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Original Article

Clinical Outcomes of Radiofrequency Ablation for Primary Great Saphenous Varicose Veins with Saphenofemoral Junction Incompetence: A Prospective Observational Study

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ABSTRACT

Background: Primary varicose veins caused by great saphenous vein reflux with saphenofemoral junction incompetence are a common source of pain, edema, functional limitation, and reduced quality of life. Radiofrequency ablation has emerged as a less invasive alternative to conventional surgery, but Indian prospective outcome data remain limited.
Objectives: To evaluate the clinical outcomes of radiofrequency ablation in patients with primary great saphenous varicose veins with saphenofemoral junction incompetence.
Methods: This prospective observational study included 40 adults with duplex-confirmed primary varicose veins in the great saphenous territory treated with radiofrequency ablation. Operative duration, hospital stay, postoperative pain, early complications, time to return to normal activities, and recurrence during follow-up were assessed descriptively.
Results: The mean age was 41.4 ± 8.7 years, and 77.5% of participants were men. Most patients were overweight and presented with CEAP C2 or C3 disease. The mean operative duration was 71.2 ± 9.4 minutes. Postoperative saphenous nerve symptoms were noted in 5.0% and induration in 10.0%. Pain decreased steadily from predominantly moderate intensity on day 1 to absent in 92.5% by day 7. Most patients were discharged on postoperative day 3, and all resumed normal activities by postoperative day 6. At 6 months, no recurrence was observed; recurrence was 5.0% at 12 months and 7.5% at 18 months.
Conclusion: Radiofrequency ablation provided favorable early recovery, low morbidity, rapid functional restoration, and acceptable mid-term recurrence in selected patients with primary great saphenous varicose veins with saphenofemoral junction incompetence.

Keywords: *Varicose veins; radiofrequency ablation; great saphenous vein; saphenofemoral junction incompetence; CEAP; venous clinical severity score.*

INTRODUCTION

Varicose veins of the lower limb are among the most frequently encountered manifestations of chronic venous disease. They arise from valvular incompetence within the superficial, perforator, or deep venous systems, resulting in reflux, venous hypertension, venous dilation, and progressive symptom burden [1-3]. Epidemiological studies have shown that chronic venous disorders impose a substantial population-level burden, with prevalence increasing with age and being shaped by occupational exposure, body habitus, and genetic predisposition [1,2]. Although some patients present primarily with cosmetic concerns, many experience heaviness, aching pain, edema, skin changes, limitation of daily activity, and, in advanced disease, ulceration [2,3]. In working-age adults, these manifestations translate into loss of productivity, repeated health-care visits, and impaired quality of life.

Standardized classification systems have improved the evaluation of venous disease and the comparability of clinical studies. The CEAP framework permits structured clinical staging, while the Venous Clinical Severity Score provides a dynamic measure of symptom and sign burden that is useful for monitoring response to treatment [4,5]. Duplex ultrasonography remains the cornerstone of assessment because it defines reflux anatomy, identifies the affected venous segments, documents junctional incompetence, and assists procedural planning [6,7]. Accurate duplex mapping is especially important when endovenous treatment is contemplated, since anatomical suitability directly influences technical success and complication rates.

Management of primary varicose veins has progressively shifted from conventional high ligation and stripping toward endovenous thermal techniques. Radiofrequency ablation offers segmental endoluminal closure of the refluxing great saphenous vein through controlled thermal energy delivered under duplex guidance. Comparative trials have shown that endovenous procedures, particularly radiofrequency ablation, are associated with less post-procedural pain and faster recovery than conventional surgery or some laser-based approaches, while maintaining durable vein occlusion and clinical improvement [8-14]. Recent evidence syntheses also support the efficacy of radiofrequency ablation as an established treatment option for truncal reflux [14].

Despite increasing acceptance of radiofrequency ablation, data from Indian tertiary-care settings remain relatively limited, especially from prospective observational cohorts that document operative profile, early morbidity, functional recovery, and short- to mid-term recurrence. Local evidence is relevant because disease presentation, occupational exposure, access to care, and the economic balance between minimally invasive technology and conventional surgery differ across settings. The present study was therefore undertaken to evaluate the treatment outcome of radiofrequency ablation in patients with primary great saphenous varicose veins with saphenofemoral junction incompetence, with specific objectives to assess operative duration, postoperative hospital stay, early and late complications, time to return to normal activities, postoperative venous severity status, and recurrence during follow-up.

METHODOLOGY

Study design and setting

This prospective observational study was conducted in the Department of General Surgery of a tertiary-care teaching hospital in Secunderabad, Telangana, over a two-year period from September 2016 to October 2018. The manuscript was prepared from the uploaded thesis dataset after consolidating the study design, operative protocol, and follow-up outcomes extracted from the dissertation source.

Participants

Forty adult patients aged 18–60 years with symptomatic primary varicose veins in the great saphenous vein territory and duplex-confirmed saphenofemoral junction incompetence were included. Eligible patients belonged to CEAP clinical classes C2–C6 and were considered anatomically suitable for radiofrequency ablation. Patients with recurrent varicose veins, saphenopopliteal junction incompetence, extensive multiple perforator disease, deep vein thrombosis, arterial disease, major cardiovascular or hematological disorders, uncontrolled medical comorbidity, anticoagulant use, markedly tortuous above-knee great saphenous veins, or a great saphenous vein diameter below 3 mm or above 12 mm in the supine position were excluded.

Preoperative assessment

All patients underwent detailed clinical evaluation and duplex ultrasonographic examination of both lower limbs. Baseline disease severity was documented using CEAP clinical grading and the Venous Clinical Severity Score. Demographic details, occupation, body mass index category, number of incompetent perforators, and operative suitability were recorded before intervention. Written informed consent had been obtained according to institutional protocol.

Procedure

Radiofrequency ablation was performed under spinal anesthesia supplemented by tumescent anesthesia. After duplex mapping of the great saphenous vein and marking of the access point at or below knee level, percutaneous cannulation was achieved and a 7-Fr introducer sheath was placed. A VNUS ClosureFAST/Closure catheter system was advanced under duplex guidance so that the tip lay approximately 1.5–2 cm distal to the saphenofemoral junction. Perivenous tumescent solution was infiltrated under ultrasonographic guidance. The target temperature on the radiofrequency generator was set at 120°C. Two 20-second ablation cycles were delivered to the proximal 7-cm segment and single cycles were used for the remaining above-knee great saphenous vein segments. Completion duplex assessment was performed to confirm successful ablation and to exclude deep venous extension.

Follow-up and outcome measures

Patients were mobilized early, managed with compression, and followed in the immediate postoperative period, at 1 week, 1 month, 6 months, 12 months, and 18 months. The primary outcome was time taken to return to normal daily activities.

Secondary outcomes included duration of surgery, postoperative hospital stay, restriction of mobility, pain intensity assessed with a 10-point visual analogue scale, early postoperative complications such as saphenous nerve symptoms and induration, and recurrence during follow-up.

Statistical analysis

The original thesis dataset reported descriptive outcomes. Accordingly, continuous variables are presented as mean ± standard deviation, and categorical variables are presented as frequencies and percentages. Pain was also summarized by clinical grade as none, mild, moderate, or severe. No additional inferential testing was introduced during manuscript preparation in order to preserve fidelity to the source dataset.

RESULTS

A total of 40 patients with primary great saphenous varicose veins and saphenofemoral junction incompetence underwent radiofrequency ablation and were included in the analysis. The mean age of the cohort was 41.4 ± 8.7 years. The largest proportion belonged to the 41–50-year age group, and men predominated markedly over women. Occupationally, most participants were engaged in work involving prolonged standing or physical exertion. Nearly half of the cohort was overweight, while a smaller proportion was obese. These baseline demographic and clinical characteristics are summarized in Table 1.

Table 1. Baseline demographic, occupational, and body mass index profile of the study population (n = 40).

Variable	Category	n	%
Age group (years)	21–30	6	15.0
	31–40	13	32.5
	41–50	15	37.5
	51–60	6	15.0
Sex	Male	31	77.5
	Female	9	22.5
Occupation	Manual labourer	11	27.5
	Conductor	6	15.0
	Housewife	8	20.0
	Tailor	5	12.5
	Watchman	7	17.5
	Constable	1	2.5
	Hotel server	1	2.5
	Shopkeeper	1	2.5
Body mass index	Normal (18–25 kg/m²)	14	35.0
	Overweight (25–30 kg/m²)	19	47.5
	Obese (>30 kg/m²)	7	17.5

Preprocedural disease severity indicated that most patients presented in the earlier symptomatic spectrum of chronic venous disease. CEAP class C2 was the most frequent category, followed by C3, whereas advanced ulcerative disease was not seen in this series. Venous Clinical Severity Score grading showed that half of the study population fell into the mild-to-moderate categories. Incompetent perforators were common, and almost half of the patients had three associated incompetent perforators in addition to saphenofemoral junction incompetence. These preoperative disease characteristics are shown in Table 2.

Table 2. Preprocedural disease severity and distribution of incompetent perforators (n = 40).

Measure	Category	n	%
Preprocedural CEAP class	C2	16	40.0
	C3	12	30.0
	C4	6	15.0
	C5	6	15.0
	C6	0	0.0
Preprocedural VCSS grade	None (0)	6	15.0
	Mild (1–10)	16	40.0
	Moderate (10–20)	14	35.0
	Severe (20–30)	4	10.0
Incompetent perforators	0	5	12.5
	1	9	22.5
	2	8	20.0
	3	18	45.0

The mean operative duration was 71.2 ± 9.4 minutes. Most procedures were completed within 60–80 minutes. When operative duration was examined in relation to perforator burden, the longest mean duration was observed in patients with three incompetent perforators. Immediate postoperative complications were infrequent. Saphenous nerve symptoms were documented in 2 patients, and localized induration along the treated venous segment was observed in 4 patients. Operative characteristics and early complications are presented in Table 3.

Table 3. Operative characteristics and immediate postoperative complications.

Parameter	Category	Value
Duration of surgery	Mean ± SD (minutes)	71.2 ± 9.4
	50–60 min	4
	60–70 min	15
	70–80 min	13
	80–90 min	8
Mean duration by perforator burden	0 perforators	61.4 min
	1 perforator	65.5 min
	2 perforators	59.4 min
	3 perforators	78.4 min
Early complications	Saphenous nerve symptoms	2 (5.0%)
	Post-procedural induration	4 (10.0%)

Functional recovery was favorable. On postoperative day 1, mobility restriction was predominantly mild or moderate, with only a small subset showing severe limitation. By postoperative day 3, almost all patients had only mild restriction. No patient was discharged on day 1; however, 35.0% were discharged on postoperative day 2, 57.5% on day 3, and the remaining 7.5% on day 4. Return to normal activity was rapid, beginning on postoperative day 3 and achieved in all patients

by postoperative day 6, with most resuming routine activity on day 4 or 5. Recovery-related outcomes are summarized in Table 4.

Table 4. Early postoperative recovery, discharge profile, and return to normal activities.

Outcome	Category	n	%
Restriction of mobility, day 1	Mild	20	50.0
	Moderate	17	42.5
	Severe	3	7.5
Restriction of mobility, day 3	Mild	38	95.0
	Moderate	2	5.0
	Severe	0	0.0
Discharge day	Postoperative day 2	14	35.0
	Postoperative day 3	23	57.5
	Postoperative day 4	3	7.5
Return to normal activities	Postoperative day 3	4	10.0
	Postoperative day 4	13	32.5
	Postoperative day 5	16	40.0
	Postoperative day 6	7	17.5

Pain intensity declined progressively across follow-up. On day 1, pain scores clustered within the moderate range, with 95.0% of patients graded as having moderate pain. By day 3, mild pain predominated, and only 5.0% continued to report moderate pain. By day 7, pain had resolved completely in 92.5% of patients, while the remaining 7.5% reported only mild pain. The detailed distribution of postoperative visual analogue scale scores and pain grades is shown in Table 5 and Table 6, respectively.

Table 5. Distribution of postoperative visual analogue scale (VAS) pain scores on days 1, 3, and 7.

VAS score	Day 1	Day 3	Day 7
0	0	3	37
1	0	17	0
2	2	18	3
3	19	2	0
4	14	0	0
5	5	0	0
6	0	0	0
7	0	0	0
8	0	0	0
Mean VAS	3.55	1.48	0.15

Table 6. Distribution of postoperative pain grades on days 1, 3, and 7.

Pain grade	Day 1, n (%)	Day 3, n (%)	Day 7, n (%)
None	0 (0.0)	3 (7.5)	37 (92.5)
Mild	2 (5.0)	35 (87.5)	3 (7.5)
Moderate	38 (95.0)	2 (5.0)	0 (0.0)
Severe	0 (0.0)	0 (0.0)	0 (0.0)

At follow-up, pain and induration had largely resolved. At 6 months, only 2 patients still reported pain and 2 had residual induration, while no recurrence was documented. By 12 months, neither pain nor induration persisted, although recurrence was noted in 2 patients. At 18 months, recurrence increased slightly to 3 patients, corresponding to a cumulative recurrence proportion of 7.5%, whereas pain and induration remained absent. Follow-up outcomes are detailed in Table 7.

Table 7. Follow-up outcomes at 6, 12, and 18 months.

Follow-up interval	Pain present	Induration present	Recurrence present
6 months	2 (5.0%)	2 (5.0%)	0 (0.0%)
12 months	0 (0.0%)	0 (0.0%)	2 (5.0%)
18 months	0 (0.0%)	0 (0.0%)	3 (7.5%)

DISCUSSION

The present prospective observational study demonstrates that radiofrequency ablation is a clinically effective and well-tolerated treatment option for selected patients with primary great saphenous varicose veins and saphenofemoral junction incompetence. The cohort was composed predominantly of middle-aged adults, with a marked male preponderance and a substantial representation of occupations involving prolonged standing. This pattern is consistent with the recognized epidemiological influence of age and occupational exposure on symptomatic chronic venous disease [1-3]. The predominance of CEAP C2 and C3 disease in the present series also suggests that many patients were treated before progression to advanced ulcerative complications, which is desirable from both symptomatic and functional perspectives [4,5].

Duplex-based patient selection formed a central part of the protocol and remains essential in modern venous intervention. Duplex ultrasonography not only confirms truncal reflux and junctional incompetence, but also identifies perforator burden and guides endovenous therapy planning [6,7]. In the present series, a high proportion of patients had associated incompetent perforators, and a greater perforator burden was accompanied by longer operative duration. This observation is clinically intuitive because more complex venous anatomy increases mapping, cannulation, and procedural handling time, even when the primary target is the great saphenous vein.

Early postoperative recovery in this cohort was favorable. Pain, although commonly moderate on the first postoperative day, decreased rapidly by day 3 and was nearly absent by day 7. This pattern aligns with randomized comparisons showing lower post-procedural pain and quicker recovery after radiofrequency ablation than after some laser or surgical approaches [8-10]. Similarly, the short hospital stay and universal return to normal activities by postoperative day 6 reinforce the functional advantages that have contributed to the wider adoption of radiofrequency ablation [9-11]. For working adults, such early restoration of mobility has practical implications that extend beyond symptom relief.

Complication rates were low. Saphenous nerve symptoms occurred in 5.0% and post-procedural induration in 10.0%, with both events being limited and non-progressive. These findings compare favorably with prior published experience, where radiofrequency ablation has generally shown low morbidity and acceptable safety in the treatment of truncal venous reflux [9,12,13]. The recurrence profile in the present study was also acceptable: no recurrence at 6 months, 5.0% at 12 months, and 7.5% at 18 months. Although follow-up was shorter than in major longitudinal series, the recurrence rate observed here remains within a clinically reasonable range and supports the durability reported in multicenter cohorts and longer-term comparative studies [12-14].

Taken together, the findings indicate that radiofrequency ablation offers a balanced combination of technical feasibility, rapid convalescence, low early morbidity, and satisfactory mid-term disease control. In appropriately selected patients within tertiary-care practice, it represents a valuable minimally invasive option for management of primary great saphenous varicose veins with saphenofemoral junction incompetence.

Limitations

This study was based on a single-center prospective cohort with a modest sample size and no parallel comparison arm. The analysis remained descriptive because the source dataset did not report inferential testing. Postoperative venous severity improvement was documented in the thesis mainly through graphical comparison rather than fully extractable tabulated values. Follow-up extended only to 18 months, which limits assessment of long-term recurrence.

CONCLUSION

Radiofrequency ablation proved to be an effective minimally invasive treatment for primary great saphenous varicose veins with saphenofemoral junction incompetence in this prospective hospital-based cohort. The procedure was associated with acceptable operative duration, limited early morbidity, rapid reduction in postoperative pain, short hospital stay, and early return to normal activity. Recurrence remained low through 18 months of follow-up, while pain and induration resolved in nearly all patients over time. These findings support radiofrequency ablation as a practical, patient-centered, and clinically useful option for appropriately selected patients in tertiary-care settings. Larger comparative studies with longer follow-up would further clarify durability, recurrence patterns, patient-reported outcomes, and cost-effectiveness.

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