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Original Article

Effect of 3D laparoscopic surgery for ureteral stricture

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Abstract: Objective: To investigate the efficacy and safety of 3D laparoscopic surgery for ureteral stricture. Methods: There were 47 patients with ureteral stricture and treated with 3D laparoscopic surgery from December 2017 to December 2020, and comprehensive analysis of relevant clinical data. Among the patients with ureteral stricture, there were 31 males and 16 females, 28 were left-sided and 19 were right-sided, aged 20-78 years, with an average age of 43 years; the number of upper and middle ureteral stricture cases was 34, and the lower ureteral stricture was 13, with a stricture length of 0.5-4.0 cm; all patients had different degrees of hydronephrosis before surgery, and the degree of separation of the renal collecting system before surgery was 36.19±4.09 mm. Preoperative serum creatinine was 82.00±35.49 μmol/L. Patients with upper and middle ureteral stricture underwent 3D laparoscopic ureteral stricture resection plus ureter end anastomosis, and patients with lower ureteral stricture underwent 3D laparoscopic ureteral bladder reimplantation. Results: All patients had successful surgery, with an operative time of 132.87±27.64 min, an estimated intraoperative bleeding volume of 58.94±22.29 ml, a postoperative hospital stay of 7.81±1.74 days, and no complications such as intestinal injury and abdominal hemorrhage occurred; the ureteral stent tube was removed 8-12 weeks after the operation, and the follow-up was 3-36 months, with a mean of 18.98±11.36 months. The patients' hydronephrosis was reduced or disappeared, and the symptoms such as back pain and swelling were effectively relieved. The degree of separation of the renal collecting system was 15.28±3.26 mm and the creatinine value was 72.38±29.20 μmol/L on postoperative reexamination, which were statistically significant compared with those before surgery ($P<0.05$). Conclusion: 3D laparoscopic ureteral stricture resection plus ureter end anastomosis or 3D laparoscopic ureteral bladder reimplantation for ureteral stricture is safe and effective, with few complications and rapid postoperative recovery.

Keywords: Ureteral stricture, 3D laparoscopy, efficacy

Introduction

Ureteral stricture is an obstruction of the urinary tract caused by partial or complete narrowing of the ureteral lumen. Ureteral stricture can lead to dilatation of the upper urinary tract or pain in the kidney area, and if left untreated, can eventually lead to irreversible renal failure. The goal of ureteral stricture treatment is to relieve ureteral obstruction, restore patency of the ureteral lumen, and protect renal function as much as possible. For ureteral stricture, different surgical approaches exist, and their respective clinical outcomes vary.

In the past, benign ureteral stricture was often treated with open surgery, including ureteral anastomosis, uretero-vesical anastomosis, and vesicoureteroplasty [1]. Although open surgery is effective, it has the disadvantages of high trauma, serious complications, and long hospital stays [2, 3]. In recent years, endoscopic techniques have become popular with some urologists. Common endoscopic techniques include balloon dilation, ureteral stent placement, and ureteral stricture segment dissection using a laser or cold knife; However, these procedures do not remove the stenotic scar tissue, and the inflammatory reaction caused by ureteral dilation and incision can cause fibroblasts to proliferate and scar the ureter again, thus creating a vicious cycle [4]. A related study showed that the success rate for patients with ureteral stricture treated with balloon dilation at three months follow-up was 60%±10%, the success rate for balloon dilation at 6 to 12 months postoperative follow-up was 54%±14%, and the average success rate for patients with ureteral stricture ≤2 cm in length was 69±16%, while the average success rate for patients with ureteral stricture >2 cm was 19±29% [5]. Balloon dilation is mainly indicated for ureteral strictures due to stones, post-lithotripsy and strictures <2 cm in length. Short-term success rates for ureteral stricture segmental endotomy have been reported in the literature to range from 63% to 83% [6]. Hafez et al. summarized that the overall efficiency of endoureteral resection for ureteral strictures ranged from 60% to 86%, and they concluded that the success rate of dilation by endoureteral resection was mainly related to the site of ureteral strictures [7]. In contrast, in the study of Razdan et al. the success rate of ureteral strictures was not exactly related to the site of stricture [8]. Therefore, there is controversy as to whether the efficiency of endotomy for ureteral stricture correlates with the site of stricture. The patient's renal function is evaluated before the decision to perform ureterotomy, and renal function affects the success of the procedure; Worf et al. studied 69 patients with benign ureteral stricture treated with 77 endoureterotomies, of which 9 patients with ipsilateral renal function below 25% of total renal function failed completely [9]. Therefore, the patient should be adequately evaluated preoperatively. Ureteral stenting can be used as a temporary treatment for ureteral stricture and is independent of the length of the ureteral stricture segment. Some studies have shown that ureteral stent placement and retention for 2-6 weeks is an appropriate treatment for patients with ureteral injuries up to 2.5 cm in length [10-12]. In patients after lithotripsy, ureteral stenting improves stone clearance and reduces the incidence of renal colic, and in patients with ureteral injury, ureteral stenting reduces the risk of ureteral stricture. However, some studies have shown a high incidence of distant ureteral stricture with ureteral stenting for medically induced ureteral injury [13, 14]. Therefore, close postoperative follow-up is required. Although the endoluminal technique has the advantages of minimally invasive, fast recovery and simple operation, this procedure has a high rate of postoperative stricture recurrence and unsatisfactory long-term results. The endoluminal technique is primarily indicated for the treatment of patients with short stricture lengths and a low degree of ureteral stricture. It can be used as the initial treatment for ureteral stricture.

In this article, we will study the efficacy as well as the safety of 3D laparoscopic ureteral stricture resection plus ureter end anastomosis or 3D laparoscopic ureteral bladder reimplantation for ureteral stricture.

Materials and methods

Materials

There were 47 patients with ureteral stricture and treated with 3D laparoscopic surgery from December 2017 to December 2020, there were 31 males and 16 females, 28 were left-sided and 19 were right-sided, aged 20-78 years, with an average age of 43 years; the number of upper and middle ureteral stricture cases was 34, and the lower ureteral stricture was 13, with a stricture length of 0.5-4.0 cm. All patients with ureteral stricture had varying degrees of low back pain or soreness and swelling at the time of admission, and all patients had varying degrees of hydronephrosis. The diagnosis of hydronephrosis can be made with the help of imaging tests, including ultrasound, X-ray, CT, and MR, which can clearly show the presence or absence of hydronephrosis, its extent, and its unilateral and bilateral nature. Currently, ultrasound and intravenous urography are the most widely used methods for grading the degree of hydronephrosis in clinical practice. According to ultrasound, hydronephrosis is classified as mild (renal collecting system separation: 2-3 cm), moderate (renal collecting system separation: 3-4 cm), and severe (renal collecting system separation: >4 cm). The preoperative degree of separation of the renal collecting system was 36.19±4.09 mm, with 5 cases of mild hydronephrosis, 35 cases of moderate, and 7 cases of severe hydronephrosis (**Table 1**).

Methods

Preoperative preparation: Complete the routine examination of admission and imaging examinations such as CTU, intravenous pyelogram, retrograde pyelogram and MRU. If the patient has severe hydronephrosis and urinary tract infection, nephrostomy, anti-inflammato-

Table 1. Basic characteristics of the patient, narrow information

Items	Value
Sex (n)	
Male	31
Female	16
Age (y)	
Mean (range)	43 (20-78)
Side (n)	
Left	28
Right	19
Location	
Upper and Middle	34
Lower	13
Stricture length (cm)	
Mean (range)	1.4 (0.5-4.0)

ry, infection control and symptomatic treatment can be performed first, and then surgery can be prepared.

Surgery methods: In 34 patients with upper or middle ureteral stricture, 3D laparoscopic ureteral stricture resection plus ureter end anastomosis was performed. Under general anesthesia, the patients were placed in the healthy-side position, routinely disinfected with towels, established a pneumoperitoneum, carefully freed the surrounding tissues, exposed the ureter, fully freed the stenotic segment of the ureter, and then resected the stenotic ureter, performed posterior ureteral wall suturing with 4-0 absorbable thread, and then placed a suitable ureteral stent tube, and then the anterior ureteral wall was sutured. The surgical area was then carefully inspected to confirm that there were no bleeding spots and a drainage tube was placed, and the incision was closed layer by layer.

13 patients with lower ureteral stricture underwent laparoscopic ureteral bladder reimplantation. Under general anesthesia, the patients were placed in a head-down position, routinely disinfected and toweled, a pneumoperitoneum was established, the ureter was exposed, the ureter was carefully separated, the dilated ureter was disconnected from the bladder, and the distal end was clamped. A double J tube was left proximally. The bottom of the affected bladder was freed to the vicinity of the triangle, and a 2-cm longitudinal incision was made on the bladder wall medial to the ureteral stump, the muscular layer and mucosal layer were incised, and the ureter was buried under the bladder mucosa by making an external papilla, and the bladder muscle layer was intermittently anastomosed to the ureteral wall with 4-0 absorbable thread, and the bladder mucosa was intermittently sutured to the external wall of the ureter with 4-0 absorbable thread. The surgical area was carefully checked for active bleeding, and after confirming that there was no bleeding, one pelvic drain was left in place and the incision was closed layer by layer.

Postoperative follow-up and outcome evaluation

The double J tube was removed 8-12 weeks after surgery. After removal of the double J tube, the patient's clinical symptoms of ureteral stricture are reduced or disappeared, and the review of urological ultrasound, urography or urological CT indicates that the hydronephrosis is reduced or not aggravated, and the review of blood creatinine value is lower than that before the operation is considered effective. Patients with unrelieved clinical symptoms or further worsening of symptoms, worsening of hydronephrosis, or elevated blood creatinine values were considered ineffective.

Statistical methods

SPSS22.0 software was applied for statistical analysis, and the measurement data were expressed as mean ± standard deviation ($\bar{x} \pm s$) and the two-sample t-test was used to compare the preoperative and postoperative data, and the difference was considered statistically significant at $P<0.05$.

Result

All patients completed the operation successfully, the operation time was 132.87±27.64 min, the intraoperative bleeding volume was 58.94±22.29 ml, all patients had no intraoperative blood transfusion, all had mild hematuria after the operation, 8 cases had low fever, and the symptoms of hematuria and low fever disappeared after postoperative treatment with anti-infection, hemostasis, rehydration and symptomatic treatment; All patients had no major bleeding, no important organ damage or serious infection and other serious complica-

Table 2. Degree of separation of the renal collecting system and serum creatinine

	Preoperative	Postoperative	P
Degree of separation of the renal collecting system (mm)	36.19±4.09	15.28±3.26	P<0.05
Serum creatinine (μmol/L)	82.00±35.49	72.38±29.2	P<0.05

tions. The postoperative hospitalization time was 7.81±1.74 days. The double J tube was removed 8-12 weeks after surgery, the follow-up period was 3-36 months, with a mean of 18.98±11.36 months. All patients' clinical symptoms were effectively relieved, and there was a statistically significant difference between the postoperative review of renal collecting system separation and preoperative comparison ($P<0.05$); there was a statistically significant difference between the postoperative follow-up review of serum creatinine and preoperative comparison ($P<0.05$) (**Table 2**).

Discussion

Ureteral stricture is one of the common diseases in urology and also difficult for urologists to manage. There are many causes of ureteral stricture, which can be divided into benign and malignant factors. Benign causes include congenital and secondary factors, such as surgical injury, ureteral stones, infection, trauma, radiation therapy, renal transplantation, etc., while malignant factors include primary ureteral malignancy or external compression by tumors adjacent to the ureter [15]. With the advancement and widespread use of endoluminal techniques, especially the damage to the ureter during laparoscopic surgery and ureteroscopic Holmium laser lithotripsy, the rate of ureteral stricture has also increased [16, 17]. According to the literature, the incidence of ureteral stricture due to holmium laser treatment of ureteral stones under ureteroscopy was reported to be 4.1% to 7.8% [17]. Ulvik Y et al. summarized 1001 patients after ureteral stone surgery and found that the incidence of ureteral stricture at 3 months after surgery was 3.0% [18]. Ureteral stricture is difficult to treat clinically, and there is no uniform standard for the treatment of ureteral stricture. Treatment of ureteral stricture is aimed at early release of obstruction, protection of renal function and relief of clinical symptoms [19, 20].

Laparoscopic surgery is characterized by minimal trauma, rapid recovery, and short postoperative hospital stay, and has been shown to have a success rate and efficiency comparable to that of open surgery [21-23]. The surgical approach is mainly determined by the location, length, and nature of the stricture. Laparoscopic pyeloplasty can be chosen for stricture of the ureteral junction, laparoscopic ureteral stricture resection plus ureter end anastomosis for upper and middle ureteral stricture with a stricture length less than 3 cm, and laparoscopic ureteral bladder stricture for lower ureteral stricture with a stricture length less than 3 cm.

As the traditional 2D laparoscopic technique lacks a sense of three-dimensionality and depth in the image, this defect leads to the loss of a sense of hierarchy in the original tissue structure, which makes it impossible for the operator to accurately identify the exact location of the organs and instruments, making the operation more difficult, especially when performing a series of delicate operations, such as microscopic knotting and suturing, which further prolongs the operation time and affects the patient's postoperative recovery and prognosis. The emergence of 3D laparoscopy has brought a new dawn to medicine, and the advantages of traditional laparoscopy have not only been retained, but also the original imaging principle has been changed to make its imaging technology more perfect, and the three-dimensional imaging sense and longitudinal depth make the presented human tissue structure closer to the real anatomy, with a clearer sense of hierarchy, allowing the operator to perform the surgery more precisely and reduce the mis-injury caused by imaging limitations [24]. 3D laparoscopic techniques provide a high quality surgical vision similar to that of open surgery, which allows surgeons to have a higher surgical precision with a shorter learning curve [25].

In this study, 3D laparoscopic ureteral stricture resection plus ureter end anastomosis or 3D laparoscopic ureteral bladder reimplantation was used to treat ureteral stricture, focusing on complete resection of the stenotic ureter followed by tension-free ureter end anastomosis or ureteral bladder reimplantation to ensure normal blood flow to the ureter. According to relevant studies, resection of the stenosed ureter followed by end-to-end anastomosis and ureteral reconstruction to restore normal ureteral peristalsis can lead to satisfactory long-term results [26]. In this study, 47 patients who underwent 3D laparoscopic ureteral stricture resection plus ureter end anastomosis or 3D laparoscopic ureteral bladder reimplantation were followed up for 3-36 months after surgery, and all patients had different degrees of symptom relief. Seideman CA et al. performed laparoscopic ureteral bladder reimplantation in 46 patients with ureteral stricture, with a mean follow-up of 24.1 months after surgery and an effective success rate of 96% for ureteral stricture [27]. Kapogiannis F et al. found laparoscopic treatment of ureteral strictures to be safe and effective through a retrospective study [28]. The choice of laparoscopic approach can be divided into transabdominal and retroperitoneal routes, both of which have advantages and disadvantages. The retroperitoneal approach is characterized by a rapid finding of the ureter without contaminating the abdominal cavity, whereas the transperitoneal approach allows for a wide range of operations and space, making it easier to operate, but postoperative complications such as infection and intestinal obstruction may be combined. In the study by Qadri et al., the retroperitoneal approach had a reduced operative time and a lower rate of tissue organ damage during the procedure compared to the transabdominal route [29]. In contrast, in the study by Abuanz et al., the transabdominal approach had less operative time and a higher probability of intermediate specialization to open surgery with the retroperitoneal approach, but the final overall results of the two approaches were close [30]. In our experience, the choice between the two approaches should be determined on a patient-by-patient basis. The retroperitoneal approach is more suitable for patients with ureteral stricture close to the renal pelvis and who have not undergone previous retroperitoneal surgery, whereas the peritoneal approach is more suitable for patients with inferior ureteral stricture, long ureteral stenotic segments, and who have undergone previous retroperitoneal surgery.

In 13 patients with lower ureteral stricture, we used 3D laparoscopic ureteral bladder reimplantation with good results in postoperative follow-up. Ureteral bladder reimplantation becomes a good option when the ureteral stricture is located in the lower ureter and the lower ureteral stricture is long and a tension-free ureteral anastomosis cannot be performed. When performing ureteral bladder reimplantation, the blood supply to the ureter should be ensured as much as possible, and distortion of the ureter should be avoided during the procedure.

We should fully evaluate the length of the stenotic segment before surgery because if the length of the stenotic segment is not fully evaluated before surgery, the stenotic segment may be too long, and then the ureteral anastomosis may be too much tension and the anastomosis may not be possible, and then we have to change the surgical approach. Our experience is that ureteral stricture resection plus ureter end anastomosis and ureteral bladder reimplantation can be considered for patients with ureteral stricture of less than 3 cm in the upper or middle segment and less than 2.5 cm in the lower segment. In this study, the longest ureteral stricture was 4.0 cm, and we believe that the tension of the anastomosis should be minimized when performing ureteral stricture resection with end-to-end anastomosis, and the maximum length of the ureteral stricture can be achieved as long as the anastomosis is tension-free. When the ureteral stricture is too long to perform ureteral stricture resection plus ureter end anastomosis, bladder flap ureteroplasty, pelvic ureteroplasty, oral mucosal ureter repair, appendiceal patch ureter repair, intestinal replacement ureter, autologous kidney transplantation and other upper urinary tract reconstruction methods can be used, However, ureteral stricture resection plus ureter end anastomosis and ureteral bladder reimplantation are the most commonly used procedures.

In order to understand the length of the ureteral stricture segment, imaging is very important. In clinical work, CTU, MRU, cascade angiography, retrograde angiography, or a combination of cascade angiography and retrograde angiography are often applied to understand the length of the ureteral stricture segment, the stricture, the thickness of the ureteral wall, adhesions with the surrounding area, and other information, which is very valuable information. There are many variables in the repair and reconstruction of the upper urinary tract. In addition to ureteral stricture resection plus ureter end anastomosis, if we can master some other alternative ureteral procedures, such as oral mucosal ureteral repair and intestinal substitution ureter, it can bring us a great help in the safety of the procedure.

The 3D laparoscope has good spatial vision, which enables the operator to better perform various laparoscopic operations, such as separation and resection, and thus effectively improves the accuracy of surgery; the tissue structure and hierarchical relationship in the human body can be clearly demonstrated under the 3D laparoscope, and the angle and direction of needle entry and exit can be better adjusted under the 3D laparoscope, which improves the accuracy and speed of laparoscopic anastomosis. On the other hand, the anatomical structure of tissues and the location of small blood vessels can be more easily identified under 3D laparoscopy, which can lead to more accurate surgical positioning and significantly reduce the incidence of intraoperative injuries and perioperative complications. This will make the surgeon more confident during the surgery and reduce the stress of the surgeon during the surgery. In the study by Nguyen DH et al., operations such as dissection, suturing, and identification of vessels could be more precise and rapid under 3D laparoscopy, and bleeding points could be quickly identified and timely and effective hemostasis performed, reducing blood loss, and the spatial orientation of the stitches could be better determined in the 3D laparoscopic view, making suturing relatively simple and therefore the time for suturing would be relatively reduced, and thus the operative time could be shortened [31]. Regarding the European Basic Skills Training Programme in Laparoscopic Urology, although there was a trend towards reduced operative time with the use of 3D vision, a meta-analysis showed no statistical difference in the use of these two imaging systems for the beginner and expert surgeon groups [32]. This may be related to the fact that different 3D laparoscopic systems were used. In a study by Romero-Loera, divided into two groups, a 3D laparoscopic group and a 2D laparoscopic group, all physicians had no experience in laparoscopic surgery, and it was found that the 3D laparoscopic group was able to complete the task faster, with a shorter time and a shorter learning curve [33]. 3D laparoscopy has a better sense of depth and spatial dimensionality, which will enable operators to operate more precisely, reduce errors, shorten the learning curve, and help the training of young surgeons. This will be of great use in teaching.

The sense of depth and spatial three-dimensionality of human tissues in the images under 3D laparoscopic system was significantly improved, which can effectively shorten the operation time for some complex movements and at the same time can guarantee the precision of the operation. In this study, 47 patients were successfully operated in 3D laparoscopy, with an average operation time of 132.87±27.64 min and bleeding volume of 58.94±22.29 ml. All patients had no serious complications, such as hemorrhage and important organ damage. No recurrence was observed during the follow-up period. It shows that 3D laparoscopic surgery for ureteral stricture is safe and effective.

Shortcomings of this study: (1) this study is a retrospective study and bias exists; (2) the sample size is small and the sample size can be increased in the future to ensure the accuracy of the study; (3) the sample source is single and a multicenter study of the clinical application of 3D laparoscopy is needed.

Conclusion

In conclusion, 3D laparoscopic ureteral stricture resection plus ureter end anastomosis or 3D laparoscopic ureteral bladder reimplantation for ureteral stricture is safe and effective without serious complications, and is worth promoting in clinical practice.

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Disclosure of conflict of interest

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References

[1] Lojanapiwat B, Soonthonpun S and Wudhikarn S. Endoscopic treatment of benign ureteral strictures. Asian J Surg 2002; 25: 130-133.

[2] Kramolowsky EV, Tucker RD and Nelson CM. Management of benign ureteral structures: open surgical repair or endoscopic dilation. J Urol 1989; 141: 285-286.

[3] Fasihuddin Q, Abel F, Hasan AT and Shimali M. Effectiveness of endoscopic and open surgical management in benign ureteral strictures. J Pak Med Assoc 2001; 51: 351-353.

[4] O'Sullivan DC, Lemberger RJ, Bishop MC, Bates CP and Dunn M. Ureteric stricture formation following ureteric instrumentation in patients with a nephrostomy drain in place. Br J Urol 1994; 74: 165-169.

[5] Lu C, Zhang W, Peng Y, Li L, Gao X, Liu M, Fang Z, Wang Z, Ming S, Dong H, Shen R, Xie F, Sun Y and Gao X. Endoscopic balloon dilatation in the treatment of benign ureteral strictures: a meta-analysis and systematic review. J Endourol 2019; 33: 255-262.

[6] Wang KJ, Zhou L and Li H. Discussion on several key issues in the treatment of ureteral stricture. Chin J Urol 2020; 41: 881-883.

[7] Hafez KS and Wolf JJ. Update on minimally invasive management of ureteral strictures. J Endourol 2003; 17: 453-464.

[8] Razdan S, Silberstein IK and Bagley DH. Ureteroscopic endoure terotomy. BJU Int 2005; 95: 94-101.

[9] Wolf JS Jr, Elashry OM and Clayman RV. Long-term results of endoureterotomy for benign ureteral and ureteroenteric strictures. J Urol 1997; 158: 759-764.

[10] Selzman AA and Spirnak JP. Iatrogenic ureteral injuries: a 20-year experience in treating 165 injuries. J Urol 1996; 155: 878-81.

[11] Png JC and Chapple CR. Principles of ureteric reconstruction. Curr Opin Urol 2000; 10: 207-212.

[12] Koukouras D, Petsas T, Liatsikos E, Kallidonis P, Sdralis EK, Adonakis G, Panagopoulos C, Al-Aown A, Decavalas G, Perimenis P, Siablis D and Karnabatidis D. Percutaneous minimally invasive management of iatrogenic ureteral injuries. J Endourol 2010; 24: 1921-1927.

[13] Choi YS, Lee SH, Cho HJ, Lee DH and Kim KS. Outcomes of ureteroscopic double-J ureteral stenting for distal ureteral injury after gynecologic surgery. Int Urogynecol J 2018; 29: 1397-1402.

[14] Chung D, Briggs J, Turney BW and Tapping CR. Management of iatrogenic ureteric injury with retrograde ureteric stenting: an analysis of factors affecting technical success and long-term outcome. Acta Radiol 2017; 58: 170-175.

[15] Tyritzis SI and Wiklund NP. Ureteral strictures revisited...trying to see the light at the end of the tunnel: a comprehensive review. J Endourol 2015; 29: 124-136.

[16] Parpala-Spårman T, Paananen I, Santala M, Ohtonen P and Hellström P. Increasing numbers of ureteric injuries after the introduction of laparoscopic surgery. Scand J Urol Nephrol 2008; 42: 422-427.

[17] Yuan YJ, Su ZM, Liang J, Li X and Xu GB. Medical risk factors for ureteral stricture in urology and prevention. Chin J Endourol 2017; 11: 423-425.

[18] Ulvik Ø, Harneshaug JR and Gjengstø P. Ureteral strictures following ureteroscopic stone treatment. J Endourol 2021; 35: 985-990.

[19] Tran H, Arsovska O, Paterson RF and Chew BH. Evaluation of risk factors and treatment options in patients with ureteral stricture disease at a single institution. Can Urol Assoc J 2015; 9: E921-924.

[20] Sabale VP, Thakur N, Kankalia SK and Satav VP. A case report on buccal mucosa graft for upper ureteral stricture repair. Urol Ann 2016; 8: 474-477.

[21] Rassweiler JJ, Gözen AS, Erdogru T, Sugiono M and Teber D. Ureteral reimplantation for management of ureteral strictures: a retrospective comparison of laparoscopic and open techniques. Eur Urol 2007; 51: 512-522; discussion 522-523.

[22] Simmons Matthew N, Gill Inderbir S, Fergany Amr F, Kaouk Jihad H and Desai Mihir M. Laparoscopic ureteral reconstruction for benign stricture disease. Urology 2007; 69: 280-284.

[23] Kozinn Spencer I, David C, Andrea S and Alireza M. Robotic versus open distal ureteral reconstruction and reimplantation for benign stricture disease. J Endourol 2012; 26: 147-151.

[24] Cicione A, Autorino R, Breda A, De Sio M, Damiano R, Fusco F, Greco F, Carvalho-Dias E, Mota P, Nogueira C, Pinho P, Mirone V, Correia-Pinto J, Rassweiler J and Lima E. Three-dimensional vs. standard laparoscopy: comparative assessment using a validated program for laparoscopic urologic skills. Urology 2013; 82: 1444-1450.

[25] Velayutham V, Fuks D, Nomi T, Kawaguchi Y and Gayet B. 3D visualization reduces operating time when compared to high-definition 2D in laparoscopic liver resection: a case-matched study. Surg Endosc 2016; 30: 147-153.

[26] Xiong M, Zhu X, Chen D, Hossain MA, Xie Y, Gou X and Deng Y. Post ureteroscopic stone surgery ureteral strictures management: a retrospective study. Int Urol Nephrol 2020; 52: 841-849.

[27] Seideman CA, Huckabay C, Smith KD, Permpongkosol S, Nadjafi-Semnani M, Lee BR, Richstone L and Kavoussi LR. Laparoscopic ureteral reimplantation: technique and outcomes. J Urol 2009; 181: 1742-1746.

[28] Kapogiannis F, Spartalis E, Fasoulakis K, Tsourouflis G, Dimitroulis D and Nikiteas NI. Laparoscopic and robotic management of ureteral stricture in adults. In Vivo 2020; 34: 965-972.

[29] Qadri SJ and Khan M. Retroperitoneal versus transperitoneal laparoscopic pyeloplasty: our experience. Urol Int 2010; 85: 309-313.

[30] Abuanz S, Gamé X, Roche JB, Guillotreau J, Mouzin M, Sallusto F, Chaabane W, Malavaud B and Rischmann P. Laparoscopic pyeloplasty: comparison between retroperitoneoscopic and transperitoneal approach. Urology 2010; 76: 877-881.

[31] Nguyen DH, Nguyen BH, Van Nong H and Tran TH. Three-dimensional laparoscopy in urology: initial experience after 100 cases. Asian J Surg 2019; 42: 303-306.

[32] Sánchez-Margallo FM, Durán Rey D, Serrano Pascual Á, Mayol Martínez JA and Sánchez-Margallo JA. Comparative study of the influence of three-dimensional versus two-dimensional urological laparoscopy on surgeons' surgical performance and ergonomics: a systematic review and meta-analysis. J Endourol 2021; 35: 123-137.

[33] Romero-Loera S, Cárdenas-Lailson LE, de la Concha-Bermejillo F, Crisanto-Campos BA, Valenzuela-Salazar C and Moreno-Portillo M. Comparación de destrezas en simulador de laparoscopia: imagen en 2D vs. 3D [Skills comparison using a 2D vs. 3D laparoscopic simulator]. Cir Cir 2016; 84: 37-44.