Treatment of Wounds Following Breast Reduction and Mastopexy With Subsequent Wound Dehiscence With Charged Polystyrene Microspheres

Oren Weissman, MD; Eyal Winkler, MD; Luc Teot, MD, PhD; Eric Remer, MD; Nimrod Farber, MD; Jonathan Bank, MD; Gabriel Hundeshagen, BMedSc; Isaac Zilinsky, MD; Josef Haik, MD, MPH

Abstract: Background. Lower T-junction wound dehiscence following breast reduction surgery or mastopexy constitutes a vexing and grievous complication both to the surgeon and the patient. Treatment modalities that can expedite wound healing and reepithelialization rates are highly craved. The objective of this study was to assess wound healing and epithelialization rates of open wounds following breast reduction and mastopexy wound dehiscence treated with charged polystyrene microspheres (CPM). Materials and Methods. Five female patients with wound dehiscence and subsequent open wounds following breast reduction and mastopexy were treated with daily with CPM-soaked dressings. Wound closure rates were documented. Results. The wounds showed both accelerated granulation tissue formation as well as swift epithelialization rates. No complications or side effects were encountered. Conclusions. Charged polystyrene microspheres may offer a new and efficacious way to heal open wounds due to wound dehiscence following aesthetic breast surgery. Further research with a larger patient population is still needed to verify these findings.

Key words: breast reduction, mastopexy, surgical complications, charged polystyrene microspheres, open wound

Breast reduction surgery is one of the most commonly performed procedures in plastic surgery. According to the American Society of Plastic Surgeons (ASPS), in 2009, 78,427 breast reduction procedures were performed in the United States alone.¹ The benefits of this procedure are well-documented with studies demonstrating long-term improvements in physical and psychological well-being.² Four One of the most commonly practiced techniques for breast reduction relies on an inferiorly based pedicle for the nipple areolar complex introduced between 1975 and 1977 by Ribeiro,³ Robbins,⁴ and Courtiss and Goldwyn.⁵ In this technique, the skin is usually removed in the Wise pattern which results in an inverted T scar in the inframammary fold. Even when using other techniques, such as the supero-medial...
pedicle with a keyhole shaped skin incision, an inverted T scar is sometimes needed to remove excess skin and manage the resulting “dog ears,” the skin and subcutaneous fat excess that is usually the result of flap rotation or advancement, frequently necessitating its excision, resulting in an additional scar.

Common complications of this procedure include wound dehiscence, hematoma or seroma formation, wound infection, fat necrosis, stitch abscesses, diminished nipple sensation, hypertrophic scarring, and sometimes skin and/or nipple-areola necrosis.8,13 From all the aforementioned complications, delayed wound healing and wound dehiscence are the most common, with a reported incidence for the latter of approximately 10%.13,15 This aforementioned dehiscence usually occurs in the convergence of the flaps in the inverted T skin scar, where the tension on the skin flaps is usually the highest. Wound dehiscence constitutes a vexing complication to both the patient and the surgeon, thus swift resolution of these open wounds is in the best interest of both sides. Existing literature regarding the management of the consequent open wound following wound dehiscence includes healing by secondary intention, local antibiotic preparations, moist dressings, hydrofiber dressings, and the application of topical negative pressure dressings.13,16,19 Still, even with the abundance of existing wound dressing solutions, the authors have yet to encounter a product or dressing regime that clearly accelerates epithelization rates.

Recently, a new product emerged claiming to expedite wound healing. This product (Polyheal-1, Polyheal Ltd, Yavneh, Israel) is a water-based sterile 0.025% suspension of charged polystyrene microspheres (CPM) with a size of 5 microns in a nutritional medium. Evidence suggests it is the size and surface properties of the charged beads that contribute to the provision of a supportive, healing microenvironment on the wound surface by serving as an additional surface for the attachment and migration of epithelial, endothelial, and inflammatory cells, including mast cells.20,21 Polystyrene microspheres have been shown to induce a pulmonary inflammatory process in rabbits, through enhancement of the release of inflammatory mediators such as substance P and histamine.22 Charged polystyrene microspheres have been shown to accelerate the healing rates of chronic wounds of different etiologies as well as to promote accelerated granulation tissue appearance.23 The company claims that in vitro and in vivo testing demonstrated the charged microspheres activate different types of cells in the wound bed (eg, inflammatory cells, fibroblasts, and keratinocytes), hence promoting the initiation of granulation tissue growth and remodeling of damaged skin tissue.

The objective of this study was to assess the feasibility of using CPM for open wounds, resulting from post-breast reduction and post-mastopexy wound dehiscence in terms of wound healing and epithelization rates.

Material and Methods

Inclusion criteria consisted of patients that presented to the Department of Plastic and Reconstructive Surgery at the Sheba Medical Center, Tel-Aviv, Israel, with wound dehiscence following breast reduction or mastopexy (with or without implants) and subsequent open wounds. The wounds were surgically debrided, if necessary, until a clean wound bed was achieved (ie, no necrotic tissue was present) and then treatment with CPM was commenced. In accordance with the manufacturer’s instructions, the CPM suspension was applied directly over the clean open wounds once daily, and then covered with sterile gauze that was soaked with the rest of the suspension. Dressings were left in place for 12 hours, after which the remaining suspension in the bottle (15 CC) was applied over the same gauze without changing it. No systemic or local antibiotic regimens were administered. Wounds were evaluated and documented via digital photography daily. Wound closure rates were measured manually (in millimeters) and any adverse reactions (ie, local infection or allergic response) were documented. Following wound closure, the patients were discharged and follow-up continued periodically in the outpatient clinic.

Results

From 2009 to 2011, 5 female patients who had undergone breast reduction or mastopexy augmentation procedures presented to the Department of Plastic and Reconstructive Surgery at the Sheba Medical Center, Tel-Aviv, Israel, with wound dehiscence of their surgical scar.
They were subsequently hospitalized and treated daily with CPM-soaked dressings as previously described. Table 1 shows patients ages and surgical procedure; duration of open wounds prior to the CPM regimen and previously attempted dressing regimens; CPM treatment duration; and average epithelialization rates calculated from daily wound dimension measurements. This Table also shows reported local pain before and during the CPM dressing regimen (graded by patients on a scale of 1 (no pain) to 10 (extreme pain), and patients’ satisfaction from the CPM dressing regimen (graded by patients on a scale of 1 (not at all satisfied) to 10 (extremely satisfied). Average patient age was 41.4 years (range 28-53). Three patients were heavy smokers while the other 2 did not smoke. Patient 5 received a long-term oral steroid regimen due to persistent asthma with subsequent diabetes mellitus. She underwent a bilateral facelift and a revision of a mastopexy augmentation, and presented with dehiscence of wounds in both breasts and postauricular suture lines. This patient was advised to take vita-

<table>
<thead>
<tr>
<th>Patient Number</th>
<th>Age</th>
<th>Smoking status</th>
<th>Operation type</th>
<th>Duration of open wound before Polyheal treatment (days)</th>
<th>Attempted local treatment modalities before polyheal</th>
<th>Polyheal treatment duration until wound closure (days)</th>
<th>Average epithelialization rate</th>
<th>Pain before vs during treatment*</th>
<th>Average patient satisfaction score*</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>52</td>
<td>Smoker</td>
<td>Bilateral breast reduction</td>
<td>21</td>
<td>2 (Silver sulfa – diazine, Silvercel)</td>
<td>17</td>
<td>2.6 mm per day</td>
<td>6/10 vs 3/10</td>
<td>10/10</td>
</tr>
<tr>
<td>2</td>
<td>28</td>
<td>Smoker of medical cannabis</td>
<td>Bilateral breast reduction</td>
<td>42</td>
<td>2 (Prontosan, Silvercel,** Mafenide – acetate)</td>
<td>24</td>
<td>2.5 mm per day</td>
<td>1/10 vs 1/10</td>
<td>10/10</td>
</tr>
<tr>
<td>3</td>
<td>46</td>
<td>Non-smoker</td>
<td>Bilateral breast reduction</td>
<td>22</td>
<td>2 (Polymem,*** Silvercel)</td>
<td>30</td>
<td>2.1 mm per day</td>
<td>1/10 vs 1/10</td>
<td>9/10</td>
</tr>
<tr>
<td>4</td>
<td>53</td>
<td>Smoker</td>
<td>Bilateral mastopexy with bilateral silicone implant exchange</td>
<td>70</td>
<td>2 (Milton solution, Silvercel)</td>
<td>156</td>
<td>0.5 mm per day</td>
<td>1/10 vs 1/10</td>
<td>10/10</td>
</tr>
<tr>
<td>5</td>
<td>28</td>
<td>Non-smoker</td>
<td>Bilateral breast reduction</td>
<td>14</td>
<td>1 (Silvercel)</td>
<td>25</td>
<td>1.8 mm per day</td>
<td>3/10 vs 1/10</td>
<td>10/10</td>
</tr>
</tbody>
</table>

*Scales 1-10: 1 = none/minimal; 10 = maximal.
**Silvercel (Systagenix, Gatwick UK), Prontosan (B. Braun Medical Ltd, Sheffield UK), ***Polymem (Ferris Mfg. Corp, Chicago, IL), Milton Solution – sodium hypochlorite.
wound area during dressing changes. When comparing local pain symptoms with the CPM treatment regimen compared to previously attempted modalities, 3 patients had no local pain before the CPM regimen or during it, while the other 2 patients had some local pain before the CPM regimen that had markedly improved during the CPM treatment regimen. This finding, while encouraging, is obviously not significant due to the temporal nature of subsequent treatment regimens. All patients reported extreme satisfaction from the CPM treatment and its results. Average follow-up was 23 months (range 14-45 months).

**Discussion**

Wound dehiscence, defined as significant wound breakdown which results in delayed healing (greater than 2 weeks),\(^1\) remains one of the most common complications after a breast reduction procedure. It constitutes a grievous complication for the patient and the surgeon. The patient, who has made a venerable financial investment, anticipates quick and aesthetically pleasing results and instead has to deal with an open wound in her breast. Based on the accumulative experience of the authors as aesthetic and reconstructive surgeons, this is usually accompanied by psychological stress, affecting both the patient and the surgeon. A treatment modality that can precipitate the healing of the wound, both in terms of filling the depressed wound, as well as expediting reepithelialization, is paramount.

Wound dehiscence, especially at the inverted T junction, depends on various factors, the most important be-
ing wound infection and tension of the wound edges.\textsuperscript{14} These factors interfere with normal wound healing by disturbing the physiological cellular continuity of events and the tension-induced arterial and venous vascular compromise. Risk factors for wound dehiscence include smoking, obesity,\textsuperscript{15} increased resection weights, and lengthened anesthetic times.\textsuperscript{24}

Current literature on the management of wound dehiscence is limited at best and prospective management options are intensively sought by plastic surgeons encountering these common complications. Healing by secondary intention is mostly suitable for small areas of dehiscence along the flap edge. These are termed partial dehiscence, (ie, T-junction breakdown), and generally heal without complication.\textsuperscript{13,17} Other reported modalities include application of certain antibiotic preparations, in case of a precipitating infection, and moist wound dressings\textsuperscript{16} and conservative surgical debridement of the small amounts of devitalized tissue.\textsuperscript{17} Other reported options for the management of acute open wounds utilize other dressing regimens including silver-hydrofiber dressing (eg, Aquacel Ag, ConvaTec, Skillman, NJ),\textsuperscript{18} and the use of negative pressure therapy.\textsuperscript{19} When total dehiscence occurs, (ie, dehiscence involving larger areas than the T-junction) further operative procedures are sometimes required.\textsuperscript{16} A surgical intervention in these instances is undesirable due to the tension needed to primarily close the wound edges and a high recurrence rate of wound dehiscence.

This study presents 5 patients with wound dehiscence following a breast reduction procedure that was successfully treated with CPM in the Department of Plastic and Reconstructive Surgery at the Sheba Medical Center, Tel-Aviv, Israel. Albeit a feasibility study with no control cases or cost analysis, the results were clinically apparent. Except for 1 patient, wound closure was clinically and visibly expedited with the use of CPM. The application of CPM was rather simple, painless, and had no apparent complications, thus rendering it as an appealing treatment option. The authors have witnessed marked promotion of granulation tissue formation in wound beds and swift epithelization rates with CPM treatment. The promotion of granulation tissue formation in wound beds aided in filling the depressed wound beds and leveled out the scar formation plane with adjacent flaps. The fact that these effects were visible, coupled with daily improvement witnessed by both physicians and patients, aided in alleviating the psychological stress of these patients. Even though in all cases the resulting scars became progressively smaller due to scar contracture, they remained as a visible remnant of the complication. The treatment with CPM did not, in the authors minds, help achieve cosmetically appealing scars, even though it prevented the development of depressed scars. The resulting scars were, in the authors’ opinion, quite similar in appearance to postoperative scars that would have been achieved with skin grafting. While skin grafting could, arguably, have promoted slightly faster results, avoiding additional surgery with its accompanying donor site scarring/pigmentation changes is paramount in this patient population (ie, the elective aesthetic patient). The patients were happy with the resulting scars and did not wish for further scar revision; but it is plausible that some of these scars will require further management later on. As there is no perfect solution for any wound, patient 4, being a heavy smoker, had no marked clinical response to the CPM treatment. That patient’s wound epithelialization rate was less than a quarter of the average epithelialization rate of the other 4 patients (0.5 mm compared to 2.25 mm per day).

**Conclusion**

These preliminary findings suggest CPM might play a significant role in the future management of postoperative open wounds, and, more specifically, in open wounds after wound dehiscence following breast reductions. However, from the very nature of this case series, there is no control of confounders and bias. Because there is no control for bias, there is also the possibility that the treatment effect observed might be overestimated.\textsuperscript{25,26}

The lack of homogeneity of the patients’ wounds in this study appears to add to the strength of the observations, because while prognostic healing factors differed between patients, a comparable effect was demonstrated. The possible benefit of presenting this case series is that it helps form the basis of the evidence hierarchy required for any therapeutic intervention, and induces upcoming randomized controlled trials to further evaluate the impact of CPM on wounds. It should be noted that several

**Keypoints**

- This study presents 5 patients with wound dehiscence following a breast reduction procedure that was successfully treated with CPM.
- Except for 1 patient, wound closure was clinically and visibly expedited with the use of CPM.
- These preliminary findings suggest CPM might play a significant role in the future management of postoperative open wounds.
other case studies are being conducted in the author's department, examining the use of CPM in other types of wounds, and are yielding promising results.

References
25. Guyatt GH, Sackett DL, Cook DJ. Users’ guides to the medical literature, II: how to use an article about therapy or prevention. A. Are the results of the study valid? JAMA. 1993;270(21):2598-2601.