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Influence of Spinal Needle Tip Design on Post-Dural Puncture Headache Following Spinal Anaesthesia: A Comparative Study

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ABSTRACT:

Background: Post-dural puncture headache (PDPH) is a significant complication following spinal anaesthesia, with incidence influenced by needle design, gauge, and patient factors. While atraumatic (pencil-point) needles such as Whitacre are associated with lower PDPH rates compared to cutting needles like Quincke, their adoption remains inconsistent, particularly in resource-limited settings. This study aimed to compare the incidence of PDPH between 25G Quincke-Babcock and 25G Whitacre needles in adult patients undergoing subarachnoid block, and to evaluate procedural characteristics such as ease of puncture and associated factors.

Materials and Methods: A prospective, double-blinded, observational comparative study was conducted over 18 months (May 2024–October 2025) at the Department of Anaesthesiology and Critical Care, Justice K.S. Hegde Charitable Hospital, affiliated with K.S. Hegde Medical Academy, NITTE (Deemed to be University), Mangaluru. A total of 174 adult patients (ASA I–II), aged 18–65 years, undergoing elective surgery under spinal anaesthesia were included. Patients received subarachnoid block using either a 25G Quincke-Babcock or 25G Whitacre needle. Standardized procedural protocols were followed, and both patients and outcome assessors were blinded to needle type. The primary outcome was the incidence of PDPH, assessed using established diagnostic criteria over a 10-day postoperative follow-up period. Secondary outcomes included ease of puncture, number of attempts, and influence of patient positioning. Statistical analysis included descriptive methods and ordinal regression to evaluate predictors of procedural difficulty.

Results: The study population had a median age of 43 years, with a slight male predominance and overall low-risk profile. Notably, no cases of PDPH were observed in either needle group during the follow-up period. Most procedures were successful on the first attempt (67.2%), and puncture was categorized as easy in most cases (67.8%). The sitting position was used more frequently than the lateral position. Ordinal regression analysis demonstrated a non-significant trend toward greater technical difficulty with the Whitacre needle compared to Quincke-Babcock (OR 1.73, p=0.095). Patient positioning (sitting vs lateral) did not significantly influence ease of puncture.

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Conclusion: In a relatively healthy, non-obstetric adult population, the use of fine-gauge (25G) spinal needles was associated with an extremely low—effectively absent—incidence of PDPH, regardless of needle design. While atraumatic needles are traditionally favoured for reducing PDPH risk, this study suggests that in low-risk populations with standardized technique, both Quincke and Whitacre needles may yield similarly favorable outcomes. However, Whitacre needles demonstrated a tendency toward increased technical difficulty, highlighting a potential trade-off between procedural ease and theoretical reduction in dural trauma. Larger, multicentric studies including higher-risk populations are required to better define the true comparative benefits and inform standardized clinical guidelines.

INTRODUCTION

Lumbar puncture (LP), colloquially known as a "spinal tap," is a cornerstone procedure in anaesthesiology and neurology, widely used for spinal anaesthesia and diagnostic purposes.[1] Since its introduction by Heinrich Irenaeus Quincke in the late 19th century, LP has evolved significantly, particularly in needle design and procedural technique, to minimize complications such as post-dural puncture headache (PDPH).[2]

PDPH is a well-recognized, potentially debilitating complication of neuraxial procedures, characterized by a positional headache that typically arises within 6–72 hours of dural puncture and is often accompanied by nausea, photophobia, neck stiffness, and, in severe cases, cranial nerve palsies.[2,3,4] The pathophysiology of PDPH involves cerebrospinal fluid (CSF) leakage through the dural defect, leading to intracranial hypotension, traction on pain-sensitive structures, and compensatory cerebral vasodilation.[2,5]

The incidence of PDPH varies widely, influenced by patient-related factors (younger age, female sex, pregnancy, low BMI, prior PDPH), procedural factors (needle design, gauge, number of attempts, operator experience), and post-procedural management.[2,4,6] Notably, needle design is among the most important modifiable determinants: cutting needles (e.g., Quincke) are associated with higher PDPH rates, while atraumatic (pencil-point) needles (e.g., Whitacre, Sprotte) significantly reduce risk by creating a smaller, self-sealing dural defect.[7,8,9,10]

Despite robust international evidence and guideline recommendations favouring atraumatic needles, [9,11] their adoption remains inconsistent,[9] especially in resource-limited settings where cost, availability, and operator familiarity influence practice. In India, there is a paucity of large, prospective comparative studies evaluating needle design and PDPH incidence in diverse surgical populations.

Study Objectives

Primary Objective: To compare the incidence of post-dural puncture headache (PDPH) following spinal anaesthesia using 25G Quincke-Babcock (cutting) versus 25G Whitacre (atraumatic) spinal needles.

Secondary Objectives:

- To compare the number of attempts required for successful dural puncture with each needle type.
- To assess ease of puncture and the influence of patient positioning (sitting vs lateral) on procedural difficulty.
- To evaluate the onset, severity, and associated symptoms of PDPH, if present.

Significance

Reducing PDPH risk translates into improved postoperative recovery, shorter hospital stays, and fewer readmissions. [9,11] Standardizing best practices in needle selection and procedural technique could yield substantial health benefits, particularly in high-throughput surgical settings. [7,11]

MATERIALS AND METHODS

Study Design

A prospective, observational, double-blinded, comparative study was conducted over 18 months (May 2024–October 2025) at the Department of Anaesthesiology and Critical Care, Justice K.S. Hegde Charitable Hospital, affiliated with K.S. Hegde Medical Academy, NITTE (Deemed to be University), Deralakatte, Mangaluru.

Ethical Considerations

- Ethics Approval: Institutional Ethics Committee approval was obtained (INST.EC/EC/138/2024 REG NO: EC/NEW/INST/2022/KA/0174, dated 13/04/2024).
- CTRI Registration: The study was prospectively registered with the Clinical Trials Registry of India (CTRI/2024/07/071395).
- Informed Consent: Written informed consent was obtained from all participants.
- Plagiarism Check: The dissertation was subjected to Turnitin plagiarism software and found to have a similarity index of 1%, within institutional guidelines.

Study Population

Inclusion Criteria:

- Adults aged 18–65 years.
- ASA Physical Status I or II.
- Undergoing elective surgery under spinal anaesthesia using a 25G Quincke or 25G Whitacre spinal needle.

Exclusion Criteria:

- Pre-existing neurological disorders or chronic headaches (including migraine).
- Conversion of spinal anaesthesia to general anaesthesia intraoperatively.
- Change of needle type or gauge during the procedure.
- BMI > 35 kg/m².
- Pregnant patients.

Sample Size

Based on prior studies (Asif and Sholapur, 2018), with an expected PDPH incidence of 12.73% in the Quincke group and 1.82% in the Whitacre group, a sample size of 86 per group (total 172) was calculated to achieve 80% power and a 95% confidence interval for detecting an 11% difference in PDPH incidence.

Sampling and Randomization

Purposive sampling was used. Allocation to groups was based on the spinal needle used during the procedure. Both patients and outcome assessors were blinded to needle type; the anaesthesiologist performing the block did not participate in postoperative assessment.

Study Procedure

- Preoperative Assessment: Comprehensive evaluation including demographic data, ASA grading, and clinical history.
- Anaesthesia Administration:
    - Preloading with 500 ml IV fluid.
    - Spinal anaesthesia at L3-L4 interspace using a midline approach and 0.5% hyperbaric bupivacaine.
    - Use of either a 25G Quincke or 25G Whitacre needle as per standard practice and operator availability.
    - Needle type recorded confidentially.
- **Perioperative Monitoring:** Non-invasive monitoring of vital signs; assessment of sensory and motor block.
- **Follow-up:**
    - Daily assessment for 10 postoperative days (in-person or telephonic if discharged early).

- Evaluation for PDPH and related symptoms.
- Needle type unblinded only after data collection was complete.

Outcome Measures

Primary Outcome: Incidence of PDPH, defined by International Headache Society criteria: onset within 6–72 hours, orthostatic nature, associated symptoms (nausea, tinnitus, visual/auditory disturbances), and relief with conservative measures.

Secondary Outcomes:

- Number of attempts for successful dural puncture.
- Ease of puncture (categorized as easy, difficult, very difficult).
- Patient position during SAB (sitting or lateral).
- Onset, severity, and associated symptoms of PDPH (if present).

Severity Grading of PDPH:

- Mild: Minimal impact, responsive to oral analgesics.
- Moderate: Interferes with activity, may require stronger analgesics.
- Severe: Debilitating, may require interventional treatment (e.g., epidural blood patch).

Statistical Analysis

- Data compiled using Microsoft Excel and analyzed with SPSS version 22 and R statistical software.
- Continuous variables summarized as mean ± SD; categorical variables as frequencies and percentages.
- Chi-square, Z-test for proportions, or Fisher's exact test used for group comparisons.
- Ordinal regression used to evaluate predictors of procedural difficulty.
- p-value <0.05 considered statistically significant.

RESULTS

Demographic and Baseline Characteristics

A total of 174 patients were included (95 males [54.6%], 79 females [45.4%]). The median age was 43 years (IQR: 33.75–53), mean weight 59.79 kg (SD 10.41), mean height 164.75 cm (SD 8.05), and mean BMI 22.07 kg/m² (SD 3.81). ASA-PS I: 90 (51.78%), ASA-PS II: 84 (48.22%).

Table 1. Demographic Characteristics of Study Population

Parameter	Value
Age (years), Median	43 (IQR 33.75–53)
Weight (kg), Mean	59.79 (SD 10.41)
Height (cm), Mean	164.75 (SD 8.05)
BMI, Mean	22.07 (SD 3.81)
Gender, n (%)	Males: 95 (54.6%)
	Females: 79 (45.4%)
ASA-PS I	90 (51.78%)
ASA-PS II	84 (48.22%)

Needle Type Distribution: Quincke: 50.6% (n=88); Whitacre: 49.4% (n=86).

Procedural Characteristics

- **Number of Attempts:**
  - Single attempt: 67.2%
  - Two attempts: 26.4%

- More than two attempts: 6.3%

- **Ease of Puncture:**
  - Easy: 67.8%
  - Difficult: 25.9%
  - Very difficult: 6.3%
- **Patient Position:**
  - Sitting: 81.6%
  - Lateral: 18.4%

Primary Outcome: Incidence of PDPH

Key Finding: No cases of PDPH were observed in either needle group during the 10-day postoperative follow-up period. Thus, onset, effect of posture, associated symptoms, or severity categories could not be reported.

Statistical Analysis

Ordinal regression analysis of 'ease of puncture' as an ordinal outcome with respect to needle type and patient position showed:

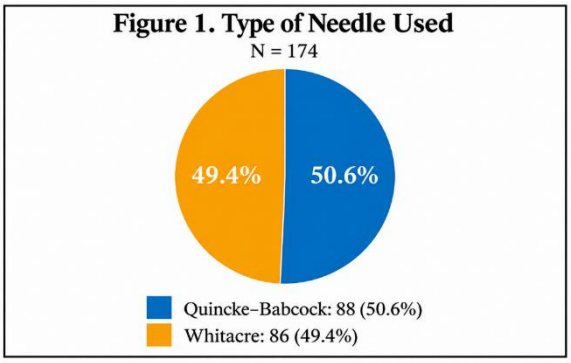
- Whitacre needle: trend toward higher difficulty compared to Quincke (OR=1.73, 95% CI 0.91–3.32, p=0.095).
- Patient position (sitting vs lateral): no significant effect on ease of puncture (OR=1.13, 95% CI 0.51–2.69, p=0.771).

Table 2. Ordinal Regression Model Coefficients – Ease of Puncture

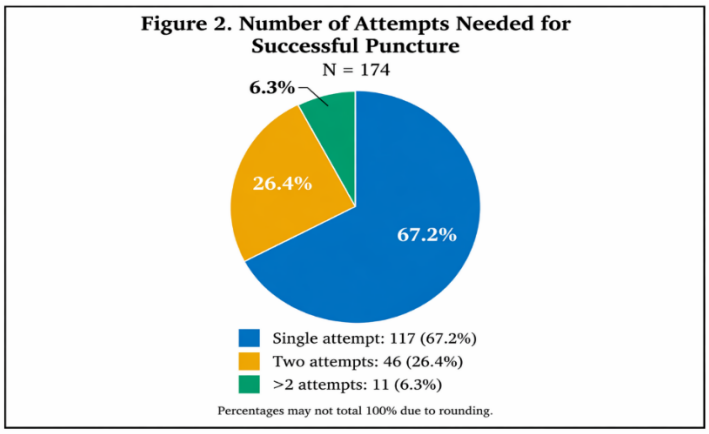
Predictor	Estimate	95% CI (Lower–Upper)	SE	Z	p	Odds Ratio
Type of Needle	0.546	0.91–3.32	0.327	1.671	0.095	1.73
Sitting Position	0.123	0.51–2.69	0.422	0.291	0.771	1.13

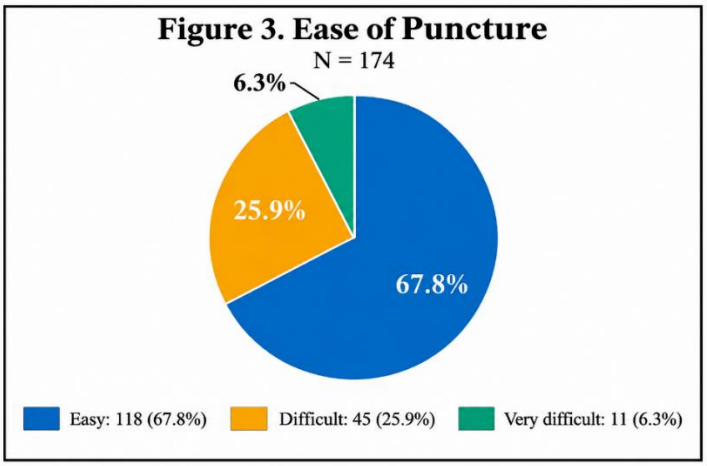
Table 3. Procedural Characteristics

Characteristic	n (%)
Number of Attempts	
- Single attempt	117 (67.2%)
- Two attempts	46 (26.4%)
- >2 attempts	11 (6.3%)
Ease of Puncture	
- Easy	118 (67.8%)
- Difficult	45 (25.9%)
- Very difficult	11 (6.3%)
Patient Position	
- Sitting	142 (81.6%)
- Lateral	32 (18.4%)



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DISCUSSION

Interpretation of Findings

This prospective, double-blinded study compared the incidence of PDPH between 25G Quincke-Babcock (cutting) and 25G Whitacre (atraumatic) spinal needles in a relatively healthy, non-obstetric adult population undergoing elective surgery under spinal anaesthesia. Remarkably, no cases of PDPH were observed in either group during the 10-day follow-up.

Comparison with Existing Literature

The absence of PDPH in this cohort is lower than the pooled estimates from broader populations, even those using small-gauge needles. [7,9,12] Classical descriptions report PDPH incidences up to 30–36% with larger cutting needles, particularly in younger and obstetric patients. [1,2] Modern studies with small-gauge (25G or finer) needles, especially pencil-point designs, report much lower rates (often <2%). [13,14,15,16]

Meta-analyses and randomized trials consistently show that pencil-point needles (e.g., Whitacre) reduce PDPH risk compared to cutting needles (e.g., Quincke), but do not abolish it entirely. [8,9,10,17,18] The present study's zero incidence likely reflects the low-risk, non-obstetric, ASA I–II population, the use of fine-gauge needles, and standardized technique. Exclusion of high-risk groups (pregnant women, those with prior PDPH, or chronic headache disorders) further reduces expected incidence. [2,4]

Technical Considerations

The study found a non-significant trend toward greater technical difficulty with the Whitacre needle (OR=1.73, p=0.095). This aligns with prior reports that pencil-point needles may require more precise alignment or greater insertion force, potentially increasing technical difficulty for some operators. [2,19] However, the clinical trade-off may be acceptable in high-risk populations where PDPH reduction is paramount. [11,13,16]

Patient positioning (sitting vs lateral) did not significantly affect ease of puncture, consistent with literature suggesting both positions are viable with optimized technique and operator experience. [2,12]

Procedural Factors

Most procedures were successful on the first attempt (67.2%), with a majority categorized as easy (67.8%). Multiple attempts and traumatic punctures are known to increase PDPH risk, [4,6] but were infrequent in this cohort, further reducing observed incidence.

Clinical Implications

The findings suggest that in low-risk, non-obstetric adult populations, the absolute risk of PDPH with either 25G Quincke or Whitacre needles may be extremely low when standardized technique and experienced operators are employed. However, this should not be generalized to higher-risk groups, such as obstetric patients, where the risk remains substantial and the benefit of atraumatic needles is more pronounced. [4,13,16]

Limitations

- **Sample Size and Power:** While adequately powered for the expected difference, the modest sample size may not detect very low but non-zero incidence.[20]
- **Population:** The study excluded high-risk groups (obstetric, obese, prior PDPH), limiting generalizability.
- **Single-Centre Design:** Results may reflect local practice patterns and operator expertise.
- **No Randomization of Needle Type:** Allocation was based on operator availability, introducing potential selection bias, though blinding mitigates this risk.

Strengths

- Prospective, double-blinded design.
- Standardized technique and outcome assessment.
- Adequate follow-up period (10 days) to capture clinically significant PDPH.
- Use of both descriptive and regression analyses.

CONCLUSION

This study demonstrates that in a relatively healthy, non-obstetric adult population, the use of fine-gauge (25G) spinal needles—whether Quincke (cutting) or Whitacre (atraumatic)—is associated with an extremely low, effectively absent, incidence of post-dural puncture headache (PDPH) when standardized technique and experienced operators are employed. While atraumatic needles are traditionally favoured for reducing PDPH risk, the findings suggest that in low-risk populations, both needle types may yield similarly favorable outcomes. However, Whitacre needles showed a non-significant trend toward increased technical difficulty, highlighting a potential trade-off between procedural ease and theoretical reduction in dural trauma.

REFERENCES

[1] Ahmed, S. V., Jayawarna, C., & Jude, E. (2006). Post lumbar puncture headache: Diagnosis and management. Postgraduate Medical Journal, 82(973), 713–716. https://doi.org/10.1136/pgmj.2006.044792

[2] Turnbull, D. K., & Shepherd, D. B. (2003). Post-dural puncture headache: Pathogenesis, prevention and treatment. British Journal of Anaesthesia, 91(5), 718–729. https://doi.org/10.1093/bja/aeg231

[3] Ghaleb, A. (2010). Postdural puncture headache. Anesthesiology Research and Practice, 2010, Article 102967. https://doi.org/10.1155/2010/102967

[4] Kwak, K.-H. (2017). Postdural puncture headache. Korean Journal of Anesthesiology, 70(2), 136–143. https://doi.org/10.4097/kjae.2017.70.2.136

[5] Headache Classification Committee of the International Headache Society. (2018). The international classification of headache disorders (3rd ed.). Cephalalgia, 38(1), 1–211. https://doi.org/10.1177/0333102417738202

[6] Seeberger, M. D., Kaufmann, M., Staender, S., Schneider, M., & Scheidegger, D. (1996). Repeated dural punctures increase the incidence of postdural puncture headache. Anesthesia& Analgesia, 82(2), 302–305. https://doi.org/10.1097/00000539-199602000-00015

[7] Arevalo-Rodriguez, I., Muñoz, L., Godoy-Casasbuenas, N., Ciapponi, A., Arevalo, J. J., Boogaard, S., &RoquéiFiguls, M. (2017). Needle gauge and tip designs for preventing post-dural puncture headache (PDPH). Cochrane Database of Systematic Reviews, (4), Article CD010807. https://doi.org/10.1002/14651858.CD010807.pub2

[8] Halpern, S., & Preston, R. (1994). Postdural puncture headache and spinal needle design: Metaanalyses. Anesthesiology, 81(6), 1376–1383. https://doi.org/10.1097/00000542-199412000-00012

[9] Nath, S., Koziarz, A., Badhiwala, J. H., Alhazzani, W., Jaeschke, R., Sharma, S., Banfield, L., Shoamanesh, A., Singh, S., Nassiri, F., Oczkowski, W., Belley-Côté, E., Truant, R., Reddy, K., Meade, M. O., Farrokhyar, F., Bala, M. M., Alshamsi, F., Krag, M., . . . Almenawer, S. A. (2018). Atraumatic versus conventional lumbar puncture needles: A systematic review and meta-analysis. The Lancet, 391(10126), 1197–1204. https://doi.org/10.1016/S0140-6736(17)32451-0

[10] Xu, H., Liu, Y., Song, W., Kan, S., Liu, F., Zhang, D., Ning, G., & Feng, S. (2017). Comparison of cutting and pencil-point spinal needle in spinal anesthesia regarding postdural puncture headache: A meta-analysis. Medicine, 96(14), Article e6527. https://doi.org/10.1097/MD.0000000000006527

[11] Rochwerg, B., Almenawer, S. A., Siemieniuk, R. A. C., Vandvik, P. O., Agoritsas, T., Lytvyn, L., Alhazzani, W., Archambault, P., D'Aragon, F., Darbellay Farhoumand, P., Guyatt, G., Laake, J. H., Beltrán-Arroyave, C., McCredie, V., Price, A., Chabot, C., Zervakis, T., Badhiwala, J., St-Onge, M., . . . Lamontagne, F. (2018). Atraumatic (pencil-point) versus conventional needles for lumbar puncture: A clinical practice guideline. BMJ, 361, Article k1920. https://doi.org/10.1136/bmj.k1920

[12] Maranhao, B., Liu, M., Palanisamy, A., Monks, D. T., & Singh, P. M. (2021). The association between post-dural puncture headache and needle type during spinal anaesthesia: A systematic review and network meta-analysis. Anaesthesia, 76(8), 1098–1110. https://doi.org/10.1111/anae.15320

[13] Choi, P. T., Galinski, S. E., Takeuchi, L., Lucas, S., Tamayo, C., & Jadad, A. R. (2003). PDPH is a common complication of neuraxial blockade in parturients: A meta-analysis of obstetrical studies. Canadian Journal of Anesthesia, 50(5), 460–469. https://doi.org/10.1007/BF03021057

[14] de Diego Fernández, R., Tisner Madrid, M. L., Cabrerizo Torrente, P., &Sanjoaquín Mur, T. (2003). [Comparison of two 27-G-caliber needles for spinal anesthesia: Study of 1,555 patients]. Revista Española de Anestesiología y Reanimación, 50(4), 182–187. https://europepmc.org/article/MED/12825306

[15] Santanen, U., Rautoma, P., Luurila, H., Erkola, O., & Pere, P. (2004). Comparison of 27-gauge (0.41-mm) Whitacre and Quincke spinal needles with respect to post-dural puncture headache and non-dural puncture headache. Acta Anaesthesiologica Scandinavica, 48(4), 474–479. https://doi.org/10.1111/j.0001-5172.2004.00345.x

[16] Shutt, L. E., Valentine, S. J., Wee, M. Y. K., Page, R. J., Prosser, A., & Thomas, T. A. (1992). Spinal anaesthesia for Caesarean section: Comparison of 22-gauge and 25-gauge Whitacre needles with 26-gauge Quincke needles. British Journal of Anaesthesia, 69(6), 589–594. https://doi.org/10.1093/bja/69.6.589

[17] Balusamy, D., Khoirom, S., Charan, N., Nahakpam, S., Devi, N. J., Divyabharathi, S., Devi, L. R., & Ali, M. A. (2022). Incidence and severity of postdural puncture headache following subarachanoid block using 25G Quincke and 25G Whitacre spinal needles: A double-blinded, randomised control study. Journal of Clinical and Diagnostic Research. https://doi.org/10.7860/JCDR/2022/55881.16931

[18] Buettner, J., Wresch, K.-P., & Klose, R. (1993). Postdural puncture headache: Comparison of 25-gauge Whitacre and Quincke needles. Regional Anesthesia, 18(3), 166–169. https://doi.org/10.1136/rapm-00115550-199318030-00005

[19] Thomas, S. R., Jamieson, D. R. S., & Muir, K. W. (2000). Randomised controlled trial of atraumatic versus standard needles for diagnostic lumbar puncture. BMJ, 321(7267), 986–990. https://doi.org/10.1136/bmj.321.7267.986

[20] Hanley, J. A., & Lippman-Hand, A. (1983). If nothing goes wrong, is everything all right? Interpreting zero numerators. JAMA, 249(13), 1743–1745. https://doi.org/10.1001/jama.1983.03330370053031