Research Article

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Epidemiological Study of Ossification of the Posterior Longitudinal Ligament Amongst Caucasian Population in A United Kingdom Specialist Spinal Unit

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ABSTRACT

Study Design: *Retrospective study.*

Objective: *This study primarily aims to determine the hospital prevalence of ossification of the posterior longitudinal ligament (OPLL) in the Caucasian population, with a secondary focus on the radiological presentation of OPLL in the UK.*

Methods: *A total of 43,647 CT scans were reviewed from September 1, 2012, to September 1, 2022. Data collected included the prevalence of OPLL, patient demographics (gender, age), radiological features (levels and size of OPLL, dimensions of the spinal canal, type of OPLL classified by Hirabayashi et al.; history of myelopathy, and any surgical interventions performed (anterior or posterior).*

Results: *OPLL was identified in 50 Caucasian patients (prevalence of 0.1%). Among them, 74% presented with myelopathy. The most prevalent type was Type B (52%), with nearly equal distributions of bridging and non-bridging cases. The C4 to C6 vertebrae were predominantly involved (18%). The mean size of OPLL was 3.8 mm at C4 and C5, with maximum sizes at C2 (4.8 mm), C6 (4.4 mm), and C7 (4.5 mm). The narrowest spinal canal dimension was found at C7 (6.84 mm). A total of 78% of patients underwent spinal surgery. 82% of these surgeries were posterior.*

Conclusion: *The prevalence of OPLL in the Caucasian population in the UK is 0.1%, significantly lower than that observed in East Asian populations. However, Caucasian individuals with OPLL exhibit more severe symptoms, including myelopathy.*

Keywords

OPLL, Ossification of posterior longitudinal ligament, Caucasian OPLL, Cervical myelopathy.

Introduction

Replacement of the posterior longitudinal ligament (PLL) with heterotopic bone is called ossification of the posterior longitudinal ligament (OPLL). OPLL predominantly affects the cervical spine, with occurrences in other spinal regions being infrequent. Ossification of the posterior longitudinal ligament (OPLL) is an uncommon pathology which poses a challenge in the domain of spinal pathology. This condition can cause substantial morbidity, neurological impairments, and spinal canal stenosis. Extensively researched and well- documented in various studies conducted on

Asian populations, with a particular focus on East Asia like Japan with as one of the regions that has been extensively researched. It is mainly because of its notably higher prevalence in that region. In contrast to the Caucasian descent group, they exhibit a lower prevalence of OPLL, with reported rates falling between 0.1% to 1.7% [1,2]. The phenomenon of OPLL has garnered significant attention in recent times. Despite the plethora of information available in these ethnic groups, the comprehension and knowledge regarding OPLL within the Caucasian population are notably scarce and remain relatively limited in comparison. The manifestation of OPLL in individuals of Caucasian descent might demonstrate resemblances to those noted in Asian populations, encompassing symptoms such as cervical myelopathy, radiculopathy, and advancing neurological impairments [1].

Nevertheless, there may be subtle discrepancies in clinical presentation, disease severity, and progression, necessitating a meticulous approach to both diagnosis and treatment. Moreover, the influence of ethnicity on clinical results, response to therapy, and long-term prognosis presents an avenue for further investigation. The advancement of the disease typically occurs at a gradual pace, with the possibility of not always resulting in manifestations related to the neurological symptoms [3]. Our primary aim of our retrospective study is to find the hospital prevalence of OPLL visiting tertiary centre in the United Kingdom. Secondary aim is to know the radiological presentation of cervical myelopathy amongst the OPLL Caucasian or western patients and how this affects the management plan. The goal of this retrospective study is to find any radiological features seen in western population patients with OPLL.

Materials and Methods

We undertook a review of computed tomography (CT) scan pertaining to the cervical spine, focusing on those conducted on Caucasian individuals who sought medical attention at our tertiary care hospital facility in the United Kingdom from 1st September 2012 to 1st September 2022. All CT reports mentioning OPLL were identified and duplicates were excluded. We included all patients with age above 18 years. Only Caucasians were included in the study.

We collected data on the gender, age, levels of OPLL, number of cervical vertebrae levels involved, Type of OPLL, Bridging or non-bridging, the level of bridging and if there is any myelopathy or no myelopathy. Other data collected were, if any spinal surgery was done and weather it was anterior or posterior spinal surgery. We also measured Size of the OPLL, narrowest spinal canal dimensions and Space available for Spinal.

Our study design was discussed in our trust for ethical clearance as a service evaluation study and it has been approved. Our proposal approval registration number is 2223_032. Patient's details will not be disclosed in our study.

Results

Total of 43,647 CT scans of cervical spine were performed in our hospital in the data collection period. 180 patients reported having OPLL, there were 69 duplicates, 61 non- Caucasians were excluded. A total of 50 (0.1 %) Caucasian patients had radiological evidence of OPLL on the CT scans. Of these 28 (56%) were males whilst 22 (44%) were females.

Radiographic classification of OPLL has been defined by the Investigation Committee on Ossification of the Spinal Ligaments, Japanese Ministry of Public Health and Welfare. They have classified OPLL into 4 types depending on the morphology. We had 2 type A(4%), 26 type B(52%), 15 type C(30%) and 7 patients with type D (14%) OPLL. There was a nearly equal distribution of bridging and non-bridging in their vertebrae. 26 (52%) vertebrae exhibited bridging, while 24 (48%) patients did not show any bridging. Most of the patients exhibited bridging of only a single vertebra, accounting for 12 (24%). This was followed by cases where two and three vertebrae were affected, with 6 (12%) and 4 (8%) cases respectively.

C4-6 was the most common level affected followed by C4-5. The detailed distribution of levels affected has been shown in Table 1. 18 patients had involvement of 3 levels (36 %) followed by 2 levels with 17 patients (34%). Detailed distribution is shown in Table 2. Size of the OPLL, narrowest spinal canal dimensions and space available for spinal cord are shown in Table 3.

Table 1: Distribution of levels involved in OPLL.

Level	Number Of Patients
C2-C3	1
C2-C4	1
C2-C5	2
C2-C7	1
C2-T3	1
C3-C5	6
C3-C6	2
C3-C4	3
C4-5	8
C4-6	9
C4-C7	1
C5-C6	8
C5-C7	2
C6-C7	5

Table 2: Table showing distribution of OPLL according to number of levels affected.

Number Of Levels Affected	Number Of Patients
1	8
2	17
3	18
4	5
6	1
9	1

Table 3: Average size of OPLL, narrowest canal dimension and narrowest space available for cord at each level in millimetres.

Level	Size Of OPLL	Canal Dimension	Space for cord
C2	4.803	15.3433	10.54
C3	3.6012	13.0976	9.49
C4	3.83	12.49562	8.66
C5	3.838	12.0246	8.18
C6	4.413	11.5892	7.17
C7	4.537	11.3843	6.84

Figure 1, shows the CT Image showing the method of measurement of Parameters on the CT which includes Size of the OPLL and space available for the Spinal cord.

Figure 1: Image showing the method of measurement of parameters on CT. Narrow line – Size of OPLL. Thick line – Canal dimension. Dashed line – Space available for spinal cord. 1066x1422mm (72 x 72 DPI).

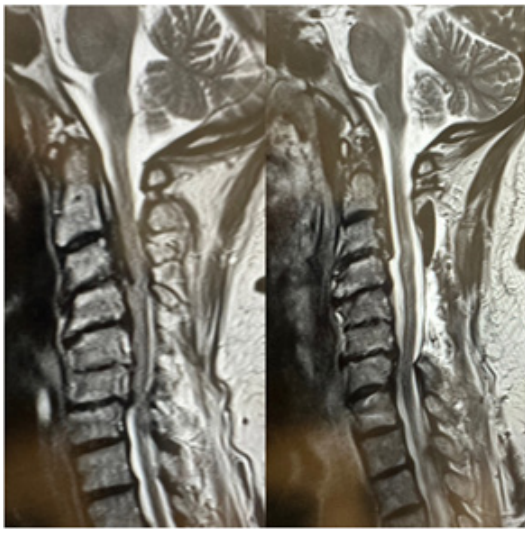

Figure 2: Pre and Post op MRI of a patient demonstrating adequate dural expansion and space for cord after posterior decompression. 240x240mm (216 x 216 DPI).

39 (78%) patients had signs/symptoms of myelopathy whilst 13 (26%) were asymptomatic. 39 patients had surgery with 32 (82%) having posterior surgery and 7 (18%) had anterior surgery. A representative example of pre and post op MRI has been shown in Figure 2.

Discussion

OPLL was initially documented by Tsukimoto in 1960 within the Japanese medical community, delineating a incidence rate of 1.9% to 4.3% among the population residing in the region [5,6]. Majority literature regarding OPLL is from eastern and south Asian regions with prevalence in western Europe and North America ranging from 0.6 – 2.2 %. It is worth noting that in Far Eastern societies, the prevalence rates are significantly higher than those seen in the regions [7,8]. The geographic concentration of literature on OPLL underscores the significance of regional epidemiological variations and sociocultural factors that may influence the manifestation and management of this disorder in distinct populations.

There are a few epidemiological investigations on OPLL conducted in the United States of America, while very few have been carried out in the United Kingdom. According to Wajeeh et al., a CT-based epidemiological analysis of OPLL in USA involved the review of 2,917 patients. Out of these, 74 patients were found to have OPLL based on CT scans, resulting in a prevalence rate of 2.5% [9]. In our own study, we examined a total of 43,647 CT scans and identified 50 cases of OPLL, leading to an incidence rate of 0.1%. Japan has around 3% incidence of cervical OPLL with a range of 1.9-4.3% when using conventional X-ray imaging techniques [10-13]. According to Fujumori et al, study in which computed tomography (CT) was used to identify the OPLL, it was reported as the incidence of cervical OPLL at 6.3% [14]. 3D-CT has been identified as a valuable tool in assessing the structural characteristics of ossified lesions and the degree of spinal cord compression resulting from OPLL [15] and therefore the CT scan was used in our study.

According to Epstein NE study, among individuals diagnosed with myelopathy, the occurrence of OPLL is reported to be 20 to 23% in the United States [16]. There is insufficient data available regarding the prevalence of cervical myelopathy among the Caucasian population due to the presence of OPLL. Our research findings indicate that a significant proportion of patients, comprising 74%, exhibited symptoms of myelopathy. Conversely, only a minority, representing 26% of the patients in our study, did not manifest any signs of myelopathy. In research utilizing MRI, the correlation between the level of compression in the spinal cord and the severity of clinical symptoms was documented [17,18]. An investigation into the rate of ossification occupancy revealed that individuals with an ossification rate exceeding 60% all displayed symptoms of myelopathy, whereas approximately half of those with an ossification rate below 60% exhibited myelopathy [19]. The most documented form of OPLL tends to differ among various research

studies, as several investigations indicate a greater prevalence of the segmental subtype (type 2) [20-22] while other studies suggest a nearly equivalent occurrence of segmental, continuous, and mixed subtypes [17,20]. Our research findings were in alignment with previous studies, revealing that 52% of individuals who were not of Asian descent exhibited the segmental type of OPLL. This suggests a significant prevalence of type 2 OPLL among non -Asian populations.

According to a study by Wajeeh B et al., the prevalence of OPLL in the United States is most frequently observed around the C6 (40.5%) or C7 (36.5%) vertebrae [9]. In contrast, our study indicate that the highest level affected is the C4 to C6 vertebrae. A research conducted by Oshima and colleagues involved the analysis of 120 CT scans from Japanese patients, revealing that the average thickness of OPLL was measured at 3.7 mm, with a range spanning from 2.0 to 8.4 mm [23]. Our own study, on the other hand, exhibited similarities in the Caucasian demographic, indicating mean measurements of 3.6 mm in C3. 3.8 mm thickness or the size of the OPLL in the C4 vertebrae as well as in the C5 region, respectively. This observation suggests a lack of significant variance between the two distinct population groups. Numerous studies have been conducted and reported in the literature regarding the measurement of the narrowest cervical canal level, which has been consistently observed to occur at the C4 vertebra. The average measurement obtained for this anatomical feature across these studies is recorded at 18.3 mm. These reports have also highlighted the presence of ethnic disparities in the measurements of the cervical canal, with individuals of White ethnicity exhibiting the widest cervical canal dimensions. Furthermore, individuals of Indian and Chinese descent were found to have intermediate measurements, with the Japanese population displaying measurements that fell between the aforementioned groups [24-26].

In our research, it was observed that the most constricted dimensions of the Spinal canal affected by OPLL within the demographic of UK Caucasian individuals were identified specifically at the C7 and C6 vertebrae levels, showcasing an average measurement of 11.3 and 11.5 respectively.

Conclusion

Our study suggests that the incidence of OPLL among individuals of Caucasian descents in the UK is less as compared to patients from eastern and south Asian countries. However, it is worth noting that in cases where OPLL is present, majority of affected individuals exhibit symptoms of myelopathy. We have also identified anatomical differences in distribution of OPLL amongst Caucasian population.

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