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CASE REPORT

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Modified nail folding approach: A novel strategy for the treatment of subungual glomus tumors—A case series study

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Key Clinical Message

The modified nail folding approach, a new surgical technique, has been shown to be safe and effective for the treatment of subungual glomus tumors, providing clinicians with a new treatment option for patients with this condition.

Abstract

Glomus tumors (GTs) are rare benign tumors that originate from the glomus body in the skin of the fingertips, toes, and nail beds. GTs are more prevalent in women than in men and can occur sporadically or as part of an inherited condition known as multiple GTs. The exact cause of GTs is unknown, but it is believed that mutations in the cells of the glomus body contribute to their development. In this study, we present the efficacy of a novel surgical technique called the modified nail folding approach for treating subungual GTs. We report a case series involving 17 patients who underwent the nail folding approach for surgical removal of subungual GTs. The primary objective of this article is to provide evidence supporting the safety and effectiveness of this technique. Additionally, we aim to introduce clinicians to a new, secure, and efficient treatment option for patients with subungual GTs.

KEYWORDS

flap, glomus tumor, nail, orthopedic surgery, subungual

1 | INTRODUCTION

Glomus tumors (GTs) are rare, benign tumors that originate from the glomus body, a specialized structure containing glomus cells found in the skin of the fingertips, toes, and nail beds. The glomus body serves the function of regulating blood flow and temperature in these areas.[1] GTs are uncommon, accounting for less than 2% of all soft tissue tumors. They primarily affect adults, with the highest incidence occurring in the fourth and fifth decades of life. GTs are more frequently observed in women than in men, with a female-to-male ratio of approximately 2:1.[2] While they most commonly occur in the fingers, particularly in the subungual area (beneath the nail), they can

also manifest in the toes, palms, and soles of the feet, albeit less frequently. GTs may develop sporadically or as part of an inherited condition known as multiple GTs.[3]

The precise cause of GTs remains unknown. However, it is believed that they originate from mutations occurring in the cells of the glomus body. These mutations result in uncontrolled cell growth, leading to tumor formation.[4] Recent studies have provided some understanding of the genetic basis of GTs. For instance, researchers have identified genetic mutations in a gene called myosin heavy chain 9 (MYH9) in certain GT cases. MYH9 plays a role in regulating cell growth and division, and mutations in this gene are known to be associated with other tumor types as well.[5] Other studies have suggested a potential link between GTs and specific viral infections, such as human papillomavirus and Epstein–Barr virus. However, further research is necessary to validate these findings.[6,7]

The diagnostic process for GTs typically involves a combination of physical examination, medical history review, and imaging tests. Imaging tests, such as X-ray, MRI, or ultrasound, are commonly employed to obtain detailed images of the affected area. These tests aid in determining the size, location, and potential spread of the tumor to nearby tissues. In some cases, a biopsy may be performed to confirm the diagnosis definitively.[8] When considering the differential diagnosis of GTs, several conditions may be taken into account, including hemangioma, neuroma, osteochondroma, ganglion cyst, epidermal cyst, fibroma, and pyogenic granuloma.[9]

The treatment of GTs is determined by factors such as tumor size, location, and associated symptoms. In many instances, treatment may not be necessary if the tumor is small and asymptomatic. However, if the tumor causes pain or other symptoms, various treatment options can be considered.[10] These options include surgery, cryotherapy, radiation therapy, and the use of nonsteroidal anti-inflammatory drugs as medications. Surgical removal of the tumor is often the preferred and curative treatment approach, with most individuals experiencing significant symptom relief post-treatment. However, there is a possibility of tumor recurrence if complete removal was not achieved during surgery. Several surgical techniques can be employed for the treatment of subungual GTs, such as nail bed incision, complete nail plate removal, nail fold approach, and subungual approach.[11,12] The current study aimed to assess the effectiveness of a novel surgical technique called the nail folding approach for treating subungual GTs. Through a case series study, the research aimed to provide evidence supporting the safety and efficacy of this technique. Moreover, the study offers clinicians a new, secure, and effective treatment option for patients with subungual GTs.

2 | CASE REPORT

A total of 17 patients were included in the study, consisting of seven males with a mean age of 38.85 ± 8.1 years and 10 females with a mean age of 31.2 ± 8.2 years. These

TABLE 1 Patients with glomus tumor by age and sex.

Patient number	Age	Sex	R/L hand	Finger location	Location in nail	Bone involvement	Color change	Nail deformity
1	28	F	L	S	Subungual	−	−	+
2	23	F	L	Ri	Subungual	+	−	−
3	31	F	R	T	Subungual	−	−	−
4	31	M	R	T	Subungual	+	+	−
5	38	F	L	Ri	Subungual	−	−	−
6	41	F	R	M	Subungual	−	−	+
7	47	M	R	T	Subungual	+	−	+
8	54	M	R	T	Subungual	−	−	+
9	14	F	R	S	Subungual	−	+	−
10	51	M	L	T	Subungual	+	−	−
11	33	F	R	T	Subungual	+	+	−
12	32	F	L	T	Subungual	−	−	−
13	31	F	L	Ri	Subungual	−	−	−
14	41	F	L	S	Subungual	−	−	−
15	42	M	R	S	Subungual	+	+	−
16	21	M	L	I	Subungual	+	−	−
17	26	M	L	T	Subungual	−	+	−

Abbreviations: F, female; I, index finger; L, left hand; M, male; M, middle finger; R, right hand; Ri, ring finger; S, small finger; T, thumb finger.

patients were identified between 2015 and 2023 based on their presentation with long-term chronic pain, deformity, and discoloration under the nails of their right/left fingers, persisting for up to 1 year. The subungual lesions resulted in nail plate deformity and avulsion. Among the patients with GT, the thumb was the most commonly affected digit, accounting for 47% of cases, while the index finger had the lowest occurrence, with only 5.8% of cases affecting each finger. Clinical assessment of the nail area confirmed the presence of GT in all patients. Systemic diseases such as diabetes or high blood pressure were absent upon physical examination, and traumatic lesions in the finger/nail area, such as impact or pressure, were observed in all patients. Preoperative physical examination revealed that among patients with GT, 41.2% exhibited involvement of the distal phalanges' bone, 29.5% showed nail discoloration, and 23.5% had nail deformity (Table 1).

2.1 | Operative technique

The modified nail folding approach was employed for surgically removing the tumor lesions. This innovative technique, performed for the first time by the present team and Dr. Ahangar, involved several steps. Firstly, a local anesthesia protocol was administered, consisting of a subcutaneous injection of 2 cc of lidocaine 10%. Subsequently, the distal finger, along with the nail, was immersed in warm water at a temperature of 55°C for a duration of 20 min. Instead of completely removing the nail plate, it was bent (nail folding), allowing for the removal of the tumor lesion. The heating of the nail plate increased its flexibility, preventing separation and breakage during the surgical procedure. Finally, the nail bed was repaired using 0.7 absorbable sutures (Figures 1–5).

2.2 | Postoperative and follow-up

The treatment progress of the patients was assessed in two stages: a 3-month follow-up and a 6-month follow-up after the surgery. Based on the findings presented in Table 2, during the 3-month follow-up, only one case (6% of cases) exhibited a change in the color of the nail bed. This change is likely attributed to the inflammatory response triggered by the surgical intervention. Additionally, within the same follow-up period, one case (6% of cases) displayed mild nail deformity, which showed significant improvement compared to the pre-intervention condition. During the 6-month follow-up, none of the cases demonstrated any signs of recurrence, nail deformity, or color changes. These results indicate positive outcomes and sustained improvement in the patients' condition over time.

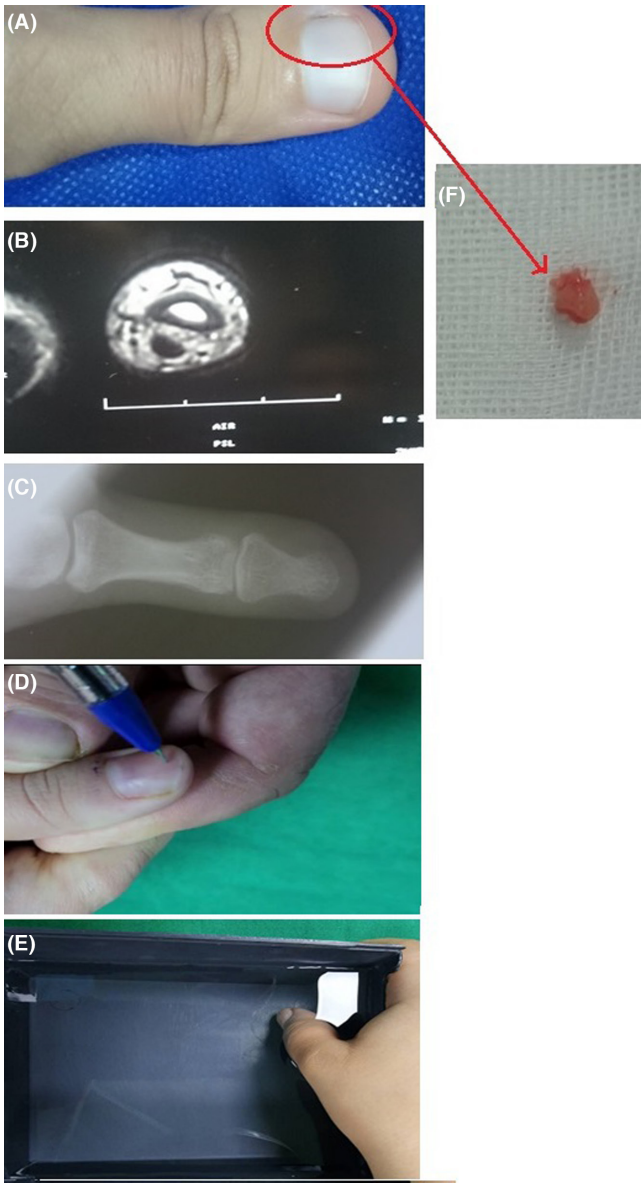

FIGURE 1 The subungual glomus tumor (GT) area was examined physically (A), followed by a T-1-weighted CT scan (B) and plain radiography (anterior–posterior [A-P] view; (C) of the thumb to determine the area for nail removal (D). The distal phalange of the thumb was then placed in warm water (at 55°C) (E), and the GT was successfully removed, measuring 0.4 × 0.4 cm (F).

3 | DISCUSSION

There are various treatment approaches available for subungual GTs. These include surgical excision, nail bed injection of steroid medication, cryotherapy using liquid nitrogen, laser therapy, and radiation therapy.[12] Different

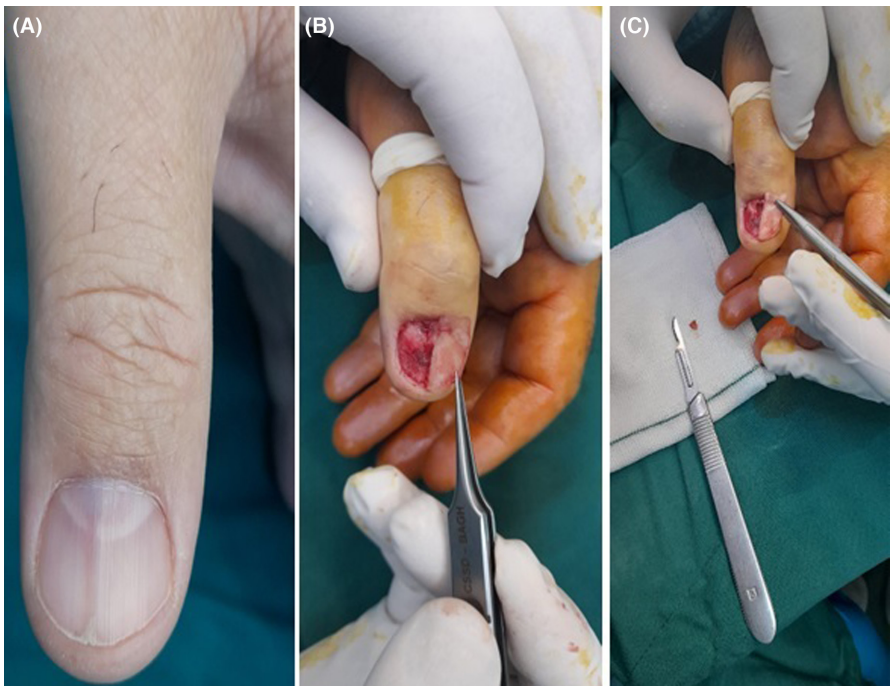

FIGURE 2 The subungual glomus tumor area was examined physically (A), the nail plate was removed after being placed in a warm water bath (at 55°C) (B), and the tumor was removed from the subungual area (0.2×0.3 cm) (C).

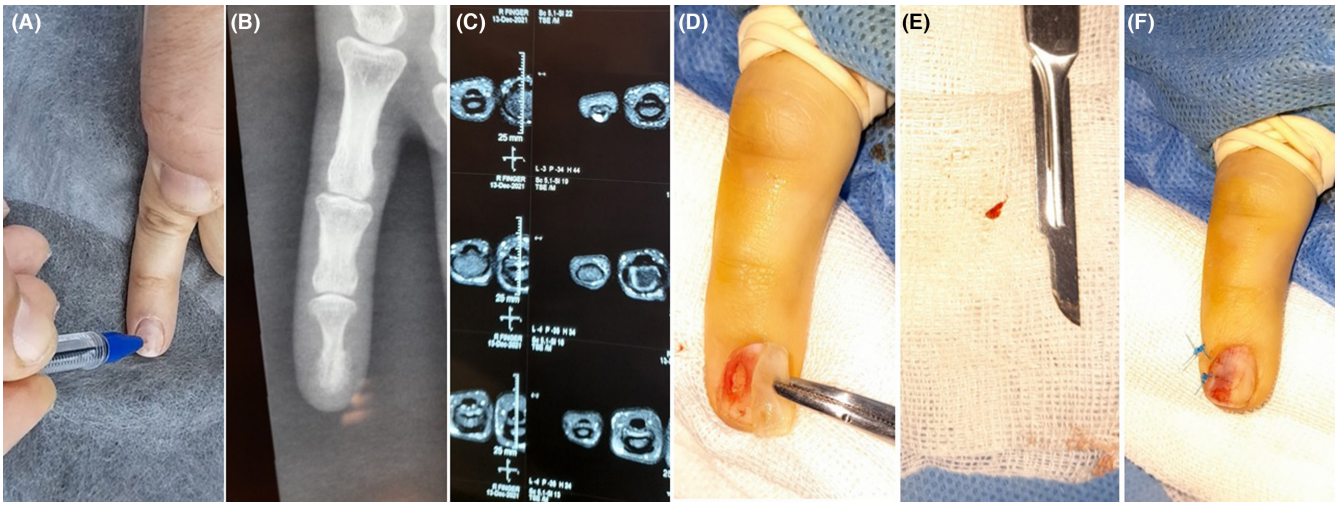

FIGURE 3 The subungual glomus tumor area was examined physically (A), followed by a plain radiography (A-P view; B) and T-1-weighted CT scan (C) of the little finger. After softening the nail plate by placing the distal phalange of the little finger in a warm water bath at 55°C (D), the tumor was removed (0.2×0.3 cm) (E), and the area was sutured (F).

surgical techniques are employed for the removal of GTs, such as nail bed incision (trans-ungual and latero-ungual or latero-digital Keyser-Littler approach), complete nail plate removal, nail fold approach, and subungual approach.[11] Jiang et al.[13] reported a case where a patient with subungual GT, experiencing chronic pain in the nail root for 15 years, underwent surgery using the complete nail plate removal technique. The follow-up revealed that the patient experienced nail deformity and slow nail growth. While the nail bed incision approach is commonly used for treating subungual GTs, it is important to note that this method has potential complications and disadvantages. These can include nail deformity (such as ridges, grooves, or discoloration), tumor recurrence, infection, pain and discomfort, slow healing, and even loss of function, which may limit its effectiveness as a treatment option.[13,14] The invasive nature of this method leads to the release of pain mediators like bradykinins and prostaglandins, which can disrupt the neovascularization process and subsequently impede nail growth.

There have been reports of limited movement and dysfunction of the finger's anatomo-physiological function following certain surgical approaches for subungual GTs. Farzan et al.[15] employed the nail bed excision approach to

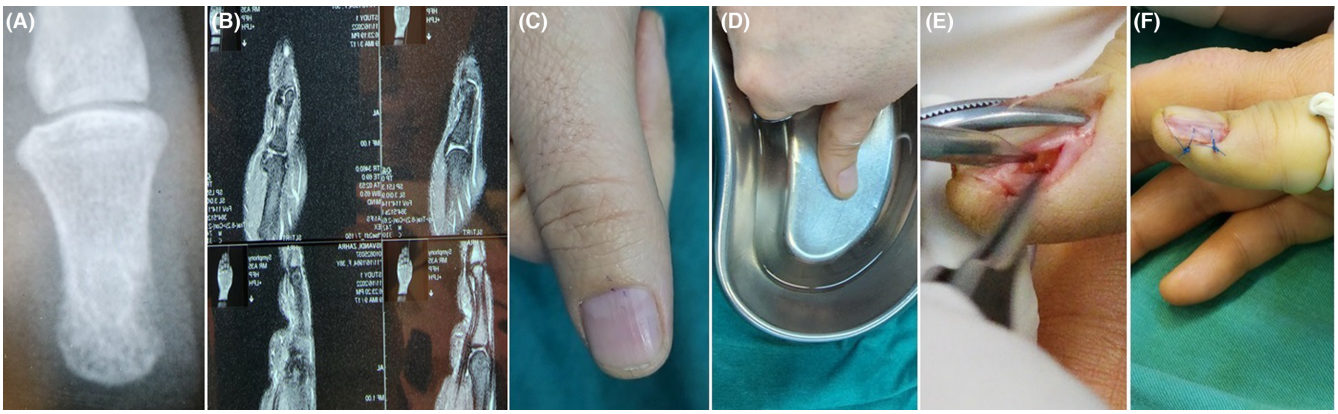

FIGURE 4 The subungual glomus tumor area was examined by a plain radiography (A-P view; A), followed by a T-1-weighted CT scan (B) and physical examination (C) of the thumb. After softening the nail plate by placing the distal phalange of the thumb in a warm water bath at 55°C (D), the tumor was removed (0.2×0.3 cm) (E), and the area was sutured (F).

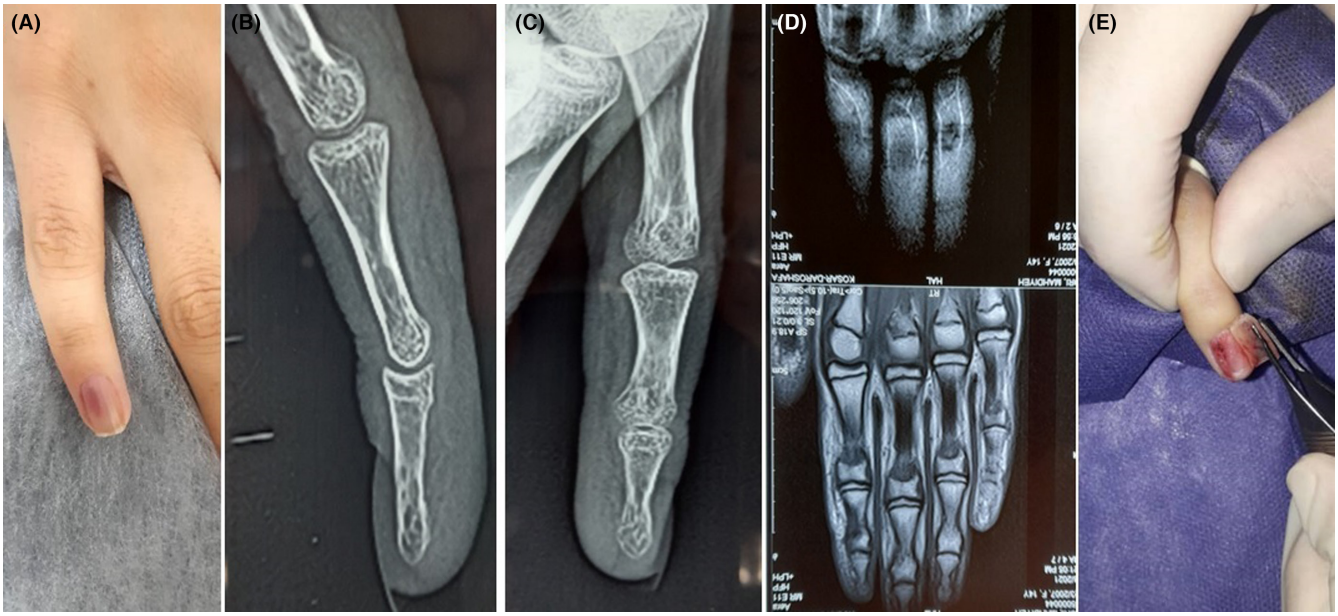

FIGURE 5 The subungual glomus tumor area was examined physically (A), followed by a plain radiography (lateral [B] and A-P [C] view) and T-1-weighted CT scan (D) of the little finger. After softening the nail plate by placing the distal phalange of the thumb in a warm water bath at 55°C, the tumor was removed (E).

treat GTs of the fingernails in 15 cases. While this method offers advantages such as effective tumor removal, the researchers observed postoperative complications, including recurrent tumors and nail deformities, in the patients.[15] Grover et al.[16] conducted a study on the surgical treatment of subungual GTs using the trans-ungual surgical excision approach. During the 8- to 24-month follow-up period, the study revealed postoperative complications such as longitudinal ridging of the nail plate and tumor recurrence.[16] Research has indicated that the trans-ungual method of nail bed incision approach has a higher incidence of postoperative nail plate deformity and tumor recurrence compared to the latero-ungual method. Therefore, the latero-ungual method is recommended, particularly for bulky and diffuse tumors, when employing the nail bed incision approach.[17] Nam et al.[18] conducted a study involving 32 cases of subungual GTs treated with nail bed incision surgery using horizontal and longitudinal incisions. During the follow-up, longitudinally oriented grooves/streaks, cracks, and tumor recurrence were observed in some cases.[18]

Indeed, the complete nail plate removal technique may carry additional complications, including slow nail regrowth, scar formation, and numbness in the affected finger or toe, resulting in a loss of sensory perceptions such as pain, temperature, touch, and pressure sensations.[19,20] The subungual approach, in addition to the complications mentioned earlier, has also been associated with nail bed

TABLE 2 Patients with glomus tumors by age and sex, and patients' condition after 3- and 6-month follow-up.

Number, age, and sex of the patient			Three months after surgery			Six months after surgery		
Patient number	Age	Sex	Recurrence	Color change	Nail deformity	Recurrence	Color change	Nail deformity
1	28	F	–	–	–	–	–	–
2	23	F	–	–	–	–	–	–
3	31	F	–	–	–	–	–	–
4	31	M	–	+	–	–	–	–
5	38	F	–	–	–	–	–	–
6	41	F	–	–	–	–	–	–
7	47	M	–	–	–	–	–	–
8	54	M	–	–	+	–	–	–
9	14	F	–	–	–	–	–	–
10	51	M	–	–	–	–	–	–
11	33	F	–	–	–	–	–	–
12	32	F	–	–	–	–	–	–
13	31	F	–	–	–	–	–	–
14	41	F	–	–	–	–	–	–
15	42	M	–	–	–	–	–	–
16	21	M	–	–	–	–	–	–
17	26	M	–	–	–	–	–	–

injury, which can potentially lead to the spread of the lesion to surrounding tissues. Each treatment method for subungual GTs has its own benefits and side effects. The nail fold approach, in particular, offers several potential advantages. These include the preservation of the nail, excellent visualization during surgery, minimally invasive nature, faster recovery time, and high success rates. Being a minimally invasive technique, the nail fold approach may result in a quicker postoperative recovery compared to more invasive surgical methods.[10]

4 | CONCLUSION

GTs are rare, benign tumors that arise from the glomus body in the skin of the fingertips, toes, and nail beds. They are more common in women than in men and can occur sporadically or as part of an inherited condition called multiple GTs. The modified nail folding approach, a new surgical technique, has been shown to be safe and effective for the treatment of subungual GTs, providing clinicians with a new treatment option for patients with this condition.

AUTHOR CONTRIBUTIONS

Parviz Ahangar: Conceptualization; methodology; resources; supervision; validation; visualization. **Mohsen Akbaribazm:** Methodology; writing – original draft; writing – review and editing. **Mohsen Rahimi:** Formal analysis; project administration; software; supervision. **Hosein Pirmohamadi:** Conceptualization; data curation; formal analysis; resources; supervision.

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The authors declare that there is no conflict of interest.

DATA AVAILABILITY STATEMENT

All data associated with the article are available if required.

CONSENT

Written informed consent was obtained from the patient to publish this report in accordance with the journal's patient consent policy.

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