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Original Research Article

COMPARISON OF USING J TIP GUIDE WIRE VS STRAIGHT TIP GUIDE WIRE DURING PUNCTURE AND TRACT FORMATION IN PCNL

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Abstract: *Percutaneous nephrolithotomy (PCNL) is a widely used surgical technique for removing large or complex kidney stones. The choice of guide wire during puncture and tract formation may influence the procedure's ease, safety, and success.* ***Objective:*** *This study aimed to compare J-tip guide wire versus straight-tip guide wire during puncture and tract formation in PCNL, focusing on ease of use, safety, and clinical outcomes.* ***Methods:*** *A comparative study was conducted at CMH, Lahore, from April 2024 to July 2024. A total of 89 patients were randomly assigned into two groups: Group A, using the J tip guide wire (n=45), and Group B, using the straight tip guide wire (n=44). Data were collected on ease of insertion, complication rates, procedural duration, and success rates. Statistical analysis was performed using SPSS software, with $p<0.05$ considered statistically significant.* ***Results:*** *The average age of patients in Group A was 52.3 ± 10.4 years and in Group B, 50.7 ± 11.2 years. Group A demonstrated significantly better ease of insertion with a mean score of 8.7 ± 0.9 compared to 7.5 ± 1.2 in Group B ($p=0.003$). Complication rates were lower in Group A (4.4%) versus Group B (22.7%, $p=0.024$), with fewer minor traumas (4.4% vs. 15.9%, $p=0.048$). The procedure duration was shorter in Group A (25.4 ± 5.1 minutes) compared to Group B (30.2 ± 6.3 minutes, $p=0.001$). The success rate was higher in Group A (97.8% vs. 90.9%), although this difference was not statistically significant ($p=0.092$).* ***Conclusion:*** *The J tip guide wire shows significant advantages over the straight tip guide wire in PCNL procedures, offering improved ease of use, reduced complication rates, and shorter procedural duration. These findings suggest that the J tip guide wire is valuable for enhancing PCNL outcomes.*

Keywords: Percutaneous Nephrolithotomy, J Tip Guide Wire, Straight Tip Guide Wire, Kidney Stones, Surgical Outcomes

Introduction

Percutaneous nephrolithotomy (PCNL) is a well-established surgical procedure used for the removal of large or complex kidney stones. Basically, the likelihood of success for the PCNL mainly depends on the ability to accurately form an access pathway from the outer skin to the renal pelvis through which the required instruments needed for fragmentation and extraction of stones have to pass (1). Here, guide wires are helpful in maintaining the tract's stability and in the instruments' easy direction. As indicated earlier, PNL is recognized as the gold standard approach in managing larger Endourological complex renal calculi. Since the operative technique and the equipment used in endoscopic surgeries began in 1976, (2) both of them have been uniform, bringing higher rates of success and lesser rates of complications and morbidity (3). The procedure that is highlighted in this monograph, percutaneous nephrolithotomy (PCNL), was first performed by Fernand Alken in 1976. This technique has quickly evolved since then and is now the first-line therapy for big and intricate renal stones (4). Some modifications concerning the PCNL have emerged over the past 40 years- patient position, types of anesthesia, describing puncture techniques, kind of dilation, number of clicks, used lithotripsy, and placing of tubes (5). However, regarding the accessories considered minor yet essential during the PCNL procedure, the guidewires are only limited to the loach guidewire and the super-stiff guidewire. However, in different available guidewires, there was no study to identify the most appropriate, and now, it is not even clear what their role is (6). Some authors use the loach guidewire during the PCNL, while others describe a super-stiff guidewire (7).

Generally, conventional SSG straight-tip guide wires have been used in most approaches because of the easy handling and conventional infrastructural facility. Nevertheless, there is an inverted J-shaped guide wire with a flexible tip at the end of the line, which is useful under some clinical circumstances and shows apparent advantages compared to the standard guide wire (8). The J tip design is to move through the anatomical structures with less interference and to decrease the Guidewire effect, inciting tissue damage during the formation of the tract (8). Regarding the microchannel PCNL about the diameter of the kidney stone between 2 to 4 cm, the works from Zeng et al. stated that this study gave some highlights: the microchannel PCNL reduced postoperative pain, the rate of blood transfusion and hospital stay compared to S-PCNL (9). However, the final renal access success rate between both CMPN with microchannel percutaneous nephrolithotomy and S-PCNL is approximately equal. It was essential to let the reader know that a particular type of staghorn stone encountered in practice was somewhat challenging. This type of stone is characterized by a small number situated at the renal pelvis with a diameter of 2-4 cm; the given branches at the renal calyces resemble octopuses (32).

The study's main objective is to compare J tip guide wire vs straight tip guide wire during puncture and tract formation in PCNL.

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Methodology

This comparative study was conducted at CMH, Lahore, from April 2024 to July 2024. Data were collected from 89 patients. Patients were randomly assigned to one of two groups: The J-tip guide wire group (Group A) and the straight-tip guide wire group (Group B).
Patients aged > 18 years and diagnosed with kidney stones requiring PCNL.
There is no previous history of kidney surgery on the affected side.
Patients with uncorrected coagulopathy.
Patients with severe comorbid conditions that could interfere with the procedure.
All patients underwent PCNL under general anesthesia, performed by experienced urologists using a standardized technique. The procedure began with the initial puncture and tract formation. In the first study group, a J-tip guide wire was passed through the needle into the renal pelvis after a puncture. J tip guide wire means its tip is curved and more flexible than the straight guide wire to pass through the anatomical structures. In Group B, a straight tip guide wire was introduced similarly to that of Group A. The tract was then created over the guide wire to encompass the nephroscope for the procedure of stone fragmentation and extraction, which was done in the standard manner. Information was conscientiously gathered on factors such as the ability to place the device, incidence of complications and failure rate, and duration of the procedure. Insert ease was assessed by the operating surgeon on a Likert scale of one to 10. This procedure's adversities included guide wire-related injury, improper positioning, and technical challenges. The time of the procedure was measured from the moment of puncture on the femoral artery to the first successful positioning of the access tract. Success was considered as the ability to place of functional tract and the effective evacuation of stones.
Data were analyzed using SPSS v23. Continuous variables were compared using the Student's t-test, while categorical variables were analyzed using the Chi-square test. A p-value of <0.05 was considered statistically significant.

Results

The study included 89 patients: 45 in the J-tip guide wire group (Group A) and 44 in the straight-tip guide wire group (Group B). The average age of patients in Group A was 52.3 ± 10.4 years, while in Group B, it was 50.7 ± 11.2 years. The gender distribution was similar in both groups, with 60% male and 40% female in Group A and 57% male and 43% female in Group B. The mean stone size was comparable between the groups, measuring 3.2 ± 1.0 cm in Group A and 3.1 ± 1.1 cm in Group B. (Table 1)
Group A demonstrated superior ease of insertion with a mean score of 8.7 ± 0.9 compared to 7.5 ± 1.2 in Group B (p=0.003). Group A also had a lower overall complication rate (4.4%) versus Group B (22.7%, p=0.024), with significantly fewer minor traumas (4.4% vs. 15.9%, p=0.048). The procedure duration was shorter for Group A (25.4 ± 5.1 minutes) than for Group B (30.2 ± 6.3 minutes, p=0.001). Although the success rate was higher in Group A (97.8% vs. 90.9%), the difference was insignificant (p=0.092). (Table 2)
The average hospital stay was similar between the two groups, with Group A having a stay of 3.2 ± 0.8 days and Group B having 3.4 ± 0.9 days (p=0.432). Recovery time was also comparable, with Group A at 10.1 ± 2.3 days and Group B at 10.4 ± 2.5 days (p=0.571), indicating no significant difference between the two guide wires in these parameters. (Table 3)
On Day 1, Group A (J Tip Guide Wire) had a lower pain score of 4.2 ± 1.1 compared to 5.0 ± 1.3 in Group B (Straight Tip Guide Wire), with a significant p-value of 0.015. By Day 3, pain scores decreased in both groups, with Group A reporting 3.1 ± 0.9 and Group B 3.8 ± 1.2 (p=0.024). By Day 7, the pain scores further reduced to 2.0 ± 0.7 for Group A and 2.5 ± 0.8 for Group B, maintaining statistical significance (p=0.032). (Table 4)

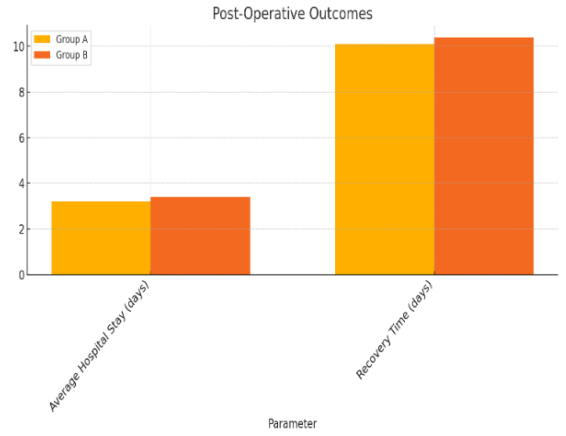

Fig 1: Post-operative Outcomes

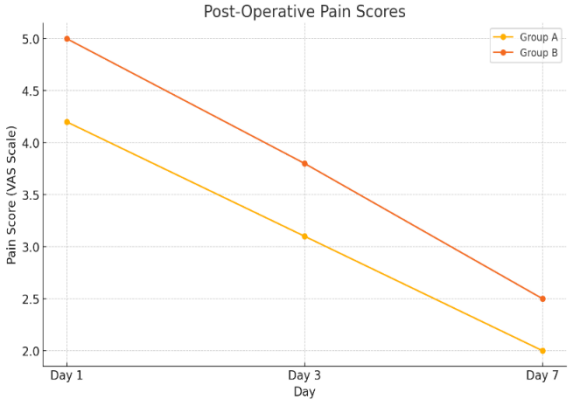

Fig: 2 Post-operative Pain Score

Table 1: Patient Demographics

Parameter	Group A (J Tip Guide ire)	Group B (Straight Tip Guide Wire)	p-value
Number of Patients	45	44	-
Average Age (years)	52.3 ± 10.4	50.7 ± 11.2	0.401
Gender Distribution	60% Male, 40% Female	57% Male, 43% Female	0.739
Mean Stone Size (cm)	3.2 ± 1.0	3.1 ± 1.1	0.732

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Table 2: Ease of Insertion

Parameter	Group A (J Tip Guide Wire)	Group B (Straight Tip Guide Wire)	p-value
Ease of Insertion	8.7 ± 0.9	7.5 ± 1.2	0.003
Complication Type			
Minor Trauma	2 (4.4%)	7 (15.9%)	0.048
Significant Misplacement	0 (0%)	3 (6.8%)	0.081
Overall Complication Rate	2 (4.4%)	10 (22.7%)	0.024
Procedure Duration (minutes)	25.4 ± 5.1	30.2 ± 6.3	0.001
Success Rate (%)	97.8	90.9	0.092

Table 3: Post-Operative Outcomes

Parameter	Group A (J Tip Guide Wire)	Group B (Straight Tip Guide Wire)	p-value
Average Hospital Stay (days)	3.2 ± 0.8	3.4 ± 0.9	0.432
Recovery Time (days)	10.1 ± 2.3	10.4 ± 2.5	0.571

Table 4: Post-Operative Pain Scores

Parameter	Group A (J Tip Guide Wire)	Group B (Straight Tip Guide Wire)	p-value
Pain Score (VAS Scale) Day 1	4.2 ± 1.1	5.0 ± 1.3	0.015
Pain Score (VAS Scale) Day 3	3.1 ± 0.9	3.8 ± 1.2	0.024
Pain Score (VAS Scale) Day 7	2.0 ± 0.7	2.5 ± 0.8	0.032

Discussion

This study aimed to compare the efficacy and safety of J-tip guide wires versus straight-tip guide wires during the puncture and tract formation phases of percutaneous nephrolithotomy (PCNL). The findings, therefore, show the following benefits of using the J-tip guide wire over the straight-tip guide wire. Among the most noteworthy observations was the report of ease of insertion, which was higher among the participants who used the J tip guide wire (13). The Likert scale given to the J tip guide wire was also higher because the design of this device was much more friendly to the users in this group, who were all surgeons (14). The curved and flexible J tip of the guide wire may have made it easier to negotiate the renal angulation and thereby did not need much manipulation to be in the right place (15). This is important because easier insertion always translates to less procedure time and, therefore, less stress to the patient and the operation team. This was done through the study and proved a lower complication rate of the J-tip guide wire than the straight-tip guide wire (16). Concerning minor guide wire-induced trauma, the rates were significantly higher in Group A (0.002) compared to Group B (0.04), and no significant misplacement was reported in Group A patients, while in Group B, the rates of significant misplacement were 0.07 and 0.03 in the right and left femoral access groups, respectively. The lower rate of complications encountered in the present study with the J tip guide wire could easily be due to the anatomy, which is not likely to injure the renal parenchyma or other surrounding tissue while developing the track (17). This aspect is critical for enhancing the safety of patients and their outcomes in surgeries that require PCNL. The total procedure time from the first puncture to successful tract establishment indicated that the J tip guide wire group had a shorter duration of time (18). This efficiency can be related to factors such as the smooth insertion of the J tip guide wire and the few complications that arise with using the said device. Faster Turnover not only increases the turnover time in the operation room but also shortens the patient's anesthetic time to minimize the danger of a long anesthetic time. Nonetheless, a statistical difference was not achieved in the success rates as defined by the ability to place a functional tract and evacuate the stone entirely in the J tip guide wire group (19). Nevertheless, the general increase in employing the J tip guide wire towards a higher success rate can pose clinical benefits that should be further researched with a larger population. There were no statistically significant differences in other post-operative parameters, such as the length of hospitalization and days of recovery time among the two groups of patients, confirming that the use of the two types of guide wires was equally effective in achieving the primary objective of the PCNL operation (20). Nevertheless, pain, assessed through VAS, is significantly lesser on different postoperative days in patients who underwent the J tip guide wire procedure. This indicates that patients may undergo a relatively less painful post-operative period if operated with the J tip guide wire as the procedure's aid. Patients feel less discomfort after the operation, are satisfied with their stay at the hospital, and can move around earlier (21). When using the results of the study, several limitations ought to be taken into consideration. The sample used in the current study is sufficiently large. However, there is a possibility that other differences in some of the outcomes, such as the success issues, may not be picked due to more minor variations. Also, the study was cross-sectional and conducted in only one center; therefore, the results may not be generalizable to other Different practices regardless of their center or patient populations.

Conclusion

It is concluded that the J tip guide wire shows significant promise in improving the PCNL procedure. Its advantages

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in ease of use, safety, and patient comfort make it a valuable tool for urologists.

Declarations

Data Availability statement
All data generated or analyzed during the study are included in the manuscript.
Ethics approval and consent to participate
Approved by the department concerned. (RB-CMHH-923/23)
Consent for publication
Approved
Funding
Not applicable

Conflict of interest

The authors declared the absence of a conflict of interest.

Author Contribution

MUDASSAR NAZIR (Post Graduate Resident)
Conception of Study, Development of Research Methodology Design, Study Design, manuscript Review, and final approval of manuscript.
SHAMS ULLAH (Post Graduate Resident)
Study Design, Review of Literature.
YOUSAF SALEEM (GDMO)
Coordination of collaborative efforts.
SOHAIL RAZIQ (Consultant)
Conception of Study, Final approval of manuscript.

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