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M. Yazici, E. Copcu, B. Etensel, N. Culhaci, M. Balkaya, S. Özkisacik, H. Gursoy THE NEW TECHNIQUE IN THE TREATMENT OF HYPOSPADIAS: TUBULARIZATION BY DOUBLE VERTICAL INCISION

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ABSTRACT

Introduction: Tubularization is one of the indispensable practices of reconstructive surgery, especially in the repair of hypospadias. In all procedures of forming a tube, the desired diameter should be reached without any complication.

Materials and Methods: We used as a new technique "double vertical incision" in 8 rabbits and compared it with free skin graft, local flap and single vertical incision. We formed 32 tubes randomly around an 8F catheter using 7/0 PDS suture. Twenty-one days after the operation, the tubes were taken, randomized to staining with Hematoxyline Eosin and Masson Trichrome and then subjected to histopathologically examination. Inflammation, fibrosis and lumen diameter were statistically evaluated.

Results: Widest lumen diameters were found in double incision group and this result was statistically different when the compared with results of other groups ($p < 0.001$).

Conclusions: Double vertical incision is promising in that it is easier to perform, provides a desired amount of tissue in cases in which the urethral bed is narrow, and causes no scar. Based on our results we obtained, we applied double vertical incision, a modification of tubularized incised plate urethroplasty popularized by Snodgrass, in four patients. The tubes were not distended, their long term follow-up showed no complication and a urethra at the desired diameter was obtained.

Key words: hypospadias, vertical incision, double, lumen diameter

INTRODUCTION

Tubularization has been used in the clinical practices of all reconstruction techniques in which a lumen is required, especially in the repair of hypospadias. Tubes can be formed either by a flap, graft or by an incision. The history of tubularization goes back to the advent of hypospadias. Hypospadias is one of the most frequently encountered anomalies, the definition and repair of which were made a very long time ago. In fact, it has an incidence of 1/300 [1]. The disease is treated with various tubularization techniques. A midline incision of the urethral bed was first used by Rich et al in Mathieu and onlay island flaps to obtain an acceptable cosmetic appearance [2]. Snodgrass described a novel technique using this incision and claimed that the technique could be performed easily in most of the patients with hypospadias [3]. He reported a considerably low rate of complications and maintained that the technique did not cause any stricture and that tubularization was performed with success and did not require an additional skin [4-7]. In the subsequent years, there have been other studies on Snodgrass' technique and the technique has been used widely [8]. The objectives of surgical intervention in the treatment of hypospadias are to form a normal urethra, cause a low rate of complications and obtain a good cosmetic appearance [4]. Among the most common complications in the surgical treatment of hypospadias are urethrocutaneous fistula and strictures. In this double blind study, we described a novel tubularization technique using double incision and compared its effects on wound healing and lumen diameter with those of other tubularization techniques. Based on the obtained promising results, we applied the tubularization with double incision in four patients.

MATERIALS AND METHODS

This study was carried out in Laboratory of Experimental Studies, Adnan Menderes University. We used 8 New Zealand white rabbits weighing between 2-3kg. Each rabbit was put in a separate case. After they adapted to the environment, the experiments were done. The whole back was shaved in all rabbits. They were anesthetized intramuscularly with 0.03 mg/kg. medetomidine and 3mg/kg. ketamine injections given for induction and additional maintenance. One surgeon formed 32 tubes from dorsal skin of the rabbit in size of 8x20mm, using four types of tubularization technique (Figure 1). The operations were performed under aseptic conditions. Flaps were marked in each group in accordance with the measurements made before.

Flaps: First, skin incisions were made down panniculus carnosus. Then, flap margins of 2mm were elevated and

turned in around a silicon catheter to form tubes.

Grafts: First, the skin on the back was elevated from its bed. Second, the grafts were turned in around a silicon catheter to form tubes. Finally, the tubes were transferred to the area of the defect.

Single Incision: First, incisions were made in accordance with those of the flaps. Second, the flaps were elevated. Third, a single vertical incision was made on the middle of each flap. Then, the tubes were formed on a catheter.

Double Incision: Flaps were harvested as in the single incision. However, double vertical incisions at 2cm-intervals were made on the middle of each flap (Figure 2).

Tubularization was performed using an 8F catheter and 7/0 PDS suture (figure 3). The ends of the tubes were sutured using 4/0 prolene and thus the tubes buried. Then, the animals were put into their cages and received a standard wound care for 21 days. At the end of this period, the tubes were removed blindly and fixated with formalin 10%. All analyses were made on three samples, obtained from the two ends and the middle of the tubes each sample was stained with Hematoxyline Eosin (figure 4) and Masson Trichrome (figure 5) for histopathological examination. Microscopic examinations were performed by one pathologist blindly. On histopathologically examinations, the characteristics of re-epithelization, nature of inflammatory cells and degree of collagen deposition were evaluated.

Hematoxyline eosin was used to determine whether inflammation was present. On histological examination, the presence of few neutrophil and occasional lymphocytes under the epithelium was considered as mild inflammation, the increased number of inflammatory cells with their occasional infiltrations into the epithelium as moderate inflammation and the presence of inflammatory cells causing destruction of the epithelium as severe inflammation. Results were evaluated according these observations and used a scale between "0 to 3". Masson Trichrome was used to determine the presence of collagen in the connective tissue. Observations by the pathologist were summarized according to concentration of the collagen and used a scale between "0 to 2".

Diameters of the tubes were measured using the micrometric method technique microscopically.

SPSS package program 10.0 was used for statistical analysis. Mann-Whitney One Way Analysis of variance test was used to compare the groups and Kruskal-Wallis test to determine differences between the groups.

RESULTS

No rabbit died of the procedures, and 21 days after the

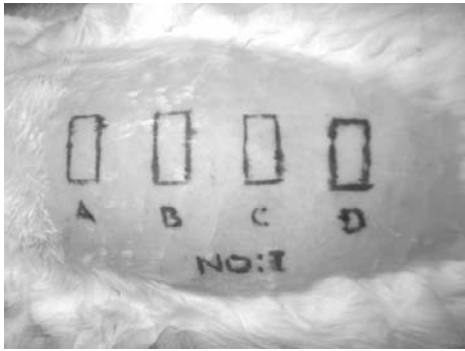


Figure 1: Dorsal skin of the rabbit. Pre-operative view. Randomized four types of tubularization were performed.

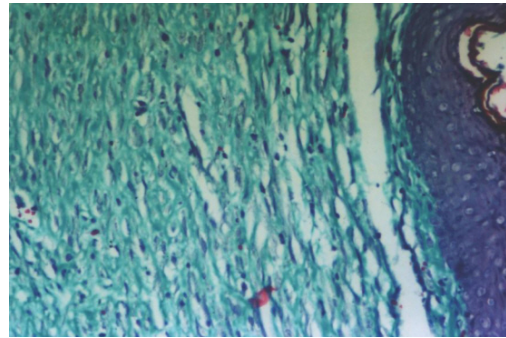


Figure 5: Microscopically view of the specimen (Masson Trichrome staining, X 200 magnification)

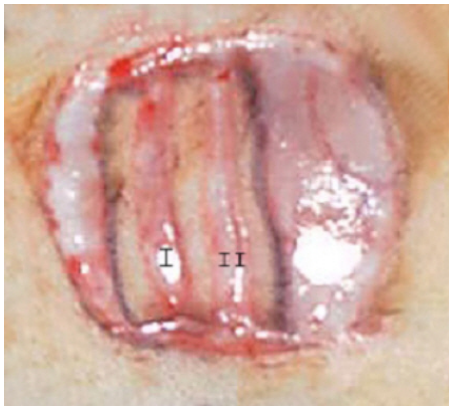


Figure 2: Preparation of flap with double incision technique. I indicates first incision, II indicates second incision.

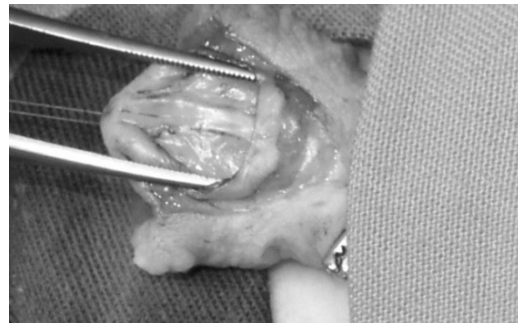


Figure 6: Clinical application of the double incision technique. Both feet of the forceps indicate the incisions.



Figure 3: Preparation of flap over the 8F catheter by using 7/0 PDS.



Figure 7 and 8: Tube was created very easily without tension by double incision technique.

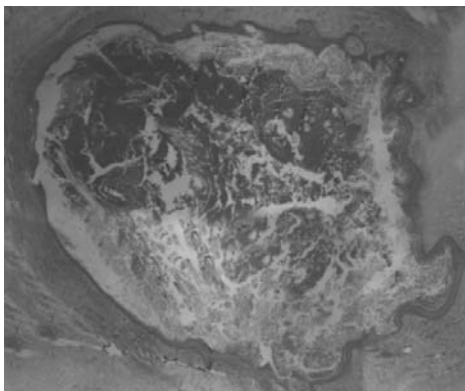


Figure 4: Microscopically view of the specimen (Hematoxyline Eosin staining, X 100 magnification)

procedures, all tubes were intact.

Results of the inflammation, collagen deposition and lumen diameters were presented in table 1.

There were less inflammation findings in group 1 (normal flap group) and most in group 2 (graft group) but no statistically difference between all of the four groups ($p < 0.05$). Results of the evaluation of the samples with Masson Trichrome were similar as inflammation findings and there were no statistically differences between the groups ($p < 0.05$).

Widest lumen diameters were found in double incision group (average was 150) and this result was statistically different when the compared with results of other groups ($p < 0.001$). Diameters of the single incision group were also wider than group 1 and group 2 statistically ($p < 0.01$). Although graft groups had greater dimension than the flap group, but there were no statistically differences ($p < 0.05$).

DISCUSSION

Tubularization is the main reconstruction technique used for the repair of not only hypospadias, but also extrophy vesica [9], epispadias [10] and the organs with lumens such as colon and larynx [11]. It is used in orthopedic surgery as well [12]. The new lumen must have a diameter as large as the original lumen, and the tissue integrity must be preserved. An ideal technique should be easy to perform, acceptable in most of the cases, performed in one stage and have the lowest rate of complications. However, the techniques described so far do not have the above-mentioned characteristics. Each technique has both advantages and disadvantages.

Hypospadias is a clinical condition, for which more surgical treatments have been described than for other clinical conditions. The reason why so many surgical procedures have been described for its treatment is lack of a simple solution to the problem and the desire to minimize the complications. The goal of hypospadiac surgery include a straight penis with a urethral meatus at the tip of the glans, a well vascularized neourethra of adequate caliber with a solid, straight urinary stream and achievement of sexual function when mature [13] Oribaus' Works (25 to 103 A.D.) translated from the Greek by Bussemars and Daremberg into French, gave credit to Heliodorand Antyl for the first description of surgical management of hypospadias. The term tube was first described by Thiersch in 1869 in an attempt to repair extrophy vesica. In 1874, Duplay described three staged cord release and formation of a ventral tube [10]. All the techniques require tubing of the tissues and transfer of the tissues from another part of the body and are applied in a single or multiple stages. Flap is a tissue that is transferred from one area of the body to another area with its original blood supply intact. But skin graft is skin that has been completely detached from its original donor site and transferred to another site where it will develop a new blood supply. The outcome in all procedures is directly related to wound healing. It is debatable that graft causes contraction. Contractile fibroblasts, known as myofibroblasts, contract open wounds [14]. The contraction of a healing graft and wound is referred to as a secondary contraction. In contrast, primary contraction refers to the immediate elastic recoil of a graft as it is cut [15] Secondary contraction is clinically important. As stricture and fistulae are frequently encountered in the clinical practice, the use of graft has been gradually decreased [16]. In this study, the smallest diameter of the lumen and unfavorable results of the wound healing were obtained by graft.

Tubed flaps should theoretically have a sufficient blood supply and thus some cause other than ischemia seems most likely, although at present elusive [17]. Urethral strictures constitute a significant problem that often requires long term management [18] The use of a longitudinal midline incision in the distal urethral plate was first described by Rich in 1989 [19] Snodgrass reported extension of the incision proximally to the level of the hypospadiac meatus and emphasized that

Table 1.

Summary of the histological results

	Inflammation	Collagen concentration	Lumen diameter
Group name	(min - max) average	(min - max) average	(min - max) average
1. Flap group	(0 - 2) 0.5	(0 - 1) 0.3	(100 - 175) 120
2. Graft group	(1 - 3) 2.14	(0 - 1) 0.5	(95- 130) 121
3. Single incision	(1 - 2) 1.1	(0 - 1) 0.5	(100-175) 128
4. Double incision	(1 - 2) 1.3	(0 - 1) 0.5	(110-190) 150

deep incision of the shallow urethral plate was the most important part of tubularized incised plate urethroplasty [4]. Excellent results have also been noted in repeat and complex hypospadias repairs [4]. The key step of the operation is deep longitudinal incision through the midline of the whole urethral plate from the hypospadiac meatus distally, which widens the plate and allows it to be tubularized without additional skin flaps [5]. It has been suggested that healing may occur through re-epithelization of the relaxing incision without obvious scarring, allowing the incised edges to remain separated [4]. Alternatively, the dorsal plate incision may heal by secondary intent through scarring, resulting in re-approximation of the incised edges [14] Bleustien thoroughly studied wound healing in five dogs, and reported that incisions healed without leaving scar at the end of 21 days [20]. Dorsal incision of urethral plate, which is integral to the repair, does not compromise the blood supply and re-epithelization occurs without gross scarring. Some may think that the favorable outcome in Bleustein's study was caused by the early results of the follow-up. However, Snodgrass, in a series of 328 patients, reported that the rate of stricture was 1.5% and did not observe a newly formed neourethral fistulae during a 15-month follow-up of 72 patients [4]. Fortunately, the long-term follow-up did not show any prominent scar.

The rate of urethral fistulae may vary between 6.8% and 43.8% depending on the suture material and the surgical technique [21]. Urethrocutaneous fistulas are a persistent problem in hypospadias repair, with an incidence of 6 to 20%. This result may be the result of an inflammatory reaction to the suture material and continued leakage from the sutured site [22]. One of the most important reason for formation of fistula is inability to obtain a sufficient closure of tube [23]. Etiology of urethral strictures can usually be traced to trauma or infection, fibrosis [24] caused by excessive collagen synthesis has been suggested. The content of the collagen type I has been found to increase while that of collagen type III decreased in urethral stricture scar formation [25].

Several investigators attempted to minimize the scars likely to be caused by the conventional Snodgrass repair, and therefore, elevated free grafts from preputial skin [12]. However, these attempts were inconclusive. In the present study, the results of the experiments supported the findings from Snodgrass' studies. In addition, double incision did not cause any complication and furthermore, a larger diameter of the lumen was reached.

The depth of the incision is another issue to be explained in Snodgrass technique, since there was no data related to exact depth of incision. Dr. William Cromie's asked how deep the incision should be. Snodgrass, in the discussion of his study in 1999, explained that the incision should be deep enough to allow the relaxation sufficient to perform tubularization [6]. In our study, using double incision, we formed the tubes easily and the incision did not cause tension. This modification is more advantageous in that it is easy to form tubes and that the technique does not cause tension even in the secondary treatment and in the presence of scar.

There have been experimental studies on the treatment of

hypospadias; however, no single model has been described. This study focuses on tubularization for the treatment of hypospadias. We formed tubes in the dorsal region of the rabbits and investigated wound healing and lumen diameter. The approach allowed us to perform a lot of experiments in a smaller number of animals. The response of the tissues from which the tubes were formed against injury was an indication of the clinical outcome, which in turn is directly related to formation of fistulae and stricture following the treatment of hypospadias. Wound healing after the treatment of hypospadias has been usually based on the clinical observations; however, Scherz et al thoroughly investigated the urethral healing in rabbits [26]. Inflammation and fibrosis in and around the urethra after urethrotomy were anticipated, as was inflammation in the skin after incision and closure. However, it was surprising to find that the skin incision and closure resulted in inflammation around the urethra, suggesting that attention needs to be given out not only to the urethra but also to handling of the skin since this also may influence healing of urethra.[5]

In the present study, there was no difference in the scar formation between the two techniques (vertical single and double incision); however, double incision allowed us to form tubes easily with a large diameter and did not cause any additional scar tissue.

In some cases of hypospadias, there may not be an appropriate bed for tubularization. In such cases, Snodgrass' technique may facilitate tubularization; nevertheless, the double incision provides a sufficient amount of material for tubularization even in the presence of a very small urethral bed. Furthermore, it does not require a deep incision and cause damage to cavernous body. The tubes can be formed by a more superficial incision, which allows epithelization and wound healing in a short period of time and thus causes a short time of hospital stay. Eberle et al have noted that hypospadias could be accompanied by a congenital anomaly such as micropenis [27]. In such cases, when the urethral bed is small, it would be difficult to form the neourethra. We think that double incision will facilitate the procedure.

CONCLUSION

Hypospadias is one of the conditions encountered in pediatric urology, the treatment of which is very difficult. There is not a single universal technique described for the treatment of hypospadias. The tubularized incised plate urethroplasty, which was popularized by Snodgrass, yields favorable results. However, it is the double incision, which will minimize the complications. This modification will also help form tubes with a large diameter easily and does not require an incision of the deep tissues. It is also promising in many cases of hypospadias, especially the cases requiring a secondary treatment, in which the previously described methods are inconclusive. We performed the double incision technique easily in four cases of hypospadias and obtained tubes without tension (figure 6,7 and 8). Furthermore, the lumens of the tubes had a large diameter without any complication. The second sutures were put easily compared to Snodgrass' technique. Moreover, the sutures were not covered with an additional preputial skin, described by Snodgrass. Long-term follow-up of the patients did not show any complication. Urethroscopy performed within the six month of the operations revealed that the lumens had a desired diameter. The only limitation of this study is its small sample size. However, the plastic surgeons will prefer the double incision technique in the clinical practice because it has many advantages over the other techniques.

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