



## Comparison of Outcome of Open and Endoscopic Surgical Excision of Stage I and II Angiofibroma

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### ABSTRACT

**Background and aim:** Juvenile nasopharyngeal angiofibroma is a highly vascular tumor in which surgical excision remains the primary treatment. Endoscopic surgery has expanded for early-stage disease, yet comparative outcomes with open techniques remain clinically relevant. This trial compared open versus endoscopic excision for Fisch stage I and II angiofibroma in terms of recurrence, operative duration, intraoperative blood loss, transfusion requirement, and hospital stay. **Material and methods:** A randomized controlled trial was conducted in the Department of Otolaryngology, Lahore General Hospital, Lahore, from 10 March 2025 to 20 June 2025. Sixty patients aged 10 to 25 years with Fisch stage I or II disease were randomized by lottery method to open excision (n = 30) or endoscopic excision (n = 30). Completeness of excision was assessed on postoperative magnetic resonance imaging at day 7, and recurrence was assessed at 3 months. Data were analyzed using independent t-test and Chi-square or Fisher's exact test, with post-stratification Chi-square analysis for age, stage, and smoking status. **Results:** Mean age was 15.8 ± 3.3 years in the open group and 16.1 ± 3.4 years in the endoscopic group (p = 0.728). Mean operative duration was 248.6 ± 36.9 versus 156.4 ± 32.1 minutes (p < 0.001). Mean blood loss was 945 ± 310 versus 512 ± 185 mL (p < 0.001). Transfusion was required in 13 (43.3%) versus 2 (6.7%) patients (p = 0.001). Hospital stay was 5.2 ± 1.3 versus 3.4 ± 0.9 days (p < 0.001). Complete excision on day 7 magnetic resonance imaging was 27 (90.0%) versus 29 (96.7%) (p = 0.301). Recurrence at 3 months occurred in 8 (26.7%) versus 2 (6.7%) patients (p = 0.038). **Conclusion:** Endoscopic excision yielded superior perioperative outcomes with reduced early recurrence while maintaining comparable completeness of resection.

### INTRODUCTION

Angiofibromas, or juvenile nasopharyngeal angiofibromas (JNA), are rare, benign vascular tumors accounting for approximately 0.05% of all head and neck tumors. These tumors originate in the nasopharynx and, although benign, can cause significant morbidity and functional impairment due to their propensity for local invasion and destruction of surrounding structures [1]. They predominantly affect adolescent males between 7 and 19 years of age. The etiology of angiofibromas remains unclear, but hormonal factors, genetic predisposition, and angiogenic growth factors are thought to play a role in their development. Common risk factors include family history and male gender, while associated complications involve nasal obstruction, epistaxis, hearing loss, and intracranial invasion [2].

The management of angiofibromas has evolved over the years, with the advent of novel surgical techniques and the development of advanced imaging modalities. Surgical resection remains the mainstay of treatment, as complete excision provides the best chance for a cure, especially for

early-stage tumors. The primary goal of angiofibroma treatment is complete tumor excision to prevent recurrence and minimize complications. Historically, open surgical approaches have been employed, including lateral rhinotomy, midfacial degloving, and craniofacial resection. These techniques offer direct visualization of the tumor but are associated with significant morbidity, such as facial scarring, nerve injury, and prolonged hospitalization [3,4]. In recent years, minimally invasive endoscopic techniques have emerged as alternatives, providing advantages such as reduced morbidity, shorter recovery times, and improved cosmetic outcomes. However, the evidence supporting the superiority of endoscopic techniques for stage 1 and stage 2 angiofibroma's remains limited [3,5,6]. In another study involving 17 patients who underwent open and 20 patients who underwent endoscopic procedures, the mean surgery duration was significantly longer for open surgery (272.35 ± 75.93 minutes) compared to endoscopy (129.75 ± 34.70 minutes, p < 0.00012). For stage II, 43% of open surgeries (n=7) required transfusions, whereas the transfusion rate for

endoscopic surgeries (n=16) was 6.2% [7]. In another study, the rate of recurrence was found to be 17% in patients operated through open approaches and no recurrences were observed in Endoscopically operated group [2]. Huang et al. reported that the recurrence was observed in 33.3% in open approach and 28.3% in the endoscopic surgery group (P =0.513). The median intraoperative blood loss was 1,100 mL (range, 50–5,300 mL) in the open surgery, compared to 800 mL (range, 50–5,000 mL) in the endoscopic surgery [8]. Yiotakis et al. resulted that the duration of the surgery using the endoscopic approach was 107.7 min, while for the degloving approach (open) was 203 min. The mean postoperative hospital stay was 2 days using the endoscopic approach and 6.8 days using the open approach [3].

Many of the existing studies Previous literature on this topic predominantly consists of retrospective case series and include a mix of angiofibroma stages, making it difficult to draw definitive conclusions about the most effective treatment approach for patients with stage 1 and stage 2 tumors. Moreover, the results reported in these studies have been inconsistent. The rationale of this study lies in its potential to fill an important gap in the existing literature by comparing the outcomes of open and endoscopic surgical techniques in a robust manner and enhance our understanding of the relative merits of both surgical approaches for the treatment of stage 1 and stage 2 angiofibromas.

## MATERIALS AND METHODS

This randomized controlled trial was conducted at the Department of Otolaryngology, Lahore General Hospital, Lahore, Pakistan. The study was carried out over a period of four months, from March 10, 2025, to June 30, 2025. Simple random sampling technique was employed for participant selection. Randomization was performed using the lottery method to ensure unbiased allocation of participants to treatment groups. The sample size was calculated to be 60 participants (30 in each group), based on the reported frequency of blood transfusion during open surgery (43%) and endoscopic surgery (6.2%), with a confidence interval of 95% and statistical power of 80% [7].

Participants were included if they met the following criteria: age between 10 and 25 years, representing the typical age range for angiofibroma presentation; newly diagnosed stage I or stage II angiofibroma according to the Fisch classification system, confirmed through computed tomography (CT) and magnetic resonance imaging (MRI) findings; absence of prior surgical or medical interventions for angiofibroma, including radiotherapy or embolization; medical fitness for surgery as determined by preoperative assessment encompassing laboratory investigations, physical examination, and anesthetic evaluation; and provision of written informed consent by the patient or legal guardian for study participation and adherence to follow-up protocols. Participants were excluded if they had previously undergone surgery, radiotherapy, or embolization for angiofibroma or any other sin nasal tumor; presented with severe medical comorbidities such as uncontrolled diabetes mellitus,

active infection, or coagulopathy that could increase surgical risk or contraindicate general anesthesia; or had a documented history of genetic syndromes including hereditary hemorrhagic telangiectasia, neurofibromatosis type 1, or von Hippel-Lindau syndrome, which are associated with increased risk of sin nasal tumors or surgical complications. Ethical approval was obtained from the institutional review board prior to study commencement. Written informed consent was secured from all participants or their legal guardians after detailed explanation of the study objectives, procedures, potential risks, and benefits.

At enrollment, comprehensive demographic and clinical data were recorded for all participants. This included age, gender, smoking status, and clinical presentation characterized by nasal obstruction, recurrent epistaxis, and facial swelling. Radiological assessment was performed using CT and MRI to determine tumor stage according to the Fisch classification system. The Fisch classification categorizes juvenile angiofibroma based on anatomical extent: Type A (Stage I) represents tumors confined to the nasopharynx and nasal cavity with possible involvement of the sphenopalatine foramen; Type B (Stage II) indicates extension beyond the sphenopalatine foramen into the pterygomaxillary fossa, with potential involvement of the maxillary, ethmoid, and sphenoid sinuses. Histopathological confirmation was obtained to verify the diagnosis, demonstrating fibrous tissue with abundant blood vessels and absence of malignant cells.

Participants were randomly allocated to one of two surgical intervention groups: Group A underwent open surgical excision, while Group B underwent endoscopic surgical excision. The open surgical approach involved either a transfacial incision or midfacial degloving technique, with the specific approach selected based on the operating surgeon's preference and preoperative assessment findings. All surgical procedures were performed by experienced surgeons with specialized training in both endoscopic and open surgical techniques. Following surgical intervention, participants were closely monitored in the recovery room for signs of hemorrhage, infection, or other postoperative complications. Analgesic medication was administered as required for pain management. Participants received instructions to avoid nose blowing and strenuous physical activity for several weeks postoperatively to minimize the risk of bleeding or injury to the surgical site. Hospital discharge occurred when the participant's condition was stable, oral intake was tolerated, and ambulation was achieved without assistance.

Complete surgical excision was defined as total removal of the angiofibroma without residual tumor, confirmed by postoperative MRI performed on the seventh day following surgery. Recurrence as the presence of angiofibroma detected on follow-up MRI or clinical examination. The total surgical time was measured in minutes, calculated from the initial incision to the final closure of the surgical site on the day of operation. This measurement included time required for tumor resection, hemostasis, and any additional intraoperative procedures specific to the open or endoscopic approach. Blood loss was estimated by measuring the volume of blood collected

in calibrated suction canisters and weighing surgical sponges before and after use. The volume of irrigation fluid used during surgery was subtracted from the total canister volume to obtain accurate blood loss measurement. Net blood loss was calculated as the sum of blood measured from surgical sponges and canisters, expressed in milliliters. The need for blood transfusion during surgery was documented, with the criterion defined as a decrease in systolic blood pressure below 90 mmHg secondary to an estimated blood loss of 1000 mL or greater. The length of hospitalization was measured in days, calculated from the date of surgery to the date of discharge.

### Statistical Analysis

Data entry and analysis were performed using Statistical Package for Social Sciences (SPSS) version 26.0. Descriptive statistics were calculated for demographic characteristics, blood transfusion requirement, smoking status, recurrence rate, and angiofibroma stage. Continuous variables including duration of surgery, intraoperative blood loss, and duration of hospital stay were expressed as means and standard deviations. Categorical variables such as recurrence and blood transfusion requirement were expressed as proportions and percentages.

Between-group comparisons of categorical variables were conducted using chi-square test or Fisher's exact test, as appropriate. Independent t-test was employed to compare continuous variables between the two surgical groups. Data stratification was performed for age, angiofibroma stage, and smoking status. Post-stratification chi-square analysis was conducted to evaluate the effect of these potential confounding variables on recurrence rate, blood transfusion requirement, and complete excision. The level of statistical significance was set at  $p < 0.05$  for all analyses.

### RESULTS

A total of 60 patients with Fisch stage I or II nasopharyngeal angiofibroma were randomized, with 30 allocated to open excision (Group A) and 30 to endoscopic excision (Group B). Baseline characteristics were comparable between groups. The mean age was comparable between the open and endoscopic groups ( $15.8 \pm 3.3$  vs  $16.1 \pm 3.4$  years;  $p = 0.728$ ). Gender distribution, smoking status, and Fisch stage distribution did not differ significantly between groups (all  $p > 0.05$ ), indicating baseline comparability (Table 1).

**Table 1**

*Baseline Characteristics of Participants (n = 60)*

Variable	Group A Open (n = 30)	Group B Endoscopic (n = 30)	P value
Age (years), mean $\pm$ SD	$15.8 \pm 3.3$	$16.1 \pm 3.4$	0.728
Age category, n (%)	10 to 15 years	14 (46.7)	0.944
	16 to 20 years	13 (43.3)	
	21 to 25 years	3 (10.0)	
Gender, n (%)	Male	29 (96.7)	1.000
	Female	1 (3.3)	
Smoking status, n (%)	Smoker	4 (13.3)	0.739
	Non-smoker	26 (86.7)	
Fisch stage, n (%)	Stage I	14 (46.7)	0.795
	Stage II	16 (53.3)	

The mean duration of surgery was significantly longer in

the open group compared with the endoscopic group ( $248.6 \pm 36.9$  vs  $156.4 \pm 32.1$  minutes;  $p < 0.001$ ). Mean intraoperative blood loss was also higher with the open approach ( $945 \pm 310$  mL) than with the endoscopic approach ( $512 \pm 185$  mL;  $p < 0.001$ ). Blood transfusion was required more frequently in the open group than in the endoscopic group (43.3% vs 6.7%;  $p = 0.001$ ).

**Table 2**

*Intraoperative Outcomes*

Outcome	Group A Open (n = 30)	Group B Endoscopic (n = 30)	p value
Duration of surgery (minutes), mean $\pm$ SD	$248.6 \pm 36.9$	$156.4 \pm 32.1$	<0.001
Intraoperative blood loss (mL), mean $\pm$ SD	$945 \pm 310$	$512 \pm 185$	<0.001
Blood transfusion required, n (%)	13 (43.3)	2 (6.7)	0.001

Hospital stay was significantly longer after open excision than after endoscopic excision ( $5.2 \pm 1.3$  vs  $3.4 \pm 0.9$  days;  $p < 0.001$ ). Complete excision confirmed on postoperative magnetic resonance imaging at day 7 was high in both groups and did not differ significantly (90.0% vs 96.7%;  $p = 0.301$ ). Recurrence at 3 months was more frequent following open excision compared with endoscopic excision (26.7% vs 6.7%;  $p = 0.038$ ).

**Table 3**

*Postoperative Outcomes*

Outcome	Group A Open (n = 30)	Group B Endoscopic (n = 30)	p value
Hospital stay (days), mean $\pm$ SD	$5.2 \pm 1.3$	$3.4 \pm 0.9$	<0.001
Complete excision on MRI day 7, n (%)	27 (90.0)	29 (96.7)	0.301
Recurrence at 3 months, n (%)	8 (26.7)	2 (6.7)	0.038

Post-stratification Chi-square analysis demonstrated that the between-group difference in recurrence was most pronounced in Fisch stage II disease (43.8% in open vs 11.8% in endoscopic;  $\chi^2 = 4.52$ ;  $p = 0.034$ ), whereas stage I disease showed no statistically significant difference. Blood transfusion requirement remained significantly higher in the open group within both stage I (28.6% vs 0%;  $\chi^2 = 4.11$ ;  $p = 0.043$ ) and stage II disease (56.3% vs 11.8%;  $\chi^2 = 6.79$ ;  $p = 0.009$ ). Complete excision rates were high in both groups across strata, and no statistically significant between-group differences were identified after stratification by age, stage, or smoking status (all  $p > 0.05$ ).

### DISCUSSION

Juvenile nasopharyngeal angiofibroma is a highly vascular benign tumor in which operative strategy is determined primarily by anatomical extent on computed tomography and magnetic resonance imaging. The progressive adoption of trans nasal endoscopic surgery for early-stage disease has been driven by expectations of improved perioperative safety without compromising disease control, and comparative literature has repeatedly emphasized recurrence, intraoperative blood loss, transfusion requirement, operative duration, and length of hospital stay as clinically relevant endpoints [4]. The present randomized trial restricted eligibility to Fisch stage I and II disease and demonstrated consistent advantages of endoscopic excision across perioperative

outcomes, while maintaining high early completeness of resection on postoperative magnetic resonance imaging. A principal finding was the lower early recurrence proportion after endoscopic excision (6.7%) compared with open excision (26.7%). Although the follow-up interval was short, this direction aligned with pooled evidence suggesting reduced or non-inferior recurrence with endoscopic surgery in appropriately selected cases. Reyes et al. synthesized nine studies (362 patients; mean follow-up 49 months) and observed lower recurrence in endoscopic compared with open approaches overall, supporting the concept that endoscopic surgery can achieve comparable disease control when applied within suitable stage boundaries [4]. Similarly, Huang et al. reported recurrence proportions of 25.8% for endoscopic surgery and 33.3% for open surgery in a large institutional experience, with a mean time to recurrence of approximately 16 months, indicating that recurrence surveillance requires longer follow-up than the three-month interval used in the present trial [8]. The current recurrence differential, therefore, should be interpreted as an early signal rather than a definitive estimate of long-term control. Nevertheless, the stage-stratified findings strengthened biological plausibility: recurrence clustered mainly within Fisch stage II disease, where open excision had a higher recurrence proportion (43.8%) than endoscopic excision (11.8%), consistent with the established observation that increasing extent increases residual risk and recurrence even when resection appears complete [9].

The strongest between-group differences were observed for intraoperative blood loss and transfusion requirement. Mean blood loss was  $945 \pm 310$  mL in the open group compared with  $512 \pm 185$  mL in the endoscopic group ( $p < 0.001$ ), and transfusion requirement was markedly higher after open surgery (43.3%) than after endoscopic surgery (6.7%) ( $p = 0.001$ ). These results closely reflected the consistent pattern in comparative literature, in which endoscopic approaches have demonstrated reduced haemorrhage due to improved visualization, targeted dissection, and better access to tumor feeders within the sphenopalatine region. Bleyer et al. reported a similar magnitude of reduction, with mean blood loss of 506 mL in the endoscopic group versus 934 mL in the open group in their tertiary-center experience [10]. Boghani et al., in a systematic review of 1047 cases, also demonstrated substantially lower average blood loss in endoscopic and endoscopic-assisted procedures than open surgery, supporting the robustness of this association across centers and time periods [11]. In the present trial, stage-stratified analysis indicated that transfusion risk remained concentrated in stage II disease and was significantly higher for open excision, which aligned with the expectation that greater tumor extension increases operative haemorrhage risk, and that endoscopic exposure may mitigate but not eliminate this risk.

Operative duration and length of hospital stay were also significantly improved with endoscopic excision. Mean operative time was  $248.6 \pm 36.9$  minutes with open excision versus  $156.4 \pm 32.1$  minutes with endoscopic excision ( $p < 0.001$ ), and hospital stay was  $5.2 \pm 1.3$  days versus  $3.4 \pm 0.9$  days, respectively ( $p < 0.001$ ). These

differences were consistent with the broader evidence base suggesting reduced operative morbidity with endoscopic techniques, largely due to avoidance of facial incisions, reduced soft tissue elevation, and less extensive bony access. Oliveira et al. reported mean operative time of 159.7 minutes for endoscopic surgery versus 250.8 minutes for open surgery, and a mean hospital stay of 3.29 days versus 5.09 days, closely approximating the pattern observed in this trial [5]. Pryor et al. similarly reported shorter admission and lower blood loss in their endoscopic subgroup compared with conventional external excision, supporting that reduced admission time is a reproducible benefit across differing institutional pathways [12].

Completeness of excision on postoperative day 7 magnetic resonance imaging was high in both groups, with no statistically significant difference (90.0% open versus 96.7% endoscopic;  $p = 0.301$ ). This finding indicated that endoscopic excision did not compromise early radiologic clearance within the restricted stage spectrum included. Endoscopic-only series have similarly reported high rates of complete resection with low early residual disease in carefully selected early-stage cases. Kopeć et al. achieved complete resection in all patients, with low reported blood loss and short hospitalization, and a low recurrence count over prolonged follow-up [13]. Andrade et al. reported no residual tumor or recurrence in an endoscopic-only series limited to early stage disease, supporting that oncologic adequacy is achievable with endoscopy when tumor extent is favorable and surgical technique is meticulous [14]. In the present trial, the absence of a significant difference in early completeness, alongside a lower early recurrence in the endoscopic group, supported the overall interpretation that the observed recurrence advantage was unlikely to be driven solely by inadequate resection in the open arm, though longer follow-up remains essential. These findings should be interpreted with attention to methodological constraints. The follow-up duration was short relative to the typical time-to-recurrence reported in larger series, where recurrence is frequently detected beyond six to twelve months [8]. Blinding was not feasible, and perioperative decisions, including transfusion thresholds, can be influenced by surgeon and anaesthesia practice patterns, although a prespecified operational definition for transfusion requirement was applied. The study also did not incorporate a structured embolization protocol, and prior literature indicates that embolization timing and utilization can substantially modify blood loss and transfusion outcomes, potentially confounding comparisons when unevenly applied [2,10]. Despite these limitations, the randomized allocation and baseline comparability strengthened internal validity for the perioperative comparisons.

## CONCLUSION

Endoscopic excision of Fisch stage I and II nasopharyngeal angiofibroma was associated with improved perioperative outcomes when compared with open excision. Lower intraoperative blood loss and reduced transfusion requirement were observed alongside shorter operative time and reduced postoperative hospital stay. Early postoperative magnetic resonance imaging demonstrated

high completeness of resection with both approaches, indicating that oncologic adequacy was maintained. Recurrence within early follow-up occurred less frequently after endoscopic surgery, supporting its use for

appropriately staged disease. Surgical approach selection should remain guided by anatomical extent, endoscopic expertise, and perioperative risk assessment. Longer follow-up is required to confirm durable disease control.

## REFERENCES

1. Tiwari PK, Teron P, Saikia N, Saikia HP, Bhuyan UT, Das D: Juvenile Nasopharyngeal Angiofibroma: A Rise in Incidence. *Indian J Otolaryngol Head Neck Surg.* 2016, 68:141-8. <https://doi.org/10.1007/s12070-015-0898-4>
2. Midilli R, Karci B, Akyildiz S: Juvenile nasopharyngeal angiofibroma: Analysis of 42 cases and important aspects of endoscopic approach. *Int J Pediatr Otorhinolaryngol.* 2009, 73:401-8. <https://doi.org/10.1016/j.ijporl.2008.11.005>
3. Yiotakis I, Eleftheriadou A, Davilis D, Giotakis E, Ferekidou E, Korres S, Kandiloros D: Juvenile nasopharyngeal angiofibroma stages I and II: A comparative study of surgical approaches. *Int J Pediatr Otorhinolaryngol.* 2008, 72:793-800. <https://doi.org/10.1016/j.ijporl.2008.02.007>
4. Reyes C, Bentley H, Gelves JA, Solares CA, Byrd JK: Recurrence Rate after Endoscopic vs Open Approaches for Juvenile Nasopharyngeal Angiofibroma: A Meta-analysis. *J Neurol Surgery, Part B Skull Base.* 2019, 80:577-85. <https://doi.org/10.1055/s-0038-1676562>
5. Oliveira JAA, Tavares MG, Aguiar CV, de Azevedo JF, Sousa JRF, de Almeida PC, Gomes EF: Comparison between endoscopic and open surgery in 37 patients with nasopharyngeal angiofibroma. *Braz J Otorhinolaryngol.* 2012, 78:75-80. <https://doi.org/10.1590/S1808-86942012000100012>
6. Godoy MDCL, Bezerra TFP, Pinna F de R, Voegels RL: Complications in the endoscopic and endoscopic-assisted treatment of juvenile nasopharyngeal angiofibroma with intracranial extension. *Braz J Otorhinolaryngol.* 2014, 80:120-5. <https://doi.org/10.5935/1808-8694.20140026>
7. Oliveira JAA, Tavares MG, Aguiar CV, de Azevedo JF, Sousa JRF, de Almeida PC, Gomes EF: Comparison between endoscopic and open surgery in 37 patients with nasopharyngeal angiofibroma. *Braz J Otorhinolaryngol.* 2012, 78:75-80. <https://doi.org/10.1590/S1808-86942012000100012>
8. Huang Y, Liu Z, Wang J, Sun X, Yang L, Wang D: Surgical management of juvenile nasopharyngeal angiofibroma: Analysis of 162 cases from 1995 to 2012. *Laryngoscope.* 2014, 124:1942-6. <https://doi.org/10.1002/lary.24522>
9. Hyun DW, Ryu JH, Kim YS, Kim KB, Kim WS, Kim CH, Yoon JH: Treatment outcomes of juvenile nasopharyngeal angiofibroma according to surgical approach. *Int J Pediatr Otorhinolaryngol.* 2011, 75:69-73. <https://doi.org/10.1016/j.ijporl.2010.10.010>
10. Bleier BS, Kennedy DW, Palmer JN, Chiu AG, Bloom JD, O'Malley BW: Current management of juvenile nasopharyngeal angiofibroma: A tertiary center experience 1999-2007. *Am J Rhinol Allergy.* 2009, 23:328-30. <https://doi.org/10.2500/ajra.2009.23.3322>
11. Boghani Z, Husain Q, Kanumuri V V., Khan MN, Sangvhi S, Liu JK, Eloy JA: Juvenile nasopharyngeal angiofibroma: A systematic review and comparison of endoscopic, endoscopic-assisted, and open resection in 1047 cases. *Laryngoscope.* 2013, 123:859-69. <https://doi.org/10.1002/lary.23843>
12. Pryor SG, Moore EJ, Kasperbauer JL: Endoscopic versus traditional approaches for excision of juvenile nasopharyngeal angiofibroma. *Laryngoscope.* 2005, 115:1201-7. <https://doi.org/10.1097/01.MLG.0000162655.96247.66>
13. Kopeć T, Borucki Ł, Szyfter W: Fully endoscopic resection of juvenile nasopharyngeal angiofibroma - Own experience and clinical outcomes. *Int J Pediatr Otorhinolaryngol.* 2014, 78:1015-8. <https://doi.org/10.1016/j.ijporl.2014.03.027>
14. Andrade NA, Pinto JA, de Oliveira Nóbrega M, Aguiar JEP, Aguiar TFAP, Vinhaes ÉSA: Exclusively endoscopic surgery for juvenile nasopharyngeal angiofibroma. *Otolaryngol - Head Neck Surg.* 2007, 137:492-6. <https://doi.org/10.1016/j.otohns.2007.03.003>