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Review

# Prepectoral implant pocket conversion in breast reconstruction

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ABSTRACT

*Introduction:* While many authors have reported their experience in immediate prepectoral breast reconstruction (BR), implant pocket conversion from a submuscular to a prepectoral plane is less well described. The aim of this study is to provide a comprehensive review on plane conversion in implant-based BR, including the indications, surgical techniques, functional, and esthetic results.
*Materials and Methods:* A literature search via PubMed, Medline, Google Scholar, and Cochrane databases was performed using the following MeSH terms: “prepectoral pocket conversion”, “subcutaneous pocket conversion”, “prepectoral plane conversion”, “subcutaneous plane conversion”, and “prepectoral breast reconstruction”.
*Results:* Ten articles in which 504 breasts were studied were deemed eligible for inclusion. The indications to perform plane conversion were animation deformity (AD), chronic pain, and implant malposition. Seven studies described complete or partial capsulectomy. The use of acellular dermal matrices (ADM) was reported in all cases except for three studies. The mean follow-up was 10.64 months. There was resolution of AD in 100% of cases. Three studies reported complete resolution of chronic pain. The overall complication rate was 12.102% and capsular contracture

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(CC) was the most frequent complication. Cosmetic revisions were reported in six studies (9.52%). The use of ADMs and fat grafting appeared to decrease the rate of subsequent CC formation and cosmetic revisions.

*Conclusions:* The current article represents the first review about implant pocket conversion from a submuscular to a prepectoral plane, delineating its indications, surgical technique, postoperative complications, and functional and esthetic outcomes.



## Introduction

Implant-based breast reconstruction (BR) is the most common BR technique. Submuscular implant placement is considered standard practice.[1–5] Owing to the advances in mastectomy techniques including skin and nipple sparing procedures allied to intraoperative indocyanine green angiography to determine skin viability and the availability of acellular dermal matrices (ADMs), prepectoral immediate breast reconstruction (IBR) has gained more acceptance.[6–8] The main advantages of prepectoral implant placement include the reduction of postoperative pain, the elimination of animation caused by dissection of the pectoralis muscles, and the possibility to recreate a more natural breast shape with more age-appropriate ptosis.[9-10]

Selection of patients for immediate prepectoral implant placement has been well described.[11-13] However, these indications can also be extended to patients with problematic submuscular reconstructions, where conversion to a prepectoral position may be beneficial.

Historically, pocket conversion from submuscular to a prepectoral plane has not been achievable due to thin mastectomy skin envelopes. The availability of ADMs and the use of fat grafting can make it possible to perform a pocket conversion in selected patients. The two main indications to pocket conversion are the appearance of muscular distortions (animation deformity (AD)) and the presence of chronic chest pain. AD can occur with any submuscular BR—regardless of the technique—and it has been observed in more than 50% of patients.[14-16]

The prevalence of chronic pain after mastectomy and BR varies between 12% and 49%.[15] Several surgical and non-surgical elements may have impact on the development of chronic pain such as trauma on local nerves, axillary nodes dissection, radiation therapy, depression and anxiety.[17,18] To date, there is still no consensus on whether the type and timing of a BR can influence the development of post-mastectomy chronic pain.[17]

Although many authors have reported their experience with immediate prepectoral BR,[5–11] delayed prepectoral conversion is less described.

The aim of this study is to provide a comprehensive review on plane conversion in implant-based BR, including the indications, surgical techniques, and functional and esthetic results.

## Materials and methods

A literature search via PubMed, Medline, Google Scholar, and Cochrane database according to Preferred Reporting Items for Systematic Reviews and Meta-Analysis (PRISMA) guidelines[19] was performed using the following MeSH terms: “prepectoral pocket conversion”, “subcutaneous pocket conversion”, “prepectoral plane conversion”, “subcutaneous plane conversion”, and “prepectoral breast reconstruction” (period: 2000–2020; last search on 19 April 2020). Two independent reviewers conducted a two-stage screening and data extraction. Different abstracts were examined to identify eligible papers. Several reference lists of relevant articles were screened for further studies.

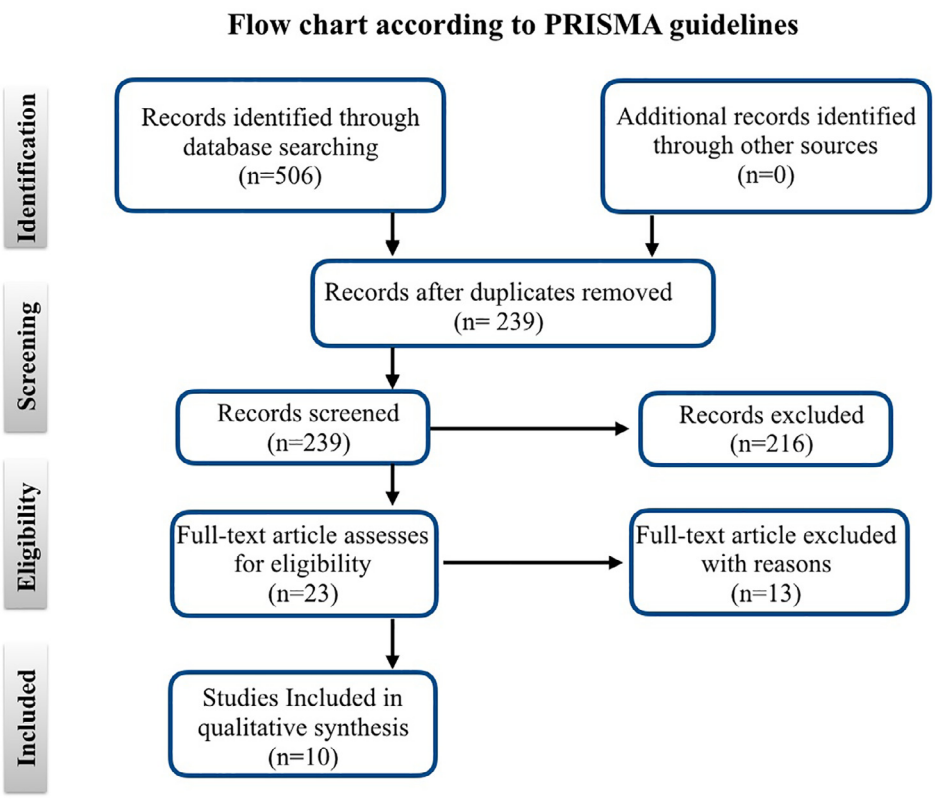


**Figure 1.** PRISMA Guidelines.

Search strategy is shown in a flowchart [PRISMA guidelines (Figure 1)].

*Inclusion and exclusion criteria*

Articles were selected based on the following inclusion criteria:

(i) Studies describing implant pocket conversion from subpectoral to prepectoral plane; (ii) studies describing pocket conversion subsequent to reconstructive breast surgery; (iii) studies that included more than eight breasts; and (iv) full text available in English.

Articles were excluded due to any one of the following criteria:

(i) Review articles; (ii) case report; (iii) studies describing pocket conversion subsequent to esthetic breast surgery; (iv) articles reporting only on surgical technique and not outcomes; (iv) studies that included fewer than eight breasts; (v) non-referenced articles; and (vi) expert opinion (Level V).

*Data collection*

Extracted data included: type of study, sample size (number of patients and breasts), age, BMI, surgical indication (AD, chronic pain, implant malposition), inclusion and exclusion criteria, surgical technique (capsulectomy, use of ADMs, type of implant), fat grafting (before, during or after pocket conversion), follow-up, outcomes (AD and chronic pain resolution, patient's satisfaction), postoperative complications, and cosmetic revisions.

*Quality assessment*

Levels of evidence (LOE) were assigned to the studies included using the American Society of Plastic Surgery (ASPS) critical appraisal check sheet.[20]

*Statistical analysis*

Statistical analyses were performed using the SPSS statistical software (version 24.0; IBM Corporation, Somers, NY, USA).

## Results

A total 239 articles were identified after having excluded duplicates. Two different reviewers examined all the records by titles and abstracts. Twenty-three full-text articles were analyzed for eligibility. Ten articles published between 2014 and 2020 were considered eligible based on appropriateness, relevance, and actuality and were included in the systematic review (Figure 1, PRISMA Guidelines).

All the studies were classified as LOE III based on the ASPS critical appraisal check sheet.[18] Among the ten selected articles, seven were retrospective studies[22-26,28,30] and three were prospective studies.[21,27,29] A total of 504 breasts were included in the review and the sample size of each article ranged from 8 to 142 breasts. The mean age of patients was 53.013, while the mean BMI of patients was 27.421 (range 19–48). The main indication to implant pocket conversion was the appearance of AD. Chronic pain and implant malposition represented the other two indications mentioned respectively in six[24,25,27-29] and three articles.[23,26-27]

In three studies the eligibility of patients was preoperatively evaluated using the pinch test.[22,29-30] In detail, one study excluded patients with pinch test of less than 2 cm;[22] one study excluded patients with pinch test less than 1.5 cm at the upper pole of the breast;[29] the last study excluded patients with pinch test less than 1 cm without availability of fat graft donor sites.[30] Sixty-one patients underwent preoperative fat grafting. In one study, previous radiation therapy, active smoking, poor skin perfusion, and uncontrolled diabetes were considered as exclusion criteria.[25] However, 41 patients included in the review underwent previous radiation therapy.

Table 1 details preoperative patient characteristics.

All the studies described the creation of a new plane above the pectoralis fascia and the anchorage of the inferior border of the pectoralis major (PM) muscle to the posterior capsule or to the chest wall (Figure 2). A few authors recommended developing the plane between the overlying mastectomy skin flap and the underlying PM muscle, while the implant is still in place in order to facilitate the dissection.

Three authors performed an intraoperative mastectomy skin flap perfusion assessment using indocyanine green angiography.[23,25,27]

Five studies described complete capsulectomy[21,23,28,30] and two studies described partial capsulectomy[22,25,29] (Figure 2). Hammond et al.[22] preserved the portion of the capsule under the PM and over the chest wall and Mangialardi et al.[29] described an anterior capsulectomy.

All of the studies reported the use of ADMs except for three studies in which a part of the sample underwent pocket conversion without ADMs (29 patients).[24–28,30] The majority of the authors reported anterior implant coverage, while three authors[28–30] described complete anterior and posterior coverage using one or two sheets of human-derived ADMs (Alloderm) or a single sheet of bovine-derived ADM (Braxon; Decomed Srl) (Figure 3). Sbitany[21] used an ADM as a lower pole hammock and an upper pole spacer between the PM and the mastectomy skin flap. Gabriel et al.[25] described three different revision options: the first consisted of total capsulectomy, removal of any preexisting ADM, and complete anterior ADM coverage with 3 cm posterior gutter coverage (partial ADM coverage); the second consisted of total capsulectomy, removal of any preexisting ADM and complete anterior and posterior ADM coverage (complete ADM coverage); the third consisted of total capsulectomy, keeping the original lower pole ADM and adding an upper pole ADM with parachute sutures.

Hammond performed fat grafting at the same time as pocket conversion in eleven patients.

**Table 1**
Patient's characteristics.

| Study | Type of study and LOE | N° of breasts | Age | BMI | Indication | Exclusion Criteria | Prior RT | Preoperative fat graft |
|---|---|---|---|---|---|---|---|---|
| Sbitany, 2014[21] | P<br>III | 8 | – | – | AD | – | None | None |
| Hammond, 2015[22] | R<br>III | 19 | 54.5 | – | AD | Pinch test <2cm | – | 8 pts<br>94.2cc |
| Schnars, 2016[23] | R<br>III | 36<br>/200 | 54 | 27.3 | AD | – | – | No |
| Lenz, 2017[24] | R<br>III | 22 | – | - | AD<br>Chronic pain | – | 3 pts | No |
| Gabriel, 2018[25] | R<br>III | 102 | 53.2 | 27.3<br>(19–47)<br>¼ obese | AD<br>Chronic pain<br>Implant malposition | Smokers<br>Previous RT<br>Poor skin quality/ perfusion<br>Diabetes (non-controlled) | – | Yes |
| Jones, 2019[26] | R<br>III | 142 | 55 | 28 | AD | None | 21 pts | No |
| Bilezikian, 2019[27] | P<br>III | 20<br>/230 | 29–82 | 19–48 | AD<br>Chronic pain | – | – | – |
| Lenz, 2019[28] | R<br>III | 55 | 49.8 | 26 | AD<br>Chronic pain<br>Implant malposition | – | 7<br>46/55 ADM) | 2 groups:<br>prior fat graft<br>27<br>no prior fat graft:<br>28 |
| Mangialardi 2019[29] | P<br>III | 20 | 50.8 | – | AD<br>Chronic pain<br>Implant malposition | Pinch test <1.5 cm at the upper pole | – | 2 pts<br>Pinch test >1.5<3 cm at the upper pole and <1 cm at the lower pole |
| Holland, 2020[30] | R<br>III | 80 b | 50.6 | 26 | AD<br>Chronic pain | Pinch test <1 cm and no donor site available for fat grafting | 10 pts | 52.5%<br>Pinch test <1 cm |

“LOE”= level of evidence; “P”= prospective; “R”= retrospective; “AD”= animation deformity; ”RT”= radiation therapy; “BMI”= body mass index; “pts”= patients.

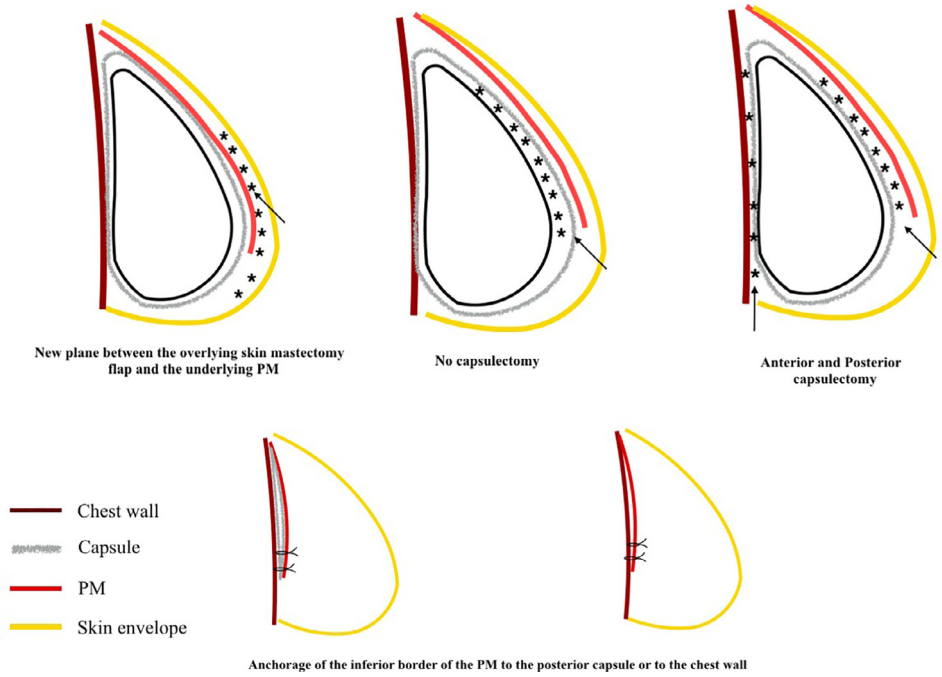


**Figure 2.** Above: Left: creation of a new plane above the pectoralis fascia between the overlying skin mastectomy flap and the underlying PM muscle while the implant is still in place. Center: Dissection plane in case of no capsulectomy (center). Right: Dissection plane in case of complete capsulectomy (anterior and posterior). Below: Anchorage of the inferior border of the PM to the posterior capsule (left) or to the chest wall (right).

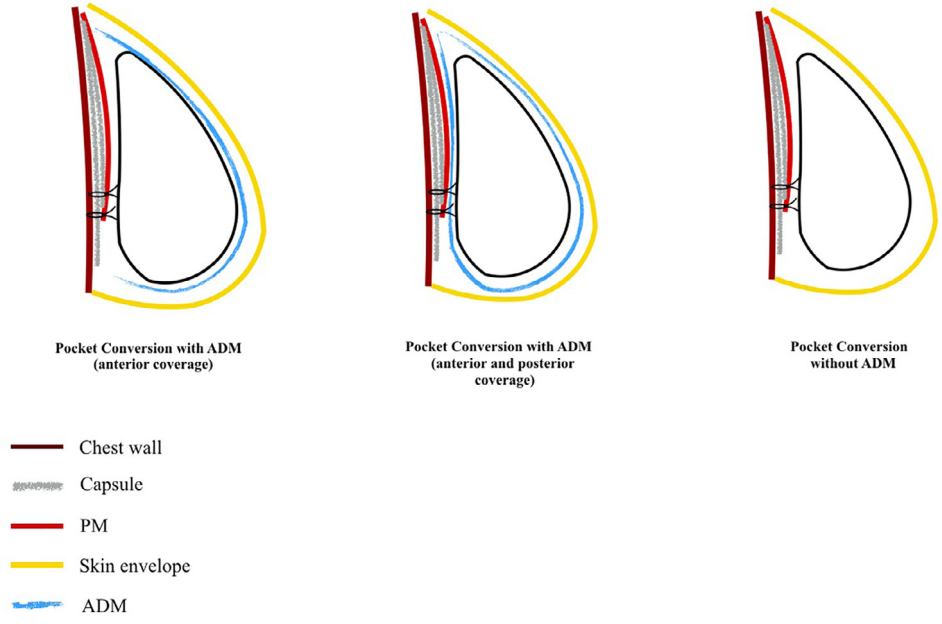


**Figure 3.** Placement of the implant in the new prepectoral pocket using an anterior ADM coverage (left), a complete ADM coverage (center), or without any ADM (right).

Seven authors reported type (round smooth silicone, anatomical texturized, cohesive gel), size (ranging from 220cc to 800cc), and projection of the implants. One study described a mean implant upsizing of 90.36cc.

Table 2 details the surgical technique used in each study.

Mean follow-up was 10.64 months (range 9–19.2 months).

All the authors reported resolution of AD in 100% of cases. Three studies reported complete and stable resolution of chronic pain as a subjective assessment. One study reported improved range of shoulder motion. Another study reported that even if chronic pain was not evaluated in the study, patients did not report pain during the follow-up period. Only one study mentioned the evaluation of preoperative and postoperative patient's satisfaction using the "Breast Q questionnaire"[31] describing an increase of 24 points in the "satisfaction with breast" domain and an increase of 20 points in the "satisfaction with outcome" domain.

Table 3 shows the postoperative outcomes of each study.

The complication rate was 12.102% ($n = 61$). Seromas were reported in 1.785% of cases ($n = 9$; 2 patients underwent previous radiation therapy), infection was reported in 4.96% of cases ($n = 25$, 2 patient underwent previous radiation therapy), partial skin necrosis was reported in 1.19% of patients ($n = 6$; 1 patient underwent previous radiation therapy), wound dehiscence was reported in 0.793% of cases ($n = 4$), postoperative hematoma was reported in 1.19% of patients ($n = 6$), implant loss was described in 1.587% of patients ($n = 8$), and only one patient demonstrated a red breast syndrome (0.198%). Seroma onset required in-office drainage aspiration in five cases, replacement of drain in one case, and any further intervention in two cases. In two cases, an implant removal was required. Infections were resolved by oral or intravenous antibiotic treatment in 10 cases and 9 cases, respectively; a reoperation performing a washout of the implant (implant removal and replacement) was necessary in three cases; the infection caused an implant loss in three patients. All cases of partial skin necrosis and wound dehiscence were managed conservatively except for two patients in whom cutaneous necrosis required an implant removal. In case of hematoma, a surgical evacuation was performed in two patients. The patient experiencing red breast syndrome was managed with conservative treatment and antibiotics.

Moreover, 15 patients (2.976%) developed capsular contracture (CC) Baker grade III or IV during the follow-up period. Among them, nine patients underwent a pocket conversion without the use of ADM. Of the 29 cases who underwent a pocket conversion without ADM, 31.034% developed a CC. Lenz et al.[24] reported that among the cohort of patients who underwent implant pocket change alone without ADM, 44.4% of cases showed CC requiring reoperation compared to zero instances of CC when ADM was employed ($p<0.01$). Similarly, Holland et al.[30] reported a CC rate pair to 26.7% and 1.5% respectively in patients undergoing pocket change without or with ADM ($p < 0.01$). Moreover, Lentz et al.[24] suggested that preoperative fat grafting might decrease the incidence of CC. Indeed, according to his study, patients who did not undergo preoperative fat grafting demonstrated a higher incidence of CC compared to patients who underwent preoperative fat grafting (4pts vs 0pts; $p = 0.11$). Similarly, in the study by Holland et al.[30], the cohort of patients undergoing pre-conversion fat grafting was associated with fewer instances of CC when compared to patients who did not undergo preemptive fat grafting (0 vs 13.2%; $p = 0.02$).

Table 4 reports complication rates for each study.

Six studies described secondary cosmetic revisions in 9.52% of patients ($n = 49$). The cosmetic revisions included fat grafting (12.01% of patients) due to minor implant edge visibility, rippling, or hollowing, implant change (0.83% of patients), and capsulectomy (1.39% of patients). One author[30] reported that the use of ADM was associated with fewer instances of asymmetry (15.4% vs 47%; $p = 0.01$) and the need for cosmetic revision surgery (6.2% vs 33.3%; $p = 0.01$). Similarly, in the same study, pre-conversion fat grafting was related to a lower incidence of additional revision operations (4.8% vs 18.4%; $p = 0.08$). Likewise, Lenz et al.[24] reported that 21.4% of patients belonging to the group that did no undergo fat grafting underwent a revision cosmetic surgery compared to 0% in the group that had undergone pre-conversion fat grafting ($p<0.01$).

Table 3 illustrates the cosmetic revisions for each study.

**Table 2**
Surgical technique.

| Study | Surgical technique | Capsulectomy | Implant | ADM |
|---|---|---|---|---|
| Sbitany, 2014[21] | capsulectomy prior to removal of the implant PM dissection from the overlying mastectomy skin. Anchorage of PM | Complete capsulectomy | – | Alloderm lower pole hammock and upper pole spacer |
| Hammond, 2015[22] | PM dissection from the overlying mastectomy skin + Fat graft 11 pt (57.9%) 115cc deep to the dermis in the subcutaneous layer in the upper part of the breast, or between the skin and ADM in the lower part of the breast Anchorage of PM | Partial capsulectomy preserving the capsule under the PM and over the chest wall. | Smooth round silicone gel implant Size: 512cc (range 280–800) | Yes |
| Schnars, 2016[23] | PM dissection from the overlying mastectomy skin Anchorage of PM | – | – | Human-derived Anterior coverage |
| Lenz, 2017[24] | Once the superior flap is well elevated, the implant is removed and a complete open periprosthetic capsulectomy is performed. (alone 7/22; ADM 15/22) | Complete capsulectomy | – | 15/22 Complete coverage |
| Gabriel, 2018[25] | Depending on the thickness and tightness of the skin flap, a direct-to-implant or two-stage tissue expander/implant reconstruction Lower pole ADM was removed as much as possible to redrape the PM back to the chest wall. In patients who had an LAD flap placed at the lower pole during primary reconstruction, the PM was detached from the flap, which was retained at the lower pole | Anterior and inferior capsulectomy | Round silicone implant Size: 603cc (400–800) | Alloderm 16 × 20 cm Anterior coverage |
| Jones, 2019[26] | PM dissection from the overlying mastectomy skin Anchorage of PM | – | >FX or FF implant profile | Alloderm 16 × 20 Anterior coverage |
| Bilezikian, 2019[27] | Acellular dermal matrix drape and fluorescent imaging (ADFI) protocol | – | Round, smooth Size: 240–800cc | DermACELL 16 × 20 cm micromeshed |
| Lenz, 2019[28] | Once the superior flap is well elevated, the implant is removed and a complete open periprosthetic capsulectomy is performed. | Complete capsulectomy | Upsize 90.36cc Smooth round cohesive or responsive silicone gel (Allergan) | 15 ADM 7 no ADM 2 sheets Complete anterior and posterior coverage |

(*continued on next page*)

**Table 2** (*continued*)

| Study | Surgical technique | Capsulectomy | Implant | ADM |
|---|---|---|---|---|
| Mangialardi 2019[29] | The plane over the anterior capsule was undermined. The PM was then dissected from the overlying subcutaneous tissue recreating a new pocket. | Anterior or subtotal capsulectomy | Anatomic textured implants with a high or extra high projection (range 265-615 cc). | Braxon Total implant coverage |
| Holland, 2020[30] | The inferior border of the pectoralis muscle is identified and incised, to gain access to the preexisting implant and capsule, both of which are removed. | Complete capsulectomy when possible. In cases where ADM removal is deemed unsafe because of thin overlying skin, it is left in place and scored to assist with recontouring. | Cohesive gel implants Size 588cc (220 –770) | Alloderm 65b Complete anterior, Partial posterior and inferior coverage |

"PM"= pectoralis major; "ADM"= acellular dermal matrix; "pts"= patients.

## Discussion

While many authors have reported their experience in immediate prepectoral BR [7–13,], prepectoral delayed BR is less well described. Our systematic review includes 504 breasts that underwent delayed prepectoral BR consisting of implant pocket conversion from subpectoral to a subcutaneous plane.

Patient selection criteria included a minimum threshold of 2 cm (preoperative) from the pinch test and the evaluation of skin envelope perfusion (intraoperative) in most of the studies. However, in case of a pinch test less than 2 cm and available donor sites, one or more preoperative fat grafting procedures were performed in order to increase mastectomy skin envelope thickness. Only one study excluded patients following previous radiation therapy, active smokers, or patients affected by uncontrolled diabetes.

### *Surgical technique*

The creation of a new plane above the pectoralis fascia was the first step in the majority of surgical descriptions. Several authors recommended developing the plane between the mastectomy skin flap and the underlying PM muscle, while the implant is still in place in order to facilitate the dissection. Seven authors reported subtotal (anterior) or total capsulectomy (anterior and posterior). The anchorage of the inferior border of the dissected PM was performed to the posterior capsule or to the chest wall depending on the type of capsulectomy.

Pocket conversions were performed employing ADMs as anterior or complete (anterior and posterior) implant coverage in the majority of breasts. In three studies, some of the patients underwent pocket conversion without an ADM. Sbitany[21] performed pocket conversion procedures with fat grafting at the same time in 11 patients, using the ADM as a lower pole hammock and an upper pole spacer between the PM and the mastectomy skin flap.

### *Animation deformity*

The main indication for pocket conversion was AD. AD has been observed in more than 50% of patients who underwent submuscular implant-based BR, significantly worsening the esthetic result. Lentz and Alcon[28] have recently examined the impact of this complication on patient's quality of life reporting that about 80% of women were bothered by AD and 48% of women experienced an interference with their daily life activities.

**Table 3**
Outcomes and cosmetic revisions.

| Study | Follow-up | AD | Chronic pain | Pt's satisfaction | Cosmetic Revision | Fat graft | Capsulectomy | Implant change |
|---|---|---|---|---|---|---|---|---|
| Sbitany, 2014[21] | 9 | 100% resolution | – | – | – | – | – | – |
| Hammond, 2015[22] | 13.8 | 100% resolution | – | 16 pts (84.2) | 6 | 2 (155 cc) | 4 | 2 |
| Schnars, 2016[23] | – | 100% resolution | – | – | – | – | – | – |
| Lenz, 2017[24] | – | 100% resolution | 100% resolution | – | 1 | – | 1 | 1 |
| Gabriel, 2018[25] | 16,7 | 100% resolution | Not evaluated although patients did not report pain during the follow-up period. | – | Yes | Yes | – | – |
| Jones, 2019[26] | 19.2 | 100% resolution | Improved range of shoulder motion | – | 26 | 25 (130 cc) | – | 1 smaller implant size |
| Bilezikian, 2019[27] | 24 | 100% resolution | 100% resolution | - | None | - | - | - |
| Lenz, 2019[28] | 8.3 | 100% resolution | – | – | 6 (21.4% of the group that did not undergo fat grafting, compared to 0% revisions performed on the group that had undergone fat grafting; $p<0.01$) | 6 | 0 | 0 |
| Mangialardi 2019[29] | 14.2 | 100% resolution | 100% resolution | BreastQ: - increase of 24 points "satisfaction with breast" domain - decrease of 20 points "satisfaction with outcome" ($p < 0.001$) | None | – | – | – |
| Holland, 2020[30] | 15.2 | 100% resolution<br>6.2%<br>4<br>cosmetic revision<br>7 asymmetric | | | 9 pts<br>Pre-conversion fat grafting and ADM cohorts were associated with fewer instances of cosmetic revision→ 4.8% VS 18.4%; ($p = 0.08$) and 6.2% VS 33.3%; ($p = 0.01$) | – | – | – |

**Table 4**
Postoperative complications.

| Study | Overall Complications | Seroma | Infection | Hematoma | Skin necrosis | Wound dehiscence | Red breast Sd | Implant Loss | CC |
|---|---|---|---|---|---|---|---|---|---|
| Sbitany, 2014[21] | 1 | – | – | – | – | – | 1 | – | – |
| Hammond, 2015[22] | 5 | 1 | – | – | – | – | – | – | 4 |
| Schnars, 2016[23] | – | – | – | – | – | | – | – | – |
| Lenz, 2017[24] | 2 | – | – | 1 | – | – | – | – | 1 (no ADM) |
| Gabriel, 2018[25] | 4 | 2 | – | 2 | 4 (1 RT) | 1 | – | 4 | – |
| Jones, 2019[26] | 13 | 3 (1 RT) | 6 (1 RT) | 1 | 1 | 1 | – | 1 | – |
| Bilezikian, 2019[27] | – | – | – | – | – | – | – | – | – |
| Lenz, 2019[28] | 13 | – | 8 | 1 | – | – | – | 1 | 5 (4 no ADM) |
| Mangialardi 2019[29] | 1 | 1 | – | – | – | – | – | – | – |
| Holland, 2020[30] | 22 | 2 | 11 | 1 | 1 | 2 | – | 2 | 5 (4 no ADM) |

“LOE”= level of evidence; “P”= prospective; “R”= retrospective; “AD”= animation deformity; ”RT”= radiation therapy; “BMI”= body mass index; “pts”= patients.

In our review, all of the patients had complete resolution of AD underlying the effectiveness of pocket conversion as treatment for this complication after reconstructive breast surgery.

Similarly, a recent review about the surgical management of AD described three techniques to eliminate AD after breast augmentation (sub-fascial implant plane change, muscle-splitting techniques, and medial pectoral nerve division) reporting excellent results (100% resolution).[32–35] Moreover, botulin toxin injections into the PM have been reported as a temporary non-surgical treatment option.[36–38]

*Chronic pain*

Chronic pain represented the other main indication for implant pocket conversion, being reported in six out of ten articles. Three studies reported complete resolution of chronic pain, and another author reported that even if the chronic pain was not evaluated, patients did not report pain during the follow-up period. However, none of the studies included clearly reported the methods of evaluation of preoperative and postoperative chronic pain.

Post-mastectomy pain syndrome (PMPS) represents a frequent complication after breast cancer surgery (incidence between 25% and 60% of patients) and it is defined as persistent pain around the area of surgery that lasts for longer than 3 months.[39] Several surgical and non-surgical elements may impact on the development of PMPS such as trauma on the local and regional nerves, axillary lymph node dissection, radiation therapy, depression, and anxiety.[18] The onset of chronic pain is a topic that has not been exhaustively discussed in the plastic surgery literature. A recent meta-analysis[40] suggests that post-mastectomy BR does not increase the incidence of PMPS. However, in our opinion, the relationship between PMPS and BR has not been sufficiently studied. The pain resolution following pocket conversion (even if not clearly stated) suggests that dissection of PM plays a role in PMPS pathogenesis. Randomized prospective studies evaluating the appearance of chronic pain following different types of BR using a standardized outcome measurement method will be essential to better understand the relationship between chronic pain and BR.

*Patient's satisfaction*

Only one study reported patient's satisfaction using the "Breast Q questionnaire" describing an improvement in both "satisfaction with breast" and "satisfaction with outcome" domains.

*Complications*

The overall complication rate was 12.896%. CC grade III or IV was the most frequent complication appearing in 15 patients. Among them, nine patients underwent pocket conversion without ADM. Two authors reported a significantly higher rate of CC in the group of patients undergoing pocket conversion alone compared to the group undergoing pocket conversion using ADMs. This is particularly important following pocket conversion, where placement of the prosthesis in the new prepectoral plane would probably result in higher risk of CC going forward, when no ADM is employed. In addition, preoperative fat grafting might decrease the CC rate. In two studies patients undergoing pre-conversion fat grafting showed fewer instances of CC than patients not undergoing preemptive fat grafting.

Other complications were the onset of seroma (1.78%), infection (4.96%), partial skin necrosis (1.19%), wound dehiscence (0.79%), and red breast syndrome (0.19%). A considerable portion of patients demonstrating complications had previously undergone radiation therapy.

*Cosmetic revisions*

Cosmetic revisions including fat grafting, implant change, and capsulectomy were described in six studies. The need to perform fat grafting depended on implant edge visibility, rippling, or hollowing. Use of ADMs and pre-conversion fat grafting may decrease the need for cosmetic revision operations.

## Conclusions

In conclusion, this article represents the first comprehensive review about implant pocket conversion from submuscular to prepectoral plane, delineating its indications, surgical technique, postoperative complications, and functional and esthetic outcomes.

According to our research, the main indications to perform pocket conversion were AD, chronic pain, and implant malposition. All patients had complete and stable resolution of AD. Four authors subjectively stated resolution of chronic pain, suggesting possible effectiveness of this technique. These data underline how prospective studies using a standardized outcome measurement method will be essential to better understand the relationship between chronic pain and BR.

The relatively high overall complication rate that emerges from our review has to be contextualized in a sample of patients who underwent delayed surgery in scarred tissues as a result of previous radiotherapy. CC was significantly higher in patients undergoing pocket conversion without the use of ADM.

Lastly, one study suggested that preoperative fat grafting may be useful in achieving better esthetic outcomes by reducing the onset of CC and the need to perform cosmetic revisions.

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None.

## Declaration of Competing Interest

None.

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