

Case Report

Canalis Sinuosus Damage after Immediate Dental Implant Placement in the Esthetic Zone

Roman Volberg¹ and Oleg Mordanov² 

¹Private Practice, Moscow, Russia

²Department of Prosthodontics, Central Research Institute of Dental and Maxillofacial Surgery, Moscow, Russia

Correspondence should be addressed to Oleg Mordanov; mordanov19@gmail.com

Received 25 September 2019; Revised 30 November 2019; Accepted 9 December 2019

Academic Editor: Hüsametdin Oktay

Copyright © 2019 Roman Volberg and Oleg Mordanov. This is an open access article distributed under the Creative Commons Attribution License, which permits unrestricted use, distribution, and reproduction in any medium, provided the original work is properly cited.

Dental implant failure in the anterior maxilla can be caused by the range of the features. One of them is neighboring neurovascular structure damage, such as the canalis sinuosus (CS), that carries the superior anterior alveolar nerve. The aim of the report is to demonstrate clinical symptomatology and radiographic signs of CS damage in a 45-year-old female patient who underwent upper left lateral incisor extraction and immediate implant placement and implant removal in 16 days secondary to pain and paresthesia in the maxillary left region.

1. Introduction

Immediate implant placement has been considered as an effective treatment for partially edentulous patients with a high implant survival rate [1]. However, not all implants that survive are necessarily successful [2]. Implant failure may be primary or secondary nature [3]. One of the examples of the secondary implant failure and, as a result, untoward consequence of performing implant dentistry could be the implant removal due to the damage to the infraorbital nerve and its branches [4].

The anterior superior alveolar nerve (ASAN) is a branch of infraorbital nerve that enters in the infraorbital canal, which has a side intrabony branch called the *canalis sinuosus* (CS) [5, 6]. The canalis sinuosus goes through the anterior wall of the maxilla and then along the lateral wall of the nasal cavity [7], residing in the alveolar process of the maxilla [8–12]. CS nerves and vessels supply anterior teeth and adjacent soft tissues [13].

The proximity to the neurovascular bundle of the CS can compromise dental implant treatment [8, 14, 15] with potential bleeding and temporary or permanent sensory disturbances [9, 16]. For example, Machado et al. [9] presented

two case reports where patients suffered from pain and it was immediately relieved after implant extractions that had been placed with CS damage. Also, McCrea [14] and Arruda et al. [17] reported different cases in which dental implant placement in the anterior maxilla in the CS led to persistent pain, and the patient's symptoms were resolved with the following removal of the implant. However, Shaeffer [18] reported a case of intractable pain following implant placement in the upper left first premolar region and the pain did not subside following the extraction of the implant.

When planning dental implants, carrying out radiographic examinations, alongside clinical examinations, has become necessary to reduce the risk of implant procedure failure and complications. The cone-beam computed tomography (CBCT) imaging is a valuable tool to determine the anatomic structures before any surgery, including implant surgery [19]. The recent literature review stated that CBCT exams were the best way to evaluate the CS [16].

Also, it was shown that the terminal portion of CS is more prevalent in the anterior region of the maxilla, more specifically in the incisor and canine regions near the palate [16]. On the other hand, the widely recommended direction for immediate implant placement in the anterior maxilla is

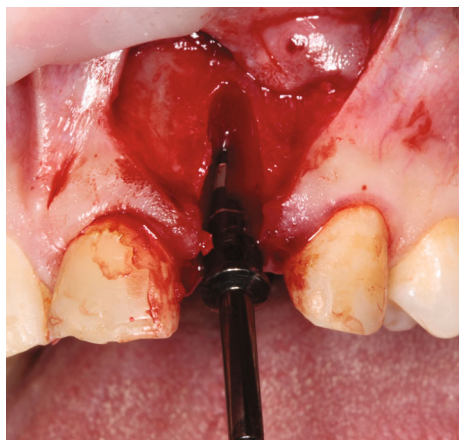


FIGURE 1: Intraoperative view. Implant site preparation after upper left lateral incisor extraction. No excessive bleeding was presented during the surgery.

palatal to the extracted root axis to engage more native bone in order to achieve maximum bony support and favorable esthetic outcome [20].

The aim of this article is to report a case with clinical and radiographic signs of CS damage after immediate dental implant placement in the maxillary left lateral incisor region.

2. Case Report

A 45-year-old female patient underwent maxillary left lateral incisor extraction secondary to severe horizontal tooth fracture below the cemento-enamel junction (CEJ). Preoperative CBCT examination was provided and evaluated before the procedure.

The CBCT scan was obtained with a 3D eXam (KaVo, Biberach, Germany) with standard exposure settings (23 cm × 17 cm field of view, 0.3 mm voxel size, 110 kV, and 1.6–20 s) and was analyzed with the I-CAT viewer software (Version 10, Hatfield, England).

The patient gave written consent before all procedures. Extraction was provided atraumatically with the luxators. The flap was reflected. Immediate implant placement was performed with the simultaneous guided bone regeneration (GBR) without corticotomy and soft tissue grafting (so-called “Burger technique” by Urban et al. [21, 22]). The implant placement and GBR procedures went without any complications (Figure 1); primary stability of the implant was 35 N cm (Dentium Implantium 3.5 mm × 10 mm). The GBR was provided using a mixture of the autogenous bone and a Bio-Oss® particulate graft (Geistlich) and Bio-Gide membrane (Geistlich). The site was sutured with Prolene 6/0. No excessive bleeding, as in the case of vessel damage, was noted during the surgery (Figure 2).

In a few hours after the procedure, the patient started complaining about the pain and paresthesia in the left maxilla. First week pain was insignificant, and 400 mg of ibuprofen was prescribed twice a day and it relieved the pain. In one week, the pain started increasing and became so strong and continuous that none of the painkillers could relieve it.

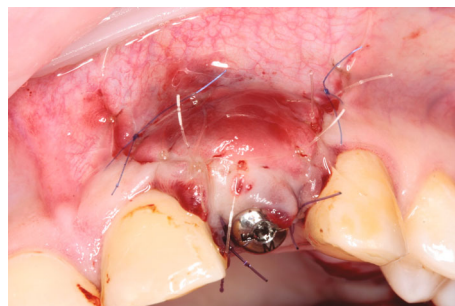


FIGURE 2: Intraoperative view. Immediate implant placement in the upper left lateral incisor region after GBR and soft tissue grafting. The healing abutment was placed and flaps were sutured.

The pain generally was located in the area of the maxillary left canine. All sensitive disorders were not located in the area of implant site—they spread out around the maxillary left canine, the palate, and the nasal region. Also, the patient complained about burning in the back of the head in the occipital region. Painkillers, tranquilizers, and neurotropic agents were ineffective at this moment. However, no significant findings were noted during extraoral and intraoral clinical examinations.

After the clinical examinations, it was suspected to be a neurological disorder, so differential diagnostic procedures were held. During these procedures, different types of the nerve blocks were performed on the patient. Palatal, incisive, and infraorbital nerve blocks were used one by one; however, only the infraorbital block relieved the pain.

No other symptoms of inflammation were found such as pain, fever, exudation, or excessive bleeding in the area of implant placement and GBR. Neither the patient nor her relatives presented neurological disease in the medical history.

New CBCT evaluation was performed after the surgery with the same equipment. During precise examination of the CBCT scans before and after the implant placement, CS was found with the diameter 2.3 mm in size with two small branches. One of them was found close to the palatal side with the diameter 1.9 mm in size; the other was found close to the buccal side in the maxillary left lateral incisor/implant region (Figures 3 and 4) with the diameter 0.7 mm in size in the most coronal point (both were referred to the lateral incisor region according to the de Oliveira-Santos et al. classification [5]).

The implant was extracted in two weeks and two days. Then, the pain and paresthesia started slowing down. However, an area of necrosis was found by the end of the third week on the palatal mucosa (Figure 5) even though the palatal flap was not reflected and no palatal and nasopalatine anesthesia was provided, so palatal blood supply was not compromised. Also, bony contours of the left greater palatal artery and nerve were visualized on the CBCT scans in the anterior maxilla 10.1 mm from the implant (Figure 5); thus, the damage of the greater palatal artery was excluded. The implant was 5.62 mm from the incisive foramen and 5.66 mm from the nasopalatine canal according to CBCT data, so the intervention to these structures is excluded as well.

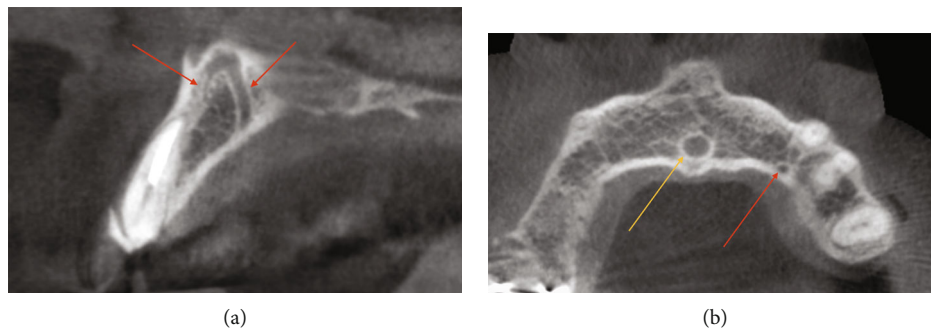


FIGURE 3: Preoperative CBCT scan. (a) Sagittal view. Accessory branches of CS (red arrows) have palatal and buccal directions close to the maxillary left lateral incisor. (b) Axial view. CS (red arrow) near the maxillary left canine and nasopalatine canal (yellow arrow).

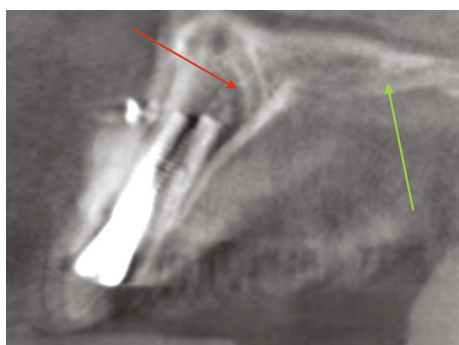


FIGURE 4: Postoperative CBCT scan, sagittal view in the left maxillary incisor region. The dental implant in situ. The diagnosis is difficult due to artefacts caused by the titanium implant; however, the major palatal branch of the CS could be seen (red arrow). Also, the bony contours of the left greater palatal artery and nerve are visualized (green arrow).

The bony defect after implant removal healed under a blood clot as an alveolar socket after tooth extraction. The patient was prescribed antiseptics for local application. Further treatment and follow-ups of the patient were impossible, because the patient decided to change the clinical practice.

3. Discussion

The CS, first described by Jones [23], carries an anterior superior neurovascular bundle through the anterior maxilla that innervates the central and lateral incisors and the canines. This small, poorly recognized bony canal is not known by surgeons unless complications such as paresthesia happen [11].

Several studies and clinical cases showed that CBCT is the best radiographic technique for CS visualization [16]. The CBCT examinations in the case showed that the accessory damaged canal of canalis sinuosus was buccal to the lateral incisor; according to von Arx et al. [12] and Machado et al. [9], the end of the CS was most frequently found palatal to the anterior maxillary teeth especially to the central incisors.

Though CBCT provides accurate three-dimensional images of dentomaxillofacial hard tissues [24], its limitation is the presence of image artefacts—deviations between the reconstructed image and the real content of the studied

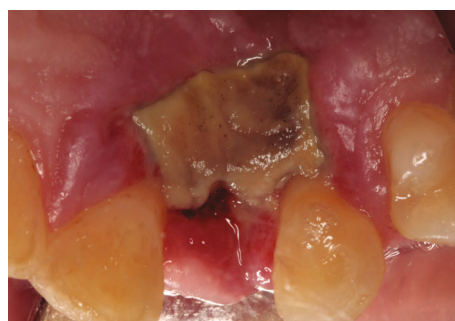


FIGURE 5: Palatal mucosa necrosis after dental implant extraction.

object [25]. A dental implant is a high-density structure that is the source of beam hardening resulting in the artefacts [26]. That is why after suspecting CS damage in the postoperative CBCT scans, it was decided to evaluate the preoperative CBCT scan for better diagnosis without the implant artefact.

During the preoperative CBCT evaluation and dental implant planning, none of the nerve structures around left lateral incisor were noticed. This demonstrates the necessity of knowing the existence of CS and its characteristics, which may influence treatment outcomes.

There are several case reports with dental implants placed in the anterior maxilla and CS damage, presenting the same neurological symptomatology [9, 17]; however, this case additionally contributes the symptoms of trigeminal neuralgia [27] as pain irradiation in the back of the head and no intraoperative excessive bleeding rather than the usual one during the implant site preparation. The tests with the different types of local nerve blocks showed a good diagnostic efficacy indicating the damaged infraorbital nerve branch.

As the damage of the greater palatal and nasopalatine nerve and blood supply was excluded, the palatal mucosa necrosis that appeared after implant extraction could be explained by the contraction of smooth muscle within the arterial wall during the neurovascular bundle constriction that leads to transient ischemia of structures and tissue necrosis [28]. However, the definite terms of the necrosis manifestation are still unclear.

To avoid sensory disturbance in the anterior maxilla in the case of CS detection, Shelley et al. [29] in their case offered a realistic fixed alternative: an adhesive

cantilever bridge that had the advantage of very low risk, rapidity of production, and low cost, to potentially damaging implant therapy.

4. Conclusion

This clinical report of immediate implant placement showed the importance of anatomical structure knowledge and accurate and precise preoperative CBCT scan estimation, especially in the esthetic zone. The damage of CS can lead to neurological symptomatology and implant extraction.

We suggest that single-tooth defects with the risk of CS damage in the region should be restored without implant treatment or with the use of surgical guides designed for fully guided implant placement.

Consent

Written consent was signed by the patient for every procedure.

Conflicts of Interest

The authors declare that they have no conflict of interests.

References

- [1] N. P. Lang, L. Pun, K. Y. Lau, K. Y. Li, and M. C. M. Wong, "A systematic review on survival and success rates of implants placed immediately into fresh extraction sockets after at least 1 year," *Clinical Oral Implants Research*, vol. 23, Suppl. 5, pp. 39–66, 2012.
- [2] D. Clark and L. Levin, "Dental implant management and maintenance: how to improve long-term implant success?," *Quintessence International*, vol. 47, no. 5, pp. 417–423, 2016.
- [3] B. R. Chrcanovic, T. Albrektsson, and A. Wennerberg, "Reasons for failures of oral implants," *Journal of Oral Rehabilitation*, vol. 41, no. 6, pp. 443–476, 2014.
- [4] G. Greenstein, J. R. Carpentieri, and J. Cavallaro, "Nerve damage related to implant dentistry: incidence, diagnosis, and management," *The Compendium of Continuing Education in Dentistry*, vol. 36, no. 9, pp. 652–659, 2015.
- [5] C. Oliveira-Santos, I. R. F. Rubira-Bullen, S. A. C. Monteiro, J. E. León, and R. Jacobs, "Neurovascular anatomical variations in the anterior palate observed on CBCT images," *Clinical Oral Implants Research*, vol. 24, no. 9, pp. 1044–1048, 2012.
- [6] A. M. V. Wanzeler, C. G. Marinho, S. M. A. Junior, F. R. Manzi, and F. M. Tuji, "Anatomical study of the canalis sinuosus in 100 cone beam computed tomography examinations," *Oral and Maxillofacial Surgery*, vol. 19, no. 1, pp. 49–53, 2015.
- [7] T. von Arx and S. Lozanoff, "Anterior superior alveolar nerve (ASAN)," *Swiss Dental Journal*, vol. 125, no. 11, pp. 1202–1209, 2015.
- [8] F. S. Neves, M. Crusóé-Souza, L. C. S. Franco, P. H. F. Caria, P. Bonfim-Almeida, and I. Crusóé-Rebello, "Canalis sinuosus: a rare anatomical variation," *Surgical and Radiologic Anatomy*, vol. 34, no. 6, pp. 563–566, 2012.
- [9] V. D. C. Machado, B. R. Chrcanovic, M. B. Felipe, L. R. C. Manhães Júnior, and P. S. P. de Carvalho, "Assessment of accessory canals of the canalis sinuosus: a study of 1000 cone beam computed tomography examinations," *International Journal of Oral and Maxillofacial Surgery*, vol. 45, no. 12, pp. 1586–1591, 2016.
- [10] L. R. C. Manhães Júnior, M. F. L. Villaça-Carvalho, M. E. L. Moraes, S. L. P. de Castro Lopes, M. B. F. Silva, and J. L. C. Junqueira, "Location and classification of canalis sinuosus for cone beam computed tomography: avoiding misdiagnosis," *Brazilian Oral Research*, vol. 30, no. 1, pp. 1–8, 2016.
- [11] G. Gurler, C. Delilbasi, E. E. Ogut, K. Aydin, and U. Sakul, "Evaluation of the morphology of the canalis sinuosus using cone-beam computed tomography in patients with maxillary impacted canines," *Imaging Science in Dentistry*, vol. 47, no. 2, pp. 69–74, 2017.
- [12] T. Von Arx, S. Lozanoff, P. Sendi, and M. M. Bornstein, "Assessment of bone channels other than the nasopalatine canal in the anterior maxilla using limited cone beam computed tomography," *Surgical and Radiologic Anatomy*, vol. 35, no. 9, pp. 783–790, 2013.
- [13] M. G. G. Torres, L. de Faro Valverde, M. T. A. Vidal, and I. M. Crusóé-Rebello, "Branch of the canalis sinuosus: a rare anatomical variation – a case report," *Surgical and Radiologic Anatomy*, vol. 37, no. 7, pp. 879–881, 2015.
- [14] S. J. J. McCrea, "Aberrations causing neurovascular damage in the anterior maxilla during dental implant placement," *Case Reports in Dentistry*, vol. 2017, Article ID 5969643, 10 pages, 2017.
- [15] R. Jacobs, M. Quirynen, and M. M. Bornstein, "Neurovascular disturbances after implant surgery," *Periodontol 2000*, vol. 66, no. 1, pp. 188–202, 2014.
- [16] R. Ferlin, B. S. C. Pagin, and R. Y. F. Yaedú, "Canalis Sinuosus: A Systematic Review of the Literature," *Oral Surgery, Oral Medicine, Oral Pathology and Oral Radiology*, vol. 127, no. 6, pp. 545–551, 2019.
- [17] J. A. Arruda, P. Silva, L. Silva et al., "Dental implant in the canalis sinuosus: a case report and review of the literature," *Case Reports in Dentistry*, vol. 2017, Article ID 4810123, 5 pages, 2017.
- [18] W. Shaeffer, "A case of intractable pain in the anterior maxilla following dental implant placement," in *Association of Dental Implantology Members' National Forum*, London, UK, 2015.
- [19] T. Genç, O. Duruel, H. Kutlu, E. Dursun, E. Karabulut, and T. Tözüm, "Evaluation of anatomical structures and variations in the maxilla and the mandible before dental implant treatment," *Dental and Medical Problems*, vol. 55, no. 3, pp. 233–240, 2018 Jul-Sep.
- [20] S. H. Chung, Y. S. Park, S. H. Chung, and W. J. Shon, "Determination of Implant Position for Immediate Implant Placement in Maxillary Central Incisors Using Palatal Soft Tissue Landmarks," *The International Journal of Oral & Maxillofacial Implants*, vol. 29, no. 3, pp. 627–633, 2014 May-Jun.
- [21] I. Urban, *Vertical and horizontal ridge augmentation: new perspectives*, Quintessence Publishing, Germany, 1st Edition edition, 2017.
- [22] I. A. Urban, H. Nagursky, J. L. Lozada, and K. Nagy, "Horizontal ridge augmentation with a collagen membrane and a combination of particulated autogenous bone and anorganic bovine bone-derived mineral: a prospective case series in 25 patients," *The International Journal of Periodontics and Restorative Dentistry*, vol. 33, no. 3, pp. 299–307, 2013.
- [23] F. W. Jones, "The anterior superior alveolar nerve and vessels," *Journal of Anatomy*, vol. 73, Part 4, pp. 583–591, 1939.

- [24] K. Abramovitch and D. D. Rice, "Basic principles of cone beam computed tomography," *Dental Clinics of North America*, vol. 58, no. 3, pp. 463–484, 2014.
- [25] S. R. Makins, "Artifacts Interfering with Interpretation of Cone Beam Computed Tomography Images," *Dental Clinics of North America*, vol. 58, no. 3, pp. 485–495, 2014.
- [26] A. Parsa, N. Ibrahim, B. Hassan, P. van der Stelt, and D. Wismeijer, "Influence of object location in cone beam computed tomography (NewTom 5G and 3D Accuitomo 170) on gray value measurements at an implant site," *Oral Radiology*, vol. 30, pp. 153–159, 2014.
- [27] J. M. Zakrzewska and M. E. Linskey, "Trigeminal neuralgia," *BMJ*, vol. 348, no. feb17 9, p. g474, 2014.
- [28] N. Gogna, S. Hussain, and S. Al-Rawi, "Case reports: palatal mucosal necrosis after administration of a palatal infiltration," *British Dental Journal*, vol. 219, no. 12, pp. 560-561, 2015.
- [29] A. Shelley, J. Tinning, J. Yates, and K. Horner, "Potential neurovascular damage as a result of dental implant placement in the anterior maxilla," *British Dental Journal*, vol. 226, no. 9, pp. 657–661, 2019.