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Research Article

Synthetic vs Biologic Graft Sacrocolpopexy for Pelvic Organ Prolapse

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Abstract

Background: Pelvic organ prolapse is a prevalent condition affecting up to 40% of women globally. Sacrocolpopexy remains the gold-standard surgical treatment, traditionally utilising synthetic materials such as polypropylene, however growing interests in biologic grafts have raised questions about their relative performance. This systematic review and meta-analysis compares objective (POP-Q stage 0) and clinical (POP-Q stage 1) cure rates between synthetic and biologic grafts 12 months post sacrocolpopexy.

Methods: A systematic search of PubMed and Scopus was conducted in line with PRISMA guidelines. Studies comparing POP-Q outcomes at 12 months post sacrocolpopexy were included. Data extraction was performed, and a meta-analysis was conducting using a DerSimonian and Laird random-effects model, reporting outcomes as odds ratios (OR) and 95% confidence intervals (CI).

Results: Five studies comprising 600 participants (304 synthetic, 296 biologic) met the inclusion criteria. Among three studies reporting objective cure, 81% of biologic and 77.4% of synthetic graft recipients demonstrated successful outcomes, with no significant difference (OR 0.563; 95% CI 0.121-2.617). Four studies reported clinical cure, with success rates of 66.7% and 68.5%, respectively (OR 0.695; 95% CI 0.263-1.840). Sensitivity analysis demonstrated significantly higher clinical cure rates in the synthetic cohort (OR 0.465; 95% CI 0.254-0.854).

Conclusion: While synthetic and biologic grafts yielded comparable objective cure rates, sensitivity analysis suggested superior clinical outcomes with synthetic materials. The heterogeneity of biologic grafts complicates direct comparisons, highlighting the need for standardized outcome reporting and further research to guide graft selection in sacrocolpopexy.

Keywords: *Prolapse; Sacrocolpopexy; Mesh; Biologics; Graft; Urogynaecology*

Abbreviations

POP-Q: Pelvic Organ Prolapse Quantification; RCT: Randomised Control Trial; UDI-6: Urogenital Distress Inventory; IIQ-7: Incontinence Impact Questionnaire

Introduction

Pelvic organ prolapse is a debilitating but common condition, affecting up to 40% of women worldwide, and carries an estimated 13% lifetime risk of requiring operative management. With an aging population, these numbers are anticipated to rise [11,13].

Sacrocolpopexy is the gold standard surgical technique for POP [8], with synthetic materials such as polypropylene being the commonest material of choice. However, complications of synthetic mesh including chronic pain, erosion and infection, have prompted researchers to seek alternative materials [7]. Biological grafts such as fascia lata autografts allografts, and xenografts such as porcine dermis and small intestine submucosa have gained traction in recent years. Autografts are particularly desirable given their potential to reduce the risk of acute foreign body reactions [6]. Despite the growing interest in biologics, comparative data with synthetic mesh remain limited. Most available studies are retrospective single arm studies or case series, making it difficult to draw definitive conclusions as to which material provides the best anatomic outcomes.

Aim of the Study

This study aimed to compare synthetic versus biological graft sacrocolpopexy with respect to anatomic restoration using POP-Q grades at 12 months postoperatively across two thresholds - objective cure (POP-Q Grade 0) and clinical cure (POP-Q Grade 0-1).

Materials and Methods

This review followed the Preferred Reporting Items for Systematic Reviews and Meta-analyses (PRISMA) guidelines [9]. The protocol was registered in the International Prospective Register of Systematic Reviews (PROSPERO ID: CRD42024586913).

Literature search

The PubMed and Scopus databases were searched from their inception to July 2025 using the MeSH terms: (sacrocolpopexy) AND (synthetic OR polypropylene OR mesh) AND (autograft OR autologous OR native OR xenograft OR porcine OR bovine OR pelvicol OR allograft OR biological). Clinical studies comparing POP-Q outcomes between synthetic and biologic grafts 12 months post sacrocolpopexy were eligible for inclusion. Single-arm case series, animal studies, laboratory studies, book chapters, technical notes, editorials and studies that did not report POP-Q scores were excluded.

Data extraction

Search results were reviewed systematically via title, abstract, then full-text screening by two independent reviewers. Disagreements were discussed, and if required, adjudicated by a third independent reviewer. The following variables were extracted from eligible studies: graft material, sample size, prolapse staging tool, proportion of patients with objective cure, and proportion of patients with clinical cure at 12 months postoperatively. Included studies were appraised using the JBI Critical Appraisal Tool [1].

Outcome measures

The primary outcome was anatomic success at 12 months, assessed using the POP-Q system. Two thresholds were used, based on consistent reporting across included studies:

- Objective cure: POP-Q Stage 0 (no prolapse beyond the hymen).
- Clinical cure: POP-Q Stage 0-I (leading edge ≥1 cm above the hymen).

While POP-Q Stage 0 is a stringent and reproducible measure, POP-Q Stage 0-I represents a more inclusive and clinically accepted threshold. Using both definitions allows for a comprehensive assessment of surgical efficacy and facilitates comparison across studies with differing success criteria.

Statistical analysis

Data from the included studies were collected as proportions and meta-analyzed using odds ratios (OR) to compare the outcomes between synthetic and biologic grafts. A DerSimonian and Laird random-effects model was applied to account for potential heterogeneity between studies. All analyses were performed using OpenMeta[Analyst] version 3.1 (Center for Evidence-Based Medicine, Brown University, RI).

Results

The initial search returned 292 results, of which 192 remained after duplicates were removed. Of the remaining studies, 183 were excluded by title and abstract. 9 full-text articles were assessed for eligibility, of which 1 case series was removed and 3 studies were excluded as outcomes were not staged using the POP-Q system (Figure 1).

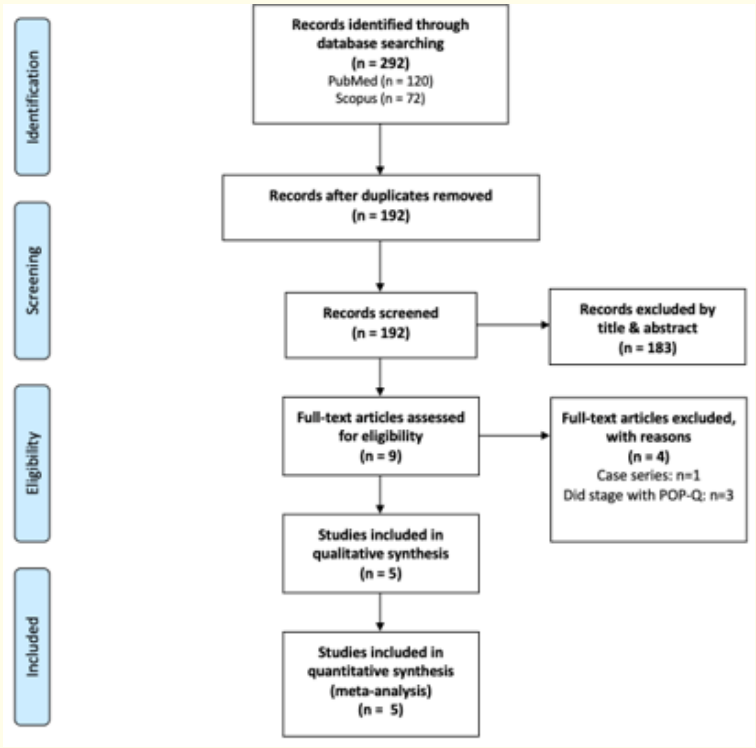

Figure 1: *PRISMA flow diagram of search results.*

Among the five studies which met the predefined inclusion criteria, there were three randomised control trials (RCTs), two prospective cohort studies, and one retrospective cohort study. A total of 600 cases were pooled from the included studies, with 304 patients receiving synthetic materials and 296 treated with biologic materials. The primary synthetic materials included polypropylene and polyester. Biologic materials used consisted of porcine dermis, porcine small intestinal submucosa, autologous or cadaveric fascia lata. Sacrocolpopexy was performed either laparoscopically, abdominally or robotically. The double-blinded RCTs provided the highest levels of evidence with strong critical appraisal scores, while cohort studies offered moderate levels of evidence and appraisal scores (Table 1).

Study	Design	Country	Inclusion criteria	Intervention	Synthetic material	Biologic material	Success measure	Level of Evidence	JBI Critical Appraisal
Quiroz., *et al*.	Retrospective cohort study	USA	All patients undergoing abdominal sacrocolpopexy	Abdominal sacrocolpopexy	Polyester or polypropylene (n = 134)	Pelvicol [porcine dermis] (n = 102) Autologous fascia (n = 23)	POP-Q Stage 0	III	Moderate
Deprest., *et al*.	Prospective cohort study	Belgium	≥ Stage II Vaginal Vault Prolapse	Laparoscopic sacrocolpopexy	Polypropylene (n = 100)	Surgisis [porcine small intestinal mucosa] (n = 25) Pelvicol [porcine dermis] (n = 25)	POP-Q Stage 0-1	II	Moderate
Culligan., *et al*. (2005)	Double-blind RCT	USA	All patients scheduled for sacrocolpopexy	Abdominal sacrocolpopexy	Polypropylene (n = 45)	Cadaveric fascia lata (n = 44)	POP-Q Stage 0-1	I	Strong
Culligan., *et al*. (2013)	Double-blind RCT	USA	≥ Stage II Vaginal Vault Prolapse	Laparoscopic sacrocolpopexy	Polypropylene (n = 58)	Pelvicol [porcine dermis] (n = 57)	POP-Q Stage 0, POPQ Stage 0-1	I	Strong
Bock., *et al*.	Prospective cohort study	USA	≥ Stage II Vaginal Vault Prolapse	Robotic sacrocolpopexy	Synthetic mesh (n = 45)	Autologous fascia lata (n = 19)	POP-Q Stage 0, POPQ Stage 0-1	II	Moderate

Table 1: *Summary of included studies.*

Table 2 outlines the baseline patient characteristics across the five included studies, stratified by cohort. Age was significantly different in several studies. Quiroz., *et al.* reported a younger synthetic group (mean age 59 ± 10.6 years) compared to their biologic cohorts (pelvicol 54 ± 13.4 years, autologous fascia 54 ± 11.1 years, p = 0.002) [10]. Deprest., *et al.* also found the synthetic group (63.1 ± 9.1 years) to be significantly younger than the biologic group (67.8 ± 9.9 years, p = 0.006), as did Bock., *et al.* (synthetic: median 68 years, range 35-78; biologic: 59 years, range 41-91, p = 0.01) [2,6]. Bock., *et al.* also reported a significantly lower median parity in the biologic cohort compared to the synthetic group (2.9 vs. 1.8, p = 0.02). Culligan., *et al.* (2005) reported a similar trend (3 vs. 2, $p<0.05$) although this was attributed to an outlier in the synthetic group who had ten vaginal deliveries [5]. BMI and pre-operative POP-Q stage were comparable across all studies.

Study	Age			Pre-operative POP-Q stage			Parity			BMI		
	Synthetic	Biologic	p-value	Synthetic	Biologic	p-value	Synthetic	Biologic	p-value	Synthetic	Biologic	p-value
Quiroz., *et al.*	59 ± 10.6	Pelvicol 54 ± 13.4 AF 54 ± 11.1	0.002	Not reported	Not reported	Not reported	2.6 ± 1.3	Pelvicol 2.6 ± 1.3 AF 2.1 ± 1.1	0.227	27 ± 4.4	Pelvicol 27 ± 4.2 AF 26 ± 4.6	0.574
Deprest., *et al.*	63.1 ± 9.1	67.8 ± 9.9	0.006	Not reported	Not reported	Not reported	2.76 ± 1.1	3.34 ± 2.5	0.063	26.3 ± 4.0	25.5 ± 2.4	0.222
Culligan., *et al.* (2005)	56.2 ± 8.5	57.7 ± 8.3	0.32	2.6 ± 0.6	2.7 ± 0.6	0.34	2.4 ± 1.4	2.6 ± 1.1	0.49	25.6 ± 3.6	24.8 ± 3.0	0.21
Culligan., *et al.* (2013)	60.4 ± 10.2	57.5 ± 10.8	Not significant	2.5 ± 0.5	2.4 ± 0.7	Not significant	3*	2*	<0.05	28.4 ± 4.7	27.3 ± 3.9	Not significant
Bock., *et al.*	68 (35-78)*	59 (41-91)*	0.01	3 (2-4)*	3 (2-4)*	Not significant	3 (1-7)*	2.1 (0-4)*	0.02	29 (20-45)*	26 (18-34)*	Not significant

Table 2: *Baseline cohort demographics per study, reported as mean ± standard deviation; *Reported as median (range); AF = Autologous Fascia Lata.*

Three studies, including 382 cases, reported the proportion of patients with objective cure at the 12-month follow-up. In total, 81% (149/184) of patients who received biologic materials and 77.4% (161/208) of patients who received synthetic mesh achieved objective cure. Pooled analysis demonstrated no statistical difference in objective cure rates between the two groups (OR 0.563; 95% CI 0.121 - 2.617; Figure 2).

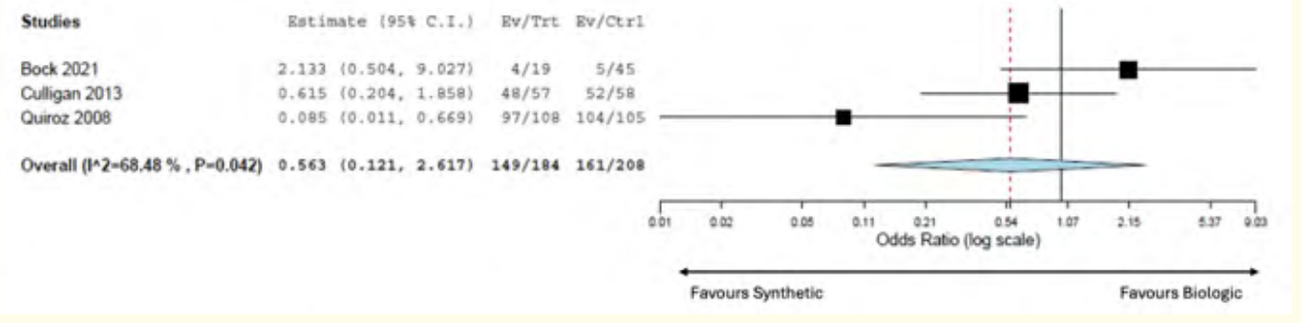

Figure 2: *Meta-analysis of studies reporting objective cure (POP-Q stage 0).*

Four studies, including 372 cases, reported the proportion of patients with clinical cure at 12 months post sacrocolpopexy. 66.7% (106/159) of patients receiving biologic materials and 68.5% (146/213) of patients receiving synthetic materials attained clinical cure. Overall, there was no statistically significant difference in clinical cure between the two groups (OR 0.695, 95% CI 0.263 - 1.840; Figure 3).

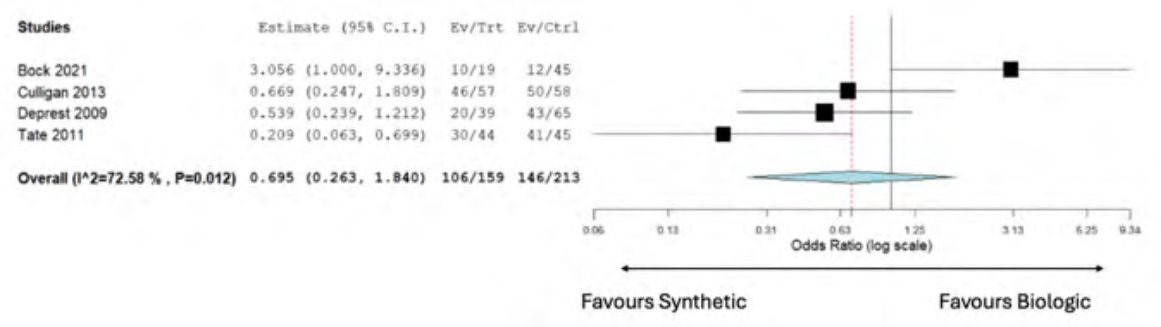

Figure 3: *Meta-analysis of studies reporting clinical cure (POP-Q stage 0-1).*

Complications

The complications reported across the studies in this review were highly variable and occurred at rates too low to allow for a meaningful subgroup analysis. Culligan., *et al.* (2005) observed more severe complications associated with polypropylene mesh erosion compared to fascia lata allograft. Two patients with polypropylene mesh erosions experienced significant complications following mesh removal, while one patient with a fascia lata erosion reported only minor symptoms at the one-year mark and underwent uncomplicated removal at the five-year follow-up [3]. Contrastingly, Bock., *et al.* reported various complications in both the fascia lata autograft and synthetic mesh groups. In the fascia lata autograft group, complications included acute tubular necrosis, hydronephrosis requiring stenting, a hematoma at the harvest site requiring transfusion, and a deep vein thrombosis. Additionally, harvest site morbidity included swelling, paresthesia, hematoma, and seroma, though no persistent pain or infections were noted. In the mesh group, a single case of mesh erosion required vaginal excision [2]. Deprest., *et al.* noted a significantly higher rate of vault infection in the biologic group, specifically with small intestinal submucosa when compared to polypropylene (5.1% vs. 0%, p = 0.044), though this was successfully managed with antibiotics alone, and no other significant differences in complications were observed [6]. In the study performed by Quiroz., *et al.* the biologic group, specifically those with Pelvicol, experienced a significantly higher incidence of erosion and sinus tracts compared to the synthetic group (9.6% vs. 3.0%, p = 0.045; 1.6% vs. 0%, p = 0.001), while complications such as granulation and vesicovaginal fistulas occurred at similar frequencies in both groups. The total incidence of graft-related complications was significantly higher in the biologic cohort compared to the synthetic cohort (24% vs. 9%, p = 0.004). Gregory., *et al.* reported no graft erosion in either the synthetic mesh or cadaveric fascia groups, with similar post-operative complication rates [10]. Culligan., *et al.* (2013) found reported one case of mesh exposure in the polypropylene group, but no other major post-operative complications [5].

Discussion

There was no difference in objective or clinical cure rates between sacrocolpopexy using synthetic or biologic grafts at 12 months postoperatively. Among the included studies, the randomised controlled trials by Culligan., *et al*. (2005) and Culligan., *et al.* (2013) represent the most robust study designs, although yielded conflicting results.

Similarly to Culligan., *et al.* (2005) the one other study which demonstrated a significant difference in outcomes also favoured synthetic materials. In their 3-arm cohort study, Quiroz., *et al*. showed greater objective cure rates with synthetic grafts (polyester and polypropylene) compared to Pelvicol (porcine dermis) and autologous fascia lata respectively, however most anatomic failures in the biologic groups occurred in those receiving Pelvicol. An isolated comparison between the synthetic and autologous fascia lata group shows no significant difference in performance, although the small sample size of the autologous fascia lata cohort limits the reliability of these findings [10].

Similarly, Bock., *et al*. did not demonstrate a difference in outcomes between synthetic mesh and autologous fascia lata. Of the three studies comparing synthetic materials and fascia lata, synthetic material only proved superior to cadaveric fascia lata. A possible explanation for this is that autografts do not invoke a foreign body response, unlike allografts which may retain immunogenic cellular debris. This might otherwise compromise structural integrity, a possible advantage shared by synthetic materials [2]. While allografts spare patients from donor site morbidity and advances in graft processing have reduced the risk of immunologic complications, post-harvest allograft preservation techniques may also reduce the durability of the graft [14].

Most studies we encountered in our literature review did not find a difference between biologic and synthetic materials when reviewing prolapse-related symptoms, even when a significant difference in POP-Q graded anatomical outcomes was reported [3,6,12]. This highlights the distinction between achieving symptomatic relief and objective anatomic correction. Bock., *et al*. found no difference in outcomes when scoring symptoms against the UDI-6, although the fascia lata group scored higher on the IIQ-7, specifically reporting significantly greater proportions of de novo stress incontinence [2]. Larger meta-analyses focusing on patient-reported outcomes using validated questionnaires would be of utility in counselling patients on material choice.

When considering the choice between synthetic mesh and biologic grafts for sacrocolpopexy, post-operative complications play a critical role. All studies included in this meta-analysis reported a relatively low incidence of post-operative complications, although the severity of complications in Bock., *et al*'s fascia lata autograft cohort exceeded that observed in the polypropylene group, which was limited to a single case of mesh erosion. There is a lack of large-scale data addressing the complications associated with each material. Prospectively collected registries and further quality trials would be valuable in optimising surgical management of pelvic organ prolapse, from graft selection and beyond.

Expanding our criteria for success to include both POP-Q stage 0 alone and POP-Q stage 0-1 was necessitated by inconsistencies in reporting of outcomes across studies. Some studies arbitrarily defined success as POP-Q stage 0 only, while others defined this as a combined stage 0-1 without disclosing the proportion of patients within each stage, thereby limiting a standardised comparison of results. To facilitate future comparisons, stratified reporting of patients per POP-Q stage would enable meta-analyses to explore outcomes across discrete thresholds and an improved benchmarking of surgical outcomes. Standardised reporting of patient-reported metrics would also permit further evaluation of the relationship between anatomical success and subjective symptoms.

Our review was limited to post-operative outcomes at 12 months which may be insufficient to assess long-term durability. Given that sacrocolpopexy aims for permanent anatomical support, longer-term studies are crucial for understanding the longevity and complication rates of these materials. Historically, a five-year follow up has been proposed to accurately evaluate surgical outcomes for pelvic organ prolapse, however a retrospective analysis by Culligan., *et al*. (2002) purported two years to be a sufficient time frame. Their study found that 81.1% of surgical failures occurred within one year post-operatively, while 94.6% occurred within the second year [4]. Initial findings by Culligan., *et al*. (2005) were upheld in the 5-year follow up by Tate., *et al.* noting significantly higher rates of anatomical cure in the polypropylene cohort compared to the cadaveric fascia lata cohort [12].

The heterogeneity amongst studies poses a limitation, restricting our ability to draw direct comparisons between individual graft performances, particularly amongst biologic cohorts such as surgisis and porcine dermis. Although the mixing of level I and level II studies permitted a broader scope of available data, this introduced variability in study quality. The inherent biases of non-randomised and retrospective studies affect the reliability of the pooled results of our meta-analysis, as seen in the studies by Deprest., *et al.* and Quiroz., *et al*. where significant differences in baseline characteristics between their cohorts were noted.

Conclusion

The present study did not identify a statistically significant difference in prolapse cure rates between synthetic mesh or biologic grafts at the one-year post-operative mark. However, biologics are a heterogeneous group and to account for a true difference in graft performance, further quality prospective trials are required, particularly given the increasing prevalence and associated morbidity of pelvic organ prolapse.

Conflict of Interest

The authors declare no conflicts of interest.

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