



COMPARISON BETWEEN OUTCOMES OF INGUINAL HERNIOTOMY BY MITCHELL BANK AND MODIFIED FERGUSON TECHNIQUE FOR PEDIATRIC INGUINAL HERNIA

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ABSTRACT

Background: Inguinal hernia is a common pediatric condition stemming from a persistent processus vaginalis. Traditional approaches recommend the Mitchell-Banks' herniotomy (MBT) for children under 2 years and the Ferguson herniotomy (FGT) for those over 2 years. This study evaluates the efficacy and safety of these techniques across a broader age range.

Objective: To compare the outcomes of MBT and FGT in children aged 3 months to 6 years, focusing on surgical success and postoperative complications.

Methods: In this randomized controlled trial, conducted from July 2020 to June 2022, 190 children were equally divided into two groups: Group A underwent FGT and Group B underwent MBT. Follow-ups were scheduled at 1 week, 1 month, 3 months, and 6 months post-surgery to assess hernia recurrence, wound infection, hydrocele, surgical hematoma, and testicular atrophy. Data analysis was performed using SPSS 25.0, with a significance level set at $P \leq 0.05$.

Results: The MBT group comprised 95 patients (89.5% male, mean age 3.22 ± 1.5 years); the FGT group also included 95 patients (88.4% male, mean age 2.85 ± 1.6 years). At one-month follow-up, no recurrences were observed in the MBT group, while the FGT group reported a 3.1% recurrence rate.

Conclusion: The Mitchell-Banks' technique is demonstrated to be a simple and effective method for inguinal herniotomy in children, showing a lower recurrence rate compared to the Modified Ferguson technique. It is viable for use in children beyond the traditionally recommended age of 2 years.

Keywords: Children, Inguinal herniotomy, Mitchell-Banks technique, Modified Ferguson technique, Recurrence, Surgical outcomes

Introduction

Inguinal hernia, characterized by the protrusion of viscera through an aberrant opening within the anatomical structures, remains a significant concern in pediatric surgery. This condition, constitutes 75% of all abdominal wall hernias, frequently leading to pediatric surgical consultations. The prevalence of inguinal hernia varies widely, affecting approximately 0.8 to 5% of full-term infants and up to 20% of preterm or very low birth weight infants. The incidence of these hernias diminishes with age. They may pose a recurrent problem, with reported rates varying from 0.68 to 4% across different studies (1,2,4,5).

Predominantly manifesting in males and typically diagnosed within the first year of life, these hernias are twice as common on right side as on the left, and are bilateral in nearly 10% of cases (6,7). The anatomical basis of pediatric inguinal hernias, primarily indirect, stems from a patent processus vaginalis which is a protrusion of the peritoneum through the deep inguinal ring and along the inguinal canal and lies lateral to the inferior epigastric vessels (8-10).

Clinical manifestations include a visible bulge in the inguinal region, which become more prominent with straining activities such as crying and subsides during sleep. The condition might be evident at birth or may not manifest for weeks or even years. The high diagnostic accuracy of ultrasonography, particularly when processus vaginalis exceeds 4 mm or shows the presence of abdominal contents, makes it the standard pre-operative assessment tool for both symptomatic and asymptomatic cases (11).

The risk of complications such as incarceration, which varies between 6% and 30% depending on the age at presentation, poses a grave risk, potentially leading to intestinal strangulation or vascular compromise of the gonads, thereby necessitating timely surgical management to preclude such severe outcomes (12,13).

Surgical correction of inguinal hernias in children is not self-resolving and requires a strategic approach, typically through herniotomy. This procedure involves the high ligation of the patent processus vaginalis at the deep inguinal ring, a technique established since 1871. Over the years, various surgical techniques have been developed, ranging from open herniotomy to laparoscopic approaches, each adapted to the surgeon's skills and available resources (14-18).

Among the open surgical techniques, the Mitchell-Banks technique (MBT) and the Gross and Ferguson technique (FGT) are predominantly used. MBT, which avoids opening the inguinal canal and involves high ligation of the hernia sac via the external ring, minimizes tissue trauma but might not be as effective in older children due to the anatomical length of the inguinal canal. Conversely, the FGT, which entails opening the inguinal canal for better visualization and repair, poses a higher risk of perioperative complications but provides more direct access to the hernia sac (19-24).

Despite the variations in techniques, the ultimate goals of hernia surgery in children are to minimize postoperative complications such as hydrocele, testicular atrophy, and scrotal edema and recurrence. The need for a comparative study between the MBT and FGT in a diverse age range of children becomes evident, especially in contexts where no single technique is universally superior. This study aims to assess and compare the outcomes of these techniques in children aged 3 months to 6 years, focusing on recurrence rates and other complications, thereby determining the most effective and least invasive method for pediatric inguinal hernia repair.



Figure-1: Operative demonstration of open inguinal herniotomy by Mitchell Bank technique.

A. Visualization of superficial inguinal ring in external oblique aponeurosis. **B.** Separation of cremasteric fibers and exposure of hernia sac from superficial inguinal ring. **C.** Hernial sac being separated from vas and vessels of spermatic cord. **D.** Complete separation of vas and vessels from the sac. **E.** Preperitoneal fat exposed at the level of deep ring, and sac excised by carefully retracting vas and vessels away from it. **F.** Proximal sac ligated at deep ring level, through which it retracts back in peritoneal cavity.

Table:		Surgical Techniques of Open Inguinal Herniotomy Used	
Name of Repair		Outline of Practical Method	Remarks
Gross and Ferguson technique		External oblique aponeuroses is incised which aids in hernial sac division and ligation high up at the level of internal ring	Gold standard technique, nearly all of surgeons perform this worldwide
Mitchell Bank repair		Hernia sac ligation done at internal inguinal ring is achieved without opening the inguinal canal	More suitable in young children who do not have fully developed canal

Methods

The study was conducted as a randomized controlled trial at the Department of Paediatric Surgery, Unit 1, The Children's Hospital & University of Child Health Sciences, Lahore over a period of 2 years. The research aimed to include 190 patients, allocated equally into two groups of 95, utilizing the "Sample Size Determination in Health Studies" software. This configuration ensured a 90% power and a 95% confidence level, considering the anticipated recurrence rates of 1% for the Ferguson technique and 10% for the Mitchell – Banks' technique (21).

Patient selection was carried out through non-probability, consecutive sampling. Following this, a computer-generated randomization process assigned the participants to one of the two surgical groups. Inclusion criteria comprised both male and female children aged 3 months to 6 years diagnosed with congenital indirect inguinal hernia. Exclusion criteria included patients presenting with hydrocele, undescended testis, or any complex hernias such as irreducible, strangulated, or incarcerated hernias, as well as those with additional congenital malformations or significant comorbidities.

After ethical approval from the hospital's Ethical Review Committee, children meeting the inclusion criteria were recruited from the surgical outpatient department. Informed consent was systematically obtained from parents or guardians, after which demographic details such as name, age, and contact information were documented on a designated proforma. The surgical intervention for group A involved the Ferguson technique with the opening of the external oblique aponeurosis. In contrast, group B underwent the Mitchell – Banks technique, where the hernial sac was manipulated without opening the external oblique aponeurosis (55,56).

Both groups received general anesthesia, and surgeries were conducted by a consultant with assistance from the researcher. For the Ferguson group, a transverse incision was made in the lowest inguinal skin crease, dissecting down to the Camper and Scarpa fasciae before incising the external oblique fascia above the internal ring. The hernial sac was isolated, ligated, and the wound closed in layers. The Mitchell – Banks group followed a similar initial approach, but the external oblique fascia was not incised, hernial sac was lifted at superficial inguinal ring and excess to deep inguinal ring attained via gentle traction on the sac.

Postoperatively, patients were monitored in the post-operative bay until discharge and scheduled for follow-up visits at 1 week, 1 month, 3 months, and 6 months. These evaluations focused on potential complications such as hernia recurrence, wound infection, hydrocele, surgical hematoma, and testicular atrophy. Recurrence was specifically defined as the reappearance of swelling in the inguinoscrotal region, confirmed clinically and by ultrasound as containing enterocele or omentum within 6 months of the follow-up.

Data collection was comprehensive, with all information entered and analyzed using SPSS version 25. Age was analyzed as a quantitative variable and presented as mean \pm standard deviation, while outcomes like recurrence and other post-operative complications were considered as qualitative variables and reported in frequencies and percentages. Statistical significance was established at a p-value of ≤ 0.05 .

This comparative analysis aims to validate the effectiveness of each technique, potentially shaping clinical practices in pediatric hernia surgery. The ultimate goal was to discern any significant differences between the two surgical techniques, thereby guiding future recommendations for the procedure that minimizes postoperative complications and aligns with the operational demands of a busy tertiary care setting.

Results

The study evaluated the outcomes of inguinal herniotomy using the Mitchell-Bank Technique (MBT) and the Modified Ferguson Technique (GFT) among pediatric patients. The participants were stratified into two groups of 95 each, with the following demographics and clinical characteristics observed:

In the MBT group, 34 patients (35.8%) were aged between 3 months and 2 years, while 61 patients (64.2%) were between 2 to 6 years, with a mean age of 3.224 ± 1.5384 years. Comparatively, in the GFT group, 43 patients (45.3%) were in the younger age bracket, and 52 patients (54.7%) were in the older age bracket, with a mean age slightly lower at 2.856 ± 1.6394 years.

Gender distribution showed a predominance of males in both groups, with 85 (89.5%) in the MBT group and 84 (88.4%) in the GFT group, complemented by 10 (10.5%) females in the MBT group and 11 (11.6%) females in the GFT group.

Regarding body weight, 49 patients (51.6%) in the MBT group weighed up to 10 kg compared to 58 patients (61.1%) in the GFT group. The remaining patients in each group weighed above 10 kg.

Hemoglobin levels varied, with 34 (35.8%) patients in the MBT group and 17 (17.9%) in the GFT group recording levels below 10 g/dL. The majority in both groups had hemoglobin levels greater than 10 g/dL.

Anatomical distribution of hernias showed similar patterns between the groups, with right-sided inguinal hernias observed in 44 (46.3%) of the MBT group and 43 (45.3%) of the GFT group. Left-sided hernias were noted in 40 patients (42.1%) in each group, and bilateral hernias were slightly more common in the GFT group at 12.6% compared to 11.6% in the MBT group.

Postoperative outcomes were noteworthy, particularly concerning recurrence rates. There were no recurrences in the MBT group, whereas the GFT group experienced a 3.1% recurrence rate one month after the surgery., a difference that reached statistical significance ($P=0.041$). In contrast, complications such as wound infections were absent in both groups, indicating effective postoperative management.

Hydrocele formation differed slightly between the groups, affecting 15 (15.7%) patients in the MBT group and 9 (9.5%) in the GFT group at the first week, although this difference was not statistically significant ($P=0.190$). Hematomas were rare, observed only in the MBT group at 2.1%, with no cases in the GFT group.

Testicular atrophy did not occur in either group, reinforcing the safety of both surgical approaches concerning this severe complication.

Further analysis using the t-test on the collected data revealed that the only significant difference between the groups was related to hemoglobin levels ($P<0.05$). Age and weight, however, showed no significant differences ($P>0.05$).

The study demonstrated that both the MBT and GFT are viable techniques for pediatric inguinal herniotomy, with MBT showing a slightly better profile in terms of recurrence rates. Such findings suggest considerations for surgical technique selection in clinical practice, tailored to patient characteristics and surgical outcomes.

Table: Comparative Analysis of Clinical Outcomes Between Mitchell-Banks Technique (MBT) and Modified Ferguson Technique (GFT) in Pediatric Inguinal Herniotomy

Variable	Category	MBT Group (n=95)	Percentage	GFT Group (n=95)	Percentage	P-value
Age	3 months to 2 years	34	35.8%	43	45.3%	0.621
	2 to 6 years	61	64.2%	52	54.7%	
Gender	Male	85	89.5%	84	88.4%	0.817
	Female	10	10.5%	11	11.6%	
Weight	<10 kg	49	51.6%	58	61.1%	0.002
	>10 kg	46	48.4%	37	38.9%	
Hemoglobin	<10 g/dL	34	35.8%	17	17.9%	0.000
	>10 g/dL	61	64.2%	78	82.1%	
Side of Hernia	Right	44	46.3%	43	45.3%	0.973
	Left	40	42.1%	40	42.1%	
	Bilateral	11	11.6%	12	12.6%	
Recurrence	1st week	0	0.0%	0	0.0%	0.041

	1 month	0	0.0%	3	3.1%	
	3 months	0	0.0%	0	0.0%	
	6 months	0	0.0%	0	0.0%	
Wound Infection	1st week	0	0.0%	0	0.0%	NA
	1 month	0	0.0%	0	0.0%	
	3 months	0	0.0%	0	0.0%	
	6 months	0	0.0%	0	0.0%	
Hydrocele	1st week	15	15.7%	9	9.5%	0.190
	1 month	0	0.0%	0	0.0%	
	3 months	0	0.0%	0	0.0%	
	6 months	0	0.0%	0	0.0%	
Hematoma	1st week	2	2.1%	0	0.0%	0.155
	1 month	0	0.0%	0	0.0%	
	3 months	0	0.0%	0	0.0%	
	6 months	0	0.0%	0	0.0%	
Testicular Atrophy	1st week	0	0.0%	0	0.0%	NA
	1 month	0	0.0%	0	0.0%	
	3 months	0	0.0%	0	0.0%	
	6 months	0	0.0%	0	0.0%	

Table: Comparison of Mean Age, Weight, and Hemoglobin Levels Between MBT and GFT Groups

Variable	MBT Group	GFT Group
Age (years)	3.224 ± 1.5384	2.856 ± 1.6394
Weight (kg)	10.84 ± 4.488	10.76 ± 4.645
Hemoglobin (g/dL)	10.596 ± 2.1741	11.452 ± 1.4725

Table: T-Test

		Levene's Test for Equality of Variances		t-test for Equality of Means						
		F	Sig.	t	df	Sig. (2-tailed)	Mean Difference	Std. Error Difference	95% Confidence Interval of the Difference	
									Lower	Upper
Age	Equal variances assumed	.027	.871	1.597	188	.112	.3684	.2307	-.0866	.8234
	Equal variances not assumed			1.597	187.245	.112	.3684	.2307	-.0866	.8234
Weight	Equal variances assumed	.767	.382	.124	188	.902	.082	.663	-1.225	1.389
	Equal variances not assumed			.124	187.779	.902	.082	.663	-1.225	1.389
Hb	Equal variances assumed	2.660	.105	-3.177	188	.002	-.8558	.2694	-1.3872	-.3244
	Equal variances not assumed			-3.177	165.249	.002	-.8558	.2694	-1.3877	-.3239

Table: Association of Age with Recurrence at 1 Month between Groups

Age	Recurrence at 1 Month	MBT Group	GFT Group	P-value
3 months to 2 years	Yes	0 (0.0%)	0 (0.0%)	–
	No	34 (35.8%)	43 (45.3%)	
	Total	34 (35.8%)	43 (45.3%)	
2 to 6 years	Yes	0 (0.0%)	3 (3.1%)	0.068
	No	61 (64.2%)	49 (51.6%)	
	Total	61 (64.2%)	53 (54.7%)	

Discussion

Inguinal hernia is a prevalent condition in early childhood, necessitating surgical intervention due to its inability to resolve spontaneously. The standard surgical approach, herniotomy, is frequently performed with the aim to alleviate the condition without recurrence. The current study focused on comparing the outcomes of two widely utilized surgical techniques: the Mitchell-Bank Technique (MBT) and the Modified Ferguson Technique (GFT). This investigation included a well-defined cohort of 190 pediatric patients, equally divided between the two groups, enabling a robust comparison of the efficacy and safety of these methods.

The demographic analysis revealed that the majority of patients in both the MBT and GFT groups were between 2 to 6 years old. This age distribution aligns with findings from previous studies, which have also reported a higher prevalence of inguinal hernia within this age range, emphasizing the need for effective surgical options across different pediatric age groups (29, 53). Notably, the current study included a significant representation of male patients, consistent with the established understanding that inguinal hernia is more common in males. These demographics corroborate with findings from other recent studies, reinforcing the generalizability of the results (54, 8).

In terms of surgical outcomes, the study found no incidences of recurrence in the MBT group, contrasting with a 3.1% recurrence rate in the GFT group at one month. This result was statistically significant and suggests a potential advantage of the MBT in terms of reducing the risk of short-term recurrence. These findings are in contrast to those of Türk et al. (2014) and Nazem et al. (2015), who reported lower recurrence rates across both techniques, suggesting that variations in technique execution or patient selection might influence outcomes (25, 53).

The incidence of complications such as hydrocele, hematoma, and testicular atrophy was also examined. Hydrocele occurrence was higher in the MBT group compared to the GFT group, although this was not statistically significant. These rates of hydrocele are higher than those reported in other studies, which could be attributed to differences in surgical technique or postoperative care (5, 54). Hematoma rates were low across both groups, aligning with the literature that suggests these are rare but possible complications of inguinal herniotomy (25, 53).

The absence of testicular atrophy in both groups is particularly encouraging, as this severe complication can have long-term consequences on patient health. This finding underscores the safety of both techniques when performed in a controlled, clinical setting.

A critical strength of this study is the randomized controlled design, which provides a high level of evidence on the efficacy and safety of the surgical techniques compared. However, the study is not without limitations. The follow-up period was relatively short, which primarily allows for the assessment of immediate postoperative outcomes rather than long-term complications or recurrence. Additionally, the study was conducted in a single center, which may limit the applicability of the findings to settings with different patient demographics or surgical expertise.

The findings from this study suggest that while both MBT and GFT are effective for the surgical treatment of pediatric inguinal hernia, MBT may offer a lower risk of early recurrence. Given the variability in outcomes observed in different studies, further research is warranted to explore the long-term efficacy and safety of these techniques across diverse clinical settings. This would potentially

include multicenter trials with longer follow-up periods to comprehensively assess the durability of surgical outcomes and the impact on the quality of life of pediatric patients.

Conclusion

The study established that the Mitchell-Banks Technique (MBT) is a superior and simpler surgical approach compared to the Modified Ferguson Technique (GFT) for the treatment of pediatric inguinal hernia, demonstrating effectiveness across a wide pediatric age range from 3 months to 6 years. These findings suggest that MBT could be preferentially recommended in clinical settings due to its lower recurrence rates and simplicity. To solidify these conclusions and potentially generalize them across various healthcare environments, further multicenter studies are recommended, allowing for a broader evaluation of the comparative effectiveness and potential regional variations in outcomes between these two surgical techniques.

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