Original Article

DOI: 10.7860/JCDR/2023/66169.18593

Double J Stent an Indispensable Device in Modern Urology Practice-Timely Removal Prevents Catastrophic Complications: A Retrospective Observational Study

Others Section

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ABSTRACT

Introduction: Double J (DJ) stent placement is routinely used for various urological procedures. The potential complications of retained or forgotten stents include haematuria, infection, pain, ureteral injury, displacement, fragmentation, encrustation, stone formation, sepsis, renal failure, or even mortality. Various methods have been used alone or in combination for the retrieval of these encrusted stents. Their timely removal is crucial as the potential complications of retained or forgotten stents are very catastrophic and not cost-effective.

Aim: To highlight the importance of timely removal/replacement of DJ stents.

Materials and Methods: A retrospective observational study was conducted in the Department of Urology at Government Medical College, Patiala, Punjab, India, and data were collected from March 2021 to March 2023. A total of 149 patients who underwent DJ stenting for various procedures in the department or were referred from outside with attempted difficult removal were included in the study. Relevant investigations were performed. Data were collected from the registers maintained in the operation theatre. Data are presented as mean, numbers, and proportions as appropriate. Various procedures were used alone or in combination for stent removal.

Results: The mean age of the study participants was 41.50 years with a range from 16 to 70 years. A total of 149 patients were included, and 163 procedures were performed to remove the DJ stents. A total of 24 (14.81%) stents patients developed complications in the form of mild encrustation of the renal and urinary bladder end of the stent, up migration, down migration, broken stents, heavy encrustations at both renal and bladder ends, partial intraperitoneal placement and stone formation at renal and bladder ends. Out of 163 total procedures,149 (91.41%) endoscopic retrievals were done, and 14 (8.59%) multiple procedures were done to remove stent fragments and stones. Postoperative complications were seen in 25 (16.78%) patients.

Conclusion: Timely removal of DJ stents prevents catastrophic complications. The phrase by Desiderius Erasmus, "Prevention is better than cure," holds merit in the present study.

Keywords: Cystoscopy, Encrustations, Forgotten stents, Lithotripsy, Ureterorenoscopy

INTRODUCTION

DJ stents are extensively used in modern urological practice. DJ stent placement is indicated in the treatment of urinary stone disease, to relieve benign or malignant obstruction, to promote ureteral healing, and to manage urinary leaks [1]. They also aid in preventing ureteral injuries in complex abdominal procedures for the identification and protection of ureters, in retroperitoneal fibrosis, and even after iatrogenic injuries to the ureter [2]. They are placed for temporary purposes and need to be removed or replaced within their maximum safe life, which ranges from three months to one year depending on the make and indication.

The potential complications of ureteral stent placement include haematuria, infection, pain, ureteral injury, displacement, fragmentation, encrustations, and stone formation. Furthermore, serious complications such as sepsis, renal failure, or even mortality have been reported with encrusted and infected stents [3,4]. Ureteral stent encrustation and stone formation begin with bacterial adhesion, colonisation, and biofilm formation. The biofilm layer protects the bacteria from the immune system and antibiotics [5]. Several grading systems have been described to predict the difficulty of treatment due to the level of encrustation in the stents [6]. Severe encrustations may prevent the cystoscopic removal of DJ stents. Various treatment methods, including combinations of Extracorporeal Shock Wave Lithotripsy (SWL), Cystolithotripsy (CLT)/ cystolitholapaxy, Retrograde ureteroscopy with intracorporeal lithotripsy, Percutaneous Nephrolithotomy (PCNL), and open surgery, have been used for the retrieval of these encrusted stents [7,8].

In the digital era, the availability of mobile phones has made it convenient to directly reach out to patients and has greatly helped in the timely removal of stents. This retrospective study was conducted to enumerate the conditions for which DJ stenting was performed and highlight the importance of timely removal of DJ stents, thus preventing the catastrophic complications that occur with retained or forgotten DJ stents.

MATERIALS AND METHODS

A retrospective observational study was conducted in the Department of Urology at Government Medical College, Patiala, Punjab, India, and data were collected from March 2021 to March 2023. The analysis of the data was done from 17/05/2023 to 31/05/2023. The study was approved by the Institutional Ethics Committee (IEC) via letter no. Trg.9 (310)2023/14799 dated 16/05/2023.

Inclusion criteria: Patients who underwent DJ stenting for various procedures in the department and those were referred to the institution from outside with DJ stent placement for more than three months and attempted difficult removal were included in the study.

Exclusion criteria: Patients who did not respond to repeated telephone calls. Patients who had their stents removed elsewhere, patients who could not be contacted due to a change in phone

numbers. Patients who were not fit for surgery. Patients who received treatment from outside after stenting were all excluded from the study.

Study Procedure

Data were collected from the registers maintained in the operation theatre and urology ward, which contained the mobile numbers and alternate numbers of the patients. Upon evaluation of records, it was found that out of 155 stented patients in the department, 144 were included into the study along with 5 referrals from outside. Eleven patients were excluded as they did not fit into the inclusion criteria. All patients were admitted before the procedure, had relevant prior investigations done, and received appropriate antibiotics pre and post procedure. Patients were informed about the stent removal on their given mobile and alternate numbers by the healthcare staff at an appropriate time.

All uncomplicated stents, i.e., stents with a duration of less than three months, were removed by rigid cystoscopy under local anaesthesia with 2% xylocaine jelly and an indwelling time of 10 minutes. Stents that had a long indwelling time, especially more than three months, were removed under fluoroscopic guidance. Rigid cystoscope, semirigid ureterorenoscope, laparoscopy, ESWL, and open procedures (Pyelolithotomy) were performed alone or in combination for the removal of encrusted/stone-containing upper and lower ends of retained stents. Dornier HM3 extracorporeal shock wave lithotriptor and intracorporeal pneumatic or holmium laser energy were used for fragmentation of encrustations or stones as appropriate.

STATISTICAL ANALYSIS

Data are presented as mean, numbers, and proportions as appropriate and results were expressed in terms of frequency and percentage.

RESULTS

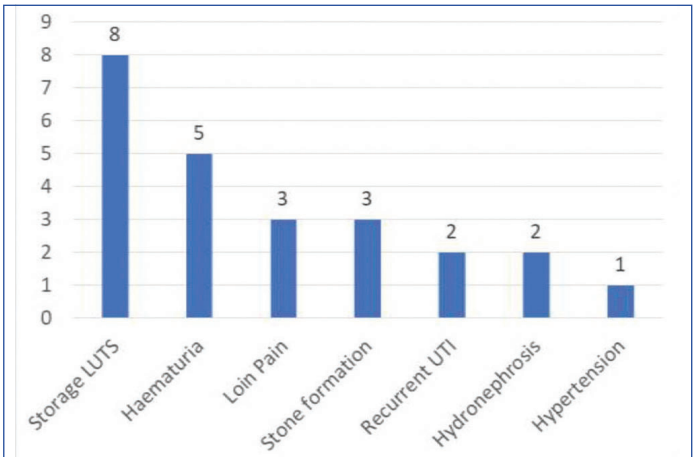
Out of the 149 patients, 94 (63.09%) were male and 55 (36.91%) were female. The mean age was 41.50 years, ranging from 16 to 70 years. The mean duration of the stent was 21.6 months, ranging from 0.5 to 84 months. DJ stenting was performed after various endoscopic and open procedures for stone removal, conservative management in cases of Road Traffic Accidents (RTA) with Grade-IV renal injury, diabetes mellitus with emphysematous pyelonephritis (papillary necrosis), reconstructive urology (pyeloplasty), iatrogenic ureteric injury, obstructive uropathy prior to Extracorporeal Shock Wave Lithotripsy (ESWL), and due to cervix and prostate malignancy. Stent replacement was done in cases of blocked stents, and prophylactic stenting was performed in cases of complex abdominal and pelvic surgeries. Outside referrals were received for encrusted/stone-bearing/broken/displaced stents [Table/Fig-1].

Patients presented with the following symptoms and signs as shown in [Table/Fig-2], indicating that stents act as foreign bodies and are associated with discomfort to the patients. From the data, it was found that the most common complication was mild encrustation at the renal and urinary bladder end of the stent, followed by down migration, up migration, broken stents, heavy encrustations at both renal and bladder ends, fine encrustations or discoloration involving the whole stent, and stone formation at the renal and bladder end. These findings indicate that if timely removal of the DJ stent is not done, it leads to various complications and requires multiple procedures to clear the urinary system of retained encrusted or stone-bearing stents. This increases the morbidity and cost of the procedure. [Table/Fig-3] shows the demographic, stent, procedure, and complication profile of the patients.

A total of 163 procedures were performed, with 149 (91.41%) being endoscopic procedures. Among these, 145 (97.31%) required simple rigid cystoscopy and 4 (2.68%) required semirigid ureterorenoscopy with or without fluoroscopy [Table/Fig-4]. Seven (4.69%) patients required multiple procedures (14, 8.58%) including Cystolithotripsy (CLT)/cystolitholapaxy, ESWL, URS±PNLT±Laser lithotripsy/removal, cystoscopic retrieval, and open procedures (pyelolithotomy for retrieval

S. No.	Procedure name	Procedure no. (Total)	1/04/21 to 31/03/22	1/04/22 to 31/03/23	No. of stents
1.	Pyeloplasty (open)	9	7	2	9
2.	Ureterorenoscopy (Semirigid)+ Pneumatic Lithotripsy	44	15	29	44
3.	Ureterolithotomy (open) (Proximal, Mid, Lower ureter)	22	10	12	22
4.	Pyelolithotomy (open)	16	10	6	18
5.	Carcinoma urinary bladder with Ureteric orifice involvement	6	3	3	6
6.	Renal calculus with pregnancy (gr III HDN*)	2	1	1	2
7.	ESWL for B/L proximal ureteric calculus (Grade-II HDN)	2	1	1	4
8.	ESWL for U/L proximal ureteric calculus or Renal calculus (Grade-II-III HDUN†/HDN)	15	7	8	15
9.	DM with B/L or U/L Emphysematous Pyelonephritis	3	2	1	5
10.	B/L Obstructive Uropathy (B/L Renal, B/L Ureteric or Renal+ureteric)	4	3	1	8
11.	Ureteric calculus with ureteric stricture S/P URS‡+PNLT§/ LLT‖+Laser endoureterotomy	2	-	2	2
12.	Iatrogenic Ureteric orifice injury (TURP)**	1	-	1	1
13.	SFK†† with Pelvic or ureteric Calculus with CKD‡‡	2	1	1	2
14.	SFK S/P Nephroureterectomy	1	1	-	1
15.	Prophylactic Stenting (Large obstetric Fistula repair, VUJ§§ calculus with gr-IV HDN, Malignant ovarian mass surgery, Heminephrectomy for Duplex System)	4	-	4	5
16.	Outside referral with encrusted/ Broken/Displaced DJ stents for variegated procedures	5	3	2	5
17.	Renal Injury Grade-IV	3	2	1	3
18.	Iatrogenic Lower ureteric injury during TAH¶ with ureteric reimplantation	1	-	1	1
19.	Carcinoma Cervix/Carcinoma Prostate with obstructive uropathy	3	3	-	5
20.	Replacement (Blocked, Rigid ureter, Ureteric stricture)	4	1	3	4
	Total	149	70	79	162

[Table/Fig-1]: Indication for DJ stenting {Unilateral (U/L) or Bilateral (B/L)}. *Hydronephrosis, †Hydroureteronephrosis, ‡Ureterorenoscopy, §Pneumatic Lithotripsy, ‖Laser Lithotripsy, **Transurethral resection of Prostate, ††Solitary Functioning Kidney, ‡‡Chronic Kidney Disease, §§Vesicoureteric junction, ¶Total Abdominal Hysterectomy



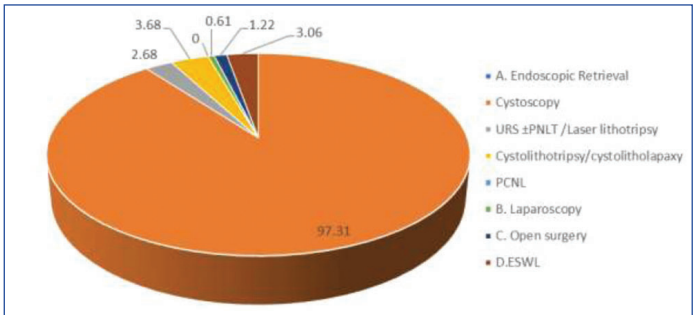
[Table/Fig-2]: Presentation of indwelling and forgotten DJ stents. LUTS: Lower urinary tract symptoms; UTI: Urinary tract infection

Age (Mean) (years)	41.50	
Sex	No.	%*
Male	94	63.09
Female	55	36.91
Stent related profile	**Total stents (162)**	**%**
Mild encrustations at both ends	12	7.41
Up migration	2	1.23
Down migration	4	2.46
Partially intraperitoneal	1	0.62
Broken	2	1.23
Heavy encrustations at both ends	2	1.23
Encrustations involving whole of stent	-	-
Stone formation at both ends	1	0.62
No. of procedure for removal	On basis of no. of patients	%
Single	142/149	95.30
Multiple	7/149	4.70
Total procedures	**163**	**%**
A. Endoscopic retrieval/Procedures	149/163	91.41
Cystoscopy	145/149	97.31
URS±PNLT/Laser lithotripsy	4/149	2.68
PCNL†	-	-
CLT/cystolitholapaxy	6/163	3.68
B. Laparoscopy	1/163	0.61
C. Open surgery	2/163	1.22
D. ESWL‡	5/163	3.06
Post-op complications	Total patients-149	
Infection	13	8.72
Bleeding	11	7.38
Sepsis	1	0.67

[Table/Fig-3]: Demographic, stent, procedure and complication profile of patients. (Total Patients 149).
*Percentage, †Percutaneous nephrolithotomy, ‡Extra corporeal shock wave lithotripsy

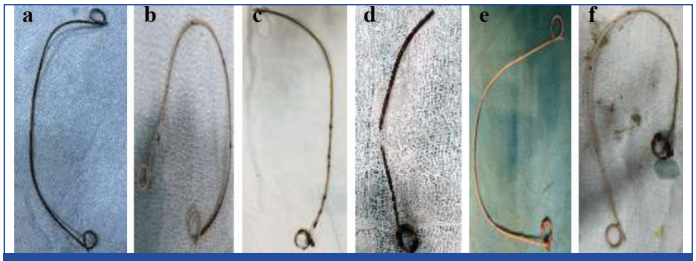
of the upper end of the stent) in combination to clear the pelvicalyceal system of residual stent fragments/stones [Table/Fig-5].

Postoperative complications were observed in 25 (16.78%) cases, with infection being the most common. Records showed that all

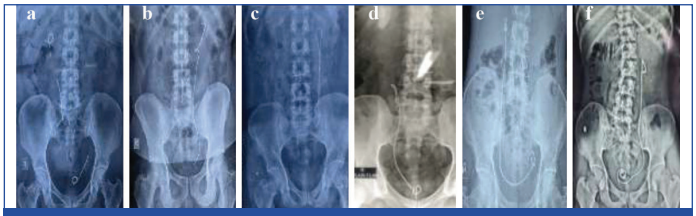


[Table/Fig-4]: Pie chart showing total procedures.

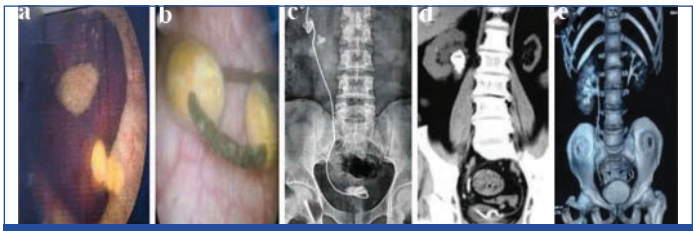
patients were successfully managed and discharged in satisfactory condition with no sequelae on follow-up at three months. [Table/Fig-6] shows the encrustations on the stents. [Table/Fig-7] shows the X-ray images of the stents. [Table/Fig-8] shows the endoscopic view, X-ray KUB, and NCCT KUB. [Table/Fig-9] shows the



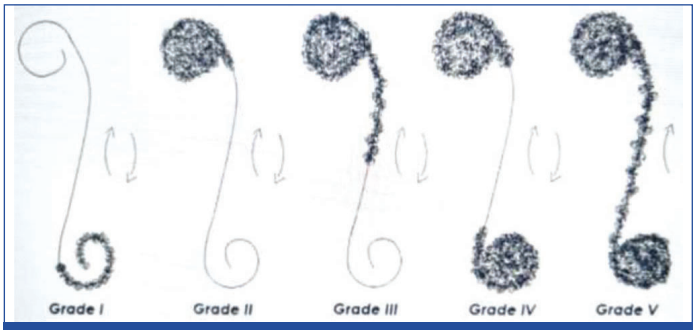
[Table/Fig-6]: (a) Discolouration; (b) Mild encrustation; (c) Moderate encrustation; (d) Heavy encrustation; (e) Stone lower end; (f) Stone upper end.



[Table/Fig-7]: X-ray (a) Broken stent; (b) Broken and Knotted stent; (c) Upmigrated stent; (d) Renal calculus with downmigrated and broken stent; (e) Intraperitoneal lower end; (f) Heavily encrusted lower end.



[Table/Fig-8]: (a) Endoscopic view; heavily encrusted bladder end; (b) Endoscopic view, Stones Lower end; (c) X-ray KUB, Stone Upper and lower end; (d) NCCT KUB, stone upper and lower end; (e) NCCT KUB reconstructed, intraperitoneal stent (lower end).



[Table/Fig-9]: Forgotten Encrusted and Calcified (FECal) ureteral stent grading system [9].
Grade-I: minimal linear encrustations along either of the pig tail portions of the indwelling ureteral stent.
Grade-II: Circular encrustations completely encasing either portion.
Grade-III: Circular encrustations completely encasing either portion with linear encrustation of ureteral aspect.
Grade-IV: Circular encrustations completely encasing both portions.
Grade-V: Diffuse and bulky encrustations completely encasing the proximal, distil and ureteral portions

S. No.	Stent related complication	Cystolithotripsy (CLT)/ Cystolitholapaxy	Ureterorenoscopy (URS)±PNLT±Laser Lithotripsy/Removal	ESWL	Open (Pyelolithotomy)	Cystoscopic removal	Total
1.	Mild encrustation	Yes	-	-	-	Yes	2
2.	Mild encrustation	Yes	-	-	-	Yes	2
3.	Heavy encrustation	Yes	-	Yes	-	Yes	3
4.	Heavy encrustation	Yes	-	Yes	Yes	Yes	4
5.	Broken stent	-	Yes	Yes	-	-	2
6.	Broken stent	Yes	Yes	Yes	-	Yes	4
7.	Stone both end of stent	Yes	-	Yes	Yes	Yes	4
		6 (3.68%)	2 (1.22%)	5 (3.06%)	2 (1.22%)	6 (3.68%)	21

[Table/Fig-5]: Multiple procedures in seven patients to remove stents.

Forgotten Encrusted and Calcified (FECal) ureteral stent grading system [9].

DISCUSSION

The DJ stent is an essential tool in urology procedures. It aids in the healing of the ureter, drainage of urine, and prevention of narrowing during the healing process. The recommended indwelling time for commonly used polymer-based stents is 3-6 months [10]. However, silicon and metallic stents made of nitinol (nickel and titanium alloy) can be kept for a longer time. In the present study, a forgotten DJ stent is defined as a stent that was left in the system for longer than three months, and it is different from a retained stent, which cannot be retrieved cystoscopically and requires additional intervention [11].

The presentation of a forgotten stent can vary. The most common presentation is stent syndrome [12], which includes symptoms such as flank pain, frequency, urgency, suprapubic discomfort, and sometimes haematuria or incontinence. In a study by Damiano R et al., flank pain was observed in 25.3% of patients, encrustations in 21.6%, irritative bladder symptoms in 18.8%, haematuria in 18.1%, fever above 104°F in 12.3%, and stent migration in 9.5% [13]. In the present study, the most common symptoms were storage Lower Urinary Tract Symptoms (LUTS) (5.37%), followed by haematuria (3.35%) and loin pain (2.01%). Encrustations [Table/Fig-6] on stents develop over time, but the exact cause is unclear. El-Faqih SR et al., reported that the stent encrustation rate increases from 9.2% for an indwelling time of less than six weeks to 47.5% at 6-12 weeks, and 76.3% for more than 12 weeks [14]. The present study found that 14 (8.64%) patients presented with this complication, and it is related to the duration of stenting.

Fragmentation is another complication of long-term stenting. Damiano R et al., and Monga M et al., reported an incidence of fragmented stents of 1.3% and 45% in their studies, respectively. However, in the present study, only 2 (1.23%) cases of fragmented stents were reported, likely because most of the stents were removed at three to four months after placement [13,15]. The exact reason for fragmentation is unclear, but it may depend on the quality of the material used for the stent.

Stent migration is another recognised complication. Upward migration can occur due to the placement of a stent that is too short for the ureter [16] or due to renal ureteric dynamics and peristalsis [17]. In the present study, 2 (1.23%) stents migrated upwards, and these were intact. Additionally, 4 (2.46%) stents migrated downwards into the bladder, either intact or broken. This incidence was lower than that reported by Damiano R et al., (9.5%). This complication can be avoided by ensuring that the full loops of the stents are kept in the bladder and pelvis, which can be confirmed under fluoroscopy.

Stone formation [Table/Fig-8] is another dreaded complication seen in 1 (0.62%) patient in the present study, compared to 25% of cases reported by Arora S et al. This difference may be due to the present study being conducted at an Institute of national importance that receives a large number of referrals [18]. The stent indwelling duration in the present study ranged from 0.5 months to seven years, with a mean duration of 21.6 months, compared to a mean duration of 22.7 months reported by Monga M et al., [15].

Several classifications of stent encrustation have been reported in the literature. The Forgotten-Encrusted-Calcified (FECal) classification given by Acosta-Miranda AM et al., is being considered favourably [Table/Fig-9] [9].

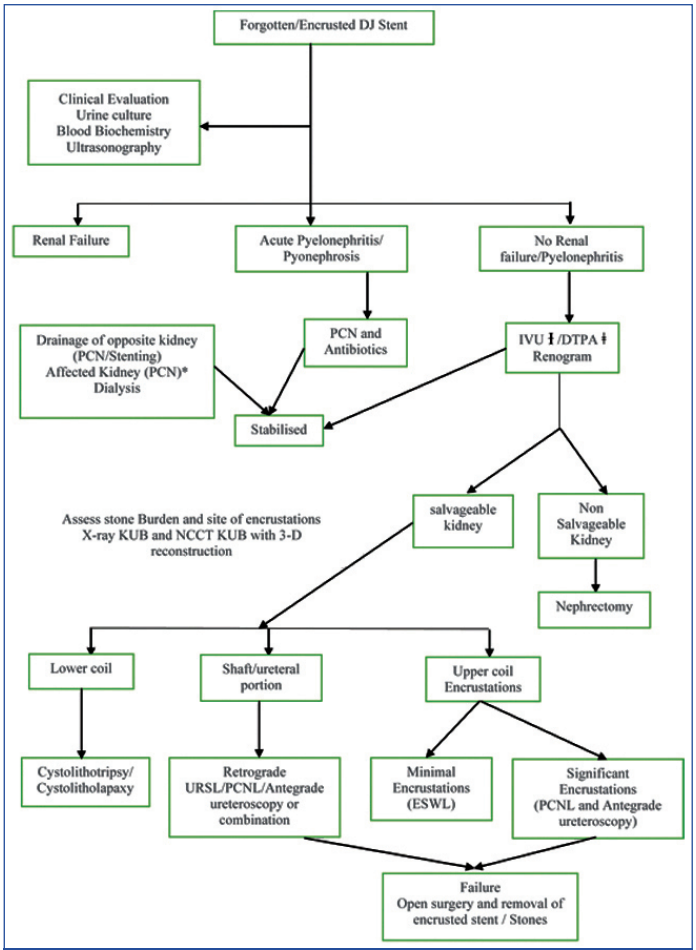
While planning management, special emphasis should be given to the site of encrustations and the stone burden. NCCT KUB with 3D reconstruction is the preferred modality when the indwelling time is more than six months. In cases without encrustations, cystoscopic removal is the optimal and successful procedure. In cases with minimal encrustations and stents retained for more than three months, cystoscopic removal is attempted under fluoroscopic guidance, ensuring that uncoiling of the proximal coil is visible, as this may be a site of resistance. If difficulty or resistance is encountered at any point, the procedure should be abandoned to avoid the risk of stent fracture or ureteral injury. There are no clear treatment guidelines for the management of moderately to severely encrusted stents. Multiple endourological approaches and sessions, including open surgery, are often needed to treat retained stents due to encrustations and associated stone burden [6]. There have been reports of multimodality approaches and surgical treatment algorithms in the literature [9,19].

In the present study, the management approach for difficult cases was based on the findings of X-ray KUB and NCCT KUB when indicated. Multiple procedures were performed in seven patients for stent removal. ESWL was used for proximal end encrusted stents, along with CLT (pneumatic lithotripter) or cystolitholapaxy for bladder end encrustations, followed by cystoscopic removal under fluoroscopic guidance. Semirigid ureterorenoscopy±PNLT/Laser lithotripsy was done for two broken and two upmigrated stents. After stent removal, RGP/check ureteroscopy was performed to rule out a ureteric injury. If any signs of ureteric injury or contrast extravasation were present, the patient was restented. For two patients, one with a large stone burden at both ends and another with heavy encrustations at both ends, the stents were cut outside the ureteric orifices after pneumatic CLT/cystolitholapaxy for the bladder end of the stents, and open pyelolithotomy was performed to remove the ureteric portion and proximal end of the encrusted or stone-bearing stent. Borboroglu PG and Kane CJ reported that their patients required an average of 4.2 endourological approaches [7], but other series have reported an average of 2.7 and 2.38 procedures for clearing patients with retained stents and associated stones [8,20]. However, in the present study, an average of 2.14 procedures were performed in cases that required multiple procedures, as the number of complicated cases was lower.

Ringel A et al., observed that in their study of 110 stented kidneys, the total complication rate was 32.7%. However, in the present study of 162 stented kidneys, 25 (16.78%) patients developed complications, mostly Clavien-Dindo Grade I-II, which were easily managed conservatively [21].

Overall, the present study showed successful removal of all uncomplicated stents in 145 (97.31%) patients. In one patient, a stent that was malpositioned into the peritoneal cavity, puncturing the ureter at the upper end, was removed laparoscopically. In another two patients, an open procedure was performed under general anaesthesia. In six patients, the procedure was performed under spinal anaesthesia, where URS±PNLT/LLT or CLT/cystolitholapaxy was required. [Table/Fig-10] shows the algorithm for the management of forgotten/encrusted DJ stent [22].

The advent of modern endourologic technology has enabled the removal of all retained stents using a complete endourologic approach, such as Endoscopic Combined Intrarenal Surgery (ECIRS) [23], or in the Galadakao-Valdivia supine position, where PCNL+RIRS or CLT+PCNL+RIRS or CLT+URS+PCNL+RIRS can be performed in the same session under a single anaesthesia [24]. However, in some cases of severe encrustations, endoscopic manipulations may not be effective, and laparoscopic or open surgery options are considered [8,20,22]. In the present study, RIRS+Holmium Laser Lithotripsy was attempted for proximal end heavy encrustations, but it was very time-consuming, larger fragments became separated, making them difficult to remove with conventional instruments, and even after releasing the stent, the



[Table/Fig-10]: Management of Forgotten/Encrusted DJ Stents.
PCN*=Per cutaneous nephrostomy; IVU†=Intravenous urography; DTPAǂ=Diethylene triamine penta acetic acid; URSL§=ureterorenoscopy lithotripsy

part remained so rigid that it did not uncoil, and the procedure had to be converted to open surgery.

Prevention is the best treatment for retained/forgotten encrusted stents. Stent replacement prior to the expected time of encrustations, which is typically three months, is the most effective and well-established method of preventing encrustations. Stents are often forgotten due to patient non compliance, such as ignoring or forgetting physician advice regarding timely removal, illiteracy, financial constraints, patients from remote areas, and communication gaps between patients and physicians. It is also important for physicians to adequately educate and counsel patients about the presence of the stent and the need for its timely removal.

To prevent such errors, various strategies have been developed. Firstly, maintaining a logbook of stented patients, featuring the date and procedure of stenting, the patient's mobile phone number, alternate phone number, and mentioning the date of removal or replacement, can help remind patients and facilitate communication between healthcare workers and patients. This strategy has been successfully implemented in the urology department at Government Medical College, Patiala. Secondly, establishing a computerised electronic database for registering stented patients can aid in tracking those in need of management [25]. Thirdly, providing education about the risks and complications of stent insertion can help increase patients' awareness and compliance. In the present study, record files were signed by the patients and their relatives to acknowledge the timing and need for stent removal or replacement, serving as a good reminder and increasing compliance in reporting back for removal. This approach is also legally safe as it involves shared responsibility. Fourthly, Withington JB et al., commented that they provide wristbands to stented patients with a barcode that serves as both a registry key and a visible reminder [26].

With proper patient education and appropriate planning, ureteric stents should be removed or replaced within the recommended time frame of three months to avoid unnecessary complications and costs.

Limitation(s)

The present study had a few limitations, including its retrospective review of records, a small number of severe FECAL Grade-IV and no Grade-V cases, the lack of PCNL intervention, and the absence of long-term follow-up results for the operated patients.

CONCLUSION(S)

Timely removal or replacement of stents is crucial in preventing the serious complications associated with retained or forgotten DJ stents. This can be achieved by maintaining logbooks that contain patients' mobile numbers and reminding them through healthcare professionals at the appropriate time for removal. Additionally, educating patients about the risks and complications of forgotten stents can help increase their awareness and promote timely removal. While minimally invasive endoscopic procedures are effective in removing encrusted stents, open removal still has its own merits. However, it is important to note that while we can effectively treat patients with encrusted stents, prevention through timely removal remains the best approach as it is less morbid and cost-effective.

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PLAGIARISM CHECKING METHODS: [Jain H et al.]
- Plagiarism X-checker: Jun 21, 2023
- Manual Googling: Aug 12, 2023
- iThenticate Software: Sep 27, 2023 (13%)

ETYMOLOGY: Author Origin

EMENDATIONS: 7

AUTHOR DECLARATION:
- Financial or Other Competing Interests: None
- Was Ethics Committee Approval obtained for this study? Yes
- Was informed consent obtained from the subjects involved in the study? Yes
- For any images presented appropriate consent has been obtained from the subjects. NA

Date of Submission: **Jun 20, 2023**
Date of Peer Review: **Jul 22, 2023**
Date of Acceptance: **Sep 29, 2023**
Date of Publishing: **Oct 01, 2023**