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Current surgical procedures in pediatric urology

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INTRODUCTION

A Brief History of Surgery

Currently, surgeons command our highest respect. Surgeons have an awe-inspiring amount of education and skill. A surgical procedure demonstrates artistry and precision, especially in the field of pediatric urology. Unlike physicians and doctors, surgeons had to overcome social stigmas to gain the position they now have. Surgeons and surgery in their current existence are a comparatively recent development.

The term surgery is derived from the latin chiurgia, which comes from the greek roots cheiros (hand) and ergon (work). As such, it included all forms of physical intervention as well as dentistry. Like the derivation of the word, the Greeks, are usually credited with the primary development of medicine and surgery. The works of Hippocrates (active in 410 B.C.) and Galen (129-216 A.D.) served for centuries as empirical reference for the field. Ancient egyptian surgeons, however, were particularly noted for their skills.

Doctors of this period were both physician and surgeon. Galen experimented with drug therapy and dissected every day to improve his surgical skills. He established the importance of learning and logic for accurate diagnosis and treatment. Medicine rose as a discipline that required a vast amount of education including the understanding of philosophy. Subsequently, the Hippocratic Oath[1] called for a division of labor: physicians concentrated on mastering the written information while surgeons learned through obser-

1. The Hippocratic Oath was not actually authored by Hippocrates. It is a text based on his writings which was published by a group of later scholars.

vation. Thus, physicians were educated theoreticians and surgeons were mere manual laborers. This dichotomy plunged surgery into a position of inferiority .

As a specialty field, surgery was limited. Prior to the discovery of anesthesia, surgery was extremely painful; infection was inevitable and the mortality rate was high. Up to the nineteenth century many surgeons earned a solid day-to-day income as barbers. These barber-surgeons also continued to perform the operations we now associate with dentists. Due to the fact that surgeons learned through apprenticeship, the majority of them could not read.

In the eighteenth century, surgeons pursued additional education and were more literate. Surgeons had found the work of the anatomist Vesalius to be beneficial since the sixteenth century and highly valued dissection for further instruction. Physicians had the benefit of endowed medical schools and hospitals at which cadavers were provided. Surgeons worked out of private "surgeries" and had to purchase cadavers on the black market from "resurrection men". In the eighteenth century the possibility of your loved one being disinterred the very night after the funeral was a fact of life (Pool 1993). Two famous "resurrection men", William Burke and William Hare, turned to murder it was such a lucrative trade (Porter 1996). These associations maintained the low opinion of society towards surgeons and even though surgeons had exciting new theories, they had no willing patients on whom they could practice them.

By the mid-eighteenth century, surgeons were able to apply their new understanding to advantage. Surgeons successfully operated to remove bladder stones and hernias. In France, surgical intervention saved the life of Louis XIV, the Sun King,and his patron-

age aided the quick rise of social acceptance. The connection between barbers and surgeons was dissolved and new colleges formed to teach surgical procedures[2] . In 1778 the first diplomas were awarded for surgery.

Surgery moved into a Golden Age during the 1800s that was enhanced by the introduction of anesthesia in 1840, antiseptic improvements in 1860, and the X-ray in 1890. Many of the surgeries performed currently are modifications of surgeries developed in the latter half of the nineteenth century. It is not that the inventiveness of surgeons was more fertile at this particular period, but that the variety of procedures that came forth represent a backlog of development restrained by the lack of public interest.

Surgery became the quick cure for every possible malady. By the 1940s, society was positively knife happy. In the United States, all children were recommended for tonsilectomy. The number of surgeries that became standard lead to the development of subspecialty fields. It was in the 1950s that Urology emerged as a lucrative specialty field.

Urology continues to be one of the specialties in high demand. There is a high occurrence of anomalies in the urogenital region and it is claimed that the number is rising (Sharpe 1994). Many medical students are being encouraged to pursue traditional pediatric urology even though the number of current positions available is limited. New technology has given rise to endoscopic, laparoscopic, and injection techniques but traditional urologic procedures have a very high success rate as will be shown by the following procedures.

2. Dentistry was left in the lower realm, but continued to advance on its own. Experiments with ether made dentists more expert with anesthesia and they assisted in surgeries as anesthetists.

I. PYELOPLASTY

Background of the Procedure

The first procedure performed for the repair of an obstruction at the junction of the ureter with the pelvis of the kidney was a ureteropelvioplasty in 1891. Küster applied current principles of anastemoses to this area in an end to side technique in which the junction is dismembered and repaired. In 1892, Fenger applied the Heineke-Mikulicz principle of transverse closure of a vertical incision to the ureteropelvic juncture (DeWeerd 1975). From here three different types of repair evolved: the flap procedure attributed to Schwyzer in 1923, the intubated procedure developed by Davis in 1943, and the dismembered procedure refined from the earliest methods by Anderson-Hynes.

The flap is based on simple incision procedures used to address pyloric stenosis. The flap procedure was instrumental in a breakthrough in infection control because it allowed the creation of a tapered funnel that successfully eased the flow of urine. It was for the refinement of this specific benefit that modifications to Schwyzer's Y-V flap procedure were published by Foley in 1937 (higher flap), Sardino and Prince in 1953 (vertical flap), and Culp in 1954 (spiral flap).

The currently used Anderson-Hynes dismembered technique returns to the methods originally used at the turn of the century, but benefits from the evolutions in the flap procedures. The Anderson-Hynes method seems simple and self-evident in comparison to the much more elaborate flap reconstructions displacing tissue from the pelvis to enhance the lumen of the ureter; however, concerns regarding infection and leakage

stalled the direct evolution of a dismembered technique. There are also social and technological developments that drove the evolution of the pyeloplasty. The simpler dismembered technique answers the demands created by the increased cost of surgery and hospitalization; new purpose-designed instruments for use in small children make it possible to create a leak-proof closure that heals faster.

The Davis technique in which an incision is made vertically along the ureter and then a tube or stent is inserted is still used, but mainly when the area of stenosis is larger and dismembering it would make the ureter too short to anastemose to the pelvis. The intubated procedure is the least complicated and continues to be modified. This procedure is cited as the precursor for endoscopic techniques that can be done with a ureteroscope and allow the junction to heal by secondary intention with the aid of a stent (Flint et al. 1998). In a recent study, a proportionate number of dismembered and intubated surgeries were performed by two surgeons between 1982 and 1987; it showed that the group treated with stents had more febrile episodes, needed more antibiotics, and were hospitalized twice as long as the unstented group (Baniela et al. 1996). This survey supports the link that had been previously suspected between stents and persistent infection. It also supports urologists in their advocacy for traditional surgery as opposed to the new minimally invasive endoscopic techniques that are currently being explored.

Case History and Pathological Indications

The patient in the procedure observed at University of Rochester was a female infant with extreme hydronephrosis. The distended kidney was easily diagnosed by palpation of the

left side and the x-ray image showed that the left kidney was three times the size of the undiseased kidney on the right. The choice of procedure is not limited to pyeloplasty; a complete nephrotomy could be indicated based on specific criteria of the case. In this case, the right kidney exhibited no compensatory hypertrophy, so the likelihood of resurrecting the hydronephrotic kidney was good (Flint et al. 1998). Another factor that aids in the pre-operative diagnosis is the state of the parenchyma. Thinning or scarring of the parenchymal tissue indicates renal damage (Schneck and Retik 1998). Even in the event that the distended kidney appeared to be nonfunctioning and compromised by infection, statistics show that there is still a good chance of recovery of function after the repair. (Flint et al. 1998) There is also the possibility that when the kidney is revealed, the damage is greater than the pyelographic images indicated; a nephrotomy would then be necessary. Statistically, the nephrectomy rate is about 8% in pediatric procedures where renal damage has been diagnosed (Saing et al. 1989).

The offending obstruction may be caused by a twist or kink in the ureter , a high junction, or an anomalous lumen. The obstruction is this case was due to poor development of the lumen at the ureteropelvic junction; this anomaly was also evident in the x-ray. The pre-operative diagnosis was appropriate and the scheduled pyeloplasty was completed successfully. The Anderson-Hynes dismembered pyeloplasty was used. There is a lower percentage of success of this procedure with children because they are still developing; it is possible for the young patient to revert or worsen and need reoperation (Saing et al. 1989). In this case, the developed anomaly was successfully removed in it's entirety, so the chances of improvement are excellent.

The Observed Procedure

[See Plate 1]

The operating table is prepared so that it peaks in the middle; the top and bottom sloped down creating an inverted V. The patient is oriented on this table so that she lies with her right side on the apex of the operating table; the enlarged left side is pushed up. Extra cushioning and blankets are used to ensure warmth and comfort and prevent bruising. The primary incision is made in the anterior abdominal region revealing the lower portion of the kidney, the pelvis, and junctioned ureter. An inspection is made of the anatomy revealed. The inspection confirmed the viability of the kidney. A cut is made midway through the narrow portion of the ureter. The insufficient lumen at that point is noted and then the vessel is trimmed to a point where the lumen is normal. The narrow remnant connected to the pelvis is also removed with a cut made at an angle to the junction. The ureter is then spatulated by making a vertical cut into the ureter and trimming the flap to create a perimeter which matched that of the opening in the pelvis. The suturing which follows is very tedious and meticulous. The first two suture lines are made from the inferior and from midline to lateral. The second lines also begin inferiorly, running lateral to midline. Any minor discrepancies are accommodated with extra sutures in the pelvis; these sutures run superior to inferior towards the junction. The final step before closure is a test for leakage in the reconstruction. The kidney is gently pressed until the pelvis and ureter are inflated with urine to ensure that no moisture escapes through the sutures. After repeated tests, if the urine continues down the ureter without any leakage, the surgery may be closed.

II. ORCHIDOPLEXY

Background of the Procedure

The history of this procedure is comparatively sparse. The technique used today still relates to that first introduced by Bevan in 1899 (Kogan 1991). The basic principles of the surgery are to locate and free the testis from the groin area so that it can be pulled down and fixed into the scrotum. The main factor in the surgery is the location of the testis which may not lie within the easily accessible groin area. Surgical ingenuity in locating impalpable testes such as intracanalicular and intraabdominal has made it possible to place virtually every undescended testis into the scrotal sac. Similar to the Pyeloplasty, some diagnoses cannot be made until the internal anatomy is explored; in this procedure an absent testis is only discovered after the surgery has commenced.

History has lead to the modification of this surgery chiefly through accumulated data that has shown that the operation is most successful when performed within the first year; the traditional approach advocated correction at older ages. The current 1% occurrence of undescended testes is said to be an increase that has risen steadily since the 1950s. According to some studies the rate has doubled leading to theories about environmental effects on development (Sharpe 1994). This determination can be questioned by the fact that impalpable testes were not so efficiently identified in the past, thus the number of corrective surgeries performed prior to 1950 do not necessarily mirror the actual number of occurrences. Even in the case of some palpable testes, normal maturation, function, and fertility can occur without surgical intervention (Kogan 1991). Another aspect to be con-

sidered is the fact that the 1950's marks the establishment of urology as a separate surgical field (see *Background* of Bilateral Implantation). One statistic is undeniable, the procedure is performed frequently and is in the stock repertoire of every current pediatric urologist.

There is also a laparoscopic orchidoplexy that has gained credibility; however, experience with endourologic techniques in pediatric urology lags behind that of adult urology (Jordan 1996). The success of current pediatric urological procedures makes it difficult to predict whether or not laparoscopy will become the norm, especially in the case of the surgical procedure for orchidoplexy which has almost one hundred years of historical precedence.

Case History and Pathological Indications

The patient in this case was a eight-year-old male child. The existence of an undescended testes was apparent by the concavity of the scrotum on the right. The testis was palpable in the groin area. The exact cause of an undescended testis is not known, but may be a combination of obstructive adhesions, fibrous bands or abnormal attachments of the gubernaculum, and a deficiency of the anterior pituitary hormone (Flocks and Culp 1954). There was no indication of prune belly which is sometimes associated with cases of undescended testes.

The Observed Procedure

[See Plate 2]

A primary oblique incision is made in the inguinal skin and carried through the underlying fascia and external oblique muscle to expose the inguinal canal. The testis is liberated from the cremasteric fascia and gubernaculum. At this point, Dr. Rabinowitz identified the ilioinguinal nerve which was superficial to the accompanying hernia. A cut is made in the peritoneal sac, lateral to the nerve. The testis and spermatic cord are then separated from the peritoneal sac. When an adequate length of cord has been exposed and the testis can reach the correct position in the scrotum, the hernia is sutured and allowed to drop back into the abdominal cavity. The fingers are used to open a channel in the fascia from the inguinal incision into the right scrotum, stretching and pulling to create a subcutaneous pouch. A lateral incision is made through the fascia of the right scrotal sac. A blunt nosed clamp is inserted up through the pocket and clamped to the thread through the inferior portion of the testis. The testis is pulled down through the channel into the subcutaneous pouch in the scrotum. A suture is made through the inferior of the right scrotal sac and the relocated testis to hold it in place. The incision in the scrotum is closed first and then the initial incision is closed.

III. BILATERAL IMPLANTATION OF DOUBLE URETERS

Background of the Procedure

The procedure for reimplantation of the ureters was developed four decades ago to correct an abnormal condition of retrograde flow of urine from the bladder known as vesicouretal reflux. Vesicoureteric reflux is one of the most common anomalies of the renal tract and may be present from birth through to adolescence. The consequence of undetected reflux is renal scarring. Implantation of the vesicouretal junction is successful for most patients suffering from reflux and associated infection. There are two approaches to reconstructing the vesicouretal junction: implantation on the outer bladder wall or implantation on the inside of the bladder. The Jewitt repair published in 1955 was not used as a repair for reflux in itself unlike the modifications of this procedure by Hutch in 1963, Lich and Gregoir in 1964, Daines and Hodgson in 1971, and Charviano in 1988. All these techniques correct the anomaly by implanting the ureter into the external wall of the bladder. The techniques developed by Politano and Leadbetter in 1958 and Paquin in 1959 implant the ureters on the internal wall of the bladder. These techniques are the precursors to the procedure used by Dr. Ron Rabinowitz.

There is currently a debate over the necessity for implantation surgery. Surgical correction does not guarantee against subsequent renal damage. Injection therapy has been equally successful in curing reflux. The Subureteric Teflon® injection technique developed in by Mentor Medical Systems in Norwell Massachusetts offers a minimally invasive and effective cure (Morecraft and MacKinnon 1996). The drawback is that the

patient must undergo long term antibiotic outpatient therapy.

The success of the new injection methods relies on the acceptance of surgeons and parents. Surgical therapy is still advocated by the majority of urologists. Historically, this surgery was instrumental in establishing urology as a specialty field; surgery has proven successful in eliminating reflux in 97% of patients (Walker 1991). For parents, the speedier solution of a one-step surgery may remain preferable to the long term therapy which has not yet proven to be less harmful. This is yet another example of how urology stands on the threshold of a new course and is currently holding to the traditional methods (see *Background* of Pyeloplasty).

Case History and Pathological Indications

In this case the ten-year-old patient was born with double ureters from both kidneys. One of her left ureters drained into the vagina. Both of her right ureters and second left ureter entered the bladder directly. The patient suffered from constant wetting and infection. When the patient was eight-years-old, this anomaly was corrected by anastemosis of the left ureter that exited at the vagina with the other left ureter superiorly to where it entered the bladder. It was hoped that the patient's urinary system would develop normally and further surgical intervention would not be necessary. It is possible for the system to correct itself as the child develops: "in the majority of patients, spontaneous resolution is expected with maturation of the uretovesical junction by lengthening of the intravesical portion of the ureter" (Schneck and Retik 1998). Two years after the initial operation the patient was experiencing vesicouretal reflux and chronic infection. The x-ray showed that

ureters formed perpendicular junctions with the bladder. The intravesicular pressure of the bladder was creating backflow into the ureters. The indications were that the ureters needed to be reimplanted at an oblique angle. Implantation is successful for most patients suffering from urinary tract infection due to backflow in the system, but there is still the possibility that further surgery may be required as the patient develops further. The two right ureters would also need to be anastemosed before implantation, but not in a separate surgery.

The Observed Procedure

[See Plate 3]

The patient is laid supine and then arranged so that the soles of her feet are rotated inward to face each other and her knees are rotated outward. Her arms are extended laterally. Double cushioning is used under her arms. An initial transverse incision is made in the pelvic region to access the bladder anteriorly. The second incision is made longitudinally through the linea alba of the abdominus rectus. The outer wall of the bladder is revealed. Blunt forceps are then used to pinch the thin tissue of the bladder wall so a small cut can be made. A syringe is then put through the small opening and all the urine from the bladder is drained and then sent for testing (the patient had undergone antibiotic treatment to sterilize the urine prior to surgery, so the urine needed to be checked for its effectiveness). A Denis-Brown retractor is then put in place to retract the fascia and muscle layers superiorly, inferiorly, and bilaterally. The cut through the bladder wall is then extended superiorly and inferiorly and the tissue is retracted laterally with suture materi-

al. The three uretal openings into the trigone of the interior bladder are identified and No.5 feeding tubes are inserted and sutured to the ureterovesical junction to allow the urine to drain outside the area of operation. Then with the smallest sized scissors, the left ureter is cut free from the bladder wall. The attached feeding tube is used to pull the ureter into the bladder until it is taut. The ureter is held taut and laid against the trigone to approximate its new position. A vertical incision through the mucosa of the bladder is then made inferior to the original junction. The mucosa is retracted to reveal the muscle layer of the bladder. The ureter is again pulled and laid onto the dissected muscle. The feeding tube is removed and blunt forceps are used to hold the ureter in place. The first two sutures attach the rim of the uretal to the the mucosa, pulling it firmly down into its new position. Then intermittent lateral sutures were made to fix the ureter to the muscle of the bladder. The reflected mucosa was then reapproximated and stitched tightly over the ureter and around the free rim of the uretal opening. The new passage was tested by reinserting the feeding tube and ensuring that the passage was clear and the new junction was oblique. The entire procedure was repeated for the right side after the ureter exiting lower into the trigone was anastemosed to the upper right ureter.

IV. HYPOSPADIAS REPAIR

Background of the Procedure

Hypospadias is the second most common urologic anomaly in boys; it occurs in 8 out of every 1000 male births. Hypospadias is associated with deformity and developmental anomalies of the urethra in which the urethral meatus is on the ventral surface of the penis. Hypospadias is also a genetic predisposition in some families. As with orchidoplexy, the number of documented occurrences of hypospadias has doubled since the 1950s and environmental factors have been questioned (Sharpe 1994).[3] An infant with hypospadias may not be circumcised because the extra tissue will be needed for the repair. Unlike the surgeries previously discussed, there are no endourologic alternatives for correction; the only treatment is surgery. The only advance that technology offers to this procedure is the recent improvement through laser soldering. Laser soldering in replace of sutures decreases complications and eliminates leaks and fistulas (P&S Journal 1997).

The challenge for surgeons to create a phallus that is functional and cosmetic is centuries old; however, it is in the last 30 years that significant advances have been made in cosmetic improvement (Atala and Retik 1998). The first mention of hypospadias by name was made by Galen. In 1542, the existence of hypospadias in a husband was cause for an annulment in Rome. The first corrective procedure was suggested in 1842 by Mettaur but not performed until further developed by Duplay in 1874.

3. Current laboratory research is being done to test certain chemicals that are suspected of increasing the outcome of hypospadias. There is some evidence to support that contact with some chemicals significantly increases the occurrence of hypospadias in offspring.

There are many different types of procedure which arose depending on the anomalies or combinations thereof which the patient displays. The Mathieu flap technique is the forefather of current procedures for distal hypospadias with chordee.

The Mathieu procedure was established as a repair which resulted in good functional and cosmetic results. In 1987, Rabinowitz published a modification of the Mathieu technique that eliminates catheterization. Complications due to infections and fistulae are greatly reduced by this modification and it has been proven effective in other hospitals such as that at the Turkey Dokuz Eyulul University (Aktug et al. 1992).

Flocks and Culp advocated that the procedure was best undertaken between the ages of 5 and 9. It is now recommended that the correction be performed within the first year of life because the psychological damage can be extensive (Schultz, Klykylo, and Wacksman 1974). There is no pain in the post-operative period. Normal function and activity return early in children. A regional dorsal nerve block facilitates ambulation and rapid recovery. With a simple transparent dressing and the lack of catheter drainage, there are no restrictions regarding mobility; however, bathing is restricted for 5 days (Rabinowitz 1988).

Case History and Pathological Indications

The patient in this case was fifteen years old. He had been scheduled for surgery three times as an infant, but had been withdrawn due to fears on the part of his parents. At the age of fifteen, the surgery is much more dangerous. There is the possibility of the patient experiencing an erection in spite of the anesthesia and destroying the sutures. The psy-

chological damage was also significant; this patient was seeing a psychiatrist on a regular basis.

The patient had a urethra that exited on the lower side of the penis approximately one inch below the tip, as well as significant tilt during erection. The symptoms would make it necessary for the patient to urinate while sitting; the chordee causing the tilt would cause painful erections.

The Observed Procedure

[See Plate 4]

The patient is oriented in a supine position. The patient is anesthetized, but also given a regional nerve block. The ventral meatal-based flap is incised and the skin pulled down away from the shaft. The tissue causing chordee was excised. A mattress stitch is made on the dorsal glans to correct the ventral glans tilt. The artificial erection test is done to confirm a straight penis. One incision is then made so that the glans flap can be retracted laterally. The skin flap is elevated from the underlying shaft. Right and left balanic incisions are made, the lateral glans flaps are retracted. The urethoplasty is performed with continuous 6-0 chromic catgut to suture the medial edges of the balanic incisions to the lateral edges of the skin flap. Suture lines are lateral to midline and subcuticular. The lateral glans flaps are reapproximated in the midline resulting in a midglandular meatus free of overlying suture lines. The ventral glans tissue is divided into lateral glans wings. The wings are then reapproximated over the neourethra. An adequate amount of glans tissue must be excised. Complete skin coverage is achieved by using some of the dorsal hood if present. The repair is complete. (Rabinowitz, 1987)

CONCLUSION

For all of the surgeries described, except the hypospadias repair, non-invasive alternatives are being developed. Urology stands on the threshold of major change. The question is: will urologic surgeons accept the change?

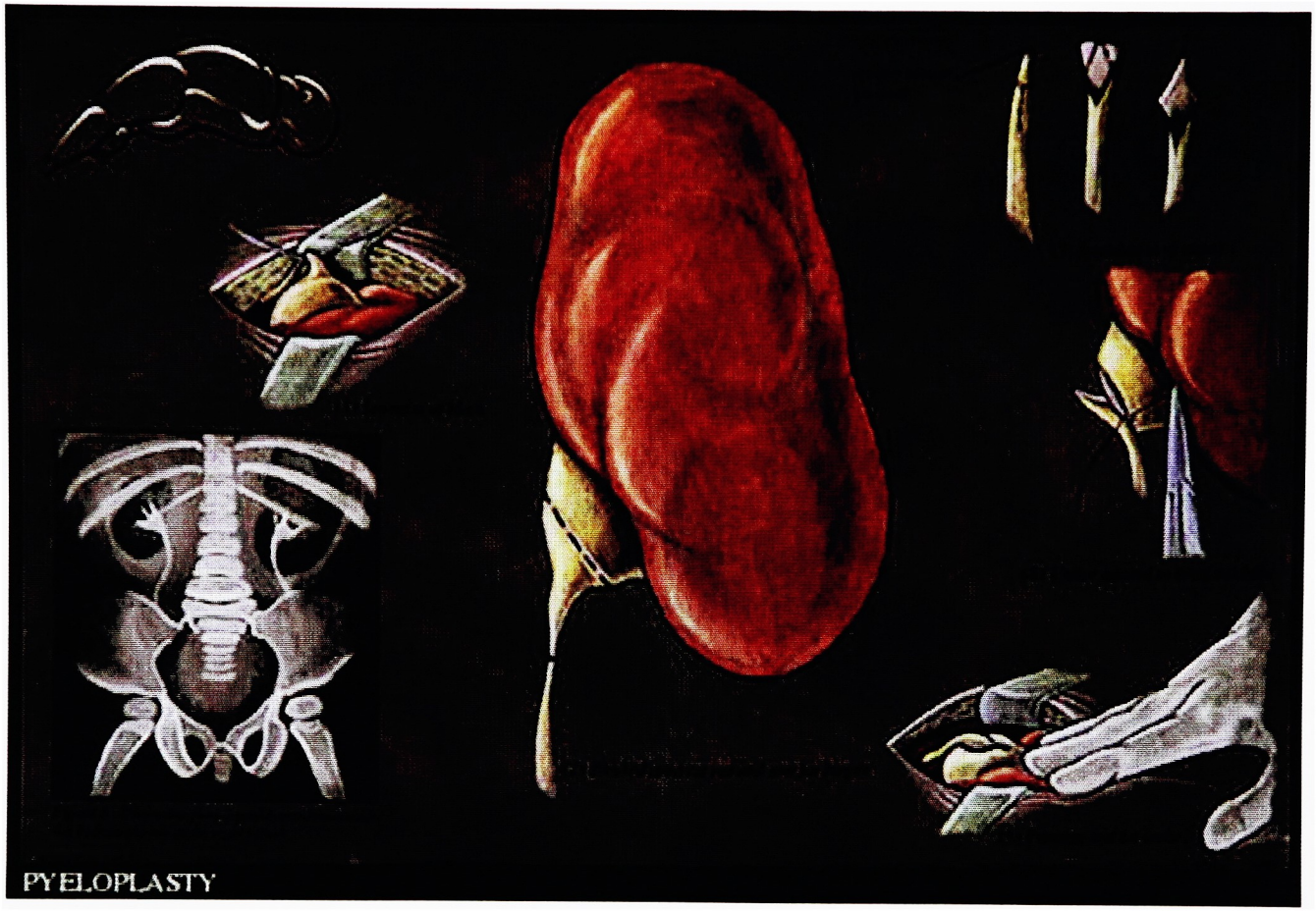
Urology developed into a subspecialty based on the high number of surgeries called for by the prevalence of urogenital anomalies. Injection therapy threatens to remove the very surgical procedure (implantation of ureters) that established urology as a specialty from the surgical realm completely. Endoscopic and laparoscopic techniques are, at least, still surgical techniques. Many surgeons in adult urology have accepted these methods; however, pediatric urologists, have not shown much support.

The other factor is the acceptance of society. The opinion of society held the advance of surgery in check for centuries. Surgery has only recently become established as a painless quick fix. Long term injection therapy for urovesicular reflux may prove to be too much of an inconvenience for the average family in this fast-paced society. The surgical procedure for implantation is as effective and takes only a few hours of the patient's life. Cost, however, has not yet been compared and may very well be the deciding factor.

The new techniques in endoscopy and laparoscopy are not guaranteed an easy evolution into social acceptance either. Patients have to be willing to undergo the new procedures before they can be established. The new procedures have not proven themselves more effective than the traditional surgeries and in the case of the endoscopic stenting pro-

cedure for pyeloplasty, the complications may be greater. Also the new technology increases the cost of the procedure.

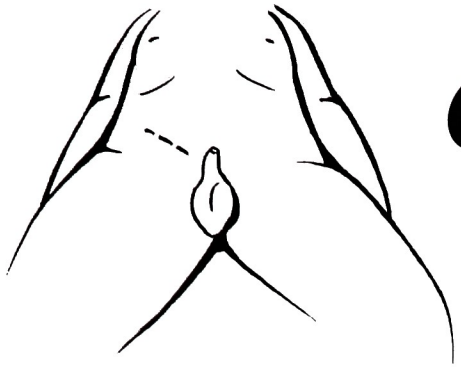
Based on historical precedence, it seems likely that the particular field of pediatric urology will continue to develop based on the traditional techniques. If it is at all within their power, it makes sense that pediatric urologists would cling to the lucrative niche that has widened and promises to widen further. Doctors are notorious for their repudiation of computer technology; computers demand a large readjustment on their part and they begrudge the technology. Laparoscopy requires completely new instruments and knowledge; surgeons may be more interested in this technology but the readjustment factor is the same. Pediatric urologists will certainly have to recognize and incorporate the new technology in their field, but it will be a slow transition and traditional surgery will never be outmoded completely.



Pyeloplasty

PLATE 1

Orchidoplexy



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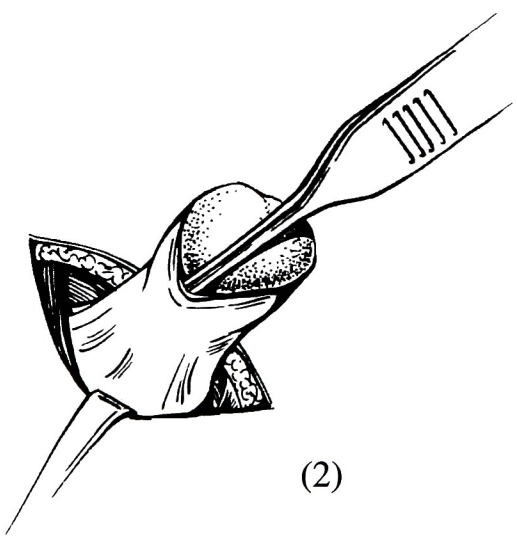

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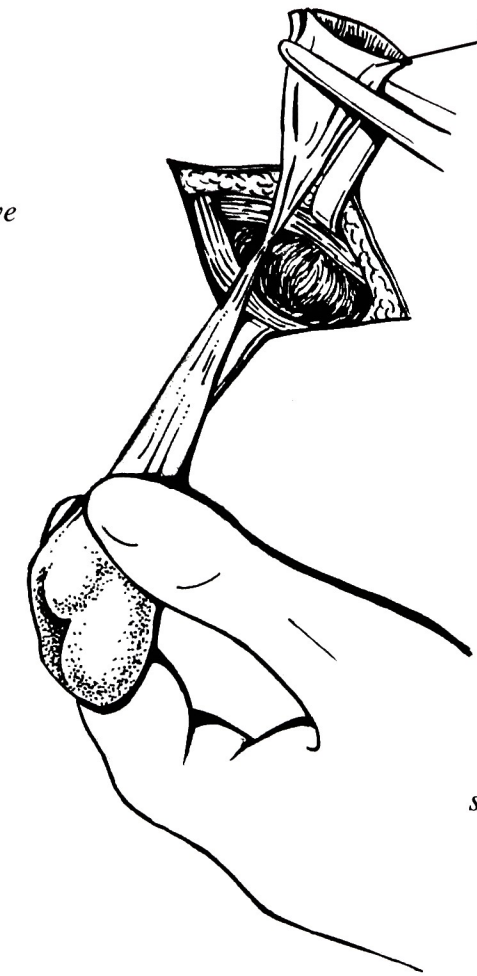

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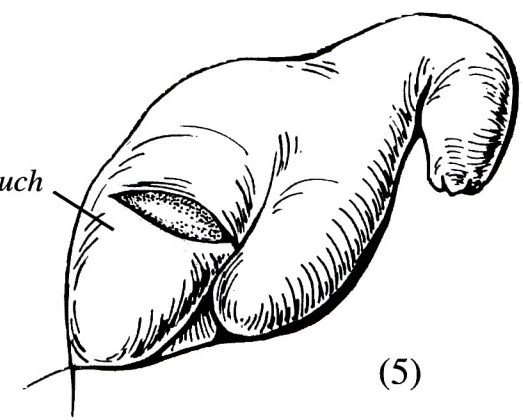

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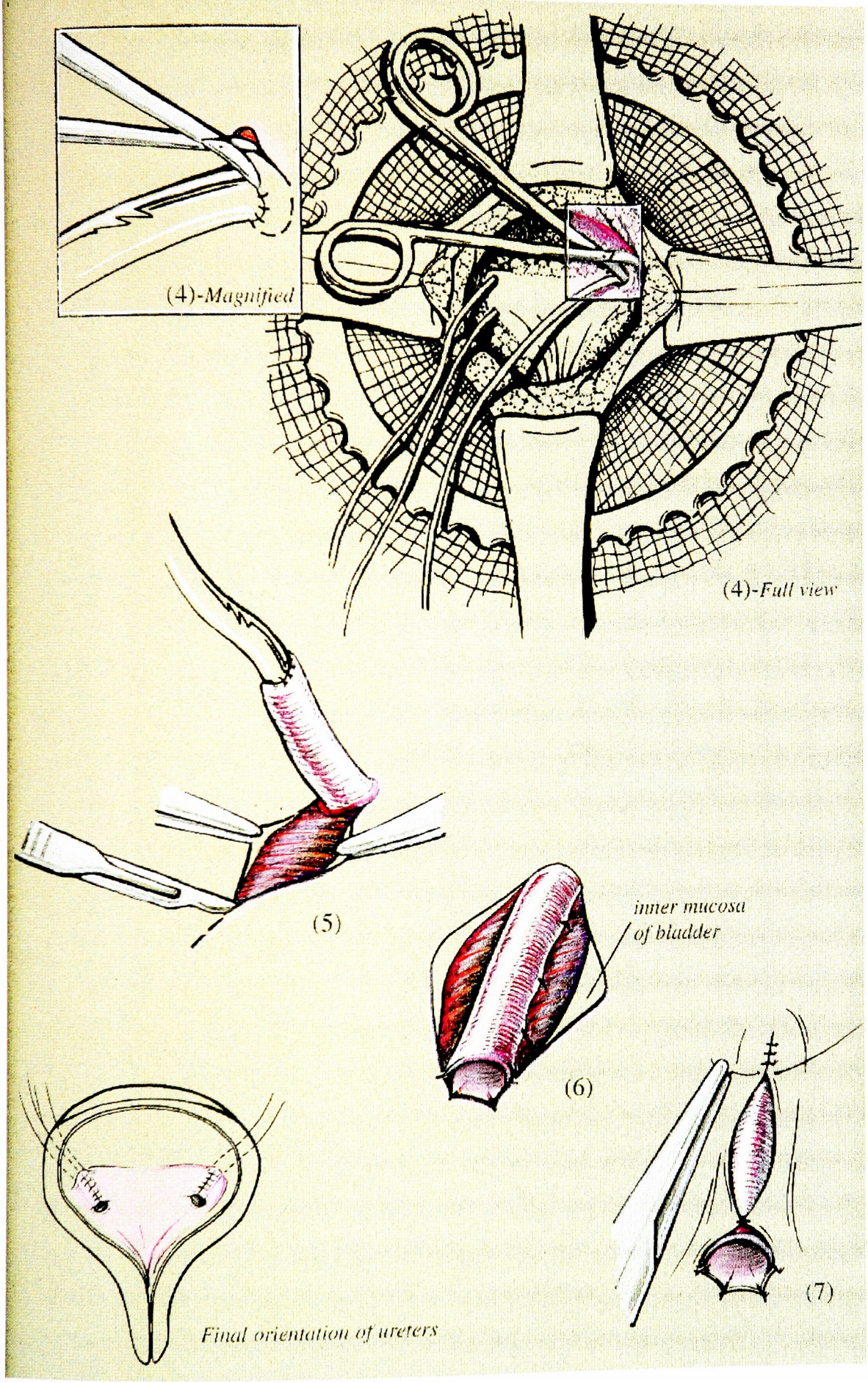
PLATE 2



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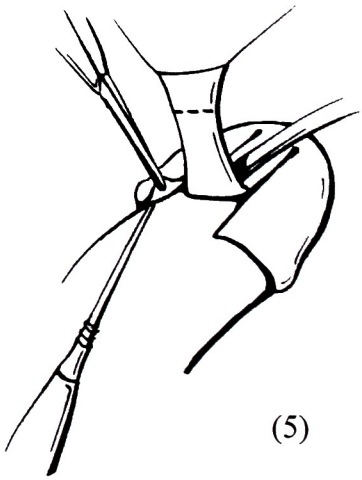

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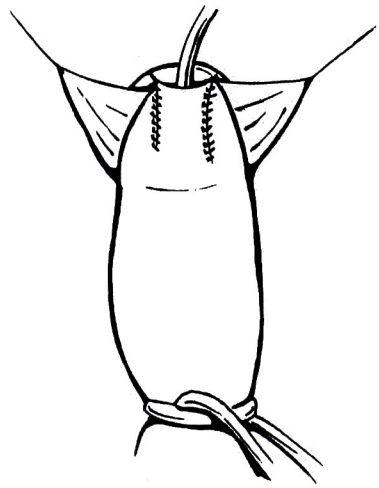

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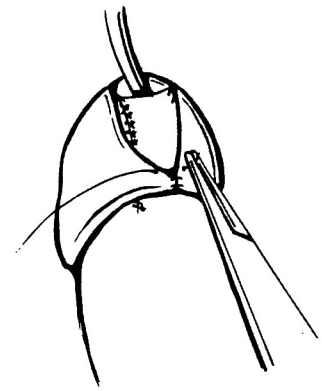

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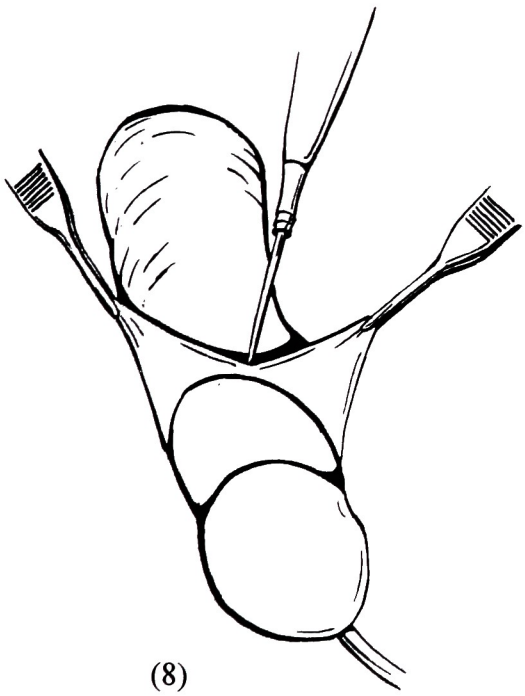

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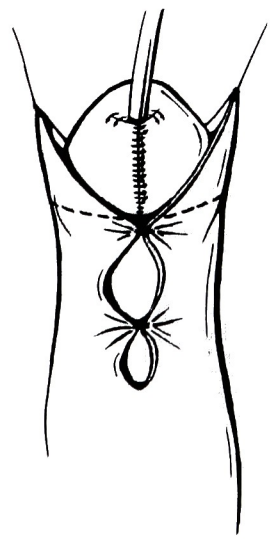
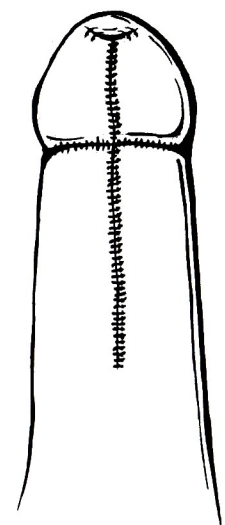


(9)



(10)

PLATE 4 *continued*

Developing Bone Marrow

PLATE 5

Thesis Exhibit

PLATE 6

PART TWO: *Personal Experience*

I. PREPARATION

Selection of Topic

I had a number of ideas for my thesis based on subjects that were visually fascinating, but I wanted a topic that would be equally strong in terms of research. I enjoyed observing surgery and the idea of illustrating and writing about its progress satisfied my criteria. I also had developed the career goal of becoming part of a medical illustration department which served a working hospital.

I initially set out to observe newly developed surgeries and then observe their traditional counterparts and present the two in juxtaposition. This turned out to be too difficult a task. I had observed many surgeries at the University of Rochester, but nothing that was groundbreaking. I then had the fortune of observing Dr. Ron Rabinowitz. The first procedure I watched him perform was the bilateral implantation.

I found it particularly appealing that pediatric surgery is performed with additional care to the patient. The temperature of the room is made more comfortable and the patient is carefully protected against post-operative bruising. Dr. Rabinowitz was also very cordial and informative. He made sure that I understood what was being done and could see the details of the procedure.

I chose to spotlight the procedures performed by Dr. Rabinowitz. Initially, I only knew that he was a pediatric surgeon and had no idea that he was specifically a pediatric urologist and operated predominantly on genitals. He does many of the same procedures

repeatedly. It took a long time to arrange to see the four different surgeries I observed.

I still hoped to present historical reference for the surgeries I was observing. My research showed that the procedures he performed weren't radically different from the surgeries illustrated in the more archaic texts I found in the Miner Library at the University of Rochester. In fact, some procedures, as with the pyeloplasty, had not changed at all. The only exception to this was the hypospadias repair which he had modified himself. I had to adjust my goals again.

In retrospect, the hypospadias procedure was the most exciting and could have stood as a topic in itself. There are a number of variations and modifications that would have been interesting to create illustrations for, based on the written material available. At the point in time when I observed the procedure, however, I had already completed a significant amount of work related to the other procedures.

My final goal was to present the surgeries I observed and in my written thesis to discuss their origins and future. I believe I have accomplished this.

Selection of Media

In the same sense that I had a view to the future in selecting surgery as a topic, I also had the need of a comprehensive portfolio in mind. I decided to focus on what I saw as my weakness: pen and ink. I had reached a degree of moderate comfort with this medium, but I wanted to be proficient. I also wanted to include a finished topical piece in Macromedia Director. I wanted to show strength in both traditional media and the newer digital techniques.

Just in case I didn't attain the skill I was hoping for with regard to pen and ink, I also decided to use a technique I'd learned and experienced success with: gouache and colored pencil on miteint paper.

The oil painting was conceived independently of future concerns. In terms of media, this was another area where I was determined to succeed. The other logic behind choosing oil paint is that it is the definitive medium of fine art. I wanted to incorporate a piece that illustrated medical subject matter in an indisputably fine art form. I wanted to pay tribute to the fine art associations that make the medical illustration program at Rochester Institute of Technology so unique.

II. EXECUTION

How the Work Got Done

Illustrating the surgeries was the most straightforward aspect of the project. The difficulty lay in proposing my aims to Dr. Rabinowitz. I had seen the bilateral implantation procedure but I needed to arrange to see more. My reluctance to make the first phone call held up my progress considerably. I am very much in awe of surgeons and the ones I had observed reinforced my humility.

It was suggested to me that he might have his own ideas for a project. Although I saw the value of this possibility, I had already made up my mind and we were approaching the final term. I even entertained the idea of just showing up at his procedures as I had done initially. I finally decided that it would be easier to make the call. I did ask if he had any ideas and he said he would discuss it with his partner. There was another delay

while I waited for his response. It is possible that if I'd given him more, time he would have come up with a suggestion; however, from later experience I believe that he was just too busy to participate. We made arrangements surgery by surgery and calling him was only slightly easier at the last. There was one instance in which he recommended that I observe his partner at the University of Rochester, but the surgery was cancelled without notification. I was sent to a room where they were prepping a middle aged women and I knew I was in the wrong place.

I observed, sketched, and took notes during the surgery. I then selected pivotal steps and created drawings. Some drawings incorporated information from consecutive steps. I then used vellum to create ink drafts of the drawings. Each step was done on a separate piece of vellum so I could play with the composition of the information. I stuck to simple line drawings for these drafts. I took these to the advisor meetings.

I was always concerned about using my time effectively. I didn't want to invest a lot of time in a drawing that may be discarded. There is always the potential to work a drawing 'up' but it is very difficult to go backwards. In most cases, I was able to apply the suggestions of my advisors to these drawings.

The animation of the bilateral implantation surgery was very time consuming. I had started it before I had observed the other surgeries, but I could have started and finished an animation of the pyeloplasty before I was done with the implantation. I tried to save myself some grief by using an illustration I'd done of the surgery as a background on which to develop the various steps. It would have been easier to use more readily editable digital images. I got locked into the look-and-feel dictated by the artwork. I didn't

particularly like the end result even though it is very organic looking.

I used the paint window in Director to create very crude animations and then pulled the cast members into Photoshop and refined them. This allowed me to work continuously in one application or the other. The instruments were all created in Photoshop and I think these are the most successful. There is a stark contrast between the crisp instruments created in Photoshop and the soft drawing that serves as the background. It bothered me, but I see now that there may effectiveness in their difference.

I got the concept for the painting while in Histology. It was a remnant of an idea I had had to do a whole exhibit of paintings based on histological views. I had particularly liked the developing bone marrow slide and I thought it would tie in nicely with pediatric studies.

I wanted the painting to be big and impressive. I already had the canvas; actually, it was in Boston. Getting it to Rochester posed a problem; I have a FIAT (people say my car is the smallest they've ever seen). The roof does come off and I briefly thought of making the seven hour trek with a canvas flapping out of the top of my car. Finally, I managed to have it brought to Rochester by my employer and former high school principal. He came from Gloucester once a month with a van full of computer wares for the Computer Show.

The next challenge was to fill the four foot square canvas with a microscopic image. I came up with the idea that if I could project the image I could get a decent sized image from which to work. I got permission from Dr. Merrill to borrow the slide from the laboratory. I took it to the biomedical photography department to have a slide made.

I was lucky and found a helpful student who was willing to do it immediately. She shot thirty six slides of the marrow specimen at 100x magnification. She let me frame the shots and I chose different areas that were visually appealing. I had planned to pick one area and work from that exclusively, but I ended up using four different slides to complete my own composition. I arranged to borrow a projector from ETC for a week. I then projected the histological image onto the wall next to where I was working. It had never occurred to me that I would be prevented from working during the day; I was working in my apartment and daylight made it impossible for me to see the projection.

I have the habit of working on a single task until it is done before I can concentrate on another. The thesis project challenged this habit in that I had to switch back and forth between the different parts I was creating in different media. The fact that I was illustrating four separate surgeries made it easier for me to reach stopping points with respect to the ink work. I completed the painting in one non-stop effort after the surgeries were done. The animation on the other hand always demanded attention. I would make lists of things that needed to be addressed and then get sidetracked by an aesthetic concern. Even after I did manage to go through the list, a run through the animation would make more necessary adjustments surface. In terms of the computer, you always want more time, but it is a mixed blessing in that you're sure to use it and then want even more. I worked on the animation all the way up until installation in the Bevier gallery and even made more modifications after that which I downloaded before the opening of the show.

Problems Along the Way

Time was the largest problem. I am fairly good estimating how long it will take me to complete my own work. Unfortunately, I don't consider all the peripheral difficulties that may arise. Accommodating other people's schedules simultaneously was a challenge. It was difficult to find times when all my advisors were available for a meeting but I managed to get them all together initially and it worked out well. After that, I found it more effective to confer with them individually.

I was also involved with a massive project for the Information Technology department. I had to make time to attend out of class planning meetings with my team. We were responsible for the coordination and art direction for the whole project. We had constant obligations that had to be dealt with as soon as they arose. I was committed to making the same contribution I would have made if that project was my sole responsibility.

There was also wasted time. While working on the animation my computer would crash more and more frequently. Here, my habit of working through to the end caused problems. I would get too involved and forget to save along the way so that a crash would wipe out as much as an hour's worth of work. The crashes became so constant that I began to be able to sense when one was imminent and try to save. I wasn't always successful.

Overall, the problems I encountered were never very devastating; the price was inevitably time. The worst thing happened when there was no more time left. I had hung the framed work and painting and the computer for my multimedia presentation was scheduled to arrive the next day, the last allowable day for installation. It was delivered without incidence and it turned out to be the same model as the one I had been working

on at home except that it had a 17" monitor. It wasn't until I loaded my program that I noticed that everything was blown up on the screen. It looked so different from what I had planned that I became frantic. I called computer services and a student came and took a look at it. He just told me I needed more video memory. Fortunately, I didn't pursue this option, I have since learned that the 6100/66 Power Mac does not hold VRAM and needs a special adapter. In fact, the 6100 Power Mac does not support a 17" monitor at anything higher than 800x600 pixels (and only that at 256 colors).

I ended up switching the monitor with a 14" from Keith for the opening. An hour before the opening, I figured out how to reduce the image area on the larger screen. I switched the hardware back for the remainder of the exhibit. Again, the problem wasn't really very difficult to solve given time, but at that point I didn't have any more time.

The Exhibit

I had an image of how I wanted my exhibit to look even before I vied for space in the gallery. The overall composition of the exhibit itself is as important as the composition of the individual pieces in it. I knew that I wanted a large eyecatching focal point and that is probably the main thing that drove me to complete the painting.

I already had frames that I had made for a previous exhibit. This was both a blessing and a curse. I was spared the time and expense of finding new frames, but I was also restricted by the dimensions of the frames. It was impossible to exhibit the original artwork in these frames; the bilateral implantation and hypospadias compositions had many steps and would have appeared crammed into the frames. I knew they could only improve

with reduction, so I scanned them and arranged them in Quark. I had dyesublimation prints made in the printing department at R.I.T. I decided it would be more interesting to have both horizontal and vertical frames. I managed to fit the two separate illustrations of the bilateral implantation side by side in the same frame, but I ended having to put the hypospadias in separate frames. (See PLATE 6)

The final touch was a vase of flowers. This element had already been in my initial vision of my final presentation and I was very specific about what I wanted for this as well. I wanted ginger flowers because the color was complimentary to the reds in the painting; it is also a very bold flower. They served as a subtle end bracket to the space. The podium is still in place, but unfortunately the flowers had died by the time I took the picture.

III. AFTERWORDS

Acknowledgements

In spite of my procrastination, the project was a positive experience. The problems I encountered were only minor hassles and were alleviated by the help of my advisors, my mother, and friends. The reception my work received at the opening was the ultimate reward; it was an exciting and memorable event.

I learned a lot and my project took me into new areas of interest. It was particularly interesting to have the slides made in the Biomedical Photography Department. I wish I could have taken one of their classes. I felt very honored when Dr. Rabnowitz went

out of his way and made it possible for me to observe his hypospadias repair at Rochester General Hospital.

Advice for the immediate future

There are some things that I have learned since completing my thesis in regard to finding a job. Making a project that served well as a portfolio piece was certainly worthwhile. My experience with multimedia has opened a lot of doors. What I wasn't expecting was to see so many PCs in the graphics departments. In many cases, Macs were not available at all. I had to have my work available on both platforms. The availability of a zip drive is not guaranteed either. I ended up having my demonstration files burnt onto a PC platform CD by a friend. CDs are cheap, so I was able to send them out with my resumes.

Membership in the AMI is very beneficial; just being on their mailing list has proven worth the price of membership. I have received many announcements of available positions; it was one of these that made it possible for me to get the job I have just accepted. The open interviews that are available to members at the annual meetings also present lots of opportunities.

Finally, a web page is essential. It is an immediate way to exhibit layout skills, familiarity with digital media, as well as a partial portfolio of traditional media. Companies are always looking for ways to screen out applicants; they currently use the lack of email capability as a reason to eliminate an applicant. It follows that a website will become a requirement for consideration in any graphic profession. For now, having a website is an edge.

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