

Insufficient Response to Venous Stripping Surgery: Is the Penile Vein Recurrent or Residual?

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ABSTRACT: There is currently controversy on whether the insufficient response to penile venous surgery done in an attempt to restore erectile function is due to recurrent or residual veins. In order to elucidate this issue, we report a study on those patients who failed to respond to the first venous surgery and subsequently underwent or declined a second operation. From July 1996 to July 2003, a total of 83 patients, aged 25 to 83, who were dissatisfied with their first venous surgery and were later diagnosed with a persistent veno-occlusive dysfunction via our dual cavernosography, were recruited into our study. Subsequently, 45 men underwent penile venous stripping surgery for a second time and were assigned to the surgery group, whereas the remaining 38 men were subject to follow-up and routine management and were assigned to the control group. All were evaluated with the abridged 5-item version of the international index of erectile function (IIEF-5) every 6 months for 1 to 5 years and cavernosogram, if necessary. In the surgery group their preoperative IIEF-5 score was 10.1 ± 3.7 , which increased to 17.1 ± 3.2 ($P < .001$) after the first surgery and further increased to 20.7 ± 3.1 ($P < .001$) after a second venous stripping of the

cavernosal vein that was consistently demonstrated on the cavernosogram. Overall, 41 men (91.1%) reported a positive response to further venous surgery, with more satisfactory coitus, after the residual veins were stripped thoroughly, although eventually 4, 3, and 3 men required additional oral sildenafil, penile implant, and intracavernosal injection, respectively. The follow-up period ranged from 12 months to 72 months, with an average of 37.0 ± 11.5 months. In the control group, however, their corresponding IIEF-5 score changed from 17.4 ± 2.9 to 16.9 ± 3.2 ($P > .05$). Finally, 11, 7, and 8 men required additional oral sildenafil, penile implant, and intracavernosal injection, respectively. Although there was no statistical significance between the 2 groups in the first postoperative IIEF-5 scores, there was a significant difference in their IIEF-5 after further venous surgery. In this study, we propose that the clinical relapse of erectile dysfunction is a result of "residual" veins rather than "recurrent" ones.

Key words: venous occlusive dysfunction, deep dorsal vein, cavernosal vein, para-arterial vein.

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Although Wooten first described ligation of the deep dorsal vein for atonic impotence in 1902 (Wooten, 1902), penile venous surgery was not popular until 1985 (Wespes et al, 1985; Bennett et al, 1986). The approach was extended from initial procedures involving single-vessel ligation of the deep dorsal vein to more elaborate techniques in which excision of the deep dorsal vein, cavernous vein, and crural vein were described (Puech-Leao et al, 1987; Lewis, 1988; Lue, 1989). Current theories, however, seem to ascribe the veno-occlusive dysfunction (VOD) to a defect within the penis rather than the veins themselves (Wespes et al, 1993) and suggest that the major contributor of erectile dysfunction is corporeal fibrosis due to an abnormality in the

regulation of collagen synthesis and suggest degradation as the most likely etiology, secondary to chronic ischemia (Nehra et al, 1996). Thereafter, venous surgery per se, regardless of how carefully it is performed or how complete in venous removal, might not resolve the erectile dysfunction of all patients (Rossman et al, 1990; Knoll et al, 1992; Freedman et al, 1993; Katzenwadel et al, 1993; Vale et al, 1995), although there was a report that venous surgery remains the current treatment in select patients (Wespes et al, 1994). Accordingly, the clinical guidelines panel of the American Urological Association supported this view in 1996 after a meta-analysis of literature reports, and declared that venous surgery was not justified for routine use (Montague et al, 1996). However, those venous surgeries were based on the penile venous anatomy previously described in the textbooks (Eardley et al, 2003).

The general consensus for penile venous surgeries was an early success with few long-term cures, because recurrence usually ensues in 1 or 2 years. Nonetheless, we used a modified venous stripping procedure that is

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microscopically manipulated and scrupulously complete, where we not only removed the deep dorsal vein (described traditionally) but also the cavernosal veins and the para-arterial veins (Hsu et al, 2003). The surgery was performed on an outpatient basis under local anesthesia (Hsu et al, 2002; Hsu et al, 2003). Neither a Bovie nor a suction apparatus is used in the entire procedure (Hsu et al, 2004), and no damage of the muscular integrity is caused (Hsu et al, 2004). Furthermore, we recently reported on a study that involved clinical evidence associated with imaging follow-up disclosing that the penile vein will not be recurrent in 17 years (Chen et al, 2005). Thus, there has been no scientific support for the belief that venous vasculature will be regenerated. We sought to report on those patients who underwent a second venous surgery due to an insufficient response to their first penile venous surgery.

Materials and Methods

From July 1996 to July 2003, a total of 83 patients, aged 25 to 83 years, who were dissatisfied with their first venous surgery were, 1–6 years after the first operation. They were diagnosed with persistent veno-occlusive dysfunction, resulting from some residual veins, via our dual pharmaco-cavernosography, in which the first set of cavernosograms was made immediately before 20 μ g prostaglandin E1 was intracavernously injected, while the arterial pulsatile function as well as its response to this agent could be assessed. Then the second set of cavernosograms was performed. Patients were excluded from participation in undergoing further surgery because of untreated chronic systemic disease or other obvious etiologies (eg, diabetes mellitus, chronic liver disease, renal failure, hormonal insufficiency, surgery- or trauma-related erectile dysfunction, etc). Subsequently, 45 of them (aged 25–83, with an average of 56 years) underwent penile venous surgery for a second time and were classified as the surgery group, whereas the remaining 38 men, ages 22–81, with an average of 58 years, were subject to follow-up and regular management and classified as the control group. They were evaluated with the abridged 5-item version of international index of erectile function (IIEF-5) scoring every 6 months for 1 to 5 years and cavernosogram, if necessary. They underwent venous stripping surgery on an outpatient basis under local anesthesia (0.8% lidocaine solution prepared in an epinephrine prerinsed steel bowl; then a proximal dorsal nerve block was performed via an infrapubic injection with a local infiltration of the penile ventral aspect and the skin layer surround the old scar) (Hsu et al, 2003).

Secondary Penile Vein Stripping (Figure 1)

A longitudinal pubic incision, along the previous operation scar, is made. The suspensory ligament is meticulously separated medially proximal along the pubic angle until the level of the infrapubic angle, where several old venous stumps (Figure 1A) may be encountered. A cavernosal vein (Figure 1B)

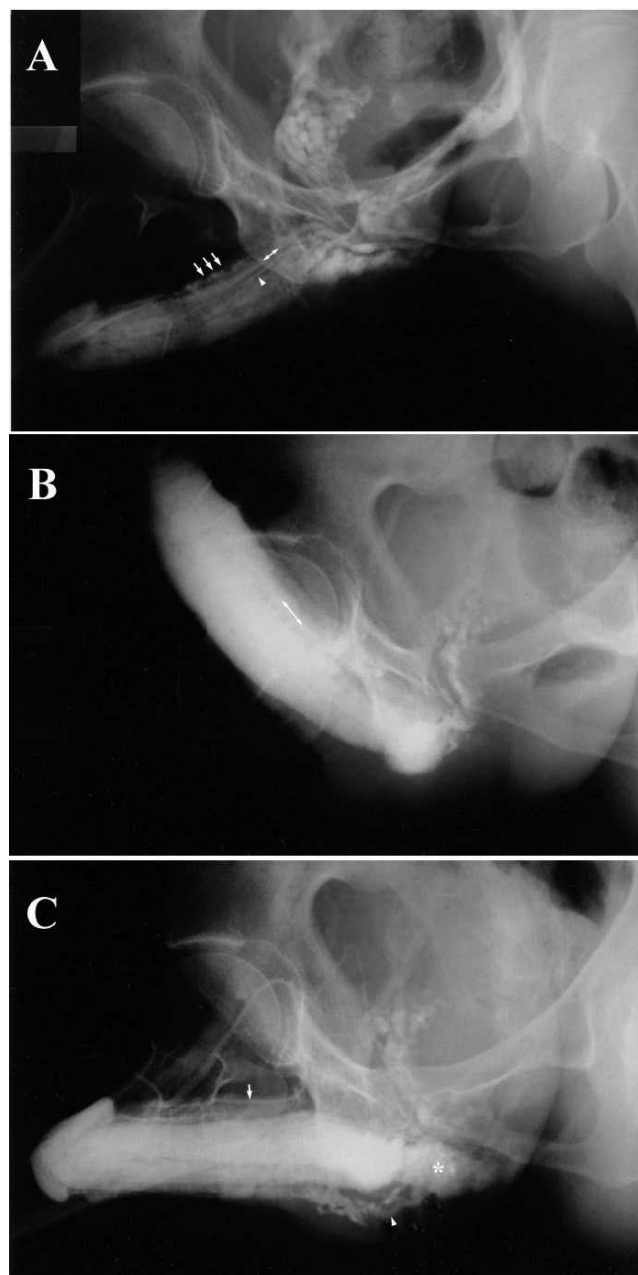


Figure 1. Cavernosograms. (A) Cavernosography is undertaken before the 20 μ g of prostaglandin E1 is injected intracavernously. This film discloses a huge deep dorsal vein (double-headed arrow) and an independent cavernosal vein (arrowhead). The notch-like appearance in the para-arterial vein (arrows) resulted from emissary vein drainage via sinusoidal blood. (B) Pharmacocavernosography then proceeded in 30 minutes via the same 21-gauge scalp needle. The drainage vein (double-headed arrow) remains opacified, albeit obscure, despite the existing rigid erection. This is a case of veno-occlusive dysfunction. (C) Voluntary follow-up film 6 months after the operation. Note that the glans penis, the corpus spongiosum, and the engorged bulbourethral vein (arrowhead) have become important routes of blood circulation. The superficial dorsal vein (arrow) is conspicuous after stripping surgery of the erection-related veins. The penile crus (asterisk) is readily distended. It is no wonder that the erectile capability was considerably improved postoperatively.

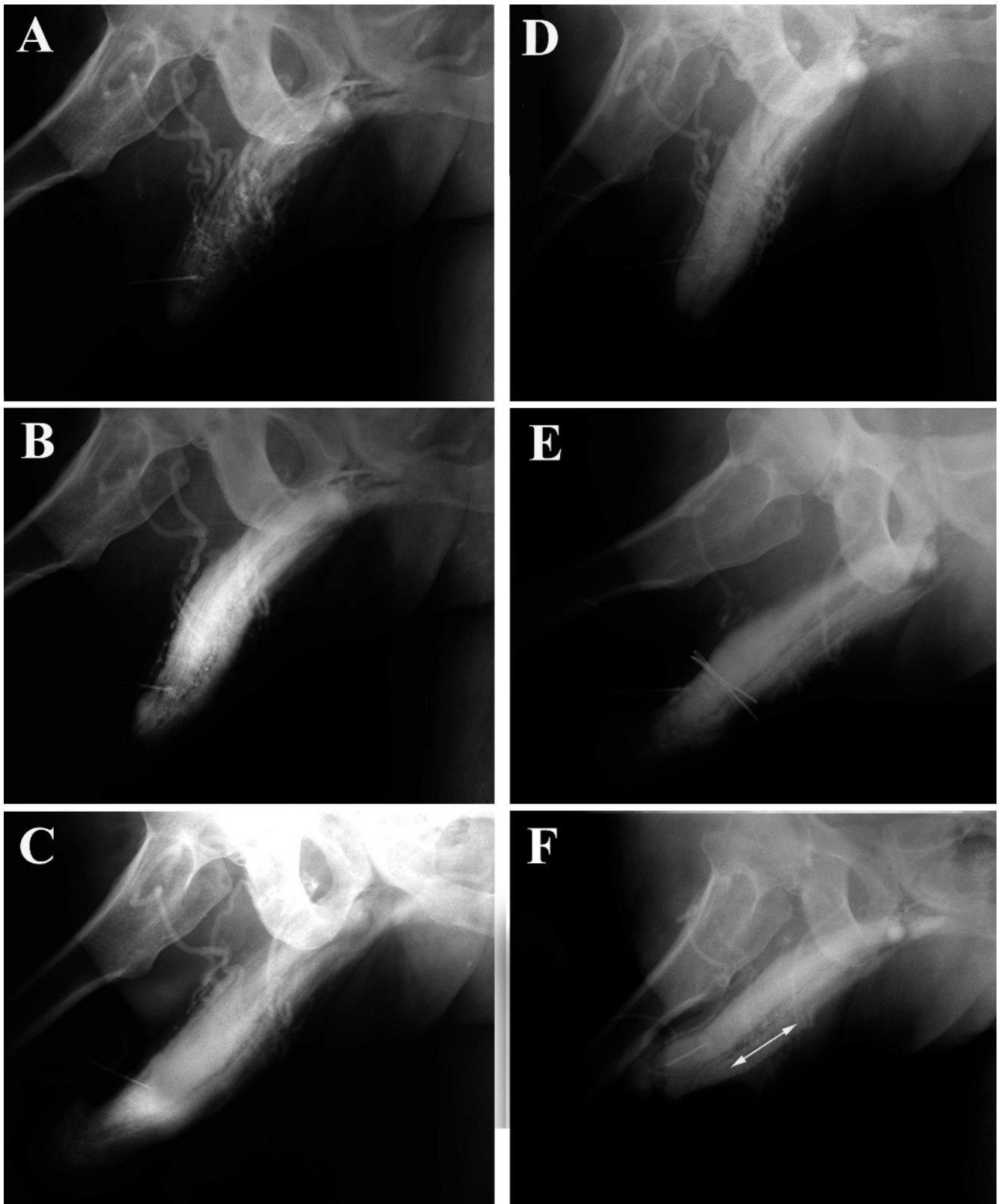


Figure 2. Cavernosograms of an 83-year-old patient showing the progression of 2 times of venous surgery. **(A)** An early phase of the cavernosograms before the first venous surgery showed many excessive drainage venous channels, including the deep dorsal vein (arrow), cavernosal vein (arrowhead), and the para-arterial veins. **(B)** A pharmacocavernosogram demonstrated that the drainage veins (arrowhead)

Summary of 83 patients who underwent venous surgery

Grouping	Patient		IIEF-5 Scores			PDE-5 Inhibitors	Implant	ICI*
	No.	Age (y)	Preop	Postop (1)	Postop (2)			
Surgery group	45	29–76	10.1±3.7	17.1±3.2	20.7±3.1	4	1	1
Control group	38	25–81	9.8±3.9	17.4±2.9	16.9±3.2	11	7	8
Total	83	15	8	9
P value†	...	NS	NS	NS	<.01	<.01	<.001	<.001

* ICI denotes intracavernosal injection of the prostaglandin E1.

† Univariate comparisons were performed using Student's *t* test, paired *t* test, and Wilcoxon signed rank test as necessary for parameters with continuous values and chi-square test with discontinuous parameters.

is consistently found, stripped thoroughly and ligated with 6-0 nylon. The para-arterial veins are managed similarly. Finally, the bilateral crural veins are ligated if encountered. The wound is closed with 5-0 catgut or 6-0 nylon sutures. A 90° Z-plasty is performed to treat a hypertrophied scar if it exists. A compression dressing is placed to encircle the penile shaft, which is stretched as much as possible by an assistant's hand.

Results

To provide a comprehensive overview, the Table summarizes the general data of these 83 patients. The follow-up period ranged from 12 months to 72 months, with an average of 37.0 ± 11.5 months. In the surgery group, their preoperative IIEF-5 score was 10.1 ± 3.7 , which was increased to 17.1 ± 3.2 ($P < .001$) after the first surgery and further increased to 20.7 ± 3.1 ($P < .001$) after a second venous surgery of the cavernosal vein. This finding was consistently correlated by the cavernosogram. Eventually, 4, 3, and 3 men required additional oral sildenafil, penile implant, and intracavernosal injection, respectively, for the achievement of satisfactory coitus. In 16 patients, a 90° Z-plasty was successfully used to solve a pubic hypertrophied scar. In the control group, however, their preoperative IIEF-5 score was 9.8 ± 3.9 , which was increased to 17.4 ± 2.9 ($P < .001$) after the first surgery and changed to 16.9 ± 3.2 eventually. Finally, 11, 7, and 8 men required additional oral sildenafil, penile implant, and intraca-

vernosal injection, respectively. Overall, 41 men (91.1%) reported a positive response to further venous surgery, with more satisfactory coitus consistently being encountered after the ascribed residual veins were stripped thoroughly.

Discussion

Initially, we planned to perform an infusion cavernosometry and cavernosography, with an intracavernosal injection of 20µg PGE1 for the follow-up investigation. A stunning PGE1-induced priapism that required emergency treatment occurred in a patient in the surgical treatment group. The necessary measurements were made following Bochinski et al (2003), and we then decided to omit the usage of prostaglandin E1 in the follow-up cavernosography. Furthermore, many patients declined the follow-up cavernosometry. Similarly, a Rigiscan monitoring might be helpful and was proposed initially, but many patients are not cooperative once the surgical response is satisfactory. The regrettably incomplete data prevent a further analysis, since they might jeopardize the study and lead to a biased conclusion, although fortunately the veno-occlusive dysfunction was confirmed preoperatively. Recent studies disclose that the veno-occlusive dysfunction may be prevalent in ED patients and even in those patients whose arterial insufficiency would be expected (Fuchs et al, 1989; Melman and Gingell, 1999; Elhanbly

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were clearly seen and an erectile penis resumed immediately to flaccid status while the infusion flow was terminated. This was an indication of venoocclusive dysfunction. (C) An intra-operative film was taken during the first venous surgery where both the deep dorsal vein and the cavernosal vein presented no more? The superficial dorsal vein (arrow), however, was clearly demonstrated. Was it a complete venous surgery? (D) A cavernosogram was taken 6 months postoperatively because an insufficiently postoperative result was reported. Note that the numerous and huge circumflex veins shunt directly with the sinusoids of the corpora cavernosal. Is it evidence of residual or recurrent veins? (E) An intra-operative film was taken and some residual venous channels should be managed while the second time of venous surgery was being undertaken. Therefore, it was stripped afterwards although challenging. Note that the location of the metal ring indicates the penopubic junction. (F) A volunteer cavernosogram was taken 1 year postoperatively, despite its being initially declined by patient, because a satisfactory postoperative result was reported. Note that only a few and small residual veins were seen in the penile hilum, and it is easier to be filled (opacified by contrast medium) in the penile crus. The corpus spongiosum (double-headed arrow) has become an important route of blood return.

et al, 2004). Thus, the prevalence of veno-occlusive dysfunction may be more substantial than commonly believed. Similarly, we found in this study that most patients are victims of the veno-occlusive dysfunction, a venous factor that cannot be separated from other contributing factors in spite of the fact that some obvious etiologies had been excluded. The number of patients indicated for penile venous surgery, therefore, might be more substantial than is commonly believed. Further scientific research of this topic is required.

Currently, penile venous surgery has been almost abandoned because of the discouraging results, which are commonly ascribed to the expectation of inevitable recurrence in 1 or 2 years. Although a large variety of techniques has been described that attempt to enhance the completeness of this surgery, complete venous stripping surgery was impossible, since the surgeon performs this surgery based on the traditionally described venous anatomy involving a single deep dorsal vein. The residual cavernosal vein, as well as para-arterial veins, should also be ligated in order to optimize the success of the surgery. Through past experience, and based on new insight into the penile venous anatomy (Hsu et al, 2003), a more thorough and complete venous removal can be achieved, despite being technically more challenging. The completeness of the venous removal appears to be each surgeon's goal rather than a good pretense of recurrence. We are currently conducting an animal experiment in which the potential regeneration of venous vasculature is studied.

Many surgeons question why and how neither a Bovie nor a suction apparatus is used in this challenging surgery. As far as we know, the sinusoidal tissues in the penis may be very susceptible to bleeding. During penile venous surgery the importance of minimizing bleeding is second to none, since poor visibility resulting from excessive blood can prevent the surgeon from continuing. The best policy, in our experience, to prevent bleeding is to keep the stripped venous channels in tension with proper compression of the sinusoidal tissue against the tunica albuginea rather than the application of electrocautery. Some surgeons have felt that the tunica albuginea acts as a barrier to transmission of electrocautery, allowing fulguration of veins on the surface of the penis without adverse effects. However, we have been concerned that cautery of emissary veins could result in clotting of sinusoidal plexuses and subsequent fibrosis, further increasing veno-occlusive dysfunction of the penis (Hsu et al, 2004).

It is impossible to overemphasize the importance of avoiding complications in any type of surgery. An

operation on the penis, which is extraordinarily delicate, can be most challenging. The described complications include postoperative shortages, curvature, numbness, lymphedema, infection, and a misligation of the penile artery, among others (Hwang and Yang, 1994; Kim and McVary, 1995; Da Ros et al, 2000). Since June 1988, we have performed the penile venous stripping procedure as an outpatient surgery under local anesthesia. Neither a Bovie nor a suction apparatus is used in the entire procedure, and no damage of any other tissue but the vein is permitted. There were no significant long-term complications. Moreover, we caution against too much separation of the tissue layers of the penile shaft and we recommend asking an assistant continually to stretch the penile shaft when a repair of the wound is being performed. By then, we no longer encounter any significant postoperative penile shortages, except for 5 cases of a slightly shorter presentation that required no more surgical intervention. Similarly, we have found no penile numbness that might be ascribed to nerve injury, misligation, or encasement. We consistently use 6-0 nylon (Hsu et al, 2002) for ligation of venous stumps, which can have as many as 76–125 sites present in each patient. It would seem logical that so many nonabsorbable sutures in the penis would be palpable postoperatively and might cause discomfort or other problems. However, these concerns were not encountered in this study. This could be due to the fact that the ligated veins are very small and located in the deeper layers of the penis, therefore making them less likely to be palpable from the penile surface. This finding in our study implies that these tiny, nonabsorbable suture materials may be suitable for this type of surgery. A suture material with less tissue reaction is important in order to avoid any possible tissue reaction. We are currently conducting a long-term study on this nonabsorbable 6-0 nylon suture material in a variety of penile surgeries to further elucidate this issue. Interestingly, no apparent tissue reaction has been found yet. This clinical application corresponds with the plastic surgeon's suggestion (Fernandez, 1960). Further scientific research is warranted.

The technique for using local anesthesia can be easily done because the penile shaft is devoid of fatty tissue and is surrounded by well-defined, layered fascia and bony-like tunica that serve as excellent landmarks for needle placement once the attending surgeon learns of the new insight into penile anatomy. This type of local anesthesia (Hsu et al, 2003; Hsu et al, in preparation), although challenging, not only keeps these operations on an outpatient basis, but also enables the patients to resume daily activity immediately after surgery. It has almost eliminated the adverse effect of anesthesia. The only shortcoming is that an inadvertent movement of

the operated patient can adversely affect the operation. Therefore, a warning should be given by the patient if he attempts a body movement.

The clinical guidelines panel of the American Urological Association declared that venous surgery was not justified in routine use, especially in patients with arteriosclerosis. Recently, we reported a hemodynamic study on 7 fresh human cadavers and found that reaching a rigid erection was, unexceptionally, attainable after the erection-related veins were removed in all subjects despite the fact that their sinusoidal tissues were not alive (Hsieh et al, in preparation). This suggests that a full-rigid erection may depend upon the drainage veins as well, rather than just the intracavernosal smooth muscle or fibrous tissue. We believe that penile venous stripping surgery deserves another look, and that it may be justified if those veins were stripped, if and only if the operation is thoroughly and properly performed, with completeness of venous removal and without tissue damage. Thus, this anatomical knowledge as well as a new insight into erection may be helpful in guiding clinical work (Hsu et al, 2006). Penile venous stripping surgery appears to be a curable option (Wespes et al, 1985) for treating ED after our clinical application for over 3000 patients in the last 2 decades (Hsu et al, 2002; Chen et al 2005). Although the number of patients is limited in this study, the postoperative outcome, coupled to its minimal invasiveness, supports our belief that this procedure remains a viable option for men refractory to medical therapy. We feel that our results differ from those of previous reports because of our surgical approach. In spite of encountering multiple small vessels, we did not use cautery or suction, since we felt that these might cause sinusoidal injury. Over the past 2 decades we have acquired extensive experience in this type of surgery, and we believe that a slow deliberate approach, at times requiring 3–6 hours and demanding between 76 and 125 ligatures per case for the sake of completeness, is the most important factor leading to surgical success and minimal tissue trauma. Penile venous surgery for erectile dysfunction, therefore, should not be discouraged. It is reasonable to perform this treatment, since the synergism of penile venous surgery and oral sildenafil in treating patients with erectile dysfunction has been shown (Wen et al, 2005). We propose that the clinical recurrence ought to be regarded as being due to residual rather than recurrent veins.

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