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Review Article

Revisiting low complications of VICRYL mesh in breast reconstruction: Insights from an updated systematic review

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ABSTRACT

Background: Alloplastic breast reconstruction continues to be the most prevalent breast reconstruction performed in the United States. Plastic surgeons are challenged to recreate the breast footprint after the ablative surgeon's mastectomy. Mesh augmentation has emerged as a valuable tool in controlling implant migration. Several soft tissue support breast meshes have been introduced, each characterized by a different risk profile, cost, and associated complications.

Objectives: This manuscript presents a comprehensive systematic review, with updated data over the last decade, of the use of a resorbable and less costly VICRYL (Ethicon, Somerville, NJ, USA) mesh in breast reconstruction after mastectomy.

Methods: The authors conducted a systematic review of the use of VICRYL mesh in breast reconstruction using Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA) guidelines. The authors queried five databases. Data was collected using a standardized form and underwent review using set inclusion and exclusion criteria. The primary outcome variable was reconstructive failure, with secondary outcomes including seroma, hematoma, skin necrosis, and infection.

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Results: A total of 693 articles were found after the multi database search. Forty articles met inclusion criteria. Following full text review, six articles analyzing 511patients were included. VICRYL mesh was utilized in 711 breast reconstructions, of which 5% were complicated by reconstructive failure (confidence interval (CI): 4.75–5.25%); 1.6% by seroma (CI: 1.53–1.67%); 3.33% by infection (CI: 3.14–3.52%); 1.83% by hematoma (CI: 1.71–1.95%); and 6.33% by skin necrosis (CI: 6.03–6.63%).

Conclusion: VICRYL mesh repeatedly demonstrates low reconstructive failure in breast reconstruction with an acceptable complication profile.

Introduction

Approximately 13.0% of women will be diagnosed with breast cancer within their lifetime, with alloplastic breast reconstruction remaining the most prevalent breast reconstruction performed in the United States.[1-4] When possible, direct-to-implant (DTI) reconstruction is often preferred as literature suggests that it provides favorable psychosocial benefits for the post-mastectomy patient, including improved image, self-esteem and satisfaction.[5] One drawback of DTI reconstruction is that the breast pocket is altered and often traumatized due to the competing interests of the breast surgeon who aims to provide a complete oncologic resection, which often violates natural anatomic borders. Thus, the plastic surgeon is challenged to re-create and reinforce the breast pocket, particularly laterally and inferiorly Figure 1.

Mesh has been adapted as tissue reinforcement to support the lower breast pole,[6] with acellular dermal matrices (ADMs) leading the forefront after Breuing and Warren's initial case report in 2005.[7] According to the American Society of Plastic Surgeons, approximately 50.5% of breast reconstructions utilized ADM in 2023, with 36,557 DTI reconstructions performed in total.[4] However, several synthetic meshes have recently come to market and provide a more affordable cost profile. Specifically, several recent studies have evaluated the cost and safety profile of Vicryl mesh used in alloplastic breast reconstruction since its first published use in 2007.[8-13]

A systematic review evaluating complications of Vicryl mesh has previously been conducted.[14] Nearly a decade later, the discussion surrounding synthetic mesh versus ADM has evolved. This study therefore seeks to provide an updated assessment of surgical complications, cost, and safety profile for the use of Vicryl mesh in breast reconstruction after mastectomy.

Methods

The authors conducted a systematic review using the Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA) guidelines, for design, implementation analysis and reporting, the original systematic review is registered with PROSPERO database CRD42014015107.

Search strategies: The authors selected studies which examined the use of Polyglactin 910 (Vicryl) mesh in breast reconstruction. The manuscripts included: original data (no abstracts, no case series <10 patients, no editorial notes etc.) and outcomes of interest (reconstruction failure, seroma, hematoma, skin necrosis, infection). The search query was done by a medical librarian in August 2023 and included the following databases: Medline/PubMed, Cochrane reviews, Web of Science, ClinicalTrials and Scopus.

The search strategy has been previously described and found in *Appendix pages 4-5*. Title/abstract and risk bias assessment was done by two independent reviewers (AB, NR), who used Fleiss-Kappa

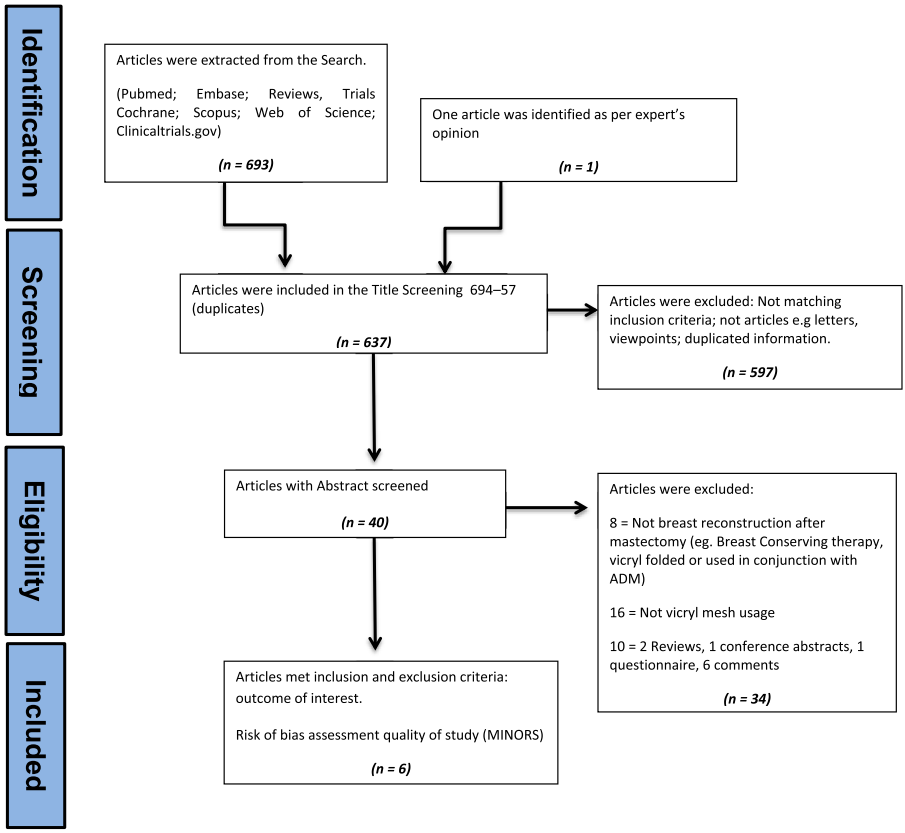

Figure 1. Flowchart diagram of search strategies.

statistics to determine interrater variability (Kappa= 0.91). In case of discrepancies, a third independent reviewer (AR) was available to reach consensus.

Inclusion and exclusion criteria

All clinical research studies that evaluated women who underwent primary alloplastic breast reconstruction using mesh for the support of an implant or a tissue expander were included. Studies in which the absorbable mesh was not used in the breast, or was used as a filler to replace volume, were excluded. Studies with fewer than 10 patients were excluded (i.e., no case reports, surgeon surveys, editorials and/or reviews of other article's patients). Quality of the papers was synthetized using the Methodological Index for non-randomized studies (MINORS).

Data extraction

Data was manually extracted onto an excel spreadsheet with all the variables. Access to this template was available only to the independent reviewers who each inputted this data independently.

Data was analyzed using Microsoft Excel (Redmond, Washington), For categorical variables, Fisher exact or Pearson χ^2 were used, and for continuous variables, a two-sided t test or ANOVA was utilized. Confidence intervals were calculated with 95%. All tests with a p-value less than 0.05 were considered statistically significant.

Results

The multi-database search yielded 694 articles. After duplicates and title screening of articles, 597 articles were deemed not to meet inclusion criteria and thus excluded from analysis. The resulting 40 articles' abstracts and manuscripts were reviewed. Thirty-four manuscripts were excluded due to use of Vicryl in other contexts in breast surgery (e.g. breast conserving therapy folding the Vicryl on itself) or for use of a combined Vicryl and ADM construct. Sixteen manuscripts did not use Vicryl as the synthetic mesh material of interest. One article was removed due to shorter length of follow up to avoid duplicated data on the longer study from the same group.[15] In total, six articles were included for analysis and the data were extracted. Only one article had a control group,[11] which precludes a meta-analysis, therefore the authors present summarized data.

Article descriptions, patient co-morbidities and oncologic data

Of the six studies that met inclusion criteria, four were retrospective cohort studies,[8-10, 12] one was a retrospective comparative study,[11] and one was a prospective observational study.[13] In the retrospective comparative study by Ganz et al.,[11] DTI breast reconstruction with Vicryl mesh was compared to a no mesh cohort. Data from Haynes et al.[13] was obtained from a prospectively maintained database of breast reconstructive patients. In Haynes *et al.*,[13] the examined cohorts were not sub-divided by delayed versus immediate reconstruction and there was no standardization regarding the definition of a delayed reconstruction.

Of the six articles included in this analysis, there were 511 patients and 711 breast reconstructions that utilized Vicryl mesh as well as 40 patients and 46 breast reconstructions without mesh. A further breakdown can be found in *Table 1*. Mean age ranged from 41.0 years[8] to 52.5 years.[11] The most noted patient co-morbidities consistent across studies were tobacco use and hypertension. Additional co-morbidities and oncologic data included diabetes, obesity, hypo/hypertension, BRCA positive, neoadjuvant chemotherapy, adjuvant chemotherapy and radiation, prior radiation, and post-operative radiation.[8-13] In Ganz et al.,[11] demographics and co-morbidities did not vary significantly upon comparison of the mesh versus no mech cohort.

Surgical technique was comparable across studies. Notably, all studies utilized Vicryl mesh to reinforce the breast pocket inferiorly and laterally, in between the chest wall and the released pectoralis major edge. Studies included all types of mastectomies included nipple-sparing mastectomy (NSM), skin-sparing mastectomy (SSM), and skin-reducing mastectomy (SRM). Implant fill volume broadly ranged from 150 cc to 800 cc across studies.[8-11,13]

Reported outcomes

Reconstructive failure was an outcome metric in all studies with a pooled incidence of 5% (confidence interval (CI): 4.75-5.25%) amongst all patients with Vicryl mesh reinforcement. Haynes reported the highest incidence of reconstructive failure at 8.7%, most commonly due to tissue expander exposure resulting in implant/expander removal, and Loustau[8] reported the lowest incidence with no reconstructive failures.[13] Notably, of the four reconstructive failures recorded by Haynes et al.,[13] three of the breasts had been previously irradiated.

There was a relatively low incidence of seroma, reported at 1.6% (CI: 1.53–1.67%), with five of the six studies reporting findings.[11] Although seroma was not well defined across studies, many studies reported on patients with seroma not requiring surgical intervention. Hematoma was collectively found to occur at an incidence of 1.83% (CI: 1.71–1.95%), with one study reporting no hematomas.[13]

Mastectomy skin necrosis demonstrated a pooled incidence of 6.33% (CI: 6.03-6.63%), although the definition varied between studies. For example, Bonomi et al.[9] recorded minor skin flap necrosis in four patients and major skin flap necrosis with implant loss in one patient. On the other hand, Faulker et al.[10] mentioned necrosis as a complication only when it required surgical debridement. Further, Ganz et al.[11] did not delineate between skin necrosis and wound dehiscence that was recorded in nine breasts. Another study reported four cases of minor necrosis treated with debridement, two nipples affected by partial necrosis not requiring surgery, and one instance of major flap necrosis necessitating

Table 1
Published incidence of complications using VICRYL mesh or no mesh for DTI breast reconstruction.

Author (year)	Study design	Type of mastectomy	Intervention	Patients	Breasts	Incidence of primary outcome	Incidence of secondary outcomes				Quality assessment			
						Reconstruction failure	Seroma	Hematoma	Skin necrosis	Infection	Implant /TE volume (cc)	Average follow up (years)	Level of evidence	MINORS scale
Cohort: VICRYL mesh														
Bonomi et al.[9]	retrospective cohort	Modified inverted-T pattern SRM	Submuscular DTI reconstruction with cohesive gel anatomical implant and Vicryl mesh sutured inferiorly to superficialis fascia, laterally to serratus fascia, and superiorly to inferior border of pectoralis major	56	62	1.6%	1.6%	4.8%	11.3%	1.6%	433 – 618	1	-	12
Faulkner et al.[10]	retrospective cohort	NSP or SSM	Subpectoral DTI IBR with polyglactin mesh sling placed to ensure inferio-lateral mammary fold	227	376	4.5%	1.1%	1.3%	3.5%	2.1%	150 - 800	-	IV	8
Ganz et al.[11]	retrospective comparative study	SSM	Submuscular-subfascial DTI reconstruction with anatomic, textured silicone-filled implant ± inferolateral Vicryl mesh pocket	97	112	6.3%	-	0.9%	8.0%	2.7%	229 - 429	3.8	III	20

(*continued on next page*)

Table 1 (*continued*)

Author (year)	Study design	Type of mastectomy	Intervention	Patients	Breasts	Incidence of primary outcome	Incidence of secondary outcomes				Quality assessment			
						Reconstruction failure	Seroma	Hematoma	Skin necrosis	Infection	Implant /TE volume (cc)	Average follow up (years)	Level of evidence	MINORS scale
Hashimoto et al.[12]	retrospective cohort	NSM or SSM	Subpectoral DTI reconstruction with Vicryl mesh covering inferolateral portion of TE	80	81	1.2%	1.2%	1.2%	8.6%	6.2%	-	1	-	11
Haynes et al.[13]	prospective observational study		Subpectoral DTI TE reconstruction with vicryl mesh covering inferolateral portion of TE	38	46	8.7%	2.2%	0	4.3%	6.5%	300 - 650	3.6	IV	12
Loustau et al.[8]	retrospective cohort	SSM	Subpectoral DTI IBR with two ribbons (lateral and inferior) of mesh	24	34	0	2.9%	2.9%	0	0	270-375	2.8	IV	8
Cohort: No mesh														
Ganz et al.[11]	retrospective comparative study	see above	see above	40	46	8.7%	-	0	2.2%	2.2%	208 - 360	5.2	III	20

SRM, skin-reducing mastectomy; NSM, nipple-sparing mastectomy; SSM, skin-sparing mastectomy; TE, tissue expander; MINORS, methodological index for non-randomized studies; DTI, direct to implant; IBR, implant-based reconstruction.
- Not reported.

surgical intervention.[12] There was significant variation across studies with regards to defining and reporting this metric.

Infection broadly occurred at an incidence of 3.33% across studies (CI: 3.14-3.52%). Severity of infection ranged from minor cellulitis requiring local antibiotics to major cellulitis requiring intravenous antibiotic administration. On the higher end, Haynes[13] and Kriethen et al. reported an infection rate of 6.5%. Of these, three infections ultimately required implant removal, with two observed in previously irradiated breasts.[13] Hashimoto et al.[12] reported three cases of surgical site infections (SSI) with *staphylococcus aureus* diagnosed six weeks after surgery that included axillary dissection.

Additional complications were reported inconsistently across studies. These included capsular contraction, implant malposition, dehiscence without implant exposure, and patient reported pain and tightness. A pooled incidence was not calculated for these variables due to reporting variability in the data. Of the articles that recorded capsular contraction, incidence ranged from 0% by Loustau et al.[8] to 12.3% by Ganz et al.[8-11, 13]

One study directly compared complications seen with Vicryl mesh use versus no mesh after DTI reconstruction.[11] Interestingly, the Vicryl mesh cohort had lower rates of reconstructive failure (6.3%) compared to the no mesh group (8.7%), but higher incidence of complications necessitating surgical intervention, including hematoma (Vicryl: 0.9%, no mesh: 0%), skin necrosis (Vicryl: 8.0%, no mesh: 2.2%) and infection (Vicryl: 2.7%, no mesh: 2.2%).

Follow up and cost

Mean length of follow up across studies was 14 months, with all but one study reporting a more than one-year follow-up.[10] Longest follow-up noted in a study was 5.2 years.[11]

Cost of Vicryl mesh and cost-savings compared to ADM were recorded by a handful of studies. Faulkner et al. [10] calculated total cost savings of $1,231,610 with use of Vicryl mesh as compared to ADM during the seven-year review period, with a 12×12-in sheet of Vicryl priced at $710 compared to an 8×16-cm AlloDerm piece priced at $3,415. Another study reported on cost per unit area, with Vicryl amounting to $1.57 per cm^2 and AlloDerm at $35.10 per cm^2, a roughly 22-fold difference.

Discussion

This systematic review updates the assessment of Vicryl mesh's surgical complications and safety profile in breast reconstruction post-mastectomy. Compared to the previous review, this study benefits from a longer follow-up time, demonstrating Vicryl mesh's sustained safety and efficacy. While not all patients require the use of a Vicryl mesh or ADM sling, some surgeons feel that using mesh in the subpectoral space helps prevent inferolateral migration of the implant, as per the current systematic review.

Comparison to acellular dermal matrices (ADMs)

The literature regarding ADM-assisted breast reconstruction reports complication rates ranging from zero to 22% for seroma, zero to 4.8% for hematoma, 5.3 to 23.8% for infection, 2.7 to 5.2% for capsular contracture, zero to 14.7% for skin necrosis, and 1.3 to 18% for reconstruction failure.[16-22] Interestingly, a recent meta-analysis on ADM mesh use in the prepectoral plane identified infection, seroma, and mastectomy flap necrosis as the most common complications.[23] By comparison, highest complication rates reported for breast reconstruction with use of Vicryl mesh demonstrates lower or equivocal complication rates with seroma at 2.9%, hematoma at 4.8%, infection at 6.5%, capsular contracture at 12.3%, skin necrosis at 11.3%, and reconstruction failure at 8.7%. Of note, recent studies have indicated the potential role of ADM in reducing risk of capsular contraction, theorizing that it acts as a protective barrier or causes decreased myofibroblast concentration.[24, 25] Although some literature has also indicated synthetic mesh may be protective against capsular contraction, it is yet unknown whether Vicryl has a similar effect.[26]

Impact of implant size and weight

Research conducted by Bonomi et al.[9] emphasizes that Vicryl mesh effectively supports implant weight, mitigating tension on mastectomy skin flaps, regardless of implant size. These findings suggest that breast implant size should not be considered a risk factor for complications when using Vicryl mesh for reconstruction. Conversely, Medor et al.[27] found a positive correlation between risk of implant rupture with implant size and higher volume to patient body mass index (BMI) ratio, emphasizing the importance of mesh support.

Consideration of patient co-morbidities and oncologic data

It has been well-established that patient co-morbidities and oncologic data significantly influence complication rates. For example, irradiated patients show higher complication rates after DTI breast reconstruction regardless of type of mesh or no mesh used, including infection and reconstructive failure.[13,17,19,20,28] This systematic review demonstrates that irradiation remains problematic for DTI reconstruction with Vicryl mesh. Notably, Haynes *et al.,*[13] demonstrate three out of the four cases of reconstruction failure occur in irradiated patients. These findings promote an in-depth consideration of the risk-benefit profile of DTI versus delayed reconstruction in women with prior skin irradiation, regardless of type of mesh or no mesh used.

Consideration of cost

Cost analysis reveals substantial savings with Vicryl mesh compared to ADM. Faulkner et al.[10] calculated over one million dollars in total cost savings over seven years using Vicryl mesh. Additionally, Vicryl's cost per unit area is significantly lower than ADM, making it an economically favorable option without compromising safety.[10,13]

Alternative synthetic meshes

While this systematic review elected to report on Vicryl mesh use in alloplastic breast reconstruction, additional low-cost synthetic meshes exist and we would be amiss to not mention them. In brief, common alternative non-biologic meshes include TIGR Mesh (poly-lactide/glycolide and trimethylene carbonate copolymers), TiLOOP (titanium-coated polypropylene), GalaFLEX (poly-4-hydroxybutyrate), and DuraSorb (polydioxanone).[29] TIGR is a long-term absorbable mesh multifilament constructed of fast and slow degrading fibers.[30] TiLOOP is a non-absorbable titanium-coated mesh designed to reduce inflammation and shrinkage.[30] GalaFLEX and DuraSorb are absorbable monofilaments, the former fabricated from high strength poly-4-hydroxybutyrate and the constructed with a microporous design.[31] There is a paucity of high quality evidence contrasting use of these alternative synthetic meshes in breast reconstruction.

Limitations

Limitations of this systematic review includes the absence of randomized controlled trials comparing Vicryl mesh to acellular dermal matrices. Additionally, the inability to conduct a meta-analysis due to the lack of control groups in included studies limits the generalizability of the findings.

Conclusion

Vicryl mesh consistently demonstrates low complication rates in breast reconstruction, making it a safe and less costly alternative to ADMs. Future research should focus on randomized controlled trials to further validate these findings and explore long-term outcomes.

Ethical approval

Not required.

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Declaration of competing interest

None.

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Supplementary materials

Supplementary material associated with this article can be found, in the online version, at doi: 10.1016/j.jpra.2025.04.002.

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