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LARYNGOLOGY

Mucosal bridges (MB): a 9-year retrospective study of their incidence with a third variant proposed

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Abstract

Background Mucosal bridges (MBs) are rare laryngeal lesions that may cause dysphonia of varying degrees. We propose the existence of a third variant of MB besides thin and thick MBs, and have termed this as an incomplete mucosal bridge (IMB). The concept of an IMB has not been previously discussed in literature. Thin and thick MBs are attached anteriorly and posteriorly on the membranous vocal fold and may cause dysphonia because of their separate vibratory characteristics from the main vocal fold. We propose the presence of an entity named as IMB, which is typically identified by palpation of a slit on the superior surface of the membranous vocal fold.

Aim To propose and describe the existence of IMBs. Furthermore, to study the percentage of various types of MBs found while performing microlaryngeal surgeries (MLS) for benign glottic lesions, over a 9-year period at our Voice Clinic.

Method An IMB may be described as a MB that does not open at its medial edge. Thus it appears as an epithelial slit on the surface of the vocal fold. On palpating this slit with a microflap elevator, a flat pocket lying just below and parallel to the vocal fold epithelium is identified. These pockets are always directed medially (never laterally) and just stop short of opening up at the medial edge. These IMBs differ from sulci and focal pit as sulci and focal pits are not covered with a hood of epithelium. Our operative records of all MLS performed for benign glottic lesions were audited from 2009 to 2017 for cases of MBs.

Results A total of 1728 MLS for benign glottic lesions were performed from 2009 to 2017 and 27 MBs were identified in 23 patients, 16 being male. A total of 11 IMBs were identified in 10 patients, with 1 case revealing a bilateral IMB. Other associated lesions were cysts, sulci, and polyps. A total of 14 thin MBs were identified in 11 patients with 3 cases revealing these bilaterally. Two thick MBs were identified in two separate cases, with one case having a bilobed hemorrhagic polyp attached to the thick MB.

Conclusion Our study found MBs in 1.33% of patients being operated for benign glottic lesions. The incidence of MBs in this group was 1.56% with IMBs accounting for 0.63%, thin MBs accounting for 0.81% and thick MBs in 0.11%. We recommend all patients undergoing MLS be actively palpated for the presence of mucosal bridges including IMBs especially if a small slit is found on the surface of the vocal fold. This is vital for accurate identification and documentation of all the lesions responsible for the patients voice quality. Ours is an ongoing study and we propose to analyze the vocal outcomes associated with surgical management of these IMBs.

Keywords Mucosal bridge · Sulcus · Phonomicrosurgery

Introduction

Mucosal bridges are rare laryngeal lesions, which may cause dysphonia of varying degrees. They are usually associated with vocal fold sulci and/or cysts but may exist independently. In spite of the technological advances made in diagnostic laryngology such as chip-on-tip videolaryngostroboscopy, most mucosal bridges are picked up during micro laryngoscopy by palpation. Furthermore, there is no definite consensus on the exact course of management of mucosal bridges.

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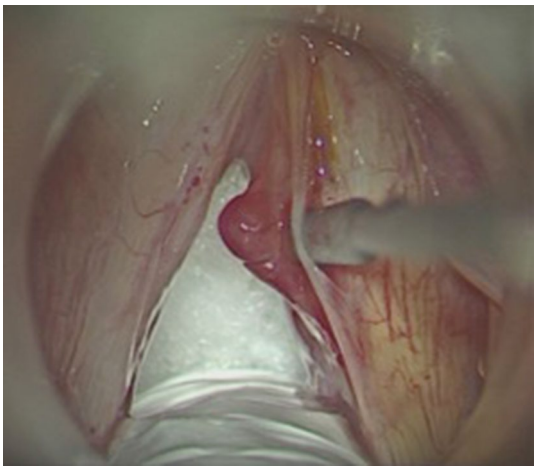

Fig. 1 A thin MB with a hemorrhagic polyp, on the right vocal fold. The microflap elevator is lifting this thin epithelial MB

Definition of the variants of mucosal bridge

Thin epithelial mucosal bridge

A thin mucosal bridge is a strip of epithelium that runs parallel to the vocal fold and is connected anteriorly and posteriorly but not attached to the free edge of the vocal fold [1–4] (Fig. 1).

Thick connective tissue mucosal bridge

Thicker mucosal bridges consist of a central axis of connective tissue, covered by a surrounding stratified epithelium [3, 5, 6]. In our experience, the thickness of this variant of mucosal bridge may be even half the total bulk of the vocal fold (Fig. 2a, b).

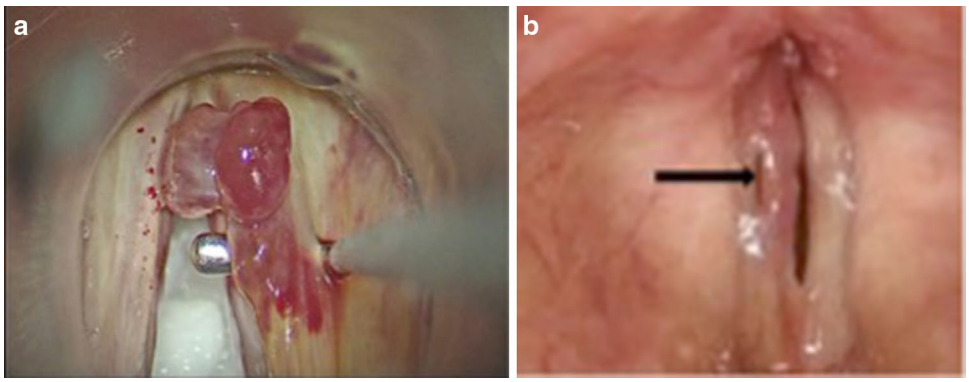

Fig. 2 **a** A thick MB of the right vocal fold, with a bilobed hemorrhagic polyp pedicled on this MB. **b** Post-operative video-laryngoscopy of the same patient, revealing the plane of cleavage (black arrow) between the right thick MB and the right true vocal fold. Reproduced from Nupur Kapoor Nerurkar, Atlas of Phonomicrosurgery, Jaypee Brothers Medical Publishers (P) Ltd., 2018, Figs. 7.18, 7.21, with permission

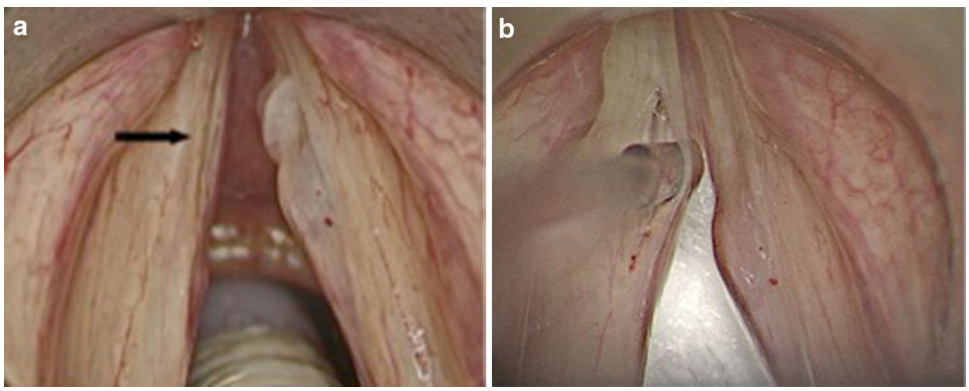

Fig. 3 **a** A slit observed (black arrow) on the superior surface of the left true vocal fold is a pointer towards an IMB. The right vocal fold reveals a cyst with overlying thick mucous. **b** The slit allows a microflap elevator to enter a subepithelial pocket which lies just below and parallel to the vocal fold epithelium and just stops short of opening up at its medial edge. The thick mucous overlying the right cyst has been sucked away. Reproduced from Nupur Kapoor Nerurkar, Atlas of Phonomicrosurgery, Jaypee Brothers Medical Publishers (P) Ltd., 2018, Figs. 7.22, 7.23, with permission

Incomplete mucosal bridge

We propose the existence of a third variant of MBs, besides thin and thick MBs, and have termed this as an incomplete mucosal bridge (IMB). The concept of an IMB has not been previously discussed in literature. An IMB, in the opinion of the Authors, is typically identified by palpation of a slit on the superior surface of the membranous vocal fold (Fig. 3a). This slit leads to a subepithelial pocket which lies just below and parallel to the vocal fold epithelium and just stops short of opening up at its medial edge (Fig. 3b). If this IMB were to open medially it would become a MB. These incomplete mucosal bridges may be thin or thick.

IMB, in the author's opinion, is a distinct entity from a focal pit, as a pit on the vocal fold is not described as being covered by a hood of epithelium. Focal pits and sulci are depressions of variable depth in the vocal fold but do not have an overlying cover of epithelium.

Methods

Our operative records of all MLS performed for benign glottic lesions were studied from 2009 to 2017 for cases of MBs. From our records we identified the total number of thin, thick, and IMB along with any associated lesions. The age, gender, and surgical procedure, if any, which had been performed, were noted.

An IMB was identified as a MB that did not open at its medial edge. Thus it appeared as an epithelial slit on the surface of the vocal fold. On palpating this slit with a microflap elevator, a flat pocket lying just below and parallel to the vocal fold epithelium was identified. An analysis of our findings with a review of literature was performed (Table 1).

Results

A total of 1728 MLS for benign glottic lesions were performed from 2009 to 2017 and 27 MBs were identified in 23 patients, 16 being male. Of these 27 MB, 10 were left-sided, 9 right-sided and 4 bilateral. All the MB had at least one associated lesion with a total of 9 polyps, 10 cysts and 15 sulci. We had only one pediatric patient in our series of 27 MB. A total of 11 IMBs were identified in 10 patients, with 1 case revealing a bilateral IMB. Other associated lesions were cysts, sulci and polyps (Fig. 3a). These IMBs were always directed medially (never laterally) and just stopped short of opening up at the medial edge. A total of 14 thin MBs were identified in 11 patients with 3 cases revealing these bilaterally. Two thick MBs were identified in two separate cases, with one case having a bilobed hemorrhagic polyp attached to the thick MB (Fig. 2a).

Discussion

A mucosal bridge is described by some as occult as it is not easily identified on flexible nasopharyngolaryngoscopy or videostrobolaryngoscopy but is mistakenly diagnosed as sulcus vocalis [7]. In fact, they may not be visible at all, especially those located on the very medial or inferior aspect of the vocal folds and thus possess a diagnostic challenge [8]. In most cases, MB are discovered after close inspection and palpation on microlaryngoscopic examination. Hence, final diagnosis is usually not made until microscopic direct laryngoscopy is performed and palpation of the true vocal fold reveals the mucosal bridge [9, 10].

In our experience, a mucosal bridge should be suspected on videostrobolaryngoscopy, if two parallel sulci are seen on the same vocal fold [11]. This scenario usually represents a single wide sulcus with an overlying thin epithelial mucosal bridge. The thin MB overlying the sulcus permits only the lateral edges of underlying sulcus to be visualized giving an appearance of two parallel sulci. Keeping this scenario in mind may help in predicting the presence of a mucosal bridge with subsequent ease in decision-making regarding the further management of the voice pathology. In our study, 25 MB were identified incidentally during surgery for some associated benign glottic lesion and only 1 MB was clearly identified on stroboscopy preoperatively in a patient who had a history of previous biopsy of that vocal fold. Another MB was suspected due to the presence of two parallel sulci observed on the surface of the vocal fold. Thus our preoperative pick up of MB was as low as 7.4%. This matches most voice centers internationally with the diagnostic rate on stroboscopy as very low [6].

Mucosal bridges are extremely rare vocal fold lesions with some authors quoting the incidence to be as low as 0.4% [12]. The incidence of MB in our series of patients being operated for benign glottic lesions was 1.56%. However, the true incidence in the general population is hard to determine, as some MB may not cause any obvious symptoms warranting a visit to the laryngologist and others may not be picked up even with high-definition videostroboscopy. Thus under-diagnosis of MB seems a strong possibility. In a study performed by Sakae et al. studying a specific group of 68 vocal fold polyp patients, a MB was found in 2 patients (12.5%) [13].

Mucosal bridges belong to the family of vocal fold cysts, sulci, vergetures and scars and very frequently coexist with one or multiple of the above. They are usually found on the ipsilateral side of sulcus-related disorders; however, this may not always be the case [14].

An ipsilateral sulcus was identified in 12 MB (80%), 8 being thin epithelial MB and 4 IMB. A contralateral sulcus was found in 3 MB (20%). In two cases it was an IMB with

Table 1 Master chart

Serial number	Name	Gender	Mucosal bridge type	Number of MB	Side	Associated lesions	Treatment of the mucosal bridge	Treatment of associated lesions
1	A. M.	F	Thin	One	L	R polyp	Excision	Polyp excised
2	L. S.	M	Thin	One	R	B/L sulcus	Excision	B/L fat injection
3	R. J.	F	Thin	Two	B/L	R sulcus, L cyst	Excision	Left cyst excision
4	M. P.	M	Thin	Two	B/L	R focal pit, L cyst	Excision	Cyst excision
5	A. P.	M	Thin	One	R	B/L sulcus	Excision	Fat implantation
6	D. H.	M	IMB	One	R	R cyst and polyp, L focal pit	Made raw using laser	R cyst and polyp excision
7	P. P.	M	Thin	One	L	B/L sulcus, L varix	Excision	Varix-lasered
8	B. P.	M	Thin	One	R	L polyp, R ectasia	Excision	Polyp excised, ectasia-lasered
9	D. T.	F	IMB	One	R	R sulcus with haemorrhagic lesion, L sulcus with contact lesion	Made raw using laser and Sutured	R lesion excised, L contact lesion-lasered
10	R. H.	F	Thin	One	R	R polyp	Excision	Polyp excised
11	M. P.	M	Thick	One	R	R polyp	–	Polyp excised
12	M. R.	M	IMB	One	L	R cyst, L sulcus	Made raw using laser	R cyst excised
13	R. B.	M	Thin	One	L	R sulcus, open cyst and small cyst, L focal pit with nodular lesion	Excision	R small cyst excised, L focal pit Ponte's release done
14	A. C.	M	Thin	One	L	R cyst, L sulcus	Excision	R cyst excised L sulcus released
15	M. I. K.	M	IMB	One	L	R polyp with 2 sulci, L contact lesion	Made raw using laser	Polyp excised
16	S. B.	M	IMB	One	L	R cyst, L shallow sulcus	Made raw using laser	R cyst excised, L sulcus Ponte's release
17	B. S.	M	IMB	One	L	B/L sulci	Made raw using laser	R sulcus Ponte's release
18	B. D.	F	IMB	Two	B/L	R polyp	Made raw using laser and sutured	Excised
19	H. L.	M	IMB	One	R	L polyp	Made raw using laser and sutured	Polyp excised
20	P. A.	F	Thin	Two	B/L	L open cyst, R focal pit	Excision	Cyst excised, pit surfaces made raw and sutured with vicryl 6-0
21	R. P.	M	Thick	One	L	R cyst, L infraglottic contact lesion	–	Cyst excised, contact lesion-lasered
22	P. N.	F	IMB	One	R	L open cyst with focal pit	Made raw using laser and sutured	Open cyst excised
23	M. S.	M	IMB	One	L	R polyp, L contact lesion	Made raw using laser and sutured	Polyp excised

a contralateral focal pit and one case a thin MB with contralateral focal pit.

MB etiology is intimately related to that causing sulci and are generally congenital though sometimes they may be post-traumatic [15]. Trauma is usually surgical and rarely intubation trauma. Surgical causes include over-resection of the superficial layer of the lamina propria, resulting in remucosalization over the deficient area and damage to the vocal ligament and deep layers of the lamina propria [16]. We had one case of post biopsy iatrogenic MB referred from another center to us (Fig. 4).

Non-surgical causes include untreated benign lesions, chronic vocal abuse, and repeated intracordal hemorrhage. Microvascular lesions (i.e., varices, capillary ectasias) also may result in scarring secondary to hemorrhage and fibrosis [16].

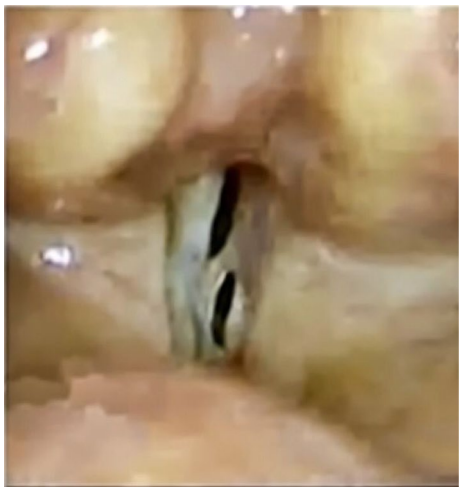

Fig. 4 A dramatic left MB is observed during stroboscopy in a patient who has a history of a previous left vocal fold biopsy. This is probably an iatrogenic mucosal bridge

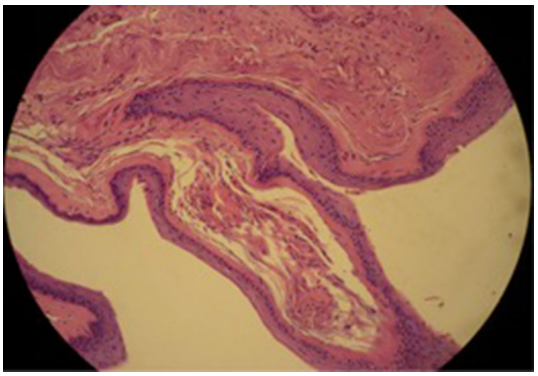

Fig. 5 Histological section of a mucosal bridge showing a thin dense connective tissue strand enveloped by non-keratinized stratified squamous epithelium

In our study a majority of MB were seen in male patients (59%) and all MB (100%) had at least one associated lesion with a total of 9 polyps, 10 cysts and 15 sulci. However, in a study by Martins et al. the majority of patients with MB were males and only 50% of MB seen by them had an associated lesion [4]. Histologically, the thin mucosal bridges consist of non-keratinized stratified epithelium with no or very little connective tissue at the core (Fig. 5), with thicker MB consisting of a significant thickness of vascularized dense connective tissue core covered by non-keratinized stratified squamous epithelium that may be accompanied by thick basement membrane [4].

Thin epithelial mucosal bridges are invariably associated with an underlying sulcus and hoarseness is due to the combination of these two pathologies. Vocal fatigue is another presentation of mucosal bridges [9]. The mucosal bridge may cause dysphonia and diplophonia of varying degree because of their separate vibratory characteristics from the main vocal fold, especially if they are associated with cysts or sulci [4]. When a cyst or polyp develops or co-exists with a MB the voice dramatically deteriorates. In such cases surgical management of only the cyst/polyp may suffice. Management of the sulcus may be deferred for a second stage if the voice is not satisfactory a couple of months after surgery. However, as thin epithelial MB tether the vocal fold during vibration, possibly resulting in two out of sync vibrating bodies, with no added benefit of providing significant bulk to the vocal fold, its excision is preferable in our opinion. This excision of MB does not apply to thicker bridges, which form a large part of the bulk of the vocal fold. Removal of the mucosal bridge in this scenario would result in a large phonatory gap with air leak. In fact there may be atrophy of the epithelial surface of the remaining vocal fold, which becomes the vibratory margin after the bridge has been removed [15].

Removal of co-existing condition such as cyst, sulci or polyp and leaving the mucosal bridge intact may achieve desirable results if the surgery is followed by good speech therapy [17]. Though thicker mucosal bridges are better left untouched to prevent a large volumetric loss of the vocal fold, their undersurface and apposing vocal fold epithelium maybe freshened and glued to obliterate the bridge. A newer technique, named ‘sandwich flap technique’ has been proposed which involves freshening and then suturing the mucosal bridge to the vocal folds [18].

This seems to be a good technique and may be modified using a laser instead of cold steel instruments to freshen the undersurface of the vocal fold and the epithelial surface of the vocal fold lying directly under the bridge. Instead of suturing the bridge to the vocal fold, fibrin glue may also be used.

An incomplete mucosal bridge may be viewed as a superficial focal pocket that runs parallel to the epithelial surface of the vocal fold and just stops short of re-opening through the medial epithelium.

In our experience, excision of the epithelium of this subepithelial pocket with or without suturing the apposing surfaces offers good vocal outcomes. Fibrin glue may be used instead of suturing, though we have been using 6-0 vicryl sutures as of now (Fig. 6a–f). Though our limited number of operated cases of IMB have shown an improvement in both vocal outcome measures and mucosal wave patterns, we do not have adequate case volume to make any conclusions as to the level of vocal outcome improvement by this surgical technique at present. The presence of co-existing lesions further confounds any conclusions made regarding the results of surgery for IMB.

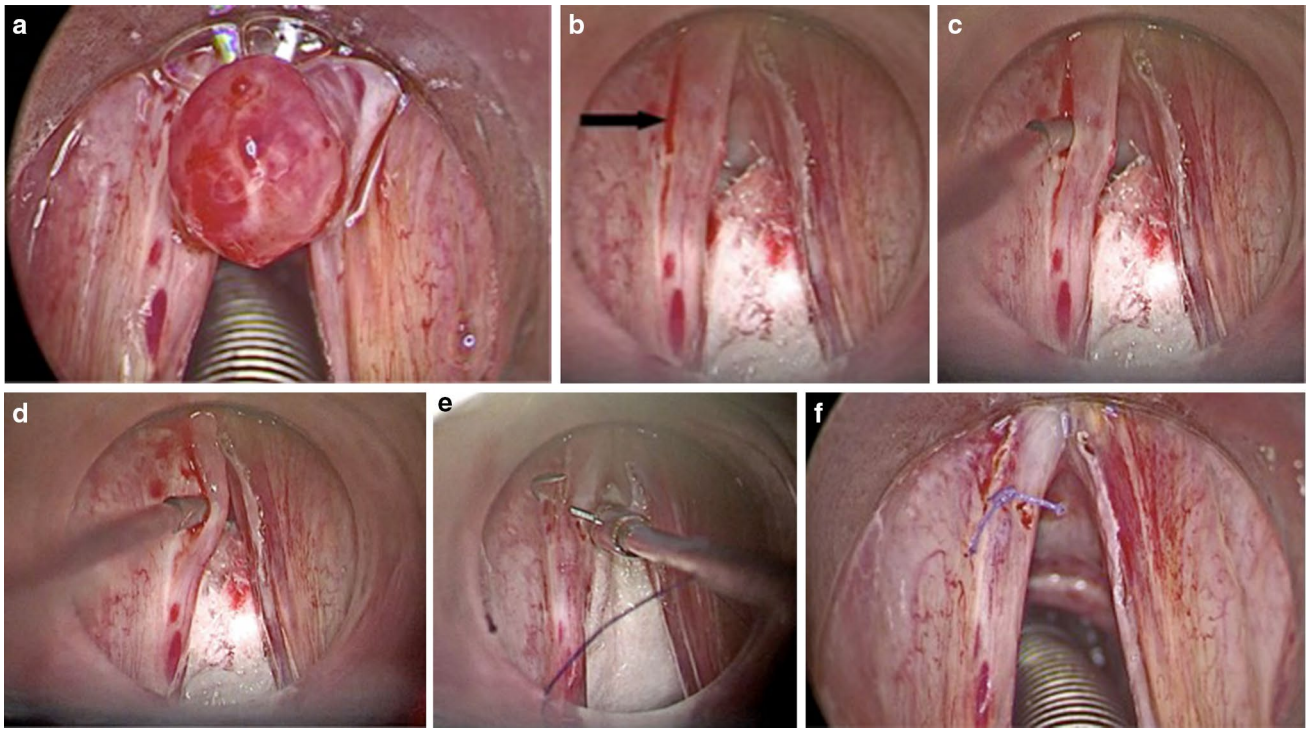

Fig. 6 **a** A right haemorrhagic polyp posted for surgery. **b** Microflap excision of the right polyp has been performed. A slit filled with blood (black arrow) is observed on the superior surface of the left vocal fold which is a pointer towards an IMB. **c** On palpation of this slit the microflap elevator slips into a subepithelial pocket directed medially. **d** The microflap dissector is lifting the left IMB. **e** Suturing with 6-0 vicryl after making the bed of the left IMB raw. **f** Left IMB sutured. Microflap excision of the right hemorrhagic polyp with no raw area can be appreciated

Conclusion

Our study found MBs in 1.33% of patients being operated for benign glottic lesions. The incidence of MBs in this group was 1.56% with IMBs accounting for 0.63%, thin MBs accounting for 0.81% and thick MBs in 0.11%.

We recommend that all patients undergoing MLS be actively palpated for the presence of MB, especially if a small slit or two parallel sulci are found on the vocal fold. Identification of two sulci at stroboscopy may be an indicator regarding the presence of a MB. Accurate identification of MB is vital for documentation of all the lesions responsible for the patient's voice quality. Ours is an ongoing study and we propose to analyze the vocal outcomes associated with surgical management of all types of MB.

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