FUNCTIONAL ENDOSCOPIC SINUS SURGERY
(THE MESSERKLINGER TECHNIQUE)

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ABSTRACT:
Messerklinger’s extensive investigation into the anatomy, mucociliary clearance mechanism and pathology of recurrent sinusitis has clearly demonstrated that most infections of the paranasal sinuses are of rhinogenic origin. These infections which begin inside the nose spread into the paranasal sinuses.

Messerklinger’s research clearly demonstrated that the health of the larger paranasal sinuses is completely dependent upon their pre-chambers through which they are connected to the anterior ethmoid and to the nasal cavity.

Messerklinger’s surgical concepts have revolutionized the surgical treatment of patients with recurring sinusitis by enabling the surgeon to carry out a specifically targeted minimally invasive and functional endoscopic surgical resection.

INTRODUCTION:
In the 1960’s, Professor Walter Messerklinger, the former Professor and Chairman of the Department of Otolaryngology at the University of Graz, Graz, Austria, decided to investigate the anatomy and physiology of the paranasal sinuses. Professor Messerklinger had become disappointed and disillusioned in the results of the “radical” surgical approaches to chronic sinusitis that were in vogue at that time. There radical surgical approaches such as frontal sinus obliteration, and the Caldwell–Luc approach to the maxillary sinus frequently left both the surgeon and the patient less than completely satisfied with their results.

The Beginning:
Professor Messerklinger commenced his original research by looking at the mucociliary clearance mechanism of the larger paranasal sinuses (the frontal and the maxillary sinuses). This, he originally accomplished by utilizing the fact that the cilia continue to beat for approximately 24 hours after death.

Professor Messerklinger observed the mucocilia re-clearance mechanism in the frontal and maxillary sinuses by sprinkling India Ink powder on the mucosa of the sinuses in "fresh"
cadaveric specimens and observing the pathways along which the mucociliary clearance mechanism moved these particles. The movement of the India Ink induced by the underlying mucociliary transport mechanism was documented by time-lapse photography.

Messerklinger was able to identify a relatively common pattern of mucociliary clearance in the frontal sinuses. In these sinuses the mucociliary transport mechanism moves superiorly along the intrasinus septum, laterally over the roof of the sinus, inferiorly down the lateral extension of the frontal sinus and medially along the floor of the sinus to exit primarily along the lateral margin of the frontal sinus ostium and the lateral border of the frontal recess into the nasal cavity. Messerklinger identified two areas in the frontal sinus in which part of the mucociliary stream could break-off and re-circulate once again through the frontal sinus. These were above the frontal sinus ostium back onto the intrasinus septum and below the frontal sinus ostium in the frontal recess to climb back through the frontal sinus ostium along its medial border and then pass upwards along the intrasinus septum.

In the maxillary sinuses, Messerklinger noted that mucociliary clearance mechanism originated on the floor of the maxillary sinus and medially across the roof of the sinus to congregate around the ostium of the maxillary sinus. It is of note that Messerklinger observed that accessory maxillary sinus ostia and inferior metal antrostomy windows did not participate in the evacuation of mucous from the maxillary sinus into the nasal cavity.

The Role of the Ethmoidal Pre-Chambers:

Messerklinger’s anatomical studies revealed that each of the larger paranasal sinuses was connected to the nasal cavity and anterior ethmoid by means of an ostium and a pre-chamber which connected the ostium with the nasal cavity. In the case of the frontal sinus, the pre-chamber is the frontal recess and in the case of the maxillary sinus, the pre-chamber is the infundibulum.

As Messerklinger attempted to correlate his observations in the Anatomy Department with the problems of his patients in the clinic, he came to the realization that in most patients with recurring episodes of sinusitis, that the problem was not within the larger paranasal sinuses themselves, but was instead a functional narrowing of the ethmoidal pre-chamber upon whose patency, the health of the larger paranasal sinus depended. Messerklinger observed that this functional narrowing of the ethmoidal pre-chambers could result from a variety of different causes, as will be discussed subsequently.

Endoscopic Studies:

In order to better examine the nasal cavity and the interior of the maxillary sinus in patients with recurring sinus infections, Messerklinger introduced the optical telescope as a diagnostic and research tool. While he originally used neurological telescopes, Professor Messerklinger was able to persuade Mr. Karl Storz, Instrument Maker, in Tuttlingen, West Germany, to make
special optical telescopes 4 millimetres in diameter and of a more suitable length for examining the nasal cavity and paranasal sinuses. Mr. Storz provided Professor Messerklinger with a series of telescopes having different forward viewing angles ranging from zero degrees, thirty degrees, forty-five degrees, and subsequently ninety degrees and one hundred and twenty degrees.

Messerklinger thus popularized endoscopic examination of the nasal cavity which has now become the routine technique for examining patients with nasal and paranasal sinus symptoms. The use of these optical telescopes enabled Professor Messerklinger to identify certain anatomical abnormalities affecting the lateral nasal wall, whose presence frequently caused compromise of the ethmoid pre-chambers and was thus indirectly responsible for sinus infections. These anatomical abnormalities will be discussed in greater detail subsequently.

**Tomographic Investigations:**

Professor Messerklinger pioneered the application of tomography in the investigation of patients with sinusitis. His original studies were performed using conventional tomography and subsequently fine tuned once computed tomography (CT) became available. Tomographic examination of patients with recurring sinusitis, particularly when carried out in the coronal plane, enabled Messerklinger and his colleagues to identify quite clearly other anatomical abnormalities which could compromise patency of the ethmoidal pre-chambers and enabled the identification of specific areas within the anterior ethmoid where localized blockage was responsible for obstruction of the ethmoidal pre-chambers and the subsequent development of sinusitis.

**The Messerklinger Concept of Sinusitis - The Rhinogenic Concept:**

As a result of the studies previously mentioned, Messerklinger proposed what is now known as the rhinogenic concept of sinusitis.

This concept is based upon the following principles:

1. The health of the larger paranasal sinuses (the frontal and the maxillary), is primarily dependent upon the patency and function of the ethmoidal pre-chamber (the frontal recess and infundibulum) through which these larger sinuses are connected to the nasal cavity.
2. Infections of these larger sinuses are usually rhinogenic in origin, and spread from the nose through the compartments of the anterior ethmoid to the frontal and maxillary sinuses.
3. When a sinus infection does not heal or recurs constantly, a focus of re-infection usually persists in one of the narrow clefts of the anterior ethmoid. These foci interfere with nasal function and it is from these areas of anatomical narrowing and/or infection that, the infection may spread locally to involve the pre-chambers primarily in the larger paranasal sinuses secondarily.

**Anatomical Abnormalities of the Lateral Nasal Wall:**

As a result of his endoscopic and radiologic investigations. Messerklinger was able to
identify certain anatomical variations of the lateral nasal wall whose presence could predispose a patient to recurring episodes of sinusitis. While these anatomical variations would not by themselves be considered “pathological”, they all had one feature in common, that is, they predisposed to compromise of the ethmoidal pre-chambers and increased probability of sinus infection.

Some of these abnormalities could be identified by direct visual inspection (endoscopic examination). These were an abnormally widened middle turbinate, an abnormally widened and aerated middle turbinate (a concha bullosa), a middle turbinate whose medial surface curved convexly into the middle meatus (a paradoxically bent middle turbinate), and a lateralized middle turbinate.

Other anatomical variations could only be identified by tomography. These include a medially bent uncinate process, a laterally bent uncinate process, and enlarged ethmoidal bulla. Tomographic examination of patients with recurring episodes of sinusitis also frequently revealed localized areas of edema, fibrosis, or polypoid tissue blocking the ethmoidal pre-chambers (the frontal recess and the infundibulum).

The Birth of Endoscopic Sinus Surgery:

Once Messerklinger had identified that the anterior ethmoid and its pre-chambers were primarily responsible for most cases of recurring sinusitis, he turned his attention to a surgical approach that would enable re-establishment of ventilation and drainage through the ethmoidal pre-chambers. Using the nasal endoscopes, Messerklinger developed a specific targeted endoscopic surgical approach to the anterior ethmoid.

Infundibulotomy—A New Approach to the Anterior Ethmoid:

Messerklinger invented the new and more direct approach to the anterior ethmoid. This was the infundibulotomy. In the infundibulotomy, the uncinate process is resected at its' base (insertion into the lateral nasal wall) and resected in one piece. This exposes the two key ethmoidal pre-chambers (the frontal recess and the infundibulum directly to the surgeon's eye via the endoscope.)

Functional Endoscopic Sinus Surgery—The Messerklinger Technique:

Over time, Messerklinger extended endoscopic ethmoidectomy to include when indicated, resection of the ethmoidal bulla, cleaning of the frontal recess, opening and widening of the maxillary sinus ostium, perforation of the ground lamella (the border between the posterior wall of the anterior ethmoid (bulla) and the anterior wall of the posterior ethmoidal sinus, and perforation of the posterior wall of the posterior ethmoidal sinus and entry into the sphenoid sinus.

With the functional endoscopic approach, a complete sphenoethmoidectomy could be perfor-
One of the more attractive features of the Messerklinger technique was that the operation in each patient was specifically targetted to the anatomical abnormalities and disease present in that patient. FESS is based upon an individualized specific minimally invasive surgical approach.

Messerklinger’s Concept of Endoscopic Sinus Surgery:
1. The health of the larger paranasal sinuses is dependent upon their ethmoidal pre-chambers.
2. Patients with recurring sinus infections usually have anatomical abnormalities which compromise the function of these ethmoidal pre-chambers (the frontal recess and the infundibulum).
3. An exact diagnostic exploration of each individual patient must be carried out to identify those anatomical abnormalities which are responsible for the patient’s symptoms.
4. This diagnostic exploration has two prime components, the endoscopic examination and the tomographic examination.
5. The endoscopic surgical approach shall be minimal and targetted specifically to the areas of narrowing and blockage.
6. After clearing of the disease in the clefts of the anterior ethmoid, and the re-establishment of ventilation and drainage via the normal physiologic roots, even massive changes in the larger dependent paranasal sinuses will usually heal without the latter been directly touched.
7. The narrow or stenotic areas primarily involved in chronic sinusitis are: the ethmoidal infundibulum at the entrance to the maxillary sinus and the frontal recess at the entrance to the frontal sinuses.

Conclusion:
Professor Walter Messerklinger has provided us with a clear understanding of the etiology and pathophysiology of sinusitis. His surgical technique, the Messerklinger technique, enables medical and surgical management to be tailored to the individual requirements of each and every patient. In a sense, each operation performed using the Messerklinger technique, is specifically “made to measure” for the individual patient.

Messerklinger’s guiding principle is the preservation of structure and the re-establishment of function by the removal of as little tissue as possible and the preservation of as much of the normal anatomical structures as possible. This preservation is a sine qua non for rapid healing and a strong likelihood of recovery.