**Two-stage BILAB technique for correction of primary proximal hypospadias with severe chordee**

**Abstract :**

Introduction: In recent years, the trend has shifted towards two-stage surgery to treat proximal forms of hypospadias with severe penile curvature. This evolution is explained by the high rate of complications associated with single-stage surgery, as well as the increasing need to address curvature, which sometimes takes precedence over urethroplasty itself in terms of priority.

In 2013, A. HADIDI published his Bilateral Based Skin Flap Technique (BILAB) for the repair of perineal hypospadias associated with severe penile curvature.

The aim of our study is to evaluate this technique, to specify its indications, and to analyze its therapeutic results.

Materials and Methods:

Prospective study of a heterogeneous series of 40 children presenting with proximal hypospadias, all operated on by the same surgeon using the two-stage BILAB technique. The average age of the patients at the time of surgery was 38.40 months.

During this study, three corporotomies without grafting were performed in 15 children to complete the treatment of penile curvature. In addition, an intermediate flap taken from the tunica vaginalis was used to cover the urethroplasty in 37 patients. The functional results were carefully evaluated using a questionnaire designed to assess the satisfaction of parents as well as that of the surgeon, both functionally and aesthetically.

Results:

Complete straightening of the penis was achieved in all patients. We noted 4 cases of urethral fistulas, 2 cases of total urethroplasty breakdown, 1 case of partial breakdown, 3 cases of glanuloplasty breakdown, 3 meatal stenoses, and one distal diverticulum. The cosmetic appearance was very satisfactory for parents in 90% of cases.

Conclusion:

The BILAB technique, a modification of the original Koyanagi technique, is a good alternative for the management of severe forms of hypospadias. Correction of penile curvature sometimes requires additional procedures such as triple corporotomy to achieve complete straightening of the penis, and the aesthetic result is generally satisfactory. The complication rate is very low compared to other techniques, but parents should be informed of the risk of reoperations.

**Key words: Hypospadias, BILAB technique, Uretroplasty, Tunica vaginalis**



1. **Introduction** :

The repair of proximal forms of hypospadias remains a complex task for pediatric urologists. The large number of surgical techniques described and the lack of data on long-term results for each of them make objective evaluation of hypospadias surgery difficult.

The Koyanagi technique[1]has attracted attention over the past three decades due to its logical flap design, but it was initially not widely used due to its high complication rate. Since that time, several improvements have been implemented, leading to more promising surgical results. However, little research has been devoted to evaluating this technique for the repair of this complex malformation, which requires meticulous surgery to ensure the best possible outcomes[2].

In 2013, A. HADIDI published his Bilateral Based Skin Flap Technique (BILAB) for the repair of perineal hypospadias.In our department, the two-stage BILAB technique has become the gold standard for the repair of proximal forms of hypospadias associated with severe penile curvature.

The objective of our study is to evaluate this technique, to specify its indications, and to analyze its therapeutic results.

1. **Patients and Methods:**

This is a prospective descriptive, non-randomized, and analytical study, involving a heterogeneous series of 40 patients who underwent surgery for proximal hypospadias, during the period from January 15, 2021, to January 15, 2024.

**Surgical Technique:**

**First Stage**

The BILAB technique can simply be described as a new modification of the Koyanagi technique; it is flexible and can be used in one or two stages, as is the case in our center.

**Positioning**

The surgical procedure is performed under general anesthesia, with an intubated patient who has already received a caudal block, in the dorsal decubitus position.

A thorough examination of the external genitalia is performed to assess the anatomy and plan the steps of the procedure.

The following measurements are taken for accurate diagnosis:

-Penile size

-Glans width

-Urethral plate width

-Testicular position

An artificial erection test is performed by intra-cavernosal injection of saline solution using a gray intranule, after applying a tourniquet at the base of the penis. This step allows for the measurement of penile curvature, providing essential data for surgical correction.

**Exposure of the Penis**

A 4/0 prolene suture is placed at the level of the glans and serves as a traction suture, accompanied by two other sutures placed on each side of the dorsal aspect of the prepuce (Figure 1).

**Incision**

A skin incision is made 3-5 mm from the balano-preputial groove.The incision is deepened to reach the tunica albuginea of the corpora cavernosa, and the fibrous tissues and hypoplastic urethral plate are resected.Without skin excision, the urethral meatus generally retracts by about 2 cm. Since the chordee in hypospadias involves only the ventral aspect of the penis, degloving is limited to the ventral aspect of the penis. This is important to preserve the Dartos fascia and the blood supply to the BILAB flaps[3].

**Chordee excision**

Complete resection of the fibrous tissues as well as the hypoplastic urethral plate usually allows for correction of penile curvature(Figure 2).

Second Artificial Erection Test

If curvature persists more than 15°, three transverse ventral corporotomies are performed[4,5].

On the midline, from the sub-coronal groove to the tip, the glans is split. The depth of the incision should be sufficient to release two wide and mobile glandular wings, as well as to prepare sufficient space for the neo-urethra.

**Incision and Mobilization of the Two Skin Flaps**

On both sides of the prepuce, a transverse incision is made at the muco-cutaneous junction.Two external preputial flaps are easily obtained, adequate to cover the glans to its tip without tension.This method differs from that of Koyanagi, where the internal mucosal collar is used to create a new urethral plate (Figure 3).

**Creation of a New Urethral Plate**

The skin of the penis and the prepuce are mobilized on either side, keeping the dartos fascia, and they are sutured together on the midline.Therefore, a new urethral plate is created and attached to the tunica albuginea on the midline (Figure 4).

**Second Stage**

***Urethroplasty***

Six months after the first stage, the urethroplasty is performed.

A CH10 trans-urethral catheter is inserted, and the urethral plate is carefully dissected on either side according to the Thiersch-Duplay technique[6,7]. This dissection is performed while preserving the vascular pedicle, while ensuring that the plate is sufficiently mobilized to allow its tubularization around the catheter without tension.

The urethroplasty is then performed using 6/0 absorbable monofilament PDS suture (Figure 5).

***Urethroplasty Coverage***

An intermediate layer of tunica vaginalis is used to cover the entire urethroplasty.The testicle is fixed to the bottom of the scrotum.This approach aims to improve results while minimizing post-operative complications (Figure 6).

***Glanuloplasty***

The two wings of the glans are brought together and sutured using 6/0 polyglactin suture, applying separate stitches according to the Blair-Donati technique. The use of these stitches also helps to distribute tensions evenly, promoting harmonious healing and effective reconstitution of the glandular anatomy, which helps to reduce the risk of post-operative dehiscence.

***Skin Coverage***

The two flaps of dorsal skin are used to cover the penis according to the Byars procedure (Figure 7).

*Dressing*

The penile dressing plays a crucial role in keeping the penis fixed, preventing edema, reducing postoperative discomfort, and avoiding trauma.

For all penile surgeries, we use a standard dressing that consists of anchoring the penis with a 4/0 prolene suture point on the anterior wall of the pubis.

Then, an antibiotic and hyaluronic acid-based ointment is applied to promote healing.

Sterile compresses are then placed, followed by a dressing.

This dressing is changed on the fifth postoperative day and removed on the tenth day (Figure 7).

It is semi-compressive, which helps to avoid painless trauma. In addition, it is easily removed while ensuring free mobility of the child.

In summary, this dressing protocol is designed to optimize recovery while ensuring patient comfort.

**Surgical Procedures Associated with Urethroplasty**

Laparoscopic orchidopexy for non-palpable testicles and classic inguinal approach for palpable testicles.

Treatment of another pathology of the peritoneal-vaginal canal.

**Antibiotic Therapy**

Antibiotic therapy was systematic in all cases with prescription of a 3rd generation cephalosporin such as cefotaxime.

**Post-operative Follow-up** The check-up is done every day during hospitalization, on the 30th post-operative day for a primary evaluation, on the 6th post-operative month for the final evaluation and decision of a surgical repair if it is necessary (Figure 8)

1. **Results**

The present study examined 40 children with proximal hypospadias, surgically treated at the pediatric surgery department of the Mother-Child Hospital of the Army (HMEA), using the BILAB technique.

The average age at the time of surgery was 38.40 months, with extremes ranging from 18 to 84 months. It was observed that 62.50% of patients (25 out of 40) were operated on after the age of 2 years.

The urinary meatus was located at the posterior penile level in 10 patients, at the scrotal level in 25 patients, and at the perineal level in 5 patients.

All children had penile curvature (100%), with varying degrees of severity: 4 boys (10%) had curvature less than 15°, 8 boys (25%) had moderate curvature, between 30° and 45°, while 28 boys (65%) had severe curvature, greater than 45°.

All children had penile curvature (100%), with varying degrees: 4 boys (10%) had curvature less than 15°, 8 boys (25%) had moderate curvature between 30° and 45°, while 28 boys (65%) had severe curvature greater than 45°.

Scrotal bifidity was observed in only one patient, while scrotal transposition was noted in 7 patients.

All these anomalies were corrected during the second surgical stage.

In our series, we identified 14 cases of cryptorchidism: 8 cases of bilateral cryptorchidism, 4 cases of left cryptorchidism, and 2 cases of right cryptorchidism.

None of the patients had undergone previous hypospadias surgery.

All patients were evaluated genetically, hormonally, and radiologically. The etiological evaluation was carried out by the pediatric endocrinology team, revealing normal hormone levels in 21 cases, partial androgen insensitivity in 8 cases, partial gonadal dysgenesis in 8 cases, and suspicion of 5α-reductase deficiency in 3 patients, thus highlighting the importance of molecular biology (see Table 1).

**Table 1:** Results of hormonal exploration in our series

|  |  |  |
| --- | --- | --- |
| Hormonal Profile | Number of Cases | Percentage (%) |
| Normal (Intact Testicu  lar Function) | 21 | 52.50% |
| Partial Androgen Insensitivity Syndrome (PAIS) | 8 | 20% |
| Partial Gonadal Dysgenesis | 8 | 20% |
| Probable 5α-Reductase Deficiency | 3 | 7.50% |
| Total | 40 | **100%** |

Hormone therapy was indicated in 13 patients with micropenis (penile size less than 2.5 SD according to the Schönefeld curve according to age, or a glans diameter less than 14mm).

The molecule used was testosterone enanthate, administered by intramuscular injection at a dose of 100 mg/m² each month for a period of 2 to 3 months, depending on the clinical response.

The results, referring to the Schönefeld curve, were considered:

Excellent in 9/13 cases (69.23%), Good in 4/13 cases (30.76%).

The gain obtained in penis length is on average 1.4 ± 0.6 cm.

The width of the glands after hormonal stimulation varies between 14 and 17 mm with an average of 15.20 mm.

The total length of stay for the first surgical procedure was 7 days, while it was 10 days for the second surgical procedure.

**Complications**

Severe complications are defined as complications

that require total or partial revision of the urethroplasty.

The overall rate of severe complications in our series was 10% (4/40) patients, divided into 2 cases of total urethroplasty breakdown, one case of partial breakdown, 1 case of urethral diverticulum associated with distal urethral stenosis.

Simple complications in our series were urethral fistulas observed in 4 cases, 3 cases of urethral meatal stenosis, and 3 cases of partial breakdown of the glanuloplasty.

In total, after the second surgical stage, surgical revision was indicated for 14 cases (35%) (Table 2).

**Table 2:** Distribution of patients according to the indication for revision.

|  |  |  |
| --- | --- | --- |
| Reason for Revision | Number of Cases | Percentage (%) |
| Isolated Fistula | 4 | 10% |
| Glanuloplasty Breakdown | 3 | 7.50% |
| Partial Breakdown | 1 | 2.50% |
| Total Breakdown | 2 | 5% |
| Meatal Stenosis | 3 | 7.50% |
| Urethrocele | 1 | 2.50% |
| Total | 14 | **35%** |

**Final Results**

In our series, the overall success rate after the first intervention was 65%.

This rate rises to 75% after the first revision in 4 patients.

One patient recently operated for urethrocele has not reached the six months required for a final evaluation, and 9 patients are awaiting surgical revision.

The location of the meatus was apical in 59.37%, proximal glandular in 25% of cases, and balanopreputial in 15.62% of cases (Table 3). The cosmetic appearance was very satisfactory in all patients (Figure 8).

Near-normal straightness was obtained in 40 patients, however, 4 patients retained curvature estimated by the operator to be minimal <10º and not requiring surgical revision

**Table 3:** Distribution of Patients by Meatus Location

|  |  |  |
| --- | --- | --- |
| Location of the Meatus | Number of Cases | Percentage (%) |
| Apical Meatus | 20 | 50% |
| Glandular Meatus | 8 | 20% |
| Balanopreputial Meatus | 3 | 7.50% |
| Patient Awaiting Revision | 9 | 22.50% |
| Total | 40 | **100%** |

1. **Discussion**

Hypospadias is one of the most common congenital malformations diagnosed in newborns[8], affecting between 0.3 and 0.8% of male births[9].

The European Surveillance of Congenital Anomalies (EUROCAT) revealed that the incidence of hypospadias increased in Europe between 1999 and 2008[10].

Hypospadias affects approximately one in 250 live male births.

Proximal hypospadias accounts for 15-20% of hypospadias cases[11].

In our series, the rate of proximal hypospadias was 23.11% compared to all types of hypospadias seen in consultation.

Hormone therapy was indicated in patients with micropenis or for repeated surgical interventions. It is difficult to know how effective these treatments are in the long term[12].

Hormonal stimulation significantly increases the length of the penis and genital skin, increases vascularization and thickness of the corpus spongiosum, which has the advantage of reducing the risk of postoperative necrosis and decreases the severity of hypospadias. [13]

However, hormone therapy can cause side effects such as pubic hair, genital pigmentation, or acne, which usually regress one to two months after the end of treatment.

It may also increase the risk of intraoperative bleeding and the formation of local hematomas, hence the preference to operate on the patient at least 3 months after the last course of hormone therapy.

Our study on a series of 32 patients with proximal hypospadias operated according to the Koyanagi-Hayashi technique[2]suggests an association between the administration of testosterone and a reduction in postoperative complications. However, in the absence of randomization, it is impossible to determine whether this association results directly from testosterone or other unmeasured confounding factors that may have influenced the decision to use this treatment.

Future prospective studies will be necessary to evaluate the value and role of testosterone in the context of hypospadias surgery.

In the literature, there is no general consensus on the use of hormonal stimulation in hypospadias surgery.

Over the past decade, the treatment of severe hypospadias has been the subject of much controversy. Although single-stage repair has shown efficacy for some forms of proximal hypospadias, many surgeons continue to favor a traditional multi-stage approach, especially in cases of moderate to severe curvature, to ensure optimal results.

This preference for multi-stage surgery is often motivated by the need to obtain satisfactory functional and aesthetic results, while minimizing potential complications associated with a single intervention.

At the beginning of his experience, the author, like many surgeons, was influenced by the protocols of his mentors in hypospadias surgery and especially by the philosophy of single-stage surgery for the correction of proximal hypospadias.

The Koyanagi-Hayashi technique, considered the gold standard for the management of proximal hypospadias, was widely adopted in his practice. However, due to a very high complication rate reaching 70%[2], the author decided to opt for a two-stage surgical approach.

In 2013, A. Hadidi presented his technique entitled "Bilateral Based Skin Flap Technique" (BILAB) for the repair of perineal hypospadias, associated with severe curvature of the penis[3].

It constitutes another modification of the Koyanagi technique while respecting the general concept; it is a simple, reproducible, and easily applicable technique to all types of proximal hypospadias. This approach reduces complications while offering satisfactory results[3].

In our protocol for the management of proximal hypospadias with moderate or severe curvature of the penis, we dedicate the first surgical stage to the treatment of this curvature. This involves sectioning the hypoplastic urethral plate as well as the ventral fibrous tissue. Corporotomies are also performed for cases of severe curvature, which remain the main objective during this first intervention[5].

This approach is considered very effective for the treatment of curvature. In this study, we observed that 4 residual curvatures of less than 10° did not require secondary correction.

Recurrent curvature is a serious complication, often associated with sexual dysfunctions when it reaches or exceeds 30°[14,15]. Correction then requires excision of the neo-urethra, ventral corporotomies, and urethroplasty by oral graft in several stages, given that the foreskin has generally been removed.

The second objective of the first operative time is to create a new urethral plate, longer and wider, using two easily mobilizable skin flaps, without compromising their vascularization. This method is both simple and safe. Moreover, if necessary, it allows for subsequent modification of the new plate or any residual cord, whether before or during the second stage.

The second stage of the operation is performed between six months and one year after the first intervention. This ensures complete healing and ensures that the surrounding tissues are flexible enough to allow further manipulations and surgical interventions.

According to HADIDI[3], the BILAB technique differs from the original Koyanagi technique in the following ways:

The external foreskin is preferred over the internal mucosa because it is less likely to swell and cause diverticulum formation. This is corroborated by our results, which revealed only one case of urethral diverticulum, which occurred due to severe stenosis of the urethral meatus.

The two lateral flaps are sutured together with the tunica albuginea on the midline. This stabilizes the flaps and underlying fascia while creating a new urethral plate. This approach also reduces manipulation of the Dartos fascia, which vascularizes the flaps.

The glans is incised deeply on the midline, and the two lateral flaps are attached to the end of the glans before tubularization. This technique achieves a slit-like meatus at the end of the glans.

The technique is easily reproducible, and the width of the new urethra can be precisely controlled around a CH12 catheter.

The BILAB technique is flexible and can be performed as a one- or two-stage procedure.

In addition to the advantages offered by the BILAB technique, it is important to highlight the benefits of two-stage surgery for severe forms of hypospadias, according to our experience.

This approach allows for better quality urethral reconstruction because it offers the surgeon the opportunity to initially correct penile curvature and prepare the tissues with well-vascularized flaps, ensuring a more resistant reconstructed urethra.

Segmentation of interventions also allows for optimal management of deficient or scarred tissues by providing the time needed to prepare a favorable environment for future reconstruction, for example with skin or buccal grafts.

In addition, this approach promotes effective correction of penile curvature, ensuring a stable base for the next phase.

Two-stage surgery is also highly adaptable, allowing the strategy to be adjusted based on the patient's progress between the two interventions, which maximizes the chances of functional and aesthetic success.

The use of the testicular tunica vaginalis as an intermediate covering plane during urethroplasty is a common practice in our therapeutic arsenal. This procedure has significantly reduced the incidence of fistulas, with only 4 cases of fistulas out of 40 patients. However, the testicular tunica vaginalis has the disadvantage of occasionally contracting during healing, which may require subsequent excision, as was the case for 3 patients included in the study.

In our series, we observed 3 urethroplasty breakdowns: two were secondary to a superinfection of a postoperative hematoma, and one was due to a retraction of the urethral plate, with the urethroplasty being performed under tension in its middle portion. Only one case of anterior urethral diverticulum observed in our series was secondary to a very tight meatal stenosis, which was corrected during a third operative time.

Our study has some limitations. It was conducted in a single center and is based on a small sample size, with all patients being operated on by the same surgeon. These factors may influence the generalization of our findings. In addition, the follow-up period was limited to a maximum of 4 years, and we do not have sufficient data to evaluate long-term results. These elements underscore the need for multicenter studies and larger samples to confirm our results and better understand the long-term impact of the interventions studied.

**Conclusion**

The BILAB technique is confirmed as a viable and effective option for the management of proximal hypospadias.

It deserves to be integrated into surgical protocols for hypospadias, while continuing to be studied to further optimize its results.

Collaboration between surgeons, pediatric endocrinologists, and families will be essential to ensure the best possible follow-up of patients and offer them the quality of life they deserve.

**Consent**

As per international standards or university standards, patient(s) written consent has been collected and preserved by the author(s).

**Disclaimer (Artificial intelligence)**

Option 1:

Author(s) hereby declare that NO generative AI technologies such as Large Language Models (ChatGPT, COPILOT, etc.) and text-to-image generators have been used during the writing or editing of this manuscript.

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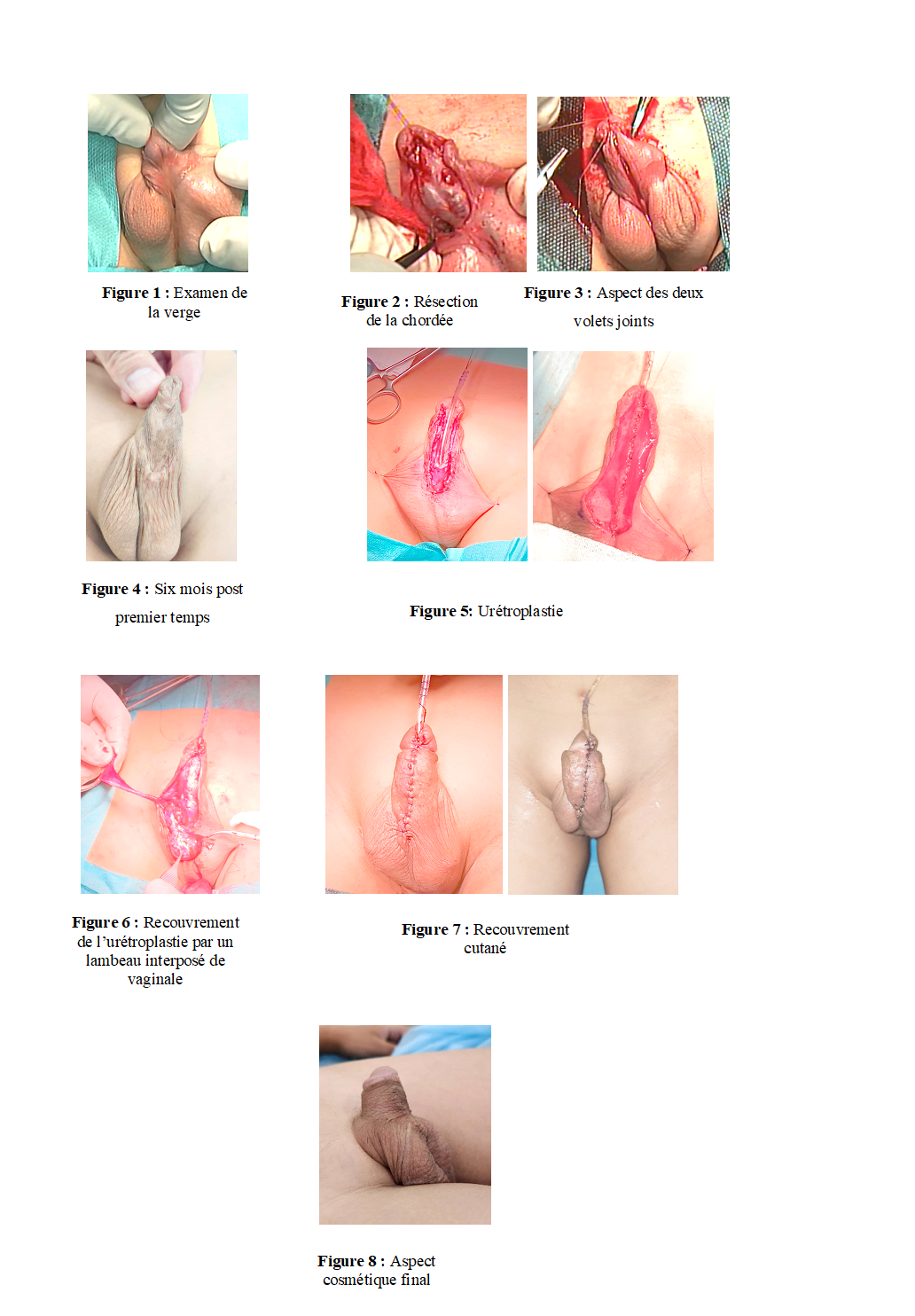
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