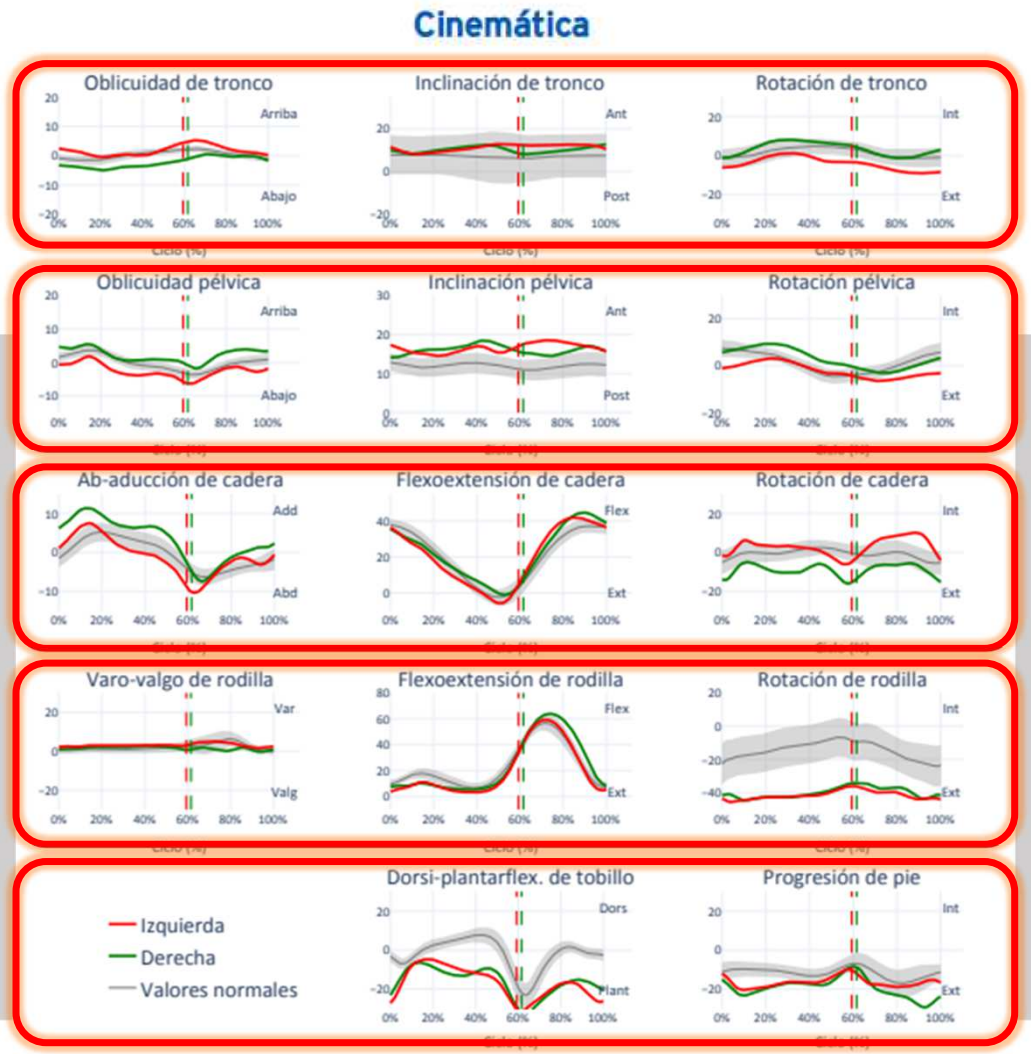




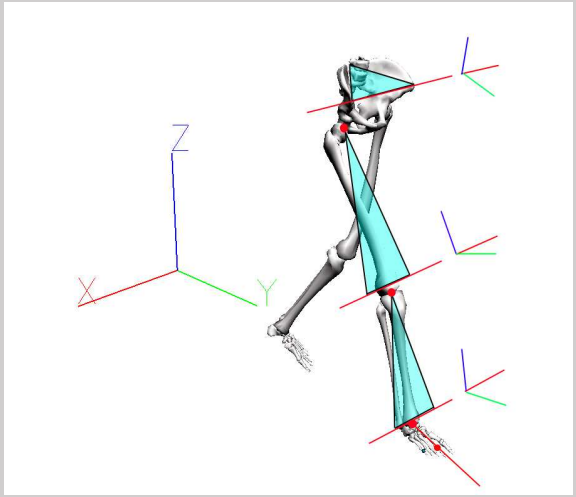

Y
Z
X

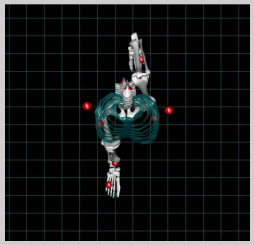


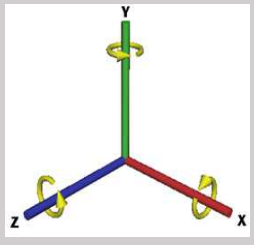


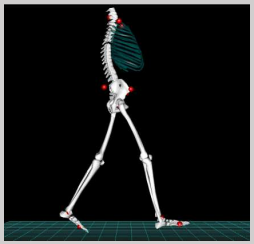

Cinemática
Oblicuidad de tronco
Arriba
Abajo
Inclinación de tronco
Ant
Post
Rotación de tronco
Int
Ext
Oblicuidad pélvica
Arriba
Abajo
Inclinación pélvica
Ant
Post
Rotación pélvica
Int
Ext
Ab-aducción de cadera
Add
Abd
Flexoextensión de cadera
Flex
Ext
Rotación de cadera
Int
Ext
Varo-valgo de rodilla
Var
Valg
Flexoextensión de rodilla
Flex
Ext
Rotación de rodilla
Int
Ext
Izquierda
Derecha
Valores normales
Dorsi-plantarflex. de tobillo
Dors
Plant
Progresión de pie
Int
Ext
0%
20%
40%
60%
80%
100%

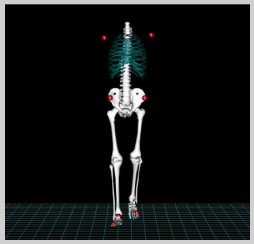
Cinemática

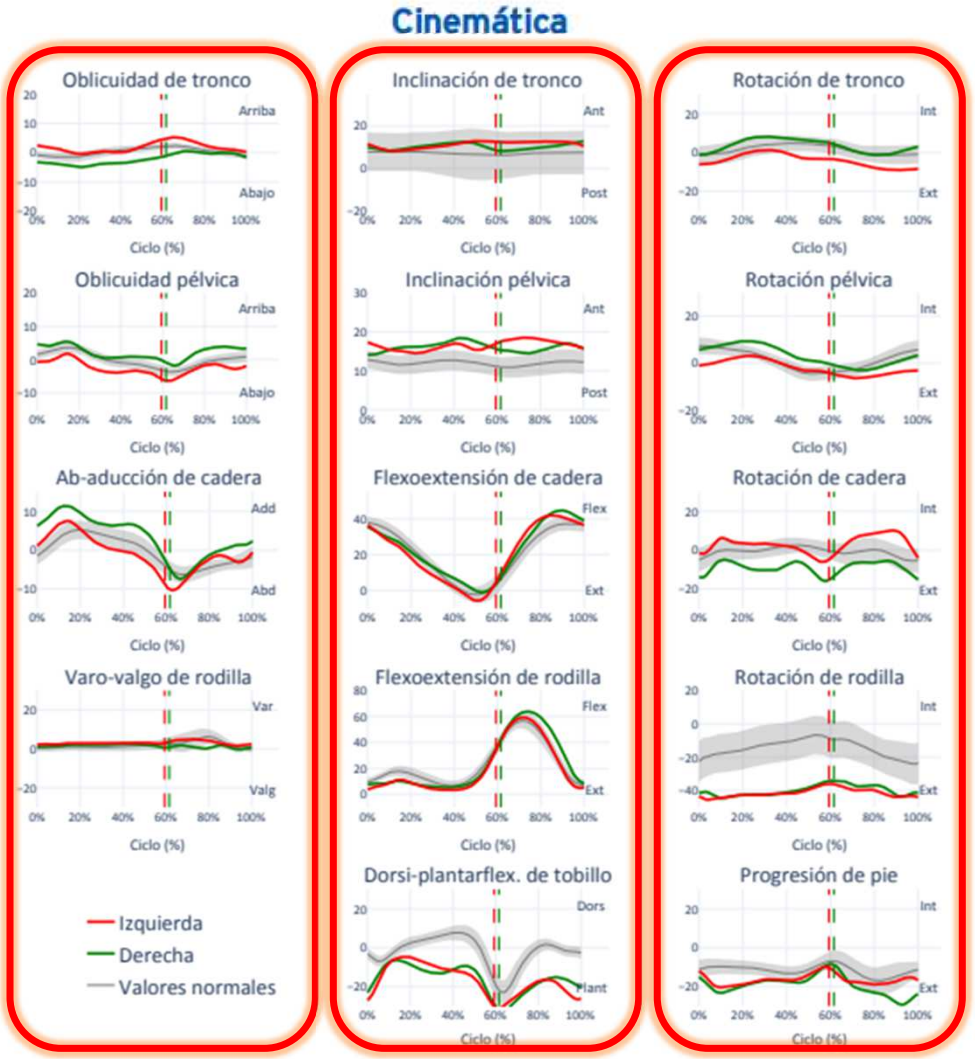

Z
Y
X

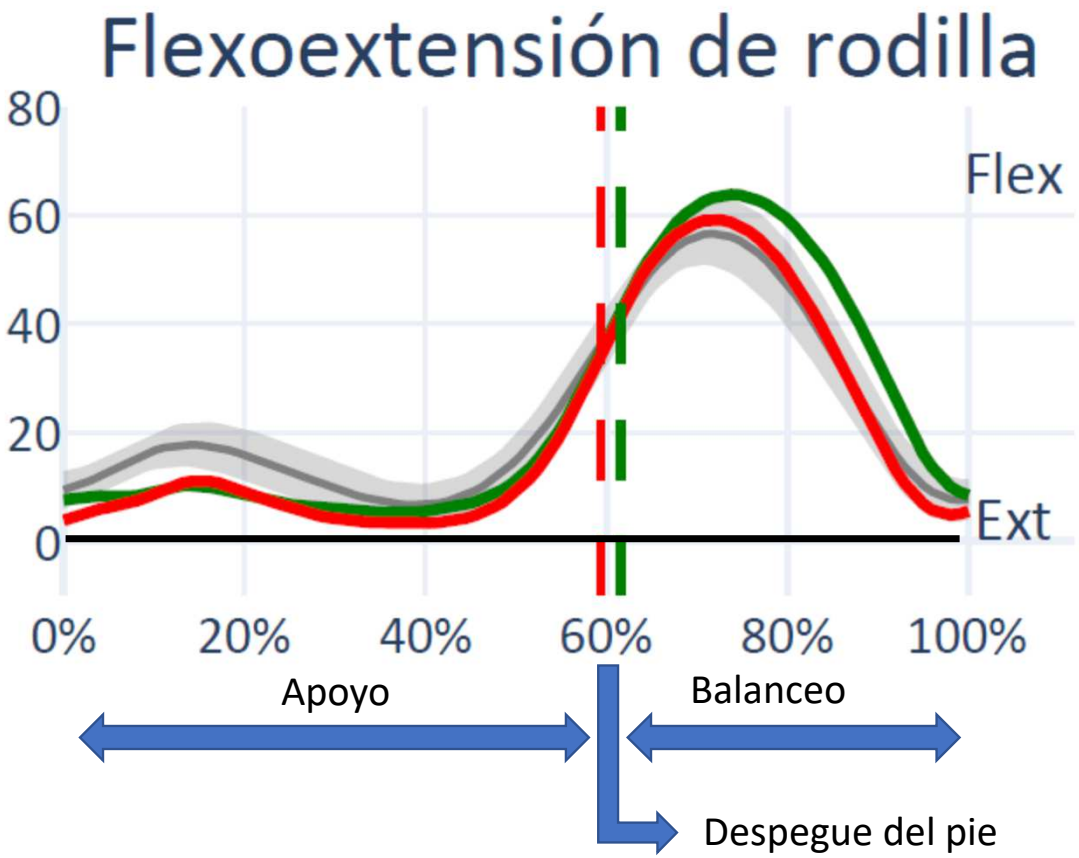



Y
Z
X






Cinemática
Oblicuidad de tronco
Arriba
Abajo
Ciclo (%)
Oblicuidad pélvica
Arriba
Abajo
Ciclo (%)
Ab-aducción de cadera
Add
Abd
Ciclo (%)
Varo-valgo de rodilla
Var
Valg
Ciclo (%)
Izquierda
Derecha
Valores normales
Inclinación de tronco
Ant
Post
Ciclo (%)
Inclinación pélvica
Ant
Post
Ciclo (%)
Flexoextensión de cadera
Flex
Ext
Ciclo (%)
Flexoextensión de rodilla
Flex
Ext
Ciclo (%)
Dorsi-plantarflex. de tobillo
Dors
Plant
Ciclo (%)
Rotación de tronco
Int
Ext
Ciclo (%)
Rotación pélvica
Int
Ext
Ciclo (%)
Rotación de cadera
Int
Ext
Ciclo (%)
Rotación de rodilla
Int
Ext
Ciclo (%)
Progresión de pie
Int
Ext
Ciclo (%)



X-AXIS

Percentage of the gait cycle.

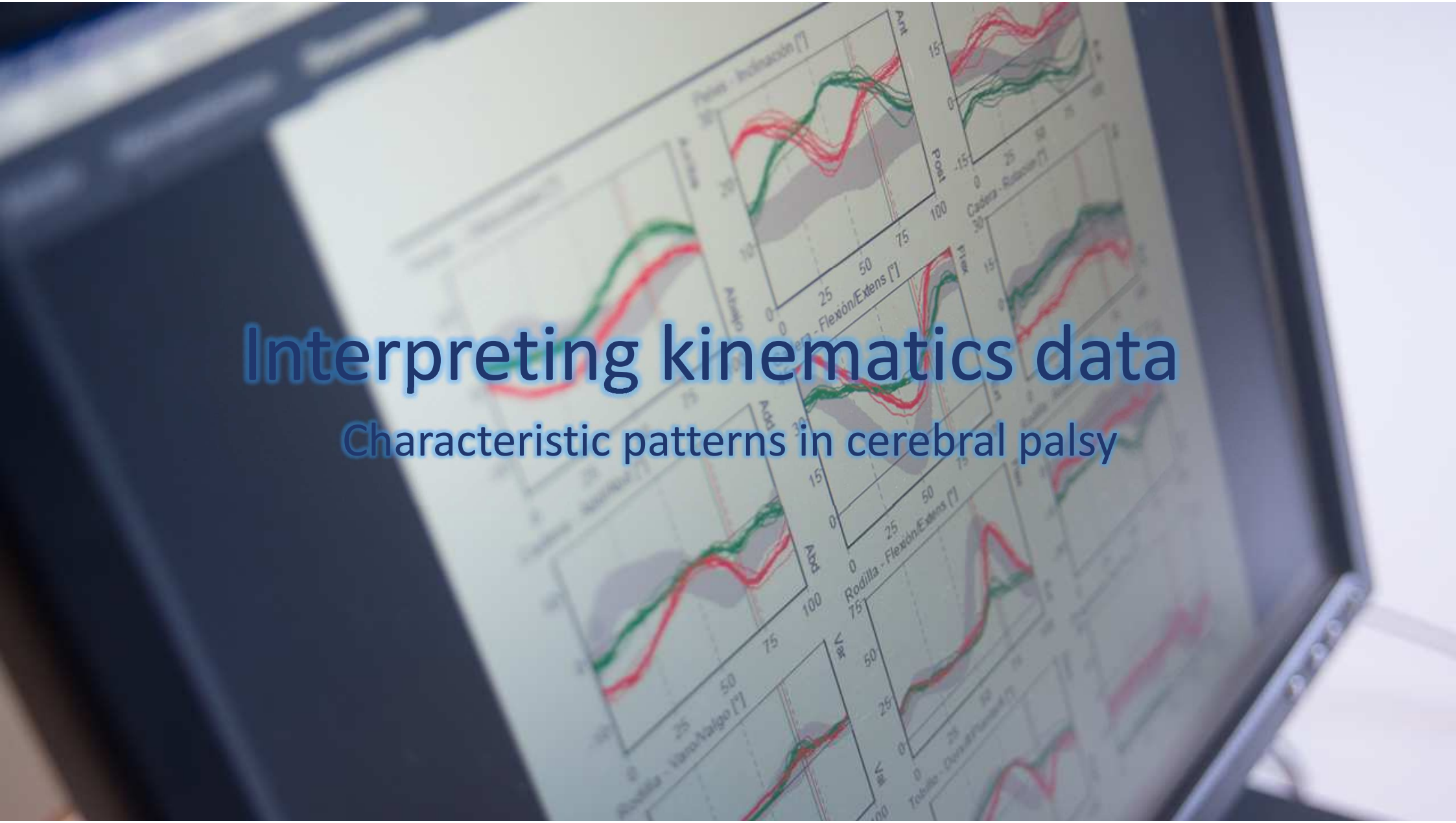
Scale never changes

Support Phase/Swing Phase

Y-AXIS

Angular variation in degrees

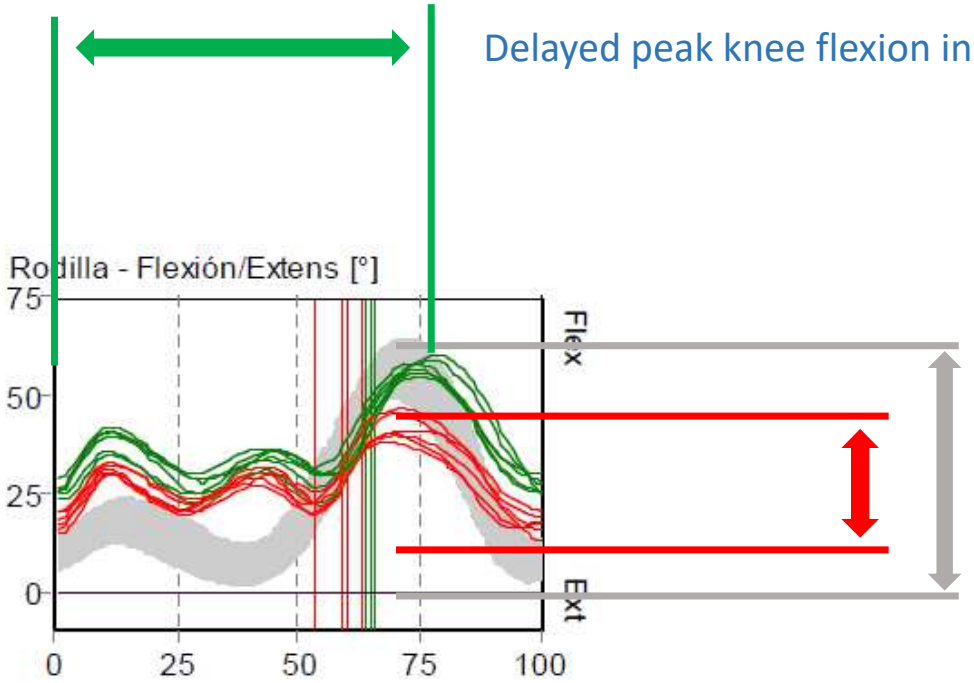
Scale changes for each joint/plane



Interpreting kinematics data

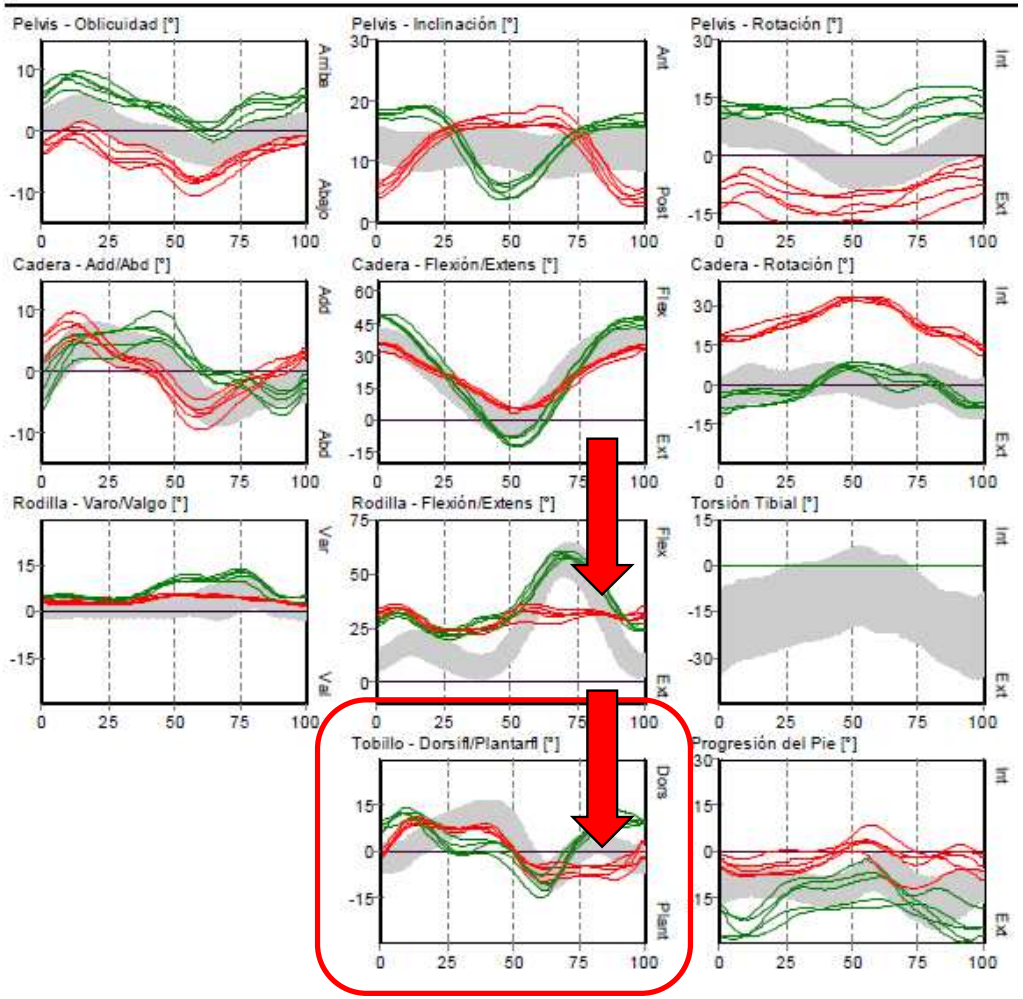
Characteristic patterns in cerebral palsy

Stiff knee



Delayed peak knee flexion in swinging

Decreased dynamic range of knee in sagittal plane

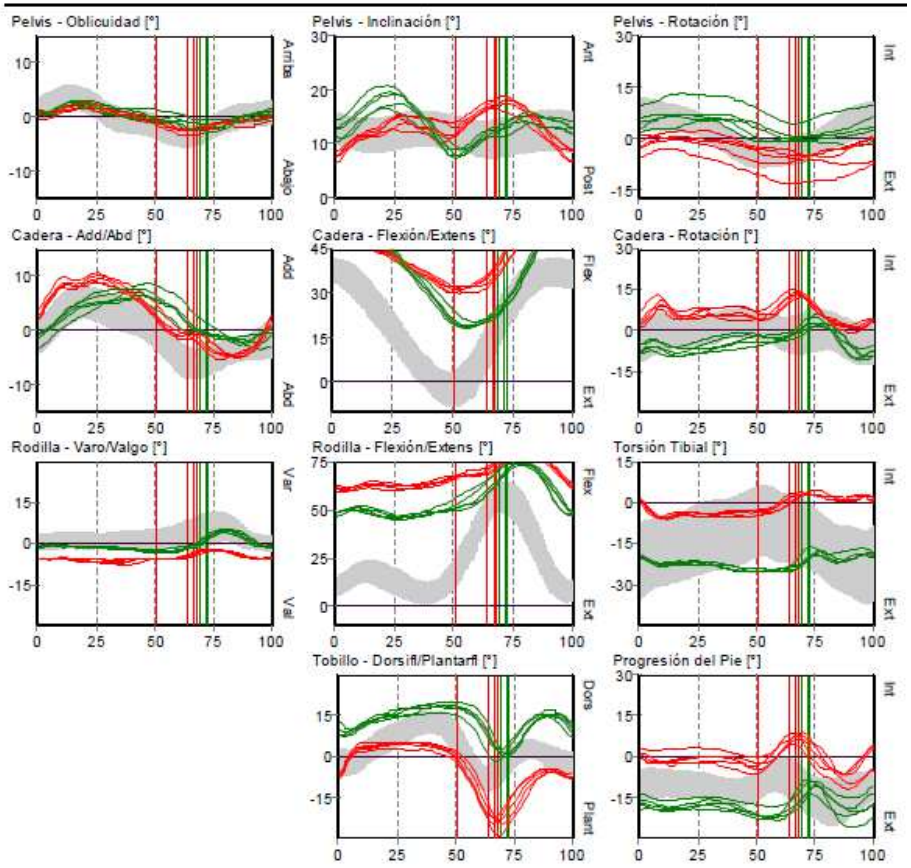


Ankle double bump

Secondary to stiff knee and equinus in contralateral swing (Right)

Secondary to spasticity of plantar flexors (Left)

Crouch gait



Initial Contact ≥ 20°

(Rozumalski and Schwartz 2008)

IC and medium support

(Sutherland and Davis 1993,

Arnold et al. 2006, Hicks et al. 2008)

Ankle dorsiflexion

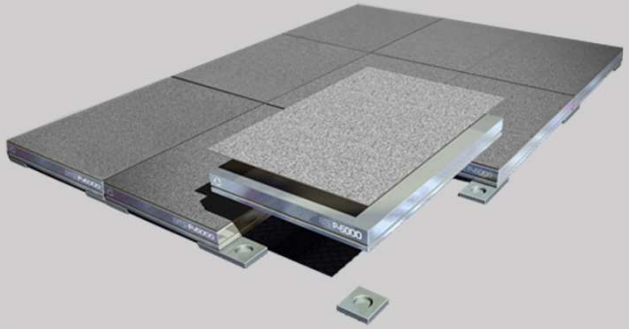
(Rodda et al. 2004.)

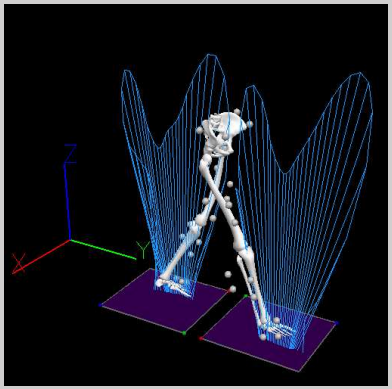
Lever arm dysfunctions

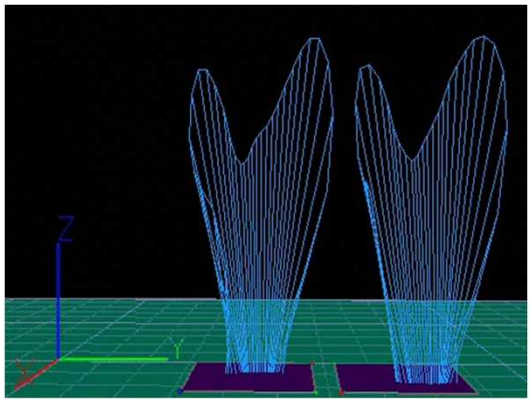
front and transverse planes

(Gage 2004)

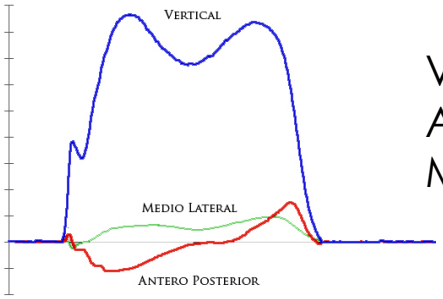
Kinetics





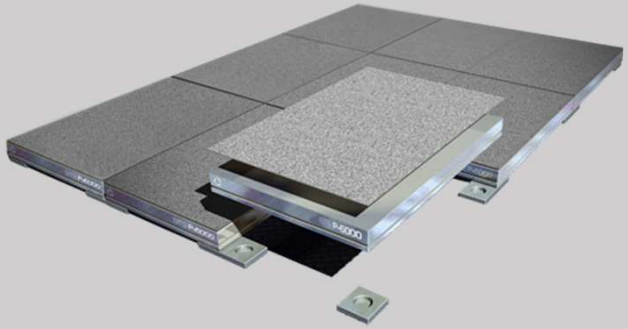


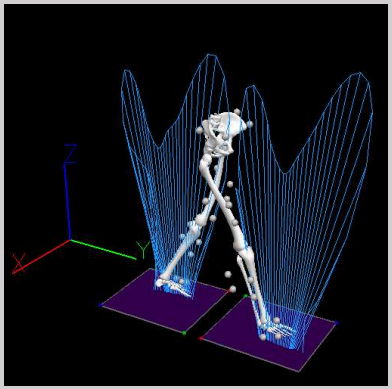
Ground reaction force

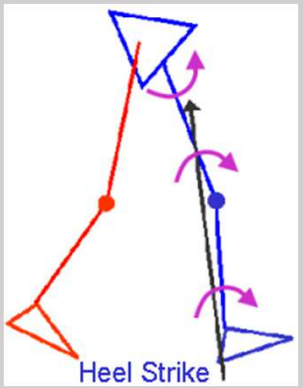


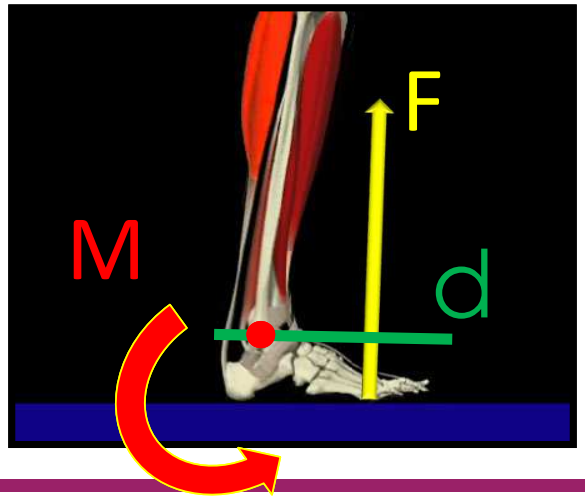
Vertical: Body support
Antero-Post: Propulsion/Deceleration
Medio-Lateral: Balance

Kinetics





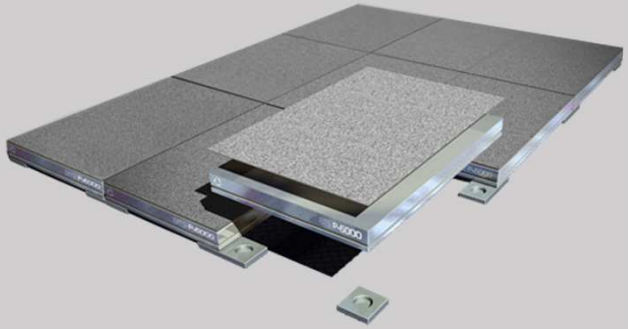


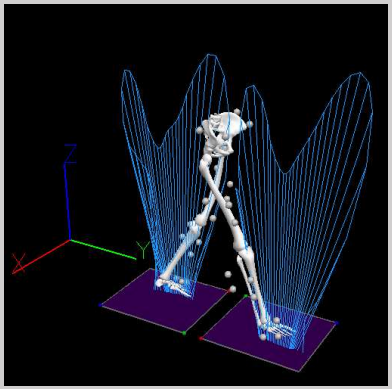


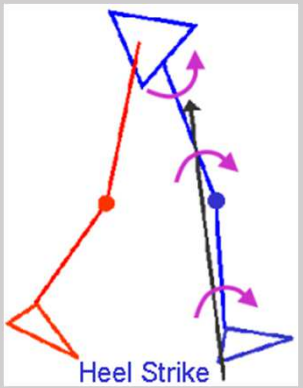
Moment = Force x Distance

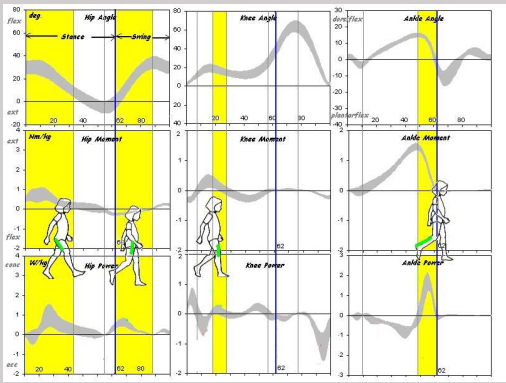
External Moment
Ground reaction force and segment weight
Internal Moment
Forces produced by muscles, ligaments and tendons

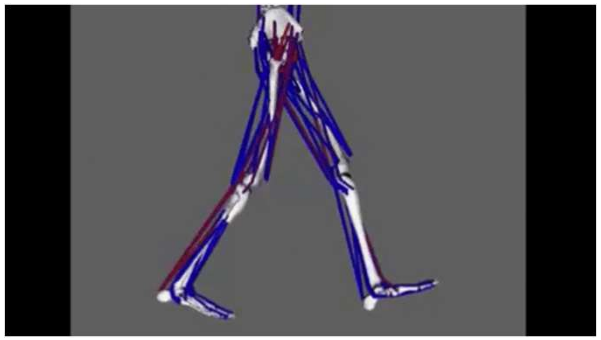
Kinetics



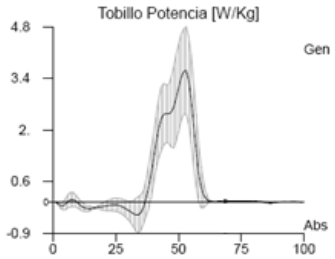






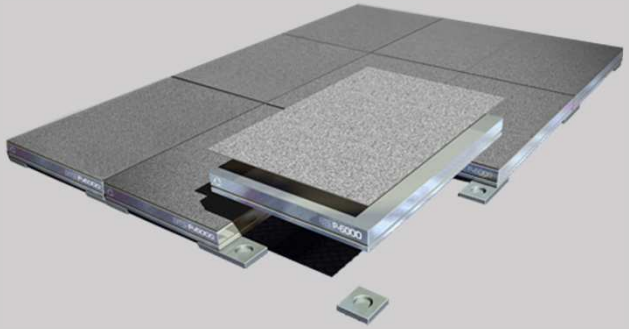


Power

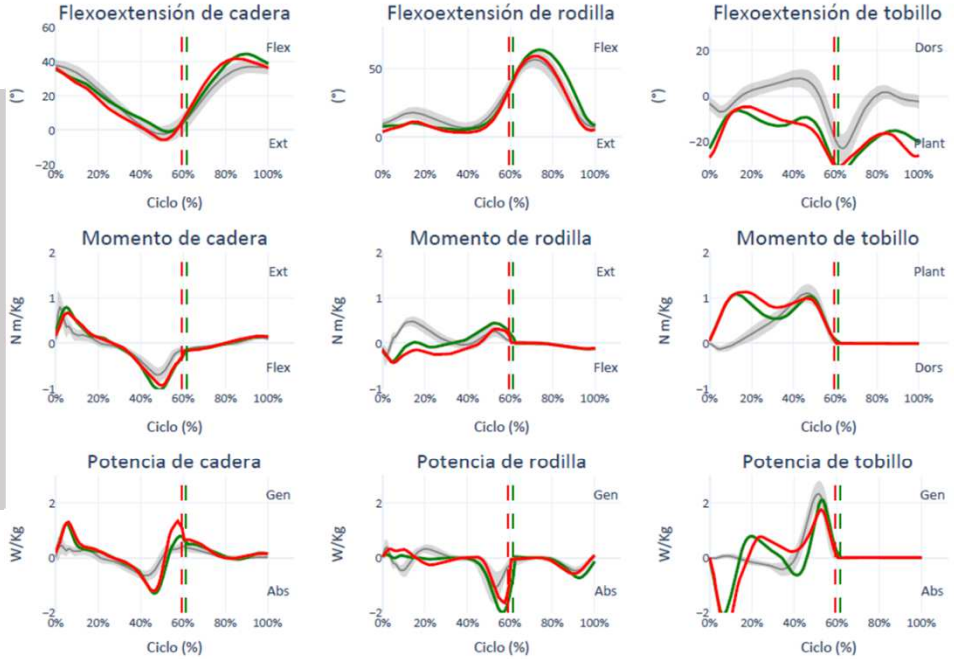


Generated
Concentric contraction/acceleration
Absorbed
Eccentric contraction/deceleration

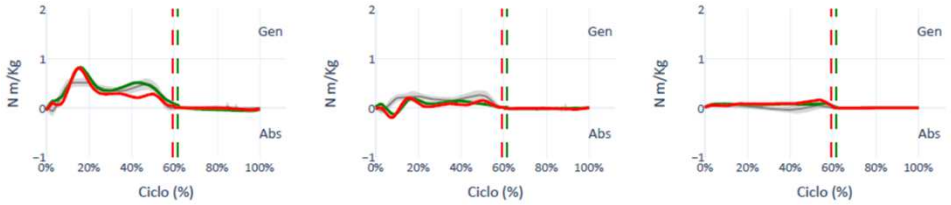
Kinetics

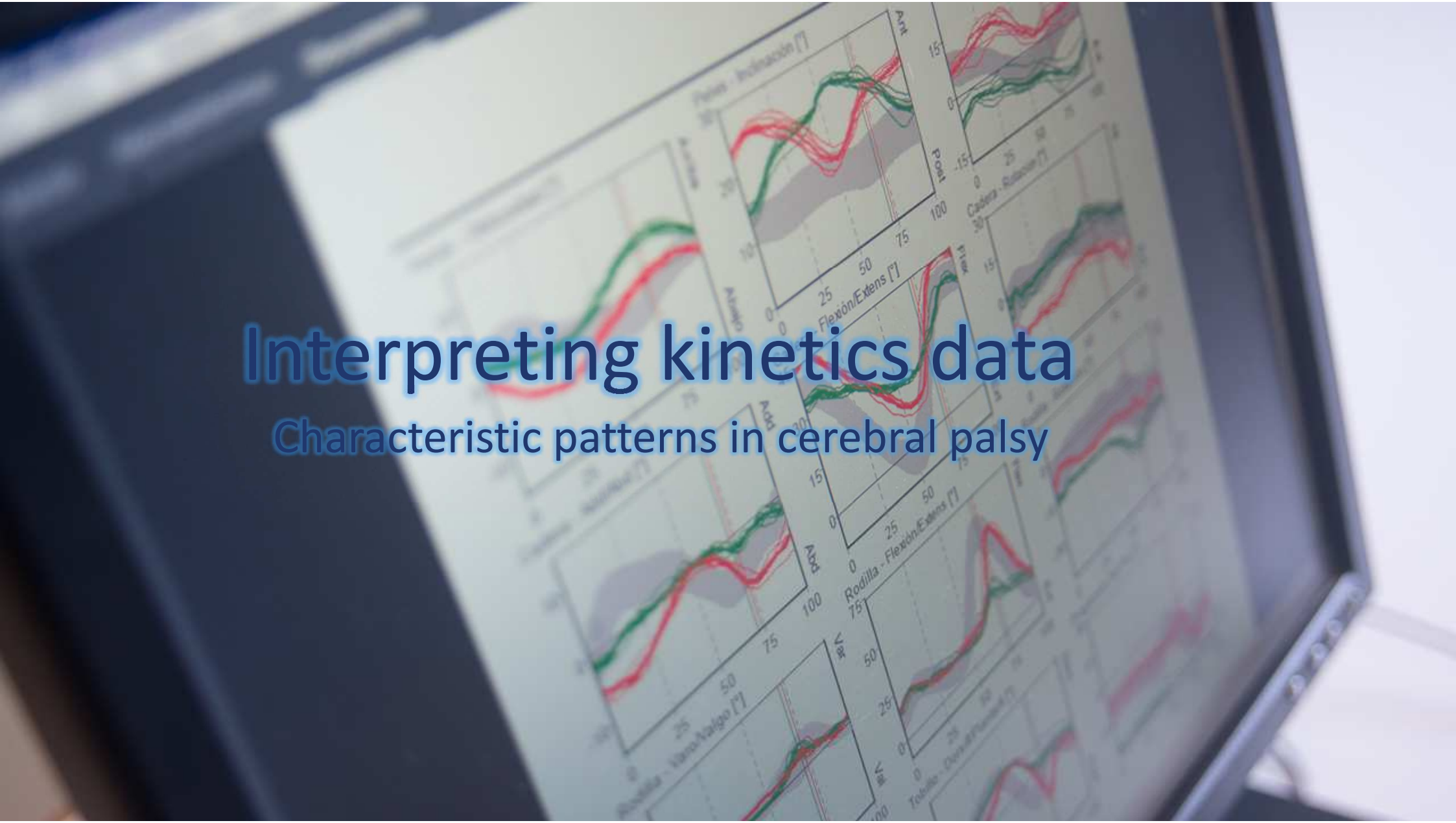


Cinética. Plano sagital



Cinética. Plano frontal

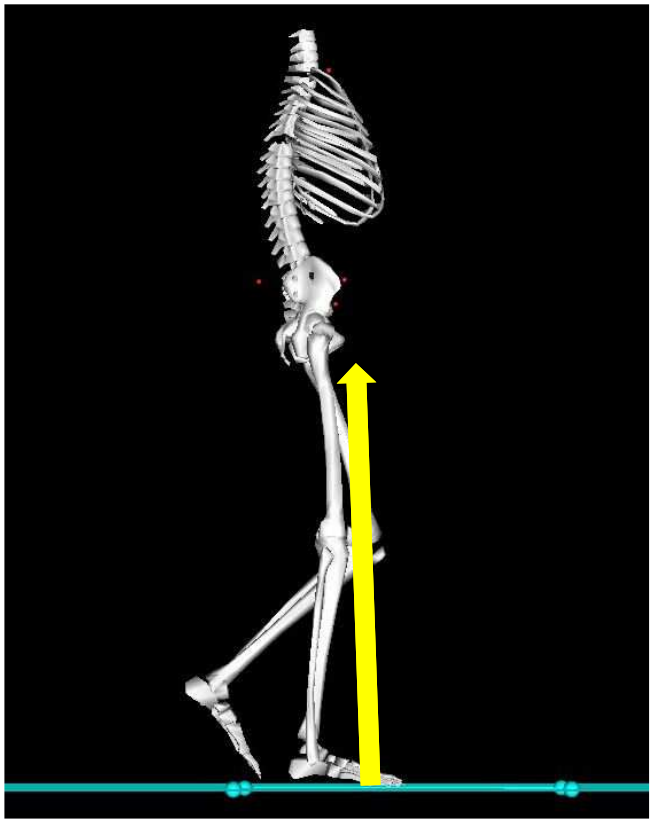


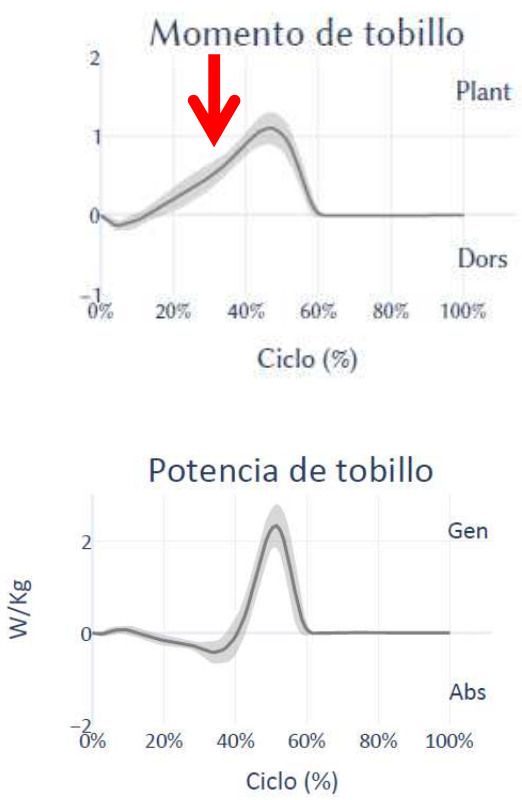


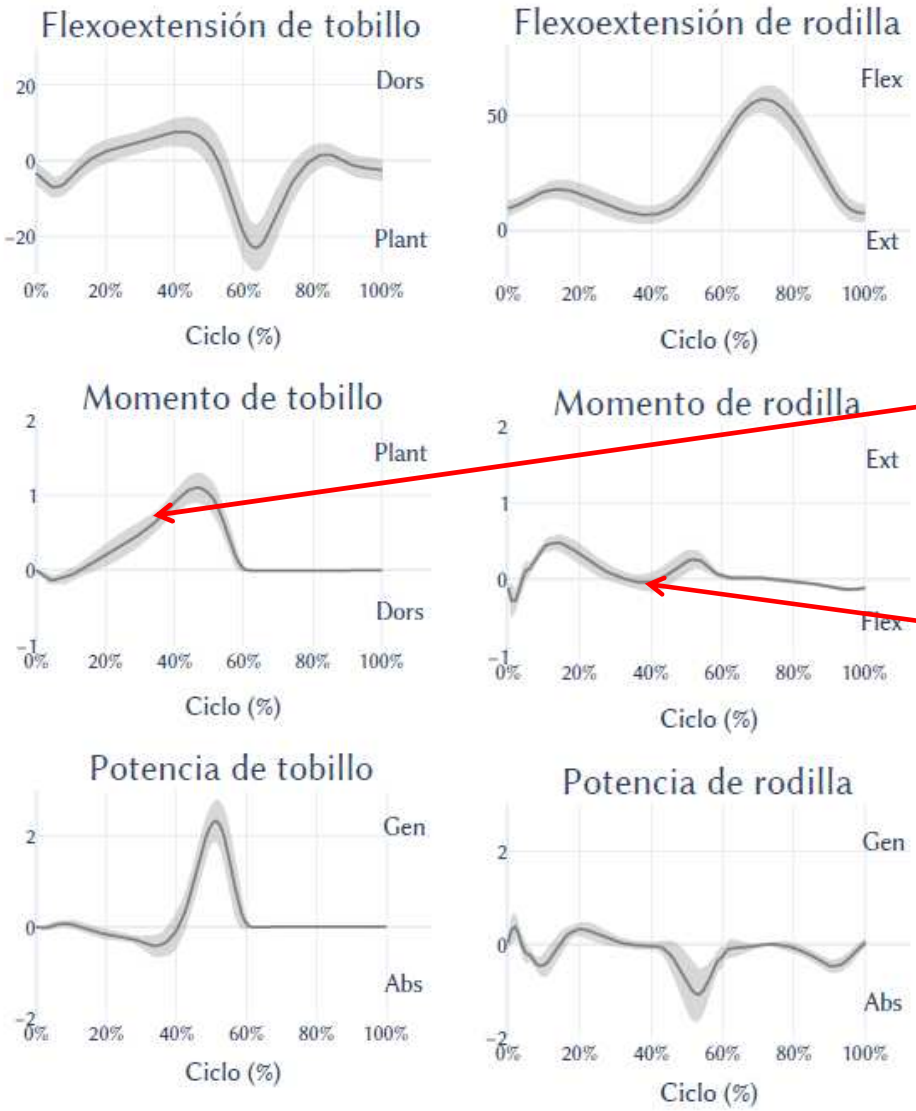
Interpreting kinetics data

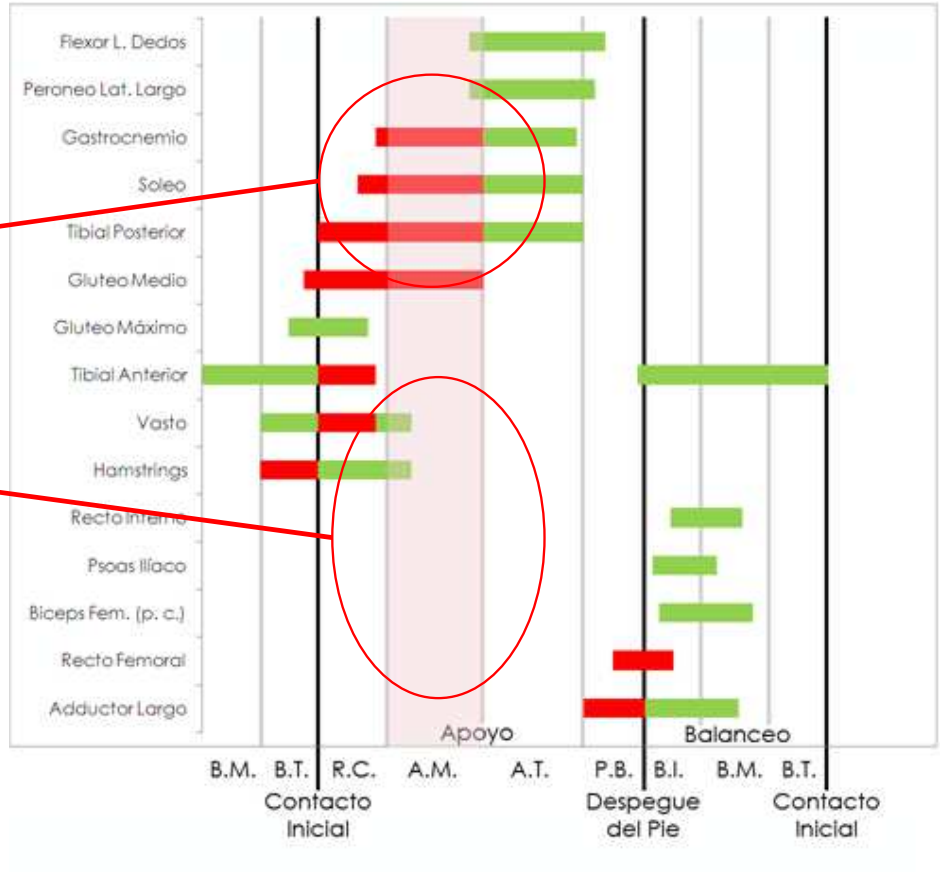
Characteristic patterns in cerebral palsy

Plantar Flexor/Knee Extensor couple



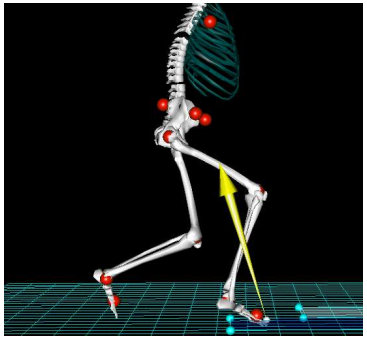



Flexoextensión de tobillo
Dors
Plant
20
0
-20
0%
20%
40%
60%
80%
100%
Ciclo (%)
Flexoextensión de rodilla
Flex
Ext
50
0
Momento de tobillo
Plant
Dors
2
1
0
-1
Momento de rodilla
Ext
Flex
Potencia de tobillo
Gen
Abs
-2
Potencia de rodilla

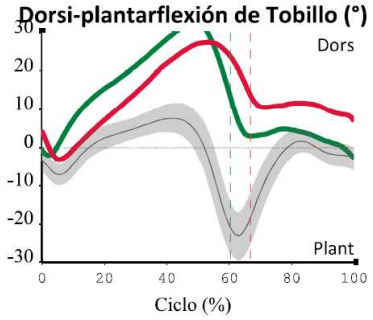

Flexor L. Dedos
Peroneo Lat. Largo
Gastrocnemio
Soleo
Tibial Posterior
Gluteo Medio
Gluteo Máximo
Tibial Anterior
Vasto
Hamstrings
Recto Femoral
Psoas Ilíaco
Biceps Fem. (p. c.)
Recto Femoral
Adductor Largo
Apoyo
Balanceo
B.M.
B.T.
R.C.
A.M.
A.T.
P.B.
B.I.
B.M.
B.T.
Contacto Inicial
Despegue del Pie
Contacto Inicial

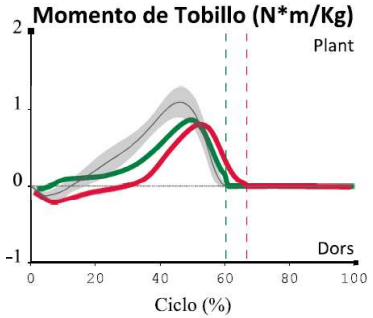
Plantar flexor weakness

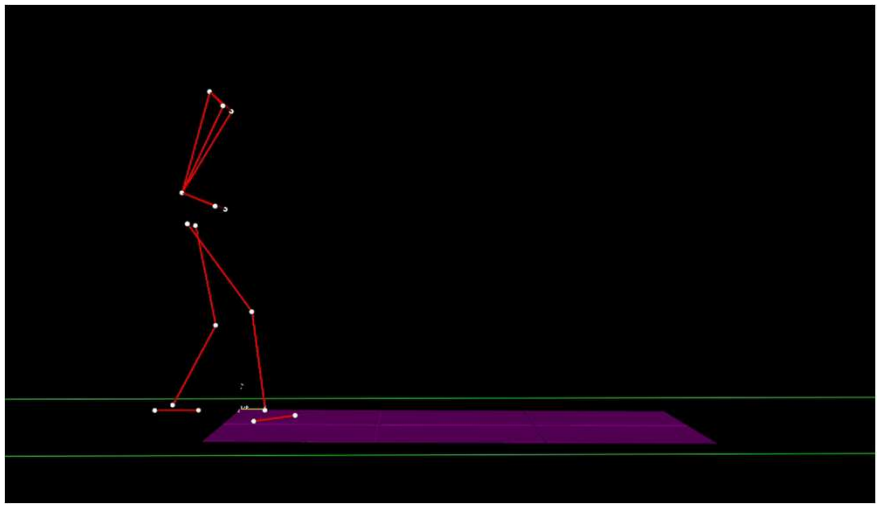
Lever arm disfunction

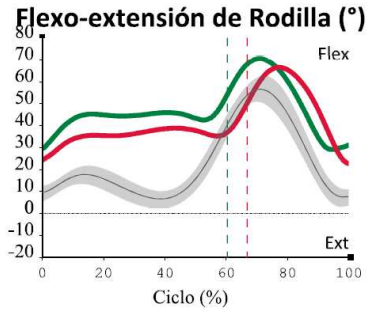


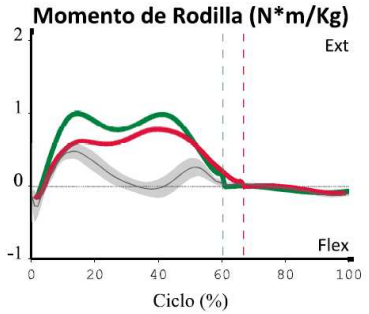
Insufficient PF/KE coupe



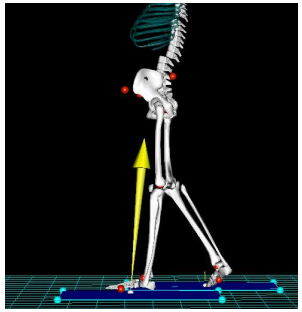




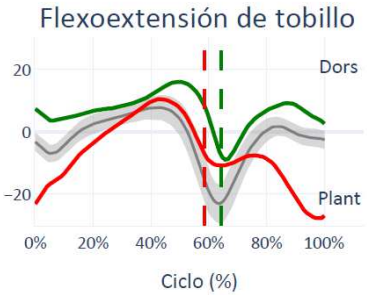


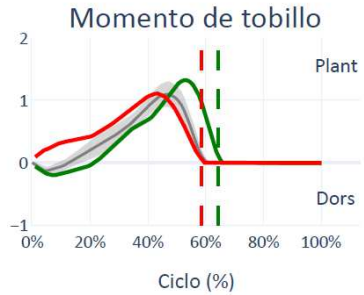


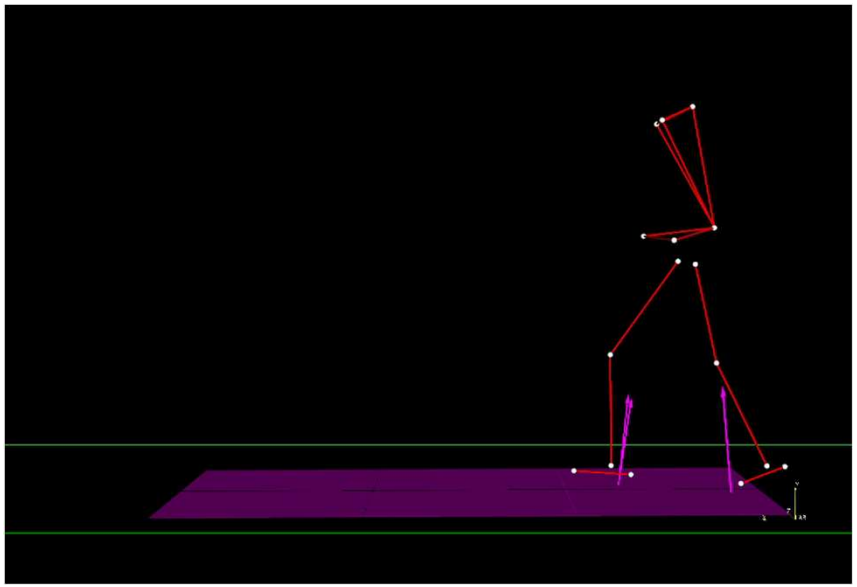
Increased activity of plantar flexors

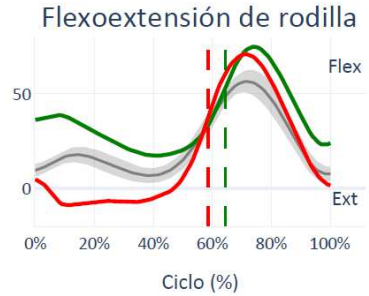


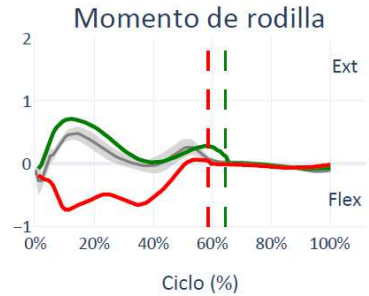
Excessive PF/KE couple



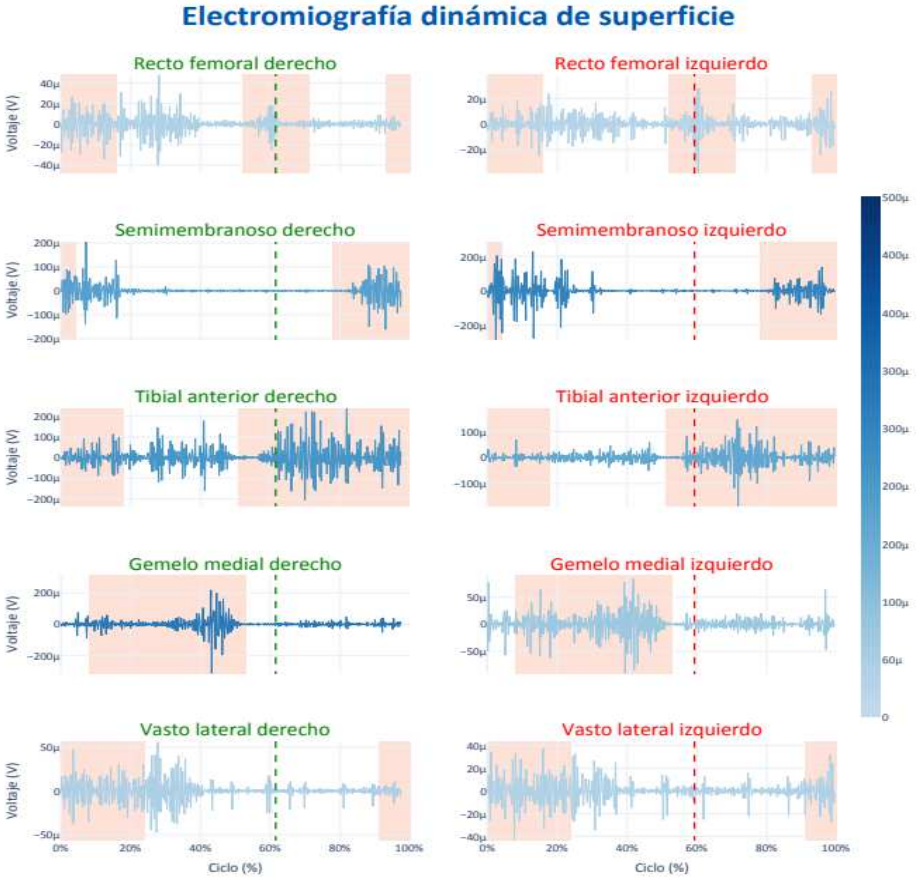


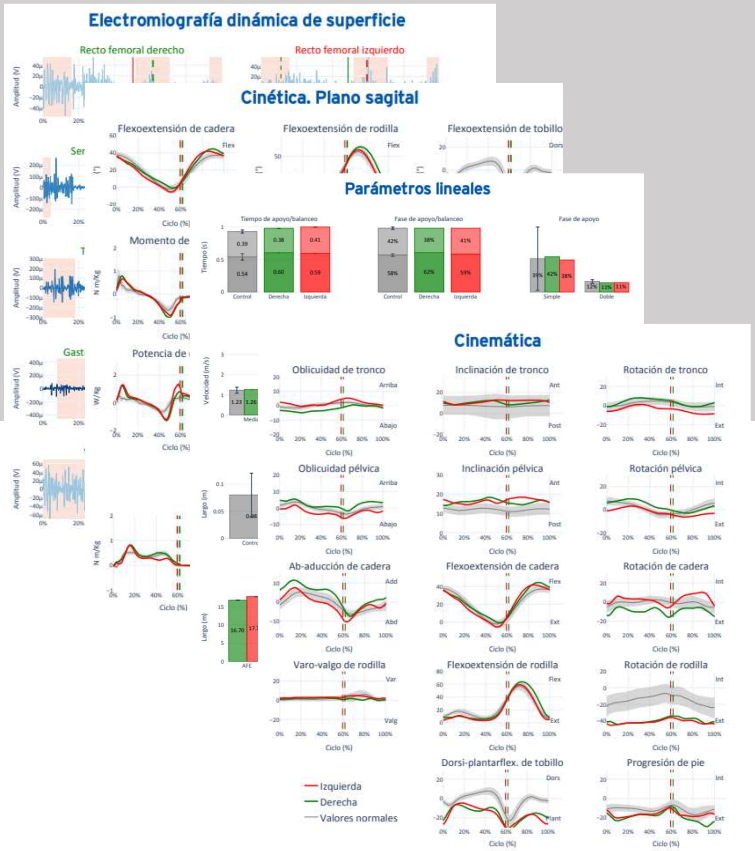


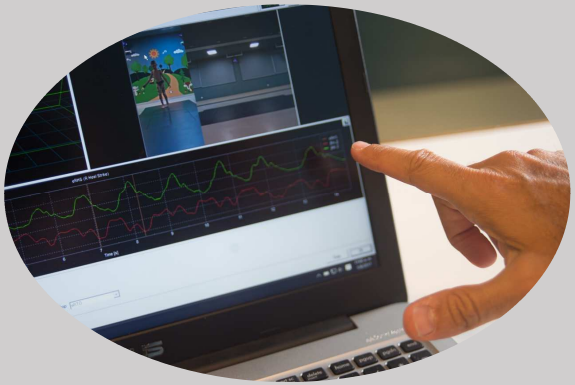




Dynamic electromyography

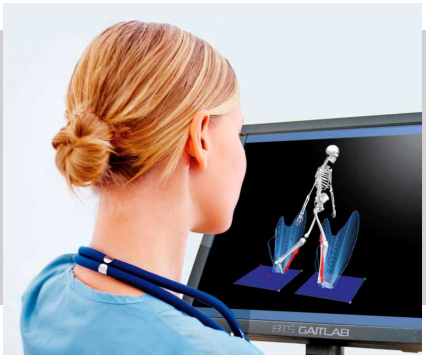






List of problems

Treatment



Clinical Gait Analysis

Total procedures are reduced.

More conservative/physiological treatments

Economic/Social impact

Impact of outcome evaluation

Preoperative gait analysis has a substantial effect on orthopedic decision making in children with cerebral palsy

Comparison between clinical evaluation and gait analysis in 60 patients

Bjørn Lofterød[1], Terje Terjesen[2], Ingrid Skaaret[1], Ann-Britt Huse[1] and Reidun Jahnsen[1]

Influence of gait analysis on decision-making for lower extremity orthopaedic surgery: Baseline data from a randomized controlled trial☆

Tishya A.L. Wren [a,b,*], Norman Y. Otsuka [c], Richard E. Bowen [d], Anthony A. Scaduto [d], Linda S. Chan [e], Minya Sheng [e], Reiko Hara [a], Robert M. Kay [a,b]

[a] Children's Orthopaedic Center, Children's Hospital Los Angeles, Los Angeles, CA, United States
[b] Orthopaedic Surgery Department, University of Southern California, Los Angeles, CA, United States
[c] NYU Hospital for Joint Diseases, NYU Langone Medical Center, New York, NY, United States
[d] Orthopaedic Hospital, Los Angeles, CA, United States
[e] Department of Pediatrics, Children's Hospital Los Angeles, Los Angeles, CA, United States

J Pediatr Orthop. 2019 Oct 29. doi: 10.1097/BPO.0000000000001461. [Epub ahead of print]

What's New in the Orthopaedic Treatment of Ambulatory Children With Cerebral Palsy Using Gait Analysis.

Sees JP[1], Truong WH[2,3], Novacheck TF[2,3,4], Miller F[1], Georgiadis AG[2,3,4].

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1 Department of Orthopedics, Nemours/Alfred I. duPont Hospital for Children, Wilmington, DE.
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3 Department of Orthopaedic Surgery, University of Minnesota, Minneapolis, MN.
4 James R. Gage Center for Gait and Motion Analysis, Gillette Children's Specialty Healthcare, St. Paul.

Flexed-knee gait in children with cerebral palsy: a 10-year follow-up study

Thierry Haumont · Chris Church · Shaun Hager · Maria Julia Cornes · Dijana Poljak · Nancy Lennon · John Henley · Daveda Taylor · Tim Niiler · Freeman Miller

Effects of Preoperative Gait Analysis on Costs and Amount of Surgery

Tishya A. L. Wren, PhD,† Michael M. Kalisvaart, MD,† Christine E. Ghatan, BS, BA,† Susan A. Rethlefsen, PT,* Reiko Hara, MA,* Minya Sheng, MS,‡ Linda S. Chan, PhD,‡ and Robert M. Kay, MD*†*

GAIT & POSTURE

Clinical efficacy of instrumented gait analysis: Systematic review 2020 update

Tishya A L Wren, Carole A Tucker, Susan A Rethlefsen, George E Gorton 3rd , Sylvia Õunpuu

Children's Orthopaedic Center, Children's Hospital Los Angeles, Los Angeles, CA, USA.
Temple University, Philadelphia, PA, USA.
Children's Orthopaedic Center, Children's Hospital Los Angeles, Los Angeles, CA, USA.
Shriners Hospitals for Children, Springfield, MA, USA.
Connecticut Children's Medical Center, Farmington, CT, USA.

The literature on 3DGA has increased.

There is strong evidence that 3DGA changes and reinforces treatment decisions.

3DGA increases confidence in treatment planning and agreement among physicians.

3DGA helps define diagnostic groups and understand expected treatment outcomes.

3DGA can improve outcomes if recommendations are followed.

Treatment outcomes. Research

Short-time kinematics changes after selective dorsal rhizotomy

Crespo Marcos, Samara Eduardo, Toledo Alfredo, Duffy Clara, Segal Eduardo, Gotter María Pia, Couto Juan Carlos

Introduction

Spasticity affects the function and muscle growth generating deviations in gait patterns of the child with cerebral palsy (CP). Selective dorsal rhizotomy (SDR) is used in a select group of patients with CP to reduce spasticity facilitating motor function and generating permanent changes over time [1]. Other authors have reported changes in gait pattern after SDR [2, 3].

The aim of this study is to evaluate the short-time kinematic changes in a group of children with CP treated with SDR.

Methods

Pre and postoperative clinical gait analysis of patients with spastic diplegia treated with SDR were retrospectively evaluated.

The selection criteria included patients whose second evaluation was performed 6 to 24 months after surgery and have not had another surgical treatment in addition to SDR between studies.

Participant Profile

Number 24 Male 16 Female 8 Edad 14.2 SD 8.16	Time post SDR Mean 12.95 month Min 6 month Max 23 month
GMFCS: I (5), II (14), III (4), IV (1)	
GDI Group Mean: 70.12 SD 11.6	

Each side of the patient was considered independent because the surgery can affect both sides differently.

The pre and postoperative variables were evaluated with a paired t-test with a 5% threshold for significance. To assess overall changes in gait

Results

The range of motion (RoM) of hips was significantly greater. The increased hip excursion was due to a significant increase in maximal flexion, also showing higher angular velocity during flexion. No changes were found in frontal and transversal planes of hip.

The knee sagittal range of motion increased significantly with higher values in peak of flexion during swing and maximal extension. The angular velocity was increased in both flexion and extension.

At the ankle, no significant changes were found.

The RoM of the pelvis tilt was slightly reduced.

Differences of gait parameters evaluated before and after SDR.

	Parameter	Pre SDR	Post SDR	p
Pelvis	RoM	7.86±3.49	6.16±2.78	*
	Mean Tilt	16.54±6.40	18.84±5.56	*
Hip	Peak of flexion	49.77±8.67	54.07±7.55	*
	Peak of extension	7.76±12.28	7.07±8.74	
	RoM	42.00±6.50	47.00±7.35	*
	Peak of angular vel. Flexion	161.77±30.08	194.11±37.51	*
	Peak of angular vel. Extension	-115.44±30.43	-120.24±25.24	
Knee	Peak of flexion	60.65±11.28	66.45±8.83	*
	Peak of extension	23.29±17.20	15.37±11.96	*
	RoM	37.37±14.20	51.09±12.76	*
	Peak of angular vel. Flexion	138.81±61.92	225.29±70.11	*
	Peak of angular vel. Extension	-13.58±47.39	-212.68±59.29	*
Ankle	Peak of flexion	2.97±17.28	3.43±11.74	
	Peak of extension	-20.65±19.48	-16.36±15.44	
	RoM	23.62±9.38	21.77±6.73	
	Peak of angular vel. Flexion	89.84±36.17	79.26±25.66	
	Peak of angular vel. Extension	-102.80±38.21	-112.37±33.45	
Distance-Time	Normalized Mean Velocity	0.24±0.11	0.28±0.09	
	Normalized Cadence	29.81±6.01	28.75±5.28	
	Normalized Step Length	0.58±0.16	0.64±0.12	*

* p<0.05 Statistically significant

The normalized mean velocity showed no change even with a significant increase of normalized step length and a slight decrease in the normalized cadence. The mean GDI significantly increased after surgery. (Pre: 70.12 ± 11.60; Post: 75.79 ± 8.95, P = 0.009)

Discussion

Changes evaluated after surgery are consistent with previous work. The reduction of spasticity leads to an increased joint excursion especially at the knee and hip where also the angular velocity was increased.

The lack of changes at the ankle can be due to muscular contracture or shortening of plantarflexors limiting joint mobility.

SDR has shown to be an effective treatment for these patients, although muscle weakness and skeletal alignment remains a problem to be solved after surgery.

It can be seen that the gait pattern improved significantly after the SDR, yet the average postoperative GDI continues outside two standard deviations from the normal gait pattern used for the calculation.

The application of orthopedic surgery should be evaluated to approach a more efficient gait.

Clinical significance

The present study provides additional information about changes in gait function after SDR in children with cerebral palsy that may be useful for clinical assessment.

References

1. Langerak NG, et al. J Neurosurg Pediatrics 2008; 1:180–6
2. Mark F. Abel et al. J Neurosurg. 2005 Mar; 102(2 Suppl):157-62
3. Langerak NG et al. Gait Posture. 2012 Feb; 35(2):244-8
4. Schwartz MH, Rozumalski A. Gait Posture. 2008 Oct; 28(3):351-7

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Research Article

Selective Dorsal Rhizotomy: Analysis of two rootlet sectioning techniques

Mantese Beatriz[1], Marcos Crespo[2], Emiliano Ravera[3], Nazar Ricardo[1], Ruben Mormandi[1], Andres Cervio[1]

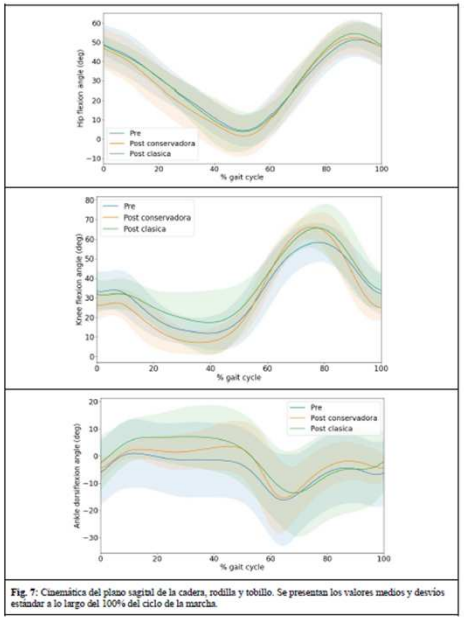


Fig. 7: Cinemática del plano sagital de la cadera, rodilla y tobillo. Se presentan los valores medios y desvíos estándar a lo largo del 100% del ciclo de la marcha.

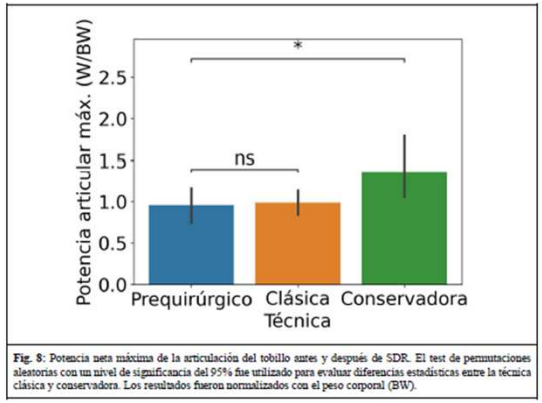


Fig. 8: Potencia neta máxima de la articulación del tobillo antes y después de SDR. El test de permutaciones aleatorias con un nivel de significancia del 95% fue utilizado para evaluar diferencias estadísticas entre la técnica clásica y conservadora. Los resultados fueron normalizados con el peso corporal (BW).

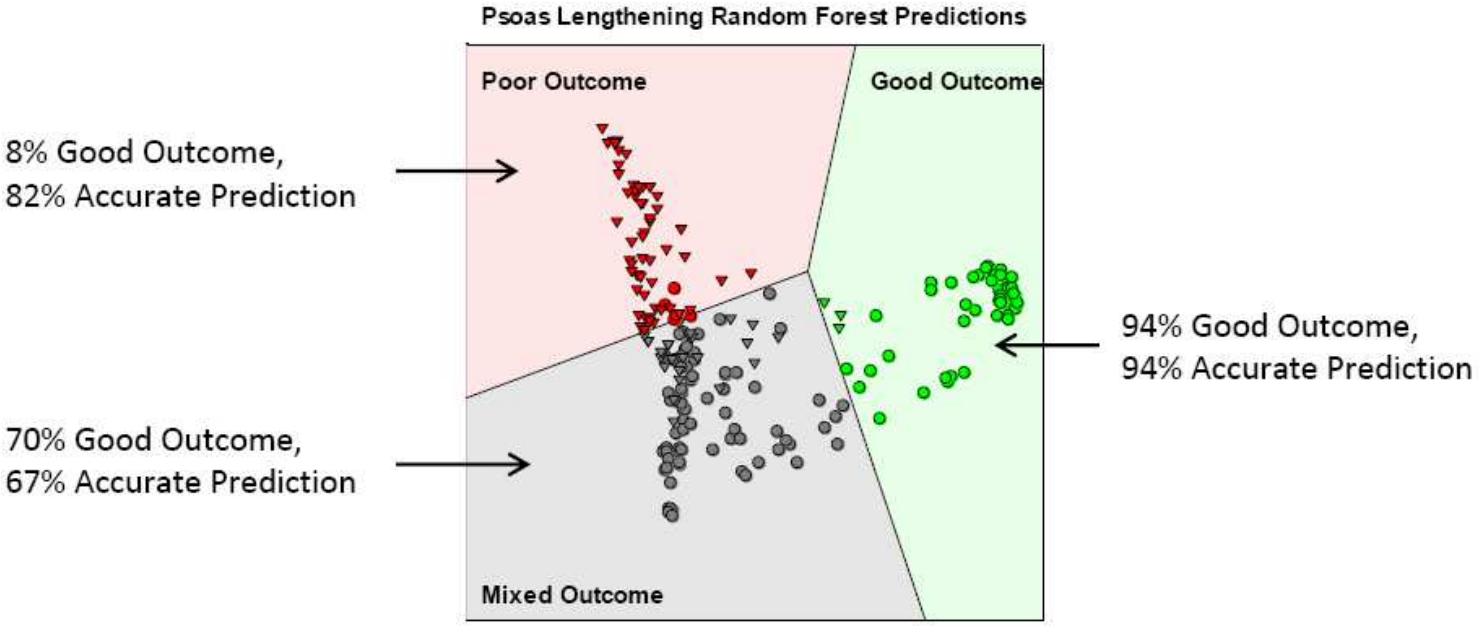
Treatment outcomes. Prediction

ESMAC Best Paper 2011

Predicting the outcome of intramuscular psoas lengthening in children with cerebral palsy using preoperative gait data and the random forest algorithm

Michael H. Schwartz [a,b,*], Adam Rozumalski [a], Walter Truong [a], Tom F. Novacheck [a,b]

[a] Gillette Children's Specialty Healthcare, St. Paul, MN, United States
[b] University of Minnesota – Twin Cities, Minneapolis, MN, United States



Algoritmo Random Forest
Breiman, L. Machine Learning (2001) 45: 5.

Adult Neurological Gait Analysis

Does gait analysis change clinical decision-making in poststroke patients? Results from a pragmatic prospective observational study

M. FERRARIN, M. RABUFFETTI, M. BACCHINI, A. CASIRAGHI, A. CASTAGNA, A. PIZZI, A. MONTESANO

SIAMOC Best Clinical Paper 2018

Impact of instrumental analysis of stiff knee gait on treatment appropriateness and associated costs in stroke patients

Andrea Merlo*, Isabella Campanini

LAM-Motion Analysis Laboratory, San Sebastiano Hospital, Correggio, Neuromotor and Rehabilitation Department, Azienda USL-IRCCS di Reggio Emilia, Reggio Emilia, Italy

The Impact of Instrumented Gait Analysis on Surgical Planning: Treatment of Spastic Equinovarus Deformity of the Foot and Ankle

David A. Fuller, M.D.*; Mary Ann E. Keenan, M.D.**; Alberto Esquenazi, M.D.**; John Whyte, M.D., Ph.D.**; Nathaniel H. Mayer, M.D.**; Rebecca Fidler-Sheppard**

Philadelphia, PA

Journal of Biomechanics 45 (2012) 2658–2661

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Journal of Biomechanics

journal homepage: www.elsevier.com/locate/jbiomech
www.JBiomech.com

Effects of ankle foot orthosis in stiff knee gait in adults with hemiplegia

Marcelo Andrés Gatti [a,*], Orestes Freixes [a], Sergio Anibal Fernández [a], Maria Elisa Rivas [a], Marcos Crespo [b], Silvina V. Waldman [c], Lisandro Emilio Olmos [c]

[a] Physical Therapy Unit, FLENI Rehabilitation Institute, Ruta 9 Km 52.5 Colectora Este, Escobar Buenos Aires, Argentina
[b] Gait Analysis Laboratory, FLENI Rehabilitation Institute, Buenos Aires, Argentina
[c] Department of Rehabilitation Medicine, FLENI Rehabilitation Institute, Buenos Aires, Argentina

Functional tests with and without AFO.

	Velocity (m/s)		Non-paretic step length (cm)		Knee flexion angle[a] (deg.)		Peak knee flexion angle (deg.)	
	With AFO	Without AFO	With AFO	Without AFO	With AFO	Without AFO	With AFO	Without AFO
Mean (SD)	0,627 (0,08)	0,476 (0,14)	420,8 (59,5)	335,2 (66,28)	18,644 (10,1)	17,224 (8,73)	30,785 (14,18)	26,316 (11,76)
Minimun score	0.51	0.21	336.00	245.00	−0.96	−1.70	3.85	1.67
Maximun score	0.78	0.71	536.00	428.00	36.32	26.30	55.04	37.62
p-Value Wilcoxon	0.007*	0.005*	0.508	0.005*				

p-Value with Wilcoxon signed ranks test.

* Significance level set at $p < 0.05$.

[a] Calculated at toeoff.

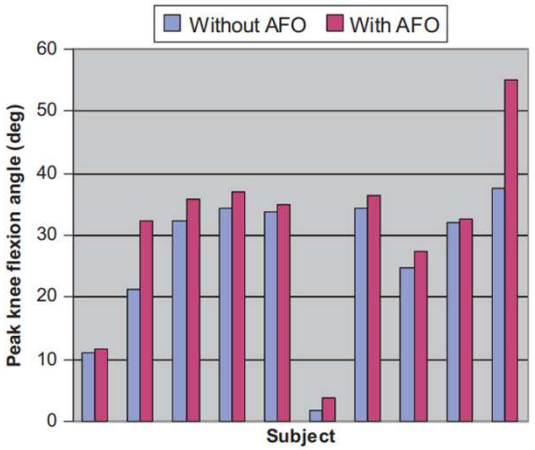


Fig. 2. Peak knee flexion with and without AFO.

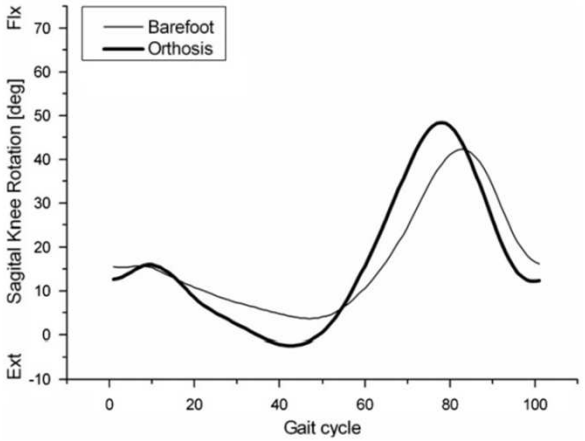


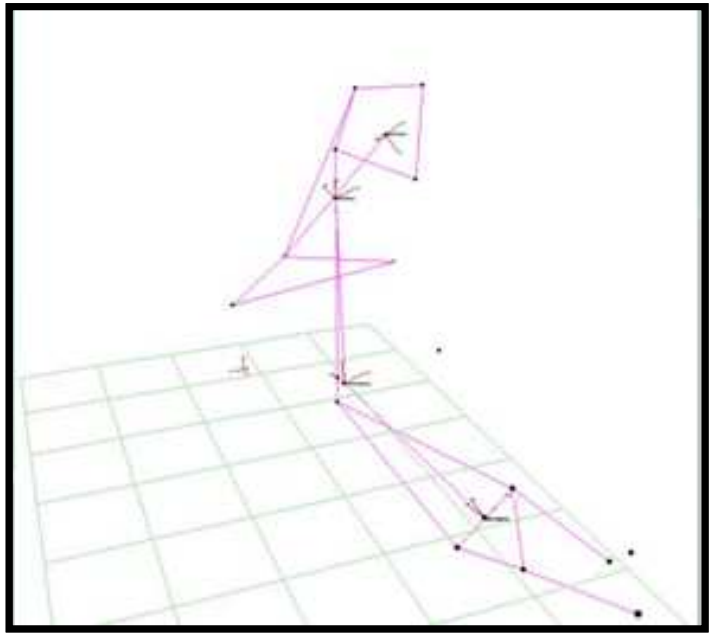
Fig. 1. Knee sagital plane angle of the paretic limb with and without AFO.

Upper Limb Biomechanics

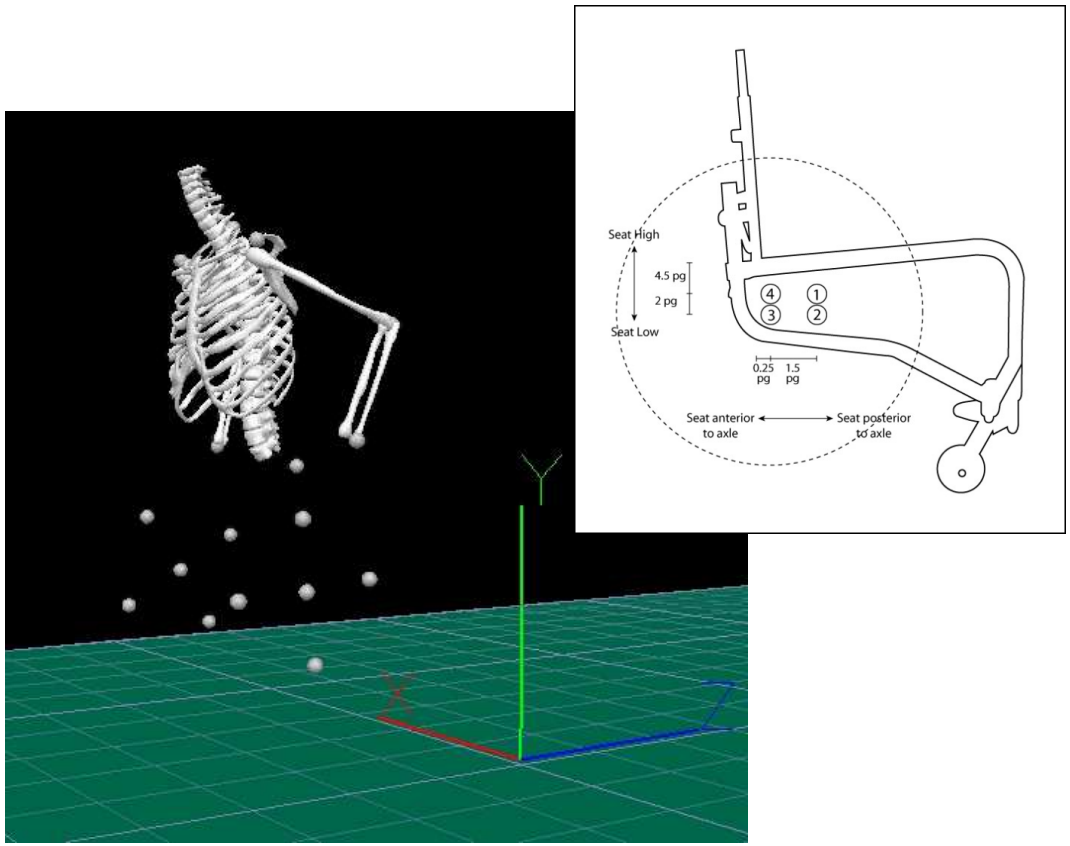
Journal of
NEUROLOGY, NEUROSURGERY
& PSYCHIATRY with Practical Neurology

Kinematic improvement following Botulinum Toxin-A injection in upper-limb spasticity due to stroke

Esteban A Fridman,[1,2,3] Marcos Crespo,[1] Santiago Gomez Argüello,[1] Lorena Degue,[1] Mirta Villarreal,[1,3] Stephan Bohlhalter,[2] Lewis Wheaton,[2] Mark Hallett[2]



Biomechanics of Wheelchair Propulsion



JRRD Volume 47, Number 7, 2010
Pages 661–668
Journal of Rehabilitation Research & Development

Wheelchair axle position effect on start-up propulsion performance of persons with tetraplegia

Orestes Freixes, PT;[1*] Sergio Anibal Fernández, PT;[1] Marcelo Andrés Gatti, PT;[1] Marcos José Crespo, MSc;[2] Lisandro Emilio Olmos, MD;[3] Iván Federico Rubel, MD[4]
[1]Physical Therapy Unit, [2]Gait Analysis Laboratory, [3]Department of Rehabilitation Medicine, and [4]Department of Orthopaedics, Fleni Institute, Escobar, Argentina

ASIA
AMERICAN SPINAL INJURY ASSOCIATION

Wheelchair Axle Position Effect on the Propulsion Performance of Persons With C7 Tetraplegia: A Repeated-Measures Study

Orestes Freixes, PT,[1] Sergio Anibal Fernández, PT,[1] Diego Alejandro Passuni, PT,[1] Marcelo Andrés Gatti, PT,[2] Eliana Buffetti, PT,[1] Maria Elisa Rivas, PT,[2] Lisandro Emilio Olmos, MD,[3] and Marcos José Crespo, MSc[4]

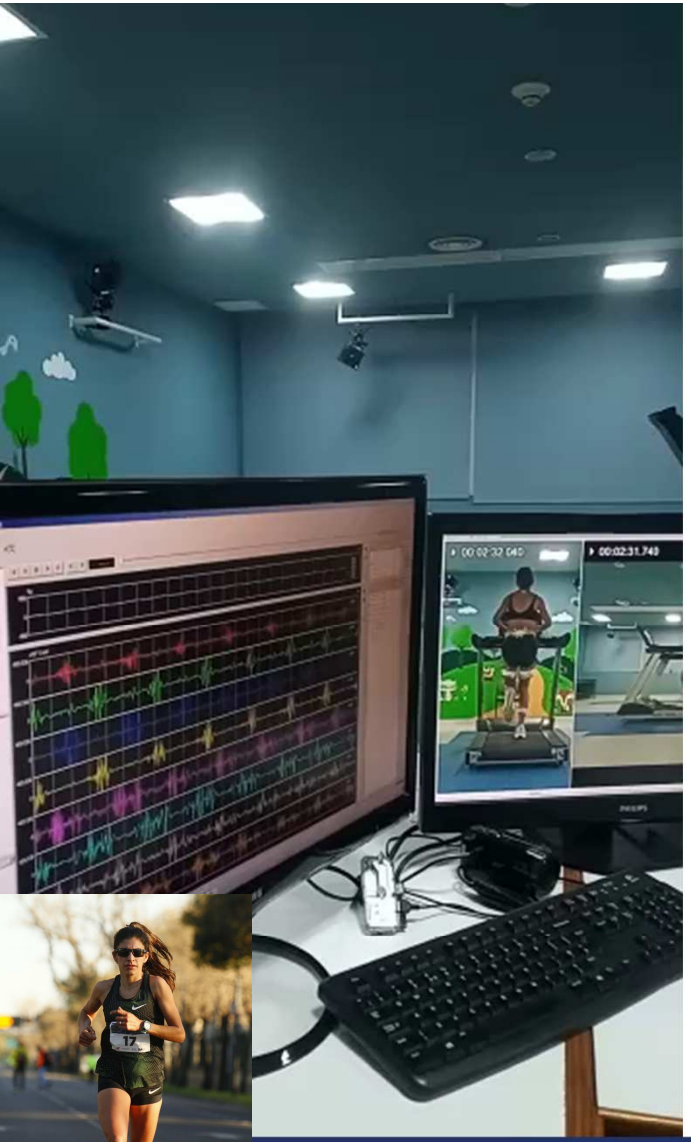
[1]Physical Therapy Unit, CINER Rehabilitation Institute, Buenos Aires, Argentina; [2]Physical Therapy Unit, FLENI Rehabilitation Institute, Buenos Aires, Argentina; [3]Rehabilitation Medicine, FLENI Rehabilitation Institute, Buenos Aires, Argentina; [4]Gait Analysis Laboratory, FLENI Rehabilitation Institute, Buenos Aires, Argentina

Proffered Paper

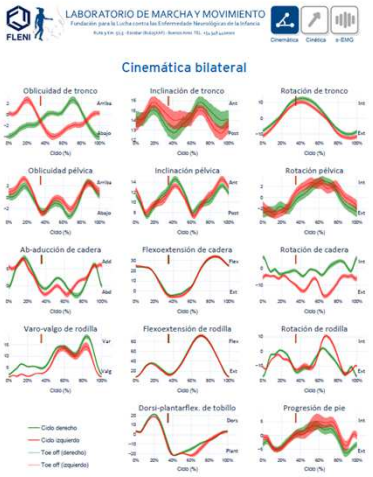
Shoulder Functional Electrical Stimulation During Wheelchair Propulsion in Spinal Cord Injury Subjects

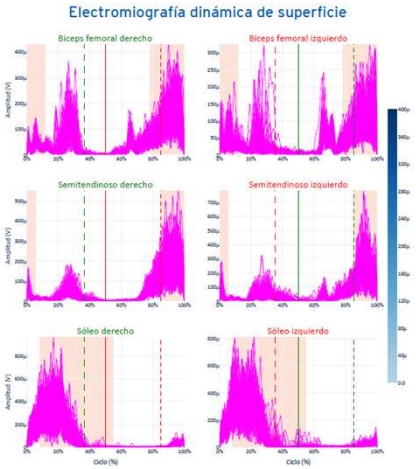
Orestes Freixes,[1] Sergio Anibal Fernandez,[1] Marcelo Andres Gatti,[1] Marcos Jose Crespo,[2] Lisandro Emilio Olmos,[3] and Maria Julieta Russo[3]

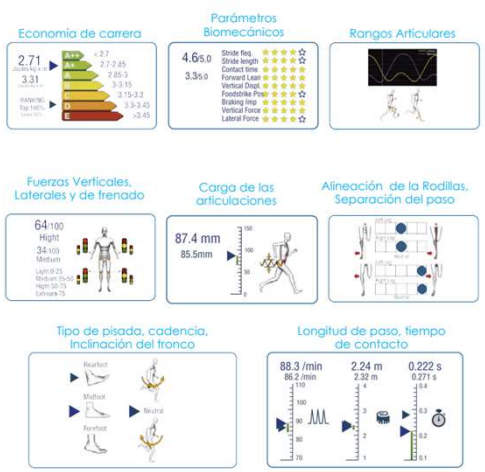
[1]Physical Therapy Unit, [2]Gait Analysis Labratory, [3]Department of Rehabilitation Medicine, FLENI Rehabilitation Institute, Buenos Aires, Argentina



Three-dimensional running analysis







- 3D angular kinematics of: trunk, pelvis, hip, knee, ankle, foot and arms
- Surface electromyography of up to 10 muscle groups simultaneously
- Critical biomechanical parameters
- Length and muscle lengthening velocity

Daiana Ocampo. Maratón
Campeona nacional 42K 2021

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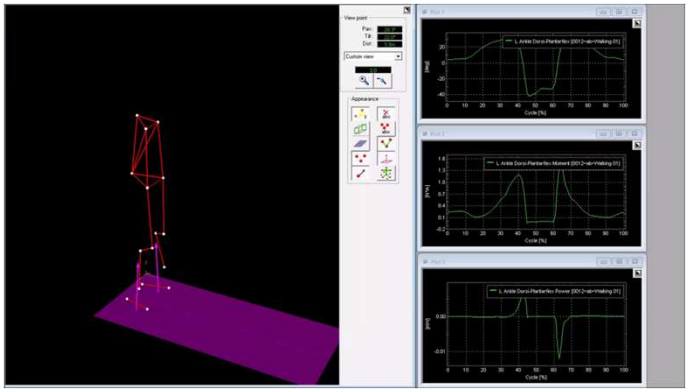
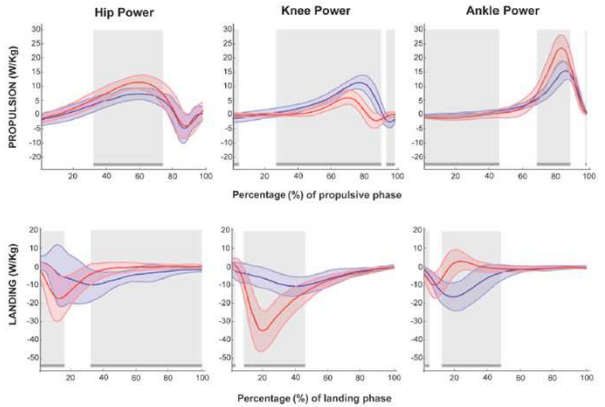
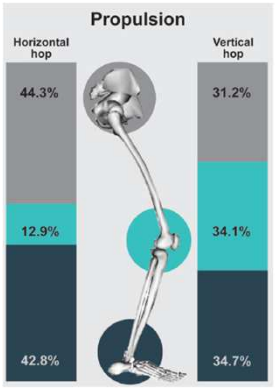
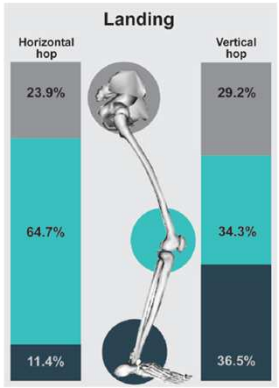
Three-dimensional jump analysis









Vertical jump. CMJ
Horizontal Jump
One foot jump

Maximiliano Diaz. Salto Triple
Campeón Sudamericano y 10 veces campeón nacional

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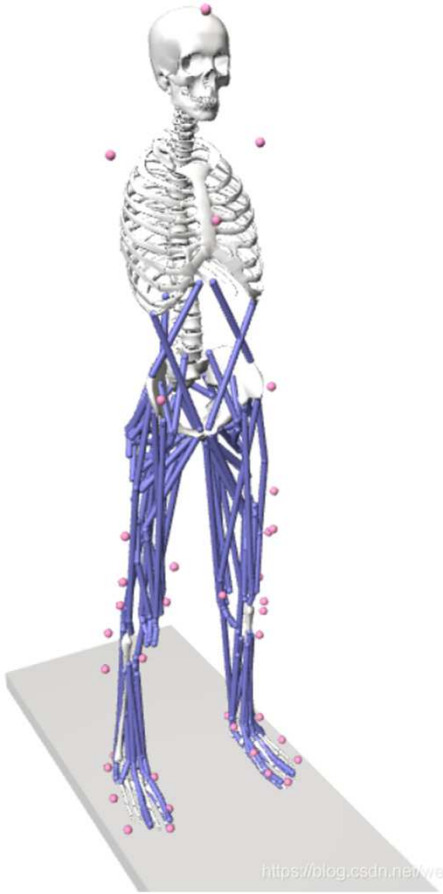
MUSCULOSKELETAL MODELING



OpenSim

The role of estimating muscle-tendon lengths and velocities of the hamstrings in the evaluation and treatment of crouch gait

Allison S. Arnold [a,*], May Q. Liu [a], Michael H. Schwartz [c], Sylvia Õunpuu [d], Scott L. Delp [a,b]

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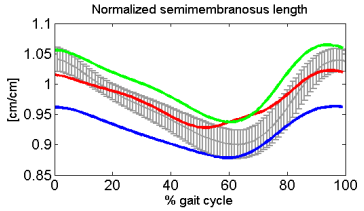
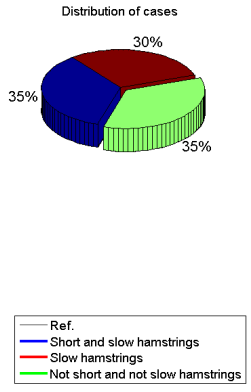
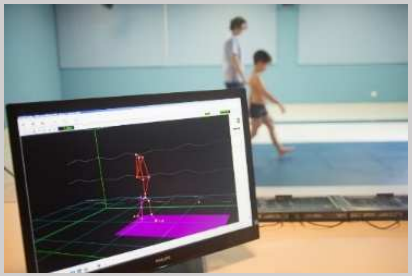
Received 26 July 2004; received in revised form 28 February 2005; accepted 17 March 2005

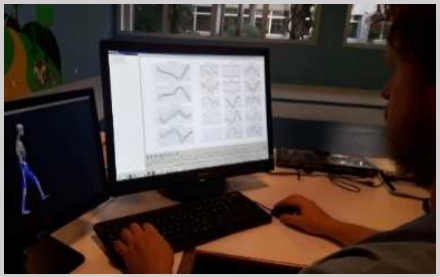


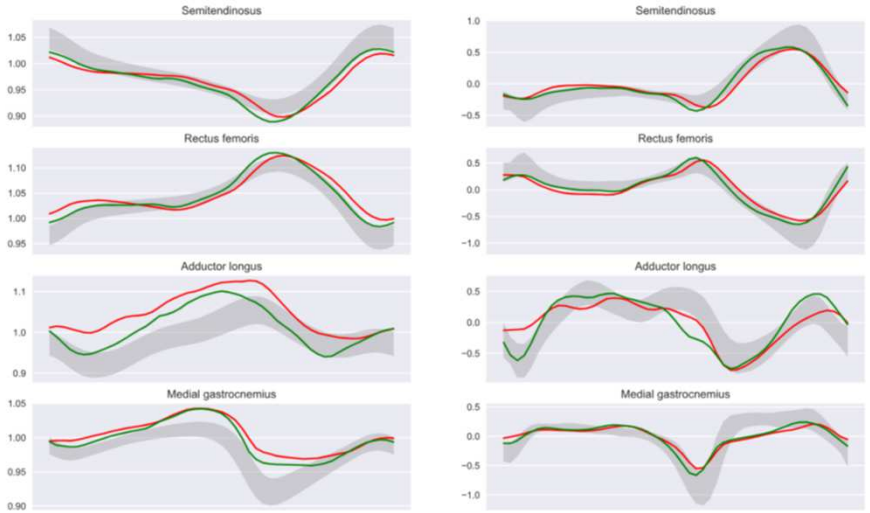


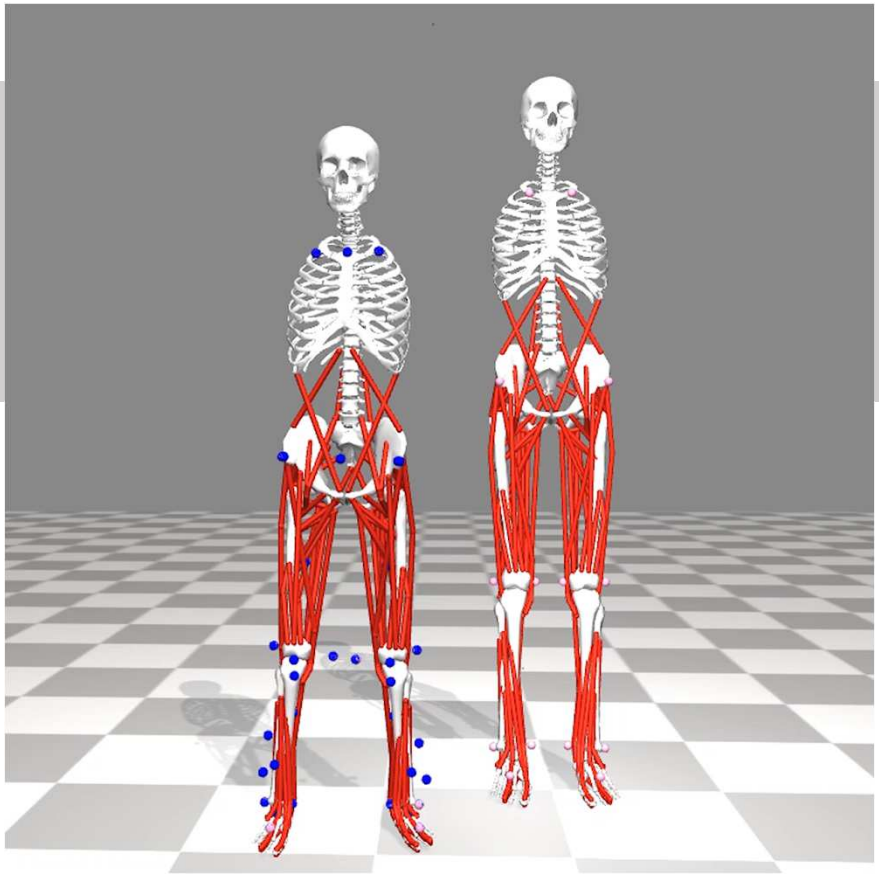
Delp, S.L., Anderson, F.C., Arnold, A.S., Loan, P., Habib, A., John, C.T., Guendelman, E., Thelen, D.G.
OpenSim: Open-source software to create and analyze dynamic simulations of movement. IEEE Transactions on Biomedical Engineering, 54(11), pp 1940-1950. (2007)

Musculoskeletal Modeling





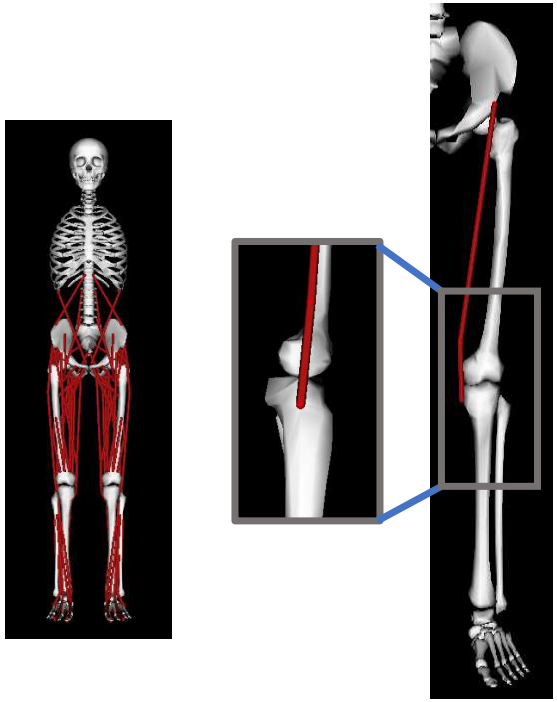




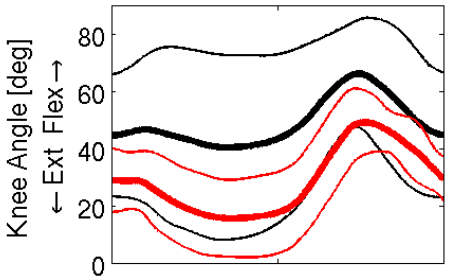
Does Rectus Femoris Transfer Surgery Improve the Muscle Energy Eficence in Stiff-knee Gait?

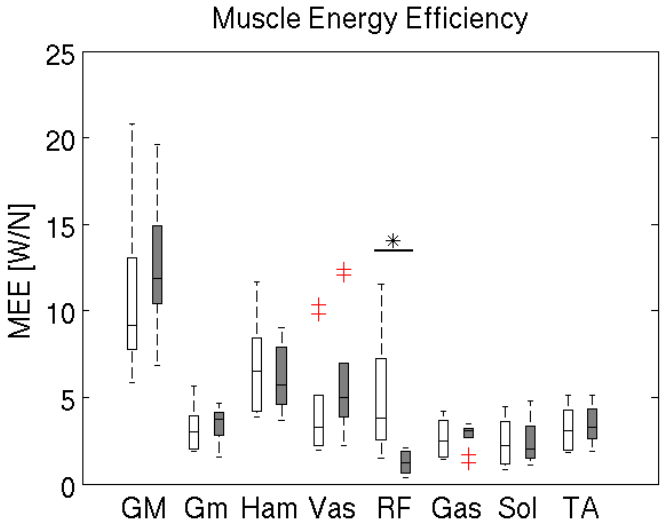
[1]**Emiliano P Ravera**, [2]Marcos Núñez. [2]Daniel Yedlin, [2]Eduardo Samara, [2]Marcos J Crespo and [1]Paola A Catalfamo Formento.

5 niños con ECNE DE. GMFCS I and II, Sin asistencia de marcha Patrón de rodilla rígida. Transferencia de RF a sartorio



$$MEE_j = \frac{1}{N}\sum_{i=1}^{N}\left(\frac{\dot{E}_i}{F_i}\right)_j$$





M. D. Fox, et al., *J. Biomech.*, **42**:614–619, 2009.
S. L. Delp, et al., *IEEE Trans. Biomed. Eng.*, **54**:1940–50, 2007.

✓La transferencia de RF mejoró la eficiencia energética del RF

SPECIFIC POPULATION MODELS

Dimensionless ME model
(Millard et al. 2013)

Escalado OpenSIM

Morphological fit for children
(TSL, OFL)
(Modenese, 2016, Davico, 2020)

Paediatric population

Journal of Biomechanics 139 (2022) 111141

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journal homepage: www.elsevier.com/locate/jbiomech

Individual muscle force–energy rate is altered during crouch gait: A neuro-musculoskeletal evaluation

Emiliano Pablo Ravera [a,b,*], Marcos José Crespo [c], Adam Rozumalski [d]

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[b] Human Movement Research Laboratory, School of Engineering, National University of Entre Ríos (UNER), Oro Verde, Argentina
[c] Laboratorio de análisis de marcha y movimiento, LAMM y Tecnología en rehabilitación, Clínica de tecnología asistiva, TA. Fleni, Escobar, Argentina
[d] The James R. Gage Center for Gait & Motion Analysis, Gillette Children's Specialty Healthcare, St. Paul, MN, United States of America

Weakness due to infiltration of muscle fat. (Kainz et al, 2018).
Lower Maximum isometric force (van der Krogt et al. 2016)

Tendon slack length: TSL increased 10% (Barber et al. 2012)

Reduced volume and section area. (Barrett and Lichtwark, 2010).
Optimal fiber length -30% (Mathewson and Lieber, 2015

Cerebral palsy

IK
CMC
OpenSIM
(Thelen 2003)

MODELOS ESPECIFICOS DE PACIENTE

Generator of specific bone morphology (Carman, 2022) → **Automatic generator of a customized musculoskeletal model. (Modenese and Renaut, 2021)** → **Results Report Generator**

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OPEN **Morphological variation in paediatric lower limb bones**

Laura Carman[1], Thor F. Besier[1,2] & Julie Choisne[1]


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www.JBiomech.com

ELSEVIER

Automatic generation of personalised skeletal models of the lower limb from three-dimensional bone geometries

Luca Modenese[a,*], Jean-Baptiste Renault[b]

[a] Department of Civil and Environmental Engineering, Imperial College London, UK
[b] Aix-Marseille University, CNRS, ISM UMR 7287, 13009 Marseille, France

"Technology is only as good as the people who use it"

Measuring Walking: A Handbook of Clinical Gait Analysis de Richard W. Baker

Muito obrigado!!

mcrespo@fleni.org.ar

Laboratorio de Análisis
de Marcha y Movimiento

Fleni Neurología Neurocirugía Rehabilitación | 60 AÑOS