TYPE OF ARTICLE: REVIEW

HISTORY OF RHINOLOGY

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ABSTRACT

***Background**: Historical progress of Rhinology is interesting. Ancient reports regarding the nose, paranasal sinuses and olfactory functions and the efforts to handle diseases of this region are found from the earliest periods.*

***Methodology:** In this review, the literature was searched from Pubmed, Proquest Central, and Google. Related information was reviewed and the historical progress of the Rhinology is presented in detail.*

***Results:** Egyptian medicals were the pioneers of nasal surgeons. They utilized instruments to take away the brain through the nasal passages, as a stage of the mummification procedure. The earliest document of a nose examination in medical literature extends as early as the sixth century before Jesus, in the Hindu record "Suchruta-samhita". Hippocrates could also be considered the "father of rhinology in terms of rhinologic practice. Celsus described the nose as "the two nasal passages separated by an intermediate bone. Galen categorized the conditions of the nose into two, namely, ozaenae and polyps. During the middle ages, there was a concerted effort by rhinologists to gain a better understanding of the nasal chambers and how they functioned. In the beginning of the twentieth century, together with the advancements in anesthetics, surgeons continued to be enthusiastic about rhinology and evolved surgical procedures to address and handle disorders in the nose and paranasal sinuses. In the midst of the XX century, the microscopes began to be put into use in nasal operations, introducing a significant success for the operative technique.*

***Conclusion:** There are a lot of doctors who have great importance to improve Rhinology to the current times. All development steps are very important to achieve modern rhinology.*

***Key words:** Rhinology, history, ancient, Egyptian medicals, Hippocrates, Celsus, Galen*

1. Introduction

Rhinology refers to the study of the nose, paranasal sinuses, and nasopharynx. The field today involves an understanding of basic science principles including physiology as it relates to the mucociliary blanket, molecular biology with respect to the inflammatory process, and microbiology as it concerns the ever-changing spectrum of organisms that may inhabit the sinus passages. Equally important are the newer surgical procedures that deal with disease in this anatomic region. The transition from open techniques to an endoscopic approach has enabled the modern physician to access vital structures in a more anatomic and functional manner[(1)].

During the second half of the nineteenth century, major progress was made in learning the anatomy and physiology of the nose and sinuses. With the beginning of the twentieth century, an outburst of technology aroused that provided notable advances in the kind and quantity of surgeries carried out. Nevertheless, the procedures of nose and sinuses contain the remarkable potential of enhancing health or seriously damaging individuals. Within the middle of the twentieth century, the general scientific understanding appeared to have caught up with the care being provided, but as the century comes to an end, we are faced with another trend of surgical practice. Possibly, in hardly any other surgical field, one can experience this much of an imbalance between the biology and surgery. Probably, the upcoming century will see an improvement regarding the balance between these measures[(2)].

Until the end of middle ages, from time to time, obscure features were attributed to the sinuses, like holding the "grease" for the motion of the eyeballs, or enabling the brain to "drain its bad spirits" to the external world, bringing about names like "la cloaca del cerebro" by Sansovino in the sixteenth century. The old French expression of "rhume de cerveau" demonstrates these ideas having passed on into modern man's vocabulary. During the seventeenth and eighteenth century, discussion was mainly about the function or purpose of the sinuses, and the rare anatomical studies were meant to support or prove one or the other’s "philosophies"[(3)].

Today's knowledge of the anatomy to a great deal goes back to the basic work of **Emil Zuckerkandl** of Austria, who starting from the 1870s, described in subtle studies the anatomical and developmental details of the nose and sinuses, opening an entire new era regarding the clinical and surgical approach to the area. The several years around the turn of the century, stand out with research on sectional and surgical anatomy, generating the

specialty of rhinology and creating today's principles of diagnosis and therapy of disorders of the nose and sinuses. Names such as **Grünwald, Onodi, Hajek** and many more are closely associated with this particular productive interval[3].

Radiology, especially the progress of conventional and computed tomography through the last 40 years assisted to "rediscover" the actual exciting details and complicated connections of the paranasal sinus system. Simultaneously the development of the operating microscope and endoscope aided to create innovative ways for functional approaches and less radical microsurgery[3].

Historical progress of Rhinology is also interesting. In this chapter, history of Rhinology is presented in detail.

2. Ancient History

Ancient reports regarding the nose, paranasal sinuses and olfactory functions and the efforts to handle diseases of this region are found from the earliest periods[4]. Egyptian medicals were the pioneers of nasal surgeons. They utilized instruments to take away the brain through the nasal passages, as a stage of the mummification procedure[3,5].

The earliest document of a nose examination in medical literature extends as early as the sixth century before Jesus, in the Hindu record "Suchruta-samhita" where they mention a tubular shaped nasal speculum, prepared from Bamboo tree, to remove the tonsils and nasal polyps[5].

The ancient Egyptian papyri clearly document the embalming process by which practitioners would extract the brain through a transnasal portal of entry[6]. Not only did this practice indicate the sophistication of the mummification process, but it also gave insight into the anatomic expertise of the ancient Egyptians. To our knowledge, the earliest named physician was the Egyptian Sekhet'enanch, who lived in approximately 350 BC. He was the attendant of Sahura, one of the pharaohs of the fifth dynasty. His legacy is engraved within the tomb of the king where it was discovered that "he healed the King's nostrils." Many other civilizations make reference to rhinology in their writings[7,8].

The Bible and the Talmud contain numerous references to a variety of ear, nose, and throat diseases. The nose is recognized as the organ for breathing as quoted in Genesis (II)[9], when the "Lord God formed man of the dust of the ground and breathed into his nostrils the breath of life." Furthermore, it is mentioned in the Babylonian Talmud that "a polyp shows itself by a bad smell of the nose." Although diagnoses are inferred in these scriptures, treatments for the conditions are not mentioned. The classic Hindu document known as the Sanskrit

Atharva-veda contained numerous bits of medical information including the diseases of the head and neck region. These writings documented the achievements of Hindu surgery. They described the manufacture of new noses by local flaps from the cheek or forehead. It is noteworthy that nasal amputation was the usual punishment for adultery during the time of that culture. It may therefore be implied that the Hindus were the originators of the modern rhinoplasty. Much of Chinese medicine was based on treatment by acupuncture including many nasal conditions[1].

2.1. Hippocrates, Celsus, and Galen

2.1.1. Hippocrates

Hippocrates was born on the island of Cos in 460 BC and founded a medical school based on the belief that illness had a physical and rational explanation. History considers him the "father of medicine." In many respects, he could also be considered the "father of rhinology. In terms of rhinologic practice, he clearly documented the treatment of nasal fractures, insisting on the necessity of fracture reduction within the first 24 to 36 hours after injury. He described the lifting of fragments of bone into place and described the use of internal splints of "Carthaginian leather" to keep the fragments in place. For severely displaced fracture, he talked about tying a long leather thong around the head and fastening it to the temples by use of glue[10]. His methods for removing nasal polyps were quite revolutionary, and the technique was practiced by rhinologists into the first millennium, as written in Voltolini's textbook in 1888[9].

Hippocrates, indeed defined management strategies to handle nose injuries. The injuries were categorized as contusions in soft tissues to complex bone injuries, suggesting specific procedures for every scenario, as the usage of bandages and braces with olive tree or reconstructions of nasal bone and cartilage. Hippocrates's texts demonstrated the concern for nose traumas, as they were frequent incidents during those times, within both the military and athletes in tournaments in the ancient Greece. These kinds of procedures were customized and determined the management strategies up till the middle ages[3,5].

To remove polyps, ***Hippocrates*** wrote about tying several strings to a sponge with the other end being fastened to a malleable probe that was pushed through the nasal passage into the nasopharynx. This sponge was then dragged across the nasal chamber and, if successful, brought the polyps with it. He described another technique for the more fibrotic polyps using the principle of the snare. He also described the use of hot irons for cauterization and advised

a local application of a caustic powder to further control hemorrhage and prevent adhesions. It is most fascinating that his rhinologic practice in principle is similar to many of the techniques that are currently in practice. The next notable personality was **Olus Cornelius Celsus**, a Roman nobleman who lived in the first century CE. He wrote an extensive series of eight books of medical encyclopedia, De Medicina, which was eventually discovered in the papal library in 1478[11].

2.1.2. Celcus

Celsus described the nose as "the two nasal passages separated by an intermediate bone. These passages break up into two branches, one for respiration and one leading to the brain through which we get our sense of smell." Celsus is most noted for his description of the cardinal signs of inflammation, rubour, tumour, calour, and dolour. He also described nasal polyps, likening them in appearance to "the nipples of a female breast." He treated polyps by using caustics but also by an operation. He described the use of a spatula-shaped instrument to mobilize the polyp from its stock and finally remove it with a type of hook. He talked about lung infections as possibly originating from the catarrh of the nasal passages (1).

2.1.3. Galen

Claudius Galenus, known as Galen, who was born in Asia Minor in 131 AD[12]. His works (13) offered a great advance in the knowledge of the anatomy of the upper respiratory tract based on precise anatomic dissection of animals. He recognized the nose as the beginning of the respiratory tract and described the muscles of the external nose as the dilators of the nostril. Galen categorized the conditions of the nose into two, namely, ozaenae and polyps. He believed that the sinuses contained fluid and mucus, which was produced by the brain and the pituitary gland and was subsequently released into the nose. Thus, he considered nasal catarrh as "a purging of the brain."[1,12].

3. The Middle Ages

During this period, there was a concerted effort by rhinologists to gain a better understanding of the nasal chambers and how they functioned. This was accomplished by meticulous anatomic dissections and astute clinical observations. Nevertheless, some myths prevailed from ancient times[1].

3.1. XV and XVI Centuries

Even though Hippocrates had indeed defined parts of the anatomy of the nose, the nasal components were actually identified in the fifteen hundreds. In 1489, Leonardo da Vinci drew the nasal turbinates as well as the nasal sinuses. Nevertheless, these paintings were truly discovered in Milan, in 1901. In 1536, **George Thomas** firstly noted the posterior insertions of the middle turbinate in his report "Anatomiae pars prior" [3,5,13].

The very first book which solely focused on the surgery methods for rhinoplasty was released in 1597 as "Treaty on Rhinoplasty". The author, **Gaspare Tagliacozzi**, was a professor at the University of Bologna and an expert in this topic. He defined new methods for rotating flaps over the nasal pyramid[3,5,13].

In 1651, **Highmore**, in England, identified the maxillary sinus, and for quite some time this sinus was referred to as the Highmore's antrum[13].

Moreover, in the Middle Ages, strange functions were ascribed to the paranasal sinuses, like keeping oils to lubricate the eyeball movements, or a drainage room for malignant spirits within the brain. The paranasal sinuses were named after such functions, for instance "la cloaca del cerebro", as reported by the Spanish physician **Sansovino**, in the sixteen hundreds[13].

The anatomy physicians of that time included **Andreas Vesalius** (1514–1564), who released his remarkable paper in De Humani Corporis Fabrica in 1543[14]. He described the maxillary, frontal, and sphenoidal sinuses, declaring that they contained nothing but air. He also named the posterior choanae.

Other anatomists of the day were ***Bartolomeus Eustachius*** (1520–1574) and ***Gabriel Fallopius*** (1523–1562), who succeeded Vesalius at Padua. It is noted that Fallopius, whose name is associated with a number of body parts, was also a significant physician in rhinology. He created a wire snare for taking out nasal polyps. He writes: "I take a silver tube which is neither too broad nor too narrow, and then a brass or steel wire, sufficiently thick, preferably the iron wire from which harpsichords are made. This doubled I place in the tube, so that from this wire a loop is made at one end of the tube by which, used in the nares, I remove the polypi"[15].

Another Latin physician, **Petras Forestus** (1522– 1597), claimed to cure ozaenae by "copious nasal douching with perfumed white wine in which were dissolved cypress, roses and myrrh." He also used silver nitrate and alum rubbed up with honey and applied with a probe[16]. On the other hand, **Fabricius** treated ozaenae with "an iron cannula inserted in the nostril, so long

that it will reach the end and equal the length of the ulceration and occupy the cavity of the nostrils. Through this a glowing hot instrument is to be introduced which, however, should not reach beyond the cannula." It is possible that the ulcerations that Fabricius referred to as ozaenae were probably manifestations of syphilis[8].

Through the Middle Ages, nasal catarrh continued to be thought of as a "purging of the brain," with mucus percolating through the bony foramina in the region of what we now call the cribriform plate. The noted **Thomas Willis (**1621–1675), whose name is associated with the circle, believed that nervous fluids were secreted by the brain and were then carried to different parts of the body by the nerves. He thought that these serous humours were being secreted into the nose through tubular structure within the mucosa[17].

A German physician, **Conrad Victor Schneider** (1614– 1680), published a classic treatise on membranes of the nose entitled **De Catarrhis** in 1660[18]. He established that the origin of the nasal secretions could not be from the cranial cavity but in fact emanated from the nasal mucous membranes themselves. This was an important revelation.

3.2. XVII and XVIII Centuries

Throughout the seventeen and eighteen centuries, the main medical debate regarding the nasal area was the function and purpose of paranasal sinuses. Numerous conditions were linked to these areas such as halitosis and acne, and the suggested procedure was total or partial middle turbinate resection. In England, **Drake and Cowper**, mentioned several patients with halitosis resulting from the suppuration of maxillary sinus in 1707. The case was treated by taking the teeth out, thus reaching the maxillary sinus through the alveolus[13]. In 1765, **Jourdain** in France, made an attempt to treat suppurations of maxillary sinuses by irrigation through the natural ostium in the middle meatus, but this was not really effective.

Although **Lamorier** started draining the maxillary sinus through the oral cavity in 1743; he did not publish his work before 1768. However his technique of draining the maxillary sinus through the tooth socket continued to be the conventional method for quite long[13,19].

3.3. XIX Century

In Berlin-1841, **Henle** microscopically differentiated various epithelia, especially reporting the function of the ciliated epithelium which was lining the nasal area and respiratory tract[13].

In Vienna, **Mikulicz-Radecki,** initially explained the opening of the maxillary sinus through the inferior meatus in 1886. Then in 1893, **Caldwell** from US, reported his technique, which

was described as entering the sinus through the canine fossa, taking the mucosal membrane out and creating a hole in the lateral wall of the inferior meatus. In Berlin, **Boenninghaus** was among the primary European surgeons to use Caldwell's technique in 1896; however, he improved it by putting a mucosal flap coating the entrance. Unaware of Caldwell's works, **Luc,** in Paris - 1897, developed his individual method, which was indeed identical to that of his American counterpart[13].

Nonetheless, present understanding of the anatomy of these structures highly depend on the studies of **Emil Zuckerkandl**, from Austria, who in 1870, defined the elements of the nose and paranasal sinuses in anatomical reports, hence starting a new field for clinical and surgical information regarding this region. The dozens of years that preceded the twentieth century enhanced the research about surgical and sectional anatomy, with scientists including **Grunwald, Hajek, Onodi** who witness the start of rhinology as a specialty, creating the cornerstone of today's principles of diagnosis and management of the diseases of nose and sinuses[13].

Rhinology demonstrated a significant push forwards as well, particularly in the concepts of diagnosis and operative methods when endoscopy was invented, attributed to **Philipp Bozzini** in 1806. **Czermak**, who initially brought up the term "rhinoscopy", and popularized the use of a nasal speculum and, later in 1879 the use of an endoscope in rhinoscopy[3,5,13,19].

Many books have been published for the purpose of medical education in the Ottoman period. Some books in the ENT field had participated in this development. The first book for the diagnosis and treatment of nasal disease, after preparation by the "**Hekimbaşızade" (Chief Physician) (Doctor Muhiddin** in 1897), was reviewed by Publication Commission of "Mekteb-i Tıbbıye-i Şahane" (Medical School). It was published in 1901 in "Mahmud Bey" Printing (Istanbul) with the consent of "Maarif Nezareti " (Ministry of Education) (Consent date: December 8, 1897, consent number: 572)[20].

3.4. XX Century

In the beginning of the twentieth century, together with the advancements in anesthetics, surgeons continued to be enthusiastic about rhinology and evolved surgical procedures to address and handle disorders in the nose and paranasal sinuses. In 1901, **Hirschmann** utilized a modified endoscope to examine the maxillary sinus. The **Brazilian Ermiro Estevam de Lima** turned to be recognized worldwide for establishing a transmaxillary approach to the ethmoidal and sphenoidal sinuses, for he designed the curette that has his name. This

particular approach in a short time was recognized internationally as "Ermiro de Lima" procedure. Furthermore, he was the founder of the Brazilian Society of Rhinology, in 1974, which had Roberto Machado Neves Pinto and Sérgio de Paula Santos as some of the initial members. In 1912[21], **Harvey Cushing** began the trans-sphenoidal approach in neurosurgery. Surgeries of the frontal and ethmoid sinuses were reported as well by **Lynch** in New Orleans, in 1921[20]. In 1926, **John Baird**, the inventor of television, patented the actual concept of transferring images via flexible glass fibers. These ideas inspired **Harold Hopkins**, who developed scopes in 1948; **Basil Hirschowitz,** carried out the first digestive endoscopy with flexible glass fibers optics and **Karl Storz**[3,13,19].

Septal surgery started with total septectomy and submucous resection by **Killian & Freer** in the beginning of twentieth century and then septoplasty by **Cottle** in middle of twentieth century. **Killian** in 1904 and **Freer** in 1905 explained submucous resection of the nasal septum. **Lothrop** in 1897 reported early closure of inferior meatal antrostomy, and Freer in 1905 recommended against radical operations and pointed out the necessity for aeration of the maxillary sinus. At the turn of the twentieth century, **Killian and Siebenmann** (1900–1910) suggested draining through the middle meatus by doing uncinectomy for the infection of the maxillary sinus[22]. Considering that nasal and sinus physiology was continuing to be learned early in the century, the majority of these earlier surgeries were not effective treating symptoms of sinusitis.

Jacque Joseph defined thoroughly reduction rhinoplasty for the nasal dorsum along with particular deformities. He especially brought up the social and psychological elements to be considered before rhinoplasty. Additionally, he developed a number of tools, which are still being used presently. He reported on surgical correction of the nose in excellent detail and founded intranasal rhinoplasty in Europe on a methodical base at the turn of the twentieth century. Also, he wrote a detailed book on rhinoplasty in 1928. Simultaneously, **John Roe** in New York continued to carry out corrective instead of reconstructive surgery and popularized intracartilagenous technique for the bulbous tip[22].

In contrast to anticipations, the 1930's - 1950's resulted in slowing in rhinology. This situation was because of antibiotics, which significantly diminished the requirement for surgical treatment of the paranasal sinuses. Furthermore, laryngology and otology progressed considerably combined with diminished attention in rhinology, which was limited to the correction of nasal septum deviations, bone injuries, treatment of nasal polyps and maxillary sinus lavage through the canine fossa[3,13].

In the midst of the century, the microscopes began to be put into use in nasal operations, introducing a significant success for the operative technique. A higher understanding concerning immunology, enabled the medical doctors distinguish and recognize allergic and non-allergic diseases. An important step regarding the progress of information on the anatomy, physiology and pathology of paranasal sinuses is attributed to professor **Walter Messerklinger** and his successor, professor **H. Stammberger**, from Austria. Their work about mucociliary activity and ventilation of the anterior ethmoidal cells in addition to the anatomy of the lateral wall of the nose and its mucociliary clearance was crucial to comprehending the drainage and ventilation mechanisms of sinuses[3,13].

Messerklinger introduced back again the endoscopes, using them for diagnostic and surgical interventions in the nasal cavity[3]. The application of newer technologies triggered a progress in endoscopic methods, specifically with the invention of the optic fiber endoscopes by **Storz** Fiberoptic Company in 1954. This kind of improvement, put onto CT scan - introduced in 1969 by **Geoffrey Hounsfield** gave the opportunity to possess a comprehensive analysis of the nose, particularly of the lateral wall and the ostium-meatal complex[3,13,19].

Reynolds and Brandow enhanced the surgery of refractory sinusitis by using antrostomies performed under endoscopic guidance. **David Kennedy, Heinz Stammberger, Wolfgang Draf** and, in Brazil, **Aldo Stamm** were primary surgeons popularizing the use of modern endoscopy in sinonasal operations. CT scan added a lot in the advancement of functional endoscopic sinus surgery as well, described by **Kennedy and Zinreich**[3,13].

Gerard Guiot was the first to make use of endoscopy for a trans-sphenoidal approach in neurosurgery. This occurred in 1970 while, including **Bushe and Halves,** they described the use of endoscopes for reaching pituitary lesions, formerly operated under microscopy; but, **Jho and Carrau** were the leaders in undertaking solely endoscopic neurosurgeries, where both entry and resection were conducted with endoscopes[3,13].

A further factor that created remarkable attraction in rhinology, was the introduction of rhinoplasties, performed by the American Academy of Reconstructive and Facial Plastic Surgery, founded in 1964, and the European Academy of Facial Surgery (Joseph Society), founded in 1977. This introduced to ENT surgeons a playing field that was previously owned merely by plastic surgeons[23]. Skull-base surgeries and neurosurgeries with endonasal approach, different techniques in the management of tumors and diseases placed within this

area built, in the same way as in otology, an alternative common ground relating to otorhinolaryngologists and neurosurgeons[23].

4. Modern History

Nasal polypi continued to be prominent lesions for discussion into the 1800s. Physicians such as Billroth in 1854 described them as adenomators in nature. In 1863, **Virchow** called them myxomata, thus describing the so-called "polysaccharide nose." The legendary Morell **Mackenzie** in 1884 seemed content to follow the lead of Virchow[8]. An important treatise on the nasal sinuses was written **by J.F.L. Deschamps** (1740–1824) of Paris in 1804 (24). He wrote about olfaction as a separate entity from the sinuses. He classified nasal polyps as "fungous and vascular, mucous and lymphatic, scirrhous and sarcomatous." He talked about a variety of treatment methods including local astringents, excision with a guarded bistoury, evulsion by forceps, the use of knotted thread, chemical caustics, and ligation with silver wire. Prototypes of the polyp snare had been developed by Hippocrates and Fallopius. The concept of the popular Jarvis snare designed in 1880 is still in use for polyp removal by many rhinologic practitioners. At the time of Deschamps, septal deviations were poorly understood, and septal surgery was nonexistent.

In 1842, **Langenbeck**[25] was the first to describe ecchondroses and exostoses of the septum as crests and spurs. What followed was the development of the submucous resection in the early 1900s. In America, **Freer**[26] described methods to ablate *and remove thickened portions of cartilage. He invented a large* number of elevators, knives, and forceps to accomplish the task.

In almost parallel fashion**, Killian**[27] elaborated and refined the techniques of septal surgery. The description by **Nathaniel Highmore** (1613– 1685), in 1651[28], of a case of oral antral fistula after dental extraction, probably led to the development of maxillary sinus surgery. A number of surgeons subsequently developed techniques to trephine the antrum of Highmore. Further perfections in the technique led to the development in the early part of the twentieth century of what we now call the Caldwell-Luc procedure. It was Caldwell of America and Luc of France who independently suggested that lesions of the antrum could be approached by making a wide opening in the canine fossa and a counter opening into the nasal cavity through the inferior meatus[29,30]. For the ethmoid and frontal sinuses, external approach surgery can be associated with the names of Lynch of New Orleans and Howarth of London,

who in 1921 described techniques to enter these sinuses without leaving unsightly scars or bony deformities[31,32].

4.1. History of Septoplasty

3500 BC: The Ebers Papyrus, containing the very first known reference to rhinologic surgery, was noted during this time period in Egypt. Many of the procedures mentioned in it were reconstructive since rhinectomy was a frequent type of punishment[33].

1757: Quelmatz was among the foremost physicians to manage septal deformities. His advice was digital pressure on the septum on a daily basis[33].

1875: Adams proposed fracturing and splinting of the septum[33].

Late 19th century: The most popular procedure in the USA was the Bosworth operation to treat nasal blockage due to nasal septal deviation. Using a customized saw, the deviation was trimmed combined with the associated mucosa. Outcomes were suboptimal[33].

1882: Ingals presented en bloc resection of smaller sections of septal cartilage. As a result of this advancement, he is ascribed as the father of modern septal surgery. Around the same period, cocaine was starting to be widely used in operations. With its advent, anesthesia and homeostasis for nasal surgery improved considerably. Lengthier and technically more enhanced procedures became possible[33].

1899: Asch was the first to recommend modifying the tensile curve of septal cartilage rather than resecting it. He suggested using full-thickness cruciate incisions[33].

1902 and 1904: Freer and Killian defined the submucous resection (SMR) operation. This procedure is the cornerstone of modern septoplasty methods. They recommended elevating mucoperichondrial flaps and resecting the cartilaginous and bony septum (which includes the vomer and perpendicular plate of the ethmoid), keeping 1 cm dorsally and 1 cm caudally to sustain support[33].

1929: Metzenbaum and Peer were the first ones to operate the caudal septum, using a number of different techniques. The traditional SMR was much less efficient in repairing this area of deviation. Moreover, Metzenbaum recommended the application of the swinging door technique, and in 1937, Peer suggested taking out the caudal septum, straightening it, and then relocating it in midline position[33].

1947: Cottle presented the hemitransfixion incision and the process of conservative septal resections. Long-term follow-up reports of individuals who were operated with the SMR technique mentioned dorsal saddling, retraction of the columella, and alar widening from time

to time; thus, conservative resections during septoplasty were planned to prevent these complications[33].

4.2. The sinus revolution

Sinus operations arise most likely from the period of the New Kingdom of ancient Egypt. Instruments had been used to take out the brain via the nasal route within the mummification procedure. The curiosity for the pathology of the maxillary sinus began gain popularity in the seventeenth century. Antral trephination for suppuration was a widespread procedure in those days. An oro-antral fistula was usually produced through the removal of a molar for the drainage of the infected maxillary sinus every day[34].

The maxillary sinus was initially accepted clinically in the sixteenth century and its function as the cause of supuration grew to be the center of interest. Efforts to drain and ventilate this readily accessible sinus started with **Nathaniel Highmore** in 1651 and proceeded throughout the twenty first century. The initial draining of the sinus was accomplished via various kinds of routes, such as the alveolar margin, anterior wall and middle and inferior meati[35]. Afterwards, the anterior wall of the maxillary sinus was exposed through the canine fossa and was maintained patent for lavage. **Caldwell** (1893), **Scanes Spicer** (1894) and then **Luc** in 1897 sealed the canine fossa incision following an intranasal antrostomy and the stripping of the infected mucosa[36].

The maxillary sinus has been the focus of surgical interest through the seventeenth century and so on mostly because of its dimensions and ease of access, at first recognized by plain x-ray. Even so, in the twentieth century, the introduction of computed tomography and nasal endoscopy has confirmed the relation of the maxillary sinus to the ostiomeatal complex in chronic rhinosinusitis, as actually shown by pioneers like **Zuckerkandl**[35].

Due to rapid development in the area of science and technology, the modern era was dawn in the management chronic rhinosinusitis. The visualization of the nose and sinuses with the fiberoptics proceeded and standard telescopes were developed which consisted of single lenses within a solid metal tube. These eventually were replaced by an outstanding technology of solid rod lens **by Prof. Hopkins**, in 1954 starting a newer period in the world of Endoscopy. With the support of a detailed study of the nose and sinuses **Prof. Walter Messeklinger** in Austria investigated mucociliary mechanism of the sinuses. In fact, **King** in 1935, previously revealed that cilia in the maxillary sinus direct the mucus to the natural ostium despite a broad dependent opening existing in the sinus. **Prof. Messerklinger** in 1967

examined and reported the genetically driven pathways of mucociliary mechanism in all of the sinuses and postulated that cilia constantly drain the mucus towards the natural ostium and any blockage in the way of this drainage was the cause of the recurrent sinus disease. He stressed how the anterior ethmoid and ostiometal complex were the “key” to the chronic sinusitis. This established the grounds for the pathophysiology of chronic recurrent sinus disease. Prof. Messerklinger in Austria and Prof. Draf in Germany afterwards shared their knowledge in nasal endoscopy, the value of definite diagnosis and its application in sinus surgery in 1978 and 1983, respectively[22].

The introduction of CT imaging and multiangled endoscopes also improved the extent of non invasive, non radical, thus more functional sinus operations, supporting the ciliary mechanism of the mucosa. Considering that ENT specialists are accustomed to work with microscope, Prof. Draf blended the usage of microscope and endoscope, hence enabling both hands to be used in the first parts of surgery. He advised usage of endoscope deeply into the nasal cavity for advanced surgery. Prof. Draf additionally led the way to non invasive approach for different skull base pathologies, such as surgery of the frontal sinus, where he defined Draf I, II, and III procedures for the constant draining of the frontal sinuses through their natural ostia. Later on Prof. H. Stammberger popularized the method and printed his experience in Endoscopic sinus surgery in 1991[22].

4.3. History of Rhinoplasty

4.3.1. History of Endonasal (Closed) Rhinoplasty

The history of nose surgical procedures is actually extensive. The Edwin Smith operative papyrus of ancient Egypt describes the diagnosis and treatment of nasal deformities several 30 centuries earlier[34]. In roughly eight hundred BCE, **Sushruta, of India,** defined a nasal reconstruction technique by transferring a pedicled forehead skin flap[37]. In the sixteenth century, **Tagliacozzi of Bologna,** Italy, applied brachial-based delayed flaps for reconstructing noses. The art and science of rhinoplasty continued to be basically at a standstill before the nineteen century. Techniques that can correct nose deformities were utilized by earlier plastic surgery pioneers including **Dieffenbach** around 1840s, who applied a buried forehead flap for cover the dorsum of nose[38].

The earliest record of a contemporary endonasal rhinoplasty was published by American otolaryngologist**, John Orlando Roe.** The original report released in 1887 was entitled "The deformity termed 'pug-nose' and its correction, by a simple operation" and explained the

management of saddle nose deformities[39]. In 1892, **Robert F. Weir,** a different U.S. operating doctor, likewise shared his techniques for repairing the saddle nose[40].

In 1898, **Jacques Joseph,** an orthopedic specialist, revealed his innovative ideas of nose surgery to the Medical Society of Berlin. Numerous ambitious rhinoplasty surgeons visited Germany to watch Joseph carry out his rhinoplasties. His traditional name as the father of modern rhinoplasty may be recognized by his impact in shaping a lot of rhinoplasty principles and techniques. Actually, the majority of the fundamental rhinoplasty maneuvers continue to be basically identical today as Joseph initially defined them. Joseph's principles and techniques were furthermore outspread (especially in the U.S.) by specialists including **Gustav Aufricht, Joseph Safian, and Samuel Fomon.** Fomon's teachings and medical review classes concerning endonasal rhinoplasty assisted in the training of numerous young rhinoplasty surgeons, such as **Maurice Cottle of Chicago and Irving Goldman of New York**[41].

In the rather brief past of modern rhinoplasty, numerous other rhinoplasty experts have assisted in the development of the techniques. Many surgeons contribute to improve our knowledge of the art and science of rhinoplasty. This ongoing sharing of information about rhinoplasty has perhaps rewarded both the patient and the surgeon[41].

4.3.2. History of External (Open) Rhinoplasty

The Ebers Papyrus of Egypt (from ~3500 BCE) contained a dialogue about nose reconstruction for rhinectomy, a punishment in ancient Eygypt. In 800 BCE, **Sushruta** carried out nose reconstruction using a pedicled forehead flap. In the 1500s, **Tagliacozzi** reported delayed arm-based flaps for nose reconstruction. In the 1750s, **Quelmatz** recommended day-to-day digital pressure for septal deformities. In 1845, **Diffenbach** performed external skin cuts to alter the shape of the nose. In 1887, **Roe** executed the initial cosmetic rhinoplasty, secondary to a pug nose deformity[42].

In the beginning twentieth century, **Killian and Freer** created submucous resection septoplasty. **Peer and Metzenbaum** executed the first manipulation to the caudal septum in 1929. In 1947, **Cottle** carried out a hemitransfixion incision along with conservation of the septum and turned out to be a strong promoter of the closed approach. In the 90's, **Sheen** enhanced his initial theories and encouraged the closed approach as well[42].

Regarding open rhinoplasty, **Rethi** firstly presented the columellar incision for open rhinoplasty for tip modification in 1921[43]. In 1957, **Sercer** used the open approach to reach the nasal cavity and septum through a columellar incision, and named the method "nasal decortication."

In the following fifteen years, open rhinoplasty lost its popularity up till **Padovan** presented his series in the early 70s, suggesting open rhinoplasty. Moreover, in the 70s, **Goodman** furthermore presented the case for the open approach (44). In 1982, Anderson, et al.[45] also published a paper on open approach. In the 90's, **Gunter** started to be a supporter of the open rhinoplasty[46].

Currently, the discussion still goes on about the advantages and disadvantages of an open versus closed approach to rhinoplasty[46-50].

4.4. History of cerebrospinal fluid rhinorrhea

From the first intracranial repair in the 1900s to the use of endoscopes and image-guidance systems, the management of cerebrospinal fluid (CSF) rhinorrhea has greatly evolved. Dandy is credited with the first surgical repair of a CSF leak via a frontal craniotomy approach in 1926. Various other authors, including Dohlman (1948), Hirsch (1952), and Hallberg (1964), subsequently reported successful repair of CSF rhinorrhea through different external approaches. In 1981, Wigand reported on the use of the endoscope to assist with the repair of a skull base defect. Since then, endoscopic repair has become the preferred method of addressing CSF rhinorrhea, given the high success rate of 90-95% and the decreased morbidity associated with this approach[51].

5. Approaching the New Millennium

A number of personalities led the development of rhinology as the new millennium approached. One such person was **Arthur W. Proetz**, Professor of Otolaryngology at Washington University, St Louis, Missouri. He wrote a thesis entitled “The Displacement Method of Sinus Diagnosis and Treatment,” which was awarded the Castlebury Prize of the American Laryngological Association in 1931[52]. He writes that the displacement principal, depends upon the elasticity of the air contained in the sinus cavities, small portions of which can be displaced by suction applied to the nostril and replaced by droplets of any fluid in contact with the ostium at the moment when the vacuum is released. Using semisophisticated

equipment and various types of head positioning, he was able to diagnose and treat the gamut of acute and chronic sinus conditions.

Another important figure of the twentieth century was **Professor O.E. van Alyea** from the University of Illinois in Chicago. He was considered by many to be the authority on nasal and sinus disease. He offered a landmark textbook in 1941 entitled Nasal Sinuses[53]. He based his book on the rapidly increasing knowledge of nasal physiology, anatomy, and a growing importance of the role of allergy as the cause of nasal and sinus conditions. The book described newer concepts such as the mucociliary blanket, mucosal inflammation caused by allergy, and pharmacotherapy, including the use of newly discovered antibiotics to treat sinus infections.

Probably the most important rhinologic figure of recent times was **Maurice H. Cottle** (1898–1981). He was considered by many to be the "rhinologist of the century". He seemed to restore rhinology to the same level as otology and laryngology. As a teacher and innovator, he taught the conservative functional approaches toward nasal and sinus surgery. He mastered the anatomy of the lateral nasal wall and perfected techniques of objective physiologic measurements using rhinomanometry[1].

In 1954, he founded the American Rhinologic Society, which, to this day, represents a flourishing organization. As a teacher, he was noted for many concepts, which are now termed "**Cottleisms**."[1].

6. Modern Era

The contemporary understanding of rhinoplasty as known today started out in 1898 with the efforts, not of a ENT specialist but an orthopaedic surgeon from Berlin, named **Jacque Joseph**. He was not a well-known surgeon amongst his fellows but made remarkable contributions to the concept of rhinoplasty. He detailed reduction rhinoplasty for the hump and other different deformities. He especially focused on the social and psychological aspects to be considered before rhinoplasty. He even developed a number of instruments that are still being used currently. He shared his report on surgical correction of the nose in excellent depth and founded intranasal rhinoplasty in Europe scientifically at the turn of the twentieth Century. He released a thorough book on rhinoplasty as well in 1928. Simultaneously **John Roe** in New York proceed with corrective rather than reconstructive surgeries and popularized intracartilagenous approach to the bulbous tip[22].

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CONFLICT OF INTEREST

The authors declare that there is no conflict of interest.

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