Treatment of Hypospadias

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One of the keys to success in the treatment of hypospadias is the ability of the surgeon to prevent complications. If he knows what causes these complications, the choice of a procedure which allows him to cope with them follows automatically. Three types of complications dominate the list of secondary deformities that require correction:
1. Persistent curvature;
2. Strictures;
3. Fistulas.

1. PERSISTENT CURVATURE

This complication is quite common and it may be caused by inadequate release of the corpus cavernosum and by inadequate closure of the resulting defect.

Inadequate release

Release of the corpus is not so much obtained by the resection of tissue (chordee) as by dissection of the corpora cavernosa. It is important that this dissection should be completed. Too often, I have operated on patients with a so-called recurrence of chordee. My personal view is that no such process exists. A corpus cavernosum that is well released and has received an adequate skin cover should remain straight.

Inadequate closure

As soon as wide exposure and release of the corpus are obtained and bleeding is no longer a problem, the defect will have to be closed. How this is done is extremely important.
Longitudinal closure with the help of two transposition flaps as in the Byars (1) procedure allows suturing without tension but the distribution of skin over the defect is not optimal. Most of the skin is transported to the distal part of the penis while the shortage of skin immediately distal to the meatus is barely corrected (Fig. 1).

Other disadvantages are that longitudinal closure is sometimes followed by the formation of a contracture which may be responsible for a persistent curvature and that later the neo-urethra will contain two instead of one longitudinal scar (Fig. 1).

One can avoid longitudinal suturing of the two flaps by placing them in such a position that the wound is closed in an S-shaped fashion (Fig. 1), but the presence of a transverse scar halfway along the neo-urethra introduces a new disadvantage (Fig. 1).

A graft seems to offer a solution for the problems described here, but unfortunately some grafts fail to take while others may contract, adding an extra source of complications. How should one then close the defect over the corpora cavernosa? Theoretically, the best way seems to be by rotation of one well tailored and vascularized flap from the penile dorsum. With such a flap there will be no longitudinal scarring in the midline of the penis, no scarring halfway along the dystopic meatus and glans, no tension to cause dehiscence and no secondary contraction.

2. STRICTURES

In a urethra made of skin, strictures may develop as a result of inadequate planning and of inadequate extensibility.

Fig. 1. Depending on the procedure that has been used for the orthoplasty four types of scar formation may be observed on the ventral aspect of the penis. a: A central scar produced by the transposition of two dorsal flaps. The result is an uneven distribution of skin. b: A S-shaped scar produced by the transposition of two dorsal flaps. The distribution of skin is even. c: Two paramedian scars produced by a graft. The quality of skin is inferior. d: A paramedian scar produced by one rotation flap. Distribution of skin and quality are excellent.
Inadequate planning

When the urethral strip has been made too small chances are great that the diameter of the neo-urethra will also be too narrow. If we want adequate expansion of the urethral tube we should not rely on the remodellation potential of the scar by which the two edges of the urethral strip are united. Misjudgement can be avoided if we first mark the correct borders of the strip by folding the skin over a catheter with the correct diameter.

Inadequate extensibility

When reconstruction of the urethra is preceded by a straightening procedure, the integrity of the skin distal from the dystopic meatus (the future lining of the urethra) is always interrupted by scars, resulting in a lack of extensibility of the urethral lining at the site where they are formed.

It is also possible that the skin in its totality has become less elastic because the defect produced by the straightening procedure was closed by a graft. Whatever the cause of the loss of extensibility, the fact that it exists should be taken into consideration when the width of the urethral strip is planned.

I have the feeling that many of the strictures which occur in the treatment of hypospadias are due to an underestimation of this aspect.

What can we do to minimize this danger? The answer seems simple:

a. avoid grafts
   Even if the graft takes, for which there is no guarantee, some loss of extensibility has to be expected.

b. avoid scars
   Two longitudinal scars seems one too many since scar tissue, in whatever direction, will decrease the elastic potential of the skin strip. Transverse scars, at the transition of the urethra to neo-urethra, in the glandular part of the neo-urethra or between these sites create, however, a greater problem. The formation of these scars cannot be avoided when reconstruction of the urethra is preceded by an orthoplasty but under these circumstances there are two precautions to be taken. One is that the diameter of the urethral strip should be sufficiently wide to compensate for the reduced extensibility. The other is that a smooth transition from one part of the urethra to the other should be obtained by interdigitation (Fig. 1).

   In addition stenosis of the dystopic meatus can also be prevented by retropositioning the meatus in continuity with the urethral delta.

3. Fistulas

This complication may have a variety of causes such as:

   inadequate closure of the wound;
inadequate suturing of the wound;
inadequate positioning of the wound;
inadequate drainage of the wound;
inadequate protection of the wound.

A. Inadequate closure

Maldistribution of skin over the neo-urethra may be the cause of fistula formation when closure of the wound is associated with tension on the wound edges. Postoperatively, this tension increases as edema occurs. The vascularization of the wound edges will diminish and dehiscence may result. That vascularization of the wound edges will also be inadequate when a flap is too long or too thin or when it has a scarred base is well known.

Two causes of insufficient vascularization, however, have not received the attention they deserve.

One is the tourniquet effect which may result from an uneven distribution of skin or from a circular bandage. The other originates in the anatomy of the penis, in general, and in the anatomy of hypospadias, in particular. Blood reaches the prepuce via the arteries which run in the midline. Division of the dorsal skin into two flaps may separate one flap from its main source of supply, increasing the danger of necrosis. In hypospadias, where plication has resulted in the formation of two oblique raphes, this circulation is even more dependent on the midline vascularization.

Procedures which advocate longitudinal division of the hood should therefore be avoided.

All these problems can be avoided by the use of one well vascularized rotation flap. Such a flap allows suturing of the wound without tension, even distribution of skin over the urethra and para-urethral positioning of the suture line.

B. Inadequate suturing

The formation of a fistula is facilitated when:
a. healing of the wound edges is prevented by the leakage of urine, and b. transcutaneous sutures are used.

Leakage though the wound will occur when the drainage of urine via the neo-urethra meets more resistance than the passage via the suture line.

The use of transcutaneous sutures is to be condemned for several reasons. The first is that rapid epithelialization may transform the suture tract into a fistula. A second reason is that this process will be enhanced when the retracted subcutaneous tissues are not included in the suture and only the skin edges are brought together (Fig. 2). Healing then becomes more difficult. The third reason is that wound healing may be disturbed by the presence of strangulating sutures. The closer these are situated and the tighter the knots, the greater the chance of fistula formation.

Is it difficult to understand how one can justify the use of transcutaneous
Advances in Hypospadias

sutures, when there are more effective methods. If wound suturing is restricted to apposition of the subcutaneous tissues with properly tied interrupted sutures (dexon or vicryl) wound healing will be much better. This technique can be made even safer by the addition of some strategic well placed sutures between subcutaneous tissues and corpus cavernosum.

C. Inadequate positioning

The presence of a wound superimposing the urethra does not have to be a cause of fistula formation itself. It may, however, become so when there are other technical weaknesses such as inadequate supplication of skin, inadequate wound closure, inadequate drainage.

The part of the wound most likely to suffer dehiscence is the area immediately distal to the meatus because it is primarily here that the impact of the urinary stream is felt, when it passes through the urethra. The very fact that the suture line is in the immediate vicinity of the urethra makes the wound more vulnerable when conditions are less than optimal.

The best way to avoid overlap of suture line and urethra is again one large rotation flap which crosses the midline and covers both the original meatus and the urethral strip.

Fig. 2. Different types of suturing. a: Intracutaneous. In the penile skin this is impossible. b: transcutaneous. This is an invitation for fistula formation. c: Subcutaneous with overlap of the sutureline. The chances of fistula formation are reduced. d: Subcutaneous without overlap of the sutureline. The chances of fistula formation are further reduced. e: Subcutaneous without overlap of the sutureline and with drainage incisions in a two-stage procedure. The chances of fistula formation are virtually nil. f: Subcutaneous without overlap of the sutureline and with drainage incisions in a one-stage procedure. The chances of fistula formation are virtually nil.
D. Inadequate protection of the wound

Many surgeons bandage the penis after correction of hypospadias. They do this to protect the wound against contamination, to prevent hematoma formation and to lessen the production of edema, which may cause the penis to accept grotesque dimensions. However, a dressing may do more harm than good. It does not protect the wound against infection since there will always be a porte d’entree at the site of the new meatus. It will enhance infection and thus fistula formation since it will prevent drainage of blood and of other debris. It will block the passage of urine via the neo urethra or via the drainage incision when a catheter does not function and urine is forced to pass along it. It may, finally, disturb the circulation in a flap and by this cause necrosis and subsequently fistula formation.

All these disadvantages outweigh the possible advantages such as the prevention of hematoma and edema. Since these conditions, in my experience, are only harmful when the circulation is already disturbed through tension etc. I have stopped using a circular dressing. Compression with a gauze is equally effective and I never had reason to regret this decision.

E. Inadequate drainage of the urine

Reconstruction of the urethra would be much more simple if perfect drainage of urine via a catheter could always be guaranteed.

Unfortunately, catheters may block from time to time or lead to straining and leakage around the catheter. When this happens and drainage of urine is impossible due to the absence of drainage incision or the presence of a constricting bandage even the best wound closure technique will be insufficient and the results may be disastrous. Urine will always follow the

Fig. 3. Illustration of urethral compression by extravasation of urine following the closure of a fistula. a: Urethral fistula. b: Compression of the urethra by extravasation of urine may occur following closure of the fistula. c: A drainage incision at a safe distance will prevent the accumulation of urine and enhance healing.
Fig. 4. Urethroplasty (I). See text.
path where it meets least resistance. Perfect drainage can be obtained when the patient is allowed to pass urine via the neo-urethra alone when it is not too long (Type I) or via the neo-urethra and one or two drainage incisions when the length of the urethral canal indicates this (Type II). In this way the patient cleans his own wound of debris and blood clots. The drainage incisions are made at a safe distance from the urethra (Fig. 6), allowing the urethral canal to form before epithelization of the drainage tract takes place. There is no danger of stasis and no wound infection can occur. If a perineal catheter or suprapubic cystostomy is used, a circular bandage should never be applied, in conjunction. Drainage via the neo urethra will then remain possible and healing will proceed normally as long as this tract offers less resistance to the urinary stream than the wound itself.

Many surgeons put complete trust in the catheter to function well and therefore will not hesitate to apply a circular bandage. The free passage of urine through the neo-urethra will then again become impossible.

In this connection, I would also like to draw attention to the fact that some surgeons tube the urethra. In my opinion, there is absolutely no need to do this. Not only because the urethral strip is perfectly capable of tubing itself and perhaps better than the surgeon could, but, most of all, because it is difficult to make a tube watertight. If the tubed urethra leaks, urine will accumulate under the skin and compress the urethra, thus preventing the drainage of urine through the neo-urethra (Fig. 7). Some surgeons feel that the passing of urine over a raw wound surface will prevent it from healing. More likely, however, the opposite seems true as the irrigation of the wound will promote healing by removal of blood and debris.

Operative procedure

The success rate of an operation is inversely proportional to the number of factors that may cause a complication. The purpose of the procedures to be described is to treat hypospadic patients with a minimum of complications by elimination of these complicating factors.

Type I procedure (Fig. 4)

This technique is used for grade I and grade II hypospadias. The principles on which it is based are the formation of a buried strip that is sufficiently wide to form an urethra of adequate diameter and the coverage of this strip with a well vascularized transposition flap, in such a way that overlap of the sutureline and the neo-urethra is avoided. This goal can be achieved by rotation of the penile skin, a principle originally described by Farmer (2) as a wrap-around procedure. Farmer's results were excellent but the redistribution of skin over the surface of the penile shaft not optimal. In order to improve this technical aspect a modification was introduced by v.d. Meulen (3, 4) in the sixties.

The dorsal hood was transected by an incision at the level of the corona.
The insertion of the inner face of the prepuce was left intact. The skin of the penile shaft was then widely mobilized to allow for easy rotation. In order to facilitate this rotation even more, a back cut was frequently used. Originally, this cut was made longitudinally and paramedially and the resulting defect on the dorsum of the penis was closed with the inner face of the prepuce.

However, this position of the back cut was soon shifted to the lateral aspect of the flap — becoming almost transverse — when it was realized that the vascularization of the flap was mainly through the middle of the dorsum.

**Technique (Fig. 4)** (5)

1. A traction suture is first passed through the dorsal rim of the glans.
2. The urethral strip and two triangular areas on both sides of the navicular fossa are marked. Care should be taken to mark a strip of adequate width.
3. Using the cutting bipolar diathermy the urethral strip is outlined and the two triangular areas are removed.
4. The inner face of the prepuce is detached from its insertion to the glans by means of a circumferential incision and the dissection is carried proximally around the shaft of the penis.
5. The dorsal hood is transected at, or somewhat distally from, the coronal level and part of the prepuce with its inner face is now discarded.
6. The dorsal skin flap is now rotated to the ventral side of the penis and a back cut is made to facilitate rotation over the urethral strip.
7. Following hemostasis, the flap is fixed to the raw areas on each side of the urethral strip with one or two rows of interrupted subcutaneous sutures.
8. The edge of the V-shaped defect, which is produced in the dorsal skin after rotation of the flap, is sutured to the corona.
9. The operation is finished with a simple “sandwich dressing” one piece of gauze below the upward bent penis and one on top. Nursing is thus made extremely simple.
10. The child is allowed to pass urine through the neo-urethra. Transmeatal catheters, urethrostomy or cystostomy are never used.

**Type II procedure**

It took several years to realize that a back cut in the dorsal hood is also eminently suitable for patients with grade III and IV hypospadias.

This step facilitates the rotation of the prepuce, changes its transverse direction into a longitudinal one, and thus makes it possible to cover large areas of denuded corpora cavernosa with the supple inner face of the prepuce simply by stretching it over the raw surface. Once this goal has been achieved the prepuce is in a perfect position allowing the surgeon to proceed with a two-stage or a one-stage procedure. In a two-stage procedure, the wounds are left to heal and reconstruction of the urethra with a buried strip made from the preputial inner face is performed in a second step.
Fig. 5A. Orthoplasty. See text.
In a one-stage procedure a strip from the preputial inner face is immediately buried below the remaining part of the dorsal hood flap. The reasons why it is advisable, in my opinion, to use the two-stage procedures have been explained in the section on complications and will not be repeated here.

Part I of the two-stage procedure (Fig. 5)

1. A traction suture is first passed through the dorsal rim of the glans.
2. The inner face of the prepuce is incised by means of a circumferential cut with the bipolar cutting diathermy. This cut runs at the level of the corona and crosses the urethral delta slightly distal from the dystopic meatus.
3. The navicular fossa is incised following a V-shaped pattern and both legs of the V are opened wide to create space for the inner face of the prepuce.
4. Holding the corpora under tension by thumb and index finger of the supporting hand, dissection of the corpora cavernosa is carried through with multiple delicate strokes of the cutting diathermy in a plane between the
urethra and the corpora cavernosa. If this step is performed well, both in a proximal and lateral direction, the fibrotic plate that causes the curvature of the penis will disintegrate. The corpora will straighten revealing a smooth glistening surface and the dystopic meatus will drop back into a more proximal position. Care should be taken not to enter the deep layer of the tunica albuginea. If this occurs inadvertently the puncture holes should be sutured carefully.

5. The dissection of the dorsal hood is carried in an avascular proximal plane to allow for complete mobilization.

6. A transverse back cut is made on the lateral aspect of the flap. The position of this cut is at the level of the corona in the vicinity of the oblique raphes. The cut almost reaches the midline, preserving the concentration of vessels in this area.

7. The freely mobile prepuce is rotated to the latero-ventral aspect of the penis and placed on the defect between the glans and the dystopic meatus. This step requires careful evaluation of the size of the defect in order to avoid a shortage, or a surplus, of skin in this critical area.

8. The inner face of the prepuce is connected with the edges of the incision in the glans and a similar transition is created for its connection with the dystopic meatus.

9. The deepest point of the back cut is sutured to the corona in the midline.

10. All the wounds are closed with interrupted subcutaneous sutures.

Part II (Fig. 5)

1. The ventral surface of the penis is inspected for any irregularities or contractures. If these are found they should first be corrected.

2. A strip of adequate width between meatus and glans is marked and incised.

3. The surplus of skin that has been banked on one lateral aspect is mobilized and anchored to the contralateral side of the penis with a double row of interrupted subcutaneous sutures.

4. Two drainage incisions are made at a safe distance of the urethra on each side of the penile base. A silicone drain is passed through these incisions. No other form of urinary drainage is used.

5. A small sandwich dressing is applied.

One-stage procedure

The idea to straighten the penis and reconstruct the urethra in one stage using the inner face of the prepuce for the urethral lining and the outer face for coverage is not a new one.

Broadbent et al. in 1961 (6), Hodgson in 1970 (7), Asopa in 1971 (8) and more recently Duckett in 1980 (9) have reported on a variety of techniques all based on this principle. There is, however, a limit to the mobility of the dorsal skin flap when transferred as a whole and it is exactly in this respect that the technique described above for the two-stage procedure distinguishes itself.
The back cut increases the range of motion of the dorsal skin and makes a complete coverage of the ventral aspect of the penis possible. The technique is, therefore, equally applicable for a one-stage procedure (Fig. 6).

The range of motion of the prepuce may even be extended when the back cut is lengthened and the dorsal skin transsected (Fig. 7).

Standoli (10) has recently published a technique which uses the outer face of the prepuce for urethral reconstruction and the inner face for coverage of the dorsal defect. The neo-urethra is covered by advancement of skin on the ventral side of the penis.

Considering the fact that the outer and inner face may be used independently as an island flap, I have modified a procedure that was developed in the early seventies but then abandoned because of its limited applicability and doubtful reliability due to overlap of urethra and suture line.

I am referring here to the use of the prepuce as a double island flap. This flap is formed by transsection of the inner and outer face at the level of the...
corona and then perforated to make transposition possible. The
disadvantages of this procedure may, however, be removed when this double
island flap or sandwich flap is spiraled around the shaft. The technique
promises to offer all the advantages of a one-stage procedure and few of its
disadvantages, but further testing is needed. Does this mean that my
objections against the use of a one-stage procedure have disappeared?
Certainly not, but if they are performed it should be by experienced hands and
even then it must be realized that delicate surgery is required and that the
chances of a higher complication rate must be anticipated and accepted.

Postoperative care

Following hemostasis and careful suturing of the wound, management
becomes extremely simple.

A catheter is never placed for the reasons explained above. In Types I and II
repairs, urinary drainage through the neo-urethra is permitted from the first
day on. In Type II repairs, one or two incisions may be added as a safety
measure.
These incisions are made at a safe distance from the urethral lining in the penile base.

In the first days postop, when edema is present and drainage through the neourethra may meet some resistance of edema, most of the urine will pass through these incisions. The neo-urethra, however, soon takes over allowing the safety incisions to heal spontaneously. The theory that the healing process is disturbed by the presence of urine is another myth that should be forgotten. A prerequisite, however, is the absence of a constricting type of dressing. A simple sandwich dressing, one gauze below the upward bent penis and one on top of it is sufficient. The dressing is fixed with adhesive tape and easily changed following each miction.

The boys are free and mobile as with every circumcision procedure. Antibiotics are contra-indicated and infections are never seen. Complications in terms of strictures or fistulas are virtually absent in the repair of Type I hypospadias (4, 5, 11-13). When they occur they are of minor importance such as a retraction of the apical meatus which can easily be repaired.

Complications may be observed, however, in the repair of Type II hypospadias. Two patients with a pin-point fistula and two others with some degree of dehiscence were seen in a group of more than 40 patients (14). Some of these complications could be attributed to the absence of drainage incisions but fold formation due to excessive length of the urethral strip or to scarring at the transition of urethra and neo-urethra and compression of the neo-urethra by excessive edema may also have played a role. The functional stenosis produced by these factors obviously remains a possible source of problems if one does not want to rely on a perineal urethrostomy or a suprapubic cistostomy for urinary drainage.

Accurate redistribution and interdigitation of skin in the first part of the two-stage procedure and the insertion of a splint in the neo-urethra to enhance drainage in the immediate postoperative period of the second part may, however, help to prevent these complications.

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This is part of a chapter on hypospadias in “Current Operative Surgery: Plastic and