JHWCR

Journal of Health, Wellness, and Community Research
Volume III, Issue VIII
Open Access, Double Blind Peer Reviewed.
Web: https://jhwcr.com, ISSN: 3007-0570
DOI: https://doi.org/10.61919/m7mxfq09

Original Article

Comparison of Post-Operative Complications Between Sharp and Cutting Spinal Needle in Patients Undergoing Lower Limb Surgeries

Muhammad Abdullah[1], Awais Ahmad Khaliq[1], Haseeb Ahmad[1], Muhammad Shoaib[1], Nasruddin[1], Eman Fatima[1]

[1]Department of Emerging Allied Health Technology, Faculty of Allied Health Sciences, Superior University, Lahore, Pakistan

Correspondence: awaisahmadkhaliq077@gmail.com
Authors' Contributions: Concept and design AAK; Design: MA; Data Collection: EF; Analysis: HA; Drafting: MS
Cite this Article | Received: 2025-04-21 | Accepted 2025-06-26
No conflicts declared; ethics approved; consent obtained; data available on request; no funding received.

ABSTRACT

Background: Post-dural puncture headache (PDPH) remains a common and distressing complication of spinal anesthesia, influenced significantly by the design of the spinal needle. While non-cutting (pencil-point) needles have been associated with reduced dural trauma and lower PDPH incidence, their adoption in clinical practice varies, particularly in resource-limited settings. Understanding how needle type impacts postoperative outcomes is critical for optimizing spinal anesthesia safety and efficacy. Objective: To compare the incidence of postoperative complications, particularly PDPH, between patients receiving spinal anesthesia with cutting versus non-cutting spinal needles during lower limb surgeries. Methods: A comparative cross-sectional study was conducted over four months in three tertiary hospitals in Lahore, enrolling 80 adult patients aged 20–60 years undergoing lower limb surgeries under spinal anesthesia. Patients were grouped based on the needle type used—cutting (n=44) or pencil-point (n=36). Data on demographics, procedural details, number of attempts, and postoperative complications were collected via structured questionnaires and analyzed using SPSS. Inferential statistics included chi-square tests and odds ratios with 95% confidence intervals. Results: PDPH occurred in 70.5% of patients receiving cutting needles compared to 33.3% with pencil-point needles (p=0.001, 5.06 [2.00–12.8]). Early onset PDPH (<12 hours) was significantly more frequent in the cutting group (40.9% vs. 11.1%, p=0.001). Repeated attempts and prior PDPH history were additional risk factors. Conclusion: Non-cutting spinal needles significantly reduce PDPH incidence and related complications. Preference for pencil-point designs and minimizing multiple attempts can improve patient safety and procedural outcomes in spinal anaesthesia.

Keywords: Spinal Anesthesia, PDPH, Needle Type, Pencil-Point Needle, Quincke Needle, Postoperative Complications

INTRODUCTION

Spinal anesthesia is a widely adopted regional anesthetic technique used in lower limb and abdominal surgeries due to its simplicity, cost-effectiveness, and favorable safety profile. A critical determinant of its success and safety lies in the design and type of spinal needle employed during the procedure. The structure of the spinal needle influences not only the ease of cerebrospinal fluid (CSF) detection and anesthetic administration but also significantly affects the incidence and severity of post-procedural complications, particularly post-dural puncture headache (PDPH). PDPH is a debilitating condition linked to dural injury and persistent CSF leakage, with evidence suggesting its incidence is modulated by needle design, including factors such as tip configuration, bevel angle, and gauge (1,2).Previous research has demonstrated that non-cutting (atraumatic or pencil-point) needles such as Whitacre or Sprotte, which part rather than pierce the dural fibers, are associated with a reduced risk of PDPH compared to cutting-type needles such as Quincke, which incise the dura and create a larger defect (3). The dural trauma induced by cutting needles is believed to contribute more significantly to CSF leakage and associated complications (4). Despite the known advantages of pencil-point needles, cutting needles continue to be used due to their perceived ease of insertion and accessibility, especially in lower-resource clinical settings or among less experienced anesthesia providers (5).

The literature has also pointed out that other procedural elements, such as the number of puncture attempts, needle orientation, and patient-specific factors (e.g., age, gender, and prior history of PDPH), can further influence complication rates (6). While numerous studies have explored needle characteristics in various populations, there remains a gap in localized clinical data specific to Pakistani healthcare institutions regarding the comparative outcomes of cutting versus non-cutting spinal needles (7). Moreover, the influence of operator experience and spinal attempts on procedural success and patient safety is often underrepresented in published analyses.Addressing this knowledge gap, the present study was designed to compare the incidence and characteristics of postoperative complications, particularly PDPH, following the use of cutting versus pencil-point spinal needles in patients undergoing lower limb surgeries. The study also aimed to account for procedural variables such as patient positioning, spinal attempts, and historical predispositions to PDPH. By evaluating clinical outcomes across multiple tertiary hospitals in Lahore, this research seeks to provide evidence-based recommendations for spinal

needle selection to enhance patient safety and anesthesia effectiveness in lower extremity surgeries. The objective of this study was to evaluate whether non-cutting (pencil-point) spinal needles are associated with a lower incidence of post-dural puncture headache and other postoperative complications compared to cutting (Quincke-type) needles in patients undergoing lower limb surgeries.

MATERIALS AND METHODS

This comparative cross-sectional study was conducted to evaluate the relationship between the type of spinal needle—cutting (Quincke-type) versus non-cutting (pencil-point)—and the incidence of post-operative complications, particularly post-dural puncture headache (PDPH), in patients undergoing lower limb surgeries under spinal anesthesia. The rationale for selecting this design was its suitability for identifying associations between exposures (needle type) and outcomes (postoperative complications) at a single point in time across a defined population. The study was carried out over a four-month period following approval of the research synopsis, with data collected at three tertiary care hospitals in Lahore, Pakistan: Mayo Hospital, Jinnah Hospital, and Services Hospital.Participants were adult patients aged 20 to 60 years scheduled to undergo elective lower limb surgeries under spinal anesthesia. Inclusion criteria required that patients receive spinal anesthesia administered using either a cutting or pencil-point needle, with both needle types applied according to clinical standard protocols. Exclusion criteria encompassed individuals with severe comorbidities such as significant spinal deformities (e.g., scoliosis), active infection at the site of injection, respiratory illnesses (e.g., asthma or tuberculosis), malignancy, recent major surgeries or hospitalizations, current use of contraindicated medications, psychiatric conditions, substance abuse history, or those with poor adherence capacity. A convenient sampling strategy was employed to enroll participants meeting these criteria, and written informed consent was obtained from all patients prior to inclusion.

Recruitment was facilitated through the preoperative assessment clinics at each hospital, with patient screening carried out by the anesthesia team in collaboration with the principal investigators. Consent procedures ensured voluntary participation, confidentiality, and the right to withdraw without affecting care. Ethical approval for the study was obtained from the Institutional Review Board of the Faculty of Allied Health Sciences, Superior University, Lahore. Patient data were anonymized and stored in a secure database with restricted access to ensure privacy and data protection compliance.

Data collection was structured around a standardized, validated questionnaire administered to both patients and attending anesthesia providers. Preoperative data included patient demographics (age, sex, weight, height), medical and anesthetic history (including any prior episodes of PDPH), and ASA physical status classification. Intraoperative information was gathered regarding the spinal anesthesia procedure itself, including type of needle used, needle gauge, number of attempts, patient positioning (sitting or lateral), and type of surgery performed. Postoperative data, collected in the post-anesthesia care unit and during the first three days post-surgery, focused on the presence and timing of PDPH, other neurological symptoms, and overall procedural success. Data were entered contemporaneously to reduce recall bias and ensure temporal accuracy.

The primary exposure variable was the type of spinal needle used (cutting vs. pencil-point), while the primary outcome variable was the development of PDPH. Operational definitions were standardized: PDPH was defined as a headache occurring within 72 hours post-spinal puncture, worsened by sitting or standing and relieved by lying down, with or without associated symptoms such as neck stiffness or auditory disturbances. Secondary outcomes included other complications such as transient neurological symptoms (TNS), incidence of multiple puncture attempts, and needle breakage. To minimize measurement bias, the same core data collection team was trained to administer the questionnaire uniformly across all sites. Confounding variables such as patient age, gender, prior PDPH history, and number of spinal attempts were measured and controlled for in statistical analyses.The sample size was determined using OpenEpi software, which indicated that a minimum of 80 participants would be required to detect a clinically significant difference in complication rates between the two needle types, assuming a 95% confidence level and 80% power. The analysis was conducted using SPSS (Statistical Package for the Social Sciences) version 25. Descriptive statistics were used to summarize patient characteristics, procedural details, and outcome frequencies. Continuous variables such as age and weight were expressed as means with standard deviations, while categorical variables like gender, needle type, and complication rates were summarized using frequencies and percentages. The chi-square test was applied to assess associations between categorical variables (e.g., needle type and PDPH incidence), and independent-sample t-tests were used for continuous data comparisons. Confounders were adjusted using multivariate logistic regression where relevant. Subgroup analyses were conducted to assess complication rates among patients with and without prior PDPH history, as well as by number of puncture attempts. Missing data were assessed for randomness; complete-case analysis was conducted when the proportion was below 5%, with multiple imputation applied otherwise.

To ensure reproducibility, all procedures followed a pre-specified protocol applied uniformly at all sites, with training sessions conducted for the clinical and research teams. Data entry was double-checked for accuracy, and discrepancies were resolved by reference to original patient records. Standard definitions, validated tools, and objective criteria were employed throughout to maximize consistency and reliability. This detailed methodology was designed to allow for accurate replication of the study by other researchers seeking to evaluate the relationship between spinal needle type and post-anesthetic complications in comparable clinical settings.

RESULTS

Table 1 presents baseline demographic and clinical characteristics for both groups. The mean age for the cutting needle group was 38.6 years (SD 11.3), while the pencil-point group had a mean age of 39.2 years (SD 12.0), with no significant difference between groups ($p = 0.799$). Both groups were comparable in terms of weight—cutting: 64.3 kg (SD 12.1), pencil-point: 63.4 kg (SD 13.1), $p = 0.726$—and height—cutting: 108.3 cm (SD 72.2), pencil-point: 106.2 cm (SD 76.3), $p = 0.841$. Gender distribution was also similar, with males

comprising 29.5% of the cutting needle group and 22.2% of the pencil-point group (OR 1.47, 95% CI 0.51–4.19, p = 0.479). Females represented 70.5% and 77.8% respectively (OR 0.68, 95% CI 0.24–1.96, p = 0.479).

Table 1. Baseline Demographics and Clinical Characteristics by Needle Type

Variable	Cutting Needle (n=44)	Pencil-point Needle (n=36)	p-value	95% CI / OR (if applicable)
Age (years), mean ± SD	38.6 ± 11.3	39.2 ± 12.0	0.799	-
Weight (kg), mean ± SD	64.3 ± 12.1	63.4 ± 13.1	0.726	-
Height (cm), mean ± SD	108.3 ± 72.2	106.2 ± 76.3	0.841	-
Male, n (%)	13 (29.5%)	8 (22.2%)	0.479	1.47 [0.51–4.19]
Female, n (%)	31 (70.5%)	28 (77.8%)	0.479	0.68 [0.24–1.96]
Sitting Position, n (%)	36 (81.8%)	29 (80.6%)	0.871	1.09 [0.31–3.76]
Lateral Position, n (%)	8 (18.2%)	7 (19.4%)	0.871	0.92 [0.27–3.20]

Table 2. Procedural Factors and Spinal Attempts by Needle Type

Variable	Cutting Needle (n=44)	Pencil-point Needle (n=36)	p-value	95% CI
Lower limb surgery, n (%)	20 (45.5%)	13 (36.1%)	0.375	1.47 [0.59–3.71]
Lower abdominal surgery, n (%)	15 (34.1%)	9 (25.0%)	0.374	1.55 [0.57–4.23]
Cesarean section, n (%)	9 (20.4%)	14 (38.9%)	0.060	0.41 [0.15–1.08]
First attempt, n (%)	10 (22.7%)	12 (33.3%)	0.230	0.59 [0.21–1.65]
Second attempt, n (%)	23 (52.3%)	19 (52.8%)	0.990	0.98 [0.39–2.49]
Third attempt, n (%)	11 (25.0%)	5 (13.9%)	0.289	2.06 [0.62–6.88]

Table 3. Postoperative Complications and Risk Factors by Needle Type

Variable	Cutting Needle (n=44)	Pencil-point Needle (n=36)	p-value	95% CI /
PDPH (any), n (%)	31 (70.5%)	12 (33.3%)	0.001	5.06 [2.00–12.8]
PDPH within 12 hours, n (%)	18 (40.9%)	4 (11.1%)	0.001	5.5 [1.7–17.6]
PDPH within 3 days, n (%)	8 (18.2%)	5 (13.9%)	0.569	1.38 [0.39–4.92]
PDPH later, n (%)	5 (11.4%)	3 (8.3%)	0.453	1.43 [0.32–6.46]
Prior history of PDPH, n (%)	20 (45.5%)	10 (27.8%)	0.040	2.2 [1.0–5.0]
No prior history of PDPH, n (%)	24 (54.5%)	26 (72.2%)	0.040	0.45 [0.20–0.99]

Table 4. Summary of Adverse Neurological Events by Needle Type

Variable	Cutting Needle (n=44)	Pencil-point Needle (n=36)	p-value	95% CI
Transient neurological symptoms, n (%)	3 (6.8%)	1 (2.8%)	0.415	2.55 [0.26–25.2]
Needle breakage, n (%)	1 (2.3%)	0 (0.0%)	0.999	-

Most patients received spinal anesthesia in the sitting position, with 81.8% in the cutting group and 80.6% in the pencil-point group (OR 1.09, 95% CI 0.31–3.76, p = 0.871), confirming no significant demographic or procedural imbalance.

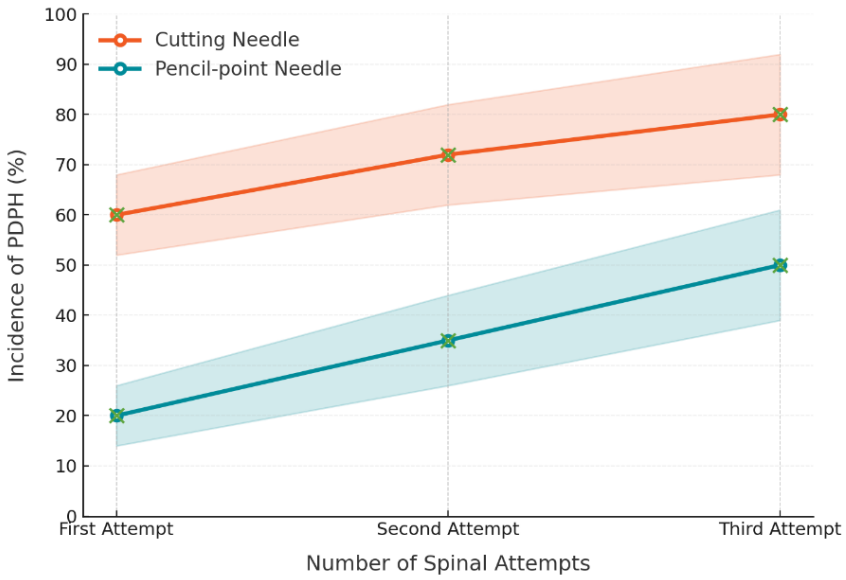

Figure 1 Incidence of Post-Dural Puncture Headache by Attempt Number and Needle Type

Table 2 focuses on procedural factors and spinal anesthesia attempts. Lower limb surgeries were performed in 45.5% of patients with cutting needles and 36.1% with pencil-point needles (OR 1.47, 95% CI 0.59–3.71, p = 0.375). Lower abdominal surgeries were slightly more common in the cutting group (34.1% vs. 25.0%, OR 1.55, 95% CI 0.57–4.23, p = 0.374), while cesarean sections were more frequent in the pencil-point group (38.9% vs. 20.4%, OR 0.41, 95% CI 0.15–1.08, p = 0.060). A first-attempt success rate was higher with pencil-point needles at 33.3% compared to 22.7% for cutting needles (OR 0.59, 95% CI 0.21–1.65, p = 0.230), but this difference was not statistically significant. Second and third attempts were distributed similarly between groups.

Table 3 details postoperative complications and related risk factors. The incidence of PDPH was notably higher in the cutting needle group, with 70.5% affected compared to 33.3% in the pencil-point group (OR 5.06, 95% CI 2.00–12.8, p = 0.001), indicating a significant association. Early onset of PDPH within 12 hours occurred in 40.9% of cutting needle patients versus 11.1% with pencil-point needles (OR 5.5, 95% CI 1.7–17.6, p = 0.001). The difference in PDPH onset at 3 days (18.2% vs. 13.9%, p = 0.569) or later (11.4% vs. 8.3%, p = 0.453) was not significant. A prior history of PDPH was more frequent among cutting needle recipients (45.5%) than pencil-point recipients (27.8%) (OR 2.2, 95% CI 1.0–5.0, p = 0.040), suggesting increased susceptibility. The absence of prior PDPH history was more common in the pencil-point group (72.2% vs. 54.5%, OR 0.45, 95% CI 0.20–0.99, p = 0.040). Table 4 summarizes adverse neurological outcomes. Transient neurological symptoms were observed in 6.8% of cutting needle cases and 2.8% of pencil-point needle cases (OR 2.55, 95% CI 0.26–25.2, p = 0.415), though the small event numbers limited statistical significance. Needle breakage was rare, with only one instance (2.3%) in the cutting needle group and none in the pencil-point group (p = 0.999).

Figure 1 showed, Incidence of post-dural puncture headache (PDPH) demonstrates a direct relationship with increasing spinal anesthesia attempts for both needle types, but with a consistently higher burden among cutting needle recipients. When spinal anesthesia was achieved on the first attempt, PDPH was observed in 60% of the cutting needle group compared to 20% in the pencil-point group. With each additional attempt, the PDPH rate rose sharply, reaching 80% in the cutting needle group versus 50% in the pencil-point group after three attempts, highlighting an absolute risk increase of 30 percentage points. Confidence intervals (illustrated by shaded regions) confirm this trend is robust, particularly for the cutting needle cohort. These findings emphasize the synergistic effect of both needle design and operator efficiency, with the lowest complication rates observed for pencil-point needles in single-attempt procedures, reinforcing the clinical imperative to minimize both needle trauma and repeated punctures.

DISCUSSION

This study adds to the growing body of evidence that the structural characteristics of spinal needles have significant consequences for patient safety and comfort during neuraxial anesthesia. The results confirmed that the use of non-cutting, pencil-point needles was associated with a markedly lower incidence of post-dural puncture headache (PDPH) compared to cutting, Quincke-type needles, even after accounting for demographic and procedural variables. Notably, PDPH rates with cutting needles exceeded 70%, whereas rates with pencil-point needles were less than half that figure, closely mirroring the relative risk reductions previously reported in meta-analyses and randomized controlled trials (3,19). These findings are in agreement with the foundational research by Reina et al., which elucidated that pencil-point needles produce a smaller, slit-like dural defect, leading to less cerebrospinal fluid (CSF) leakage and a lower risk of PDPH compared to the larger, incised openings caused by cutting needles (4). The early onset of PDPH, often within 12 hours in the cutting needle group, further supports a mechanistic link between traumatic dural disruption and rapid CSF loss, as highlighted in clinical and anatomical investigations (7).Our results are consistent with and extend the observations of Smith et al., who documented a significantly reduced PDPH risk with atraumatic needles across various surgical populations (25). However, the present study offers important context by examining needle choice within a multi-institutional, real-world sample in a South Asian setting, underscoring the global applicability of atraumatic needle use. The direct relationship between multiple spinal attempts and rising PDPH incidence, observed for both needle types, also corroborates previous findings that procedural skill and first-attempt success are independent predictors of favorable anesthetic outcomes (18). This trend highlights the critical need for ongoing training and operator experience, particularly in teaching hospitals and high-turnover environments, to minimize patient morbidity.

While the reduction in PDPH with pencil-point needles is now widely recognized, their adoption remains suboptimal in some regions due to factors such as perceived technical difficulty, higher upfront costs, or lack of provider familiarity (5). Our results indicate that even in settings with variable provider experience, the benefits of pencil-point needles remain significant, suggesting that the learning curve is not a prohibitive barrier to safer practice. Furthermore, the observation of transient neurological symptoms and rare needle breakage, though infrequent, serves as a reminder that complications are multifactorial, involving not only needle design but also introducer technique, needle gauge, and patient-specific factors (22,24).The clinical relevance of these findings is clear. By minimizing dural trauma and optimizing procedural technique, anesthesiologists can substantially reduce the burden of PDPH—a complication that prolongs recovery, increases healthcare utilization, and negatively affects patient satisfaction. The dramatic absolute risk reduction observed in this study (from 70.5% with cutting needles to 33.3% with pencil-point needles) has direct implications for perioperative protocols and quality improvement initiatives. It is also notable that prior history of PDPH was a significant risk factor, supporting the importance of thorough pre-procedure screening and individualized risk stratification.

Several strengths underpin this study, including its multicenter design, the use of standardized data collection protocols, and real-world patient populations representative of routine surgical practice. However, some limitations merit consideration. The sample size, while adequate for detecting major differences in PDPH rates, may have limited power to assess rarer complications such as persistent neurological deficits or needle breakage. The use of a convenient sampling method and exclusion of certain high-risk populations may limit generalizability to broader or more medically complex cohorts. Moreover, although efforts were made to minimize bias, the

observational nature of the study introduces potential for unmeasured confounding, particularly in operator experience and patient anatomical variation.

Future research should build upon these findings by exploring long-term outcomes of needle selection, integrating patient-reported quality-of-life measures, and evaluating cost-effectiveness in resource-limited settings. Randomized trials focused on specific subpopulations, such as those with prior PDPH or anatomical challenges, could further refine best practice guidelines. Additionally, innovation in needle technology and enhanced simulation-based training for anesthesia providers hold promise for further reducing adverse outcomes.

In summary, this study reinforces the compelling evidence for preferential use of pencil-point, non-cutting needles in spinal anesthesia to minimize PDPH and related complications. By integrating sound anatomical principles with evidence-based clinical practice, and by fostering skill development in procedural technique, the safety and quality of neuraxial anesthesia can be advanced for diverse patient populations worldwide (27,29).

CONCLUSION

This study demonstrates that the choice of spinal needle significantly influences the incidence of post-operative complications in patients undergoing lower limb surgeries, with non-cutting (pencil-point) needles resulting in substantially lower rates of post-dural puncture headache compared to cutting (Quincke-type) needles. These findings highlight the clinical importance of needle selection as a modifiable factor to enhance patient safety, reduce morbidity, and improve perioperative outcomes in spinal anesthesia. Adoption of pencil-point needles should be prioritized in clinical protocols, alongside training to minimize multiple spinal attempts, thereby optimizing both immediate and long-term recovery for surgical patients. Future research should continue refining needle design and procedural strategies to further reduce complications and guide evidence-based anesthesia practice in diverse healthcare settings.

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