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## Case Report

# Preoperative endovascular arterial embolization to avoid maxillary artery injury in maxillary gingival cancer surgery <sup>☆,☆☆</sup>

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## ABSTRACT

For maxillary gingival carcinomas, especially those in the molar region, surgical resection is often performed beyond the maxillary tuberosity. Bleeding from the posterior superior alveolar or maxillary artery into the pterygoid process is difficult to stop during partial maxillary resection. Advances in catheterization and materials have enabled the embolization of various vessels. In this report, we describe two cases of maxillary gingival cancer in which preoperative endovascular arterial embolization prevented bleeding due to unexpected vascular injury, allowing for a safe surgery with minimal blood loss. This technique effectively avoids emergency hemostasis for unexpected bleeding when resecting gingival cancers in the maxillary molar region.

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## Introduction

In maxillary gingival carcinoma surgery, resection often extends into the posterior maxillary tubercle or pterygoid pro-

cess. In such cases, substantial bleeding may occur because of damage to the posterior superior alveolar or maxillary artery. Bleeding control is crucial for safe and smooth surgery. Endovascular arterial embolization in the maxillofacial region is reportedly useful for stopping bleeding in end-stage oral can-

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cer, multiple facial fractures, and sclerotherapy for hemangiomas [1-6].

This report describes two cases where endovascular arterial embolization before maxillary gingival cancer surgery effectively controlled intraoperative bleeding.

## Case report

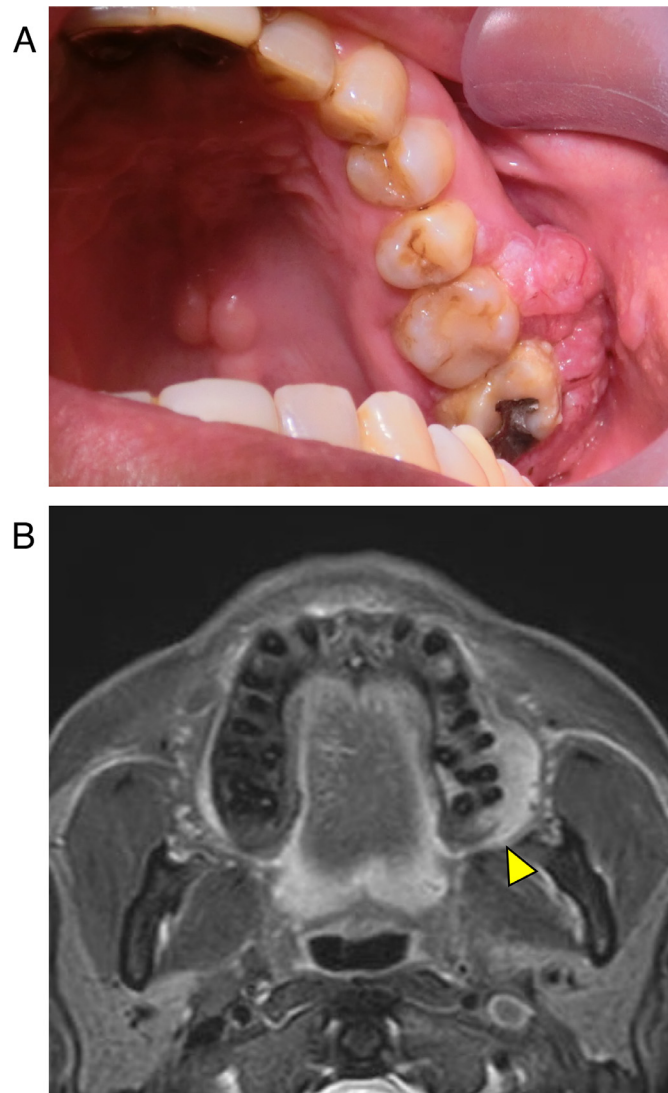
### Case 1

A 62-year-old man presented to our department with a gingival mass in the left maxillary molar region. The mass extended from the upper left first molar to the maxillary tubercle behind the second molar (Fig. 1A). No cervical lymph nodes or distant metastases were observed. After biopsy, the patient was diagnosed with left maxillary gingival squamous

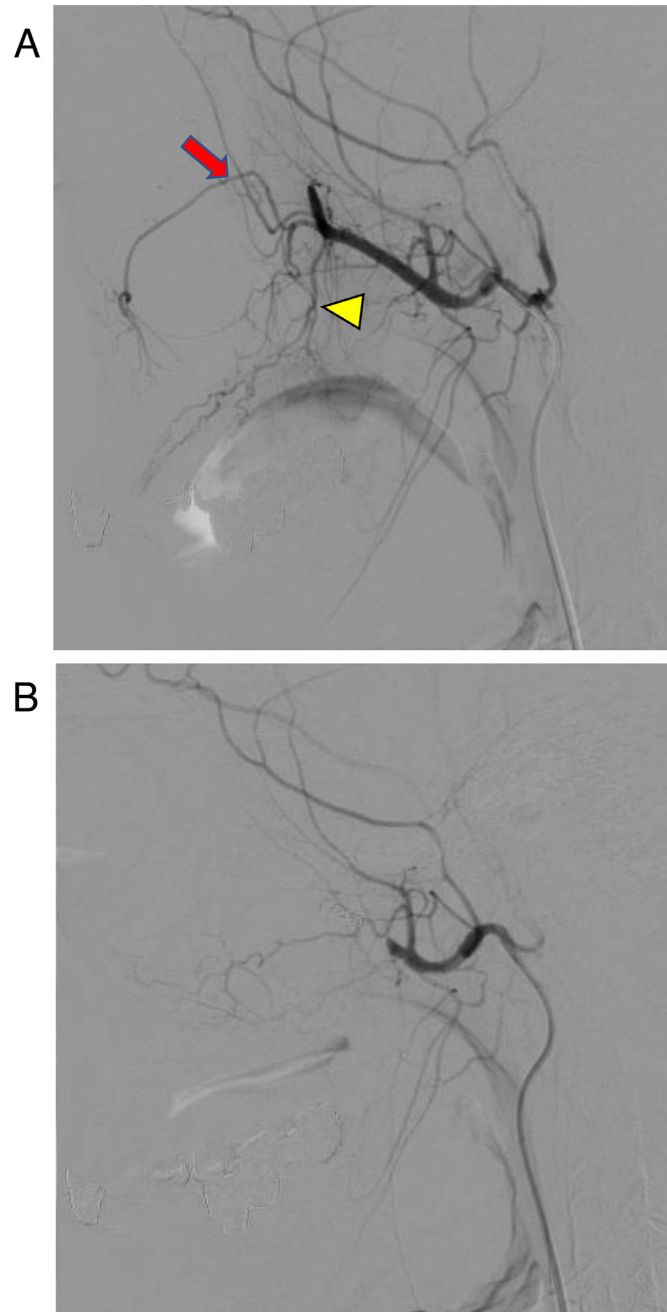
cell carcinoma (T4aN0M0), and partial left maxillary resection was scheduled.

The tumor was of the posterior extension type and was close to the inferior cranial fossa and pterygopalatine fossa, as indicated by magnetic resonance imaging (MRI) (Fig. 1B). Therefore, when a 10-mm safety margin was set for the tumor, the posterior portion of the resection area included the base of the pterygoid process. Owing to the difficulty of achieving intraoperative hemostasis and to ensure a safe procedure, we performed the partial maxillary resection following vascular embolization. The embolization was performed by a radiologist, and the embolization target was the peripheral portion of the maxillary artery from its bifurcation to the middle meningeal artery.

The following were successively placed: an introducer in the left femoral artery for angiography, a 4Fr catheter in the external carotid artery, and a microcatheter in the maxillary artery under fluoroscopy. Contrast medium was injected to confirm blood flow in the left maxillary artery (Fig. 2A).



**Fig. 1 – Case 1: Intraoral lesion and magnetic resonance (MR) image. (A) Mass with surface irregularities centered on the maxillary second molar. (B) MR image showing a mass extending into the maxillary tuberosity (arrowhead).**

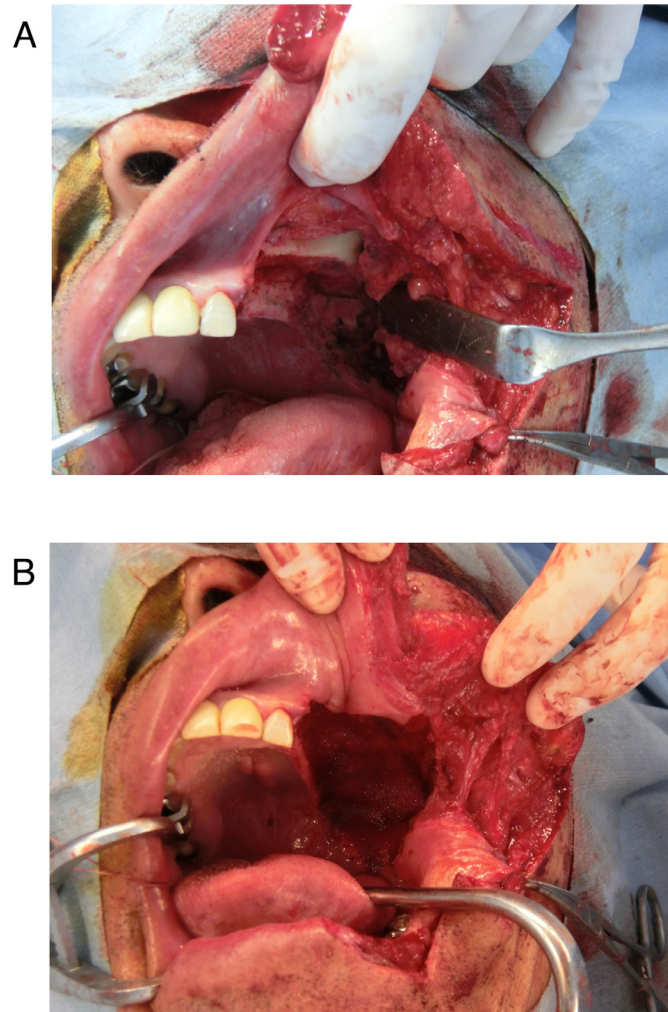


**Fig. 2 – Case 1: Angiographic images. (A) Angiographic view of the posterior superior alveolar artery (arrow) and descending palatine artery (arrowhead), which are branches of the maxillary artery located peripherally from the middle meningeal artery. (B) The coils were embolized at the end of the middle meningeal artery.**

Thereafter, Embospheres® (500-700  $\mu\text{m}$ ), hydrophilic, nonabsorbable, biocompatible spherical particles made of acrylic copolymers impregnated and coated with porcine gelatin sponges, were injected into the left posterior superior alveolar artery, left palatine artery beyond the middle meningeal artery. Four microcoils were used to further embolize the left posterior superior alveolar artery (Fig. 2B) and an additional four to embolize the peripheral vessels at the bifurcation of the middle meningeal artery. No complications were observed after embolization.

Partial left maxillectomy was performed under general anesthesia the day after embolization. The buccal division made it easier to see the operative field, and the resection area included a 10-mm safety margin. The posterior portion of the tumor was resected, including part of the pterygoid process, and the upper portion was partially opened into the maxillary sinus (Fig. 3A).

The buccal fat body was pulled into the opened maxillary sinus floor. A polyglycolic acid (PGA) sheet was trimmed and positioned at this site, and the wound was sprayed with fibrin



**Fig. 3 – Case 1: Surgical findings. (A) Resection extending to the maxillary sinus (superior) and maxillary tuberosity (posterior). (B) Wound covered with a polyglycolic acid sheet.**

glue (Fig. 3B). The surgery was completed by applying gauze coated with an antimicrobial agent and pre-prepared protective bedding to the wound. Intraoperative blood loss totaled 105 mL. There was no postoperative bleeding, and the previously open sinus cavity was completely closed 1 month after surgery. Three years after surgery, the patient remains in good health without recurrence or metastasis.

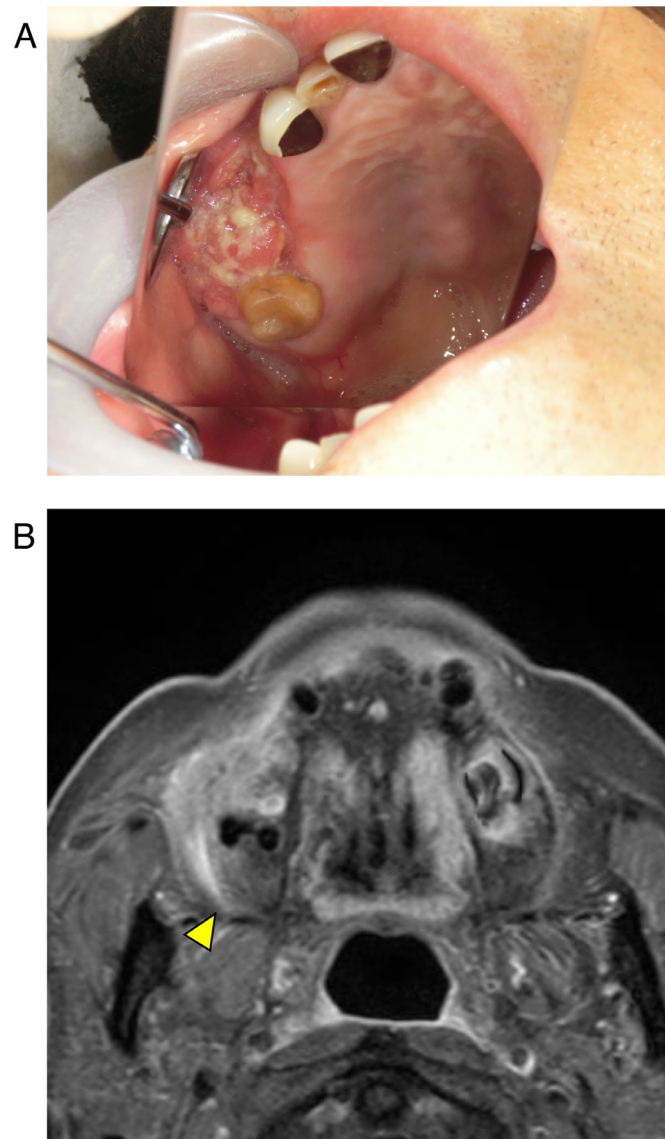
### Case 2

An 81-year-old man presented to our department with a mass extending from the buccal gingiva of the right maxillary molar to the right buccal mucosa (Fig. 4A). After various imaging examinations, the patient was diagnosed with right maxillary gingival cancer (T4aN0M0). Based on the extent of the lesion on MRI (Fig. 4B), partial right maxillary resection was performed; the planned resection site extended posteriorly to the base of the pterygoid process and the posterior wall of the right maxillary sinus. Preoperative embolization was conducted to ensure a safe procedure with minimal bleeding.

For angiography, a 4Fr catheter was inserted from the right inguinal region into the right external carotid artery the day before surgery. Angiography of the right maxillary artery revealed tumor staining consistent with a right maxillary gingival carcinoma at the end of the right posterior superior alveolar artery (Fig. 5A). A microcatheter was guided close to the bifurcation of this artery, and the artery was embolized with four microcoils (Fig. 5B).

Digital subtraction angiography after embolization revealed that the distal portion of the right maxillary artery was not visible, tumor staining was reduced, and paralysis was absent. The day after embolization, partial right maxillary resection with buccal division was conducted under general anesthesia. The tissue in the 10-mm safety zone surrounding the tumor site was excised, and the base of the pterygoid process and the posterior wall of the maxillary sinus were partially resected (Fig. 6A). The buccal fat body was towed over the resection site, covered with a PGA sheet, and fixed using fibrin glue (Fig. 6B). Intraoperative blood loss was 50 mL. One year after surgery, the patient was doing well without recurrence or metastasis.





**Fig. 4 – Case 2: Intraoral lesion and magnetic resonance (MR) image. (A) An uneven surface mass centered on the maxillary first molar. (B) MR image showing a mass extending to the base of the pterygoid process (arrowhead).**

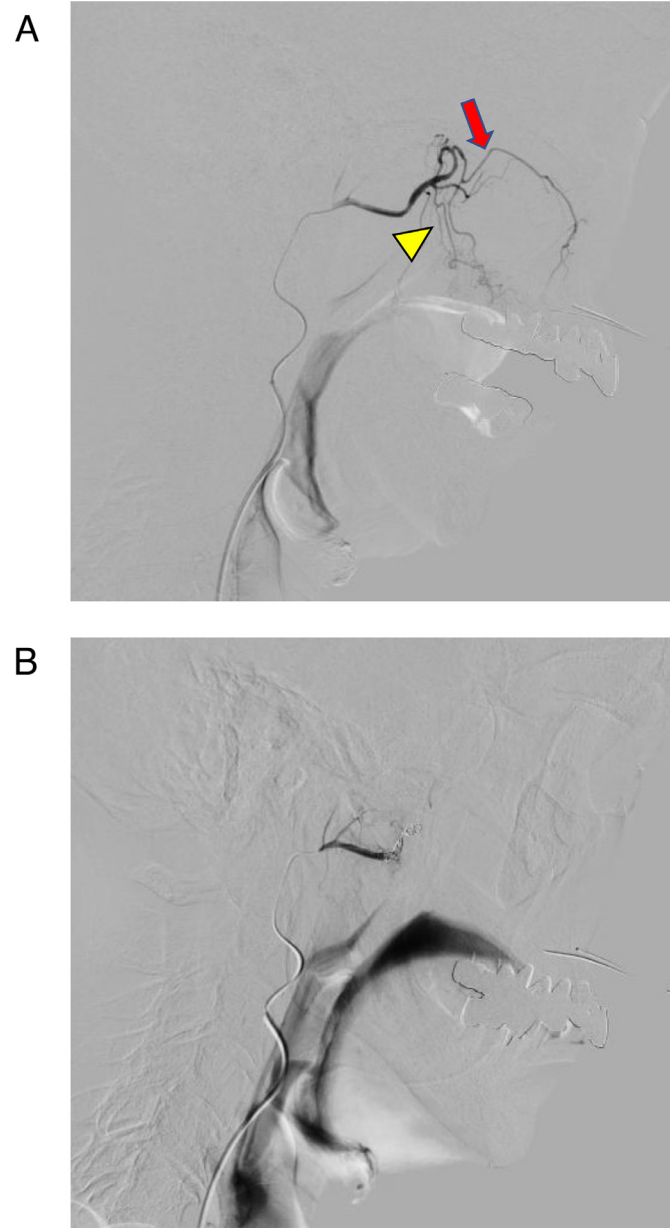
## Discussion

For maxillary gingival carcinomas with posterior extension, the surgical field may include the pterygopalatine or submandibular fossa, and bleeding from the maxillary artery and its branches may complicate surgery. Generally, intraoperative bleeding is treated via compression hemostasis, blood vessel ligation, and suturing. Ligation of the external carotid artery is frequently performed because it is considered effective when hemostasis is difficult to achieve [7,8]. However, it is an invasive procedure, and even with ligation, wound hemostasis may be a challenging goal in cases of advanced oral cancer in which bleeding occurs.

Recent advances in interventional radiology, including the elucidation of vascular anatomy, the development of diagnostic radiology procedures such as digital subtraction angiography, and the use of guidewires, catheters, and embolization

materials, have enabled the safe and accurate performance of endovascular embolization [9,10]. Endovascular embolization is now performed in patients with recurrent or advanced oral cancer [11–13]; for these patients, it has been shown to be an effective hemostatic treatment for bleeding that is difficult to control locally [14–16]. In the current study, preoperative super-selective arterial embolization of the dominant artery at the resection site was performed to reduce intraoperative bleeding in two cases of maxillary gingival cancer with posterior extension.

Coils are used for permanent embolization, while gelatin sponges are used for temporary embolization. In Case 1, a catheter was inserted from the left external carotid artery into the left maxillary artery, the principal vessel of the maxilla. After confirming that the entire tumor was contrast-enhanced, a mixture of Embospheres® and contrast medium was slowly injected to embolize the left posterior superior alveolar artery and left submental artery. The left maxillary artery was em-



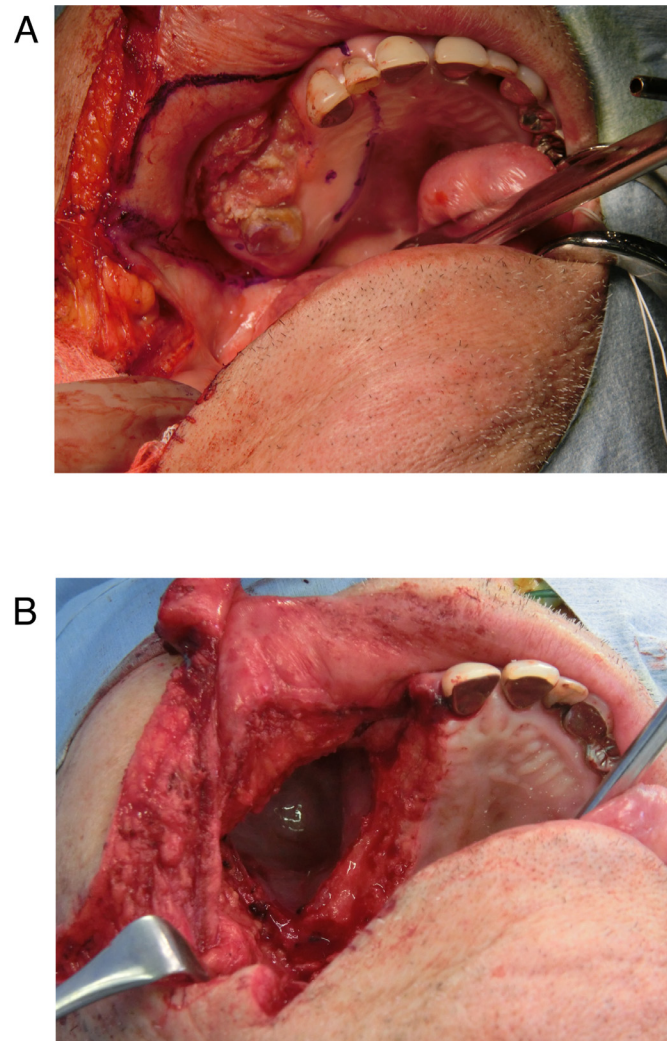
**Fig. 5 – Case 2: Angiographic images. (A) Angiographic images of the posterior superior alveolar artery (arrow) and descending palatine artery (arrowhead), which are branches of the maxillary artery located peripherally to the middle meningeal artery. (B) The posterior superior alveolar and descending palatine arteries are occluded by embolizing a coil peripherally from the middle meningeal artery.**

bolized near the middle meningeal artery bifurcation using microcoils. In Case 2, the right maxillary artery was embolized with microcoils only peripherally from the right middle meningeal artery. Although Embospheres® have the advantage of permanent embolization [17], microspheres that unexpectedly escape from the microcatheter can enter a vessel via the bloodstream, causing backflow and embolization. Therefore, for greater reliability, embolization was performed with coils as well as with Embospheres® in Case 1.

When embolization is performed to stop bleeding in end-stage oral cancer, the embolization duration, resumption of

circulation, and formation of peripheral collateral vessels are risk factors for rebleeding [1]. In our cases, embolization was performed the day before surgery, and its effect was considered minimal.

Embolization of the posterior superior alveolar, infraorbital, and descending palatine arteries, all of which emanate from the wing palate region of the maxillary artery and supply the posterior maxilla, is thought to reduce bleeding [18]. The middle meningeal artery bifurcation is a good embolization site. However, embolization proximal to this artery should be avoided to prevent vision loss due to reti-



**Fig. 6 – Case 2: Surgical findings. (A) Resection extending to the maxillary sinus (superior) and maxillary tuberosity (posterior). (B) Wound covered with a polyglycolic acid sheet.**

nal embolization of the ophthalmic artery, one of its branches [19,20]. No serious complications, such as ocular symptoms or abnormal facial sensations, were observed in our cases.

Because embolization is a standby procedure that can be performed under conscious local anesthesia, it is safer than emergency hemostatic surgery and requires less time. However, owing to the complexity of the vascular anatomy of the maxillofacial region, it carries the risk of serious complications related to the cranial nerves. In cases of maxillary gingival cancer that require resection of the posterior maxilla, it is crucial to discuss the extent of resection, actual vascular geometry, and embolization site with a radiologist before surgery.

In conclusion, in cases of maxillary gingival carcinoma involving the posterior wall of the maxillary sinus, preoperative vascular embolization peripherally from the middle meningeal artery can prevent unexpected intraoperative bleeding and minimize complications. Preoperative embolization with metal coils is useful for avoiding bleeding from branches of the maxillary artery.

### Patient consent

The authors declare that written, informed consent for publication of the patient's case was obtained from the patient.

### Ethical approval

This study was approved by the Research Ethics Committee of the Social Medical Corporation of Our Lady of the Snows (Decision Notice No. 23-0901).

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