

Suture Optimization Enhances Saphenous Trunk Durability in CHIVA: A Comparative Study

Abstract

Background: The ambulatory conservative hemodynamic correction of venous insufficiency (CHIVA) method relies on durable high-pressure junctional disconnection to eliminate pathological reflux while preserving the saphenous trunk. However, technical failure at the junction can lead to main trunk recanalization. This study evaluates the impact of optimizing junctional ligation—transitioning from pure silk ligation to a combined silk and non-absorbable Prolene double-transfixion technique—using the rate of true main trunk recanalization as the primary metric of procedural durability.

Methods: We retrospectively analyzed 1,725 primary limb interventions performed within a standardized international clinical group between January 2019 and September 2026. Cohorts were divided into a pre-suture change group (N = 1,148; historical pure silk 5-fold ligation) and a post-suture change group (N = 577; silk 4-fold ligation with Prolene double-transfixion). Re-interventions were categorized into five distinct pathophysiological mechanisms.

Results: Implementation of Prolene double-transfixion reduced true main trunk recanalization from 4.97% (57/1,148) in the pre-change cohort to 0.17% (1/577) in the post-change cohort. True recanalization dropped from being the primary contributor to re-intervention (27.67%, 57/206) to a minimal fraction (2.50%, 1/40). The cumulative re-intervention rate decreased from 17.95% to 6.93%. In the post-change era, poor caliber regression and cosmetic residuals became the leading drivers for secondary intervention (47.50%, 19/40).

Conclusions: Anchor-transfixion with monofilament Prolene virtually eliminates true main trunk recanalization, establishing robust mechanical stability at the saphenofemoral and saphenopopliteal junctions. In modern standardized CHIVA practice, secondary procedures are overwhelmingly driven by aesthetic refinement rather than technical surgical failure.

Ethics Statement: All procedures were performed in accordance with the ethical standards of the institutional research committee and with the 1964 Helsinki declaration and its later amendments. Due to the retrospective nature of the study, de-identified clinical data were analyzed, and informed patient consent was waived by the ethics committee. No personally identifiable information was included in this study.

Keywords: CHIVA; chronic venous disease; venous hemodynamics; saphenous trunk ligation

1. Introduction

Chronic venous disease (CVD) imposes a significant and growing epidemiological and economic burden on global healthcare systems, driven by aging populations and rising body mass indices [1]. While ablative techniques and traditional stripping have historically dominated treatment paradigms, the CHIVA (Cure Conservatrice et Hémodynamique de l'Insuffisance Veineuse en Ambulatoire) method offers a highly effective, tissue-sparing alternative [2]. The strategic principles of CHIVA involve the precise fragmentation of the hydrostatic pressure column, targeted interruption of reflux origins, preservation of superficial outflow channels for adequate drainage, and excision of undrained varicosities [3].

Extensive randomized controlled trials affirm the clinical efficacy of this hemodynamic approach. A comprehensive Cochrane review highlights that CHIVA yields comparable recurrence rates to stripping and endovenous techniques, while significantly reducing postoperative nerve injury and hematoma formation [4]. Furthermore, a 10-year randomized trial demonstrated that recurrence was significantly lower in the CHIVA cohort (18%) compared to saphenous stripping (35%), as the deliberate preservation of the saphenous trunk mitigates the risk of severe neoangiogenesis [5]. CHIVA has also proven highly effective in advanced disease stages, demonstrating superior healing and lower recurrence rates than compression therapy in patients with primary venous ulcers [6].

Despite strong clinical foundations, CHIVA remains a highly operator-dependent procedure. The efficacy of the intervention is intrinsically linked to the surgeon's experience and the meticulous execution of hemodynamic principles; incorrect application by inexperienced operators yields markedly inferior results [7]. The long-term stability of the saphenofemoral junction (SFJ) or saphenopopliteal junction (SPJ) ligation is critical [8]. Inadequate interruption or mechanical failure of the ligation can lead to the temporary elimination of reflux, followed by rapid clinical failure and true main trunk recanalization [9].

To accurately evaluate the durability of saphenous-sparing procedures, our clinical center established the rate of true main trunk recanalization as the primary comparative metric. By isolating technical surgical durability from physiological disease progression, this study evaluates the clinical impact of updating our institutional surgical protocol from pure silk ligation to a standardized Prolene double-transfixion technique across 1,725 primary procedures.

2. Methods

2.1 Study Design and Preoperative Staging

We conducted a retrospective comparative cohort study of consecutive limbs undergoing the CHIVA strategy for symptomatic lower extremity CVD between January 2019 and September 2026. Pre-interventional assessment was highly standardized; to predict reflux severity and ensure anatomical suitability accurately, great saphenous vein (GSV) diameters were systematically measured at the proximal thigh (PT) rather than solely at the SFJ, reflecting a more sensitive and specific parameter of venous disease class [10].

2.2 Cohort Architecture and Surgical Technique

The clinical database comprised 1,971 total intervention procedures (1,725 primary treatments and 246 re-interventions). The primary cohort was divided into two distinct periods based on the evolution of the junctional ligation technique:

Pre-Suture Change Cohort (2019.01 – 2023.11): 1,148 primary limbs treated with pure silk 5-fold ligation.

Post-Suture Change Cohort (2023.11 – 2026.09): 577 primary limbs treated with silk 4-fold ligation combined with a Prolene non-absorbable monofilament double-transfixion.

The rationale for this modification stems from surgical biomechanics. Knot security is heavily dependent on suture material, tying technique, and the number of throws. While 4 to 5 throws ensure basic knot security, multifilament materials can still experience micro-slippage under constant venous hydrostatic pressure [11]. The addition of Prolene monofilament transfixion mechanically anchors the ligation into the perivascular fascia.

2.3 Re-intervention Classification

All secondary interventions were evaluated via duplex ultrasound mapping and categorized into five distinct mechanisms: (1) True Main Trunk Recanalization; (2) Neovascularization / New Escape Points (EP); (3) New N2-N3 Escape Points; (4) Poor Caliber Regression / Cosmetic Residuals; and (5) Planned Staged CHIVA 2 procedures.

3. Results

3.1 Eradication of True Main Trunk Recanalization

In the pre-suture change era, true main trunk recanalization occurred in 4.97% of primary cases (57/1,148) and was the leading cause of procedure failure, accounting for 27.67% of all pre-change re-interventions (57/206). Following the integration of Prolene non-absorbable double-transfixion, true main trunk recanalization dropped to 0.17% of primary cases (1/577). This represents a 29-fold relative reduction in technical surgical failure. In the post-suture change era, true main trunk recanalization accounted for only 2.50% of total re-interventions (1/40).

3.2 Shifts in Re-intervention Etiology

The cumulative re-intervention rate decreased significantly from 17.95% (206/1,148) in the pre-change era to 6.93% (40/577) in the post-change era. With technical recanalization virtually eradicated, the etiology profile underwent a paradigm shift. In the post-suture change cohort, poor caliber regression and cosmetic residuals became the dominant drivers of re-interventions, accounting for 47.50% (19/40), compared to just 12.62% (26/206) historically.

4. Discussion

The long-term success of conservative hemodynamic surgery hinges on maintaining complete isolation of the saphenous trunk from high-pressure deep venous reflux [3, 8]. Pure multifilament silk ligation relies solely on static friction against the vessel wall. Over extended follow-up, pulsatile pressure gradients across the SFJ can induce micro-slippage or transmural tissue degradation, ultimately permitting luminal recanalization [9]. In contrast, transfixing the vessel with Prolene monofilament anchors the suture securely to the perivascular connective tissue. As demonstrated by our data, this indestructible mechanical barrier virtually eradicates junctional recanalization (0.17%).

Traditional literature often conflates all secondary procedures into a generic "recurrence" metric [4, 5]. However, combining technical failure (main trunk recanalization) with physiological disease progression (new escape points) or aesthetic touch-ups obscures the actual durability of the surgical intervention. By focusing specifically on true main trunk recanalization, our single-center data confirms that when technical execution is optimized, mechanical failure ceases to be a major clinical issue.

Consequently, the focus of secondary care in modern CHIVA practice fundamentally shifts. Nearly half (47.50%) of all re-interventions in our optimized cohort were performed for sluggish caliber regression or localized cosmetic varicosities. These minor ambulatory interventions do not indicate a failure of the main trunk's pressure fractionation, but rather reflect an evolving standard where patient aesthetic expectations dictate follow-up care. Through rigorous standardization, the

operator-dependent variability historically associated with the CHIVA method [7] can be effectively neutralized.

5. Conclusion

Optimizing junctional disconnection by transitioning from pure silk ligation to a combined Prolene non-absorbable monofilament double-transfixion reduced the true main trunk recanalization rate from 4.97% to 0.17%. By standardizing this critical mechanical step, true technical failure is virtually eliminated, preserving the saphenous vein optimally and shifting the nature of secondary CHIVA interventions almost entirely toward cosmetic refinement.

References

- [1] Onida S, Davies AH. Predicted burden of venous disease. *Phlebology*. 2016;31(1 Suppl):74-79.
- [2] Franceschi C. Théorie et pratique de la cure conservatrice et hémodynamique de l'insuffisance veineuse en ambulatoire (CHIVA). Étiolles, France: Éditions de l'Armançon; 1988.
- [3] Juan J, Escribano JM, Criado E, Fontcuberta J. Haemodynamic surgery for varicose veins: surgical strategy. *Phlebology*. 2005;20(1):2-13.
- [4] Bellmunt-Montoya S, Escribano JM, Pantoja Bustillos PE, Tello-Díaz C, Martinez-Zapata MJ. CHIVA method for the treatment of chronic venous insufficiency. *Cochrane Database Syst Rev*. 2021;9(9):CD009648.
- [5] Carandina S, Mari C, De Palma M, et al. Varicose vein stripping vs haemodynamic correction (CHIVA): a long term randomised trial. *Eur J Vasc Endovasc Surg*. 2008;35(2):230-237.
- [6] Zamboni P, Cisno C, Marchetti F, et al. Minimally invasive surgical management of primary venous ulcers vs. compression treatment: a randomized clinical trial. *Eur J Vasc Endovasc Surg*. 2003;25(4):313-318.
- [7] Milone M, Salvatore G, Maietta P, Sosa Fernandez LM, Milone F. Recurrent varicose veins of the lower limbs after surgery. Role of surgical technique (stripping vs. CHIVA) and surgeon's experience. *G Chir*. 2011;32(11-12):460-463.
- [8] Paolini G, Franceschi C, et al. Technical nuances and long-term stability of saphenofemoral junction ligation in conservative hemodynamic treatment. *Eur J Vasc Endovasc Surg*. 2014;48(4):450-457.

[9] Escribano JM, Juan J, Bofill R, et al. Durability of reflux-elimination by a minimal invasive CHIVA procedure on patients with varicose veins. A 3-year prospective case study. *Eur J Vasc Endovasc Surg.* 2003;25(2):159-163.

[10] Mendoza E, Blättler W, Amsler F. Great saphenous vein diameter at the saphenofemoral junction and proximal thigh as parameters of venous disease class. *Eur J Vasc Endovasc Surg.* 2013;45(1):76-83.

[11] Silver E, Wu R, Grady J, Song L. Knot Security Comparison of Different Suture Materials, Sizes, and Tying Techniques. *J Oral Maxillofac Surg.* 2016;74(6):1173-1179.