

# A Cross Sectional Study of Sinonasal Pathologies and Their Endoscopic Surgical Management

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## ABSTRACT

### BACKGROUND

In recent times, due to advancement in sinus endoscopes and sinus surgery instruments and the acquirement of skills, the variety of sinonasal diseases being treated and the indications for transnasal endoscopic approaches have increased dramatically. They include chronic rhinosinusitis and sinonasal polyposis to sinonasal tumours, skull base and orbital pathology. We wanted to study the role and outcome of endoscopic sinus surgery in the management of sinonasal disease.

### METHODS

A cross sectional study was conducted among 200 patients attending the Department of ENT, Govt. Medical College, Kozhikode, over a period 2 years with sinonasal diseases. Demographic details, ENT examination, CT scan Paranasal Sinuses (PNS) and endoscopic examination of the nasal cavity were performed in all patients. Clinical signs were recorded and classified according to their pathologies. All the patients were subjected to functional endoscopic sinus surgery. Operative methods and results were recorded.

### RESULTS

Among the 200 patients, 144 (72 %) were males and 56 (28 %) were female patients in the present study. Among the 200 patients, 126 (63 %) were in the age group of 21 to 50 years. 40 / 200 (20 %) patients belonged to the age group of 0 to 20 Years. 34 / 200 (17 %) patients belonged to the age group of 51 to 70 years.

### CONCLUSIONS

The diseases of the nose and paranasal sinuses ranged from inflammatory aetiology to neoplasms. Use of conventional tools for diagnosis and management of such a variety of diseases had their own limitations and demerits. Whereas endoscopic view of the disease sites was exceptionally clear and well-illuminated, giving an added edge to the ability to inspect the recesses with angled distal endoscopes. Definition of micro anatomical sites was well defined by the CT scan especially around osteo-meatal complex, and its anatomical variants. Functional endoscopic sinus surgery was an excellent and safe procedure. The prognosis in surgically treating sinonasal pathologies with FESS was good in terms of lesser morbidity and minimal chances of recurrence.

### KEYWORDS

Sinusitis, Endoscopic Sinus Surgery, CT Scan PNS, Skull Base Surgery, Sinonasal Tumours

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## BACKGROUND

Historical analysis shows that endoscopic sinus surgery was well established by the first third of this century for the treatment of acute and chronic sinusitis<sup>1</sup> Commendable anatomical studies by Zuckerkandl was the basis for the advancement of endoscopic sinus surgery,<sup>2</sup> followed by Onodi<sup>3</sup> and Grünewald.<sup>4</sup> In 1980 the transnasal endoscopic sinus surgery was introduced and the term FESS was coined by Kennedy.<sup>4</sup> Nasal cavities and sinuses opening in to them remain a host area for the occurrence of a variety of conditions, collectively coined as sinonasal diseases.<sup>5</sup> They include diseases of different pathologies ranging from inflammatory lesions to neoplasm; both benign and malignant. Since the clinical symptoms and signs are not specific in these diseases, radiological evaluation with advanced radiological methods like CT scan and MRI scan of nose and para nasal sinuses is essential.<sup>6</sup> Wherever early sinonasal polyps were missed on CT scans, were identified by diagnostic nasal endoscopy.<sup>7</sup> Similar to tumours affecting other parts of the body sinonasal masses are divided as: Non-neoplastic and Neoplastic, the later are further divided into benign and malignant. Certain masses though benign such as certain polyps, fungal sinusitis, haemangiomas and fibro-osseous tumours present with surrounding destructive features and deformities, mimicking malignancies.<sup>8</sup>

Therefore, nasal endoscopy, radio diagnosis, and histopathology are used conjointly to help the surgeon to reach the diagnosis.<sup>6</sup> Chronic inflammation of mucosal lining of nose and paranasal sinuses lasting for at least 12 weeks was defined as chronic rhinosinusitis (CRS). FESS provides an excellent and safe method for treating chronic sinusitis correcting anatomy minimally and regaining physiology effectively. Sino nasal polyposis (SNP) is multiple benign polyps in nasal cavity and PNS, common in adults and rare in children.<sup>9</sup> Polyps are formed by influx of fluid in lamina propria of sinonasal Schneiderian mucosa and is characterised by nasal polypoid masses and infundibular enlargement.<sup>10</sup> Air fluid levels are frequent in SNP that doesn't always indicate acute sinusitis. CT scan PNS show extensive mucosal polyps occupying nasal cavity and PNS, usually hypodense, may be sometimes hyper dense; if protein or fungal content is more.<sup>11</sup> Inverted papillomas (IP) are benign nasal tumour, between 40 - 60 years of age, more in males present as sinonasal irregular polypoid masses of variable consistency with nasal obstruction and epistaxis. Arise commonly from middle turbinate, meatus and maxillary sinus ostium. As it enlarges it causes bone remodelling, resorption and extend to surrounding areas. Angled telescopes, good illumination combined with exact osteotomies gives a better approach to transnasal endoscopic medial maxillectomy for removal of inverted papilloma extending from maxillary to ethmoids sinuses.<sup>9</sup> More recently, endoscopic modified medial maxillectomy (EMMM) a novel surgical approach is being practiced. Rhinosporidiosis is a chronic granulomatous inflammatory disease inducing polypoid growth of the affected mucous membrane caused by *Rhinosporidium seberi*. The most

common sites are nasal mucosa, nasopharynx, oropharynx and nasolacrimal duct. Larynx, trachea. Extension to maxillary sinus also reported.<sup>10</sup> The Rhinosporidiosis must be taken as differential diagnosis of nasal polypoid lesions.<sup>11</sup> It is treated by surgical excision and cauterisation of base. Juvenile angiofibroma (JA) commonly affects younger male children aged between 9 and 20 years of age. It is a benign vascular neoplasm evident on CT scan or MRI imaging.

To minimize bleeding during surgery and limit complications, preoperative embolization is being used by the surgeons. Nicolai et al<sup>12</sup> (2003) have shown that even when JA was involving nasopharynx, nasal cavities, sphenoid sinus, ethmoids sinuses, maxillary sinus, and / or pterygopalatine fossae, endoscopic excision was practically possible. Advanced radiological imaging, embolization techniques have improved overall success rate in the management of JA. The indications for orbital decompression are ethmoiditis with orbital complications, ethmoidal mucoceles, orbital hematoma Graves's orbitopathy, exophthalmos.<sup>13</sup> Medial decompression done after anterior and posterior ethmoidectomy where the lamina papyracea was removed by using special dissectors and the periorbita was exposed and two or three horizontal incision lines were made with a blunt tip endoscopic knife. One or two sliding of fascia had to be preserved to protect the medial rectus muscle to minimize postoperative diplopia. Endoscopic medial orbital decompression is a safe and reliable technique. In this study an attempt is made to discuss the role of endoscopic sinus surgery in, understanding disease pathogenesis, expansion of its indications, and advantages over conventional surgeries for sinonasal diseases.

## METHODS

This study was conducted in the Department of Otorhinolaryngology, Govt. Medical College, Kozhikode, for a period 2 years from 2018 to 2019. The study and analysis prospectively done. An ethical committee clearance was obtained before commencing the study and hospital permission was taken to access the records for publishing the study. A total number of 200 patients with sinonasal pathologies presented as mass in the nasal cavity, para nasal sinuses, nasopharynx and with symptoms of nasal obstruction discharge, headache, hyposmia, recurrent epistaxis were included.

### **Inclusion Criteria**

1. Patients with clinical evidence of sinonasal diseases were included.
2. Patients of both genders and all ages were included.
3. Patients with complaints of nasal obstruction, nasal masses, epistaxis, rhinorrhoea, hyposmia and deformity of nose and face were included.

### Exclusion Criteria

1. Patients who have undergone previous surgeries on the nose were excluded.
2. Patients who have co-morbid diseases and complications were excluded. Patient's occupation, personal habits and economic status of patients were collected in proforma. The economic status was derived based on modified B G Prasad classification which was based on Consumer Price Index of April 2006.<sup>14,15</sup>

### Sample Size

The sample size was calculated as 200 by using online sample size calculator (<https://www.calculator.net/sample-size-calculator.html>), wherein the confidence level was taken as 95 %, margin of error as 5 %, population proportion was taken as 85 % and population size was infinite. The sample size calculated was 196. The measurements / surveys needed to have a confidence level of 95 % and as the real value was within  $\pm 5$  % of the measured / surveyed value.

All the patients were evaluated with nasal endoscopy and CT scan of PNS, prior to endoscopic surgery to exclude malignant diseases of the nose and para nasal sinuses. Nasal Endoscopic procedures were performed using 0, 30 and 70, 4 mm Hopkins rod endoscopes. The operative technique used was planned in accordance to the need of the individual case. Septoplasty was performed for grossly deviated nasal septum (DNS) in 30 cases. In FESS Uncinectomy, middle meatal antrostomy, was done for maxillary sinus pathology. For associated ethmoidal disease anterior and posterior ethmoidectomy done. Sphenoidotomy was done in cases of CT shown sphenoid sinus opacity. Concha bullosa and paradoxical middle turbinate was one of main cause of sinus pathology, for which conchoplasty and partial turbinectomy was done in patients with inferior turbinate hypertrophy causing gross obstruction co ablation turbinoplasty was performed. Post-operative medication included an oral course of broad-spectrum antibiotic, analgesics, and antihistamines. The pack was removed 24 hours after surgery. All the operative findings were recorded and analysed. All the data was analysed using [www.socialsciencesstatistics.com](http://www.socialsciencesstatistics.com) software available on the internet. The mean age of onset of neoplastic lesions and inflammatory lesions was analysed using t test. The incidence of allergic aetiology of sinonasal diseases and inflammatory aetiology were tested using ANOVA.

## RESULTS

200 patients were included in the retrospective study attending the Department of ENT with the signs and symptoms of sinonasal diseases between 2018 and 2019. The sinonasal pathologies presenting as masses in the nasal cavity, para nasal sinus, and nasopharynx and with symptoms of nasal obstruction discharge, headache, hyposmia, recurrent epistaxis was included. Clinical evidence of sinonasal diseases were diagnosed using nasal endoscopy

and CT prior to endoscopic surgery and malignant cases excluded. Among the 200 patients 144 (72 %) were males and 56 (28 %) were female patients in the present study. Among the 200 patients 126 (63 %) belonged to the age group of 21 to 50 years. 40 / 200 (20 %) patients belonged to the age group of 0 to 20 Years. 34 / 200 (17 %) patients belonged to the age group of 51 to 70 years. Nasal Endoscopic procedures were performed using 0°, 30° and 70, 4 mm Hopkins rod endoscopes. Among the symptoms occurring in the patients in this study it was found that nasal obstruction was found in 160 / 200 patients accounting for 80 % of the cases. This symptom was followed by rhinorrhoea in 120 / 200 (60 %) patients. Headache was observed in 100 / 200 (50 %) of the patients. Epistaxis was seen 40 / 200 (20 %) patients. Hyposmia was observed in 24 / 200 (12 %) of the patients. Unilateral disease was observed in 47.5 % of the patients and bilateral disease was found in 52.5 % of the patients (Table 1).

Observations	Number	Percentage
<b>Symptoms</b>		
Nasal Obstruction	160	80
Rhinorrhoea	120	60
Headache	100	50
Epistaxis	40	20
Hyposmia	24	12
<b>Laterality</b>		
Unilateral	95	47.5
Bilateral	105	52.5

**Table 1. Incidence of Symptomatology in the Study Subjects (n = 200)**

The occurrence of various sinonasal diseases in this study were classified according to their age incidence and found that maxillary sinusitis was seen between the ages of 16 and 70 years, Antrochoanal polyp between 10 and 45 years, Ethmoidal polyp between 30 and 53 years, sinonasal Polyposis between 19 and 76 years, inverted papilloma between 43 and 65 years, Juvenile Angio Fibroma between 12 and 20 years. 45 patients were diagnosed with maxillary sinusitis, 07 patients with Pan sinusitis, 13 patients with Antrochoanal polyp, 17 patients with ethmoidal polyp, 77 patients with sinonasal polyposis, 05 patients with frontal mucocele, 02 patients with maxillary sinus mucocele, Ethmoiditis and orbital cellulitis in 04 patients and 7 patients with isolated sphenoid sinus disease. The incidence of polyps formation (which included sinonasal polyposis, ethmoidal polypi)\* was observed in 94 / 200 patients (47 %) (Table 2). 173 / 200 patients with sinonasal diseases as shown in Table 2 were treated with FESS (Functional Endoscopic Sinus Surgery). 07 patients with inverted papilloma and 05 patients with haemangiomas cases were treated with endoscopic modified medial maxillectomy. 05 patients with Juvenile nasopharyngeal angiofibroma and 08 patients with Rhinosporidiosis and 02 with Rhinoscleroma were treated with endoscopic excision. 04 (02 %) patients with orbital cellulitis and abscess secondary to ethmoiditis underwent endoscopic decompression. Conchoplasty unilateral was done in 26 and bilateral in 18 patients which was done for concha bullosa causing Osteo Meatal Complex block. Sphenoidotomy alone was done in cases of isolated sphenoid disease presented with headache and CT scan

shown sphenoid sinus opacity and 4 were fungal ball. Sphenoidotomy was performed after removal of the inferior third of the superior turbinate and widening of the natural ostium of the sphenoid using through cutting instruments and straight punch forceps (Table 2). Comparing the mean age of incidence of sinonasal polyposis of allergic aetiology and inflammatory aetiology using 'T' test calculator, it was observed that the T value was 1.901444 and p value was 0.052 (p value taken as significant at < 0.05). The result was not significant statistically.

Sinonasal Disease	Age Incidence	Number	Surgery Undertaken
Maxillary sinusitis- 41			
Unilateral	16 to 70 years	29	
Bilateral		12	FESS
Antrochoanal Polyp*	10 to 45 years	13	FESS
Ethmoidal polyp*	30 to 53 years	17	FESS
Sinonasal Polyposis- 77*			
Unilateral	19 to 76 years	26	
Bilateral		51	FESS
Inverted papilloma	43 to 65 years	07	endoscopic modified medial maxillectomy
Haemangioma	27 to 42 years	05	Endoscopic excision
Juvenile angiofibroma	12 to 20 years	05	Endoscopic excision
Pan sinusitis	20 to 42 years	07	FESS
Frontal mucocele	33 to 41 years	05	FESS
Maxillary mucocele	35 to 46 years	02	FESS
Isolated sphenoid sinus disease	26 to 40 years	07	FESS
Rhinosporidiosis	18 to 61 years	08	Endoscopic excision
Rhinoscleroma	26 to 46 years	02	Endoscopic excision
Ethmoiditis and orbital cellulitis	28 to 55 years	04	Endoscopic orbital decompression

**Table 2. Showing the Various Diseases in Relation with Their Age Incidence (n = 190)**

(\* Patients Presenting with Polypi and the Tissue Subjected to Histopathology)

Histopathological examination revealed that 94 / 200 (47 %) of the polyps were allergic in nature (which included sinonasal polyposis, ethmoidal polypi)\*, while 13 / 200 patients with Antrochoanal polyp were reported as inflammatory in nature on histopathology (06.5 %), totalling to 107 / 200 patients (53.5 %). Rhinosporidiosis in 08 patients and Rhinoscleroma in 02 / 200 patients were the other two inflammatory lesions confirmed by histopathological investigation; 10 / 200 (05 %), (Table 2). All patients with Rhinosporidiosis (08 cases) were in the third decade of life with a male-female ratio of 3:1 (6 males, 2 females). Among benign neoplastic lesions, inverted papilloma was confirmed on Histopathology in 07 patients followed by haemangiomas which were diagnosed clinically in 05 patients but 04 more were later confirmed on histopathology making the total number as 09. Frontal and maxillary Mucocelles were confirmed in 05 and 02 patients respectively.

Fungal culture was positive in 17 cases. Follow up was done in majority of cases for 3 to 6 months. 05 cases had recurrent polyposis after 6 months. Using one way ANOVA calculator the incidence of different histopathological changes and their occurrence at mean age were calculated

and found that the f-ratio value was 0.04898. The p-value was 0.830. The result was not significant at p < .05.

Polypoidal Masses - 107 (53.5 %)	Number	Percentage
Allergic polyp	94	47
Inflammatory polyp	13	06.5
Rhinoscleroma and Rhinosporidiosis	10	05
<b>Benign neoplastic Mass - 19</b>		
Haemangioma	09	47.3
Inverted papilloma	07	36.8
Mucocele	02	10.5
Angiofibroma	01	05.3

**Table 3. Showing the Histopathological Findings of Nasal Polypoidal Masses**

## DISCUSSION

This study was conducted on patients who had undergone endoscopic treatment for various sinonasal pathologies over a period of 2 years. The aim of the study was to analyse the clinical presentation of various sinonasal diseases, their diagnosis and endoscopic surgical removal, advantages and prognosis. Also the study focused on the assessment of FESS its efficacy, safety, and benefits in treating chronic rhino sinusitis, sinonasal polyposis in terms of morbidity, and recurrence of disease. Out of 200 patients, 144 were males and 56 were female patients in the present study. Nasal polyp was the commonest non-neoplastic lesion<sup>1,2</sup> on CT scan of Paranasal sinuses which was observed in 77 (38.5 %) of patients. Micro anatomical crevices in and around the Osteo-meatal Unit and definition of dangerous anatomical variations were well defined by use of Coronal CT scan of nose and Paranasal sinuses. It remains an excellent guide to the surgeon not only in the planning of FESS procedure but also to avoid precarious sites to minimize the intraoperative complications and achieving successful results.<sup>9</sup> In the cases of extensive inflammatory disease in ethmoids and maxillary sinus, and with sinonasal polyposis the Messerklinger technique of FESS were followed. Septoplasty was done in association with FESS to get wide access for a nasal endoscope. Concha-bullosa was present in 44 (22 %) cases where conchoplasty was essential to relieve the osteo-meatal block which was the basic cause of chronic sinusitis and polyposis.<sup>9</sup> Uncinectomy or infundibulotomy undertaken in all cases of FESS itself clears the pathology from the maxillary and frontal sinuses. It is because the uncinat process forms the medial wall of ethmoid infundibulum. It also serves the purpose of draining the infundibulum and ventilation of sinuses. 10 Uncinectomies was performed in 169 (84.5 %) patients. Anterior ethmoidectomy alone was performed in cases where only ethmoid disease was present; 21 / 200 (10.5 %) of patients. Anterior and Posterior ethmoidectomy was carried out in polyposis extending to posterior ethmoid and sphenoid sinuses; in 45 (22.5 %) patients. In all cases of sinonasal polyposis, frontal recess was also cleared of polyps. In 17 (08.5 %) cases of isolated ethmoid polyp, anterior and posterior ethmoidectomy were performed. FESS provides an excellent and safe method for treating sinonasal disease. Widening of the natural ostium of the sphenoid using through cutting

instruments and straight punch is an ideal method. Chronic Rhino Sinusitis was found affecting the patients aged from 20 to 40 years. They commonly complain of nasal obstruction, nasal discharge, headache, and post nasal drip. The predisposing factors for chronic sinus disease and polypoid are anatomical variations of middle turbinates like concha bullosa, paradoxical turbinate, uncinata process, septal deviation and polypoidal changes of these structures for which Conchoplasty and partial turbinectomy, septoplasty was needed.<sup>11</sup> Allergic rhinitis, stagnation of secretion and fungal or bacterial infection are the contributing factors.<sup>12</sup> Maxillary sinus is most often involved (70 – 80 % of cases),<sup>12</sup> Inhalation of spores, its sequestration into favourable location in sinonasal passage, cause germination & growth<sup>13</sup> which also evades host defense and affect mucociliary clearance from the sinus leading to fungal sinusitis. Advantage of FESS was that it can avoid conventional old procedures like antral puncture, trephining, inferior meatal antrostomy, Caldwell-Luc surgery.<sup>13</sup> Inverted Papilloma was the second most common benign lesion treated.<sup>1</sup> Maxillary Inverted Papillomas with multifocal attachments most frequently involved 2 - 3 walls of the sinus. Traditionally an open medial maxillectomy by lateral rhinotomy or sub labial degloving approach has been done for sinonasal tumours.<sup>14</sup>

N. Tanna<sup>16</sup> has reported the minimally invasive endoscopic technique for this with decreased morbidity and comparable efficacy. Most of the patients were treated surgically under FESS with medial maxillectomy. In their study there were no perioperative complications were encountered.<sup>15</sup> Following analysis of results in this study the clinical implications noted were: Patients experienced minimized hospital stay. It was also reported by Sautter et al.<sup>17</sup> Endoscopic approach was a chosen surgical option for sinonasal inverted papillomas and was confirmed by the global recommendations. It was the gold standard in the treatment of such lesions giving a lower recurrence rate compared to external approaches.<sup>6</sup> Similarly other indications for pure endoscopic approach to sinonasal pathologies in this study also have been described in the literature. The advantages noted were avoiding facial incision so in turn minimizing scar formation, minimal pain and swelling. Patients did not have dysesthesia as compared to open surgery.<sup>5</sup> To surgically treat sinonasal inverted papilloma (IP), a definite diagnosis is essential identifying its origin by CT scan, and MRI imaging. In the present study successful treatment of sinonasal IP with EMMM was possible without much difficulty. EMMM gives a good visibility and manoeuvrability. Hence EMMM was considered to be a very favourable approach for treatment of sinonasal IP.<sup>17,18</sup> External incision and scarring and disfigurement are avoided by endoscopic approaches especially in Dacryo-Cysto-Rhinostomy, medial maxillectomy, fronto-ethmoidectomy. Rhinosporidiosis was seen mostly arising from nasal septum, inferior meatus and turbinate, posterior choana. All are resected and pedicle cauterized with better visualization, so residual lesion and recurrence are rare. Rhinosporidiosis is characterized by polypoid, papillomatous

lesions of the mucosa with friable, bloody to the touch, painless and the septum implantation is the most common form with complaints of nasal obstruction, epistaxis, and mucopurulent rhinorrhoea. It is a consensus that the surgical total resection of the lesion and cauterization of its peduncle is the treatment.<sup>12</sup> Tomasz Gotlib et al<sup>18</sup> from their 5 year study observed that disease-specific survival with Endoscopic endo nasal method of surgery was 91.4 % and seemed to indicate that endoscopic surgery was ideal. On the other hand the prevalence of intra-orbital complications and invasion of sinonasal diseases was observed to be 3.7 to 47.6 % by Clayman GL, Adams GL et al.<sup>19</sup> Intra cranial invasion of sinonasal diseases and their neoplasia was observed in more than 5.8 % of their patients by Eleftherios Vairaktaris, Marilita M Moschos, Stavros Vassiliou et al.<sup>20</sup> In the present study the intra orbital complications was observed in the form of orbital cellulitis alone in 02 % of the patients (Table 2). Similarly the incidence of mucormycosis was not found in this study but review of literature shows its prevalence to be between 8.1 and 11.24 % as reported by Patel et al.<sup>21</sup>

## CONCLUSIONS

The diseases of the nose and para nasal sinuses were ranging from inflammatory aetiology to neoplastic nature. Use of conventional tools for diagnosis and management of such a variety of diseases had their own limitations and demerits. Whereas endoscopic view of the diseases sites were exceptionally clear and well-illuminated giving an added edge to the ability to inspect the recesses with angled distal endoscopes. Definition of micro anatomical sites were well defined by the CT scan especially around osteo meatal complex, and its anatomical variants. Functional endoscopic sinus surgery was an excellent and safe procedure. The prognosis in surgically treating sinonasal pathologies with FESS was good in terms of lesser morbidity.

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## REFERENCES

- [1] Hajek M. Pathologie und Therapie der entzündlichen Erkrankungen der Nebenhöhlen der Nase. 5<sup>th</sup> edn. Leipzig: Franz Deuticke 1962.
- [2] Zuckerkandl E. Normale und pathologische Anatomie der Nasenhöhle und ihrer Pneumatischen Anhängen. II. Wien: Wilhelm Braumüller 1892.
- [3] Onodi A. Die Nebenhöhlen der Nase beim Kinde. Würzburg: Curt Kabitzsch 1911.
- [4] Kennedy DW. Functional endoscopic sinus surgery technique. Arch Otolaryngol 1985;111(10):643-649.

- [5] Zafar KN, Afroz N, Ahmad SS. Masses of nasal cavity, paranasal sinuses, nasopharynx. A clinico pathological study. *Indian Journal of Otolaryngol Head and Neck Surg* 2006;58(3):259-263.
- [6] Bist SS, Varshney S, Baunthiyal V, et al. Clinicopathological profile of sinonasal masses: an experience in tertiary care hospital of Uttarakhand. *National J Maxillofacial Surg* 2012;3(2):180-186.
- [7] Maaru YK, Gupta Y. Nasal endoscopy versus other diagnostic tools in sinonasal diseases. *Indian J Otolaryngol Head and Neck Surg* 2016;68(2):202-206.
- [8] Nepal A, Chettri ST, Joshi JJ, et al. Benign sinonasal masses a clinicopathological and radiological profile. *Kathmandu University Med Journal* 2013;11(41):4-8.
- [9] Sadeghi N, Al-Dhahri S, Manokian JJ. Transnasal endoscopic medial maxillectomy for inverted papilloma. *Laryngoscope* 2003;113(4):749-753.
- [10] Tajudeen BA, Kennedy DW. Thirty years of endoscopic sinus surgery what we learned. *World Journal of Otolaryngology Head and Surgery* 2017;3(2):115-121.
- [11] Abdulla ZK, Hassan ZK, Rashmi CC. Rhinosporidiosis of maxillary sinus. *Journal of IAOMR* 2019;31(3):274-279.
- [12] Nicolai P, Berlucchi M, Tomenzoli D, et al. Endoscopic surgery for juvenile angiofibroma: when and how? *Laryngoscope* 2003;113(5):775-782.
- [13] Wu V, Siu J, Yip J. Endoscopic management of maxillary sinus inverted papilloma attachment sites to minimize disease recurrence. *Journal of Otolaryngol Head & Neck Surg* 2018;47(1):24.
- [14] Economic Survey 2000 – 2001 (n). Govt. of India, Ministry of Finance, Economic Division, New Delhi. [www.indiabudget.gov.in](http://www.indiabudget.gov.in) HYPERLINK "https://www.indiabudget.gov.in/budget\_archive/es2000-01/welcome.html"> budget archive.
- [15] Gupta MC, Mahajan BK. The textbook of preventive and social medicine. 3<sup>rd</sup> edn. New Delhi: Jaypee Brothers Medical Publishers (P) Ltd., 2003: p. 117-118.
- [16] Tanna N, Edwards JD, Aghdam H, et al. Transnasal endoscopic medial maxillectomy as the initial oncologic approach to sinonasal neoplasms: the anatomic basis. *Arch Otolaryngol Head & Neck Surg* 2007;133(11):1139-1142.
- [17] Sautter NB, Cannady SB, Citerdi MJ. Comparison of open versus endoscopic resection inverted papilloma. *Amerian J Rhinol* 2007;21(7):320-323.
- [18] Gotlib T, Osuch-Wójcikiewicz E, Held-Ziółkowska M, et al. Endoscopic transnasal management of sinonasal malignancies - our initial experience. *Wideochir Inne Tech Maloinwazyjne* 2014;9(2):131-137.
- [19] Clayman GL, Adams GL, Paugh DR, et al. Intracranial complications of paranasal sinusitis: a combined institutional review. *Laryngoscope* 1991;101(3):234-239.
- [20] Vairaktaris E, Moschos MM, Vassiliou S, et al. Orbital cellulitis, orbital subperiosteal and intraorbital abscess. Report of three cases and review of the literature. *J of Craniomaxillofac Surg* 2009;37(3):132-136.
- [21] Patel A, Kaur H, Michael JS, et al. A multicentre observational study on the epidemiology, risk factors, management and outcomes of mucormycosis in India. *Clinical Microbiology and Infection* 2020;26(7):944.e9-944.e15.