




**European Society of Movement Analysis
for Adults and Children**


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Gait Lab review:
Evaluation of Gait Lab clinical data

Course TRAMA Project
September 20th 2007







Gait lab review

Gait Analysis Lab


IRCCS San Raffaele,

Tosinvest Sanità ,Rome, IT

Amsterdam , 28 Sept. 2006

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Introduction

The Pediatric Dept and the Gait Analysis Lab presentation

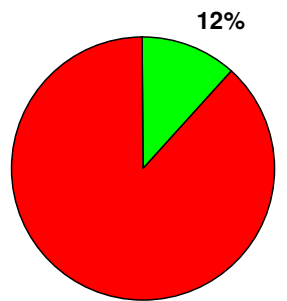


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...some data of the Pediatric Rehabilitative Dept

- From June 1997




88%
■ Hospital Stay Children
■ Day Hospital Children



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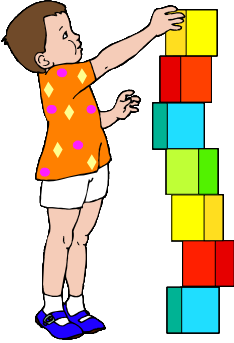

Evaluation of each patient: interdisciplinary approach

Neurological

Psychological

Speech evaluation

Medical



Pedagogical


Biomechanics

Rehabilitation Therapist


Physiatrist and orthopedist

Paediatric


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The Gait Analysis Lab was born thanks to the scientific collaboration between




Gait Analysis Lab


Develop. Disabilities Rehabilitation and Prevention Medicine Department

IRCCS San Raffaele Pisana

ROME, IT

www.sanraffaele.it






Gait Analysis Lab

Bioeng. Dept.


Politecnico di Milano

Italy

www.movlab.it




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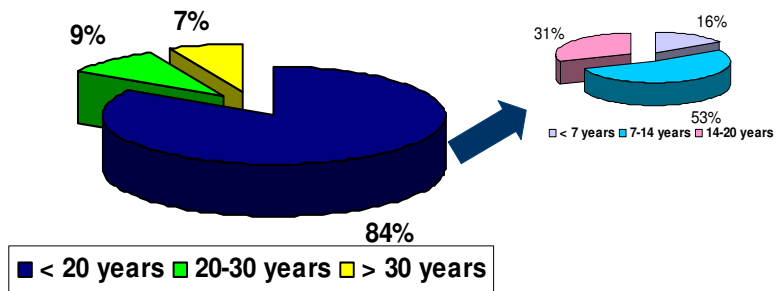
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Some data of the GAL

N. patients evaluated in the Gait Lab (from 1997): 2125

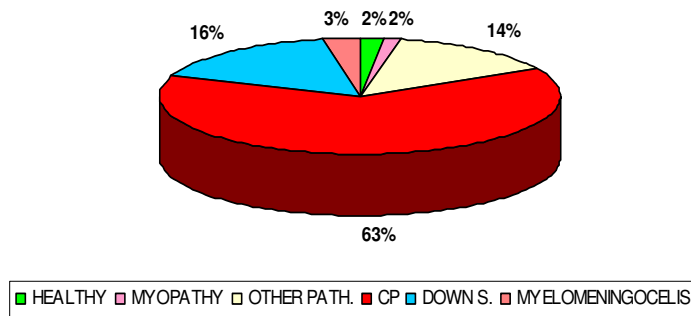
Age of evaluated patients



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Pathologies evaluated at the Gait Lab



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The staff of GAL

- ✓ **Director**
Prof Giorgio Albertini , Neurologist

- ✓ **Tecnical director**
Eng., PhD , Manuela Galli , Researcher
Bioeng Dept, Politecnico di Milano

- ✓ **Tecnician**
Mr. Nunzio Tenore, Physiotherapist

- ✓ **Physicians**
Dr Gabriella di Girolamo,
Dr Claudia Condoluci,...



- ✓ **Orthopedists**
Dr. Francesco Costici,...



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The equipment of GAL

- ✓ 12-camera optoelectronic system (ELITE2002, BTS, Italy)
- ✓ 2 force platforms (Kistler, CH)
- ✓ 2-camera video system (BTS, Italy)
- ✓ 1 telemetric EMG units (16 channel) (Pocket EMG, BTS, Italy)
- ✓ Baropodometric system (FScan system)



Used protocol
Helen Heyes Marker Set

R. B. Davis, "A gait analysis data collection and reduction technique,"

Hum. Mov. Sci., vol. 10, pp. 575-587, 1991.


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The case report D.C.

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Patient 's Presentation

- ✓ **General data:** birthday 09/07/1990 ,female, spastic diplegia, unknown etiology
- ✓ **History :** Normal maternal pregnancy, birth at 40 weeks of pregnancy, weight 3750g, younger of 3 brothers. Walking onset age : 13 months. Arrived at IRCCS San Raffaele at 1992 and followed with periodic visits (approximately one for each year).
- ✓ **Previous treatments :**
1994 Bilateral Achilles Tendon lengthening.
1999 Bilateral Achilles Tendon, Psoas, Hamstrings tenotomies , tranfer Rectus Femoris .
- ✓ **Rehabilitation program:** approximately 2 times a week at home. Rehabilitation program:
Puccini –Perfetti.

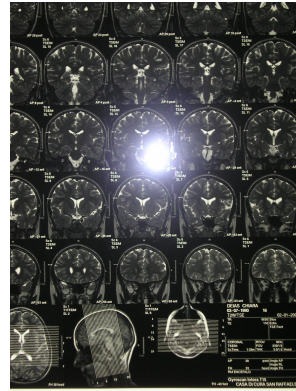
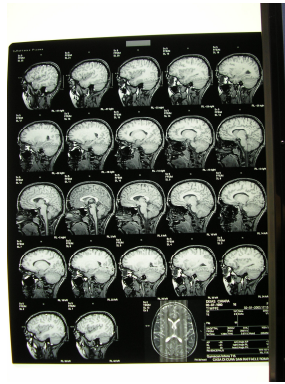
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Patient 's Presentation

Neurological situation



MRI evaluation at 1997: negative



MR results: no significant alterations
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Patient 's Presentation

- ✓ Cognitive evaluation: "WISC" test modified for children WISC - R (last evaluation at 2004)

Verbal score	70
Performance score	44
Total score	114

- ✓ WISC-R results: negative, good results mainly in verbal test



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Evaluation at 27/05/2006

- ✓ **Aim of the evaluation:** a multifactorial evaluation of actual general condition after the puberty development (age: 15y+10m) in order to evaluate the necessity for new treatments (on bone or soft tissue surgical treatment ??). Last multifactorial evaluation on 2005 (Gait Analysis included).
- ✓ **General remarks:** good general conditions, good social activity, no particular problems respect the previous visit (18/06/2005).
Gait characterized by a left limb intra-rotation. She suspended the therapeutically program during the last year. She walks outside the home for community distances, she is independent .

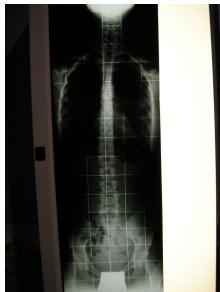


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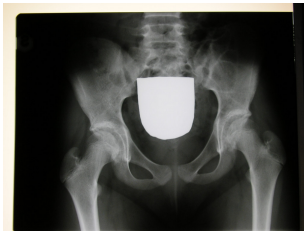


Clinical evaluation, 27/05/2006

XR evaluation: Rachis and Pelvis



Posterior view



Lateral view

✓XR results: vertebral column in axis without scoliosis, pelvic obliquity down on the left side with an entity of 1.5 cm (less on left respect to right) . No alteration in sagittal plane. The situation remains unchanged respect to previous evaluation (last XR evaluation in 2005).



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Physical assessment



Video of physical assessment

✓ Physical assessment in supine position : good range of motion of hip and knee joint . Good position of the lower limb in supine position. During passive movement high rigidity in both ankle joints (more on right) . Hyperactivity of Left Tibialis Posterior.

✓ Physical assessment in sitting position: limited range of ankle joint during active movement , more evident on right side (max dorsi-flexion angle: 3 degr right vs 15degr left) . Inability to separate during the test in sitting position the movement of the right foot and the left (cross talk).

✓ Gross Motor Function Measure: 68.6 /100.

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Gait by observation



Video gait assessment

✓ In standing position : slight shoulder posterior tilt , upper limb normal, shoulder obliquity down on the left side. Feet cavus both sides, inability to maintain the toe standing , slight knee hyperextension more evident on the left side.

✓ Gait by observation : independent ambulatory . Short stride length. Alteration on the ankle joint movement in both sides. Intra- rotation of the whole left side . On the right side , foot drop . Light compensation with the pelvis and with the trunk.



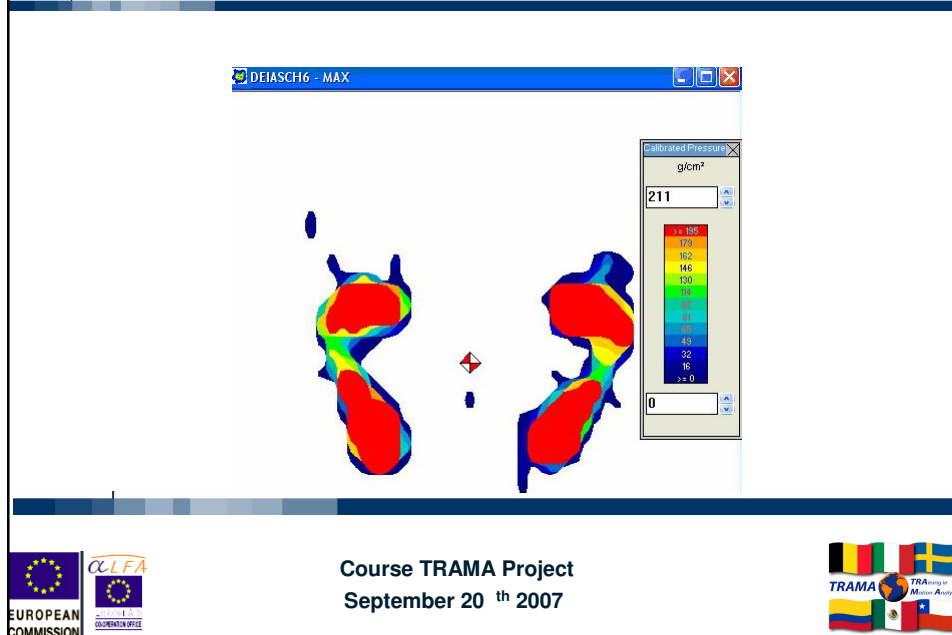
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Instrumented evaluation of feet





QUANTITATIVE 3D GAIT EVALUATION

✓ Experimental description:




- Multifactorial acquisition of kinematics, kinetics, surface emg (Tibialis Anterior, Lateral Gastrocnemius , Rectus Femoris, Biceps Femoris Caput Longus,) and video.
- Acquisition right versus left (kinematics, kinetics and EMG), self selected speed, barefoot.
- Composite Average Normal Selected for comparison: teenagers control group patients (age range: 12 - 18 years).


 **Gait Analysis evaluations :video and 3D reconstruction**



 

Video synchronized with kinematics, kinetics and Emg

3D skeleton reconstruction
(trial. 2782xa06.Ric)

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 **Gait Analysis results: Right Vs Left**

Kinematics and Kinetics

Emg

Trial n. 2782xA06 (pdf format)

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Gait Analysis data evaluation: consistency



Right vs Right vs Right vs Right

Left vs Left vs Left vs Left

Trials n. 2782xA04, 2782xA05, 2782xA06, 2782xA07

(pdf format)

✓ Main considerations: high consistency both in kinematics and kinetics patterns



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Gait Analysis data evaluation: mean curves



Mean of n. 2782xA04, 2782xA05, 2782xA06, 2782xA07

(pdf format)



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Gait Analysis data evaluation: GGI

Gillette Gait Index (formally Nomalcy Index):

75.9 ± 9.9 (vs 16.36 ± 8.6 of Composite Average Normal)

Right: 73.31 ± 5.9

Left: 78.67 ± 7.2

- ✓ Main considerations on GGI :
higher values on Left side (not significant different from Right side).



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Gait Analysis main observations

✓ Spatio/temporal parameters: reduced walking velocity and cadence , reduced step and stride length , increased step width bilaterally.

✓ **Off-set angles** (standing evaluation): hip intra-rotated bilaterally, hyperextension of knee more evident on the left side. Slight shoulder obliquity down on the left side.

✓ Kinematics:

Ankle and foot: On Right side ankle joint plantarflexed at initial contact, reduced dorsiflexion in mid stance, absence of dorsi-flexion recovery (foot drop) during swing. On left side ankle joint dorsiflexed in stance with a reduction of plantar flexion during terminal stance. No dorsi-flexion during swing. Left foot intrarotated. Right side quite normal.

Knee: at Initial contact knee flexed, slight hyperextension more evident on the left side during mid stance. Delayed timings of knee patterns.

Hip : hip abducted and intrarotated . Hip flexion extension normal.

Pelvis: light double bump in pelvic tilt bilaterally, increased range of motion on pelvic obliquity. Increased ROM on pelvic rotation, more intra-rotated at initial contact in the left side.



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Gait Analysis main observations

✓Kinetics: reduced and delayed push off ability in both ankle joints. Absence of dorsiflexion moment in first rocker ankle joints , absence of knee extension moment in stance, abnormal mediolateral CoP pattern on the left side and alteration on anterior posterior CoP pattern in both sides .

✓EMG : Prolonged co-contraction between Rectus Femoris and Biceps femoris during stance bilaterally. Absence of phasic muscular activity of L Rectus Femoris during all the gait cycle. On R side co - contraction of Anterior Tibialis and Gastrocnemius Lateralis . R Gastrocnemius activation during swing. On left side weakness on Gastrocnemius Lateralis during all gait cycle, quite normal Tibialis Anterior.



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Main conclusions

Treatment suggestion :

From the gait analysis outcomes and clinical evaluation results the staff suggested to test the effect of Botulinum Toxin injection on LEFT Tibialis Posterior .

This could be considered like a temporal simulation of the spasticity reduction of Left Tibialis Posterior and a first step in order to program a future treatments (surgery on soft or bone tissues,..)

The staff requires a Gait Analysis evaluation within the first month after the BTX injection .



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***Gait Analysis Lab of IRCCS San Raffaele
thanks to ESMAC Gait Lab review.***



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