



Original Article

## Outcomes of Ultrasound-Guided Endovenous Laser Ablation of Varicose Veins Using Straight End-on and Radial Fibres in a Tertiary Care Centre: A Prospective Study.

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### ABSTRACT

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**Background:** Chronic venous insufficiency (CVI) leads to varicose veins and associated complications, affecting quality of life. Endovenous laser ablation (EVLA) is a minimally invasive alternative to surgery. This study aimed to compare outcomes of EVLA using straight end-on (bare-tip) versus radial fibres in patients with symptomatic varicose veins. **Methodology:** In this prospective observational study at Vishesh Jupiter Hospital, Indore (September 2021–August 2025), 400 patients underwent EVLA (210 straight fibre, 190 radial fibre). Procedural parameters, complications, symptom improvement, vein closure, recurrence, patient satisfaction, and time to return to routine work were recorded. Follow-up was at 1 week and 6 months. **Results:** Radial fibre EVLA had shorter procedure time (49.7 vs. 52.8 min,  $p=0.01$ ) and lower energy use (72.4 vs. 75.2 J/cm). Postoperative pain (6.8% vs. 18.1%), bruising (10.5% vs. 22.4%), and induration (7.9% vs. 16.7%) were lower with radial fibre. Vein closure was excellent in both groups (99.5% vs. 97.6%), with minimal recurrence. Patient satisfaction and early return to work were higher in the radial group. **Conclusion:** Both fibres are safe and effective, however, radial fibre EVLA provides shorter procedure time, less postoperative discomfort, faster recovery, and higher patient satisfaction, supporting its preferential use.

**Keywords:** Varicose veins, Endovenous laser ablation, Straight fibre, Radial fibre, Outcomes.

### INTRODUCTION

Chronic venous insufficiency (CVI) is a debilitating disease in which failure of the venous valves causes reflux and sustained venous hypertension. Varicose veins are tortuous, dilated superficial vein and often the first sign of progressive venous disease. Symptomatic varicose veins lead to complications such as oedema, thrombophlebitis, haemorrhage, skin changes and ulceration. Risk factors include increasing age, positive family history, obesity occupations requiring prolonged standing, pregnancy and parity. Globally, prevalence ranges from 10–15 % in men and 20–25 % in women in Western nations.<sup>1,2</sup>

Endovenous laser ablation (EVLA) has replaced traditional high ligation and stripping as the preferred modality due to its minimally invasive nature, reduced morbidity, and faster recovery. Two commonly used fibres in EVLA are the straight end-on (bare-tip) fibre and the radial fibre. The former delivers laser energy in a forward-directed manner, while the latter disperses energy circumferentially, potentially reducing vein wall perforation, pain, and bruising.<sup>3</sup> Previous international studies have demonstrated comparable occlusion rates but variable differences in complication profiles.<sup>4-6</sup> Despite increasing adoption of EVLA in India, limited comparative data exist regarding fibre-specific outcomes in real-world tertiary care settings.<sup>7</sup> This study prospectively analyzes outcomes of EVLA using straight end-on versus radial fibres among patients attending surgery OPD at a tertiary care centre.

## MATERIAL AND METHODS

This prospective, hospital-based observational study was conducted at Vishesh Jupiter Hospital, Indore, between September 2021 and August 2025. A total of 400 patients aged 18 years or older with symptomatic lower limb varicose veins and documented venous reflux who underwent endovenous laser ablation (EVLA) with complete intraoperative and postoperative records were included, of which 210 were treated with a straight fibre (Image-1,2,3,4) and 190 with a radial fibre. Data were collected using a predesigned semistructured questionnaire, and follow-up was conducted at 1 week and 6 months. All patients underwent baseline clinical evaluation, including Clinical Etiologic Anatomic Pathophysiologic (CEAP) classification and Venous Clinical Severity Score (VCSS) assessment. Duplex ultrasound was performed preoperatively and repeated at 6 months to assess vein closure and recurrence. Symptom severity was evaluated using VCSS at baseline and follow-up, postoperative pain was assessed using the Visual Analog Scale (VAS), and patient satisfaction at 6 months was measured using a 5-points Likert scale ranging from “very dissatisfied” to “very satisfied.” For analysis, patients reporting “satisfied” or “very satisfied” were categorized as having “high satisfaction.” Functional recovery was assessed by recording the number of days taken to resume routine work. Data were entered in Microsoft Excel and analyzed using SPSS trial version 20. Continuous variables were presented as mean  $\pm$  SD and compared using the independent t-test, while categorical variables were expressed as frequencies or percentages and analyzed using the chi-square or Fisher’s exact test. A p-value  $<0.05$  was considered statistically significant.



**Image-1: Intraoperative view of venous access during ultrasound-guided EVLA**



**Image-2: Intraoperative view of 16 gauge IV cannulation during ultrasound-guided EVLA**



**Image-3: Intraoperative view of infusion of chilled saline for perivenous cushion during ultrasound-guided EVLA**



**Image-4: Intraoperative transcutaneous visualization of the straight laser fibre tip.**

## RESULT

**Table 1. Baseline Demographic and Clinical Characteristics**

S.No.	Variables	Straight End-on Fibre (n=210)	Radial Fibre (n=190)	p-value (t-test and Chi-square test)
1.	Mean Age (years, $\pm$ SD)	48.2 $\pm$ 11.9	47.4 $\pm$ 13.2	0.54
2.	Male:Female ratio	122:88	104:86	0.62
3.	Mean BMI (kg/m <sup>2</sup> )	27.3 $\pm$ 3.8	27.1 $\pm$ 3.6	0.67
4.	CEAP classification: C2–C3 (%)	66 (31.4)	54 (28.4)	0.49
5.	CEAP classification: C4–C6 (%)	144 (68.6)	136 (71.6)	0.49
6.	Mean baseline VCSS score	9.4 $\pm$ 2.1	9.1 $\pm$ 2.3	0.38

The mean age of patients in the straight fibre and radial fibre groups was 48.2 and 47.4 years, respectively. Mean BMI was 27.3 kg/m<sup>2</sup> in the straight fibre and 27.1 kg/m<sup>2</sup> in the radial fibre group. The majority of patients in both groups were classified as CEAP C4–C6 (68.6% and 71.6%, respectively). Baseline VCSS scores were also similar between groups (9.4 vs. 9.1, respectively).

**Table 2. Intraoperative Parameters**

S.No.	Parameters	Straight End-on Fibre (n=210)	Radial Fibre (n=190)	p-value (t-test and Chi-square test)
1.	Mean procedure time (minutes)	52.8 $\pm$ 8.1	49.7 $\pm$ 7.9	0.01

2.	Mean energy delivered (J/cm)	75.2 ± 10.6	72.4 ± 9.8	0.03
3.	Additional phlebectomy needed	38 (18.1%)	32 (16.8%)	0.72

The mean procedure time was significantly shorter in the radial fibre group compared to the straight fibre group (49.7 vs. 52.8 minutes). Mean energy delivered was lower with radial fibre (72.4 vs. 75.2 J/cm). The need for additional phlebectomy was similar between groups (18.1% vs. 16.8%).

**Table 3. Postoperative Complications**

S.No.	Complications (within 1 week)	Straight End-on Fibre (n=210)	Radial Fibre (n=190)	p-value (Chi-square test and Fisher's exact test)
1.	Pain (VAS ≥4)	38 (18.1%)	13 (6.8%)	0.002
2.	Bruising	47 (22.4%)	20 (10.5%)	0.01
3.	Induration	35 (16.7%)	15 (7.9%)	0.03
4.	Paresthesia	6 (2.9%)	4 (2.1%)	0.67
5.	DVT	0	0	–

Postoperative pain (VAS ≥4) occurred in 18.1% of straight fibre group compared to only 6.8% in radial fibre group. Bruising (22.4% vs. 10.5%) and induration (16.7% vs. 7.9%) were significantly lower in the radial fibre group. Paresthesia rates were low and not significantly different (2.9% vs. 2.1%).

**Table 4. Clinical Outcomes and Patient Satisfaction**

S.No.	Outcomes and Patient Satisfaction	Straight End-on Fibre (n=210)	Radial Fibre (n=190)	p-value (Chi-square, t-test and Fisher's exact test)
1.	Vein closure at 6 months (%)	205 (97.6%)	189 (99.5%)	0.21
2.	Mean VCSS at 6 months	2.8 ± 1.0	2.4 ± 0.9	0.02
3.	Recurrence at 6 months (%)	5 (2.4%)	1 (0.5%)	0.21
4.	Patient satisfaction (Satisfied and very satisfied)	177 (84.3%)	176 (92.6%)	0.04
5.	Return to work <7 days (%)	152 (72.4%)	162 (85.3%)	0.003

Both groups achieved high vein closure rates at 6 months (97.6% vs. 99.5%), with no significant difference in recurrence (2.4% vs. 0.5%). Radial fibre patients had significantly lower VCSS scores at 6 months (2.4 vs. 2.8). Patient satisfaction was higher in the radial group (92.6% vs. 84.3%), and a greater proportion returned to work within 7 days (85.3% vs. 72.4%).

## DISCUSSION

The present study compares the outcomes of straight and radial fibres used in EVLA for varicose veins, highlighting procedural outcomes complications and patient satisfaction. The mean age was 48.2 and 47.4 years in straight and radial fibre group respectively. Setia et al. reported a higher mean age of 56 years (range 23–90),<sup>8</sup> while Hartmann et al. had a mean of 53.2 years.<sup>9</sup> By contrast, Elzefzaf et al. enrolled a younger sample (37.3 ± 8.3 years),<sup>10</sup> and Ewida et al. randomized patients with a mean ~30.6 ± 7.6 years,<sup>11</sup> reflecting centre-specific referral patterns. Studies by Aslam et al.<sup>2</sup> and Agarwal et al.<sup>7</sup> have shown that the prevalence of chronic venous disease increases with age. The age pattern seen in our middle-aged study group is consistent with these reported population trends.

In our study, there was no significant difference in sex distribution between the two groups (p = 0.62). This finding is consistent with other procedural studies that have included both male and female patients, though their proportions varied. For example, Setia et al. reported a female predominance (61%),<sup>8</sup> Ewida et al. found 56% females,<sup>11</sup> while Elzefzaf et al. observed more males (63%).<sup>10</sup> At the population level, Aslam et al.<sup>2</sup> and Agarwal et al.<sup>7</sup> found that women tend to have a higher burden of symptomatic varicose veins. Agarwal et al. noted a prevalence of 46.7% in females versus 27.8% in males.<sup>7</sup>

The mean BMI in our study was similar between the two groups (27.3 vs. 27.1 kg/m<sup>2</sup>), aligning with previous reports. Setia et al. reported a mean BMI of 26.4 kg/m<sup>2</sup> (males 27.2, females 25.9).<sup>8</sup> Aslam et al. summarized mostly positive association between varicose veins and BMI, especially in women,<sup>2</sup> whereas Agarwal et al. found no significant association.<sup>7</sup>

Disease severity, assessed using the CEAP classification, showed a higher proportion of advanced stages (C4–C6) in both groups (68.6% vs. 71.6%). This pattern is similar to hospital-based studies where patients often present late. Setia et al. reported 48.6% in C3, 23.7% in C4, and 10.2% in C6.<sup>8</sup> Elzezfaz et al.<sup>10</sup> and Hartmann et al.<sup>9</sup> also observed considerable proportions in higher CEAP classes. Our baseline VCSS (9.4 vs. 9.1), was higher than that reported by Setia et al. (mean 6)<sup>8</sup> but lower than Hartmann et al. (mean 18.5).<sup>9</sup> This likely reflects differences in disease severity at the time of referral across studies.

In our study, procedures performed using the radial fibre were more efficient compared to those with the straight fibre. The radial fibre group had shorter procedure time (49.7 vs. 52.8 min) and required less energy per cm (72.4 vs. 75.2 J/cm). The need for additional phlebectomy was similar in both groups. Reffat et al. found no significant difference between bare-tip and radial fibres in operative time, suggesting that variations may depend on technique or operator experience.<sup>12</sup> Postoperative complications were significantly lower in the radial fibre group. These patients experienced less pain (VAS  $\geq 4$ : 6.8% vs. 18.1%), bruising (10.5% vs. 22.4%), and induration (7.9% vs. 16.7%), with no major complications like DVT. Similarly, Reffat et al. reported low rates of complications across both EVLA groups, with minor bruising and increased analgesic requirement more frequent in the bare tip group, though differences were not statistically significant (pain 14.8% vs. 3.7%; bruising 7.4% vs. 3.7%).<sup>12</sup>

In terms of efficacy, both fibres achieved excellent closure rates, 97.6% (straight) and 99.5% (radial) at 6 months with very low recurrence (2.4% vs. 0.5%). Reffat et al. similarly observed near-complete ablation in both groups, with only one incomplete ablation in the bare tip group (3.7%) requiring surgical excision.<sup>12</sup>

Symptom improvement and functional recovery was better in radial fibre group, with lower VCSS at 6 months (2.4 vs. 2.8), higher patient satisfaction (92.6% vs. 84.3%), and quicker return to work (85.3% vs. 72.4%). These findings highlight not only faster rehabilitation but also enhanced quality of life outcomes following radial fibre EVLA. Reffat et al. reported no statistically significant difference in VCSS improvement between bare tip and radial fibre groups at serial follow-ups. Their mean VCSS declined steadily in both groups from preoperative values ( $11.63 \pm 0.84$  vs.  $12.0 \pm 0.94$ ) to  $1.52 \pm 0.51$  vs.  $1.41 \pm 0.51$  at 6 months, indicating comparable symptom resolution. Reffat et al. observed similar recovery times ( $2.9 \pm 0.5$  vs.  $3.1 \pm 0.6$  days) in both groups.<sup>12</sup>

Overall, our findings confirm that both straight and radial fibres in EVLA are highly effective and safe for treating varicose veins. However, the radial fibre shows advantages in operative efficiency, lower postoperative pain and bruising, faster recovery, and higher patient satisfaction.

## CONCLUSION

Straight end-on and radial fibres in ultrasound-guided endovenous laser ablation (EVLA), both proved to be safe and highly effective for treating varicose veins, achieving excellent vein closure rates and minimal complications. However, the radial fibre demonstrated distinct advantages, including shorter procedure time, lower energy use, reduced postoperative pain, bruising, and induration, along with greater patient satisfaction and faster return to normal activities. While both fibres ensure comparable efficacy, the radial fibre offers superior procedural efficiency and patient comfort, making it the preferred option where available.

## Recommendations

Future multicentric and long-term studies are recommended to validate these results, assess durability of vein closure, and evaluate cost-effectiveness in the Indian healthcare setting.

**Conflict of Interest:** None

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## REFERENCES

1. Youn YJ, Lee J. Chronic venous insufficiency and varicose veins of the lower extremities. *Korean J Intern Med.* 2018;34(2):269.
2. Aslam MR, Muhammad Asif H, Ahmad K, Jabbar S, Hayee A, Sagheer MS, Rehman JU, Khalid S, Hashmi AS, Rajpoot SR, Sharif A. Global impact and contributing factors in varicose vein disease development. *SAGE Open Medicine.* 2022 Aug;10:20503121221118992.

3. Stokbroekx T, De Boer A, Verdaasdonk RM, Vuylsteke ME, Mordon SR. Commonly used fiber tips in endovenous laser ablation (EVLA): an analysis of technical differences. *Lasers Med Sci.* 2014;29(2):501–7.
4. Hirokawa M, Kurihara N. Comparison of bare-tip and radial fiber in endovenous laser ablation with 1470 nm diode laser. *Ann Vasc Dis.* 2014;7(3):239–45.
5. Hirokawa M, Ogawa T, Sugawara H, Shokoku S, Sato S. Comparison of 1470 nm laser and radial 2-ring fiber with 980 nm laser and bare-tip fiber in endovenous laser ablation of saphenous varicose veins: a multicenter, prospective, randomized, non-blind study. *Ann Vasc Dis.* 2015;8(4):282–9.
6. Rajendran S, Nair HR. Endovenous laser ablation of incompetent great saphenous veins with 1470-nm laser using bare tip and radial fibers results in similar short-term outcomes. *J Vasc Surg Venous Lymphat Disord.* 2021;9(5):1209–14.
7. Agarwal V, Agarwal S, Singh A, Nathwani P, Goyal P, Goel S. Prevalence and risk factors of varicose veins, skin trophic changes, and venous symptoms among northern Indian population. *Int J Res Med Sci.* 2016 May;4(5):1678-82.
8. Setia A, Schmedt CG, Beisswenger A, Dikic S, Demhasaj S, Setia O, Schmitz-Rixen T, Sroka R. Safety and efficacy of endovenous laser ablation (EVLA) using 1940 nm and radial emitting fiber: 3-year results of a prospective, non-randomized study and comparison with 1470 nm. *Lasers in Surgery and Medicine.* 2022 Apr;54(4):511-22.
9. Hartmann K, Gholam P, Dietrich C, Fink C. Efficacy and safety of endovenous laser ablation with the 1470 nm diode laser using a novel optical probe. *International Journal of Medical Sciences.* 2022 Mar 28;19(4):695.
10. Elzefzaf N, Elfeky MA, Elshatlawy KM, Abdelal A, Elhendawy A, Ahmed A, Nada M, Ouf T. Evaluation of endovenous laser ablation in the management of varicose veins. *Cureus.* 2023 Sep 12;15(9):e45096.
11. Ewida AM, Hammada MI, Ibrahima ES, Ibrahim A. Comparative Study between Using of Radio Frequency Ablation and Endovenous Laser Ablation in the treatment Of Primary Lower Limb Varicose Veins. *International Journal of Health Sciences.* 2023;6(S5):7138-49.
12. Reffat S, El Yamani M, Taha A, El-Zayat ES. Bare Tip versus Radial Endovenous Laser Ablation for the Treatment of Primary Varicose Veins. *Suez Canal University Medical Journal.* 2016 Oct 1;19(2):174-83.