# Nasal Mucosa Injury

Subjects: Otorhinolaryngology

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Nasal mucosa injury can be caused by trauma, radiotherapy, chronic infection such as sinusitis, and post sinus surgery. The rate of healing and its treatment are important in the recovery of patients especially in post sinus surgery, which introduces new injuries.

Keywords: nasal mucosa ; wound healing

## 1. Introduction

Nasal diseases, particularly as a result of chronic inflammation and infection such as rhinosinusitis, significantly affect the quality of life of the patient [1]. Rhinosinusitis is a common nasal disease that affects approximately 5–15% of the general population [2]. Treatments such as antibiotics, nasal douche, steroid, and nasal sprays are commonly being prescribed to patients to eliminate infection, reduce inflammation, and revert the diseased mucosa to normal, functional respiratory epithelium. Another common treatment is a surgical intervention known as endoscopic sinus surgery (ESS), which is prescribed after the failure of conservative treatment following nasal diseases such as chronic rhinosinusitis and nasal polyposis [3].

## 2. Postoperative Complications of Endoscopic Sinus Surgery

ESS is a technique that utilizes endoscopic vision to enable the surgeon to reach the paranasal sinuses with minimal damage to the surrounding tissue [3]. It is one of the most common procedures performed in otorhinolaryngology and its success rate depends on the postoperative wound healing outcome [3].

Following the introduction of surgical injury, bleeding is anticipated due to the fact that the nasal cavity is rich with blood supply derived from the external and internal carotid arteries in this region [4]. Postoperative bleeding most commonly occurs within the first 24 h of the procedure but can be delayed for days or even weeks. In the event of hematoma formation within the nasal mucosa, its removal is necessary to prevent ischemia and fibrosis leading to the development of scarring [5].

Another common complication following ESS is tissue adhesion, which is also known as nasal synechiae. Nasal synechiae form when two moist, opposite surfaces inside the nose heal together, forming fused fibrous tissue that may block the normal airflow through the nose [6]. Due to its role in extracellular matrix (ECM) deposition and remodeling, the nasal fibroblast is thought to be responsible for nasal synechiae.

There is also a subgroup of patients with recurring chronic rhinosinusitis who have presented bone thickening known as osteitis. Osteitis is the thickening of the bone due to inflammation. Diseased mucosal can affect the viability of the bone underneath it. Over time, this poor viability can develop into bony inflammation that finally leads to the bone thickening. Little is known about post-surgical osteitis and the strategy to treat this condition [7].

Hence, major objectives of postoperative management of nasal wound healing aim to control postoperative bleeding, preventing adhesions, and expedite the healing process [5].

## 3. Post-Surgical Management of Nasal Wound Healing

A multitude of topical interventions and dressings has been used to facilitate the nasal mucosa wound healing following invasive sinus surgery. Interventions that have been used include intravenous antibiotics or steroids, nasal douching, and nasal packing to prevent infection and attenuate prolonged inflammation, thus collectively improving the nasal mucosa healing process.

### 3.1. Systemic Drug

Post-surgical management with systemic drugs involves the oral or intravenous delivery of steroids and antibiotics that are used to reduce the inflammation and infection that halts the progression of the wound healing following sinus surgery [8].

Among corticosteroids that were being used post-surgically were oral betamethasone [9] and oral prednisolone [10]. The use of systemic steroids in FESS perioperatively is arguable; however, recent systematic reviews and meta-analysis have revealed that the administration of systemic steroids, especially postoperatively, might be associated with the improvement of endoscopic scores and reduce the risk of recurrence among patients with chronic rhinosinusitis with nasal polyposis [8]. Jorrisen and Bachert investigated oral betamethasone (2 mg for seven days) followed by topical momethasone furoate sprays (200 µg b.i.d for six months) to be associated with reduced risk of sinusitis (RR 0.76, 95% CI 0.31, 1.90), and improved postoperative endoscopic score. On the other hand, postoperative administration of prednisone (oral, 30 mg for nine days) was observed to result in healthier sinus cavities [10].

Despite having most of the patients benefiting from systemic steroids in terms of wound recurrence prevention, a significant proportion of patients still experienced wound recurrence even in the immediate postoperative period [8]. Furthermore, long-term use of systemic steroids can lead to a plethora of adverse side effects [11].

There was little evidence to support the use of antibiotics in post-FESS patients [12]. A three-week course of amoxicillin and clavulanate potassium (375 mg, t.d.s. for three weeks) was shown to have no significant difference in terms of symptoms and endoscopic score as compared to the control [13]. A similar result was also demonstrated in a randomized, double-blind controlled trial with oral amoxicillin (250 mg, t.d.s for four weeks) [14]. Meanwhile, a short follow-up study reported that the two-week course of amoxicillin and clavulanate (625 mg, b.d) only improved nasal obstruction and drainage on the fifth day in regards to other symptoms and improved endoscopic scores at day five and 12 [15]. Due to the emergence of bacterial resistance against macrolide, the risks outweigh the benefits, and the reduced usage of antibiotics should be prompted.

### 3.2. Nasal Spray

Nasal spray is a method of delivering drugs, mainly steroids, into the intranasal space using an aerosol spray bottle. The main objective of post-surgical management with nasal spray is to modulate the inflammation phase of the nasal wound healing [16][17]. It is considered as the standard medical treatment for the control of the recurring sinusitis following surgical intervention [9]. Beclomethasone dipropionate, the first aerosolized topical corticosteroid, has been used clinically since the 70s. Numerous other aerosolized steroid preparations have been described in the literature including prednisolone acetate, mometasone furoate, triamcinolone acetonide, and fluticasone propionate [16]. Meanwhile, different types of intranasal steroid spray were reported to have different efficacy following post-FESS [18]. This has been demonstrated by the recent clinical trial (ClinicalTrials.gov: NCT02194062) that determine two types of intranasal steroid spray (fluticasone and budesonide) to reduce the incidence of polyposis in post-FESS chronic rhinosinusitis patients. Budesonide was observed to be superior (improvement in Sino-Nasal Outcome Test (SNOT-22) and Lund–Kennedy scores) than fluticasone [18].

Topical antibiotic and antifungal delivery using nasal spray were once considered to be the cornerstone of post-surgery management following ESS. This is due to the old paradigm that postulated that the inflammation seen in post-surgical nasal is a result of a microorganism infection in the sinus. In the age of the antibiotic-resistant microorganism, both therapies have generally fallen out of favor in terms of post-surgery management following ESS [16].

As the technology has developed, nasal spray is used to deliver bioactive compounds such as ECM component or coagulation cascade component. In the in vitro skin wound healing model, the ECM protein hyaluronan has been shown to enhance re-epithelialization [19]. Nebulized sodium hyaluronate administration into the nasal cavity has been shown to induce a faster recovery following ESS while maintaining the patient’s comfort throughout the process [20].

The idea of delivering coagulation cascade component into the nasal cavity centers around resolving the hemostasis phase to allow wound healing to progress [21]. A prospective study comparing the administration of aerosolized fibrin and non-absorbable nasal packing has revealed that crusting, adhesion, bleeding, granulation tissue formation, infection, and frontal sinus ostium stenosis after endoscopic surgery, as well as overall comfort, improve after using fibrin spray [22].

### 3.3. Nasal Packing

Simultaneous to the development of nasal spray is the use of biomaterials as a nasal packing. A major goal of nasal packing is to enhance postoperative wound healing by expediting the healing process, preventing adhesions, and control

postoperative bleeding. Massey and Singh have published a thorough review of the biomaterials used in nasal packing [23]. Nasal packing is designed as a foam or sponge that can act as a tampon that is inserted into the nasal cavity to provide pressure to stop bleeding. Nasal packing can be absorbable or non-absorbable.

The non-absorbable packing has been used in sinus surgery for decades before the emergence of its absorbable variant [23]. Nasal packing can be a source of pain and discomfort for patients due to the removal process of the nasal packing. In many cases, its removal has been described by some patients as the most painful part of the entire procedure [24]. Thus, the development of absorbable nasal packing follows in the following decades.

In terms of absorbable nasal packing, several materials have been known to be used to fabricate them. In general, they can be divided into three categories: ECM protein, coagulation agent, and biopolymer. Such materials include gelatin, hyaluronan, fibrin, chitosan, cellulose, potato starch, carboxymethyl cellulose, polyurethane, and polyethylene glycol [23]. They have been fabricated into various forms including foams, gels, meshes, films, and powders. Although bioabsorbable nasal packing provides a better outcome in terms of preventing synechiae and halting epistaxis, its effect on wound healing enhancement is moderate to insignificant.

The earliest form of absorbable nasal packing is in the form of gelatin film [25] or foam [26]. When compared to the untreated nose, no significant differences were seen in terms of adhesions, granulation tissue, or edema outcomes [25][26].

Hyaluronan is one of the major components of the extracellular matrix that is known to enhance re-epithelialization in vitro [19]. Hyaluronan in gel form, MeroGel, has been extensively studied with a total of four RCTs conducted to our knowledge. When compared with the non-absorbable nasal pack, MeroGel performed better with respect to preventing adhesions at 4 and 12 weeks postoperatively in one study [27]. However, the other three earlier studies were not able to observe significant differences in terms of wound healing outcome such as postoperative edema and scarring between the treatment (MeroGel) and the control group [28][29][30]. Moreover, trials with crosslinked hyaluronan water-insoluble gel [31] and hydrogel [32] were reported to have performed better. Taken together, hyaluronan products seem to confer modest benefit with respect to the wound healing of nasal mucosa.

In terms of other biomaterials, two materials, fibrin [33] and chitosan [34][35], demonstrated superior wound healing and hemostatic properties in comparison to the non-absorbable nasal packing while cellulose [36], potato starch [37], carboxymethyl cellulose [38], polyurethane [39], and polyethylene glycol [40] remain similar to the untreated control or non-absorbable packing [23]. **Table 1** summarizes the effect of absorbable nasal pack made with different biomaterials. In general, utilization of nasal pack is equivalent to the control.

**Table 1.** Effect of absorbable nasal pack on nasal wound healing parameters.

| **Absorbable Nasal Pack** | | | | | | |
|---|---|---|---|---|---|---|
| **Study** | **Intervention** | **Control** | **Endoscopic** | **Adhesion** | **Granulation** | **Edema** |
| [25] | **Gelatin film** | **Unpacked** | **NA** | **=** | **=** | **NA** |
| [26] | **Gelatin foam** | **Unpacked** | **NA** | **=** | **=** | **=** |
| [27] | **Hyaluronan gel** | **Polyvinyl acetate (PVA)** | **NA** | **+** | **NA** | **NA** |
| [28] | **Hyaluronan gel** | **PVA** | **NA** | **=** | **NA** | **=** |
| [30] | **Hyaluronan gel** | **PVA** | **=** | **NA** | **NA** | **NA** |
| [29] | **Hyaluronan gel** | **Unpacked** | **NA** | **=** | **NA** | **=** |
| [31] | **Hyaluronan gel** | **Unpacked** | **+** | **+** | **NA** | **NA** |
| [32] | **Hyaluronan gel** | **Unpacked** | **NA** | **+** | **NA** | **NA** |
| [33] | **Fibrin glue** | **PVA** | **NA** | **NA** | **NA** | **+** |
| [34] | **Chitosan gel** | **Unpacked** | **=** | **NA** | **NA** | **+** |
| [35] | **Chitosan gel** | **Unpacked** | **=** | **NA** | **NA** | **+** |
| [36] | **Cellulose powder** | **PVA** | **+** | **+** | **NA** | **+** |
| [37] | **Potato starch** | **Gelatin-thrombin matrix** | **NA** | **NA** | **NA** | **=** |
| [38] | **Carboxymethyl cellulose** | **Potato starch** | **=** | **=** | **=** | **=** |

| Absorbable Nasal Pack | | | | | | |
|---|---|---|---|---|---|---|
| **Study** | **Intervention** | **Control** | **Endoscopic** | **Adhesion** | **Granulation** | **Edema** |
| [39] | Polyurethane foam | Unpacked | + | NA | NA | + |
| [40] | Polyethylene glycol | Hyaluronan gel | NA | = | NA | = |

NA (Not applicable); + (Favors intervention); = (Equivalent).

As the field progresses, the postoperative management of nasal wound healing has shifted into the paradigm of a functional nasal pack. In this paradigm, biomaterials that were fabricated into an absorbable nasal packing were used as a delivery vehicle for known medications for wound healing such as steroids and antibiotics.

Silsos gel® is a registered nasal packing that is made from silver sucrose octasulfate in association with potassium sucrose octasulfate, sodium hyaluronate, propylene glycol, carbomer, and water [41]. Silver is a well-known antimicrobial agent that is commonly used for cutaneous wounds. In a randomized, placebo-controlled trial, the patients who were treated with Silsos gel® were reported to have performed better at the Sino-Nasal Outcome Test 22 (SNOT22) scale compared to the placebo group. Better mucosal integration has also been observed in the Silsos gel® group endoscopically. The placebo contains the gel (carbopol and propylene glycol) without the silver. The study has successfully shown the efficacy of silver in nasal mucosa wound healing [41].

SinuBandFP is a 2 cm × 2 cm bi-layered thin film that is made up of fibrinogen and is fortified with a total of 160 µg fluticasone propionate. After application of SinuBandFP in the nasal cavity, the corticosteroid fluticasone propionate will be released over time. In a randomized controlled trial to investigate its safety and efficacy, the SinuBandFP group had demonstrated local safety, ocular safety, and no significant changes in urine cortisol after 24 h when compared to the SinuBand without the corticosteroid. In terms of efficacy, the SinuBandFP group did better in terms of polyp score, adhesion occurrence, and general pain [42].

Nasopore® is a bioabsorbable nasal packing that is made of a fragmentable poly (DL-lactide-co-E-caprolactone) urethane. In a randomized, placebo-controlled study, Grzeskowiak and colleagues compared the efficacy of the Nasopore® packing impregnated with either steroid (betamethasone) or antibiotics (ciprofloxacin) [43]; Nasopore® impregnated with saline was used as a placebo. The study indicated a significant improvement with both steroid-eluting and antibiotic-eluting bioabsorbable packing on the postoperative healing process and patient satisfaction as compared to saline-soaked packing. **Table 2** summarizes the effect of a functional nasal pack in the different outcomes of nasal wound healing. Nasal pack offers a drug delivery system that can be tailored according to the needs of the patient.

**Table 2.** Functional nasal pack for drug delivery.

| Functional Nasal Pack | | | |
|---|---|---|---|
| **Study** | **Nasal Pack** | **Drug Delivered** | **Outcomes** |
| [41] | Silsos gel | Silver | Improves SNOT22 score and mucosal healing |
| [42] | SinuBandFP | Fluticasone propionate | Improves polyp score, adhesion, pain |
| [43] | Nasopore | Betamethasone | Improves healing and satisfaction |
| | | Ciprofloxacin | Improves healing and satisfaction |

## References


1. Camelo-Nunes, I.C.; Solé, D. Allergic rhinitis: Indicators of quality of life. J. Bras. Pneumol. 2010, 36, 124–133.
2. Bachert, C.; Pawankar, R.; Zhang, L.; Bunnag, C.; Fokkens, W.J.; Hamilos, D.L. ICON: Chronic rhinosinusitis. World All ergy Organ, J. 2014, 7, 1–28.
3. Fokkens, W.J.; Lund, V.J.; Mullol, J.; Bachert, C.; Alobid, I.; Baroody, F.; Georgalas, C. EPOS 2012: European position paper on rhinosinusitis and nasal polyps 2012. A summary for otorhinolaryngologists. Rhinology 2012, 50, 1–12.
4. Pant, H. Hemostasis in endoscopic sinus surgery. Otolaryngol. Clin. North Am. 2016, 49, 655–676.

5. Shyras, J.A. A comprehensive study on complications of endoscopic sinus surgery. Int. J. Otorhinolaryngol. Head Neck Surg. 2017, 3, 472.
6. Jae, Y.L.; Seung, W.L. Preventing lateral synechia formation after endoscopic sinus surgery with a silastic sheet. Arch. Otolaryngol. Head Neck Surg. 2007, 133, 776–779.
7. Bhandarkar, N.D.; Sautter, N.B.; Kennedy, D.W.; Smith, T.L. Osteitis in chronic rhinosinusitis: A review of the literature. I nt. Forum. Allergy Rhinol. 2012, 3, 355–363.
8. Pundir, V.; Pundir, J.; Lancaster, G.; Baer, S.; Kirkland, P.; Cornet, M.; Fokkens, W.J. Role of corticosteroids in Function al Endoscopic Sinus Surgery: A systematic review and meta-analysis. Rhinology 2016, 54, 3–19.
9. Jorissen, M.; Bachert, C. Effect of corticosteroids on wound healing after endoscopic sinus surgery. Rhinology 2009, 4 7, 280.
10. Wright, E.D.; Agrawal, S. Impact of perioperative systemic steroids on surgical outcomes in patients with chronic rhinosi nusitis with polyposis: Evaluation with the novel Perioperative Sinus Endoscopy (POSE) scoring system. Laryngoscope 2007, 117, 1–28.
11. Rojita, M.; Samal, S.; Pradhan, P.; Venkatachalam, V.P. Comparison of steroid and itraconazole for prevention of recurr ence in allergic fungal rhinosinusitis: A randomized controlled trial. J. Clin. Diagn. Res. 2017, 11, MC01–MC03.
12. Sawatsubashi, M.; Murakami, D.; Komune, S. Antibiotic treatment for chronic rhinosinusitis after endoscopic surgery: H ow long should macrolide antibiotics be given? Int. J. Otolaryngol. Head Neck Surg. 2014, 4, 44.
13. Jiang, R.S.; Liang, K.L.; Yang, K.Y.; Shiao, J.Y.; Su, M.C.; Hsin, C.H.; Lin, J.F. Postoperative antibiotic care after functio nal endoscopic sinus surgery. Am. J. Rhinol. 2008, 22, 608–612.
14. Liang, K.L.; Su, Y.C.; Tsai, C.C.; Lin, J.S.; Jiang, R.S.; Su, M.C.; Liang, K.L.; Su, Y.C.; Tsai, C.C.; Lin, J.S.; et al. Postop erative care with Chinese herbal medicine or amoxicillin after functional endoscopic sinus surgery: A randomized, doubl e-blind, placebo-controlled study. Am. J. Rhinol. Allergy 2011, 25, 170–175.
15. Albu, S.; Lucaciu, R. Prophylactic antibiotics in endoscopic sinus surgery: A short follow-up study. Am. J. Rhinol. Allergy 2010, 24, 306–309.
16. Luk, L.J.; DelGaudio, J.M. Topical drug therapies for chronic rhinosinusitis. Otolaryngol. Clin. N. Am. 2017, 50, 533–54 3.
17. Snidvongs, K.; Kalish, L.; Sacks, R.; Craig, J.C.; Harvey, R.J. Topical steroid for chronic rhinosinusitis without polyps. In Cochrane Database of Systematic Reviews; Kalish, L., Ed.; John Wiley & Sons, Ltd.: Chichester, UK, 2011.
18. Neubauer, P.D.; Schwam, Z.G.; Manes, R.P. Comparison of intranasal fluticasone spray, budesonide atomizer, and bud esonide respules in patients with chronic rhinosinusitis with polyposis after endoscopic sinus surgery. Int. Forum Allergy Rhinol. 2016, 6, 233–237.
19. Nyman, E.; Huss, F.; Nyman, T.; Junker, J.; Kratz, G. Hyaluronic acid, an important factor in the wound healing properti es of amniotic fluid: In vitro studies of re-epithelialisation in human skin wounds. J. Plast. Surg. Hand Surg. 2013, 47, 8 9–92.
20. Casale, M. New prospectives of hyaluronic acid in the upper airway chronic inflammation diseases. Glob. J. Otolaryngo l. 2015, 1, 555558.
21. Erkan, A.N.; Cakmak, O.; Kocer, N.E.; Ylmaz, I. Effects of fibrin glue on nasal septal tissues. Laryngoscope 2007, 117, 491–496.
22. Yu, M.S.; Kang, S.-H.; Kim, B.-H.; Lim, D.J. Effect of aerosolized fibrin sealant on hemostasis and wound healing after endoscopic sinus surgery: A prospective randomized study. Am. J. Rhinol. Allergy 2014, 28, 335–340.
23. Massey, C.J.; Singh, A. Advances in absorbable biomaterials and nasal packing. Otolaryngol. Clin. North Am. 2017, 50, 545–563.
24. Wang, J.; Cai, C.; Wang, S. Merocel versus Nasopore for nasal packing: A meta-analysis of randomized controlled trial s. PLoS ONE 2014, 9, e93959.
25. Tom, L.W.C.; Palasti, S.; Potsic, W.P.; Handler, S.D.; Wetmore, R.F. The effects of gelatin film stents in the middle meat us. Am. J. Rhinol. 1997, 11, 229–232.
26. Wee, J.H.; Lee, C.H.; Rhee, C.S.; Kim, J.-W. Comparison between gelfoam packing and no packing after endoscopic si nus surgery in the same patients. Eur. Arch. Oto Rhino Laryngol. 2012, 269, 897–903.
27. Berlucchi, M.; Castelnuovo, P.; Vincenzi, A.; Morra, B.; Pasquini, E. Endoscopic outcomes of resorbable nasal packing after functional endoscopic sinus surgery: A multicenter prospective randomized controlled study. Eur. Arch. Oto Rhino Laryngol. 2009, 266, 839–845.

28. Miller, R.S.; Steward, D.L.; Tami, T.A.; Sillars, M.J.; Seiden, A.M.; Shete, M.; Welge, J. The clinical effects of hyaluronic acid ester nasal dressing (Merogel) on intranasal wound healing after functional endoscopic sinus surgery. Otolaryngol. Head Neck Surg. 2003, 128, 862–869.
29. Wormald, P.J.; Boustred, R.N.; Le, T.; Hawke, L.; Sacks, R. A prospective single-blind randomized controlled study of u se of hyaluronic acid nasal packs in patients after endoscopic sinus surgery. Am. J. Rhinol. 2006, 20, 7–10.
30. Franklin, J.H.; Wright, E.D. Randomized, controlled, study of absorbable nasal packing on outcomes of surgical treatm ent of rhinosinusitis with polyposis. Am. J. Rhinol. 2007, 21, 214–217.
31. Kimmelman, C.P.; Edelstein, D.R.; Cheng, H.J. Sepragel sinus (Hylan B) as a postsurgical dressing for endoscopic sin us surgery. Otolaryngol. Head Neck Surg. 2001, 125, 603–608.
32. Shi, R.; Zhou, J.; Wang, B.; Wu, Q.; Shen, Y.; Wang, P.; Shu, X.Z. The clinical outcomes of new hyaluronan nasal dress ing: A prospective, randomized, controlled study. Am. J. Rhinol. Allergy 2013, 27, 71–76.
33. Vaiman, M.; Shlamkovich, N.; Eviatar, E.; Segal, S. Use of fibrin glue as a hemostatic in endoscopic sinus surgery. Ann. Otol. Rhinol. Laryngol. 2005, 114, 237–241.
34. Ngoc Ha, T.; Valentine, R.; Moratti, S.; Robinson, S.; Hanton, L.; Wormald, P.-J. A blinded randomized controlled trial ev aluating the efficacy of chitosan gel on ostial stenosis following endoscopic sinus surgery. Int. Forum. Allergy Rhinol. 20 13, 3, 573–580.
35. Valentine, R.; Athanasiadis, T.; Moratti, S.; Hanton, L.; Robinson, S.; Wormald, P.-J. The efficacy of a novel chitosan gel on hemostasis and wound healing after endoscopic sinus surgery. Am. J. Rhinol. Allergy 2010, 24, 70–75.
36. Al-Shaikh, S.; Muddaiah, A.; Lee, R.J.; Bhutta, M.F. Oxidised cellulose powder for haemostasis following sinus surgery: A pilot randomised trial. J. Laryngol. Otol. 2014, 128, 709–713.
37. Beyea, J.A.; Rotenberg, B.W. Comparison of purified plant polysaccharide (HemoStase) versus gelatin-thrombin matrix (FloSeal) in controlling bleeding during sinus surgery: A randomized controlled trial. Ann. Otol. Rhinol. Laryngol. 2011, 120, 495–498.
38. Antisdel, J.L.; Meyer, A.; Comer, B.; Jang, D.; Gurrola, J.; Khabbaz, E.; Kountakis, S. Product comparison model in otol aryngology: Equivalency analysis of absorbable hemostatic agents after endoscopic sinus surgery. Laryngoscope 201 6, 126, S5–S13.
39. Kastl, K.G.; Reichert, M.; Scheithauer, M.O.; Sommer, F.; Kisser, U.; Braun, T.; Leunig, A. Patient comfort following FES S and Nasopore® packing, a double blind, prospective, randomized trial. Rhinology 2014, 52, 60–65.
40. Song, K.J.; Lee, H.M.; Lee, E.J.; Kwon, J.H.; Jo, K.H.; Kim, K.-S. Anti-adhesive effect of a thermosensitive poloxamer a pplied after the removal of nasal packing in endoscopic sinus surgery: A randomised multicentre clinical trial. Clin. Otola ryngol. 2013, 38, 225–230.
41. Ottaviano, G.; Blandamura, S.; Fasanaro, E.; Favaretto, N.; Andrea, L.; Giacomelli, L.; Bartolini, A.; Staffieri, A. Silver s ucrose octasulfate nasal applications and wound healing after endoscopic sinus surgery: A prospective, randomized, d ouble-blind, placebo-controlled study. Am. J. Otolaryngol. Head Neck Med. Surg. 2015, 36, 625–631.
42. Adriaensen, G.F.J.P.M.; Lim, K.H.; Fokkens, W.J. Safety and efficacy of a bioabsorbable fluticasone propionate–eluting sinus dressing in postoperative management of endoscopic sinus surgery: A randomized clinical trial. Int. Forum. Allerg y Rhinol. 2017, 7, 813–820.
43. Grzeskowiak, B.; Wierzchowska, M.; Walorek, R.; Seredyka-Burduk, M.; Wawrzyniak, K.; Burduk, P.K. Steroid vs. antibi otic impregnated absorbable nasal packing for wound healing after endoscopic sinus surgery: A randomized, double bli nd, placebo-controlled study. Braz. J. Otorhinolaryngol. 2018, 85, 473–480.