



Conquest of the Weak Point of the Side-to-side Anastomosis: The Novel Technique that Can Reinforce a Weak Point with Stapling

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Authors' contributions

This work was carried out in collaboration between both authors. Both authors read and approved the final manuscript.

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ABSTRACT

Introduction: The improvement of stapling devices has been remarkable. As the stapler evolved from two lines to three lines of staples, the lateral strength of the anastomosis increased. However, the strength of the crotch did not change and the crotch remains the weak point of the side-to-side anastomosis. We previously reported the weakness of the crotch and the reinforcement method with animal model [1,2].

Technique: We describe our novel technique to reinforce the crotch using a physician-modified stapling device. A stapler with three rows of staples per side is arranged on a 6 cm segment using an EndoGIA Reinforce. Polymer felt is attached to both the cartridge fork and anvil fork of the stapler. The felt is then trimmed, as a length of 2 cm is sufficient for reinforcement of the crotch.

Results: With this method, we can reinforce the weak point of the side-to-side anastomosis at the same time as the anastomosis.

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Conclusions: This method is a simple and novel technique to reinforce the crotch of a side-to-side anastomosis.

Keywords: Side-to-side anastomosis; crotch; reinforce; stapling.

1. INTRODUCTION

As stapling devices evolve over time, the variety, safety, and ease of use increase. Stapling devices are used in respiratory surgery, cardiovascular surgery, and a variety of other operations besides those on the gastrointestinal tract. In the gastrointestinal tract, these devices have become a necessary tool for gastrointestinal anastomosis and enterotomy closure. There are various methods for creation of a gastrointestinal anastomosis, but as laparoscopy becomes more and more common, the side-to-side anastomosis is increasingly utilized [3,4].

Characteristics of the side-to-side anastomosis:

- The anastomosis is completed using only a linear stapler without need for a circular stapler and is therefore less expensive.
- In every type of gastrointestinal anastomosis, the anastomosis can be performed in a similar, reproducible fashion, and with technical ease.
- The technique can be used in both laparoscopic and open surgery.
- Anastomotic stenosis is rarely a problem.

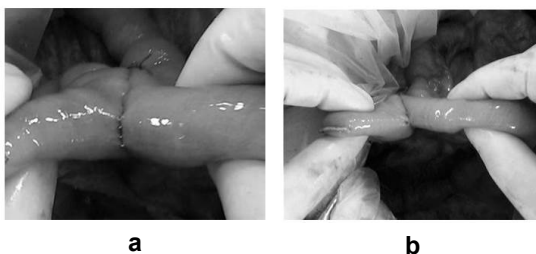


Fig. 1. The crotch of the side-to-side anastomosis

a: Exposed staples, b: After reinforce the crotch with suture

As the stapler evolved from two lines to three lines of staples, the lateral strength of the anastomosis increased. However, the strength of the crotch did not change and the crotch remains the weak point of the side-to-side anastomosis. For this reason, a suture is often added to

reinforce the crotch, a technique easily done in open surgery but with some difficulty in laparoscopic surgery (Fig. 1). We describe our novel technique to reinforce the crotch using a physician-modified stapling device.

2. METHODS

2.1 Surgical Technique

A stapler with three rows of staples per side is arranged on a 6 cm segment using an EndoGIA Reinforce (Covidien, Tokyo, Japan). These staplers consist of either 3/3.5/4 mm staplers prior to firing. Post-fire heights are 1.25/1.5/1.75 mm. Polymer felt is attached to both the cartridge fork and anvil fork of the stapler. The buttressing material, which is PGA (Polyglycolic Acid) with a thickness of 0.15 mm, is a version of Neoveil felt developed by GUNZE Ltd, which has been validated clinically in the Japanese market for more than 20 years. Both sides of this felt are 5 mm longer than the length of the stapler. The felt is fixed with a nylon thread in both ends of the stapler (Fig. 2a). The felt is then trimmed, as a length of 2 cm is sufficient for reinforcement of the crotch (Fig. 2b). Therefore, we trim the felt as depicted in Fig. 2c. The stapler tip side of the felt is fixed, but other fixation is also necessary. We turn the trimmed part of the felt outward, and fix it using a Steri-Strip™ (Fig. 2d).

Points to be noted:

- It is necessary to prevent position changes of the felt when the stapler is inserted in the intestinal tract and the position adjusted.
- When stapling and cutting are finished and the stapler has been removed, the fixed part of the felt must be separated from the Steri-Strip™.

Use of a Steri-Strip™ with its adhesive strength is therefore critical. In addition, the length of the felt to fix is only around 2-3 mm. We use a long Steri-Strip™ to facilitate the retrieval of the Steri-Strip™ if it falls off the stapler. After trimming of the felt and fixation are finished, we perform a side-to-side anastomosis using the stapler as

usual. Closure of the enterotomy can be performed with another stapler or it can be handsewn (Fig. 3).

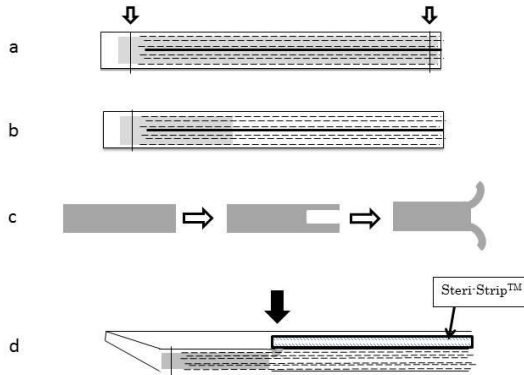


Fig. 2. Schema of trimming the felt of stapler
a: Original shape of felt and stapler
b: Nylon thread
c: Cancel extra felt
d: Trimming of the felt edge ☆
e: Fixed felt using Steri-Strip™ (↑)

3. DISCUSSION

Various factors contribute to anastomotic leak, including blood flow to the intestine, presence of infection, and nutritional status. Above all, mechanical factors are important. Mechanical factors can be classified into two parameters. One is anastomotic strength. This strength is

dictated by the state of the organization, height, number, and sequence of staples. The other parameter is tension on the anastomosis.

The improvement of stapling devices has been remarkable. The size of staples has become thin and small, and staples are made to best approximate appropriate sutures. Furthermore, the two-row stapler evolved into the three-row stapler. New staplers with varied staple heights were made specifically to divide large blood vessels.

Gastrointestinal anastomoses are highly variable depending on the location of the anastomosis. Intestinal tissue type, diameter differences, whether the anastomosis is done laparoscopically or via open surgery, cost, and surgeon preference affect the anastomosis. Above all, because it is technically the least difficult, the side-to-side has become the principle method by which to anastomose two segments of intestine, whether it be the esophago-jejunal anastomosis after total-gastrectomy, the gastro-jejunostomy, or small and large intestinal anastomoses.

We performed side-to-side anastomoses between the esophagus and small intestine of a pig using various staplers, investigated the weak part of the anastomosis and measured the burst pressure [2]. We used the GIA™ 60-3.8, the Endo GIA™ 60-3.5, and the Endo GIA60AMT.

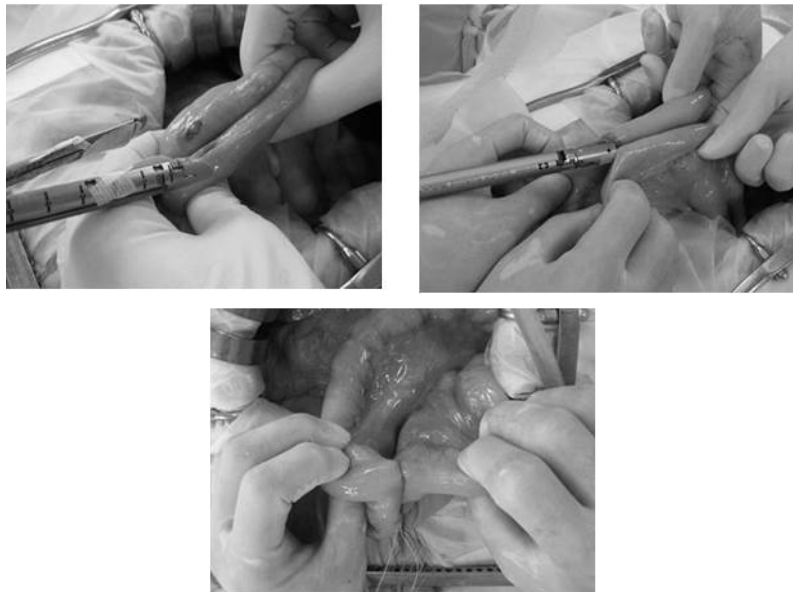


Fig. 3. Operative findings of side-to-side anastomosis by our methods

With the GIA™ 60-3.8, the sequence of staples is two rows on one side, and three rows on the opposite side. With the GIA™ 60-3.5 and Endo GIA60AMT, staple height and arrangement vary along the course of the stapler. In the GIA™ 60-3.8 group, burst pressures were 34.5 mmHg and burst points in this group were in the side in one case, the side and crotch at the same time in two cases, and the crotch in two cases. The differences between the crotch and side were not clear. In contrast, all leak points were at the crotch although the burst pressures were higher in the group with three rows of staplers.

In a different experiment, we performed side-to-side anastomoses using the small intestine of a pig, and measured the burst pressures of the crotch and the side individually [1]. Mean crotch burst pressure was 39.8 mmHg, and mean side burst pressure was 109.9 mmHg. After reinforcing the crotch using a tube-type of Neoveil®, the burst pressure rose to 83.3 mmHg at the crotch. Based on this result, we began to use tube-type Neoveil® for our side-to-side anastomoses, for gastrojejunostomy and for small and large intestinal anastomosis [5-7]. However, it is necessary to remove the suture seamed in with the Neoveil®, as it is bulky when it is attached to the stapler, and can unnecessarily enlarge the stapler entry enterotomy.

The newly approved Endo GIA Reinforced Reload will enable surgeons to deliver an advanced polymer felt material to provide additional support to fragile tissues. The Neoveil felts are completely absorbed in 15 weeks. Since they are not made from animal products or plastic polymers, the risk of infection or viral transmission are thought to be negligible [8,9]. The felt is fixed with a thread in both ends of the stapler and the thread is designed to escape fixation after stapling. The length of the felt is about 7 cm, but the length needed for crotch reinforcement is only 2 cm; any excess felt can get caught in the entry enterotomy if not properly trimmed.

4. CONCLUSION

This method is a simple and novel technique to reinforce the crotch of a side-to-side anastomosis.

CONSENT

It is not applicable.

ETHICAL APPROVAL

It is not applicable.

COMPETING INTERESTS

Authors have declared that no competing interests exist.

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