European Annals of Otorhinolaryngology, Head and Neck diseases xxx (2016) xxx–xxx

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Technical note

# Optimal enlargement of the frontal sinus approach

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ARTICLE INFO

*Keywords:*
Frontal sinus
Surgery
Frontal craniotomy

ABSTRACT

After recalling the main anatomical characteristics of the frontal sinuses, the authors describe the frontal craniotomy surgical procedure and its variants. A bicoronal skin incision is performed. An inferior-based pericranial flap is created, with its limits situated away from the osteotomies. Osteotomies are performed with an oscillating saw. The inferior osteotomy is horizontal, tangentially following the supraorbital margin as far as the lateral limit of each sinus. The osteotomy is continued medially as far as the nasion, passing an average of 3 mm above the floor of the medial part of the sinuses, immediately above the frontonasal ducts. The superior osteotomy is performed in a vertical coronal plane through the summit of the sinuses. It is arc-shaped, concave downwards, joining the lateral extremities of the inferior osteotomy. The posterior wall of the sinus can be resected to perform frontal sinus cranialization, allowing access to the midline anterior cranial fossa. The posterior wall of the sinus is removed with a high-speed burr in the same way as the anterior wall. At the end of the procedure, the bone flap is sutured with nylon suture material and the pericranium is sutured over the bone flap.

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## 1. Introduction

Frontal craniotomy, isolating a bone flap in the anterior wall of the frontal sinus, has been used for a very long time exclusively as an approach to one or both frontal sinuses. This incision constitutes an excellent surgical approach to treat tumors or trauma of the frontal sinuses. It has only been since the 1950s that several authors, such as Malecki, have combined frontal craniotomy with resection of the posterior wall of the frontal sinuses, allowing an anterior and midline trans-sinus approach to the anterior cranial fossa [1]. After recalling the main anatomical characteristics of the frontal sinus, we will describe the frontal craniotomy technique and its variants.

## 2. Surgical anatomy

This paragraph recalls the main anatomical characteristics of the frontal sinuses that constitute the basis of the surgical technique.

Each frontal sinus is a cavity situated in the inferior and median part of the vertical portion of the frontal bone, between the skull surface anteriorly and the anterior cranial fossa posteriorly. The sinus cavity is composed of:

- a main, central and vertical portion situated anteriorly and superiorly to the ethmoidal labyrinth;
- a lateral and horizontal expansion, directed superiorly and posteriorly in the anterolateral portion of the roof of the orbit, corresponding to the orbital plate of the frontal bone [2].

Each frontal sinus resembles a triangular pyramid composed of:

- the anterior and posterior walls of the sinus, composed of the outer and inner tables of the frontal bone, respectively, with a mean thickness of 4 mm and 2 mm, respectively [3];
- the intersinus septum usually situated in a paramedian sagittal plane; only its superior part is deviated towards one side or the other, while the lower part is generally midline [2];
- the base or floor, comprising a very thin lateral or orbital part, constantly present above the frontal process of the maxilla, regardless of the volume of the paranasal sinus and a midline or nasal part related to the anterior ethmoidal cells [2].

The floor of the frontal sinus is continuous with the anterior cranial fossa, an average of 3.1 mm (1.8–4.5) below the nasion, 4.9 mm above the plane of the cribriform plate and 2.3 mm above the jugum sphenoidale [4] (Fig. 1). In the technique described here, the nasion

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http://dx.doi.org/10.1016/j.anorl.2016.04.008
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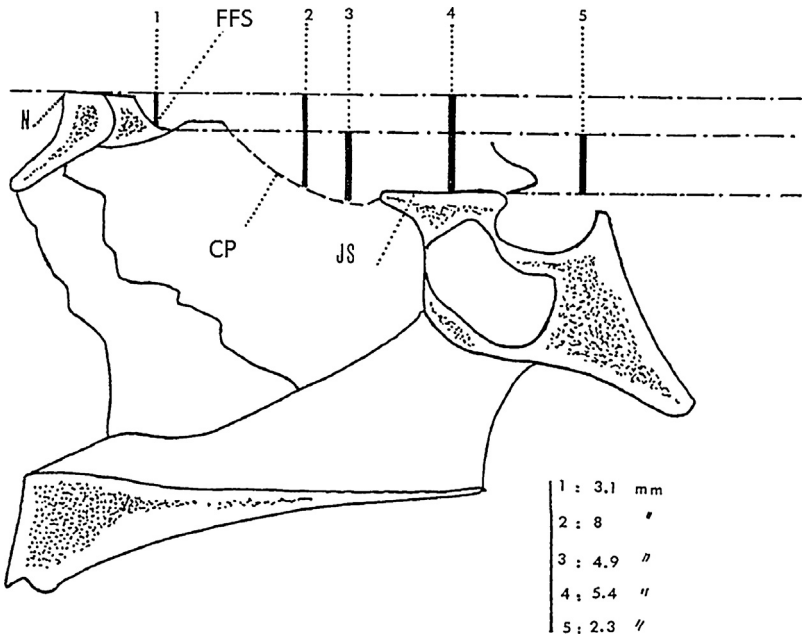


**Fig. 1.** Height of the skull base compared to the nasion and the floor of the frontal sinus. N: nasion; FFS: floor of the frontal sinus; CP: cribriform plate; JS: jugum sphenoidale. Values expressed in millimeters.

constitutes an important exocranial anatomical landmark to perform frontal craniotomy as close as possible to the anterior edge on the skull base.

According to Lang's definition, drainage of the frontal sinus towards the nasal cavities occurs either via the nasofrontal duct, when it is longer than 3 mm (77% cases), or via a frontal ostium when it is shorter than 3 mm (23% of cases) [4]. When the nasofrontal duct is present, it is oblique inferiorly and posteriorly with an angle of 116° with respect to the Frankfort plane. The frontal sinus is opened at a dependent point in the posteromedian part of the floor of the sinus, an average of 10 mm away from the recess situated on either side of the intersinus septum [2,5]. The lateral margin is situated exactly in line with the medial wall of the orbit [4].

The shape and dimensions of the frontal sinus are extremely variable. There are 3 types of frontal sinus: small, intermediate and large. Large frontal sinuses are characterized by a large extension into the temporal bone, supraorbital margins and orbital roofs. Fig. 2 shows Lang's observations concerning orbital extension of the frontal sinuses [4,6]. The frontal sinus can also extend into the nasal bones and crista galli in 23% and 10% of cases, respectively. They can protrude posteriorly and transform the grooves of the cribriform plate into a tunnel extending underneath the anterior part of the frontal lobes [4]. Unilateral or bilateral agenesis of the frontal sinuses may also be observed in 12 to 15% of Caucasian subjects, and between 2 to 52% of other subjects according to their ethnic origins [7].

## 3. Surgical technique

### 3.1. Incision

The incision consists of a Cairns–Unterberger bicoronal incision. The skin incision is arc-shaped, symmetrical, extending from one temple to the other. It is performed parallel and posteriorly to the hairline. In men, the position of the incision with respect to the

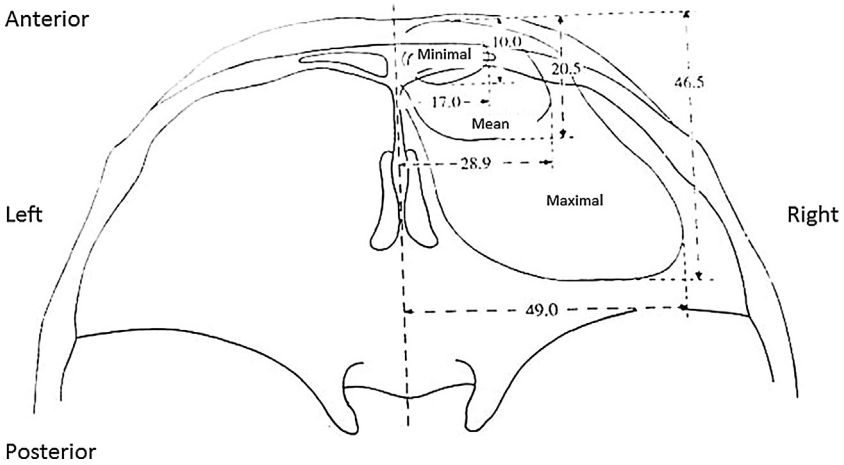


**Fig. 2.** Variations of the orbital extension of the frontal sinus. Values expressed in mm, according to Lang [4].

Please cite this article in press as: Righini CA, et al. Optimal enlargement of the frontal sinus approach. European Annals of Otorhinolaryngology, Head and Neck diseases (2016), http://dx.doi.org/10.1016/j.anorl.2016.04.008

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