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# SOMATO-SENSORY EVOKED POTENTIAL AS A PROGNOSTIC MARKER IN CERVICAL SPONDYLOTIC MYELOPATHY.

**Orthopaedics**

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## ABSTRACT

**Objective:** To study the use SSEP for predicting surgical outcome of cervical myelopathy.Goals of the study. **Methods:** Cervical spondylosis is a common cause of cervical myelopathy in patients over the age of 50, and its incidence increases with age. Clinical signs and radiological findings aid in the diagnosis of cervical spondylotic myelopathy. In some cases where clinical presentations are unclear, neurophysiological investigations such as somatosensory-evoked potentials (SSEPs) may be useful for establishing a clinical diagnosis. However, the prognostic value of these investigations is not well-established Single center, retrospective study wherein forty nine patients (mean age of participants was 39.63 years with standard deviation ± 5.75) who had cervical spine surgery for cervical spondylotic myelopathy with documented preoperative time required for somatosensory-evoked potentials (SSEP) were followed for 12 weeks postoperatively. We evaluated the N17 time, P19 time for right and left median nerve and P47 time of right and left tibial nerve and compared it with the MJOA score recovery rate for each period. Methods used to achieve the study goals. **Result:** It was found that improvement in the SSEP during the early decompression period and a good surgical outcome at 12 weeks postoperatively was significant statistically. **Conclusion:** Somatosensory evoked potential of median nerve is useful in determining the functional abnormality of the spinal cord. **Results:** Results/findings of the study. **Conclusions:** Conclusions drawn from the work. Abstracts for reviews, technical notes, and historical vignettes do not need to be separated into sections. They should begin with a clear statement of the paper's purpose followed by appropriate details that support the authors' conclusion(s).

## KEYWORDS

Somatosensory evoked potential, median nerve, cervical myelopathy.

## INTRODUCTION:

Cervical spondylosis is a common cause of cervical myelopathy in patients over the age of 50, and its incidence increases with age[1,2]. More than 50% of middle-aged people have radiographic evidence of cervical alteration, yet only 10% have symptoms of spinal cord compression or cervical radiculopathy.[3]

The cervical myelopathy syndrome was first described in 1952, in some cases performed by Brain and colleagues.[4] The primary pathophysiological changing is the reduction of the sagittal diameter of the spinal canal. Static and dynamic factors are responsible for the narrowed canal with spinal cord compression. This process might also occur secondary to ischemic damage, contributing to additional spine cord injury[1]

Regarding the clinical onset, a large number of patients with cervical myelopathy are asymptomatic at first, but once the symptoms start, most present in a stepwise manner, with periods of stability of the symptoms, alternating with worsening.[5]

The degenerative changes in the cervical spine, such as thickening of bone and ligamentous structures, and protrusion of intervertebral disc material, can lead to narrowing of the spinal canal and potential injury to the spinal cord. This can result in lesions in the dorsal and lateral columns, as well as degeneration of the ascending and descending tracts, causing various symptoms such as gait disturbance, clumsiness, paresthesia, and dysfunction of the pyramidal and posterior columns.

Clinical signs and radiological findings aid in the diagnosis of cervical spondylotic myelopathy.

In some cases where clinical presentations are unclear, neuro physiological investigations such as somatosensory-evoked potentials (SSEPs) may be useful for establishing a clinical diagnosis. However, the prognostic value of these investigations is not well-established. This study aimed to evaluate the effectiveness of using median-nerve short-latency SSEPs to predict postoperative outcomes in CSM patients. It is important to note that an accurate assessment of patients with CSM is difficult to make based on radiolFiguogical findings alone, and additional diagnostic tools such as SSEPs may be necessary.State the purpose of the article.

**Modified Japanese Orthopedic Association Score:**

A. Motor dysfunction score of the upper extremities
- 0: inability to move hands
- 1: inability to eat with a spoon but able to move hands
- 2: inability to button shirt but able to eat with a spoon
- 3: able to button shirt with great difficulty
- 4: able to button shirt with slight difficulty
- 5: no dysfunction

B. Motor dysfunction score of the lower extremities
- 0: complete loss of motor and sensory function
- 1: sensory preservation without ability to move legs
- 2: able to move legs but unable to walk
- 3: able to walk on flat floor with a walking aid
- 4: able to walk up and/or down stairs with hand rail
- 5: moderate to significant lack of stability but able to walk up and/or down stairs without hand rail
- 6: mild lack of stability but walk unaided with smooth reciprocation
- 7: no dysfunction

C. Sensation
- 0: complete loss of hand sensation
- 1: severe sensory loss or pain
- 2: mild sensory loss
- 3: no sensory loss

D. Sphincter dysfunction score
- 0: inability to micturate voluntarily
- 1: marked difficulty with micturition
- 2: mild to moderate difficulty with micturition
- 3: normal micturition

**Radiological Findings:**

**A) Plain films**

X-rays are still a method that has been used in many centers throughout the world. Typical finds may consist in osteophytosis, a decrease of disc space, inversion of cervical lordosis, uncovertebral joint hypertrophy, as well as spinal stenosis.[6] However, these alterations may be commonly seen in age people, characterizing a non-specific method used for diagnosing cervical spine disorders, and therefore,its usage has been decreasing over the last decades.[6] From the surgical standpoint, some authors have been justifying its usage by the better understanding of the sagittal balance of the cervical spine. This might be achieved by using dynamic X-rays, *i.e.* with flexion-extension plain films in the sagittal plane, which may reveal any potential spinal instability, which would be helpful to programming the best approach used in surgery.[7]

**Lateral Radiograph:**

The Pavlov ratio, which is the ratio of canal diameter [ measured from posterior aspect of the vertebral body to the corresponding spino-laminar line] to the vertebral body width [measured anterior to

posterior] should be determined. If the ratio is less than 0.8, congenital narrowing of spinal canal is present, which greatly increases the patient risk of symptomatic stenosis and cord compression. Based on lateral radiograph, a canal diameter of 12mm or less will often indicate cord compression whether or not patient is symptomatic. Sagittal plane alignment should also be assessed on upright lateral radiograph.

Flexion Extension views: Are used to identify the presence of any angular or translational instability that may be present.

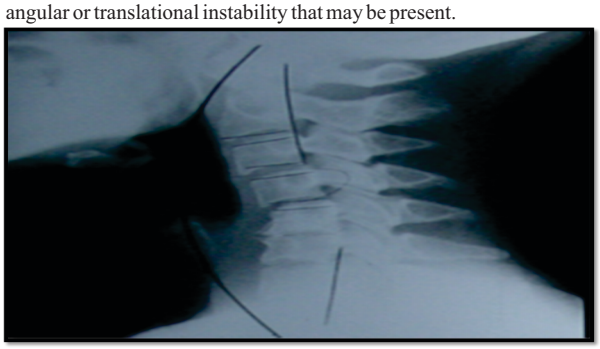


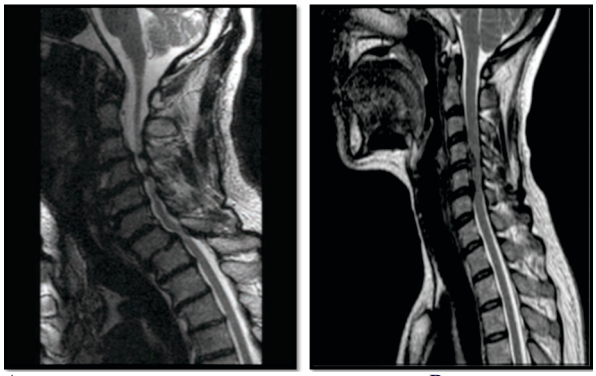
**Figure A:** Simple radiograph demonstrating C4-C5 subluxation as well as C5-C6 degenerative spondylosis in a patient with symptoms of CSM.

**B) Computed tomography**

Considered as an essential imaging tool in CSM cases computed tomography (CT) scan is superior to X-rays and MRI concerning bone assessment itself. Thus, CT scan evaluates bone anatomy, osteophytes, and degenerative alterations better than any other image modality. Altogether, CT scan should be part of armamentarium used in CSM patients, as well as a supplementary method to MRI, mainly in surgical patients.[8,9]

**C) Magnetic resonance imaging**

Regarded the mandatory study in CSM patients, MRI is the gold standard image tool in those patients (Figure A & B).[10] Being able to evaluate well discs, ligaments, subarachnoid space, the spinal cord itself, and any extradural compression, MRI is superior to CT scan in all these mentioned parameters.[10]. Moreover, T1 and T2-weighted images inboth sagittal and axial are the most used sequences in clinical practice. The presence of a hypointense signal on T1 sequences and hyperintense in T2 is associated with poor prognosis. In addition to this, its high sensitivity may create some troubles since it might diagnose some degenerative conditions in asymptomatic patients. As high as 57% of aged patients may have disk degeneration and herniation without having necessarily any symptoms.[11] For this reason, the perfect match between the clinical exam and the MRI findings are mandatory for all neurologists who are dealing with those patients. Interestingly, diffusion tensor images (DTI) tractography has become a promising tool for evaluation of CSM. Despite the lack of spatial resolution, which means that we cannot trust in the real position of the fiber after a given compression, it may provide us with a qualitative assessment.



A B

**Figure B1,2**

[B1: Typical cervical spine magnetic resonance imaging in cervical spondylotic myelopathy showing severe spinal cord compression in different levels.

B2: T2-weighted sagittal MRI demonstrating a 2-level CSM with predominantly anterior compression due to soft disc herniation.]

**Electrodiagnostic Studies**

Not usually considered a tool in the diagnostic armamentarium for CSM, electromyography (EMG) may be useful when the differential diagnosis is ALS. More accurately than EMG, somatosensory evoked potentials might reveal any spinal cord dysfunction, increasing the sensibility of EMG.[12] Therefore, diseases that cause superior and inferior motor neuron disease may be diagnosed in an easy fashion, ruling out some conditions such as ALS and multiple sclerosis.[13]

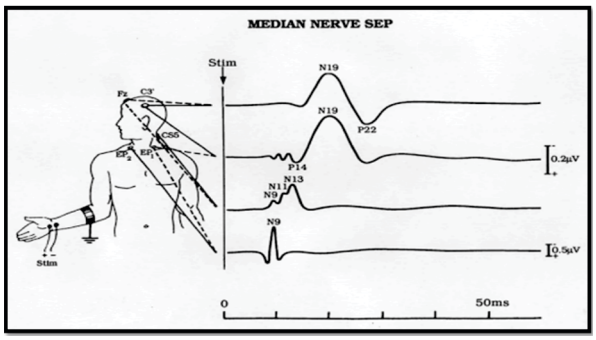
**Somatosensory Evoked Potential (sep Or Ssep)**

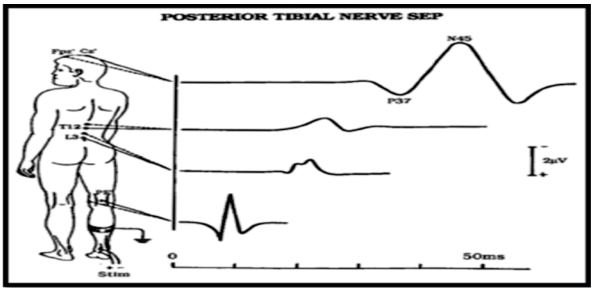
It is the electrical activity of the brain that results from the stimulation of touch. SEP tests measure that activity and are a useful, noninvasive means of assessing somatosensory system functioning. By combining SEP recordings at different levels of the somatosensory pathways, it is possible to assess the transmission of the afferent volley from the periphery up to the cortex. SEP components include a series of positive and negative deflections that can be elicited by virtually any sensory stimuli. However, SEPs are most commonly elicited by bipolar transcutaneous electrical stimulation applied on the skin over the trajectory of peripheral nerves of the upper limb (e.g., the median nerve) or lower limb (e.g., the posterior tibial nerve), and then recorded from the scalp.[14] In general, somatosensory stimuli evoke early cortical components (N25, P60, N80), generated in the contralateral primary somatosensory cortex (S1), related to the processing of the physical stimulus attributes. About 100 ms after stimulus application, additional cortical regions are activated, such as the secondary somatosensory cortex (S2), and the posterior parietal and frontal cortices, marked by a parietal P100 and bilateral frontal N140. SEPs are routinely used in neurology today to confirm and localize sensory abnormalities, to identify silent lesions and to monitor changes during surgical procedures.[15]

Median nerve SEP begins with the delivery of an electrical stimulus to that nerve at the wrist. A 100–300 microsecond square wave electrical pulse is delivered at intensities strong enough to cause a 1–2 cm thumb twitch. Upon delivery of such a stimulus, nerve action volleys travel up sensory fibers and motor fibers to the shoulder, producing a peak as they enter. This peak is formally known as N9. In the course of conduction, the sensory fibers then transverse the cervical roots and enter the cervical cord. The median nerve pathway then joins the posterior columns, sending off collateral branches to synapse in the midcervical cord. This midcervical cord activity gives rise to a peak known as N13.

The N13 is best measured over the fifth cervical spine. Further conduction in the posterior columns passes through the synapse at the cervicomedullary junction and enters the lemniscal decussation. A scalp P14 peak is generated at this level. As conduction continues up the medial lemniscus to upper midbrain and into the thalamus, a scalp negative peak is detected, the N18. After synapsing in the thalamus and traversing the internal capsule, the N20 is recorded over the somatosensory cortex contralateral to the wrist stimulated, corresponding to arrival of the nerve impulses at the primary somatosensory region.[15]

Posterior tibial nerve stimulation at the ankle gives rise to a similar series of subsequent peaks. An N8 potential can be detected over the posterior tibial nerve at the knee. An N22 potential can be detected over the upper lumbar spine, corresponding to the collateral activity as the sensory fibers synapse in the lumbar spinal cord. More rostrally, a cervical potential can occasionally be detected over the mid- or upper cervical spine. Finally, a P37 scalp potential is seen over the midline scalp lateral to the midsagittal plane, but ipsilateral to the leg stimulated.[15]






**AIMS:**
To study the effect of Somatosensory evoked potential (SSEP) for detecting functional abnormality of spinal cord.

**OBJECTIVES:**
1. To study the use SSEP for predicting surgical outcome of cervical myelopathy
2. To investigate clinical and neurophysiological significance of SSEP.

To predict the post-operative prognosis of cervical myelopathy patients

**Methods: Materials and Methods:**
**1. Study Design**: A single center, retrospective study.

**2. Study Duration**: 18 months starting from the date of ethics committee approval.

**3. Sample size**:
This was calculated using the following method- Sample size was calculated based on the findings of a similar study conducted by Lyu RK et al. The authors investigated the use of somatosensory evoked potentials for clinical significance and surgical outcomes in patients with cervical myelopathy.

They scored 49 patients according to the modified Japanese Orthopedic Association score [MJOA] for cervical myelopathy. Mean +/- SD MJOA score before surgery was 13.1 +/- 4.0 and at 6 months after surgery was 16.8 +/- 3.2.the improvement of MJOA score was significant [$p < 0.001$, paired Students T test].

We used the formula for sample size for before – after study [using the paired T test ][2]to calculate the number of patients to be included for our study.

Considering,
Type I error [2 – tailed] = 0.05
Type II error = 0.2
Effect size = 1.5 and
Standard Deviation =3.2
We calculated a sample size of 36 patients.
Formula:
The standard normal deviate of $\alpha = Z\alpha = 1.960$
The standard normal deviate of for $\beta = Z\beta = 0.842$
$A = 1.000$
$B = [Z\alpha + Z\beta]^2 = 7.849$
$C = [E/S(\Delta)]^2 = 0.220$
$AB / C = 35.72$
Sample size (N) = 36

**5. Sampling Unit:**
All retrospective data with diagnosed cases of cervical myelopathy.

**6. Sampling technique**: Convenient Sampling method

**7. Selection criteria of study subjects:**
- **Inclusion criteria**:

Males and Females in the age group of 18 to 55 years with diagnosed cervical myelopathy.

- **Exclusion criteria:**

1. Data with Cervical spine fractures and dislocation
2. Data with tumors
3. Age less than 18 years
4. Cases whose data was not available.

**METHODOLOGY:**
**Step 1: Designing of Questionnaire & Validation of Questionnaire**
A Predesigned, pretested was prepared in accordance with study objectives. The questionnaire was prepared in English.

**Step 2: Ethical considerations**
Permission to conduct the study and ethical clearance was obtained from the Institutional Ethics Committee.

**Step 4: Data collection method;**
In study data was collected as inclusion and exclusion criteria.Patient with diagnosed cervical myelopathy was included in the study that was presented to institute between the years July 2019 to December 2020.

Documented data of patients with cervical myelopathy was collected.

Documented preoperative and postoperative 12 weeks SSEP values of those patients was collected.

Documented preoperative MJOA score and postoperative 12 weeks MJOA score.

**Factors were assessed in this study:**
1. Age
2. Sex
3. Cardio vascular co morbidities
4. Diabetes Mellitus
5. BMI
6. Smoking
7. Complications during surgery
8. History of previous surgery

**Outcome Measurement**:
MJOA score:
Good outcome was MJOA score more than 15.
Poor outcome was MJOA score less than 15.

**Data Analysis Plan**
**Step I:**
All responses were tabulated by the investigator using Microsoft-Excel 2016 Software. Graphical representations were made wherever necessary.

**Step II:**
Data was analyzed by using SPSS software version 25.0
Statistical tools used were-
Mean
Standard deviation
Proportions and percentages
Paired t test
Median
Range= Minimum to maximum

Describe the methods used. Include approval from the local institutional review board regarding human subjects or information regarding the humane treatment of animals if applicable.

**RESULTS:**
**Table no. 1: Distribution of patients according to their age (N=36):**

| Age group (Years) | No. of patients | Percentage (%) |
|---|---|---|
| 31 to 35 | 13 | 36.11 |
| 36 to 40 | 04 | 11.11 |
| 41 to 45 | 15 | 41.66 |
| ≥46 | 04 | 11.11 |
| Total | 36 | 99.99 |
| Mini. Age= 31 years & Maximum age = 49 years | | |
| Mean ± SD= 39.63 ± 5.75 | | |
| Median= 41 | | |

Table no. 1 shows the distribution of patients according to their age group. The minimum age of participant was 31 years whereas maximum was 49 years. The mean age of participants was 39.63 years with standard deviation ± 5.75. The maximum patients i.e. 41.66% were belonged to 41-45 age group. The graphical presentation was shown in fig. no.1.

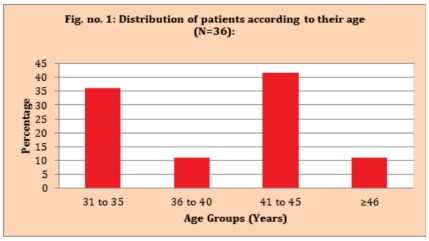



**Table No. 2- Distribution of patients according to their sex (N=36):**

| Sex | No. of patients | Percentage (%) |
|---|---|---|
| Male | 14 | 38.88 |
| Female | 22 | 61.11 |
| Total | 36 | 99.99 |
| Male: Female= 7/11 | | |

Table no. 2 shows there were 38.88% male participants and 61.11% were females. The graphical presentation is shown in fig. 2.

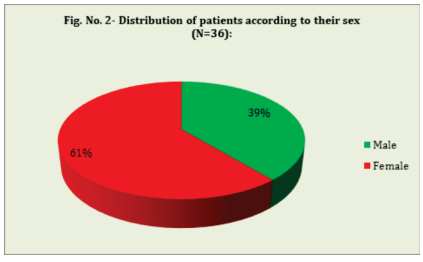



**Table No. 3: Median nerve**

**Table No. 3.1: Comparison of somatosensory evoked potentials for Right median Nerve -N17 in preoperative and postoperative 12 weeks cases (N=36)**

| Somatosensory evoked potentials (Milliseconds) | Preoperative | | Postoperative 12 weeks | |
|---|---|---|---|---|
| | No. of patients | Percentage (%) | No. of patients | Percentage (%) |
| 12.14 to 13.14 | 21 | 58.33 | 00 | 00 |
| 13.15 to 14.15 | 15 | 41.66 | 23 | 63.88 |
| >14.15 | 00 | 00 | 13 | 36.11 |
| Total | 36 | 99.99 | 36 | 99.99 |
| Min. & Max. response milliseconds) | 12.14 & 13.6 | | 13.24 & 14.26 | |
| Median | 12.48 | | 13.69 | |
| Mean ± SD | 12.76 ± 0.51 | | 13.84 ± 0.33 | |
| t value= 10.66, df= 70<br>p value= <0.0000001 (statistically significant) | | | | |

The mean time required for Somatosensory evoked potentials (Milliseconds) for Right median Nerve -N17 in Preoperative group is 12.76 ± 0.51 and in post-operative group is 13.84 ± 0.33 which is higher in postoperative group. This difference is statistically significant. This is presented in fig. no. 3.1

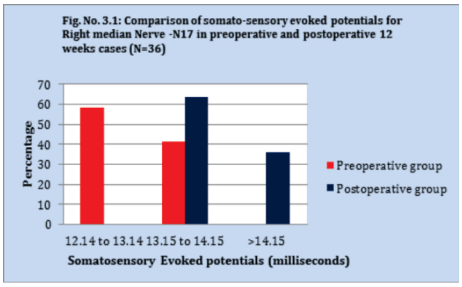



**Table No. 3.2: Comparison of somatosensory evoked potentials for Left median Nerve –N17 in preoperative and postoperative 12 weeks cases (N=36)**

| Somatosensory evoked potentials (Milliseconds) | Preoperative | | Postoperative 12 weeks | |
|---|---|---|---|---|
| | No. of patients | Percentage (%) | No. of patients | Percentage (%) |
| 11.2 to 13 | 08 | 22.22 | 00 | 00 |
| 13.1 to 15 | 23 | 63.88 | 31 | 86.11 |
| 15.1 to 17 | 05 | 13.88 | 05 | 13.88 |
| Total | 36 | 99.99 | 36 | 99.99 |
| Min. & Max. response (milliseconds) | 11.2 & 16.4 | | 14.1 & 16.45 | |
| Median | 13.6 | | 14.24 | |
| Mean ± SD | 13.52 ± 1.42 | | 14.64 ± 0.75 | |
| t value= 4.18, df= 70<br>p value= 0.00008 (statistically significant) | | | | |

The mean time required for Somatosensory evoked potentials (Milliseconds) for Left median Nerve -N17 in Preoperative group is 13.52 ± 1.42 and in post-operative group is 14.64 ± 0.75 which is higher in postoperative group. This difference is statistically significant. This is presented in fig. no. 3.2.

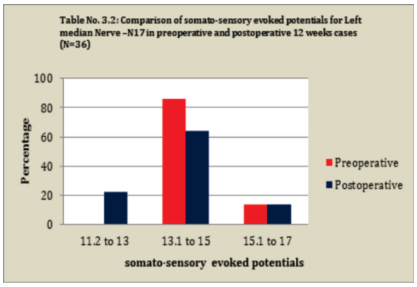



**Table No. 4: Median nerve**

**Table No. 4.1: Comparison of somatosensory evoked potentials in Right Median Nerve –P19 in preoperative and postoperative 12 weeks cases (N=36)**

| Somatosensory evoked potentials (Milliseconds) | Preoperative | | Postoperative 12 weeks | |
|---|---|---|---|---|
| | No. of patients | Percentage (%) | No. of patients | Percentage (%) |
| 13.48 to 15.47 | 29 | 80.55 | 30 | 83.33 |
| 15.58 to 17.47 | 07 | 19.44 | 06 | 16.66 |
| Total | 36 | 99.99 | 36 | 99.99 |
| Min. & Max. response (milliseconds) | 13.48 & 15.76 | | 13.24 & 14.26 | |
| Mean ± SD | 14.92 ± 0.71 | | 15.38 ± 0.57 | |
| Median | 15.13 | | 15.4 | |
| t value= 3.03, df= 70<br>p value= 0.003 | | | | |

The mean time required for Somatosensory evoked potentials (Milliseconds) for Right median Nerve –P19 in Preoperative group is 14.92 ± 0.71 and in post-operative group is 15.38 ± 0.57 which is higher in postoperative group. This difference is statistically significant. This is presented in fig. no. 4.1.

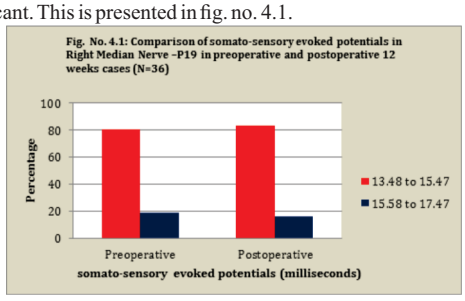



**Table No. 4.2: Comparison of somatosensory evoked potentials in Left Median Nerve –P19 in preoperative and postoperative 12 weeks cases (N=36)**

| Somatosensory evoked potentials (Milliseconds) | Preoperative | | Postoperative 12 weeks | |
|---|---|---|---|---|
| | No. of patients | Percentage (%) | No. of patients | Percentage (%) |
| 13.28 to 15.27 | 09 | 25 | 07 | 19.44 |
| 15.28 to 17.27 | 22 | 61.11 | 18 | 50 |
| 17.28 to 19.27 | 05 | 13.88 | 11 | 30.55 |
| Total | 36 | 99.99 | 36 | 99.99 |
| Min. & Max. response (milliseconds) | 13.28 & 16.29 | | 15.20 & 17.96 | |
| Mean ± SD | 15.53 ± 1.36 | | 16.67 ± 1.12 | |
| Median | 15.52 | | 16.21 | |
| t value= 3.88, df= 70<br>p value= 0.0002 | | | | |

The mean time required for Somatosensory evoked potentials (Milliseconds) for Left median Nerve –P19 in Preoperative group is 15.53 ± 1.36 and in post-operative group is 16.67 ± 1.12 which is higher in postoperative group. This difference is statistically significant. This is presented in fig. no. 4.2.

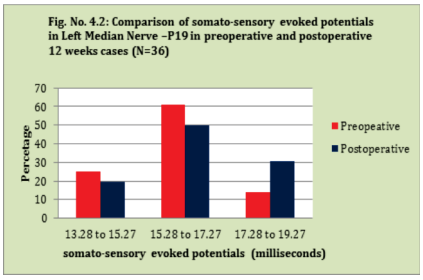



**Table No. 5: Tibial Nerve**

**Table No. 5.1: Comparison of somatosensory evoked potentials in Right Tibial Nerve –P47 in preoperative and postoperative 12 weeks cases (N=36)**

| Somatosensory evoked potentials (Milliseconds) | Preoperative | Postoperative 12 weeks | | |
|---|---|---|---|---|
| | No. of patients | Percentage (%) | No. of patients | Percentage (%) |
| 33.14 to 39.13 | 08 | 22.22 | 08 | 22.22 |
| 39.14 to 45.13 | 18 | 50 | 18 | 50 |
| 45.14 to 51.13 | 10 | 27.77 | 10 | 27.77 |
| Total | 36 | 99.99 | 36 | 99.99 |
| Min. & Max. response (milliseconds) | 33.14 & 45.18 | | 35.21 & 45.90 | |
| Mean ± SD | 41.12 ± 4.36 | | 42.14 ± 3.83 | |
| Median | 42.08 | | 43.21 | |
| t value= 1.04, df= 70<br>p value= 0.29 (statistically not significant) | | | | |

The mean time required for Somatosensory evoked potentials (Milliseconds) for Right Tibial Nerve –P47 in Preoperative group is 44.12 ± 4.36 and in post-operative group is 42.14 ± 3.83 which is slightly lower in postoperative group. This difference is not statistically significant. This is presented in fig. no. 5.1.

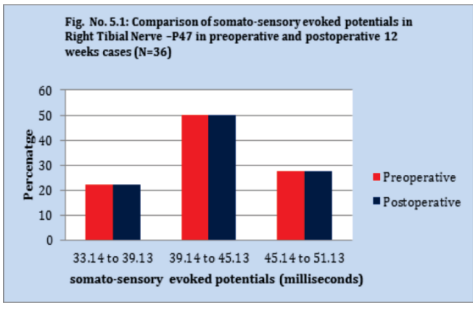



**Table No. 5.2: Comparison of somatosensory evoked potentials for Left Tibial Nerve –P47 in preoperative and postoperative 12 weeks cases (N=36)**

| Somatosensory evoked potentials (Milliseconds) | Preoperative | Postoperative 12 weeks | | |
|---|---|---|---|---|
| | No. of patients | Percentage (%) | No. of patients | Percentage (%) |
| 35.22 to 39.21 | 08 | 22.22 | 08 | 22.22 |
| 39.22 to 43.21 | 18 | 50 | 13 | 36.11 |
| 43.22 to 47.21 | 10 | 27.77 | 15 | 41.66 |
| Total | 36 | 99.99 | 36 | 99.99 |
| Min. & Max. response (milliseconds) | 35.22 & 44.96 | | 36.20 & 45.96 | |
| Mean ± SD | 41.26 ± 3.66 | | 42.19 ± 3.49 | |
| Median | 41.6 | | 42.29 | |
| t value= 1.15, df= 70<br>p value= 0.27 (statistically not significant) | | | | |

The mean time required for Somatosensory evoked potentials (Milliseconds) for Left Tibial Nerve –P47 in Preoperative group is 41.26 ± 3.66 and in post-operative group is 42.19 ± 3.49 which is higher in postoperative group. This difference is not statistically significant. This is presented in fig. no. 5.2.

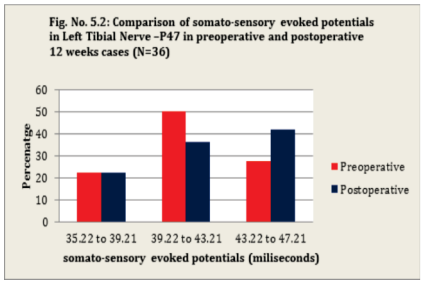



**Table No. 6: Comparison of MJOA scores in preoperative and postoperative 12 weeks cases (N=36)**

| MJOA score | Preoperative | Postoperative 12 weeks | | |
|---|---|---|---|---|
| | No. of patients | Percentage (%) | No. of patients | Percentage (%) |
| Mild (≥ 15) | 07 | 19.44 | 36 | 100 |
| Moderate (12 to 14) | 29 | 80.55 | 00 | 00 |
| Severe (<12) | 00 | 00 | 00 | 00 |
| Total | 36 | 99.99 | 36 | 99.99 |
| Min. & Max. response (milliseconds) | 13 & 15 | | 16 & 18 | |
| Mean ± SD | 13.66 ± 0.78 | | 17.11 ± 0.61 | |
| Median | 13 | | 18 | |
| t value= 20.9, df= 70<br>p value=< 0.0000001 (statistically significant) | | | | |

The mean score of MJOA for in Preoperative group is 13.66 ± 0.78 and in post-operative group is 17.11 ± 0.61 which is higher in postoperative group. This difference is statistically significant. This is presented in fig. no. 6.

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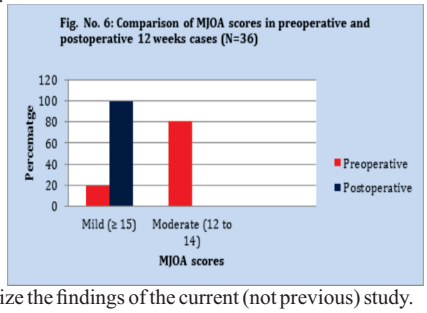


Summarize the findings of the current (not previous) study.

## DISCUSSION:

Emphasize the results and the significance of the study. Cervical spondylosis is most common myelopathy. For Cervical myelopathy neurophysiological investigations such as SSEP may be useful to establish clinical diagnosis. Somatosensory evoked responses following stimulation of a nerve in the arm can be recorded with surface electrodes from the brachial plexus, cervical spine and scalp and the conduction time between each recording site can thus easily be found. In this study this method was applied to the patients with symptoms of cervical spondylosis and tested the diagnostic utility of SSEPs and tested whether any consistent relation exists between the SSEP value [ pre- op and post -op] to the clinical functional outcome postoperatively (Determined by MJOA score).

Thus, a single center retrospective study conducted to evaluate efficacy of SSEP in nerves to predict post -operative prognosis and surgical outcome in Cervical myelopathy patients.

The minimum age of participant was 31 years whereas maximum was 49 years. The mean age of participants was 39.63 years with standard deviation ± 5.75. The maximum patients i.e. 41.66% were belonged to 41-45 age groups (Table no. 1).

**R.K Lyu et al. (2003)**[16] conducted a study with mean age 56.7 years, range 27–77 years to study the use of evoked potentials for clinical correlation and surgical outcome in cervical spondylotic myelopathy. This mean age of patients is much higher than the present study.

**Y. Morishita et al. (2005)**[17] conducted a prospective study in which mean age 68.1 years, range 44–78 years and a study conducted by **Hongyan Cui et al. (2015)**[18] the mean age was 60.4 ± 11.2 years (range, 55–70 years). In all above studies the mean age of patients is more than this present study.

There were 38.88% male participants and 61.11% were females (Table no. 2).

**R.K Lyu et al. (2003)**[16] conducted a study in which there were 65% males and 34.69% females and this proportion is opposite to our study. And similar results (i.e male proportion 54% is higher than female proportion 45%) were found in study conducted by **Hongyan Cui et al. (2015)**[18].

The mean time required for Somatosensory evoked potentials (Milliseconds) for Right median Nerve -N17 in Preoperative group is 12.76 ± 0.51 and in post-operative group is 13.84 ± 0.33 which is higher in postoperative group (Table no. 3.1).

The mean time required for Somatosensory evoked potentials (Milliseconds) for Left median Nerve -N17 in Preoperative group is 13.52 ± 1.42 and in post-operative group is 14.64 ± 0.75which is higher in postoperative group (Table no. 3.2).

The mean time required for Somatosensory evoked potentials (Milliseconds) for Right median Nerve –P19 in Preoperative group is 14.92 ± 0.71 and in post-operative group is 15.38 ± 0.57 which is higher in postoperative group (Table no. 4.1).

The mean time required for Somatosensory evoked potentials (Milliseconds) for Left median Nerve –P19 in Preoperative group is 15.53 ± 1.36 and in post-operative group is 16.67 ± 1.12 which is higher in postoperative group (Table no. 4.2).

The mean time required for Somatosensory evoked potentials (Milliseconds) for Right Tibial Nerve –P47 in Preoperative group is 44.12 ± 4.36 and in post-operative group is 42.14 ± 3.83 which is slightly lower in postoperative group (Table no. 5.1).

The mean time required for Somatosensory evoked potentials (Milliseconds) for Left Tibial Nerve –P47 in Preoperative group is 41.26 ± 3.66 and in post-operative group is 42.19 ± 3.49 which is higher in postoperative group (Table no. 5.2).

The mean score of MJOA for in Preoperative group is 13.66 ± 0.78 and in post-operative group is 17.11 ± 0.61 which is higher in postoperative group (Table no. 6). Range of MJOA for Preoperative group is 13-15 where in postoperative group was 16-18. There is improvement in score in postoperative group. This is found statistically significant.

**R.K Lyu et al. (2003)**[16] the mean JOA scores before surgery and at 6 months after surgery were 13.1 (4.0) (range 2–21) and 16.8 (3.2) (range 9– 21), respectively. The improvement of the JOA score was significant (p,0.001, paired Student's t test). This study also shows improvement of MJOA score as seen in present study.

**Similar to present study Hongyan Cui et al. (2015)**[18] conducted a study in which the preoperative JOA score increased from 4 to 14 with a mean value 10.68, and the postoperative JOA score increased from 7.5 to 17 with a mean value 13.90.

## CONCLUSIONS:

Cervical spondylosis is most common myelopathy. For Cervical myelopathy neurophysiological investigations such as SSEP may be useful to establish clinical diagnosis. Somatosensory evoked responses following stimulation of a nerve in the arm can be recorded with surface electrodes from the brachial plexus, cervical spine and scalp and the conduction time between each recording site can thus easily be found. In this study this method was applied to the patients with symptoms of cervical spondylosis and tested the diagnostic utility of SSEPs and tested whether any consistent relation exists between the SSEP value [pre- op and post -op] to the clinical functional outcome postoperatively (Determined by MJOA score).

Thus, a single center retrospective study conducted to evaluate efficacy of SSEP in nerves to predict post -operative prognosis and surgical outcome in Cervical myelopathy patients.

1. The minimum age of participant was 31 years whereas maximum was 49 years. The mean age of participants was 39.63 years with standard deviation ± 5.75. The maximum patients 41.66% were belonged to 41-45 age groups (Table no. 1).
2. There were 38.88% male participants and 61.11% were females (Table no. 2).
3. The mean time required for Somatosensory evoked potentials (Milliseconds) for Right median Nerve -N17 in Preoperative group is 12.76 ± 0.51 and in post-operative group is 13.84 ± 0.33 which is higher in postoperative group. This difference is statistically significant (Table no. 3.1).
4. The mean time required for Somatosensory evoked potentials (Milliseconds) for Left median Nerve -N17 in Preoperative group is 13.52 ± 1.42 and in post-operative group is 14.64 ± 0.75which is higher in postoperative group. This difference is statistically significant (Table no. 3.2).
5. The mean time required for Somatosensory evoked potentials (Milliseconds) for Right median Nerve –P19 in Preoperative group is 14.92 ± 0.71 and in post-operative group is 15.38 ± 0.57 which is higher in postoperative group. This difference is not statistically significant (Table no. 4.1).
6. The mean time required for Somatosensory evoked potentials (Milliseconds) for Left median Nerve –P19 in Preoperative group is 15.53 ± 1.36 and in post-operative group is 16.67 ± 1.12 which is higher in postoperative group. This difference is statistically significant (Table no. 4.2).
7. The mean time required for Somatosensory evoked potentials (Milliseconds) for Right Tibial Nerve –P47 in Preoperative group is 44.12 ± 4.36 and in post-operative group is 42.14 ± 3.83 which is slightly lower in postoperative group. This difference is not statistically significant (Table no. 5.1).
8. The mean time required for Somatosensory evoked potentials (Milliseconds) for Left Tibial Nerve –P47 in Preoperative group is 41.26 ± 3.66 and in post-operative group is 42.19 ± 3.49 which is higher in postoperative group. This difference is not statistically significant (Table no. 5.2).
9. The mean score of MJOA for in Preoperative group is 13.66 ± 0.78 and in post-operative group is 17.11 ± 0.61 which is higher in postoperative group. This difference is statistically significant (Table no. 6).

Somatosensory evoked potential of median nerve is useful in determining the functional abnormality of the spinal cord.

There is statistically significant improvement in SSEP postoperative 12 weeks and Modified Japanese Orthopedic Association score.

So, SSEP can be used as a marker in patients of cervical spondylosis Myelopathy for detecting postoperative prognosis and recovery.

Restate the major findings and address their potential implications or applications.

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