One–Stage Repair of Severe Hypospadias: Original versus Modified Koyanagi Technique

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Background/ Purpose: Although the original Koyanagi technique seemed applicable for the repair of severe hypospadias at or proximal to the penoscrotal junction, its use has resulted in a high complication rate. The technique was modified to ensure better vascularity of the flaps. The purpose of this study is to report the results of original Koyanagi technique and its modifications in patients with severe hypospadias.

Materials and Methods: The original Koyanagi parameatal prepuital flap technique was performed in 16 boys with severe hypospadias (group I). In a subsequent 11 patients, the modified Koyanagi technique was used to preserve blood supply to the flaps (group II). The meatus was located at or proximal to the penoscrotal junction in all patients. Moderate to severe degrees of chordee was noted in all of them. The median age of patients was 13 and 20 months at time of repair for group I and II respectively. Each patient was evaluated as regard to site of the new meatus, straightness of the phallus, and stream of urine, development of fistula, urethral or meatal stenosis, any other complication, and the need for another operation. Follow up ranged from 36 to 84 months in group I, and 3 to 36 months in group II.

Results: A fistula developed in 8 of the 27 patients (29.6%). The frequency of fistula was more common in group I (6/16) than in group II (2/11). Urethral diverticulum occurred in one patient in group II, and mental stenosis in 2 in group I. Significant infection resulted in a regressed meatal position in 2 (one in each group). Good cosmetic results were achieved in all except the latter 2 cases. Secondary operations were needed in 8 patients (6 in group I and 2 in group II). The indication for secondary surgery were closure of persisted urethrocuteaneous fistula in 6 patients (5 in group 1 and 1 in group 2) and regressed meatus in 2 (one in each group).

Conclusions: A single staged repair can be safely and effectively performed even in patients with the most severe penoscrotal hypospadias. The modified Koyanagi technique has relatively lower complication rate than original Koyanagi repair. The complication rate is acceptable considering the severity of these cases.

Index Word: urethra, hypospadias, one stage repair, complications

INTRODUCTION

A controversy exists regarding the optimum technique for repair of severe hypospadias. For many years there was a consensus that is severe cases of hypospadias are better treated with a planned 2-stage approach rather than a single stage procedure. Recently, there has been a growing interest in one-stage repair of all varieties of hypospadias including severe types.

In 1984 Koyanagi et al reported meatal based foreskin flap repair for proximal hypospadias. This procedure ensures the complete release of chordee and adequate length of the neourethra, which may be
brought to the tip of the glans at one-stage. Although the Koyanagi technique seemed especially applicable for the repair of hypospadias at or proximal to the penoscrotal junction, its use has resulted in a high complication rate with reoperation in as many as 20-50% of cases.8,17

Several modifications were reported in an attempt to improve on this technique18-21. This retrospective study was designed to review the results Koyanagi technique and its modifications in patients with severe hypospadias.

**MATERIAL AND METHODS**

From 1998 through 2002 the original Koyanagi repair was performed in 16 patients aged 8 to 37 months (mean 18.7 months, median 13 months). From 2003, we adopted Emir et al modification of the original Koyanagi technique.19 The subsequent 11 patients were treated by this modified technique. In each case the meatus was located at or proximal to the penoscrotal junction. None of the patients had previously undergone penile surgery. Human chorionic gonadotropin was used in 6 patients (1500-3000 IU twice weekly for 3 weeks preoperatively). Local testosterone ointment was used in another 5 patients. Bifid scrotum was present in 4 cases and associated penoscrotal transposition in 5, both of which were corrected at the time of surgery.

Each patient was evaluated as regard to: site of the native urethral opening, degree of chordee, presence of bifid scrotum or penoscrotal transposition, preoperative hormonal therapy, operative technique, cosmetic results, complications, and details of secondary surgical procedures. Follow up ranged from 36 to 84 months in Group I, and 3 to 36 months in group II.

**Original Koyanagi technique:**

Parameatal preputal flaps are used to construct the neourethra. Outer and inner incisions are used to detach the flaps from all surrounding tissues except at the region of the meatus (fig. 1A:-1E). The outer incision extends distally from the meatus and incorporates the inner prepuce. The inner incision is a circular incision just proximal to the coronal sulcus (fig. 1B). Elements of chordee are excised. The urethral plate is mobilized as needed to complete chordee repair (fig. 1C, 1D). The 2 flaps are joined and tubularized over an 8 Fr silicone catheter which is left for drainage. A running subcuticular 6 or 7-zero polyglactin sutures is used (fig. 1E). The glans is divided in the midline to create glanular wings The meatus is brought to the tip of the glans penis. The glanular wings are approximated using 6-zero polyglactin mattress sutures. Bayers dorsal skin flaps are used to cover the new urethra. Patients with scrotal transposition are corrected at the same time. A compression dressing is applied. The catheter remains in place for 7-10 days (fig. 1 E).

**Modified surgical technique:**

In the modified Koyanagi repair, a 5-zero polypropylene suture is placed in the dorsum of the glans. The meatal-based flaps are outlined and the inner incision is made first, which allows the urethral plate to be mobilized sufficiently to excise all ventral and lateral tissues that contribute to the chordee (fig. 2A, 2B). The penis is essentially degloved circumferentially through the inner incision (fig.2C). Residual chordee may be evaluated with an artificial erection to determine persistent chordee and the need for a Nesbit procedure or tunica albuginea plications to correct the curvature. The outer incision is then made but only through the skin, preserving the underlying vascular supply to the skin flaps. The well vascularized 7 to 8 mm. wide flaps are then joined together to form the neourethra (fig 2D). All lateral blood supply to the neourethra is thus protected. The neourethra is tubularized with 6 or 7-zero polyglactin suture, and the neourethral meatus is placed at the tip of the glans by dividing the glans to form lateral wings (fig.2D&2E). The blood supply is not compromised as it is brought towards the ventral midline. It provides an additional layer of well vascularized protection to the ventral suture line. Skin resurfacing of the rest of the shaft completes the procedure. (fig.2F). An 8 Fr silicon catheter is used for drainage, and a sterile dressing covers the repair. Patients are discharged home on the second postoperative day and antibiotics are continued for 5-7 days.

Statistical comparison between patients in both groups was done using Chi-square test (X2) and Fisher Exact test for qualitative data, with P value less than 0.05 was considered significant.
**Fig 1 A.** Preoperative appearance of a case of proximal hypospadias with severe chordee and bifid scrotum.

**Fig 1 B.** Outline of incisions. The outer incision is made first.

**Fig 1 C.** The parameatal preputal flaps (arrow) are separated from the reaming skin of the shaft.

**Fig 1 D.** The penis is essentially degloved circumferentially through the inner incision, and chordee is released.

**Fig 1 E.** Glanular wings are created and tabularization is completed.

**Fig 1 F.** Postoperative appearance at 10 days after surgery just before removal of the catheter.

**Fig 1. Original Koyanagi technique**
Fig 2A. Outline of incisions of the flaps. An inner circular incision just proximal to the coronal sulcus, and an outer incision extends distally from the meatus and incorporates the inner prepuce.

Fig 2B. The meatal-based flaps are outlined. The urethral plate is mobilized sufficiently to excise all ventral and lateral tissues that contribute to the chordee.

Fig 2C. The penis is essentially degloved circumferentially through the inner incision, which is made first. The inner part of prepuce is shown.

Fig 2D. Dorsal portion of 2 flaps are sutured together. Using inverting running suture.

Fig 2E. Glanular wings are created and tabularization of the neourethra is completed, and reaches to tip of the glans easily.

Fig 2F. Repair is completed.

Fig 2. Modified Koyanagi technique
Table 1. Postoperative complications

<table>
<thead>
<tr>
<th>Complication</th>
<th>Group I (16 patients)</th>
<th>Group II (11 patients)</th>
<th>Total (27 patients)</th>
<th>Statistical significance</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Original Koyanagi</td>
<td>Modified Koyanagi</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Urethocutaneous fistula</td>
<td>6 (37.5%)</td>
<td>2 (18.18%)</td>
<td>8 (29.6%)</td>
<td>0.40</td>
</tr>
<tr>
<td>Regressed meatus</td>
<td>2 (12.5%)</td>
<td>1 (9.09%)</td>
<td>3 (11.1%)</td>
<td>1.00</td>
</tr>
<tr>
<td>Urethral stricture</td>
<td>2 (12.5%)</td>
<td>0</td>
<td>2 (7.4%)</td>
<td>0.50</td>
</tr>
<tr>
<td>Urethral diverticulum</td>
<td>0</td>
<td>1 (9.09%)</td>
<td>1 (3.7%)</td>
<td>0.41</td>
</tr>
<tr>
<td>Secondary operation</td>
<td>6 (37.5%)</td>
<td>2 (18.18%)</td>
<td>8 (29.6%)</td>
<td>0.40</td>
</tr>
</tbody>
</table>

RESULTS

The operative time ranged from 150-210 minutes. A fistula developed in 8 of the 27 patients (29.6%), 2 of them healed spontaneously while 6 were corrected successfully in a subsequent surgical procedure. The rate of fistula was higher in group I (6/16) than in group II (2/11). The vascularity at the very distal part of the flaps was compromised in 3 cases in group I. The subcutaneous tissue of the distal portion of the flap around the glans was removed which makes this distal part a free graft, two of these 3 cases developed urethral stricture and required repeated dilatations.

Urethral diverticulum developed in one patient in group II, the patient had to do milking of the urethra at the end of micturation to evacuate the retaining urine. The parents are not accepting surgical intervention at moment, but a secondary surgical procedure to repair this diverticulum will probably be needed in the future.

Significant infection resulted in a regressed meatal position in 3 (2 in group I, and 1 in group II). Good cosmetic results were achieved in all except the latter 3 cases. Blocking of the urethral catheter occurred in 4 occasions. One of them required suprapubic drainage. Good cosmetic results were achieved in all except the 3 cases. The complications are summarized in table 1.

Secondary operations were needed in 8 patients (6 in group I and 2 in group II). The indication for surgery were closure of persisted urethrocotaneous fistula for more than 6 months in 6 patients (5 in group I and 1 in group II) and regressed meatus in 2 (one at each group).

Although the frequency of postoperative complications was more in group I than in group II, none of these differences reached a statistical significant level (table 1).

DISCUSSION

A great deal of controversy exists regarding the ideal approach for repair of proximal hypospadias. The primary question is which type of operation is most appropriate for these severe cases. Options include a one or two-stage urethroplasty with often a third procedure for correction of the penoscrotal transposition. Powell et al noted that severe hypospadias repair was associated with a significant complication rate of about 30%, they observed that free grafts were associated with a significantly higher proximal stricture rate when a tube rather than an onlay was used.

Some previous reports have concluded that a planned 2-stage urethroplasty reliably leads to fewer complications and improved cosmesis. Many surgeons believe that a certain subset of patients with severe proximal hypospadias, chordee and a small phallus may benefit from a 2-stage approach. Other surgeons believe that a single stage repair should be the gold standard, and requested to develop modifications of existing procedures or new techniques to achieve good results instead of regressing to the two-staged approach.
Our approach has been to plan a single stage procedure to correct all aspects of the hypospadias. The initial 16 patients in our series were treated with the original Koyanagi technique. Although the cosmetic results using this technique have been satisfactory, the complication rate was considerably high since 6 of the 16 patients (37.5%) required another surgical procedure to close a persistent fistula (n=5), or to repair regressed meatus (n=2). The reported initial series treated with the Koyanagi repair in the literature had been associated with a quite similar high complication rates. Glassberg et al reported a complication rate of 50% in 14 boys, and the largest and most recent series presented by Koyanagi et al of 70 patients had a complication rate of 47%.11

Recently we switched to the Emir et al19 modification of the Koyanagi technique with encouraging early results. Only 2 of the recent 11 patients (18.1%) treated with the modified technique required another surgery. The incidence of fistula was significantly less in this group compared to original technique (18.1% versus 37.5%). Although it seems that the results of the modified technique looks much better than the original technique in our series, at least part of this improvement may be due to the learning curve as the second group of patients were treated more recently. The reported recent series treated with a modified technique at other institutions also showed a lower complication rates of 17% to 20%.19,21 The higher success rate in both our recent group of patients and similar series of modified Koyanagi technique is believed to reflect the impact of preservation of the lateral blood supply to the skin flaps and not to rely entirely on the microvasculature emanating from the region of the urethral meatus and its surrounding corpus spongiosum.19

Another advantage of the modified Koyanagi technique is minimal disturbance of the blood supply to remaining skin of the shaft of the penis. This has a great impact on its viability. The resurfacing of the shaft after reconstruction of the neourethra is usually easy in these cases in contrast to original Koyanagi approach in which skin deficiency is sometimes a technical problem.

Sugita et al reported their modification of the original Koyanagi technique, they claimed that removal of the subcutaneous tissue of the distal portion of the flap around the glans makes this distal part a free graft and allows more flexibility than a pedicle flap and provides adequate neourethral length even in cases of scrotal or perineal hypospadias.20 We used these modifications in 3 cases in group 1 with inadequate blood supply at the very distal part of the flaps, the results were unfavorable as 2 of these 3 cases developed meatal stenosis. We believe that every effort should be made to maintain the vascular integrity of the entire repaired urethral tube.

Although 29.6% of patients in these series (18.1% in group 1 and 37.5% of group 2) have undergone some sort of secondary surgery to repair a fistula or to correct regressed urethral meatus, they had finally good cosmetic and functional results with a straight phallus and a neourethra brought to the tip of the glans. The secondary surgical procedures were very much accepted by the parents, who were satisfied with final results.

CONCLUSIONS

A single staged repair can be safely and effectively performed even in patients with the most severe proximal hypospadias. Both the original Koyanagi 1-stage repair and its modification provide excellent cosmetic results in severe hypospadias while preserving the available urethral plate tissue. The complication rate is significantly lower in modified technique. Despite the need for a second surgical procedure in a significant number of these patients, the results are acceptable considering the severity of hypospadias. We believe that one-stage approach should be a natural progress in the field of hypospadias, and that 1-stage techniques should be encouraged and popularized.

REFERENCES


