REVIEW ARTICLE

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Surgical outcomes of endoscopic versus open resection for the management of sinonasal malignancies

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Abstract (J Korean Assoc Oral Maxillofac Surg 2020;46:373-378)

The purpose of this review is to assess the surgical outcomes of two different treatment modalities, endoscopic and open resection, for the management of sinonasal malignancies by comparing the effectiveness of these two methods. A wide search was carried out considering various electronic databases for English language articles from 2013 to 2018 using keywords such as sinonasal malignancies, endoscopic surgery, open resection for sinonasal malignancies, and endoscopic versus open surgery. One thousand articles were identified from the literature for screening. After a thorough systematic assessment and based on the selection criteria, 10 articles with 4,642 patients were included in this quantitative analysis. With a total of 4,642 patients, 1,730 patients were operated on using endoscopic resection and 2,912 patients were operated on using open resection. The endoscopic approach was found to have a shorter hospital stay compared to open surgical resection (P<0.05). The rate of positive margins and the recurrence rate for open surgical resection were both smaller compared to those for endoscopic resection (P>0.05), and the endoscopic approach had smaller complication rates and a higher survival rate compared to open resection (P>0.05). Though endoscopic resection and open surgical resection have comparable postoperative benefits, preoperative evaluation of cases presenting with sinonasal malignancies is necessary for determining the right treatment method to obtain the best possible results postoperatively.

Key words: Sinonasal malignancy, Endoscopic approach, Open resection

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I. Introduction

Malignant tumors involving sinonasal region are rare, comprising only 3% of head and neck cancers[1]. The most preferred sites of occurrence for these tumors are the nasal cavity followed by the maxillary sinus and ethmoid sinuses[2,3]. Squamous cell carcinoma (SCC) is the most common histologic diagnosis[4,5]. Sinonasal malignancies have a poor prognosis, and the 5-year survival rate was only 30% to 59%[6,7]. Two treatment modalities are practiced in routine basis: open resection via the craniofacial approach, which is a standard method employed for the management of sinonasal tumors; and endoscopic resection, which is a recent method compared to open surgical resection.

Open surgical resection provides wider access and better visibility with high rates of complete resection[8,9]. However, open resection offers high rates of complications that can occur immediately following surgery, in a delayed fashion with an infection rate up to 18% at the surgical site, as a complication of the central nervous system with rates up to 15%, or even as complications that lead to postoperative mortality with rates up to 4.5%[10,11]. Endoscopic resection is a minimally invasive procedure with better cosmesis, and complete resection of the tumor can be ensured, similar to open resection, while ensuring long term survival rates with minimal complications[12,13].

The purpose of this paper is to compare the surgical outcomes of two different approaches, namely endoscopic resection and open resection, in terms of the positive margins. We compare these two methods by considering their complication rates, length of hospital stay, recurrence rate and the overall survival rate in the management of sinonasal malignancies.

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II. Materials and Methods

1. Search strategy

This present systematic review was carried out based on the PRISMA (Preferred Reporting Items for Systematic Reviews and Meta-Analyses). A Literature search was performed for various electronic databases such as the PubMed, Scopus, ScienceDirect, Google Scholar, and Cochrane Library databases from 2013 to 2018 using the key words sinonasal malignancies, endoscopic surgery, and open resection for sinonasal malignancies. All the articles were assessed based on multiple inclusion and exclusion criteria.

2. Selection criteria

The articles included in the present review were clinical trials with comparative treatment modalities: endoscopic resection and open surgery, histopathology of malignancies involving sinonasal cavity, articles reported with one surgical approach, and age >20 years. The surgical outcomes measured include the complication rate, positive margins, rate of recurrence, length of hospital stay, and histologic subtypes. Exclusion criteria were histologic representation of mucosal melanoma since they dictate the type of tumor, case series and case reports, cranio-endoscopic approaches, recurrent pathologies of sinonasal cavity, and cases that received preoperative chemotherapy or radiotherapy.

III. Results

1. Literature search

A wide search through the English literature yielded 1,000 studies. After removal of 478 duplicates, inclusion and exclusion criteria were applied for 522 studies. Of the articles, 496 articles were excluded (cranio-endoscopic approaches, preoperative exposure to chemotherapy or radiotherapy, not in the sinonasal region, and case reports/case series) and 26 articles were included in the full text analysis. Among the 26 articles, 16 were excluded due to the following reasons: 6 mucosal melanoma cases, 4 recurrent histologies, 3 hybrid surgeries, and 3 articles with no appropriate data. Finally, 10 articles comprising 4,642 patients were considered for quantitative analysis.(Fig. 1)

2. Demographics and clinical features

In the present review, a total of 4,642 patients were included with a mean age ranging from 38 to 75 years and 40%

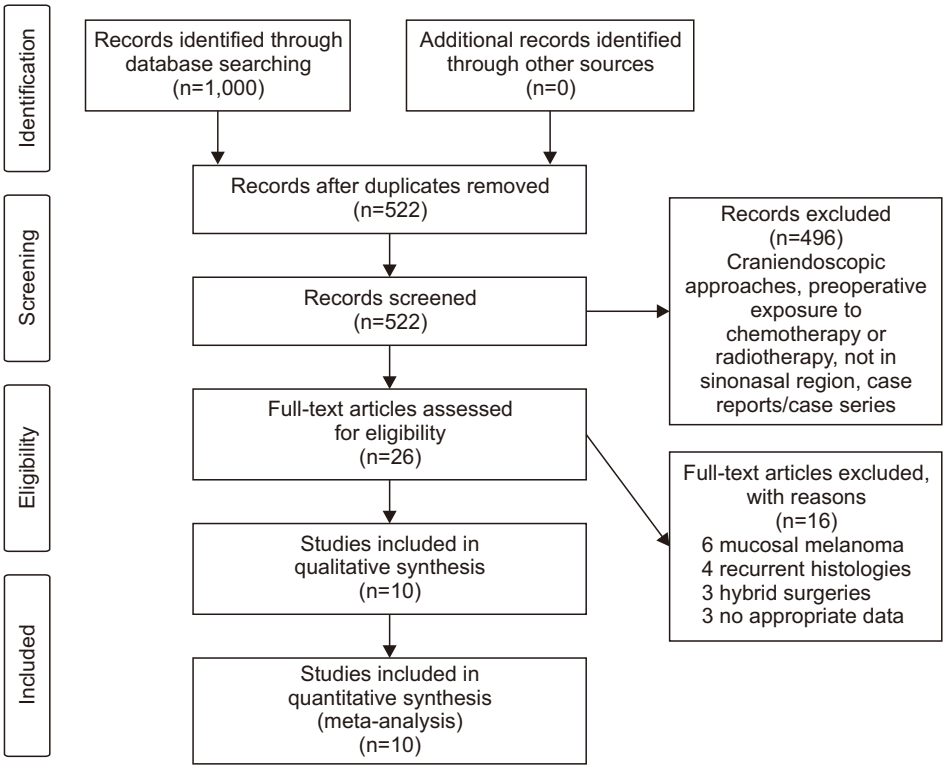

Fig. 1. PRISMA (Preferred Reporting Items for Systematic Reviews and Meta-Analyses) search strategy.
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to 98% were male. Of the patients, 1,730 patients underwent endoscopic resection and 2,912 patients underwent open surgical resection with a mean follow-up of 20 to 76 months. For numerous sinonasal malignancies, SCC was the most common occurrence.(Table 1)

3. Positive margins

Arnold et al.[14] observed 68% positive margins in endoscopic resection and 62% in open resection (*P*=0.636). Farquhar et al.[15] observed 33% positive margins in endoscopic resection and 32% in open resection (*P*=0.708). Finally, Hagemann et al.[16] observed positive margins of 22% and 24% in endoscopic resection and open resection (*P*=0.080), respectively.(Table 2)

4. Length of hospital stay

Farquhar et al.[15] observed 3 days of hospital stay for the endoscopic approach and 6 days for the open resection approach (*P*=0.0001). Hagemann et al.[16] identified 6 days of hospital stay with endoscopic resection and 9 days with open resection (*P*=0.001). Mortuaire et al.[17] observed 5 days of hospital stay with the endoscopic approach and 8 days with the open resection approach (*P*=0.001). Similarly, Fu et al.[18] also identified a shorter length of hospital stay for endoscopic resection than for open surgical resection of 6 days and 12 days (*P*=0.01), respectively.(Table 2)

5. Complication rates

Naunheim et al.[12] reported 1 case of cerebrospinal fluid (CSF) leak in endoscopic resection and 12 wound infections, 3 meningitis cases, and 2 CSF leaks in the open resection (*P*=0.75). Arnold et al.[14] described 5 complications: 2 CSF leaks, 2 local bleeding, and 1 case of pneumocephalon with open resection; however, they observed no complications with endoscopic resection (*P*=0.396). Hagemann et al.[16] observed 1 patient CSF leak in endoscopic resection and 8 patients with open surgical resection (*P*=0.54). Mortuaire et al.[17] observed complications in 2 patients (1 hematoma and 1 wound infection) in open resection and no complications in endoscopic resection (*P*=0.80). Fu et al.[18] highlighted the occurrence of 2 patients CSF leak in endoscopic resection and 1

Table 2. Surgical outcome variables for endoscopic and open resection

Outcome variables	Endoscopic resection	Open resection	*P*-value
Positive margins (%)			
Arnold et al.[14]	68	62	0.636
Farquhar et al.[15]	33	32	0.708
Hagemann et al.[16]	22	24	0.080
Length of hospital stay (day)			
Farquhar et al.[15]	3	6	0.0001*
Hagemann et al.[16]	6	9	0.001*
Mortuaire et al.[17]	5	8	0.001*
Fu et al.[18]	6	12	0.01*
Complication rate (n)			
Naunheim et al.[12]	1	17	0.75
Arnold et al.[14]	0	5	0.396
Hagemann et al.[16]	1	8	0.54
Mortuaire et al.[17]	0	2	0.80
Fu et al.[18]	2	1	0.20
Recurrence rate (n)			
Farquhar et al.[15]	16	13	0.058
Hagemann et al.[16]	57	52	0.490
Fu et al.[18]	14	7	0.21
Saedi et al.[19]	59	58	0.168
Huang et al.[20]	66	66	0.359
Overall survival rate (%)			
Naunheim et al.[12]	5 yr: 41	5 yr: 41	0.14
Farquhar et al.[15]	3 yr: 91	3 yr: 76	0.135
Hagemann et al.[16]	5 yr: 76	5 yr: 59	0.001*
Saedi et al.[19]	2 yr: 34	2 yr: 44	0.13

*$P<0.05$.

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Table 1. Demographics of the included study

Study	Study type	Malignancy	Total size (n)	Endoscopic resection (n)	Open resection (n)	Mean age (yr)	Sex (M/F) (%)	Mean follow-up (mo)
Kilic et al.[4]	RCT	SCC	1,483	353	1,130	35	65/35	60
Naunheim et al.[12]	RCT	SCC	55	10	45	58	69/31	27.4
Arnold et al.[14]	RCT	SCC	900	399	501	63	67/33	36.3
Farquhar et al.[15]	RCT	SCC	124	82	42	54	53/47	40
Hagemann et al.[16]	RCT	SCC	225	123	102	63	60/40	45.4
Mortuaire et al.[17]	RCT	Adenocarcinoma	43	20	23	70	98/2	79.2
Fu et al.[18]	RCT	SCC	87	15	72	57	57/43	-
Saedi et al.[19]	RCT	SCC	83	28	55	46	70/30	21
Huang et al.[20]	RCT	SCC	47	27	20	58	60/40	73.6
Povolotskiy et al.[26]	RCT	Non SCC	1,595	673	922	59	54/46	60

(RCT: randomized clinical trial, SCC: squamous cell carcinoma, M: male, F: female)

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patient with open surgical resection (*P*=0.20).(Table 2)

6. Recurrence

Farquhar et al.[15] observed recurrence in 16 patients with endoscopic resection and 13 patients with open resection (*P*=0.058). Hagemann et al.[16] observed recurrence in 57 patients for the endoscopic approach and in 52 patients for the open resection approach (*P*=0.490). Fu et al.[18] identified recurrence in 14 patients and 7 patients for endoscopic and open surgical resection (*P*=0.21), respectively. Saedi et al.[19] observed recurrence in 59 and 58 patients with endoscopic resection and open resection (*P*=0.168), respectively, while Huang et al.[20] observed 66 patients recurrence for both endoscopic and open resection (*P*=0.359).(Table 2)

7. Overall survival rate

Naunheim et al.[12] observed a 5-year survival rate of 82% in both the endoscopic and open resection approaches (*P*=0.14). Farquhar et al.[15] reported a 3-year survival rate of 91% and 76% for endoscopic and open resection (*P*=0.135), respectively. Hagemann et al.[16] reported a 5-year survival rate of 76% and 59% for endoscopic and open surgical resection (*P*=0.001), respectively. Finally, Saedi et al.[19] reported an overall survival rate of 2 years of 34% with endoscopic resection and 44% with open resection (*P*=0.13).(Table 2)

IV. Discussion

The purpose of this review paper is to systematically compare two different treatment modalities, endoscopic resection and open surgical resection, in terms of postoperative outcome variables such as positive margins, length of hospital stay, complication rates, recurrence rate and overall survival rate in the management of sinonasal malignancies.

Patients with sinonasal malignancies generally present with symptoms of unilateral nasal bleeding and obstruction of the nose[1]. In the past decades, the use of endoscopic surgeries in the sinonasal region was limited and predominantly preferred in cases with inflammatory nasal masses. The scope of resection through an endoscopic approach has widely been increased and various advanced methodologies have been implemented in the English literature[21,22]. The potential benefits of endoscopic resection are the elimination of facial scars and deformities caused by the open resection approach, short hospital stay, minimal trauma and cost effectiveness. However, endoscopic surgery has many limitations such as not being appropriate in cases with high volumes of tumor mass, which eventually results in high recurrence and a low survival rate postoperatively compared to open surgical resection[23-25].

1. Positive margins

Hagemann et al.[16] suggested that open surgical resection is the gold standard method for obtaining negative margins compared to endoscopic resection. However, Arnold et al.[14] reported insignificant differences in the percentage of patients with positive margins between endoscopic resection and open resection surgeries, similar association to the results of the current paper and Farquhar et al.[15] (*P*>0.05). Kilic et al.[4] reported that malignant tumors at stage IV B were treated with endoscopic approach. One probable explanation was that the surgeon would have been a skilled and experienced endoscopic surgeon. However, the authors did not verify this hypothesis as they did not indicate the number of patients treated by each surgeon. Another potential reason was that the surgeon may have mostly preferred a less invasive surgery since obtaining negative margins in advanced tumors is unlikely. This hypothesis is supported by the fact that even though the positive margins are comparable between endoscopic and open surgeries, the rate of positive margins was significantly greater in stage IV B patients who underwent endoscopic resection (endoscopic: 78.9%, open resection: 53.3%, *P*=0.045).

2. Length of hospital stay

Farquhar et al.[15] and Fu et al.[18] observed a shorter hospital stay with endoscopic surgery. The results of the above study agree with the current paper, as well as with Naunheim et al.[12], Mortuaire et al.[17], and Hagemann et al.[16]. The average length of hospital stay ranges from 3.0 to 4.7 days for endoscopic resection and 5.7 to 11.5 days for open resection. The reduction in hospital stay may be attributed to reduced costs, decreased postoperative complication rates, and readmission rates in sinonasal surgery[26]. Thus, the length of stay should be taken into consideration when deciding between endoscopic and open approaches for sinonasal malignancies.

3. Complication rates

Any surgical procedure can present with complications postoperatively, however the rates of complication according

to surgery remains unclear. Naunheim et al.[12] observed high rates of complication with open resection approach, and the occurrence of CSF leak was greater in cases with the endoscopic approach, showing similar correlations with Fu et al.[18]. In 2016, Hagemann et al.[16] performed a meta-analysis by comparing the surgical outcomes of the endoscopic and open resection approaches. Here, the authors reported that the outcomes for the endoscopic approach were similar to or greater than those for the open resection approach. Arnold et al.[14] reported that the complication rates were significantly lower in the endoscopic approach (60%) than in the open resection approach (78%), which agreed with Mortuaire et al.[17]. As found in the English literature[18], the overall complication rates between the endoscopic and open approaches range from 3% to 26% and 15% to 53%, respectively. The CSF leak rates were 3% to 12% for the endoscopic approach and 4% to 10% for the open approach.

4. Recurrence rate

In the current paper, the rate of recurrence was low in open surgical resection compared to the endoscopic approach (P>0.05). The above results agreed with Saedi et al.[19], wherein the authors reported a recurrence rate of 58 patients with open resection and 59 patients with endoscopic resection (P=0.168). Moreover, the authors found no significant findings in the time period between the treatment procedure and recurrence. Hanna et al.[27] observed 15% recurrence in 120 patients, where 93 patients were treated with endoscopic resection and 27 patients were treated with open resection, finding insignificant differences between these groups (P>0.05).

5. Overall survival rate

The overall survival rate was greater in endoscopic resection compared to open resection (P>0.05), which was a similar result to that found by Saedi et al.[19]. Here, the authors described a survival rate of 24 and 15 months for endoscopic resection, and 28 and 17 months for open resection, with insignificant differences found between endoscopic and open resection surgery (P=0.13). Hagemann et al.[16] reported 5-year survival rates of 87.5% in endoscopic resection and 84.6% in open resection for small tumors (T1 and T2) and 10-year survival rates of 52% in endoscopic resection and 33% in open resection for T4 tumors. Nicolai et al.[28] observed a 5-year survival rate of 91.4% and 58.8% for the endoscopic and open resection approaches, respectively. In contrast, Farquhar et al.[15] reported a 3-year survival rate for open resection of 86%, while that for the endoscopic resection approach was 74%.

6. Limitations

The current review has a few limitations:

1. The randomized controlled trial comparing the surgical outcomes between the endoscopic and open resection approaches was limited to studies in English.

2. Each approach uses a different technique to access the malignancies of the sinonasal region, which influences the surgical outcome, e.g., positive margins. Further studies should be encouraged to provide a detailed description of the surgical outcomes.

V. Conclusion

The overall surgical outcomes between endoscopic resection and open surgical resection for the management of sinonasal malignancies cannot be concluded from the studies and results described in the English literature. Though both approaches have comparable advantages and disadvantages, preoperative evaluation of cases based on the primary site, age of the patient, gender, tumor size, American Joint Committee on Cancer (AJCC) staging, and histologic grading is needed for determining the right treatment method, which can benefit patients by providing lower morbidity rates postoperatively.

Author's Contributions

Literature search, data collection, data analysis, data interpretation, manuscript writing was contributed by B.R.

Conflict of Interest

No potential conflict of interest relevant to this article was reported.

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