The Caldwell-Luc approach to maxillary cyst enucleation

Todor L.[1], Riviş M.[2*], Todor S.A.[3], Ghircau Radu R.[4], Fluieras R.[4], Vasca E.[5], Matichescu A.M.[6]

[1]Department of Dental Medicine, Faculty of Medicine and Pharmacy, University of Oradea, Romania
[2]Department 2, Faculty of Dental Medicine, Victor Babes University of Medicine and Pharmacy, Timisoara, Romania
[3]Dentist doctor, private medical office, Oradea, Romania
[4]Department of Dentistry, Faculty of Dentistry, Faculty of Medicine, "Vasile Goldiş" Western University of Arad, Romania
[5]Department of Oral Rehabilitation, Faculty of Dental Medicine, "Vasile Goldiş" Western University of Arad, Romania
[6]Department of Preventive, Community Dentistry and Oral Health, Translational and Experimental Clinical Research Center in Oral Health (TEXC-OH), 14A Tudor Vladimirescu Ave., 300173 Timisoara, Romania

Correspondence to:
Name: Mircea Riviş
Address: Department 2, Faculty of Dental Medicine, Victor Babes University of Medicine and Pharmacy, Eftimie Murgu Square, No. 2, 300041 Timisoara, Romania
Phone: +40 722287582
E-mail address: rivis.mircea@umft.ro

Abstract

In the era of endoscopic surgery of the maxillary sinuses, an external approach to them may be ideal in certain situations. The Caldwell-Luc procedure uses an external approach for the surgical treatment of severely diseased maxillary sinus. It is reserved for selected patients with extensive maxillary disease, especially those with massive polyposis or fungal disease, chronic maxillary sinusitis, or massive cysts of various etiologies. Failure to completely clean the maxillary mucosa can lead to early postoperative recurrence of the disease. The anterior and inferior regions of the maxillary antrum are particularly difficult to access endoscopically.

Keywords: Caldwell-Luc procedure, maxillary cysts, endoscopic surgery

INTRODUCTION

The sinuses are the air spaces within the pneumatic bones situated at the frontobasal region of skull. There are four in number: frontal, maxillary (the largest), sphenoidal and ethmoidal. Clinical-pathological aspects of maxillary sinusitis was described by Nathanial Highmore (1651), therefore maxillary sinus is also known as Highmore's antrum [1].

The Caldwell Luc operation is an approach to the maxillary sinus through the anterior wall by making a window just below the canine fossa, simultaneously making an intranasal counterdrainage through the inferior meatus (Figure 1) [2]. It was introduced by George Caldwell (1893) and Henry Luc (1897).

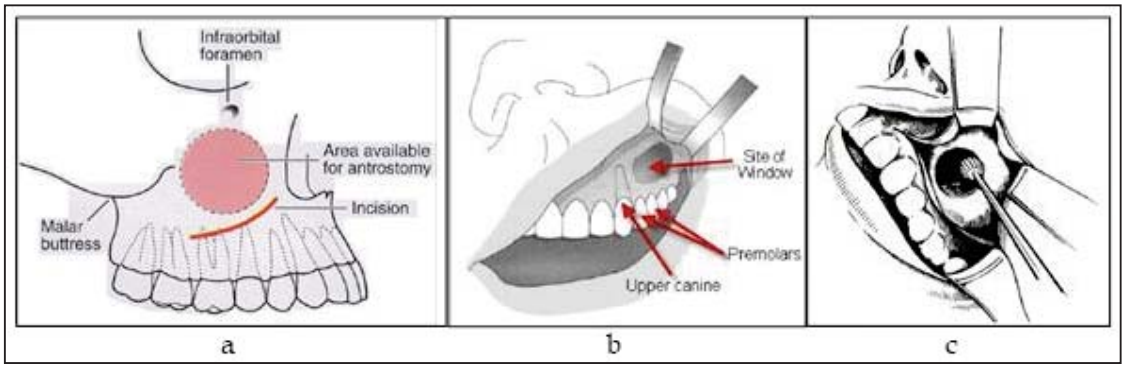

Figure 1. Caldwell Luc surgery. a) Area available for antrostomy. b) Caldwell-Luc surgical procedure showing the location of the window in the anterior maxillary sinus. c) Diagram showing the surgical technique in which a long sublabial incision facilitates gentle tissue retraction and the anterior antrostomy is created through a cutting burr. [3] (Modified image)

George W Caldwell, a surgeon in New York, combined the canine fossa approach with intranasal drainage to gain access to the maxillary sinuses in order to improve therapeutic outcomes. He published his work in the New York Medical Journal in 1893. In parallel, the French surgeon Henry Luc performed a similar surgical intervention for chronic sinusitis in 1897. The difference between the two techniques was the location of the antrostomy. Caldwell performed inferior meatal antrostomy and Luc performed middle meatal antrostomy [1].

This procedure was the treatment of choice for chronic and recurrent maxillary sinusitis until the introduction of Functional Endoscopic Sinus Surgery (FESS) to improve physiological drainage at the natural ostia [2,4-6]. The lower meatal antrostomy allows passive drainage of reaccumulated secretions and facilitates postoperative toileting [7].

The Caldwell-Luc operation is mainly used for neoplasms, intrasinus trauma, removal of foreign bodies, repairing oroantral fistulae and to ensure access to the orbital floor and pterygomaxillary fossa [2,8,9].

MATERIALS AND METHODS

Caldwell-Luc surgery is usually performed under general anesthesia, but can also be performed under local anesthesia. It is recommended to use topical anesthesia and inject adrenaline into the soft tissues at the level of the canine fossa.

The incision is made from the lateral incisor to the second molar. The mucoperiosteal flap is then raised to expose the anterior wall of the sinus which is opened at the level of the canine fossa where the bone is relatively thin. The opening can be enlarged with Hayek or Kerrison forceps to produce a hole large enough to provide access, for example to allow the removal of sinus lining or the insertion of an endoscope and instruments.

Clinical case

A 45-year-old patient is referred to the Timișoara Oral and Maxillo-Facial Surgery Clinic, with a recurrent history of painful swelling on the right cheek for approximately 6 months. The clinical examination reveals two pseudotumoral formations at the level of the maxillary vestibule next to the root remnants 1.6 and 1.4. On palpation, the soft, elastic consistency of the formations is noted (Figure 2).

Figure 2. The intraoral image of the cystic formation

The orthopantomographic radiological examination (OPG) and cone beam computer tomography (CBCT) revealed the presence of a cystic formation of 2/2 cm at the apex of the first molar (1.6) and an osteitis near the apex of the first premolar (1.4). The root of the second premolar (1.5) is not involved in the cystic lesion, it being located tangent to the cystic membrane (Figure 3).

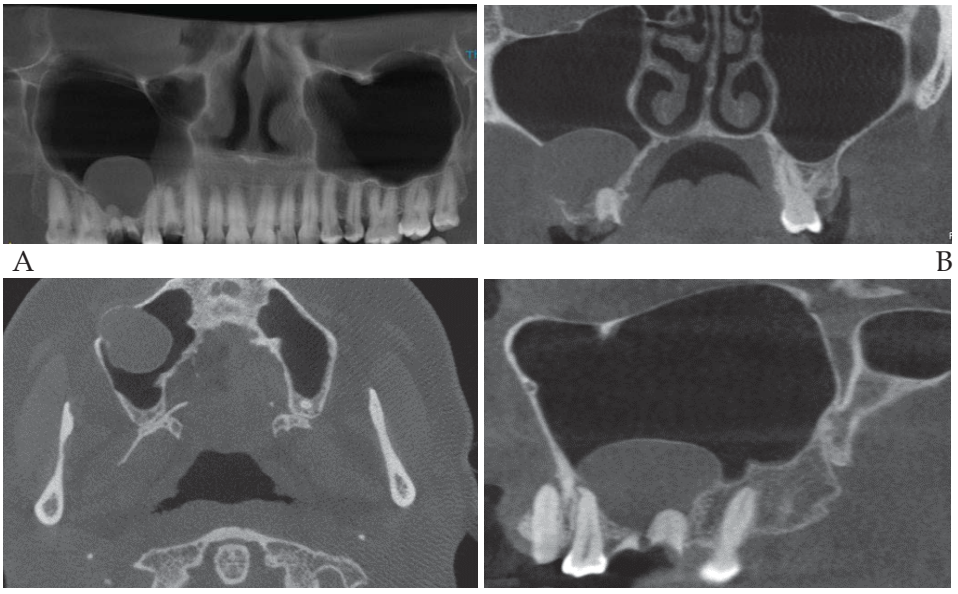

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Figure 3. A) OPG image from CBCT; B) CBCT image, coronary section; C) CBCT image, axial section; D) CBCT image, sagittal section

The patient is offered endodontic treatment of the second premolar (1.5). Following the refusal of endodontic treatment, it is decided to extract the tooth. The classic Caldwell-Luc method is used surgically to expose the cystic formation (Figure 4).

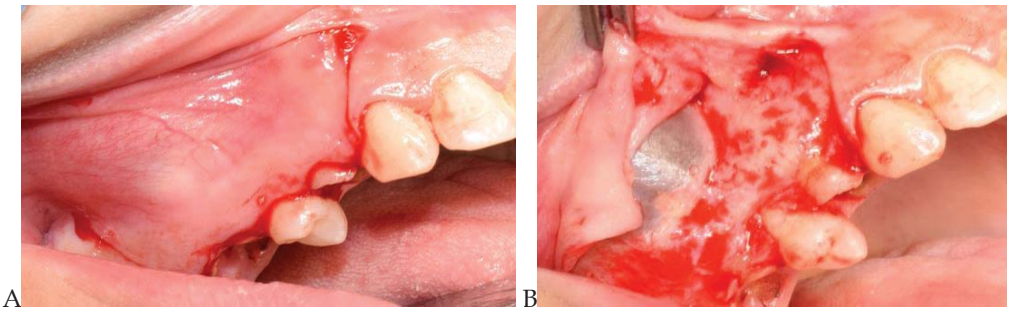

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Figure 4. A) Incision; B) Detachment of the mucoperiosteal flap

After exposing the cystic formation, its contents are aspirated (Figure 5).

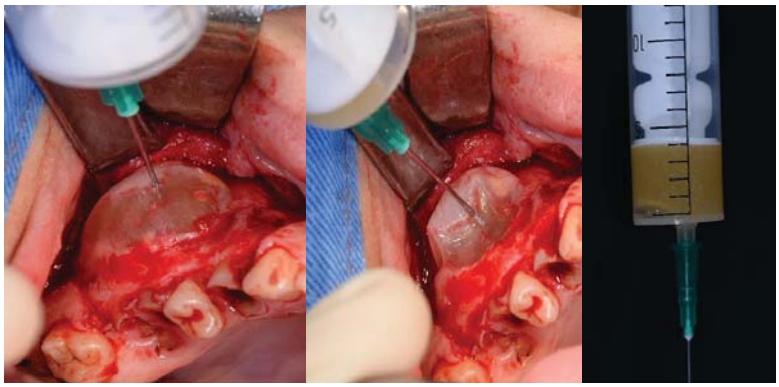

Figure 5. Aspiration of cystic fluid

Cystectomy is performed followed by the extraction of teeth 1.4, 1.5 and 1.6 (Figure 6).

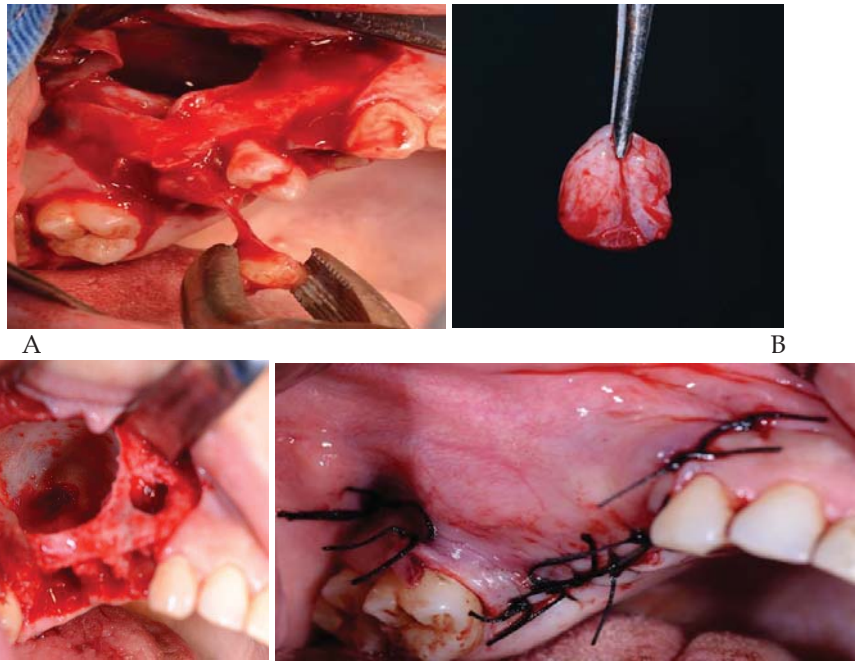

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Figure 6. A) Cystectomy and intraoperative extraction of causative teeth; B) Cystic membrane; C) Bone geode; D) Suture

Clinical case

A 51-year-old patient is referred to the Timişoara Oral and Maxillofacial Surgery Clinic, as a result of a right genial swelling and the symptoms of maxillary sinusitis.

Following the clinical examination (Figure 7) and the radiological examination (Figure 8), the diagnosis of odontogenic cyst of the right maxillary first molar (1.6) with intrasinus evolution is made.

Figure 7. Intraoral image of the cystic formation

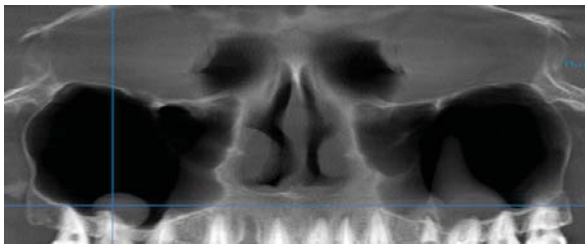
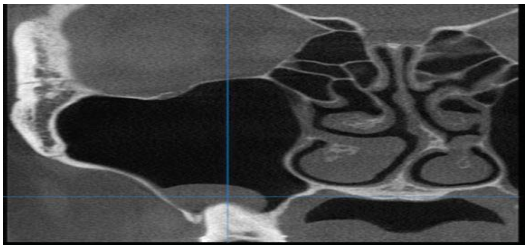
A   B

Figure 8. A) OPG image from CBCT; B) CBCT image, coronary section

Surgery is performed using the classic Caldwell-Luc method to expose the cystic formation followed by the extraction of the maxillary right first molar (1.6) (Figure 9).

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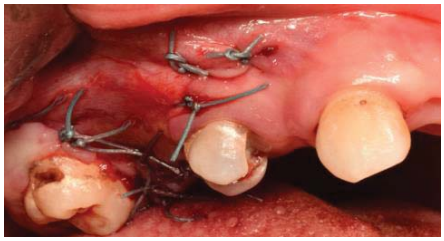
C   D

Figure 9. A) Extraction of the first molar, cystectomy and communication of the dental alveolus with the cystic lesion; B) Bone geode following cystectomy; C) Cystic membrane; D) Suture

RESULTS

The histopathological examination in the first case: fragment of the cystic wall (serial sections) lined by non-keratinized squamous stratified epithelium with focus of reactive epitheliosis, on a fibrous connective support, hyalinized with perivascular, subepithelial lymphoplasmacytic infiltrates and suppurative micro foci. Absence of active odontogenic epithelial remnants. On the periphery of the cystic wall partial insertion of cortical lamellar bone tissue.

The cyst had a sinus evolution, it pushed the floor of the maxillary sinus superiorly, there was no communication between the sinus and the cystic lesion, and no signs of sinusitis.

The histopathological examination in the second case revealed a polypoid thickened sinus mucosa, lined by exulcerated respiratory pseudo-stratified epithelium on a loose connective support with inflammatory edema, lymphoplasmacytic infiltrates and dystrophic microcalcifications, and on the surface of the mucosa there is mucus and fibro-leukocyte detritus.

Clinically, postoperatively, the patients presented no complications, with a good healing of the bone tissue and there were no oral-antral communications.

DISCUSSIONS

There are studies that highlight the problems associated with this radical surgery and find that the regenerated antral mucosa would not have normal motility and ciliary function [1].

Caldwell-Luc surgery (CLS) is a well-established procedure. Until the era of antibiotics and endoscopic sinus surgery, this operation was a fundamental surgical technique for treating inflammatory sinus disease. Despite the success of the endoscopic technique there are well-documented indications for Caldwell-Luc surgery, which ensures good access to the sinus, perisinus and pterygomaxillary fossa [2,5,10].

Huang and Chen [8] in their study with CLS without inferior meatal antrostomy concluded that creating sinonasal window after clearing dental origin tumors/cysts from maxillary cavity do not change surgical outcome.

Becker *et al*. [11] compared maxillary sinus specimens removed during Caldwell-Luc procedures and traditional maxillary sinus antrostomies. They found that in a few cases, post CLS, samples from the antrum had necrotic bone debris compared to the control group where they found relatively healthy mucosa. They concluded that this surgery should be used as a last resort when other modalities fail.

Han *et al*. [12] performed a study on patients with a history of failed Caldwell-Luc surgery. They found that endoscopic revision of the maxillary sinus yields comparable results to repeat Caldwell-Luc procedure in these patients.

Inferior meatal antrostomy (IMA) theoretically allows passive drainage and postoperative suction toileting. IMA has been criticized for prolonged operative time, damage to the nasolacrimal duct, epistaxis from the sphenopalatine artery, and deviation from normal sinus physiology [13]. Al-Belasy showed in a study that IMA closes within 3 months of surgery in 82% of 367 cases [7]. And other studies suggest that IMA is not necessary in the Caldwell-Luc surgery for odontogenic sinus disease [8].

CONCLUSIONS

The Caldwell-Luc procedure has been the method of choice in maxillary sinus surgery, its use declining with advances in endoscopic technology and the discovery of new antibiotics.

The Caldwell-Luc operation is safe and effective provided the sinus wall is handled gently and carefully and should remain in the repertoire of surgeons managing maxillary sinus conditions.

REFERENCES

1. Datta RK, Viswanatha B, Shree Harsha M. Caldwell Luc Surgery: Revisited. Indian J Otolaryngol Head Neck Surg. 2016 Mar;68(1):90-3. doi: 10.1007/s12070-015-0883-y. Epub 2015 Jul 31. PMID: 27066419; PMCID: PMC4809813.
2. Matheny KE, Duncavage JA. Contemporary indications for the Caldwell-Luc procedure. Curr Opin Otolaryngol Head Neck Surg. 2003;11(1):23-26. doi:10.1097/00020840-200302000-00005
3. https://exodontia.info/caldwell-luc-operation-intra-oralantrostomy/
4. Har-El G. Combined endoscopic transmaxillary-transnasal approach to the pterygoid region, lateral sphenoid sinus, and retrobulbar orbit. Ann Otol Rhinol Laryngol. 2005;114(6):439-442. doi:10.1177/000348940511400605
5. Barzilai G, Greenberg E, Uri N. Indications for the Caldwell-Luc approach in the endoscopic era. Otolaryngol Head Neck Surg. 2005;132(2):219-220. doi:10.1016/j.otohns.2004.09.014
6. Liau I, Lynch N, Hearn B, Cheng A. Endoscopically Assisted Modified Caldwell-Luc Approach to Enucleation of Dentigerous Cyst With Ectopic Tooth From the Maxillary Sinus. J Craniofac Surg. 2018 Sep;29(6):e568-e570. doi: 10.1097/SCS.0000000000004346. PMID: 29762318.
7. Al-Belasy FA. Inferior meatal antrostomy: is it necessary after radical sinus surgery through the Caldwell-Luc approach?. J Oral Maxillofac Surg. 2004;62(5):559-562. doi:10.1016/j.joms.2003.07.009
8. Huang YC, Chen WH. Caldwell-Luc operation without inferior meatal antrostomy: a retrospective study of 50 cases. J Oral Maxillofac Surg. 2012;70(9):2080-2084. doi:10.1016/j.joms.2011.09.044
9. Agbara R, Fomete B, Omeje K, Onyebuchi P. Is the Caldwell-Luc operation and its modifications still useful in the era of endoscopic sinus surgery? Findings from a resource-limited setting. Journal of Stomatology. 2019;72(2):63-69. doi:10.5114/jos.2019.86985.
10. Çelik OE, Ceylan ME. Sinus Augmentation Using Caldwell-Luc Technique in the Existence of Ectopic Tooth in the Maxillary Sinus: A Multidisciplinary Approach. J Craniofac Surg. 2022;33(7):e758-e761. doi:10.1097/SCS.0000000000008702
11. Becker SS, Roberts DM, Beddow PA, Russell PT, Duncavage JA. Comparison of maxillary sinus specimens removed during Caldwell-Luc procedures and traditional maxillary sinus antrostomies. Ear Nose Throat J. 2011;90(6):262-266. doi:10.1177/014556131109000607
12. Han JK, Smith TL, Loehrl TA, Fong KJ, Hwang PH. Surgical revision of the post-Caldwell-Luc maxillary sinus. Am J Rhinol. 2005;19(5):478-482.
13. Amin ZA, Amran M, Khairudin A. Removal of extensive maxillary dentigerous cyst via a Caldwell-Luc procedure. Archives of Orofacial Sciences. 2008;3(2):48-51.