

Modifications of the Caldwell-Luc procedure for the prevention of post-operative sensitivity disorders

E. FEREKIDIS, M.D., PH.D., P. TZOUNAKOS, M.D., D. KANDILOROS, M.D., PH.D.,
A. KABEROS, M.D., PH.D., G. ADAMOPOULOS, M.D., PH.D.

Abstract

The effectiveness of some modifications of the Caldwell-Luc standard procedure in the prevention of post-operative mid-facial sensitivity disorders was investigated in a prospective comparative study at the ENT Department, Faculty of Medicine, University of Athens, Greece, from 1986–1992. Sixty-nine maxillary sinuses were operated on in 61 patients suffering from benign pathological conditions. The modifications concerned the type of mucoperiosteal incision and the site and size of the created anterior antrostomy. Only 8.7 per cent of the sinuses operated on by the modified technique presented with post-operative disorders whereas among those operated on by the classical technique, the ratio climbed to 33 per cent. In view of the findings of this study, the modifications applied can be valuable in treating non-extensive maxillary sinus disease with minimal post-operative sensitivity disorders.

Key words: Maxillary sinus, surgery; Post-operative complications, prevention and control

Introduction

The transbuccal radical antrostomy, better known as the Caldwell-Luc (CL) procedure, has been extensively employed in maxillary sinus surgery for approximately 100 years (Macbeth, 1968; Yarrington, 1984; De Freitas and Lucente, 1988). The technique has been safe and effective mainly for the treatment of benign diseases. In the past decades however, it has been criticized due to increasing post-operative complications (Macbeth, 1968; Pfeifer and Schmitz, 1973; Hüttenbrink and Clemens, 1986; Stefansson *et al.*, 1988).

In order to overcome some of these complications, especially mid-facial sensitivity disorders, various modifications of the operative technique were introduced (Lindorf, 1974; Feldmann, 1978; Brusis, 1979; Yarrington, 1984). This prospective comparative study was conducted at the ENT Department, Faculty of Medicine, University of Athens, to further investigate the beneficial effects reported by Brusis (1979).

Materials and methods

Between July 1986 and July 1992, 83 maxillary sinuses were subjected to the Caldwell-Luc (CL) procedure with, or without, modifications. Of 73 patients, 48 were male, with an average age of 40.5 years ranging between 28 and 63 years, and 25 female, with an average age of 37.8 years ranging between 26 and 50 years. Ten of these patients,

seven males and three females, were operated bilaterally. The one side was operated according to the classical CL procedure and the other one using our modified technique, based on that of Brusis. The operations were performed consecutively. Of the remaining 63 sinuses in the unilateral disease, 42 were subjected to the classical technique and 21 to the modified technique. All operations were performed under general anaesthesia. Selected patients suffered from the three most common pathological conditions, namely chronic sinusitis with, or without, polyps and antral choanal polyp which represent the vast majority of the benign maxillary sinus diseases.

In contrast to the established CL-technique (Group A), the following modifications were applied (group B):

1. Instead of the classical horizontal gingivolabial mucoperiosteal incision from the canine tooth to the first molar, a vertical incision about 1–2 cm long was made laterally above the canine tooth and before the first premolar.
2. The extensive nephroid opening in the anterior wall of the sinus was replaced by a considerably smaller, posteriorly situated antral window in an area of poor nerve distribution and thin bony coverage. The window was formed using a hammer and chisel and then a nibbling forceps lateral to a line joining together the exit point of the infraorbital nerve (foramen infraorbitalis) and the canine tooth, under the foramen infraorbitalis.

From the Department of Otolaryngology, Faculty of Medicine, University of Athens, Greece.
Accepted for publication: 16 December 1995.

TABLE I

INDICATIONS AND OPERATIVE PROCEDURE IN 69 OPERATED SINUSES FOLLOWED-UP 12–15 MONTHS AFTER THE OPERATION. GROUP A: CLASSICAL CL TECHNIQUE; GROUP B: CL MODIFIED WITH SMALL ANTERIOR ANTRAL WINDOW; GROUP C: CL MODIFIED WITH EXTENDED ANTERIOR ANTRAL WINDOW

Indication	No. of sinuses	Operative procedure		
		Group A	Group B	Group C
Chronic sinusitis	42	26	12	4
Chronic sinusitis with polyps	22	12	7	3
Antral choanal polyp	5	1	4	0
Total	69	39	23	7

The lower margin was kept sufficiently above the alveolar ridge so as not to harm the arch-like connections of the posterior, middle and anterior alveolar nerves. The diameter of this concentric opening compressed at four sides was approximately one and a half centimetres.

In 10 sinuses out of the 31 operated on using these modifications, we had to widen the anterior window due to extensive sinus pathology. A third group was therefore formed, in addition to those initially planned (group C).

The patients were offered a single follow-up between 12 and 15 months after the operation. It consisted of a routine clinical examination including the detection of teeth-sensitivity and a detailed questionnaire to determine either mild or severe sensitivity disorders. This time interval was based on a clinical observation by Pfeifer and Schmitz (1973) according to which no substantial change in possible post-operative disorders could be expected one year after the operation.

Results

Of the 73 operated patients, 12 did not come in for the follow-up appointment. Table I contains the three groups of the 69 operated sinuses in 61 patients, who were followed-up after the operation. Eight of these patients were subjected to a bilateral operation.

In answering the questionnaire, the patients expressed one or, more often, a combination of symptoms in the operated side. In the bilateral cases, special effort was made to accurately determine to which side the complaint referred. As some of our patients were operated bilaterally, using one or the other technique, the numbers in the statistics refer to sinuses rather than patients. According to the answers in the questionnaire, 13 out of 39 (33 per cent) of the operated sides in group A involved some

kind of complaint either mild or severe; two out of 23 (8.7 per cent) in group B and two out of seven (28.5 per cent) in group C (Table II). A further analysis of the reported answers revealed that in the modified operation group (B), no severe disorders present in any of the cases; feeling of pressure and/or cheek discomfort resulting from or irrespective of weather changes were the most common complaints in this group. More severe complications such as neuralgiform mid-facial pain and teeth devitalization were not found. In group C the most common reported complaints were pressure feeling and/or cheek discomfort with or without weather change in 28.5 per cent of the cases. In this group the absence of severe complications was also striking. In the group that underwent the standard procedure (A), the most common complaints were: numbness of the upper lip, teeth or gum (33 per cent), pressure feeling and/or cheek discomfort with or without regard to weather changes (25.6 per cent and 28.2 per cent respectively). Severe complications such as neuralgiform facial pain and devitalized teeth were present in 12.8 per cent and 5.1 per cent of the cases respectively (Table II).

Discussion

In the present study, a modified technique first carried out by Brusis (1979) was tested comparing a group of patients subjected to the classical procedure (group A), with a second group operated using the reported modifications (group B). In addition to those two groups, in the course of the investigation, a third group was created (group C) to include operations with a vertical mucoperiosteal incision and an extension of the initially planned small anterior window.

The incidence of numbness of the upper lip, teeth or gum approximated or reached zero in groups B and C in contrast to the 33 per cent in group A.

TABLE II

POSTOPERATIVE SENSITIVITY DISORDERS IN GROUPS A, B, C, REPORTED 12–15 MONTHS AFTER THE OPERATION

Type of disorder	Group A			Group B			Group C		
	Mild	Severe	Incidence	Mild	Severe	Incidence	Mild	Severe	Incidence
Numbness of upper lip, teeth or gum	10	3	33.0%	1	0	4.3%	0	0	0.0%
Facial hypo- and/or paraesthesia	6	1	17.9%	1	0	4.3%	1	0	14.2%
Neuralgiform mid-facial pain	3	2	12.8%	0	0	0.0%	0	0	0.0%
Pressure feeling and/or cheek discomfort	9	2	28.2%	2	0	8.7%	1	1	28.5%
Cheek discomfort with weather change	9	1	25.6%	2	0	8.7%	2	0	28.5%
Devitalized teeth	0	2	5.1%	0	0	0.0%	0	0	0.0%

TABLE III
COMPARISON OF INCIDENCE (%) OF POSTOPERATIVE SENSITIVITY DISORDERS IN GROUPS B AND C WITH CORRESPONDING RESULTS FROM OTHER STUDIES IN WHICH A MODIFIED TECHNIQUE WAS ALSO EMPLOYED

Type of disorder	Group B	Group C	Lindorf (1981)	Yarington (1984)	Hüttenbrink and Clemens (1986) (Feldmann's method)
Numbness of upper lip, teeth or gum	4.3%	0%	} 3%	} 0.36%	} 23.3%
Facial hypo- and/or paraesthesia	4.3%	14.2%			
Neuralgiform mid-facial pain	0%	0%	0%	0%	11.2%
Pressure feeling and/or cheek discomfort	8.6%	28.5%	7.1%	0%	16.8%
Cheek discomfort with weather change	8.6%	28.5%	0%	0%	2.8%
Devascularized teeth	0%	0%	1.4%	0.73%	25%

Facial hypoesthesia and/or paraesthesia dropped to 4.3 per cent in group B and to 14.2 per cent in group C, whereas it was as high as 17.9 per cent in group A (Table II). The near-elimination of numbness and hypoesthesia or paraesthesia of the midface in the groups with the modifications is attributed to the fact that the branches of the infraorbital nerve distributed over the mucosa of the canine fossa area and the accompanying vessels run along a vertical course and can only be preserved by performing the gingivolabial incision in the same direction (Brusis, 1979). Lindorf (1981), using his own osteoplastic method, reported a considerable reduction of post-operative sensitivity disorders to only three per cent of 70 operated sinuses. Hüttenbrink and Clemens (1986) using Feldmann's osteoplastic method (Feldmann, 1978) succeeded in decreasing the occurrence of these disorders to 23.3 per cent (Table III).

The occurrence of the disorders including teeth devitalization, depends also on the extent of the resection of the anterior sinus wall and the subsequent damage to the alveolar nerves (Brusis, 1979; Hüttenbrink and Clemens, 1986). Thus the minimal disorders in groups B and C resulted from the effort to avoid traumatizing the superior dental plexus during the creation, and the subsequent extension, of the anterior antral window. This in combination with the selective removal of the antral mucosa seems to be the reason why no devitalized teeth were detected in these groups. In contrast, the corresponding incidence in group A (classical operation) was 5.1 per cent, whereas Hüttenbrink and Clemens (1986) reported teeth denervation in 25 per cent of the cases. Yarington (1984) employed modifications similar to those presented here and was able to detect a near-elimination of post-operative complications. In the description of his method however no details were given concerning the size and the exact site of the created anterior antral window.

The absence of neuralgiform mid-facial pain in the groups with the modifications (B,C) in view of the corresponding results in the group with the standard operation agrees with the data from other authors (Lindorf, 1981; Yarington, 1984) and is to be attributed to the fact that the technique used was oligotraumatic. Also the created window was always kept within the area of the anterior antral wall which had a poor nerve supply. If the upper limit of the anterior antrum opening closely reaches the infra-orbital foramen, the scarring process can cause strangulation and stretching of the infraorbital nerve toward the open sinus cavity thus resulting in

neuralgia-like pain (Brusis, 1979; Lindorf, 1981; Hüttenbrink and Clemens, 1986; Stefansson *et al.*, 1988).

A feeling of pressure and/or cheek discomfort with or without regard to weather changes could not be avoided in group C. The incidence of these symptoms decreased in group B, in view of the corresponding results in group A (Table II), and approximated when summated the results obtained by Hüttenbrink and Clemens (1986). Lindorf (1981) detected a feeling of pressure and/or cheek discomfort in 7.1 per cent of the operated sides and Yarington (1984) reported the absence of such complaints (Table III). The inevitable extension of the small window in group C, carried out in consideration of the anatomical conditions, seems to be responsible only for a stretching of the soft tissue of the cheek without causing strangulation of the infraorbital nerve. On the other hand, the scarring following a more or less radical removal of the antral mucosa shrinks concentrically and draws the marginal bony wall of the created big anterior window and the adjoining soft tissues of the cheek toward the antrum cavity. This probably explains the cheek discomfort or the mid-facial pressure feeling especially with weather changes (Brusis, 1979; Lindorf, 1981; Hüttenbrink and Clemens, 1986).

Conclusions

Despite the current widespread use of new, revolutionary endonasal techniques in paranasal sinus surgery, the Caldwell-Luc procedure with its long-term evaluation remains almost universally the method of choice in certain pathological conditions. It has become apparent in the course of the present study that this procedure should not be viewed as a static approach, but as a flexible technique subject to modifications based on a close investigation of the surgical anatomy of the area and a comparative overview of the abundant international literature. The modifications discussed above can be valuable in treating maxillary sinus disease, especially that of limited extent, with minimal post-operative sensitivity disorders.

References

- Brusis, T. (1979) Wie können neuralgische Beschwerden nach Kieferhöhlen-operationen vermieden werden? *Laryngologie Rhinologie* **58**: 54-65.
- De Freitas, J., Lucente, F. E. (1988) The Caldwell-Luc procedure: Institutional review of 670 cases: 1975-1985. *Laryngoscope* **98**: 1297-1300.

- Feldmann, H. (1978) Osteoplastische Kieferhöhlenoperation. *Laryngologie Rhinologie* **57**: 373–378.
- Hüttenbrink, K. B., Clemens, S. (1986) Spätfolgen der Caldwell-Luc Operation: Vergleich zwischen klassischer und osteoplastischer Technik nach Feldmann. *Laryngologie Rhinologie Otologie* **65**: 69–73.
- Lindorf, H. H. (1974) Knochendeckelverschluß nach oraler Kieferhöhleneröffnung. *Deutsche zahnärztliche Zeitschrift* **29**: 587–590.
- Lindorf, H. H. (1981) Nachuntersuchungen osteoplastischer Kieferhöhlenoperationen (Knochenschleimhautdeckel-Methode). *Deutsche zahnärztliche Zeitschrift* **36**: 829–835.
- Macbeth, R. (1968) Caldwell-Luc operation 1952–1966. *Archives of Otolaryngology* **87**: 630–636.
- Pfeifer, G., Schmitz, R. (1973) Über Schmerzen in Oberkiefer nach Kieferhöhlenoperationen. *Deutsche zahnärztliche Zeitschrift* **28**: 989.
- Stefansson, P., Andreasson, L., Jannert, M. (1988) Caldwell-Luc operation: Long-term results and sequelae. *Acta Otolaryngologica (Suppl) (Stockholm)* **449**: 97–100.
- Yarington, C. T. (1984) The Caldwell-Luc revisited. *Annals of Otolaryngology and Laryngology* **93**: 380–384.

Address for correspondence:

Dr A. Kaberos,
Arifronos 6,
Kypseli 11364,
Athens,
Greece.