

## Early Results of Endovenous Ablation with a 980-nm Diode Laser for an Incompetent Vein of Giacomini

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**Objective:** We wanted to evaluate the effectiveness of endovenous ablation of the incompetent vein of Giacomini using a 980-nm diode laser.

**Materials and Methods:** A total of 18 patients (18 limbs, 4%) had the incompetent vein of Giacomini. Retrograde reflux originating from the great saphenous vein was noted in sixteen limbs and paradoxical diastolic anterograde reflux from the saphenopopliteal junction was observed in two limbs. After tumescent anesthesia, laser ablation using a 980-nm wavelength laser fiber was performed under ultrasound and/or fluoroscopic guidance. Patients were evaluated clinically and with duplex ultrasound at one week and at one, three, six and twelve months after laser ablation for the technical and clinical success.

**Results:** In the 18 limbs, the technical success rate was 100%. Continued closure of the vein of Giacomini was seen in 18 of 18 limbs after one month, in 12 of 12 limbs after three and six months and in six of six limbs after twelve months. No recanalization of the vein and no major complications occurred.

**Conclusion:** Endovenous laser ablation with a 980-nm wavelength is an effective and safe procedure for treating an incompetent vein of Giacomini.

**Index terms:** Vein; Ultrasound; Laser

### INTRODUCTION

The vein of Giacomini (VG) is an intersaphenous anastomosis that was first described in 1873 (1). The VG typically presents in three sections: the distal and proximal sections in the saphenous compartment (2, 3),

and the middle section that is usually subcutaneous (4). On transverse scanning of the posterior thigh, the VG is detected in a groove between the semitendinosus muscle medially and the long head of the biceps muscle laterally (4, 5).

The VG is sometimes involved in varicose vein disease, and Delis et al. (6) reported that reflux of the VG was found in 10 of 212 limbs (5%), and this was graded as C2 in five limbs and as C3-6 in the remaining five limbs. Such reflux usually occurs with retrograde flow originating in the great saphenous vein (GSV) or pelvic veins. Less frequently, this gives rise to a particular "paradoxical" varicose vein pattern with antigravitational upward diastolic flow from the saphenopopliteal junction (SPJ) (7).

In the last few years, endovenous laser treatment (EVL) has evolved into an accepted option for eliminating truncal reflux. Laser systems, including a 980-nm wavelength laser, have been used for the incompetent GSV or small

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saphenous vein (SSV) with the reported rates of saphenous vein occlusion ranging from 88% to 100% at the end of follow up (8-11). However, although EVLT using a 980-nm wavelength is an effective and safe modality for the management of incompetent saphenous veins, it is difficult to find independent reports on EVLT with using a 980-nm wavelength laser for an incompetent VG. Therefore, we performed EVLT using a 980-nm diode laser for 18 patients who each had an incompetent vein of Giacomini and we evaluated its technical feasibility and the early results.

## MATERIALS AND METHODS

### Patient Selection and Evaluation

From July 2005 to November 2008, 774 patients presented with varicose vein (CEAP Classification: C2-C6) at the out-patient departments of vascular surgery and thoracic and cardiovascular surgery and these patients subsequently underwent a duplex ultrasound examination after being referred to a vascular interventional radiologist. Duplex ultrasound was performed with the patients in the standing and supine positions and in a neutral state and with the patients performing the Valsalva maneuver to diagnose both reflux into the saphenous veins or the VG, and the presence of deep vein thrombosis. Reflux was defined as a reversal of flow in the saphenous vein or VG for over 0.5 sec after releasing the calf or thigh compression while the patient was standing and during the Valsalva maneuver while the patient was in the supine position. Diastolic anterograde VG was defined as unidirectional anterograde systolic and diastolic flow (4). Those patients younger than 18 years of age, those with nonpalpable pedal pulses or deep vein thrombosis and those who were non-ambulatory, in generally poor health, allergic to the sclerosant, pregnant, nursing or planning to become pregnant during the course of treatment were excluded from the study. The patients with an incompetent VG were given the choice of surgical management or EVLT.

Four hundred fifty-four patients were treated using endovenous sclerotherapy followed by EVLT. The total number of limbs was 587. Among them, 18 patients (18 limbs, 4%) had an incompetent vein of Giacomini. Therefore, 18 patients (M:F = 8:10; mean age, 42.2 years; range, 29-64) were enrolled in our prospective study. On the duplex ultrasound exams, retrograde reflux originating from the great saphenous vein was noted in sixteen limbs (89%) and paradoxical diastolic antegrade reflux from the

saphenopopliteal junction was observed in two limbs (11%). Written informed consent, with delineating the predicted result and the potential complications of this method, was obtained from all patients and our Institutional Review Board approved this study.

### Procedure

After providing written informed consent, the patient was brought to the interventional procedure room. The patient was placed in the supine position on the fluoroscopy table for the treatment of the VG. After draping the patient, the VG was accessed through the SSV or VG itself. However, if that access failed, then the VG was accessed through the GSV. Under ultrasound guidance, the SSV or VG was accessed using a 21-gauge needle (Cook, Bloomington, IN); the GSV was accessed in the groin area. Once the saphenous vein had been successfully punctured, a 0.018-inch wire and a 4- or 5-Fr microsheath (Cook, Bloomington, IN) were introduced into the puncture site under ultrasound (Medison, Seoul, Korea) or fluoroscopic guidance (Axiom Artis dTA: Siemens, Erlangen, Germany) after removing the puncture needle. A 0.035-inch guide wire (Terumo, Tokyo, Japan) was then advanced into the VG, and a 5-Fr Envoy guiding catheter (Cordis, Miami, FL) was advanced over the guide wire into the VG. When the guiding catheter had been stabilized, a 600 micrometer, sterile bare-tipped laser fiber (wavelength: 980-nm) (Daedeok Laser, Daejeon, Korea) was inserted into the guiding catheter. Under ultrasound guidance and using a percutaneous needle, a tumescent solution of 100-250 mL of 0.05% Lidocaine was delivered along the course of the VG or the saphenous vein within the fascial envelope under ultrasound guidance. The aiming laser beam was visualized, and the guiding catheter and laser fiber were pulled back together through the skin. Laser energy was delivered at 8-12 W in the continuous mode. The laser fiber was withdrawn at an average speed of about 5 mm per second.

Immediately after the procedure, the patient was discharged and the patient wore a class II (30-40 mmHg) full-thigh graduated support stocking for at least one month at all times, except while sleeping or showering. Patients were instructed to immediately ambulate and resume their normal activities. Each patient was given a prescription for analgesics and antibiotics for seven days.

Endovenous foam sclerotherapy using a microcatheter was performed in the varicose tributaries from the incompetent VG or saphenous vein before EVLT (10) (Fig. 1).

**Follow Up and Assessment**

Technical success in the EVLT procedure was defined as successful access and traversing the segment planned for ablation, adequate administration of tumescent anesthesia and delivery of laser energy to the incompetent VG.

The patients were evaluated clinically and using duplex ultrasound at one week and at 1, 3, 6, and 12 months after treatment and annually thereafter. The duplex ultrasound criteria used to define successful treatment were: non-compressibility of the treated veins with no blood flow within the ablated VG or saphenous veins. When the patients returned for follow-up evaluation, the clinical

evaluation included palpation, visual inspection and communication with the patient; the ultrasound evaluation was then performed by the surgeon who referred the patient and the interventional radiologist who performed the procedure. Improvements in varicosities were clinically assessed versus the pretreatment photographs, which were available for all patients. The patients were also checked for any adverse effects such as bruising, tightness, deep vein thrombosis, skin burns or paresthesia.



**Fig. 1. Endovenous laser ablation of incompetent vein of Giacomini with varicose vein.**

**A.** 33-year-old man with varicose veins in right lower extremity. **B.** Appearance of varicose veins was markedly improved at 12-month follow up after endovenous 980-nm laser ablation of incompetent vein of Giacomini.

## RESULTS

Technical success for accessing the VG, selective catheterization, tumescent anesthesia and EVLT was noted in all patients with an incompetent VG.

During the follow-up period, continued closure of the treated VG was seen in 18 of 18 limbs (100%) at the 1-month follow up, in 12 of 12 available limbs (100%) at the 3-month and 6-month follow up, and in all six available limbs at the 12-month follow up.

The varicose tributaries treated by endovenous foam sclerotherapy demonstrated no visible vascularity and no compressibility along their entire course in 16 of 18 limbs (89%) at the 1-month follow up, in all 12 limbs (100%) at the 3-month and 6-month follow up and in all six limbs at the 12-month follow up (Fig. 1). The volume of injected foam ranged from 2 to 8 ml (mean, 4.2 ml). Two limbs were selected for additional percutaneous sclerotherapy even though the varicose segment with compressibility was much shorter than the occluded segments. No limbs with complete occlusion in the varicose tributaries at the 1-week follow up exhibited reappearance of blood flow and compressibility on the later follow ups.

Two common side effects were noted with EVLT. The first was bruising, which was noted in 10 of 18 limbs (56%) at the 1-week follow up; however, the bruising was asymptomatic and it resolved completely in all limbs by the 1-month follow up. The other side effect was tightness or pain at the treatment site ( $n = 12$ , 67%). This was most commonly noted within one week after the EVLT, but it was greatly improved or it resolved by three or six months after the initial treatment.

Hyperpigmentation was noted in 11 of 15 limbs (73%) at the 1-month follow up. The limbs that were available for 6-month and 12-month follow up exhibited improved or no hyperpigmentation. There were no significant complications such as skin burns, skin necrosis, paresthesia, pulmonary embolism, cerebral infarction or allergic reaction.

## DISCUSSION

As an etiology of varicose veins, truncal reflux is usually associated with the GSV, the SSV and the anterolateral branch of the GSV. However, reflux in another branch leading to varicose vein disease is less documented, but it is of significant clinical interest as the diagnosis and treatment of venous disease has improved (12). Giacomini

described a thigh extension from the SSV that passed to join with the GSV, which consequently bears his name; he also described other deep vein destinations of this thigh extension through perforators or at the end of multiple tributaries in the superficial tissues or muscles (13, 14).

Based on a literature review, the prevalence of VG ranges from 82% (15) to 52% (16). Two color duplex studies reported that the prevalence of the VG was 63% (17) and 70% (18), respectively. Georgiev et al. (13) described the VG was affected by varicose disease with reflux. They studied 1226 limbs in 1000 consecutive patients and in whom GSV or SSV reflux was observed on duplex scanning. The VG, as described by Giacomini, was affected by varicose disease with reflux in 76 limbs (6%). This affected 5% of the limbs with primary varicose veins and 10% of the limbs with recurrent varicose veins after previous greater saphenous surgery. Other studies also reported that the prevalence of reflux in the VG ranged from 2% to 19% (6, 19-22). However, we could not evaluate the prevalence of VG among all patients who underwent Doppler US because we only evaluated the incidence of an incompetent VG. Comparable to previous reports, our study showed that the vein of Giacomini was affected in 4% of the limbs with varicose veins.

Vein of Giacomini involvement in varicose vein disease usually results from retrograde flow originating in the GSV or pelvic veins. Less frequently, this gives rise to a particular paradoxical varicose vein pattern with antigravitational upward diastolic flow from the SPJ. Primary varicose veins due to SPJ insufficiency with this anterograde diastolic flow are fairly rare, and they accounted for 1% of the patients in a previous study (4). In that previous study, 16 limbs had retrograde flow from the GSV into the incompetent VG and two limbs had anterograde diastolic flow into the incompetent VG, which is known as "paradoxical reflux". Therefore, identification of the incompetent VG and its reflux pattern is important since treatment that focuses on the GSV and SSV, which often results in removal of healthy veins, would not be effective in such cases.

Traditionally, the treatment for incompetent VG is hook phlebectomy or sclerotherapy. However, hook phlebectomy of the subcutaneous portion leaves an untreated incompetent vein with a greater potential for recurrence. Segmental phlebectomy of the subfascial branch requires larger incisions and operative dissection with the usual expected sequelae that can occur. The cosmetic appearance after these procedures can be an issue for patients (12).

Escribano et al. (4) suggested that it is important to determine the exact location of the junction of the VG with the SSV in the preoperative stage. In their study, which was done 1995 and 1997, seven cases of anterograde diastolic flow in the VG were treated with local avulsion of the varicose branch of the VG, but four of seven (57%) cases of clinical varicose vein recurred after 12 months' follow up and five of seven (71%) cases of sonographic reconnection ( $p = 0.0013$ ) were reported.

Since the first endovenous laser treatment (EVLT) of a saphenous vein was reported in 1999 (9, 10), subsequent studies of EVLT as a minimally invasive modality for the treatment of incompetent saphenous veins have been conducted. Different laser systems with various wavelengths have been used with the reported success rates of saphenous vein occlusion ranging from 88% to 100% at the end of follow up (9, 10). Kabnick (11) determined the relative effects of two laser wavelengths (810-nm versus 980-nm) for the treatment of GSV insufficiency. The result of that study revealed some positive trends in favor of the 980-nm wavelength laser in terms of bruising at the procedure site, the postprocedural pain intensity and decreases in the visible varicosities and phlebitis. Therefore, we selected an endovenous laser with a wavelength of 980-nm for our study. We achieved 100% technical success and 100% closure after six and twelve months. When compared to the previous studies on EVLT for incompetent saphenous vein, our study showed favorable and comparable results without any remarkable major complications. Bruising and tightness, which were considered complications after EVLT, presented only in the early period. These disappeared by the 1-month follow up or they were well-tolerated with no additional treatment. Compared to other studies that reported the incidence and results of these complications, we believe that the incidence and outcome of these complications in our study are acceptable.

Our study has some limitations and shortcomings. First, data collection over the 12-month follow up period was not fully achieved. Second, we did not evaluate the prevalence and anatomical pattern of the VG; rather, we just evaluated the presence of reflux in the VG. Third, there were risks associated with radiation exposure to the patients because fluoroscopy was chosen as modality to guide the procedure, in addition to ultrasound. Fourth, endovenous sclerotherapy using a microcatheter is not yet accepted as a common treatment for varicose tributaries.

In conclusion, despite these limitations and

shortcomings, endovenous laser treatment using a 980-nm diode laser is an effective, safe and technically successful method for treating an incompetent VG.

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