Vol : 8 Issue: 2

EDJ

Maxillary Rehabilitation with Pterygoid Implants: Evaluating Success and Complications in 58 Clinical Cases

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ABSTRACT

Background and Objective: The rehabilitation of the posterior maxilla is often hindered by unfavorable bone quality, sinus pneumatization, and anatomical constraints. Pterygoid implants are a desirable alternative to traditional techniques by engaging dense pterygoid plate, thereby circumventing sinus augmentation. The objective of this study was to retrospectively evaluate clinical outcomes of unilateral versus bilateral pterygoid implant placements regarding implant success and rate of complications.

Methods: This retrospective clinical study included 58 patients treated between February 2018 and August 2024. Data were retrieved from patient records and split based on the implant site placement: unilateral (posterior Maxillary one side rehabilitation) (n=29) or bilateral (full arch Maxillary rehabilitation) (n=29). All the patients underwent treatment with pterygoid implants placed with a standardized surgical procedure. Success was considered as absence of mobility, pain, infection, and lack of peri-implant radiolucency.

Results: The age range of the patients in the study is from 29 to 77 years with Mean Age of 56.8 years. All 58 cases demonstrated a 100% implant survival rate. Only one patient was with complications, while minor, non-critical complications were reported in the remaining cases. There were no statistically significant differences between the unilateral and bilateral groups in terms of complication or success rates.

Conclusion: Both unilateral and bilateral pterygoid implant placements yielded good clinical outcomes with minimal complications. It is evident from this research that both methods can be used successfully in prosthetic rehabilitation of the atrophied posterior maxilla depending on the specific anatomical and clinical condition.

Keywords: Pterygoid implant, unilateral, bilateral, posterior maxilla, implant success

Article Information

Submission Date: 15/6/2025
Revision date: 25/6/2025
Acceptance date: 17/7/2025
Publishing date: Dec 2025

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DOI: doi.org/10.15218/edj.2025.26

INTRODUCTION

Restoration of the posterior maxilla through dental implants is faced with several challenges due to its unique anatomical and physiological characteristics. These include reduced bone volume upon tooth loss, reduced bone quality-primarily Type III or IV bone and maxillary sinus pneumatization that has the tendency to decrease vertical bone height for the placement of implants.[1,2] These anatomical constraints render conventional implant placement difficult or even impossible without additional surgical procedures. To overcome these limitations, multiple solutions have been suggested, ranging from sinus floor elevation with bone grafting techniques to placement of short implants, tilted implants, and zygomatic or pterygoid implants.[2,3] Among these alternatives, pterygoid implants have gained wider acceptance as a minimally invasive alternative to sinus grafting, notably in the rehabilitation of atrophied posterior maxilla. First described by Tulasne in the late 1980s, the pterygoid implant technique involves anchoring implants in solid cortical bone of the pterygoid process of the sphenoid bone through the maxillary tuberosity.[4] The technique makes posterior anchorage possible without violating the maxillary sinus and with excellent primary stability that can be used for immediate or early loading. The pterygoid region presents a solid and stable anatomical site for implant anchorage.

Implant lengths are usually 15 to 25mm, and an insertion angle of 45 to 75 degrees from the maxillary plane. When placed correctly, pterygoid implants eliminate the need for distal cantilevers, reduce the number of implants, and provide stable posterior support for fixed full-arch prostheses.[5]

The procedure is technically demanding, requiring thorough knowledge of the regional anatomy and surgical expertise to avoid penetration into the pterygoid plexus or surrounding neurovascular structures.[6] There have been several studies that guaranteed the long-term stability and dependability of pterygoid implants. Their survival rates ranged from 90% to 99% for follow-up period up to 10 years.[2,7,8] They also give biomechanical advantages by distributing occlusal forces along the posterior arch, reducing torque on anterior implants, and enhancing prosthetic stability.[9] Even though pterygoid implants possess these benefits, they are yet to be accepted universally, primarily due to their anatomical complexity and steep learning curve.

One of the persistent clinical concerns involves t he number and distribution of pterygoid implants. While bilateral placement is typically recommended in full-arch reconstructions to avoid asymmetrical loading distribution, unilateral placement may be sufficient in specific situations, especially with anatomical limitations, patient preference, or economic boundaries.[10] However, there is little clinical evidence on the relative efficacy of unilateral versus bilateral pterygoid implants. With increasing popularity of one-piece dental implants, there has been a clinical focus on using one-piece implants in extreme atrophied cases.[2,11] The aim of this study is to fill that gap through a retroprospective analysis or bilateral pterygoid implants over a 4-year period. The primary aim is to compare the rate of implant success and complications incidence between the two groups of patients. Secondarily, to evaluate whether unilateral placement offers an equal alternative to bilateral design in terms of both clinical performance and patient outcome.

METHODS

Study Design and Setting

This retrospective study was conducted from May 2018 to August 2024. Ethical approval for this study was given by the institutional scientific committee prior to data collection. All procedures were conducted as per the ethical standards and as per the Helsinki Declaration.

Patient Selection

A total of 58 patients were included in this study based on the following inclusion criteria:

- Age ≥ 18 years.
- Received at least one pterygoid implant during the study period.
- Minimum follow-up duration of six months post-prosthetic loading.

Exclusion criteria:

- Incomplete patient records or radiographs.
- Systemic conditions contraindicating implant surgery (e.g., uncontrolled diabetes, recent chemotherapy).
- History of radiation therapy in the maxillofacial region.

Grouping and Data Collection

Patients were divided into two groups based on the number of pterygoid implants placed:
(posterior Maxillary one side rehabilitation) (n=29) or bilateral (full arch Maxillary rehabilitation)

- Group 1 (Unilateral): Patients who received a single pterygoid implant for rehabilitation of one side of posterior Maxilla.
- Group 2 (Bilateral): Patients who received two pterygoid implants, one on each side in full arch Maxillary rehabilitation

Demographic data (age, gender), date of surgery, implant configuration and sites (unilateral vs. bilateral), implant dimensions (diameter and length) were recorded. Additional variables included the postoperative complications, and implant survival.

Surgical Protocol

All implants were placed by the same surgical team under local anesthesia. Standard aseptic protocols were followed. The pterygoid implant was placed through the maxillary tuberosity toward the pterygoid process of the sphenoid bone, following an insertion angle of 30°–50°, depending on patient anatomy after careful planning depending on OPG and CBCT. All the pterygoid implant were inserted free-hand without using surgical guide and with flapless approach (Figure 1).

One-piece Compressive implants from ROOTT Implant System (TRATE AG, Swiss) were used in the present study (Figure 2). Implants are specifically engineered for use in narrow ridges and atrophied cases. The implant body is tapered with V-shaped threads; it ensures high implant stability which encourage immediate loading of the prosthesis.

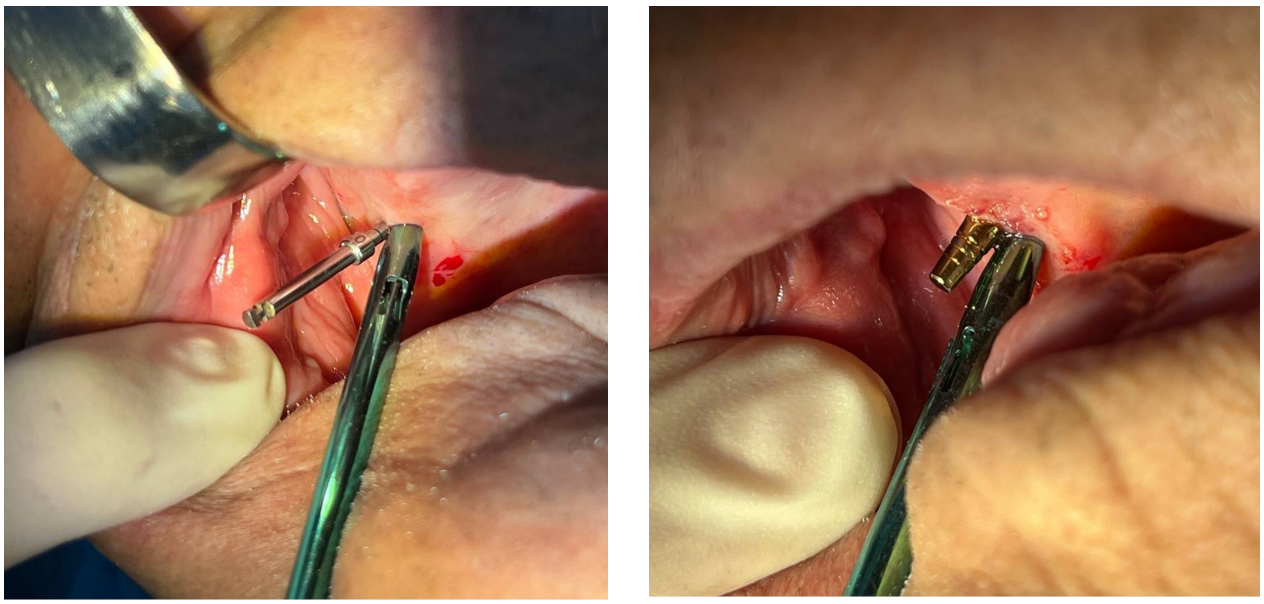

Figure 1. Flapless surgery and placement of pterygoid implants

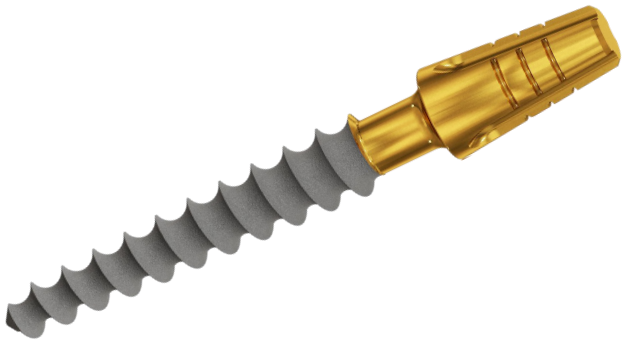

Figure 2. Compressive Implants, ROOTT Implant System (TRATE AG, Swiss)

DOI: doi.org/10.15218/edj.2025.26

Implants used varied in length (15 mm to 20 mm) and diameter (3.5 mm to 4.5 mm). All implants were either splinted with other posterior implants or incorporated into full-arch prostheses (Figure 3).

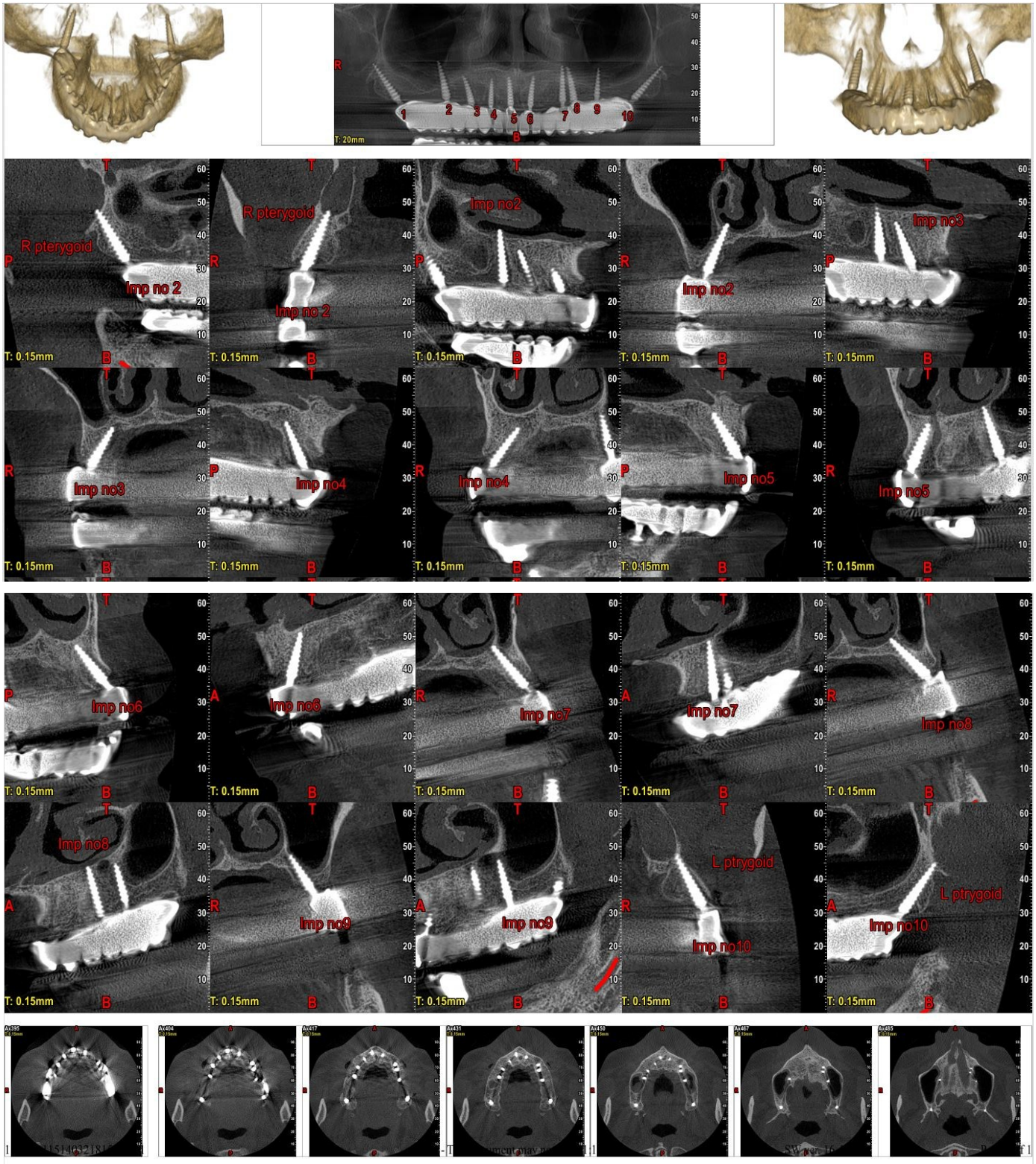

Figure 3. CBCT view of full arch case treated with compressive implants and bilateral pterygoid implants

Success and Complication Criteria

Implant success was defined as:[2]

- Absence of clinical mobility.
- No signs of pain or infection.

No radiographic evidence of peri-implant bone loss or radiolucency.

Complications were categorized as:

- Surgical (e.g., sinus penetration, bleeding).
- Prosthetic (e.g., Implant fracture, implant misalignment).

Biological (e.g., mucositis, soft tissue inflammation).

Statistical Analysis

Descriptive statistics were used to summarize patient demographics and clinical outcomes. Implant survival and complication rates were compared between the unilateral and bilateral groups by using ANOVA and t-test. Data were analyzed using the Statistical Package for Social Sciences (SPSS, version 29).

RESULTS

A total of 58 patients were included in the study, consisting of 29 cases with unilateral pterygoid implants and 29 cases with bilateral placement. The age range of the patients in this study was 29 to 77 years with mean Age of 56.8 years.

Implant Success

All 58 implants placed demonstrated complete osseointegration and functional stability during the observation period, yielding a 100% survival rate. No implant failures were reported in either the unilateral or bilateral groups.

Complications

Non-critical complications were encountered in 57 cases (98.3%), all of which were transient soft tissue inflammation or a minor prosthetic complications, none of which compromised the implant stability or required removal. Only One case (1.7%) was associated with critical complication; where the implant was fractured after loading for 4 years, the facture was in in the neck of the implant (Figure 4).

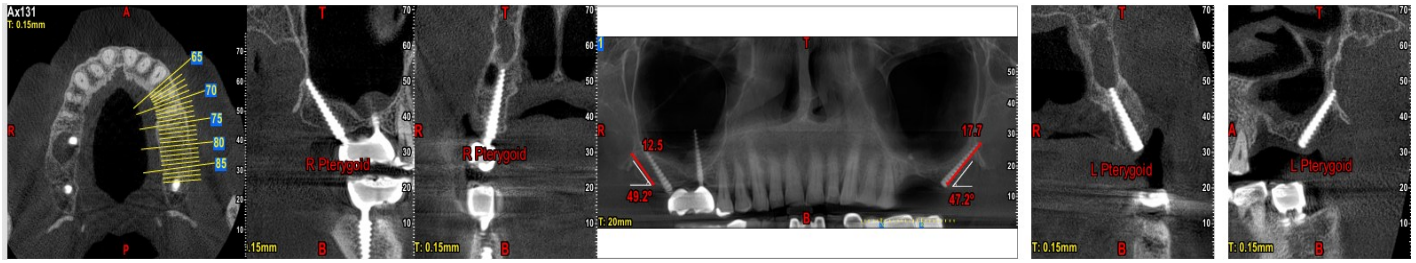

Figure 4. Fracture at neck of pterygoid implant for a unilateral case after 4 years in service

Comparison Between Groups

There were no statistically significant differences in implant survival or complication rates between the unilateral and bilateral groups. Both approaches demonstrated excellent clinical outcomes without major problems.

Clinical Outcomes

Table 1 is illustrating the details of clinical outcomes of the study regarding the implant success, complications and prosthesis.

Table 1. Summary of Clinical Outcomes

Parameter	Unilateral (n=29)	Bilateral (n=29)	Total (n=58)
Implant Success	29 (100%)	29 (100%)	58 (100%)
Without Complications	28 (96.6%)	29 (100%)	57 (98.3%)
With Complications	1 (3.4%)	0 (0%)	1 (1.7%)
Telescopic Abutments Used	6 (20.7%)	9 (31.0%)	15 (25.9%)

DOI: doi.org/10.15218/edj.2025.26

Statistical Analysis Between Groups

- **Independent T-test:**
  - t-statistic: −1.0803
  - p-value: 0.2847
  - **Interpretation:** No statistically significant difference in mean age between the unilateral and bilateral groups ($p > 0.05$).
- **One-way ANOVA:**
  - F-statistic: 1.167
  - p-value: 0.2847
  - **Interpretation:** Confirms the T-test result—no significant age variance between the two groups.

DISCUSSION

This retrospective study assessed the clinical success of unilateral versus bilateral pterygoid implants for posterior maxillary reconstruction in 58 patients. The two groups demonstrated an impressive 100% survival rate during the follow-up period, with no implant failure. These results confirm the high success rate of pterygoid implants, supporting their use as a reliable alternative to conventional treatment in challenging posterior maxillary cases. These results are consistent with several clinical studies that have reported high rates of long-term survival for pterygoid implants ranging from 90% to 99% for time periodsup to 10 years.[1,2,7] The absence of failure for the unilateral or the bilateral group suggests that implant success is more dependent on surgical technique, prosthetic type, and patient selection rather than the number of pterygoid implants inserted. While bilateral implants are favored in full-arch rehabilitation to achieve maximum force distribution and posterior support,[5] unilateral placement is equally effective and biomechanically adequate, which would offer significant clinical benefits in the form of reduced surgical time, cost, and patient morbidity, especially in medically compromised or elderly patients or patients with anatomic restrictions on one side.[6]

Minor complications were observed in 98.3% of the cases, most of which were non-severe and did not affect overall implant success. These included soft tissue inflammation, prosthetic misfits, or transient discomfort, and were managed with conservative interventions. One case, in the unilateral group, was completely free of complications. Such high complication rate may initially appear concerning, but it reflects the routine nature of minor post-operative events in complex implant cases and reinforces the need for meticulous post-operative care and regular follow-ups.[12]

There were some minor complications, which were for the most part non-severe and did not affect the overall success of the implants. These were soft tissue inflammation, prosthetic misfits, or transient discomfort, and were managed by conservative treatments. There was only one case, within the unilateral group, that was totally complication-free (98.3% of the cases) and thereby it highlights the need for rigorous post-operative care and frequent follow-up.[12]

Prosthetically, telescopic abutments were used in 25.9% of the patients, with improved hygiene, retrievability, and patient satisfaction. The increasing trend of using telescopic designs reflects a shift toward angulated implant abutments in full-arch cases, especially in one-piece implnats.[2,13]

No notable statistical differences were found in age, gender distribution, or complication rates between the unilateral and bilateral groups as confirmed by both t-tests and ANOVA ($p > 0.05$). This outcome attests to the clinical flexibility of the pterygoid implant procedure: unilateral and bilateral configurations can be used effectively depending on anatomical status, patient choice, and prosthetic requirement. Moreover, the even distribution of male and female patients eliminates gender bias and strengthens the generalizability of the study.

Biomechanically, pterygoid implants offer several advantages. By engaging the dense cortical bone of the pterygoid process, they provide excellent primary stability and eliminate the need for cantilevers. This translates into improved load-bearing capacity and reduced stress on anterior implants, particularly in full-arch cases.[2,14,15] Their long angulated trajectory also allows for immediate loading in many cases, further reducing treatment time and enhancing patient satisfaction.[16,17]

From a biomechanical perspective, pterygoid implants offer several advantages. By reaching the dense cortical bone of the pterygoid process, they provide better primary stability and reduce the need for cantilevers. This ensures improved load-bearing and less posterior implant stress, particularly in full-arch cases[2,14,15] Their angulated long path also allows immediate loading in the majori-

ty of cases, further reducing treatment time and enhancing patient satisfaction.[16,17,18]

CONCLUSION

The results of the current study confirm the clinical success and predictability of bilateral and unilateral pterygoid implants in posterior maxillary rehabilitation. Decision between bilateral or unilateral placement should be based on thorough evaluation of anatomical, prosthetic, and patient-related parameters. The outcomes provide valuable information for clinicians handling challenging posterior maxillary cases and necessitate further studies to maximize pterygoid implant protocols.

ACKNOWLEDGMENTS

The author would like to thank the surgical and prosthodontic team at the College of Dentistry, Hawler Medical University, for their clinical support and assistance with patient management and data collection.

CONFLICTS OF INTEREST

The author declares no conflict of interest.

FUNDING

This research received no external funding and was self-supported by the author.

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DOI: doi.org/10.15218/edj.2025.26