# ASSESSMENT OF INCREASE IN DIMENSIONS WITHIN THE ACOUSTIC TARGET WINDOW FOR NEURAXIAL NEEDLE PLACEMENT IN CROSS-LEGGED SITTING POSITION IN TERM PREGNANCY USING ULTRASONOGRAPHY

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**Abstract:**

**Background:** Neuraxial anesthesia refers to placement of local anesthetic in or around the peripheral nervous system, it includes both spinal, epidural and caudal anesthesia. Spinal anesthesia is a neuraxial anesthesia technique in which local anesthetic is placed directly in the intrathecal space (subarachnoid space) which houses CSF.

**Aims:** To assess the effect of different positions on the dimensions of paramedian target area in pregnant women using Ultrasonography.

**Methods:** This prospective, observational study was conducted at LD Hospital, Govt. Medical College, Srinagar over a period of eighteen months. After obtaining approval from the Institutional Ethical Committee and informed consent of the patients for participation in the study. A total of 47 patients were included as per our inclusion and exclusion criteria. We assessed the increase in dimensions within the acoustic target window for neuraxial needle placement in Cross legged sitting position in term pregnancy using Ultrasonography. The various parameters we observed were age, gestational age, abdominal circumference, labouring status, comorbidities, comfort level of patients in both SP and CLP and increase in dimensions (PLL, LF, ILD) within acoustic target window using ultrasonography.

**Results: S**onographically visualized length of PLL (mean 20.85), ILD (mean 30.36), LF (mean 12.72) in CLP were significantly greater as compared to SP and this difference was statistically significant (P value <0.001). In addition the comfort level in CLP were significantly greater as compared to SP and this difference is statistically significant (P value <0.001).

**Conclusion:** In conclusion, positioning the patient in Cross legged sitting position in term pregnancy significantly increased the length of PLL, ILD, LF compared to SP, suggesting easier performance of lumbar neuraxial block. Further clinical studies are required to determine if Cross legged sitting position improve the success rate of lumbar neuraxial block for an easier and more efficient insertion.

**Keywords:** Anaesthetic techniques, spinal, Monitoring, Ultrasound, patient positioning

**Introduction:**

The imaginary horizontal line connecting the superior aspect of the posterior iliac crests, known as Tuffier‟s line, Jacoby‟s line, or the intercristal line, has long been used as an anatomical landmark for the estimation of vertebral levels during placement of neuraxial anesthesia. This is not just an interesting anatomical landmark; it is an issue of great concern for patient safety. Correct identification of vertebral levels is essential to avoid needle trauma to the spinal cord during these procedures. There are numerous reports of major morbidity when the vertebral level is misidentified during the placement of spinal block. [1,2] These cases, although rare, continue to occur and incorrect identification of the vertebral level can have dire and permanent consequences. In addition to the neurologic consequences, the cephalad extent of sensory blockade is related to the level at which injection is performed. [3,4]

In 1899, Jacoby described the line joining the top of the iliac crests as passing through the L4 vertebral body, and this observation has subsequently been verified multiple times.[5,6] It is speculated that, during pregnancy, the intercristal line is positioned higher than the L4 or L5 vertebral levels.[7] Clinical estimation of the intercristal line using anatomical landmarks may be inaccurate.

Subarachnoid block (Spinal anaesthesia), is the preferred anaesthetic technique in lower extremity, anorectal, urologic, obstetric, and lower abdominal surgeries.[8] Compared to general anaesthesia Subarachnoid block (Spinal anaesthesia) has decreased incidence of cardiovascular morbidity, deep venous thrombosis (DVT) and pulmonary embolism (PE), blood loss, pain, and length of hospital stay. It is also known that Subarachnoid block improves rehabilitation compared to GA.[9-11]

Recently, the use of ultrasonography has become popular in operating rooms. The lumbar neuraxial block was traditionally performed using a surface landmark-guided technique. However, ultrasound (US)-guided technique has been more frequently used for neuraxial block.[12]

Evidence was found to support US-guided neuraxial blockade for different patient populations, including an obese parturient. An ultrasound examination prior to neuraxial blocks (pre-puncture US) increases the success rate on the first attempt, reduces the number of attempts and improves technical and clinical outcomes.[13,14]

Ultrasound can identify the midline of the spine, the intervertebral level, the proper needle insertion point, the optimal angle for needle insertion and can measure the depth of the epidural space. [15,14, 16]When used for obstetric epidural analgesia, it also improves the quality of analgesia, reduces procedure-related complications and improves patient satisfaction.[15,16]

**Methods:**

The study was conducted in LD hospital, Government Medical College, Srinagar over a period of 18 months from 2020 to 2022. After obtaining approval from the Institutional Ethical Committee. Written informed consent was obtained from 47 patients non labouring women for participation in the study.

**Inclusion Criteria:**
Adult (Age > 18 years), Women with singleton pregnancy and gestational age more than 37 weeks who presented to the obstetric unit for an elective cesarean delivery, induction of labor or during the first stage of labor (cervical dilation < 4cm) while demonstrating no obvious signs of painful contractions.

**Exclusion Criteria**:
A history of spinal trauma or surgery, congenital spine abnormality, language barrier and women in advanced first stage of labour.
We demonstrated to the consenting subjects the way to assume both positions and the procedure for obtaining ultrasound images of their lower back in detail. Demographic and patient details such as age, gestational age were recorded. Each subject was instructed to sit with her shoulders relaxed, chin tucked into the chest and was asked to curl their back out. Wes canned subjects in two positions. The two positions for each subject were; (1) The standard position and; (2) The crossed-leg position.

**1. Standard position (SP):** In the standard position, subjects sat on the bed with their feet supported by a stool, spine flexed, arms hugging a pillow and knees bent at a 90 degree angle.

**2. Crossed-leg position (CLP):** In this position, subjects sat on the bed with their legs and ankles crossed, arms hugging a pillow.
For every subject the L3-L4 right paramedian interspace was identified first ultrasonographically by identifying the sacral plateau in longitudinal paramedian view while scanning cranially, and then counting the hyperechoic saw tooth structures of the laminae until the L3-L4 interspace was visualized. The scans were being obtained using 5-2 MHz curvilinear transducer (Sonosite HFL38). The subjects were initially asked to assume sitting position and this was followed by cross legged position. In each position, transducer was adjusted in an attempt to find most optimal picture of Posterior longitudinal ligament (PLL), Ligamentum flavum (LF), Interlaminar distance (ILD). The best imagewas selected and captured for each individual parameter in the paramedian view (PLL, LF, ILD). The ILD was measured between the highest, most superficial, points of L3 and L4 laminae. The LF was identified as a bright hyperechoic line between L3 and L4 laminae.The length was measured from the most superior to the most inferior point visible on ultrasound in the paramedian view. The PLL was identified as a deepest bright hyperechoic line below the LF. At the end of the scan subjects was asked to score their comfort level while seated in each position using Likert scale: 1=very uncomfortable, 2=uncomfortable, 3= Neutral, 4=comfortable and 5=very comfortable.

**Determination of sample size:**
Using G POWER software (Version3.0.10), it was estimated that the least number of patients required with effect size of 0.35, 80% power and 5% significance level is 46. Therefore, a total of 46 Patients was included in our study.

**Statistical Methods:**
The recorded data was compiled and entered in a Spread sheet (Microsoft Excel) and then exported to data editor of SPSS Version 20.0 (SPSS Inc., Chicago, Illinois, USA). Continuous variables were expressed as Mean±SD and categorical variables were summarized as Percentages. Appropriate statistical tests were employed to analyze the data. AP value of less than 0.05 was considered statistically significant.

**Conflict of interest: Nil**
**Funding: Nil**

**Results:**
Majority of study participants belonged to age group between 28-32 years (34%) [Table 1].

**Table.1: Distribution of study participants according to Age Group.**

| Age Group(yrs) | Frequency | (%) |
|---|---|---|
| 18-22 | 12 | 25.5 |
| 23-27 | 15 | 31.9 |
| 28-32 | 16 | 34.0 |
| 33-38 | 4 | 8.5 |
| Total | 47 | 100.0 |

Gestational age of the majority of study participants 21 (44.7%) was 38-39 weeks followed by 39-40 weeks in 15 (31.9%) patients and 37-38 weeks in 11 (23.4%) patients [Table 2].

**Table.2 Distribution of Gestational Age (wks) among study participants**

| Gestational Age(wks) | Frequency | Percent |
|---|---|---|
| **37-38** | **11** | **23.4** |
| **38-39** | **21** | **44.7** |
| **39-40** | **15** | **31.9** |
| **Total** | **47** | **100.0** |

Majority of study participants were represented with hypothyroid (40.4%) [Table 3].

**Table 3. Distribution of Comorbidity among study participants**

| Comorbidity | Frequency | Percent |
|---|---|---|
| No Comorbidity | 18 | 38.3 |
| Hypertension | 5 | 10.6 |
| Diabetes Milletus | 5 | 10.6 |
| Hypothyroid | 19 | 40.4 |
| Total | 47 | 100.0 |

Most of the patients are for elective caesarean section (44.7%) among the study population [Table 4].

**Table.4 Distribution of Labouring Status among study participants**

| Labouring Status | Frequency | Percent |
|---|---|---|
| Elective Caeserean Section | 21 | 44.7 |
| Induction Of Labour | 11 | 23.4 |
| First Stage Of Labour | 15 | 31.9 |
| Total | 47 | 100.0 |

In cross-legged position, majority of patients i.e. 23 (48.9%) were comfortable, 14 (29.8%) were neutral, 7 (14.9%) were very comfortable while only 3 (6.4%) were uncomfortable [Fig 1].

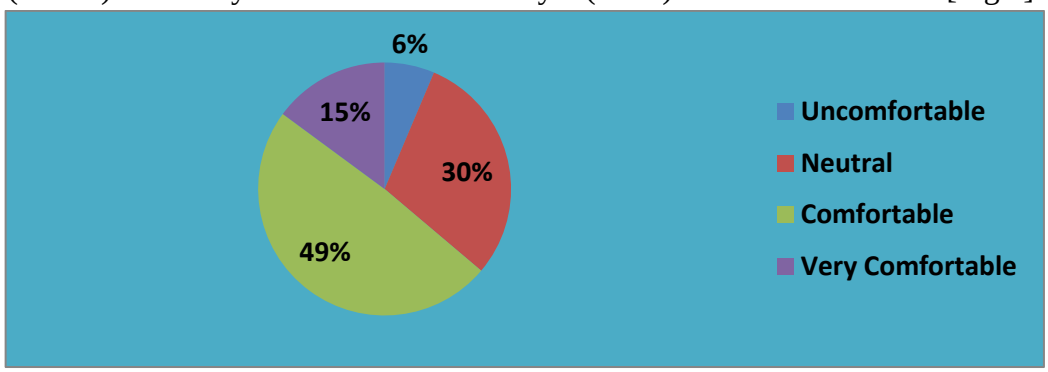


**Fig 1.** Pie chart depicting Comfort Level distribution

The dimension of Posterior Longitudinal Ligament was higher in Crossed-Leg Position (Mean 20.85mm) as compared to Standard Position (18.22), and this difference was statistically significant with a p Value of < 0.001 [Fig 2].

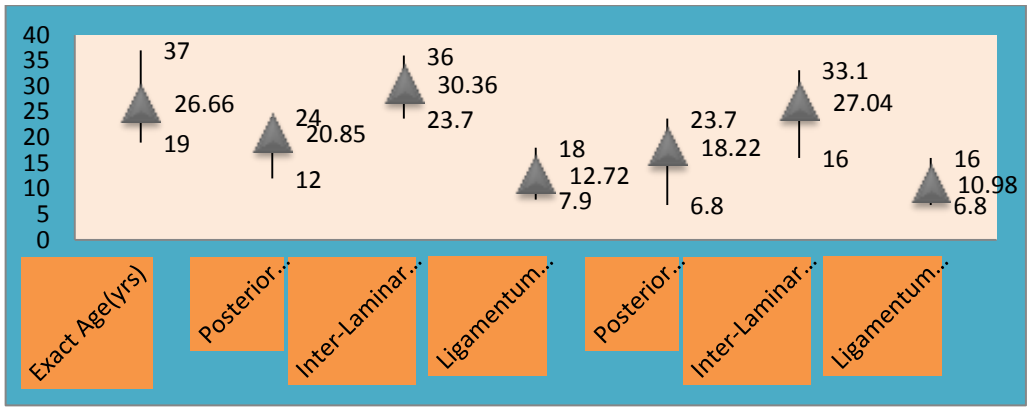


**Fig 2**

The dimension of Ligamentum Flavum was higher in Cross-Legged Position (Mean 12.72mm) as compared to Standard Position(10.98), and this difference was statistically significant with a p value of < 0.001 [Fig 3].

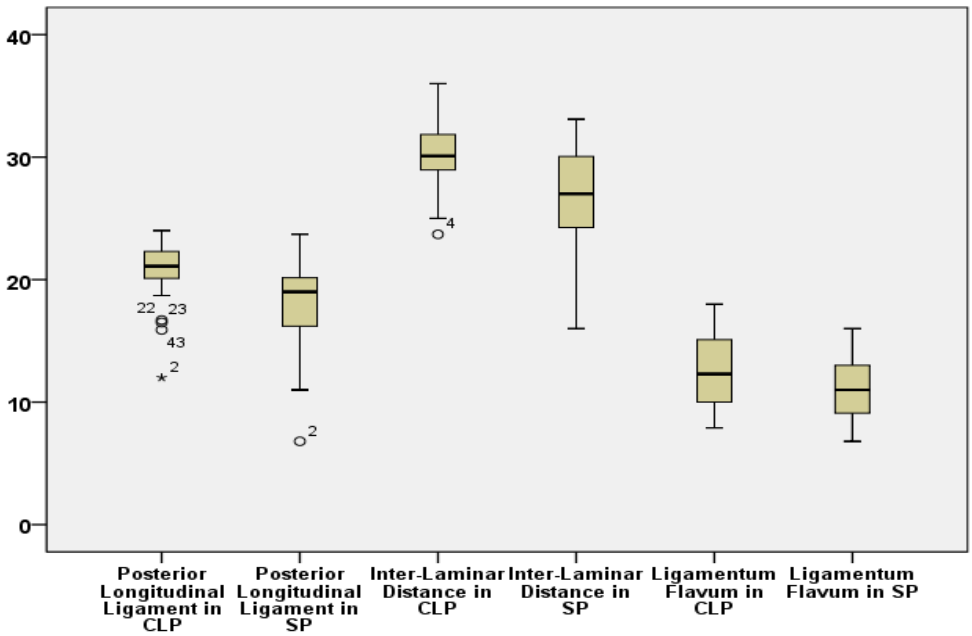


**Figure 3.** Box Plot depicting distribution of different measurements in Cross-leg Position & Standard Position.

Relationship between Comfort Level in Cross-legged and Standard Position is depicted in (Fig 4)

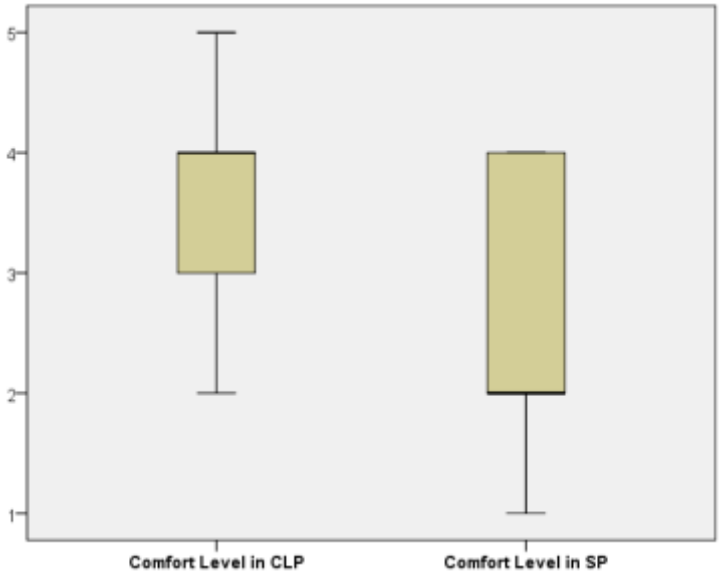


**Fig 4.** Box Plot showing comparison of comfort level between Cross legged position and Standard Position.

**Discussion:**

Lumbar spinal or epidural anesthesia is constantly administered in various surgeries to give anesthesia and postoperative analgesia. The most important procurator affecting success during spinal and epidural interventions is the patient positioning.( 17) downgraded lumbar lordosis may grease the palpation of vertebral spinous processes and identification of intervertebral distance.(18,19)

This prospective observational study demonstrated that the sonographically visualized length of PLL is significantly greater when measured in the CLP (Mean 20.85) as compared with the SP (18.22), and this difference is statistically significant with p value of <0.001. In addition the dimensions of Inter-Laminar distance was higher in CLP (Mean 30.36mm) as compared to SP (27.04), and this difference was statistically significant (p value < 0.001). The dimensions of LF was higher in CLP (mean 12.72mm) as compared to SP (10.98), and this difference is statistically significant with a p value of <0.001. The comfort level (LIKERT SCALE) in CLP of study participants was found to more than in SP and this difference is statistically significant (P value <0.001).

**Sandoval et al.,[24]** compared the three different positions for lumbar puncture toidentify the widest interspinous distance with US at the emergency department. The mean of intervertebral L4 L5 space of their 16 volunteers were reported between 1.91 cm to 2.02 cm in three different positions. In our study the mean of the L3–L4 intervertebral space in three different positions were approximately 40-50% wider comparing to their results. We assumed that performing our measurements at the longitudinal paramedian approach instead of sagittal approach and using the apexes of the acoustic shadows of two lamina as a reference point caused this difference. They reported that the sitting and the feet supported position produced the widest interspinous space.
In the present study, we chose the longitudinal paramedian instead of the midline view as it provides superior sonographic visualization of structures within the central neuraxial canal and because it is well suited to identifying a larger acoustic window.[25,26] **Grau et al., [27]** analyzed the transverse, median longitudinal and paramedian longitudinal approaches of vertebral US and compared the quality of monitoring andconcluded their study as the paramedian longitudinal window was excellent. We performed US imaging through the longitudinal approach in our patients. The physical characteristics in our study including age, abdominal circumference and gestational age. Relationship between age group and abdominal circumference was statistically insignificant (p value <0.068.)

**Lee ES et al, [22]** demonstrated that lumber lordosis decreases as position changes from standing to 90 degree sitting. The upper lumbar spine is more flexible in individuals in their twenties compared to those in their sixties.

**Lin N et al, [23]** performed a study in 2015, abdominal circumference but not the degree of lumbar flexion affects the accuracy of lumbar interspace identification by Tuffier‟s line palpation method: They concluded that patient‟s abdominal circumference, BMI, and age are factors that may impact the accuracy of lumbar level identification. Tuffier‟s line, as identified by palpation, does not seem to be a reliable landmark for lumbar interspace identification in all cases.

**Jones AR et al., [28]** in their study to assess whether applying dorsal table tilt to a seated parturient positioned for neuraxial anesthesia (i.e. facing laterally with her legs over the side of table) increases the size of the target area for the neuraxial needle. They performed lumbar USG on 20 pregnant women with the table level 00 and tilted 80 and 150 dorsally. They found significant increases in the mean (SD) size of the target area with increase in table tilt. Although they demonstrated the greatest

increase in the target area with 150 of table tilts. With patient safety and comfort in mind, a tilt of 150 may be dangerous and so lesser degree of tilt may be used.

**Mohammadi SS et al.,[29]** performed a study to compare three different sitting positions for ease of spinal needle insertion in patients undergoing spinal anesthesia. They concluded that each of the three positions can be used as an alternative sitting position for administration of neuraxial anesthesia. However, pregnant patients were excluded from their study.

**Sharma M et al.,[30]** assess the dimensions within the acoustic target window for neuraxial needle placement in term pregnancy in which 29 women completed the study. They observed significant increases in the lengths of posterior longitudinal ligament, ligamentum flavum and interlaminar distance at L3-L4 interspace. They also scored comfort level in each position using Likert scale. They concluded that cross legged position caused statistically significant increase in the target dimensions with equal comfort levels. However whether such findings translate clinically into easier needle placement need further studies.

**Puthenveettil N et al.,[31]** performed a randomized controlled trial in 2020 about the comparison of cross legged sitting position with the traditional sitting position for the ease of insertion of an epidural catheter in parturient for providing labor analgesia. They randomized 50 patients into two groups of TSP (traditional sitting position) and CLSP (cross-legged sitting position) using a computer generated random sequence of numbers by closed envelope technique. Group TSP received epidural in a traditional sitting position and group CLSP received epidural in a cross legged sitting position with knee and hip flexed. They found the percentage of parturient with successful epidural placement in the first attempt was higher in CLSP group than in TSP group (88% vs 44%, p=0.004). The landmark, needle-bone contact and comfort during positioning were comparable between the two groups. They concluded that CLSP is a better position than the TSP for the ease of insertion of labor epidural catheter.

**Ramsay N et al.,[32]** performed thoracic ultrasonography on 30 adult volunteers to measure the length of the PLL at the T9/10 interspace; P1, neutral; P2,thoracic and lumbar flexion; P3, as in position 2 with dorsal table tilt to 10 degree; P4 ,as in position 2 with 45 degree rightward shoulder rotation; and P5, as in position 2 with 45 degree leftward shoulder rotation. They found that in volunteers, flexion with 10 degree dorsal table tilt and flexion with right rotation significantly increased the length of the ipsilateral PLL, compared with the standard flexed sitting position, as visualized by paramedian ultrasonography at the level of T9/10.

**LIMITATION:**

One limitation of this study was that it evaluated only patients with normal BMI. So, the results may not be applicable to the obese patients.

Another limitation was that we did not compare any success rate of neuraxial anesthesia, number of needle bone contacts, or easiness of neuraxial anesthesia. Thus, clinical studies with these positions will be required for confirmation.

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