Hemorrhage Secondary to Interforaminal Implant Surgery: Anatomical Considerations and Report of a Case

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Understanding the anatomy of the floor of mouth is very important as severe submandibular hemorrhages are life threatening. This case report illustrates the potential hemorrhage consequences of implant surgery within the interforaminal region. The highly vascularized interforaminal region is susceptible to hemorrhage, which can be induced simply by instruments causing vascular trauma. The risk of intraoperative bleeding can be minimized by painstaking preoperative clinical and radiological examination but cannot be averted as it is inherent in the underlying anatomy of the region.

Key Words: oral implants, interforaminal region, hemorrhage

INTRODUCTION

Mandibular atrophy as a result of long-term edentulousness in the mandible often results in functional and esthetic problems. 1 Supporting the lower denture by means of dental implants was for many years the main way for clinicians to improve an edentulous patient’s unsatisfactory situation. 2–4 Here, the interforaminal region is considered to be the place for such implantation. The anterior region of the lower jaw, like the entire facial region, is well supplied by collateral arterial systems, including the facial, lingual, and sublingual arteries that give the main supply to the highly vascular area of the anterior floor of the mouth. 5

The facial artery is an anterior branch of the external carotid artery. It ascends the side of the neck, runs deep to supply the submandibular gland, and crosses the lower border of the mandible just in front of the angle of the mandible. At this point a submental branch of the artery runs along the inferior border of the mandible to the chin. After this submental branch, the facial artery crosses the mandible and travels across the face. The lingual artery supplies the tongue and the tissue of the floor of the oral cavity. It branches off the external carotid artery below the facial artery and then travels forward and deep, going beneath the hyoglossus muscle of the tongue and ending in 3 branches: (1) the dorsal lingual artery to the deep posterior part of the tongue, (2) the deep lingual artery to the deep anterior part of the tongue, and (3) the sublingual artery to the ventral surface of the tongue and floor of the mouth (Figure 1).

The exact topographical relationship of the end branches of the sublingual artery (arteria interalaris medialis and lateralis and arteria spinalis) was described by Tsusaki in 1955. 6 About halfway between the upper and lower edge of the lingual mandibular body this vessel divides into a descending and an ascending branch. The ascending branch splits into 2 twigs, a medial and a lateral one. The medial twig enters the bone between the medial and lateral incisors (medial interalar foramen); the lateral twig enters the bone between the lateral incisor and the canine (lateral interalar foramen). The descending branch also divides into 2 twigs, a superior and an inferior one. The twigs use the interspinal, supraspinal, and subspinal foramina to enter the bone near the mandibular spine. 6 In the course of operations of the floor of the mouth,
strong arterial anastomosis was very often found to be running in an alveolar process direction. The points of emersion of the arteries in the mandible were located in an anatomical study. With the aid of anatomical dissections in fixated corpses and 100 macerated mandibles with full dentition, the characteristic sites of predilection were located and found to correspond with clinical suppositions.

The previous study showed that the right and left arteria interalveolaris medialis and the right and left arteria interalveolaris lateralis were present in 81%, 83%, 6%, and 14%, respectively, of all cases (Figure 2).

The narrow network of blood supply under the tongue region is the reason why life-threatening bleeding can occasionally result from minor oral and implant surgery.\textsuperscript{7–12} In fact, the loose sublingual adipose and connective tissue does not constitute an effective barrier. As a result, the hematoma spreads to the neighboring submandibular space and the tongue before self-tamponade can take effect, ultimately blocking the passage of air. Such lingual arterial bleedings at the interforaminal area run slowly and painlessly; therefore, they are dangerous because of possible compromise of the respiratory tract.\textsuperscript{13–18}

The main objective of this article was to stress the potential hemorrhage consequences of inter-
foraminal implant surgery that, if accidentally left untreated, would eventually lead to the aforementioned complications.

**CASE REPORT**

A 66-year-old man presented with a chief complaint of unsuccessful previous conventional treatment with full dentures, resulting in severe atrophy of the alveolar ridge. The patient had no history of bleeding disorders and did not take any anticoagulant medications. In 2007, the patient underwent distraction osteogenesis for his anterior mandible using the technique of Mono-Endo-Distraction implant Krenkel, which enabled him to gain 10 mm of newly developed bone after a retention time of 4 months. The patient was then scheduled for insertion of 4 mandibular implants (ITI Straumann, Basel, Switzerland) measuring diameter $\varnothing = 4.1$ mm and length $L = 16$ mm. On implantation day, intraoperative bleeding was noticed after a crestal incision was performed and 4 interforaminal implants were placed according to the system standard technique (Figure 3). The source of bleeding on the lingual gingiva was localized, and coagulation of the vessels was achieved using electrical cauterization (Figure 4a and b). Bleeding was controlled and the gingiva was tightly sutured around the implant healing abutments that were placed in position, and a postoperative panoramic radiograph was obtained (Figure 5). The implants healed well and were connected by a customized bar and fitted with 10-mm posterior cantilevers on an overdenture exactly 6 months after implantation.

**DISCUSSION**

The patient developed an immediate hemorrhage during implant surgery. Immediate bleeding has been reported previously. The floor of the mouth is supplied by various branches of the sublingual artery, which anastomose with the inferior alveolar artery and the submental artery. The terminal branches of the submental artery and the sublingual artery run toward the lingual side of the anterior mandible parallel to the mylohyoid muscle, and they anastomose during running. Bavitz et al. conducted a study of 74 human cadavers that was chiefly concerned with the relationship of the submental and sublingual arteries to each other and the rate of recurrence with which each was responsible for supplying the floor of the mouth. Their observations showed that the submental artery was most often in charge and that in 53% of cases the sublingual artery was small or missing. When present, the submental artery was found to have an anterior course along the inferior surface of the mylohyoid muscle, supplying the submandibular triangle, the anterior belly of the digastic muscle, and the mylohyoid muscle. The sublingual artery was found on the floor of the mouth medial to the sublingual gland, supplying the gland, the mucous membrane of the floor of the mouth, the mylohyoid muscle, the lingual gingival, and the mandible. Also, Loukas et al. examined 100 adult human cadavers injected with red latex. They found that the sublingual artery originated from the lingual artery in 73% of cases and from the submental artery in the remaining 27% of cases. It was possible to identify the anastomotic pattern between the sublingual and submental arteries in 40% of cases. Further cadaver studies illustrate a variation in which a submental branch of the facial artery pierces the mylohyoid muscle to supply this area. These blood vessels are located adjacent to bone in the case of an atrophic edentulous ridge, and this location might result in injury to the concerned vessels when the bone is accidentally perforated. Consistently, anastomoses present with the submental and contralateral sublingual arteries explain why injuries of these vessels tend to cause severe bleeding. Some of these anastomotic branches are quite well and regularly developed and are easily injured by dental instruments or during oral surgery. Particularly with local anesthesia, poor access and lack of patient cooperation hamper hemostasis at this site. The small surgical field and the important structures, that is, the lingual nerve and the submandibular duct, defy targeted hemostasis. Contained nicks caused by injecting a local anesthetic may also cause uncontrolled bleeding. Bleeding at this site is bound to become dangerous if its onset is delayed for several hours by the vasoconstrictor component of the local anesthetic. The effect of the vasoconstrictors in the local anesthetic along with damage of the lingual arteriovenous plexus can result in delayed swelling, causing respiratory distress. This complication may result when the initial hemostasis of the constricted
vessel, which should form a blood clot, does not occur until the vasoconstrictive effect is diminishing and hence late bleeding may occur.

Injuries of the terminal branches of the sublingual artery cause severe hemorrhage and may result from deep dissection of the mucoperiosteum of an atrophied mandible, from drilling too far apically, or when drilling occurs in a faulty direction and the lingual cortex is penetrated.\textsuperscript{7,8,12} On the other hand, when drilling occurs in a faulty direction and the atrophied mandible, from drilling too far apically, or from deep dissection of the mucoperiosteum of an arterial artery cause severe hemorrhage and may result and hence late bleeding may occur.

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The complication associated with implant placement in the mandible described in this report suggests the following considerations:

1. Bleeding sources should be meticulously controlled during interforaminal implant surgery.

2. Inferior alveolar nerve blocks are preferred to a local anesthetic injected lingually. Bleeding from nicks in the vessel wall does not cease spontaneously. These nicks may be caused by multiple injections of a local anesthetic.

3. Preventive measures to avoid perforating the lingual cortex should always be considered.

4. A local anesthetic with a vasoconstrictor effect may delay the onset of sublingual hematoma by several hours in the floor of the mouth.\textsuperscript{6,11,14}

5. Once diagnosed, extensive sublingual hematomas should be treated as soon as possible to control the bleeding. In an early event of massive hemorrhage, essential measures should be taken. Most important is instant bimanual compression at the related perforation site and transfer of the patient to the nearest hospital to protect the airway. Endotracheal intubation for securing the airway, tracheostomy, hemostasis with hemostatic agents, electric cauterization, arterial ligation, and other procedures have been performed to treat the problem.\textsuperscript{13,14,16,19,27}

\textbf{CONCLUSION}

It is essential to understand the blood supply to the floor of mouth as bleeding might be dangerous. Whenever performing interforaminal implant placement and surgery on the lingual aspect of the mandible or the floor of the mouth, or even when simply injecting a local anesthetic at this site, the possibility of injuring the arterial vessels should be considered. Hemorrhage at this site is bound to become hazardous if its onset is delayed for several hours by the vasoconstrictor component of the local anesthetic. All patients developing hematomas should be immediately referred to a specialized hospital service 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 for life-threatening events. It is advisable to perform pre- and postoperative 3-dimensional CT scans in both dentate and edentulous jaws.

\textbf{ABBREVIATION}

\textit{CT} = computerized tomography

\textbf{REFERENCES}


