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RESEARCH ARTICLE

Comparative Efficacy of Finney and Jaboulay Pyloroplasty for the Relief of Pyloric Stenosis in Dogs

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ABSTRACT

In view of the high incidence of pyloric stenosis in dogs, this study was conducted to compare the efficacy of two surgical techniques, viz. Finney and Jaboulay pyloroplasties in providing relief to gastric outlet obstruction and to report complications, if any. Healthy mongrel dogs (n=24) with similar physique, age and body weight were selected and randomly divided into three groups i.e. Groups A, B and C comprising eight dogs each. The dogs in Groups A and B were operated upon with Finney and Jaboulay pyloroplasty, respectively, whereas Group C dogs served as Control. Efficacy of the techniques was compared in terms of wound healing as ascertained through clinical findings; post-operative increase in external pyloric diameter as measured through B-mode ultrasonography and exploratory laparotomy; accuracy of the anastomosis and signs of leakage if any, as evidenced by contrast radiography, and the amount of adhesion formation, checked through exploratory laparotomy. Wound healing in both groups A and B was satisfactory, except for transient post-operative complications in three dogs, subsequently managed through proper medication. Sonographic measurements of the anastomosed external pyloric diameter strikingly correlated with measurements taken 3 months' post-operatively through an exploratory laparotomy, and revealed a wider pyloric lumen in Group B (Jaboulay Pyloroplasty) suggesting better gastric drainage in this group ($P \leq 0.001$) as compared to Group A (Finney Pyloroplasty). Consequently no sign of leakage was observed in either group. Conclusively, Jaboulay pyloroplasty proved superior to Finney pyloroplasty, in providing a wider lumen facilitating relief from pyloric stenosis and better gastric drainage post-operatively.

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INTRODUCTION

The canine pylorus performs the important physiologic function of anti-reflux and serves as a sphincter withholding food in the stomach till its passage into the duodenum (Halfacree, 2010). Clinically, among gastric diseases, the pylorus and antrum are reported to be the actual site in more than 50% of the presenting ailments, thus necessitating prompt and careful treatment regimes.

Pyloric stenosis supervenes as the most common problem in the region of the pyloric inlet and the antrum, and various surgical interventions are adopted for its relief. Pyloric stenosis occurs due to spasms of the pyloric sphincter which lead to constriction. Three etiological factors are muscular hypertrophy, mucosal hypertrophy and antral pyloric hypertrophy (Walter *et al*., 1993). Benign and malignant diseases are the more common causes of pyloric stenosis (Kochhar and Kochhar, 2010).

Clinically, pyloric stenosis is manifested by projectile vomition. Acute cases show dullness, depression, dehydration and acute vomition, while chronic cases present with complaints of chronic vomition and weight loss. Vomitus consists of undigested food materials. Despite easy passage of some food materials and fluids, the condition of partial pyloric obstruction produces intermittent projectile vomiting. Contrarily, complete obstruction causes complete retention and obstruction to

the passage of food materials into the duodenum, and hence, produces the clinical symptoms of a fluid-filled distended stomach (Halfacree, 2010).

Various surgical techniques have been applied for the relief of pyloric stenosis. These include pylorotomy (Fredet-Ramsted procedure), YU Advancement Pyloroplasty (Ueno *et al*., 2009), Transverse Pyloroplasty (Heineke-Mikulicz procedure), Bilroth I and Bilroth II (Lipof *et al*., 2006), Finney pyloroplasty (Sánchez-Margallo *et al*., 2007) and Jaboulay pyloroplasty (Suradom, 2008). Furthermore, pyloric surgery is importantly recommended as the ultimate treatment for the peptic ulcer disease and hypertrophic pylorus-induced stenosis, when endoscopic balloon-dilation technique fails to resolve the problem. However, the feasibility of the surgical technique for the relief of pyloric stenosis depends upon the cause of the obstruction and its location (Hoya *et al*., 2009).

Among the various surgical repair methods, Finney pyloroplasty, Heineke-Mikulicz and Jaboulay pyloroplasty are currently documented as valuable techniques for gastric drainage in gastric outflow obstruction (Søreide *et al*., 2006). This project was thus aimed towards investigation into currently used techniques of Finney and Jaboulay pyloroplasty, in order to opt for a more efficacious surgical technique for relief of pyloric stenosis in dogs.

MATERIALS AND METHODS

Selection of dogs and group allocation: After approval by the Animal Ethical Committee, 24 adult healthy mongrel dogs were selected, acclimatized and randomly divided into three groups viz., Groups A, B and C, comprising 8 dogs each. Group A dogs 1-8 were allocated for Finney pyloroplasty, Group B dogs 9-16, for Jaboulay pyloroplasty, while Group C dogs 17-24, served as Control.

Surgical Intervention: The dogs were sedated using injection atropine sulphate @ 0.03 mg/kg (Atrostar®, Star Laboratories, Pakistan) and xylazine HCl @ 0.5 mg/kg (Xylaz®, Farvet, Holland), intramuscularly. Ketamine HCl (Ketasol®, Indus Pharma, Pakistan) @ 10mg/kg body weight was injected intravenously for induction (Das *et al*., 2012).

After patient positioning, scrubbing and draping of surgical site, the skin was incised from the xiphoid cartilage to the umbilicus and the abdominal cavity was opened after an incision into the linea alba. The pylorus was extracted out with hocking fingers. Stay sutures were applied to hold the organs in position. The external diameter of the pylorus was measured. Subsequently, the two surgical techniques were applied (Fig. 1) as follows:

Finney Pyloroplasty (Group A): An inverted U-shaped incision, 10 cm in length, was given from the descending duodenum to the pyloric canal and antrum. Edges of the lower side of the incision were closed with simple continuous transmural suture pattern using Vicryl®, size 3/0 (Ethicon, Johnson & Johnson, Pakistan). Thereafter, edges of upper sides of the incision were closed in the same manner (Soreide *et al*., 2006). **Jaboulay Pyloroplasty (Group B):** Two, 5 cm long, parallel incisions were given on the anterior segment of duodenum and along the greater curvature of the stomach at the level of the pyloric antrum. The edges were closed similar to Group A dogs (Oida *et al*., 2011). The abdominal incision was closed in routine manner. **Control (Group C):** This group served as control with only exploratory laparotomy.

Post-operative care and evaluation: The surgical procedures were assessed for effectiveness of the technique in restoring gastric outlet obstruction, enlargement of external pyloric diameter and minimal post-operative complications (Imtiaz *et al*., 2012), using the following parameters:

Animals were daily observed for TPR (Temperature, Pulse and Respiration), appetite, feeding, vomition, stool, urine, pain in abdomen and wound healing, post-operatively. Contrast radiography was performed for evaluation of both surgical techniques (Sánchez-Margallo *et al*., 2005) and to detect signs of leakage if any (Fig. 2). The duodenum, pylorus and stomach were evaluated sonographically for motility, external pyloric diameter (Fig. 3), evaluation of walls and signs of leakage (Choi *et al*., 2012). After lapse of 3-month experimental period, exploratory laparotomy was performed in one dog of each group; external pyloric diameter was measured and healing assessed at surgical site.

Statistical analysis: Paired *t-test* was applied to analyze difference in external pyloric diameters. Means were compared for significant difference using Duncan's Multiple Range test.

RESULTS

Physical findings: TPR (Temperature, Pulse and Respiration) all dogs were recorded twice daily and at times of abnormal clinical findings in experimental dogs. The temperature and pulse of all dogs of group A and group B remained slightly elevated or towards the upper limit of the normal range, i.e. 102.5-104°F and 70-120 beats/minute, respectively, during the first 60 hours post-surgery. On an average, the TPR values in Group A dogs were 39.5°C (temperature), 103beats/min (pulse), and 25/min (respiration), except dog #7, which suffered slight hypothermia (37ºC) during the first 36 hours post-surgery.

Average TPR values recorded in dogs of Group B were 40°C, 103 beats/minute, and 24/minute respiration. However, dog #18 in Group B suffered transient hypothermia, as also dog #7 of Group A. Yet, with proper treatment, both dogs recovered well and the temperature in these dogs rebounded towards the normal range as for all other dogs.

Appetite and feeding: All the dogs were kept on infusions for the first three days post-surgery; then, from day 5th up to the 14th day, milk was given as diet; by the 21st day post-surgery, liquid diet (milk) was gradually changed to a normal diet. The dogs were fed twice daily and appetite was normal in all dogs, except for dog#5 and 18, which were completely anorectic on the 5th and 7th days post-surgery, respectively, and hence had to be maintained on intravenous infusions on the respective days, till recovery.

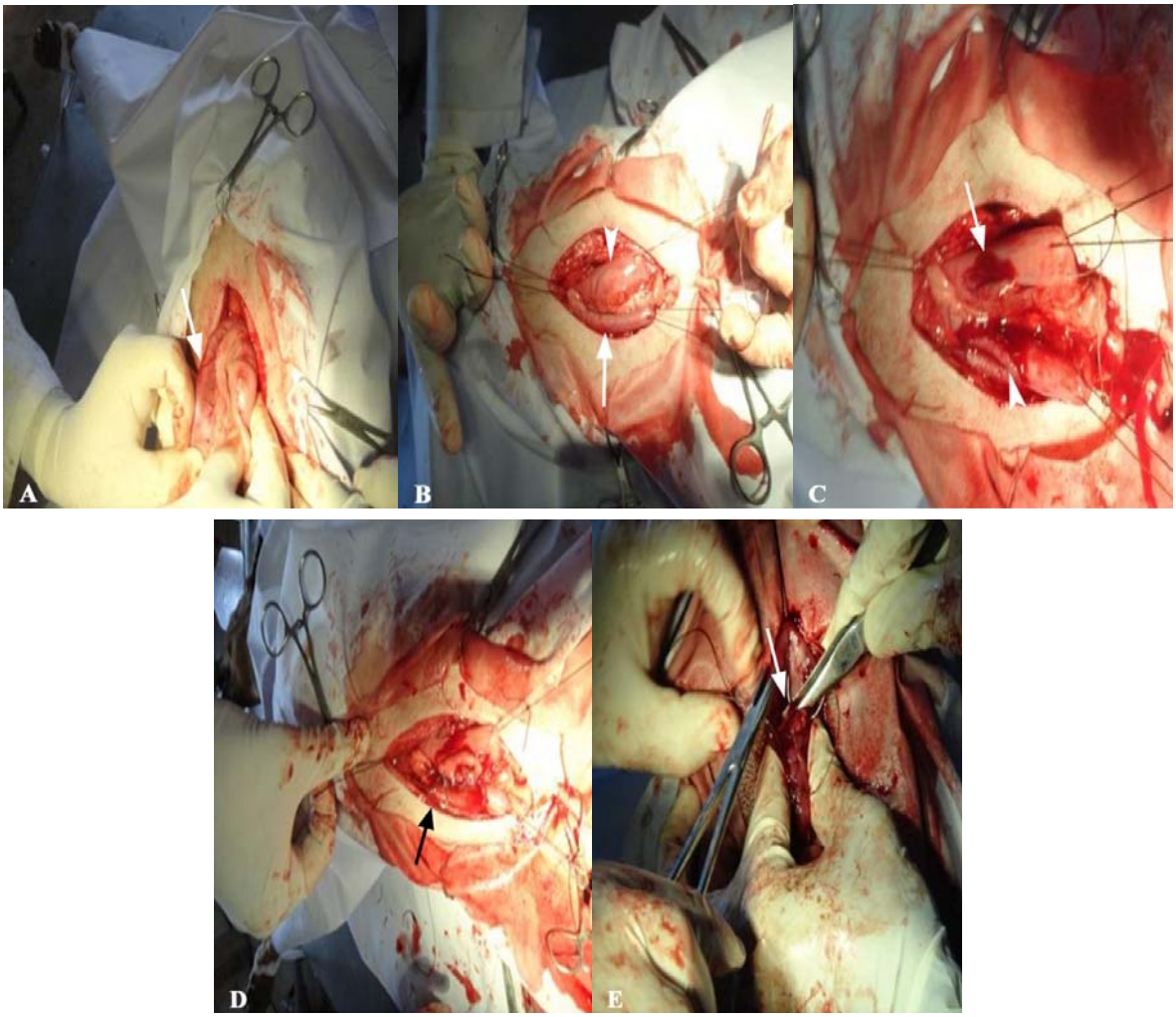

Fig. 1: Surgical Techniques elaborating pylorus exteriorization and suture application for Finney and Jaboulay Pyloroplasties. **A,** Exteriorization of pylorus (arrow) for pyloric surgery. **B,** Placement of stay sutures to hold the gastric antrum (white arrow head) and duodenum (white arrow) in position. **C,** Parallel incisions in gastric antrum (white arrow) and proximal duodenum (white arrow head) for Jaboulay pyloroplasty. **D,** Suturing the Parallel incisions of gastric antrum and proximal duodenum (black arrow) for making bypass in Jaboulay Pyloroplasty. **E,** Union of gastric and duodenal walls (white arrow) in Finney pyloroplasty using simple continuous suture pattern.

Hematemesis/vomiting: The Group A dogs # 2, 3, 5, 7 and all dogs of group B showed post-operative hematemesis only at the time of recovery from anesthesia. The condition was successfully treated by intramuscular administration of tranexamic acid [Injection Transamine®, 250 mg/mL (Hilton Pharma, Pakistan) and no recurrence was observed at any other stage in the post-operative period.

Likewise, persistent vomition was observed, 10 minutes after food intake, in dogs # 3 and #4 (Group A) and dog #9 (Group B), on days 15 and 16. The condition was successfully treated by intramuscular administration of metoclopramide [Injection Maxolon® (GlaxoSmith Kline, Pakistan)] with no recurrence noted later.

Stool and urine examination: The dogs in both Groups A and B were observed to pass small amount of slightly blood-tinged loose feces, the very next day after surgery. Stool volume increased and the color changed to a reddish brown on 6th day of surgery and remained thus till the end of the experimental period. Only dog #7 (Group A) did not pass blood-tinged feces. Contrarily, the dogs in the Control group defecated normally. Urine color of all dogs was deep pale yellow for the first three days, and changed to light pale yellow thereafter, however on general observation, the consistency was normal.

Abdomen pain: Only dog # 7 (Group A) showed signs of severe abdominal pain on the 2nd day, postoperatively, however, after appropriate treatment with intramuscular administration of diclofenac sodium [Injection Voren® (Continental Chemical Company, Pvt. Ltd), twice daily, the pain signs were alleviated and cured.

Wound healing: The wounds healed satisfactorily in all dogs however, wound healing took slightly longer than the anticipated normal time. Slight hemorrhage from the site of skin sutures was observed in dog #7 (Group A), dog #13 (Group B) and dog #21 (Group C) on day 1, post-surgically, however, this was covered through an intramuscular injection of Transamine® (Hilton Pharma, Pakistan) at a dosage of 250mg/day/dog. Dog #5 expired on fifth day, post-operatively, while all the others remained viable till the end of the experimental period without any complications.

Table 1: Difference between preoperative and postoperative external pylorus diameter (cm) in all dogs

Group A (Finney Pyloroplasty)				Group B (Jaboulay Pyloroplasty)				Group C (Control)			
Dog #	Pre-OEPD	Post- OEPD	Diff	Dog #	Pre-OEPD	Post- OEPD	Diff	Dog #	Pre-OEP D	Post- OEPD	Diff
1	2.38	5.57	3.19	9	3.34	6.34	3.00	17	3.22	3.21	-0.01
2	3.02	5.98	2.96	10	2.23	5.45	3.22	18	3.40	3.41	0.01
3	3.02	6.11	2.91	11	3.00	6.25	3.25	19	3.21	3.21	0
4	3.41	6.64	3.23	12	2.94	6.33	3.39	20	3.04	3.00	-0.04
5	3.23	6.3	3.07	13	3.22	6.54	3.32	21	3.13	3.14	0.01
6	3.05	6.38	3.33	14	3.19	6.36	3.17	22	3.28	3.28	0
7	3.33	Died		15	3.03	6.17	3.14	23	3.38	3.40	0.02
8	3.30	6.81	3.51	16	3.15	6.58	3.43	24	2.99	3.01	0.02
Mean±SE	3.12±0.12	6.26±0.79	3.17±0.40	-	3.00±0.12	6.2±0.12	3.24±0.05	-	3.21±0.05	3.21±0.06	0.001±0.01
t-value		2.40				78.987				0.367	
P-value		0.05				0.0001				0.72	

Pre-OEPD=Preoperative external pyloric diameter; Post-OEPD=Postoperative external pyloric diameter; Diff: Difference. The paired sample t-test was applied to compare the pre-operative and post-operative external pyloric diameters. In comparison with Group A (P≤0.05), Group B (t value: 65.27; P=0.0001) showed a highly significant increase in luminal diameter between pre and post pyloric surgery, thus emphasizing better efficacy of Jaboulay Pyloroplasty.

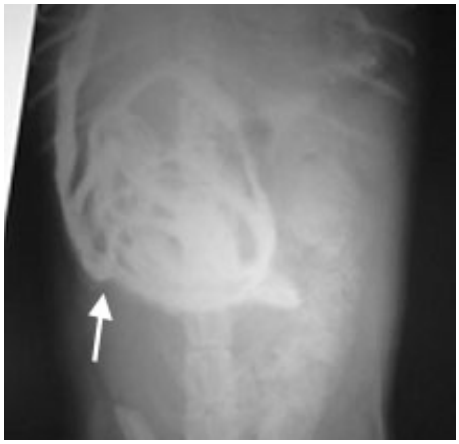

Fig. 2: Contrast Radiography of the stomach and upper GIT using oral Barium Sulphate suspension (concentration adjusted to 56 g/ dL and dosed @ 8 mL/ kg body weight) to rule out post-operative complication of leakage in operated dogs. (The white arrow indicates the passage of Contrast material through the intestinal tract without any sign of leakage).

Fig. 3: B-Mode Sonographic measurement (white arrow) of External Pyloric Diameter (the white cursor mark shows the reading taken). A convex 5.0 MHz transducer was used in this case. Pre-operative external pyloric diameter in this dog measured 3.04 cm.

Radiographic findings: Each dog was radiographed first through a survey radiograph and then with a contrast, using Barium sulphate suspension at a concentration of 56 grams per/dl, and dosed at the rate of 8ml suspension/kg live body weight of the animal. Both, dorsal and right lateral recumbent views were taken. The shadow of barium sulphate was present in pyloric region as well as in duodenum which showed patency of the passage. The results of radiography were quite satisfactory in all dogs of Groups A and B, with no signs of leakage in any dog (Fig. 2).

Ultrasonographic findings: All the dogs were kept off-feed for 12 hours; prior to ultrasonography, an average of 240 mL of clean drinking water was administered through the nasogastric tube for better visualization of the stomach, pylorus and duodenum. B-mode sonography was used to evaluate gastric motility, external pyloric diameters, evaluation of the wall structure and signs of leakage, if any (Fig. 3).

Postoperative exploratory laparotomy: After lapse of the 3-month experimental period, exploratory laparotomy was performed in one dog of each group. During this procedure, the external pylorus diameter was re-measured (Table 1). Furthermore, the surgical site was also evaluated for leakage, bleeding, infection, wound dehiscence, stricture or perforation at the pyloroplasty site. None of the animal showed any abnormality; healing was normal. There was no leakage and no bile staining of abdominal cavity. The laparotomy incision was closed thereafter, as routine.

DISCUSSION

Obstruction to the outflow of gastric contents into the duodenum is not an uncommon problem in dogs (Abel et al., 2002) and pyloric stenosis supervenes as the most significant problem in the region of the canine pylorus and pyloric antrum. In this condition, the passage between the stomach and the small intestine becomes narrowed down, a major etiological factor documented to be the lack the receptors sensitive for nitric oxide, which otherwise stimulate pyloric muscle relaxation. Hence, due to lack of the specific receptors, the pyloric muscles remain contracted. With the passage of time the condition further aggravates and pyloric muscles become thicker and larger, hence culminating in pyloric stenosis. The condition is frequently encountered in toy breeds and affected animals consequently develop chronic hypertrophic gastropathy (Walter *et al*., 1993; Leib *et al*., 1993).

Whilst medical management serves transient relief, permanent relief from pyloric stenosis necessitates implication of a pyloroplasty, which is a surgical technique which decreases the chances of gastric outlet obstruction and reduces gastric emptying time with least complications (Khan *et al*., 2007). This technique simply augments drainage of the gastric contents by increasing the diameter of the pyloric canal (Shevchuk, 1994). Various techniques of pyloroplasties have been practiced and preferred for the management of various kinds of acquired and congenital abnormalities of pylorus. These include pylorotomy (Fredet-Ramsted procedure), YU advancement pyloroplasty, (Ueno *et al*., 2009), transverse pyloroplasty (Heineke-Mikulicz procedure), Bilroth I and Bilroth II (Lipof *et al*., 2006), Finney pyloroplasty (Sanchez-Margallo *et al*., 2007) and Jaboulay pyloroplasty (Suradom, 2008). Among these, the latter two are the latest techniques for a pyloroplasty and hence were investigated in this study.

Among vital signs, the temperature, pulse and respiration in both groups A and B were recorded to increase slightly, but became normal after a few days; similar elevations of physical parameters were noted in the initial days after pyloroplasties performed in different patients, as reported by Tani *et al*. (2006). The post-operative finding of persistent vomition, 10 minutes after food intake, as recorded in dogs #3 and #4 (group A) and dog#9 (group B) was also in agreement with the findings of Kennedy *et al*. (2005).

Wound healing was satisfactory in all animals; this was in agreement with similar findings reported by Hoshino *et al*. (2009) and Sanchez-Margallo *et al*. (2007) after Finney pyloroplasty and Jaboulay pyloroplasty, respectively. However, wound healing time was observed to be slightly prolonged. This was attributed to the low atmospheric temperature at the time when this experimental study was conducted. Delay in wound healing due to temperature fluctuations, has also been documented upon by Fossum (2002) and Jain and Shakya (2009). On the whole, no severe clinical symptoms were showed by any dog in either group A or B, one month postoperatively; this was also in accordance with the findings of Hoshino *et al*. (2009), who reported a good recovery.

B-mode sonography proved to be an efficacious modality in providing direct visualization of the anastomosed, dilated pylorus, post-surgically. The increase in post-operative external pyloric diameter was found to be 7% more in group B (Jaboulay pyloroplasty), as compared with group A (Finney pyloroplasty), Table 1. Furthermore, on contrast radiography, no leakage was observed in any patient of either group. Similar findings were documented by Oida *et al*. (2011) after Jaboulay pyloroplasty and Sanchez-Margallo *et al*. (2007) after Finney pyloroplasty, respectively. B-mode sonography and contrast radiography confirmed the findings of a significant increase in pyloric diameter postoperatively, in both groups' dogs i.e. group A and group B, as compared with control group C.

Conclusion: Based on the findings of this study, Jaboulay pyloroplasty proved to be better than Finney pyloroplasty, in terms of postoperative increase in pyloric diameter, minimal organ manipulation and preservation, minimal complications and better drainage of gastric contents.

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