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The ladder of learning in exstrophy closure — A 5 year initial faculty experience

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ABSTRACT

Purpose: Closure of bladder exstrophy is one of the most complex reconstructive procedures. Basic concepts of these operations, as well as their subtle nuances, require years of experience. However, the volume of these cases is low. The authors describe the experience of a junior surgeon learning the details of exstrophy closure during fellowship and her initial career.
Methods: Fellows graduating in 2014 were surveyed for their exstrophy experience during fellowship and the following four years. Operative logs of the junior faculty member were reviewed during the same time. Average operative times were calculated for each year.
Results: Seventeen of the 25 fellows responded to the survey. Eight surgeons did one or fewer exstrophy closures during fellowship; 14 did one or fewer closures as an attending. The junior faculty member assisted in 18 closures as a fellow and 48 exstrophy closures during the next four years. Average operative time decreased from 485 to 309 min from attendingship year one to four.
Conclusions: There are subtle details inside and outside of the operating room required to ensure a successful outcome in this important step of exstrophy reconstruction. Working alongside senior colleagues is essential to allow the junior surgeon to ascend this ladder of mastering exstrophy closure.
Type of study: Diagnostic.
Level of evidence: V

In 2013, Wang et al. demonstrated that, after fellowship, the majority of pediatric urologists felt prepared to discuss surgical options as well as perform surgical procedures in practice [1]. Concurrently, Gearhart et al. showed that the site directors of subspecialty surgical fellowships, including pediatric urology, felt that their mentees were technically proficient after fellowship [2]. However, both of these studies raise the question recently addressed by Suson et al.: what are these surgical cases that pediatric urologists, and their mentors, are comfortable performing after fellowship? Suson et al. recently examined the initial case logs of 71 pediatric urologists applying for certification for case volume and complexity within the first six months of attendingship [3]. The study showed a significant range of case volumes (117–1043) and demonstrated that the majority of cases among pediatric urologists are of minimal complexity. Even among the pediatric urologists in the highest quartile for case volume, the mean number of significantly complex cases was only 10.8. In four case logs out of the 71 examined, no cases of significant complexity were even performed [3]. While the study only looked at the case logs for the initial six-month practice period, the results are still somewhat alarming. With such a small percentage of pediatric urologists performing complex cases, how can we expect our pediatric urologists to become proficient in these particular cases?

Some of the most complex reconstructive procedures encountered by the pediatric urologist include closure of classic bladder exstrophy (CBE), cloacal exstrophy (CE), and the respective variants. Recently, Schaeffer et al. reported on the practice patterns for infants with bladder exstrophy. In this study, they examined data from 43 tertiary care pediatric hospitals in the United States and found that, on average, a high-volume center for CBE closure did only 1.7 closures yearly with a maximum of 3 closures per year; low volume centers did on average 0.33 closures per year [4]. In a similar but older study by Nelson et al., hospitals from the Nationwide Inpatient Sample were identified that performed a surgical repair of bladder exstrophy; the authors found that high volume centers (≥5 cases/year) had a lower total hospital cost as well as lower in-hospital morbidity rates for exstrophy patients [5]. Therefore, if moderate to high-volume center is only doing approximately 1.7–4 CBE closures a year, the learning process for any pediatric urologist will be extremely arduous. In this study, we compare the exstrophy

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experience of pediatric urology fellows graduating in 2014 and their first four years of attendingship. Furthermore, we describe the ladder of learning of one such junior faculty member learning the details of exstrophy closure through pediatric fellowship into the beginning of her career at a major exstrophy referral center in the United States.

1. Materials and methods

An anonymous survey was sent to the most updated email addresses of the pediatric urology fellows completing their fellowships in 2014 using the Society of Pediatric Urology and American Urologic Association websites. The survey assessed the number of exstrophy closures the surgeon participated in as a fellow and in their first four years of attendingship. The survey also assessed whether there was a senior surgeon assisting during the exstrophy closures. The average yearly number of exstrophy closures performed in fellowship and as an attending was calculated based on survey results. This yearly average as a fellow and as an attending was then stratified as less than or equal to one, more than one up to two closures, more than two up to three closures, or more than three closures per year.

The operative logs of the junior faculty member were reviewed during fellowship and during the first four years of practice as an attending surgeon at a major exstrophy referral center. Closure of CBE, CE, exstrophy and cloacal exstrophy variants were included. Both primary closures and reclosures were included. Cases were included if the junior faculty surgeon was the fellow, the cosurgeon or the primary surgeon on record. The primary outcome after surgery was successful closure; failed closure was defined as a dehiscence, prolapse, or vesicocutaneous fistula. Postoperative complications were also collected, including superficial wound infection, urinary tract infection, pin site infection, and others.

Operative times were calculated for each exstrophy closure during the four years of attendingship using the anesthesia or nursing logs for the respective cases. For each case, the patient undergoes placement of a tunneled epidural catheter after anesthesia induction. If this time was not specified in the anesthesia or nursing log, 60 min was given for this procedure. In each case that underwent a concomitant osteotomy with application of external fixation, 150 min was dedicated to this part of the surgical procedure if the operative time was not specifically indicated in the anesthesia or nursing logs. Two patients underwent a concomitant omphalocele repair; this part of the operation was allocated 90 min. The average operating time for an exstrophy closure was then calculated for each year of attendingship for the junior faculty member.

2. Results

2.1. Survey results

The anonymous survey assessing exstrophy experience was sent to 25 email addresses, including the junior faculty member at the author's institution. See Appendix 1 for full survey. Of these 25 pediatric urologists, there was an overall response rate of 68%, with 17 completed surveys. As fellows, less than half of pediatric urologists performed one or less closures (8/17) while there were four fellows who performed an average of more than three exstrophy closures per year; see Fig. 1. As attendings, the results continued to diverge. On average, 14 of the pediatric urologists performed one or less exstrophy closure per year as attendings and only two pediatric urologists performed more than three closures per year.

2.2. Operative case logs

During clinical pediatric urology fellowship year, 18 total exstrophy closures were performed by the fellow and senior surgeon (11 CBE, 3 CE, 2 BE variants, 2 CE variants). During the first four years as a faculty member at the same institution, 48 total exstrophy closures were performed by the junior faculty member and same senior surgeon (34 CBE, 6 CE, 6 BE variants, 2 CE variants); see Table 1. There was one failed

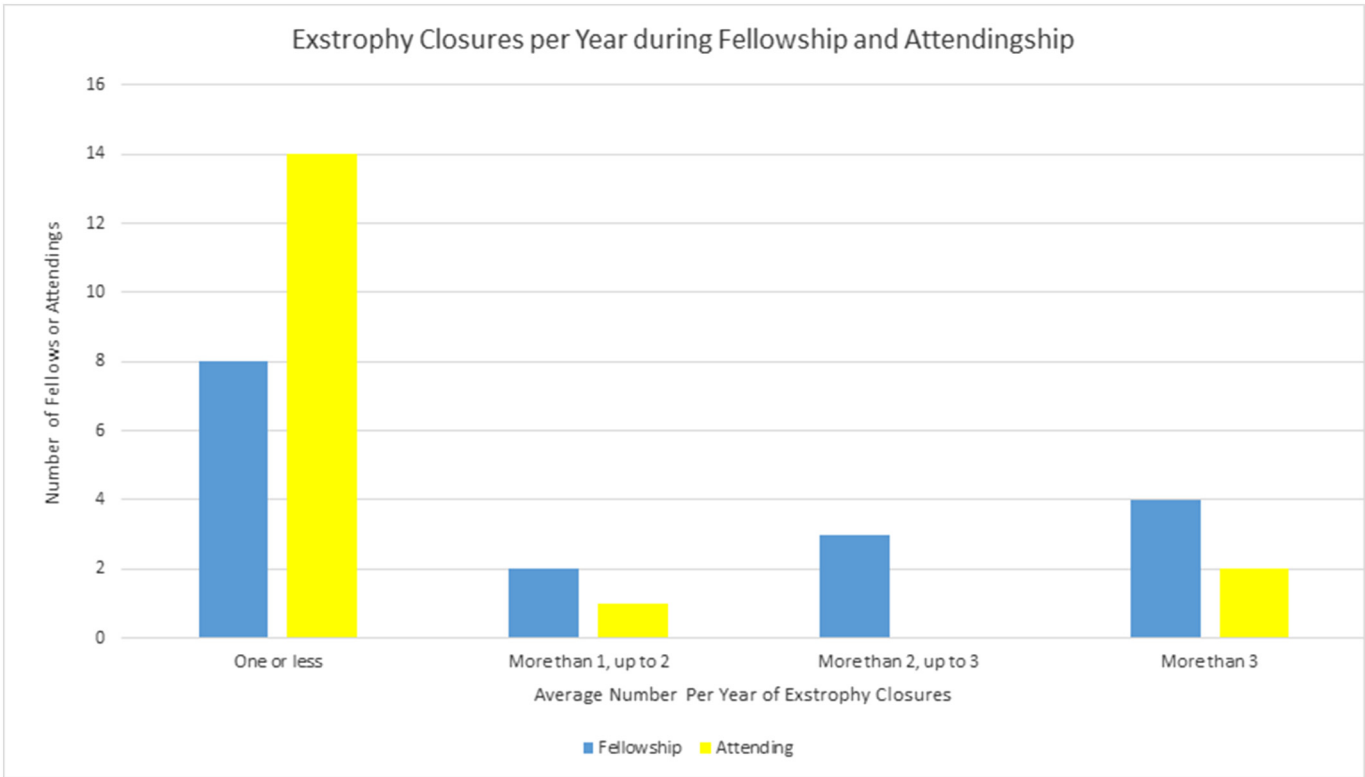

Fig. 1. Survey responses for exstrophy experience.

Table 1
Exstrophy closures by year and type.

	Classic Bladder Exstrophy	Cloacal Exstrophy	Bladder Exstrophy Variants	Cloacal Exstrophy Variants	Total Closures
Fellowship	11	3	2	2	18
Year 1	10	-	1	-	11
Year 2	7	2	3	-	12
Year 3	6	1	1	1	9
Year 4	11	3	1	1	16

primary newborn closure occurring in the second year of attendingship. This patient was a classic bladder exstrophy that was initially closed without osteotomy but was successfully reclosed with pelvic osteotomies and external fixation. The complication rates were also examined per year of attendingship. Year one saw a complication rate of 33%, year two with 79%, year three with 71%, and year 4 with 50%. The majority of the complications included urinary tract infection, superficial wound infection, or pin site infection. However, there was one case in year one where a patient had urethral edema requiring a urethral stent placement. In year two, there was one patient with a failed primary closure owing to a wound dehiscence as well as one patient who had a cardiac arrest, thought to be owing to sepsis. In year three, one patient had bilateral ureteral stent migration with subsequent obstruction requiring nephrostomy tubes and in year four there were no major complications. The complication rates were not statistically significant among the four years of attendingship, $p = 0.14$.

2.3. Operative time

Average operative times for exstrophy closure were calculated by year of attendingship; see Table 2. Overall, there was a change in approximately 175 min from attendingship year one to attendingship year four. The greatest decrease in operative time occurred from the transition of attendingship year one to attendingship year two, with a decrease of 159 min.

3. Discussion

As Suson clearly demonstrated, the rate of significantly complex cases performed by pediatric urologists in the first six months of practice is very low. The majority of pediatric urologists are performing minimally complex cases including circumcision, orchiopexy, and hernia repairs. Furthermore, of the 71 case logs examined, 4 case logs did not include any complex cases and, on average, the highest volume of complex cases was only 10.8 [3]. This is also evident in other surgical subspecialties; in pediatric surgery, it has been shown recently that the average number of several complex index cases during pediatric surgery training is decreasing. In this recent abstract presented at a pediatric surgery meeting, the average number of portoenterostomy, excisions or sacrococcygeal teratoma, and repair of thyroglossal duct cyst or sinus has decreased from 2004 to 2016 [6]. It is therefore hard to imagine a pediatric urologist becoming proficient with these significant complex cases in the beginning of their career.

Even at certain high-volume centers in the United States for CBE closure, the rate of closure is only 1.7 per year on average, with a maximum of 3 closures per year in the study by Schaeffer et al. [4]. This trend of few high-volume centers is mirrored in this study's survey results of the 2014 graduating pediatric urology fellows. In fellowship, where the budding pediatric urologist is exposed to a breadth of cases and develops surgical proficiency, only seven fellows performed more than two exstrophy closures on average each year. As this is a complex reconstructive case that requires surgical repetition in order to master the operation, it is not surprising that only two of the pediatric urology fellows graduating in 2014 performed an average of more than three exstrophy closures during their first four years of attendingship while the majority performed one or less exstrophy closures. Of note, all outside junior faculty members completed their exstrophy closures with a senior mentoring attending.

Table 2
Average Pediatric Urology Operative Times for Exstrophy Closure.

Year of Attendingship	Average Operative Time (min) ± SD
1	483.8 ± 59.9
2	324.8 ± 95.0
3	295.9 ± 65.6
4	309.8 ± 74.6

The experience in the United States, with only a few centers performing a high volume of exstrophy closures, is similar to that in Europe. In mainland Europe, there are only several high-volume centers performing six or more CBE closures or epispadias repairs per year, with the majority of centers performing one to five CBE closures or epispadias repairs per year or less [7]. In 1998, the British Association of Paediatric Urologists regionalized the treatment of bladder exstrophy owing to poor surgical outcomes, limiting the treatment to only two centers throughout United Kingdom in hopes to standardize treatment and obtain excellent surgical results [8]. With only limited centers performing large volumes of CBE closure, or other complex reconstructive cases, there must be a way in which pediatric urologists can learn to master these types of cases in order to obtain excellent surgical outcomes.

Several teaching styles have been proposed to try to close the gap in knowledge and experience for these complex cases. As Suson elucidates in her paper, such examples are excellent mentor–mentee relationships, e-learning or online modules, proctoring, as well as live streaming index cases [3]. Another method has been to establish a multi-institutional consortium in which multiple surgeons from different hospitals participate in some form during complex cases across the participating institutions, with one specific for BE known as the Multi-Institutional Bladder Exstrophy Consortium (MIBEC.) While the surgeons from the outside institutions do not directly operate on the patient, they are involved real time via high-definition video and active commentary, and then later via retrospective review and critique [9]. However, in each of these teaching styles, the beginning pediatric urologist is often a passive learner without any hands-on experience. In a recent submission, a more active teaching style has been proposed termed the “cosurgeon” [10]. In this method, a patient's primary pediatric urologist, from an outside institution, is credentialed and involved in the surgical operation which allows informed close follow up at the home office as well as allowing the outside pediatric urologist to maintain their surgical skills with the mentoring of a senior surgeon. Whether individual centers regionalize care, such as in the UK, use telementoring, or create multi institutional consortiums to perform these complex cases, these are demanding surgical procedures, and, in the case of BE, the first closure must be successful or the chance for eventual voided continence is lost.

Our institution endorses a graduated learning process at this high-volume center with a junior faculty member learning from a senior attending in order to understand the complexities of exstrophy closure and other complex reconstructive cases. As a relative beginner in the exstrophy closure process, the fellow begins to learn the subtle details both inside and outside of the operating room with the guidance of the senior surgeon. As attendingship begins, there is still a significant learning curve to gain the knowledge to ensure a successful outcome in this complex case. Specifically, in exstrophy closures, it is imperative to understand the proper use of osteotomy, radical dissection of the urogenital diaphragm fibers, maximal urinary tract drainage, postoperative immobilization and appropriate pain control. To better understand the nuances of the orthopedic part of the surgery, the fellow scrubs with the senior orthopedic attending during the osteotomy and application of the external fixator. Therefore, it is essential to work alongside a

senior colleague on a daily basis not only to pick up the nuances of exstrophy closure, but to begin to gain the confidence to dictate and guide the operation and postoperative care.

The results of this study clearly demonstrate the evolution of the junior faculty member in learning the nuances of exstrophy. As a first year attending, the average operating time for an exstrophy closure was 484 min. This dropped dramatically by year two, where the average operating time was 325 min. In years three and four, it appears that the average operating room time plateaued around 300 min. Therefore, over a few years, and with all closures but one being successful, the junior faculty member achieved success while also obtaining proficiency. This is mirrored in a study by Tasian et al. who examined the learning curve in robotic assisted pyeloplasty in pediatric urology fellows in 2013. In this study, the operative time for four pediatric urology fellows over 20 robotic cases each was calculated and compared to a senior faculty member. On average, Tasian et al. found that the operative time decreased by 3.7 min per case for each fellow and that the caseload to achieve the median operative time of a senior attending surgeon was approximately 37 cases [11]. While the type of case is very different – robotic pyeloplasty vs exstrophy closure – both Tasian's study and this author's study demonstrate that a gradual decrease in operative time is one way in which to demonstrate proficiency in a certain procedure.

In this center, the junior faculty member determined that it took approximately 30 cases to feel comfortable and confident in performing the exstrophy closures independently. This would coincide with the beginning of year four in the junior faculty's attendingship. The decrease in operative time at this time point would lend support to achieving proficiency at this time. It also coincides with the junior faculty member starting to perform these exstrophy cases without the assistance of the senior mentor. This number of cases prior to proficiency is similar to findings in other studies in the reconstructive urologic field. Falcone et al. examined the learning curve in a male-to-female penoscrotal vaginoplasty at a single institution using surgical outcomes as well as operative time to determine proficiency. The authors found that it took approximately 30–40 cases to achieve appropriate surgical outcomes and a stabilization of operative time, thus becoming proficient in this reconstructive case [12]. A similar study by Faris et al. studied the learning curve in male urethral reconstruction by assessing surgical success rates. In this study, Faris et al. determined that it took approximately 100 cases to reach proficiency for all types of reconstruction and 70 cases to reach proficiency in bulbar urethroplasty [13]. As reported earlier, Tasian et al. found that it took approximately 37 cases for a fellow to reach proficiency, based on operative time and surgical outcome, during a pediatric robotic assisted pyeloplasty [11]. Therefore, while there is a range of the number of cases needed to be completed prior to proficiency, it is not unreasonable that a junior attending can begin to be proficient at bladder exstrophy closure around 30 cases.

This study highlights the gradual transition from fellow to cosurgeon to primary surgeon. As the junior faculty member performs more of these complex reconstruction cases under the guidance of a more senior surgeon, there will be a transition of responsibility and eventually, the mentee will become the mentor. This experience has been invaluable to the junior faculty member's ability to successfully perform complex surgical reconstructions. The possibility of having such an experience was a critical reason why the junior faculty member chose this fellowship opportunity and to stay at the same institution to start their surgical career.

4. Conclusions

Unfortunately, few pediatric urology graduates are experienced in exstrophy closure, a finding that is reflected in only a few exstrophy centers in the United States and abroad. This lack of experience in exstrophy closure may reflect a general lack of experience in complex reconstructive cases, as has been shown in several studies looking at recent pediatric urology and pediatric surgery graduates. In order to bridge this knowledge gap, especially in complex reconstructive cases, there are many teaching styles that have been proposed. While each of these styles may be able to achieve excellent results in complex reconstructive cases, our institution endorses a graduated learning process. In this style, there is an intimate relationship between the junior and senior faculty members, and it has been shown to allow the junior faculty member to reach proficiency early in their career. While the ladder of learning in exstrophy reconstruction may be arduous, with appropriate mentoring and time, surgical independence can be achieved and will lead to a new wave of accomplished senior surgeons.

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