Secondary Augmentation Mammoplasties and Periprosthetic Infection: A Three-Year Retrospective Review

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Abstract
Background: Secondary or revision surgery following primary augmentation mammoplasty is common. There are several published studies on the incidence and prevention of infection after primary augmentation mammoplasty, but there is a paucity of information on the incidence of periprosthetic infection after secondary or revision augmentation mammoplasty procedures.

Objectives: The author evaluates the incidence of periprosthetic infection in a series of revision and secondary mammoplasty patients from his practice.

Methods: A retrospective review was performed of the charts for 92 consecutive patients who underwent bilateral secondary mammoplasty with the author between July 2008 and April 2011. Each breast was taken as a single unit, for a total of 184 breasts. The data were compiled and compared with previous studies related to periprosthetic infection following primary augmentation mammoplasty.

Results: The average age of the patients was 35.8 ± 7.9 years (range, 19-54 years). One patient developed unilateral periprosthetic infection in her left breast. This incidence of 0.54% was comparable to infection incidence of 0.5% for primary augmentation mammoplasty previously reported by the author.

Conclusions: In this series, there was no higher incidence of infection seen in secondary augmentation mammoplasty than was seen in previous studies on primary mammoplasty.

Level of Evidence: 4

Keywords
antibiotic prophylaxis, implant infection, secondary breast surgery, periprosthetic infection, augmentation mammoplasty

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The ready availability of information, the safety profiles of newer-generation breast implant devices, and a decrease in the overall incidence of capsular contracture (CC) following primary augmentation mammoplasty have resulted in the procedure becoming increasingly popular. Augmentation mammoplasty is one of the most commonly performed procedures by aesthetic plastic surgeons in the United States.1 There has been an equal and proportionate rise in the rate of revision or secondary augmentation mammoplasties being performed today.2 Different reoperation rates following augmentation have been reported in the literature, ranging from 0% in a three-year prospective study of Inamed Style 410 silicone gel, form-stable devices (Allergan, Inc., Irvine, California)3 to 13% with saline implants used for the same duration in another prospective premarket approval study.4 However, there are no available statistics showing how many of the mammoplasties performed each year (eg, 311,957 mammoplasties in 2009) are primary versus secondary mammaplasties.5 With a threefold increase in the number of primary procedures performed in the past 13 years,6 a similar trend can be expected in the number of secondary mammoplasties.

The causes leading to the need for secondary procedures are many, and the secondary procedure itself carries...
the potential of complications similar to those seen with primary augmentation, which would then require further corrective surgery. The complications related to primary and secondary augmentation mammoplasties can be broadly divided into early or late. Early complications—which are the focus of this report—include infection and hematoma, with an acceptable incidence of 0.5% to 2.5% and 0.6% to 1.26%, respectively, in primary augmentation mammoplasty. Although the overall incidence of these early complications is low, they often require emergency treatment, including surgical intervention.

The incidence, prevalence, and prevention of infection following augmentation mammoplasty have been extensively studied and reported in the literature. However, the previous reports have focused on primary augmentation mammoplasty, revision surgery for breast augmentation/augmentation mastopexy, or implant/expander placement for breast reconstruction. Secondary augmentation mammoplasty procedures, which have been associated with a high incidence of microorganism presence in the capsule, should be more prone to infection. On the contrary, a low incidence of infection following revision or secondary augmentation mammoplasty is a common occurrence. Surprisingly, no published study has entirely and exclusively focused on the incidence of infection or its prevalence following secondary or revision augmentation mammoplasty alone. To that end, the author investigates the incidence of infection in a series of patients who underwent secondary augmentation mammoplasty at his clinic.

**METHODS**

A retrospective chart review was performed for 92 patients who had undergone secondary or revision bilateral augmentation mammoplasty with the author between July 2008 and April 2011. Each breast was taken as a single unit, for a total of 184 breasts. The data were compiled into an Excel spreadsheet (Microsoft, Redmond, Washington), analyzed, and compared with the results of previous studies related to periprosthetic infection following primary augmentation mammoplasty.

**Statistical Analysis**

The data were analyzed with SPSS version 17.0 software (SPSS, Inc., an IBM Company, Chicago, Illinois). The categorical variables were calculated as frequencies and percentages, whereas the numerical variables were presented as mean ± standard deviation (SD). Statistical analysis was performed for age, implant volumes, and duration of implantation differences with the Student t-test. Statistical analysis for the infection rates of primary versus revision augmentation mammoplasty was carried out with the chi-square/Fisher exact test where appropriate. A P value of < .05 was considered statistically significant.

**RESULTS**

The mean age of the patients in this series was 35.8 ± 7.9 years (range, 19-54 years). Mean duration of breast implants was 5.1 years (range, three months to 18 years). Mean prerevision and postrevision implant size was 305.5 cc (range, 175-755) and 437 cc (range, 230-850 cc), respectively (Table 1).

All secondary mammoplasty procedures in this series were performed through an inframammary incision. Capsulectomy was performed in patients presenting with Baker Grade III or IV CC (18 bilateral and six unilateral); otherwise, the author preferred capsulotomies for Baker Grade I and II patients. Multilayer capsulorrhaphy was also performed for patients who presented with bottoming out. Cephalospinor was the antibiotic of choice. All 92 patients received a single dose of intravenous systemic antibiotics, and 78 (84.7%) patients had a five-day postoperative oral course of antibiotics. Patients with a history of penicillin allergy were given erythromycin as an alternative to cephalosporin, to prevent potential cross-sensitive allergic reactions. Drains were placed in 14 (15.2%) patients who showed persistent oozing following capsulectomy; eight of these patients (8.6%) were current smokers. The reason for secondary surgery in 92 patients was CC (18 bilateral and six unilateral), followed by rippling (six), bottoming out (seven), change for bigger size (32), change for smaller size (three), flipping of implants (five), siliconomas (two), implant rupture (four), and other causes (nine) (Table 2). Thirteen primary implants in 10 patients showed signs of rupture upon explantation.

Bacteriological swabs taken from the pocket following explanation were sent for analysis and showed no bacteriological growth. No surgical samples of capsules were analyzed for culture and sensitivity. There were no cases of hematoma noted in the series, and all patients were treated on an outpatient basis. All patients had copious povidone iodine and normal saline irrigation prior to reinsertion of new implants. All but two patients (four breasts) received round, textured silicone implants as their secondary devices (Table 3).
Inflammation, swelling, pain, and discharge were considered standard clinical signs of infection; periprosthetic infection was seen in one breast out of 184 (0.53%). Results of the bacteriological swabs taken from this patient showed *Staphylococcus aureus*.

The results of the Fisher exact test showed no significant difference between the rate of infection for this series versus the rates shown in the author's previously-published study on primary augmentation mammaplasty ($P > .5$).

Clinical results are shown in Figures 1-4.

**DISCUSSION**

With the rise in popularity of primary augmentation mammaplasty procedures, there is also an equivalent and proportional rise in revision or secondary augmentations. The reasons for secondary augmentation mammaplasty are many, but the most frequent reason for the procedure in the current series was change for bigger size, followed by corrective surgery for CC (Table 2; Figures 1-4). In the current series, almost one-third of

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**Figure 1.** (A, C, E) This 39-year-old woman was unhappy with the inadequate enhancement during her primary augmentation, during which she received 175-cc, low-profile, silicone gel implants in the partial submuscular plane. (B, D, F) Six months after revision augmentation mammaplasty with 375-cc, round, high-profile, silicone gel implants placed in a muscle-splitting biplane pocket.
patients (the single largest group) requested change of implants for bigger implant volumes. However, the vast majority of patients in this sample did not undergo their primary operation with the author, so this statistic does not truly represent a single surgeon’s own reoperation rate. Of the 13 ruptured implants found in 10 patients during surgery, only four patients had booked their surgery with a preoperative diagnosis of unilateral rupture. All preoperatively-diagnosed ruptured implants were symptomatic, presented with breast autoinflation, and

Figure 2. (A, C, E) This 29-year-old woman presented with Baker Grade IV capsular contracture in her right breast two years after augmentation mammoplasty with 350-cc implants placed in a subglandular plane. (B, D, F) One year after right-side capsulectomy and bilateral implant replacement with 400-cc, round, high-profile cohesive gel silicone devices placed in a muscle-splitting biplane pocket.
were Poly Implant Prothèse (PIP) devices (La-seyne-sur-mer, France) (Table 4).12-15

Plastic surgical procedures are considered clean and clean-contaminated. An overall infection rate of 2.8% is considered acceptable.16 Primary augmentation mammoplasty is considered a clean plastic surgical procedure with an acceptable periprosthetic infection rate of 0.5% and 2.5%.6-9 Antibiotic prophylaxis is recommended because of the reported presence of Staphylococcus epidermidis in nipple secretions and during insertion of prostheses.18 However, a lack of understanding exists due to a similar range of reported infection rates in primary

Figure 3. (A, C, E) This 33-year-old woman presented with breast rippling, bottoming out, and nipple-level asymmetry eight years after breast augmentation with 340-cc, round, high-profile cohesive gel implants placed in a subglandular plane. (B, D, F) Four months after revision surgery with 360-cc, high-profile, round, cohesive silicone gel implants placed in a muscle-splitting biplane pocket. The patient also underwent concurrent multiplane internal glandulopexy and bilateral relocation of the inframammary crease.
augmentation mammoplasty with and without the use of antibiotics (0.7%<sup>19</sup> and 2.2%,<sup>8</sup> respectively). Therefore, more research is needed to understand the role of antibiotics, preferably in a controlled, double-blinded, randomized trial.<sup>20</sup> The role and efficacy of antibiotics have been retrospectively investigated by the author in primary augmentation mammoplasty in a study that showed no statistical difference between the various groups analyzed.<sup>6</sup>

In a series related to the placement of breast implants and expanders in breast reconstruction, an infection rate of 6% was reported in 168 implants in 130 women.<sup>21</sup> An infection incidence of 2.1% was reported in a retrospective study that included revisions of 1534 implants, but the group included both primary augmentation mammoplasty and breast reconstruction procedures.<sup>22</sup> Also, a 0% complication rate was reported for revision breast implant surgery in 198 patients treated over a period of four years with a neopectoral pocket, but the group included augmentation mastopexy procedures in addition to secondary augmentation mammoplasties without a separate analysis of either procedure.<sup>23</sup> Also, an implant

Figure 4. (A, C, E) This 38-year-old woman presented with Baker Grade IV capsular contracture eight years after primary augmentation mammoplasty with 300-cc, round, high-profile cohesive silicone gel implant placed in a subglandular pocket. (B, D, F) One year after bilateral capsulectomy and implant replacement with 400-cc, round, high-profile cohesive silicone gel devices placed in a muscle-splitting biplane.
infection incidence of 0.5%24 and 0%25 was reported for primary breast augmentation with mastopexy, but to date, there has been no such study regarding the incidence or prevalence of periprosthetic infection exclusively limited to secondary augmentation mammoplasty. Because of the various reported rates of infection following primary augmentation mammoplasty,6-9 it was difficult to choose one study as a reference for comparative analysis. Instead, data from the author’s own retrospective series on the incidence of infection following primary augmentation mammaplasty6 were compared with the current series of secondary augmentation mammaplasty, and a statistical analysis showed no significant difference (P > .5).

Despite the reported bacterial colonization of the capsules,6 the infection rate in secondary procedures was lower than expected. This gives rise to many questions that need to be explored in better-designed, prospective studies. Is it CC that attracts microorganisms, or is it the microorganism that leads to capsular formation? How and why do microorganisms start living in symbiosis with the device? Although there was no microbiological growth found in the swabs sent for culture and sensitivity in this series,12-15 the presence of S epidermidis in nipple secretions6 and coagulase-negative staphylococcus in capsular contracture11 along with the insertion of a prosthesis19 (as shown in previous studies) made it reasonable to give at least a single dose of antibiotics.

It is difficult to pinpoint the exact predisposing factors for periprosthetic infection in this retrospective study based on a single reported case. The only infection occurred in a patient who was a smoker with Baker Grade I capsule. She selected a large-size implant (700 cc) for revision surgery and did not have any drains placed postoperatively. Since only 8.3% of the patients were smokers, tobacco use can be regarded as a strong predisposing factor, similar to high body mass index or diabetes. The patient’s bacteriological swab for culture and sensitivity showed growth of S aureus. All other 18 bilateral CC (36 breasts) and six unilateral breast CC cases—Baker Grades III and IV—did not show any postoperative periprosthetic infection. The findings suggest a very low clinical implication of the presence of capsular S epidermidis11,26,27 in the pathogenesis of postoperative periprosthetic infections, as one would expect. Administering the intravenous antibiotic followed by a five-day postoperative oral course did not seem to provide any prophylaxis against the single infection seen in the series, but this merely reflects the limitation of a small and heterogeneous sample.

Due to insolvency, closure, and legal disputes in the author’s previous workplace, it was extremely difficult to retrieve the complete data for more than 400 secondary augmentation mammoplasties performed by the author in the 12 years of practice prior to this study for comparison. However, a larger, multicenter, controlled, randomized, double-blinded trial could help establish an antibiotic protocol for this group of patients and examine the reasons behind the lower-than-expected infection rate in this group of patients despite a high incidence of bacterial colonization of implant capsules.

### Table 2. Causes for Secondary or Revision Mammaplasty

<table>
<thead>
<tr>
<th>Cause</th>
<th>Number of Patients</th>
</tr>
</thead>
<tbody>
<tr>
<td>Change of implants for bigger size</td>
<td>32</td>
</tr>
<tr>
<td>CC bilateral</td>
<td>18</td>
</tr>
<tr>
<td>CC unilateral</td>
<td>6</td>
</tr>
<tr>
<td>Change for smaller size</td>
<td>3</td>
</tr>
<tr>
<td>Bottoming out</td>
<td>7</td>
</tr>
<tr>
<td>Rippling</td>
<td>6</td>
</tr>
<tr>
<td>Implant rupture</td>
<td>4</td>
</tr>
<tr>
<td>Back-to-front implant flipping</td>
<td>5</td>
</tr>
<tr>
<td>Siliconomas</td>
<td>2</td>
</tr>
<tr>
<td>Other</td>
<td>9</td>
</tr>
</tbody>
</table>

CC, capsular contracture.

### Table 3. Distribution of Implant Types Placed in the Series

<table>
<thead>
<tr>
<th></th>
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</thead>
<tbody>
<tr>
<td>Perthese (Perouse Plastie)</td>
<td>70</td>
<td>4</td>
</tr>
<tr>
<td>Nagor</td>
<td>64</td>
<td>0</td>
</tr>
<tr>
<td>Allergan</td>
<td>30</td>
<td>0</td>
</tr>
<tr>
<td>Mentor</td>
<td>4</td>
<td>0</td>
</tr>
<tr>
<td>Poly Implant Prothese (PIP)</td>
<td>6</td>
<td>0</td>
</tr>
</tbody>
</table>

### Table 4. Manufacturing Information for Ruptured Primary Implants in This Series

<table>
<thead>
<tr>
<th>Implant Make</th>
<th>Number of Implants</th>
<th>Preoperative Diagnosis of Rupture</th>
<th>Intraoperative Implant Rupture Finding</th>
</tr>
</thead>
<tbody>
<tr>
<td>Perthese (Perouse Plastie)</td>
<td>70</td>
<td>None</td>
<td>None</td>
</tr>
<tr>
<td>Poly Implant Prothese (PIP)</td>
<td>32</td>
<td>4</td>
<td>5</td>
</tr>
<tr>
<td>Mcghan</td>
<td>32</td>
<td>1</td>
<td>None</td>
</tr>
<tr>
<td>Nagor</td>
<td>18</td>
<td></td>
<td>None</td>
</tr>
<tr>
<td>Siltex</td>
<td>2</td>
<td></td>
<td>1</td>
</tr>
<tr>
<td>Eurosilicone</td>
<td>6</td>
<td></td>
<td>None</td>
</tr>
<tr>
<td>Mentor</td>
<td>4</td>
<td></td>
<td>None</td>
</tr>
<tr>
<td>Not readable</td>
<td>14</td>
<td>6</td>
<td></td>
</tr>
</tbody>
</table>
Following an independent study by Becker\textsuperscript{28} on the effect of Betadine (Purdue Products, LP, Stamford, Connecticut) on saline inflatable implants, the US Food and Drug Administration has given manufacturers a labeling requirement to contraindicate contact of breast implants with povidone iodine. Povidone iodine is still used in the United States as an off-label product,\textsuperscript{29} and its use in Europe was never restricted for breast implants.\textsuperscript{30} To reduce incidence of CC, the author routinely irrigates the implant pocket with povidone iodine solution for all secondary augmentation mammoplasties and secondary augmentation mastopexies. The author also immerses silicone gel breast implants in povidone iodine before insertion into the breast pocket in all primary and secondary augmentation mammoplasty and augmentation mastopexy cases and has not observed any untoward outcome, which is consistent with the published reports.\textsuperscript{30,31}

**CONCLUSIONS**

The prevalence of periprosthetic infection following secondary or revision augmentation mammoplasty is low, similar to what is seen in primary augmentation mammoplasty. The previously-reported presence of *S. epidermidis* in implant capsules did not seem to predispose these secondary procedures to a higher incidence of infection in this group of patients. Because of the paucity of information on the incidence of periprosthetic infection in secondary augmentation mammoplasties, the data from this study provide a framework upon which future studies can be built and, it is hoped, will help other surgeons during the informed consent process.

**Acknowledgment**

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**Disclosures**

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