

The Effect of Electrocoagulation on the Sinusoids in the Human Penis

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ABSTRACT: We give an overview of patients who have undergone removal of the deep dorsal vein for venous grafting in treating Peyronie disease with or without a Bovie effect. From June 1998 to May 2002, 23 men received grafting of the deep dorsal vein for morphologic correction. Among them, 7 men underwent electrocoagulation treatment of bleeders per surgeons' customary practice during the entire procedure and were categorized as the electrocoagulation group. Sixteen patients received simple ligation of bleeding stumps, with 6-0 nylon sutures, and were classified as the ligation group. All were followed for satisfaction of penile morphology and assessed by the abridged 5-item version of the international index of erectile function (IIEF-5) scoring for erectile capability. In the electrocoagulation group, a mean preoperative IIEF-5 score of 22.5 ± 1.6 decreased to a mean postoperative IIEF-5 score

of 17.9 ± 4.1 . Among them 2 men (28.6%) had sustained postoperative infection. Follow-up cavernosograms showing relatively poor filling are commensurate with intracavernosal fibrosis. In the ligation group, however, the mean IIEF-5 score was 22.3 ± 1.9 preoperative and 22.9 ± 2.0 postoperative. Although there was no statistical significance between the 2 groups in preoperative IIEF scores, there was a significant difference between groups postoperatively. Application of electrocoagulation appears to be disadvantageous in preserving erectile tissues. A Bovie effect should be avoided in this erectile organ in order to preserve erectile capability and avoid infection.

Key words: Electrocauterization, ligation, Peyronie disease, deep dorsal vein, impotence, corporeal fibrosis.

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The anatomy and the layered nature of the human penis are unique (Dewire and Lepor, 1992; Hsu et al, 1992; Baskin et al, 2000; Hsu et al, 2002). Its erectile capability might be compromised if the erectile tissue is not handled properly during surgery. Every urologic surgeon has to face many types of surgeries on this delicate organ, some of which are meant to save erectile capability. It is rational for any surgeon to apply surgical principles to any organ encountered; therefore it is taken for granted that a Bovie should be applied to any bleeder when the penis is operated on (Kramolowsky and Tucker, 1991).

There are many reasons and purposes for operating on the penis. It is generally acceptable to destroy the erectile capability if surgery is to eradicate a cancerous entity. In contrast, however, if an operation is designed for reconstruction, in which case reduced erectile capability may draw protests from the patient (Lue, 1989; Hauri, 1999; Porena et al, 2002), the surgeon should make every effort to preserve erectile function. Herein, we analyze 2 groups of patients who underwent venous patch surgery for treat-

ing Peyronie disease with or without the application of a Bovie.

Materials and Methods

From June 1998 to May 2002, 23 men aged 24 to 57 (mean age, 35.0 ± 6.7) years with penile deviation of from 30° to 90° , which prevented them from performing satisfactory coitus, received an autologous penile venous patch of the deep dorsal vein for morphologic correction of their Peyronie disease. Patients were excluded from participation in the study because of untreated chronic systemic disease (eg, diabetes mellitus, chronic liver disease, renal failure, hormonal insufficiency, etc). Among them, 7 men underwent electrocoagulation treatment of any bleeding stump for hemostasis via electrocautery in which a monopolar electrode (ELMED, Addison, Ill) was connected to a Bovie® 400-SR Electrosurgical Unit (SYBRON, Rochester, NY) while the output power was set between 25 to 45 watts, as per the surgeons' customary practice during venous removal of the deep dorsal vein, fashioning of the venous tissue to the corporeal defect, and other procedures. These patients were classified into the electrocoagulation group. In addition, 16 patients received simple ligation of their bleeders. This surgical procedure using 6-0 nylon sutures, albeit sophisticated, is technically feasible, especially if the surgeons have had adequate microvascular surgery training in rats before initiating this operation on human patients (Hsu et al, 2003). Patients receiving this procedure were categorized as the ligation group. The operation time was re-

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corded in both groups. The times for circumferential incision followed by degloving the prepuce and finally skin closure with 5-0 chromic suture were similar between groups.

In the electrocoagulation group, 2 patients subsequently received a penile implant to treat their annoying erectile dysfunction. Some sinusoidal tissues were taken for histologic examination. In the ligation group, 1 patient underwent a second curvature correction in spite of the curvature being less than 15°, which did not prevent him from performing normal coitus. A piece of sinusoidal tissue was taken for histologic comparison. Masson trichrome stain was used.

Cefamezine (1000 mg) and gentamycin (80 mg) were routinely used intravenously and intramuscularly, respectively, as prophylactic drugs preoperatively; cefadroxil monohydrate (500 mg orally twice daily) and acetaminophen (500 mg 4 times daily) were prescribed for 1 week postoperatively. All were followed for satisfaction of penile morphology with a pharmacocavernosography (Figures 1 and 2) if required and assessed by the abridged 5-item version of the international index of erectile function (IIEF-5) scoring for erectile capability. Student's *t* test and Fisher's exact test were applied whenever necessary.

Results

The Table summarizes the general data of these patients. The follow-up period varied from 7 months to 4.5 years, with an average of 23.7 ± 6.2 months. There is no significant difference of age distribution between the 2 groups. Overall, the postoperative penile shape was satisfactory in 21 (91.3%) patients in whom the postoperative penile deviation was less than 10°. However, mild penile deviation of less than 15° was reported in 2 (8.7%) patients, one of whom received a second curvature correction. Among patients who underwent an electrocoagulation or ligation, statistically there was no preference of treatment in predicting postoperative morphology of the penis.

Erectile function was unchanged in the ligation group, in whom a mean preoperative IIEF-5 score of 22.3 ± 1.9 varied to a mean postoperative IIEF-5 score of 22.9 ± 2.0 . In the electrocoagulation group, the mean IIEF-5 score of 22.5 ± 1.6 decreased to a mean postoperative IIEF-5 score of 17.9 ± 4.1 despite the fact that the morphology was satisfactory. The group with electrocoagulation was statistically susceptible to infection ($P = .001$); of them 2 men (28.6%) sustained postoperative infection that was treated for 1 and 2 months, although the time for the operation was significantly reduced ($P < .0001$). The follow-up cavernosograms, which indicated relatively poor filling, are commensurate with intracavernosal fibrosis; 2 of 4 patients who sustained erectile dysfunction subsequently received a penile implant. Statistical significance ($P < .01$) was encountered between 2 groups postoperatively.

A histologic comparison (Figure 3) of both groups disclosed extensive fibrosis in the electrocoagulation group in which normal smooth muscle cells were not readily seen, while abundant amounts of collagen was characteristic. In contrast there were plenty of smooth muscle cells that intermingled with fewer collagen fibers in the ligation group.

Discussion

It is rational to apply a Bovie whenever a bleeder is encountered according to our surgical training background (Watson and Loughman, 1978; Polk et al, 2001). However, in our analysis, this principle may require alteration if the organ is related to erectile tissues of the penis. Because the penis is an overwhelming bleeder, it may be unwise to apply a Bovie to overcome the tendency of bleeding. Surgeons may need to alter their attitude in managing this unique organ during operations. We believe that simple ligation, although sophisticated and difficult, of any bleeders encountered may be the best policy because there will be no further damage to the erectile tissues. We used fine 6-0 nylon, which is sufficiently tenacious and biocompatible, rather than a coarser or absorbable kind.

Initially, we planned to perform a penile biopsy every 6 months. The patients in the ligation group declined to receive such an invasive follow-up procedure. The patients in the electrocoagulation group were also unwilling. In spite of the fact that sinusoidal tissue was limited to 3 patients, the disadvantages of the electrocautery to the erectile capability are inferable in this study because the patients who received electrocautery consistently sustained poor erection, which was commensurate with poorer IIEF-5 scores associated with cavernosograms. This adverse effect, however, may be acceptable to the erectile capability if the electrocautery is targeted to the bleeders superficial to the Buck fascia rather than those related directly to the sinusoids of the corpora cavernosa. Similarly, a randomized experiment is promising, but most patients are not cooperative because the superiority of simple ligation, which requires a prerequisite of microsurgical drills in rats, is so obvious. We eagerly look forward to having a more comprehensive set of data based on ongoing cadaveric and animal studies.

Corporeal fibrosis is hypothesized to develop secondary to abnormalities in the regulation of normal collagen synthesis and degradation, which results in veno-occlusive dysfunction (Moreland, 2000). There are many vascular insults that induce intracavernosal fibrosis. Those events, such as hypoxia, ischemia, hypercholesterolemia, and hyperglycemia, ultimately result in smooth muscle cell atrophy and death and progressive fibrous accumu-

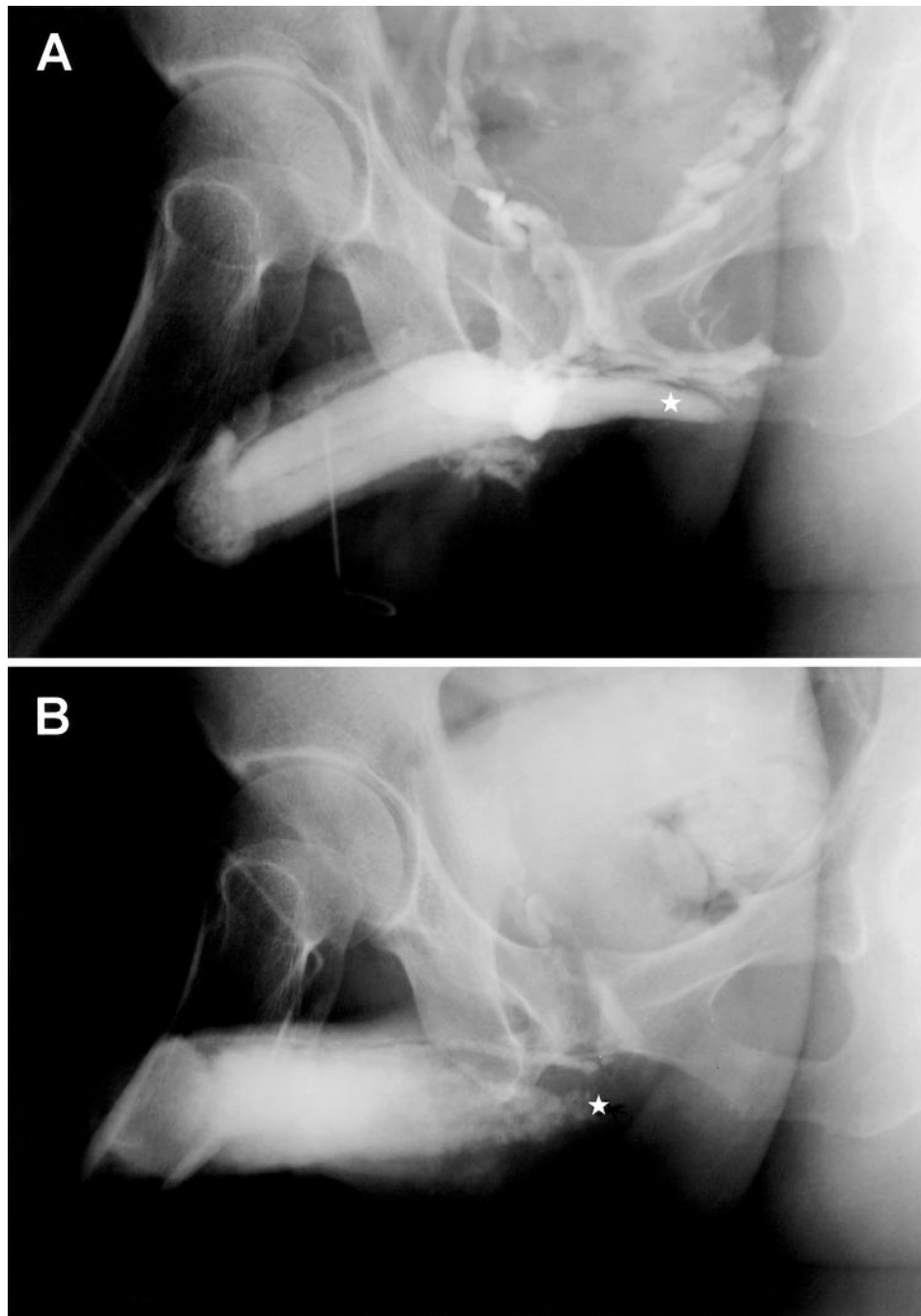


Figure 1. Pharmacocavernosograms of a 36-year-old patient in the electrocoagulation group. **(A)** Image of the flaccid state disclosing that the leftover branch of the deep dorsal vein is obscure and the situation of the sinusoid is difficult to determine. **(B)** Image after 20 μg of the prostaglandin E1 was intracavernously injected for 30 minutes showing that the appearance of the sinusoids is uneven and mottling. In the penile crura the absence of the contrast medium denotes that the distensibility of the sinusoid is significantly compromised.

lation (Moreland, 1998; Wespes, 2002). According to our investigation, the electrocoagulation may induce more extensive, remarkable, and irreversible impairment of those delicate erectile tissues. Some may feel that the cavernosometry rather than a cavernosogram may be a preferable tool to assess the sinusoidal status. We do not own

these data of the patients since they were not prompted to consult us for erectile dysfunction before operation.

The subtunical venular plexus collects sinusoidal blood and is the origin of the emissary veins. These veinlets penetrate the sinusoid by branching several times. The emissary vein runs obliquely through the tunica albuginea

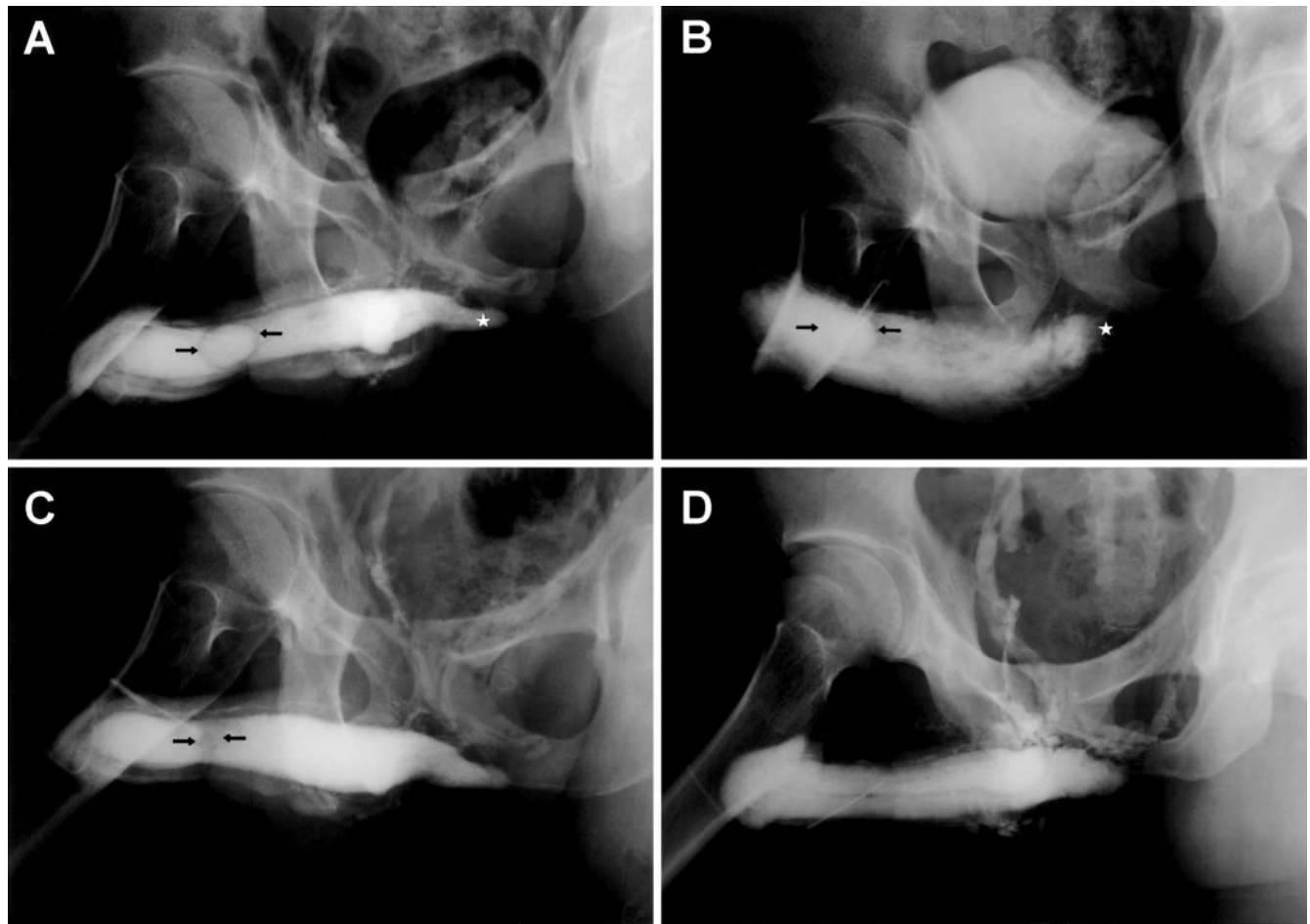


Figure 2. Comparison of cavernosograms. (A) Cavernosogram in the flaccid state of a 37-year-old man in the electrocoagulation group showing a coinlike ball (between arrows) around the scalp needle tip, which strongly suggests intracavernosal fibrosis. (B) After 20 µg of the prostaglandin E1 was intracavernously injected for 30 minutes, the filling of the contrast medium within the sinusoids is uneven and mottling, meanwhile the coinlike ball persists. The penile crus is unable to be filled in spite of the rigid erection during the injection. The dispersion of the contrast material around the tip of the scalp needle (arrow) is difficult. Thus the communication ability within the sinusoids is very limited. (C) Six months later the follow-up image shows the coinlike ball has disappeared and is replaced by a radiolucent area. (D) Image of a 37-year-old patient in the ligation group. In contrast to the man in the electrocoagulation group, the distensibility of the penile crus is good, implying that the erectile tissue is healthy. The deep dorsal vein is absent because it was removed previously.

Summary of pertinent features in 2 groups of patients who underwent venous patch surgery for treating Peyronie disease

Group	No. of Patients	Age, y	Angle of Deviation, Degrees		IIEF-5 Score		Operation Time, min	Postoperative Infection
			Preoperative	Postoperative (<10°)	Preoperative	Postoperative		
EG*	7	24–53 (34.3 ± 6.9)	30–75	6	22.5 ± 1.6	17.9 ± 4.1	195.3 ± 31.5	2
LG*	16	29–57 (36.8 ± 6.3)	30–90	15	22.3 ± 1.9	22.9 ± 2.0	273.5 ± 23.3	0
Total	23			21				2
P value†		NS	NS	NS	NS	<.01	<.0001	.001

* EG denotes the electrocoagulation group; LG, the ligation group.

† Univariate comparisons were performed using the Student's *t* test parameters with continuous values and Fisher's exact test for parameters with discontinuous values. NS (not significant) indicates *P* > .05.

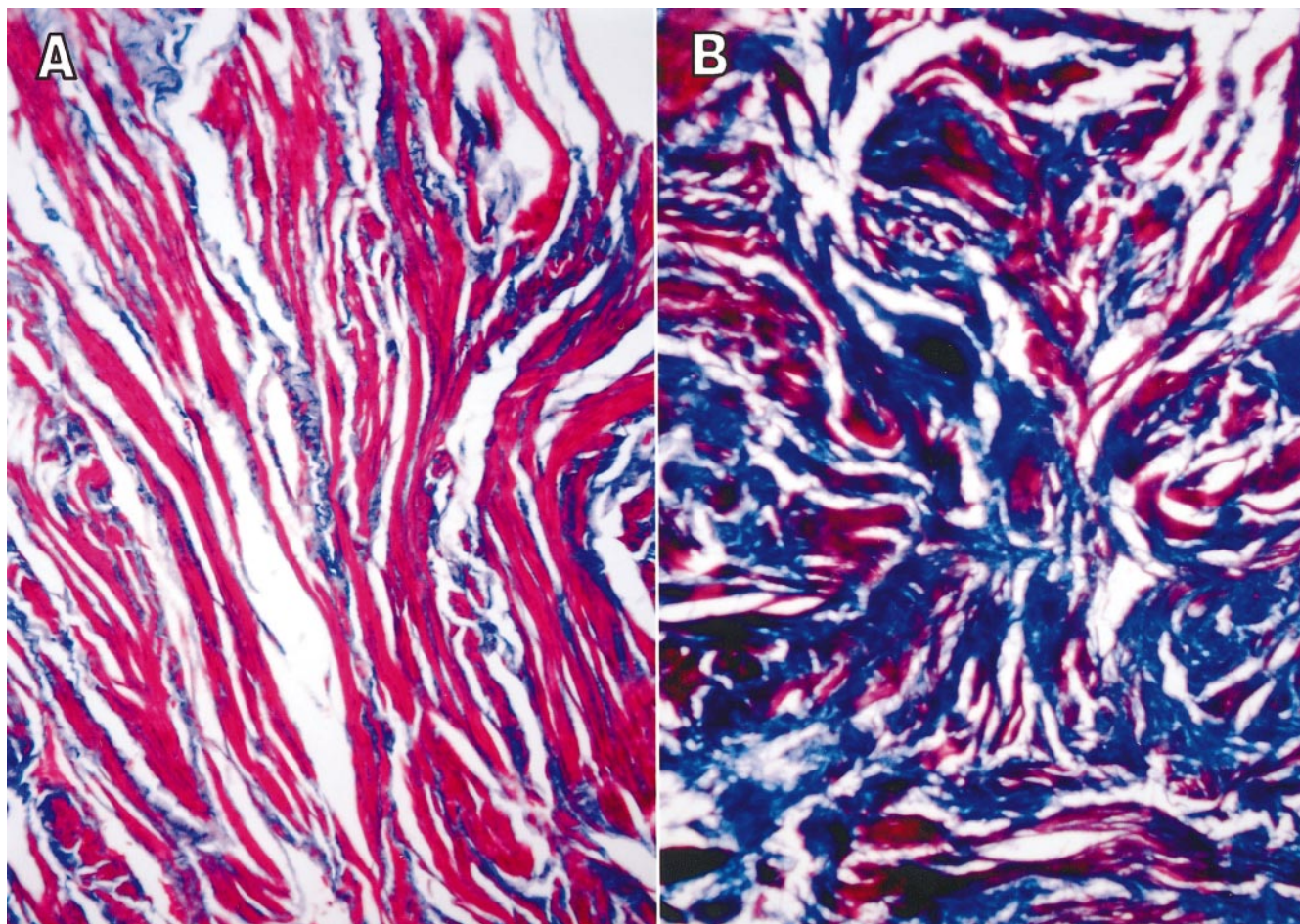


Figure 3. Histologic comparison: (A) Image of the sinusoid in the corpus cavernosum of a 51-year-old patient in the ligation group. The regular and health sinusoid with abundant smooth muscle (red color) is evident (reduced from $\times 400$, Masson trichrome stain). (B) Image of the sinusoid of the corpus cavernosum taken from a 37-year-old male during penile implantation in the electrocoagulation group disclosing extensive and significant fibrosis in which the collagen filers (blue color) predominated (reduced from $\times 400$, Masson trichrome stain).

and coalesces to drain into the deep dorsal vein. Once an emissary vein is stumped from the exit to the deep dorsal vein, its relationship to the sinusoids mimics a grapevine to a cluster of grapes (Banya et al, 1989). The electrocoagulation effect might be transmitted to the deep sinusoids if a Bovie is applied from the venous stump of an emissary vein, which, in turn, may lead to irreversible intracavernosal fibrosis, resulting in a bunch of raisins instead of grapes. Not surprisingly, erectile dysfunction may result.

It is generally agreed that excessive application of electrocoagulation current can produce tissue destruction extending far beyond the actual treatment site (Sebben, 1998). The treatment technique is crucial, however difficult to control, in applying a Bovie. As a result, slow healing (Liboon et al, 1997) and tissue necrosis can lead to an unsightly or hypertrophic scar. The postoperative infection that might be invited through the use of electrocautery is one of the major concerns in any type of penile

surgery (Bennett and Kraffert, 1990; Soballe et al, 1998). Although modern cardiac pacemakers are very well shielded and provide excellent rejection of any external electric interference, electrocautery can have significant detrimental effects in the paced patients (Levine et al, 1986). Some studies have shown that electrosurgical smoke can carry viable viruses within the particulate matter of the smoke. Moreover, the administration of electrosurgical current to tissue produces immediate vaporization of fluids with an aerosolization of tissue fluids and blood. The microdroplets may be dispersed a great distance and possibly be inhaled by nearby medical personnel (Sebben, 1998).

In 1900, electric current was first used in a surgical procedure. There are 2 types of electrocautery devices that currently exist: the monopolar and the bipolar (Sebben, 1989). It is commonly believed that the bipolar device allows more precise delivery of energy during an operative procedure and higher current density than

monopolar devices (Kerl and Staubesand, 1988). Although there are more advanced models of the Bovie available, which may cause fewer adverse complications to erectile tissues (Burns et al, 1999), and in spite of the fact that we have used a monopolar device in this study, we advise avoiding the application of a Bovie or similar tools since the generated energy is difficult to limit, and the penile tissue is unique and delicate. The penile hilum in the anatomic vicinity of the arterial, neural, lymphatic, and venous tissues is too close for a Bovie to be applied regardless of whether an advanced model is used.

Endothelial cells of the sinusoid can be reproduced via culturing of the corpus cavernosum, and the regeneration potential has been promising. However, its renaissance has not been proved. In our clinical experience, erectile capability cannot significantly be resumed within 3 years once a patient sustains erectile dysfunction after an operation. This implies that the adverse effect of a Bovie to the penis is irreversible. According to the available anatomic knowledge, the penis is a vascular organ in which the endothelial and smooth cells are susceptible to a Bovie effect. Therefore, it is not wise to apply an electrocoagulation to any vascular tissue in a reconstructive surgery.

Application of a Bovie appears to be disadvantageous to erectile tissues of the human penis. We feel that an electrocoagulation, preferably altered to a simple ligation, of the vessel stump should be avoided in this erectile organ in order to preserve erectile capability and avoid infection.

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