

# Caldwell-Luc Operation Without Inferior Meatal Antrostomy: A Retrospective Study of 50 Cases

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**Purpose:** In the standard Caldwell-Luc operation, an inferior meatal antrostomy is performed to promote sinus drainage. However, inferior meatal antrostomy has been criticized for its additional operation time and wound, early loss of the opening, and risk of injury to the nasolacrimal duct. This study retrospectively reviewed the results of the Caldwell-Luc operation without inferior meatal antrostomy in the treatment of odontogenic maxillary sinusitis or odontogenic sinus disease.

**Patients and Methods:** The records of 50 patients who had an odontogenic sinus disease and underwent the Caldwell-Luc operation without inferior meatal antrostomy were reviewed. The data included the patient's age, gender, surgical indications, surgical condition, and complications.

**Results:** From April 2004 to October 2010, there were 27 male patients and 23 female patients aged 14 to 70 years (mean, 37 years) who underwent the modified Caldwell-Luc operation. The surgical indications included intrasinus odontogenic cysts (44%), oroantral fistulae with chronic sinusitis (44%), odontoma (4%), odontogenic sinusitis (4%), and foreign bodies in the maxillary sinus (4%). The patients were successfully treated with minimal complications.

**Conclusions:** The modified Caldwell-Luc operation provides easier postoperative care and involves fewer complications. It is not necessary to create the inferior meatal antrostomy in the Caldwell-Luc operation when treating odontogenic sinus disease.

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The Caldwell-Luc operation has a long history in the treatment of sinus disease. It was first described by George Caldwell in 1893 and Henri Luc in 1897 as a surgical approach to maxillary sinus disease. This procedure was a mainstay of treatment for chronic and recurrent maxillary sinusitis until the introduction of functional endoscopic sinus surgery for improving

physiologic drainage at the natural ostia.<sup>1-3</sup> Currently, the Caldwell-Luc operation is mainly used for intrasinus neoplasm or trauma and for providing access to the perisinus and the pterygomaxillary fossa.<sup>3-5</sup>

In the standard Caldwell-Luc operation, the maxillary sinus is entered through the canine fossa, and the diseased sinus membrane is stripped and removed. A counter-opening is created on the lateral wall of the inferior nasal meatus to promote sinus drainage, and temporary antral and meatal packs are usually inserted. This inferior meatal antrostomy theoretically allows passive drainage of reaccumulated material and facilitates suction toilet postoperatively.<sup>3,4,6,7</sup> However, this procedure has been criticized for its additional operation time and wound, early loss of the opening, and risk of injury to the nasolacrimal duct.<sup>6,8,9</sup> Moreover, studies show that the mucociliary transport physiologically always drives the mucus toward the natural ostium, despite surgical alteration.<sup>4,10-12</sup> Therefore the necessity of inferior meatal antrostomy for the Caldwell-Luc operation is controversial.

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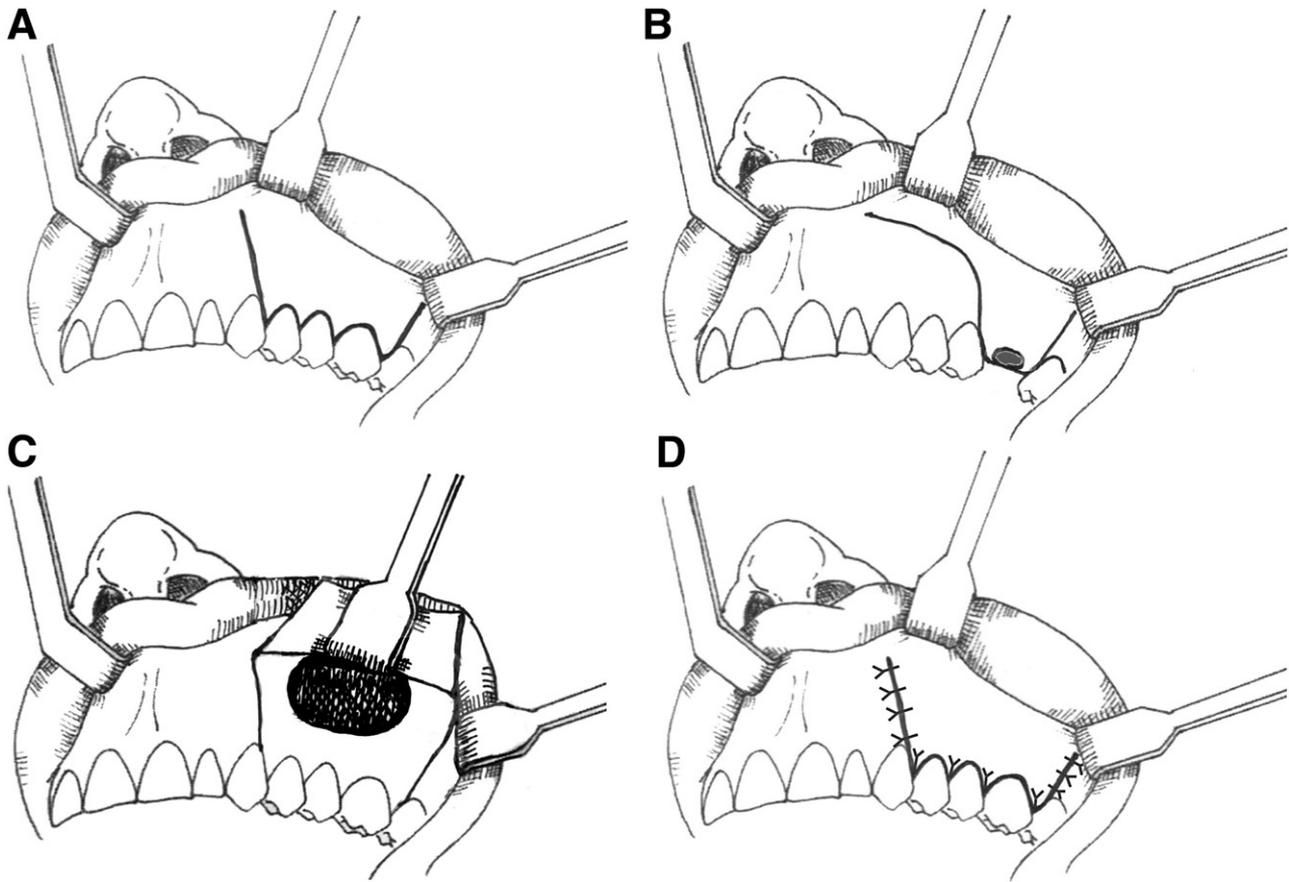
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**FIGURE 1.** A, An intrasulcular incision with 2 vertical releasing cuts was made at the cyst/tumor-involving area. B, A buccal advanced flap to repair the oroantral communication was designed. C, A bone window was made at the canine fossa. No inferior meatal antrostomy was made at the end of the operation. D, The intraoral incision was closed with absorbable sutures.

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This study retrospectively reviews the results of the Caldwell-Luc operation in the treatment of odontogenic maxillary sinusitis or odontogenic cysts and tumors. A modified operation procedure that does not make a counter-opening in the inferior nasal meatus is introduced.

### Patients and Methods

A total of 50 patients who underwent the Caldwell-Luc operation at the Department of Oral and Maxillofacial Surgery, Chang Gung Memorial Hospital, Taoyuan, Taiwan, between 2004 and 2010 were reviewed retrospectively. The study protocol was approved by the Institutional Review Board of Chang Gung Memorial Hospital. All patients were diagnosed as having a dental origin of sinus pathology that indicated sinus surgery through the Caldwell-Luc approach. Patients with nonodontogenic sinusitis were excluded. All procedures were performed by the same surgeon to eliminate operator variability. The data recorded included the

patient's age, gender, surgical indications, surgical condition, and complications.

### SURGICAL TECHNIQUE

A modified Caldwell-Luc operation without inferior meatal antrostomy was carried out in all cases. Surgery was performed with the patient under general anesthesia and with nasotracheal intubation. Before the operation, antibiotic prophylaxis with 1 g of ce-fazolin was prescribed. Gingivobuccal fold incision or intrasulcular incision with vertical releasing cuts was made at the cyst/tumor-involving area (Fig 1A). If the patient had an oroantral communication, the incision was designed to create a buccal advanced flap to cover the defect (Fig 1B). The infraorbital nerve was carefully protected during periosteal elevation. A bone window was made at the canine fossa (Fig 1C). The sinus pathology and the diseased sinus membranes were all enucleated and stripped down. Normal mucous membrane of the maxillary sinus was left intact. At the end of the procedures, the maxillary sinus cavity was packed with iodoform gauze impreg-

nated with bacitracin-neomycin ointment, except the cases whose sinus membrane was mostly intact with no oozing. No counter-opening was made in all cases. The intraoral incision was then closed with absorbable sutures (Fig 1D).

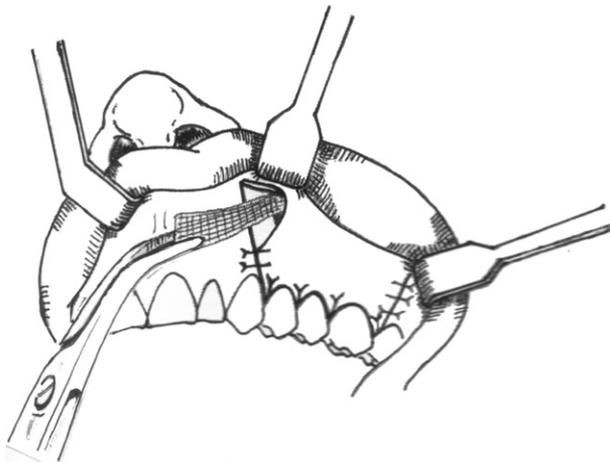
Antibiotics (500 mg of cefazolin intravenously 4 times daily for 3 days and 500 mg of penicillin V by mouth 4 times daily for 7 more days) were prescribed for all operated patients for 10 days after the surgery. For the penicillin-allergic patients, 150 mg of clindamycin by mouth 4 times daily was chosen. The patients were instructed to use sinus precaution for 2 weeks, and they were also instructed to avoid brushing their teeth near the operation site, touching the wound with their tongue, and blowing or exercising the cheek.

The patients with sinus packing returned to our clinic for removal of the iodoform gauze packing on the fifth day after surgery. This procedure was performed with patients under local anesthesia. After 3 stitches of suture removal, the packing was pulled out gently from the maxillary sinus through the previous intraoral incision line (Fig 2). The wound was then resutured with No. 3-0 silk. All suture materials were removed on the twelfth day after surgery.

## Results

Fifty patients underwent the modified Caldwell-Luc operation from April 2004 to October 2010: 27 male patients and 23 female patients with a mean age of 37 years (range, 14-70 years). Indications for the Caldwell-Luc approach are summarized in Table 1.

The modified Caldwell-Luc operation was performed in 22 patients (44%) for intrasinus odonto-



**FIGURE 2.** By use of a mosquito hemostat, the iodoform gauze packing was pulled out gently from the maxillary sinus through the previous intraoral incision line.

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**Table 1. INDICATIONS FOR CALDWELL-LUC OPERATION IN 50 PATIENTS**

Indications	No. of Patients	%
Intrasinus odontogenic cyst	22	44
Intrasinus odontoma	2	4
Traumatic chronic sinusitis with oroantral fistula	14	28
Traumatic chronic sinusitis with oroantral fistula and dental root tip	8	16
Odontogenic sinusitis	2	4
Foreign body	2	4

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genic cysts, and the pathologic examination showed dentigerous cyst (10 cases), radicular cyst (5 cases), odontogenic keratocyst (1 case), retention cyst (2 cases), and other odontogenic cyst (4 cases). Surgery was performed in 22 patients (44%) for oroantral fistulae with chronic sinusitis, including 6 first-molar fistulae, 8 second-molar fistulae, 2 third-molar fistulae, and 1 first-premolar fistula. The remaining 6 patients received this procedure because of odontoma in the maxillary sinus (2 patients [4%]), odontogenic sinusitis (2 patients [4%]), and foreign bodies (stainless steel screw, zinc oxide eugenol) in the maxillary sinus (2 patients [4%]). Sinus packing was used in 44 cases (88%). The mean blood loss during the operation was 110 mL, and the maximum was 850 mL.

Immediate postoperative information was available (Table 2). The postoperative hospital stay ranged from 1 to 3 days. Facial swelling was reported in all patients on postoperative day 2, including mild swelling (fullness sensation only) in 16 patients (32%), moderate swelling (swelling without infraorbital involvement) in 28 patients (56%), and heavy swelling (swelling with infraorbital involvement) in 6 patients

**Table 2. IMMEDIATE POSTOPERATIVE COMPLICATIONS OF 50 PATIENTS**

Immediate Postoperative Complications	No. of Patients	%
Postoperative facial swelling	50	100
Mild (fullness sensation only)	16	
Moderate (swelling without infraorbital involvement)	28	
Heavy (swelling with infraorbital involvement)	6	
Fever (>38.0°C)	14	28
Rhinorrhea and postnasal dripping	50	100
Nasal obstruction	0	0
Hemorrhage	0	0

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(12%). The swelling usually decreased starting on the third day after surgery and resolved within 1 week. Mild temperature elevation (38.0°C-38.5°C) was noted in 14 patients (28%) on the second day after surgery, 11 of whom had moderate or heavy facial swelling. All patients had some degree of rhinorrhea with postnasal dripping after the operation, but it usually resolved within 4 weeks. No patient complained about nasal obstruction. Mild epistaxis was not uncommon after removal of the intrasinus packing on postoperative day 5, but no patient had significant epistaxis that required repacking.

Two patients—who had the modified Caldwell-Luc operation because of odontogenic cyst and oroantral fistula, respectively—had persistent oroantral fistulae for more than 3 months after surgery, and they were treated successfully by a second operation with the same procedure. In 1 patient who underwent the modified Caldwell-Luc operation for oroantral fistula, acute sinusitis developed at 2.5 months after surgery, and functional endoscopic sinus surgery was performed for treatment. Of the 50 patients, 25 were followed up at 6 months postoperatively, 5 of whom had tenderness to palpation at the infraorbital region. No other major long-term complications were observed.

## Discussion

The Caldwell-Luc operation is a well-established procedure. Until the development of antibiotics and endoscopic sinus surgery, this operation was a fundamental surgical technique for treating inflammatory paranasal sinus disease. Endoscopic sinus surgery has largely replaced the Caldwell-Luc procedure because endoscopic surgery has proven safe and effective in the treatment of chronic sinusitis. Despite the success of the endoscopic technique, there are still several well-documented indications for the Caldwell-Luc operation because the procedure provides good access to the sinus, perisinus, and pterygomaxillary fossa. Current indications include intrasinus cysts and tumors, intrasinus foreign bodies, oroantral fistulae, maxillary osteonecrosis, epistaxis control, sinusitis with irreversible mucosal change, mycotic fungal balls, and facial trauma.<sup>1,3,5,12</sup>

Odontogenic maxillary sinusitis is etiologically distinct from the rhinogenic sinusitis and should be managed differently. It usually occurs when the normal ciliary function of the schneiderian membrane is disrupted by conditions such as odontogenic infections or odontogenic pathology or by iatrogenic factors such as tooth extraction. The treatment requires concomitant management of the sinus infection and the odontogenic focus. A combination of medical and surgical intervention is usually required.<sup>4,13,14</sup>

In the standard Caldwell-Luc operation, inferior meatal antrostomy is usually performed to promote postoperative drainage of bloody discharge or sloughs through gravity.<sup>8,12,15</sup> However, there is controversy about the necessity of inferior meatal antrostomy for the Caldwell-Luc operation.

In 1941 Hilding<sup>16</sup> performed a series of experiments in rabbits, creating antral windows at different sites of the sinuses. The study showed that the maxillary sinus in rabbits could not tolerate operative procedures at or near the natural ostium; however, they were tolerated fairly well if made at a distance from the natural ostium. As a result of this work, the concept of avoiding surgery on the natural ostium was firmly established and inferior meatal antrostomy became largely accepted.<sup>6</sup> However, later studies showed that the primary mucociliary flow pattern originated from the sinus floor and remained toward the natural ostium despite the inferior meatal antrostomy or Caldwell Luc procedure. The nasal antral window did not cause redirection of the mucociliary clearance pattern.<sup>11,17</sup> In addition, there was a high incidence of stenosis or complete closure of the small inferior meatal antrostomies. The patency rates of inferior meatal antrostomies were about 70%, whereas those of middle meatal antrostomies were greater than 90%.<sup>6,15,17,18</sup> The Caldwell-Luc operation does not preserve the integrity of the natural mucociliary pathway, and the regenerated sinus mucosa often lacks an adequate mucociliary function.<sup>11,12</sup> These factors pose a disadvantage because the creation of an inferior meatal nasoantral window may not provide a physiologic drainage pathway. Other reported flaws of the inferior meatal antrostomy include additional operation time and wound, risk of nasolacrimal duct injury, and possible epistaxis from the sphenopalatine artery.<sup>6</sup>

Reported complications of the standard Caldwell-Luc operation included facial swelling (90%), cheek discomfort (33%), fever (12%), hemorrhage, facial asymmetry, facial paresthesia, oroantral fistula, dacryocystitis, devitalized teeth, recurrent polyps, and recurrent sinusitis.<sup>5</sup> To treat the odontogenic sinusitis and odontogenic pathology, we performed a modified Caldwell-Luc operation to remove the odontogenic focus and diseased sinus mucosa. In our modified Caldwell-Luc operation, the inferior meatal antrostomy was not carried out because the pathophysiology of the odontogenic sinusitis was different from the rhinogenic sinusitis. For prevention of immediate postoperative bleeding and facial edema, the sinus cavity was packed with iodoform gauze impregnated with bacitracin-neomycin ointment, which was removed on the fifth day after surgery. In our cases no patient had immediate postoperative bleeding that required reopening. Only 6 patients (12%) had heavy facial swelling in

the infraorbital region, and the swelling usually resolved within 1 week. The antral packing was removed through the intraoral route, and this method decreased the postoperative complaint of nasal obstruction and risk of nasolacrimal duct injury. No serious long-term complications were encountered, except for 2 postoperative oroantral fistulae, which could be revised by a repeat modified Caldwell-Luc operation.

For patients who had a history of the Caldwell-Luc operation and presented with maxillary sinusitis, both endoscopic revision maxillary antrostomy and a repeat Caldwell-Luc operation could be used, and the outcomes would be comparable.<sup>19</sup> Although endoscopic sinus surgery can be applied to many cases of post-Caldwell-Luc sinus diseases, there are still some cases that cannot be approached through a strictly endoscopic approach, such as oroantral fistula or odontogenic neoplasm. We suggest that for post-Caldwell-Luc rhinogenic sinusitis, both endoscopic management and the Caldwell-Luc approach can be applied. However, for post-Caldwell-Luc odontogenic sinusitis, the Caldwell-Luc operation is favored.

The Caldwell-Luc operation is safe and effective if one can manipulate the sinus wall gently and carefully. The etiology of odontogenic sinusitis is different from that of rhinogenic sinusitis. In cases of odontogenic sinusitis or odontogenic sinus pathology, the Caldwell-Luc operation is still the surgical approach of choice. The modified Caldwell-Luc operation could provide easier postoperative care and fewer complications; therefore we suggest that it is not necessary to create the inferior meatal antrostomy in the Caldwell-Luc operation for odontogenic sinus disease.

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