# Pyloromyotomy for infantile hypertrophic pyloric stenosis using a modification of the Tan and Bianchi circumumbilical approach

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**Background/purpose** Different approaches have been advocated for pyloromyotomy. Since the introduction of umbilical pyloromyotomy, a number of studies have shown that it is as safe as the traditional right upper quadrant approach with superior cosmetic results. The aim of this study was to assess the feasibility and the safety of pyloromyotomy for infantile hyprtrophic pyloric stenosis using a modification of the Tan–Bianchi approach.

**Patients and methods** Over a period of 2 years, 20 infants with infantile hypertrophic pyloric stenosis have been clinically evaluated. The umbilical approach was modified so that a transverse muscle cutting incision rather than a longitudinal midline linea alba incision was performed.

**Results** The total number of cases included in this study was 20 [16 male (80%) and four female (20%) patients]. Their ages ranged from 23 to 60 days (average $42.6 \pm 13.54$ days), and their weights ranged from 2700 to 4000 g (mean $3605 \pm 437.4$ g). Pyloromyotomy was performed safely with negligible blood loss. Four cases of serosal tear occurred, with an incidence of 20%. None of our cases showed significant complications. The mean operating time was $52.5 \pm 5.073$ min. The postoperative hospital stay ranged from 24 to 72 h. The postoperative course was uneventful in all patients, and, on follow-up, the circumumbilical incision left an almost undetectable scar.

**Conclusion** Pyloromyotomy for infantile hypertrophic pyloric stenosis using the modified Tan and Bianchi technique is feasible and safe, having an accepted operative time, early initiation of postoperative feeding, and short hospital stay. This modification combines the advantage of circumumbilical incision with its better cosmetic results and right transverse upper abdominal approach with its easy and feasible access to the pyloric mass. *Ann Pediatr Surg* 12:1–4 © 2016 Annals of Pediatric Surgery.

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## Introduction

Infantile hypertrophic pyloric stenosis (IHPS) is the most common cause of nonbilious vomiting during infancy, with a reported incidence of one to three per 1000 live births [1]. The first pyloromyotomy was described by Ramstedt [2] using a vertical midline incision, modified in 1966 to the right upper quadrant (RUQ) approach by Randolph [3]. Although effective in providing an excellent exposure of the pylorus with almost minimal complications, the RUQ results in a permanent abdominal scar that grows with the child and becomes significant with time to the extent that these children come to regard it as a stigma [4].

Different umbilical approaches have been advocated for pyloromyotomy, including either supraumbilical incision popularized by Tan and Bianchi [5] or the right semicircular umbilical skin-fold incision introduced by Alberti *et al.* [6]. Another method of access is a transverse muscle-cutting incision across the linea alba and the right rectus abdominis muscle [7].

Since the introduction of the umbilical pyloromyotomy, a number of studies have shown that it is as safe as the traditional approach with superior cosmetic results [8–12]; however, in up to 30% of cases, the supraumbilical skin-fold incision does not allow a comfortable access to deliver the hypertrophied pyloric muscle, which is often located deep in the right hypochondrium, resulting in unexpected seromuscular lacerations [8]. The aim of this study was to assess the feasibility and the safety of pyloromyotomy for IHPS using a modification of the Tan–Bianchi approach, entering the abdominal cavity through a right transverse muscle-cutting incision after making the circumumbilical skin incision.

## Patients and methods

The present study included patients who underwent pyloromyotomy for IHPS in the Pediatric Surgery Unit, General Surgery Department, Tanta University Hospitals, between June 2013 to June 2015. The parents of each infant had been informed about all steps of our study, including the operative technique, and a signed informed consent was obtained. Privacy of the participants and confidentiality of the data were maintained. The study was approved by the ethical committee of the hospital.

Demographic data, duration of symptoms, and clinical findings of all patients were recorded and preoperative imaging and correction of dehydration, electrolyte and/or acid–base imbalance were performed. Separate prepping of the umbilicus was performed preoperatively with either bovidone iodine or cholhexidine solution, followed

**Fig. 1**



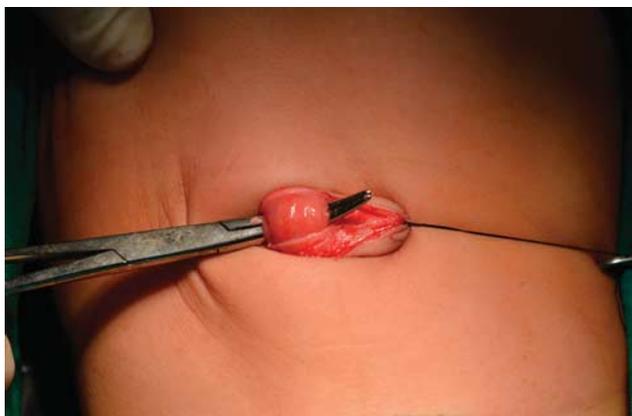The right circumumbilical skin incision.

**Fig. 2**



Retraction of the umbilicus to the left and exposure of the abdominal wall muscles.

**Fig. 3**



Division of the right rectus abdominis muscle.

**Fig. 4**



Opening the peritoneal cavity.

**Fig. 5**



Delivery of the pyloric mass into the wound and pyloromyotomy completed.

by the standard preparation. Prophylactic broad-spectrum antibiotic was administered, and all patients were taken to the OR and subjected to pyloromyotomy using the modified Tan–Bianchi umbilical approach.

A semicircular incision was placed circumumbilically in the natural skin fold following the curve of the umbilicus to the right side (Fig. 1). In the approach described by Tan and Bianchi, the linea alba and the peritoneum were divided longitudinally in the midline. In our cases, we performed undermining, followed by retraction of the incision by cutting the right anterior rectus sheath (Fig. 2), the right rectus muscle (Fig. 3), and the right posterior rectus sheath with the peritoneum (Fig. 4). After the peritoneum was opened, the pylorus was delivered by traction on the antrum, aided by squeezing the palpable pylorus into the wound. Sometimes it was difficult to deliver the pylorus and so the deep muscular incision had to be extended more laterally. After delivery of the pylorus, a classical pyloromyotomy was performed (Fig. 5) and then the pylorus was returned to the abdomen and the wound was closed in layer.

| Criterion | Number/Measure |
|---|---|
| Sex [n (%)] | |
|   Male | 16 (80) |
|   Female | 4 (20) |
| Age at presentation (days) | 23–60 (mean 42.6) |
| Weight (kg) | 2.7–4 (mean 3.6) |
| Duration of symptoms (days) | 4–25 (mean 23.6) |
| Palpable pyloric mass [n (%)] | 8 (40) |
| Pyloric size (by ultrasound) | |
|   Length (mm) | 14–21 (mean 18.98) |
|   Thickness (mm) | 4.7–6 (mean 5.68) |
| Operating time (min) | 45–60 (mean 52.5) |
| Postoperative hospital stay (h) | 24–72 (mean 41.4) |

**Fig. 6**



The circumumbilical scar 3 months after surgery.

After surgery, the following data were collected: operating time, the postoperative course, and the length of postoperative hospital stay. After discharge, the patients were followed up for 6 months for possible late complications and for evaluation of scar appearance.

## Results

Over a period of 2 years, the total number of IHPS patients presented to us was 20; all of them were managed with pyloromyotomy using the modified umbilical approach. The study included 16 male (80%) and four female (20%) patients; their ages at presentation ranged from 23 to 60 days (mean 42.6 ± 13.54 days), and their weights ranged from 2700 to 4000 g (mean 3605 ± 437.4 g). In all patients, the signs and symptoms were similar to the classical features of IHPS reported in the literature. The pyloric masses were detected with ultrasound in all patients, and the length of pyloric canal ranged from 14 to 21 mm (mean 18.98 ± 2.19 mm). The pyloric single-muscle thickness ranged from 4.7 to 6 mm (mean 5.68 ± 0.47 mm).

The deep muscular wound had to be extended in six of the 20 cases to deliver the pylorus, particularly when it was large and/or located more laterally. However, skin incision was not extended in any of these cases. In all infants, an adequate pyloromyotomy was performed safely with negligible blood loss. Four cases of serosal tear occurred, with an incidence of 20%. None of our cases suffered significant complications such as mucosal perforation or duodenal injury. The operating time ranged between 45 and 60 min (mean 52.5 ± 5.073 min). Oral feeding was started 6 h postoperatively and was gradually increased in all cases. The postoperative hospital stay ranged from 24 to 72 h (mean 41.4 h) (Table 1). The postoperative course was quite uneventful in all patients. After discharge, the patients were followed up in the outpatient department at 1, 3, and 6 months after surgery; the wound healed primarily without wound infection, wound dehiscence, or incisional hernia. In all patients, the periumbilical incision left an almost undetectable scar, integrating well with the natural umbilical skin folds, and the parents were quite satisfied in almost all cases (Fig. 6).

## Discussion

This study included 20 patients (16 male and four female) diagnosed with IHPS and managed with the modified Tan and Bianchi technique. The sex distribution found in our study is in agreement with that reported in the literature [13] and in the study by Zeidan et al. [14]. However, a higher male-to-female ratio of 196 : 33, 11 : 2, and 16 : 3 were described in the studies by Oomen et al. [15], Yokomori et al. [16], and Bertozzi et al. [17], respectively. As regards the age distribution, the mean age at presentation in this study was higher than the mean age in the study by Ordorica-Flores et al. [18], in which it was 30 ± 9 days. In contrast, our mean age was lower than the mean age of the extracavitary pyloromyotomy group in the study by Eltayeb et al. [19], in which the mean age was 65.1 ± 19.8 days.

In the present study, the mean operating time was significantly longer than that in patients operated using the RUQ incision in the literature [9], mostly because of a more difficult delivery of the pylorus through the umbilical incision. However, the operating times decreased with the surgeons' cumulated experience using the umbilical incision. Our mean operative time was almost similar to that obtained with the Tan–Bianchi technique (52 ± 14 min). With the exception of serosal tears that occurred in four cases (20%) compared with 4.4% in the study by Leinwand et al. [20], this study did not show significant intraoperative complications. To make the delivery of the pylorus easier and to avoid excessive traction on the stomach, which may cause seromuscular lacerations, we have used some modifications to the umbilical approach described by Tan and Bianchi [5]. We performed a transverse muscle-cutting incision; this gives a more direct access to the pylorus. Moreover, the pylorus was delivered by traction on the antrum, aided by squeezing of the palpable pylorus into the wound rather than by making traction alone. These modifications together with careful manipulation seem to be essential to avoid the intraoperative complications. One of the fatal and life-threatening intraoperative major complications, especially if not detected intraoperatively, is duodenal perforation, with the incidence ranging from 3.4 to 9.4% in the umbilical approach [9,21]. In our study

there was no incidence of mucosal perforations; this is in agreement with that reported by Yagmurlu et al. [22], who showed that no cases of his open group had mucosal perforations. An incidence of 3% was reported in the studies by Fitzgerald et al. [8], Leinwand et al. [20], and Poli-Merol et al. [10], and an incidence of 5% was reported in the study by Eltayeb and Othman [19].

Rapid advancement of the strength and amount of feeding following pyloromyotomy is attractive, as it can allow early discharge [23]. In our study, feeding started after 6 h of the operation as recommended in the study by Graham et al. [24] and Khan and Al-Bassam [25]. In young infants, the umbilicus could be an area of colonization; the proximity of a circumumbilical incision to this area may contribute to an increased wound infection rate as reported by some authors [26,27]. To avoid this risk, we performed good disinfection of the umbilicus before the routine preparation, correction of alkalosis preoperatively because alkalosis is thought to compromise immunity in infants [27]. Moreover, we routinely used prophylactic antibiotics in all patients. However, our impression is that the umbilical incision should not be used with frank umbilical sepsis. As regards the length of postoperative hospital stay, it was equal to that reported in other studies using the umbilical technique [22,28]. In our work, the postoperative course was uneventful, and the wound healed without complications in all patients. Excellent cosmetic results were obtained through this technique, with hardly visible scar, which did not grow with age.

## Conclusion

Pyloromyotomy for IHPS using the modified Tan and Bianchi technique, entering the abdominal cavity through a transverse muscle-cutting incision after making a circumumbilical skin incision, is feasible, having excellent cosmetic results, accepted operative time, early initiation of postoperative feeding, and short hospital stay. Using this modification, we believe that we combine the advantage of circumumbilical incision with its better cosmetic results and the right transverse upper abdominal approach with its easy and feasible access to the pyloric mass. We recommend using this technique for large and/or distant pyloric masses. However, studies with larger number of patients and long-term follow-up are needed for better evaluation of this modification of the technique.

## Acknowledgements

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