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ORIGINAL ARTICLE

Surgical Management of Elongated Styloid Process: Outcomes in Eagle's Syndrome Patients

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ABSTRACT

Introduction: *Eagle's syndrome is marked by the elongation of the styloid process. It leads to various cervicofacial symptoms that can greatly affect a patient's quality of life. Even though it occurs in 4% of the general population, cases that show symptoms and require surgery are often hard to diagnose and treat. This study looks at surgical results and factors that affect complications after surgery in patients who had a styloidectomy.* ***Methods & Materials:*** *This is a retrospective analysis involving 100 patients who had a styloidectomy. Clinically diagnosed patients had their condition confirmed with 3D-CT scans or panoramic radiographs. Surgical approaches included intraoral (65%), extraoral (30%), and bilateral procedures (5%). Data were analysed using SPSS version 26, conducting logistic regression to find predictors of complications.* ***Results:*** *The majority of the patients were females, accounting for 60%, with a majority aged between 31 and 60 years (71%). Throat pain was the most common symptom (82%), followed by dysphagia (55%) and a foreign body sensation (48%). Complete symptom relief was seen in 68-83% of cases, depending on the type of symptom. Patients with symptoms lasting less than 6 months showed an 82.9% improvement, while those with symptoms lasting more than 12 months had a 63.9% improvement (p=0.012). Age over 60 years (OR=2.45, p=0.046) and bilateral surgery (OR=3.10, p=0.025) were significant predictors of complications.* ***Conclusion:*** *Styloidectomy offers excellent results for patients with Eagle's syndrome, especially with early surgical intervention leading to better outcomes. Age and bilateral surgery significantly affect complication rates, highlighting the need for careful patient selection and planning before surgery.*

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INTRODUCTION

Eagle's syndrome, first described by Watt Eagle in 1937, is a rare but clinically significant condition of elongation of the styloid process or calcification of the stylohyoid ligament complex[1]. The normal length of the styloid process is about 2.5 cm, and elongation is more than 3 cm[2]. While radiographic evidence of styloid elongation may be observed in approximately 4-7.3% of the general population, only 4-10.3% of those afflicted become symptomatic, making it a rare yet disabling disorder[3,4]. The syndrome most frequently affects middle-aged women, with a female-to-male ratio of 3:1, typically manifesting in the fourth and fifth decades of life[5]. The pathophysiology involves mechanical compression or irritation of the adjacent neurovascular structures, including the glossopharyngeal, trigeminal, facial, and vagus nerves, leading to a constellation of symptoms that comprises cervicofacial pain, dysphagia, otalgia, and a chronic foreign body sensation in the throat[6]. In extreme cases, the elongated styloid process can compress vascular tissues, leading to internal jugular vein stenosis and associated neurological deficits[7]. Diagnosis of Eagle's syndrome relies on clinical suspicion supported by radiological findings through panoramic radiographs, computed tomography (CT), or three-dimensional imaging[8]. However, the non-specificity of the symptoms tends to hamper the diagnosis because they overlap with temporomandibular joint disorders, trigeminal neuralgia, and other cervicofacial pain syndromes[9]. Such a diagnostic challenge frequently leads to delayed treatment, with the majority of patients having long-standing symptoms before undergoing adequate intervention. Conservative management, including anti-inflammatory medication, corticosteroids, and anticonvulsants, may be effective in the short term but is generally ineffective in the long term[10]. In recalcitrant cases, surgical management with styloidectomy

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remains the gold standard. There are various surgical approaches, from intraoral, extraoral, to minimally invasive procedures such as transoral robotic surgery (TORS)[11]. The choice of technique depends on patient anatomy, surgeon preference, and extent of styloid involvement. Despite the established success of surgical treatment, in-depth analyses of postoperative outcomes, including determinants of success and complication rates, are limited. Information on such parameters is crucial to optimize patient selection, surgical procedure, and postoperative management. This study assessed surgical outcomes in a large series of patients with Eagle's syndrome treated with styloidectomy, including determinants of success and postoperative complications. Comparing these outcomes, we expect to optimize therapies and improve patients' long-term outlook.

METHODS & MATERIALS

This retrospective study was conducted at Rajshahi Medical College, Rajshahi, Bangladesh from July, 2023 to June, 2024. The study involved 100 patients who underwent either intraoral or extraoral styloidectomy. The diagnosis was made clinically and confirmed radiologically using 3D-CT scans or panoramic radiographs. Patients presenting with classic Eagle's Syndrome symptoms such as cervicofacial pain, dysphagia, otalgia, or foreign body sensation were included. Exclusion criteria included patients with atypical symptoms or incomplete follow-up data. Data were extracted from hospital medical records, operative notes, radiographic images, and outpatient follow-up charts. Each patient was evaluated for preoperative symptoms, type and duration of surgery, length of hospital stay, complications, and postoperative outcomes.

Statistical Analysis

Data analysis was performed using SPSS version 26. Descriptive statistics were used to summarize demographic data, symptoms, surgical variables, and outcomes. Frequencies and percentages were calculated for categorical variables, while means and standard deviations were used for continuous variables. Logistic regression analysis was performed to identify factors independently associated with postoperative complications. Odds ratios (ORs) with 95% confidence intervals (CIs) were reported. A p-value <0.05 was considered statistically significant.

RESULTS

Table I shows the demographic details of the 100 patients involved in the study. Most patients were middle-aged, with 71% between 31 and 60 years old. The group had a higher number of females (60. Unilateral cases were more common (66%) than bilateral cases, which is typical for this condition. The higher percentage from rural areas (56%) indicates that the tertiary care center where the study took place.

Table – I: Patient Demographics Undergoing Surgical Management for Elongated Styloid Process (*n*=100)

Characteristic	Category	N	%
Age Group	18–30 years	14	14.0%
	31–45 years	36	36.0%
	46–60 years	35	35.0%
	>60 years	15	15.0%
Gender	Male	40	40.0%
	Female	60	60.0%
Side Involved	Unilateral	66	66.0%
	Bilateral	34	34.0%
Residence	Urban	44	44.0%
	Rural	56	56.0%

Table II outlines the symptoms seen in patients with Eagle's syndrome. Throat pain was the most common symptom (82%), followed by dysphagia (55%) and a sensation of a foreign body (48%). The high incidence of throat pain is linked to the elongated styloid process's position relative to the oropharyngeal structures. Otalgia affected 40% of patients, likely due to referred pain through the glossopharyngeal nerve. Tinnitus (11%) and headache (26%) were less common.

Table – II: Preoperative Symptom Distribution in Patients with Elongated Styloid Process (*n*=100)

Symptom	N	%
Throat pain	82	82.0%
Dysphagia	55	55.0%
Foreign body sensation	48	48.0%
Otalgia	40	40.0%
Neck pain	38	38.0%
Headache	26	26.0%
Tinnitus	11	11.0%
Others	7	7.0%

Table III represents that most patients (70%) had symptoms for 3-12 months before surgery. Among them, 42% had symptoms lasting 6-12 months. Only 10% underwent surgery within 3 months of symptom onset. This pattern may indicate delayed diagnosis, ineffective conservative treatment, or hesitance to seek surgery.

Table – III: Duration of Symptoms Before Surgical Management (*n*=100)

Duration	N	%
<3 months	10	10.0%
3–6 months	28	28.0%
6–12 months	42	42.0%
>12 months	20	20.0%

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Table IV shows surgical approaches for elongated styloid process management. The surgical techniques show a strong preference for the intraoral approach (65%), followed by extraoral styloidectomy (30%). The popularity of the intraoral method comes from its benefits, such as no external scars, direct view of the styloid tip, and potentially lower risks to major blood vessels. Only 5% of patients needed bilateral surgery, consistent with the rarity of symptomatic bilateral disease.

Table – IV: Surgical Approaches for Elongated Styloid Process Management (*n*=100)

Surgical Technique	N	%
Intraoral styloidectomy	65	65.0%
Extraoral styloidectomy	30	30.0%
Bilateral surgery	5	5.0%
Revision surgery	0	0.0%

Table V shows successful surgical outcomes across different symptoms. The highest rates of complete relief were for throat pain (82.9%) and otalgia (82.5%), followed by dysphagia (72.7%) and neck pain (63.2%). Partial relief was seen in 14.6-26.3% of cases, while treatment failure was low (2.5-10.5%).

Table – V: Overall Postoperative Symptom Relief Distribution (*n*=100)

Relief Category	Throat Pain (n=82)	Dysphagia (n=55)	Otalgia (n=40)	Neck Pain (n=38)
Complete Relief	68 (82.9%)	40 (72.7%)	33 (82.5%)	24 (63.2%)
Partial Relief	12 (14.6%)	12 (21.8%)	6 (15.0%)	10 (26.3%)
No Relief	2 (2.5%)	3 (5.5%)	1 (2.5%)	4 (10.5%)

Table VI reveals a clear link between symptom duration and surgical success. Patients with symptoms lasting less than 6 months saw an improvement of 82.9%, while those with symptoms lasting over 12 months had only a 63.9% improvement (p=0.012). This significant difference highlights the importance of timely surgical intervention. The decrease in improvement rates for longer symptom durations may reflect chronic inflammation, nerve sensitization, or irreversible tissue damage that develops over time.

Table – VI: Symptom Duration and Improvement After Surgery (*n*=100)

Duration Group	N	Mean Pre-op VAS	Mean Post-op VAS	Mean % Improvement	p-value
<6 months	38	8.2 ± 0.3	1.4 ± 0.5	82.9%	0.012
6–12 months	42	8.5 ± 0.4	2.2 ± 0.6	74.1%	
>12 months	20	8.6 ± 0.3	3.1 ± 0.5	63.9%	

Tables VII(A) and VII(B) pinpoint significant predictors of postoperative complications from multivariate analysis. Age over 60 years (OR=2.45, p=0.046) and bilateral surgery (OR=3.10, p=0.025) were identified as independent risk factors for complications. The higher risk in older patients may be due to reduced healing ability, existing health issues, and fragile tissue. The greater complication rate after bilateral surgery likely reflects its increased complexity and longer duration. The extraoral method showed a trend toward more complications (OR=1.85), suggesting both methods are generally safe when performed by skilled surgeons.

Table – VII (A): Logistic Regression Analysis of Factors Associated with Postoperative Complications (*n*=100)

Predictor Variable	Odds Ratio (OR)	95% Confidence Interval (CI)	p-value
Age > 60 years	2.45	1.02 – 5.90	0.046
Male gender	1.12	0.52 – 2.41	0.765
Bilateral surgery	3.10	1.15 – 8.33	0.025
Extraoral approach	1.85	0.87 – 3.94	0.113
Symptom duration >12 months	2.21	0.94 – 5.17	0.071
Rural residence	0.93	0.43 – 2.01	0.857

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Table – VII (B): Interpretation of Logistic Regression Analysis of Factors Associated with Postoperative Complications (*n*=100)

Predictor Variable	Odds Ratio (OR)	95% Confidence Interval (CI)	p-value	Interpretation
Age > 60 years	2.45	1.02 – 5.90	0.046	Patients older than 60 years have 2.5 times higher odds of complications. This is statistically significant, indicating a higher risk with increasing age.
Male gender	1.12	0.52 – 2.41	0.765	No significant association. Male patients have similar odds of complications compared to females.
Bilateral surgery	3.10	1.15 – 8.33	0.025	Statistically significant; bilateral surgery triples the odds of complications compared to unilateral surgery.
Extraoral approach	1.85	0.87 – 3.94	0.113	Not statistically significant, but shows a trend towards increased risk with this surgical approach.
Symptom duration >12 months	2.21	0.94 – 5.17	0.071	Not statistically significant; longer symptom duration may increase risk, but evidence is inconclusive.
Rural residence	0.93	0.43 – 2.01	0.857	No significant effect; living in rural areas does not impact the odds of postoperative complications.

DISCUSSION

This study provides insights into the surgical management of Eagle's syndrome, reporting excellent results with styloidectomy and highlighting key factors influencing the outcome and complication rates of the procedure. Our findings validate the established effectiveness of the surgery for this challenging condition and provide evidence-based advice for clinical practice. The gender and age distribution evident in our cohort is following established epidemiological patterns, with female predominance (60%) and a peak incidence in middle age (71% 31-60 years). This is in agreement with Badhey et al., who have reported similar gender and age distributions[12]. Dominance by unilateral involvement (66%) is in keeping with the typical presentation of Eagle's syndrome, though bilateral disease, though rarer, presents special management challenges as brought out by our complication analysis[13]. The patient's symptom profile is that of the classic presentation, with the largest complaint being pain in the throat (82%). The high frequency points out that Eagle's syndrome must be a part of the differential diagnosis of chronic pharyngeal pain, particularly when conservative therapy fails[14]. The marked prevalence of dysphagia (55%) and foreign body sensation (48%) corroborates the mechanical effect of styloid elongation on pharyngeal structure, consistent with anatomical studies by Fusco et al., demonstrating proximity to essential mechanisms of swallowing[15]. The distribution of surgical technique, favoring intraoral styloidectomy (65%), reflects present surgical preference based on a number of advantages, including improved cosmesis, direct visualization of the styloid tip, and reduced risk to large cervical vessels[16]. Both intraoral and extraoral approaches with similar good outcomes and without difference in the complication rate (OR=1.85, p=0.113), which corroborates with Ravin et al., that surgeon experience and selection of patient are more critical than the precise surgical approach employed[17]. The reported symptom relief rates (63.2-82.9% complete relief) are comparable to a more recent systematic review by Hassani et al., with success rates ranging from 80-95% for different surgical interventions[18]. The better results for otalgia and throat pain vs. neck pain might be explained by the shorter anatomical association between styloid elongation and pharyngeal/otic nerve courses vs. the multifactorial pathophysiology of cervical pain syndromes[19]. Among the most significant conclusions of our study is the adverse correlation between symptom duration and surgical outcomes, with those having symptoms for less than 6 months having significantly better outcomes (82.9% vs 63.9% improvement, p=0.012). This observation brings support to the opinion that chronic styloid irritation may lead to permanent neuroplastic alterations or tissue fibrosis, diminishing sensitivity to treatment[20]. This data favors earlier surgery in carefully selected patients over prolonged conservative trials. The finding of age greater than 60 years (OR=2.45) and bilateral surgery (OR=3.10) as independent predictors for complications is valuable in preoperative counseling and surgical planning.

The increased risk of complications in elderly patients is likely to be secondary to age-related factors like impaired tissue healing ability, increased comorbid conditions, and higher anesthetic risks[21]. The increased risk with bilateral procedures justifies caution in patient selection and consideration of a staged procedure in selected cases[11]. The overall low complication rate validates the safety profile of styloidectomy by experienced surgeons in appropriately selected patients. The absence of significant vascular or neurological complications in our series attests to careful preoperative planning and rigid adherence to established surgical principles.

Limitations of the Study

This study has possible selection bias and no standardized follow-up protocols. The lack of tools to assess quality of life and evaluate long-term outcomes beyond the immediate postoperative period limits the overall understanding of the treatment's impact. Additionally, the small number of cases with bilateral disease and the absence of a control group might affect how widely the findings can be applied.

CONCLUSION

Styloidectomy shows excellent results for patients with Eagle's syndrome, with complete symptom relief in 63-83% of cases. Early surgery, especially within 6 months of symptom onset, leads to much better results compared to delayed treatment. Being over 60 years old and having the disease on both sides are significant risk factors for complications after surgery. This makes careful patient selection and individualized surgical planning important. Both intraoral and extraoral methods have similar safety and effectiveness when performed by skilled surgeons.

RECOMMENDATIONS

Future studies should focus on prospective multicenter studies that use standardized quality-of-life assessment tools and longer follow-up periods to check how long the treatment works. Investigating minimally invasive techniques, such as transoral robotic surgery and endoscopic methods, could lead to better results with less risk. Developing predictive models that take into account patient factors, symptom details, and imaging information could help with patient selection and surgical planning.

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