The MAGPI Hypospadias Repair in 1111 Patients

JOHN W. DUCKETT, M.D., and HOWARD McC. SNYDER III, M.D.

The meatal advancement and glanduloplasty (MAGPI) procedure was first described in 1981 for the repair of distal hypospadias. In the past decade, our experience has grown to more than 1000 procedures. An excellent surgical result requires careful case selection, avoiding cases with thin or rigid ventral parameatal skin or a meatus too proximal or too wide. The glans wrap to support the advanced ventral urethral wall requires a solid tissue approximation in two layers to prevent a retractive meatus. Meatal stenosis can be avoided by assuring an adequate dorsal Heineke-Mikulicz tissue rearrangement and making an incision from within the urethral meatus well distally into the urethral groove. The MAGPI procedure routinely is performed on an outpatient basis without any urinary diversion. Our experience in 1111 cases during 12 years has required a second procedure in 1.2% of cases. The overall success rate with the MAGPI procedure suggests that it should continue to be used in the repair of distal hypospadias.

In 1981 we described a hypospadias technique for advancement of the meatus and reconfiguration of the glans for the most common manifestation of this anomaly. Since its introduction the meatal advancement and glanduloplasty (MAGPI) procedure has withstood the test of time, has become internationally accepted, and is the most common hypospadias technique used today.

Hypospadias occurs in 1 of 300 male births with the meatus position distal in 65%, in the middle of the shaft in 15%, and in the penoscrotal or scrotal position (posterior) in 20%. In those with the anterior classification, the dystopic meatus is located on the inferior glans 15% of the time, in the coronal groove 50%, and subcoronal 30%, and the megameatus intact prepuce (MIP variant) in 5% of cases. Perhaps 50% or more of these anterior variants will be amenable to the MAGPI. Approximately one third of all cases of hypospadias are suited for this single repair. While we have continued to be satisfied with this operation, others have reported excessive meatal retraction and meatal stenosis.2-4 Our purpose in this paper is to review our results and describe the modifications of the procedure we have added since its original description that will help others avoid the reported complications.

Results

Records of patients who have had the MAGPI procedure performed at The Children's Hospital of Philadelphia were reviewed for the period July 1987 to May 1990 (282 cases). The complications were itemized as to fistula, meatal retraction, presence of chordee, meatal stenosis, or cosmetic skin irregularity. Two cases required secondary surgery, one with a fistula and one with persisting chordee, for a 0.8% rate of reoperation. Previous reviews that we reported comprised the cumulative results of 1111 cases. From 1978 to 1981, 207 cases were reported; from 1981 to 1985, 510 cases; from 1985 to 1987, 128 cases; and from 1987 to 1990, the current 266 cases reviewed herein. Thus an average of 85 cases per year were managed. The complications included 5 fistulas (0.45%), 7 meatal retractions (0.6%), 1 residual chordee (0.09%), and no meatal stenoses. The incidence of complications requiring secondary surgery was 1.2% for the entire group. For the last 5 years it was 1% (4 of 394 cases) (Table 1).

The average follow-up was 2.3 months, with a 2-week to 2-year range. No follow-up was obtained in 16 of the 282 cases (6%). We think an average follow-up of 2.3 months is adequate to assess the outcome of healing of this type of hypospadias repair. It would be more complete to have long-range assessment of these patients; however we think that it is psychologically inappropriate to have a child come back for evaluation of a congenital anomaly.


Address reprint requests to John W. Duckett, M.D., Division of Urology, Children's Hospital of Philadelphia, 34th St. and Civic Center Blvd., Philadelphia, PA 19104.

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that, in essence, has been repaired completely before his knowledge of the anomaly. Because most of these anomalies are repaired when the child is 6 months to 1 year old, the child does not remember the operative experience. The parents are instructed to subtly observe the child’s urinary stream periodically throughout childhood to make sure there is no spaying, diminished force, deflection, or cosmetic skin irregularity. The parents are encouraged to return for a visit whenever they feel the need for re-evaluation. This rarely occurs because the repair typically matures nicely with the child.

Selection of Cases and Technique

The technique for the MAGPI procedure has been modified considerably since it was first described in 1981. Textbook and atlas diagrams have been modified through the years, but it is still difficult to depict adequately the meatal enlargement and advancement and the three-dimensional glanular rearrangement that is required for the excellent cosmetic result that can be achieved.

In selecting a case for the MAGPI repair, the nature of the meatus and the parameatal skin is of paramount importance in achieving a successful glans reconfiguration. The parameatal skin should be thick and pliable, permitting it to be lifted easily off the underlying urethra. This is essential to permit the ventral parameatal skin to be advanced distally. The glans configuration must permit it to wrap around this advanced ventral urethral wall. If the parameatal skin is thin or nonpliable, then the MAGPI procedure is inappropriate. An onlay island flap often is more appropriate.

The size of the meatus also is an important consideration. Usually the meatus is small and after the ventral wall has been advanced distally, it is not difficult to dissect laterally to expose the glans for the placement of sutures solidly into glans tissue (Fig. 1g) to reconfigure it from its typically flat configuration into a more normal conical shape. The healing of glans to glans maintains the ventral support for the advanced meatus and thus prevents later falling back of the ventral meatal wall, a retrusive meatus.

If the meatus is large, as is usually seen in the MIP variant of hypospadias, then the glans cannot be exposed for the placement of the glansplasty sutures, and either a pyramid or Mathieu procedure with a glansplasty involving formal mobilization of glans wings will result in a more satisfactory long-term glans reconfiguration.

In cases of distal hypospadias, it is rare to see chordee due to more than a ventral skin or subcutaneous tissue abnormality. The flattened glans so frequently seen in these cases appears to indicate that once the shaft skin has been dropped back, an artificial erection will reveal straight corporal bodies.

Cases ideal for the MAGPI procedure usually have a meatus positioned at the coronal margin or subcoronally. There is commonly a lip of tissue distal to the meatus that deflects the urinary stream ventrally to a variable degree. The glanular groove varies in its depth and may require deepening with the initial Heineke-Mikulicz maneuver that advances and flattens the dorsal urethral wall. This step corrects the ventral deflection of the urinary stream. Often there is an accessory dorsal periurethral duct located in the glanular groove distal to the meatus, but this does not interfere with the repair.

Technique

After a holding stitch of 5-0 prolene is placed in the glans for traction, a 1:100,000 concentration of epinephrine in 1% xylocaine is injected in the subcoronal area and glans groove. A circumferential incision is made around the corona proximal to the meatus. The exact placement of this circumferential incision is not important at this stage because excess skin will be trimmed as the glanuloplasty develops. Others have indicated the importance of the initial incision in the construction of the future glanular configuration; however we think it is not necessary to configure a definite skin incision unless the Firlit skirt or mucosal collar is used.

The penile skin is mobilized as a sleeve back to the penoscrotal junction and thus results in freeing of the tethering fibers of the subdartos fascia, particularly on the ventrum. This is the most probable cause for the ventral tilt of the glans frequently seen in these cases. The straightness of the penis is checked with an artificial erection. If curvature is present, this is usually caused by corporal disproportion and not chordee involving the dorsal urethra. Correction is carried out easily using dorsal plating sutures.

The meatal advancement of the dorsal urethral wall is accomplished by a Heineke-Mikulicz vertical incision and horizontal closure. More commonly now wedge removal of a segment of glanular tissue distal to the meatus, which includes the dorsal meatal wall, is performed. This horizontal closure flattens out the glanular bridge and permits the dorsal urethra to be advanced out onto the glans tissue to the apex of the glanular groove where it is sutured with interrupted 7-0 vicryl. This flattens the deflecting ridge of glans and permits the stream to be directed forward.
The glanuloplasty is made by reconfiguring the flattened glans into a conical shape. By rotating the lateral wings around to the midline proximal to the meatus, a proper conical glans shape can be recreated. There will be skin adjacent to the glanular edges that must be excised in a precise angle to reapproximate the glanular wings together in the midline on the ventrum (Fig. 1). The deep glanular tissue is brought together with interrupted 6-0 vicryl or PDS interrupted sutures and the superficial epithelial edges are run with 7-0 chromic suture. In this manner mesenchymal glans tissue heals to glans tissue between the epithelial layers of the urethra and the outer epithelium of the glans, and this prevents meatal retraction. This rotation of the glans wings reconfigures a nearly normal glanular appearance. A bougie-a-boule is used to calibrate the meatus and ensure that the glanuloplasty has not compromised the lumen of the distal glanular urethra.

While a sleeve reapproximation of the penile skin usually is sufficient for skin cover, ventral transposition of the preputial skin may be necessary to replace a skin deficiency on the ventrum. Fine 7-0 chromic is used for the skin closure to help avoid the development of later suture sinuses.

No stents or catheters are required for diversion. These procedures are done in the day surgical unit. A vaseline gauze dressing that is similar to a circumcision dressing will cover the incision for 24 to 48 hours and is removed by the parents at home.

**Discussion**

For many years techniques were not available to reconstruct reliably the urethra out to the tip of the glans in patients with a distally placed meatus. Because there was minimal functional impairment, surgeons were reluctant to subject a patient to complications that might be more severe than the untreated anomaly. Techniques available to correct distal hypospadias, Mathieu, Mustarde, and Devine-Horton flip-flap require the construction of a neourethra. The MAGPI procedure allows...
Figs. 2A-I. MAGPI (operative series). (A) Typical meatal location with distal bridge of tissue to be removed in a wedge. (B) Glanular groove opened to apex and into dorsal meatus. Note generous meatal mucosa; probe in paraurethral duct. (C) Straight erection after skin takedown; slitlike meatus at apex. (D) Ventral view with holding stitch in ventral meatal edge; excess skin trimmed up to epithelium of glans. (E) Suture is approximating mesenchymal thick glanular tissue as deep layer with holding sutures on glans wings. (F) Closure of glans epithelium with fine chromic. (G) Glanuloplasty complete; catheter in meatus at apex. (H) One month postoperative result: conical glans; slitlike meatus.
the surgeon to avoid a urethroplasty and provides a reliable, reproducible procedure for reconfiguring the glans and meatus without the use of catheters and with a very low morbidity rate.

Diagramming the technique for teaching the method has been difficult. In the past 10 years, modifications have been made that bring glanular tissue together in a more solid ventral closure that avoids meatal regression. An additional layer approximating deep glans tissue has been added that replaces the vertical mattress stitches described in the original diagram (Figs. 2f and g). The glans mesenchyme is now approximated deeply, with an epithelial layer closure superficially. This is a more secure closure to avoid the ventral meatus separation that leads to meatal regression. Usually the glanular reconfiguration produces a nearly normal-looking glans with an unnoticeable ventral glans scar.

Fortunately meatal stenosis has never been a problem with this reconstruction, although it is reported by others. When the dorsal incision is made vertically and closed transversely, this opens up the meatus in a wide configuration. While many of these anomalies have a significant meatal stenosis to begin with, the meatoplasty in a Heineke-Mikulicz fashion suffices to widen this in all cases when the incision is made well into the stenotic meatus.

The ventral meatal edge is elevated forward and the glans wings are rotated medially, reapproximating the normal conical glans shape. The meatal advancement is maintained as a result of glanular rotation and secure healing to glans. The ventral meatal edge is fixed to the glanular tissue with interrupted chromic sutures to keep it from retracting beneath the glanuloplasty.

Some modifications of the technique have been used in specific cases. For instance the ridge of tissue in the glanular groove may be quite thick so that a transverse wedge must be removed to advance the dorsal urethra further into the glans. At other times the glanular groove may be quite wide with a prominent lip on each side. This redundancy may leave a fold of the meatal lip as a lateral 'dog ear.' A transverse excision of this is needed to create a vertical neomeatus. The meatus may be extended even further toward the apex of the glans in some cases with a wide groove by denuding the epithelial layer ventrally and stitching these edges together.

Inappropriate application of the MAGPI technique to unsuitable cases causes most of the poor results reported by others. The ventral distal urethra must be mobile to be advanced into the glans. The MIP variant (megameatus with an intact prepuce) is definitely not a proper selection, nor is the wide, deep meatal groove with a subcoronal meatus.

Modifications of the MAGPI that have distinct indications have been developed by others. Arap proposed a method of urethral extension for those cases with a more proximal meatus. The ventral meatal edge is brought forward with two holding stitches 7 to 10 mm apart in an 'M' configuration. The middle 'V' of the 'M' is closed, forming a urethral extension that is buried beneath the glanular approximation. A dorsal meatal advancement is not beneficial in this setting. A glans approximation procedure was published recently, but it does not relate to cases amenable to a MAGPI.

Others have reported their results with the MAGPI. Livne et al. had excellent results in 66 cases with no meatal stenosis or retraction, with only three cases having minor cosmetic deficiencies. MacMillan et al. studied 44 MAGPI results with photographs of their streams and uroflows. All but one case had an excellent cosmetic result (one small meatal flap was later considered acceptable with no surgery). Photography of the streams demonstrated a satisfactory if not entirely normal pattern and flow rates were normal. They stated 'Until recently, the price of perfection in the management of anterior hypospadias was significantly high. However, with the advent of the MAGPI repair, which virtually guarantees perfect cosmetic results and fully preserves micturitional function, all boys with distal hypospadias should be offered early surgical correction.'

Others report unacceptable results. Ozen and Whittaker had a 6% rate of meatal retraction in 67 patients and only 91% excellent results. Issa and Gearhart described eight cases with meatal retraction, five attributed to technical failure and three to poor case selection. The recent report of Hastie et al. described a significant meatal retraction problem but none back to the position of the original meatus, and the direction of the urinary stream was not affected.

After 10 years of experience, the primary criticisms of the MAGPI procedure are meatal regression and meatal stenosis. Our attention now is focused on teaching surgeons to avoid these problems. First the meatoplasty must extend the dorsal incision into the meatus to increase caliber. Second the glans wings must be brought together ventrally and fixed snugly to assure solid healing to avoid meatal regression. Our results have confirmed that when properly selected and executed, the MAGPI technique for hypospadias is very successful with a low morbidity rate and great parental satisfaction.

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References


DISCUSSIONS

DR. MAURICE JURKIEWICZ (Atlanta, Georgia): This was a splendid presentation of a straightforward, deceptively simple procedure described originally by the author in 1981, as he indicated to you, for distal hypospadias repair.

Coronal and subcoronal hypospadias, as he indicated, is the most common variant of this anomaly, which is among the most common of the somatic malformations occurring, as he indicated, in as few as 1 in 300 live births. Before the description of this operation, there was no good, reliable procedure to correct the extreme deformation, the appearance of the penis, and the accompanying ventriculature simultaneously. All previous procedures involved construction of a neourethra from the existing penile skin. Furthermore, until the Horton-Devine turnover flap procedure, reconstruction involved two stages with attendant complications.

Thus, unless there was a significant degree of ventriculature, the coronal hypospadias, in general, was left uncorrected. And so it was with training and my practice.

Before John Duckett, the late Lewis T. Byars of St. Louis, a member of this Association, a Regent of the College, and the man who was my principal teacher of reconstructive surgery and was, arguably, the best hypospadias surgeon around.

He devised a two-stage procedure adaptable to most hypospadias repairs, and in his hands it was remarkably free from complications. For example, when I completed my residency, he had a consecutive series of about 135 repairs without a single fistula, which was an unmatched record.

His operation, properly done, actually brought the meatus very close but not quite to the tip. In his procedure the glanular epithelium was replaced in the first stage by preputial skin. He emphasized this glanular reconfiguration, just as Dr. Duckett has, to give a normal appearance. However, because skin was used to construct a neourethra, stream deformation was a problem.

In the manuscript, to facilitate the dissection, Lidocaine and Epinephrine are injected into the penis. This operation is done at a very early age now, 6 months to 12 months. Dr. Duckett uses 1% Lidocaine with 1 to 100,000 Epinephrine, and I take it you have had problems with it.

I have used 0.25% with 1 to 400,000 Epinephrine, which gives me the same amount of hemostasis and obviates any toxic problems or flap problems.

These are done, as I understand it, as day surgery procedures, and I wonder if you would supply some information about the instructions to parents, how many of these patients have had to come back because of bleeding, or other problems.

To my knowledge, this is the first time any paper on congenital anomalies of the genitalia has ever been given before this Association.

DR. PAT MOYNIHAN (New Orleans, Louisiana): As a pediatric surgeon, I really do not do hypospadias repairs, but I follow with interest many of the patients that I see and refer to my urologic colleagues. It seems that the major complication outside of Dr. Duckett's group is meatal regression, and I would like your thoughts on the primary cause of meatal regression.

When you have this complication, how soon do you do a second repair?

The other thing I'm interested in, because we do so many outpatient surgeries at the present time, is what percentage of your patients do you do as outpatients, and are they a highly selective group?

DR. JAMES O'NEILL (Philadelphia, Pennsylvania): I enjoyed the opportunity to read this manuscript. This is a complicated paper about a complicated subject, notwithstanding Dr. Jurkiewicz's remarks about it being deceptively simple.

I have been an avid pediatric urology watcher and perhaps a Duckett watcher for the last 9.5 years and have been convinced about the validity of this procedure. Let me summarize by saying that all previous procedures that I have been aware of have involved construction of a neourethra, that is, a urethroplasty.

What Dr. Duckett and his colleagues did in 1978 when they initiated the procedure was to simplify repair by eliminating the need for urethroplasty while at the same time following the principle that a two-layer closure of good tissue is necessary for success.

What he has learned, as have his colleagues over time, is that not all patients with these anterior forms of hypospadias are amenable to the original MAGPI or, as the Europeans call it, the Duckett operation, so it has been modified over time.

He has also learned which cases to avoid when applying the MAGPI, and he might tell us a bit about that. For these, he devised the island flap on-layer procedure that he showed you in 1985.

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