Diseases of the Colon & Rectum

Original Contributions

Efficacy of Anal Fistula Plug in Closure of Cryptoglandular Fistulas: Long-Term Follow-Up

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PURPOSE: The long-term efficacy of Surgisis® anal fistula plug in closure of cryptoglandular anorectal fistulas was studied. METHODS: Patients with high cryptoglandular anorectal fistulas were prospectively studied. Additional variables recorded were: number of fistula tracts, and presence of setons. Under general anesthesia and in prone jackknife position, patients underwent irrigation of the fistula tract by using hydrogen peroxide. Each primary opening was occluded by using a Surgisis® anal fistula plug, which was securely sutured in place at the primary opening and tacked to the periphery of the secondary opening. RESULTS: Forty-six patients were prospectively enrolled during a two-year period. Follow-up was six months to two years (median, 12 months). At final follow-up, all fistula tracts had been successfully closed in 38 patients, for an overall success rate of 83 percent. Seven patients had multiple tracts, for a total of 55 fistula tracts in the series. Of the 55 individual tracts, 47 (85 percent) were closed at final follow-up. Patients with one primary opening were most likely to have successful closure by using the anal fistula plug, although this was not significant. Successful closure was not correlated with the presence of setons. CONCLUSIONS: Long-term closure of cryptoglandular anorectal fistula tracts using Surgisis® anal fistula plug is safe and successful in 83 percent of patients and 85 percent of tracts. [Key words: Fistula-in-ano; Fistulotomy; Fibrin glue; Surgisis® anal fistula plug]

Recent studies using the Surgisis® anal fistula plug (Cook Surgical, Inc., Bloomington, IN) reported successful closure of high cryptoglandular fistulas in 87 percent of cases compared with 40 percent using fibrin glue.[1] Other studies of fibrin glue have reported closure as low as 15 percent.[2–6] The higher closure rates with the fistula plug are likely a result of the ability to suture the plug securely into the primary opening, compared with fibrin glue, which tends to run out of the fistula tracts. Surgisis® anal fistula plug is a bioabsorbable xenograft made of lyophilized porcine intestinal submucosa. The material has inherent resistance to infection, produces no foreign body or giant cell reaction, and becomes repopulated with host cell tissue during a period of three months.[7,8] In addition to suturing the plug securely at the primary opening, insertion of a conical plug into the high-pressure area of the fistula produces a mechanically stable system. A two-year prospective evaluation of Surgisis® anal fistula plug in closing cryptoglandular anorectal fistula was performed.

PATIENTS AND METHODS

Patients with high cryptoglandular anorectal fistula were prospectively enrolled during a two-year period. Patients with superficial (low transsphincteric or less) were excluded, as were patients with Crohn's disease. Variables recorded were: number of fistula tracts and presence of setons. Patients reported in a previous publication[1] were included in the current long-term analysis.

Dr. David Amstrong has a patent-licensing agreement with the manufacturer of Surgisis® (Cook Surgical, Inc., Bloomington, IN).

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Anal Fistula Plug Technique

All patients underwent mechanical bowel preparation the day before surgery followed by 2 g of metronidazole by mouth the same evening. A broad-spectrum parenteral antibiotic was given on induction of anesthesia. All procedures were performed under general anesthesia and in a prone jackknife position. All fistula tracts were identified and the primary opening was located by using conventional fistula probe and/or hydrogen-peroxide installation.

A fistula probe or hemostat was passed through the fistula tract from the secondary opening and exited *via* the primary opening. If a seton was present in the tract (Fig. 1A), this was cut and used to pull the plug into the tract. A 2-0 vicryl tie was sutured to the tip of the plug, secured to the probe or seton, and the plug was pulled tip-first into the internal opening (Fig. 1B), until resistance was encountered. The excess plug material was trimmed flush with the primary opening (Fig. 1C), and the plug was buried into the primary opening using a figure-of-eight 2-0 vicryl suture, which was inserted deep to the internal sphincter muscle. The tip of the plug was further secured at the secondary opening by "tacking" the tip of the plug to the edge of the secondary opening. Care was taken not to completely occlude the secondary opening to allow drainage of exudate and to avoid a closed system. Mechanical stability of the plug relies on firmly suturing the head of the plug into the primary opening, which is optimally covered by at least submucosa and preferably internal sphincter.

Follow-Up

All patients were instructed to stay on a clear liquid diet for 48 hours, avoid any strenuous activity, take warm Sitz baths as needed, and apply topical 10 percent metronidazole *t.i.d.* (SLA Pharma®, Watford, UK). The patients were followed up at two weeks, four weeks, and then on an individual basis as clinically appropriate. Long-term follow-up was performed in the office setting or by telephone interview. Median follow-up in weeks was calculated for fistulas that were successfully closed. The status (open *vs.* closed) of the fistula was determined at final follow-up. Success criteria were defined as: closure of all secondary openings; an absence of fistula drainage; and an absence of abscess formation. In patients with multiple openings, the presence of a single persistent tract was considered an overall failure, even if one or more tracts had been successfully closed.

Use of both the Surgisis® anal fistula plug was approved by the institutional review board, and informed consent was obtained in all patients. Anal fistula plug patients were identified by their respective attending and fistula status (open *vs.* closed) confirmed by the fellows. The study was self-funded, and no financial support was requested or received. The senior author (DNA) receives royalties on sales of the product.

RESULTS

Forty-six patients were prospectively studied during a two-year period. Median follow-up was 12

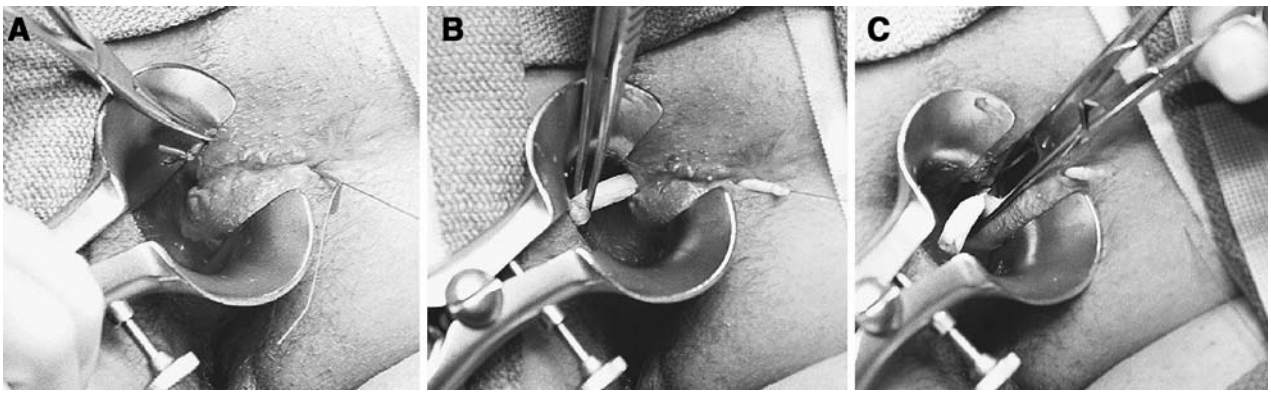

Figure 1. (A) Fistula tract containing a seton: the "tail" of the plug is tied to the seton, which is then cut, and used to pull the plug into the fistula tract. (B) The plug is pulled into the tract until light resistance is met. With most transsphincteric fistulas, this occurs when approximately one-half the plug is pulled into the tract. (C) The excess plug is cut at the level of the primary opening and is further secured into place using a figure of eight 2-0 vicryl suture.

(range, 6–24) months, and no patient was lost to follow-up.

Thirty-nine patients had single-tract radial fistulas, and seven patients had multiple fistulas, for a total of 55 individual fistula tracts. Four patients had horseshoe fistulas, two had multiple anterior fistulas, and one patient had a total of four fistula tracts, three of which were iatrogenic.

At final follow-up, 38 of 46 patients (83 percent) had successful closure of all their fistula tracts. Of the total of 55 individual tracts, 47 (85 percent) were closed at final follow-up and 8 (15 percent) persisted. There was no statistical correlation between multiple tracts and closure rates (Table 1).

Of the eight failures, seven patients failed within 30 days of surgery, and one patient developed a recurrent fistula 9 months after surgery. Of the seven early failures, four plugs were extruded from the fistula tract, as a result of excessive patient activity, or inadequate suturing technique. Extrusions tended to occur from shorter, more superficial tracts, with few if any extrusions occurring from deeper, longer tracts. Two additional failures were patients with horseshoe tracts, in which the tract containing the plug closed, but the contralateral tract persisted. One patient experienced persistent drainage, without recognized plug extrusion. The one late recurrence was a female patient who developed a recurrent abscess at the same site as a previously closed (anterior) fistula tract. This was drained and a temporary seton was inserted.

There were a total of nine setons in the series, all of which were in the setting of multiple tracts. There was no statistical correlation between closure rates and presence or absence of setons (Table 2).

Table 1.
Patients (n = 46) with Cryptoglandular Fistulas: Impact of Single *vs.* Multiple Tracts on Closure Rates

	Fistula Closed	Fistula Open	Total
Single fistula	33	6	39
Multiple fistula	5	2	7
Total	38	8	46

$P > 0.05$, Fisher's exact test; NSD (no significant difference).

Table 2.
Impact of Setons in Individual Fistula Tracts (n = 55) on Closure Rates

	Fistula Closed	Fistula Open	Total
Seton	7	2	9
No seton	40	6	25
Total	47	8	55

$P > 0.05$, Fisher's exact test; NSD (no significant difference).

DISCUSSION

Management of high anorectal fistulas is a difficult problem, with recurrence rates as high as 54 percent and incontinence rates as high as 35 percent reported.[9,10] Conventional fistulotomy is generally not an option in these cases, and use of setons is usually a temporizing measure. The use of fibrin glue to occlude the fistula tract was a sound concept, but success rates as low as 15 percent have been recently reported,[2–6] probably because of the liquid glue "running out" of the tract. Advancement flaps have reported success in 59.6 to 75 percent [10–13] of cases, but the procedure can be technically difficult, especially in posterior fistulas, and the procedure has a surprisingly high incontinence rate of 32 to 35 percent.[14,15]

In the current study, 83 percent of patients had successful closure of all fistula tracts, and 85 percent of all fistula tracts were closed, at a median of 18 months' follow-up. This figure is similar to the original 87 percent short-term closure rate previously reported by us.[1] Most failures occurred during the first 30 days and resulted from dislodgement of the plug. The majority of dislodged plugs was extruded from the secondary opening, not *via* the anal canal, and could usually be attributed to excessive activity by the patient or inadequate suturing technique. To address this problem, a stronger suture (2-0 vicryl) was used, and the first "throw" of the suture was inserted into the head of the plug before pulling it into final position in the primary opening. The primary opening was then closed over the head of the plug by using a deep figure-of-eight suture. This prevented the plug from being extruded from the tract, as well as protecting the plug from luminal content. In addition, the importance of avoiding any excessive activity for two weeks was emphasized to patients. As a result of these measures, the number of "extruded" plugs decreased. Extrusions occurred mostly from shorter, more superficial tracts, even when intersphincteric and low transsphincteric tracts had been previously excluded. This is probably a result of inadequate supporting tissue around shorter, more superficial tracts, compared with deeper tracts, which have more adequate supporting

tissue. This finding also serves to underline the role for fistula plugs in deeper, complex fistulas, rather than shorter, simpler tracts.

Horseshoe fistulas represented the next most common cause of failure. Of the four patients with horseshoe fistulas, two failed. In all "horseshoe failures," the tract containing the plug closed, but the empty tract persisted. Because persistence of one or more tracts in any patient was considered an overall failure, these were considered overall failures, although one tract was successfully closed. One of these failed "horseshoe" patients subsequently underwent a modified Hanley procedure, and the second was replugged. Horseshoe failures are likely a result of failed closure of the "common" primary opening, which may be too large to adequately close with a plug. One solution is to plug the second tract at a later stage if it recurs. Alternatively, two plugs may be inserted, one into each side of the horseshoe tract. This is illustrated in Figure 2, which demonstrates a horseshoe fistula with four secondary openings: two on the left and two on the right. In this case, two separate plugs were used: one inserted into the left tract and one into the right tract. At five weeks postoperatively all drainage had ceased, and all four secondary openings were successfully closed. Closure rates were the highest with single fistula tracts, when one common primary opening is closed with a single anal fistula plug. In complex fistulas, in which one primary opening "feeds" multiple secondary openings, closure of the common primary opening results in closure of all the secondary openings distal to that point, irrespective of their number.

Figure 2. Horseshoe fistula with a total of four secondary openings: two on the left and two on the right. Note the old fistulotomy scar in the left anterior quadrant. In this case, two plugs were used: one inserted into the left tract, and one into the right tract. At five weeks, the patient reported all drainage had ceased, and all four secondary openings were successfully closed and dry.

One patient experienced persistent drainage after closure of a single tract, without recognized plug extrusion. This is likely a result of a persistent tract adjacent to the plug and represents a technical failure to adequately close the primary opening or primary plug failure.

Only one patient presented with late failure, at nine months. This is consistent with the fibrin glue data,[2–6] in which the majority of failures occurred early, and the number of late failures was relatively low. Ingrowth of native tissue into the extracellular scaffold of the plug, therefore, seems to provide stable and long-term closure of the fistula tracts.

The presence of setons was not found to be statistically significant in impacting closure rates; however, inserting the plugs is much simpler when a seton is in place. The presence of a seton "matures" the fistula tract, making the wall more fibrotic and capable of retaining sutures, and minimizes induration and any lingering sepsis. Having matured the tract(s), insertion of the plug is technically easier, because the presence of a seton obviates the need to locate the primary opening because the seton is previously in the tract. The seton also can be used to "pull in" the plug, by tying the plug to the cut seton, and using the seton to pull the plug into the primary opening. The role of setons in anal fistula plug closure of fistulas requires further study.

There was no instance of plug "infection" despite inserting the plugs into an obviously contaminated field. Resistance to infection has been well described in previous studies of Surgisis implanted into infected surgical fields. Recent studies [16–18] reported repair of contaminated abdominal hernias using Surgisis®, and neither study reported any instance of chronic implant infection. Resistance to infection is likely imparted from ingrowth of host capillaries and immune-competent cells into the extra cellular matrix, which is repopulated by native tissue during the course of the ensuing months. The extracellular matrix is, therefore, eventually completely replaced by host tissues, thus avoiding the risks of chronic infection seen with implanted synthetic materials.[7,8]

Closure of cryptoglandular anorectal fistulas with Surgisis® anal fistula plug is a promising new technology. Few late failures were identified in the

current study, and principal cause of failure, *i.e.*, plug extrusion has been addressed by use of a sturdier suture, and emphasizing the need to avoid any excessive activity for two weeks after surgery. Continued follow-up is currently in progress.

CONCLUSIONS

Long-term follow-up of Surgisis® anal fistula plug closure of cryptoglandular fistula tracts is successful in 83 percent of patients and 85 percent of fistulas. The most common cause of early failure was plug extrusion, and this was addressed by burying the head of the plug into the primary opening, with deeper bites of a 2-0 vicryl suture. Other causes of failure were persistence of the contralateral tract in horseshoe fistulas, and persistent drainage adjacent to the plug was noted in one patient. One patient experienced a late recurrence, nine months after closure of the tract. There was no instance of early plug infection. Closure of deep cryptoglandular fistulas is a promising new technology, with high closure rates, and few late recurrences.

REFERENCES

1. Johnson E, Gaw JU, Armstrong DN. Efficacy of anal fistula plug *vs.* fibrin glue in closure of anorectal fistula. Dis Colon Rectum 2006;49:371–6.
2. Buchanan GN, Bartram CI, Phillips RK, *et al.* Efficacy of fibrin sealant in the management of complex anal fistulas. Dis Colon Rectum 2003;46:1167–74.
3. Sentovic SM. Fibrin glue for anal fistulas. Dis Colon Rectum 2003;46:498–502.
4. Lindsey I, Smilgin-Humphreys MM, Cunningham C, Mortensen NJ, George B. A randomized, controlled trial of fibrin glue *vs.* conventional treatment for anal fistula. Dis Colon Rectum 2002;45:1608–15.
5. Singer M, Cintron J, Nelson R, *et al.* Treatment of fistulas-in-ano with fibrin sealant in combination with intra-adhesive antibiotics and/or closure of the internal fistula opening. Dis Colon Rectum 2005;48:799–808.
6. Cintron J, Park JJ, Orsay CP, *et al.* Repair of fistulas-in-ano using fibrin adhesive: long-term follow-up. Dis Colon Rectum 2000;43:944–9.
7. Badylak SF. The extra cellular matrix as a scaffold for tissue reconstruction. Semin Cell Dev Biol 2002;13:377–83.
8. Badylak SF. Small intestinal submucosa (SIS): a biomaterial conducive to smart tissue remodeling. In: Bell E, ed. Tissue engineering: current perspectives. Cambridge: Burkhauser Publishers, 1993:179–89.
9. Garcia-Aguilar J, Davey CS, Le CT, Lowry AC Rothenberger DA. Patient satisfaction after surgical treatment for fistula-in-ano. Dis Colon Rectum 2000;43:1206–12.
10. Zimmermann DD, Briel JW, Gosselink MP, Schouten WR. Anocutaneous advancement flap repair of transsphincteric fistulas. Dis Colon Rectum 2001;44:1474–80.
11. Sonoda T, Hull T, Piedmonte MR, Fazio VW. Outcomes of primary repair of anorectal and rectovaginal fistulas using endorectal advancement flap. Dis Colon Rectum 2002;45:1622–8.
12. Schouten WR, Zimmermann DD, Briel JW. Transanal advancement flap repair of transsphincteric fistula. Dis Colon Rectum 1999;42:1419–23.
13. Mizrahi NM, Wexner SD, Zmora O. Endorectal advancement flap. Are there predictors of failure?. Dis Colon Rectum 2002;45:1616–21.
14. Tsang CB, Madoff RD, Wong WD, *et al.* Anal sphincter integrity and function influences outcome in rectovaginal fistula repair. Dis Colon Rectum 1998;41:1141–6.
15. Schouten WR, Zimmermann DD, Briel HD. Transanal advancement flap repair of transsphincteric fistulas. Dis Colon Rectum 1999;42:1419–23.
16. Ueno T, Pickett LC, de la Feunte SG, Lawson DC, Pappas TN. Clinical applications of porcine small intestinal submucosa in the management of infected or potentially contaminated abdominal defects. J Gastrointest Surg 2004;8:109–12.
17. Franklin ME, Gonzalez JJ, Glass JL. Use of porcine small intestinal submucosa as a prosthetic device for laparoscopic repair of hernias in contaminated fields: 2 year follow-up. Hernia 2004;8:186–9.
18. Helton WS, Fisichella PM, Berger R, *et al.* Short-term outcomes with small intestinal submucosa for ventral abdominal hernia. Arch Surg 2005;140:549–62.