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Original Article

Radiology Section

Unveiling Neck Pain in Young Adults: A Descriptive Study using Magnetic Resonance Imaging of Cervical Spine Highlighting Poor Posture and Degenerative Disc Disease

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ABSTRACT

Introduction: Neck pain is a widespread issue among the elderly, often causing disability and affecting daily activities. Recently, there has been an alarming rise in neck pain among young adults.

Aim: To assess the causes of neck pain in symptomatic young adults (ages 11-35 years) and identify modifiable risk factors.

Materials and Methods: An observational descriptive study was conducted in the Department of Radiodiagnosis of Government Medical College, Akola, Maharashtra, India from October 2023 to June 2024. A set of predefined questions was used to collect data on clinical symptoms, socio-demographic information and factors associated with neck pain. Magnetic Resonance Imaging (MRI) of the cervical spine was performed using a 1.5 Tesla Philips Ingenia system. Structural pathologies in the cervical spine and cervical spinal cord, like degenerative changes and congenital/developmental anomalies with their associated findings, were noted. Descriptive statistics was used and results were expressed in terms of frequency and percentage.

Results: Out of the 50 participants, 32 were males and 18 were females, with mean age of 27 years. Abnormal MRI findings were identified in 18 males (56.25%) and 10 females (55.56%). The leading cause among the abnormal findings was degenerative disc disease, with 18 cases (64.29%), followed by congenital and developmental factors-6 cases (21.43%), trauma-3 cases (10.71%) and inflammatory conditions-1 case (3.57%). Among the 18 cases of disc degeneration, 14 (77.78%) were involved in prolonged sedentary behaviour (more than eight hours per day), while 4 (22.22%) were engaged in an active lifestyle. Additionally, 9 cases (50%) reported more than four hours of daily mobile or computer use, whereas only 3 cases (16.67%) reported less than two hours of daily use.

Conclusion: There is a strong link between neck pain, prolonged sedentary behaviour and extensive mobile or computer use.

Keywords: Cell phone, Cervical vertebrae, Sedentary behaviour

INTRODUCTION

Nowadays, young adults are increasingly suffering from neck pain [1]. It has been attributed to changes in lifestyle and technology. High utilisation of smartphones, tablets and computers has resulted in poor posture over a long period, often referred to as “tech neck” or “text neck” [2]. This is because individuals bend forward for a long time when using their gadgets thus stretching the spinal cord. The absence of neck movement may lead to a weakening of the neck muscles thereby causing discomfort and pain [3].

Cervical disc disease is the most common cause of neck pain, with most commonly affected site being the C5-C6 disc [4]. Multiple factors are responsible for such degeneration, which include age, axial loading of the disc, posture, vascular growth and an impairment in the synthesis and turnover of collagen and proteoglycan [5]. This eventually results in disc herniation, radiculopathy and chronic discogenic neck pain [6].

The MRI is the preferred initial investigation for neck pain [7]. It very well demonstrates the extradural soft tissues (e.g., intervertebral discs), paravertebral musculature, exiting nerve roots and intradural structures (e.g., spinal cord and intrathecal roots).

The causes of neck pain include:

Mechanical: Postural (muscle sprain and strains), cervical spondylosis, cervical canal stenosis associated nerve compression, facet arthropathy and trauma [8].

Inflammatory: Infections (e.g., tuberculosis), transverse myelitis [9], rheumatoid arthritis [10], axial spondyloarthritis, polymyalgia rheumatica [11] and psoriatic arthritis [12].

Metabolic: Axial calcium pyrophosphate deposition disease [13] and fibrous dysplasia [14].

Neoplastic: Metastases, lymphoma [15], myeloma [16] and intrathecal tumours.

Others: Fibromyalgia [17] and torticollis.

Referred pain: From pharynx, aortic aneurysm [18], cervical lymph nodes, Pancoast tumour [19], dental disease and angina pectoris.

Developmental and congenital abnormalities: Arnold-Chiari syndrome [20], Hirayama disease [21] and Lafora disease [22].

Therefore, the study aimed to assess the causes of neck pain in symptomatic young adults and identify modifiable risk factors.

MATERIALS AND METHODS

An observational descriptive study was conducted in the Department of Radiodiagnosis of Government Medical College, Akola, Maharashtra, India, from October 2023 to June 2024. This study was conducted with the approval of the Institutional Ethics Committee (88/2023).

Inclusion criteria: Patients aged 11-35 years with neck pain who were referred to the Radiology Department for an MRI of the cervical spine during the study period.

Exclusion criteria: Pregnant women, patients younger than 10 years or older than 35 years, individuals with metallic implants (e.g., cardiac pacemakers, cochlear implants, ocular prostheses, dental implants and implantable cardiac defibrillators) and those with claustrophobia.

Study Procedure

A 1.5 Tesla MRI scanner (Ingenia, Philips, New York, USA) was used for cervical spine scanning. Detailed patient history was taken to rule out any exclusion criteria was taken. Details of the scan were explained to the patient and their relatives and a written informed consent was taken regarding participation in the research and publication of the research findings. The authors investigated structural pathologies in the cervical spine and cervical spinal cord, like degenerative changes and congenital/developmental anomalies, along with their associated findings.

STATISTICAL ANALYSIS

Data was collected and manually analysed using Microsoft Excel 2016. Descriptive statistics was used and results were expressed in terms of frequency and percentage.

RESULTS

The present study was conducted with 50 individuals with mean age of 27±6.3 years, which included 32 males and 18 females, to investigate neck pain using MRI. Among the males, 18 out of 32 (56.25%) had abnormal MRI findings. Similarly, among females, 10 out of 18 (55.56%) had abnormal results. In total, 22 cases showed normal MRI findings [Table/Fig-1].

MRI findings	Males n (%)	Females n (%)	N (%)
Abnormal MRI	18 (36)	10 (20)	28 (56)
Normal MRI	14 (28)	8 (16)	22 (44)
Total	32 (64)	18 (36)	50

[Table/Fig-1]: MRI findings with gender.

The most common cause of neck pain was degenerative disc disease, affecting 64.29% of cases [Table/Fig-2]. The age group 31-35 years was most susceptible to this condition, being 50% of those showing disc degeneration [Table/Fig-3].

Aetiologies	Males n (%)	Females n (%)	N (%)
Degenerative	11 (39.3)	7 (25)	18 (64.3)
Trauma	2 (7.1)	1 (3.6)	3 (10.7)
Inflammation	0 (0)	1 (3.6)	1 (3.6)
Congenital	5 (17.9)	1 (3.6)	6 (21.4)
Total	18 (64.3)	10 (35.7)	28

[Table/Fig-2]: Neck pain aetiologies and their gender-wise distribution.

Age (years)	Males n (%)	Females n (%)	N (%)
10-15	0	0	0
16-20	0	1 (5.6)	1 (5.6)
21-25	2 (11.1)	1 (5.6)	3 (16.7)
26-30	4 (22.2)	1 (5.6)	5 (27.8)
31-35	5 (27.8)	4 (22.2)	9 (50)
Total	11 (61.1)	7 (38.9)	18

[Table/Fig-3]: Degenerative disc disease and its age and gender-wise distribution.

Excluding other causes, 88.89% of the 18 cases with disc degeneration involved the C5-C6 intervertebral disc, 66.67% involved C4-C5 and only 33.33% involved C3-C4 [Table/Fig-4].

Of the 18 cases with disc degeneration, 9 (50%) regularly used mobile devices or computers for more than four hours daily and only 3 (16.67%) for <two hours daily [Table/Fig-5]. Furthermore,

Level of affected disc	Males n (%)	Females n (%)	N (%)
C1-C2	0	0	0
C2-C3	0	0	0
C3-C4	3 (16.7)	3 (16.7)	6 (33.3)
C4-C5	7 (38.9)	5 (27.8)	12 (66.6)
C5-C6	10 (55.6)	6 (33.3)	16 (88.9)
C6-C7	5 (27.8)	3 (16.7)	8 (44.4)

[Table/Fig-4]: Degenerative disc involvement and its gender-wise incidence.

14 (77.78%) had prolonged sedentary behaviour (over eight hours per day), with 10 being students or working in sedentary jobs. The remaining 4 (22.22%) were engaged in active lifestyle [Table/Fig-6].

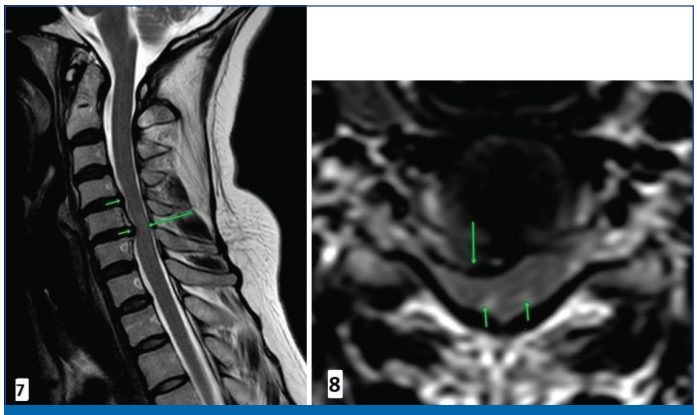
Mobile/computer use	Males n (%)	Females n (%)	N (%)
<2 hours	1 (5.6)	2 (11.1)	3 (16.7)
2-4 hours	4 (22.2)	2 (11.1)	6 (33.3)
>4 hours	6 (33.3)	3 (16.7)	9 (50)

[Table/Fig-5]: Habit-wise incidence of degenerative disc disease.

	Active lifestyle		Prolonged sedentary behaviour	
Age (years)	Males n (%)	Females n (%)	Males n (%)	Females n (%)
10-15	0	0	0	0
16-20	0	0	0	1 (5.6)
21-25	1 (5.6)	0	1 (5.6)	1 (5.6)
26-30	1 (5.6)	0	3 (16.7)	1 (5.6)
31-35	2 (11.1)	0	3 (16.7)	4 (22.2)
Total	4 (22.2)	0	7 (38.9)	7 (38.9)
Total	4 (22.2)		14 (77.8)	

[Table/Fig-6]: Disc degeneration and its age-wise and lifestyle-wise distribution.

Out of 18 cases with disc degeneration, 13 showed involvement at multiple contiguous sites [Table/Fig-7,8], one had involvement at multiple non contiguous sites and four had involvement at a single intervertebral disc [Table/Fig-9,10].



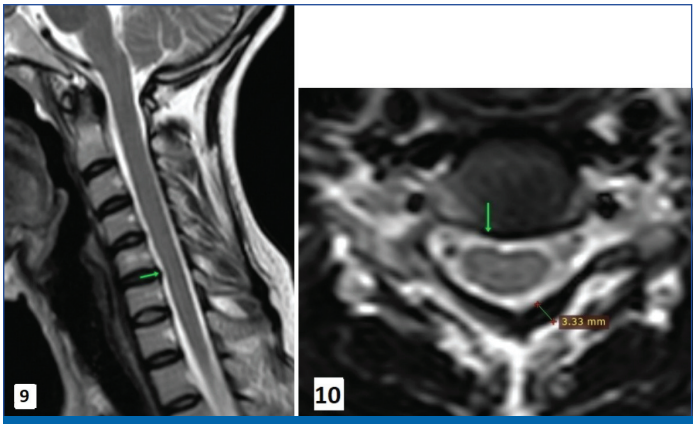
[Table/Fig-7,8]: MRI findings in degenerative disc disease. **[Table/Fig-7]:** T2W sagittal- Involvement of contiguous intervertebral disc levels C4-C5 and C5-C6 (small arrows) with associated cervical myelopathy (large arrow). **[Table/Fig-8]:** T2W axial (at C5-C6 level)- Disc osteophyte complex with posterior and right paracentral disc protrusion (large arrow) indenting right exiting nerve root with moderate spinal canal stenosis and associated changes in cervical cord (small arrow).

Six patients were with congenital or developmental deformities which included Arnold-Chiari Malformation (3), Hirayama Disease (1), Lafora Disease (1) and Friedreich's Ataxia (1).

Trauma was seen in three cases in the recent past and had neck pain post trauma. All cases showed associated mild degenerative changes with no fracture.

Inflammation was seen in one case, who was diagnosed with longitudinally extensive transverse myelitis.

Bone haemangiomas were noted incidentally in three cases, mostly in the C2 and C7 vertebral bodies, with other degenerative findings.



[Table/Fig-9,10]: MRI findings in degenerative disc disease. **[Table/Fig-9]:** T2W sagittal- Significant postero-central disc bulge (arrow) at single C5-C6 level. **[Table/Fig-10]:** T2W axial (at C5-C6 level)- Intervertebral disc showing mild posterior and right paracentral disc protrusion (arrow) indenting the anterior subarachnoid space with mild ligamentum flavum hypertrophy (callipers).

DISCUSSION

Cervical disc degeneration is the most common MRI finding in patients of neck pain worldwide, followed by primarily foraminal stenosis, disc desiccation and herniation [23].

In the present study, 64% of the cases were male, while 36% were female. Among the 32 males with neck pain, 18 (56.25%) were found to have abnormal MRI findings and among the 18 females, 10 (55.56%) also had abnormal MRI findings. Thus, a slightly higher prevalence of abnormal MRI findings was found in males than in females. Men are more prone to disc degeneration than women. A retrospective study done by Guvercin AR et al., indicated that the prevalence of cervical disc degenerative disease was higher in men than in women [24]. This is likely because young men are more prone to physical exertion, mechanical stress and injury [25].

The point prevalence of neck pain is higher in females compared to males in all age groups [26,27]. In men, apparent disc degeneration is detectable nearly a decade earlier than in women [25]. These differences are because women have a higher risk for chronic pain conditions, lower pain thresholds and tolerance, genetic predispositions, endogenous opioid functioning and sex hormone differences [28].

Degenerative disc disease: In the present study, degenerative disc disease was the most common abnormality noted (64.29%) and was mostly seen in the 31-35 years age group.

Disc desiccation refers to the replacement of glycosaminoglycans of nucleus pulposus by fibrocartilage, reducing the disc height [29]. A review by Peng B and DePalma MJ in 2018 outlined the association among cervical disc degeneration, inflammation and discogenic pain. Discogenic pain is marked by nerve fibre ingrowth into hitherto aneural tissue, stimulated by inflammatory cytokines and neurotrophins produced by disc cells and infiltrating immune cells, as well as by neurotrophin receptors and their modulators [6].

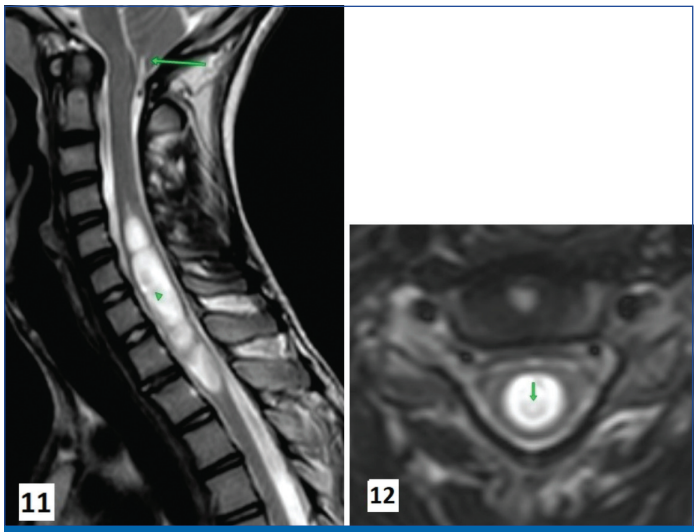
In the present study, most commonly involved level was C5-C6 (88.89%), followed by C4-C5 (66.67%) and least commonly C3-C4 (33.33%). These findings correlated with those in various studies, including one by Suzuki A et al., (2017), which studied 1,059 patients and found that disc degeneration was common at the level of C5-C6, followed by C4-C5 in young adults [4].

Among the 18 cases revealing disc degeneration, 14 (77.78%) had a history of prolonged sedentary behaviour. Only four cases (22.22%) indulged in an active lifestyle. In a study by Jahre H et al., (2021) found a significant association of prolonged sedentary behaviour with neck pain, was found [OR of 1.6, 95% Confidence Interval (CI) (1.0-2.5)] [30]. Globally, the most common risk factor for neck pain is awkward or sustained posture [31]. Work, study time and body position are found to contribute significantly to neck pain [32]. The most commonly reported mechanism for this is the selective and sustained activation of type I motor units during low-intensity tasks (referred to as the Cinderella hypothesis). This leads to calcium accumulation in the active motor units, disrupts local blood supply and metabolite removal. Other mechanisms include nociceptor sensitisation caused by intramuscular shear forces [33].

Of the 18 cases with disc degeneration, 9 (50%) used mobile devices/computers for more than four hours per day. In a meta-analysis by Mazaheri-Tehrani S et al., found that computer/mobile phone use was a significant risk factor for neck pain, with ORs of 1.3 (1.12, 1.53) and 2.11 (1.32, 3.42), respectively [34].

Arnold-Chiari malformation: Arnold-Chiari is a group of congenital deformities of the posterior fossa and hindbrain. There are four types, with Chiari I being the most common, occurring in approximately 0.5% to 3.5% of the general population, with a slight female predominance (1.3:1). Most common presentation is suboccipital headaches and/or neck pain (80%) [20].

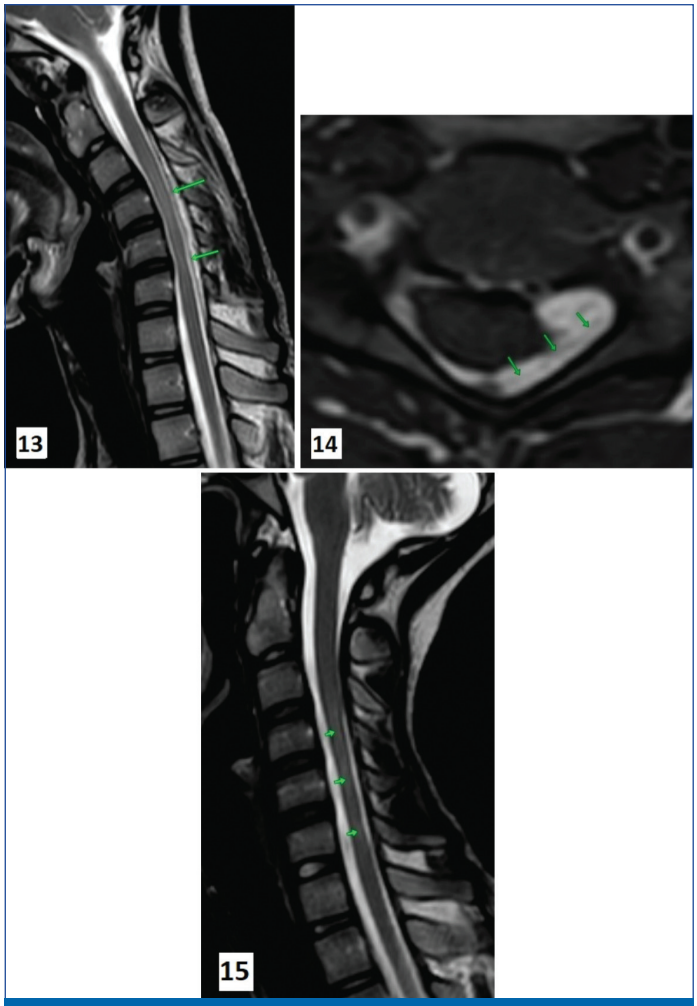
The authors had three patients of Arnold-Chiari Malformation type I, who revealed cerebellar tonsillar herniation by 6 mm in two patients and 8 mm in one patient, below the McRae's line. Spinal cord syrinx was also seen for variable lengths, extending from C4 to D3 in one case and from C5 to D11 in another. The third case had syrinx formation with atrophy of spinal cord from D4 extending to rest of the spinal cord [Table/Fig-11,12]. These findings align with a recent study by Hatgaonkar AM et al., which reported downward displacement of the cerebellar tonsils across the foramen magnum and hydrosyringomyelia in Chiari I malformation [35]. This displacement obstructs the cerebrospinal fluid flow, increasing pressure on the brainstem and cervical spinal cord, This can lead to muscle tension, nerve irritation and pain which worsens with neck movements, as the abnormal positioning places strain on surrounding tissues.



[Table/Fig-11,12]: Typical MRI findings in Arnold Chiari Malformation- Type I. **[Table/Fig-11]:** T2W sagittal- Cerebellar tonsillar herniation 6 mm below McRae's line (arrow). Spinal cord syrinx extending for a length of 7.3 cm from the C4 to T3 vertebral level (arrow head). **[Table/Fig-12]:** T2W axial (at C5-C6 level)- Spinal cord syrinx.

Hirayama disease: The case of Hirayama disease among the patients revealed anterior migration of posterior dura with prominent posterior epidural space mainly in neck flexion, with avid post-contrast homogeneous enhancement. Cervical myelopathy, asymmetric cord compression and neuropathy predominantly involving C3 to C6 levels were also evident [Table/Fig-13-15]. A study conducted by Kumari R et al., (2010) revealed similar findings, of localised lower cervical cord atrophy, asymmetric cord flattening, loss of attachment of the dorsal dural sac in the neutral position with its anterior displacement on flexion and strongly enhancing epidural space [36].

Hirayama disease usually manifests as non progressive oblique amyotrophy. The most plausible cause of this focal anterior horn cell disease is impairment of microcirculation because of forward

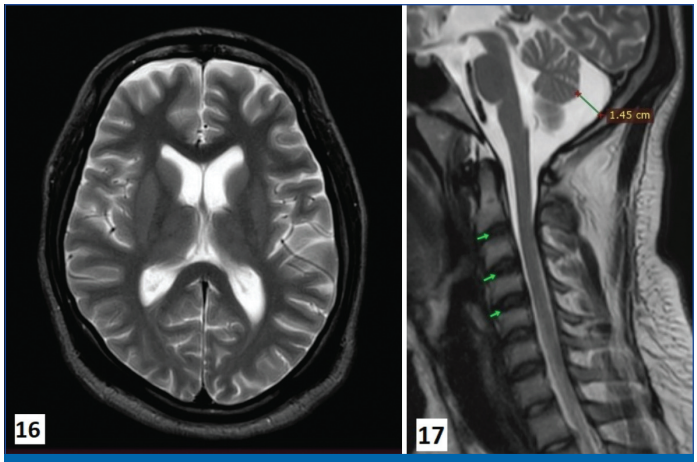


[Table/Fig-13-15]: Characteristic MRI findings in Hirayama disease. **[Table/Fig-13]:** T2W sagittal- Anterior migration of posterior dura with prominent posterior epidural space from C3 to C6 level, exaggerated on cervical flexion. **[Table/Fig-14]:** T1W post contrast axial- Anterior migration of posterior dura away from subjacent lamina (left>right) for more than 2/3rd of lamina length, with significant compression of spinal cord and obliteration of subarachnoid space. **[Table/Fig-15]:** T2W sagittal- Less prominent anterior migration of posterior dura on cervical extension. Abnormal signal intensity in spinal cord at same levels suggesting cervical myelopathy (arrows).

displacement of tight dura, leading to dynamic compression on flexion [37]. Classical findings range from neck and back pain, muscle atrophy and weakness of the forearms and hands without sensory loss [21].

Lafora disease: Lafora disease is a rare neurodegenerative disorder that belonging to a group of progressive myoclonus epilepsies [38]. Its prevalence is approximately four cases per million individuals and it occurs mostly in South India, Mediterranean countries, North Africa and Middle East [39]. Symptoms include myoclonus, hallucinations, generalised tonic-clonic seizures, muscle wasting, behavioural changes and cognitive decline [22]. Symptoms worsen over time, with a fatal outcome within 10 years of symptom onset [40].

There was one case of Lafora disease in the present study. MRI findings included mild cerebral cortical atrophy, a mega cisterna magna and moderate disc desiccation at the upper cervical levels [Table/Fig-16,17]. A study by Ferlazzo E et al., (2014) revealed similar MRI findings of mild brain atrophy in 6 of 17 patients with typical LD and in 2 of 5 patients with mild LD [41]. The findings were associated with metabolic and chemical changes in the brain parenchyma, as the NAA/creatine ratio was significantly reduced in the cerebral cortex, basal ganglia and cerebellar hemispheres, according to Villanueva V et al., (2006) [42]. This generalised neurodegeneration and cervical disc desiccation leads to neurological dysfunction, including muscle rigidity and spasms causing discomfort and pain in neck.



[Table/Fig-16,17]: MRI findings in Lafora disease. **[Table/Fig-16]:** T2W axial- Generalised cerebral atrophy with prominent ventricular system. **[Table/Fig-17]:** T2W sagittal- Mega cisterna magna (callipers) and upper cervical disc desiccation (arrows).

Friedreich's ataxia: Friedreich's ataxia is the most common hereditary ataxia, in which the patient presents with neurodegeneration manifesting as muscle weakness, sensory and proprioception abnormalities and impaired speech [43].

The authors had a case of Friedreich's Ataxia, which unveiled mild cerebral and cerebellar atrophy. There was moderate atrophy of entire spinal cord. An extensive review by Cocozza S et al., (2021) reported similar typical of normal cerebellar volume/mild cerebellar atrophy. A decrease of the anteroposterior diameter of the medulla oblongata and the cervical spinal cord was associated with signal abnormalities in the posterior or lateral columns, a finding consistent with degeneration of the ascending dorsal column system [44].

In Friedreich's ataxia, the spinal cord atrophy, particularly in the dorsal columns and lateral columns, leads to sensory and motor dysfunction. This leads to loss of motor control, muscle weakness or spasticity and muscle strength (ataxia), causing postural changes, particularly in neck muscles, leading to muscle strain and neck pain.

Limitation(s)

The study population is limited to 50 participants only. It may not represent all young adults to neck pain and does not capture the full range of causes or variations because it only includes those who seek medical attention and are referred for MRI. Some patients may be excluded from the study because of contraindications for MRI, such as metallic implants, claustrophobia, or pregnancy. MRI captures the static image of the cervical spine and cannot therefore assess dynamic conditions or movements which may contribute to pain.

CONCLUSION(S)

Young adults are experiencing a marked rise in the occurrence of neck pain, with the age group of 31 to 35 years being the most afflicted. MRI is a valuable diagnostic tool for identifying structural abnormalities, such as degenerative disc disease accounting to be the most common cause. Poor posture and developmental pathologies contribute significantly to neck pain in young adults. A combination of rest, physical therapy and ergonomic adjustments to daily activities can help decrease the risk of neck pain.

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