



Gait Analysis Laboratory

Centro de Rehabilitación Infantil Teletón

Estado de México

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Inaugurated:
May thirteen of 1999

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1999-2009

Centro de Rehabilitación Infantil Teletón Estado de México



CRIT Estado de México



NIÑOS/FAMILIAS
ATENDIDOS
DESDE LA APERTURA

9,045

PACIENTES ATENDIDOS
DESDE LA APERTURA

27,135

SERVICIOS BRINDADOS
DESDE LA APERTURA

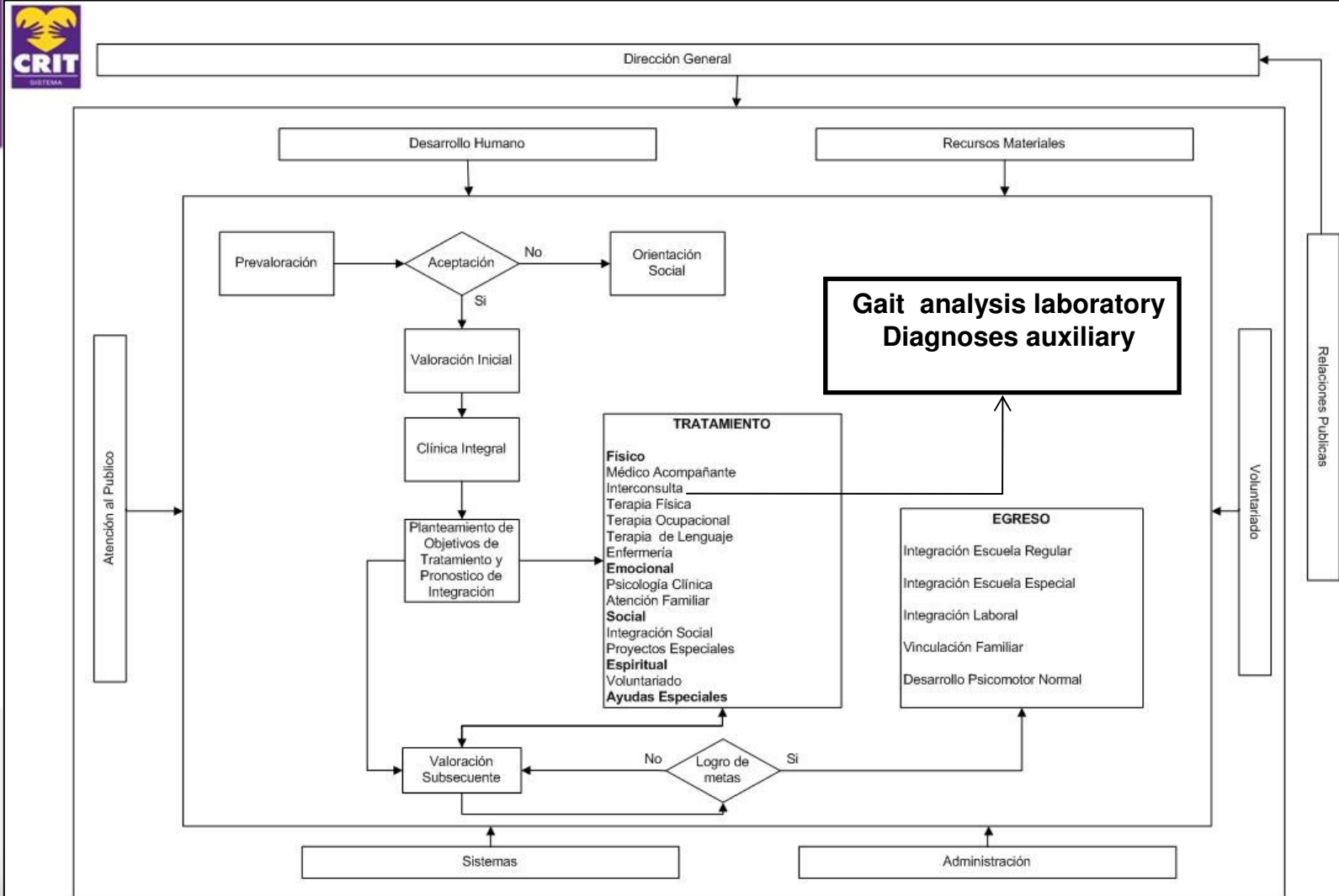
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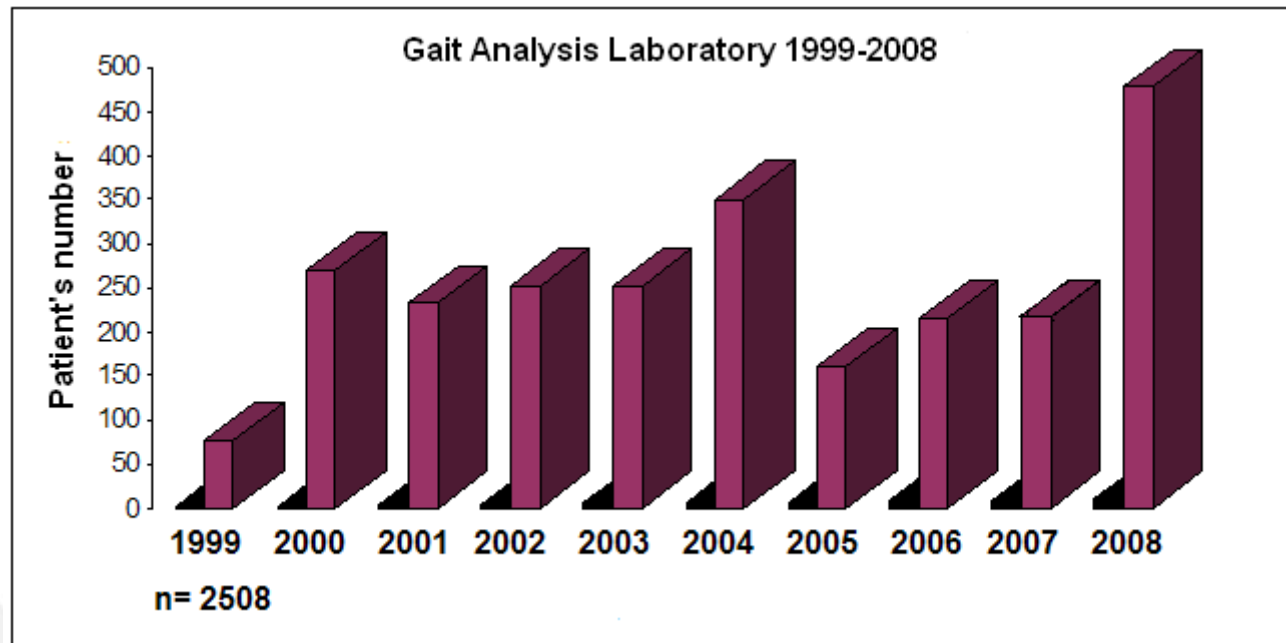
NIÑOS Y FAMILIAS
ATENDIDAS EN EL 2008

4,000

PACIENTES ATENDIDOS
EN EL 2008

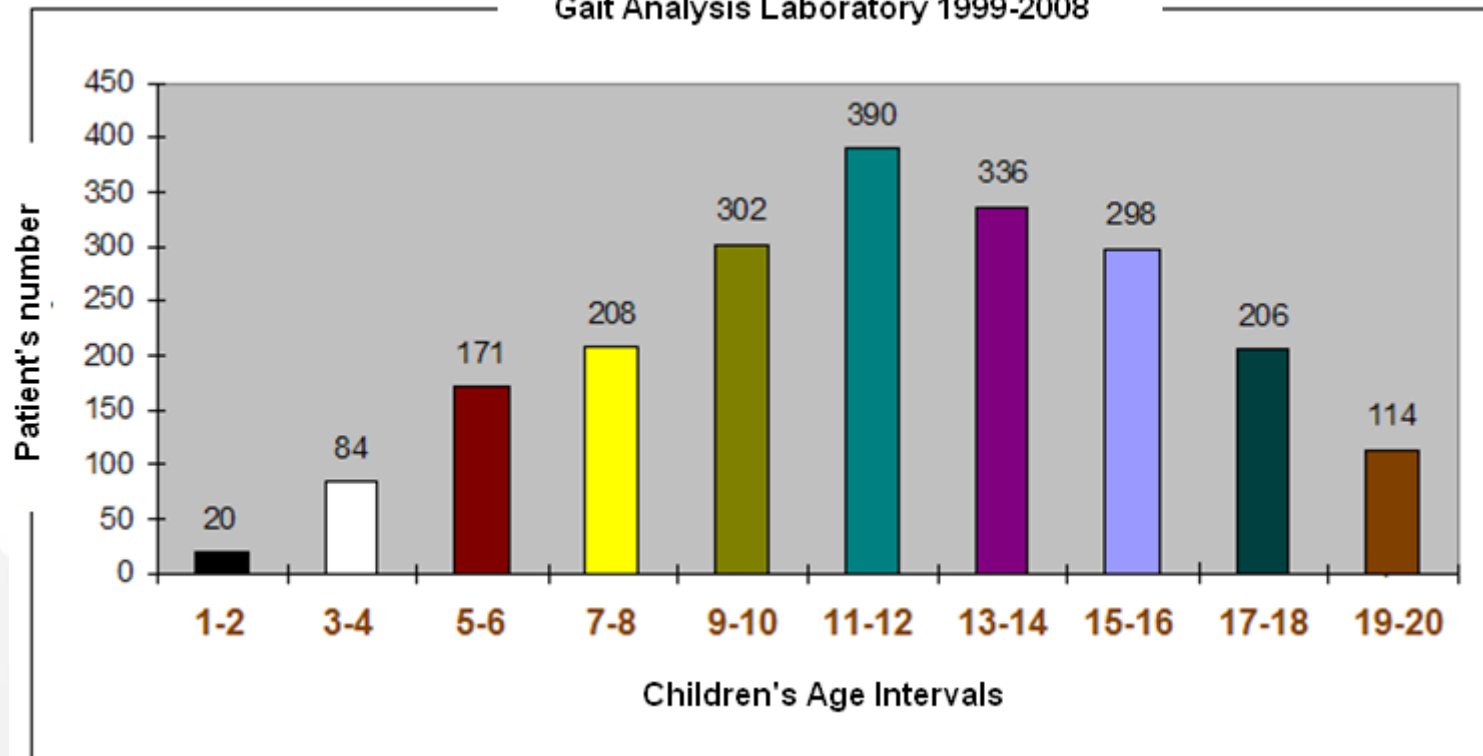
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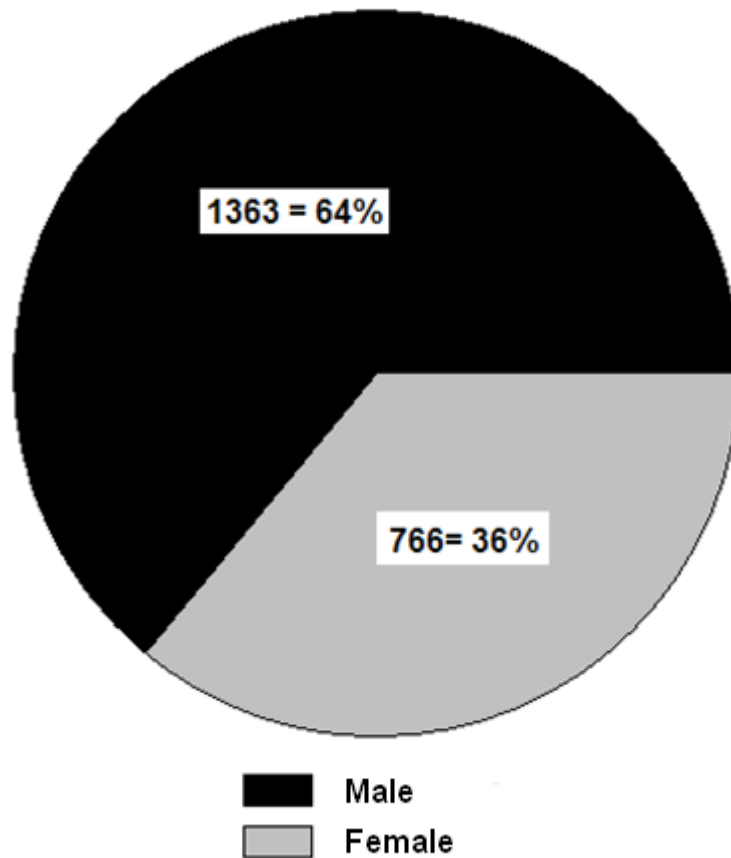


Gait Analysis Laboratory 1999-2008





Gait Analysis Laboratory
Patient's CRIT-EM





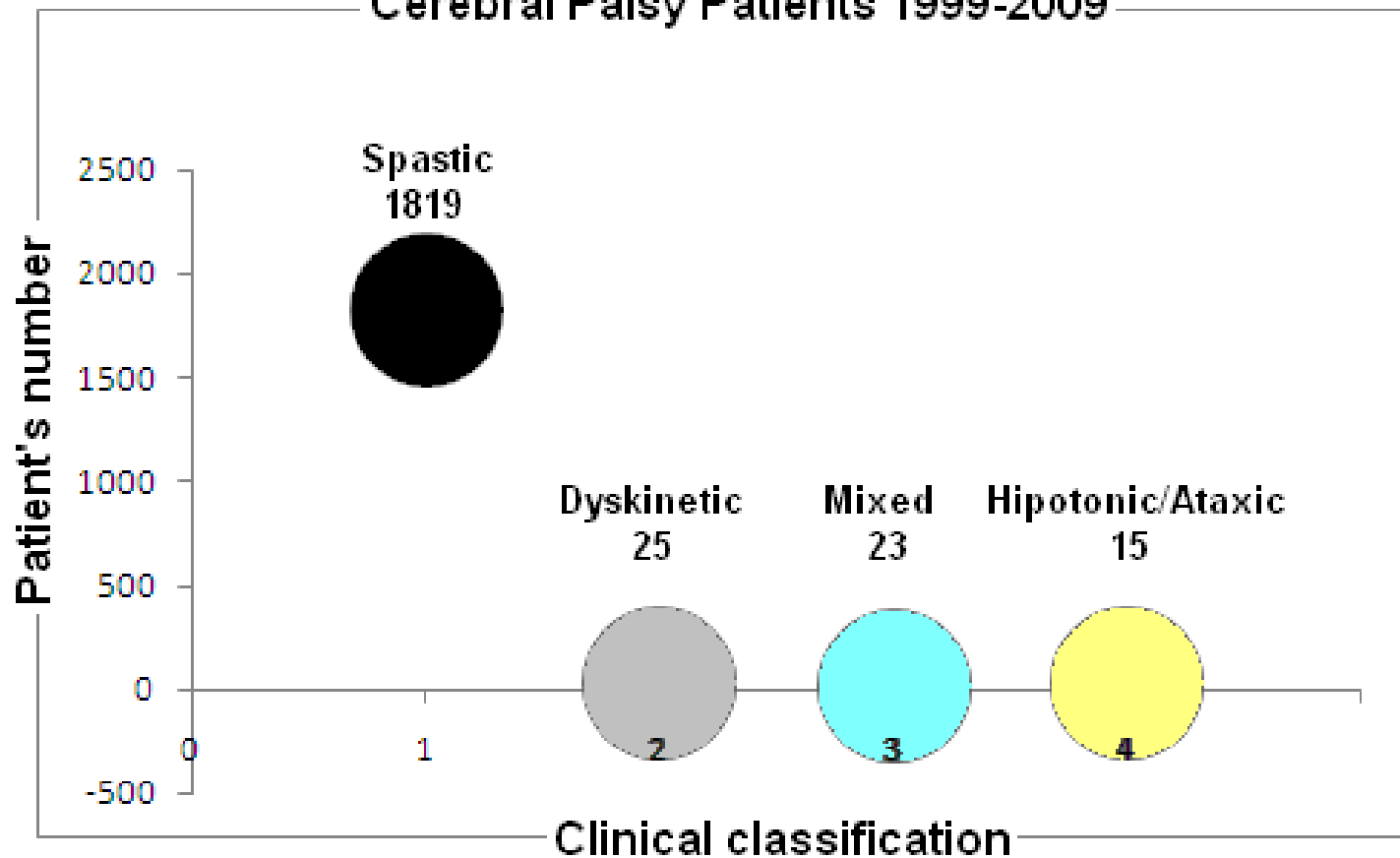
Gait Analysis Laboratory
CRIT-EM
August 1999-July 2009
2890





Gait Analysis Laboratory CRIT-EM

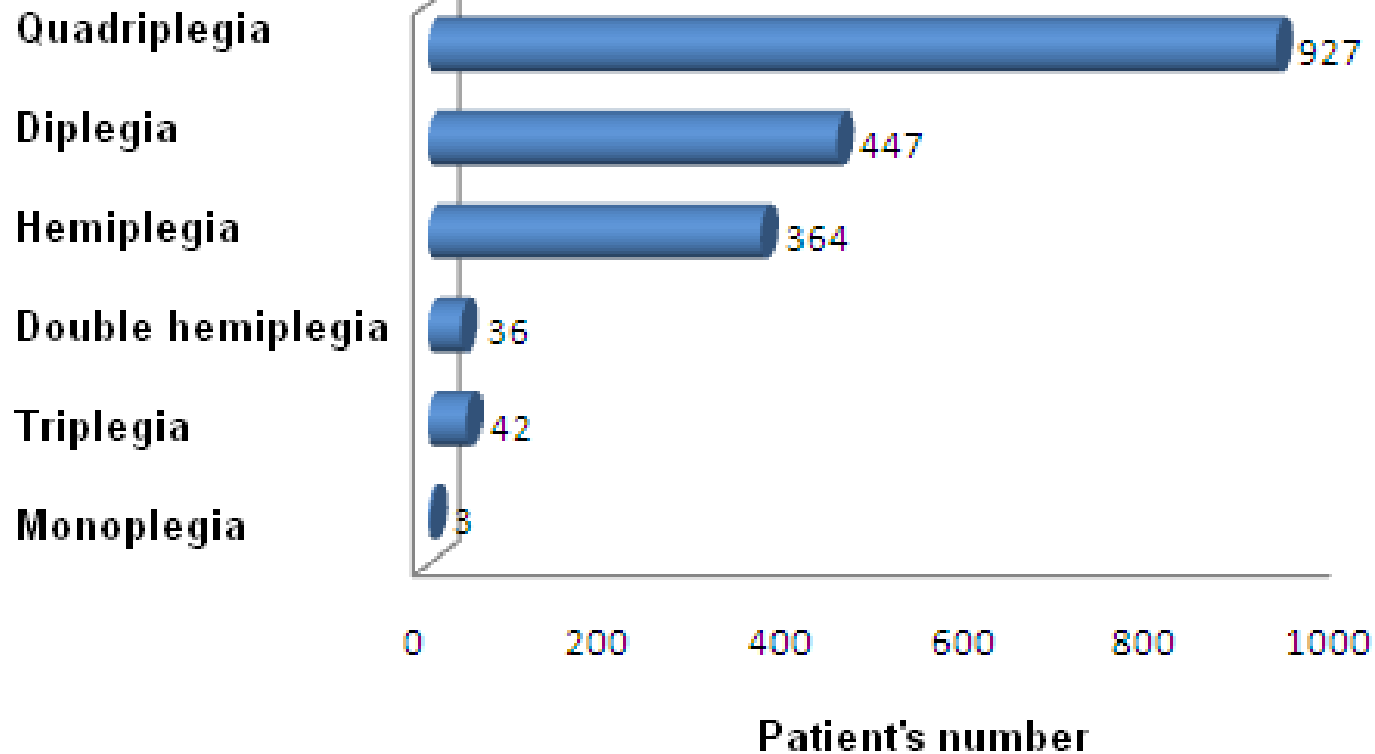
Cerebral Palsy Patients 1999-2009





CRIT-EM
Gait Analysis Laboratory
Cerebral Palsy Patients 1999-2009

Anatomical classification





Protocols

- Davis protocol
- Short protocol
- Upper limb protocol





Upper Limb Protocol

Cerebral Palsy: Hemiplegia & Quadriplegia, n= 77





Cerebral palsy (CP)

- Cerebral palsy (CP) describes a group of disorders of the development of movement and posture, causing activity limitation, that are attributed to non-progressive disturbances that occurred in the developing fetal or infant brain.

Bax M, Rosembaun P, Leviton A, Golgstein M, Paneth N & Damiano D. Proposed definition and classification of cerebral palsy, April 2005. *Developmental Medicine & Child Neurology* 2005, 47: 571–576.



Clinical classification

| B Clinical classification | |
|----------------------------------|---------------------------------------|
| <i>Tonus</i> | <i>Lesion site</i> |
| Spastic | Cortex |
| Dyskinetic | Basal ganglia - extrapyramidal system |
| Hypotonic / Ataxic | Cerebellum |
| Mixed | Diffuse |

Berker N, Yalcin S. The help guide to cerebral palsy. Global HELP Organization. 2005.



Anatomical classification

| C | | Anatomical classification |
|-------------------|--|--|
| <i>Location</i> | | <i>Description</i> |
| Hemiplegia | | Upper and lower extremity on one side of body |
| Diplegia | | Four extremities, legs more affected than the arms |
| Quadriplegia | | Four extremities plus the trunk, neck and face |
| Triplegia | | Both lower extremities and one upper extremity |
| Monoplegia | | One extremity (rare) |
| Double hemiplegia | | Four extremities, arms more affected than the legs |

Berker N, Yalcin S. The help guide to cerebral palsy. Global HELP Organization. 2005.



Support

- Hand trajectories became smoother and less variable with age.
- Immature patterns of reaching were characterised by increased variability in younger compared to older children.
- Only children between 8 and 10 years old had variability similar to adults.
- Schneiberg S, Sveistrup H, McFadyen B, McKinley P, Levin MF. The development of coordination for reach-to-grasp movements in children. *Exp Brain Res*. 2002 Sep; 146(2): 142-54.



Support

- Clinical assessment does not provide objective and quantitative evaluation of the upper limb function.
- Based on instrumental gait analysis a upper limb protocol for three-dimensional motion analysis has been developed.
- The aim of this study is to evaluate the results of instrumental upper extremity motion.



Support

- 3-D kinematics detected deficits in timing, ROM, and proximal compensatory strategies during upper-limb functional task performance in children with hemiplegia.
- Mackey AH, Walt SE, Stott NS. Deficits in upper-limb task performance in children with hemiplegic cerebral palsy as defined by 3-dimensional kinematics. Arch Phys Med Rehabil. 2006 Feb; 87(2):207-15.



- **Inclusion criteria:**
- Ambulatory children with a diagnosis of spastic quadriplegic or hemiplegic CP aged between 6 and 18 years.



- Exclusion criteria included:
- Previous upper limb surgery or botulinum toxin injections within the last six months
- Any disabilities that would make it difficult for the child to understand the study or cooperate fully.



Gross Motor Function Measure (GMFM)

- Palisano et al. (1997) and Wood and Rosenbaum (2000) have both reported good to excellent interrater reliability for 'severity' of gross motor function limitations in children with CP using the GMFCS.

| <i>Level</i> | <i>Description</i> |
|--------------|--|
| I | Walks without restrictions; limitations in more advanced gross motor skills |
| II | Walks without assistive devices; limitations walking outdoors and in the community |
| III | Walks with assistive mobility devices; limitations walking outdoors and in the community |
| IV | Self-mobility with limitations; children are transported or use power mobility outdoors and in the community |
| V | Self-mobility is severely limited even with the use of assistive technology |



Modified Tardieu Scale

- The modified Tardieu scale was used in upper limbs to assess the spasticity over biceps and triceps muscles.



Upper Limbs

Children with

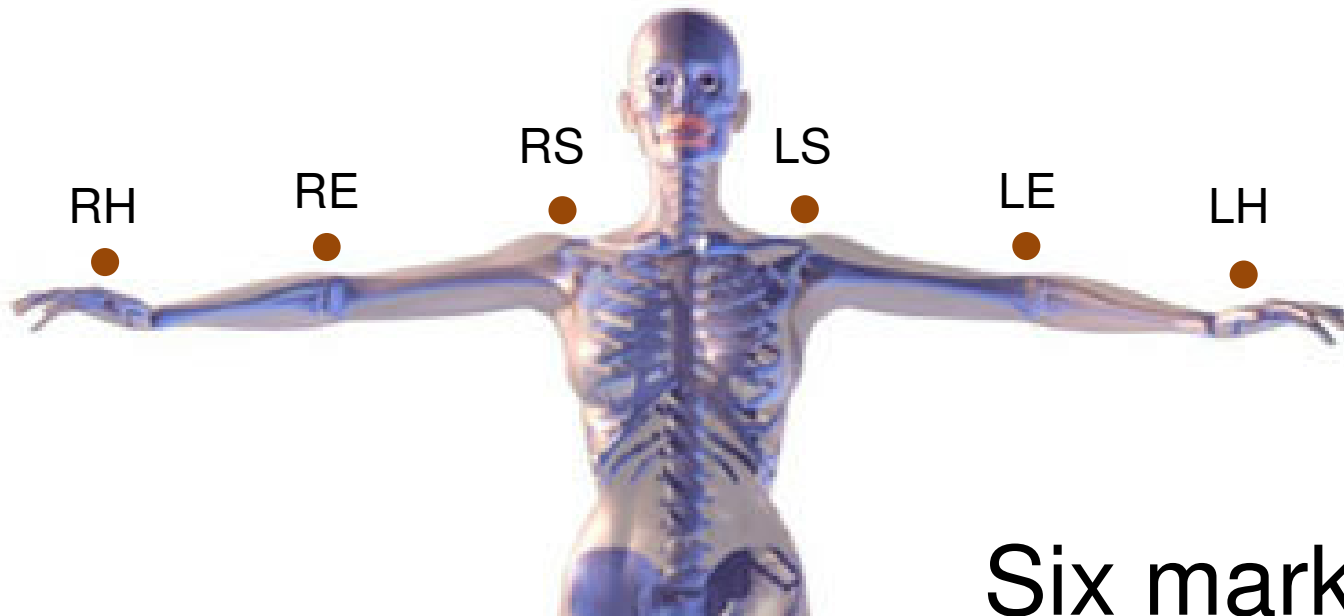
Neuromusculoskeletal disorders



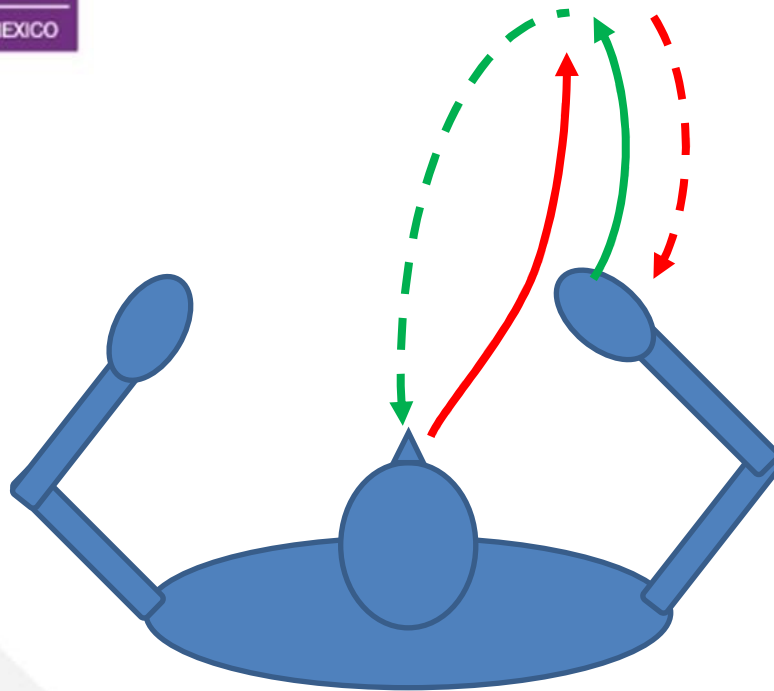
Main objectives

Measurement

1. Functional Status
2. Rehabilitation Outcomes



Six markers



- T1
- - - T2
- T3
- - - T4

$T1 + T2 + T3 + T4 = 1 \text{ cycle (100\%)}$



4 channels

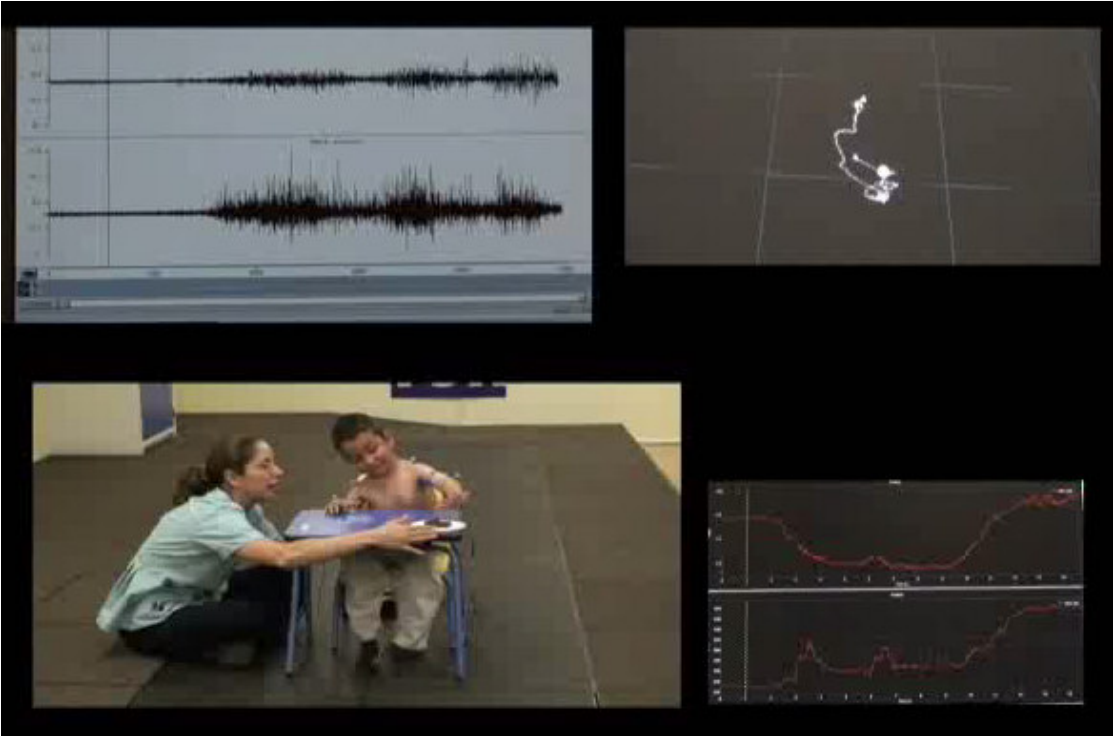
EMG

Biceps Brachii
Triceps Brachii



Hand

Distance (m)
Time (s)
Velocity (m/s)



Elbow joint

Flexion-Extension (deg)
Angular velocity (deg/s)

EMG



| | |
|------------------|----|
| Quadripareisis | 15 |
| Tripareisis | 3 |
| Dipareisis | 4 |
| Hemipareisis | 23 |
| Monopareisis | 4 |
| Myelomeningocele | 1 |
| Syndromes | 2 |

N=52



Hemiparesis

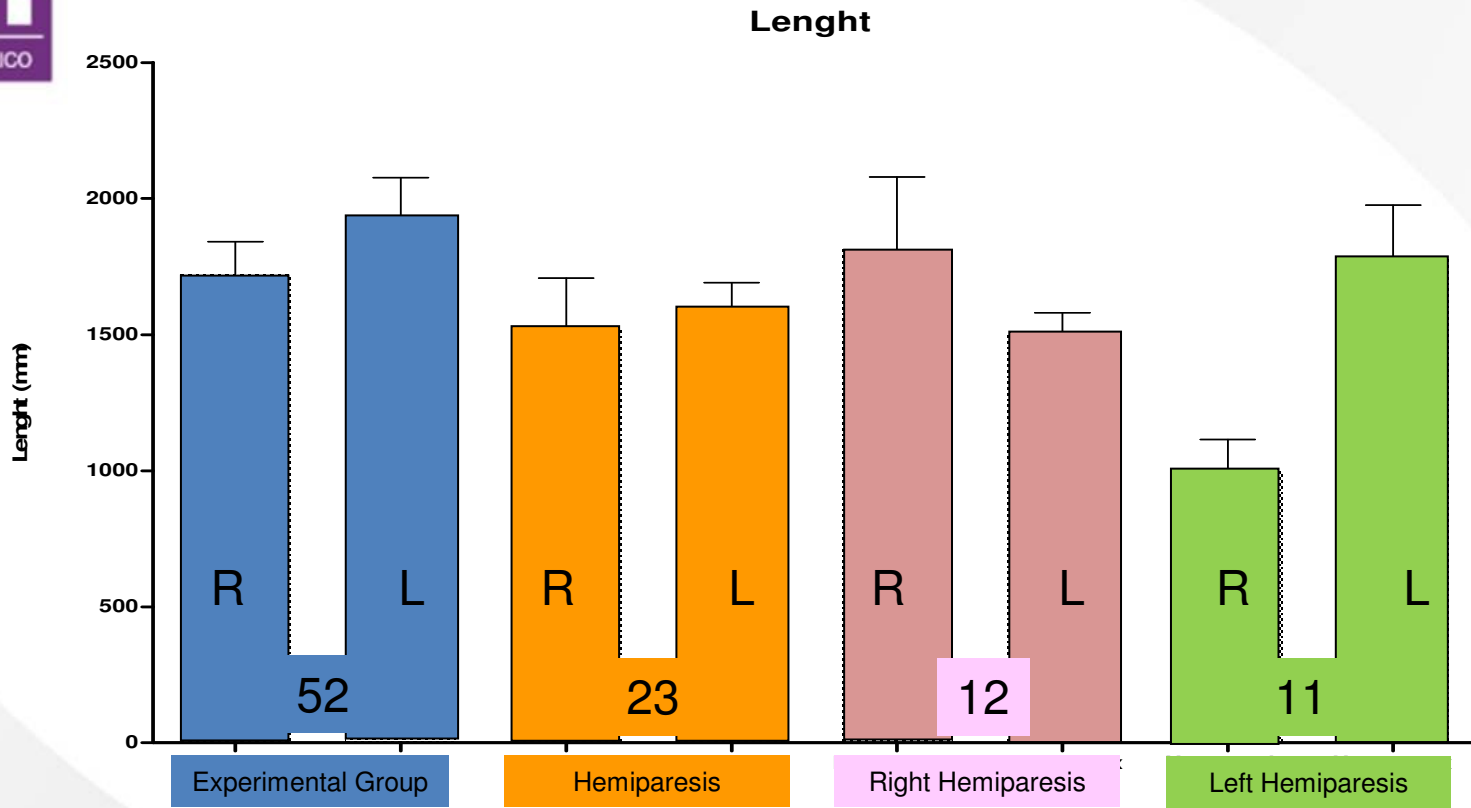
N=23

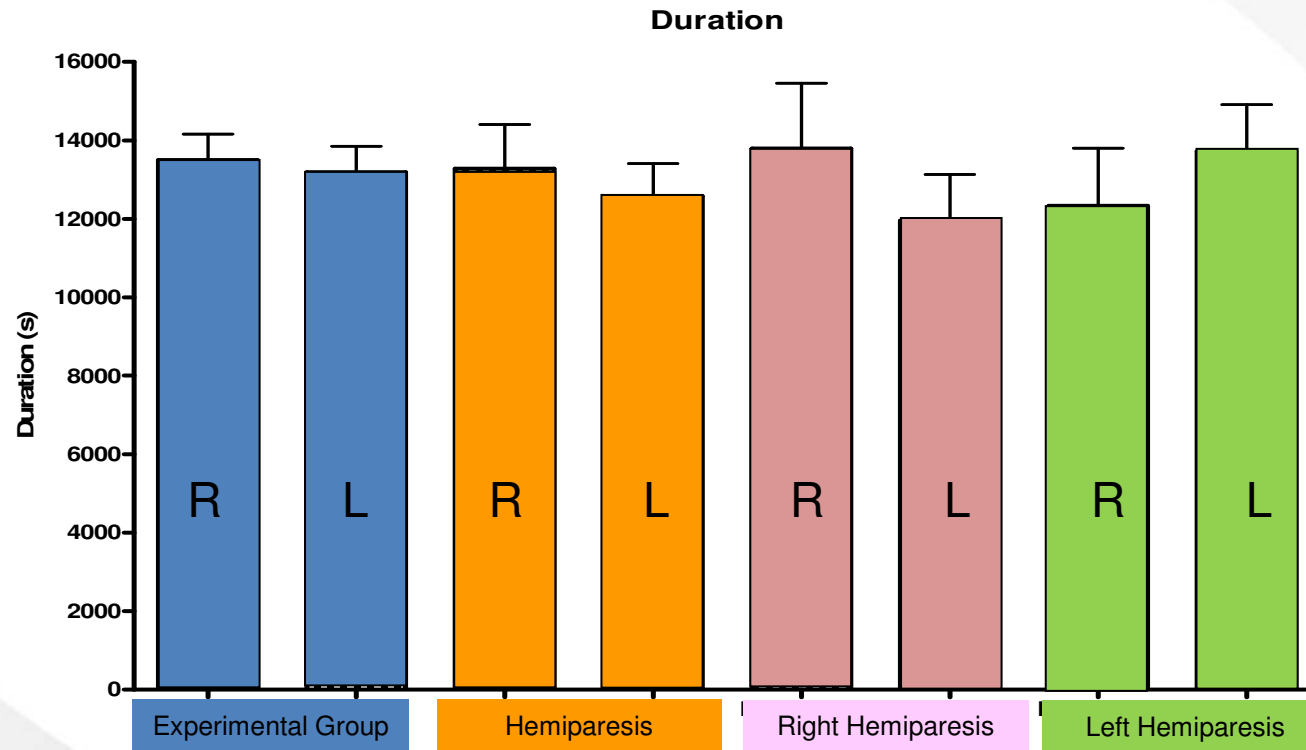
| | Age | Weight (kg) | Height (cm) |
|------|------------|--------------------|--------------------|
| Mean | 7.5 | 29.3 | 124.5 |
| SD | 5.0 | 19.5 | 30.5 |
| Max | 16.0 | 65.00 | 181.0 |
| Min | 1.0 | 9.00 | 83.0 |



Right Hemiparesis 12

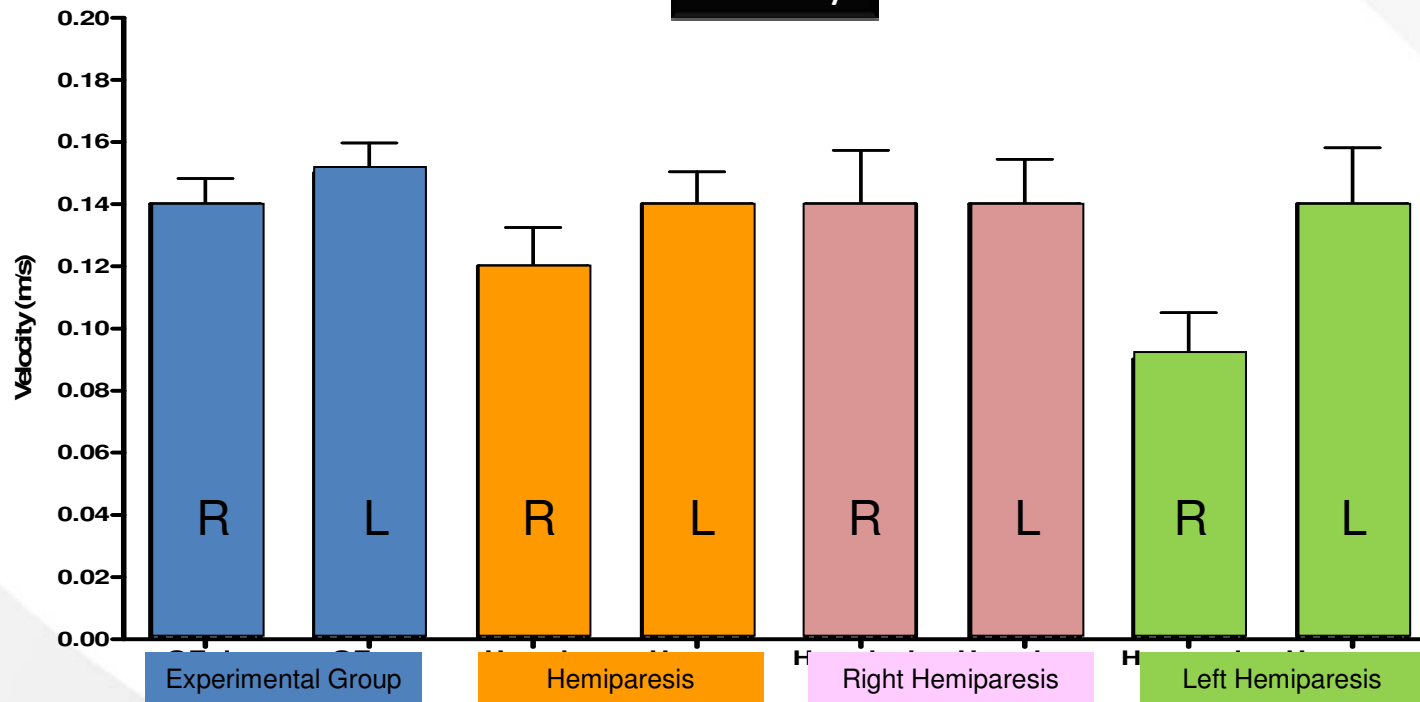
Left Hemiparesis 11





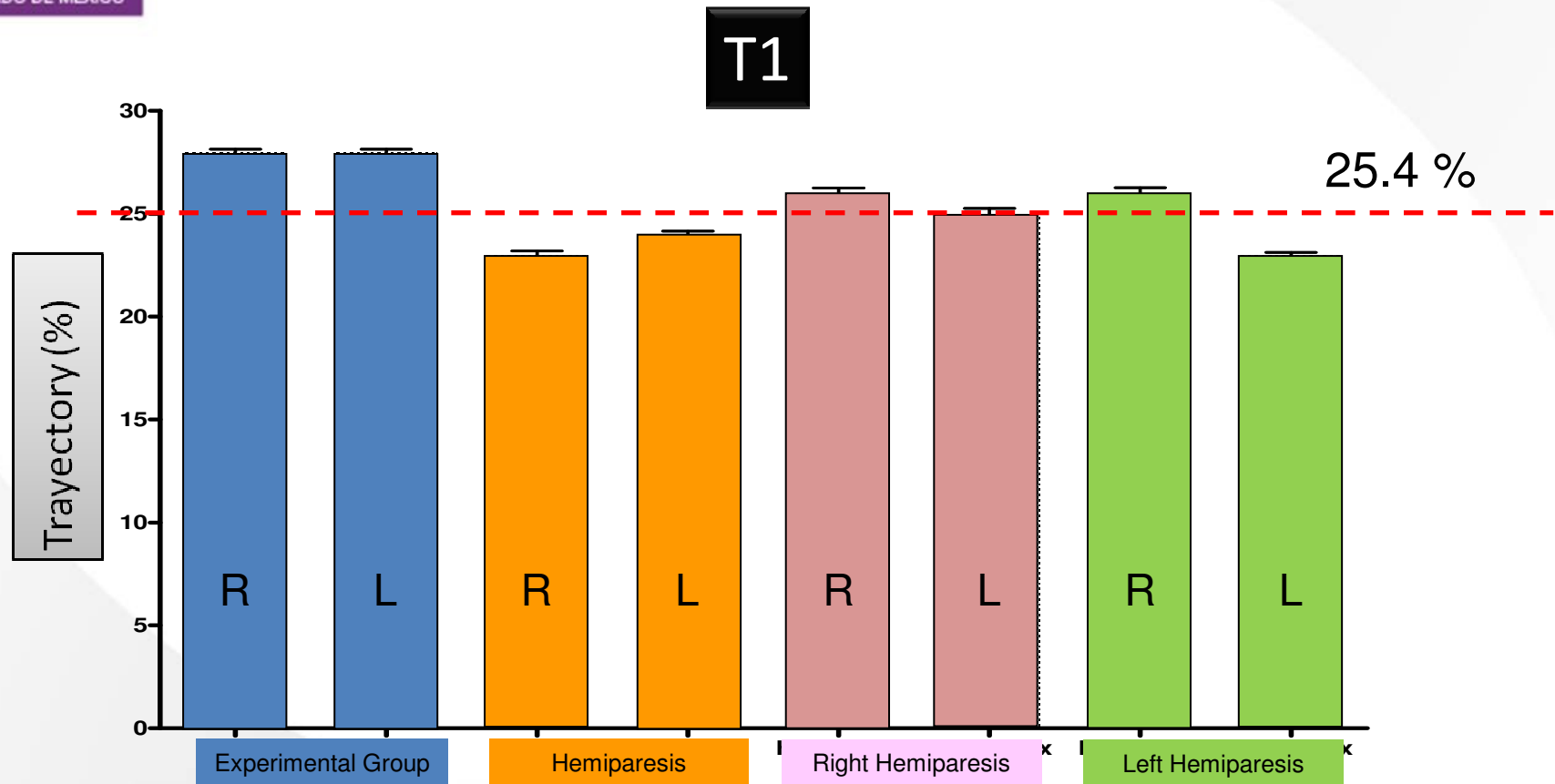


Velocity





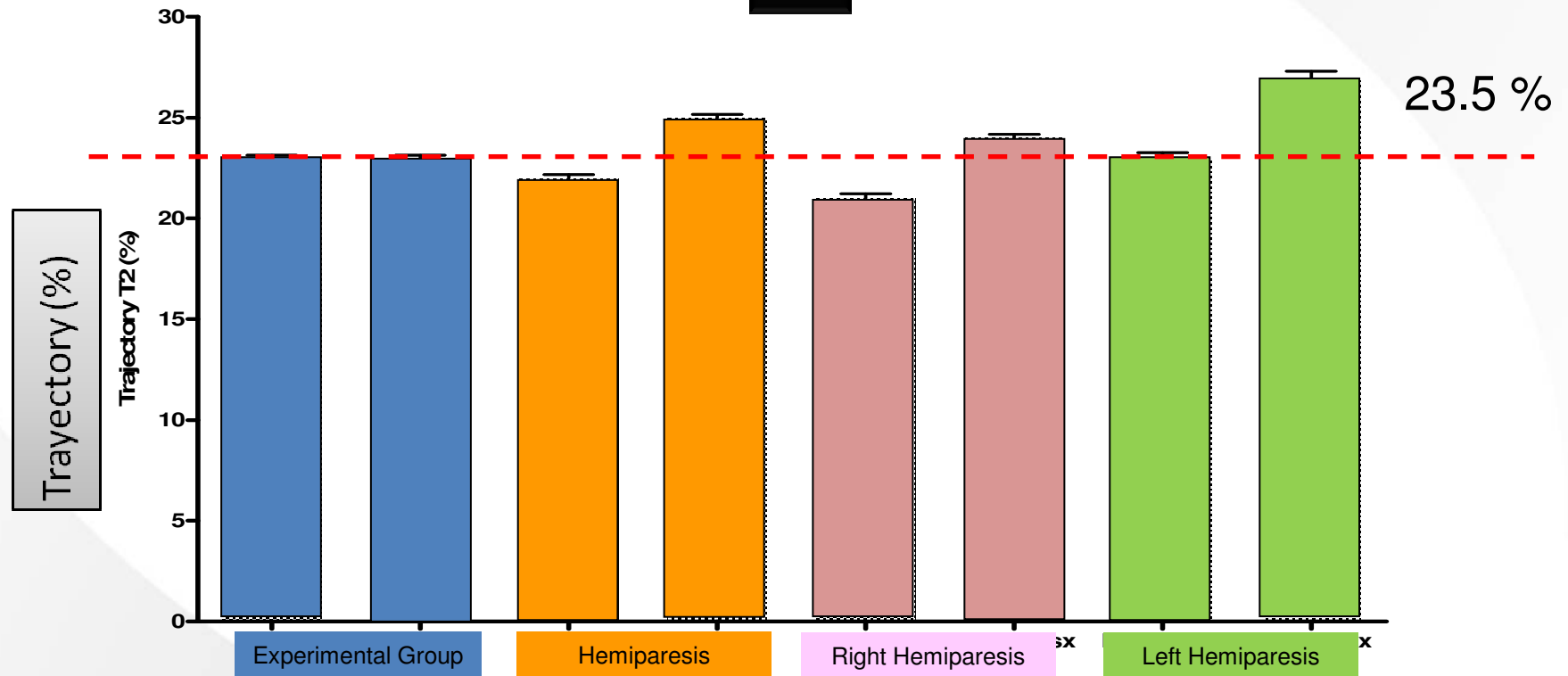
Relative proportion (%) of cycle of the movement





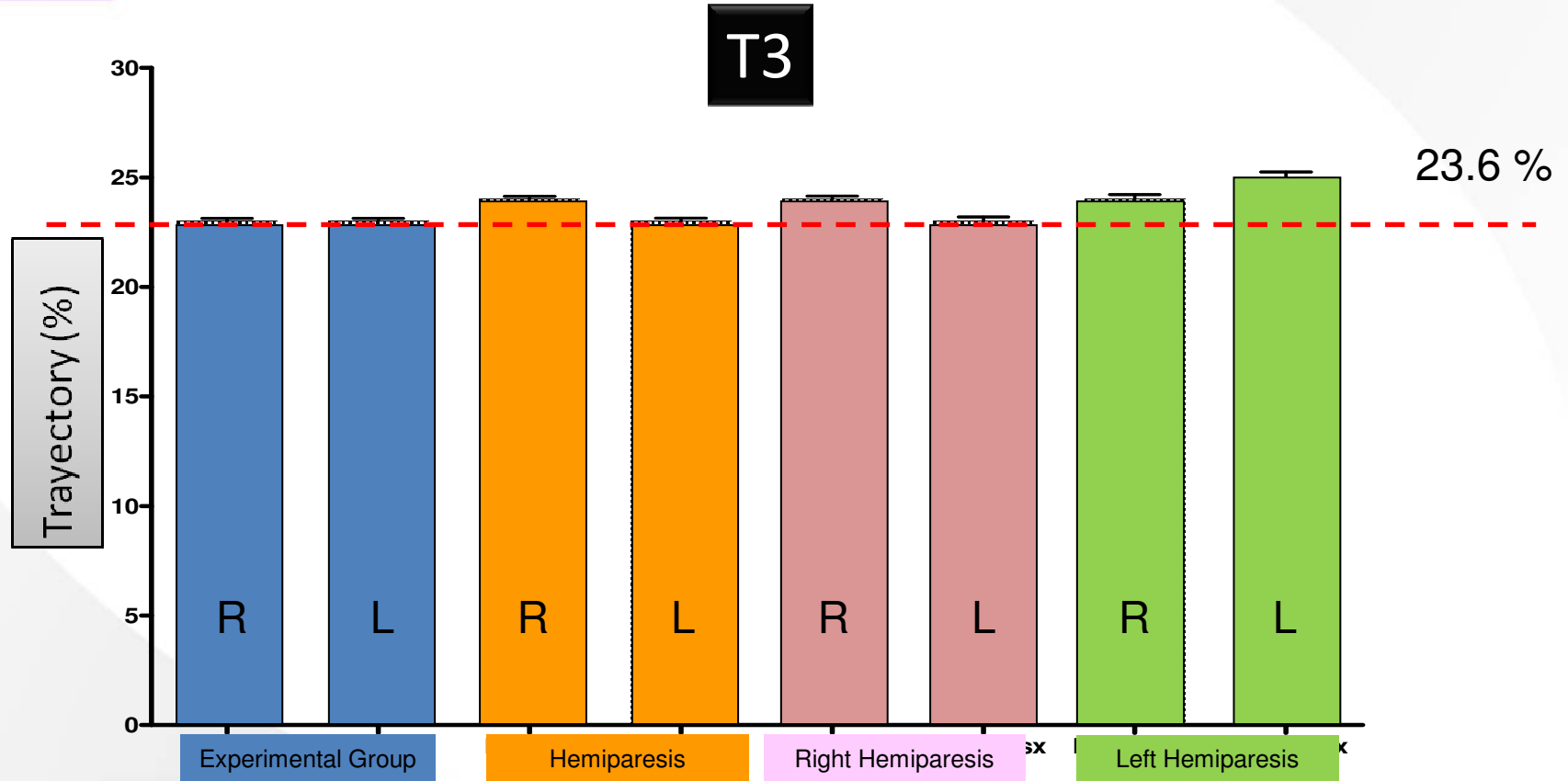
Relative proportion (%) of cycle of the movement

T2





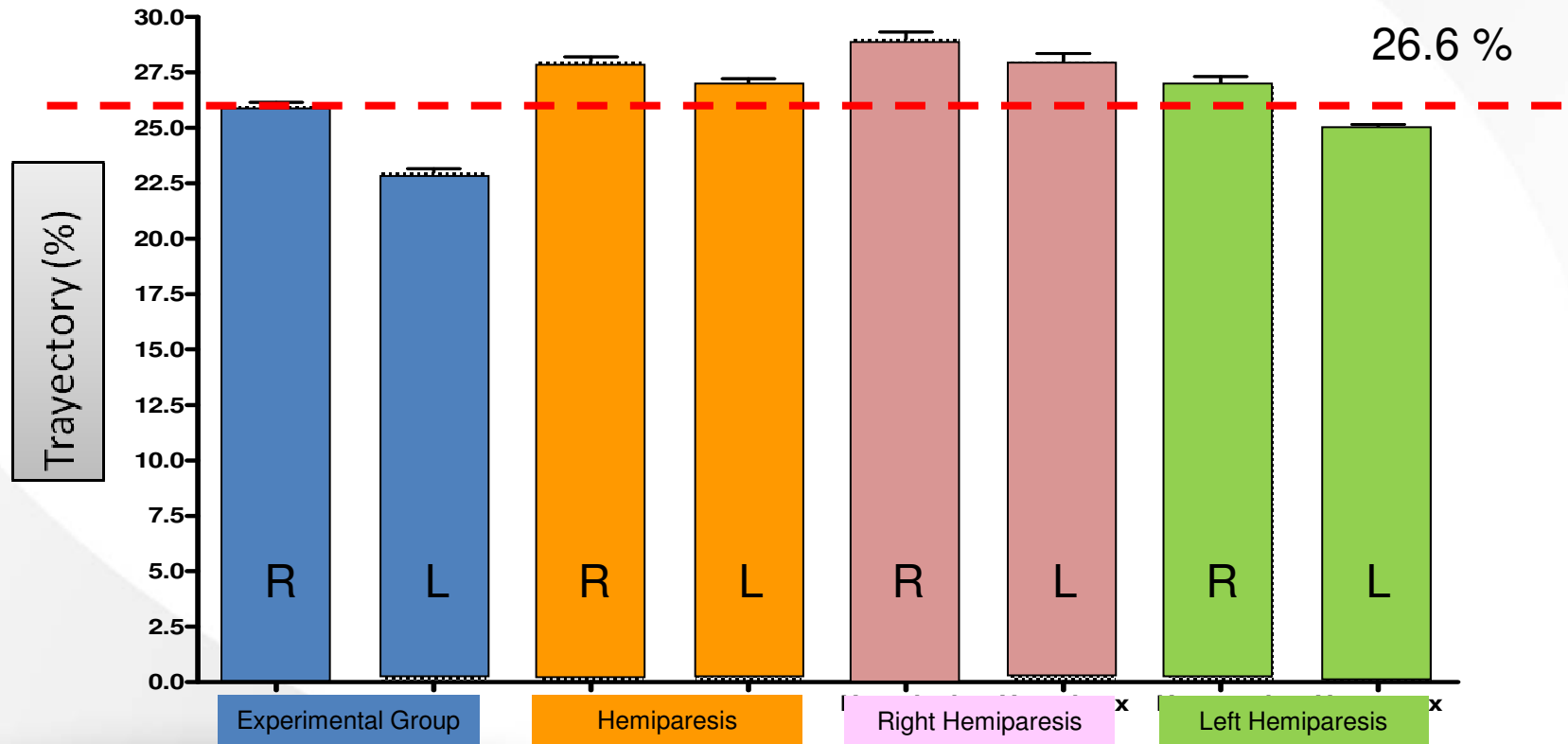
Relative proportion (%) of cycle of the movement





Relative proportion (%) of cycle of the movement

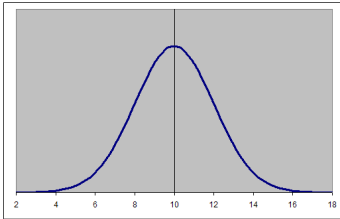
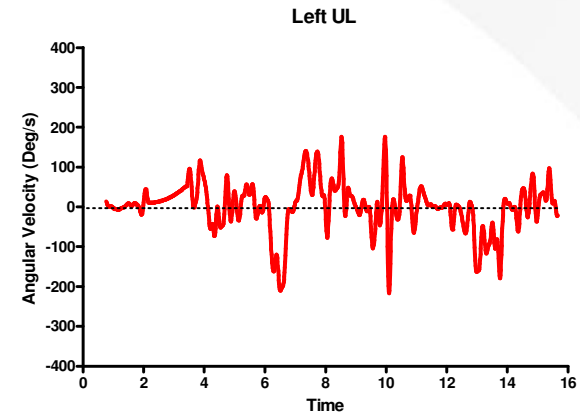
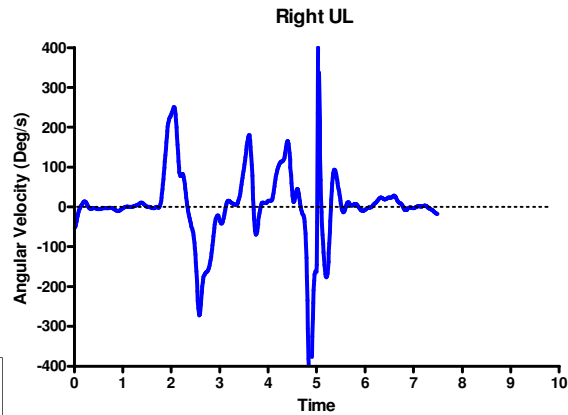
T4



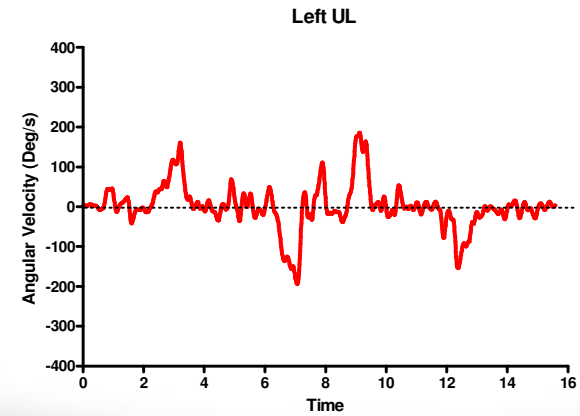
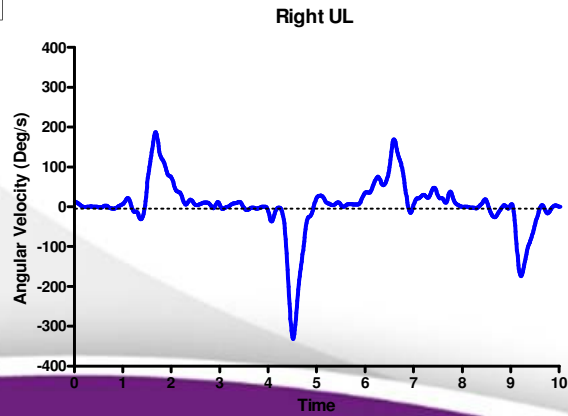


Angular Velocity Joint Elbow

Before Treatment

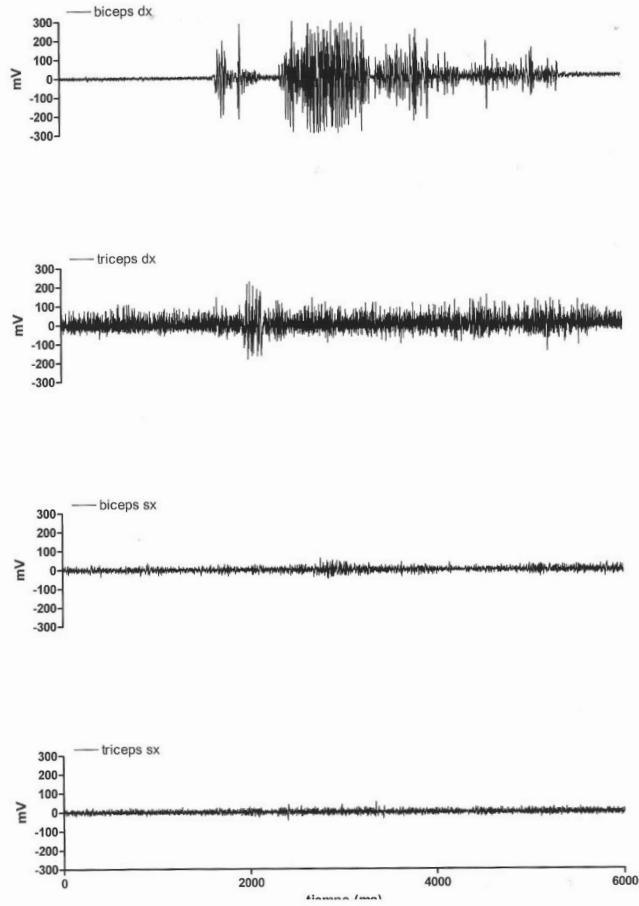


After Treatment

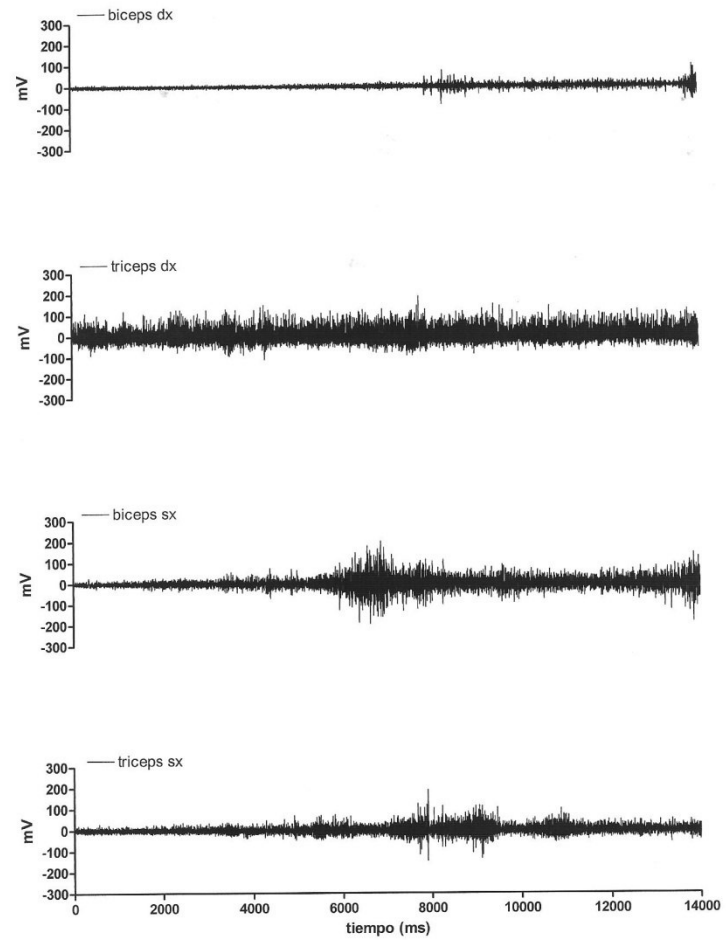




0280xc02-EMG-Derecha



2080xc.pzf:2080xc06-ermg-sx - Wed Aug 06 13:06:55 2008
2080xc06-EMG-Izquierda





Centro de Rehabilitación Infantil TELETON
Laboratorio de Análisis de Movimiento

2013xd03 Movimiento Mano Derecha

| | | |
|----------------------------|------|-----|
| Longitud | 1433 | mm |
| Duración Trayectoria total | 8340 | ms |
| Velocidad m/s | 0.17 | m/s |

Movimiento Mano Derecha

| | tiempo (s) | | duración (s) |
|------------------------------------|------------|---------------------|--------------|
| Inicia movimiento hacia objetivo | 1.52 | T1 | 0.83 |
| Alcanza el objetivo | 2.35 | T2 | 0.66 |
| Inicia el movimiento hacia la boca | 2.62 | T3 | 0.60 |
| Alcanza la boca | 3.28 | T4 | 0.45 |
| Inicia el regreso al objetivo | 4.36 | tiempo total | 2.54 |
| Alcanza el objetivo | 4.96 | | |
| Inicia regresa al origen | 5.62 | | |
| Alcanza el origen | 6.07 | | |

T1 duración del trayecto de origen a objeto

T2 duración del trayecto de objeto a boca

T3 duración del trayecto de boca a objeto

T4 duración del trayecto de objeto a origen



Centro de Rehabilitación Infantil TELETON
Laboratorio de Análisis de Movimiento

Reporte

Fecha: Febrero 4, 2009

Datos del Paciente

Paciente: Alan Salarich Sandoval (19473)
Diagnóstico: Hemiparesia Derecha
Edad: 4 años
Peso: 15 kg
Altura: 103 cm
Fecha de Estudio: Octubre 22, 2008
Número de archivo: 2013xd03, 2213xd06
Protocolo: MmSs

Médico Acompañante: Dra. Eloísa Sánchez Zúñiga
Médico Interno LAM: Dr. Juan Carlos Moreno Pérez

Informe:

Tipo de Estudio: Cinemática de Miembros Pélvicos
Comentarios: _____



Future Work

