Journal of Andrology, Vol. 26, No. 1, January/February 2005
Copyright © American Society of Andrology

The Progression of the Penile Vein: Could It Be Recurrent?

SHYH-CHYAN CHEN,* CHENG-HSING HSIEH,* GENG-LONG HSU,* CHII-JYE WANG,†
HSIEN-SHENG WEN,* PEI-YING LING,* HSIU-MEI HUANG,* AND GUO-FANG TSENG‡

*From the *Microsurgical Potency Reconstruction and Research Center, Taiwan Adventist Hospital, Taipei Medical University, Taipei, Taiwan, Republic of China; †Kaohsiung Medical University and ‡Department of Anatomy and Cell Biology, College of Medicine, National Taiwan University, Taipei, Taiwan, Republic of China.*

ABSTRACT: Our aim was to study retrospectively the destiny of the deep dorsal vein of the penis in the event of its stripping surgery or its simple ligation in patients diagnosed with venoocclusive dysfunction 17 years ago. From June 1986 to May 1987, a total of 31 men were seen for erectile dysfunction due to venous leakage resulting from priapism, aging, or congenital or idiopathic factors. Of these, 23 men underwent venous stripping of the deep dorsal vein and are referred to as the stripping group. The remaining 8 patients received a simple ligation of the deep dorsal vein and are classified as the ligation group. A total of 21 patients (16 of the 23 and 5 out of the 8) were available for follow-up by using the abridged 5-item version of the International Index of Erectile Function (IIEF-5) scoring system and cavernosograms. In the ligation group, the imaging demonstrates some compensatory veins that are commensurate with impotence postoperatively. In the stripping group, however, the follow-up cavernosograms disclosed no venous recurrence, but residual ones that were not crucial to the rigidity. The IIEF-5 scoring in the ligation group changed from a preoperative mean IIEF-5 score of 10.0 ± 4.5 to 9.8 ± 3.6 postoperatively. In the stripping group, however, the mean preoperative IIEF-5 score of 9.8 ± 4.1 increased to a mean postoperative IIEF-5 score of 18.9 ± 2.1. Although there was no significant difference between the 2 groups' preoperative IIEF-5 score, there was a statistically significant difference between treatments ($P < .001$). The penile venous vasculature bears no evidence of regeneration even as long as 17 years after their removal. This finding is in contrast to what is commonly believed, that erectile dysfunction will recur about 2 years after ligation of the deep dorsal vein. We therefore believe that the clinical recurrence may not be due to venous regeneration, and penile venous surgery, if properly performed, may be durable, although larger studies will be required.

Key words: Venous destiny, venous ligation, venous stripping, deep dorsal vein, venous regeneration.

J Androl 2005;26:53–60

The anatomy of penile vasculature has been thoroughly studied and well described. Although Wooten first published ligation of the deep dorsal vein for atonic impotence in 1902 (Wooten, 1902), penile vein ligation was not popular until 1985 (Wespes and Schulman, 1985; Bennett et al, 1986). The approach was extended from early single vessel ligation of the deep dorsal vein to excision attempts of the deep dorsal vein, the cavernous vein, and the crural vein (Puech-Leao et al, 1987; Lewis, 1988; Lue, 1989). However, the limited accessibility of these offensive veins forces the surgeon to widen the dissection, which, in turn, leads to unnecessary damage to the delicate tissues. Given the disappointing outcome of surgical treatment, routine venous and arterial operation has not been justified since 1996 (Montague et al, 1996). Thereafter, penile venous surgery was generally condemned. It is currently rarely indicated and should only be performed in highly selected patients (Freedman et al, 1993; Berardinucci et al, 1996; Da Ros et al, 2000).

Correspondence to: Dr Geng-Long Hsu, Microsurgical Potency Reconstruction and Research Center, Taiwan Adventist Hospital, 424 Pa-Te Road, Sec 2, Taipei 105, Taiwan, ROC (e-mail: glhsu@tahsda.org.tw).

Received for publication April 15, 2004; accepted for publication July 29, 2004.

The regeneration of the artery and the capillary has been described (Buschmann and Schaper, 2000; Carmeliet, 2000). However, there are no descriptions of the outcome of the venous vasculature. It is generally agreed that reappearance of a venous channel at its original position is due to residual venous stump or collaterals. We sought to conduct a retrospective long-term study of the penile veins with the ultimate goal of exploring what the destiny of the penile vein is after surgical treatment.

Materials and Methods

From June 1986 to May 1987, a total of 31 men underwent venous surgery. Of these, 23 patients received venous stripping surgery. These are classified as the stripping group. A simple ligation was performed on the remaining 8 men. These are allocated as the ligation group (Tsai et al, 1988). Of those 23 patients, 16 were available for follow-up, and of the 8 patients, 5 were available for a follow-up. The abridged 5-item version of international index of erectile function (IIEF-5) scoring and cavernosography were performed in order to study the outcome of penile veins after patients underwent surgical treatment. One patient in the stripping group was excluded from the study because he died of hepatoma 4 years ago. Statistically the paired t test or Student's t test was applied whenever appropriate.

*Summary data of the 21 follow-up patients**

Patients	Age at Operation, y	IIEF-5 score (0–25)†		Cavernosogram‡		Sexual Activity 17 Years Postop
		Preop	Postop	Preop	Follow-up	
Ligation group						
1	54	11	9	Numerous huge veins, 2 major trunks, and a smaller one	Engorged veins with same number	Unable for 11 years
2	57	6	9	Excessive and numerous veins, 2 major trunks	Engorged veins with same number	Unable for 13 years
3	33	16	15	Excessive filling of corpus spongiosum, 2 major trunks	Engorged veins with same number	Dependent on sildenafil
4	56	12	11	Excessive and numerous veins, 1 major trunk	Engorged veins with same number	Unable for 6 years
5	42	5	5	Excessive and numerous veins, 3 major trunks	Engorged veins with same number	Unable for 15 years
Mean ± SD	47.6 ± 12.0	10.0 ± 4.5	9.8 ± 3.6			
Stripping group						
6	68	5	17	Excessive filling of corpus spongiosum, 2 major trunks	Some residual veins	Dependent on sildenafil
7	45	17	22	Excessive numerous veins, 2 major trunks, 1 smaller	No residual, marked corpus spongiosum	Naturally
8	70	6	15	Excessive numerous veins, 2 major trunks, 2 smaller	Significant residual veins	Masturbation sometimes
9	41	5	18	Excessive numerous veins, 3 major trunks	Some residual veins and corpus spongiosum	Sildenafil occasionally
10	30	12	21	Filling of corpus spongiosum, 2 major trunks	Some residual, marked corpus spongiosum	Naturally
11	57	13	23	Marked residual proximal vein, 2 major trunks	No residual, marked corpus spongiosum	Naturally
12	58	11	19	Excessive and huge veins, 2 major trunks, 2 smaller	Minimal residual, marked corpus spongiosum	Sildenafil occasionally
13	55	13	18	Filling of corpus spongiosum, 2 major trunks	Some residual veins, visible corpus spongiosum	Dependent on sildenafil
14	43	6	19	Marked corpus spongiosum, 2 major trunks	Minimal residual veins	Sildenafil occasionally
15	19	13	21	Huge numerous proximal veins, 2 major trunks	No residual vein, visible corpus spongiosum	Naturally
16	36	7	19	Excessive numerous veins, 2 major trunks, 1 smaller	No residual vein	Sildenafil occasionally
17	27	16	21	Excessive numerous veins, 1 major trunk	Minimal residual, visible corpus spongiosum	Naturally
18	65	7	17	Excessive numerous veins, 2 major trunks	Marked residual veins	ICI§
19	59	5	18	Excessive numerous veins, 2 major trunks, 1 smaller	Some residual veins, some corpus spongiosum	Sildenafil occasionally
20	43	12	17	Excessive numerous veins, 2 major trunks, 2 smaller	Some residual veins	Dependent on sildenafil
21	61	9	18	Excessive numerous veins, 2 major trunks, 2 smaller	Some residual veins	Dependent on sildenafil
Mean ± SD	48.6 ± 15.4	9.8 ± 4.1	18.9 ± 2.1			

* There was a statistically significant difference between treatments ($P < .001$), using Student's *t* test.
† Preop data were recorded from a retrospective memory recall of each patient. IIEF, International Index of Erectile Function.
‡ Interpretation based on the new insight of penile venous anatomy (Hsu et al, 2003).
§ ICI, intracavernosal injection.

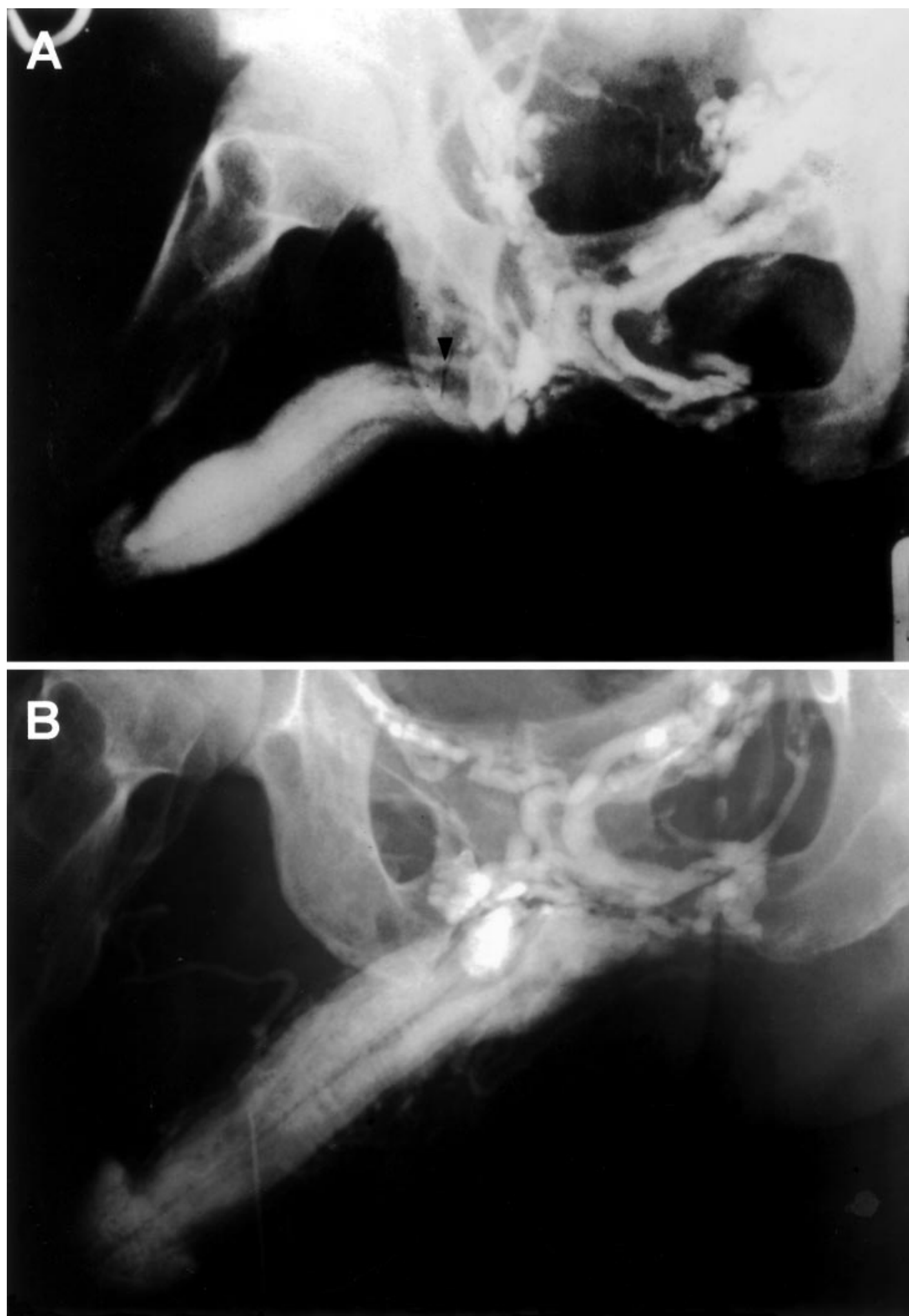

Figure 1. **(A)** In the ligation group a 56-year-old patient (age at surgery), a postoperative cavernosogram discloses obviously the trunk of the deep dorsal vein (arrowhead) that was distally ligated to the level of the penopubic fold 17 years ago. **(B)** Seventeen years later a follow-up cavernosogram shows that those residual veins are more engorged and numerous. Note that there is some distension of the penile crus, but it is insufficient to obtain a rigid erection after operation.

Results

To provide a comprehensive overview, the Table summarizes the general data of these 21 patients. Of the 5 patients available for follow-up in the ligation group, the cavernosograms (Figure 1) showed the entire venous channel to be engorged and numerous except at the ligation sites. A mean preoperative IIEF-5 score of 10.0 ± 4.5 shifted to 9.8 ± 3.6 after operation, which is commensurate with a poor responsiveness of venous ligation alone, although 1 of the patients could consistently enjoy satisfactory sexual intercourse with the use of oral sildenafil.

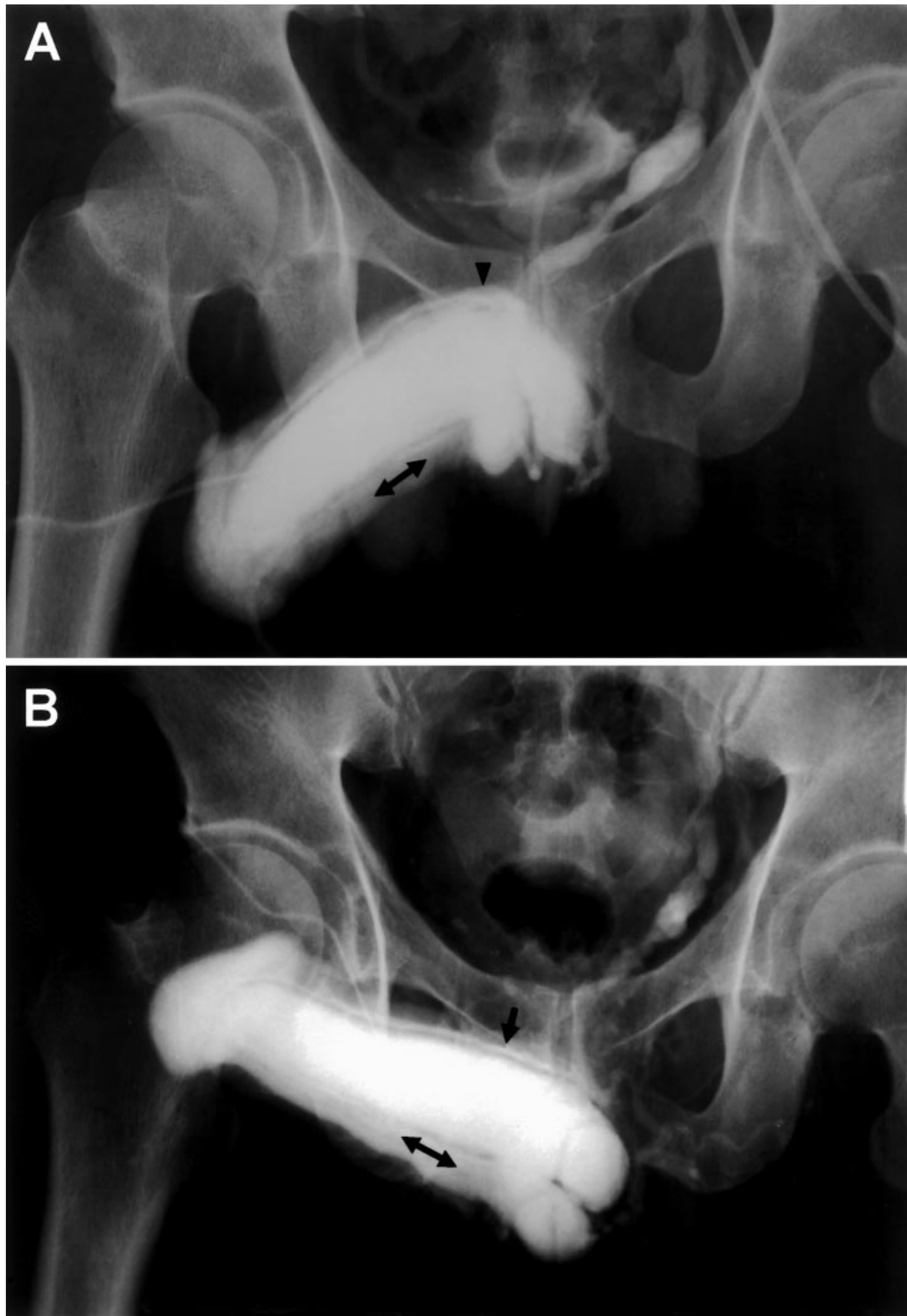

Figure 2. Cavernosograms of a patient in the stripping group. **(A)** In a 30-year-old male the venoocclusive dysfunction resulted from a straddle injury followed by a priapism. The huge venous plexus (arrowhead), the glans penis, and the corpus spongiosum (double-head arrow) are well opacified. During venous stripping 17 years ago the deep dorsal vein was removed almost thoroughly but not the cavernosal and para-arterial veins. This might be able to explain the reason of venoocclusive dysfunction because this patient has enjoyed normal coitus for 17 years. **(B)** Seventeen years later a follow-up cavernosogram shows a smaller vein (arrow) that might be regarded as a recurrent vein because it looks like it is in its original position; however, in our study it is indeed the ''residual'' cavernosal vein. Note that it is readily full in the crui after those veins were removed.

In the stripping group of 16 men (Figures 2 through 4), the leakage veins shown on the preoperative cavernosograms could not be demonstrated on the postoperative films except for some residual ones after 17 years. The mean preoperative IIEF-5 score of 9.8 ± 4.1 increased to a mean postoperative IIEF-5 score of 18.9 ± 2.1 postoperatively. Five of them could have satisfactory sexual activity naturally, and another 5 could enjoy sexual life with oral sildenafil occasionally required. Four men have depended on oral sildenafil for several years, and 1

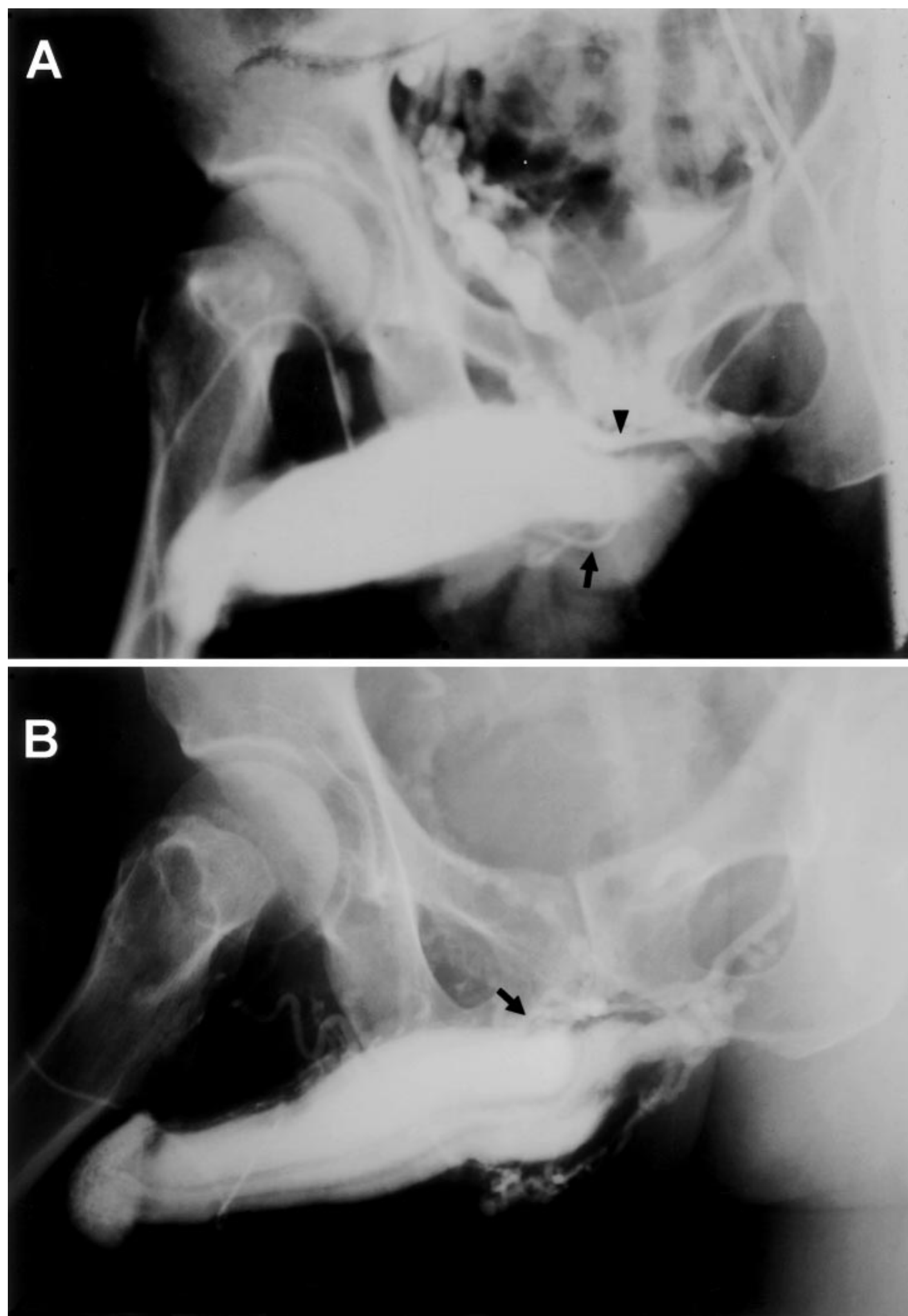

Figure 3. Cavernosograms of the spongiosal leakage. **(A)** In a cavernosogram of a 58-year-old patient, the huge vein (arrowhead), the glans penis, and the corpus spongiosum (arrow denotes the indwelled Foley catheter) were obviously visible and commensurate with erectile dysfunction 17 years ago. Then we removed those offensive veins between the 7 and 5 o'clock positions dorsally except those between the corpora cavernosa and the corpus spongiosum. **(B)** After 17 years a follow-up film discloses no venous recurrence, but a very tiny residual vein (arrowhead) that is not crucial in determining erectile function. Therefore it is not surprising that the patient is still able to enjoy natural coitus. Note that the internal pudendal vein is not readily opacified since the venous surgery.

uses penile intracavernosal injection of prostaglandin E1 occasionally. One patient was unable to have sexual intercourse.

The corpus spongiosum (Figure 4B) and the superficial dorsal vein become the important routes of circulation once the venous stripping of the erection-related veins has been well performed. Although there was no significant difference between the 2 groups before the operation, a statistically significant difference was found between the 2 treatments ($P < .001$).

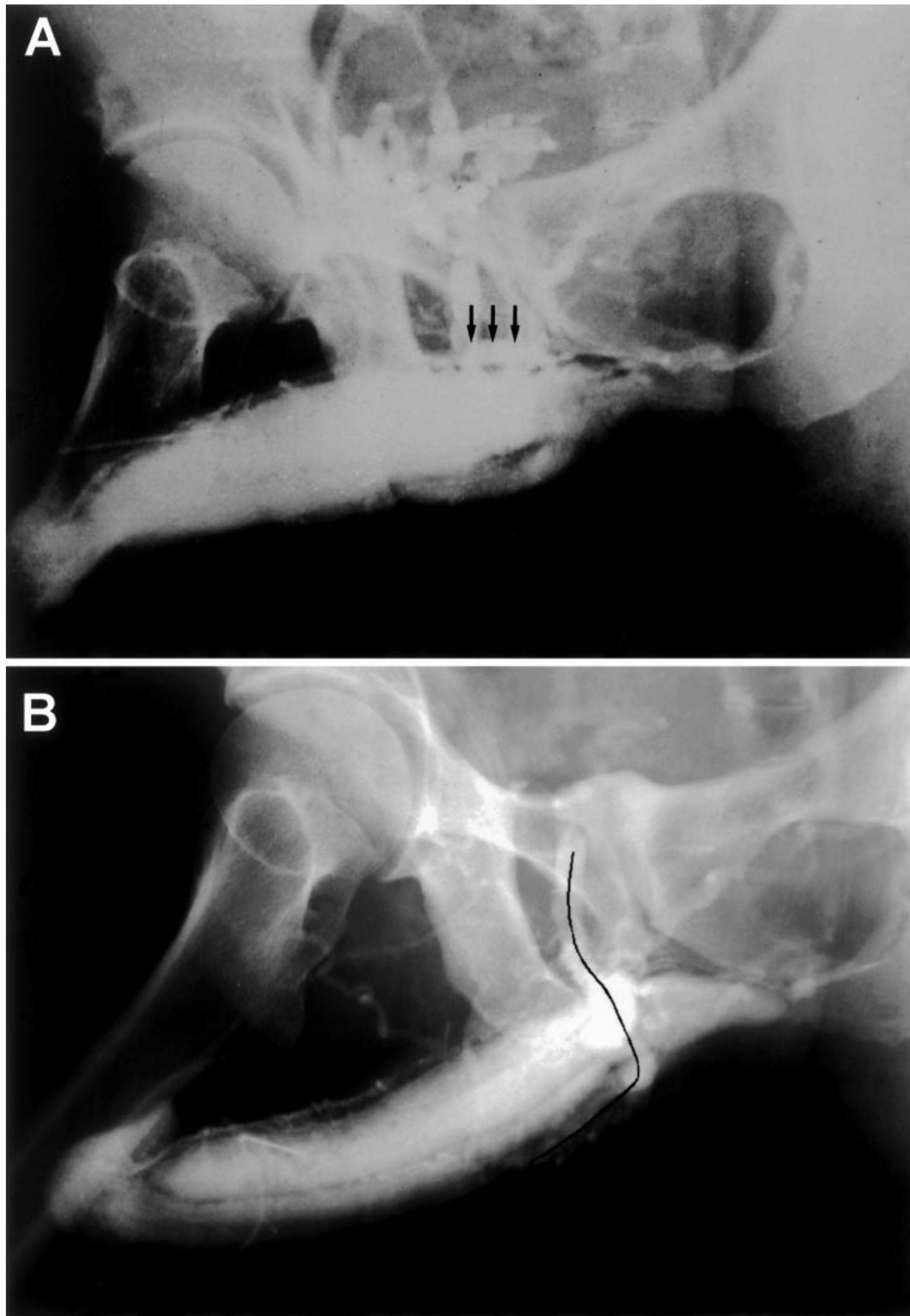

Figure 4. Cavernosograms in a 57-year-old patient. Erectile dysfunction had been improved for only 2 months despite the venous surgery about 18 years ago. **(A)** Then in our Institute a cavernosogram disclosed conspicuous veins (arrows) 17 years ago. Are they residual or recurrent? After those residual veins were stripped out, the patient could resume natural coitus. **(B)** The patient requested to have a follow-up film in 2003. Is there any recurrent vein in 17 years? Note that the bulbourethral vein (dark line) becomes the exclusive route of blood return. The penile crui are well distended in contrast to that in **panel A.**

Discussion

It is commonly believed that collateral veins are responsible for the recurrence in any part of the human body of a disease entity such as the varicose vein, hemorrhoid, and varicocele testis (Arbman et al, 2000; Jiang et al, 2000; Niedzielski and Paduch, 2001). It is therefore rational to perform the venous stripping on the legs, hemorrhoidectomy on the rectum, and varicocelectomy on the scrotum. However it has been commonly believed that erectile dysfunction will recur about 2 years after penile venous surgery is performed, and this type of surgery was

deemed unjustified after 1996. We believe that penile venous stripping surgery deserves another look, and that it may be justified if those veins were stripped thoroughly and carefully, without the expense of tissue damage.

Anatomically the human penis is a unique structure in which skeletal-muscle structures surround and contain smooth-muscle structures that are rich in the arterial and sinusoidal tissues. Moreover, the venous vasculature intermingles with small arterioles, lymphatic vessels, and delicate nerves. Therefore during venous surgery, as well as a variety of penile surgeries, the penis is susceptible to damage of its muscular integrity and a traumatization of those delicate tissues (Hsu et al, 2004). Despite associated difficulty, we advocate that atraumatic microscopic techniques used for management of the thin murine vein be deemed prerequisite to operation. Otherwise the vulnerability of venous bleeding might scare the surgeons and prevent them from further and complete removal of those offensive veins. In order to avoid tissue trauma, neither a Bovie nor a suction apparatus should be used throughout the entire procedure. In our surgical application the site of ligatures varies between 76 and 125 positions. This is much more numerous than that of any other kind of venous surgery in the human body. Thus, it is important for the surgeon to have the prerequisite microsurgical technique, but not at the expense of iatrogenic tissue damage and irreversible trauma resulting from widening the wound.

It is believed that one of the important leakage patterns is that of the spongiosal leakage. This involves the veins between the corpora cavernosa and the corpus spongiosum, and spongiolysis seems to be an exclusive solution for ousting them (Shabsigh et al, 1991; Motiwala et al, 1993). In our study, however, we treated such patients (Figures 2 and 3) by removing those offensive veins between the 7 and 5 o'clock positions dorsally except the ones between the corpora cavernosa and the corpus spongiosum. Then they could resume normal sexual activity despite the different treatment. The penis is flaccid and hangs down its dorsal surface faces anteriorly, but it faces posterosuperior when erect. Thus overwhelming stretch ensues on the corpus spongiosum when the penis is erect since the hammock action of the collagen bundle will control these veins. We believe that the corpora cavernosa could be the best milieu to apply the Pascal law in the human body.

Venous vasculature in the human penis is well described (Fuchs et al, 1989; Moscovici et al, 1999). It is commonly believed that a deep dorsal vein and a pair of dorsal arteries are found in between the tunica albuginea and the Buck fascia. Thus the penis is the 1 exception in the human body where the number of arteries is greater than the number of veins. However, recent reports have described that each of the paired dorsal arteries is sandwiched in with the medial and the lateral para-arterial veins, and the deep dorsal vein is sandwiched in by the cavernosal veins, which proximally coalesce to form one and then lies right but is housed in a different perivascular sheath (Hsu et al, 2003). Hence in the human body as a rule the number of veins is greater than the number of arteries. Not surprisingly, it is not difficult to leave a "residual vein" which is, in turn, described as a "recurrent vein," if a postoperative result is disappointing when venous surgery is attempted. In this study, 17 years after the stripping of the erection-related veins had been well performed in a human patient, the imaging of penile venous vasculature still bears no evidence of regeneration. This is contrary to the common belief that erectile dysfunction will recur in about 2 years, which has not been supported by any evidence of bioregeneration of the veins. We therefore believe that penile venous surgery, if and only if done well, could be durable and acceptable, although a study of larger sample size is mandatory.

The present consensus of the pathophysiology is that erectile dysfunction is due to the cavernosal factor, an inability to achieve a rigid erection attributed to loss of smooth-muscle relaxation and fibrous compliance. Recently we conducted a hemodynamic study on 7 fresh human cadavers and found that reaching a rigid erection was unequivocally attainable after the erection-related veins were removed in all subjects in spite of the fact that their sinusoidal tissues were not alive (Hsieh et al, 2004). This implies that a full-rigid erection may depend upon the drainage veins as well, rather than just the intracavernosal smooth muscle. We might elucidate that the mechanism of erection is also a matter of vascular hemodynamics. In conclusion, the physiology of penile erection warrants further scientific investigation, and there may be a role for penile venous surgery. Further scientific studies should be conducted to clarify this dilemma.

References

Arbman G, Krook H, Haapaniemi S. Closed vs. open hemorrhoidectomy—is there any difference? *Dis Colon Rectum.* 2000;43:31–34.

Bennett AH, Rivard DJ, Blanc RP, Moran M. Reconstructive surgery for vasculogenic impotence. *J Urol.* 1986;136:599–601.

Berardinucci D, Morales A, Heaton JP, Fenemore J, Bloom S. Surgical treatment of penile veno-occlusive dysfunction: is it justified? *Urology.* 1996;47:88–92.

Buschmann I, Schaper W. The pathophysiology of the collateral circulation (arteriogenesis). *J Pathol.* 2000;190:338–342.

Carmeliet P. Mechanisms of angiogenesis and arteriogenesis. *Nat Med.* 2000;6:389–395.

Da Ros CT, Teloken C, Antonini CC, Sogari PR, Souto CA. Long-term results of penile vein ligation for erectile dysfunction due to cavernovenous disease. *Tech Urol.* 2000;6:172–174.

Freedman AL, Costa Neto F, Mehringer CM, Rajfer J. Long-term results of penile vein ligation for impotence from venous leakage. *J Urol.* 1993;149:1301–1303.

Fuchs AM, Mehringer CM, Rajfer J. Anatomy of penile venous drainage in potent and impotent men during cavernosography. *J Urol.* 1989; 141:1353–1356.

Hsieh CH, Wang CJ, Hsu GL, Chen SC, Ling PY, Wang T, Fong TH, Tseng GF. Penile veins play a pivotal role in erection: the hemodynamic evidence. *Int J Androl.* 2004;27:1–5.

Hsu GL, Hsieh CH, Wen HS, Chen YC, Chen SC, Mok MS. Penile venous anatomy: an additional description and its clinical implication. *J Androl.* 2003;24:921–927.

Hsu GL, Hsieh CH, Wen HS, Hsu WL, Wu CH, Fong TH, Chen SC, Tseng GF. Anatomy of the human penis: the relationship of the architecture between skeletal and smooth muscles. *J Androl.* 2004;25: 426–431.

Jiang P, van Rij AM, Christie RA, Hill GB, Thomson IA. Venous physiology in the different patterns of recurrent varicose veins and the relationship to clinical severity. *Cardiovasc Surg.* 2000;8:130–136.

Lewis RW. Venous surgery for impotence. *Urol Clin North Am.* 1988; 15:115–121.

Lue TF. Penile venous surgery. *Urol Clin North Am.* 1989;16:607–611.

Montague DK, Barada JH, Belker AM, Levine LA, Nadig PW, Roehrborn CG, Sharlip ID, Bennett AH. Clinical guidelines panel on erectile dysfunction: summary report on the treatment of organic erectile dysfunction. *J Urol.* 1996;156:2007–2011.

Moscovici J, Galinier P, Hammoudi S, Lefebvre D, Juricic M, Vaysse P. Contribution to the study of the venous vasculature of the penis. *Surg Radiol Anat.* 1999;21:193–199.

Motiwala HG, Patel DD, Joshi SP, Baxi HM, Desai KD, Shah KN. Experience with penile venous surgery. *Urol Int.* 1993;51:9–14.

Niedzielski J, Paduch DA. Recurrence of varicocele after high retroperitoneal repair: implications of intraoperative venography. *J Urol.* 2001;165:937–940.

Puech-Leao P, Reis JM, Glina S, Reichelt AC. Leakage through the crural edge of corpus cavernosum. diagnosis and treatment. *Eur Urol.* 1987; 13:163–165.

Shabsigh R, Fishman IJ, Toombs BD, Skolkin M. Venous leaks: anatomical and physiological observations. *J Urol.* 1991;146:1260–1265.

Tsai TC, Hsu GL, Chen SC, Wang CL. Analysis of the results of reconstructive surgery for vasculogenic impotence. *J Formos Med Assoc.* 1988;87:182–187.

Wespes E, Schulman CC. Venous leakage: surgical treatment of a curable cause of impotence. *J Urol.* 1985;133:796–798.

Wooten JS. Ligation of the dorsal vein of the penis as a cure for atonic impotence. *Texas Med J.* 1902;18:325–328.