Rhinology

Video endoscopic oro-nasal visualisation of the anterior wall of maxillary sinus: a new technique

Visualizzazione endoscopica oro-nasale della parete anteriore del seno mascellare: una nuova tecnica

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SUMMARY

The anterior wall of the maxillary sinus represents a blind spot in maxillary sinus endoscopic surgery because of the absence of proper visualisation and instrumentation to reach it. The aim of this study was to validate a new approach through the oral cavity into the nose with a flexible video endoscope (oro-nasal endoscopic approach; ONEA) to visualise the entire anterior maxillary wall including the antero-medial angle. We started from a dried bone cadaver model, and then dissected fresh-frozen cadavers. The maxillary sinus was explored with a rigid and a flexible endoscope entering from the nose. Next, a flexible endoscope was introduced through the mouth and back up through the choana, it accessed the maxillary middle antrostomy, entering inside the sinus and looking at the anterior wall. A small ruler inserted inside the sinus demonstrated all the angles visualised. The new ONEA technique allows complete visualisation of the anterior wall of the maxillary sinus with inspection of all blind spots. It is therefore possible to detect lesions that would normally not be visible with a normal rigid endoscope. We demonstrate the validity of a novel technique that allows visualisation of the infero-medial angle of the anterior wall of the maxillary sinus.

KEY WORDS: Cadaver dissection • Maxillary sinus • Oro-nasal endoscopic approach (ONEA) • Endoscopic surgery • Endoscopy

RIASSUNTO

La parete anteriore del seno mascellare rappresenta un punto cieco nella chirurgia endoscopica del seno mascellare a causa dell'impossibilità di visualizzarla correttamente e della strumentazione adatta a raggiungerla. L'obiettivo del presente studio è stato di convalidare un nuovo approccio attraverso il cavo orale fino nel naso con un video-endoscopio flessibile (approccio oro-nasale endoscopico - ONEA) per visualizzare la parete anteriore del mascellare nella sua interezza, includendo l'angolo antero-mediale. Abbiamo iniziato la nostra indagine su un modello scheletrico e poi su cadavere. Il seno mascellare è stato esplorato con endoscopi rigidi e flessibili entrando dal naso. Poi un endoscopio flessibile è stato introdotto dal cavo orale e attraverso la coana, accendendo alla antrostomia media del mascellare, entrando nel seno ed esaminando la parete anteriore. Un piccolo righello inserito nel seno ha mostrato tutti gli angoli visualizzati. La nuova tecnica ONEA permette la completa visualizzazione della parete anteriore del seno mascellare ispezionando tutti i punti ciechi. È possibile pertanto visualizzare lesioni che non sarebbero altrimenti visibili con un endoscopio rigido normale. Abbiamo quindi dimostrato la validità di una nuova tecnica che permette la visualizzazione dell'angolo infero-mediale della parete anteriore del seno mascellare.

PAROLE CHIAVE: *Dissezione su cadavere • Seno mascellare • Approccio endoscopico oro-nasale (ONEA) • Chirurgia endoscopica • Endoscopia*

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Introduction

The anterior wall of the maxillary sinus is a blind spot in functional endoscopic sinus surgery. The absence of wide visualization and correct instrumentation makes exploration of this area problematic and surgery is difficult to perform. Many benign and malignant pathologies involve the anterior wall of the maxillary sinus, which still remains hidden to the endoscopic surgeon. The sinus can be approached endoscopically with a Sturmann-Canfield procedure (or endonasal Denker operation) [1], or through canine fossa puncture. If canine fossa puncture fails to provide adequate access to the maxillary sinus anterior wall or is inadequate, it could be useful to create a septal door through which it is possible to guide the instruments and completely access the entire anterior sinus wall. [2].

The aim of the present study was to test a new approach to the nose using an alternative route of access through the oral cavity with a flexible video-endoscope (oro-nasal endoscopic approach; ONEA) to visualize the entire anterior maxillary wall, including its antero-medial portion of the sinus.

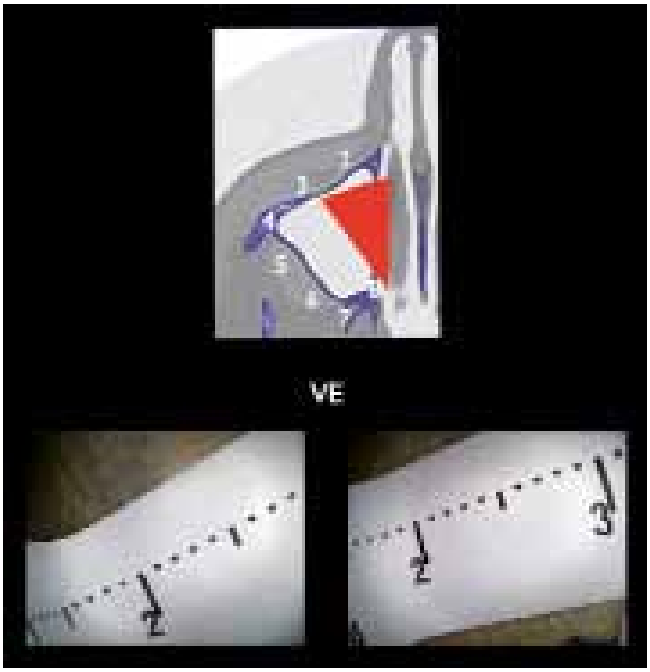

Fig. 2. Improved visualisation of the maxillary sinus lateral wall by introducing the video endoscope (VE) through the mouth.

Materials and methods

We used a dried bone cadaver model and 3 thawed, fresh-frozen cadaver heads. Endoscopic instrumentation (0°-30°-45°-70°-120° rigid scopes and flexible video-endoscope) was used in the present study. A dried bone cadaver skull model was studied before proceeding to dissection. The skull was cut superiorly in an axial plane passing through the frontal sinus and inferiorly through the palatine bone. The possibility to explore the maxillary sinus at all angles was demonstrated by introducing a paper ruler inside the sinus, surveying the walls first with different angled rigid scopes (0°, 30°, 45°, 70°, 120°) (Fig. 1), and then with a flexible video endoscope introduced first through the nose and then through the mouth to reach the nose in a retrograde fashion (Fig. 2) (ONEA technique).

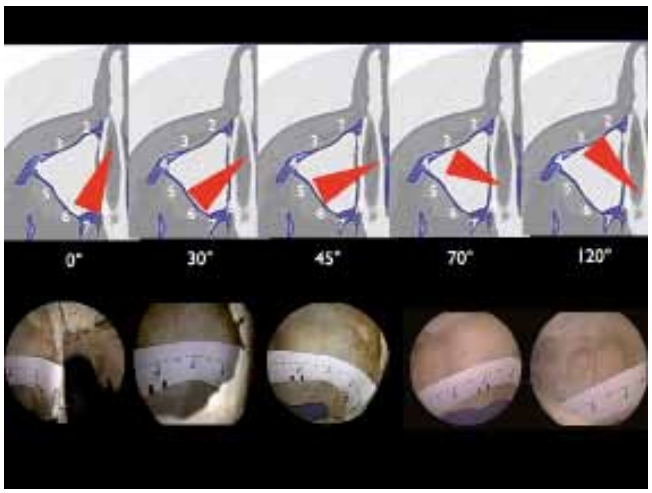

Fig. 1. Consecutive axial CT scan and endonasal view of the right maxillary sinus wall (on which the paper ruler is located) surveyed with different angled rigid scopes (0°, 30°, 45°, 70°, 120°).

Before initiating dissection on the three thawed fresh-frozen cadaver heads, the specimens were placed in the same surgical position. Either a 0° or a 30° nasal rigid endoscope was utilised to obtain an excellent view of the maxillary sinus through the nose. On the other hand, a flexible video endoscope was introduced both through the nose and through the mouth using a tongue depressor to ease the passage to the rhinopharynx. The latter instrument was used to explore the maxillary sinus both through the nose and the mouth.

The cadaveric specimens were then dissected in a staged manner. Stage I dissection included partial uncinectomy without widening of the ostium and anterior ethmoidectomy. Stage II dissection included maxillary ostium enlargement to the widest possible maxillary antrostomy and insertion of flexible video-endoscope through the mouth walking back up to the choana. The scope reached the maxillary middle antrostomy, entering inside the sinus and looking at the anterior wall (Fig. 3a).

A paper ruler was put inside the maxillary sinus and pressed against the perimeter walls. The first view was made with a 0° rigid scope, and only a few angles of the postero-lateral wall were visible. The same was done with 30°, 45°, 70° and 120° rigid scopes, consecutively, in order to obtain a more obtuse angle of inspection proceeding as far lateral as possible (Fig. 1).

Next, a flexible video-endoscope was introduced through the nose. The video endoscope was finally introduced

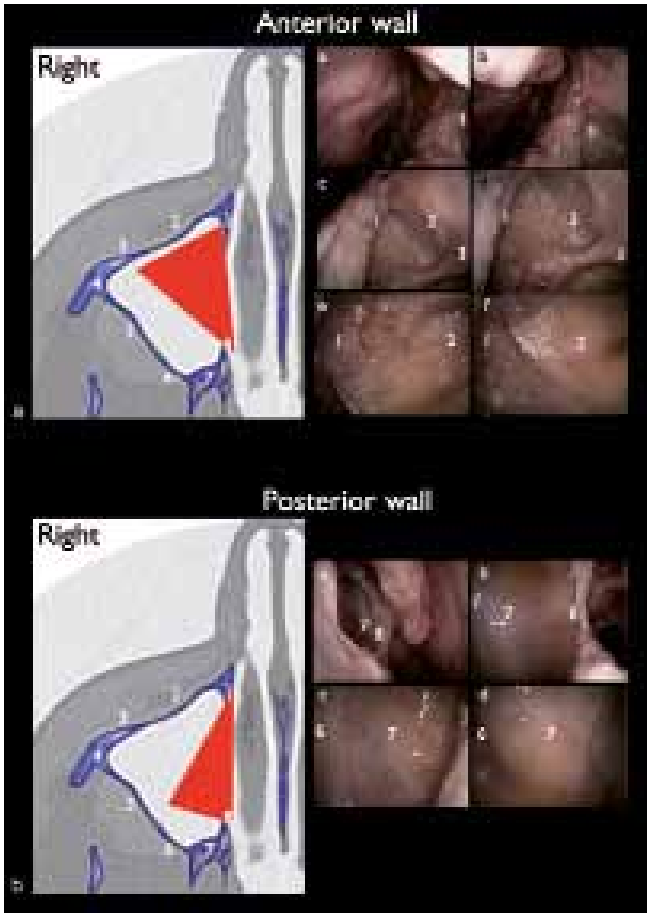

Fig. 3. a: Maxillary sinus anterior wall explored by a flexible video-endoscope introduced through the mouth. In the correlated CT scan, the red triangle base shows the visualisation capacity of the instrument on the schematised numbers. b: Posterior wall of the right maxillary sinus explored with a flexible video-endoscope introduced through the nose and respective CT scan scheme.

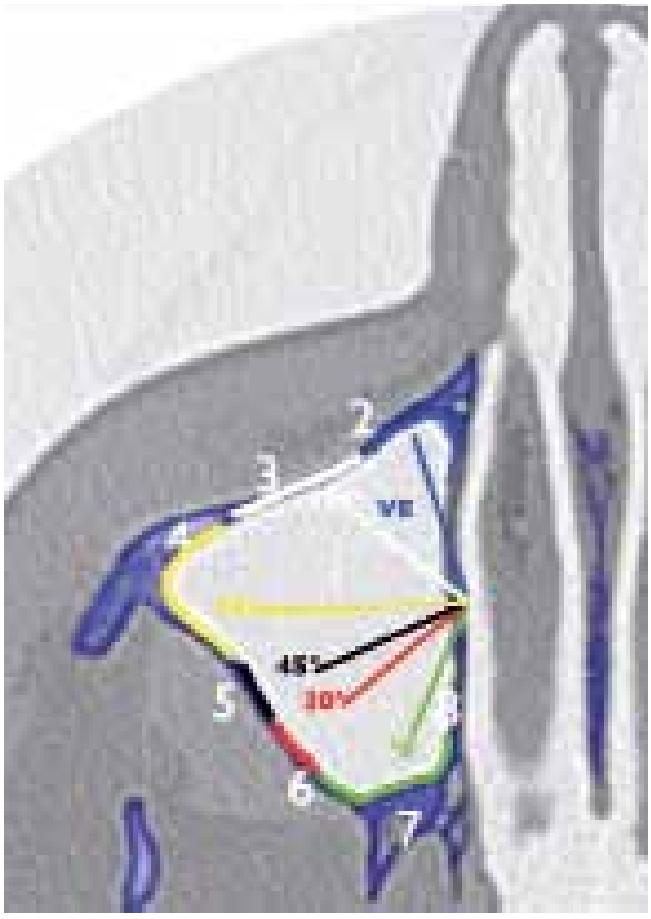

Fig. 4. Axial CT scan scheme of the right maxillary sinus. Numbers on the perimeter reflect the numbered paper ruler inserted in the cadaver. Each number is visualised by a different angled scope (rigid and flexible).

through the mouth, running through the choana and reaching the sinus from the posterior side of the nasal cavity to correctly visualize the anterior wall of the maxillary sinus (Fig. 3a).

Results

The new ONEA technique allows complete visualisation of the anterior wall of the maxillary sinus with broad inspection of the entire blind spot. This was demonstrated through a simple model. A paper ruler pushed into maxillary sinus walls showed effective evaluation of consecutive inspection of the sinus wall. As shown in Figure 1, it was progressively possible to view the entire length of the ruler using a more angled scope introduced through the nose. The cadaver model was correlated to a CT image that directly demonstrated this possibility (Fig. 4). The axial section is marked with the stylised illustrated ruler on maxillary sinus perimeter. Each number is associated to a different angled scope (rigid and flexible).

A 0° rigid scope allowed visualisation of the numbers 6, 7, and 8 on the paper ruler, the 30° scope up to number 5, the 45° scope up to number 4.1, the 70° scope up to number 3.8 and the 120° scope of numbers greater than 2.5 (Fig. 1). The visualisation of the lateral wall of the maxillary sinus can also be improved if the scope is advanced alongside the nasal septum. By introducing the video endoscope through the mouth, it is also possible to see the numbers 1 and 2 (Fig. 2).

A flexible video-endoscope introduced through the mouth allows exploration of the anterior wall (Fig. 3a). The posterior wall of the maxillary sinus could be explored as well with a flexible video-endoscope introduced through the nose, running along maxillary sinus medial wall (Fig. 3b).

Discussion

The cadaver model was the first step of the present ONEA study, and practical demonstration of the technique was shown using a fresh cadaver specimens. ONEA is an alternative technique for visualisation of the maxillary sinus anterior wall and inferior medial recesses, and provides the basis for diagnoses. Also, our aim was to use correct

instrumentation to reach all areas of the maxillary sinus anterior wall. The next step will be to design specially angled curettes and malleable forceps that can resect tumours or obtain a biopsy if recurrence is suspected. The anterior wall of the maxillary sinus is a blind spot in endoscopic surgery, even if some authors [3] have stated that all aspects of maxillary sinus can be reached by using curved instruments and burrs with a 70° endoscope. However, this is not the common opinion [4-6].

Harvey [7] and Ramakrishnan [8] underline the difficulty in visualizing and reaching with commonly used instruments the anterolateral maxillary sinus and the infratemporal fossa. They first discussed the importance of a transseptal approach and then focalised on the use of a septal dislocation after medial maxillectomy in performing this type of endoscopic surgery.

While the literature does not debate the approach to antero-medial angle of the maxillary sinus anterior wall specifically, it reflects general difficulties by various authors in maxillary sinus endoscopic surgery.

Some investigators mention the difficulty in approaching the maxillary sinus, especially considering the prelacrimal recess or the bottom of the maxillary sinus [9]. Others have suggested a combined approach in inverted papilloma surgery, due to the trouble of following maxillary extension only by endoscopic surgery [10]. In papilloma surgery, our technique could help to visualise the anterior wall and the inferior medial angle in the course of endoscopic surgery to see whether residual tumour was overlooked with standard scopes. During follow-up, frozen sections of this area could be obtained through a working channel using flexible scopes and – if positive – revision surgery can be performed.

According to Durucu et al., an endoscopic technique is more useful in early-stage tumours involving the maxillary sinus. Otherwise, it is safer to use a combined approach in advanced cases [11]. Klimek et al. still claim that for tumours localised in the anterior-caudal and lateral parts of the maxillary sinus an open approach should be preferred (osteoplastic open rhinotomy) [12].

Our aim was to reconsider ways to visualise the anterior maxillary sinus wall and associated pathologies, which is not possible or at least difficult with traditional scopes and routes of access through the nose. Accessing the anterior wall of the maxillary sinus requires destruction of the antero-medial angle or entering the contralateral nasal fossa and using a septal door in a pure endoscopic approach.

Our technique reaches the sinus in the most conservative way by simply using the natural pathway from the mouth to the nose with standard instrumentation for viewing access and intervention. Compared with previous methods, ours is more conservative, and it is easier to reach the maxillary sinus anterior wall without resorting to medial maxillectomy.

The advantages of our technique are similar to those obtained with extended endoscopic medial maxillectomy as described by Landsberg et al. [3 13]. In comparison with a sublabial transoral approach, midfacial degloving or lateral rhinotomy, it is possible to avoid external scarring, to not touch the medial palpebral ligament and to not have oroantral fistula, which are all associated with lower morbidity and shorter hospitalisation times.

The limitations of endoscopic medial maxillectomy are the extensive involvement of maxillary sinus, especially the anterior and lateral walls, or a large pneumatised maxillary sinus with deep alveolar recess [14]. These limitations are not present using our ONEA technique. In a Denker procedure, the piriform aperture is resected and damage to the superior alveolar nerve can also occur, leading to numbness of the frontal teeth, which does not happen with the ONEA technique.

Conclusion

Herein, it was demonstrated that the infero-medial angle of the maxillary sinus anterior wall can be fully visualised with a novel technique (ONEA) in cadaver dissection.

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