A STUDY ON THE THICKNESS OF LIGAMENTUM FLAVUM IN ASYMPTOMATIC PERSONS AND PATIENTS WITH LOW BACK PAIN AND ITS VARIATION WITH GENDER IN EASTERN INDIAN POPULATION- AS MEASURED USING MRI


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ABSTRACT

Background: Lumber spinal canal stenosis is common spinal disorder in elderly patients causing low back pain. Ligamentum Flavum (LF) covers most of the postero-lateral part of spinal canal, hypertrophy of which considered an important causative factor in development of lumbar spinal canal stenosis which significantly contributes to low back pain and sciatica.

Materials and Methods: To measure the thickness of LF in in lumbar region at L1-L2, L2-L3, L3-L4, L4-L5, L5-S1 level on MRI a cross sectional MRI study of lumbar spine was carried out between the age group of 20-50 yrs in IPGMER and SSKM hospital, Kolkata. The study population comprised of two groups with a total 120 population of which first group comprised of patients with low back pain (LBP) (n=60), second group was control groups, persons without low back pain (n=60). T1 weighted magnetic resonance images of lumbar segments were taken and thickness of LF was measured on both right and left side in all lumbar segments.

Results: The mean thickness of LF in lumbar segment in LBP group was 3.47mm which was significantly thicker than control group measuring 2.63 mm.

Conclusion: Patients with low back pain had significantly thicker LF in lumbar segments when compared to asymptomatic persons in both the sides which may be a contributing factor for LBP.

KEY WORDS: Ligamenta flava, Lumbar spine, Low back pain.

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INTRODUCTION

Ligamentum Flavum (LF) is an important structure in spinal architecture. LF is a yellow elastic ligament connecting laminae of two adjacent vertebrae and extending from C2 vertebrae to S1 segment. Lumbar spinal canal stenosis is the most common spinal disorder in elderly patients causing low back pain, leg pain and paresis [1]. As LF covers most of the posterolateral part of lumber spinal canal, hypertrophy of the LF is considered an important causative factor in the development of lumbar spinal stenosis, leading to compression of the dural sac and roots and significantly contributes to low back pain and sciatica [1-13]. Measurement of the thickness of LF in the lumbar segments was taken because in the lumbar segments, hypertrophic facets and thickened ligamenta flava are the most common offending structures for narrowing of spinal canal [13].

The study was a Radiological, observational, comparative study where two population groups were taken. First group was asymptomatic persons without low back pain and second group was patients with low back pain. T1-weighted Magnetic Resonance Images (T1WI) of lumbar spine was taken and thickness of LF was measured. The purpose of the study was to measure the thickness of LF in asymptomatic persons in relation to age and gender to understand how these pertinent variables influence the thickness of LF and also to measure thickness of LF in patients with low back pain. In this study, T1WI were used as the tool for the measurement by a standardized technique [14].

MATERIALS AND METHODS

A cross sectional and observational study of MRI lumbar spine was performed in the age group between 20-50 years in Eastern Indian population. This study was conducted on a SIGNA3T HDXT MRI machine (3Tesla) by GE Medical Systems in the department of Radiology of IPGMER &SSKM hospital, Kolkata over a period of 5 months from Sep 2016 to Jan 2017 after obtaining ethical committee clearance.

Our method of measuring LF is in accordance to Chokshi F. H. et al (2010). LF thickness is measured on the axial T1WI that was perpendicular to the spinal canal axis and parallel to the laminae, where LF was seen along the entire length. We made the measurement of LF at the half its length where it appeared the thickest. A normal value for LF thickness was established by measuring the thickness at half the length of the LF. Fig. 1 shows the technique used for measurement of LF thickness.

Subjects’ Inclusion Criteria:

For symptomatic patients: Patients attending orthopaedic out-patient department with chronic low back pain where symptoms persists more than 3 months in active young life and clinically diagnosed as Low Back Pain (LBP) of mechanical cause.

For Control group: The patients referred to MRI centre, IPGME&R &SSKM hospital for MRI of brain, shoulder joint and abdominal ailment or for MRI screening without any manifestation related to diseases involving dorso-lumbar regions.

Subjects’ Exclusion Criteria: Patients with significant trauma, infection, inflammation, neoplasia and osteoporosis, osteomalacia etc were excluded from the study. Spinal deformity like scoliosis was also excluded from the study.

Sample Size: 30 male and 30 female subjects as control (CON) were studied without any back problems and similar number of male and female subjects with low back pain.

Softwares used for analysis of the study were Statistica version 6 [Tulsa, Oklahoma: StatSoft Inc., 2001] and Graph Pad Prism version 5 [San Diego, California: Graph Pad Software Inc., 2007].

Fig. 1: Measurement of LF thickness taken at the intervertebral disc level, perpendicular to the border of the laminae (AP is the thickness of LF).
RESULTS

Table No.1 shows mean age of Low Back Pain (LBP) group was 40.28yrs (SD=8.273). The mean thickness of Ligamentum Flavum in different lumbar spinal levels on the Right side were as follows: L1-L2:3.73mm, L2-L3:3.63mm, L3-L4:3.54mm, L4-L5:3.45mm, L5-S1:3.37mm. The thicknesses of LF on the Left side at different lumbar levels were L1-L2:3.61mm, L2-L3:3.48mm, L3-L4:3.39mm, L4-L5:3.30mm, L5-S1:3.24mm.

Table No.2 shows mean age of Control group (CON) was 40.02 yrs (SD 8.36). The mean thickness of LF on the Right and Left sides at L1-L2, L2-L3, L3-L4, L4-L5 and L5-S1 levels were as follows: 2.66mm, 2.66mm, 2.67mm, 2.7mm, 2.69mm and 2.54mm, 2.57mm, 2.63mm, 2.64mm respectively.

From Table No.3 we can find that the thickness of LF was significantly higher in LBP group than in Control group in each side in all lumbar segments (p value<0.05). The thicknesses of LF in both the groups were compared by Student’s independent samples t test.

Table No.4 shows paired comparisons of sides in LBP group (n=60). The mean thickness of LF in L1-L2, L2-L3, L3-L4, L4-L5, L5-S1 levels was significantly higher on right side than Left side in LBP group (p<0.05).

From Table No.5 we can find that in control group the mean thickness of LF was higher on right side in all lumbar segments but it was statistically significant in upper three lumbar segments only.

Table No.6 shows comparison of thickness of LF between male and female within LBP group by Student’s unpaired t test. The mean thickness of LF was higher in all lumbar segments in male in LBP group except L4-L5 on the left side but it was not statistically significant.

Table No.7 shows comparison of data in the control group between male (n=30) and female (n=30) and revealed no sexual dimorphism. In control group the mean thickness of LF was more in male than female except L2-L3 level on both the side but it was not statistically significant.
DISCUSSION

A total of one hundred twenty (120) subjects were selected, of which sixty (60) was control group and sixty (60) belonged to Low Back Pain group. Male and female distribution was similar, thirty (30) in each LBP group and control group.

The reason for choosing the lumbar levels in this study is these segments are mostly affected, due to weight bearing nature and their dependent position [15].

The mean thickness of LF in LBP group ranges from 3.73 mm to 3.37 mm on the right side and 3.61 mm to 3.24 mm on the left side respectively. The mean thickness of LF in the control group ranges from 2.66 to 2.69 and 2.54 to 2.64 on the right and left side respectively. The thickness was seen to be significantly higher in LBP group than in Control group in both the sides in all lumbar segments. The study findings corroborated with the studies of Fukuyama et al [16], Abbas et al [17], Safak et al [15], Altinkaya et al [18], Kolte V S et al [19] whereas it differed from the studies performed by Grenier et al [20], Chokshi et al [14]. The difference might be due to sample size and racial variation.

The thicknesses of LF in both the groups were compared by Student’s independent samples t test. The thickness was seen to be significantly higher in LBP group in each side in all lumbar segments (p value<0.05). The present study had a similar finding with Park et al3, where they noted that the mean thickness in lumbar spinal

![Fig. 2: Axial T1 weighted image showing normal thickness of ligamentum flavum.](Image)

![Fig. 3: Axial T1 weighted image showing ligamentum flavum on right side at L2 level (3.55mm).](Image)
CONCLUSION

LF is an important anatomical structure, thickening of which can cause spinal and/or lateral recess stenosis resulting in LBP and leg pain. Therefore, the thickness of the LF should be measured carefully as an etiology for the pain and also for surgery in case of the suspected spinal stenosis because the thickness is liable to vary in relation to different pertinent variable.

So, this study might be a helpful guide not only for the anatomist but also for the orthopaedician and neurosurgeon.

CHECKED FOR OBJECTIVITY

Our study had a similar finding with Abbas J, Hamoud Y et al [17] where significant asymmetry had been found at L3L4 and L5S1 level. Paired t test revealed right sided LF was significantly thicker than left side. According to them this could be attributed to the right thoracic built in rotation in non scoliotic spine at the mid and lower thoracic vertebrae. A compensatory rotation to the left of the lumbar spine increases the tension force in the right spine complex, LF included, leading in time to a greater thickening of the right LF. The study findings are also consistent with the study conducted by Andrew J. Haig et al [21] and Haveen A. Akreyi et al [22] where they found that thickness of LF was thicker on right side than left side in asymptomatic individuals and individuals with LBP.

In the present study the difference of thickness of LF between Right and Left side and male and female was also observed. The mean thickness of LF in L1L2, L2L3, L3L4, L4L5, L5S1 were significantly higher on right side than left side in LBP group. In control group though the mean thickness was higher on right side in all lumbar segments it is statistically significant in upper three lumbar segments. In the present study the mean thickness of LF was more in case of male than female except at L4L5 in LBP group and L2L3 in control group but it was not statistically significant (p value<0.05).

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Abbreviations

MRI - Magnetic Resonance Imaging.
LF - Ligamentum Flavum.
L1-5 - 1st TO 5th Lumbar vertebra.
S1 - 1st Sacral Vertebra
IPGMER & SSKM - Institute of Post Graduate Medical Education & Research, & Seth Sukhjal Karnani Memorial Hospital, Kolkata.
LBP - Low Back Pain.
N/n - Valid Subject Number
T1WI - T1-Weighted Magnetic Resonance Images
T2WI - T2-Weighted Magnetic Resonance Images
C1-12 - 1st to 12th Cervical Vertebra.
LSCS - Lumbar Spinal Canal Stenosis.
Std.Dev - Standard Deviation.
Diff - Difference.

Conflicts of Interests: None

REFERENCES

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