بسم الله الرحمن الرحيم

الحمد لله رب العالمين

صدق الله العظيم

(الفتح ١)

Influence of Cervicocephalic Kinesthetic Sensibility on Postural Control and Vertebral Artery Blood Flow in Cervical Discogenic Lesions

تأثير الإحساس الحركى العنقي على إتزان القوام وتدفق الدم في الشريان الفقاري في اصابات الغضاريف العنقية

INTRODUCTION

Cervical radiculopathy is a pathologic process involving the nerve root, arising from disk herniation, spondylosis, tumor, or trauma causing nerve root avulsion ***(Carette and Fehlings, 2005).***

Cervical radiculopathy had an influence on dynamic balance as it impairs performance on balance tests such as computerized posturography ***(James, 2000).***

- ***Cervical kinesthetic sensibility*** is the sensation and awareness of active or passive cervical movements

- Impaired Cervical kinaesthesia appears with CR especially with a higher degree of pain and ***(Armstrong et al., 2005)*** .

Rehabilitation programmes including kinaesthetic exercises have resulted in an improvement of not only kinaesthetic sensibility, but also in an alleviation of neck complaints *(De Hertogh et al., 2007; Field et al., 2008).*

Cervical collars have been prescribed to relieve symptoms of pain and muscle spasm or to limit neck movement ***(Thomas et al., 2003).***

Physiotherapists cautionary advice that wearing the collar may affect balance, especially when vision and vestibular systems are affected.

Statement of the Problem

- What is the impact of alteration of cervicocephalic kinesthetic sensibility by decreasing it by wearing cervical collar and increasing it, by specific cervical proprioceptive training on postural control and cervical arterial blood flow in patients with cervical discogenic radiculopathy?

Purposes of the Study were to dertermine the effects of

1- Wearing standard hard cervical collar for four weeks on postural control in patients with cervical discogenic radiculopathy

Purposes of the Study Cont.....

2- Wearing standard hard cervical collar for four weeks on vertebral artery blood flow in patients with cervical discogenic radiculopathy.

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Purposes of the Study Cont.....

3- Selected cervical proprioceptive training on postural control in patients with cervical discogenic radiculopathy

SUBJECTS, MATERIALS, AND METHODS

A. Subject Selection

- Thirty six patients diagnosed as having cervical radiculopathy due to disc herniation participated in this study.
- Patients were randomly allocated to one of two equal groups (A and B) of 18 patients each on the basis of the first visit.
- Their age ranged from 35 -50 years.
- None of the selected patients wore a cervical collar before this study.

Subject Selection (cont.....)

All of the selected patients had the following: 1-Neck pain.

2-Limitation of neck movements.

3-Evidence of cervical radiculopathy (manifested by sensory, motor and reflex changes).

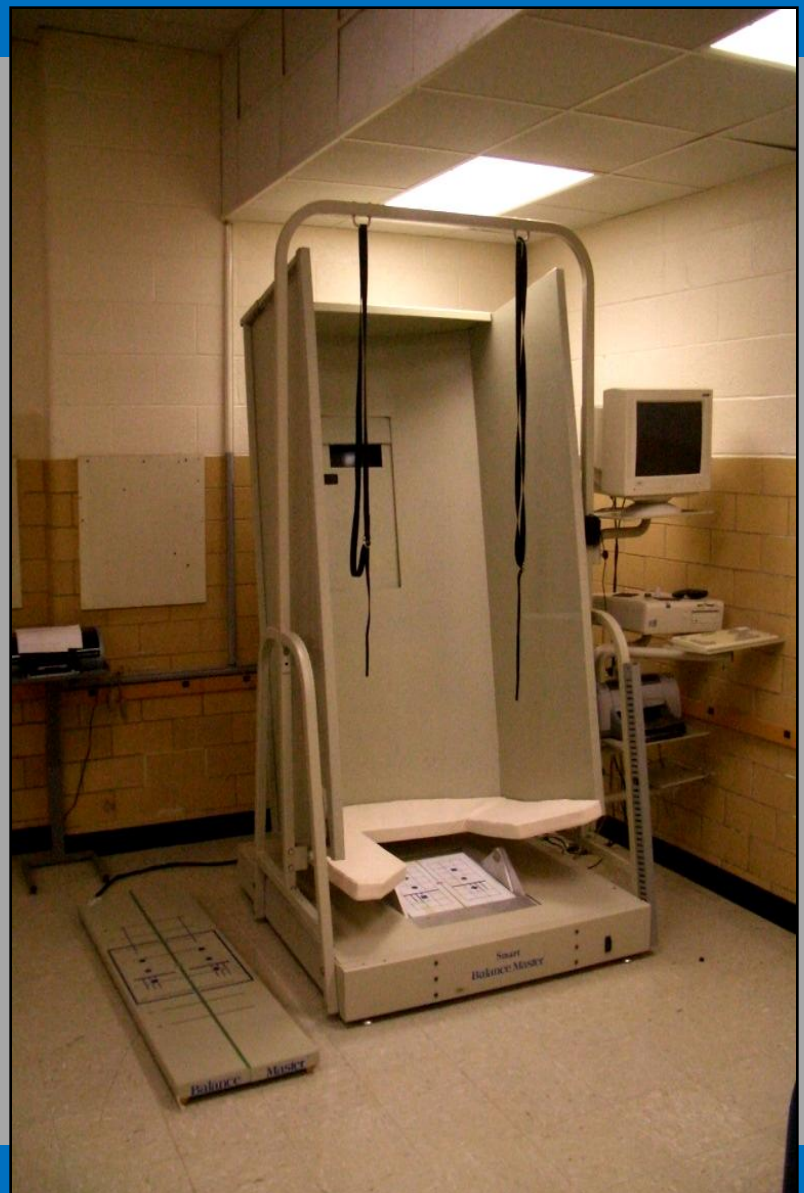
Exclusion Criteria.....

- Presence of any neurological disorder affecting postural stability.
- Previous history of vertebrobasilar insufficiency (VBI).
- Cervical myelopathy with evidence of pyramidal, posterior column, or/and spinothalamic tracts lesions.
- History of frequent loss of balance or falling.
- Presence of musculoskeletal disorders including lower limb contractures and fixed deformities especially at the ankle joint.

Instrumentations and Materials

Instrumentations and Materials for evaluation

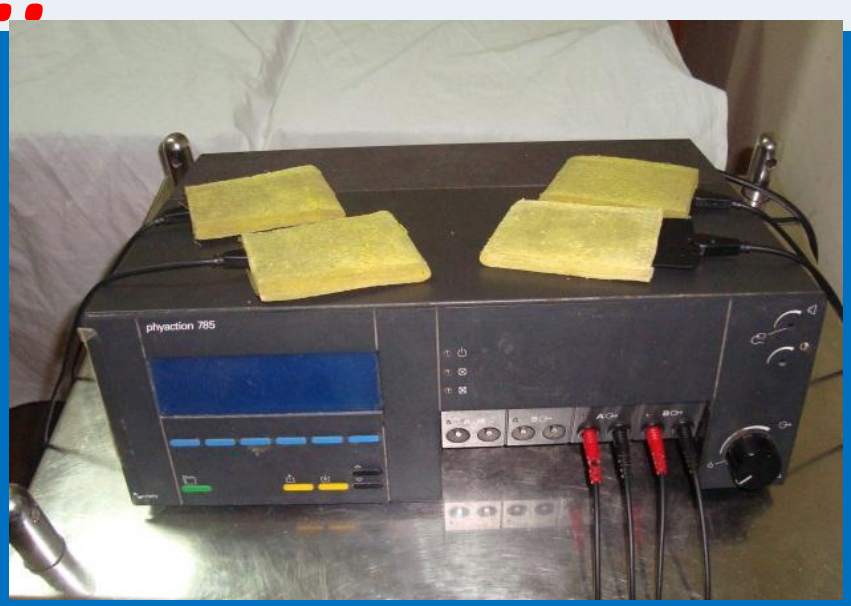
Computerized Dynamic Posturography [Balance master version 7.0.4]



Cervical range of motion goniometer (CROM)

Colour pulsed doppler ultrasonographic apparatus (Phillips HDI 5000)

Instrumentations and Materials for Treatment……..



US *TENS*

Electrotherapy modalities

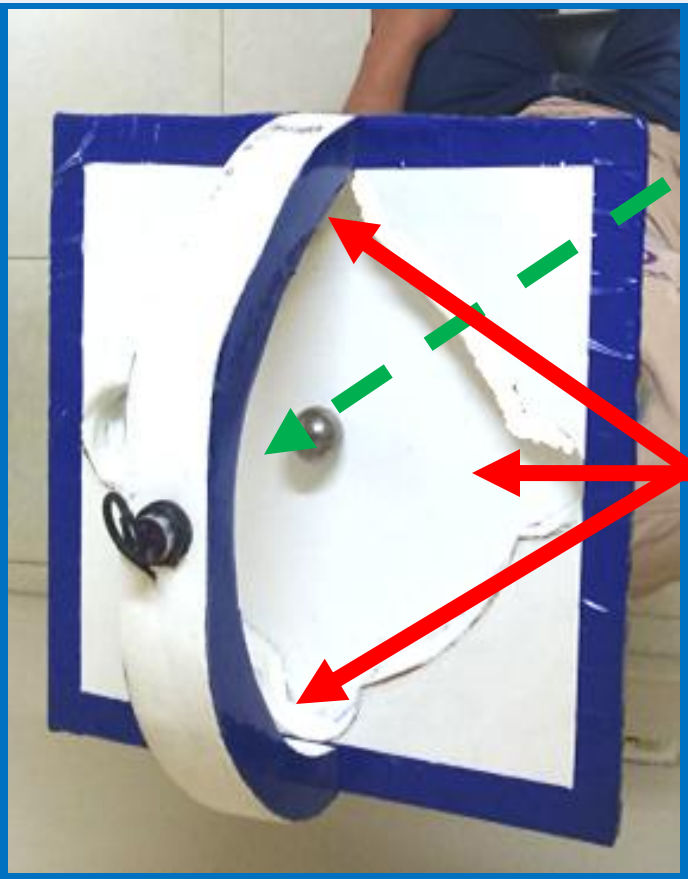
Instrumentations and Materials for Treatment Cont……..

hard collar

Balance and strengthening exercises materials……

Swiss ball *Foam block* *Theraband* *Sandbags*

Neck coordination exercise device……..



C. Procedures

1. All the patients in both groups (A and B) were assessed for postural control by the limits of stability test (LOS); the modified clinical test of sensory interaction on balance (MCTSIB) ; and tandem walk test (TWT) which was assessed by the NeuroCom Balance Master.
2. The vertebrobasilar insufficiency was assessed by duplex Doppler ultrasound immediately before and after wearing the collar for the selected duration (four weeks).

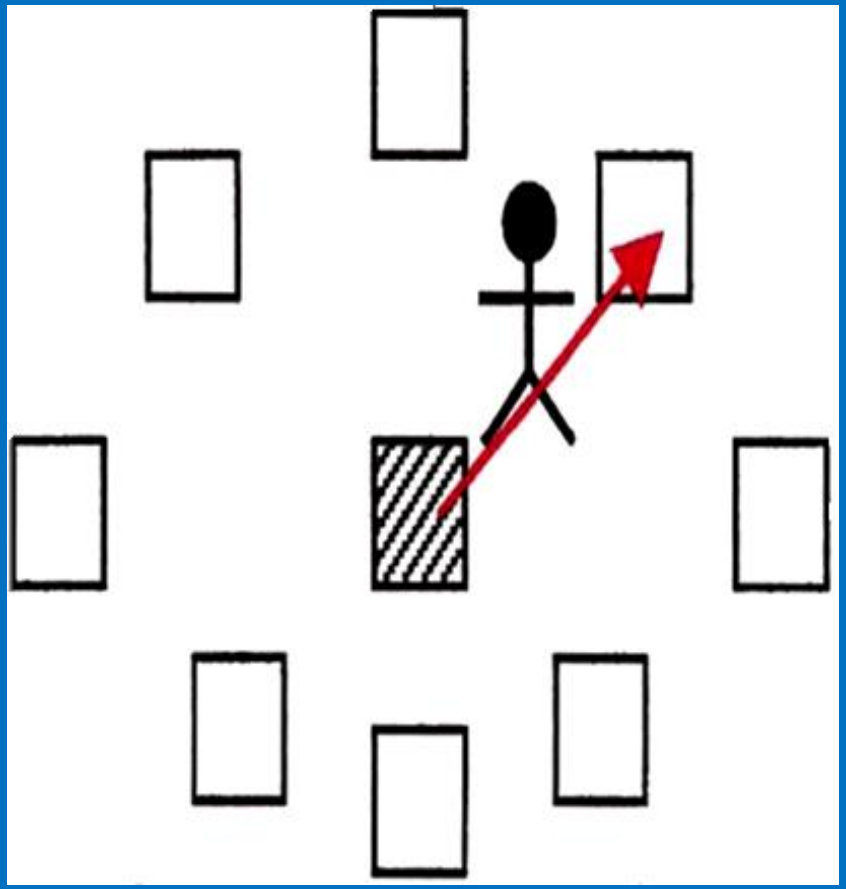
C. Procedures Cont……

3.Cervical proprioception was measured by cervical position sense test (CPST) using cervical range of motion (CROM) goniometer

The examination protocols

Postural control

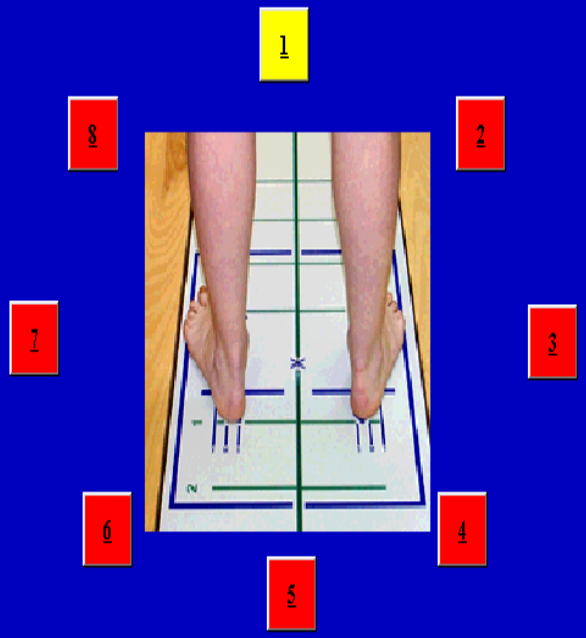
2- Testing protocol for Limits of Stability (LOS) test



- **The measured parameters in eight directions were:**
  - Reaction Time
  - Movement velocity
  - End point excursion
  - Maximum excursion
  - Directional control

LIMITS OF STABILITY

Align medial malleolus to wide blue line and lateral calcaneous to "M" line.

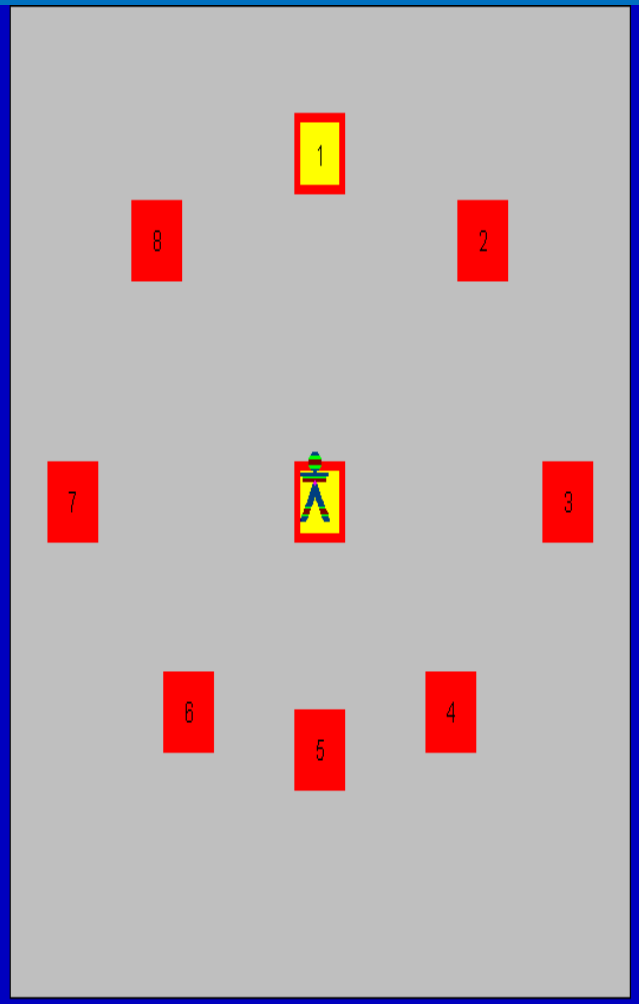


Forward

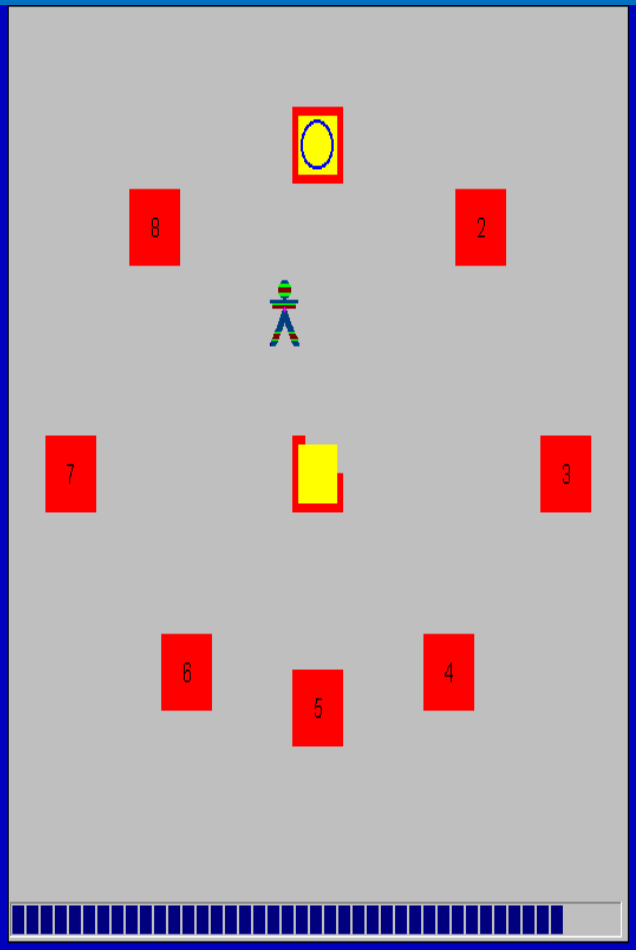
Click on Start button to start.

Auto Advance

Start | Next Test | Assessment Menu | Main Menu

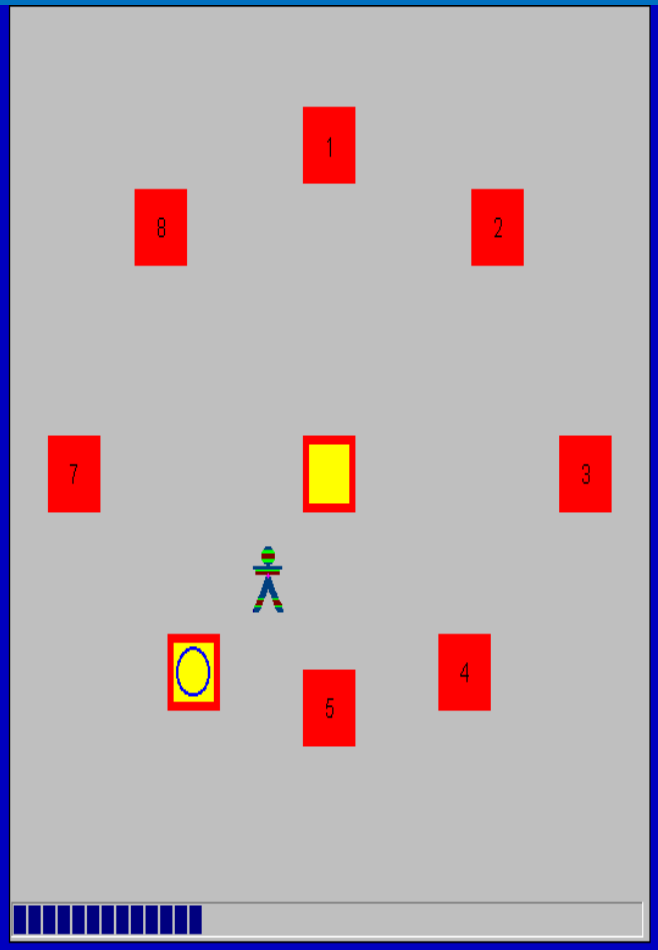


Keep Cursor in Center Target, Click on A Mouse Button to Score.



Go and Move Cursor to Target.

Press any key or click on a mouse button to interrupt



Go and Move Cursor to Target.

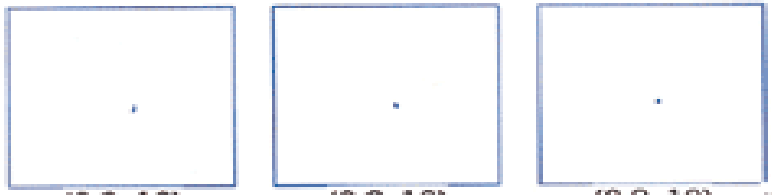
Press any key or click on a mouse button to interrupt

2- Testing protocol for Modified Clinical Test of Sensory Interaction on Balance (MCTSIB):

The measured parameter ***COG sway velocity:*** The movement of the COG was measured for ten seconds per trial, and the amount of sway was expressed in degrees per second.

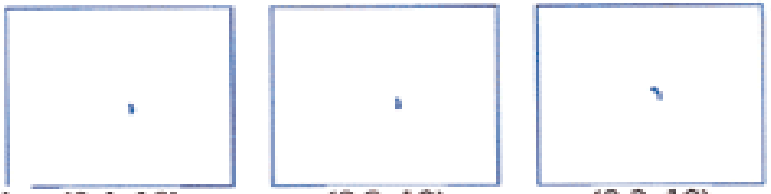
Modified CTSIB

1. Firm--Eyes Open (FIRM-EO)



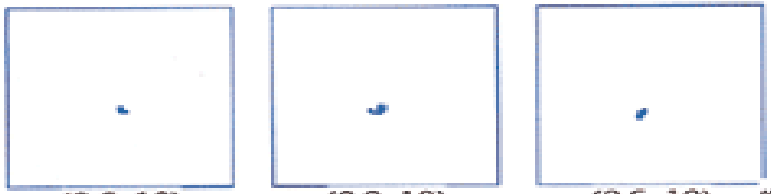
(0.2, 10) Trial 1 | (0.2, 10) Trial 2 | (0.2, 10) Trial 3

2. Firm--Eyes Closed (FIRM-EC)



«(deg/sec)» (0.4, 10) Trial 1 | (0.3, 10) Trial 2 | (0.3, 10) Trial 3

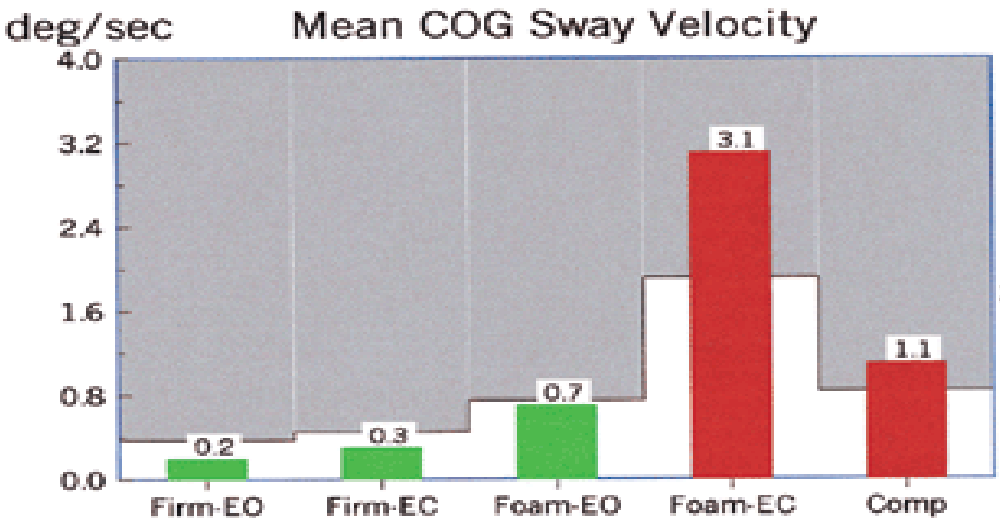
3. Foam--Eyes Open (FOAM-EO)

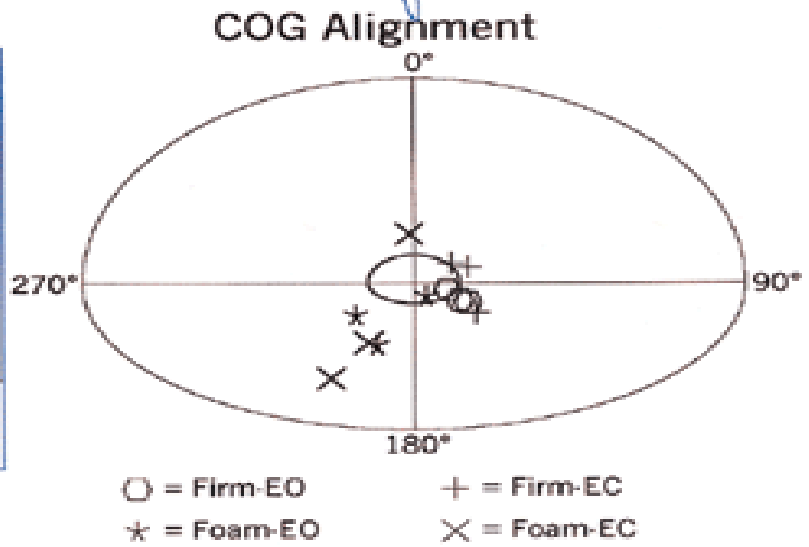


(0.6, 10) Trial 1 | (0.9, 10) Trial 2 | (0.6, 10) Trial 3

4. Foam--Eyes Closed (FOAM-EC)

«(deg/sec)» (1.7, 10) Trial 1 | (FALL, 10) Trial 2 | (1.7, 10) Trial 3





COG Alignment:
Left/Back, 28%LOS @224.1 degree

2- Testing protocol for ***Tandem walk test (TWT)***

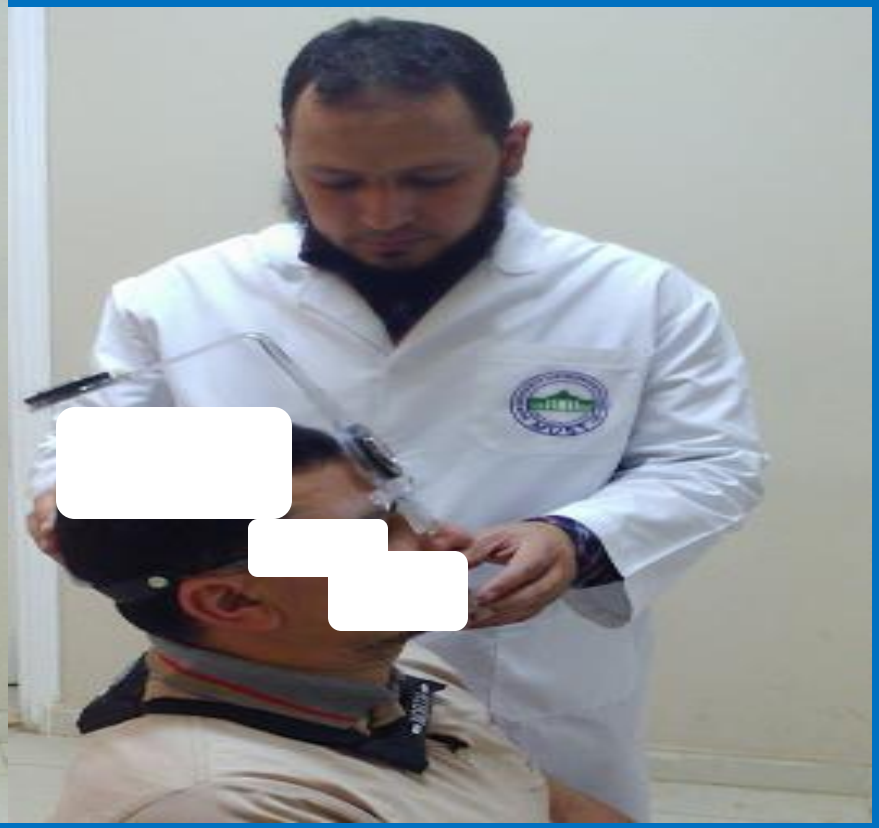
The measured parameters

Step width: the lateral distance in centimeters between the left and right feet on successive steps.

Speed: the velocity in centimeters per second of the forward progression.

Cervical proprioception

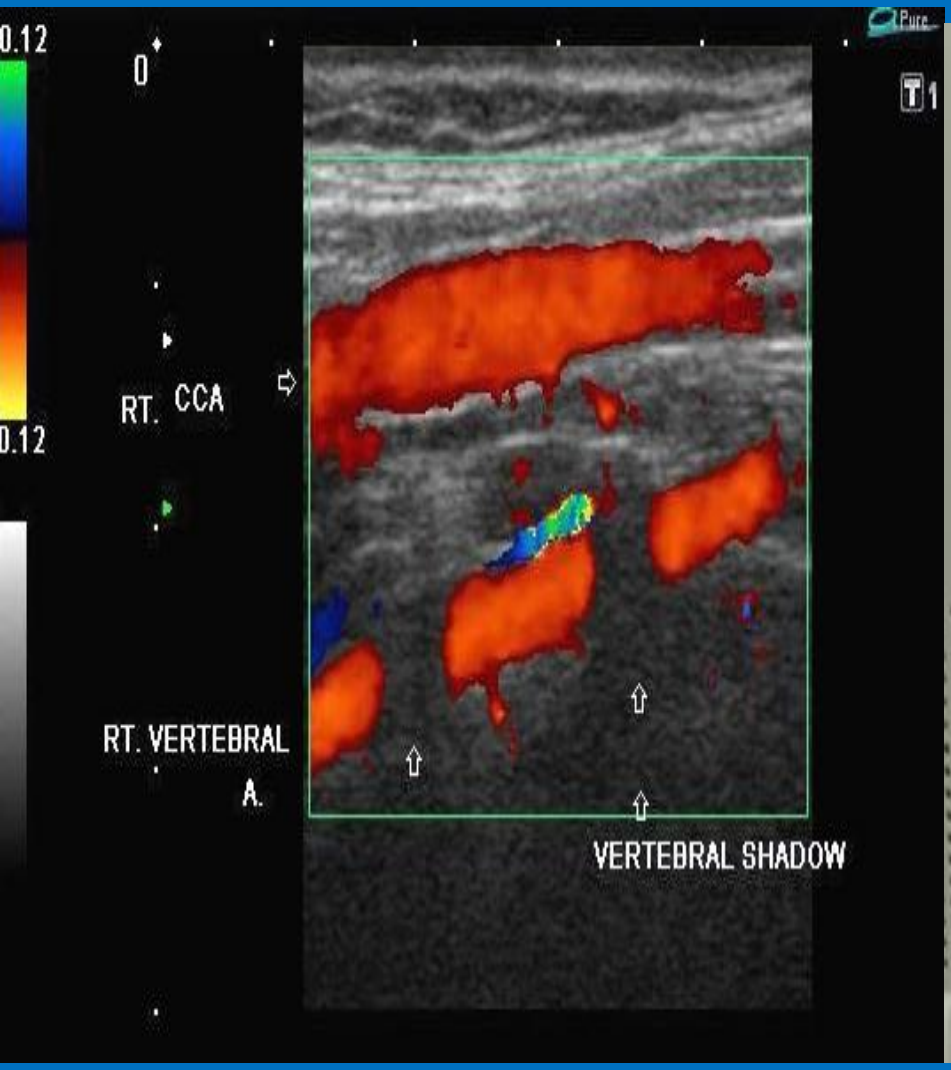
*2- Testing protocol for **cervical position sense test (CPST) by CROM***



Vertebral artery blood flow

*2- Testing protocol for **vertebral artery blood flow:***

Blood flow velocity was measured at initial ventricular contraction yielding the peak systolic velocity (PSV) and at the end of ventricular contraction yielding the end diastolic velocity (EDV).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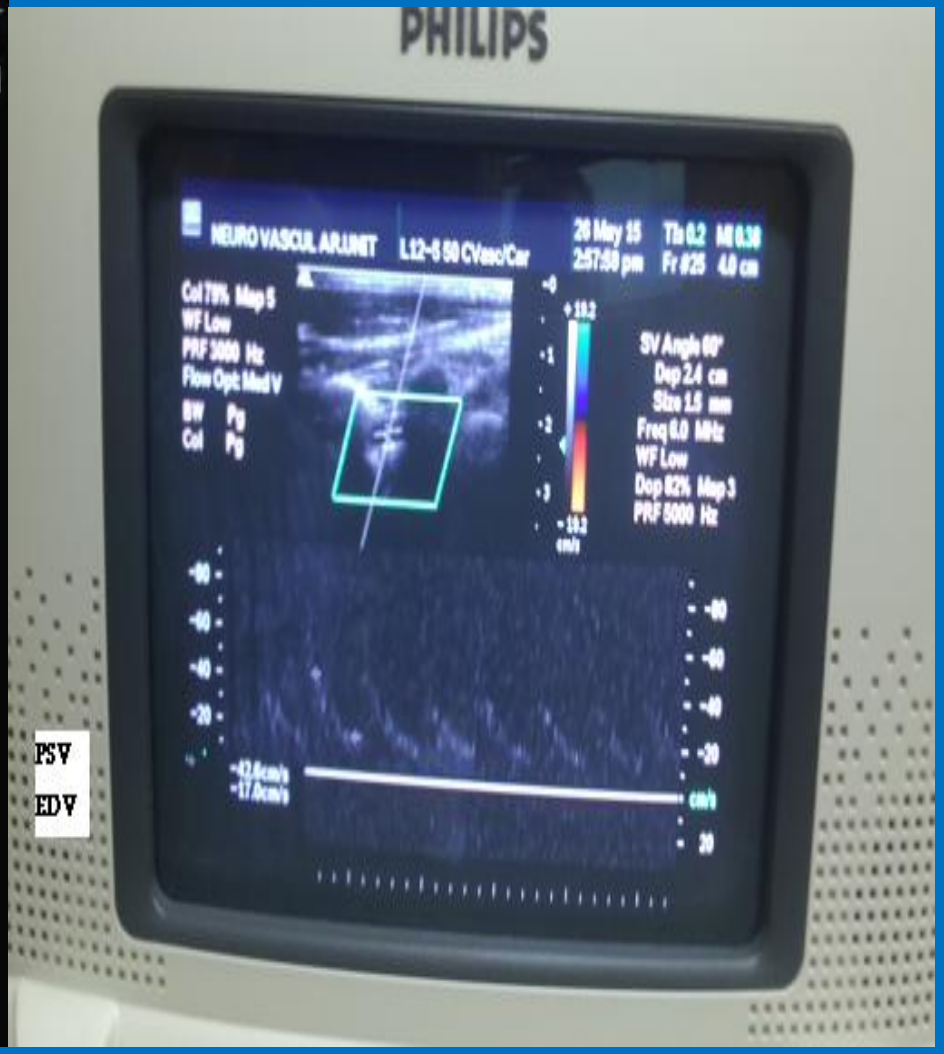
A.
VERTEBRAL SHADOW


PHILIPS
NEURO VASCULAR UNIT
PSV
EDV

Treatment protocols

Treatment procedures……

- All the patients in both groups (A and B) wore standard hard collar at all daytimes and take it off at the time of sleep and received three sessions per week every other day for four weeks.

Group A

- Patients of group A wore standard hard collar and received conservative physical therapy modalities.

Group B

- Patients of group B wore standard hard collar and received conservative physical therapy modalities in addition to cervical proprioceptive rehabilitation program in the form of

1- Strengthening exercises,

2- balance exercises and

3- oculomotor and head/eye exercises.

4- neck coordination training,

Strenathenina exercises

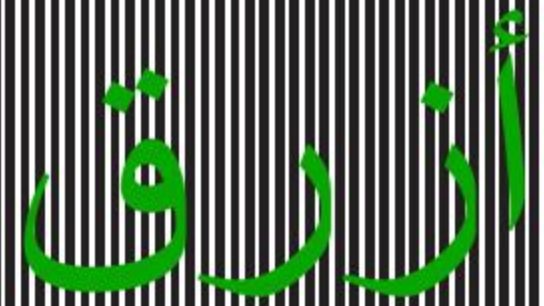
Oculomotor and head/eye exercises:

Head to target

Eye to target

Eye to target on a swiss ball

Saccadic eye movements:



Saccadic eye movements Cont...

أخضر

Balancing exercises

Neck coordination exercise:

Starting position

End position

RESULTS

Postural Control
Limits of Stability test LOS
Group A

	Pre Mean± standard deviation	Post Mean± standard deviation	Mean difference	Percentage of change	p-value
EPE (%)	74.88 ± 4.82	72.22 ± 8.44	2.66	3.55	0.09
MXE (%)	82.55 ± 8.31	80.11 ± 9.73	2.44	2.95	0.38
DCL (%)	65.55 ± 7.95	69.44 ± 8.49	-3.89	5.93	0.08
MVL (degree/sec)	2.69 ± 0.49	2.42 ± 0.6	0.27	10.03	0.11
RT (sec)	1.33 ± 0.33	1.53 ± 0.5	-0.2	15.03	0.2

Postural Control

Limits of Stability test LOS Cont...

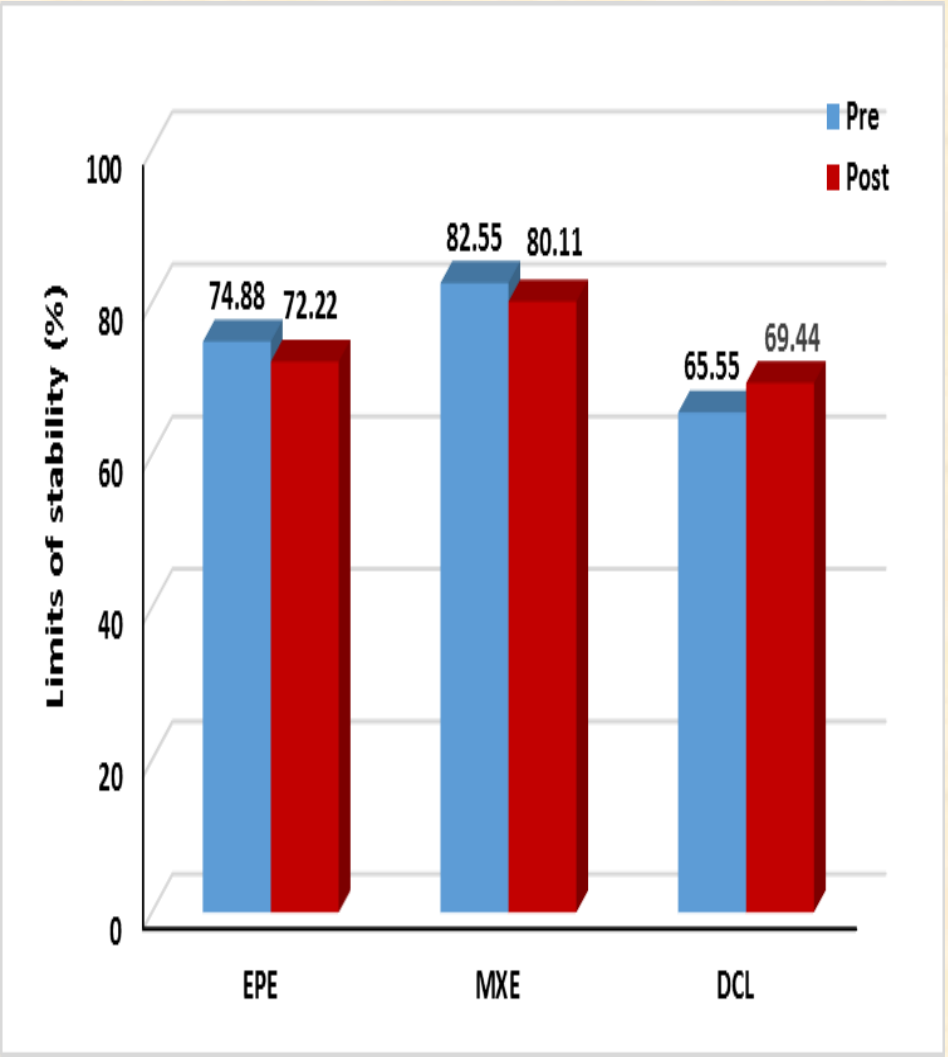
Group B

	Pre Mean± standard deviation	Post Mean± standard deviation	Mean difference	Percentage of change	p-value
EPE (%)	72.16 ± 9.13	82.27 ± 9.95	-10.11	14.01	0.0001*
MXE (%)	80.5 ± 9.99	89.66 ± 9.41	-9.16	11.37	0.0001*
DCL (%)	68.77 ± 8.69	61.55 ± 9.93	7.22	10.49	0.002*
MVL (degree/sec)	2.55 ± 0.7	3.27 ± 0.74	-0.72	28.23	0.001*
RT (sec)	١.45± 0.34	1.33 ± 0.4	0.12	8.27	0.02*

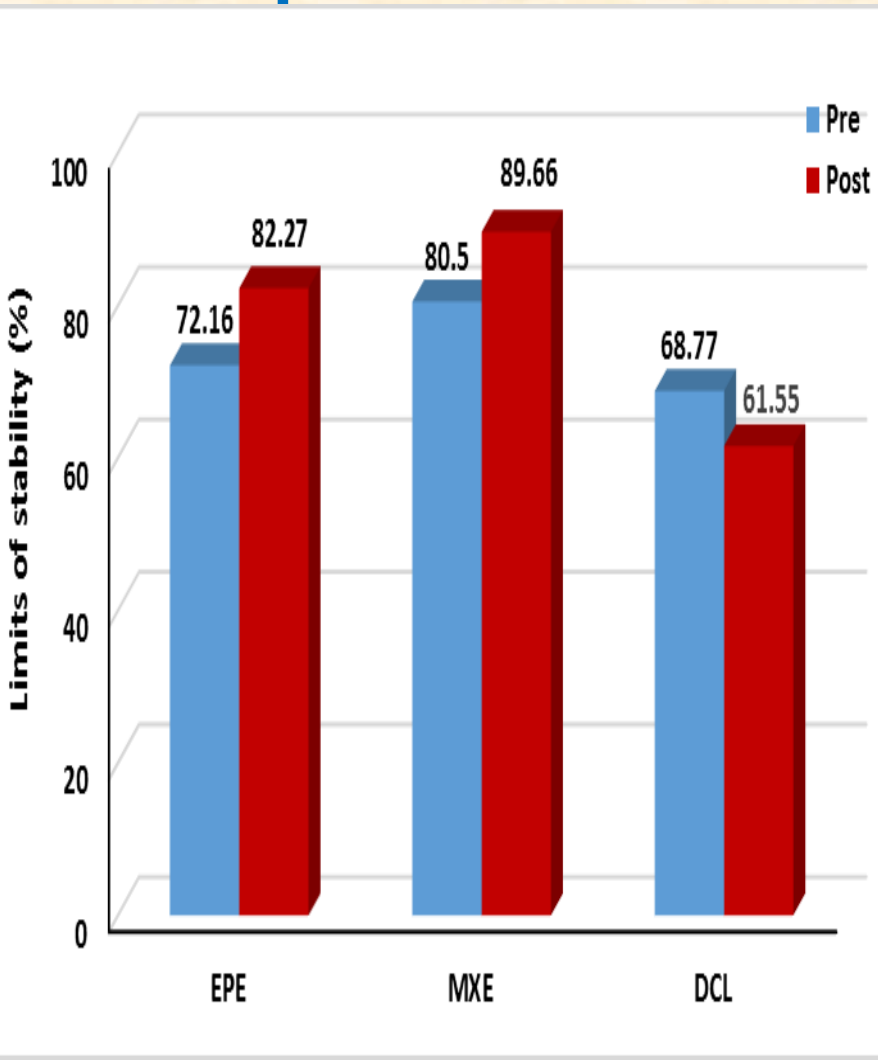
Postural Control

Limits of Stability test LOS Cont...

Group A



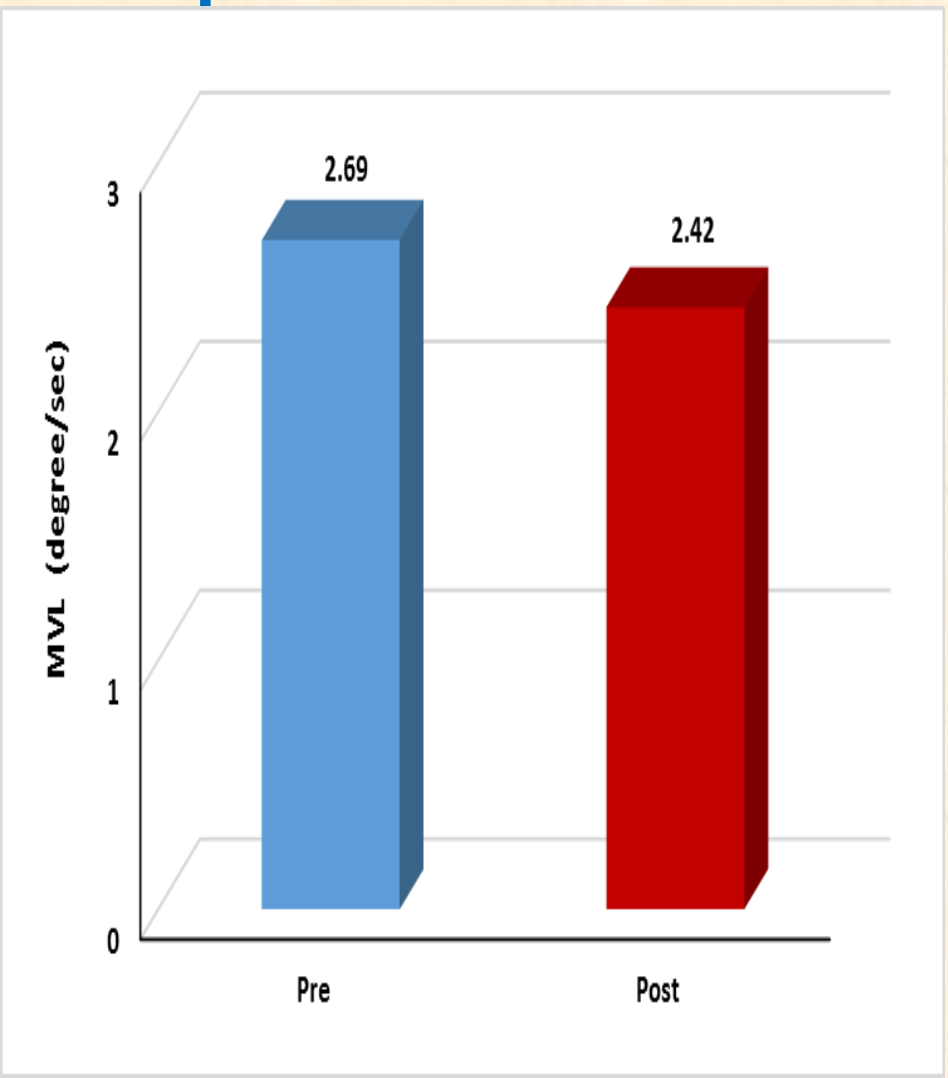
Group B



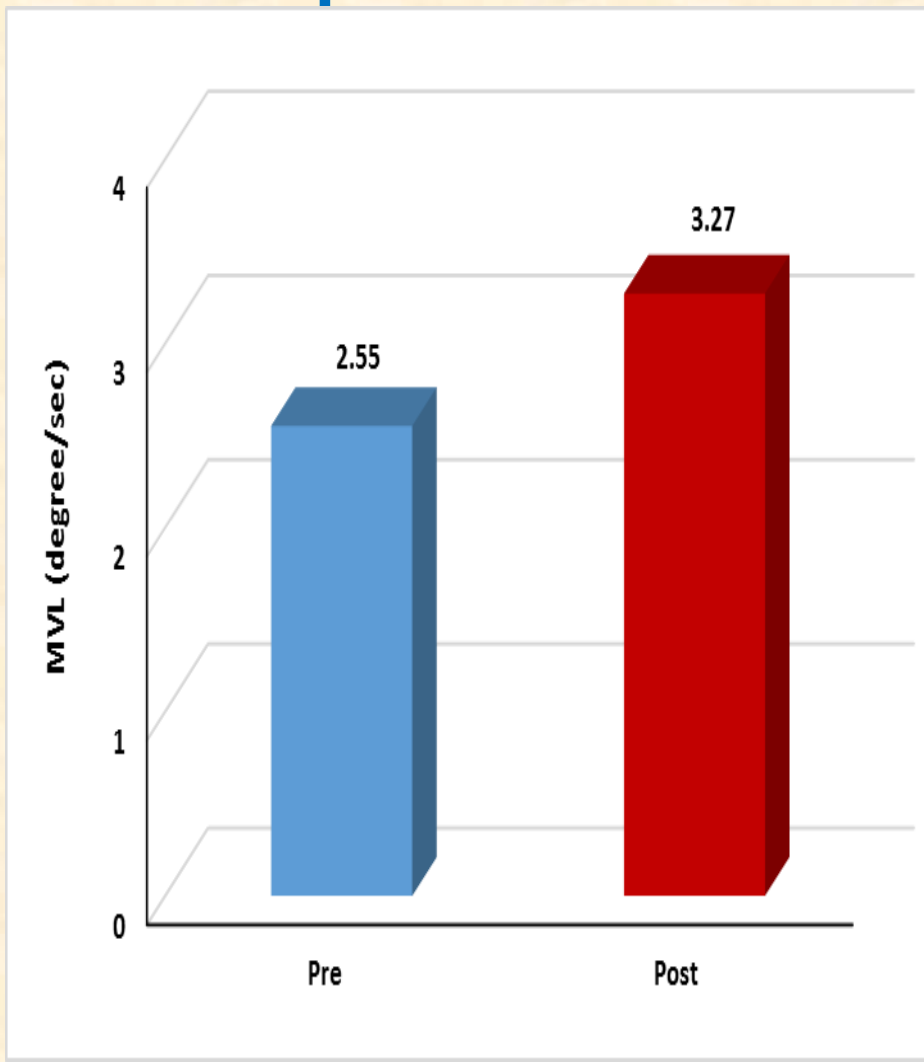
Postural Control

Limits of Stability test LOS Cont...

Group A



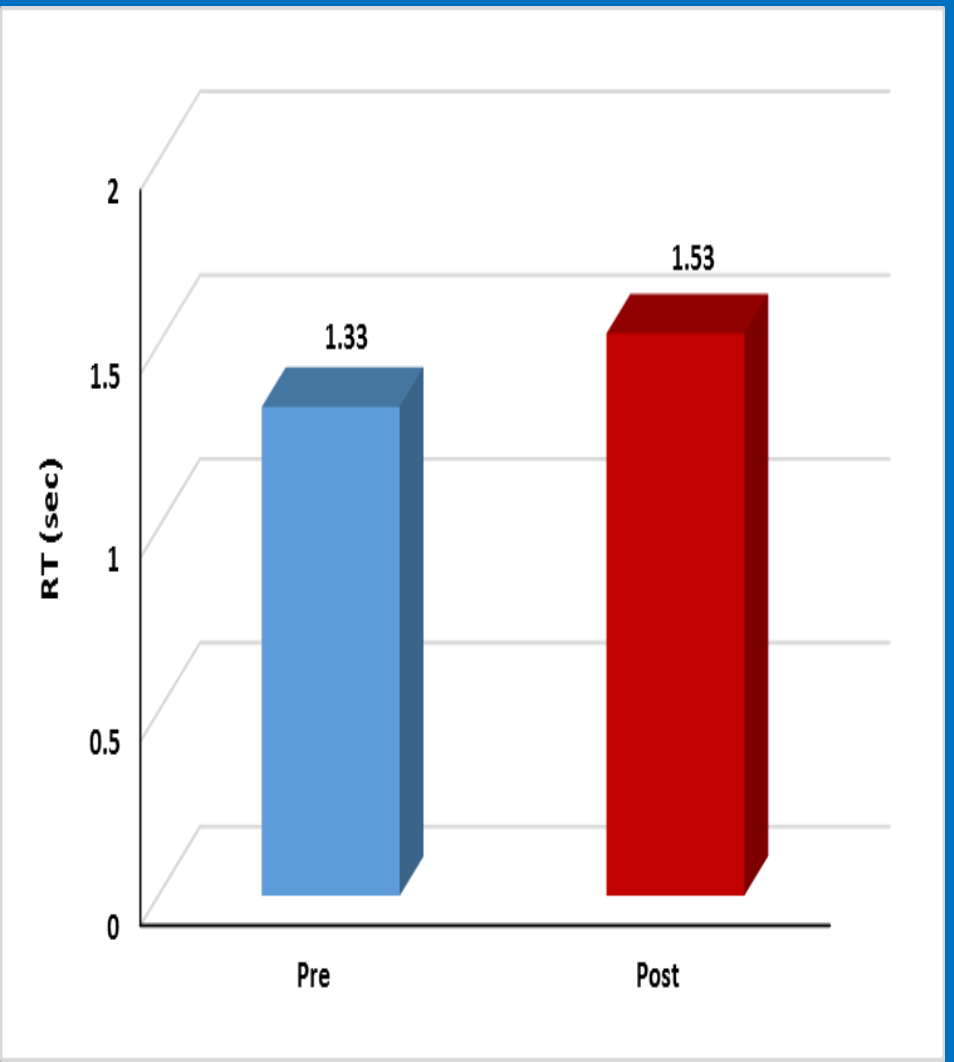
Group B



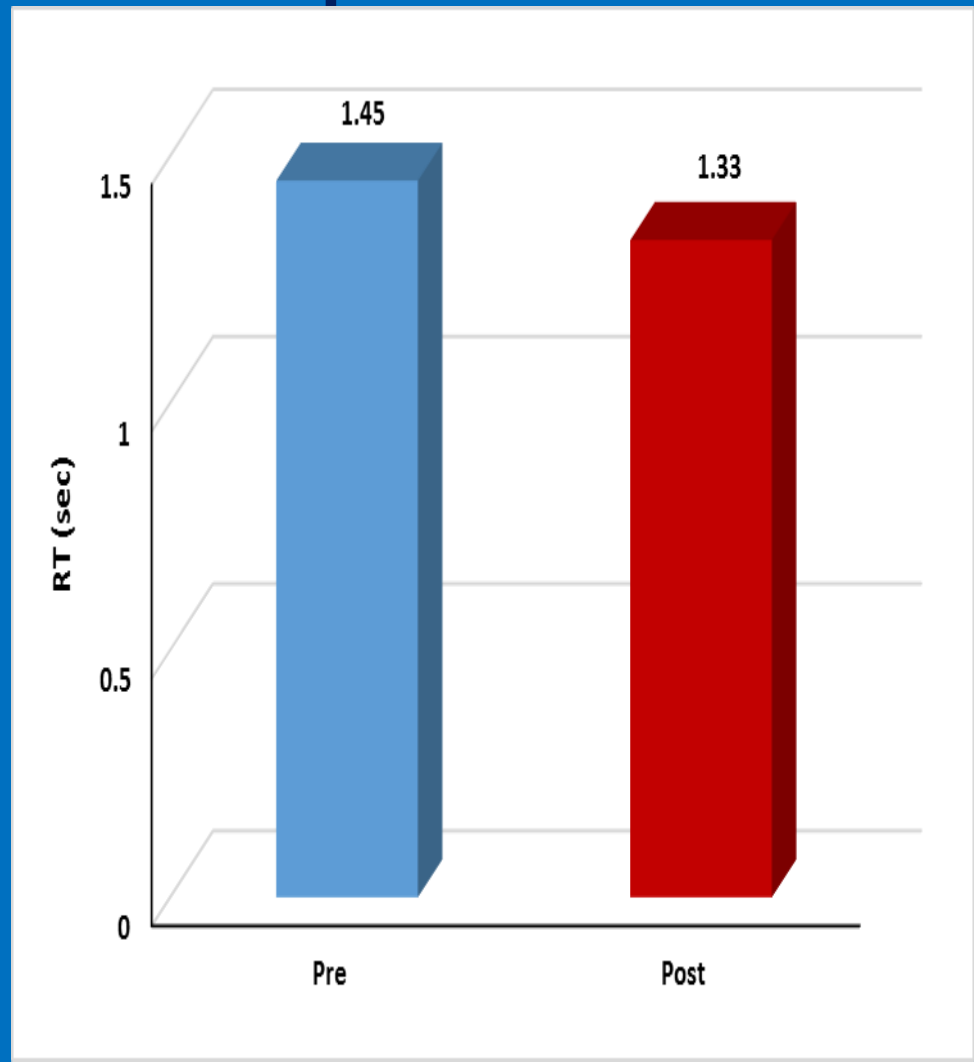
Postural Control

Limits of Stability test LOS Cont...

Group A



Group B



Postural Control

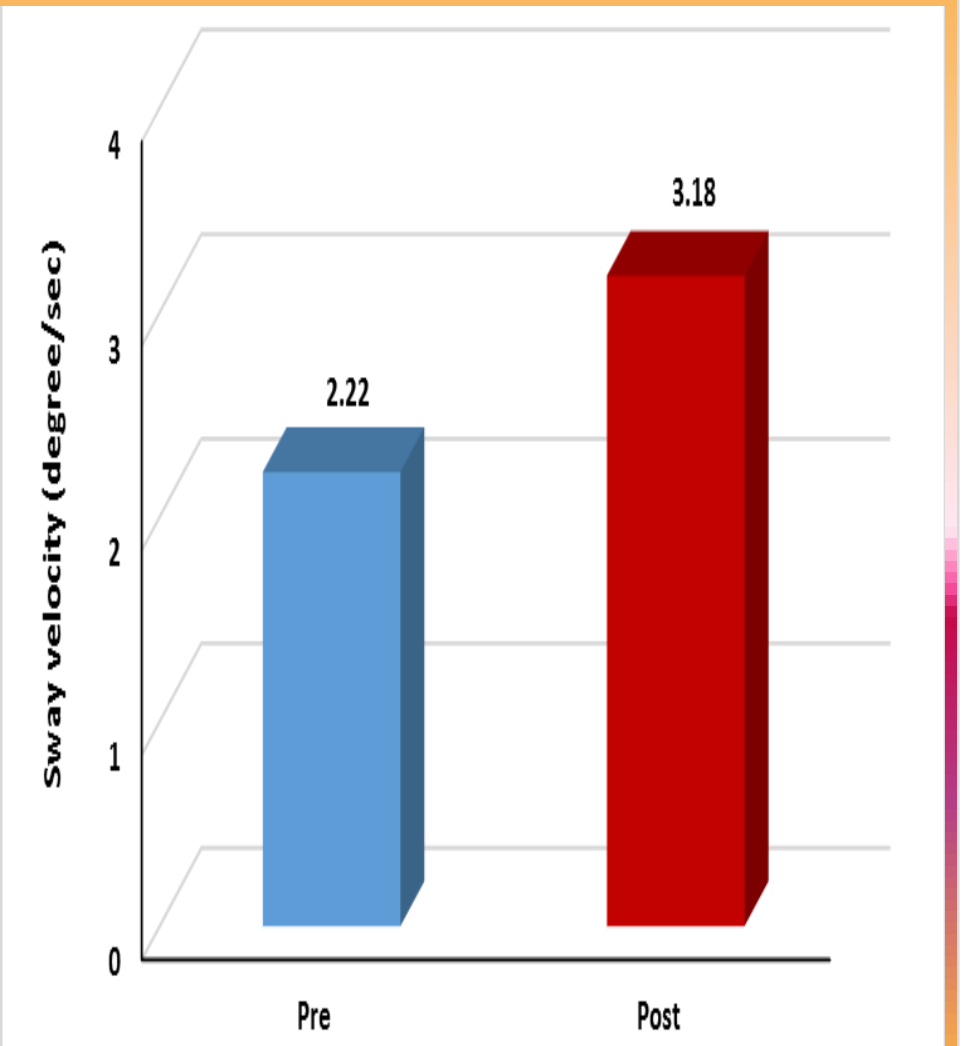
Modified clinical test of sensory interaction on balance (MCTSIB)

COG sway velocity (deg/sec)

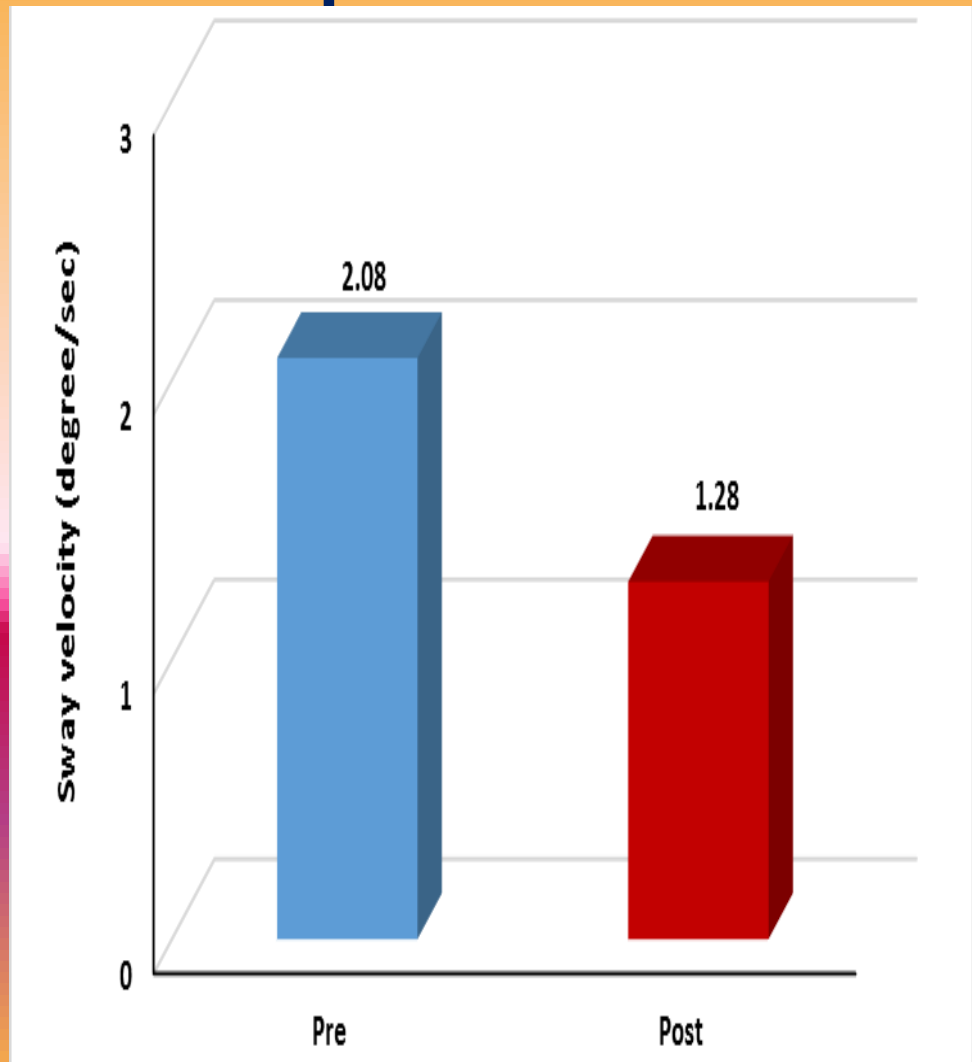
	Pre Mean± standard deviation	Post Mean± standard deviation	Mean difference	Percentage of change	P- value
Group A	2.22 ± 0.89	3.18 ± 0.98	-0.96	43.24	0.0001*
Group B	2.08 ± 0.46	1.28 ± 0.47	0.8	38.46	0.0001*

Modified clinical test of sensory interaction on balance (MCTSIB) Cont…..

Group A



Group B



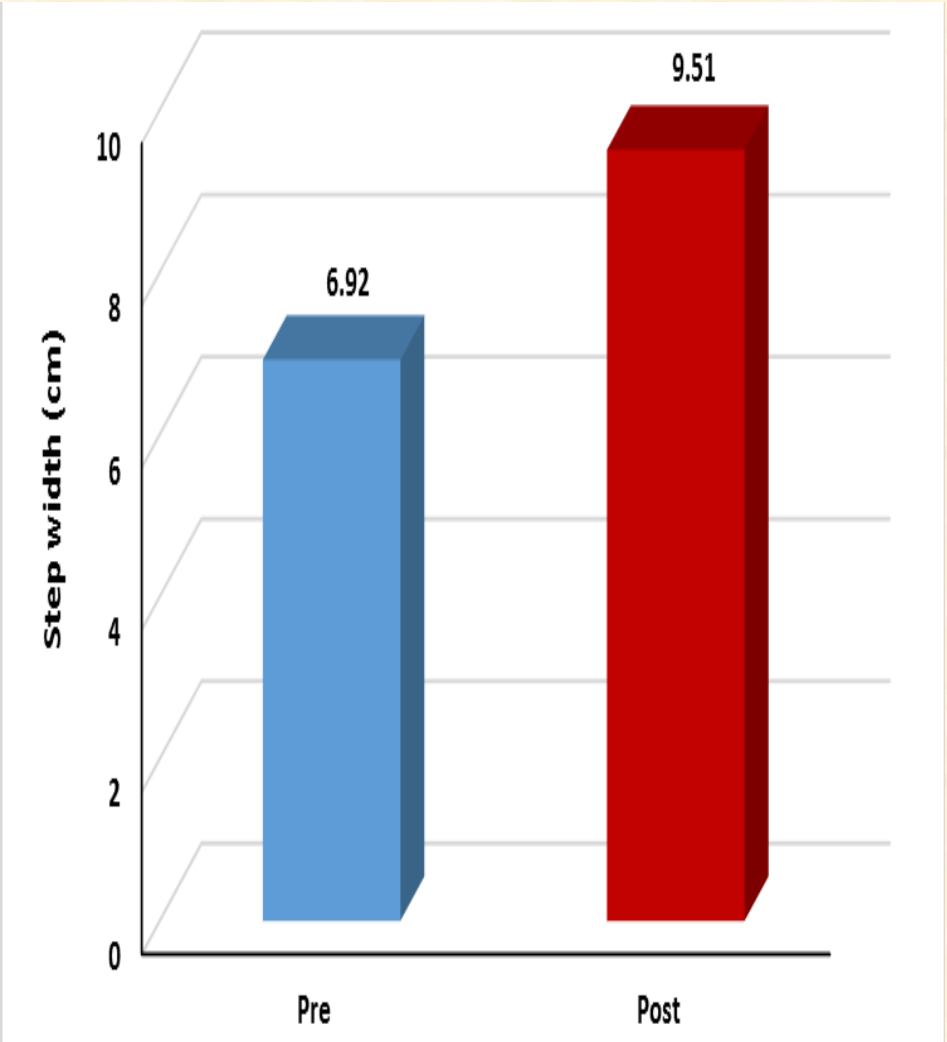
Postural Control

Tandem Walk Test(TWT)

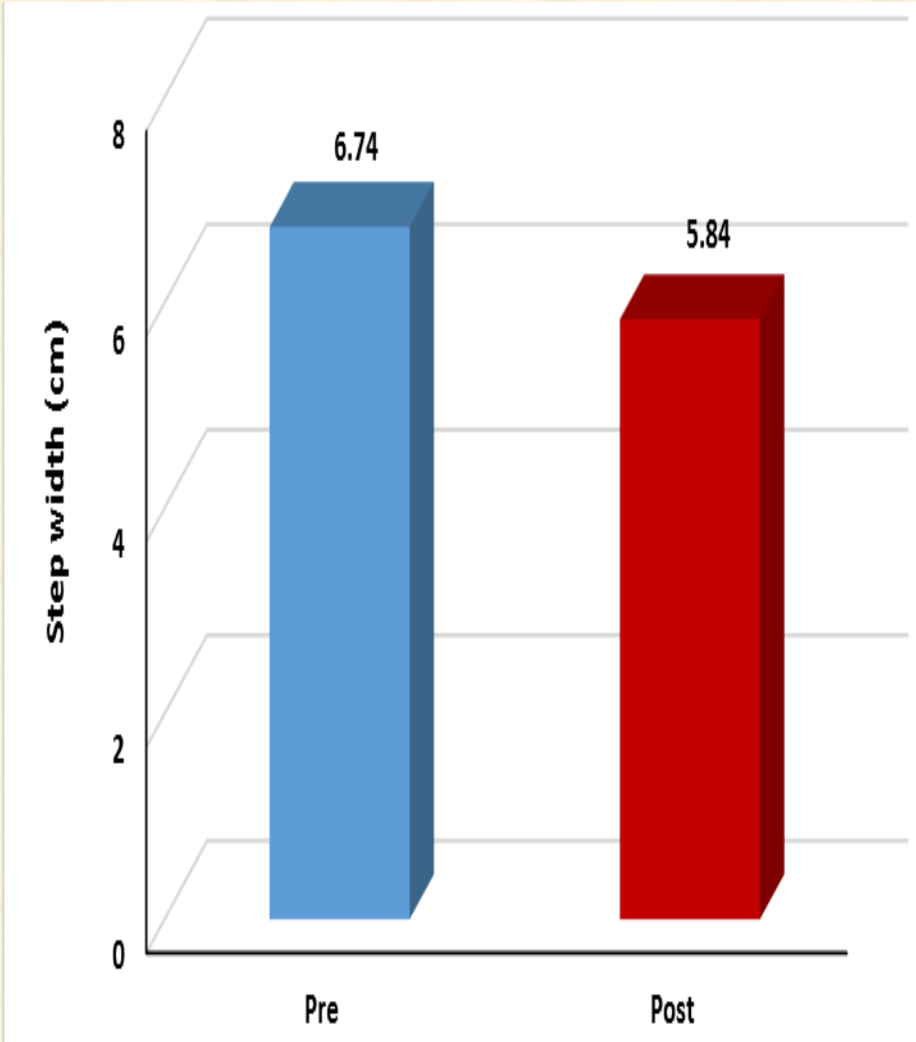
		Pre Mean± standard deviation	Post Mean± standard deviation	Mean difference	Percentage of change	P- value
Group A	Step width (cm)	6.92 ± 1.59	9.51 ± 2.4	-2.59	37.42	0.0001*
	Speed (cm/sec)	11.51 ± 1.82	9.3 ± 2.16	2.21	23.76	0.0001*
Group B	Step width (cm)	6.74 ± 1.1	5.84 ± 1.4	0.9	13.35	0.0001*
	Speed (cm/sec)	12.82 ± 3.27	16.17 ± 3.48	-3.35	26.13	0.0001*

Tandem walk test(TWT) Cont…..
Step width

Group A

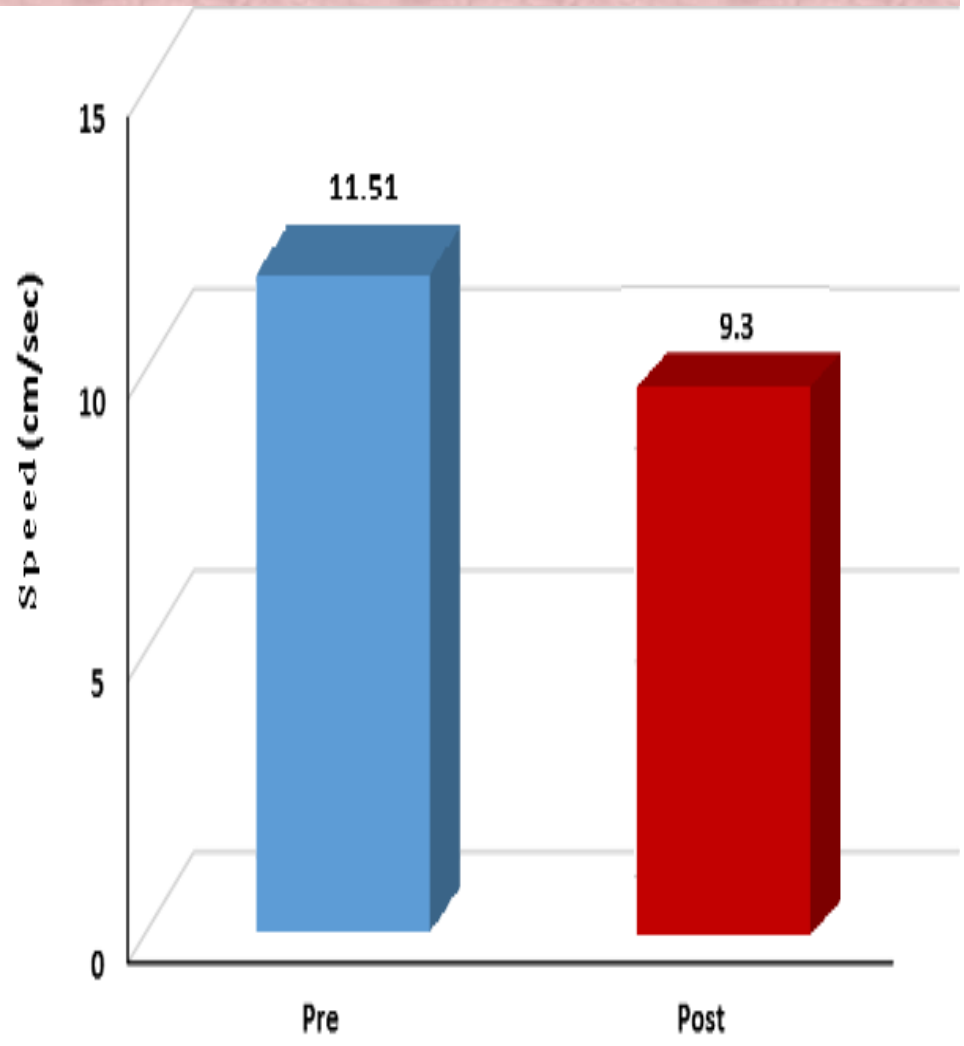


Group B

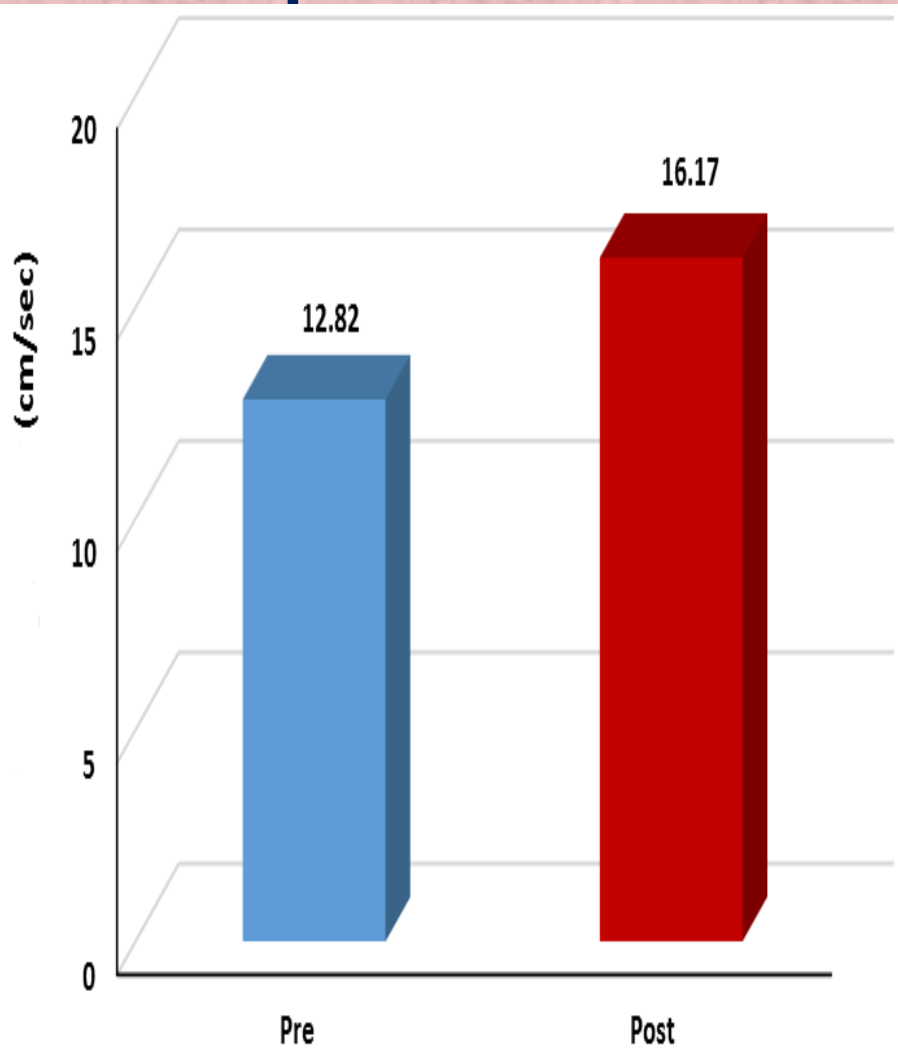


Tandem walk test(TWT) Cont…..
Walking speed

Group A



Group B



Cervical proprioception

Cervical position sense test (CPST)

Cervical proprioception

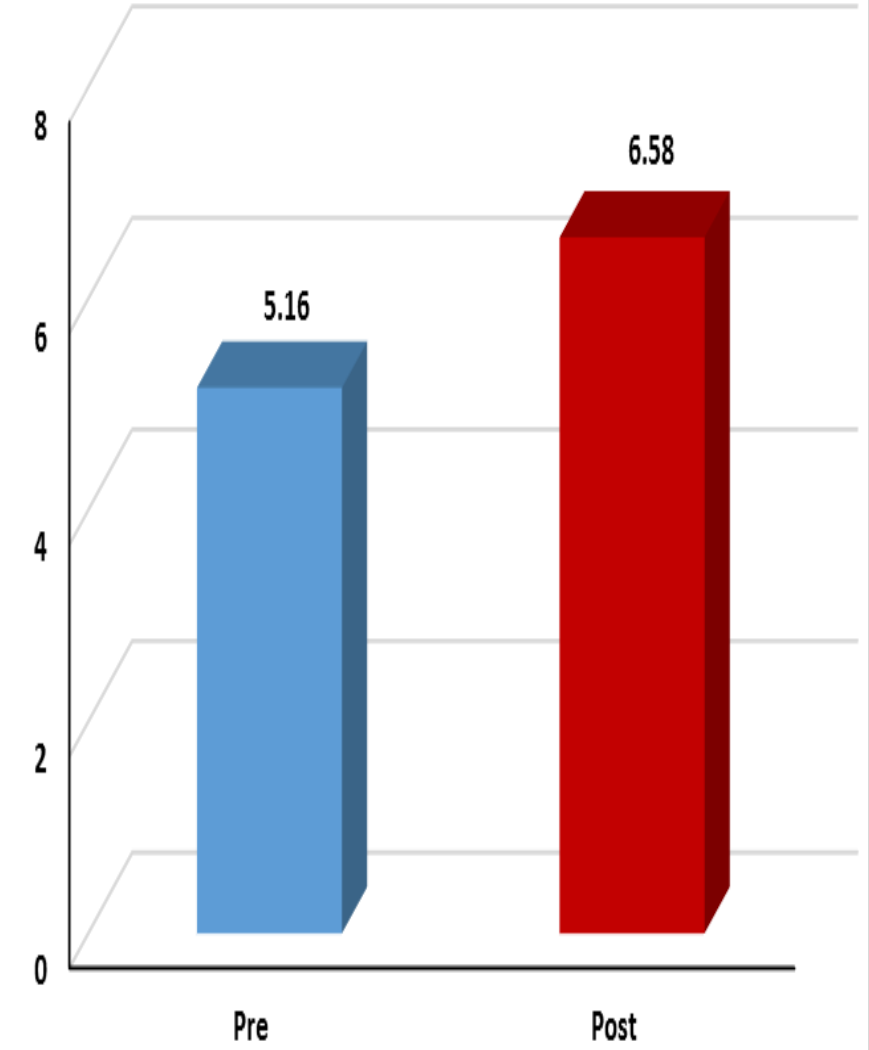
Cervical position sense test (CPST)

Error score (deg)

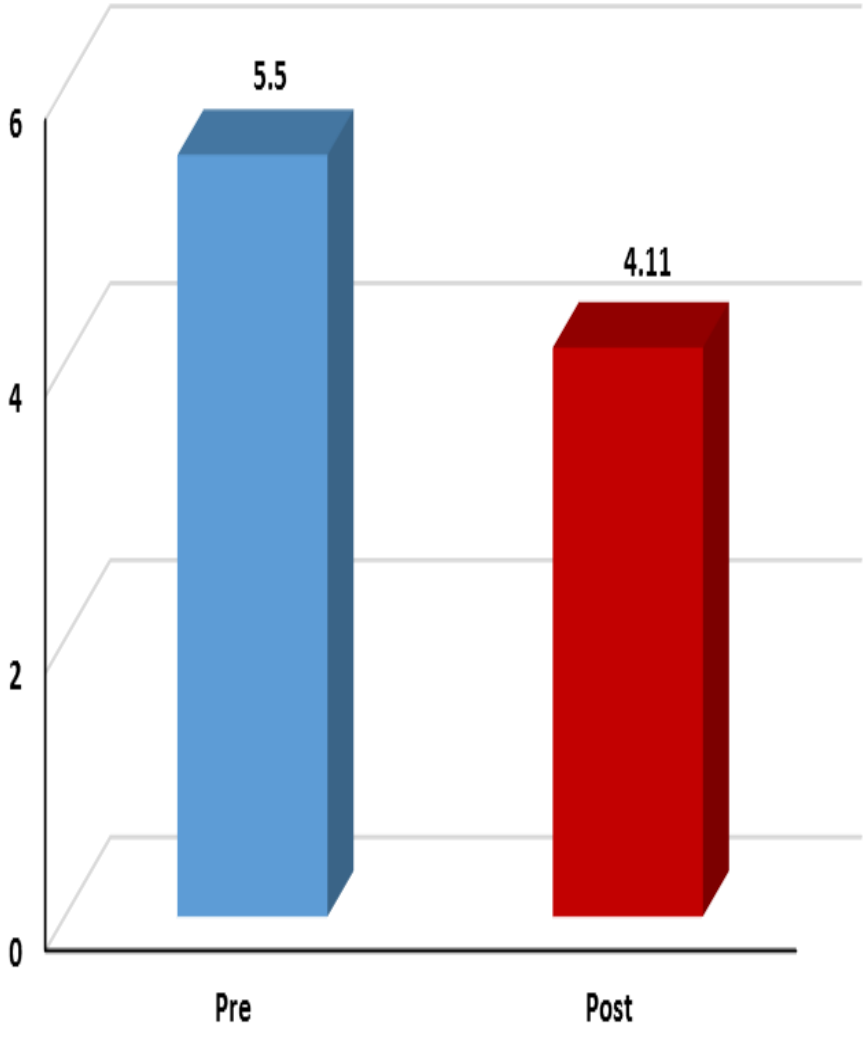
	Pre Mean± standard deviation	Post Mean± standard deviation	Mean difference	Percentage of change	P- value
Group A	**5.16 ± 1.15**	**6.58 ± 1.98**	-1.42	27.51	**0.002***
Group B	**5.5 ± 1.52**	**4.11 ± 2.35**	1.39	25.27	**0.02***

Cervical position sense test (CPST) Cont…..
Error score

Group A



Group B



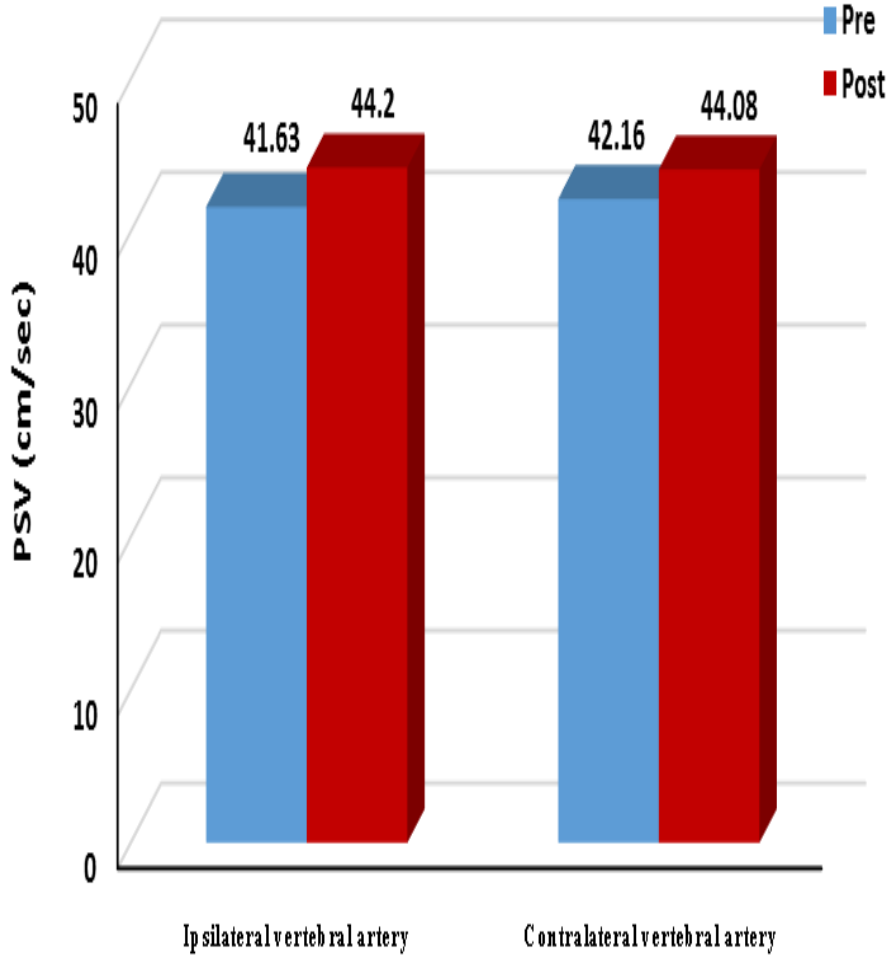
Vertebral artery blood flow

Vertebral artery blood flow Group A

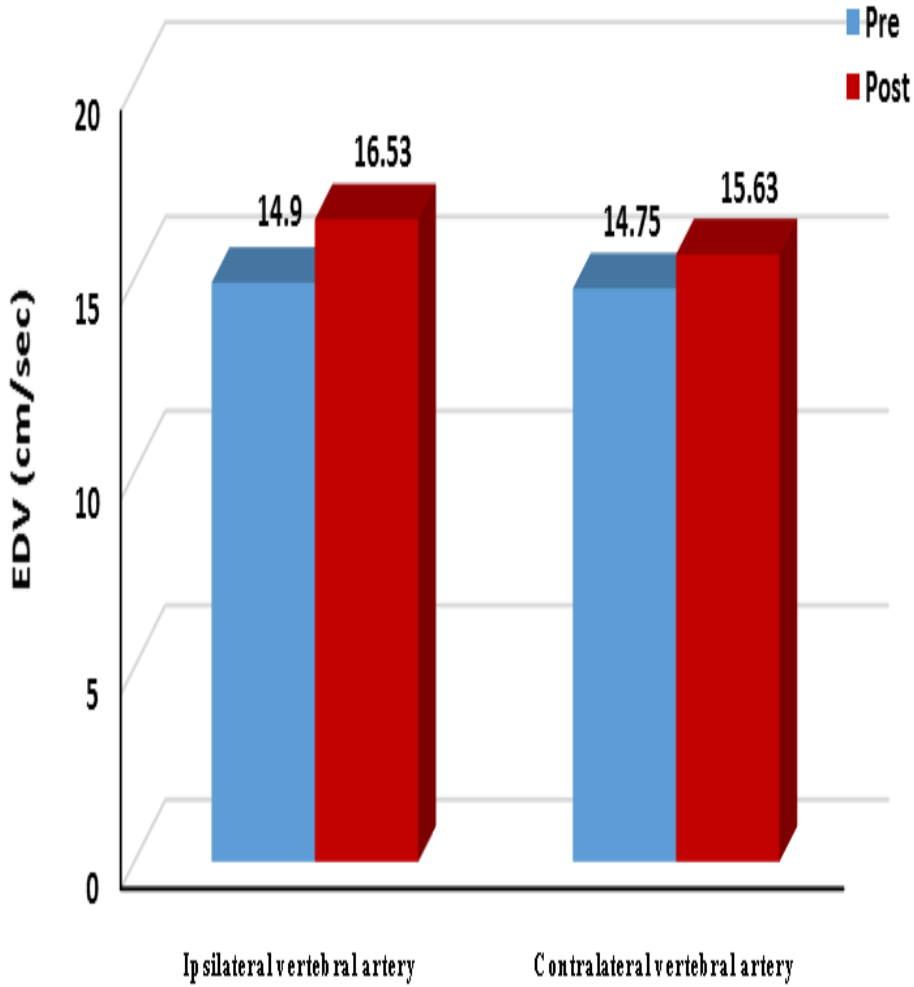
		Pre Mean± standard deviation	Post Mean± standard deviation	Mean difference	Percentage of change	P- value
Ipsilateral vertebral artery	**PSV** (cm/sec.)	41.63 ± 9.12	٤4.2 ± 8.62	-2.57	6.17	0.11
	EDV (cm/sec)	14.9 ± 3.51	16.53 ± 4.79	-1.63	10.93	0.1
Contralateral vertebral artery	**PSV** (cm/sec.)	42.16 ± 9.01	44.08 ± 7.94	-1.92	4.55	0.26
	EDV (cm/sec)	14.75 ± 3.53	15.63 ± 2.75	-0.88	5.96	0.19

Vertebral artery blood flow Cont…..
Group A

PSV



EDV

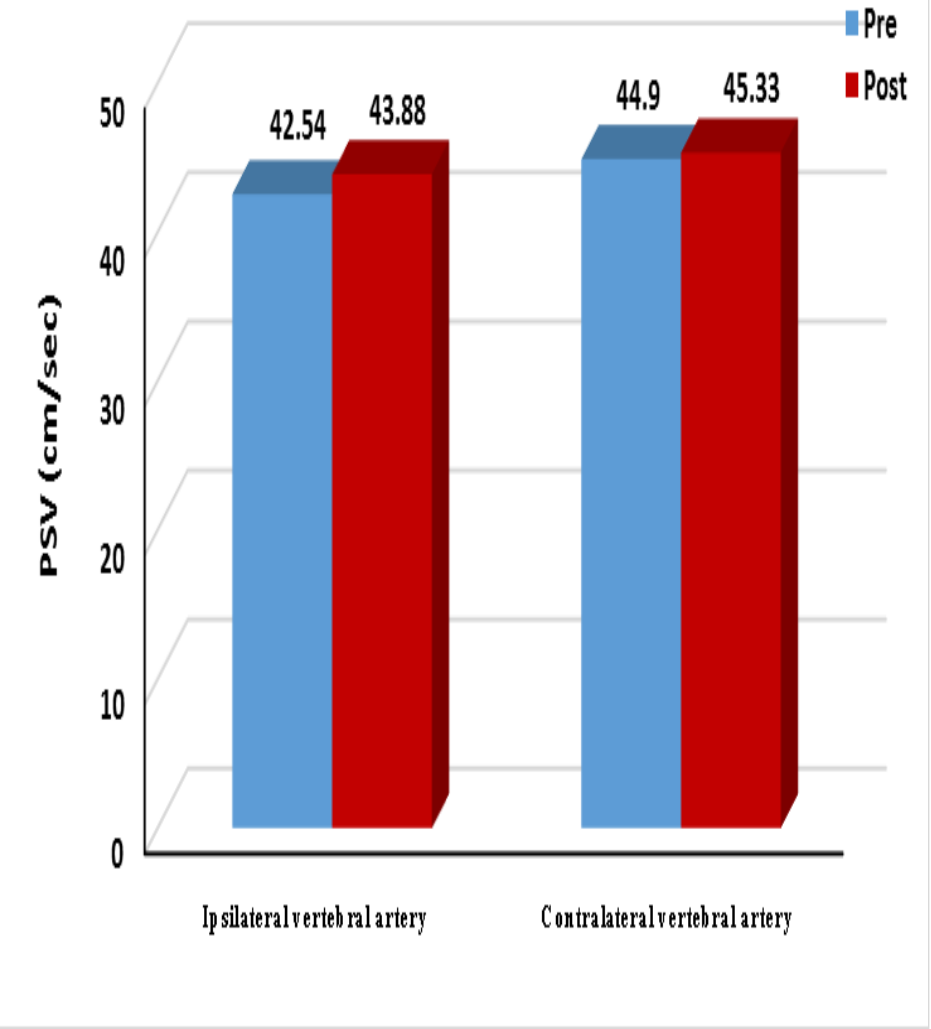


Vertebral artery blood flow Group B

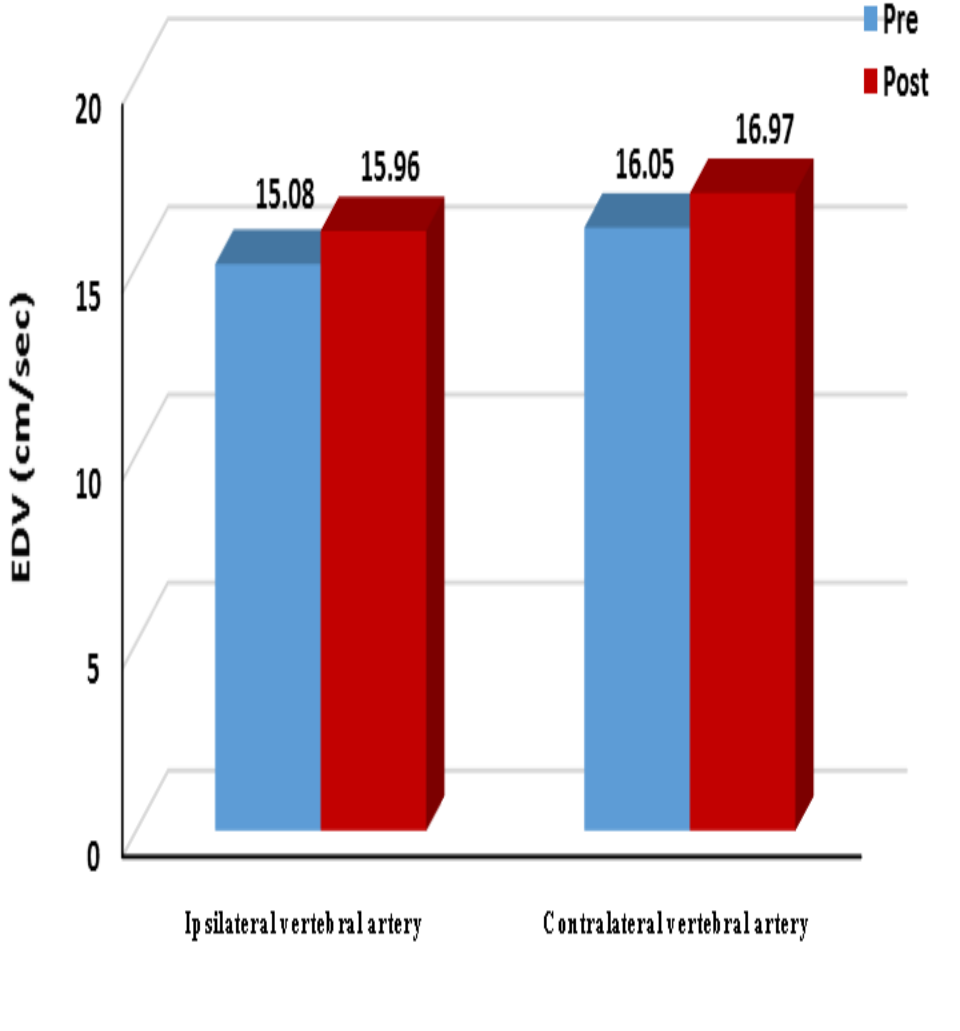
		Pre Mean± standard deviation	Post Mean± standard deviation	Mean difference	Percentage of change	P- value
Ipsilateral vertebral artery	**PSV** (cm/sec.)	42.54 ± 7.7	43.88 ± 7.6	-1.34	3.14	0.23
	EDV (cm/sec)	15.08 ± 3.64	15.96 ± 4.11	-0.88	5.83	0.08
Contralateral vertebral artery	**PSV** (cm/sec.)	44.9 ± 6.71	45.33 ± 5.12	-0.43	0.95	0.41
	EDV (cm/sec)	16.05 ± 2.52	16.97 ± 3.42	-0.92	5.73	0.11

Vertebral artery blood flow Cont…..
Group B

PSV



EDV



DISCUSSION

The results of this study proved that postural stability was reduced by wearing cervical collars in patients with cervical discogenic radiculopathy owing to reduction in cervical proprioceptors.

Wearing cervical collar decreases postural stability in patients of group A, however this effect was significant in modified clinical test of sensory interaction on balance test parameter (MCTSIB) and tandem walk test (TWT) parameters and not significant in limits of stability (LOS) test parameters.

- LOS test represents anticipatory component of postural control while MCTSIB represents reactive component. So, this points out to the greater effect of wearing cervical collar on reactive components of postural control more than anticipatory one.

This study showed decreased accuracy in movement performance with wearing cervical collars. This was manifested by abnormal endpoint excursion, maximum excursion, and directional control.

This can be caused by inaccurate postural reactions which depend primarily on feedback mechanism

In this study wearing a hard collar affects cervical proprioception negatively in patients of group A. This had been explained by the fact that wearing a cervical collar reduced the sensory inputs to the CNS, more so in the patients with cervical radiculopathy

The results of this study proved that patients of group B showed significant positive changes in proprioceptive acuity and postural control after receiving specific cervical proprioceptive training

- A possible explanation to the effects may be improved function of the deep cervical muscles, which are known to contain a high density of muscle spindles, and thereby are important for the postural control.

- The results of this study suggested that rigid cervical collar placement do not appear to pose a risk to blood flow to the hindbrain through vertebral arteries. Blood flow in the vertebral arteries varied but was not significantly changed by placement of rigid cervical collar.

RECOMMENDATIONS

- Further studies should be conducted to investigate the influence of cervical collars on postural stability in patients with mechanical neck pain
- The effect of cervical collars on gait parameters should be addressed
- Further studies should be conducted to investigate the influence of cervical collars on antero-posterior versus medio-lateral stability.

Clinical Implications

- 1- Before recommending hard collar, assessing VBI, Balance and cervical proprioception is a must
- 2-When recommending hard cervical collar; physiotherapist should integrate balance exercises into the program of TTT concerning more on reactive component than anticipatory one.
- 3- Also, cervical proprioceptive training should be integrated into program of TTT to avoid side effects of Hard collar

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THANK YOU