Review

Tissue sealants may reduce haematoma and complications in face-lifts: A meta-analysis of comparative studies

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KEYWORDS
Face-lift; Rhytidoplasty; Rhytidectomy; Tissue sealant; Haematoma; Platelet-rich plasma

Summary The use of tissue sealants has increased among different surgical specialities. Face-lift and rhytidoplasty may cause several complications such as haematoma, ecchymosis, oedema, seroma, skin necrosis, wound dehiscence and wound infection. However, administration of tissue sealants may prevent the occurrence of some complications.

We performed a meta-analysis of studies that compared tissue sealant use with controls to evaluate the outcomes. A systematic literature search was performed. The primary outcome was the incidence of haematoma. Secondary outcomes were wound drainage amount, oedema, ecchymosis, seroma, skin necrosis and hypertrophic scarring.

Thirteen studies involving 2434 patients were retrieved and included in the present analysis. A statistically significantly decrease in post-operative haematoma [risk ratio (RR), 0.37; 95% CI, 0.18–0.74; p = 0.005] and wound drainage (MD, −16.90, 95% CI −25.71, −8.08, p < 0.001) was observed with tissue sealant use. A significant decrease in oedema was detected (RR, 0.30; 95% CI, 0.11–0.85, p = 0.02) but not in ecchymosis, seroma, skin necrosis, and hypertrophic scarring with tissue sealant use. The use of tissue sealants prevents post-operative haematomas and reduces wound drainage. Previous studies have shown a similar trend, but the power of this meta-analysis could verify this perception.

Level of Evidence: III.

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Introduction

Face lift procedures may cause several complications such as haematoma, ecchymosis, oedema, seroma, skin necrosis, wound dehiscence, nerve injury and wound infection. Among them, haematoma is one of the most common, with a rate of 1.1%–9% and representing 62% of all complications.1,2 Haematoma may compromise the skin flap’s vascularity, thus delaying post-operative recovery because of possible ecchymosis, oedema and seroma. Nonetheless, the long-term course may lead to local unwanted effects such as hyperpigmentation and contour changes due to possible sub-cutaneous scarring. Therefore, any strategy to decrease all these complications is attractive.

Fibrin-based tissue adhesives have gained popularity among plastic surgeons for different procedures,3 particularly facial plastic surgery.4 Different fibrin sealant products are available in the market, and previous studies suggest that these sealants have numerous proven benefits, including the reduction of wound drainage, oedema, ecchymosis and comfort in addition to haematoma.5–8 However, none of these studies were sufficiently powered to demonstrate the effectiveness of tissue sealants in facelifts. A previous meta-analysis on this topic failed to show significant benefits; however, it reported a trend towards diminished post-operative drainage and ecchymosis using data from three studies.9 Furthermore, the use of fibrin-based tissue adhesives has been recently investigated by several studies, which were not included in the above-mentioned meta-analysis.7,8,10 Thus, we performed a meta-analysis of comparative studies to evaluate the outcomes, hypothesising that tissue sealants may provide significant benefits in preventing not only haematoma rates but also complications in face-lifts.

Materials and methods

The present systematic review and meta-analysis followed the guidelines of the Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA) statement, and the relevant checklist was completed.11

Search strategy

All authors individually performed a full systematic literature search of all records through Medline, Cochrane Library, Embase, Scopus, Google Scholar and Research Gate for any study on tissue sealants use in human subjects for face-lift/rhytidectomy procedures.

The terms employed in the search were ‘fibrin tissue adhesive’, ‘tissue sealant’ and ‘platelet rich plasma’ combined with ‘face-lift’, ‘rhytidoplasty’, ‘rhytidectomy’ and ‘facial plastic surgery’, and they were combined using Boolean operators. In addition, the reference lists of all relevant articles were scrutinised. Each author’s search results were merged and duplicate citations were discarded.

The search was performed from inception to 29 June 2016, aiming at those studies that compared the outcomes of tissue sealant use in face-lifts with internal or external control in both randomised and non-randomised fashion. No language restrictions were applied.

Study selection

We searched for and assessed studies that compared the use of any fibrin sealant with any control in face-lift procedures. Studies included in this review had to match predetermined criteria according to the PICOS (patients, intervention, comparator, outcomes and study design) approach. Criteria for inclusion and exclusion are specified in Table 1. No limitations were applied on ethnicity, age of patients or type of fibrin sealant used.

Two authors (SG and EV) independently reviewed the abstracts and articles. In addition, the reference lists of all relevant articles were scrutinised. For the purpose of this analysis, studies reporting on quantitative outcomes after fibrin sealant use compared with control in face-lift procedures were considered eligible.

Each study was independently evaluated by two co-authors (SG and EV) for inclusion or exclusion from this analysis (Table 1). To be included, studies had to provide details on baseline characteristics, type of face-lift procedure, type of fibrin sealant, and outcomes of post-
operative complications compared with control patients or side in the same patient (internal control).

Data extraction

Data were independently collected by two investigators (SG and EV) and checked by a third investigator (IK) only from the retrieved articles. Disagreement on collected data was settled by consensus between these investigators. No attempt was made to obtain specific or missing data from the authors. The following data were extracted: first author, year of publication, study design, number of patients, type of procedure, and primary and secondary measures.

The quality of the included studies was independently assessed by three investigators (SG, EV and IK) using the Cochrane Collaboration’s risk of bias assessment tool for randomized controlled trials (RCT)\(^1\) while using the Newcastle–Ottawa scale to evaluate individual non-randomised studies.\(^1\) The research team convened to resolve any disagreement on the assessment and reach consensus.

Outcome measures

The primary outcome measure was haematoma occurrence requiring re-operation. The secondary outcome measures were the drainage amount from the wound bed after 24 h; post-operative ecchymosis; oedema when reported; and seroma, skin necrosis and hypertrophic scarring at follow-up. We assumed that drainages were not placed in patients. The quality of the included studies was independently assessed by three investigators (SG, EV and IK) using the Cochrane Collaboration’s risk of bias assessment tool for randomized controlled trials (RCT)\(^1\) while using the Newcastle–Ottawa scale to evaluate individual non-randomised studies.\(^1\) The research team convened to resolve any disagreement on the assessment and reach consensus.

Outcome measures

The primary outcome measure was haematoma occurrence requiring re-operation. The secondary outcome measures were the drainage amount from the wound bed after 24 h; post-operative ecchymosis, oedema at 7–8 days or, when reported, seroma, skin necrosis and hypertrophic scarring at follow-up. We assumed that drainages were not placed in studies not reporting outcomes on drainage amount. Definitions for these endpoints were those adopted by the investigators of the included studies. However, minor haematoma, reported in two studies, was considered as ecchymosis,\(^5,14\) whereas prolonged oedema with ecchymosis, described in one study,\(^5\) and haematoma-seroma not requiring surgical intervention, stated in one study,\(^15\) were considered as seroma. Missing data were dealt according to previously validated estimations.\(^5\)

The patient’s contralateral side was used as control in some of the included studies, represented by the contralateral face side, whereas in the other studies, patients were allocated into different groups according to whether fibrin sealants were used or not. Therefore, the outcome occurrence pooled in the analysis was the one by face side when studies with internal and external control were pooled together.\(^17\)

Statistical analysis

Statistical analysis was performed using Review Manager 5.3 software (Copenhagen: The Nordic Cochrane Centre, The Cochrane Collaboration, 2014).\(^18\) Differences in continuous variables were expressed as mean difference (MD) with 95% confidence interval (CI). Differences in dichotomous variables and outcome endpoints were reported as risk ratio (RR) with 95% CI. Heterogeneity was assessed by \(I^2\) statistic, which describes the percentage of total variation across the studies, which is due to heterogeneity rather than chance.\(^19\) \(I^2\) values were evaluated as low, moderate or high at 25%, 50% or 75%, respectively. In almost all the cases, we performed random-effect analysis, which considers both within- and between-study variations,\(^20,21\) because of the observational nature of some studies included in this analysis. However, in one pooled analysis including only RCTs (Figure 3A), a fixed effect was used. A \(p < 0.05\) was considered statistically significant.

Finally, we conducted sensitivity analyses omitting each study in turn using the ‘leave one out’ methodology to determine whether the results were excessively influenced by a single study. Publication bias was assessed using the funnel plot for primary outcomes.

Results

Literature search yielded 4912 articles, of which 13,\(^5\)8,10,12,22–27 were pertinent to the present meta-analysis and had sufficient sources of information on outcomes using fibrin sealants for face-lifts to be included in the meta-analysis (Table 2), involving a total of 2434 patients. The literature search flowchart is shown in Figure 1. All the studies showed different approaches and different

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Inclusion criteria</th>
<th>Exclusion criteria</th>
</tr>
</thead>
<tbody>
<tr>
<td>Patients</td>
<td>Patients of any age undergoing face-lift surgery.</td>
<td>Patients underwent mini-invasive rejuvenation or other types of facial procedures.</td>
</tr>
<tr>
<td>Intervention</td>
<td>Local application of any type of fibrin sealant, including autologous plated-rich plasma.</td>
<td>Studies comparing different types of fibrin sealants.</td>
</tr>
<tr>
<td>Comparator</td>
<td>Any type of control, internal (face side) or external.</td>
<td></td>
</tr>
<tr>
<td>Outcomes</td>
<td><strong>Primary outcome measure</strong>: haematoma occurrence requiring re-operation. <strong>Secondary outcome measures</strong>: drainage amount from the wound bed after 24 h; post-operative ecchymosis; oedema when reported; and seroma, skin necrosis and hypertrophic scarring at follow-up.</td>
<td>Reviews, expert opinion, comments, letter to editor, case reports, studies on animals, conference reports. Shorter follow-up, &lt;1 month. Studies with no outcomes reported.</td>
</tr>
<tr>
<td>Study design</td>
<td>Randomized controlled trials; non-randomized observational trials; retrospective, prospective, or concurrent cohort studies. At least 1-month follow-up.</td>
<td></td>
</tr>
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</table>

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Table 2: Retrieved studies included in the analysis.

<table>
<thead>
<tr>
<th>Author</th>
<th>Study type</th>
<th>Total number of patients</th>
<th>Control</th>
<th>Sides of faces</th>
<th>Mean age (years)</th>
<th>Procedure</th>
<th>Sealant</th>
<th>Volume</th>
<th>Outcome measures extracted</th>
</tr>
</thead>
<tbody>
<tr>
<td>Marchac, 1994</td>
<td>Retrospective non-randomized</td>
<td>200</td>
<td>100</td>
<td>200 vs 200</td>
<td>39–73</td>
<td>SMAS plication and liposuction</td>
<td>Tissucol R</td>
<td>0.5–1 ml</td>
<td>Haematoma, Ecchymosis, Oedema, Hypertrophic scar, Skin necrosis</td>
</tr>
<tr>
<td>Oliver, 2001</td>
<td>RCT</td>
<td>20</td>
<td>Self</td>
<td>20 vs 20</td>
<td>44–70</td>
<td>Sub-cutaneous, SMAS plication</td>
<td>Beriplast P</td>
<td>1 ml</td>
<td>Drainage at 24 h</td>
</tr>
<tr>
<td>Powell, 2001</td>
<td>RCT</td>
<td>8</td>
<td>Self</td>
<td>8 vs 8</td>
<td>N/A</td>
<td>Deep-plane face-lift</td>
<td>Platelet-rich Plasma</td>
<td>7–8 ml</td>
<td>Ecchymosis, Oedema</td>
</tr>
<tr>
<td>Fezza, 2002</td>
<td>Retrospective non-randomized</td>
<td>24</td>
<td>24</td>
<td>48 vs 48</td>
<td>48–87</td>
<td>Strip SMAS and liposuction</td>
<td>Haemaseel APR</td>
<td>1 ml</td>
<td>Haematoma</td>
</tr>
<tr>
<td>Marchac &amp; Greensmith, 2005</td>
<td>RCT</td>
<td>30</td>
<td>Self</td>
<td>30 vs 30</td>
<td>42–72</td>
<td>Vertical U incision, SMAS plication</td>
<td>Tisseel</td>
<td>N/A</td>
<td>Drainage at 24 h, Ecchymosis, Oedema, Skin necrosis</td>
</tr>
<tr>
<td>Brown, 2005</td>
<td>Prospective non-randomised</td>
<td>33</td>
<td>14</td>
<td>38 vs 28</td>
<td>55–56</td>
<td>Deep-plane face-lift</td>
<td>Platelet-rich Plasma</td>
<td>7 ml</td>
<td>Haematoma, Ecchymosis, Oedema</td>
</tr>
<tr>
<td>Kamer, 2007</td>
<td>Retrospective non-randomized</td>
<td>100</td>
<td>100</td>
<td>200 vs 200</td>
<td>45–81</td>
<td>Deep-plane face-lift</td>
<td>Tisseel</td>
<td>1 ml</td>
<td>Drainage at 24 h, Haematoma, Seroma, Skin necrosis</td>
</tr>
<tr>
<td>Zoumalan, 2008</td>
<td>Retrospective non-randomized</td>
<td>605</td>
<td>146</td>
<td>918 vs 292</td>
<td>37–79</td>
<td>Deep-plane face-lift, lateral SMASectomy</td>
<td>Tisseel</td>
<td>N/A</td>
<td>Haematoma (major, minor)</td>
</tr>
<tr>
<td>Lee, 2009</td>
<td>Retrospective non-randomized</td>
<td>9</td>
<td>Self</td>
<td>9 vs 9</td>
<td>N/A</td>
<td>Deep-plane face-lift</td>
<td>Crosseal</td>
<td>2 ml</td>
<td>Ecchymosis, Oedema</td>
</tr>
<tr>
<td>Hester &amp; Gerut, 2013</td>
<td>RCT</td>
<td>45</td>
<td>Self</td>
<td>45 vs 45</td>
<td>18–75</td>
<td>Sub-cutaneous, SMAS plication or elevation</td>
<td>Artiss</td>
<td>0.02–0.04 ml</td>
<td>Haematoma, Drainage at 24 h, Seroma</td>
</tr>
<tr>
<td>Hester &amp; Shire, 2013</td>
<td>RCT</td>
<td>71</td>
<td>Self</td>
<td>71 vs 71</td>
<td>18–75</td>
<td>Sub-cutaneous, SMAS plication or elevation, liposuction</td>
<td>Artiss</td>
<td>0.02–0.04 ml</td>
<td>Haematoma, Drainage at 24 h, Seroma</td>
</tr>
<tr>
<td>Costa, 2015</td>
<td>Retrospective non-randomized</td>
<td>1089</td>
<td>502</td>
<td>1174 vs 1004</td>
<td>35–89</td>
<td>SMASectomy or SMAS stacking</td>
<td>Platelet-rich Plasma</td>
<td>8 ml</td>
<td>Haematoma</td>
</tr>
<tr>
<td>Berry, 2015</td>
<td>Retrospective non-randomized</td>
<td>200</td>
<td>100</td>
<td>200 vs 200</td>
<td>35–81</td>
<td>SMAS dissection, plication, SMAS flap, e-SMAS</td>
<td>Tisseel</td>
<td>1 ml</td>
<td>Haematoma, Hypertrophic scar, Skin necrosis</td>
</tr>
</tbody>
</table>
Tissue sealants may reduce haematoma in face lifts

All but one study, involving a total of 2425 patients, reported the incidence of post-operative haematoma, and pooled analysis showed significant difference that favoured tissue sealants (RR, 0.37; 95% CI, 0.18–0.74; p = 0.005; Figure 2). Sub-group analysis for the assessment of overall haematoma among only RCTs (RR, 0.26; 95% CI, 0.08–0.83; p = 0.02, Figure 3A) and among only comparative studies (RR, 0.39; 95% CI, 0.17–0.88; p = 0.02, Figure 3B) confirmed these outcomes.

Sub-group analysis for haematoma among the most used sealants showed significant outcomes only for Artiss (RR,
0.13; 95% CI, 0.03−0.86; p = 0.03; Figure 4C), although a trend towards benefit was noted (Figure 4A–B). When subgroup analysis was performed on the basis of dissection plane, tissue sealants were significantly beneficial for subcutaneous face-lifts (RR, 0.27; 95% CI, 0.10−0.73; p = 0.01, Figure 5A), but not for deep-plane face-lifts (Figure 5B).

Similarly, analysis of five studies6−8,24,25 reported a significantly reduced post-operative wound drainage using tissue sealants (MD, −16.90, 95% CI = −25.71, −8.08, p < 0.001; Figure 6). Pooled analysis comparing haematoma rates in patients where tissue sealants were used without drains (8/2748) with those in patients where tissue sealants were used with drains (2/204) did not show significant difference (RR, 3.37; 95% CI, 0.72−15.75; p = 0.14).

Among the secondary endpoints, no significant difference was detected in ecchymosis (RR, 0.58; 95% CI, 0.21−1.62; p = 0.30; Figure 7), but oedema occurrence was significantly lower (RR, 0.30; 95% CI, 0.11−0.85; p = 0.02; Figure 8). We did not find a significant difference between the two treatment groups with regard to seroma occurrence (RR, 0.41; 95% CI, 0.15−1.11; p = 0.08), skin necrosis (RR, 0.49; 95% CI, 0.11−2.26; p = 0.36) and hypertrophic scarring (RR, 0.19; 95% CI, 0.03−1.12; p = 0.07). Although not statistically significant, these pooled results showed a certain trend towards the reduction of skin necrosis and hypertrophic scarring; however, these results were obtained from only two studies.5,10

Finally, the exclusion of any study from the analysis did not materially change the summary estimates, and absence of significant asymmetry in the funnel plot for haematoma was observed (Figure 9A). However, wound drainage funnel plot showed some asymmetry because of the high heterogeneity (Figures 7 and 9B).

Discussion

The present meta-analysis including 13 studies and 2434 patients provides compelling evidence that tissue sealants are effective in preventing haematoma occurrence and reducing post-operative drainage amount in patients undergoing face-lift independent of the technique used (Figure 2 and 3). Haematoma rates were similar using fibrin sealants with or without drains. In addition, it was also observed that the occurrence of oedema was significantly reduced (Figure 6). However, the use of tissue sealant did not significantly prevent the incidence of ecchymosis, seroma, skin necrosis or hypertrophic scarring.

Haematoma is one of the most common complications in face-lift, with incidences up to 9%, that can require surgical evacuation.1,28−30 Previous studies showed that possible risk factors are high BMI, hypertension, perioperative nausea/vomiting and heparin prophylaxis.1,29 Interestingly, male patients experience this complication almost three times more than female patients.1 This fact may be due to hormonal factors, facial follicle differences, and thicker and more vascularized facial flaps, which are prominent in males.1,30 In this analysis, we included only haematoma requiring re-operation, excluding the minor non-expanding ones. In fact, data concerning patients’ baseline risk factors were not elucidated in the included studies.

Reducing the wound drainage amount and oedema are important to improve patients’ comfort and reduce possible infection, the second most common complication in face-lifts, occurring in 0.3% of cases.1 Infection was not considered an endpoint in this pooled analysis, and it was not mentioned in most studies on this topic.
Figure 4  A–C. Forest plots for haematoma occurrence using Tisseel (A), Platelet-rich plasma (B), or Artiss® (C), favouring the fibrin sealant patient group only for Artiss® (C).

Figure 5  A–B. Forest plots for haematoma occurrence in sub-cutaneous face-lifts (A) and deep-plane face-lifts (B), favouring the fibrin sealant patient group only for sub-cutaneous face-lifts (A).
The safest plane dissection for face-lift remains controversial because it is mostly personal and related to the patient. Some authors prefer limited incision techniques to reduce haematoma, while others propose a relatively aggressive technique to obtain more sustained results in term of rejuvenation. According to our study, fibrin sealants seem beneficial independent of the dissection amount and plane used. Moreover, for deeper plane techniques, fibrin sealants may improve superficial muscular aponeurotic system (SMAS) fixation after face-lift.

Figure 6  Forest plot showing the significantly reduced wound drainage amount in the fibrin sealant patient group compared with the control group.

Figure 7  Forest plot showing ecchymosis occurrence in the fibrin sealant patient group compared with the control group.

Figure 8  Forest plot showing the significantly reduced oedema occurrence in the fibrin sealant patient group compared with the control group.

Figure 9  A–B. Funnel plots for bias assessment in haematoma occurrence (A) and wound drainage amount (B).
repositioning with sutures, thus reducing their tension because of adhesion properties (gluing together of structures). Particularly, Tissucol seems to have better gluing effects than Quixil. A previous meta-analysis on this topic including only prospective randomised studies failed to show significant benefits, but it reported a trend towards diminished post-operative drainage and ecchymosis using data from three studies. More recently, another meta-analysis including seven trials demonstrated a significant reduction of haematoma incidence; however, their pooled analysis on 24-h post-operative wound drainage was based on only two studies.

To evaluate the efficiency of any tissue sealant, it is of great importance to conduct research in a double-blinded and controlled setting to eliminate any confounding elements such as patients’ age, the plane of dissection, the type of sealant used, and control treatment. Hence, it can be concluded that the current scientific evidence on the benefit of tissue sealants is still limited and inconsistent and bias effect should be considered. Thirteen studies were used for this pooled analysis, and only five of them were RCTs, with self-control, represented by the contra-lateral face side. When pooling data of studies with internal and external controls, we considered face sides to reduce overestimation bias, and to further clarify this, we performed a sub-group analysis using only RCTs with hemi-face self-control (Figure 3A) and retrospective studies using different groups (Figure 3B). However, four studies of the 13 received financial support from industrial sources, which may cause bias.

Tissue sealants comprise two natural materials, thrombin and fibrinogen, forming the final common pathway of the coagulation cascade. However, as several products are available in the market, a major limitation of this analysis is due to the heterogeneity and plurality of the tissue sealants used. In general, tissue sealants can be used in the included articles were Tisseel in four studies, Tissucol in three studies, Floseal and Surgiflo in one study, respectively. Although the products used in the included articles were Tisseel in four studies and ARTISS in two studies.

Because fibrin sealants are derived from human or animal source, they can potentially cause an allergic reaction and have the theoretical possibility of transmitting infectious disease in homologous-derived forms. From this perspective, the use of autologous platelet gel could be beneficial; only two fatal adverse reactions have been reported during neurosurgical procedures, which may be due to the co-ingredient tranexamic acid. Platelet-rich plasma is well known for its haemostatic, adhesive and healing properties because of the multiple growth factors released from the platelets.

The cost of tissue sealants varies between different products: fibrin products cost approximately 250 US$ per unit, gelatin products costs vary from 1300 to 2700 US$, BSAG products cost approximately 300 US$ per unit and DuraSeal costs approximately 100 US$ per unit. However, according to literature, only fibrin products have been specifically used in rhytidoplasty.

As demonstrated in this meta-analysis, tissue sealants reduce the risk for haematoma, which also correlates to the finding that these patients have less post-operative drainage. Haematomas may range in severity from minor bruising requiring only conservative management to large expanding collections that demand aggressive surgical measures. Therefore, the application of fibrin sealants would be cost-effective if their use prevents one haematoma evacuation in every 25 patients (i.e. 4%). As the rate of haematoma after rhytidectomy ranges from 0.2% to 8% and its incidence ranges from 3% to 4%, fibrin tissue sealants appear to be beneficial in economic terms. This evaluation obviously covers the cost of not only reoperations but also minor bruising due to extra load in outpatient clinic, including additional time and costs.

Nonetheless, the linked trend in reducing skin necrosis and hypertrophic scarring can be cost beneficial as well, although we did not find it statistically significant in our pooled analysis.

We had to exclude some interesting studies reporting outcomes on fibrin sealants because they did not provide sufficient data for the meta-analysis. Our analysis has several limitations. As discussed above, only comparative studies were included in this meta-analysis, thus excluding the one-arm cohorts. The quality of the included studies was heterogeneous as five of them were RCTs and the others were comparative studies. Nevertheless, six studies involved self/internal control, i.e. tissue sealant was applied in one side, whereas in other studies, patients were allocated into groups where tissue sealants were either used or not used (Table 1). All these issues certainly confer further bias and might affect the outcomes. Another major weakness of this meta-analysis is due to the methodological heterogeneity in the surgical technique used and the amount of undermining performed, which might affect the incidence of complications. In particular, only five studies reported outcomes on post-operative wound drainage, while the others did not provide sufficient data regarding this.

However, we found a benefit in all the studies independent of the product used. Interestingly, the haematoma rates were considerably high in many studies, which may not reflect the typical practice scenarios, adding further possible bias. Nevertheless, patients’ comorbidities and medications among the included studies were not taken into account, and this may also affect the outcomes.

Additional studies are needed to validate this promising treatment modality for these complications, particularly in patients with high risks, such as those who are obese, smokers, and using anti-coagulants or corticosteroids.

Conclusions

Fibrin sealants prevent haematoma occurrence and reduce the amount of wound drainage in face-lifts. Thus, we recommend their use, especially in the case of more extensive dissection techniques, to reduce complications. However, these sealants cannot be considered a replacement for meticulous haemostasis but an adjunct to improve outcomes.

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Conflicts of interest

The authors have no financial interest to declare in relation to the content of this article.

Appendix A. Supplementary data

Supplementary data related to this article can be found at http://dx.doi.org/10.1016/j.bjps.2016.11.028

References