Fondazione Don Carlo Gnocchi Onlus

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Balance in strabismic subjects

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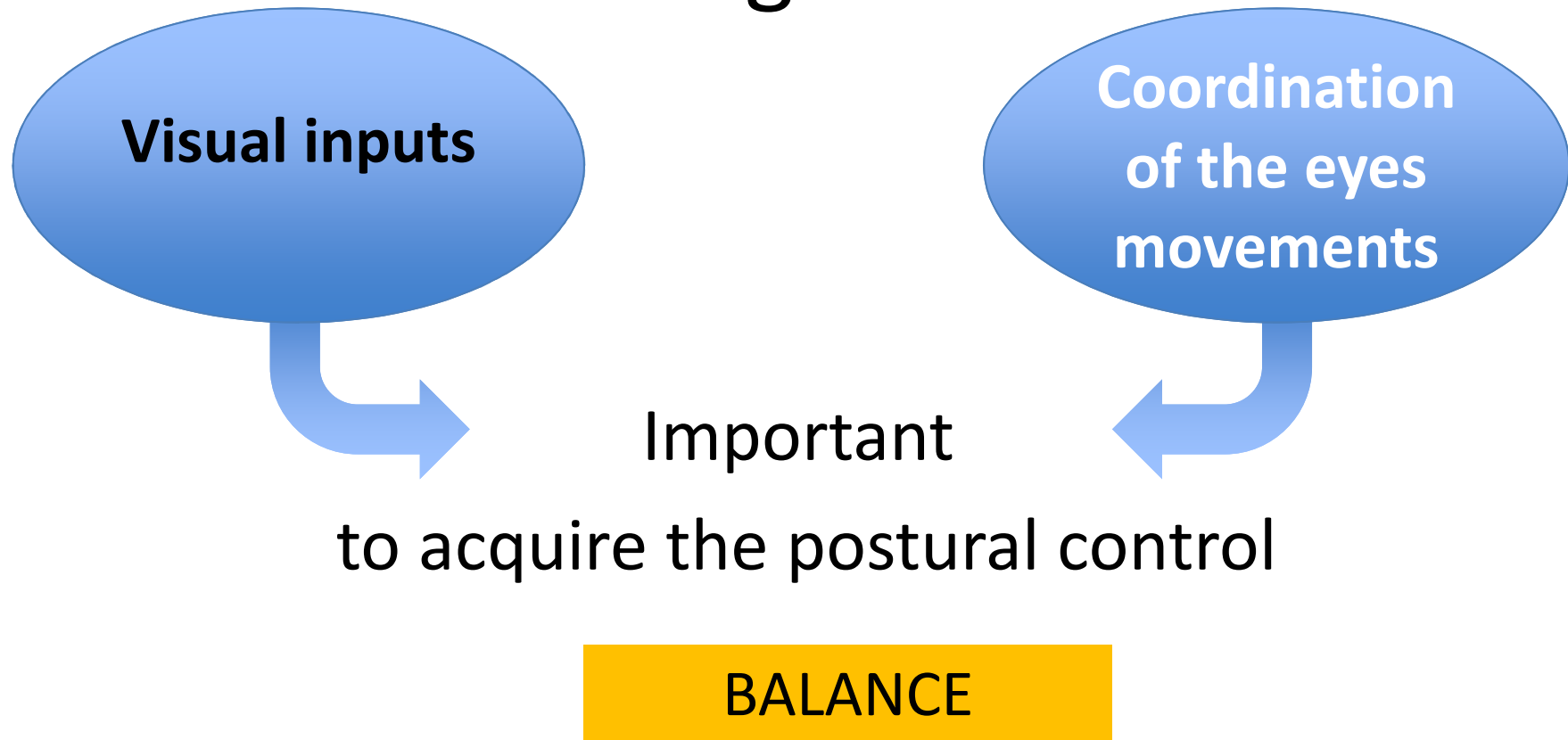[2]Istituto di Oftalmologia, Dipartimento Scienze Chirurgiche testa e collo, Università Cattolica del Sacro   Cuore, Roma;
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Balance represents a complex interplay between the sensory and motor systems

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Vestibular System

Visual System

AFFERENT WAY

EFFERENT WAY

MUSCULAR RECEPTORS

JOINT RECEPTORS

SENSITIVE RECEPTORS

Background

Visual inputs

Coordination of the eyes movements

Important
to acquire the postural control
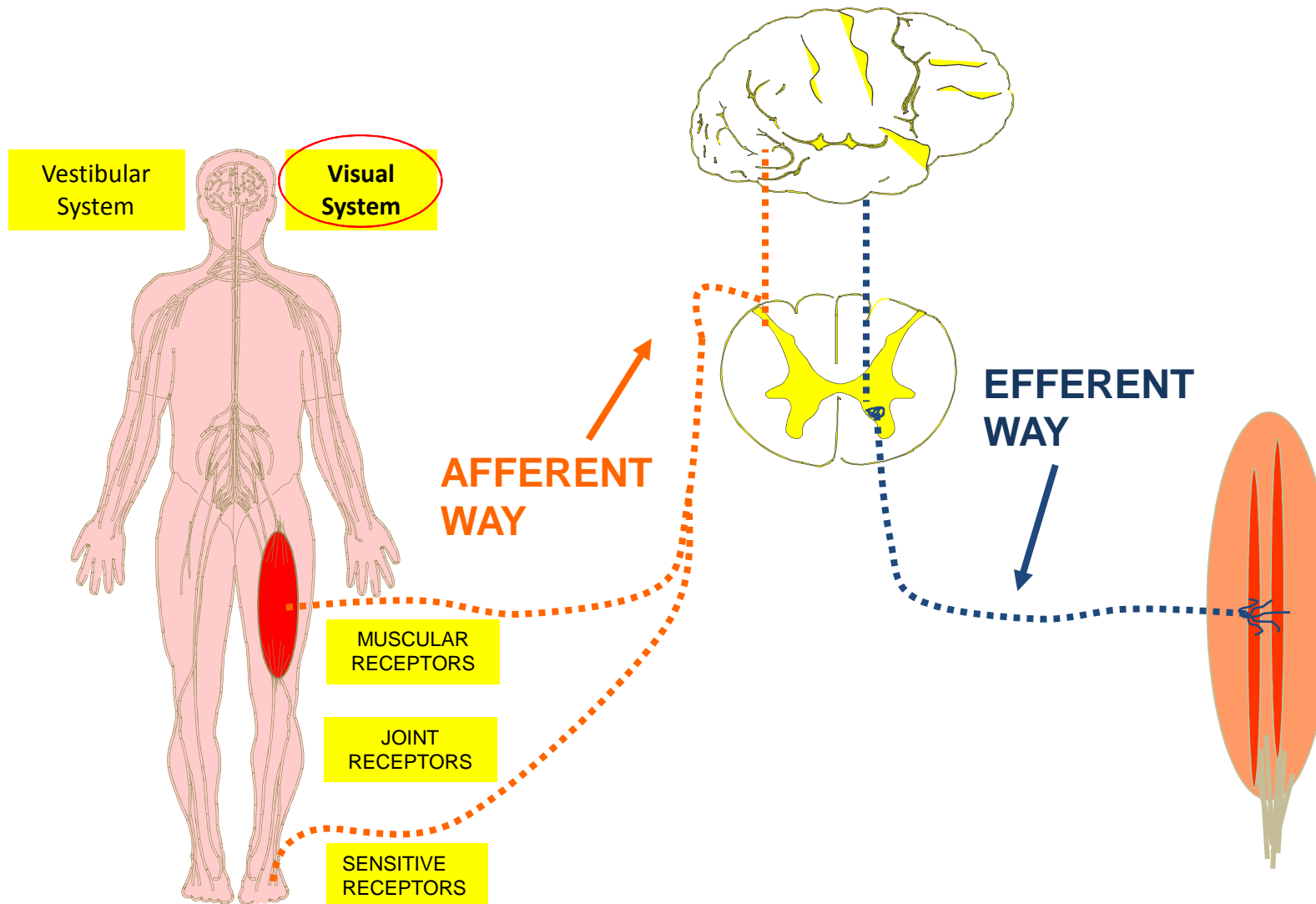
BALANCE

few evidences about relationship between
balance and **disorders of ocular motility**

Aim

- to examine balance in strabismic subjects

- to evaluate relationship between stabilometric parameters and kind of strabismus, age and visual acuity

Materials and Methods

- **Inclusion criteria**
  - congenital or early onset (within one year of age)
  - age > 6 Yrs.

- **Exclusion criteria**
  - strabismus acquired after one year of age
  - bad compliance (age or cognitive deficit)
  - presence of systemic or neurological pathologies
  - evidence of orthopedic or postural problems

Materials and Methods

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- # Sample

  (mean age : 15.2 aa; SD: 10.8)

  – 40 strabismic subjects

    - congenital or early onset strabismus
    - No diplopia
    - 8 female and 6 male
    - Mean age 12 yrs. Range 6-24 yrs.

  Comparable for age, sex, weight and height

- # Control Group

  (mean age: 13.2 aa; SD: 4.8)

  – 17 healthy subjects

    - emmetropic or BCVA 6/6, NBSV, no anomalies of ocular motility, stereopsis =>60"

Materials and Methods

- All Subjects (sample and control group)
  - complete ophthalmological and orthoptic evaluation
- Strabismic subjects divided according to
  - Horizontal / Vertical + Horizontal
  - Δ visual acuity (VA of better eye –VA of worse eye)
  - Age

Materials and Methods

- All Subjects (sample and control group)

  ⬇

- static balance evaluation using a stabylometric platform (*Prokin B, Tecnobody*)

- Distance of fixation
  - About 50 cm

- Three conditions
  - open eyes
  - closed eyes
  - alternate eye occlusion

Bipodalic platform (Prokin, from Tecnobody).
This is a dynamometric platform consisting of 4 strength sensors (strainguages) oriented in according to the vertical and horizontal directions and positioned at the vertex of the square inscribed in the platform. This device can be used fixed or whit a variable damping, allowing static and dynamic balance evaluation

Balance parameters

Open eyes/closed eyes

Sway Center of Pression (sway CoP)

Area Center of Pression (area CoP)

Antero-posteral velocity (AP velocity)

Medio-lateral velocity (ML velocity)

Y axis proiection (Y CoP)

X axis proiection (X CoP)

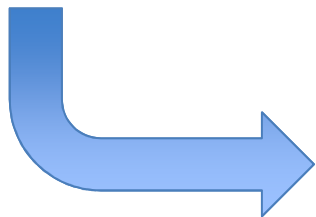$$\frac{\text{Sway CoP CE}}{\text{Sway CoP OE}} = \text{Romberg Test}_{sway}$$

$$\frac{\text{Area CoP CE}}{\text{Area CoP OE}} = \text{Romberg Test}_{area}$$

Trunk acceleration
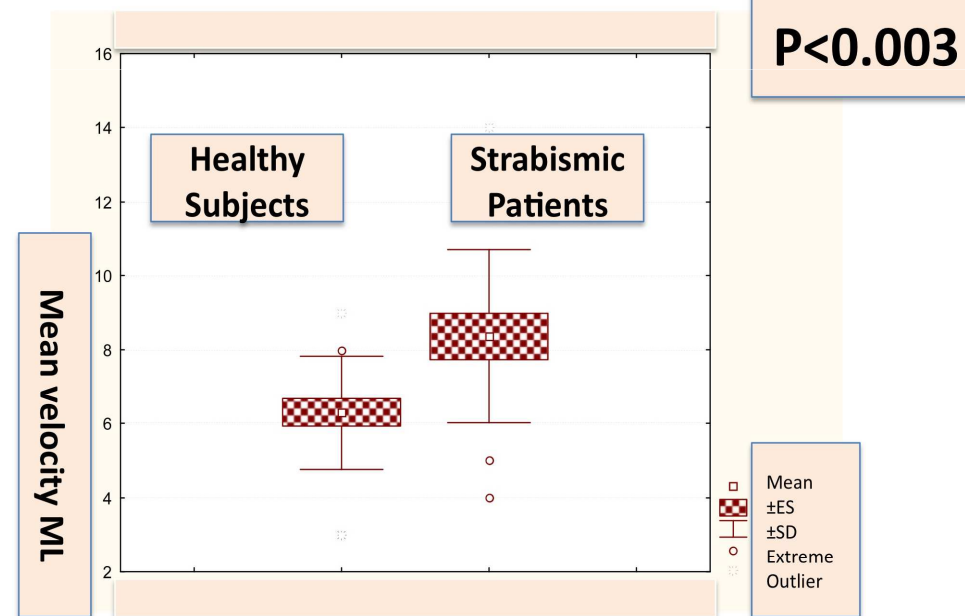(total SD ; antero-posterior and medio-lateral)

Results

Comparison between strabismic and healthy subjects

Strabismic patients show a significative higher **mean M/L velocity** than healthy subjects
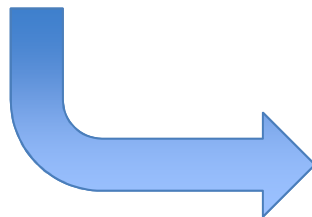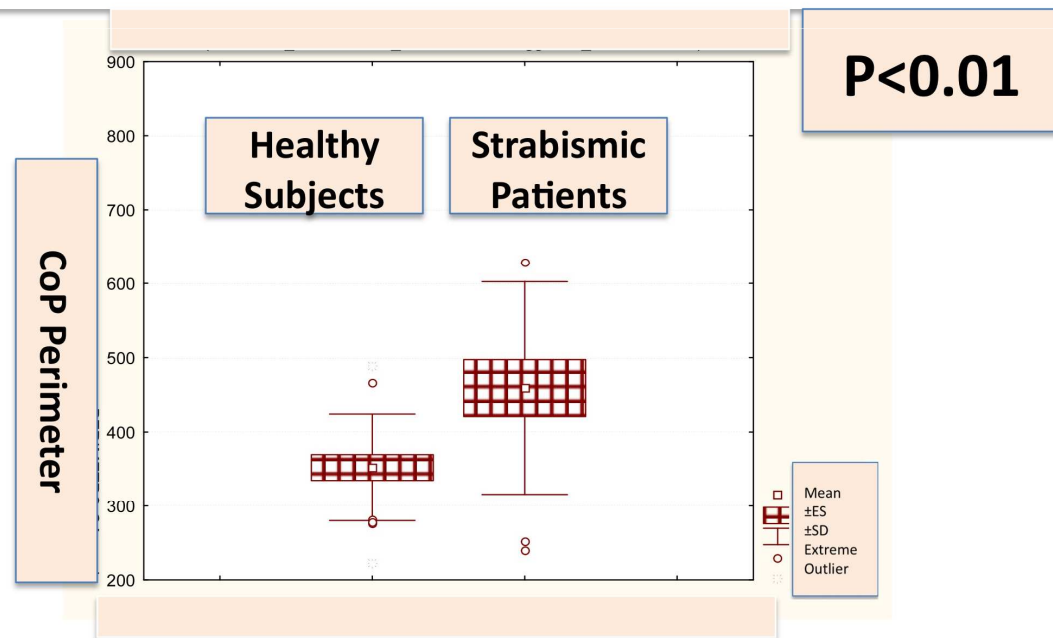
Open Eyes condition - **Mean velocity ML**

P<0.003

Results

Comparison between strabismic and healthy subjects

Strabismic patients show a significative higher **CoP sway** than healthy subjects

Open Eyes condition - CoP Perimeter

P<0.01

Healthy Subjects

Strabismic Patients

CoP Perimeter

- Mean
- ±ES
- ±SD
- Extreme
- Outlier

Results

Comparison between strabismic and healthy subjects

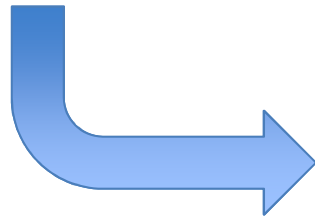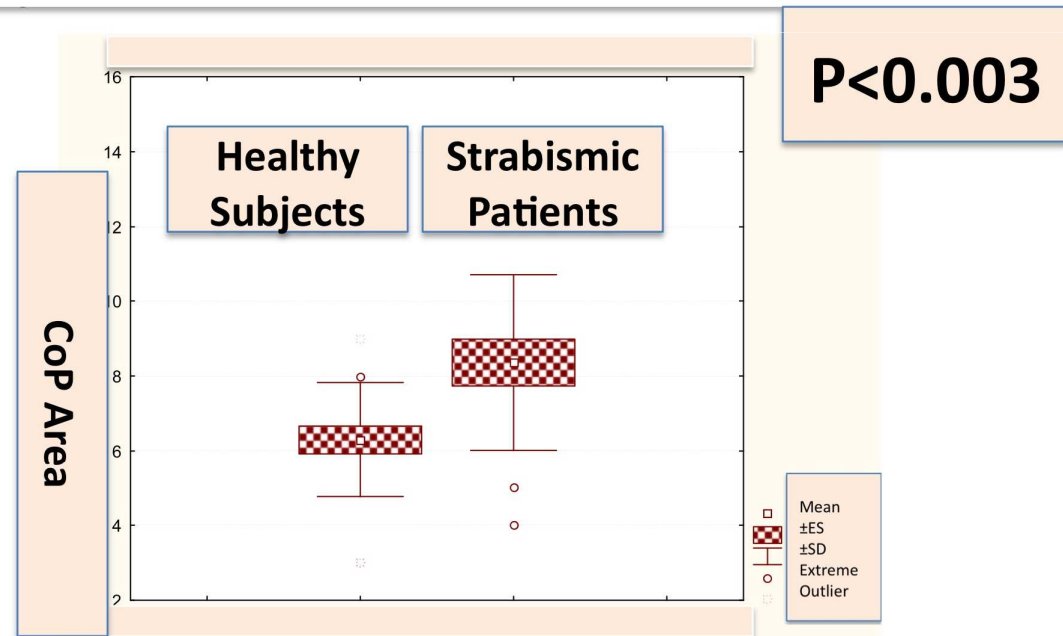Strabismic patients show a significative higher **CoP area** than healthy subjects

Open Eyes condition - **CoP Area**

P<0.003

Results
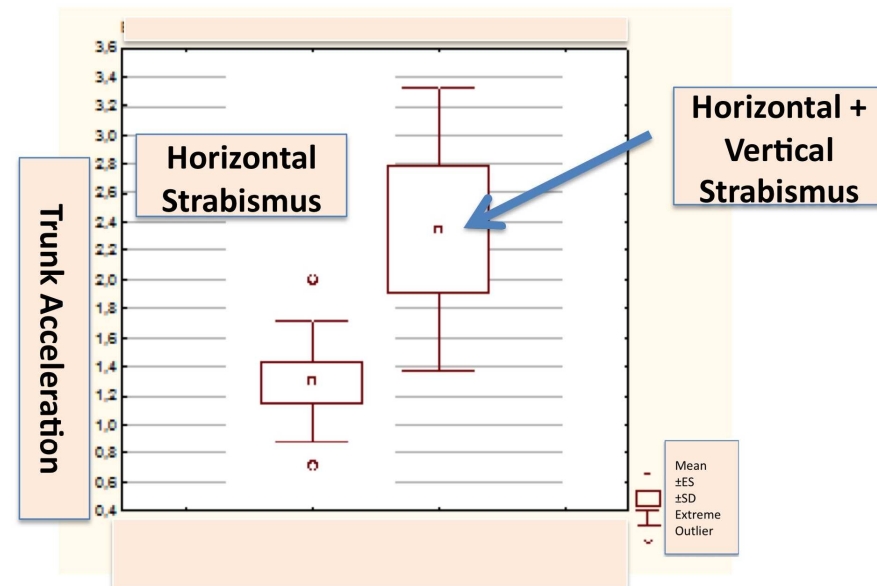
Correlation between type of strabismus and balance

Classification of Strabismic patients
into two groups:

A. *Pure horizontal deviation*

B. *Horizontal + vertical deviation*

Group B shows a higher trunk
acceleration than group A

with eye closed there is only a
trend but we lose the
significance

Horizontal vs. Horizontal + Vertical Strabismus
Trunk Acceleration

Results

Relationship between Δ visual acuity and balance parameters (Spearman Test)

	Cases	Spearman R	P-level
A/P Mean Velocity	10	0,64	**0,04**
M/L Mean Velocity	10	0,63	**0,05**
Sway CoP	10		NS
Area CoP	10		NS
Total SD of the Trunk	13	-0.7	**0.01**
Antero-posterior SD of the Trunk	13	-0.6	**0.02**
Medio-lateral SD of the Trunk	13	-0.6	**0.02**

Patients with higher Δ VA show an higher AP and ML velocity (namely higher instability) but lower trunk oscillation

Results

Correlation between age and balance

Strabismic patients classified in two groups

A. subjects age <10 yrs.

B. subjects age >10yrs.

Comparison between the two group shows that subjects with age <10 have a higher AP mean velocity, CoP sway and CoP area then those with age >10

Results

"Near vision"

Coppie di Variabili	Test Camp. App. di Wilcoxon (Tabella Test marcati significativi liv. p <,05000			
	N Validi	T	Z	p-level
Vel. Media A/P (mm/sec) OA occh VICINO & Vel. Media A/P (mm/sec) OC occh VICINO	39	60,0000	4,288987	0,000018
Vel. Media M/L (mm/sec) OA occh VICINO & Vel. Media M/L (mm/sec) OC occh VICINO	39	29,0000	4,590414	0,000004
Perimetro (mm) OA occh VICINO & Perimetro (mm) OC occh VICINO	39	33,5000	4,974957	0,000001
Area ellisse(mm2) OA occh VICINO & Area ellisse(mm2) OC occh VICINO	39	87,0000	4,228364	0,000024

"Far vision"

Coppie di Variabili	Test Camp. App. di Wilcoxon (Tabella Test marcati significativi liv. p <,05000			
	N Validi	T	Z	p-level
Vel. Media A/P (mm/sec) OA occh LONTANO & Vel. Media A/P (mm/sec) OC occh LONTANO	21	33,50000	2,035539	0,041798
Vel. Media M/L (mm/sec) OA occh LONTANO & Vel. Media M/L (mm/sec) OC occh LONTANO	21	64,50000	0,568057	0,569996
Perimetro (mm) OA occh LONTANO & Perimetro (mm) OC occh LONTANO	21	68,00000	1,650988	0,098742
Area ellisse(mm2) OA occh LONTANO & Area ellisse(mm2) OC occh LONTANO	21	83,50000	1,112245	0,266034

Closing eyes in near vision worse balance more then closing eyes in far vision

Results

Comparison between binocular and monocular vision

Closing dominant eye

	Test Camp. App. di Wilcoxon (Tabella Test marcati significativi liv. p <,05000			
Coppie di Variabili	N Validi	T	Z	p-level
Vel. Media A/P (mm/sec) OA occh VICINO & Vel. Media A/P (mm/sec) OA occhio DOMINANTE chiuso	24	15,5000	3,341274	0,000834
Vel. Media M/L (mm/sec) OA occh VICINO & Vel. Media M/L (mm/sec) OA occhio DOMINANTE chiuso	24	12,0000	2,726217	0,006407
Perimetro (mm) OA occh VICINO & ...	24	30,5000	3,414286	0,000640
Area ellisse(mm2) OA occh VICINO & ...	24	76,0000	2,114286	0,034492

Closing no dominant eye

Closing dominant eye balance worse more than closing no dominant eye

	Test Camp. App. di Wilcoxon (Tabella Test marcati significativi liv. p <,05000			
Coppie di Variabili	N Validi	T	Z	p-level
Vel. Media A/P (mm/sec) OA occh VICINO & Vel. Media A/P (mm/sec) OA occhio NON dominante chiuso	24	58,0000	1,998565	0,045656
Vel. Media M/L (mm/sec) OA occh VICINO & Vel. Media A/P (mm/sec) OA occhio NON dominante chiuso	24	28,5000	2,855949	0,004291
Perimetro (mm) OA occh VICINO & Perimetro (mm) OA occhio NON dominante chiuso	24	85,0000	1,857143	0,063292
Area ellisse(mm2) OA occh VICINO & Area ellisse(mm2) OA occhio NON dominante chiuso	24	116,0000	0,971429	0,331336

Conclusion

Strabismic patients show a significative lower balance than healthy subjects

Kind of strabism

Strabismic subjects with vertical + horizontal deviation have a lower balance comparing to those with pure horizontal deviation

Vertical component?
Horizontal + Vertical component?

Conclusion

Visual acuity

Influence of Visual Acuity on balance is known

S. Mohapatra, V. Krishnam, A. S. Aruin, *The effect of decreased visual acuity on control of posture,* Clinical Neurophysiology, 123 (2012) 173-182

Important difference of visual information from the two eyes to CNS

Bad integration CNS

Higher instability

Conclusion

Age

Strabismic patients under 10 yrs. show a worse postural control with respect the >10 yrs. group

In children all nervous pathways for postural control could not be completely developed so in strabismic children the physiological instability seems to be amplified

Could early onset strabismus influence the correct development of postural control?

Conclusion

Near vision (50 cm): closing eyes worse almost all balance parameters

Far vision (>5m): closing eyes worse only antero-posterior velocity

Binocular versus monocular visione: closing the dominant eye worse balance

Conclusions

Our preliminary findings

– Confirm data of literature: balance involvement in Strabismic subjects

– Add some information and suggest:

appropriate treatment of strabismus

(improving binocular cooperation
oculomotor coordination)

Rehabilitation treatment focused on balance

<10 years of age
mixed deviation

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Thank You for kind attention

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