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# Evaluation of Cervical Spine in Neck Pain by 1.5 Tesla Mri In A Long Term Technology Device Users: A Pilot Study

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***Abstract:***
***Objectives****: The objective of this study was evaluation of cervical spine by 1.5 tesla mri in a young long term technology device users presented with neck pain.*
***Materials and Methods****: The present prospective study is carried out at department of radiology, Guru Gobind Singh Hospital and shri M P Shah Medical College, Jamnagar. This is study of total 400 patients carried out in 12 month duration from January 2020 to January 2021, in which 200 patients aged between 20-45 yrs selected as study group presented with complaint of neck pain using technological devices like mobile and laptop for long time (average duration of technology device use was 5 years) and 200 patients aged between 45- 70 yrs selected as comparison group presented with complaint of back pain.*
***Results****: Degenerative cervical spine changes are seen in young age group using technological device like mobile phones and laptops for long duration of time and these degenerative changes are more or less similar to age related degenerative cervical spine changes found in comparison group which primarily come for lumbar spine study.*
***Conclusion:*** *MRI is modality of choice for early detection of cervical degenerative changes in young population presenting with neck pain in early life using technological device for long time and working in office, banks and education field.*
***Key Word****: **Cervical spine, technological devices, mobile, laptop.***

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## I. Introduction

- Cervical degenerative disc disease is a common cause of neck pain and radiating arm pain. It develops when one or more of the cushioning discs in the cervical spine starts to break down due to wear and tear. As a result of this, cervical disc degenerations, kyphotic cervical stenosis, cord tension, radicular symptoms are encountered. [1,2,3]
- In a current scenario use of technological devices like mobile phones, computers and laptops are increasing day by day particularly in a field of education, business, publishing, banking and even entertainment. We do not know the damages that the mobile phones give to the spine, especially cervical region. Most laptops are designed with the screen joined to the keyboard, making it impossible to adjust separately in terms of screen height and distance leading to prolonged flexion at cervical spine with consequent higher activity in cervical erector spinae and upper trapezius muscles results in musculoskeletal disorders of neck. The posture of staring at a monitor, located below the height of eyesight, makes the head move forward, anterior curve in the lower cervical and posterior curve in the upper thoracic vertebrae could be exaggerated. [1]
- The purpose of our study is MRI evaluation of cervical spine in young adults using technological devices for long time (average duration was 5 years) presenting with complaint of neck pain. Cervical spine evaluation done using cervical spine imaging protocol by 1.5 T Siemen's MRI scanner after taking written informed consent from patients.
- This is study of total 400 patients, in which 200 patients aged between 20-45 yrs selected as study group referred to department of radiology from orthopaedic department for dedicated cervical spine imaging and 200 patients aged between 45- 70 yrs selected as comparison group presented with complaint of back pain for dedicated lumbar spine imaging, in comparison group cervical spine changes found on whole spine screening using spine combo sequence taken for comparison with study group.

- MRI cervical spine evaluation done using following sequences T2 Stir cor, T1 sag, T2 Sag, T2 ME2D tra, T1 tra (C4-T1), T2 cor + sag myelo sequences with whole spine screening using T2WI sag combo sequence.
- Brief radiological anatomy description of cervical spine: [4,5,7,8]

o Cervical spine is divided into 2 regions (Sub-Occipital and Typical). Cervical Spine has anterior curve. Stability to neck is provided by bony structures/ligaments and muscles. In-between two vertebrae, there is disc called intervertebral disc, it has no blood supply.

o This disc is made up of fibrocartilage and has two parts, outer and inner Outer part called annulus fibrosis which resist tension and rotational force.

o Inner part called nucleus pulposis which maintain compression forces. The fibers arranged in cross manner. Cervical region consists of three ligaments, one is ligamentum flavum, second is anterior longitudinal ligament and third name as posterior ligament.

- Magnetic resonance imaging is the modality of choice in investigating early changes of degeneration in cervical spine in young patients using long term technological devices with neck pain +/- radiating to shoulder/ arm with high yielding results.

## II. Aims And Objective

- Aim of this study is to identify changes in cervical spine in study group aged between 20-45 yrs using technological device like mobile, computer or laptop for a long time.
- Comparison of cervical spine changes in comparison group aged between 45-70 yrs with study group population.
- Compare the severity of cervical spine changes in study group with the average duration use of technology devices.

## III. Material And Methods

The present prospective study of 400 patients (200 study group + 200 comparison group) is carried out between the time periods of January 2020 to January 2021 at department of radiology, Guru Gobind Singh Hospital and M.P Shah medical college, Jamnagar.

**Study Design:** Prospective open label observational study.
**Study Location**: This was a tertiary care teaching hospital based study done in Department of Radio-diagnosis, at Guru Gobind Sinh Hospital, Jamnagar, Gujarat.

**Study Duration:** January 2020 to January 2021.
**Sample size:** 400 patients.
**Subjects & selection method**: The study population was drawn from young (25-45 years of age) patients who presented to Guru Gobind Sinh Hospital with cervical pain between from January 2020 to January 2021. Patients were divided into two groups (each group had 200 patients) according to the age of patients.
Group A (N=200 patients) –Study group of 20-45 year old patient with cervical changes in spine;
Group B (N=200 patients) –Comparision group of 45-70 year old patients with lumbar changes in spine.

**Inclusion criteria:**
1. Young adult with long term technological device users presented with complaint of neck pain +/- radiating to shoulder/arm, aged between 20 to 45 yrs included in study group.
2. Patient presented with complaint of back pain aged between 45-70 yrs included in comparison group for comparing cervical spine changes found on whole spine screening using combo spine sequence.

**Exclusion criteria:**
1. Patients with congenital deformities, serious surgical or neurological diseases, traumatic injuries and tumor.
2. Patients with the condition that could affect the spine were excluded from study like rheumatic diseases, ankylosing spondylitis, deformities, connective tissue disease, previous spine surgery, bone cancer, significant cervical trauma and TB.
3. Patient having claustrophobia, aneurysmal clip any orthopaedic implant, pacemaker devise.

**Imaging technique:**
- All patients in study group evaluated by 1.5 tesla Siemens MRI scanner using cervical spine protocol. No contrast evaluation done.
- All patients in comparison group evaluated by same using lumbar spine protocol and whole spine screening done using T2sag combo sequence.

**OBSERVED IMAGING FINDINGS AFTER MRI CERVICAL SPINE EVALUATION:**

1. **Changes in cervical spine alignment:** Loss of cervical lordosis, and reversal of cervical lordosis.
2. **Changes in cervical vertebra:** Reduced in cervical vertebra height, modic changes, schmorl's nodes formation and osteophytes formation.
3. **Changes in cervical disc:** Disc degeneration, reduced disc height, diffuse disc bulge, disc herniation, annular ligament tear
4. **Neuronal changes:** Compression over nerve roots, indentation over thecal sac, impingement over spinal cord, narrowing of cervical spinal canal and changes of myelomalacia.

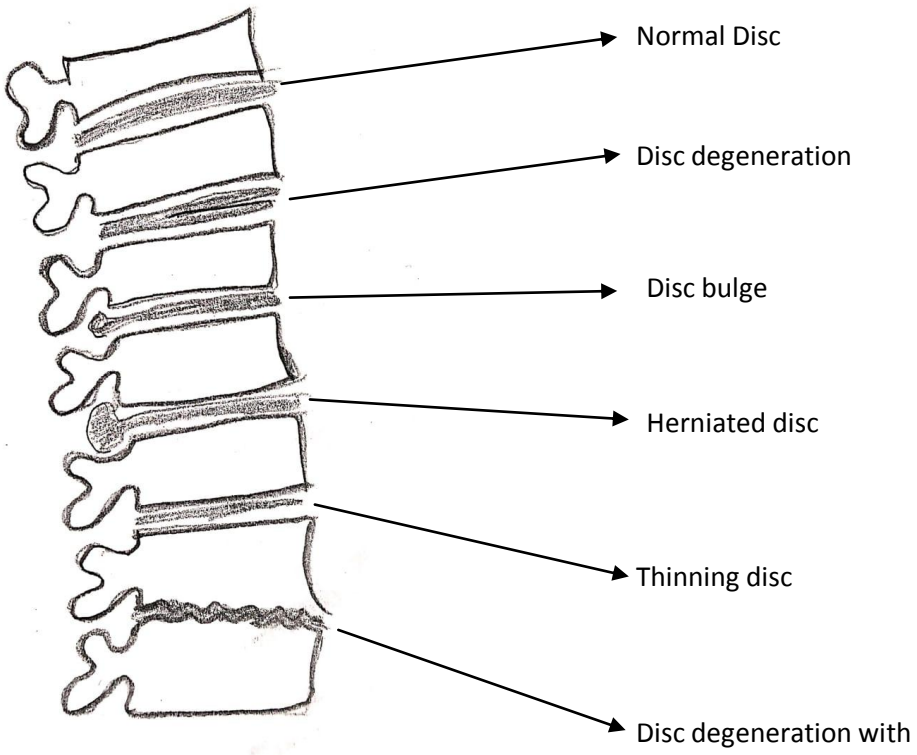



IMAGE 1 [7]

**Statistical analysis: Both the groups (study and comparison group) are statistically analyzed by using Z test and statistical results are summarized into following below mentioned tables.**

| Z TEST FOR COMPARING TWO GROUPS FOR DEGENERATIVE VERTEBRAL BODY CHANGES | | | | | | |
|---|---|---|---|---|---|---|
| **Sr.** | | **STUDY GROUP (20-45 YEARS) Total number of patients (200)** | | **COMPARISON GROUP (45-70 YEARS) Total number of patients (200)** | | **Z test of difference of proportion- (P Value)** |
| | | **NUMBER** | **PROPORTION** | **NUMBER** | **PROPORTION** | |
| **1** | **LOSS OF CERVICAL LORDOSIS** | 66 | 0.33 | 99 | 0.495 | 3.35 (0.0008) |
| **2** | **REVERSAL OF LORDOSIS** | 11 | 0.055 | 16 | 0.08 | 0.99 (0.318) |
| **3** | **REDUCED VERTEBRAL HEIGHT** | 15 | 0.075 | 17 | 0.085 | 0.37 (0.711) |
| **4** | **MODIC CHANGES** | 14 | 0.07 | 11 | 0.055 | 0.62 (0.535) |
| **5** | **OSTEOPHYTE FORMATION** | 94 | 0.47 | 53 | 0.265 | 4.25 (0.00001) |
| **6** | **SCHMORL'S NODES** | 0 | 0 | 4 | 0.02 | 2.01 (0.044) |

| Z TEST FOR COMPARING TWO GROUPS FOR DEGENERATIVE INTERVERTEBRAL DISC CHANGES | | | | |
|---|---|---|---|---|
| **Sr.** | | **STUDY GROUP (20-45 YEARS) Total number of patients (200)** | **COMPARISON GROUP (45-70 YEARS) Total number of patients (200)** | **Z test of difference of proportion-** |

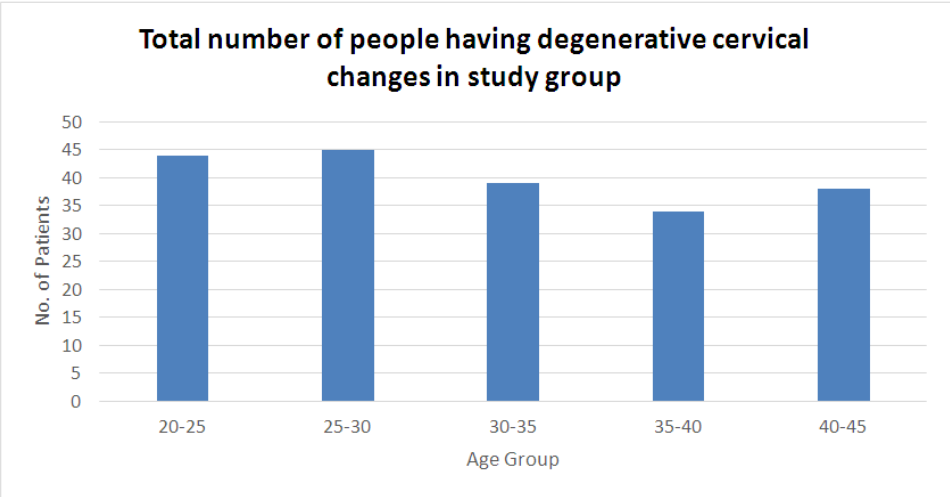
| | | NUMBER | PROPORTION | NUMBER | PROPORTION | (P Value) |
|---|---|---|---|---|---|---|
| 1 | DISC DEGENERATION | 157 | 0.785 | 151 | 0.755 | 0.71 (0.48) |
| 2 | REDUCED DISC HEIGHT | 8 | 0.04 | 14 | 0.07 | 1.32 (0.187) |
| 3 | DISC BULGE | 19 | 0.095 | 15 | 0.075 | 0.718 (0.472) |
| 4 | DISC HERNIATION | 15 | 0.075 | 9 | 0.045 | 1.26 (0.208) |
| 5 | ANNULAR LIGAMENT TEAR | 1 | 0.005 | 11 | 0.055 | 2.93 (0.0034) |

| Z TEST FOR COMPARING TWO GROUPS FOR NEUROLOGICAL CHANGES | | | | | | |
|---|---|---|---|---|---|---|
| Sr. | | STUDY GROUP (20-45 YEARS) Total number of patients (200) | | COMPARISON GROUP (45-70 YEARS) Total number of patients (200) | | Z test of difference of proportion- (P Value) |
| | | NUMBER | PROPORTION | NUMBER | PROPORTION | |
| 1 | NARROWING | 8 | 0.04 | 7 | 0.035 | 0.26 (0.795) |
| 2 | NERVE ROOT COMPRESSION | 9 | 0.045 | 8 | 0.04 | 0.25 (0.803) |
| 3 | INDENTATION OVER THECAL SAC | 155 | 0.775 | 147 | 0.735 | 0.93 (0.352) |
| 4 | IMPIGMENT OVER SPINAL CORD | 18 | 0.09 | 26 | 0.13 | 1.23 (0.200) |
| 5 | CHANGES OF MYELOMALACIA | 10 | 0.05 | 12 | 0.06 | 0.44 (0.659) |

- For degenerative vertebral body changes reversal of lordosis and reduced vertebral height cases are more in comparison group than study group, and modic changes are more in study group than comparison group but the difference seen is statistically not significant.
- For degenerative vertebral body changes loss of cervical lordosis, osteophyte formation and schmorl's nodes are more in study group than comparison group and the difference seen is statistically significant with Z test of difference of proportion and P value being 3.35 and 0.0008; 4.25 and 0.00001; and 2.01 and 0.044 respectively.
- For degenerative intervertebral disc changes reduced disc height cases are more in comparison group than study group, and disc degeneration, disc bulge and disc herniation are more in study group than comparison group but the difference seen is statistically not significant.
- For degenerative intervertebral disc changes annular ligament tear are more in comparison group than study group and the difference seen is statistically significant with Z test of difference of proportion and P value being 2.93 and 0.0034 respectively.
- For degenerative neurological changes impingement over spinal cord and changes of myelomalacia cases are more in comparison group than study group, and narrowing nerve, root compression and indentation over thecal sac are more in study group than comparison group but the difference seen is statistically not significant.

## IV. Observation and Results

1. **AGE WISE DISTRIBUTION OF CERVICAL SPINE CHANGES IN STUDY GROUP**



2. **AGE WISE DISTRIBUTION OF DEGENERATIVE VERTEBRAL BODY CHANGES IN STUDY GROUP.**

| Observed degenerative changes in vertebral body in study group | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| Age group | Total | LOSS OF CERVICAL LORDOSIS | REVERSAL OF LORDOSIS | REDUCED VERTEBRAL HEIGHT | MODAIC CHNAGES | OSTEOPHYTE FORMATION | Schmorl's nodes | % |
| 20-25 | 44 | 20 | 3 | 6 | 1 | 14 | - | 22% |
| 25-30 | 45 | 16 | 2 | 4 | 3 | 20 | - | 22.5% |
| 30-35 | 39 | 10 | 3 | 2 | 4 | 20 | - | 19.5% |
| 35-40 | 34 | 8 | 1 | 2 | 4 | 19 | - | 17% |
| 40-45 | 38 | 12 | 2 | 1 | 2 | 21 | - | 19% |
| Total | 200 | 66 | 11 | 15 | 14 | 94 | - | 100% |

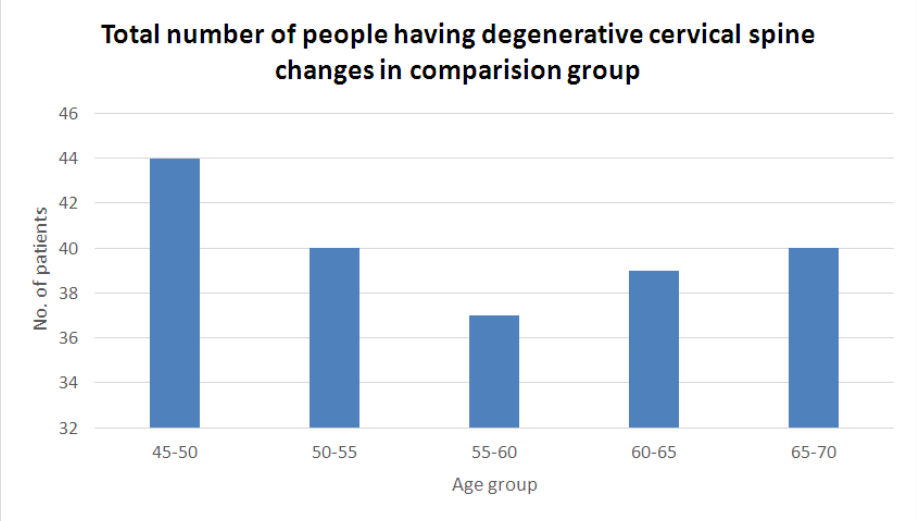
**3. AGE WISE DISTRIBUTION OF DEGENERATIVE INTERVERTEBRAL DISC CHANGES IN STUDY GROUP.**

| Observed degenerative intervertebral disc changes in study group | | | | | | | |
|---|---|---|---|---|---|---|---|
| AGE GROUP | TOTAL | DISC DEGENERATION | REDUCED DISC HEIGHT | DISC BULGE | DISC HERNIATION | ANNULAR LIGAMENT TEAR | % |
| 20-25 | 44 | 30 | 4 | 6 | 4 | - | 22% |
| 25-30 | 45 | 36 | 2 | 4 | 3 | - | 22.5% |
| 30-35 | 39 | 32 | 1 | 3 | 3 | - | 19.5% |
| 35-40 | 34 | 29 | 1 | 2 | 2 | - | 17% |
| 40-45 | 38 | 30 | - | 4 | 3 | 1 | 19% |
| | 200 | 157 | 8 | 19 | 15 | 1 | 100% |

**4. AGE WISE DISTRIBUTION OF NEUROLOGICAL CHANGES IN STUDY GROUP.**

| Observed neurological changes in study group | | | | | | | |
|---|---|---|---|---|---|---|---|
| AGE GROUP | TOTAL | NARROWING | Nerve root COMPRESSION | INDENTATION OVER THECAL SAC | IMPIGMENT OVER SPINAL CORD | CHANGES OF MYELOMALACIA | % |
| 20-25 | 44 | 2 | 2 | 35 | 2 | 3 | 22% |
| 25-30 | 45 | 3 | 3 | 32 | 5 | 2 | 22.5% |
| 30-35 | 39 | 1 | 1 | 30 | 5 | 2 | 19.5% |
| 35-40 | 34 | 1 | 2 | 26 | 3 | 2 | 17% |
| 40-45 | 38 | 1 | 1 | 32 | 3 | 1 | 19% |
| Total | 200 | 8 | 9 | 155 | 18 | 10 | 100% |

**5. AGE WISE DISTRIBUTION OF CERVICAL SPINE CHANGES IN COMPARISION GROUP**




**6. AGE WISE DISTRIBUTION OF DEGENERATIVE VERTEBRAL BODY CHANGES IN COMPARISION GROUP.**

| Observed cervical spine changes in combo spine sequence in comparison group | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| AGE GROUP | TOTAL | LOSS OF CERVICAL LORDOSIS | REVERSAL OF LORDOSIS | REDUCED VERTEBRAL HEIGHT | MODIC CHANGES | OSTEOPHYTE FORMATION | Schmorl's nodes | % |
| 45-50 | 44 | 20 | 4 | 8 | 2 | 10 | - | 22% |
| 50-55 | 40 | 15 | 5 | 2 | 4 | 12 | 2 | 20% |
| 55-60 | 37 | 24 | 2 | 1 | 2 | 8 | - | 18.5% |
| 60-65 | 39 | 22 | 1 | 2 | 1 | 12 | 1 | 19.5% |
| 65-70 | 40 | 18 | 4 | 4 | 2 | 11 | 1 | 20% |
| Total | 200 | 99 | 16 | 17 | 11 | 53 | 4 | 100% |

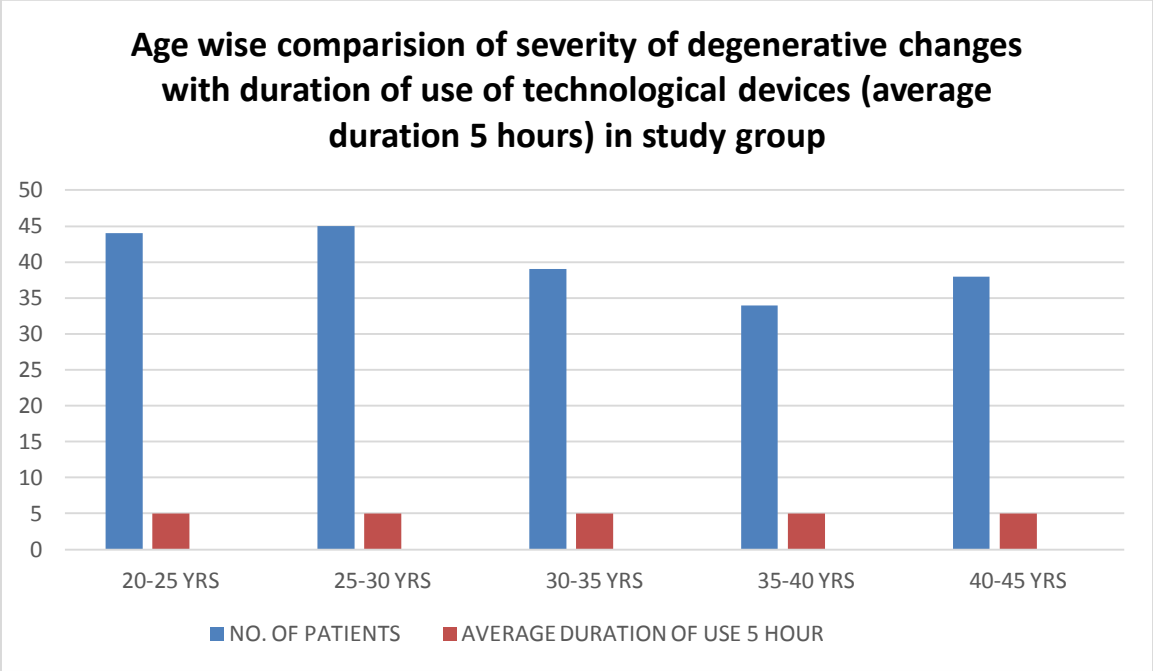
**7. AGE WISE DISTRIBUTION OF DEGENERATIVE INTERVERTEBRAL DISC CHANGES IN COMPARISION GROUP.**

| Observed disc degenerative changes in combo spine sequence in comparison group | | | | | | | |
|---|---|---|---|---|---|---|---|
| AGE GROUP | TOTAL | DISC DEGENERATION | REDUCED DISC HEIGHT | DISC BULGE | DISC HERNIATION | ANNULAR LIGAMENT TEAR | % |
| 45-50 | 44 | 32 | 3 | 4 | 1 | 4 | 22% |
| 50-55 | 40 | 30 | 4 | 2 | 2 | 2 | 20% |
| 55-60 | 37 | 31 | 2 | 1 | 1 | 2 | 18.5% |
| 60-65 | 39 | 28 | 2 | 6 | 2 | 1 | 19.5% |
| 65-70 | 40 | 30 | 3 | 2 | 3 | 2 | 20% |
| Total | 200 | 151 | 14 | 15 | 9 | 11 | 100% |

**8. AGE WISE DISTRIBUTION OF NEUROLOGICAL CHNAGES IN COMPARISION GROUP.**

| Observed neurological changes in combo spine sequence in comparison group | | | | | | | |
|---|---|---|---|---|---|---|---|
| AGE GROUP | TOTAL | NARROWING | NEREV ROOT COMPRESSION | INDENTATION OVER THECAL SAC | IMPIGMENT OVER SPINAL CORD | CHANGES OF MYELOMALACIA | % |
| 45-50 | 44 | 2 | 2 | 30 | 8 | 2 | 22% |
| 50-55 | 40 | 1 | 1 | 28 | 6 | 4 | 20% |
| 55-60 | 37 | - | - | 32 | 4 | 1 | 18.5% |
| 60-65 | 39 | 3 | 3 | 25 | 5 | 3 | 19.5% |
| 65-70 | 40 | 1 | 2 | 32 | 3 | 2 | 20% |
| TOTAL | 200 | 7 | 8 | 147 | 26 | 12 | 100% |

**9. AGE WISE COMPARISION OF SEVERITY OF DEGENERATIVE CHANGES WITH DURATION OF USE OF TECHNOLOGICAL DEVICES IN STUDY GROUP**



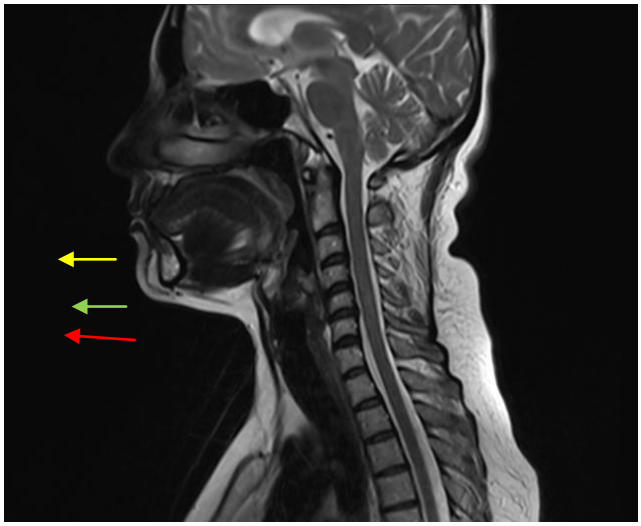

## V. Discussion

- Increased flexion/hyper flexion in the cervical region causes changes in the cervical region. Because of the prolonged tendency to flexion, the weight effect created by the weight of the head and the strain of the neck muscles will cause degeneration of the cervical vertebrae and discs, loss of lordosis and kyphosis. [6]
- Muscles in cervical region are strained, ligamentous structures are deteriorating. These are the most important causes of loss of cervical lordosis. According to the degree of flexion, the stress in the cervical region increases, loads on discs increase, loss of lordosis and degenerative processes accelerate. This can be the source of pain. [6]
- In our study, degenerative cervical changes was noticed 22% (20-25 yrs), 22.5% (25-30 yrs), 19.5% (30-35 yrs), 17% (35-40 yrs) and 19% (40-45 yrs) in young patients using technological devices for long time with average duration of technology device use was 5 hours.
- In comparison group degenerative cervical disc changes was noticed 22% (45-50 yrs), 20% (50-55 yrs), 18.5% (55-60 yrs), 19.5% (60-65 yrs) and 20% (65-70 yrs).

- In our study most common degenerative change seen in young patient was loss of cervical lordosis. Similar findings seen in study done by Azaria et al on cervical spine with neck pain in mobile phones users.
- Second most common finding noticed in study group was formation of osteophytes and most common neurological findings noted is indentation over thecal sac.
- In short, young technology device users are at greatest risk for development of cervical spondylosis in their early life similar findings seen by Dr mithun jakkan in his study of smart phones with cervical spine published in July 2020.

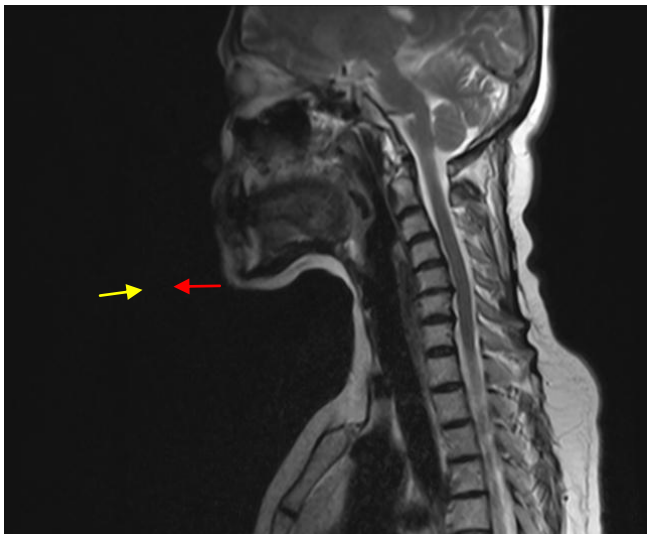
## VI. Figures:

**CASE: 1**



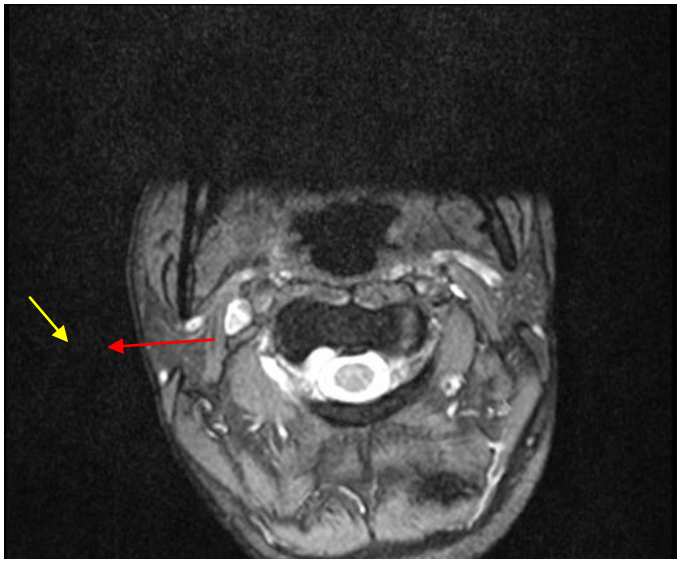
- ***SAGITAL T2WI: Shows loss of lordosis. Disc dessication (red arrow), Indentation over thecal sac (Green arrow) and Osteophyte formation (Yellow arrow).***

**CASE: 2**



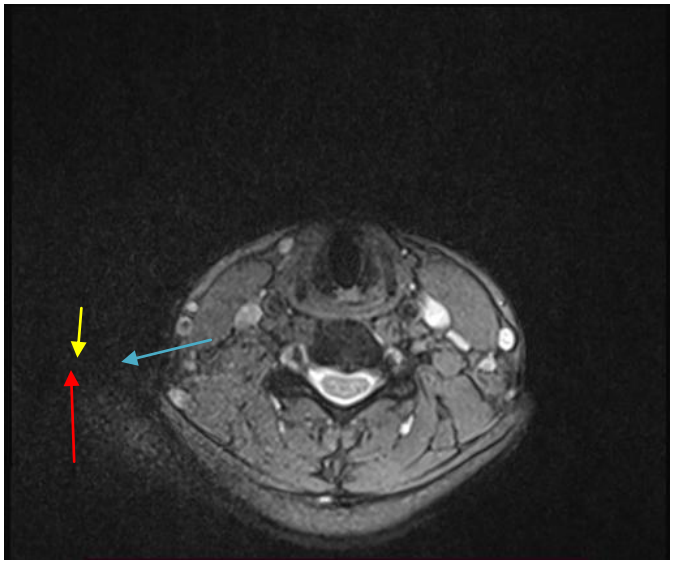
- ***SAGITAL T2WI: Shows reversal of lordosis. Indentation over thecal sac (Red arrow) and reduced Intra-vertebral disc space (Yellow arrow).***

**CASE: 3**



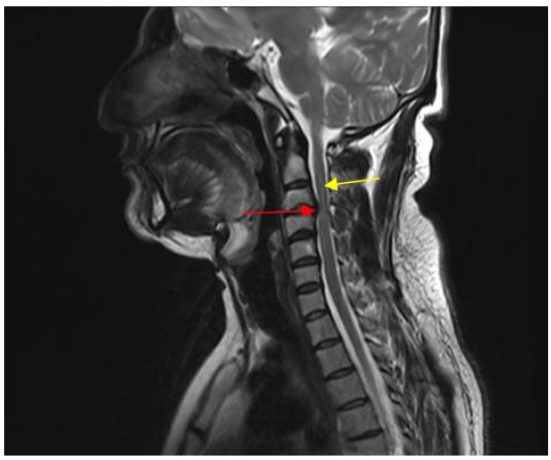
- ***Axial T2WI: Central annular tear (Yellow arrow )and central disc herniation (Red arrow)..***

**CASE: 4**



- ***Axial T2WI: Nerve root compression (Blue arrow), Central disc protrusion (Red arrow) and Central annular tear (Yellow arrow).***

**CASE: 5**



- ***SAG T2WI: Impingement of spinal cord (Red arrow) and Changes of myelomalacia (Yellow arrow)***

## VII. Conclusion

- As a result of our study, we compare the degenerative changes in young adults using technological devices for long time with age related cervical spine changes in comparison group then what we found degenerative changes are more or less similar in both the groups. Young age group usually not prove for cervical degenerative changes but in current life style with use of laptops and mobiles for longer duration of time risk of cervical spine degenerative disease become increasing in youngster therefore cervical spine problems that will develop with the necessity of flexion of the cervical region and lifestyle in this way affect our lives in the future.

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