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Clinical Case and Literature Review of a Potentially Life-Threatening Complication Derived from Mouth Floor Hematoma after Implant Surgery

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Abstract

The placement of dental implants is a safe and predictable procedure when performed by qualified staff. The incidence of complications derived from this type of surgery has increased due to the greater number of patients undergoing dental rehabilitation treatments in recent years. Floor of the mouth hematoma is a rare, but potentially fatal, complication that every oral surgeon should recognize for early diagnosis. As part of the clinical case presented here, two implants were removed and a hemorrhage in the floor of the mouth was found, which required an urgent intervention to control the bleeding. Two independent researchers conducted an electronic search of the available scientific evidence in relation to bleeding of the floor of the mouth in dental implant surgery. The research included references, which were written in English or Spanish, and published up to December 2022. Case reports, case series, systematic reviews, and meta-analysis were part of the inclusion criteria. Sixty-four bibliographic references were identified, and 39 full-text articles were selected. There were 30 cases of floor of the mouth hematoma in relation to implant surgery. In 13 patients the main location was interforaminal, in 5 in the canine area, in 6 in the incisor area, and in 6 in the molar premolar region. All cases were caused by perforation of the cortical bone or surgical manipulation (disruption of the periosteum, perforation of the sublingual mucosa by the stiff suture). The sublingual artery was most frequently involved. The clinical sign observed in all cases was elevation of the floor of the mouth. In 21 of the cases there was airway involvement, so the main treatment was intubation or tracheostomy. Floor of the mouth hematoma may be one complication associated with implant surgery. Given the seriousness of this clinical picture, early detection by the dentist and hospital referral are essential. Warning signs are sudden swelling of the floor of the mouth or submandibular area, accompanied by dysphagia and dyspnea.

Keywords
- dental implant
- hematoma
- hemorrhage
- floor of mouth

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Introduction

Complications in dental implant surgery are infrequent and normally self-limiting. This has caused the technique to become an almost routine procedure.[1] Ever since the discovery of dental implants, its surgery has become more prevalent and now it is routinely done in a clinical setting due to its high success rate and safety.[2] More than two million dental implants are placed annually around the world, with constantly increasing prevalence. It is a highly predictable option to replace missing teeth, and gives excellent results with success rates above 95%.[3] Although considered a safe and routine procedure, several intra- and postoperative complications can occur. These are abundantly described in the literature and include among others: inferior alveolar nerve injury, infection, mispositioning of implants and injury to adjacent teeth, fracture of mandible, implant displacement, swallowing and aspiration, and bleeding during or after implant placement.[2–5] Most of these potential complications are often preventable and are manageable at the outpatient clinic when they occur. Despite being uncommon, life-threatening complications can arise requiring urgent hospital care.[2]

In certain cases, if there is a problem with the implant (fracture, peri-implantitis, and others) explantation may be necessary.[2,3,6]

Bleeding during implant surgery can be a serious setback, but it is especially so when it develops in the floor of the mouth. During the preparation of the surgical bed for the implant, intraosseous or extraosseous perforation of an artery could occur causing bleeding, which may pose a fundamental problem. This is because lingual, sublingual, submandibular, and submental hematomas, which expand progressively, tend to displace the tongue and floor of the mouth, and obstruct the oropharynx. Since this can rapidly lead to dire consequences, it is essential to ensure airway permeability.[1,7–9]

Adequate planning of surgery is required, with thorough knowledge of the anatomical features of the surgical zone, and the use of complementary techniques such as cone-beam computed tomography (CBCT), to avoid possible risk situations. Nevertheless, despite such precautions, some patients are at an increased risk of bleeding due to physiological anatomical variants.[1]

The aim of this article, since the literature previously published seems to be scarce, was to report a complication in the surgical extraction of two implants as well as its management. The authors provide a structured review of reported cases in the previous years. We give a table analyzing the different variables for treating this condition. This complication can be life-threatening, so an early suspected diagnosis is essential at the dental clinic for early hospital referral.

Clinical Case

A 37-year-old female with no medical history of interest, who was treated in a private clinic for the extraction of two fractured implants in the 4th quadrant in the area corresponding to 45–46 (Fédération Dentaire Internationale numbering system[10]). Prior to surgery, a CBCT was performed for surgery planning. The findings of the CBCT confirmed the previous digital examination of implant mobility: lineal fracture of the two implants and alveolar bone shortage.

The fractured implants had a length of 8.5 mm and a diameter of 3.3 mm. An insufficient size for the area where they were placed, since according to the manufacturer Ziacom, this diameter is reserved for the incisor sector.

The clinic used heterologous bone, "OsteoBiol Apatos, Osteogenos," a biomaterial of porcine mesenchymal origin which is a mixture of spongy and collagenated cortical bone, and collagen membrane of heterologous origin "Evolution OsteoBiol, Osteogenos" to prevent further atrophy after surgery. The explantation proceeded without incident and the surgery was conducted as planned. After surgery, a panoramic control X-ray was performed (orthopantomogram). The following postoperative measures were taken: medication with antibiotic therapy, "amoxicillin/acid-clavulanic acid 875-125 mg"; anti-inflammatory, "dexketoprofen 25 mg"; and corticosteroid, "Zamene 30 mg." A control follow-up was set for a week later.

After half an hour, the patient returned to the clinic with right submandibular and submental swelling and odynophagia. In addition to the extraoral signs, the floor of the mouth had begun to rise, so the patient was referred to the hospital emergency department (ED) for assessment by a specialist in maxillofacial surgery.

Upon arrival at the ED, the patient was hemodynamically stable, without neurological focality and with intolerance to decubitus due to dyspnea. Physical examination revealed significant submandibular and submental swelling, 25 mm trismus with pain, clots at the surgical bed level of the 4th quadrant, and ankyloglossia. Bimanual palpation of the floor of the mouth showed a significant bulging of this region. A peripheral venous catheterization was placed to initiate fluid replacement therapy (saline 0.9%, 500 mL every 8 hours), corticotherapy (methylprednisolone 1 mg/kg/8 h), antibiotic (amoxicillin-clavulanic acid 1 g/8 h), dexketoprofen (50 mg/8 h), and pantoprazole (20 mg/24 h). Vital signs of blood pressure, heart rate, and oxygen saturation were monitored. The following complementary tests were performed: electrocardiogram (ECG), chest X-ray, severe acute respiratory syndrome coronavirus 2 nasopharyngeal exudate, and neck CT scan with contrast. In the ECG there was a cardiac frequency of around 70 beats per minute and in the chest X-ray there were no pathological findings. The coronavirus disease 2019 test was processed ultra-quickly with a negative result. In the CT scan (►**Fig. 1**), we observed an area of high density suggesting a hematoma adjacent to the lingual cortex of the right mandibular body, of $4 \times 4 \times 3$ cm (anterior-posterior $\times$ craniocaudal $\times$ transverse) without caudally exceeding the mylohyoid muscle. The high-density area exerted a mass effect by displacing the midline of the airway at the level of the oropharynx. Possible disruption of the lingual cortex of the 4th quadrant is observed in the osseous window (►**Fig. 2**). An urgent surgical intervention was

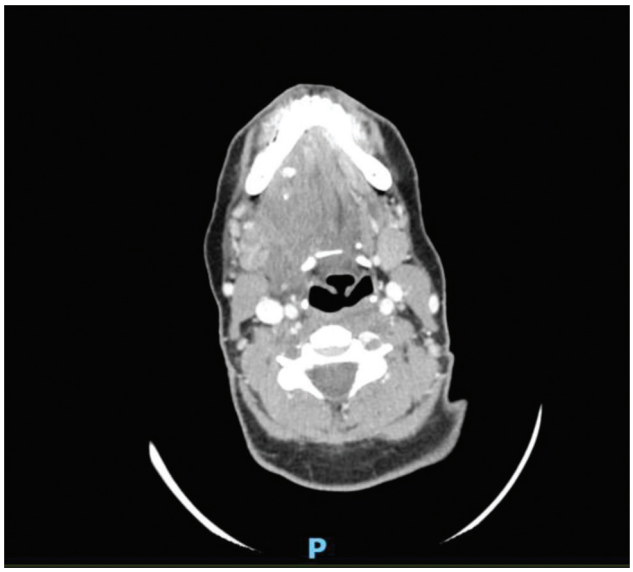

Fig. 1 Computed tomography (CT) image showing a high-density collection compatible with hematoma adjacent to the lingual cortex of the right mandibular body, measuring 4 × 4 × 3 cm (anterior-posterior [ap] × craniocaudal [cc] × transverse [t]) without causally exceeding the mylohyoid muscle (MH). The described collection exerts a mass effect displacing the midline of the airway at level of the oropharynx.

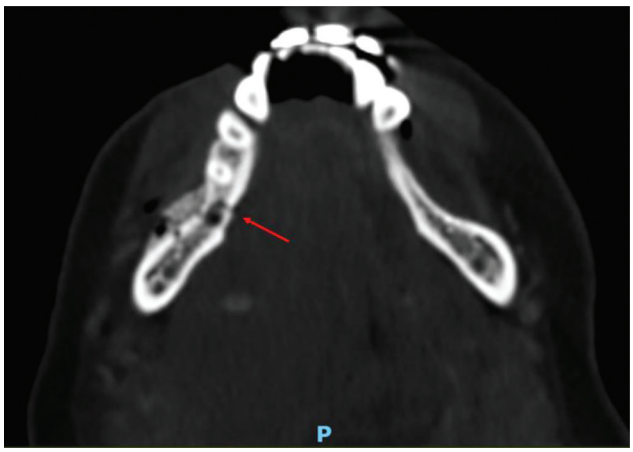

Fig. 2 Computed tomography (CT) image showing possible disruption of the 4th quadrant lingual cortex.

performed under general anesthesia, using nasotracheal intubation with fiberscope. We performed an initial intraoral approach, with reopening of the crestal incision, removal of clots and foreign body material (membrane and bone graft). After subperiosteal dissection of the lingual gingiva, it was not possible to find the origin of the arterial bleeding, so a right submandibular cervical approach was recommended. Through this last approach, ligation of the branch of the lingual artery and ligation of the right lingual vein were conducted, with intraoperative cessation of bleeding. A #12 Redon vacuum drain was placed and closed flat with Vicryl 3/0 and staples.

The postoperative period was uncomplicated. The patient remained hospitalized for 48 hours after the intervention, and after drainage removal with an output of less than 20 mL. Intravenous treatment administered from the ED was maintained with progressive reduction of corticotherapy (1 mg/kg/8 h on arrival, 1 mg/kg/12 h on the second day, 1 mg/kg/24 h on the third day). An oral diet was resumed 24 hours after no signs of bleeding were evident. Upon discharge, the patient maintained oral antibiotic therapy treatment with amoxicillin-clavulanic acid 875 mg/8 h for 5 days along with analgesia using ibuprofen 600 mg/8 h and paracetamol 650 mg/8 h. Hygienic dietary measures of oral hygiene and rinsing with salt water after meals were prescribed, while maintaining a soft diet for at least 10 to 15 days. At the checkup, after 1 month, the patient presented a cervical scar without dehiscence, and at the intraoral level healed gum with hypoesthesia of the associated lingual nerve. At 6 months the patient did not present new incidents in the operated area but she did present paresthesias near the right lingual nerve. This temporary sequela could be explained by the previous surgical manipulation during the urgent intraoperative exploration of the area to find the origin of the hemorrhage. However, the authors also postulate a presumed lingual paresthesia prior to emergency surgery, as the explantation of the implant could also have disrupted the lingual cortex causing nerve contusion. After 1 year of follow-up, the paresthesias had resolved and she continued to attend regular checkups with her dentist.

Methods

Research of the subject using online databases was conducted in December 2022. PubMed, MEDLINE, ScienceDirect, Clinical Key, Web of Science, Embase, Cochrane Library, and Google Scholar databases were searched with the combining keywords: "Dental implant AND bleeding OR haematoma OR haemorrhage AND floor of mouth." All keywords were used as Medical Subject Headings terms. The research focused on articles published in English or Spanish with no limits of the time period.

Studies that met the following criteria were selected:

Inclusion Criteria

(1) Study population: patients diagnosed with mouth floor hemorrhage in relation to dental implant surgery
(2) Case reports, case series, systematic reviews, and meta-analysis
(3) Articles written in English or Spanish

Exclusion Criteria

(1) Preclinical and laboratory studies
(2) Narrative reviews, editorials, and opinion articles
(3) Conference presentations (abstracts and posters)

The selection of the studies was performed by two independent reviewers, who did a first reading of the titles and abstracts of the articles identified in the electronic search.

In a consensus meeting of all the authors, the final selection of the articles for this review was reached.

Data Extraction, Variables Collected, and Presentation of Results

Data was obtained independently by two reviewers with the help of a purpose-built data collection sheet. The variables collected to identify our objective were: author, year, number of patients, age, artery involved, location of the implant, bleeding time, and treatment (►**Table 1**).

Results

The electronic search identified 64 bibliographic references. After a first selection by title and abstract, 39 full-text articles were found. For the collection of case reports, 27 articles were selected (►**Fig. 3**), which gave 30 cases from which the following variables were extracted:

Author, year, number of patients, age, cause, clinical signs, artery involved, location of the implant, bleeding time, and treatment.

Qualitative Synthesis

Thirty cases of hemorrhage in the floor of the mouth after manipulation in implant surgery were found.

In 13 patients the main location was interforaminal, in 5 in the canine area, in 6 in the incisor area, and in 6 in the molar premolar region. In 25 cases the hemorrhage was caused by perforation of the cortical, and in 5 by surgical manipulation (such as mucosal flap harvesting, periosteal perforation, intraosseous perforation, stitches).

In many cases the artery involved was not specified, but of the nine cases where it was specified, in eight the sublingual artery was involved and in one the lingual artery. The clinical sign that occurred in all cases was elevation of the floor of the mouth, which caused deviation of the airway. In 21 of the cases there was airway involvement, so the main treatment was intubation or tracheostomy. A surgical approach with ligation or cauterization of the artery was performed in 13 cases and bleeding was only controlled by compression in 6.

Discussion

The placement of osseointegrated implants is generally accepted as a safe and minimally invasive procedure with a low rate of surgical morbidity.[32]

It is crucial for clinicians to be able to promptly recognize life-threatening emergencies and act appropriately. With pertinent preparation, knowledge of anatomic structures, and preventative protocols, these adverse events can be prevented.[2]

Despite these precautions, some patients present an increased risk of bleeding due to physiological anatomical variants.[1]

Computer-assisted implant surgery (CAIS), either static or dynamic, is well documented to significantly improve the accuracy of implant placement. Nonetheless, the current evidence does not suggest any difference regarding intraoperative complications, immediate postsurgical healing, osseointegration success, and survival of implants placed with CAIS or freehand protocols.[33,34]

Table 1 Case reports on life-threatening vital bleeding after implant surgery published up to December 2022

Author	Year	P	Age	Cause	Clinical signs	Artery involved	LOC	Time to bleeding	Treatment
Mason et al[11]	1990	1	54	Perf	EFM, SBLH, SBMH, SMNDH, RD	–	Interforaminal	4–5 h	Intub + SA
ten Bruggenkate et al[12]	1993	2	58	Perf	EFM, SBLH, SMNDH, RD	SBLA	Canine	6 h	Intub + Med
			42	Perf	EFM, SBLH	SBLA	PM	Immediate	Comp + Obs
Mordenfeld et al[13]	1997	1	69	PERF	EFM, SBLH, SBMH, SMNDH		Canine	Immediate	Intub + SA + Med
Darriba and Mendonça-Caridad[14]	1997	1	72	SM	EFM, SBLH, intraoral bleeding, airway obstruction		Interforaminal	Immediate	Trach + SA + Med
Givol et al[15]	2000	1	63	Perf	EFM, SBLH, SBMH, SMNDH	SBLA	Canine	Immediate	Trach + SA
Niamtu[16]	2001	1	64	Perf	EFM, SBLH, SBMH, SMNDH, RD		Canine	Immediate	Trach
Boyes-Varley et al[17]	2002	1	50	Perf	EFM, SBLH, SBMH, RD	–	Lateral incisor	30 min	Trach + SA

Table 1 (*Continued*)

Author	Year	P	Age	Cause	Clinical signs	Artery involved	LOC	Time to bleeding	Treatment
Isaacson[18]	2004	1	56	Perf	EFM, SBLH	–	Interforaminal	Immediate	Intub + Comp
Kalpidis and Konstantinidis[19]	2005	1	43	Perf	EFM, SBLH	–	1°PM	Immediate	Comp + Obs
Budihardja et al[20]	2006	1	80	Perf	EFM, SBLH, RD, intraoral bleeding		Interforaminal	Immediate	Intub + SA + Med
Woo et al[21]	2006	1	47	Perf	EFM, SBLH, LH, RD	SBLA	Central incisor	Immediate	Trach + SA
Del Castillo-Pardo de Vera et al[22]	2008	1	53	Perf	EFM, SBLH, LH, RD	–	1°PM-1°M	Immediate	Comp + Obs
Ferneini et al[23]	2009	1	77	Perf	EFM, SBLH		2° PM 1° M	Immediate	Med + Obs
Pigadas et al[24]	2009	1	71	Perf	EFM, SBLH, SBMH, SBMNDH	–	Interforaminal	Immediate	Intub, Trach
Dubois et al[25]	2010	2	76	Perf	EFM, SBLH, SBMH, RD	–	Interforaminal	Immediate	Trach + Comp
			62	Perf	EFM, SBLH, airway obstruction	LA	Interforaminal	7 h	Trach + SA + drainage
Sakka and Krenkel[26]	2013	1	66	Perf	Bleeding	SBLA	Interforaminal	Immediate	SA
Hwang et al[27]	2013	1	53	Perf	EFM	SBLA	Incisive area	Immediate	SA
Marini et al[6]	2013	1	85	Perf	EFM, RD		Incisor	5 h	Intub + Med
Limongelli et al[35]	2015	1	45	Perf	EFM, airway obstruction	SBLA	Lateral incisor	Immediate	Comp + Obs + Med
Schiegnitz et al[4]	2015	1	52	Perf	EFM, SBLH, dysphagia		Lateral incisor	2 h	Trach + SA + drainage
Bidra[28]	2015	1	60	SM	EFM, ecchymosis		PM, M	24 h	Obs
Vehmeijer et al[29]	2016	1	62	Perf	EFM, airway obstruction		Interforaminal	Immediate	Intub + Obs
Gaudio et al[30]	2017	1	50	SM	EFM, dyspnea		Central incisor	Immediate	Trach + drainage
Law et al[5]	2017	1	64	Perf	EFM, SBLH		Canine	2 h	Intub + SA + Med
Peñarrocha-Diago et al[8]	2019	2	56	SM	EFM, airway obstruction		Interforaminal	Immediate	Comp + Trach
			80	SM	EFM	SBLA	Interforaminal	24 h	Comp + Obs
Barrientos-Lezcano et al[31]	2021	1	59	Perf	SBLH, RD		Interforaminal	Immediate	Trach
Blanc et al[3]	2021	1	69	Perf	EFM		1°PM	Immediate	Intub + SA

Abbreviations: Comp, compression; EFM, elevation of the floor of the mouth; Intub, intubation; LA, arteria lingual; LH, lingual hematoma; LOC, location; M, molar; Med, medication; Obs, observation; P, patient; Perf, perforation; PM, premolar; RD, respiratory distress; SA, surgical approach; SBLA, arteria sublingual; SBLH, sublingual hematoma; SBMA, arteria submental; SBMH, submental hematoma; SM, surgical manipulation; SMNDH, submandibular hematoma; Trach, tracheotomy.

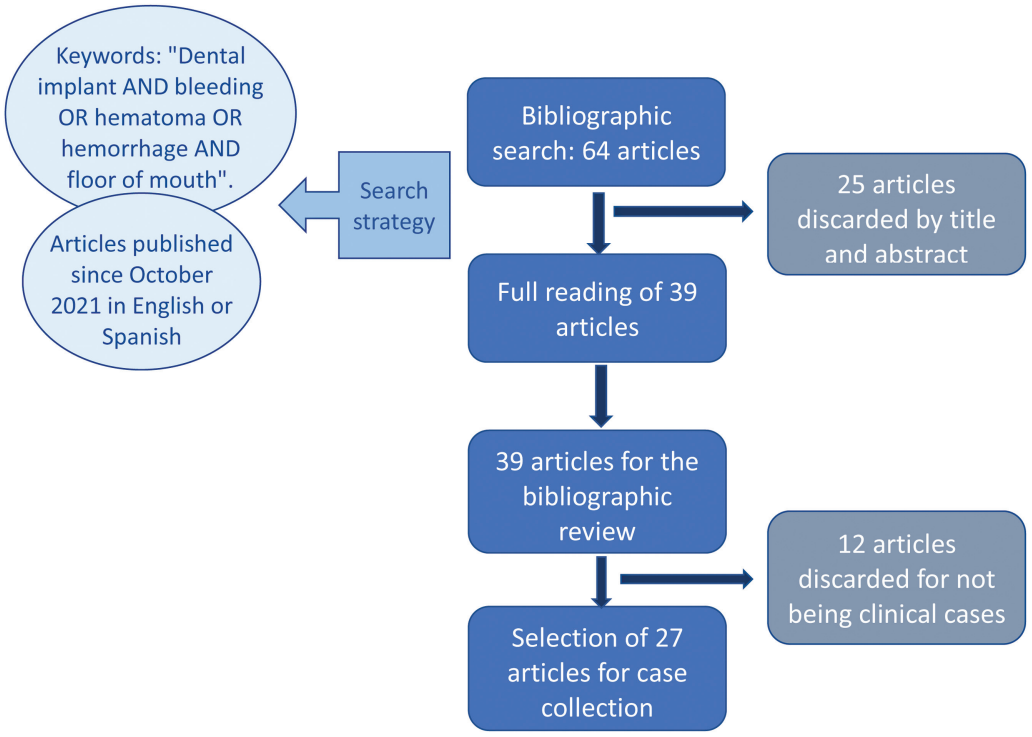

Fig. 3 Flowchart for the research.

This study provides new articles published from 2019 that add scientific evidence to the scarce literature of this complication. According to the later literature review until December 2022, the etiology of the hemorrhage seems to be similar to previous reports. Nevertheless, the artery involved appears to be, to at greater extent, the sublingual artery and not the mylohyoid artery.

Hemorrhage and hematoma of the floor of the mouth may be a more frequent complication than reflected in the limited literature that has been published, as clinicians may often be reluctant to report unfavorable cases and complications, with risk of publishing bias.[1]

In the authors' experience, early diagnosis is essential even to prevent the patient from tracheostomy. In the case reported, oral intubation with the aid of fiberscopy under general anesthesia was successful. The authors remark on the relevance of multidisciplinary professional teams in tertiary hospital units.

This review attempts, therefore, to provide a useful guideline for prevention, diagnosis, and treatment alternatives of this rare but life-threatening condition.

Factors Increasing the Risk of Hematoma Related to Implants

Arterial Anatomy and Anatomic Variations

The most common cause of mouth floor hematoma during implant surgery is hemorrhage of the sublingual or submental arteries. To a lesser extent, it may also be secondary to bleeding from the mylohyoid artery. According to a review of the available literature,[8] the causative mechanism seems to be an arterial disruption after perforation of the lingual cortex. This may be perforated in the anterior area, especially in the canine region; or in the posterior area, at the level of lingual depression. In this area the bone cortical is especially thin, which is susceptible to accidental rupture, causing bleeding episodes whose origin can be difficult to locate.[3,4,6,11–13,15–27,29–31,35]

The submandibular and sublingual anatomical spaces have a rich blood supply with branches derived from the external carotid artery (ECA). The common carotid artery bifurcates at the level of the thyroid cartilage into its internal carotid branches and ECA. From the ECA emerge six collateral branches along its path: the superior thyroid, lingual, facial, occipital, posterior auricular, and ascending pharyngeal arteries. Finally, it is divided into two terminal branches: superficial temporal and maxillary.[2]

Facial artery is also known as the external maxillary artery. It runs along the nasolabial fold toward the medial corner of the eye. It passes deep to the digastric and stylohyoid muscles and arches anteriorly to enter a groove on the submandibular salivary gland.[9]

The facial artery will then curve over the body of the mandible (to the platysma muscle), as the anteroinferior angle of the masseter will ascend forward and upward through the cheek, to the angle of the mouth, and along the side of the nose.

There are two main branches of the facial artery: the facial and cervical. The five branches of the facial portion supply the facial areas about the eye, nose, and lips. There are four branches of the cervical portion. The ascending palatine and tonsillar branches supply the structures of the pharynx, soft palate, and auditory tube. The glandular branch consists of three or four vessels that supply the submandibular gland, lymphatics, and the overlying skin. The submental branch is

the largest of the cervical branches and arises from the facial artery. At this site it leaves the groove of the posterior submandibular gland and runs anteriorly on the surface of the mylohyoid muscle inferior to the body of the mandible and deep to the digastric muscle. The submental branch anastomoses with the sublingual branch of the lingual artery and with the mylohyoid branch of the inferior alveolar artery.[9]

The submental artery is also divided into the superficial and deep branch. The superficial branch anastomoses with the inferior labial artery. The deep branch also anastomoses with the inferior labial artery, as well as the mentonian branch of the inferior alveolar artery. The inferior alveolar artery (also known as inferior dental artery, Latin: *arteria alveolaris inferior*) is a branch of the maxillary artery that supplies the mylohyoid muscle, mandible, tooth sockets, lower teeth, skin, and muscles in the chin region.

The inferior alveolar artery descends in the infratemporal fossa. Before it passes through the mandibular foramen into the mandibular canal, the artery gives off a mylohyoid branch. This branch runs in the mylohyoid groove on the inner surface of the ramus of the mandible. It then distributes in the mylohyoid muscle and anastomoses with the submental artery.

Afterwards, the inferior alveolar artery runs along the mandibular canal within the mandible. On its way, it supplies the mandible, tooth sockets, and teeth, and divides into the incisive and mental branches near the first premolar tooth.

The incisive branch of the inferior alveolar artery continues forward below the incisors to the midline, where it forms anastomoses with the corresponding vessel of the opposite side. The mental artery emerges onto the face via the mental foramen and supplies the chin. It also forms anastomoses with the submental and inferior labial arteries.

Normal vascular anatomy of the mandible and floor of the mouth is shown in ►**Fig. 4**.

Several studies have been conducted to clarify the course of the arteries that supply the floor of the mouth, since anatomical variations have been seen that could facilitate the complication described in this article.[36–40]

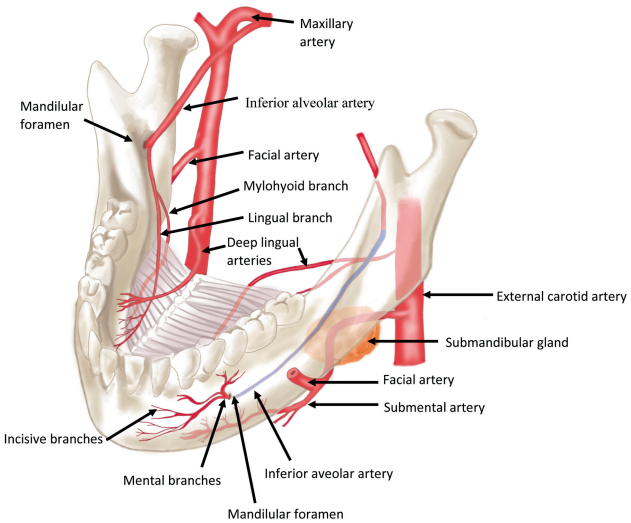

Fig. 4 Normal course of the arteries/anatomy of mandibular blood supply.

Katsumi et al[37] published a study on 27 cadavers to describe the three-dimensional courses of the submental and sublingual arteries and their topographical relationship with the jaw. They concluded that:

The submental and sublingual arteries were divided into four patterns:

- Type 1: The sublingual space was supplied by the sublingual artery in 63% of cases.
- Type 2: The sublingual space was supplied by the sublingual and submental artery in 5.6% of cases.
- Type 3: The sublingual space was supplied by the submental artery without the sublingual artery in 29.6% of cases.
- Type 4: The sublingual space was supplied by the submental artery without the sublingual artery and without the deep lingual artery, which originated in the lingual artery in 1.8% of cases.

Types 2, 3, and 4, although less common, are more susceptible to injury during implant surgery, since in these cases the submental artery perforates the mylohyoid muscle or takes an indirect route to travel near the surface of the jaw, which causes greater susceptibility to injury in case of cortical perforation.[37]

Another research by Rosano et al[36] on 80 cadavers, concluded that the blood vessels of the floor of the mouth may be remarkably close to the lingual cortical of the mandibular midline. This is consistent with the findings conducted by Hofschneider et al[40] where they dissected 34 corpses. The hypothesis of both research groups involve that bleeding can occur when the mandibular cortical is perforated even minimally. Consequently, the authors recommend careful planning for the placement of implants in the mandibular midline, possibly opting for the use of an even number of implants in the anterior mandibular region, avoiding the risk of surgical trauma to the lingual cortical plate of the mandibular midline.[36,38] They also recommend an elevation of the lingual periosteum of the jaw in cases of unclear identification of the sublingual fossa.[40]

Finally, the authors of this article highlight the age of the patient as another factor to be taken into account in the placement of dental implants and its anatomical variations. It is known that with age and edentulism the submental artery may be relocated to be very near or in actual contact with the medial mandibular surface. Thus, there is a potential for an encounter increasing the risk of bleeding.[41]

Other Risk Factors

In addition to the anatomical variations reviewed above, there are other factors that carry an increased risk of bleeding from the floor of the mouth after dental implant surgery. Among others may be cited the mandibular bone anatomy, the type of surgical procedure, and the length-thickness of the selected implants.

- Regarding bone anatomy, extremely concave sublingual fossae and frequent lingual angulation of the internal mandibular cortical in the canine and first premolar regions

may explain the potentially fatal hemorrhagic episodes induced by perforations of the lingual cortical.[7,13,17] Uchida et al[42] conducted a study investigating the relationship of the location between the sublingual fossa and the lateral lingual foramen, to prevent perforation of the lingual cortical bone and damage to adjacent blood vessels by placing an implant in the mandibular interforaminal region. Although in most of the 30 cases there was perforation of the cortical, in 4 of them this was not so. In fact, Peñarrocha-Diago et al[8] state that it is not necessary for the implant to penetrate the cortical to produce hemorrhage and an osteotomy but can produce this hemorrhage by sectioning the artery. This would produce a vasospasm of the artery, which would retract to the floor of the mouth producing a hemorrhage and hematoma.

- Of all surgical procedure types, only one case refers to complication secondary to explantation surgery and not the placement of implants. Even though explantation surgery may entail higher risks of suffering more serious complications since it is a more aggressive, albeit less frequent, surgery. Marini et al[6] published a case of hematoma of the mouth floor in an 85-year-old patient, after implant placement, which months later required explantation. From the two treatment options (use of trephine or piezoelectric), they decided to use piezoelectric to protect the anatomical structures and prevent new episodes of hemorrhage.

A hematoma produced by sublingual artery injury does not usually connect to the submandibular space, unlike the submental artery.[7,12,25] A truly fatal hemorrhage can occur if a hematoma occurs in the submandibular space and expands against the pharynx; possibly occluding the airway.

- As the ideal implants selected, the authors recommend the use of short lengths, since the jawbone usually has dense bone, which offers great support. The use of longer implants increases the risk of producing complications. An example would be the use of 5 mm. The surgical bed should be previously treated with bone regeneration techniques to offset the small diameter of the implant, not so convenient for posterior sectors.

However, we do not recommend the use of short implants in this case due to the crown-to-implant ratio, as it would be insufficient. Bone regeneration techniques would be necessary to increase the height and width of the bone.

In the anterior area, some authors[26] agree to place implants far from the midline. According to our experience, this may be inappropriate because the sublingual terminal arterioles may have multiple entries into the lingual of the mandible.

Surgical Manipulation

In most of the 30 cases there was perforation of the cortical, although in 4 cases there was not so. Peñarrocha-Diago et al stated that it is not necessary for the implant to penetrate the cortical to produce hemorrhage and an osteotomy can produce this hemorrhage by sectioning the artery. They report two cases where it is possible for the lingual artery to be damaged intraosseously. This is because the terminus of the sublingual artery is held by connective tissue in the foramen (nutrient canal) and thus enables an osteotomy drill to cut through it.[8]

Bidra published a case of hematoma of the mouth floor in a 60-year-old patient after implant placement after surgical manipulation. In this case, they describe that hematoma occurred due to irritation of the sublingual mucosa by the stiff suture tags from the polypropylene and subsequent bleeding.[27] This irritation might ultimately evoke a perforation of the mucosa with the consequent bleeding.

A case report presented by Gaudio et al showed this was caused by unspecified surgical manipulation.[30]

Darriba and Mendonça-Caridad reported a case in which the hemorrhage is secondary to a perforation of the periosteum, due to an incorrect incision and lingual access.[14]

Timing of Hematoma Occurrence: Warning Signs

Early Hematoma

When this complication occurs, it is important that the clinician knows how to recognize the warning signs. These mainly consist of the appearance of submandibular swelling, swelling of the floor of the mouth, or both. Other signs that accompany this clinical picture are odynophagia and respiratory distress.[19] In our case, the hemorrhage was immediate, which appeared just after the surgical procedure and is also in accordance with previous literature.[3,8,12,16,18–27,29–31,35] The onset of the clinical symptoms varies from the first 5 to 15 minutes depending on the cases.

Delayed Hematoma

According to other authors bleeding may not be evident from half an hour to 24 hours later.[4–6,11,12,17,25,27] Arterial section can cause a vasospasm that would slow down bleeding and retraction of the artery.[19] This is also favored using vasoconstrictors that carry local anesthesia and may delay bleeding for hours.[26] Thus, the patient must be informed of the warning signs precisely, so that they can report them quickly before the appearance of possible serious complications.

Management

General Considerations

As for treatment, manual compression should be the first option approach.[43] If performed effectively, it could prevent airway involvement. According to our literature review, almost half of the cases (6 in total out of 14) were solved with compression. Nevertheless, this simple technique has its limitations. Most important, the difficulty in determining the origin of the bleeding makes it less effective than it might seem. Therefore, in most published cases, an intraoral or extraoral surgical approach was necessary to successfully isolate and bind the traumatized vessels.[3–5,11–13,15,20,21,25,44]

Surgical Intervention

When surgical identification of the bleeding vessel is virtually impossible or unsuccessful, ligation of the original main

artery can be lifesaving. Although ligation of the lingual artery is considered the classic approach to definitively control excessive bleeding in the floor of the mouth, there are anatomical and clinical tests that support the initial ligation of the facial artery.[40]

The usefulness of surgical drainage is controversial, as most bleeding episodes are self-limiting due to pressure from adjacent tissues, so drainage can worsen this self-tamponade mechanism and aggravate bleeding.[5,22]

Barrientos-Lezcano et al[31] recommend an extraoral approach if the bleeding vessel is ligated, as tissue distortion makes intraoral access difficult and endangering. This is in line with our experience described in the clinical case.

Niamtu[16] suggests angiographic embolization as an alternative if surgical efforts fail.

In any case, given the scarce reports, it is not possible to obtain solid guidelines on this rare and unpredictable complication, so clinical decision-making ultimately rests with the caregiver.[31]

Bleeding from the floor of the mouth, if left uncontrolled, can be life-threatening.[15,19] According to Peñarrocha-Diago et al,[8] the professional involved should be prepared to perform an emergency tracheostomy if the patient begins to suffocate. This may be debatable given that performing tracheostomy in the out-of-hospital setting may result in high failure rates leading to increased morbidity and mortality. In this article, we emphasize the importance of recognizing the early clinical signs for an adequate hospital referral, where the appropriate means are available to secure the patient's airway.[16,45]

Postsurgical Considerations

All patients developing hematomas should immediately be referred to a tertiary hospital as an emergency case, particularly if clotting disorders or preexistent vascular damage cannot be ruled out. In view of the potential for severe complications, patients should be hospitalized for treatment and alerted to the possibility of life-threatening events. It is advisable to perform pre- and postoperative three-dimensional CT scans in both dentate and edentulous jaws.[25]

Once hospitalized, it is important to monitor the patient during the first 24 to 48 hours to ensure that there is no new bleeding, monitor drains if present, and perform airway control. It is also essential to continue with intravenous access for antibiotic prophylaxis, for pain, administration of corticotherapy, and above all serum therapy to control large blood losses (option of transfusion if necessary). Taking of vital signs to assess that the patient is hemodynamically stable and afebrile prior to discharge. At discharge, close clinical follow-up by their regular dentist and maxillofacial team is recommended. First week or 10 days avoiding overstress and soft diet with adequate hygiene.[2,4,6,8,19,20,24,25,30,32,35]

Suggestions for Future Clinical Practice

Hematoma of the floor of the mouth usually occurs in cases of jaw atrophy as most cases are caused by perforation of the cortex. The removal of an implant creates a defect when its extraction is necessary, so the two factors together can lead to a difficult rehabilitation. The placement of implants could be an alternative if after the radiographic study the bone allows it. Particularly in the case presented, it is not an option since the diameter of the implant that could be placed is not the recommended one for the molar area. To place implants in this case, bone regeneration would be necessary.

The alternative to implant placement would be a fixed bridge if the edentulous gap is not too large and we have anterior and posterior abutments.

As a last option, the edentulous section could be rehabilitated with a removable partial prosthesis.

After an event like this, it is likely that the patient would be reluctant to undergo further surgery, so it is important to open the range of alternatives to restore function and aesthetics in other ways.

Conclusion

(1) Mouth floor hematoma is one of the complications associated with implant surgery, although it is rare.
(2) It is a secondary complication in most cases to an accidental perforation of the mandibular cortical.
(3) As described in the literature, it seems to be more frequent when there is an anatomical variation of arterial perfusion and in cases of greater bone loss in all three dimensions.
(4) Warning signs are sudden swelling of the floor of the mouth or submandibular area, accompanied by dysphagia and dyspnea.

This complication is potentially fatal so early clinical suspicion by the dentist and hospital referral for management is essential.

Ethical Responsibilities

Protection of people and animals: The authors state that no experiments have been conducted on humans or animals for this research.

Confidentiality of data: The authors state that they have followed their workplace's protocols on the publication of patient data.

Right to privacy and informed consent: The authors obtained the informed consent of the patient referred to in the article. This document is in the possession of the corresponding author.

Authors' Contributions

B.C.N contributed for manuscript and literature review writing, selection of studies for inclusion in the narrative review, and final approval. M.C.C.D contributed for literature review and selection of studies for inclusion, critical review of the manuscript, and final approval. I.U.F contributed for writing of the clinical case, critical review of the manuscript, and final approval. R.G.D contributed for Maxillofacial surgeon who operated on the patient and resolved the complication described in the clinical case, writing the clinical case, critical review of the manuscript,

and final approval. G.S.A. did the critical review of the manuscript and final approval.

Summary Box

What is known:

Life-threatening complications during implant surgery are rare, and few articles have been published.

What this article adds:

The manuscript describes a case of hematoma of the floor of the mouth during explantation surgery for two implants. This is a complication that could be more prevalent than for implantation due to its difficulty. Nevertheless, it is reported less frequently in the literature. A literature review and unification of all reported cases was conducted and presented in this study.

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Conflict of Interest

None declared.

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