Testicular rerouting by modified Prentiss maneuver: Usefulness in bilateral synchronous orchidopexy for high inguinal undescended testes

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A B S T R A C T

Objectives: To describe our experience and illustrate the surgical procedure of synchronous bilateral testicular rerouting in high inguinal undescended testes (HIUT) by extending the use of “modified Prentiss maneuver” in bilateral situation, to establish this as a procedure of choice in bilateral HIUT and secondly to demonstrate the length gained by maneuver itself.

Methods: Between January 2011 and December 2012 ten boys (8 months–6 years) with diagnosis of bilateral HIUT were included in the study. Bilateral orchidopexy was done by “modified Prentiss maneuver” under general anesthesia. Postoperatively all patients were evaluated at 3 months, 6 months and 1 year by physical examinations and ultrasound.

Results: It was possible to reroute the testes underneath inferior epigastric artery (IEA) without its mobilization and thus locate testicular pedicle through a fascial hole above pubic tubercle, well medial to IEA. The average gain in scrotal positioning was 16 mm (10–22 mm). No retractions, atrophy of testis, clinical weakness of anterior abdominal wall or inguinal herniation was noted in any patient up to one year follow up.

Conclusions: Testicular re-routing by “modified Prentiss maneuver” is a simple, feasible, safe and efficient method for bilateral orchidopexy in bilateral HIUT. Preserving the inferior epigastric artery bilaterally has physiologic advantages.

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Cryptorchidism is a common problem in children and its incidence is about 4% at birth [1]. About 75% of the undescended testes at birth will descend at the age of one year, the remaining 25% requires surgical intervention [2,3]. The testis can be brought to the scrotum mostly through standard orchidopexy techniques. In difficult situations the testicular vessels are usually the limiting factor [2].

In 1955, Prentiss [4] described that, in case of high inguinal undescended testes (HIUT) ligation and division of the inferior epigastric artery (IEA) and incision of the fascia transversalis to bring the testicular vessels medially in a straight course can be a useful step. The average gain in length with inguinal dissection alone is about 2.0 cm and this increases up to 5.5 cm after Prentiss maneuver [5]. However, this technique is not favored universally because of its invasiveness and in bilateral situation this maneuver will sacrifice both IEAs, which can lead to various adverse events immediately as well as later in life [6–8].

Ayub et al. [9] described “modified Prentiss maneuver” by rerouting testes sub-fascially through the intact posterior wall without ligation of IEA for unilateral orchidopexy. Although, described in 1998, the literature regarding the utility of this procedure is scarce. Similarly, its use in bilateral HIUT has not been described to the best of our knowledge.

Our objectives were to illustrate the surgical procedure of bilateral synchronous orchidopexy using “modified Prentiss maneuver”, to establish the synchronous bilateral orcheopexy as a procedure of choice in bilateral HIUT and to demonstrate the length gained by this maneuver.

1. Material and methods

During the two years period between January 2011 and December 2012, ten boys aged between 8 month and 6 years were included in the study prospectively. The selection criteria were the patients with bilateral HIUT (location of testes at the level of deep ring or midway between deep or superficial ring by high resolution ultrasound (HRUSG)) in whom testes were viable and of adequate size and could not reach up to the mid scrotum after adequate inguinal and retroperitoneal dissection. Three patients with bilateral HIUT were excluded from the study because adequate length was achieved after inguinal and retroperitoneal dissection. The institutional ethical approval was obtained and it was in accordance with the Declaration of Helsinki.

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of Helsinki. All the boys were evaluated with history, clinical examination and HRUSG for location and size of testes. After informed consent, bilateral synchronous orchidopexies were performed by modified Prentiss maneuver. Postoperatively, all boys were reviewed in outpatient department by history, clinical examination and HRUSG at 3 months, 6 months and 6 monthly, thereafter.

2. The technique (Fig. 1)

Bilateral synchronous orchidopexy was performed by modified Prentiss maneuver [9] under general anesthesia. The approach was through transverse skin incision above the inguinal crease. The external oblique was divided in the line of its fibers. The spermatic cord was identified and dissected free from the cremaster fibers anteriorly. The inferior cremaster fibers were swept by blunt dissection up to deep ring. The cord structures were freed from surrounding fascial attachment by blunt and sharp dissection. The internal spermatic fascia was divided to separate the processus vaginalis from the vas and vessels. The processus vaginalis was freed to the level of the peritoneum and ligated. The gubernaculum at the lower pole was divided. The cord was dissected free up to the internal ring (Fig. 1A). The vas and testicular vessels were dissected and freed from the surrounding tissues and further dissected retroperitoneally by opening of the deep ring laterally and all lateral condensations of endopelvic fascia and bands were freed. Anteriorly a long Langenbeck or Deaver retractor was placed under the peritoneum anterior to the vessels in the internal ring. The bands of the endopelvic fascia were bluntly dissected from vessels by retracting the peritoneum anteriorly. After complete mobilization of vas and vessels, level of easy reach of testes over scrotum was marked by ink and patients in whom testes reached up to the mid scrotal level easily were excluded from the study and underwent conventional orchidopexy. The inferior epigastric vessels were identified medial to the deep ring but no attempt was made to dissect or mobilize them. A small opening was then made in the fascia transversalis above the pubic tubercle (Fig. 1B) and a mosquito haemostatic forceps was passed behind the fascia, bringing its tip out of the deep ring. The testis was held in the tip of the forceps by its tunica. By withdrawing the forceps the testis was pulled behind the fascia transversalis and out of the small hole (Fig. 1C). The small opening above the pubic tubercle guards against subsequent displacement of an account of the ‘button-hole’ effect [9] (the button-hole made in the fascia above pubic tubercle also prevents retraction of the testis). Our intention was to bring the testes at the bottom of scrotum without any tension (Fig. 1D). After this maneuver the level of easy reach of testes over the scrotum was marked and the distance between the two markings was measured with a ruler, representing the gain in cord length (GCL) of the testis after the application this maneuver. Fixation of the testis was done in the subdartos pouch by conventional method [10]. The deep ring was approximated and the external oblique was repaired with absorbable sutures, creating a small external ring. The skin was closed by non-absorbable monofilament suture subcuticularly.

3. Results (Table 1)

Bilateral synchronous orchidopexy was performed in 10 boys. The mean age was 28 months (8 months–6 years). Preoperative mean testicular size was 0.48 (0.42–0.56) ml in right side and 0.45 (0.40–0.52) ml in left side. Of the 10 boys, 7 had bilateral testes at the deep inguinal ring, 2 had one testis at the deep ring and another between deep and superficial ring and 1 boy had both the testes at the level of midway between the superficial and deep ring. It was possible to reroute testes underneath IEA without its mobilization and thus locate testicular pedicle medial to IEA in all patients. The average gain in

![Fig. 1. A: After dissection the cord structures are freed up to deep ring. B: Small opening in the fascia transversalis above the pubic tubercle and tunnel behind fascia transversalis. C: Straightened course of testicular pedicle by re-routing behind fascia transversalis. D: After re-routing testes reach up to bottom of scrotum without tension.](image)
scrotal positioning was 16 mm (10–22 mm). We encountered no major complication in peri- and post-operative period according to modified Clavien system [11] except scrotal edema in one patient (modified Clavien grade II) which was managed conservatively. The mean hospital stay was 2 days. The post-operative mean testicular size at mean follow up of 13 months was 0.50 (0.45–0.59) and 0.48 (0.44–0.60) ml in right and left side, respectively. No retractions, atrophy of testis, clinical weakness of anterior abdominal wall or inguinal herniation was noted on physical examination and ultrasound during follow up.

4. Discussion

The aim of orchidopexy is to bring the testis to the mid scrotal level without any damage to the vas and vessels and without tension on the pedicle. When testes are brought to the mid scrotal level with tension, chances of atrophy and retraction are high [9]. After standard inguinal dissection, high inguinal testes could be brought up to the superficial inguinal pouch/high scrotal position or sometimes to the mid scrotal level but with obvious tension and testicular vessels are usually the limiting factor [2]. Many operative maneuvers have been evolved to gain the length and to relieve the tension on cord structures i.e. the division of spermatic vessels, [12,13] Prentiss’s maneuver [4,5] for high inguinal testes, planned one or two-staged Fowler–Stephens procedure [14], auto-transplantation [15] for intra-abdominal testes or orchidopexy without opening the external oblique fascia for superficial inguinal undescended testis [16].

The Prentiss maneuver which has the advantage of spermatic vessels preservation is based on the fact that, if we divide the posterior wall of the inguinal canal, the testicular vessels acquire a direct route rather than a curved one and extra length is achieved.

The anterior abdominal wall have the several sources of the arterial blood i.e. superior epigastric artery (a branch of internal thoracic artery) and IEA (a branch of external iliac artery) [17,18] The IEA supplies the lower central area of the rectus and posterior rectus sheath [18].

In condition of bilateral HIUT, Prentiss maneuver will sacrifice both IEAs, which can lead to insufficient blood flow and atrophy of recti muscles [6]. Additionally, it leads to loss of a wide, pre-established channel connecting subclavian system to external iliac system which may be handy later in life to prevent leg ischemia by reversing its flow if there is an aorto-iliac block [7,8].

Yurdakul et al. [8] showed that in 95% of patients with aortoiliac occlusion, the internal thoracic artery–IEA pathway was functioning as a collateral and had an excellent flow with significant contribution to lower extremity perfusion. Thus, this collateral pathway, which is less affected by atherosclerosis compared with the other potential collateral networks, would be important in a patient with aorto-iliac occlusive disease.

Krupski et al. [7] showed that in aorto-iliac occlusive disease IEA flow is reversed so determination of IEA blood flow with the directional Doppler effect may give a useful screening information in patients with lower extremity ischemia. Further harvesting of the transversus rectus abdominus muscle flap may become impossible if bilateral IEA is sacrificed [18]. So whenever possible IEA should be preserved.

The testicular re-routing is a modification of the Prentiss procedure. In this procedure we do not divide the posterior wall of the inguinal canal but make a sub fascial tunnel, thus avoiding dissection and disruption of the posterior inguinal wall integrity while at the same time we get the benefit of extra length. After this procedure we can avoid the mobilization of IEA thus risking any local bleed or hematoma and more importantly both testes can be placed in the scrotum synchronously without any harm. The button-hole made in the fascia above pubic tuberclle also safeguards against retraction of the testis [9].

In case the re-routing maneuver does not bring the testicle to the appropriate location, a second stage orchidopexy after 6–12 months should be performed. However auto-transplantation is also an optional surgical approach for preservation of the inferior epigastric vessels.

The laparoscopic orchidopexy has the advantage of creating a new internal ring medial to inferior epigastric vessels to achieve the straight vascular course to the scrotum [19]. Our procedure is similar to the laparoscopic approach where the testis is exteriorised through a hole in the fascia.

Wound infection, bleeding, scrotal edema, retraction and testicular atrophy are complications of orchidopexy [20]. We didn’t encounter any peri- and post-operative complication except scrotal edema in one patient which was managed conservatively with scrotal support and antibiotics.

The most significant complication of orchidopexy is testicular atrophy [21]. Dissection of the testicular vessels and/or postoperative swelling and inflammation can lead to ischemic injury and testicular atrophy [22]. The testicular atrophy is noted in 5%–10% of patients after orchidopexy and does not depend on the age at which orchidopexy is performed [22–24]. The ultrasound offers the greatest accuracy of all clinical methods used to determine testicular volume [25–27]. We measured testicular size by HRUSG using formula for a prolate ellipsoid: (π/6 × Length × width × height) [28] and observed that pre-operative testicular size was similar to normal reference value [29] of descended testis in relation to age. Hussain et al. [30] showed similar results and concluded that pre-pubertal size of undescended testis does not differ significantly from that of normal reference value of descended testis in relation to the age and location. Post-operatively we monitored testicular size at 3 months, 6 months and 1 year and noted normal growth pattern without any atrophy. We performed physical examination at each visit to note any abdominal wall weakness, inguinal herniation and retraction of testes. We didn’t find any of these in any patient up to mean follow up of 13 months.

Recently, the safety and efficacy of Prentiss maneuver in high inguinal testes performed for unilateral UDT have been documented [31]. After 1-year follow up, the authors documented that 72%, 20% and 8% testes were located in lower, mid and upper scrotum and that the average gain in cord length was 13 mm (range, 6–20). With our modification, the average gain in cord length was adequate, i.e. 16 mm (range, 10–22). Our results also prove the safety of the synchronous bilateral orchidopexy by this procedure in bilateral HIUT.

There are certain limitations of this study like relative increased age of our patients (8 months–6 years), small number of cases, lack of comparison with the other approaches and short follow up.

### Table 1

Characteristics of patients and results.

<table>
<thead>
<tr>
<th>Characteristic</th>
<th>Total patients (n=10)</th>
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<tbody>
<tr>
<td>Mean age in months (range)</td>
<td>28 (8–72)</td>
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<tr>
<td>Mean hospital stay in days (range)</td>
<td>2 (1–3)</td>
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<tr>
<td>Site (no.)</td>
<td></td>
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<tr>
<td>Bilateral at deep ring</td>
<td>7</td>
</tr>
<tr>
<td>One side at deep ring and another side at midway</td>
<td>2</td>
</tr>
<tr>
<td>between deep and superficial ring</td>
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<tr>
<td>Bilateral at midway between deep and superficial ring</td>
<td>1</td>
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Mean (range) pre op testicular size (ml)

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<tr>
<th>Side</th>
<th>Value (range)</th>
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<tr>
<td>Right</td>
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Average gain in scrotal length in mm (range)

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<td>16 (10–22)</td>
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Mean follow up in months (range)

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<td>13 (6–24)</td>
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Complications

| Clavien grade I | 4 |
| Clavien grade II | Scrotal edema: 1 |
5. Conclusions

Testicular re-routing by “modified Prentiss maneuver” is a simple, feasible and safe method for bilateral synchronous orchidopexy in bilateral high inguinal undescended testes. Preserving the inferior epigastric artery bilaterally has physiologic advantages. This maneuver is efficient to gain adequate cord length of HIUT to place the testes in a distal scrotal location.

References