DEVELOPMENTAL DISABILITIES IN ADULT AGE:

GAIT ANALYSIS AND RESEARCH

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IRCCS San Raffaele Pisana – Tosinvest

Rome, Italy

Santiago, 13 march 2008

LIVE EXPECTANCY IN DEVELOPMENTAL DIASABILITIES

IS CONTINUOSLY GROWING

- new clinical problems
- needed for new research

GAIT ANALYSIS IN ADULT AGE
Santiago, 13
march 2008

IRCCS SAN RAFFAELE

Child Adult Aging
Developmental Center

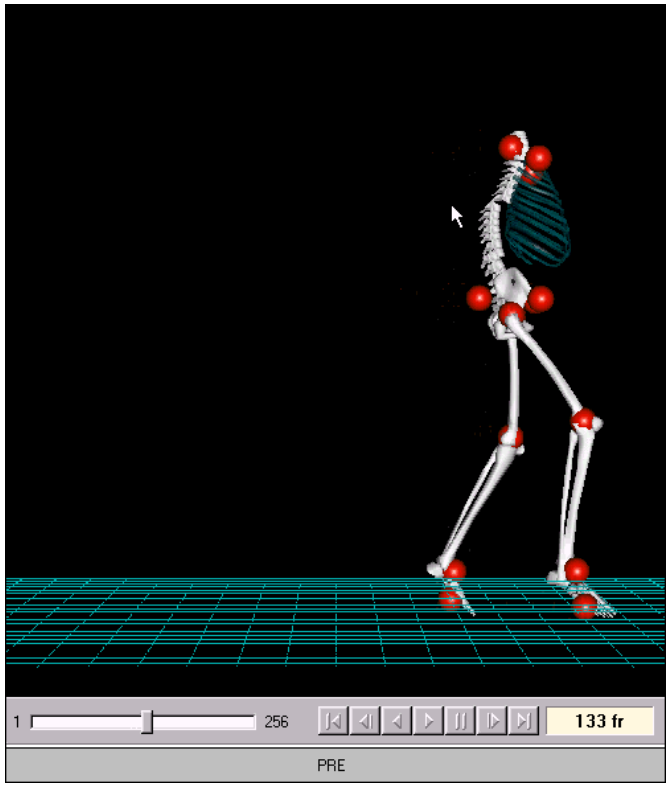
- Missions of the Center:
  - Follow-up Developmental Disabilities in a Lifespan Perspective

- Missions of the Center (2):
  - clinical assistance and treatment of people with developmental disabilities.
  - research in the field of developmental disabilities

- ACTIVITY
  - About 500 in-patients with DD/year
  - About 2500 people with DD/year at the evaluation day-hospital
  - About 100 children for regular rehabilitation treatment

- The Department equipment (1)

- Gait lab

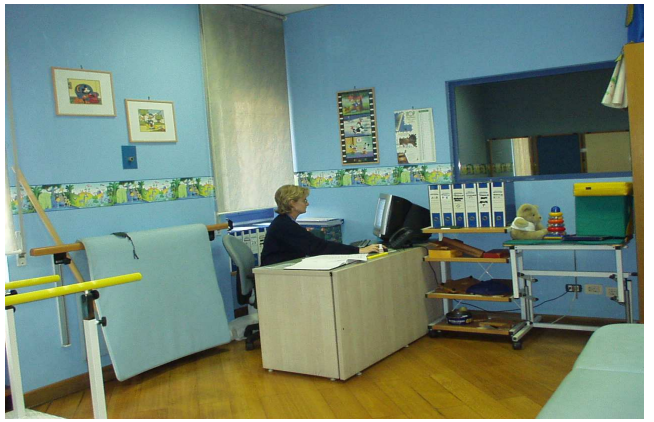


The Department equipment (2)

- Ophtalmologic lab
- Neurofisiology lab:
  - EEG, video EEG, poly-somnography
  - EMG
  - Evocated potentials:
    - visual,
    - uditory,
    - somesthetic

The Department equipment (3)

- 4 gyms for motor rehabiltation
- 3 rooms for speech-therapists
- 2 rooms for Psycologists
- 1 room for psychomotricist
- 1 room for informatic activity
- 14 PC in an intranet connection

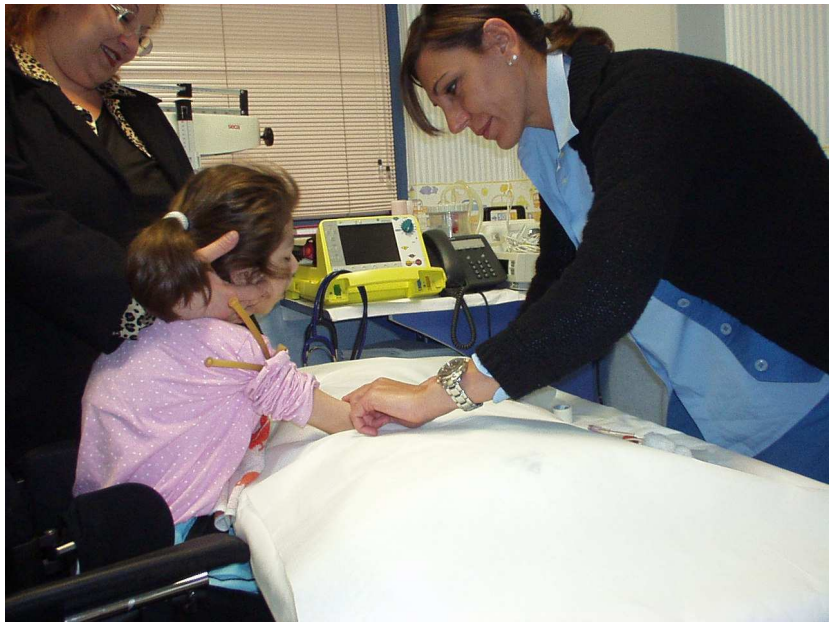


The San Raffaele equipment (1)

- Echocardiography
- Radiology:
  - X-ray
  - TC
  - MRI
  - Echography
  - Echo-doppler

- The San Raffaele equipment (2)

- Audio-phonology lab
- Vestibology lab
- Idro-therapy
- Blood sample lab



- Theoretical model:
  - Cerebral plasticity
  - Systemic theories
  - Environment

Cerebral plasticity

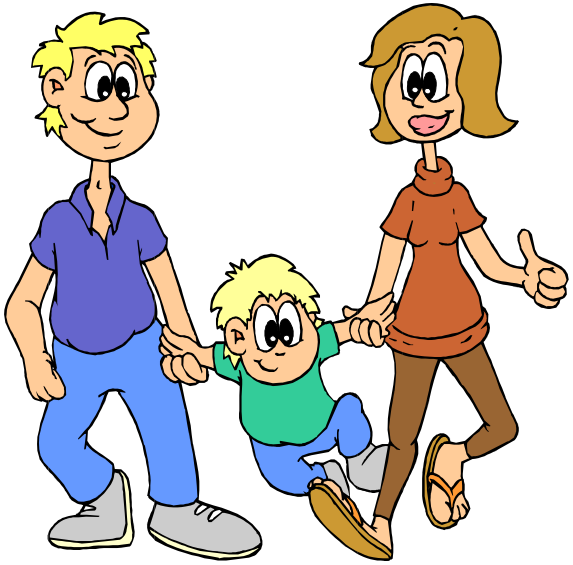
- The brain is genetically programmed for plasticity.

Cerebral plasticity

- It offers the child the possibility to develop lots of competences.
- It happens if environment and education, family and school, are creative, promote an active role of the child, offering a broad spectrum of experiences.

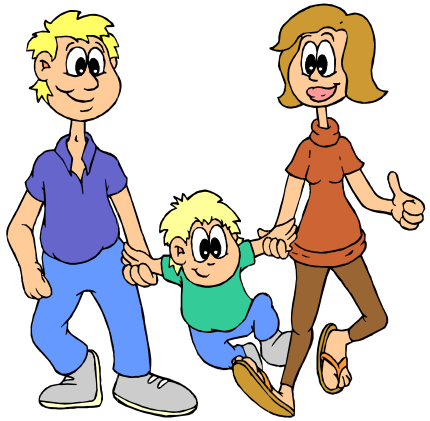
ENVIROMENT/BRAIN

THE BRAIN IS GENETICALLY PROGRAMMED FOR PLASTICITY



BRAIN AS A PART OF A SYSTEM (Edelman)

BRAIN – DEVELOPMENT - ENVIRONMENT



- New scientific evidence led us to extend Edelman and Systemic Theories from infancy to the other phases of life (adolescence, youth, adult age, aging).

Developmental disabilities

-Intellectual disabilities (with-without etiological diagnosis)

-Down syndrome

-Cerebral palsy

-Other genetic disorders

-Behavioural problems

First steps

- different approach according to diagnosis
- evaluation of the developmental level
- planning of treatment

Developmental disabilities and health

The clinical protocols

The staff (1):

- pediatrician
- neurologist
- orthopedic
- physiatrist
- child neuropsychiatrist
- ophtalmologist
- dentistry
- orthoptist
- epileptologist
- dermatologist
- endocrinologist
- urologist
- .....

The staff (2):

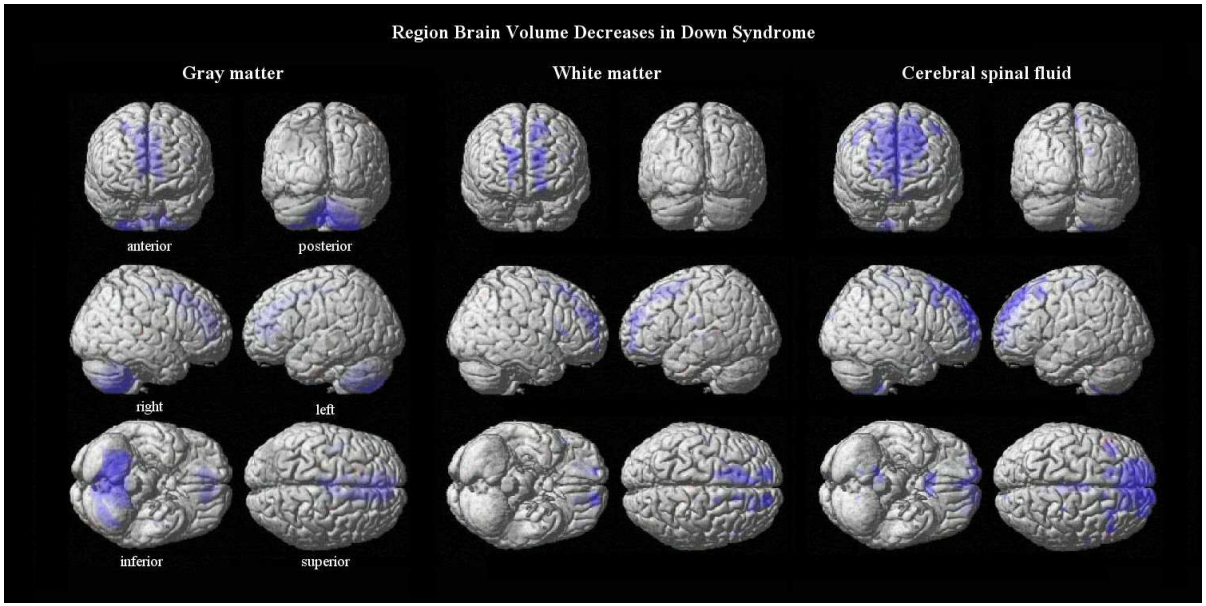
- psychologists
- speech therapists
- motor therapists
- educators
- informatics
- music therapists
- developmental psycho-motricists
- bio-engineer
- molecular biologist

Research activity

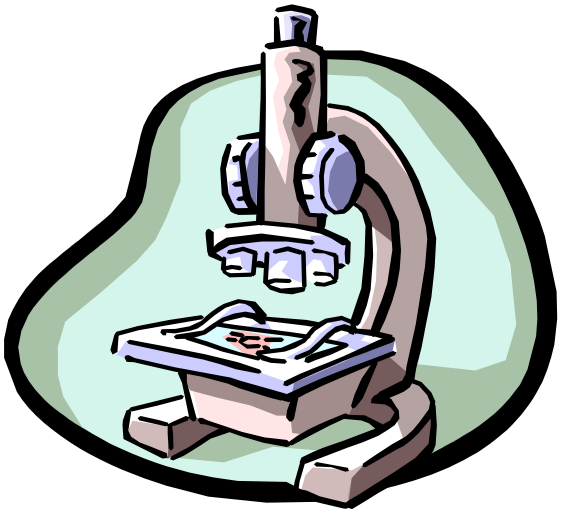
- All the staff is involved in the research activity
- Clinical research
- Basic research

- Person centred evaluation in a multi-disciplinary, life span perspective: proposal of an experimental battery. From a problem centred clinical database to the person centred clinical database.

- Magnetic resonance imaging volumetry of the hippocampus, amygdala, and frontal lobe in Down syndrome patients

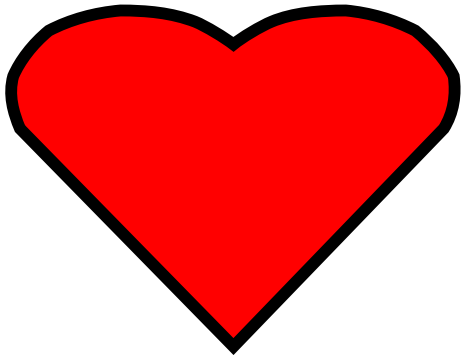


- Pharmacological profile of young adults and adults with Down syndrome and depression.



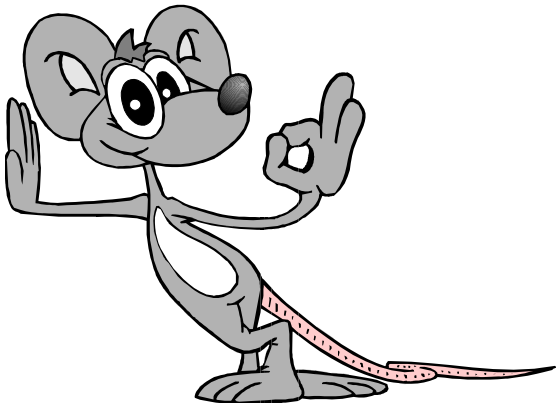
- Quality of life of persons with intellectual disabilities

- Down syndrome and heart
  - Cardiovascular risk factors
  - Heart rate variability in adolescents and young adults



- Proteomic approach to mouse model of Down syndrome

- Relationship(s) between learning/memory deficits and developmental neuronal plasticity in a model of Down syndrome-the Ts65Dn mouse



- Neuronal, cellular and molecular defects in Down syndrome and potential therapeutic approaches

- Journal of Policy and Practice in Intellectual Disabilities, the Official journal of the International Association for the Scientific Study of Intellectual Disabilities (IASSID)

- **EBIFF:** european passport on professional training in early childhood intervention

EBIFF

Education and Culture
Leonardo da Vinci
Pilot projects

- Telemedicine
  - Contact with families at home
  - Video-conferences network for scientific collaboration
  - For teaching activity

- Telemedicine
  - Contact with families at home
    - For a medical consultation in case of problems, for a selected gruop of patiens
    - For a conclusive report after a day-hospital at the Clinic (Messanger): “The virtual day-hospital”

- Telemedicine
  - Video-conferences network for scientific collaboration
  - A new apparatus (Polycom system) for video-conferences is being installed in all the San Raffaele Clinic, laboratories, Research Laboratories and in the collaborative Centers (IBR, New York).

- Telemedicine
  - For teaching activity

Clinic and research activity of the

Gait Analysis lab at

IRCCS San Raffaele Pisana

In cooperation with the

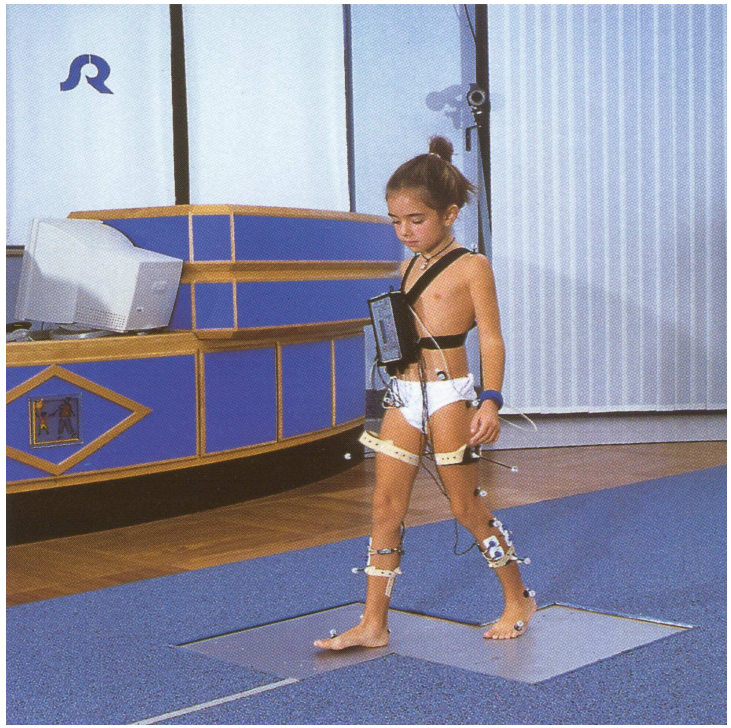
Dept. of Bioengineering of the

Politecnico di Milano

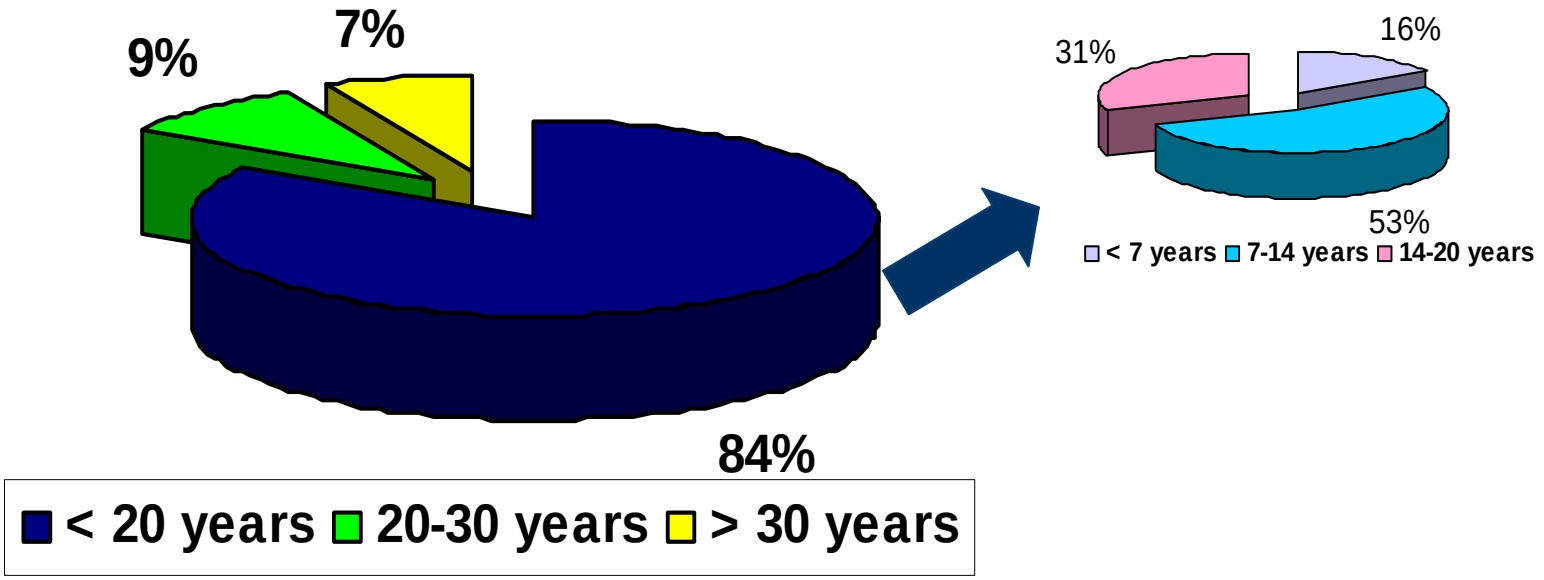
The history

The Lab in Rome started at 1997 but since 1992 Prof. Albertini was looking for the possibility to have in his hospital a Gait Analysis Lab

In 10 years (1997 – 2007) 3125 patients were evaluated in the Gait lab of San Raffaele and studied with the bioingeneers of Politecnico of Milan

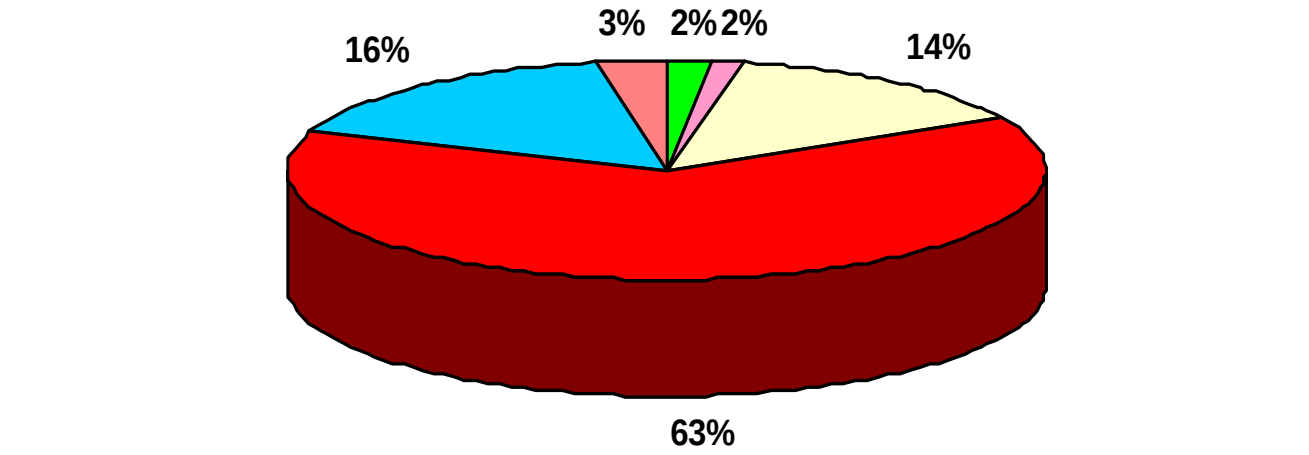


Age of patients



Mainly pediatric patients

Pathologies



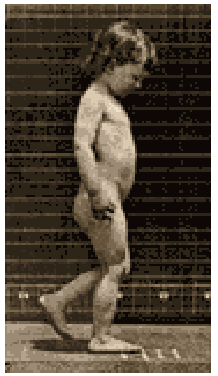
Mainly Cerebral Palsy

The gait analysis lab in a clinic and research institute:

- Clinical use
- Field of research

The movement study

Gait is one of the most important human movements



Before gait analysis

- Qualitative kinematics
- 2D analysis of movement
- No dynamic information
- No muscular activity information

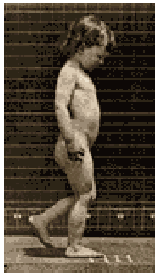
Gait analysis offers:

- **Quantitative kinematic evaluation**
- **Quantitative dynamic evaluation**
- **Muscular activity evaluation**

MULTIFACTORIAL QUANTITATIVE ANALYSIS

Gait Analysis:

MULTIFACTORIAL QUANTITATIVE ANALYSIS (kinematics + dynamics + EMG+Video) of walking movement



Technical characteristics of instrumentation

- **Dynamics and EMG relevation**
- **3D**
- **Non-invasivity**
- **Quantitative information**
- **Integrated multifactorial analysis**

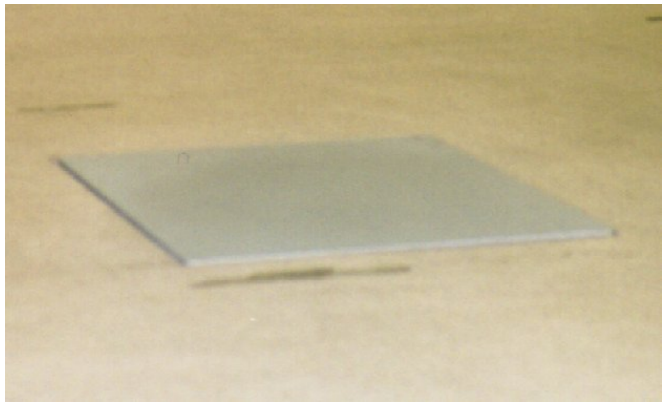
The equipment of GAL

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

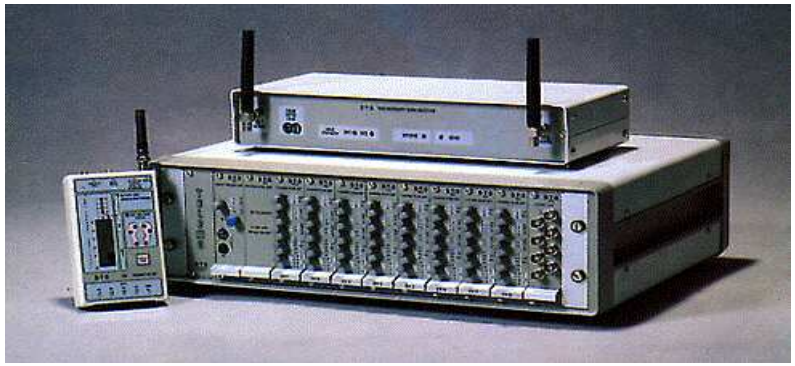
Acquired in 2006

New hardware and software acquisition in order to maintain the lab at the first level (high technology)

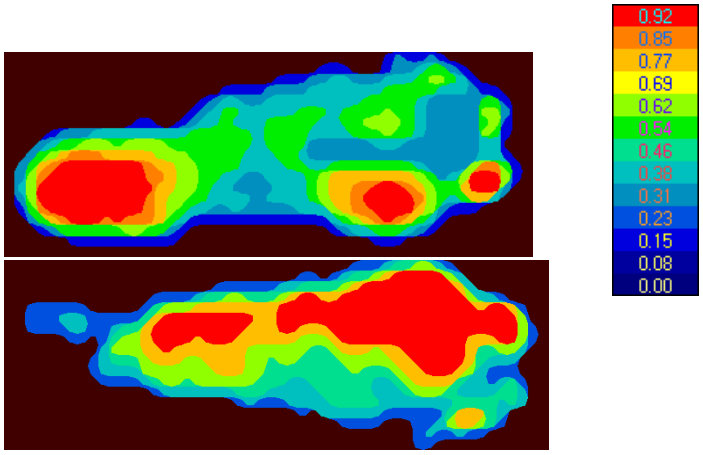
12 TV, 100 HZ (ELITE2002, BTS)



2 PLATFORMS (KISTLER)

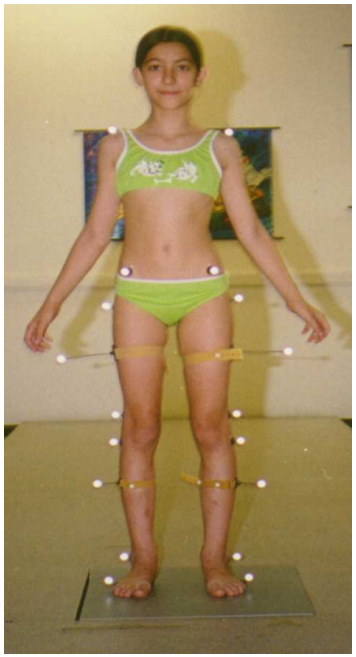


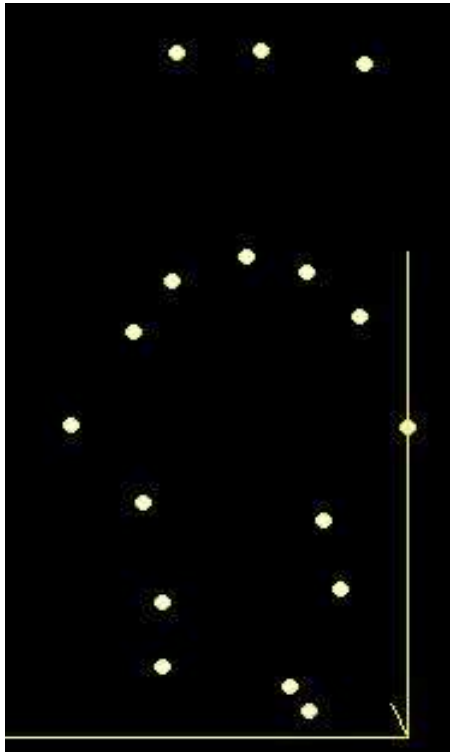
16 CHANNEL TELEMETRIC EMG (ELITE2002, BTS)



FSCAN AND CLINICAL SEAT

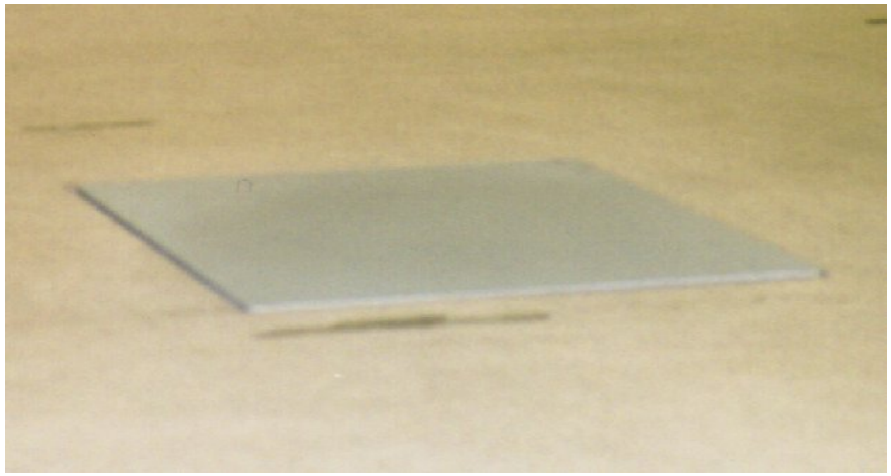
The optoelectronic system

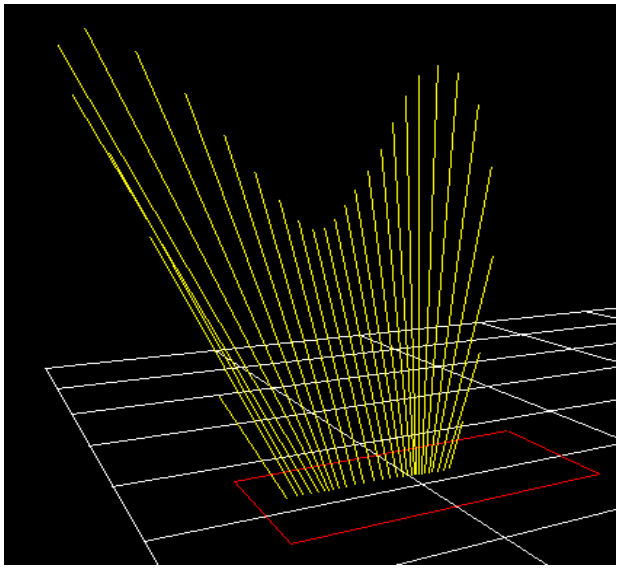




For kinematics

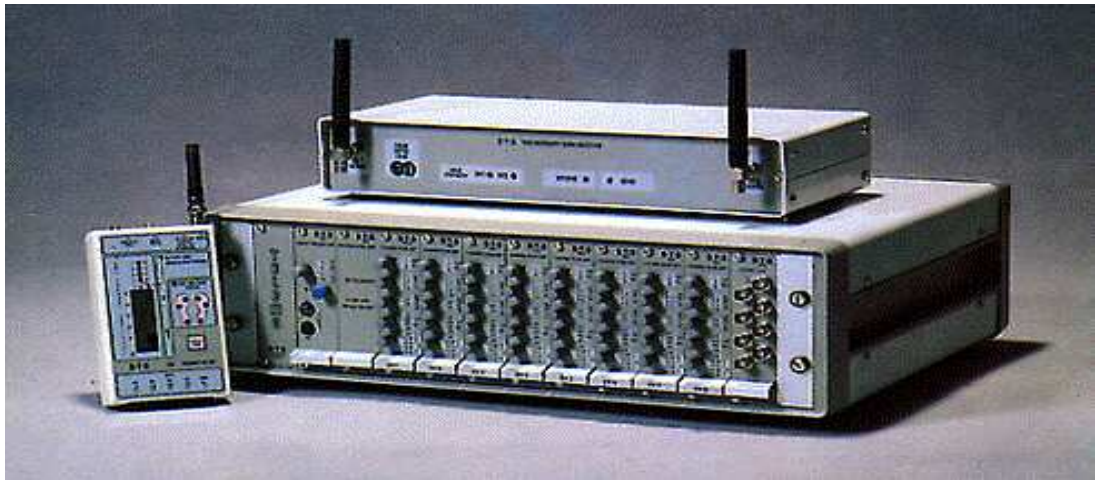
The force platform

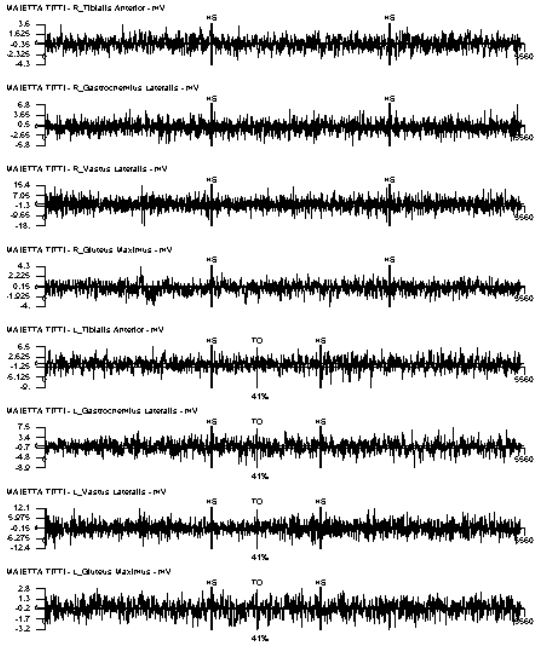




For dynamics

The telemetric EMG





For measuring muscular activity

The ergospirometer

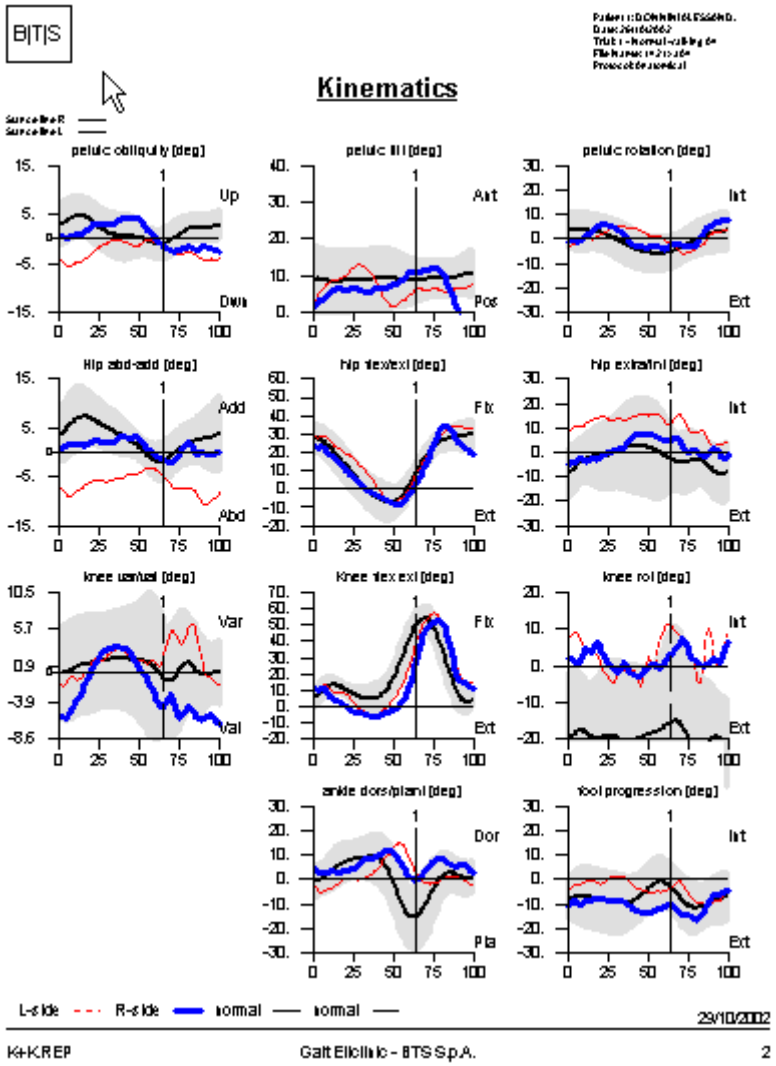
HR

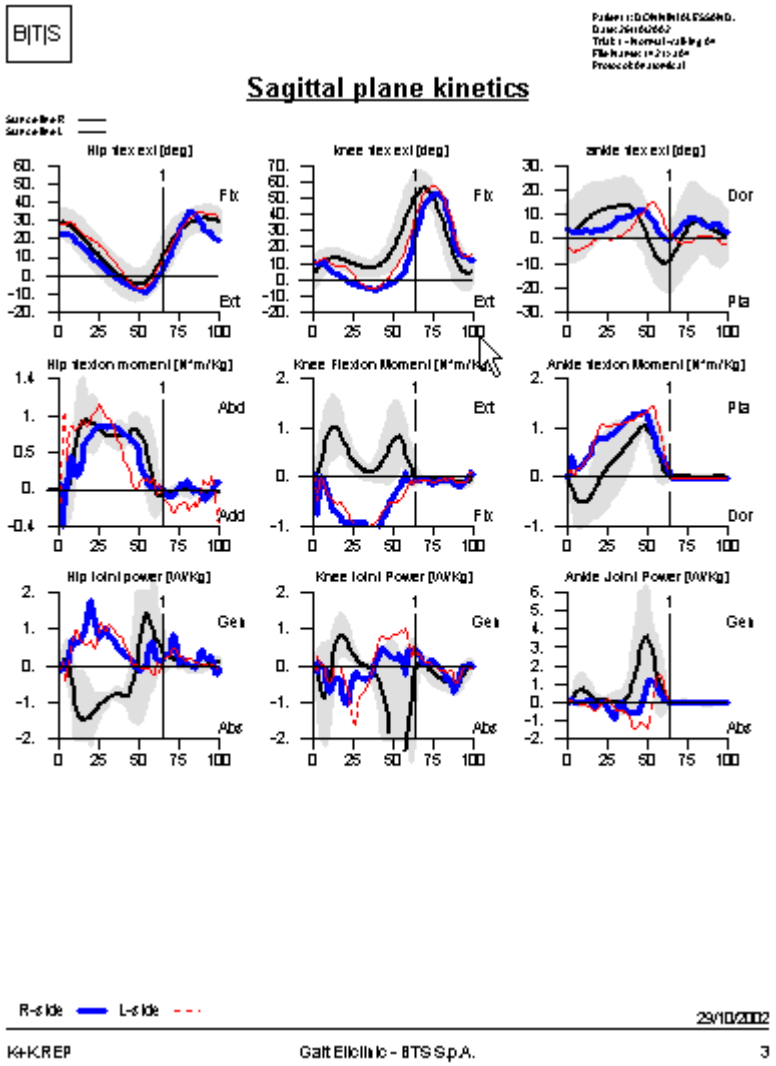
FiO2

CO2

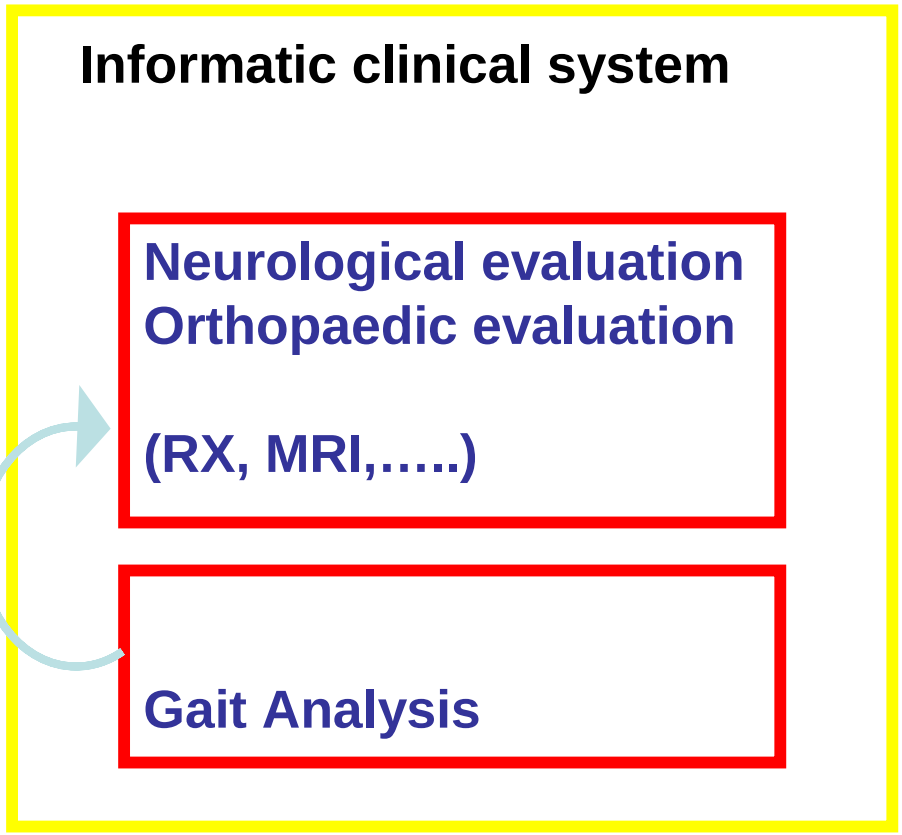
For energetic waste

REPORT AND DATA ANALYSIS



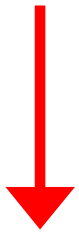


Gait analysis for the Clinical activity


Informatic clinical system
Neurological evaluation
Orthopaedic evaluation
(RX, MRI,…..)
Gait Analysis

The use of gait analysis has radically changed the treatment of CP children

Before treatment



Better evalution of decision making

After treatment

Outcome evaluation

Gait Analysis for the Research

- **Movement disorders**
- **Myelomeningocele**
- **Posturography**
- **Upper limb movements**
- **Integration of Vestibular and Gait Analysis Lab**
- **Down syndrome**

Down syndrome

- Most common cromosomal abnormality in humans
- No-disjunction during the maternal meiosis

Down syndrome

- 3 genotypes for Down syndrome:
  - "free" trisomy: about 95%
  - unbalanced translocation: 2-3%
  - mosaicism: 1-2%
- Same phenotype

Down syndrome

- Clinical features:
  - low birth weight
  - typical phenotype

Down syndrome

- Phenotype
  - Facies: eyes, mouth, tongue, neck, hands and feet
  - Short limbs, hands and feet
  - Congenital malformations

Down syndrome

- Congenital malformations
  - Heart defects (about 40%)
  - Gastrointestinal
  - Renal
  - Congenital cataract

Children with Down syndrome

- cardiological controls:
  - congenital/acquired heart defects
- ophtalmological controls
  - eyesight problems
  - nystagmus
  - cataract

Children with Down syndrome: medical controls

- endocrinological control
- celiac disease

Children with Down syndrome: other controls

- hearing evaluation
- dentistry
- periodic EEG controls
- X-ray – MRI controls:
  - hip in the second year of life
  - cervical spine in second infancy

Muscuolo-skeletal abnormalities

- Atlantoaxial instability
- Atlantooccipital instability
- Degenerative skeletal changes
- Abnormalities of the cervic spine
- Hip dislocation
- Patella subluxation
- Foot problems

Muscuolo-skeletal abnormalities

- For the diagnosis and treatment:

Combined role of clinical examination, X-ray and neuroimaging, and gait analysis

Children with Down syndrome: Psychomotor development

Mild psychomotor delay

Autonomic walking: 18 – 24 months
Speech problems
Mild-moderate intellectual disability

Maturing persons with Down syndrome:

- Physical maturation
- Sexual development
- Medical concerns
- Phsychiatric – behavioral issues
- Educational aspects
- Social maturation
- Recreational activities

TRAMA project 10 - 14 march 2007:

13 march clinical case

Down syndrome

Renata C.

Date of birth: 28.09.1979
Maternal age at birth: 45 yrs
Birth weight: 2.500 g
Gestational age: 41 weeks
Normal perinatal period

Renata C.

Autonomic walking: 24 months

Very good autonomy in daily life

IQ: 50

Renata C.

No congenital malformation
No celiac disease
No thyroid problems

Overweight

Renata C.

Cervical X ray

- static study: mild spodilo-arthrosys C3 – C4 and C4-C5
- dynamic study: normal

Renata C.

Orthopedic evaluation

- No relevant clinical problems
- Mild lumbar hyper-lordosis

TRAMA

GAIT ANALYSIS IN ADULT AGE
2008