

Sclerotherapy vs. Laser therapy: Competing or complementary approaches for oral vascular malformations?

Escleroterapia vs. Terapia a laser: Abordagens concorrentes ou complementares para malformações vasculares orais?

Escleroterapia vs. Terapia con láser: Enfoques competitivos o complementarios para malformaciones vasculares orales?

Received: 08/11/2025 | Revised: 08/14/2025 | Accepted: 08/14/2025 | Published: 08/15/2025

Guilherme Farias Apolonio

ORCID: <https://orcid.org/0000-0003-2176-2816>
Santo Amaro University, Brazil
E-mail: gfaolonio@gmail.com

Antônio Roberto Garcia Júnior

ORCID: <https://orcid.org/0000-0003-2400-8982>
University of São Paulo, Brazil
E-mail: antonio.r.garcia@usp.br

Carina Domaneschi

ORCID: <https://orcid.org/0000-0001-8615-3283>
University of São Paulo, Brazil
E-mail: domaneschi@usp.br

Celso Augusto Lemos Júnior

ORCID: <https://orcid.org/0000-0002-3372-6719>
University of São Paulo, Brazil
E-mail: calemosj@usp.br

Paulo Sergio Pina

ORCID: <https://orcid.org/0000-0001-8205-9935>
University of São Paulo, Brazil
E-mail: ps.souzapina@alumni.usp.br

Camilla Vieira Esteves

ORCID: <https://orcid.org/0000-0001-9673-2756>
University of São Paulo, Brazil
E-mail: camilla.santos@usp.br

Abstract

Oral vascular malformations (VMs) are low blood flow vascular anomalies that present therapeutic challenges, often requiring minimally invasive approaches. This study aims to evaluate, through a comprehensive literature review, the clinical effectiveness of sclerotherapy and FDIP in managing VMs in the oral cavity, particularly regarding lesion volume reduction and symptomatic relief. This narrative review examined the clinical outcomes of sclerotherapy and forced dehydration with induced photocoagulation (FDIP) in the treatment of oral VMs. A total of ten studies published between 2014 and 2024, encompassing 2,120 patients, were included. The lower lip, tongue, and buccal mucosa were the most affected sites. Monoethanolamine oleate (5%) and polidocanol, particularly in foam form, were the most effective agents, yielding high rates of lesion regression with low complication rates. Pingyangmycin/Bleomycin showed promising results, especially in combination with electrochemical therapy, while sodium tetradecyl sulfate demonstrated lower efficacy but favorable safety. FDIP emerged as an effective alternative, though its broader use is limited by cost. The findings support sclerotherapy as a first-line, safe, and effective treatment for low-flow oral vascular malformations.

Keywords: Sclerotherapy; Mouth Mucosa; Vascular Malformations; Polidocanol; Bleomycin.

Resumo

As malformações vasculares orais (MV) são anomalias vasculares de baixo fluxo sanguíneo que apresentam desafios terapêuticos, frequentemente exigindo abordagens minimamente invasivas. Este estudo tem como objetivo avaliar, por meio de uma revisão abrangente da literatura, a eficácia clínica da escleroterapia e do FDIP no manejo das malformações vasculares (MV) na cavidade oral, especialmente no que diz respeito à redução do volume das lesões e ao alívio dos sintomas. Esta revisão narrativa analisou os desfechos clínicos da escleroterapia e da desidratação forçada com foto coagulação induzida (FDIP) no tratamento das MVs orais. Foram incluídos dez estudos publicados entre 2014 e 2024, abrangendo um total de 2.120 pacientes. O lábio inferior, a língua e a mucosa jugal foram os locais mais acometidos.

Oleato de monoetanolamina a 5% e polidocanol, especialmente na forma de espuma, foram os agentes mais eficazes, promovendo altas taxas de regressão das lesões com baixas taxas de complicações. Pingyangmycin/Bleomicina apresentou resultados promissores, especialmente em combinação com terapia eletroquímica, enquanto o laurilsulfato de sódio mostrou menor eficácia, mas com perfil de segurança favorável. A FDIP demonstrou ser uma alternativa eficaz, embora seu uso mais amplo seja limitado pelo custo. Os achados apoiam a escleroterapia como tratamento de primeira linha, seguro e eficaz para malformações vasculares orais de baixo fluxo.

Palavras-chave: Escleroterapia; Mucosa Bucal; Malformações Vasculares; Polidocanol; Bleomicina.

Resumen

Las malformaciones vasculares orales (MV) son anomalías vasculares de flujo sanguíneo bajo que representan desafíos terapéuticos, a menudo requiriendo enfoques mínimamente invasivos. Este estudio tiene como objetivo evaluar, mediante una revisión exhaustiva de la literatura, la eficacia clínica de la escleroterapia y del FDIP en el manejo de las malformaciones vasculares (MVs) en la cavidad oral, particularmente en lo que respecta a la reducción del volumen de las lesiones y al alivio de los síntomas. Esta revisión narrativa examinó los resultados clínicos de la escleroterapia y la deshidratación forzada con fotocoagulación inducida (FDIP) en el tratamiento de las MV orales. Se incluyeron diez estudios publicados entre 2014 y 2024, con un total de 2.120 pacientes. El labio inferior, la lengua y la mucosa bucal fueron los sitios más afectados. El oleato de monoetanolamina al 5% y el polidocanol, especialmente en forma de espuma, fueron los agentes más eficaces, con altas tasas de regresión de lesiones y bajas tasas de complicaciones. La pingyangmicina/bleomicina mostró resultados prometedores, especialmente en combinación con la terapia electroquímica, mientras que el sulfato de tetradecil sódico presentó menor eficacia pero buena seguridad. La FDIP surgió como una alternativa eficaz, aunque su uso más amplio está limitado por el costo. Los hallazgos respaldan la escleroterapia como tratamiento de primera línea, seguro y eficaz para las malformaciones vasculares orales de flujo bajo.

Palabras clave: Escleroterapia; Mucosa Bucal; Malformaciones Vasculares; Polidocanol; Bleomicina.

1. Introduction

Vascular malformations (VMs) are anomalies that can occur in the oral cavity, affecting veins, arteries, and capillary vessels (Balasundaram et al., 2014). The literature classified the VMs into two groups: low-flow lesions, which include venous and capillary malformations, and high-flow lesions, which involve an arterial or arteriovenous component (Silva et al., 2020). Spontaneous regressions are rare, which is one of the main differences between VMs and hemangiomas. The main affected areas are tongue, lips, palate and buccal mucosa and the clinical signs and symptoms include pain, bleeding, ulceration and aesthetic alterations (Balasundaram et al., 2014. Silva et al., 2020. Ribeiro et al., 2018).

Trauma, pregnancy, and hormonal influences have been consistently highlighted in the literature as potential contributing factors to the development or exacerbation of vascular malformations (Clemens et al., 2015). A precise diagnosis, particularly one that accurately characterizes the vascular components involved (arterial, venous, or both), is essential to guide appropriate treatment planning. Management options include laser therapy, surgical excision, embolization, electrosurgery, and sclerotherapy, which can be employed either as standalone treatments or in combination (Ribeiro et al., 2018. Zheng et al., 2013).

Minimally invasive approaches are increasingly favored over surgical interventions, primarily due to the potential morbidity and complications associated with surgery. While surgical excision remains a valid option for select cases, other modalities such as local or systemic corticosteroids, sclerotherapy, and, more recently, forced dehydration with induced photocoagulation (FDIP), have demonstrated promising outcomes (Heimlich et al., 2024).

Among the minimally invasive modalities, sclerotherapy stands out as a conservative technique that involves the intralesional injection of sclerosing agents to trigger an inflammatory response, ultimately leading to vessel occlusion and sclerosis, and resulting in lesion regression (Balasundaram et al., 2014. Ribeiro et al., 2018). Commonly used agents include bleomycin, ethanol, monoethanolamine oleate (EAO), pingyangmycin, polidocanol, and sodium tetradecyl sulfate (Balasundaram et al., 2014. Hammer et al., 2001).

This study aims to evaluate, through a comprehensive literature review, the clinical effectiveness of sclerotherapy and FDIP in managing VMs in the oral cavity, particularly regarding lesion volume reduction and symptomatic relief.

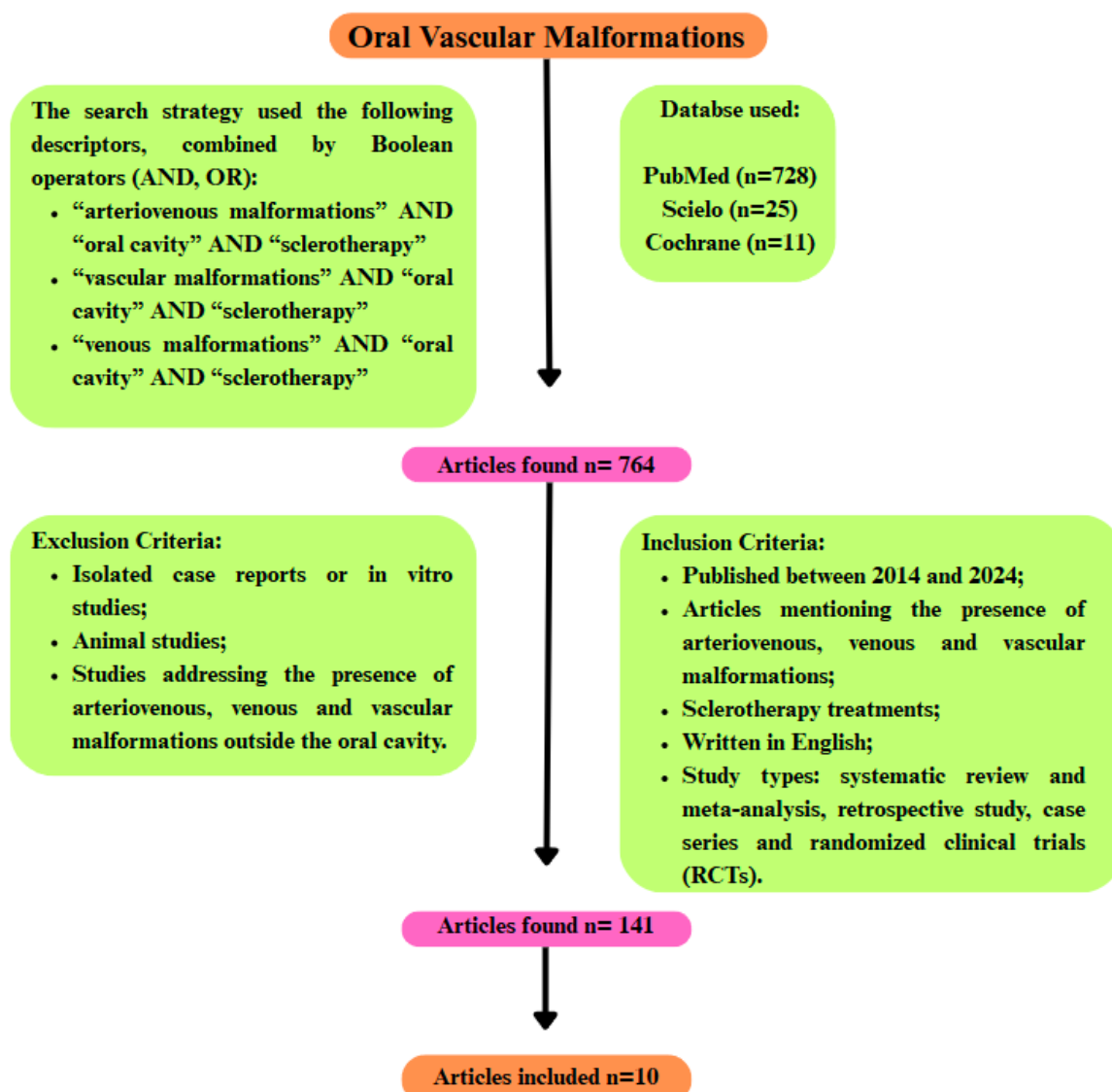
2. Methodology

A qualitative research was conducted, of the narrative bibliographic review type (Pereira et al., 2018), to provide a structured overview of the current scientific evidence on therapeutic approaches for oral vascular malformations. This approach allows for the integration of recent findings, critical analysis of methodologies, and synthesis of key outcomes from the most relevant studies, serving as the foundation for the subsequent methodological description and analysis.

This study is a comprehensive narrative review focused on evaluating the effectiveness of sclerotherapy and FDIP in the treatment of vascular, venous, and arteriovenous malformations diseases. The literature search covered studies published between 2014 and 2024, aiming to identify relevant evidence on the treatment of VMs, according to the databases PubMed, Sicelo, Cochrane, using descriptors A, B, and C respectively as arteriovenous, vascular, and venous malformations. The inclusion criteria were also as follows: articles written in English, and that described treatment approaches involving sclerotherapy. Exclusion criteria were established to refine the results and ensure the clinical relevance of the selected studies. Initially, isolated, duplicated case reports and in vitro studies were excluded, as these models do not provide robust evidence or direct clinical applicability. Animal studies were also disregarded, as they do not meet the focus of this review, which is centered on interventions in humans. Additionally, studies that addressed vascular malformations located outside the oral cavity were excluded, since the scope of this review is limited to lesions located specifically within the intraoral region. The application of these criteria allowed for the elimination of publications that did not directly contribute to the analysis of sclerotherapy as a therapeutic approach for oral vascular malformations. From the total of 141 articles initially identified, all titles and abstracts were read carefully. Among these, 10 articles were selected based on their relevance, recency, and thematic interconnection. These studies were considered the most pertinent for the proposed analysis, as they addressed similar concepts and provided complementary perspectives. It is important to emphasize that the selection process was not guided by predefined filters or exclusion criteria, nor by any intentional bias, but solely by the content and quality observed during the reading.

The study selection process is illustrated in Figure 1.

Figure 1 - Diagram showing the selection of articles reviewed.



Source: Authors’ own source.

The search strategy used descriptors combined with Boolean operators (AND, OR), including terms such as “arteriovenous malformations,” “vascular malformations,” and “venous malformations,” always associated with “oral cavity” and “sclerotherapy.” Three databases were consulted: PubMed (728 articles), Scielo (25 articles), and Cochrane (11 articles), totaling 764 publications. Exclusion criteria included single-case or in vitro studies, animal research, and studies on malformations outside the oral cavity. Inclusion criteria encompassed articles published between 2014 and 2024, in English, addressing sclerotherapy and oral vascular malformations, including systematic reviews, meta-analyses, retrospective studies, case series, and randomized clinical trials. After applying these criteria, 10 articles were ultimately included. The flowchart clearly illustrates the methodological pathway, ensuring transparency and reproducibility.

3. Results and Discussion

A total of X articles was identified through the literature search. Following the removal of Y duplicates and the exclusion of W articles that did not meet the predefined eligibility criteria, T studies were included in the final analysis. Based on the data extracted from the 10 included studies. In table 1 a total of 2,120 patients were evaluated.

Table 1 - Comparative table for the articles reviewed. Based on the Therapeutic approach, Number of Patients, Localization, results, and Outcomes.

	Article Tittle	Author / Year	Therapeutic Approach	Number of Patients	Localization	Results	Outcomes
1	Sclerotherapy as an esthetic indication in oral vascular malformations: a case series.	Manzano B, 2019.	Monoethanolamine Oleate 5%.	19 Patients.	Lower and Upper Lip, Labial Mucosa, Labial Commissure.	Complete resolution of lesions in all cases.	Patients reported local burning sensation, edema and mild ischemia.
2	Sclerotherapy for Venous Malformations of Head and Neck: Systematic Review and Meta-Analysis.	De Maria L, 2020.	Bleomycin, Ethanol, Monoethanolamine Oleate, Pingyangmycin, and Sodium Tetradecyl Sulfate.	2.067 Patients.	Lower and Upper Lip, Buccal Mucosa, Labial Mucosa.	Overall complete cure rate of 64.7%; patient satisfaction of 91%; improvement in quality of life of 78.9%.	Permanent morbidity of 0.8%; no cases of mortality.
3	Therapeutic Effect of Polidocanol Sclerotherapy on Oral Vascular Malformations.	Fukuzawa S, 2021.	Polidocanol 1%.	9 Patients.	Tongue, Buccal Mucosa , Lower and Upper Lips and Floor of Mouth.	88% of cases registered with complete cure and 12% of cases partially cured (Floor of Mouth and Tongue).	Local pain and swelling; no serious adverse effects.
4	Sclerotherapy of Vascular Malformations in the Oral Cavity- Minimizing Postoperative Morbidity.	Zeevi I, 2020.	Monoethanolamine Oleate 5%.	25 Patients.	Lower and Upper Lip, Buccal Mucosa, Labial Commissure.	91% of cases resolved and after 6 weeks of applications the cure rate was 97%.	Pain, local edema, hematoma and ulceration.
5	Benign oral vascular lesions treated by sclerotherapy with ethanolamine oleate: a retrospective study of 43 patients.	Fernandes DT et al. 2018.	Sclerotherapy with 5% ethanolamine oleate, intralesional injection.	43 Patients.	Lips (70%), tongue (16%), buccal mucosa (14%).	Complete regression in 91% of cases. Safe, effective, and affordable procedure.	No complications or recurrences were reported during the follow-up period.
6	Sclerotherapy of Venous Malformations Using Polidocanol.	Schmitt N et al. 2023.	Image-guided percutaneous sclerotherapy with polidocanol (1–3%).	167 Patients	Head and neck (62%), extremities (30%), trunk (5%).	Symptom improvement in 67.5%. Adverse events in 10.2%, more frequent in extremities. Less effective in children.	Adverse effects included pain, hematoma, severe swelling, necrosis, limited mobility, and paresthesia.
7	Foam Polidocanol Sclerotherapy for Low-Flow Vascular Malformations of Tongue.	Mukul SK et al. 2019.	Ultrasound-guided foam sclerotherapy with 3% polidocanol (Tessari method).	15 Patients.	Tongue.	93.3% showed complete or partial regression. Effective, low-cost, and minimally invasive technique.	Reported complications included transient swelling lasting 2–3 days and, in one case, partial necrosis of the tongue mucosal lesion.

8	Utility of sodium tetradecyl sulfate sclerotherapy from benign oral vascular lesion.	Choi BE et al. 2016.	Direct injection of 1% sodium tetradecyl sulfate (STS).	3 Patients (case series).	Buccal mucosa, upper lip, lower lip.	All cases showed significant lesion regression. Positive aesthetic and functional outcomes.	No complications were related.
9	Sclerotherapy of face and oral cavity low flow vascular malformations: our experience.	Górriz-Gómez E et al. 2014.	Foam sclerotherapy with 0.5% polidocanol (Tessari method with CO ₂).	15 Patients.	Lips, tongue, cheek, chin.	All lesions reduced. One complication (superficial necrosis). Effective and well-tolerated technique.	Local pain, postoperative inflammation and superficial necrosis in one case.
10	Efficacy of foam sclerotherapy with polidocanol for the management of oral venous malformations.	Kato T et al. 2024.	Direct injection of 1% polidocanol foam (Tessari method, 1:4 air ratio).	16 Patients (22 lesions).	Lips, tongue, buccal mucosa, masseter, pharynx.	6 complete responses, 10 partial. No severe adverse events. Safe and effective treatment.	Localized injection site pain or swelling.

Source: Authors' own source.

The table compares different therapeutic approaches for vascular malformations, with a focus on sclerotherapy, detailing the author, the number of patients, the location of the lesions, the results, and the outcomes (complications or long-term effects).

The sclerosing agents most reported in the literature were monoethanolamine oleate (EAO), ethanol, bleomycin, polidocanol, and sodium tetradecyl sulfate. Data extracted from the selected studies included the type of vascular anomaly, treatment modality, therapeutic outcomes, and any reported complications. Given the narrative design of this review, no statistical analysis was conducted. Instead, the findings were synthesized qualitatively to compare the effectiveness and safety profiles of the treatment approaches.

The diagnosis of venous malformations typically involves clinical evaluation complemented by imaging methods such as Doppler ultrasound and magnetic resonance imaging (MRI), which are essential for accurate characterization and treatment planning. However, two studies, (Manzano et al., 2019 and Zeevi I et al., 2020), employed a different approach by using diascopy as a diagnostic tool. This simple, non-invasive technique allowed for the identification of the characteristic blanching response of venous lesions under pressure, demonstrating its usefulness in the initial clinical assessment.

Several studies have evaluated the efficacy and safety of sclerotherapy in the treatment of VMs, using different sclerosing agents. EAO has shown favorable results in multiple reports, such as Manzano et al., 2018, described a case series of 19 patients with 21 VMs treated exclusively with 5% EAO, reporting lesion resolution in 76.2% of cases after one or two applications, with mild and transient side effects such as local burning and edema. Zeevi et al., 2020, reinforced EAO's effectiveness, noting that injection volumes greater than 0.3 mL per session and lesions larger than 5 mm increase the risk of complications. They recommended a 12-week interval between sessions to minimize morbidity. Fernandes et al., 2018, also reported excellent outcomes, with complete clinical regression in 91% of cases and satisfactory results after a single application in 58% of patients, then EAO was considered safe, effective, and low cost.

Polidocanol, in both liquid and foam forms, was another widely used agent. In accord of Fukuzawa et al., 2021, reported a response rate of 88.2%, with an average of 1.6 applications and a mean dose of 2.86 mL per lesion, Kato et al., 2024, observed complete resolution in 37.5% of cases and significant reduction in 62.5%, with no serious adverse effects and, in a similar study, Górriz-Gómez et al., 2014, reported clinical improvement in all patients, with only one case of superficial necrosis that healed completely, but on the other hand, Makul et al., 2019, described complete or partial regression in 93.3% of cases, with response correlated to lesion size and excellent tolerability. Moreover, Schmitt et al., 2023, demonstrated symptomatic improvement in

67.5% of patients, though children showed lower response rates (57.1%), and lesions located on the extremities had more adverse events (8.4%). The overall adverse event rate was acceptable at 10.2%.

Sodium tetradecyl sulfate (STS) was also assessed by Choi et al., 2016, who reported its use in three cases of benign oral vascular lesions, with gradual regression and high patient satisfaction. STS was considered an effective, minimally invasive, and low-cost alternative to surgical treatment.

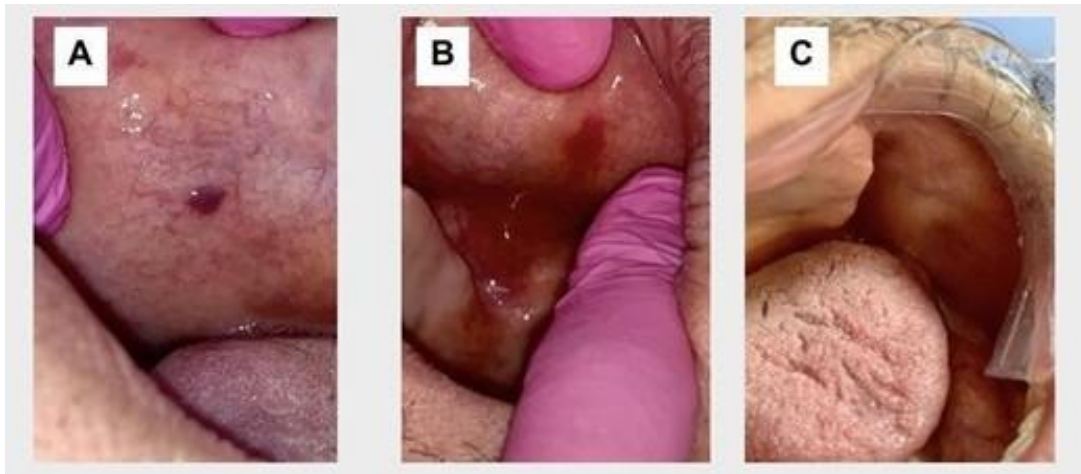
Finally, De Maria et al., 2020, evaluated several agents in percutaneous sclerotherapy for cervicofacial VMs. The overall cure rate was 64.7%, with Pingyangmycin/Bleomycin showing the highest efficacy (82.9%) and STS the lowest (55.5%). Nevertheless, milder agents such as bleomycin and STS presented better safety profiles compared to more aggressive substances like ethanol. Patient satisfaction was high (91%), with improved quality of life reported by 78.9% of patients and a low rate of permanent morbidity (0.8%).

The management of venous malformations (VMs) in the oral cavity represents a clinical challenge. A wide variety of sclerosing agents are currently available, each exhibiting distinct mechanisms of action. Accurate diagnosis is essential for successful treatment (Balasundaram et al., 2014).

Consistent with the literature, sclerotherapy emerges as a widely adopted and generally successful treatment for oral VMs. Our synthesized results particularly highlight the high efficacy of EAO

Our findings corroborate the high therapeutic efficacy of agents such as EAO, polidocanol, and pingyangmycin, which are generally associated with a low incidence of significant adverse effects. The choice of an ideal treatment remains multifactorial, depending on lesion characteristics, location, and specific properties of the sclerosing agent, as illustrated in Figure 2.

Figure 2 - Clinical case, with a time lapse after seven days and the follow-up of two years.



Source: Images obtained at School-Clinical of University of Santo Amaro.

For this patient we had: (A) Buccal mucosa with vascular malformation (VM) (B) clinical appearance of lesion on seventh day post-procedure (C) Follow-up 2 years after procedure.

Previous series using EAO frequently reported high response rates (Balasundaram et al., 2014. Ribeiro et al., 2018. De Maria et al., 2020). In one trial involving 27 patients (30 lesions), a 100% regression rate was achieved, with smaller lesions resolving more rapidly (Johann et al., 2005). A larger comparative study of 83 patients reported complete resolution in 79 lesions and significant improvement in 6 more, with acceptable adverse events such as transient pain, swelling, occasional superficial sloughing (Hoque et al., 2011).

Polidocanol stands out for its good tolerability, reduced pain during application, and a lower risk of tissue necrosis. In contrast, absolute ethanol, although more potent, is associated with higher rates of local and systemic complications (Berenguer et al., 1999). Both the liquid and foam forms of polidocanol are effective; however, the foam has demonstrated superior efficacy at lower concentrations and doses, thereby minimizing complications and enabling a safer treatment approach. Although its curative potential may be inferior to that of ethanol, polidocanol generally causes fewer serious adverse effects, with low rates of skin necrosis and only mild reactions such as pain or swelling at the injection site. Supporting these safety concerns, Hammer et al., 2001. reported in a prospective study that systemic ethanol contamination during sclerotherapy of VMs could be detected in 25 of 30 cases (83.3%).

Pingyangmycin / Bleomycin has emerged as a highly effective sclerosing agent for venous malformations (VMs). In the present study, complete cure rates reached up to 82.9% in cervicofacial malformations, with low permanent morbidity (0.8%). A more recent retrospective study (2022–2024) involving 29 patients with various VM locations achieved grade 3–4 responses in all cases, with a significant reduction in pain (VAS score of 4 to 1) and no major complications (He et al., 2025).

Furthermore, in one clinical trial demonstrated that the combination of pingyangmycin with ECT in the treatment of tongue malformations was 97% effective, compared to 73% with pingyangmycin alone, and without necrosis or nerve damage (Yuan et al., 2024). These data reinforce the position of pingyangmycin as a highly effective agent, especially in large-volume lesions or complex locations. STS is a surfactant widely used in sclerotherapy, with established application in superficial VMs, especially in lesions of the oral cavity. Its mechanism of action is based on the chemical destruction of the vascular endothelium, leading to thrombosis and subsequent vascular fibrosis. Although STS is considered moderately potent compared to agents such as ethanol, bleomycin, or ethanolamine oleate, it offers important advantages, including easy handling, low cost, and good local tolerance. (Manzano et al., 2019. Mukul et al., 2019).

However, in the current study, STS showed lower efficacy. Two articles evaluating its use reported conflicting results: one demonstrated satisfactory VM regression, while the other showed a low response rate (Manzano et al., 2019).

A relevant aspect is the importance of adequate evaluation before initiating treatment. Accurate diagnosis of venous malformations, with the aid of imaging tests such as Doppler ultrasound and magnetic resonance imaging (MRI), is essential to differentiate these lesions from hemangiomas, as well as arterial or lymphatic malformations, and to appropriately guide therapeutic management. In this context, two studies included in this review reported the use of diascopy as a preliminary clinical tool for the assessment of venous malformations (Manzano et al., 2019. Zeevi et al., 2020). Diascopy involves the application of digital pressure to the lesion using a transparent object, such as a glass slide, resulting in partial or complete blanching due to vascular emptying a clinical feature characteristic of VMs (Manzano et al., 2019). Although it does not replace advanced imaging techniques, diascopy serves as a valuable and accessible method in outpatient settings, contributing to the initial differential diagnosis and to the selection of the most appropriate imaging strategy (Legiehn et al., 2008).

About the alternative approach, in addition to sclerotherapy, high-power laser therapies are emerging as an effective option, especially for superficial VMs that demonstrate that high-power diode laser is safe and effective in the management. This method provides excellent clinical healing and a low recurrence rate. In Heimlich et al., 2024, were reported the advantages of FDIP over conventional surgery include reduced intervention time, reduced need for local anesthesia, and improved hemostasis, which improves visibility of the affected area. The diode laser offers good coagulation properties, absence of postoperative bleeding and pain, and good wound healing, resulting in less edema, bleeding, and infection. However, the high cost of laser equipment is an important limiting factor. Although the diode laser may not completely remove all lesions after a single session (Heimlich et al., 2024).

4. Conclusion

The management of oral vascular malformations (VMs) is a complex clinical challenge that requires careful diagnosis and individualized treatment planning. Among the available options, sclerotherapy remains a highly effective, safe, and accessible approach, particularly for low-flow lesions. Agents such as monoethanolamine oleate (5%) and polidocanol, especially in foam form, demonstrated high success rates and low morbidity. Pingyangmycin also showed significant therapeutic potential, particularly in combination with electrochemical therapy, while sodium tetradecyl sulfate despite its lower efficacy remains a viable alternative due to its favorable safety profile.

High-power diode lasers, including the FDIP technique, are emerging as valuable minimally invasive tools, offering excellent healing and reduced postoperative complications. However, their high-cost limits widespread use. Despite these advances, sclerotherapy continues to be a mainstay in the treatment of oral VMs, supported by consistent clinical outcomes and patient satisfaction. The growing use of newer technologies should be viewed as complementary rather than substitutive, reinforcing the role of sclerotherapy as a fundamental and enduring therapeutic modality.

References

- Balasundaram, I., Al-Hadad, I., Rehman, K., McCafferty, I., & Monaghan, A. (2014). The use of foam sclerotherapy to treat low-flow vascular malformations of the head and neck. *Journal of surgical case reports*, 2014(9), rju095. <https://doi.org/10.1093/jscr/rju095>
- Berenguer, B., Burrows, P. E., Zurakowski, D., & Mulliken, J. B. (1999). Sclerotherapy of craniofacial venous malformations: complications and results. *Plastic and reconstructive surgery*, 104(1), 1–15.
- Choi, B. E., Kim, Y., Leem, D. H., Baek, J. A., & Ko, S. O. (2016). Utility of sodium tetradecyl sulfate sclerotherapy from benign oral vascular lesion. *Maxillofacial plastic and reconstructive surgery*, 38(1), 44. <https://doi.org/10.1186/s40902-016-0094-9>
- Clemens, R. K., Pfammatter, T., Meier, T. O., Alomari, A. I., & Amann-Vesti, B. R. (2015). Vascular malformations revisited. *VASA. Zeitschrift für Gefasskrankheiten*, 44(1), 5–22. <https://doi.org/10.1024/0301-1526/a000402>
- De Maria, L., De Sanctis, P., Balakrishnan, K., Tollefson, M., & Brinjikji, W. (2020). Sclerotherapy for Venous Malformations of Head and Neck: Systematic Review and Meta-Analysis. *Neurointervention*, 15(1), 4–17. <https://doi.org/10.5469/neuroint.2019.00213>
- Fernandes, D. T., Elias, R. A., Santos-Silva, A. R., Vargas, P. A., & Lopes, M. A. (2018). Benign oral vascular lesions treated by sclerotherapy with ethanolamine oleate: A retrospective study of 43 patients. *Medicina oral, patologia oral y cirugia bucal*, 23(2), e180–e187. <https://doi.org/10.4317/medoral.22253>
- Fukuzawa, S., Yamagata, K., Okubo-Sato, M., Terada, K., Uchida, F., Ishibashi-Kanno, N., & Bukawa, H. (2021). Therapeutic Effect of Polidocanol Sclerotherapy on Oral Vascular Malformations. *Dentistry journal*, 9(10), 119. <https://doi.org/10.3390/dj9100119>
- Górriz-Gómez, E., Vicente-Barrero, M., Loras-Caballero, M. L., Bocanegra-Pérez, S., Castellano-Navarro, J. M., Pérez-Plasencia, D., & Ramos-Macías, A. (2014). Sclerotherapy of face and oral cavity low flow vascular malformations: our experience. *The British journal of oral & maxillofacial surgery*, 52(1), 43–47. <https://doi.org/10.1016/j.bjoms.2013.04.006>
- He, G., Zhang, L., Guo, L., & Han, A. (2025). Efficacy of sclerotherapy with pingyangmycin and polidocanol for venous malformations. *Frontiers in surgery*, 12, 1565333. <https://doi.org/10.3389/fsurg.2025.1565333>
- Heimlich, F. V., de Arruda, J. A. A., Kato, C. N. A. O., Silva, L. V. O., Souza, L. N., Ferreira, M. V. L., Pinheiro, J. J. V., Silva, T. A., Abreu, L. G., & Mesquita, R. A. (2024). Experience with 808-nm diode laser in the treatment of 47 cases of oral vascular anomalies. *Brazilian oral research*, 38, e025. <https://doi.org/10.1590/1807-3107bor-2024.vol38.0025>
- Hammer, F. D., Boon, L. M., Mathurin, P., & Vanwijck, R. R. (2001). Ethanol sclerotherapy of venous malformations: evaluation of systemic ethanol contamination. *Journal of vascular and interventional radiology : JVIR*, 12(5), 595–600. [https://doi.org/10.1016/s1051-0443\(07\)61482-1](https://doi.org/10.1016/s1051-0443(07)61482-1)
- Hoque, S., & Das, B. K. (2011). Treatment of venous malformations with ethanolamine oleate: a descriptive study of 83 cases. *Pediatric surgery international*, 27(5), 527–531. <https://doi.org/10.1007/s00383-010-2824-x>
- Johann, A. C., Aguiar, M. C., do Carmo, M. A., Gomez, R. S., Castro, W. H., & Mesquita, R. A. (2005). Sclerotherapy of benign oral vascular lesion with ethanolamine oleate: an open clinical trial with 30 lesions. *Oral surgery, oral medicine, oral pathology, oral radiology, and endodontics*, 100(5), 579–584. <https://doi.org/10.1016/j.tripleo.2004.12.021>
- Kato, T., Katayama, Y., Fukuhara, S., Watanabe, T., Yamanaka, S., Nakao, K., & Morimoto, N. (2024). Efficacy of foam sclerotherapy with polidocanol for the management of oral venous malformations. *Medicine international*, 4(3), 24. <https://doi.org/10.3892/mi.2024.148>
- Legiehn, G. M., & Heran, M. K. (2008). Venous malformations: classification, development, diagnosis, and interventional radiologic management. *Radiologic clinics of North America*, 46(3), 545–vi. <https://doi.org/10.1016/j.rcl.2008.02.008>

- Manzano, B. R., Premoli, A. M., Santaella, N. G., Ikuta, C. R. S., Rubira, C. M. F., & Santos, P. S. D. S. (2019). Sclerotherapy as an esthetic indication in oral vascular malformations: a case series. *Anais brasileiros de dermatologia*, 94(5), 521–526. <https://doi.org/10.1016/j.abd.2019.09.010>
- Mukul, S. K., Singh, A., Kumar, A., Pandey, S., Singh, S., & Kumar, A. (2019). Foam Polidocanol Sclerotherapy for Low-Flow Vascular Malformations of Tongue. *Annals of maxillofacial surgery*, 9(2), 257–260. https://doi.org/10.4103/ams.ams_81_19
- Pereira, A. S. et al. (2018). Metodologia da pesquisa científica. [free ebook]. Santa Maria: Editora da UFSM.
- Ribeiro, M. C., de Mattos Camargo Grossmann, S., do Amaral, M. B. F., de Castro, W. H., Navarro, T. P., Procopio, R. J., da Silva, T. A., de Nazaré Alves de Oliveira Kato, C., & Mesquita, R. A. (2018). Effectiveness and safety of foam sclerotherapy with 5% ethanolamine oleate in the treatment of low-flow venous malformations in the head and neck region: a case series. *International journal of oral and maxillofacial surgery*, 47(7), 900–907. <https://doi.org/10.1016/j.ijom.2017.12.004>
- Schmitt, N., Lorenz, J., Hohenstatt, S., Semmelmayr, K., Ruping, F., Hoffmann, J., Günther, P., Bendszus, M., Möhlenbruch, M. A., & Vollherbst, D. F. (2023). Sclerotherapy of Venous Malformations Using Polidocanol: Effectiveness, Safety, and Predictors of Outcomes and Adverse Events. *Journal of vascular and interventional radiology : JVIR*, 34(12), 2103–2109. <https://doi.org/10.1016/j.jvir.2023.08.032>
- Silva, H. C., Teles, A. C., Rocha, G. F., Silveira, E. M., Douglas-de-Oliveira, D. W., & Mesquita, A. T. (2025). Minimally invasive treatment of benign oral vascular lesions: A retrospective study. *Medicina oral, patologia oral y cirugia bucal*, 30(2), e217–e223. <https://doi.org/10.4317/medoral.26809>
- Yuan, W., & Wang, X. (2024). Therapeutic evaluation of electrochemical therapy combined with local injection of pingyangmycin for the treatment of venous malformations in the tongue. *Frontiers in neurology*, 15, 1425395. <https://doi.org/10.3389/fneur.2024.1425395>
- Zeevi, I., Chaushu, G., Alterman, M., & Chaushu, L. (2020). Sclerotherapy of Vascular Malformations in the Oral Cavity-Minimizing Postoperative Morbidity. *Medicina (Kaunas, Lithuania)*, 56(5), 254. <https://doi.org/10.3390/medicina56050254>
- Zheng, J. W., Mai, H. M., Zhang, L., Wang, Y. A., Fan, X. D., Su, L. X., Qin, Z. P., Yang, Y. W., Jiang, Y. H., Zhao, Y. F., & Suen, J. Y. (2013). Guidelines for the treatment of head and neck venous malformations. *International journal of clinical and experimental medicine*, 6(5), 377–389.