Silastic “Spring” Spacers for Use Following Endoscopic Sinus Surgery

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Received: 7 May 2018 / Accepted: 20 July 2018 / Published online: 25 July 2018
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Abstract The prevention of middle turbinate lateralization, and middle meatal synechiae formation, is the key to maintain a patent ostiomeatal complex following endoscopic sino-nasal surgery (ESS). Different techniques have been described to prevent this undesirable outcome, however, most of them are invasive, expensive, uncomfortable and/or obstructive. We present our technique to modified silastic sheets to circumvent these problems and improve ventilation and drainage of sinuses after surgery. The aim of this paper is to present how this silastic sheeting can be easily customized to the shape of the ethmoid cavity after ESS, allowing for ventilation of the aerated sinonasal cavities and at the same time preventing problematic synechiae/scar formation. A practical and easy technique to customize silastic stents following ESS is presented. Silastic sheets could be easily customized of the ethmoid cavity after ESS providing an excellent alternative to reduce middle turbinate lateralization and synechiae formation.

Keywords Functional endoscopic sinus surgery · Middle meatal stents · Tissue adhesions · Middle meatus

Introduction

Post-operative scarring and synechiae formation are well-known complications following endoscopic sino-nasal surgery. While adhesions may occur anywhere that two opposing mucosal surfaces are abraded/denuded, the sinus surgeon is particularly interested in minimizing post-operative scarring in areas that will lead to obstruction of the sinus drainage pathways, and subsequent suboptimal post-surgical results. Of particular concern is the middle meatus, and specifically the ostiomeatal complex (OMC), as aeration of this space is the key to maintaining adequate long-term ventilation and drainage of the maxillary, ethmoid and frontal sinuses.

The concept of middle turbinate preservation, in our view, deserves important attention. This structure plays a key role in fulfilling the main nasal functions (humidifying, warming, and filtering the inspired air). Middle turbinate respiratory mucosa has been shown to have important mechano-sensitive, tactile, and temperature receptors. The loss of this mucosa, due to injury or resection, may lead to atrophic rhinitis, and potentially a condition characterized by paradoxical nasal obstruction, known as empty-nose syndrome [1]. Preservation of this structure through careful atraumatic surgical technique is therefore advocated.

The prevention of middle turbinate lateralization, and middle meatal synechiae formation, is the key to maintaining a patent OMC and providing an avenue for post-operative sinus surveillance and debridement. Despite best efforts, mucosal trauma to the lateral surface of the middle turbinate and the lateral nasal wall frequently occurs during endoscopic sinus surgery (ESS). This may result in synechiae formation in this important common drainage pathway, if the middle turbinate is not prevented from lateralizing.

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A number of techniques have been described to prevent middle turbinate lateralization. These include suture techniques [2, 3] and planned adhesion creation between the medial surface of the middle turbinate and septum using mitomycin C [4], tissue adhesive [5] or via mucosal injury with a microdebrider (“Bolgerization”) [6]. The usage of clips [7] and/or haemostatic agents, such as FlosealTM, has been shown to increase rather than decrease the incidence of synechiae formation [8]. Insertion of middle meatal spacers [9] and/or silastic sheeting [10, 11], as well as more aggressive techniques such as middle turbinate reduction [12] has been advocated by different authors as methods of reducing the incidence of middle turbinate synechiae.

Silastic sheeting has been shown in randomized trials to be safe, inexpensive and useful to reduce adhesions, scar formation and middle turbinate lateralization [11]. The aim of this paper is to present how this silastic sheeting can be easily customized to the shape of the ethmoid cavity after ESS, allowing for ventilation of the aerated sinonasal cavities and at the same time preventing problematic synechiae/scar formation. Thereby, we explain our step-by-step customization technique for any surgeon interested in simple modification of these inexpensive silastic sheets at the conclusion of ESS.

During ESS, the authors routinely perform anterior and posterior ethmoidectomy followed by a middle meatal antrostomy. If a concha bullosa is identified, the lateral half of the aerated middle turbinate is resected.

Our post-operative stenting technique involves patient-specific modification of the shape, size and positioning of a 1.02 mm silastic sheet to create a middle meatal ‘stent’. Silastic sheets of varying thicknesses were trialed, and 1.02 mm was preferred; it is thin enough to allow for appropriate customization of the shape with a simple suture technique, and thick enough to ‘spring’ apart once sutured to medialize the middle turbinate during the healing phase. The elastic spreading effect, customized shape and careful placement under endoscopic visualization allows this “Spring” spacer to sit, without sutures, in the ethmoid complex/middle meatus, encouraging wide patency of the post-op ethmoid complex, preventing lateralization of the middle turbinate and avoiding formation of adhesions between the middle turbinate and the lateral nasal wall.

Patients and Methods

Since 2010, the senior author has performed approximately 250 endoscopic sinus procedures per year for chronic rhinosinusitis with and without nasal polyposis. Modified silastic ‘stents’ as we describe herein, are placed following ESS in all patients except those without intact middle turbinates [i.e. where the middle turbinate(s) have been

partially or totally resected]. Barring complications (such as post-operative bleeding), intranasal packing is not placed, and patients are discharged on the same day of surgery and prescribed a 10-day course of antibiotics, high-volume saline nasal rinses (started 36 h post-operatively) and topical and/or oral steroids (depending on the degree of inflammation/polypoidosis seen at the time of surgery). All patients are reviewed between 2 and 3 weeks post-operatively in an ambulatory outpatient clinic. At this appointment, the silastic middle meatal stents are removed and rigid endoscopic examination and debridement of the nose and surgically-aerated paranasal cavities is carried out under topical anaesthesia. Removal of the middle meatal spacer can routinely be accomplished with a headlight, nasal speculum and a pair of bayonet forceps. Alternatively, especially in the setting of crusting or debris obscuring visualization of the anterior end of the silastic stents, they are removed under endoscopic visualization immediately prior to debridement.

Stent Creation and Insertion

Step 1: A 1.02 mm silastic sheet (Ref 1532520, Medtronic[®]) is modified by first folding it in half. A 4.0 non-absorbable (Nylon) suture is placed centrally, approximately 8–10 mm inferior to the folded edge, as shown (Fig. 1a, b). The suture should not be tightened, as this creates the ‘spring’ effect to medialize the middle turbinate and stent open the ethmoid complexes in the medial–lateral dimension.

Step 2: Using a pair of straight Mayo scissors, several cuts are made to shape the stent to fit within the surgically created posterior ethmoid complex, anterior ethmoids/frontal recess and extend anterior to the anterior end of the middle turbinate, as shown (Fig. 2a, b, 3).

Step 3: Under endoscopic visualization, the spacer is placed using bayonet forceps into the nasal cavity and then directed into the middle meatus. The spacer is then guided superiorly under the axilla of the middle turbinate so that the superior “step” fits snugly in the frontal recess (Fig. 4) and the inferior portion of the stent sits on the superior aspect (the ‘root’) of the inferior turbinate, leaving the surgically created maxillary antrostomy accessible posteriorly (Fig. 5).

Step 4: The same procedure is repeated for the opposite nasal cavity. The spacers remain in situ for 2–3 weeks.

Customization of the cuts made is based upon:

1. The height of the posterior ethmoid complex (distance between the posterior skull base and (posterior) horizontal basal lamella of the middle turbinate)—shown as ‘A’ in Fig. 2b.

Fig. 1 Folding and suturing the silastic sheet **a** side (lateral) view and **b** End-on (A-P) view

Fig. 2 **a** An oblique view of the basic stent shape and **b** basic stent shape with important lengths labeled

Fig. 3 A 5 mm hole is cut out in the top of the stent to enable aeration and drainage of the frontal sinus

Fig. 4 Endoscopically guiding the stent under the right middle turbinate and into the surgically-created common ethmoid complex

Fig. 5 Anterior portion of stent sitting on the root of the inferior turbinate. Note that the surgically-created maxillary anastomy is accessible posterior to the stent

2. The anterior/posterior length of the entire ethmoid complex (distance from the anterior margin of the frontal recess to the anterior face of the sphenoid)—shown as 'B' in Fig. 2b.
3. The slope of the skull base/depth of the frontal recess is used to determine the height of measurement 'C' in Fig. 2b. More sloped skull bases require 'C' be longer/deeper.
4. The cut shown as 'D' in Fig. 2b must be at least the length of the posterior ethmoids (from basal lamella to anterior face of sphenoid). This may be enlarged to promote better post-operative ventilation and irrigation delivery into the maxillary anastomy.

- Finally, an additional small ventilation hole is cut along the top of the folded edge, so as to enable ventilation, drainage, and possibly irrigation, of the frontal sinus (Fig. 3).

In the setting of mucosal injury or resection of the mid/posterior portion of the middle turbinate (i.e. following concha bullosa resection), the posterior/inferior portion of the stent may be modified such that synechiae between the posterior middle turbinate and the posterior fontanelle area can be avoided (Fig. 6a, b).

Patient follow-Up

Anecdotally, when the patients are seen in the outpatient clinic 2–3 weeks following surgery, they reported no adverse effects related to the spacers remaining in situ for this period. They appear well tolerated, with most patients unaware of a foreign body sensation at all. Very few patients report displacement of the spacers during irrigations or nose blowing. Our presumption is that this occurs when the stents are made too small for the ethmoid complex. On rigid nasal endoscopy following removal of the spacers, routinely the middle turbinates are noted to be in the original anatomical position, or slightly medialized, and the entrance to the ethmoid cavity is widely patent with no synechiae between the turbinate and the lateral wall.

Discussion

Otolaryngologists performing sinus surgery recognize the importance of preventing middle turbinate lateralization and synechiae formation between the middle turbinate and lateral nasal wall, which may lead to the obstruction of the middle meatus, suboptimal surgical results and potential difficulties in post-operative surveillance/instrumentation. While several techniques have been described to achieve this objective, most of them are invasive, expensive, uncomfortable and/or obstructive.

Summary of the Strengths of This Technique

We propose the following strengths of this technique:

1. Cost: This technique requires two 1.02 mm silastic sheets and a single nylon suture. At our center, the cost of a 4.0 nylon suture is \$1.57CDN and the silastic costs \$138CDN for a box of 10 sheets.
2. Simplicity and minimal required intraoperative time: Customization and insertion of the stents take the senior author approximately 3–5 min.
3. Non-destructive: The middle turbinate is left intact, unabraded and unsutured.
4. Minimal infectious risk: unlike tampons or packing materials, silastic is inert and therefore is less likely to act as a medium for the collection and growth of bacteria.
5. Comfortable: The thin silastic is soft, and the “spring” applies a minimal force on the middle turbinate. Upon removal, there are no sutures to cut out, the silastic does not adhere to tissues and it slides easily out of the nostril by deforming its shape.
6. Non-obstructive: The “open-tube” design allows for immediate irrigation and promotes immediate and continuous drainage of debris (blood, mucus) from the sinuses. The ventilation hole cut in the superior aspect of the stent enables drainage and potential irrigation of the frontal sinus. This non-obstructive feature has the potential to eliminate days of postoperative sinus congestion symptoms when compared to other middle meatal spacers.
7. Low risk of synechiae formation: This is of utmost importance in stent design/usage. We believe that the ability to tailor the silastic stent such that it sits between any (and all) cut/abraded mucosal surfaces enables the surgeon to minimize this risk as much or better than any other described technique.
8. Customizable: Since intra-nasal anatomy varies in each patient (particularly the height and depth of the frontal recess and the posterior ethmoid complex), one benefit of this technique is the degree of

Fig. 6 **a** Stent modification to prevent synechiae between the posterior portion of the middle turbinate and lateral nasal wall after concha bullosa resection (side view) and **b** modified stent sitting in ethmoid complex after concha bullosa resection

customizability it provides. Further benefits of the customizability are seen below in the example of alteration in stent shape in the setting of an aerated middle turbinate.

Clinical Applicability of the Technique

Silastic sheets are widely available and familiar to most otolaryngologists who have traditionally used them following septal surgery or division of adhesions between the inferior turbinate and septum. By carrying out a simple modification of these sheets, they can be easily introduced into (and removed from) the middle meatus as described. Patients may also report a more immediate feeling of ventilation and drainage of their sinuses, as there is no delay waiting for packing removal or biodegradable stenting materials to dissolve. The spacers remain in situ for only 2–3 weeks.

Compliance with Ethical Standards

Conflict of interest The authors declare that they have no conflict of interest.

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