Capsule formation represents the response of the immune system to foreign materials and is usually influenced by both implant and host factors, such as hormonal profile, patient age, history of irradiation or tabagism, clinical or subclinical infection, hematoma or seroma development, and implant structural features. In case of breast reconstruction or breast augmentation for aesthetic purposes, this fibrotic process can become clinically relevant, leading to capsular contracture development. Nevertheless, over the past decades, plastic surgeons started to consider the breast implant capsule not only as an enemy but also as a potential source of tissue, thus describing its use both as a flap and a graft for different clinical indications. Taking inspiration from their expertise in this field, the authors reviewed their experience, presenting in this study the possible clinical applications of capsular flaps in the coverage of exposed breast implants.

MATERIALS AND METHODS

Patients
From March 2011 to June 2014, at the Plastic and Reconstructive Surgery Department, Campus Bio-Medico University of Rome, 18 capsular flap procedures were performed to salvage 13 tissue expanders and 5 definitive breast implants. Indications for the procedure were as follows: partial implant exposure, incipient implant exposure associated with reduced thickness of soft tissues covering the implant, and nonhealing breast fistula. Patients affected by massive implant exposure/extrusion or breast implant infection unresponsive to targeted antibiotic therapy were excluded from the study and underwent implant removal or implant flap salvage procedures (latissimus dorsi flap).
Preoperative Evaluation

All the enrolled patients underwent preoperative evaluation by means of blood tests and microbiological samples obtained from the wounds to document systemic and/or local infection, respectively. In case of specific bacterial identification, targeted antibiotic therapy was delivered. Ultrasonography examination was routinely performed to exclude or confirm the concomitant presence of abscess, seroma, or hematoma around the implant. Patients affected by systemic or local infection unresponsive to targeted antibiotic therapy were excluded from the study.

Surgical Technique

All the operations were performed under general anesthesia. Access to the implant pocket was gained through the previous surgical incisions and the implant was temporarily removed or simply deflated in case of tissue expander exposure. The capsular flaps were designed in a rectangular fashion, maintaining a pedicle base as wide as possible to ensure their vascularity (Fig. 1A). The flaps were harvested either from the anterior or parietal capsular layers and were superiorly, inferiorly, medially, or laterally based according to defect location and quality and texture of the surrounding tissues. Blunt dissection was performed toward

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Fig. 1. A case of incipient tissue expander exposure in a 59-year-old patient with a history of bilateral mastectomy (skin nipple sparing on the right side). A, Preoperative planning showing the inferiorly based flap which will be harvested from the anterior capsular layer. B, Intraoperative view of the flap reflected downward to improve lower pole thickness of the reconstructed breast. C, The patient at the end of the procedure, with the nonabsorbable transfixing mattress sutures placed at the inframammary fold. D, Three months after second-stage bilateral breast reconstruction.

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flap base until complete tension-free mobilization was achieved (Fig. 1B). The removed implant was again placed in its original pocket and the flap finally inset into the defect to obtain a complete stable coverage. The capsular flap was secured to the surrounding skin by nonabsorbable transfixing mattress sutures, eventually removed 1 week postoperatively (Fig. 1C). Skin flaps were then approximated over the capsular flap to reinforce the surgical repair. A suction drain was always placed in the pocket and removed 7–10 days postoperatively. In case of tissue expander coverage, new inflations were allowed only 2 months after the procedure.

RESULTS
Our series consisted of 10 cases of partial implant exposure, 5 cases of incipient implant exposure associated with reduced thickness of soft tissues covering the implant, and 3 cases of nonhealing breast fistula. Mean age was 55 years (range, 38–69 years). Previous irradiation was observed in 67% of patients (12 of 18). Specific wound bacterial identification before surgery was achieved in 72% of patients (13 of 18). Mean surgical time was 45 minutes. All the harvested capsular flaps were viable to obtain a complete coverage of the exposed implant. Follow-up period ranged from 3 months to 3 years postoperative (mean follow-up, 12 months) (Fig. 1D). No complications were observed except a case of late infection leading to delayed implant removal. Of the 13 salvaged tissue expanders, 6 were substituted with definitive implants and 7 are still waiting for second-stage breast reconstruction.

DISCUSSION
The first experience with capsular flaps dates back to 1991, with the studies of Bengtson et al.4 The authors demonstrated in pig models that capsular tissue could survive as a local pedicled flap and provided enough inherent vascularity to support a skin graft. Moreover, they observed that expansion provided increased vascularity and viability of the flaps.

In 2002, Gargano et al5 first used capsular flaps in humans. Since their study, several indications have been reported for breast implant capsule flaps, such as management of implant malposition and symmastia or treatment of capsular herniation, localized depressions, and wrinkling.

The authors have recently published their experience with the use of breast capsular flaps in case of pharyngeal reconstruction and redefinition of the inframammary fold in breast reconstruction.6,7 After the second report by Gargano et al,4 who treated 6 cases of implant extrusion, this further study consolidates the previously published experiences and represents the larger series of capsular flaps used as a salvage procedure in breast reconstruction.

Implant exposure represents one of the most challenging situations the plastic surgeon has to deal with, both in the aesthetic and the reconstructive setting.5 This condition may have different clinical presentations, ranging from incipient exposure, usually associated with an excessive pressure produced by the implant against the skin envelope, to partial or massive exposure. Many etiological factors are reported to be associated with this problem, such as poor primary representation or secondary acquired thinning of the skin envelope, subclinical infection, history of tabagism, and previous breast irradiation.

In case of massive exposure, implant removal and staged reconstruction represent the most recommended surgical strategy; only in selected cases, with recent noninfected extrusion, salvage procedures with immediate latissimus dorsi10 or local perforator flaps11 can be attempted.

On the contrary, the classically described approach to partial or incipient exposure consists of a more conservative strategy, usually based on targeted antibiotic therapy, drainage and lavage of the cavity, fistulectomy, and primary closure whenever possible. This approach, even if correct in most of the cases, may result in late implant removal and breast reconstruction failure, especially in irradiated patients. The use of capsular flaps, as documented in previously published reports and also in this series, proved to be very useful to improve the surgical outcome and obtain a better soft-tissue coverage of the implant. In this scenario, the use of more invasive surgical techniques (flap salvage procedures) can be avoided or simply saved and delayed for future recurrences.

CONCLUSIONS
The use of capsular flaps represents a reliable option to treat partial or incipient breast implant exposure both in the aesthetic and reconstructive setting. This innovative approach can be considered as an immediate conservative solution to a challenging situation. However, a longer follow-up period and a more consistent number of cases would be useful to evaluate long-term stability of the flaps and their resistance to infection.

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