



# Skin flap vaginal augmentation helps prevent and cure post obstetric fistula repair urine leakage: a critical anatomical analysis

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Our aim was to describe a new surgical method for prophylaxis/cure of post obstetric fistula repair leakage based on restoring vaginal elasticity with Singapore skin flap. The rationale for this operation was based on the integral theory: scarring removes elasticity required for independent function of oppositely acting urethral closure forces so they become 'tethered, forcibly opening the urethra when give the signal to close'. Skin graft restores elasticity and closure. Used prophylactically with Goh type 4 fistula ( $n = 45$ ), 46% were dry against an expected 19%. In patients with successful fistula closure, still with severe leakage ( $n = 24$ ), 71% were dry against an expected 26%.

**Keywords** Connective tissue, obstetric fistula, post-vesicovaginal fistula repair incontinence, Singapore flap graft, stress urinary incontinence, tethered vagina syndrome, vaginal scarring.

**Tweetable abstract** Singapore skin flap restores elasticity and prevents and treats incontinence in patients with successful obstetric fistula repair.

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## Introduction

The problem with obstetric fistulas is not only fistula repair, but ongoing incontinence in up to 55% of patients following successful closure.<sup>1,2</sup>

Attempts to address this problem have included the Martius labial fat graft,<sup>3</sup> which has not stand the test of time,<sup>4</sup> and disappointing results from suburethral slings.<sup>2</sup>

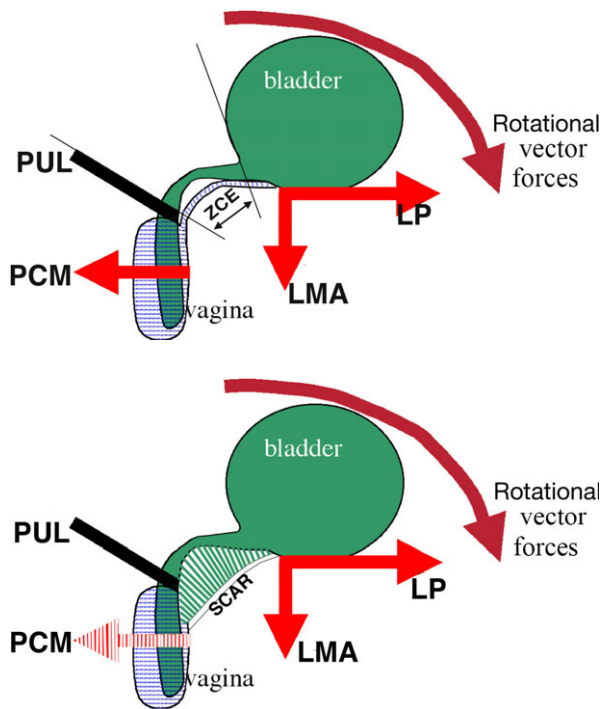
In 2015, the authors looked at the problem from the perspective of the integral theory of female urinary incontinence<sup>5</sup> which emphasises the importance of adequate vaginal elasticity in the bladder neck area of the vagina ['zone of critical elasticity' (ZCE)]. Elasticity is required to facilitate independent action of the opposite striated muscle vectors which close the urethra (Figure 1). We hypothesised<sup>6</sup> that urine leakage following vesicovaginal fistula repair may be a more extreme version of the 'Tethered vagina syndrome' (TVS) (Figure 1).<sup>5,7,8</sup> With TVS, the scar tissue at ZCE 'tethers' the stronger posterior muscle vectors to

overcome the weaker anterior closure vectors (Figure 1). This action forcibly opens the urethra, resulting in massive leakage, even at rest. We hypothesised that the aims of surgical restoration should include restoring anterior vaginal wall elasticity with vascular skin flaps (for example, Singapore flap), restoration of pubourethral ligament (PUL) and formation of a smooth muscle neo-urethra.

The aim of this paper is to describe the surgical methodology for the prevention and cure of post vesico-vaginal fistula (VVF) repair urine leakage and to analyse systematically the anatomical basis of this method.

## Ethics

No ethical approval was required for this operation. The Singapore Flap is not new. What is new is conceptual: understanding how obstetric fistula causes scarring, how scarring removes the vaginal elasticity,<sup>5</sup> and how the Singapore Flap restores elasticity and continence. Information was collected prospectively from records entered into an electronic database, ensuring patient anonymity.



**Figure 1.** Mechanism of urine loss with Tethered Vagina Syndrome. Upper figure: Normal urethral closure in the female during coughing or straining. PCM, m.pubococcygeus; LP, levator plate; LMA, conjoint longitudinal muscle of the anus; PUL, pubourethral ligament. ZCE (zone of critical elasticity) allows separate action of forward and backward vectors. By permission Peter Petros. Lower figure: Mechanism of scar induced incontinence. During effort, LP/LMA vectors overcome the weaker PCM vector (weakness indicated by broken lines) to open out the urethra as per micturition.

## Methods

The purpose of the surgery is restoration of vaginal elasticity by a Singapore Flap. This is performed either prophylactically at the time of fistula repair or secondarily, that is, after successful fistula closure but in those women who remain with debilitating, continuous incontinence, reminiscent of the complete incontinence with a fistula.

When repairing a severe type 4 Goh fistula (almost all urethra involved, most of the vagina destroyed and severe vaginal scarring), the standard operation was performed by the senior author (A.B.). This includes reconstitution of a urethral tube contiguous with the bladder and creation of competent midurethral ligament support. In addition, normal vaginal elasticity was restored using a Singapore flap. All three structures (urethra, ligament and vagina) are thought to be essential for normal bladder function.<sup>5</sup> In our 2015 hypothesis, we proposed that the skin flap should be applied prophylactically,<sup>5</sup> that is, at the time of the initial fistula repair.

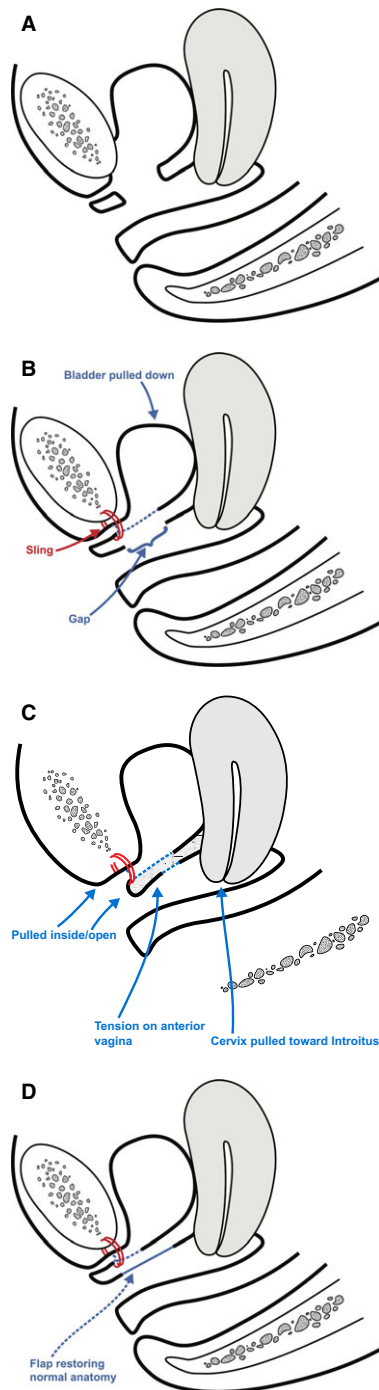
The Singapore flap can also be used to treat ongoing incontinence despite a successfully closed fistula. The

operation to improve continence used by the senior author aimed at restoring normal urethra anatomy, reconstructing the pubourethral ligament, and restoring normal vaginal elasticity. Often much of the urethra has been totally or subtotally destroyed by the obstructed labour and the repaired urethra may be only 0.5 cm wide and gaping, so a normal urethral length and width was restored using bladder tissue. A sling of autologous material is used to replicate the pubourethral ligament using either pubococcygeal muscle or rectus sheath, anchoring it to the pubic arch anterior lateral to the urethra on either side. Finally, the vagina was repaired with no tension using the Singapore flap in those women in whom, after releasing the vagina from the urethra, bladder and pelvis, it was impossible to approximate the vaginal edges without tension.

### Singapore flap technique – step by step (author A.B.)

The Singapore flap can be done on the left or the right. The site is determined by which side of the vagina has the largest defect. The flap has its pedicle base just medial to the ischial tuberosity (Figures 2 and 3, Video S1).

- Palpate the ischial tuberosity to locate the base of the pedicle.
- Measure the length you need, using a finger or gauze measuring from the pedicle base to the point in the vagina furthest from the pedicle.
- Lay the length along the groin crease, add 2–3 cm more.
- Mark the anterior margin with your scalpel.
- Mark the posterior margin medial to the ischial tuberosity at the level of the posterior forchette.
- Incise the skin medial to the groin crease, connecting your anterior and posterior landmarks.
- Incise the lateral margin of the flap, extending it widely anteriorly and tapering off to the posterior edge.
- Dissect on the anterior margin through the skin incision to the muscle below.
- Traditionally, the fascia is taken off the muscle. This series only took the deep fascia under the fat, leaving the fascia on the muscle.
- Develop the flap to leave a wide pedicle posteriorly, preserving the blood supply medial to the ischial tuberosity.
- Undermine the skin posteriorly to gain further length to the flap.
- Make a tunnel into the vagina above, anterior to the descending pubic ramus. Ensure this is wide enough not to strangulate the pedicle. The pedicle consists of skin, fat and fascia down to the muscle and bone layer.
- Introduce the flap into the vagina.
- Suture the anterior portion of the flap to the contralateral vagina.



**Figure 2.** (A) Circumferential Vesico-urethral fistula- sagittal view. (B) Dissection off bone and scar completed; vaginal tissue deficit (gap); urethra repaired; recreation of pubourethral ligament-sagittal view. (C) The old method of vaginal closure pulling the vaginal gap together, scarring and pulling the urethra open. Ongoing incontinence almost always results. (D) Completion of normal anatomy with Singapore Flap (used by permission from Maternity Africa).

- Mark the amount skin of the flap in the vagina, then excise the posterior skin of the flap that is lying within the tunnel.
- Suture the flap in place to the lateral vaginal walls and into the proximal and distal vagina.
- Repair the donor site in three layers, one deep, anchoring it to the fascia over the muscle. One deep to the dermis and one skin layer.
- Suture a pack to cover the donor site wound.
- Pack the vagina.

The vaginal pack is removed the next day.

The gauze is removed after 48 hours. After removal of the gauze the patient is encouraged to keep clean and dry.

Instruct the patient not to sit for 48 hours after the procedure. She can lie or walk but if she sits on her ischial tuberosity, where the pedicle arises, this may compromise the blood supply.

### Catheter management

#### *Prophylactic group*

The catheter was left on free drainage for 10–14 days in the prophylactic group (10 days for new cases, 14 days for repeat cases).

#### *Group with ongoing incontinence despite prior successful fistula closure*

The catheter was left in place for 5–7 days.

#### *All groups*

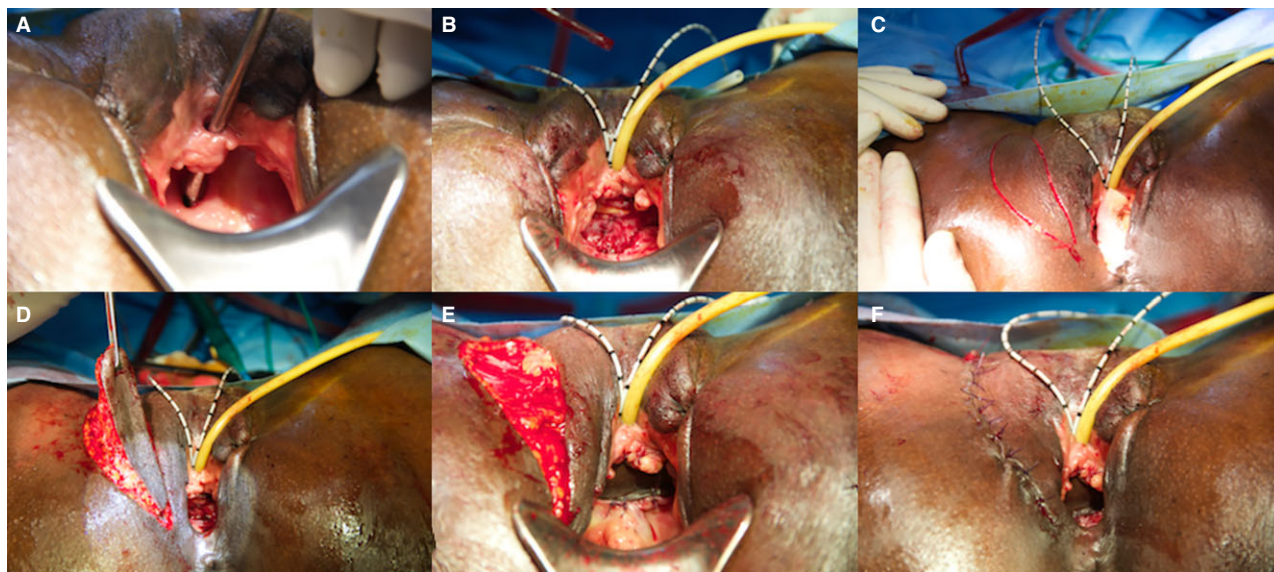
After catheter removal, all patients had ‘trials of void’, during which they voided, measured the voided volume and checked the residual volume with an in-out catheter. Patients were diagnosed with urinary retention if the retained volume was >50% of the voiding volume or >100 mL. This was managed with catheterisation.

## Results

The mean age of the 69 patients treated was 30 years (median 25, range 16–70); mean parity 2, median 1 (mean range 1–8), mean 3 days in labour (range 1–7). Mean review time for all cases was 2 weeks.

### Preliminary results

Comparisons were made with like groups from historical records of the author.<sup>9</sup> These records consist of almost 4000 consecutive cases going back 10 years. The cases were matched in the prophylactic group with a large Goh type 4 fistula, with nearly all of the urethra destroyed, a significant



**Figure 3.** Stages in urethral repair and augmentation of vagina with Singapore Skin Flap Graft. (A) Circumferential urethrovesicovaginal fistula; (B) Urethra and bladder repaired; (C) Skin incision for Singapore Skin Flap Graft; (D) Graft prepared; (E) Graft applied to vagina; (F) Graft site sutured (used by permission from Maternity Africa).

portion of the vagina destroyed and severe vagina scarring, often leaving no vaginal tissue remaining. Only 19% of these patients were dry using the same surgical techniques but not including flaps to restore the vagina.

For the cases with severe ongoing incontinence, the cases were matched with those women with complete incontinence and continuous leakage, and not voiding. In these women, there was severe vaginal scarring and loss of vaginal capacity (up to 100% loss) and multiple previous operations. Only 26% of these patients were dry using the same techniques to restore urethral length and width and to recreate the pubourethral ligament, but without restoring vaginal elasticity.

Prophylactically, with Goh type 4 fistula ( $n = 45$ ), 46% were dry against an expected 19%. With successful closure but still severe leakage ( $n = 24$ ), 71% were dry against an expected 26%.

## Discussion

This is the first time a skin flap has been systematically used to restore continence in patients with post VVF repair incontinence. The rationale was inspired by the integral theory to restore vaginal elasticity in the bladder neck area of the vagina – ‘zone of critical elasticity’ (ZCE) (Figures 1 and 2C): the bidirectional vectors act independently to close the distal and proximal urethra.<sup>5–8</sup>

We use the term ‘method’ instead of ‘technique’ because there is nothing new about a Singapore flap operation. What is new is the idea that the prime cause of this type of incontinence is the intense vaginal scarring which prevents

the opposite closure actions of the pelvic floor muscles and also scars the urethra, keeping it open (Figures 1 and 2C).

The Singapore flap was added routinely to A.B.’s standard fistula repair methodology, which includes midurethral support and fashioning a urethral tube, where required, from bladder smooth muscle

Clearly, it is preferable to insert the graft prophylactically during the initial surgical intervention. The indications for the graft are simple: if, after full dissection of the vagina off the pubic bones and urethra, the two sides of vagina remain separated, a skin flap is required to augment the vagina. Details of the technique are important. Adequate space must be left in the tunnel where the graft is pulled into the vaginal cavity. Because the wound tissues contract substantially in the 48 hours postoperatively, the tunnel may constrict sufficiently to choke the arterial supply to the graft. Haemostasis is important. A haematomata may lift the graft and cause necrosis and failure.

Because the midurethral ligament attachment to the vagina is almost invariably destroyed by head compression during the obstructed labour, midurethral attachment to symphysis with a sling of muscle or fascia is essential to restore closure.<sup>5,7–11</sup>

## Conclusions

These preliminary results demonstrate a dramatic initial leap in cure compared with previous methods. Logistic and geographical considerations precluded longer-term follow up, which clearly is required. However, 25 years of



experience with skin grafting for the Tethered vagina syndrome gives cause for optimism as regards longer term cure.<sup>7,8,10,11</sup>

### Disclosure of interests

None declared. Completed disclosure of interests form available to view online as supporting information.

### Contribution to authorship

AB, PP and GW conceived of the concept and designed the paper. AB performed all the surgeries, collected and analysed data. AB, PP and GW wrote the paper. Figures were drawn by PP and AB. AB produced the video.

### Details of ethics approval

No ethics approval was required.

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### Acknowledgements

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## Supporting Information

Additional Supporting Information may be found in the online version of this article:

**Video S1.** The 1st author (A.B.) describes his technique in detail. Video by permission, Maternity Africa. ■

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