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Double Mesh Sandwich Repair for Abdominal Wall Defects Following Wide Excision of Desmoid Tumours: A Retrospective Analysis of Monocentric Surgical Experience and Systematic Review of Literature

Joseph Francis[1], Linta Maria David[2]

[1]MBBS, MS, Associate Professor, Department of General Surgery, Travancore Medical College, Kollam, Kerala.
ORCID ID: 0000-0002-3186-6742
[2]MBBS, Junior Resident, Department of General Surgery, Travancore Medical College, Kollam, Kerala.
ORCID ID: 0009-0001-0837-6278

Corresponding Author: Dr. Joseph Francis

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ABSTRACT

Background: Desmoid tumours of the abdominal wall are rare, locally aggressive fibroblastic neoplasms that often arise in females, particularly following pregnancy or abdominal surgery. Surgical excision with adequate margins remains the mainstay treatment; however, large resultant defects pose a significant reconstructive challenge. This study presents a retrospective case series of five female patients treated with the double mesh "sandwich" repair technique, along with a systematic review of published literature on abdominal wall desmoid tumour reconstruction.
Methods: Five consecutive patients treated between January 2016 and June 2025 were retrospectively analysed. All were females, of which three patients had prior history of lower segment caesarean section, diagnosed with abdominal wall desmoid tumours confirmed histopathologically. The "double mesh sandwich repair" technique was used for reconstruction following wide local excision. Demographic data, intraoperative details and postoperative outcomes were recorded. A systematic review of existing literature was conducted following PRISMA guidelines with an emphasis on the surgical technique and outcome.
Results: Complete tumour excision with negative margins was achieved in all patients. The mean defect size was 57.2 ± 30.4cm². The double mesh repair technique provided excellent abdominal wall strength and contour with no mesh-related infections during the follow-up duration ranging from 6 to 116 months. One out of the five patients, however developed recurrence [7 mm lesion in the subcutaneous plane] after 1 year, which was detected in follow up CT scan, despite resection of the tumour with clear margins. Cosmetic outcomes and patient satisfaction were favourable. The systematic review also supports the growing use of double mesh repair technique in complex abdominal wall reconstructions.

Keywords: Desmoid tumour, Abdominal wall reconstruction, Double mesh sandwich repair, Fibromatosis

1. INTRODUCTION

Desmoid tumours, also known as aggressive fibromatoses, discovered in the year 1832, are rare benign but locally infiltrative neoplasms arising from musculoaponeurotic structures of the abdominal wall or extra-abdominal sites [1]. They account for approximately 0.03% of all neoplasms and less than 3% of all soft tissue tumours [16]. Although histologically benign, desmoids are notorious for local recurrence despite clear surgical margins [2].

Abdominal wall desmoids predominantly affect women of reproductive age, during or after pregnancy and are often associated with previous surgery or trauma, such as caesarean section or laparotomy scars [3-5]. Hormonal factors, particularly estrogen, have been implicated in their pathogenesis [6].

Complete surgical excision with adequate margins remains the primary modality of treatment, but it frequently results in large full-thickness abdominal wall defects. Reconstruction of these defects poses a significant surgical challenge to achieve both functional integrity and aesthetic contour. Several techniques have been proposed, including component separation, autologous tissue flaps, and prosthetic mesh repairs in various literatures [7-9].

The double mesh sandwich repair technique—utilising a sublay/ intralay mesh, depending upon the extend of resection and onlay mesh separated by tissue layers—provides durable reinforcement and minimizes complications such as bulging, herniation, and infection [10-12]. Despite its growing adoption, detailed case-based data on its use for desmoid tumour reconstruction remain sparse.

The present monocentric study retrospectively analyses five cases of abdominal wall desmoid tumours treated by the authors using the double mesh sandwich repair between January 2016 and June 2025, supplemented by a systematic review of literature on this reconstructive approach.

2. CASE SERIES

2.1 Study Design

A retrospective analysis of prospectively treated patients was conducted at a single tertiary care centre from January 2016 to June 2025 with a special focus on the surgical management and documented as case series.

2.2 Data Collection

Demographic data, tumour site and size, previous surgical history, intraoperative parameters, mesh type, complications, and follow-up outcomes were analysed.

2.3 Surgical Technique

All patients were placed in the supine position under combined spinal and epidural anaesthesia. Preoperative marking was performed to delineate tumour margins and skin excision limits. Skin and subcutaneous fat flap was raised sufficiently to visualise the tumour and resectable margins. Wide local excision with adequate margins was performed, including involved fascia and muscle. During the resection of muscle, simultaneous running locked sutures of the margins were taken with 2-0 polyglactin [vicryl] sutures to prevent retraction of the fibres away from the surgical site. The peritoneum was resected when found invaded and excision specimen was sent for histopathology examination. Defect size post excision was measured in all the 5 patients and was found to range from 6×6 cm to 12×10 cm.

Double Mesh Sandwich Technique

1. An inner intraperitoneal composite/PTFE mesh was used in cases where complete excision of the abdominal wall including peritoneum was done; sublay polypropylene mesh was placed in cases where peritoneum was retained and also where muscles were partially excised. The mesh was sutured circumferentially to the edges of the defect with nonabsorbable interrupted sutures.
2. A second polypropylene mesh was placed as an onlay, overlapping the

margin of the defect by a minimum of 4 cm.

3. The two meshes which were sutured together along the margins of the defect and to the abdominal wall in full thickness as well as the overlaid portion created a reinforced "sandwich" configuration, distributing abdominal tension evenly.
4. Closed suction drains were placed in the subcutaneous plane and removed after 5–7 days.

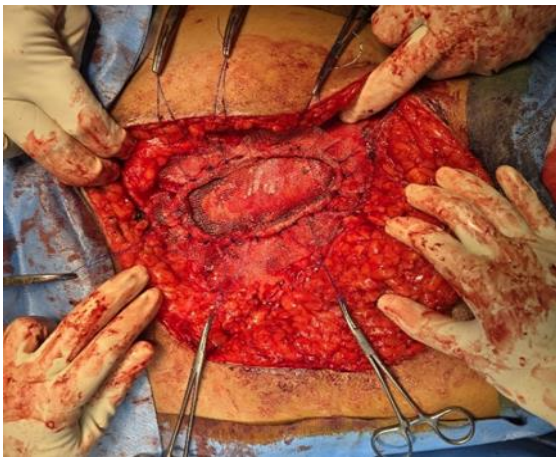


Figure 1: Placement of inner sublay mesh sutured along the margins of the defect, overlapping the defect margins by about 3 cm.

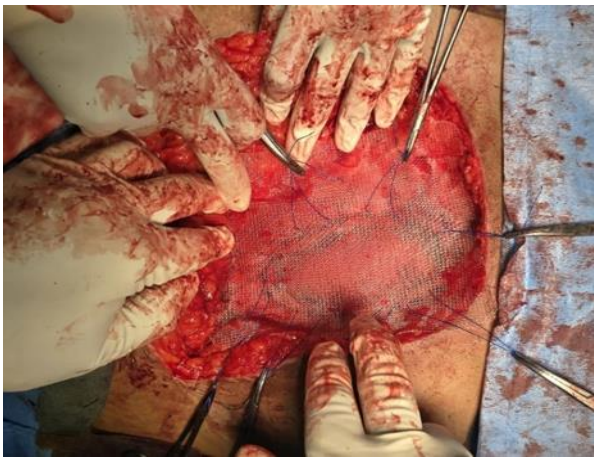


Figure 2: Outer larger polypropylene mesh placed over the sublay mesh and fixed with full thickness sutures through the anterior abdominal wall.

All patients received broad-spectrum antibiotic coverage postoperatively and were mobilized on postoperative day 2. There were no major intraoperative or immediate post operative complications. However, all the patients reported mild to moderate postoperative pain which subsided with symptomatic treatment and elastic abdominal wall support. Follow-up included 3-monthly clinical assessment and annual imaging.

3. RESULTS

Serial no	Patient age [years]	Gender	Anatomic location of tumor	Prior abdominal surgery	Defect size [cm]	Margins	Alloplast used		Duration of surgery [min]	Duration of Hospital stays [days]	Follow up [months]	Tumour recurrence	Complications [F/A][c]
							Sublay/ Intralay	Onlay					
1	22	F[#]	AW[b]- Right side	Nil LCB[*]- 2 year	12 x 9	R0[a]	15 x 10	15 x 15	220	7	116	-	-
2	32	F	AW- Left side	Nil LCB[*]- 1 Year	5 x 6	R0	12 X 12	15 x 10	200	6	95	-	-
3	56	F	AW - epigastrium	LSCS -20 years prior	8 x 5	R0	12 x 15 cm	15 x 15 cm	150	6	35	-	-
4	27	F	AW-Right side	LSCS - 2 years prior	8 x 6	R0	Dual mesh	15 x 15	180	6	17	Y[d]	-
5	30	F	AW- Right side	LSCS-2 years prior	10 x 6	R0	10 x 12	15 x 15	165	8	10	-	-

[*]LCB-Last child birth, [#]F– Female, [a]R0- no visible or microscopic cancer cells are found at the edges (margins) of the removed tissue, [b]AW- Abdominal wall, [c]F/A- Functional / Aesthetic, [d]Y- Yes [7mm sized lesion in the subcutaneous plane of right side of abdominal wall after 1 yr 4 months, detected in followup CECT, under follow up at present]

All five patients were females with mean age at presentation being 33.4 ± 13.18 years. The tumours were located in the anterior abdominal wall often near previous LSCS scar or in the infra/paraumbilical regions. All underwent complete resection with histologically clear margins. No intraoperative or immediate postoperative complications were observed.

The mean defect size was 57.2 ± 30.2 cm^2, reconstructed using dual-layer polypropylene mesh. The mean duration for repair and reconstructive surgery was 183 ± 27.74 min and average hospital stay was 6.6 ± 0.89 days. Postoperative recovery was uneventful; except for mild to moderate postoperative-pain which subsided with symptomatic management and elastic abdominal wall support. Follow-up duration ranging from 6-116 months revealed no functional or aesthetic complications. However, one out of the five patients developed recurrence after 1 year despite resection of the tumour with clear margins. Cosmetic satisfaction was reported as good to excellent in all cases.

4. SYSTEMATIC REVIEW

4.1 Search Strategy

A literature search was performed in PubMed, Scopus, and Google Scholar using the keywords *"abdominal wall desmoid tumour," "reconstruction," "double mesh repair,"* and *"sandwich technique."* Studies published between 1963 and 2025 were included.

4.2 Selection Criteria

Inclusion Criteria

- Female patients aged 20–60 years.
- Histopathologically proven desmoid tumour of the abdominal wall.
- Previous abdominal surgery (e.g., LSCS, laparotomy).
- Underwent complete excision with double mesh sandwich reconstruction.
- English-language studies reporting abdominal wall desmoid tumours with surgical management.

Exclusion Criteria

- Extra-abdominal desmoid tumours or non-surgical reports.
- Recurrent desmoids previously treated with radiotherapy.
- Desmoid tumours associated with *Familial Adenomatous Polyposis (FAP)*.
- Pregnancy at the time of diagnosis.
- Abdominal wall sarcomas or malignant soft tissue tumours misclassified as desmoids.

4.3 Study Selection

A total of 60 records were identified in the initial search. After exclusions and removing duplicates 27 full-text articles were assessed for eligibility. 18 studies were included in the review [with prime focus on the operative and perioperative outcomes] encompassing 6 studies reporting sandwich/double mesh technique [5, 8, 9, 10, 13, 15].

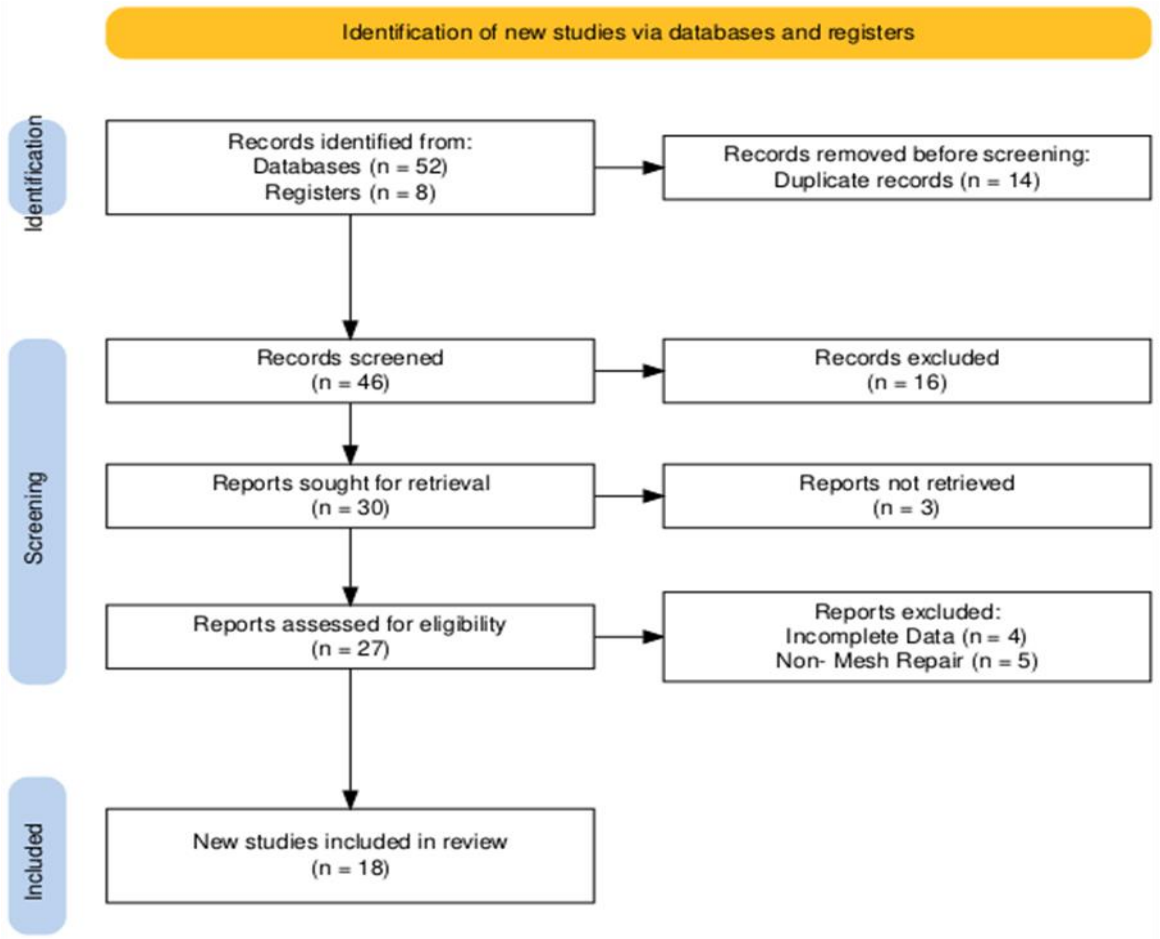
4.4 Summary of Key Findings

A systematic review of six studies encompassing 52 patients with histologically confirmed abdominal wall desmoid tumours was performed to evaluate surgical outcomes associated specifically with the reconstruction techniques using prosthetics. The cohort included both primary and recurrent cases managed by wide local excision followed by immediate prosthetic reconstruction.

The earliest report by Sutton and Thomas (1999) [5] described five patients undergoing wide local excision and single layer polypropylene mesh repair, with no recurrences at a mean follow up of 40 months, establishing mesh reinforcement as a safe and durable reconstructive option. Subsequently, Bertani et al. (2009) [13] reported on 14 patients of whom two developed minor postoperative bulging following intraperitoneal/underlay placement of single polypropylene mesh. However, there was no true tumour recurrences. Catania et al (2012) [8] and Aamer & Metwally (2016) [10] advanced this approach using dual layer or sandwich mesh

repairs, combining an underlay placement of ePTFE or composite mesh with an onlay placement of polypropylene mesh to improve tensile strength and reduce tension on the defect margins following tumour excision. Similarly, Yang (2013) [15] and Gomes et al (2014) [9] reported single centre experiences emphasizing immediate full- thickness excision with prosthetic reconstruction, both noting excellent abdominal wall stability and cosmesis.

PRISMA Flow Diagram [19]



Across these six series, the mean sample size was approximately 8-9 patients per study [range = 4-14] and the mean follow- up period was 31 months [range = 12-55 months]. Collectively, the studies documented no histological recurrences following complete resection, yielding a pooled recurrence rate of 0%. The absence of recurrence within the observed follow-up period should be interpreted cautiously, as late recurrences beyond this period cannot be entirely ruled out. Minor postoperative complications occurred in ~8% of patients – mainly seroma, superficial wound infection or local mesh bulge, all of which resolved with conservative management. Polypropylene mesh remained the most frequently used prosthesis, either alone or in combination with ePTFE. It was found that biologic meshes were not employed in any series.

Apart from the six studies analysed in this review, Köckerling et al. (2018) [11] – in a broader analysis of over 120 complex abdominal wall repairs using the double mesh sandwich repair technique, further validated its mechanical integrity, reporting recurrence rates below 5% and infection rates

under 4%. This broader evidence reinforces the theoretical and biomechanical rationale for preferring the double – mesh approach in reconstructing large abdominal wall defects.
Taken together, these reports suggest that wide local excision combined with immediate prosthetic reconstruction using a dual- mesh sandwich technique offers a stable, low-morbidity solution for abdominal wall desmoid tumours. The technique appears to provide excellent long-term integrity of the abdominal wall, minimal postoperative deformity and a significantly reduced risk of local recurrence even in previously operated abdominal walls.

5. DISCUSSION

Desmoid tumours of the abdominal wall remain challenging due to their unpredictable biological behaviour and tendency for local recurrence even after margin-negative resection [14,15]. While medical management with NSAIDs, anti-estrogens, and tyrosine kinase inhibitors is emerging, surgery remains the definitive treatment for resectable disease [17,18].
Large post-excisional defects require careful reconstruction to restore abdominal wall continuity and function. The double mesh sandwich technique offers several advantages:

- Provides dual-layer reinforcement ensuring strength and tension distribution.
- Minimizes bulging and hernia formation- it was found that *taking continuous locked sutures through the resected margins of the muscle simultaneously helps to prevent retraction of fibres and prevent the later possible disruption/ bulging of the mesh.*
- Prevents direct contact between viscera and mesh.
- Offers satisfactory cosmetic outcomes and reduces recurrence risk

This study adds to the limited literature by providing operative details and long-term follow-up outcomes from a consecutive series of five patients. The technique is reproducible, safe, and yielded favourable functional and aesthetic results. Restrictions on the generalizability of these findings stem from:

- Small sample size limits statistical significance.
- Retrospective single-centre design.
- Lack of a control group using alternative reconstruction techniques.
- Functional assessment limited to clinical evaluation without validated quality-of-life scoring.
- Short-to-intermediate follow-up duration in some cases, may not capture late recurrences.

6. CONCLUSION

Desmoid tumours of the abdominal wall, though benign, require precise surgical planning to achieve oncologic safety and durable reconstruction. The double mesh sandwich technique provides a robust, tension-free closure with low complication rates, making it particularly suitable for female patients with prior abdominal incisions. Ongoing studies with larger cohorts are essential to confirm its reproducibility and long-term outcomes.
Future researches should emphasize:
Multicentric prospective studies comparing alternative reconstruction techniques and with longer follow-ups are recommended to evaluate durability and recurrence rates comprehensively.
Incorporation of standardized functional scoring.
Investigation into hormonal modulation or targeted therapies as adjuncts to surgery.
Biomechanical modelling of mesh-tissue integration for long-term stability.

7. AUTHORS' CONTRIBUTIONS

We certify that we have participated sufficiently in the intellectual content, conception and design of this work or the analysis and interpretation of the data as well as the writing of the manuscript, to take public responsibility for it and have agreed to have our name listed as a contributor.

Ethical Considerations: The authors certify that all appropriate patient consent forms in accordance with the Declaration of Helsinki were duly obtained and is archived. Care was taken to maintain the anonymity of all patients throughout the report.

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Conflict Of Interest: Authors declare no conflict of interest.

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