• Smooth Pursuit Neck Torsion Test
  • in Patients with
  • Cervical Spondylosis

• Takwa A. Gabr
• Lecturer of Audiology
• ENT Dep. Tanta University
Cervical spondylosis is a common condition of the cervical spine which results from disk degeneration.

Subjects are usually complaining of neck, shoulder or suboccipital pain, headache, dizziness as well as visual disturbances (Treleaven, 2003).
Proprioceptive signals important for postural neck reflexes arise from receptors located in the upper cervical spine.

These proprioceptors are thought to be responsible for the generation of the cervico-ocular reflex (COR) (Barnes and Forbat, 1979).

The COR is a part of the vestibulo-collic reflex (VCR) which attempts to stabilize head position in space during trunk movements.

Smooth pursuit eye movement keeps the image of the target within the foveal area.

Smooth pursuit neck torsion test (SPNT) can be used for evaluating COR (Takemura and King, 2005).
In this test, eye movement is measured with the head in a neutral forward facing position then with the trunk rotated beneath the head 45º to the right and then to the left.

The latter two positions are thought to stimulate the cervical receptors (which include both the CCR and COR) but not the vestibular receptors (Treleaven et al., 2005).

**Parameters calculated in SPNT include:**

- **Gain:** the ratio between the velocity of eye movement and target movement. The optimal gain required for vision is close to one.

- **The phase:** time relation between eye and target movements. It ranges between ±180º. +ve values imply a phase lag while -ve values imply a phase lead (Lencer and Trillenberg, 2008).
This work was designed to:

- Determine how SPNT is influenced by cervical spondylosis.
- Evaluate the ability of SPNT to predict abnormality in those subjects even asymptomatic ones.
I- Subjects:

**Group I:** 20 normal hearing subjects with no complaints or history of neck problems.

**Group II:** 30 subjects with cervical spondylosis.

  - **Subgroup IIa:** 12 cases not complaining of dizziness.
  - **Subgroup IIb:** 18 cases complaining of dizziness.
II- Procedure:

- Full audiological history
- Otological examination.
- Basic audiological evaluation.
- X-rays of cervical spines.
- Office test examination of dizzy patients.
- VEMP
- VNG including SPNT.

SPNT procedure was performed as described by Tjell and Rosenhall (1998).

The subject was seated in a chair facing the VNG light bar and fitted with infrared goggles of ICS-VNG.

Subjects were instructed to follow a light target moving sinusoidally at 0.25Hz over a 34º arc as closely as possible with their eyes while keeping their head still.
SPNT was done in 3 positions:

- First position → Neutral.
- Second position → RT neck torsion.
- Third position → LT neck torsion.

Gain and phase were calculated in each position.
Results of VEMPs

➢ Group I: they were elicited in all cases.

➢ Group II:

  Subg. IIa: 33.3% of subjects.

  Subg. IIb: 27.8% of subjects.

In both subgroups there was significant delayed latency &/or reduced amplitude.
Despite of these abnormalities, VEMPs findings could not be attributed to abnormality of COR in these subjects.

This is because VEMPs depend on the condition of both the saccule and the inferior vestibular nerve (Welgampola and Colebatch, 2005).

Results of VNG

- Both groups showed normal findings in oculomotor, positional and positioning tests.
- The caloric test showed bilateral normal symmetrical response.
- **SPNT** was done in 3 positions. In each position, the average gain for rightward and leftward directed target movements was calculated.

- Gain in Rightward and Leftward SPNT were not significantly different in both groups. So, their mean was calculated and compared with gain in the neutral position.

- **SPNT phase** was also calculated.

### SPNT Gain

<table>
<thead>
<tr>
<th></th>
<th>Neutral</th>
<th>SPNT</th>
<th>SPNT difference</th>
</tr>
</thead>
<tbody>
<tr>
<td>Group</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>I</td>
<td>1.14</td>
<td>1.06</td>
<td>0.08</td>
</tr>
<tr>
<td>Subg.</td>
<td>(100%)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Ila</td>
<td>1.06</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>0.6*</td>
<td></td>
<td>0.48*</td>
</tr>
<tr>
<td>Subg.</td>
<td>(100%)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>IIb</td>
<td>0.96.</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>0.43*</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Rt SPNT (50%)</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>Lt SPNT (66.6%)</td>
<td>0.6*</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Rt SPNT (66.6%)</td>
<td>0.53*</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Lt SPNT (77.7%)</td>
<td>0.43*</td>
</tr>
</tbody>
</table>
Results in the control group are consistent with Tjell and Rosenhall (1998) and Naeem et al., (2009) who demonstrated that no change in SP eye movement occur in normal subjects with change of head position from the neutral to the SPNT.
Abnormal gain results in group II were consistent with Tjell & Rosenhall (1998) who reported that in the neutral position, the neck proprioceptive reflexes (which are impaired in those cases) are not stimulated.

However, in SPNT both subgroups showed either no or significant gain ↓. This is because torsioned positions would stimulate the impaired cervical proprioceptives in cases with neck disorders (Tjell et al., 2003).

Subjects with cervical spondylosis and dizziness showed an ↑ no. of cases with no gain calculation compared with subjects without dizziness.

This is consistent with Treleaven et al., (2005) who reported that these cases have greater deficits in controlling eye movement.
This abnormality could be attributed to failure of SP to approximate target speeds. So, saccades are used to attain foveation of targets (Lencer & Trillenberg, 2008).

This also suggests the presence of postural proprioceptive influence generated from upper cervical spine (Mclain, 1994).

SPNT difference showed greater values in patients with neck problems than control and this is consistent with Treleaven, et al., (2005).
As regards the phase, group I showed no significant difference between different positions (phase lead).

This could be explained by the predictable nature of sinusoidal stimuli. This predictability is a higher cortical function and it means an anticipatory smooth eye movement during tracking of sinusoidal targets (Salman et al., 2005).

In group II, there was no significant difference in phase in the neutral position.

In SPNT positions, there was a significant phase lag when compared with control.
These phase abnormality could be explained by retinal errors that occurred in neck torsioned position.

These errors are corrected by saccades that are generated to bring the target closer to the fovea.

Alternatively, these phase errors could be simply due to gain reduction of eye velocity without any true phase lag (Lencer and Trillenberg, 2008).

Mean of phase in the control and study subgroups in different positions of the neck.
Normal and abnormal SPNT.

<table>
<thead>
<tr>
<th>Subgroup</th>
<th>Gain</th>
<th>Phase</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>IIa</td>
<td>86%</td>
<td>81%</td>
</tr>
<tr>
<td>IIb</td>
<td>90%</td>
<td>91%</td>
</tr>
<tr>
<td>Sensitivity</td>
<td>63%</td>
<td></td>
</tr>
<tr>
<td>Specificity</td>
<td>80%</td>
<td>57%</td>
</tr>
<tr>
<td>Specificity</td>
<td>80%</td>
<td>66%</td>
</tr>
</tbody>
</table>
SPNT seems to be useful for diagnosing subjects with cervical spondylosis who do and who do not complain of dizziness.

It also revealed that patients with dizziness have greater deficits in control eye movements which may be related to error in neck proprioceptive activity.
SPNT is simple, painless and easy to perform in a relatively short period using standard oculomotor test equipment.

This test appears to be able to differentiate neck injured patients from healthy subjects or those complaining of dizziness due to vestibular disorders.
SPNT could be recommended to be used as a fast tool for assessing subjects suspected to have cervical dizziness even asymptomatic ones.