Original Article

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Comparison of Early and Late Complications of the Mitchell-Banks Technique and Modified Ferguson Herniotomy in Children Over 2 Years of Age

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A B S T R A C T

Background: Inguinal hernia is a usual operative complication in children and must be repaired surgically to avoid complications. Herniotomy is performed using different methods such as the Mitchell Banks technique and modified Ferguson herniotomy. This study aimed to determine the comparative rates of early and late postoperative complications of these two methods in children above the age of two years undergoing repair on inguinal and umbilical hernias.

Setting and Duration: This retrospective comparative study was done at the Department of Pediatric Surgery, Qazi Hussain Ahmad Medical Complex (MTI Nowshera) between January 2019 and January 2024.

Methods: 190 children aged 2 to 16 years with primary inguinal hernia undergoing open surgical repair were enrolled. Patients received either Mitchell-Banks technique (MBT, n=95) or modified Ferguson herniotomy (FH, n=95) in two groups of equal size. Hospital records were used to determine demographic characteristics, operative parameters, and postoperative complications. Acute complications were poor wound healing, scrotal edema and hemorrhage, whereas late complications were recurrence, atrophy of testicles and chronic pain.

Results: The MBT group had a mean age of 5.12 ± 1.5 years and the FH group had a mean age of 6.33 ± 1.6, (p=0.015). The MBT group had a significantly less operative time (22.4 ± 3.1) as compared to FH group (30.2 ± 4.1, p=0.001). MBT group also had a shorter hospital stay (6.5 ± 2.1 hours) as compared to FH group (8.3 ± 2.7 hours, p<0.001). Early complications did not differ significantly between both groups on the basis of wound infection (2.1% vs 3.1%), scrotal edema (5.3% vs 6.3%) and hematoma (1.1% vs 2.1%). They recurrence was observed in 0% of MBT group patients in contrast to 3.1% of FH group (p=0.083).

Conclusion: The safety profiles of both the methods were similar with minimal cases of early and late complications. Though, Mitchellbanks technique showed lesser operating period as well as hospitalization, which indicated benefits on operative performance and recovery after the operation.

Keywords: Inguinal hernia, Mitchell-Banks technique, Ferguson herniotomy, pediatric surgery, postoperative complications.

Introduction

Inguinal hernia is one among the most frequent surgical diagnoses seen in pediatric patients and it represents a large percentage of pediatric operations throughout the world. The condition occurs because the processes vaginalis had failed to shut, which enabled abdominal contents to poke out through the inguinal canal. Pediatric inguinal hernia has been reported to have an incidence of 1 -5 percent in full-term infants and can possibly go up to 30% in preterm infants and it is an often considered indicator of surgical intervention within the early years of infancy.[1,2] As compared to certain hernias that may present in adults, children may not resolve spontaneously thus, surgery is believed to serve as the ultimate remedy to eliminate deviant outcomes like incarceration, strangulation, and compromised testes.[3]

The common pediatric surgery used in repairing the inguinal hernia sites is herniotomy, and is widely considered as identification and high ligation of the hernia sacs. A number of operative procedures are outlined to produce a safe and effective repair with a minimum of complications. Some of them include the Mitchell-Banks technique (MBT) and the modified Ferguson herniotomy (FH), which are widely used methods of pediatric surgery. The Mitchell-Banks method is a high ligation of the hernia sac via the external inguinal ring, but it does not open the inguinal canal and thus, does not dissect the external oblique aponeurosis. Alternatively, the modified Ferguson procedure uses an exposure of the inguinal canal to isolate the hernia sac, then do a high ligation and reconstruct the canal structures.[4,5]

The choice of surgical technique has traditionally been strongly dependent on the age of the child. Mitchell-Banks procedure has traditionally been used in infants and children younger than two years of age, since the

inguinal canal at these ages is relatively short and the hernia sac can be accessed easily without dissecting the canal. Common techniques that have been preferred by surgeons to be used in older children have included Ferguson herniotomy, a technique that requires opening of the inguinal canal to provide enough accessibility of the structures of hernias sacs and cord.[6] But in recent years this age difference is something that has been strongly challenged. Findings using such large series of clinical studies have indications that the Mitchell-Banks procedure could be safely conducted in children of older age with no harm to complication and recurrence rates.[7]

Postoperative complications are another important factor in the choice of the most suitable surgery method in repairing pediatric inguinal hernias. Early complications in postoperative include wound infection, hemorrhage, and scrotal edema and late complications may comprise recurrence, persistent groin pains, and atrophy in the testicles. Even though both MBT and FH are generally safe procedures, there are slight variations in the degree of tissue dissection and the amount of manipulation of the inguinal canal that could affect postoperative morbidity and recovery.[8] It has been proposed that the structural integrity of the inguinal canal is maintained by the avoidance of opening the inguinal canal during the operation since the Mitchell-Banks technique decreases the duration of operation, decreases the risk of nerve injury and preserves the integrity of the inguinal canal.[9]

Regardless of these possible benefits, the best surgical method in children above the age of two years is still a controversial topic. Recent population based studies have indicated that the recurrence patterns are not similar to all patients following repair of inguinal hernias, with children generally showing dissimilarity in recurrence rates among older individuals, necessitating further research through age-specific research focusing on an age based surgical treatment of this condition.[10] However, there is no direct comparative evidence to assess the immediate and delayed postoperative outcomes of MBT and FH among children past infancy.

Hence, the current research was carried out to compare the early and late complications of the Mitchell-Banks method and altered Ferguson herniotomy in children aged 2-16 years during inguinal hernia surgery. This study will help return more evidence to influence the decision of surgery and better manage the inguinal hernia among children by comparing complication rates and surgical outcomes in these two procedures and improving the selection between these two techniques.

Methodology

This retrospective comparative study was carried out at the Department of Pediatric Surgery, Qazi Hussain Ahmad Medical Complex (Medical Teaching Institution - MTI Nowshera). The review of the medical records of pediatric patients with inguinal hernia undergoing surgery repair was carried out within the period between January 2019 and January 2024. The objective of the investigation was to make a comparison of early and late complications encountered during a postoperative period in the Mitchell-Banks Technique and the Modified Ferguson Herniotomy among children aged above two years. The study was conducted with an ethical approval of the institutional ethical review committee of Qazi Hussain Ahmad Medical Complex and confidentiality of patients during the study was ensured.

The study sample consisted of children between the age of 2 and 16 years who were diagnosed with primary inguinal hernia and had undergone an open hernia repairing procedure using either of the two surgeries at the time of study. The study involved a total of 190 patients. The patients were divided into two groups, on the basis of surgery type done, namely, the Mitchell-Banks technique (MBT) group and the modified Ferguson herniotomy (FH) group; with 95 patients in each group. All of the eligible patients who were treated within the study period were included in the study through consecutive sampling. The study sample consisted of all the patients who met the inclusion requirements in the study period.

Children who were diagnosed with a primary inguinal hernia, underwent open inguinal hernia repair using the Mitchell-Banks technique or modified Ferguson herniotomy, had complete medical records with sufficient follow-up information, and were between the ages of 2 and 12 years old were included. Patients who had recurrent inguinal hernias, had undergone laparoscopic hernia repair, had associated abdominal or groin pathologies requiring additional surgical procedures, or had incomplete or missing clinical records were excluded.

All procedures were carried out by skilled pediatric surgeons under general anesthesia. Without opening the inguinal canal or making an incision in the external oblique aponeurosis, the hernia sac was located and ligated at a high level through the external inguinal ring using the Mitchell-Banks technique. This method keeps the inguinal canal intact and reduces tissue dissection. The modified Ferguson herniotomy involved cutting the external oblique aponeurosis to open the inguinal canal, isolating the hernia sac from the spermatic cord structures and ligating it at a high level. Once the repair was finished, the inguinal canal was rebuilt.

A standardized Performa was used to retrieve data from hospital records. Demographic features (age and

gender), clinical characteristics (right, left, or bilateral hernia), operative parameters (operative time and length of hospital stay), and postoperative results were among the variables noted. Early complications were defined as those that happened within 30 days following surgery, and late complications were defined as those that happened after 30 days during follow-up. Wound infection, haematoma formation, and scrotal oedema were among the early complications; recurrence, testicular atrophy, and persistent postoperative pain were among the late complications.

In order to reduce reporting bias, clinical outcomes were obtained from official medical records rather than from patient recall. To make sure the surgical methods were comparable, the two groups' baseline characteristics were also examined.

Data were analyzed using IBM SPSS Statistics version 26. Continuous variables were expressed as mean ± standard deviation, while categorical variables were presented as frequencies and percentages. The independent sample t-test was used to compare continuous variables, and the chi-square test or Fisher's exact test was applied for categorical variables. A p-value ≤ 0.05 was considered statistically significant.

Results

A total of 190 pediatric patients who underwent open inguinal hernia repair during the study period were included in the analysis. Patients were divided into two equal groups according to the surgical technique used: Mitchell-Banks Technique (MBT) and Modified Ferguson Herniotomy (FH), with 95 patients in each group.

The mean age of patients in the MBT group was 5.12 ± 1.5 years, whereas the mean age in the FH group was 6.33 ± 1.6 years. The difference in age distribution between the two groups was statistically significant (p-value = 0.015). In both groups, the majority of patients were male. In the MBT group, 85 patients (89.5%) were male and 10 patients (10.5%) were female, while in the FH group 84 patients (88.4%) were male and 11 patients (11.6%) were female. There was no statistically significant difference in gender distribution between the groups (p-value = 0.81).

In the context of the hernia side, the most frequent presentation in both groups was a right-sided hernia. Within the MBT group, 11 patients (11.6%) had bilateral hernias, 20 patients (21.0%) had left-sided hernias, and 64 patients (67.4%) had right-sided hernias. Twelve patients (12.6%) had bilateral hernias, 25 patients (26.3%) had left-sided hernias, and 59 patients (62.1%) had right-sided hernias in the FH group. No significant difference was observed in the distribution of hernia side between the two groups (p-value = 0.59). The demographic and clinical characteristics of the patients are summarized in Table I.

Table I: Demographic and Clinical Characteristics of the Study Sample .

Variable	Mitchell-Banks Technique (MBT) group (n=95)	Modified Ferguson Herniotomy (FH) group (n=95)	P-value
Age of patients (years)			
Mean ± SD	5.12 ± 1.5	6.33 ± 1.6	0.015
Gender of the patients			
Male	85 (89.5%)	84 (88.4%)	0.810
Female	10 (10.5%)	11 (11.6%)	
Side of Hernia			
Right	64 (67.4%)	59 (62.1%)	0.590
Left	20 (21.0%)	25 (26.3%)	
Bilateral	11 (11.6%)	12 (12.6%)	

Operative outcomes showed that the mean operative time was shorter in the MBT group (22.4 ± 3.6 minutes) compared with the FH group (30.2 ± 4.1 minutes). Similarly, the mean duration of hospital stay was lower in the MBT group (6.5 ± 2.1 hours) than in the FH group (8.3 ± 2.7 hours). The mean follow-up duration for both groups was 12 ± 3 months, allowing adequate observation of late postoperative complications. These operative characteristics are presented in Table II.

Table 2: Comparison of Operative Characteristics between both groups.

Parameter	Mitchell-Banks Technique (MBT) group (n=95)	Modified Ferguson Herniotomy (FH) group (n=95)	P-value
Operative Time (minutes)			
Mean ± SD	22.4 ± 3.6	30.2 ± 4.1	<0.001
Hospital Stay (hours)			
Mean ± SD	6.5 ± 2.1	8.3 ± 2.71	<0.001
Follow-up Duration (months)			
Mean ± SD	12 ± 3.0	12 ± 3.0	0.984

Early postoperative complications occurring within 30 days of surgery were evaluated in both groups. Wound infection occurred in 2 patients (2.1%) in the MBT group and 3 patients (3.1%) in the FH group (p-value = 0.652). Scrotal edema was observed in 5 patients (5.3%) in the MBT group and 6 patients (6.3%) in the FH group (p-value = 0.758). Hematoma formation occurred in 1 patient (1.1%) in the MBT group and 2 patients (2.1%) in the FH group (p-value = 0.563). No statistically significant differences were

observed between the two groups in terms of early postoperative complications. These findings are shown in Table III.

Table III: Comparison of Early Postoperative Complications between both groups.

Complication	Mitchell-Banks Technique (MBT) group (n=95)	Modified Ferguson Herniotomy (FH) group (n=95)	P-value
Wound Infection	2 (2.1%)	3 (3.1%)	0.652
Scrotal Edema	5 (5.3%)	6 (6.3%)	0.758
Hematoma	1 (1.1%)	2 (2.1%)	0.563

Late postoperative complications were assessed during the follow-up period beyond 30 days. Hernia recurrence was not observed in any patient in the MBT group, while 3 patients (3.1%) in the FH group developed recurrence (p-value = 0.083). Testicular atrophy was reported in 1 patient (1.1%) in the FH group and was not observed in the MBT group (p-value = 0.319). Similarly, chronic postoperative pain was reported in 2 patients (2.1%) in the FH group and none in the MBT group (p-value = 0.158). Although these complications were observed only in the FH group, the differences were not statistically significant. The comparison of late postoperative complications is summarized in Table IV.

Table IV: Comparison of Late Postoperative Complications between both groups.

Complication	Mitchell-Banks Technique (MBT) group (n=95)	Modified Ferguson Herniotomy (FH) group (n=95)	P-value
Recurrence	0 (0%)	3 (3.1%)	0.083
Testicular Atrophy	0 (0%)	1 (1.1%)	0.319
Chronic Pain	0 (0%)	2 (2.1%)	0.158

Discussion

One in every 200-300 live male births worldwide has The present study compared the Mitchell-Banks technique (MBT) with modified Ferguson herniotomy (FH) in 190 children with primary inguinal hernia. The results were that MBT was correlated with significantly shorter operative time and hospital stay, whereas there were no differences between early and late postoperative complications between the two techniques. The results in this study indicate that MBT can be used as a safe and effective treatment alternative for selected children older than two years.

The mean age was significantly lower in the MBT group than in the FH group (5.12±1.5 years vs. 6.33±1.6 years, respectively; p=0.015), while there was no significant difference between the two groups with respect to sex or the side of the hernia. The preponderance of males in both groups is typical of the known epidemiology of inguinal hernia in children. Importantly, the age difference could represent a continued preference for age-specific approach to surgical technique, rather than a difference in disease characteristics. In children older than 2 years, a large retrospective study comparing inguinal herniotomy with and without incision of the external oblique aponeurosis showed no difference between the two in the incidence of postoperative complications, suggesting that in this age group less extensive dissection is safe.[11] A meta-analysis similarly reported no significant differences in recurrence and major postoperative complications between pediatric herniotomy techniques performed with and without incision of the external oblique aponeurosis.[12] These findings support the feasibility of MBT in children beyond the traditionally preferred younger age group.

The mean operative time was significantly shorter with the use of MBT (22.4±3.6 minutes' vs 30.2±4.1 minutes; p<0.001), which was a major finding of the present study. The difference is clinically significant as MBT does not involve opening the external oblique aponeurosis and resulting reconstruction, thereby requiring less dissection of the inguinal canal. Similar outcomes have been noted in a comparative study of older boys (more than two years of age) where MBT had favorable operative outcomes when compared to Ferguson and Gross herniotomy.[13] Another recent prospective comparison also found a significantly shorter operating time when compared to Ferguson and Gross herniotomy.[14] These results are consistent and suggest an operative-efficiency benefit of MBT, but variation between studies may be due to differences in surgeon experience, patient selection, and surgical practice at different institutions.

The duration of hospital stay was also significantly reduced in the MBT group (6.5±2.1 hours vs. 8.3±2.7 hours; p<0.001). Limited tissue dissection can help to facilitate earlier discharge and recovery from surgery. While there are some factors associated with anesthesia during surgery and with monitoring after surgery that can affect the number of days spent in hospital, the combination of shorter operative time and shorter hospital stay with MBT suggests that there may be a practical benefit. Existing evidence-based guidelines support that the age consideration for the repair of inguinal hernia in children is flexible and depends on patient characteristics and surgeon experience at performing inguinal hernia surgery.[15]

The rates of early postoperative complications were low and similar between groups. Wound infection was

seen in 2.1% of MBT and 3.1% of FH patients, scrotal edema in 5.3% and 6.3% respectively, and in 1.1% and 2.1% of patients respectively, had hematoma. These findings are consistent with the previously reported low complication rates associated with both MBT and Ferguson herniotomy.[11,13] There have also been recent systematic comparisons of open with laparoscopic surgery in pediatric inguinal hernia repair that have shown equivalent postoperative results for the two procedures, with some differences in complication rates.[16]

Systematic recent evidence has also shown similar postoperative results for open versus laparoscopic inguinal hernia surgery in children, with varying complication rates.[16] The low frequency of wound infection and hematoma in the present study further indicates that both open techniques were associated with acceptable short-term morbidity.

Late complications were also infrequent. No recurrence occurred in the MBT group compared with 3.1% following FH, although the difference was not statistically significant (p=0.083). Similarly, testicular atrophy and chronic pain occurred only in the FH group, but neither difference reached statistical significance. The numerical trend toward fewer late complications with MBT is therefore clinically interesting but should not be interpreted as evidence of superiority because the study was not sufficiently powered to establish differences in these relatively uncommon outcomes. Previous comparative evidence has also demonstrated low recurrence rates following pediatric inguinal hernia repair with different open techniques.[11-13]

The 12±3-month follow-up in the present study permitted assessment of early and intermediate postoperative outcomes, but longer follow-up may be important when evaluating recurrence and testicular complications. A systematic review examining testicular vascularization after pediatric inguinal hernia repair found that temporary postoperative changes in testicular blood flow may occur following open repair, but persistent impairment was not consistently demonstrated.[18] Moreover, a recent nationwide cohort study noted that the recurrence risk is dependent on age, underscoring the need for longer-term follow-up when assessing post-inguinal hernia repair outcomes.[17]

It is important to mention that the above results should be considered in the context of current paediatric hernia surgery. Nationwide comparative data has recently demonstrated that both open and laparoscopic techniques can be equally effective for repair; however, the differences in operative characteristics and complication rates may vary based on the technique used.[19] A recent Cochrane systematic review also pointed out that the decision between open and laparoscopic surgery should be guided by the clinical situation and any pros and cons of the two procedures.[20] The findings underscore the need for surgical skills and the selection of appropriate surgical techniques, rather than a reliance solely on age-based preferences.

Conclusion

The Mitchell-Banks technique showed no difference in early and late postoperative complications rates and significantly reduced operative time and length of hospital stay compared to modified Ferguson herniotomy in children older than 2 years who underwent open inguinal hernia repair. These findings suggest that Mitchell-Banks herniotomy is a safe and efficient alternative to modified Ferguson herniotomy in this age group. These findings should be confirmed in further prospective studies with larger numbers of patients and longer follow-up periods, and the long-term recurrence results should be assessed.

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