Balance in strabismic subjects

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Balance represents a complex interplay between the sensory and motor systems.
Background

Visual inputs

Coordination of the eyes movements

Important to acquire the postural control

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

• **Sample**
  - 40 strabismic subjects
    - congenital or early onset strabismus
    - No diplopia
    - 8 female and 6 male
    - Mean age 12 yrs. Range 6-24 yrs.

• **Control Group**
  - 17 healthy subjects
    - emmetropic or BCVA 6/6, NBSV, no anomalies of ocular motility, stereopsis =>60”

(mean age: 15.2 aa; SD: 10.8)

Comparably for age, sex, weight and height

(mean age: 13.2 aa; SD: 4.8)
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 accordance 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 with 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-posterior velocity (AP velocity)
- Medio-lateral velocity (ML velocity)
- Y axis projection (Y CoP)
- X axis projection (X CoP)

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

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

\[
\frac{\text{Sway CoP CE}}{\text{Sway CoP OE}} = \text{Romberg Test}_{\text{sway}}
\]
Comparison between strabismic and healthy subjects

Strabismic patients show a significative higher mean M/L velocity than healthy subjects.
Comparison between strabismic and healthy subjects

Strabismic patients show a significative higher CoP sway than healthy subjects.
Comparison between strabismic and healthy subjects

Strabismic patients show a significative higher CoP area than healthy subjects

Results

Open Eyes condition - CoP Area

P<0.003
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.
## Results

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

<table>
<thead>
<tr>
<th></th>
<th>Cases</th>
<th>Spearman R</th>
<th>P-level</th>
</tr>
</thead>
<tbody>
<tr>
<td>A/P Mean Velocity</td>
<td>10</td>
<td>0.64</td>
<td>0.04</td>
</tr>
<tr>
<td>M/L Mean Velocity</td>
<td>10</td>
<td>0.63</td>
<td>0.05</td>
</tr>
<tr>
<td>Sway CoP</td>
<td>10</td>
<td></td>
<td>NS</td>
</tr>
<tr>
<td>Area CoP</td>
<td>10</td>
<td></td>
<td>NS</td>
</tr>
<tr>
<td>Total SD of the Trunk</td>
<td>13</td>
<td>-0.7</td>
<td>0.01</td>
</tr>
<tr>
<td>Antero-posterior SD of the Trunk</td>
<td>13</td>
<td>-0.6</td>
<td>0.02</td>
</tr>
<tr>
<td>Medio-lateral SD of the Trunk</td>
<td>13</td>
<td>-0.6</td>
<td>0.02</td>
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</tbody>
</table>

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 >10 yrs.

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

Comparison OE/CE

### “Near vision”

<table>
<thead>
<tr>
<th>Coppie di Variabili</th>
<th>Test Camp. App. di Wilcoxon (Tabella Test marcati significativi liv. p &lt; .05000)</th>
</tr>
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<tbody>
<tr>
<td></td>
<td>N Validi</td>
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<tr>
<td>Vel. Media A/P (mm/sec) OA occh VICINO &amp; Vel. Media A/P (mm/sec) OC occh VICINO</td>
<td>39</td>
</tr>
<tr>
<td>Vel. Media M/L (mm/sec) OA occh VICINO &amp; Vel. Media M/L (mm/sec) OC occh VICINO</td>
<td>39</td>
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<tr>
<td>Perimetro (mm) OA occh VICINO &amp; Perimetro (mm) OC occh VICINO</td>
<td>39</td>
</tr>
<tr>
<td>Area ellisse(mm2) OA occh VICINO &amp; Area ellisse(mm2) OC occh VICINO</td>
<td>39</td>
</tr>
</tbody>
</table>

### “Far vision”

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<th>Coppie di Variabili</th>
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<tr>
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</tr>
<tr>
<td>Vel. Media A/P (mm/sec) OA occh LONTANO &amp; Vel. Media A/P (mm/sec) OC occh LONTANO</td>
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<tr>
<td>Vel. Media M/L (mm/sec) OA occh LONTANO &amp; Vel. Media M/L (mm/sec) OC occh LONTANO</td>
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</tr>
<tr>
<td>Perimetro (mm) OA occh LONTANO &amp; Perimetro (mm) OC occh LONTANO</td>
<td>21</td>
</tr>
<tr>
<td>Area ellisse(mm2) OA occh LONTANO &amp; Area ellisse(mm2) OC occh LONTANO</td>
<td>21</td>
</tr>
</tbody>
</table>

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

Comparison between binocular and monocular vision

<table>
<thead>
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<th>Coppie di Variabili</th>
<th>T</th>
<th>Z</th>
<th>p-level</th>
</tr>
</thead>
<tbody>
<tr>
<td>Vel. Media A/P (mm/sec) OA occhio VICINO &amp; Vel. Media A/P (mm/sec) OA occhio DOMINANTE chiuso</td>
<td>15,5000</td>
<td>3,341274</td>
<td>0,000834</td>
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<tr>
<td>Vel. Media M/L (mm/sec) OA occhio VICINO &amp; Vel. Media M/L (mm/sec) OA occhio DOMINANTE chiuso</td>
<td>12,0000</td>
<td>2,726217</td>
<td>0,006407</td>
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<tr>
<td>Perimetro (mm) OA occhio VICINO &amp; Vel. Media A/P (mm/sec) OA occhio DOMINANTE chiuso</td>
<td>30,5000</td>
<td>3,414286</td>
<td>0,000640</td>
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<td>2,114286</td>
<td>0,034492</td>
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</tbody>
</table>

Closing dominant eye

Closing no dominant eye

Closing dominant eye balance worse more than closing no dominant eye
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

Influence of Visual Acuity on balance is known

Important difference of visual information from the two eyes to CNS

Bad integration CNS

Higher instability
Conclusion

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
Thank You for kind attention