

## ORIGINAL RESEARCH

# Restoring Pathways: Clinical Insights and Outcomes of Tubal Recanalisation Surgery

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### ABSTRACT

**Background:** Tubal recanalization is a surgical procedure that aims to restore fertility in women who have had tubectomy in unforeseen circumstances or if the women desire to bear more children. This study aimed to evaluate the efficacy of open tubal recanalization, performed using microsurgical techniques, as a viable option in resource-limited settings for women seeking to reverse tubal ligation. It also assessed pregnancy rates post-procedure and analyzed demographic and operative factors. **Material and methods:** The present study was a retrospective analysis of 29 women who underwent tubal recanalization, in a tertiary care centre in Northern India over a period of 1 year. The women were followed up for a period of six months. **Results:** The main reason for sterilization reversal in our study was death of the only male child in 70%. The mean age of patients was 33.51 years. Bilateral spill of dye during tubal recanalization was observed in 89% of patient. The post-operative tubal length was more than 5 cm in 51% of patients, and this group showed a statistically significant higher conception rate ( $p = 0.04$ ). The most commonly performed anastomosis was ampullo-ampullary followed by isthmo-ampullary. **Conclusion:** Recanalisation is a technically simple, requires minimal resources, and can lead to favorable pregnancy outcomes. Success is influenced by factors such as the woman's age, time since sterilization, post-operative tubal length, and the site of the anastomosis.

**Keywords:** tubal surgery, recanalization, sterilization, end to end anastomosis, conception rate

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### INTRODUCTION

Sterilisation is a surgical permanent method of birth control and is the most common contraceptive method in India. According to the National Family Health Survey (NFHS-5), 37.9% of women in India use sterilization as a form of contraception. Largely due to its extensive use in India, it accounts for 48 per cent of the global number of women who use female sterilisation. Nearly 5% of women who underwent sterilization regretted it, mainly the population with single alive child or no live child.<sup>1</sup> Tubal recanalization is a surgical procedure that aims to restore fertility in women who have had tubectomy in unforeseen circumstances or if the women desire to bear more children. In actuality, there are two choices: tubal anastomosis or assisted reproductive technologies. Despite the widespread availability of assisted reproductive technology or in vitro fertilization, patients often opt for microsurgical tubal recanalization as a first alternative due to economic restrictions.

Since the late 1960s, tubal recanalization has been carried out.<sup>2</sup> Over time, the method has been refined. It started with the gold standard approach as laparotomy, and today it is carried out by a number of organizations worldwide utilizing minimally invasive surgical methods, using robotic aid or laparoscopy. The success of recanalization depends on factors such as patient age, previous sterilization method, duration between sterilization and recanalization, anastomosis site, adhesions, and post-operative tubal length. This study sought to determine the efficacy of the open method of tubal recanalization, performed in accordance with microsurgical principles, as a feasible option in resource-limited settings to offer renewed hope to women who have undergone tubal ligation and need more children. Additionally, the study aimed to assess the pregnancy rates following tubal recanalization and to analyse the demographic profile and operative variables.

## MATERIAL AND METHODS

This was a retrospective study of 29 women who underwent tubal recanalization, in a tertiary care centre in Northern India over a period of 1 year, from April 2023 to March 2024. All the study participants were followed for a period of six months. All women seeking tubal reversal during the study period were included in this research.

Women were selected in accordance with the standard guidelines established by the Ministry of Health and Family Welfare. The couples received counselling regarding the surgical procedure and its associated success rates. The male partners were assessed for fertility with semen analysis. The pre-requisite criteria for patients were as follows: patients with tubal obstruction resulting from sterilization (either laparoscopic or open), those exhibiting normal ovulatory function (demonstrated by regular menstrual cycles), and couples in which the husband's semen analysis was within normal parameters.

The data regarding various aspects of sterilization, including the age at which the procedure was performed, parity at the time of sterilization, the specific method of sterilization employed, the interval between sterilization and subsequent reversal, and the motivations for pursuing reversal was recorded. Detailed obstetric histories were collected, noting parity and any reported causes of death of previous child, where applicable. Additionally, comprehensive details of the recanalization procedure were recorded, including the site of anastomosis and the tubal length and intraoperative spillage or leakage of dye through anastomosed ends. The standard approach for recanalization was implemented using a laparotomy incision. An operative microscope was utilized to enhance visualization and precision. The principles of microsurgery were strictly adhered to throughout the procedure. Bipolar cautery was employed during the procedure, and continuous irrigation with heparinized

Ringer's lactate solution was utilized to minimize adhesion formation. The cut ends of the occluded tubes were identified, and the fibrosed portions of both the medial and lateral segments were excised. Tubal patency was confirmed by injecting methylene blue dye, with no stent used throughout the procedure. The mesosalpinx was sutured with 6-0 polyglactin, while anastomosis was performed using 8-0 polyglactin suture material for the muscularis layer. The first bite was taken at the 6 o'clock position (mesenteric border), followed by bites at the 3, 9, and 12 o'clock positions. The serosal layer was approximated similarly, and patency was verified post-anastomosis. In cases requiring fimbriectomy, a cuff salpingostomy was performed. Perfect hemostasis was achieved using bipolar cautery. Hydroflotation was done with normal saline.

All statistical analyses were conducted using SPSS for Windows version 17.0 (SPSS Inc., Chicago, IL, USA). Data were presented as means, medians, standard deviations, and percentages. Student's t-test was employed to compare group means, while Fisher's exact test was used to assess proportions. A p-value of less than 0.05 was considered statistically significant.

## RESULTS

The main reason for sterilization reversal in our study was death of the only male child in 70%, 20% for remarriage and death of all the children and wish to have more issues in 10% cases. Out of 29 women posted for tubal recanalization, 12 women (41.3%) conceived, out of which 11 were intrauterine and 1 was tubal ectopic pregnancy.

In the present study, majority of women (55%) belong to 30-39 age group as shown in table 1. However, there was no statistically significant difference between the women who conceived and who did not achieved conception with respect to age.

**Table 1: Distribution of patient according to age of patients.**

Age (yr)	Conceived	Did not conceived	Total (%)
20-29	6	2	08(27.58)
30-39	5	11	16(55.17)
40-49	1	4	05(17.24)
Total	12	17	29(100.0)
Mean±SD: 33.51±5.13 Range (24-42) P value: 0.9			

This study revealed 69% of patient seeking recanalization belonged to urban strata (Table 2).

**Table 2: Distribution of patient according to residence of patient**

Residential status	Conceived	Did not conceived	Total (Percent)	P-Value
Rural	3	6	9(31.0)	0.55
Urban	9	11	20(69.0)	
Total	12	17	29(100.0)	

Table 3 shows distribution of patient according to previous delivery. In the present study, 96% of patient with previous normal vaginal delivery underwent recanalization and out of them 39% patients conceived. (p value- 0.41, not significant).

**Table 3: Distribution of patient according to previous delivery.**

Previous mode of delivery	Conceived	Did not conceived	Total (Percent)	P value
Normal vaginal	11	17	28 (96.6)	0.41
Previous caesarean	1	0	1(3.4)	
Total	12	17	29(100.0)	

The distribution of patient according to method of sterilization is described in table 4. In the present study 86% of patient had tubectomy by laparotomy and 13% of patients had laparoscopic ligation. Conception rate is not significantly associated with the mode of previous delivery (p value- 0.138).

**Table 4: Distribution of patient according to method of sterilization.**

Method	Conceived	Did not conceived	Total (Percent)	P value
Laparoscopic ligation	3	1	4(13.8)	0.14
Laparotomy	9	16	25(86.2)	
Total	12	17	29(100.0)	

The patient's distribution according to interval between sterilization and recanalization is revealed in table 5. In the present study, maximum patient conceived in interval of 5 year, however not statistically significant (p value- 0.46).

**Table 5: Distribution of patient according to Interval between sterilization and recanalization**

Interval (year)	Conceived	Did not conceived	Total (Percent)	P value
0-5	6	7	13(44.8)	0.46
6-11	4	9	13(44.8)	
>11	2	1	3(10.3)	
Total	12	17	29(100.0)	

Table 6. shows distribution of patient according to tubal patency during recanalization. 89% of patient had bilateral spill of dye during tubal recanalization. The conception rate is statistically insignificant.

**Table 6: Distribution of patient according to tubal patency during recanalization**

Intraoperative Spillage of Dye	Conceived	Did not conceived	Total (Percent)	P value
Bilateral Spill present	11	15	26(89.6)	0.65
Bilateral Spill absent	1	2	3(10.3)	
Total	4	25	29(100.0)	

The total post-operative tubal length after tubal anastomosis was more than 5cm in 51% of patients and conception rate was significant statistically in them (p value- 0.04) as depicted in table 7.

**Table 7: Distribution of patient according to total length of tube.**

Length	Conceived	Did not conceived	Total (Percent)	P value
<5cm	2	12	14(48.2)	0.04
>5cm	10	5	15(51.7)	
Total	12	17	29(100.0)	

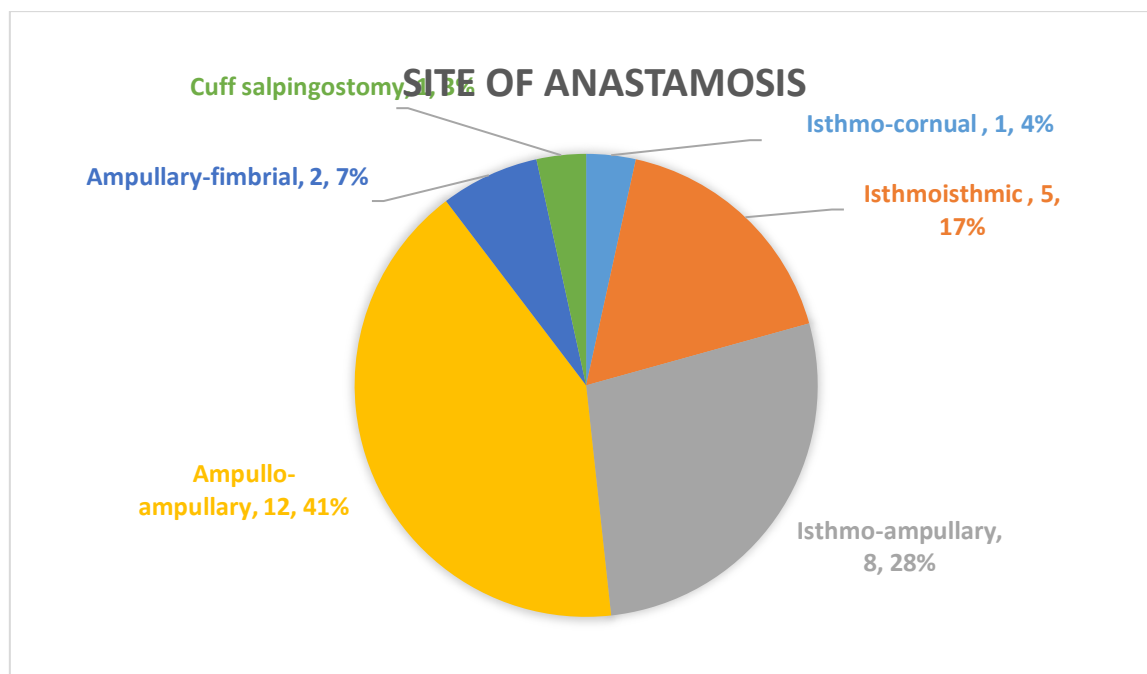
The pre-anastomotic and post-anastomotic proximal and distal segment's tubal length has been depicted in table 8. The mean segmental length obtained after surgery was less as compared to pre anastomosis length. This is owing to the resection of fibrosed portions of tube during surgery.

**Table 8: Operative findings of recanalization showing the tubal length at the site of anastomosis:**

		Mean(cms)	Std. Deviation	P value
Right proximal	Pre-surgery	3.784	1.7420	0.001
	Post-surgery	3.386	1.6713	
Right distal	Pre-surgery	2.940	1.3785	0.258
	Post-surgery	2.50	1.38	

Left proximal	Pre-surgery	3.759	1.8353	0.001
	Post-surgery	3.172	1.7023	
Left distal	Pre-surgery	2.889	1.2583	0.001
	Post-surgery	2.537	1.3296	

The site of anastomosis has been shown in figure 1. The most commonly performed anastomosis was ampullo-ampullary followed by isthmo-ampullary.



**Figure 1: Pie diagram showing distribution of site of anastomosis**

## DISCUSSION

Recanalization offers a promising option for women wishing to regain fertility through this procedure. The mean age of women seeking recanalization surgery in our institute was 33.51 years, with 55% patients in 30-39 years age group. A systematic review and meta-analysis by Sastre J, et al also revealed the mean age of participants was 34.4 years.<sup>3</sup> Age has a definite effect on fertility of a patient. In our study maximum patients who conceived were in age group of 20-29 years. The higher conception rate observed in the younger age group (20-30 years) may be due to their increased fertility potential, as demonstrated in the study by Brar et al.<sup>4</sup> Jain et al. also reported a higher pregnancy rate (75%) among patients under the age of 25.<sup>5</sup> Similarly, in a study by Koteshwar S and Siddesh A, the pregnancy rate was significantly higher ( $p = 0.006$ ) when the age of the patient seeking reversal was 30 years or less.<sup>6</sup>

Yun Fing et al. conducted a study on 156 cases of oviduct anastomosis and found that the pregnancy rate decreased with increasing age. Additionally, they observed that a post-operative oviduct length of less than 7 centimeters was linked to a lower pregnancy rate.<sup>7</sup> The length of the reconstructed tubes is the most critical factor in improving the effectiveness of recanalization. In a prospective study by Jain et al., the importance of tubal length in achieving live birth rates

was confirmed. When the tubal length exceeded 8 cm, the pregnancy rate was 83.33%, but this rate dropped dramatically to just 4% when the tube length was less than 4 cm.<sup>5</sup> Similarly, in a study by Maya et al., when the reconstructed tubal length was greater than 8 cm, the pregnancy rate was 100%. For tubal lengths between 4 cm and 8 cm, the pregnancy rate was 53.3%, while no pregnancies occurred when the tubal length was under 4 cm.<sup>8</sup> The present study also highlighted that the post-operative tubal length is significantly associated with pregnancy rate. This may be because if the tube is too short following recanalization (due to severe damage, scarring, or significant removal of the blocked section), there may not be enough length to facilitate the natural flow of the egg and sperm, reducing the chance of fertilization and a successful pregnancy.

In present study, the most commonly performed anastomosis was ampullo-ampullary (41%) followed by isthmo-ampullary (28%). The most common site for anastomosis in tubal recanalization was isthmo-isthmic (42.7%), followed by isthmo-ampullary (27.1%), with cuff salpingostomy being the least common at 7.3% in a study by Naskar A, et al.<sup>9</sup> These findings align with studies by Brar et al.<sup>4</sup> and Biswas and Mondal,<sup>10</sup> which reported that the most frequent type of anastomosis was isthmo-isthmic, occurring in 48% and 49.1% of cases, respectively. The literature

consistently shows that the best chances of conception and tubal patency are achieved with same-luminal anastomosis, with isthmo-isthmic anastomosis yielding the most favorable results.<sup>4-10</sup> This is likely because the most successful anatomical reconnection occurs when the two segments of the tube have the same lumen size, allowing for a more precise and effective anastomosis. This underscores important considerations during sterilization procedures. Surgeons should aim to occlude the isthmus of the fallopian tube, as it offers the best outcomes for future recanalization. The loop used for occlusion should be less than 1.5 cm in length to preserve tubal length and precautions should be taken to prevent adhesions, which can hinder future tubal recanalization and reduce fertility potential.

In the present study, maximum patient conceived in interval of 5 year between tubal ligation and recanalization, however not statistically significant (p value- 0.46). It was observed in study by Naskar<sup>4</sup> that greater conception rate (100%) has been recorded when the gap between sterilization and reversal operation is less than 4 years.<sup>9</sup> According to Biswas and Mondal's study, 50% of women seek sterilization reversal within 3 years of the procedure.<sup>10</sup> In a research by Brar et al., the pregnancy rate was 100% when the interval was less than two years.<sup>4</sup>

The death of only male child was main cause of recanalization in the present study. In the context of male-dominated societies, Biswas and Mondal<sup>10</sup> noted that the death of a male child (53.5%) often motivates couples to pursue reversal, and Promila et al.<sup>11</sup> similarly found that the death of a male child (64.2%) was the leading cause for seeking sterilization reversal. The most common reason for couples seeking sterilization reversal was the death of one or more children, accounting for 70.8% of cases in a study by Naskar A et al.<sup>9</sup> This aligns with findings from Mukherjee et al.,<sup>12</sup> who reported that the death of all children was the primary reason for reversal in 91.8% of cases, a result that is also consistent with Jain et al.,<sup>5</sup> where 70% of women sought reversal due to the death of all their children. This contrasts with trends observed in Western countries, where the most common reasons for seeking sterilization reversal are remarriage or divorce, reported in 80-90% of cases, according to Grunert et al.<sup>13</sup>

The two most commonly used sterilization methods in our country are laparoscopic sterilization with the use of the Falope ring and via laparotomy by Pomeroy's method. In our study, 86 % of women had sterilization by Pomeroy's technique. Ramalingappa A. observed that women who underwent laparoscopic sterilization had a higher chance of conception following reversal (50%) compared to those sterilized using the Pomeroy method (30%).<sup>14</sup> Similarly, in a study by Jain et al.,<sup>5</sup> patients who were sterilized with the Falope ring had better outcomes (68.57%) compared to those who underwent Pomeroy's method (40%). Laparoscopic sterilization is associated with minimal tubal injury,

which likely contributes to the higher chances of successful conception after reversal. Notably, 10% of individuals sought recanalization because they wished to have more children. This underscores the importance of providing comprehensive counselling about the permanent nature of sterilization and informing patients about the availability of reversible contraceptive options.

The limitation of the present study was the retrospective nature and short duration of follow-up of patients.

## CONCLUSION

The open method of tubal recanalization, performed using microsurgical principles, is an effective and cost-efficient treatment for reversing tubal sterilization, especially in resource-limited settings. It is technically simpler, requiring minimal resources, and can result in favourable pregnancy outcomes. Key factors influencing success include the woman's age, the time elapsed since sterilization, the postoperative tubal length, and the site of the anastomosis. Younger women with a shorter interval since sterilization and an anatomic isthmo-isthmic tubal anastomosis tend to have the best outcomes.

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