

A 12-Year Single Centre Study of Long-Term Functional Outcomes in Female Anorectal Malformations Following Anterior Sagittal Anorectoplasty

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Abstract: *Anorectal malformations (ARMs) are congenital anomalies that require timely surgical correction to achieve satisfactory bowel function and continence. This retrospective cohort study evaluated the long-term functional outcomes of female patients with ARMs who underwent definitive surgical management at the Department of General Surgery, Baba Raghav Das Medical College, Gorakhpur, India, over 12 years. Demographic and clinical characteristics, operative details, postoperative complications, bowel function, continence, and quality-of-life outcomes were retrieved from hospital records. Functional outcomes were assessed using the Krickenbeck classification, and statistical analysis was performed using SPSS version 26.0. A total of 240 female patients were included, with a mean age of 3.7 ± 3.17 years. Ano-vestibular malformation was the most common type of ARM (60.0%), and anterior sagittal anorectoplasty (ASARP) was the most frequently performed definitive procedure (78.3%). Normal continence was achieved in 87.5% of patients, while postoperative complications occurred in 20.0%, with wound infection being the most common. Constipation and soiling were observed in 11.25% and 10.0% of patients, respectively. Associated anomalies ($p = 0.025$) and the type of definitive surgical procedure ($p < 0.001$) were significantly associated with long-term functional outcomes, whereas the anatomical type of ARM was not. Overall, female patients with ARMs had satisfactory long-term functional outcomes following definitive surgical repair, with good bowel continence and acceptable quality of life in most cases. Regular long-term follow-up remains important to identify patients requiring ongoing bowel management and supportive care. Further prospective multicenter studies are needed to validate these findings.*

Keywords: Anorectal malformations, Anterior sagittal anorectoplasty, ASARP, Functional outcomes, Bowel continence, Quality of life

1. Introduction

Anorectal malformations (ARMs) are a diverse group of congenital anomalies involving abnormal development of the distal rectum and anus, with an estimated incidence of approximately 1 in 2,500–5,000 live births [1]. In female patients, rectovestibular fistula is the most frequently encountered type of ARM and requires timely surgical correction to restore normal anorectal anatomy and preserve bowel function. Although advances in neonatal care and pediatric surgery have substantially improved survival, the long-term success of treatment depends not only on anatomical reconstruction but also on the achievement of satisfactory bowel function and continence [2].

Over the past few decades, surgical management of ARMs has evolved considerably. Posterior sagittal anorectoplasty (PSARP), introduced by Peña and DeVries, remains the standard procedure for many anorectal malformations [3]. However, anterior sagittal anorectoplasty (ASARP), first described by Okada and colleagues, has become an established alternative for female patients with rectovestibular fistula and other low-type anomalies [4]. The

anterior approach provides excellent exposure of the rectovaginal plane, facilitates accurate placement of the rectum within the sphincter complex, and allows reconstruction of the perineal body with minimal disruption of the posterior sphincter muscles. Several studies have reported favorable continence rates, acceptable cosmetic results, and a low incidence of postoperative complications following ASARP [5,6].

Despite these encouraging surgical outcomes, many children continue to experience long-term functional problems such as constipation, soiling, impaired voluntary bowel control, and the need for bowel management programmes. These issues often extend beyond childhood and may influence education, social participation, emotional well-being, and overall quality of life [7]. Functional assessment has therefore become an essential component of postoperative follow-up, with the Krickenbeck classification being widely used to evaluate continence, soiling, and constipation in children with ARMs. Long-term follow-up is particularly important because bowel function may continue to evolve throughout childhood and adolescence [8].

Although several studies have evaluated the early outcomes of ASARP, evidence describing long-term functional results in female patients remains limited, particularly from India and other low- and middle-income countries. Data on bowel continence, constipation, soiling, postoperative complications, and quality of life beyond the early postoperative period are still insufficient. Long-term follow-up is essential not only to assess the durability of surgical repair but also to identify patients who may benefit from continued bowel management and multidisciplinary care.

Therefore, the present study was undertaken to evaluate the long-term functional outcomes of female patients with anorectal malformations who underwent definitive surgical management, with anterior sagittal anorectoplasty (ASARP) being the predominant procedure, at a single tertiary care centre over a 12-year period. The study aimed to assess bowel function, continence, constipation, soiling, postoperative complications, and factors associated with long-term functional outcomes, thereby contributing evidence to support long-term follow-up and optimize the management of female patients with anorectal malformations.

2. Materials and Methods

Study design and setting: This retrospective cohort study was conducted in the Department of General Surgery, Baba Raghav Das Medical College, Gorakhpur, Uttar Pradesh, India. The study included female patients with anorectal malformations managed between 2014 and 2026, after obtaining approval from the Institutional Ethics Committee.

Sample size: As this was a retrospective cohort study, all eligible female patients who underwent definitive surgical management during the study period were included. Therefore, no formal sample size calculation was performed.

Inclusion criteria: Female patients diagnosed with anorectal malformations, including rectovestibular fistula, rectoperineal fistula, anal stenosis, anterior ectopic anus, and other related low-type anomalies, who underwent definitive surgical management and had complete medical records with adequate follow-up information were included in the study.

Exclusion criteria: Male patients with anorectal malformations, patients with incomplete medical records, and those with inadequate follow-up information were excluded from the study.

Study procedure: Data were collected retrospectively from hospital admission records, operative notes, discharge summaries, outpatient follow-up records, and patient case files using a structured case record form. Demographic characteristics, type of anorectal malformation, associated anomalies, surgical details, postoperative complications, and long-term functional outcomes were recorded. Surgical details included the type of definitive surgical procedure performed, use of colostomy, and perioperative findings. Functional outcomes were assessed using the Krickbeck classification, including voluntary bowel movements, continence, constipation, and soiling. Information regarding additional surgical interventions, bowel management, and

quality-of-life outcomes, wherever available, was also collected.

Statistical analysis: Data were entered into Microsoft Excel and analysed using the Statistical Package for the Social Sciences (SPSS) version 26.0. Continuous variables were expressed as mean $\pm$ standard deviation, while categorical variables were presented as frequencies and percentages. Associations between categorical variables were analysed using the Chi-square test or Fisher's exact test, as appropriate. A p-value of <0.05 was considered statistically significant.

Ethical considerations: The study was conducted after obtaining approval from the Institutional Ethics Committee of Baba Raghav Das Medical College, Gorakhpur. Informed consent was obtained from the parents or legal guardians of the participants. Confidentiality of patient information and data privacy were maintained throughout the study.

3. Results

A total of 240 female patients with anorectal malformations were included in the study. The majority of patients (85.0%) were aged 0–5 years, while 10.0% were between 6 and 10 years and 5.0% were aged 11–20 years. The mean age of the study population was 3.7 ± 3.17 years. Most patients belonged to rural areas (66.7%), whereas 33.3% were from urban areas. Ano vestibular malformation was the most common type of anorectal malformation, accounting for 60.0% of cases, followed by rectovaginal (15.0%), rectovestibular (10.0%), and cloaca (10.0%). Perineal canal and anorectal malformation without fistula constituted 2.9% and 2.1% of cases, respectively. Associated congenital anomalies were present in 30.0% of patients, while 70.0% had no associated anomalies. Regarding the mode of delivery, 66.7% of patients were delivered by normal vaginal delivery (NVD), and 33.3% were born by lower segment caesarean section (LSCS).

Anterior sagittal anorectoplasty (ASARP) was the most commonly performed definitive surgical procedure, accounting for 78.3% of cases. Posterior sagittal anorectoplasty (PSARP) was performed in 18.3% of patients, while 2.9% underwent limited ASARP and 0.4% underwent anoplasty. The majority of patients (85.0%) underwent definitive surgical correction without a colostomy, whereas 15.0% required a colostomy (Table 1).

Table 1: Baseline Demographic and Clinical Characteristics of the Study Population (n = 240)

Characteristic	Category	Frequency (n)	Percentage (%)
Age Group (years)	0–5	204	85.0
	6–10	24	10.0
	11–20	12	5.0
	Mean $\pm$ SD (years)	3.7 ± 3.17	—
Residence	Rural	160	66.7
	Urban	80	33.3
Type of Anorectal Malformation	Ano vestibular	144	60.0
	Rectovaginal	36	15.0
	Rectovestibular	24	10.0
	Cloaca	24	10.0
	Perineal canal	7	2.9
	ARM without fistula	5	2.1

Associated Anomalies	Yes	72	30.0
	No	168	70.0
Mode of Delivery	NVD	160	66.7
	LSCS	80	33.3
Type of Procedure	ASARP	188	78.3
	PSARP	44	18.3
	Limited ASARP	7	2.9
	Anoplasty	1	0.4
Colostomy Status	Yes	36	15.0
	No	204	85.0

Postoperative complications were observed in 20.0% of patients, while 80.0% had an uncomplicated postoperative course. Wound infection was the most common complication, occurring in 11.67% of patients, followed by stricture (5.0%) and fistula formation (3.33%). Regarding continence, 87.5% of patients achieved normal continence, whereas 12.5% had partial continence. Bowel symptoms were absent in the majority of patients (78.75%). Constipation and soiling were reported in 11.25% and 10.0% of patients, respectively. Additional surgical intervention was required in 5.0% of patients. All patients had normal bladder function, and no cases of urinary incontinence or recurrent urinary tract infection were recorded (Table 2/ Figure 1).

Table 2: Postoperative Functional and Clinical Outcomes of the Study Population (n = 240)

Outcome	Category	Frequency (n)	Percentage (%)
Postoperative Complications	Wound infection	28	11.67
	Stricture	12	5.00
	Fistula	8	3.33
	None	192	80.00
Continence Status	Normal	210	87.50
	Partial	30	12.50
Bowel Symptoms	Constipation	27	11.25
	Soiling	24	10.00
	Asymptomatic	189	78.75
Additional Clinical Outcomes	Additional surgery	12	5.00
	Normal bladder function	240	100.00
	Urinary incontinence	0	0.00
	Recurrent UTI	0	0.00

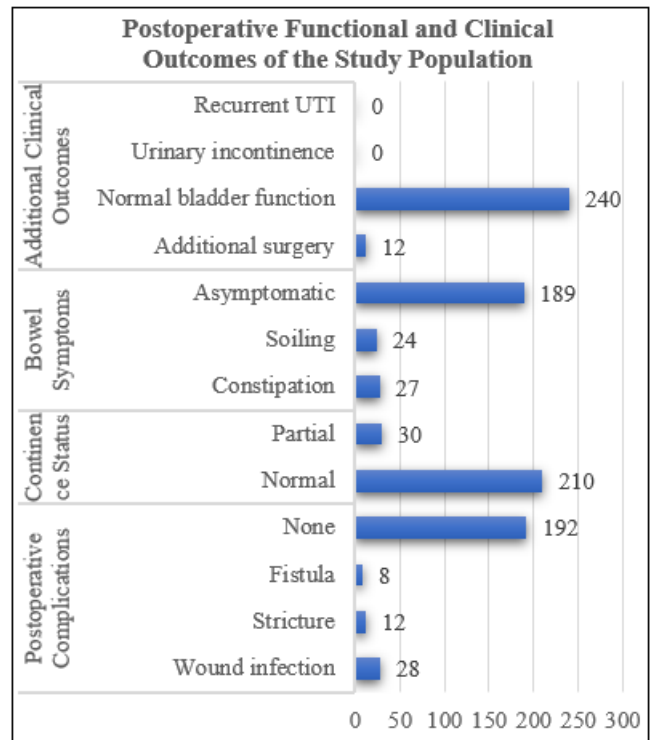


Figure 2: Distribution of Postoperative Functional and Clinical Outcomes in the Study Population (n = 240)

The quality-of-life scores were generally comparable across the different types of anorectal malformations. Patients with rectovestibular malformations had the highest mean scores in the physical (76.76 ± 14.90), emotional (75.76 ± 14.10), and social (79.29 ± 14.70) domains. Patients with cloaca had comparatively lower mean scores in the physical (70.20 ± 13.30) and social (71.22 ± 10.50) domains, while those with ARM without fistula had the lowest emotional domain score (70.50 ± 11.33). However, no statistically significant differences were observed in the physical ($p = 0.955$), emotional ($p = 0.726$), or social ($p = 0.594$) quality-of-life domains among the different types of anorectal malformations (Table 3).

Table 3: Distribution of Quality-of-Life Scores According to Type of Anorectal Malformation (n = 240)

Type of Anorectal Malformation	Physical (Mean $\pm$ SD)	Emotional (Mean $\pm$ SD)	Social (Mean $\pm$ SD)
Ano Vestibular (n = 144)	74.85 $\pm$ 16.10	75.25 $\pm$ 13.60	73.80 $\pm$ 14.30
Rectovaginal (n = 36)	70.38 $\pm$ 15.20	72.54 $\pm$ 15.90	78.62 $\pm$ 12.10
Rectovestibular (n = 24)	76.76 $\pm$ 14.90	75.76 $\pm$ 14.10	79.29 $\pm$ 14.70
Cloaca (n = 24)	70.20 $\pm$ 13.30	72.80 $\pm$ 10.50	71.22 $\pm$ 10.50
Perineal Canal (n = 7)	72.46 $\pm$ 11.20	73.80 $\pm$ 12.50	74.60 $\pm$ 12.50
ARM without Fistula (n = 5)	71.00 $\pm$ 11.30	70.50 $\pm$ 11.33	74.80 $\pm$ 10.90
p-value	0.955	0.726	0.594

The majority of patients achieved a good outcome across all types of anorectal malformations, with the highest proportion observed among patients with ano vestibular malformations (95.8%). Patients without associated anomalies had a significantly higher proportion of good outcomes than those with associated anomalies (78.7% vs. 62.5%; $p = 0.025$).

Similarly, patients who underwent primary procedures demonstrated better outcomes than those who underwent staged procedures (93.1% vs. 55.6%; $p < 0.001$). A significantly higher proportion of good outcomes was also observed among patients delivered by LSCS compared with those delivered by normal vaginal delivery (97.5% vs. 90.0%; $p = 0.001$). However, no statistically significant association was found between the final outcome and type of anorectal malformation ($p = 0.880$), place of residence ($p = 0.069$), or postoperative complications ($p = 0.300$) (Table 4).

Table 4: Association of Clinical and Demographic Characteristics with Final Outcome (n = 240)

Characteristic	Category	Good Outcome n (%)	Poor Outcome n (%)	p-value
Type of ARM	Ano vestibular	138 (95.8)	6 (4.2)	0.880
	Rectovaginal	28 (77.8)	8 (22.2)	
	Rectovestibular	22 (91.7)	2 (8.3)	
	Cloaca	20 (83.3)	4 (16.7)	
	Perineal canal	6 (85.7)	1 (14.3)	
	ARM without fistula	4 (80.0)	1 (20.0)	
Associated Anomalies	No	140 (78.7)	38 (21.3)	0.025
	Yes	45 (62.5)	27 (37.5)	
Residence	Rural	142 (88.8)	18 (11.3)	0.069
	Urban	70 (87.5)	10 (12.5)	
Postoperative Complications	Wound infection	18 (64.3)	10 (35.7)	0.300
	Stricture	10 (83.3)	2 (16.7)	
	Fistula	6 (75.0)	2 (25.0)	
	None	173 (90.1)	19 (9.9)	
Procedure Type	Primary	190 (93.1)	14 (6.9)	<0.001
	Staged	20 (55.6)	16 (44.4)	
Mode of Delivery	NVD	144 (90.0)	16 (10.0)	0.001
	LSCS	78 (97.5)	2 (2.5)	

The mean age was significantly lower among patients with a good outcome compared with those with a poor outcome (6.65 ± 4.75 vs. 10.54 ± 5.32 years; $p = 0.010$). Although patients with a poor outcome had a higher mean age at surgery (3.25 ± 1.36 years) than those with a good outcome (2.69 ± 1.35 years), the difference was not statistically significant ($p = 0.124$). Similarly, patients with a good outcome had slightly higher mean physical (77.04 ± 15.21 vs. 71.42 ± 15.65), emotional (75.54 ± 14.01 vs. 73.83 ± 15.13), and social (75.46 ± 14.67 vs. 78.50 ± 13.17) quality-of-life scores; however, none of these differences were statistically significant

(physical: $p = 0.171$; emotional: $p = 0.705$; social: $p = 0.426$) (Table 5/ Figure 3).

Table 5: Distribution of Continuous Variables According to Final Outcome (n = 240)

Variable	Good Outcome (n = 205) Mean $\pm$ SD	Poor Outcome (n = 35) Mean $\pm$ SD	p-value
Age (years)	6.65 ± 4.75	10.54 ± 5.32	0.010
Age at Surgery (years)	2.69 ± 1.35	3.25 ± 1.36	0.124
Physical QoL Score	77.04 ± 15.21	71.42 ± 15.65	0.171
Emotional QoL Score	75.54 ± 14.01	73.83 ± 15.13	0.705
Social QoL Score	75.46 ± 14.67	78.50 ± 13.17	0.426

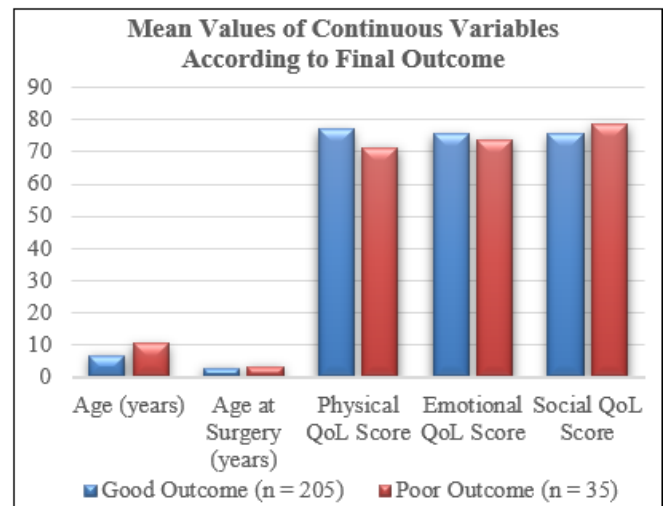


Figure 3: Comparison of Continuous Variables According to Final Outcome (n = 240)

Constipation was most frequently observed among patients with ARM without fistula (20.0%), followed by those with rectovestibular malformations (16.7%), perineal canal (14.3%), rectovaginal malformations (13.9%), cloaca (12.5%), and ano vestibular malformations (6.9%). Soiling was most common among patients with perineal canal (42.9%), followed by rectovaginal malformations (33.3%), rectovestibular malformations (25.0%), cloaca (20.8%), ARM without fistula (20.0%), and ano vestibular malformations (5.6%). However, no statistically significant association was observed between the type of anorectal malformation and the occurrence of constipation ($p = 0.147$) or soiling ($p = 0.362$) (Table 6).

Table 6: Distribution of Bowel Symptoms According to Type of Anorectal Malformation (n = 240)

Bowel Symptom	Ano Vestibular	Rectovaginal	Rectovestibular	Cloaca	Perineal Canal	ARM without Fistula	p-value
Constipation, n (%)	10 (6.9)	5 (13.9)	4 (16.7)	3 (12.5)	1 (14.3)	1 (20.0)	0.147
Soiling, n (%)	8 (5.6)	12 (33.3)	6 (25.0)	5 (20.8)	3 (42.9)	1 (20.0)	0.362

4. Discussion

The majority of patients in the present study underwent definitive surgical management during early childhood, with a mean age of 3.7 ± 3.17 years. Ano vestibular malformation was the predominant anorectal malformation (60.0%), while associated anomalies were identified in 30.0% of patients. These findings are consistent with previous studies reporting vestibular fistula as the most common anorectal malformation in female patients. **Wakhlu et al.** [9] reported favorable outcomes in 95% of 1,206 patients with vestibular fistula

managed using ASARP, while **Goyal et al.** [5] observed that vestibular fistula accounted for 92.99% of cases in their series. The prevalence of associated anomalies in our study was also comparable to that reported by **Goyal et al.**, [5] who identified associated anomalies in 19.75% of patients, although slightly lower than the 32.4% reported by **Maneesha et al.** [2]. Early diagnosis and comprehensive evaluation for associated anomalies remain essential, as timely surgical intervention and multidisciplinary management are important determinants of favorable long-term functional outcomes.

In our study, most patients had an uncomplicated postoperative course, with no complications observed in 80.0% of cases. Among those who developed complications, wound infection was the most common, followed by stricture and fistula. Overall functional outcomes were favorable, with 87.5% of patients achieving normal continence, while constipation and soiling were observed in a relatively small proportion of patients. These findings are comparable with previous reports. **Wakhlun et al.** [9] reported good surgical outcomes in 95% of patients undergoing ASARP. Similarly, **Goyal et al.** [10] reported early postoperative complications in 5.09% and late complications in 12.73% of patients, with anal stenosis being the most common late complication. **Maneesha et al.** [2] also observed good continence in 91.2% of patients, with an overall postoperative complication rate of 11.8%.

In our study, quality of life was comparable across the different types of anorectal malformations, with no statistically significant differences observed in the physical, emotional, or social domains. These findings suggest that the type of anorectal malformation alone may not be the primary determinant of long-term quality of life following definitive surgical repair. Similar observations have been reported by **Kyrklund et al.** [10], who noted that although long-term functional symptoms were common, most patients achieved social continence and maintained a satisfactory quality of life. **Bhojwani et al.** [11] also demonstrated that quality of life improved following appropriate bowel management and surgical intervention, while **Baldanza et al.** [12] reported that poor adherence to bowel management programmes was significantly associated with reduced quality of life ($p < 0.01$). Collectively, these findings indicate that long-term quality of life depends not only on the anatomical type of anorectal malformation but also on effective bowel management, psychosocial support, and structured long-term follow-up.

In the present study, associated anomalies, procedure type, and mode of delivery showed a statistically significant association with the final outcome. Patients with associated anomalies had poorer outcomes than those without associated anomalies, highlighting the influence of coexisting congenital defects on long-term functional recovery. In contrast, **Wang et al.** [13] reported that associated anomalies were not significantly associated with long-term bowel function, whereas reoperations were the only significant predictor of poor outcome. Similarly, **Schmitt et al.** [14] demonstrated that higher ARM level was associated with poorer voluntary bowel movements (OR 1.84, $P < 0.001$) and increased soiling (OR 1.72, $P < 0.001$), while surgical approach was significantly associated with constipation (OR 2.98, $P = 0.01$). Overall, these findings suggest that associated clinical factors and surgical management may have a greater influence on long-term outcomes than the anatomical subtype alone.

In the present study, patients with poor outcomes were significantly older than those with good outcomes, whereas age at surgery and quality-of-life scores did not differ significantly between the groups. Similar findings have been reported by **Elrouby et al.** [15], who demonstrated favorable long-term functional outcomes following early ASARP, and by **Niramon Sukarnjanaprai et al.** [16], who found that PSARP performed before 6 months significantly increased

the likelihood of achieving voluntary bowel movement (OR 4.1). These findings highlight the multifactorial nature of long-term functional outcomes in anorectal malformations and the need for continued long-term follow-up after definitive repair.

Despite the strengths of a relatively large cohort and long-term follow-up, this study has certain limitations. The retrospective single-center design may limit the generalizability of the findings, and variations in follow-up duration could have influenced the assessment of long-term outcomes. Furthermore, information on factors such as bowel management practices and psychosocial support was not consistently available for analysis. Future multicenter prospective studies with standardized follow-up are warranted to further strengthen the evidence on long-term functional outcomes in female anorectal malformations.

5. Conclusion

Long-term functional outcomes were generally satisfactory in female patients with anorectal malformations, the majority of whom underwent anterior sagittal anorectoplasty (ASARP), with most patients achieving good bowel continence and an acceptable quality of life. Associated anomalies and the type of surgical procedure were found to influence long-term outcomes, whereas the anatomical type of anorectal malformation did not show a significant association. These findings support individualized surgical management and regular long-term follow-up to achieve the best possible functional outcomes. Further prospective multicenter studies are needed to confirm these findings and to better understand the factors influencing long-term outcomes in this patient population.

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