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Arytenoid adduction asymmetry among patients with laryngeal disorders

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Abstract

Background Arytenoid asymmetry is usually an incidental finding during video-pharyngo-laryngoscopic examinations, and few otolaryngologists have described the clinical implications of this among patient with laryngeal disorders.

Aim The aim of the study is to document the prevalence of arytenoid adduction asymmetry in patients who had video-pharyngo-laryngoscopy and determine if there is any possible association between arytenoid adduction asymmetry and hoarseness.

Methods This is a retrospective descriptive study involving patients who had video-pharyngo-laryngoscopic examinations for various indications. The medical charts and video-pharyngo-laryngoscopic examination findings recorded in the stored database in ENT outpatient departments of two institutions over a 2-year period were retrospectively reviewed for age, sex, occupation, presenting complaint, and indication for video-pharyngo-laryngoscopic findings and diagnosis. Arytenoid adduction asymmetry was defined in relation to the position of the corniculate cartilages, cuneiform cartilages, and aryepiglottic angle. All the variables in the data were analyzed using Statistical Product and Service Solution (SPSS) version 25.

Results A total of 152 out of 209 patients had complete information needed for the review, 59 were males and 93 females with age range 20–91 years, and mean age was 46 ± 15.5 years. The overall prevalence rate for adduction asymmetry was 44.7%. Arytenoid asymmetry was seen commonest among the 5th and 6th decades of life and highest among the professional voice users (55%), while the male-to-female ratio was 1.6:1.

Hoarseness constituted 40.1% of all indications for video-pharyngo-laryngoscopy, with 71% of patients with hoarseness having a primary laryngeal lesion, 26% had laryngopharyngeal reflux, and 3.3% were due to pubertal voice changes. A significant association was found between arytenoid asymmetry of the male gender P -value 0.027 and hoarseness P -value 0.026.

Conclusion Arytenoid adduction asymmetry is prevalent in the 5th and 6th decades of life, among patients with hoarseness resulting from unilateral primary laryngeal disorders.

Keywords Arytenoid adduction asymmetry, Laryngeal disorders, Video-laryngoscopy hoarseness

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Background

The vocal cords play a major role in phonation [1], and failure of adduction can occur as a result of lesion on the vocal cords or paresis of recurrent laryngeal nerve impairing the movement of the cords resulting in dysphonia [2]. The larynx plays a prominent role in physiology of breathing and phonation and also aid with deglutition [3]. Voice production depends on the balance between the two vocal folds. Various researchers have documented laryngeal adduction asymmetries in the absence of voice complaints [2, 4]. It is possible to infer that many cases of arytenoid adduction asymmetries seen in patients with voice disorders may have no bearing on their presenting complaint [4]. Arytenoid adduction is an important feature in the assessment of persons with voice complaints, and arytenoid adduction asymmetries are considered to be part of the pathology when it exists with paralysis, paresis, arytenoid dislocation, and arytenoid fixation [5].

Various prevalence values have been documented for arytenoid adduction asymmetry ranging from 13 to 54% [6–8]. The documented prevalence varies with the type of asymmetry, the patient's age, and sex [2–5]. The prevalence increases with aging process due to changes in the various component of the larynx affecting the cartilages, joints, muscles, and epithelial lining of the vocal fold [2].

Arytenoid adduction asymmetry is commoner in male compared to female [2–4, 6–8], and it is commoner in the 3rd and 4th decades of life [2–4, 6–8].

Arytenoid adduction asymmetry has been documented in both normophonic and dysphonic patients [2–4, 6–8]. Among dysphonic patient symptoms and diseases documented were high pitch strain while singing, sore throat, hoarseness, pharyngeal dryness, vocal process granuloma, muscle tension dysphonia, and ventricular band dysphonia [2, 3, 5–7]. Arytenoid adduction asymmetry has been documented among normophonic patients without any vocal symptoms or diseases [2, 4] with laterality of asymmetry more on the right compared to the left [2, 3, 5–8].

Arytenoid asymmetries were classified according to the position of the corniculate, cuneiform cartilages, and the aryepiglottic angle [2, 3, 5–8].

The commonest adduction asymmetry is the anteroposterior position of the corniculate or cuneiform cartilages which is more frequent in older people and singers [4].

The justification for this study is to fill the knowledge gap as there is paucity or dearth of literature on the topic in the subregion giving the impression that it is an uncommon finding where most studies carried out were on laryngeal disorders, and the various causes of

dysphonia [9–15] were also added to the existing body of knowledge of our findings on this topic.

Research hypothesis

Null hypothesis

There is no significant association between hoarseness and arytenoids asymmetry among patients with laryngeal disorders.

Alternate hypothesis

There is a significant association between hoarseness and arytenoids asymmetry among patients with laryngeal disorders.

The aim is to document the prevalence of arytenoid adduction asymmetry in patients who had video-pharyngo-laryngoscopy in two tertiary institutions in the South West Nigeria over a period of 2 years from October 2020 to September 2022 and to determine if there is any association between arytenoid adduction asymmetry and hoarseness.

Methods

This is a retrospective and descriptive study carried out in two tertiary health institutions in South West Nigeria. A review of the medical charts and video-pharyngo-laryngoscopic examination findings were recorded in the stored database of all patients 18 years and above that were seen over the 2-year period of October 2020 to September 2022 with laryngopharyngeal disorders in the Ear, Nose, and Throat Clinics of Lagos University Teaching Hospital Idi-Araba Lagos and Babcock University Teaching Hospital Ilisan Ogun State.

A review of all the records of patients that had videolaryngoscopic examinations using 90degrees Karl-Storz rigid laryngeal telescopes connected to a Karl-Storz Endoscope Telepack X LED TP100 with both still and dynamic images saved in the device storage. Both the video and still laryngoscopic images were examined at the point of maximum adduction of the vocal folds. Arytenoid adduction postures were visually rated for asymmetry of the anatomic structures based on the previously documented classification [2] as stated below.

The types of asymmetry are as follows: anterior position of the cuneiform tubercles, overlapping posture of the corniculate tuberculum, and sharpness of the angle of the aryepiglottic folds.

These are defined as follows:

1. Anterior posture of the cuneiform tubercle
 - a. Left cuneiform tubercle anterior to the right cuneiform tubercle, rated mild, marked, overlap, or absent

- b. Right cuneiform tubercle anterior to the left cuneiform tubercle was rated as mild, marked, overlap, or absent.
2. Overlapping posture of the corniculate tuberculum
 - a. Left corniculate tuberculum overlapping the right corniculate tuberculum was rated as mild, marked, overlap, or absent.
 - b. Right corniculate tuberculum overlapping the left corniculate tuberculum was rated as mild, marked, overlap, or absent.
 3. Sharpness of the angle of the aryepiglottic fold
 - a. Left aryepiglottic angle sharper than the right aryepiglottic angle was rated as either present or absent.
 - b. Right aryepiglottic angle sharper than the left aryepiglottic angle was rated as either present or absent.

A harmonized consensus of the still and dynamic images were done by three senior ENT consultant surgeons and were classified accordingly [2, 3] and recorded in the questionnaire. This was done over a 4-month period.

A structured questionnaire was used to obtain bio-data of patients' age, sex, occupation, presenting complaint, indication, and findings from previous video-laryngoscopy and diagnosis from the medical charts. The reviewed video-laryngoscopy findings regarding adduction asymmetry of the arytenoids from the archived images were also recorded in the questionnaire.

Data entry and analysis were carried out using the Statistical Package for Social Sciences (SPSS) by IBM version 27.0. Categorical data were summarized as proportion and as percentages. Association between adduction asymmetry and selected characteristics was assessed using chi-square and Fisher exact test. P -value < 0.05 was assumed significant at 95% confidence interval.

Inclusion criteria

These were patients with complaints of hoarseness and other laryngopharyngeal symptoms who had video-laryngoscopy within the period under review and in whom all information needed were complete.

Exclusion criteria

These were patients who had previous laryngeal surgery, previous irradiation, patients on tracheostomy, and patients with incomplete data.

Ethical approval was obtained from the institution's Health Research and Ethics Committee.

Results

A total of 209 records were retrieved out of which 152 patients had all information required. Fifty-nine (59) were males and 93 females. The age ranges from 20 to 91 years and mean age at presentation of 46.8 years \pm 15.5 years.

Table 1 showed the age and sex distribution of patients who had video-laryngoscopy for various pharyngo-laryngeal complaints. Ninety-one percent of all participants (91%) were within the 3rd and 7th decades of life with a mean age of 46.80 \pm 15.5 years, the female gender predominates with a proportion of 93 (61%) out of 152 patients, while males accounted for 59 (39%). Occupational distribution showed that professional voice users like lawyers, teachers, and singers constituted 23.7%, 32.9% were skilled workers, 13.8% were unskilled workers, and others like students, pensioners, and traders were 29.6%.

Figure 1 showed the various indications for video-laryngoscopy, hoarseness constituted the majority (40.1%), while nonvocal symptoms are like feeling of a lump in the throat (31.6%), dryness in the throat (9.9%), recurrent cough (7.2%), itchy throat (4.6%), and others (6.6%).

Among the 61 patients that presented with hoarseness, 43 (71%) had hoarseness resulting from a primary

Table 1 Age gender and occupational distribution of participants

Variable	Frequency (n = 152)	Percentage
Age group (years)		
20–29	17	11.2
30–39	40	26.3
40–49	36	23.7
50–59	28	18.4
60–69	18	11.8
70–79	8	5.3
80–89	4	2.6
≥ 90	1	0.7
Mean \pm SD	46.80 \pm 15.5	
Occupation		
Unskilled worker	21	13.8
Skilled worker	50	32.9
Professional voice users	36	23.7
Others	45	29.6
Gender		
Male	59	38.8
Female	93	61.2

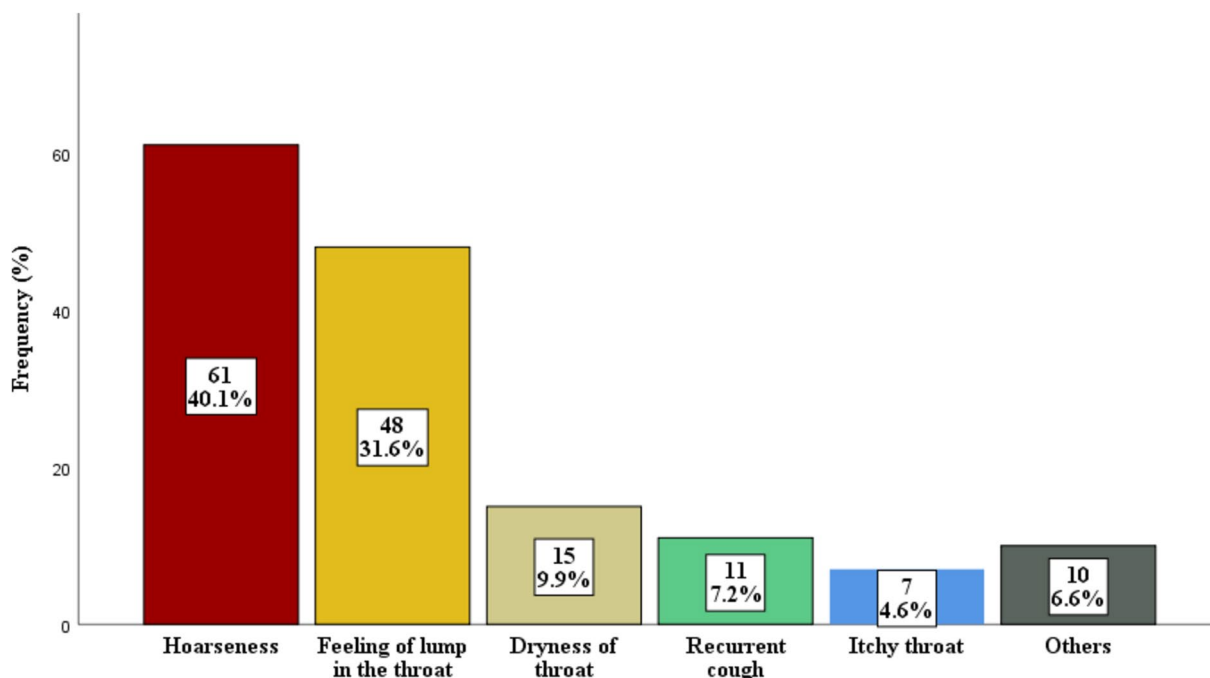


Fig. 1 Indications for laryngoscopy

Table 2 Posture of the cuneiform tubercle

Variable	Frequency (n = 152)	Percentage
Left cuneiform tubercle anterior to the right		
Yes	20	13.2
No	132	86.8
Degree of asymmetry of left relative to right (n = 20)		
Mild	15	75.0
Marked	4	20.0
Overlap	1	5.0
Right cuneiform tubercle anterior to the left		
Yes	38	25.0
No	144	75.0
Degree of asymmetry of right, relative to left (n = 38)		
Mild	28	73.7
Marked	8	21.1
Overlap	2	5.3

laryngeal pathology, 16 (26%) had laryngopharyngeal reflux, and 2 (3.3%) were voice change from puberty.

Table 2 showed the video-laryngoscopic reviews of posture of the cuneiform. The left cuneiform tubercle is anterior to the right cuneiform tubercle in 13.2% with varying degrees of severity from mild 75%, marked 20%, and overlap in 5%. Twenty-five (25%) of right cuneiform tubercle were anterior to the left cuneiform tubercle with

varying degrees from mild in 73.3%, marked in 21.1%, and overlap in 5.3%

Table 3 showed the overlapping posture of corniculate tubercle. The left corniculate tubercle was anterior to the right corniculate tubercle in 8.6% with varying degrees of asymmetry from mild 53.8%, marked 38.5%, and overlap 7.7%. The right corniculate tubercle is anterior to the left corniculate tubercle in 17.1% with varying degrees of asymmetry as mild in 73.1%, marked in 23.1%, and overlap in 3.8%.

Table 4 showed that the right aryepiglottic angle was more acute in 15.8%, while the left aryepiglottic angle is more acute in 7.9%. Overall, arytenoid asymmetry was reported in 68 (44.7%) of all 152 patients involving the cuneiform, corniculate, and aryepiglottic angle.

Table 5 showed the association between sociodemographic characteristics and diagnosis of adduction symmetry. Arytenoid asymmetry was seen commonest among the 5th and 6th decades of life, while the male-to-female ratio was 1.6:1. Adduction asymmetry was recorded among 55% of the professional voice users, 44.0% of skilled workers, 28.6% unskilled workers, and 44.4% of other groups comprising students, pensioners, and traders. There was no significant association between arytenoids asymmetry and the age groups as well as the occupation of the subjects.

Among the 61 patients who presented with hoarseness, 43 (71%) patients had primary laryngeal pathology

Table 3 Overlapping posture of corniculate tubercle

Variable	Frequency (n = 152)	Percentage
Left corniculate tuberculum anterior to the right		
Yes	13	8.6
No	139	91.4
Degree of asymmetry of left relative to right tuberculum (n = 13)		
Mild	7	53.8
Marked	5	38.5
Overlap	1	7.7
Right corniculate tuberculum anterior to the left		
Yes	26	17.1
No	126	82.9
Degree of asymmetry of right relative to left (n = 26)		
Mild	19	73.1
Marked	6	23.1
Overlap	1	3.8

Table 4 Sharpness of the angle of aryepiglottic fold

Variable	Frequency (n = 152)	Percentage
Left aryepiglottic angle sharper than right aryepiglottic angle		
Yes	12	7.9
No	140	92.1
Right aryepiglottic angle sharper than left aryepiglottic angle		
Yes	24	15.8
No	128	84.2

ranging from acute laryngitis, tuberculous laryngitis, abductor paralysis of the vocal cord, vocal cord papilloma, vocal cysts, polyps, singers nodes, and early vocal tumors, 16 (26%) had laryngopharyngeal reflux, and 2 (3.3%) had pubertal voice change.

Table 6 showed association between hoarseness and adduction symmetry. Adduction asymmetry was recorded in 35 (55.7%) among patient who presented with hoarseness, while 34 (37.4%) patients among those that presented with nonvocal symptoms also had adduction asymmetry. There is a significant association between hoarseness, male gender, and arytenoids asymmetry *P*-value 0.026 and *P*-value 0.027, respectively, while there was no significant association found between age, occupation, and arytenoid asymmetry.

Table 7 showed the primary video-laryngoscopic diagnosis ranged from acute laryngitis 2%, tuberculous laryngitis 1.3%, abductor paralysis of the vocal cords 7.9%, singer nodes 2%, and early vocal tumors 3.9%, 26.3% had laryngopharyngeal reflux and chronic pharyngitis 3.9%, while 34.9% of the patients had normal laryngoscopic findings.

Table 5 Association between sociodemographic characteristics and diagnosis of adduction symmetry

	Diagnosis of adduction asymmetry in relation to age groups, gender, and occupation		χ^2	<i>p</i> -value
	Yes	No		
Age group (years)				
20–29	6 (35.3%)	11 (64.7%)	4.490	0.722
30–39	17 (42.5%)	23 (57.5%)		
40–49	19 (52.8%)	17 (47.2%)		
50–59	15 (53.6%)	13 (46.4%)		
60–69	6 (33.3%)	12 (66.7%)		
70–79	3 (37.5%)	5 (62.5%)		
80–89	2 (50.0%)	2 (50.0%)		
≥90	0 (0.0)	1 (100.0%)		
Gender				
Male	33 (55.9%)	26 (44.1%)	4.889	0.027*
Female	35 (37.6%)	58 (62.4%)		
Occupation				
Unskilled worker	6 (28.6%)	15 (71.4%)	3.937	0.268
Skilled worker	22 (44.0%)	28 (56.0%)		
Professional voice users	20 (55.6%)	16 (44.4%)		
Others	20 (44.4%)	25 (55.6%)		

χ^2 chi-square

*Statistically significant

Discussion

Phonation is one of the critical functions of the larynx. Arytenoid adduction assessment is an important assessment in patients that presented with voice disorders. Arytenoid adduction asymmetry is often considered an incidental finding as most otolaryngologists do

Table 6 Association between hoarseness and adduction symmetry

	Adduction asymmetry		χ^2	p-value
	Yes	No		
With hoarseness	34 (55.7%)	27 (44.3%)	4.988	0.026*
Without hoarseness	34 (37.4%)	57 (62.6%)		

* shows there is significant association between hoarseness and arytenoid adduction asymmetry

Table 7 Diagnosis

S/no	Disease	Frequency	Percent
1	Chronic nonspecific pharyngitis	6	3.9
2	Pharyngeal candidiasis	2	1.3
3	Acute nonspecific laryngitis	3	2
4	Singer's nodes	3	2
5	TB laryngitis	2	1.3
6	Laryngopharyngeal reflux	40	26.3
7	Fish bone impaction	2	1.3
8	Muscle tension dysphonia	1	0.7
9	Palatal paralysis	1	0.7
10	Unilateral abductor paralysis (left 6) (right 3)	9	5.9
11	Bilateral abductor paralysis	3	2
12	Unilateral adductor paralysis (L)	1	0.7
13	Laryngeal cyst (left)	2	1.3
14	Laryngeal nodules (left)	6	3.9
15	Laryngeal polyps left	5	3.3
16	Laryngeal papilloma left	2	1.3
17	Vocal cord leukoplakia	2	1.3
18	Laryngeal tumor (left 3, right 2, Ant. Comm. 1)	6	3.9
19	Pubertal voice change	2	1.3
20	Drug (lisinopril) induced cough	1	0.7
21	Normal endo larynx	53	34.9
		152	100

not attach any clinical or pathologic importance to such findings. This study documented an overall prevalence of 44.7% including corniculate cuneiform and aryepiglottic asymmetry among patient with laryngopharyngeal symptoms. The highest prevalence occurs among the age group 40–59 years (52.6%) and also among professional voice users (55.6%). A-L Hamdan et al. [6] found a prevalence of 53.6% in singers with or without vocal symptom, a proportion higher than prevalence in this study. The difference may lie in the population studied; while this study population involved subjects with a wider array of complaints necessitating a

video-laryngo-pharyngoscopy, the population in A-L Hamdan study was restricted to singers.

Though anatomic references have described arytenoids asymmetry as more prevalent in older age groups [2], the age range of 18–91 years in this study with a mean age of 46.8 years ranks close with the study by P. Claros et al. [3] with a similar age range of 18–85 years and a mean age of 38.54 years. The difference may however be due to higher number of participants in the study by P. Claros et al. [3] as well as the exclusion of patients with vocal polyps, nodules cysts, and other tumors being excluded, while participants with those lesions were included in our report. These pathologies thus included in our study tend to occur at an age around the mean as reported in this study. A-L Hamdan et al. [6] described an age of 15–39 years with a mean age of 23.4 years with a population size of 110 participants. This may be due primarily to the younger age range thus selected for their study, and such age as considered young adults is less likely to manifest such changes relating to aging and the development of such laryngeal lesions as included in this study.

There were 59 males and 93 females in our study; however, we found 60% of the males in our study have varying degrees of arytenoids adduction asymmetry, while only 38% of the females had arytenoids asymmetry giving a male-to-female ratio of 1.6:1. This agrees in terms of male preponderance with studies by P. Claros et al. [3] who found a ratio of 1.02:1 and A-L Hamdan et al. [6] who found a ratio of 2:1

This study found 40.1% of the participants presented with hoarseness which can be regarded as vocal symptoms while 59.9% with non-voice symptoms ranging from feeling of lump in the throat, dryness in the throat, itchy throat and recurrent cough, among others. A-L Hamdan et al. [6] studied arytenoid adduction asymmetry in relation to vocal symptoms and found only about 25% of the participants with vocal symptoms; in his study, only 19% of the participants presented with hoarseness, and other vocal symptoms presented with included voice fatigue and contracted range. The higher prevalence of hoarseness in our study could be explained by the dominance of visible pathologies on the vocal cord and the larynx.

We found 55.7% of patients with hoarseness had varied degrees of arytenoid asymmetry and 37.4% of participants with other non-voice symptoms with varied arytenoids asymmetry. The prevalence of 37.4% among patients with non-voice symptoms is similar to the finding by Arya Raviraj et al. [8] among normophonic speakers which reported a prevalence of 36.4%. However, our prevalence among patients with hoarseness is at variance with the findings by Heather et al. [2] who found 100% varying degrees of arytenoids asymmetry in both patients with vocally normal speakers and speakers with voice

disorders. The type of laryngeal pathologies in both studies is similar; however, the recorded prevalence differs.

The higher prevalence of cuneiform asymmetry of 38.2% with right preponderance agrees with findings by P. Claros et al. [3] with 37.6% but lower than 49.1% by A-L Hamdan et al. [6]; however, this may be attributed to the lower sample size. Our finding varies significantly with the study by Heather et al. [2] who found 87% cuneiform preponderance among patients without voice disorders and 85% among those with voice disorders; however, they had a smaller sample size of 52 subjects in comparison. Heather et al. [2] however found that about 57% of the patients with nonvocal symptoms had marked asymmetry, while 71% of those with vocal symptoms had marked asymmetry.

The varied prevalence of arytenoids asymmetry in various studies suggests that some degree of arytenoids asymmetry may occur as anatomic variants which could become enhanced with changes in voice use and in some pathologic states.

The dominance of hoarseness as an indication for laryngoscopy might not be unconnected with limitations to communication and the desire to be heard, and hence, the individual seek medical consultation. Individuals with hoarseness with vocal pathology in an attempt to be heard during communication might put strain on other parts of the larynx resulting in adduction asymmetry as a compensatory mechanism as stated by Matthew et al. [5].

The preponderance of right-sided asymmetries of cuneiform, corniculate, and aryepiglottic angle asymmetries in this study could also be associated with the compensatory mechanism in patients with unilateral laryngeal pathology, and Heather et al. [2] also noted that those without voice disorders had an almost equal distribution between the left and the right cuneiform asymmetries and found no difference in frequency distribution between the right and the left corniculate. P. Claros et al. [3] found that asymmetry of the aryepiglottic angle occurs more frequently than the asymmetry of the corniculate tubercle.

The finding of a significant association between arytenoid asymmetry and hoarseness as vocal symptoms with a P -value of 0.026 (Table 6) may not be unconnected with the pathologies within the larynx and the degree of effort put into compensation attempts by the patient. A significant proportion of the patients with laryngeal disorders in this study had unilateral pathologies, and the limitation of function as a result of the pathology may have put a physiological task to compensate on the contralateral vocal cord. This is at variance with P. Carlos et al. [3], A-L Hamdan et al. [6], and Heather [2] studies who found no significant correlation between arytenoids asymmetry and vocal symptoms. In the same vein, it demonstrated a

significant association between the male gender and arytenoids asymmetry with a P -value of 0.027.

Conclusion

Arytenoid adduction asymmetry is prevalent in the 5th and 6th decades of life, among patients with hoarseness resulting from unilateral primary laryngeal disorders.

Limitation of the study

This is a retrospective study, with a small sample size, and a more prospective study with a large sample size among patients with hoarseness might be more representative.

Supplementary Information

The online version contains supplementary material available at <https://doi.org/10.1186/s43163-024-00591-8>.

Additional file 1. Questionnaire on arytenoid adduction asymmetry among patients with laryngeal disorders: Image of the larynx with points of interest labeled. Image of the larynx with points of interest labeled. Examples of the features and categories of arytenoid adduction asymmetry: a. symmetrical cuneiforms; b. mildly asymmetrical cuneiforms; c. markedly asymmetrical cuneiforms; d. symmetrical/non-overlapping corniculates; e. mildly overlapping corniculate; f. markedly overlapping corniculate; g. equal angles of the aryepiglottic folds; h. right angle of aryepiglottic folds is more acute; i. left angle of the aryepiglottic folds is more acute [2].

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The authors thereby state that this manuscript has not been presented in any meeting or conference.

Guarantors

All the contributors take responsibility for the integrity of the work.

Statement of authors

This manuscript has been fully read and approved by all the authors and authorized for publication.

Authors' contributions

This manuscript has been reviewed and approved by all authors. BAB, concept, design, literature search, data acquisition, data analysis, statistical analysis, interpretation of data, and manuscript drafting. MAA took part in data acquisition, interpretation of data, and manuscript review. AAO, literature search, data acquisition, and manuscript review. AOS, concept and design of study, literature search, data acquisition, manuscript editing, and revising manuscript critically for intellectual content. All authors read and approved the final manuscript.

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Availability of data and materials

The datasets used and analyzed during the current study are available from the corresponding author on reasonable request.

Declarations

Ethics approval and consent to participate

Ethical exemption is attached, given by the Lagos University Teaching Hospital (LUTH) Health Research Ethics Committee, Lagos Nigeria. Reg. no. 19/12/2008a.

Consent for publication

Not applicable.

Competing interests

The authors declare that they have no competing interests.

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