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Original Article

Analysis of clinical and patient-reported outcomes in post-ELAPE perineal reconstruction with IGAP flap – A 5-year review ☆

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ABSTRACT

Background: Extralevator abdominoperineal excisions (ELAPE) are now the accepted treatment option for low rectal cancers, which result in large perineal defects necessitating reconstruction. The aim of our study was to assess the clinical outcomes as well as the quality-of-life parameters (QOLP) following these reconstructions. **Methods:** A series of 27 patients who underwent ELAPE and immediate reconstruction with inferior gluteal artery perforator flaps (IGAP) between December 2013 to December 2018 were retrospectively analysed on patient demographics, disease and treatment, complications, and QOLP. **Results:** With a mean age of 71.6 years, all patients had low rectal cancers and underwent ELAPE (24 open, 3 lap-assisted) and immediate IGAP flap reconstruction. The follow-up period was 1 year. The overall perineal early minor complication rate was 25.9% and the early major complication rate of 14.8%. QOLP, such as tolerance to sit, perineal pain, perineal aesthetics, showed high patient satisfaction of 77.7%, 40.74%, and 66.6%, respectively at 1 year. The perineal hernia rate was 14.8% with all patients being female (p 0.0407; significant). **Conclusion:** IGAP flaps

☆ **Conflict of Interest Disclosure** The authors declare no conflict of interest and no relationships that might lead to bias.

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are a reliable option for reconstructing post-ELAPE defects with good patient satisfaction and outcomes.

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Introduction

Extralevator abdominoperineal excision (ELAPE) has been deemed to be an ideal treatment option for low rectal cancers in the present day. Over the last 15 years, the treatment of low rectal cancers has evolved from anterior resection and abdominoperineal resection (APE) to the current practised concept of ELAPE.

ELAPE has been widely accepted to reduce the incidence of positive circumferential resection margin (CRM), thereby proving to be an effective method of treatment increasing the overall survival rate as well as disease control following surgery.¹

The role of the plastic surgeon in this operation is essential in managing the rather large dead space and closure of the resultant defect. The defect left behind after an ELAPE is much larger than that of an APE.² Though some defects are amenable to primary closure, wound breakdown and wound healing complications are a major concern following this.⁴ Hence, these wounds require reconstruction of some form with known available options of V-Y advancement flaps, gluteal muscle flaps, rectus abdominis flap, and free tissue transfers – ALT or latissimus dorsi or even with newer modalities like meshes and dermal substitutes.

Patients and Methods

A 5-year retrospective analysis of patients between December 2013 and December 2018 who were reconstructed by a single senior surgeon at Wexham Park Hospital was included in the analysis. The necessary permissions to access patient data were taken from the audit department of the hospital. A total of 27 patients were included in this study. The review was conducted to analyse the outcomes of patients who underwent this procedure.

The data collected included age, gender, co-morbidities, and smoking status, if the cancer was primary or not, any neoadjuvant therapy, method of reconstruction, TNM staging, spectrum of post-surgery complications, length of stay (LOS), and time to healing. Amongst the quality-of-life parameters (QOLP), we looked into the tolerance to sitting, pain, and aesthetic outcomes. Long-term outcome measures that were also recorded were perineal hernia and recurrence/distal metastatic disease.

We have divided complications into early perineal complications and non-perineal complications. Most of the early perineal complications were minor complications, such as minor wound dehiscence, cellulitis, superficial abscess, and major complications, which included major wound dehiscence (requiring surgical intervention and /or Vacuum Assisted Closure (VAC)) and sinus formation. The early complications were those seen in the first 30 days following the surgery.

The follow-up period in this study was 1 year from a plastic surgery perspective.

Data of the patients were recorded for the above parameters, and the data were then tabulated and analysed statistically with tables, percentages, mean, and Fisher's test.

Operative Procedure

Following the abdominal part of mobilisation of the descending colon and performing the end colostomy, the abdomen was closed, and the patient was then turned to the prone jack-knife position for perineal dissection. This was followed by flap reconstruction.

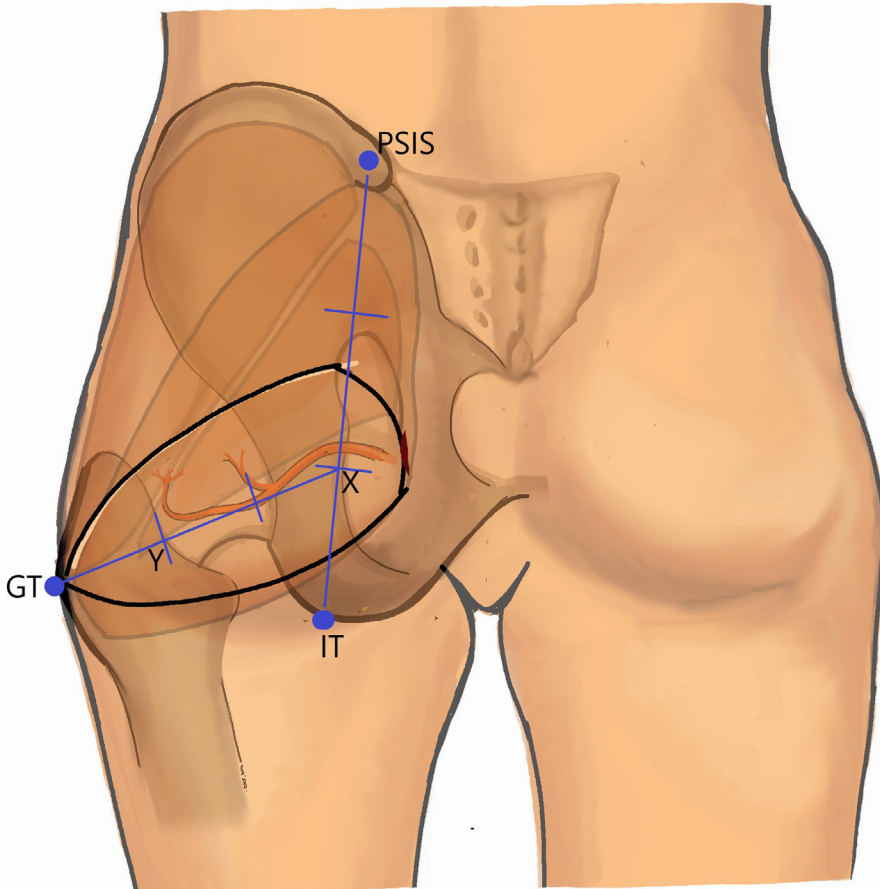


Figure 1. IGAP flap marking:

Note: PSIS - Posterior Superior Iliac Spine, IT - Ischial Tuberosity, GT - Greater Trochanter, X - point at the junction of the lower and middle third of PSIS-IT. Y - junction of the lateral 1/3 and medial 2/3 of X-GT distance. The most constant perforator is usually observed near Y.

The inferior gluteal artery perforator flap (IGAP) was marked as shown in (Fig. 1) after performing a preoperative doppler study to identify the perforators. The adipofasciocutaneous flap was harvested from unilateral/bilateral buttock (Fig. 4, 5) depending on the size of the defect and thickness of tissue available. Care was taken to exclude the irradiated field as much as possible from the flap. The flap was raised sub-facially from lateral to medially. After the initial lateral incision, perforators were identified at the junction between the lateral third and middle thirds and dissected through the muscle to help gain mobility of the flap. The posterior cutaneous nerve of the thigh was identified and preserved. Other perforators were preserved when possible, depending on the extent of flap medial transposition required. The medial incision was then completed to mobilise the flap on the perforators (Fig. 2). The medial $\frac{1}{3}$ to $\frac{1}{2}$ of the flap was de-epithelised to obliterate the space in the perineum as shown in (Fig. 3). Inset was done in multiple layers using delayed absorbable sutures. A suction drain was placed and brought out away from the flap site to facilitate the application of VAC dressings over the suture line. Patients were nursed on their side and allowed to ambulate as soon as they were comfortable.

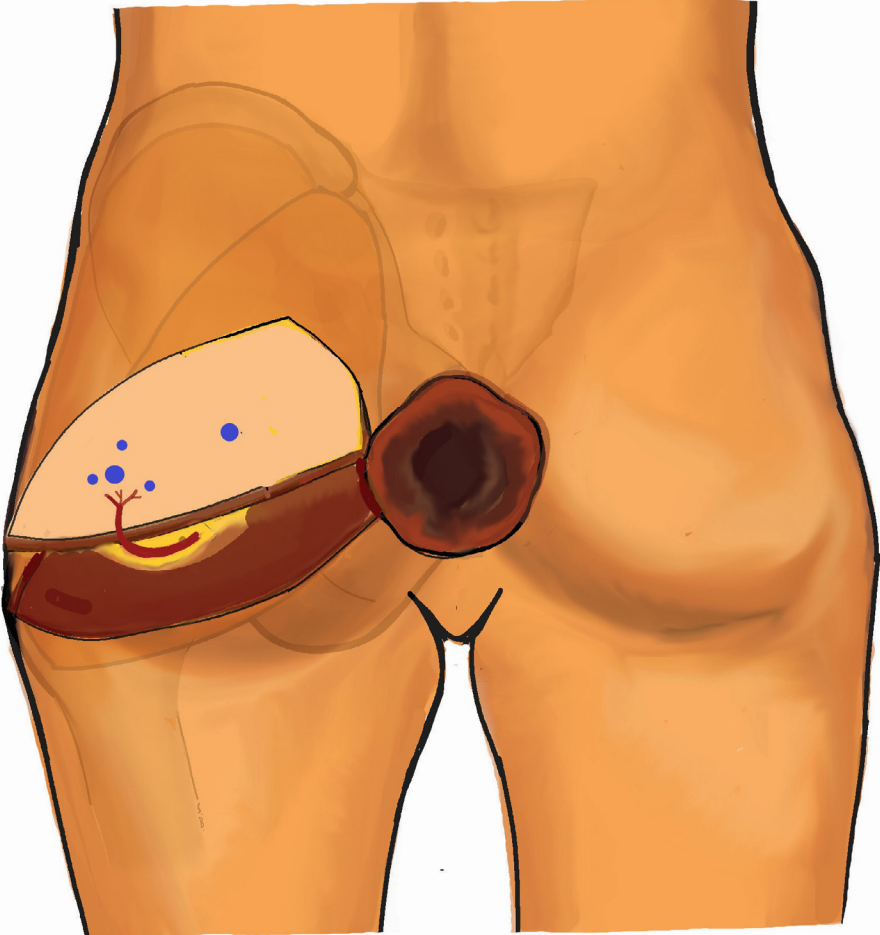


Figure 2. Flap elevation:

Position of the perforator entering the skin marked with a blue dot. Flap is elevated along the course of IGA within the muscle.

Results

A total of 27 patients underwent the procedure of reconstruction in the 5-year period.

Patient Demographics

The patient demographics are shown in [Table 1](#).

The commonest co-morbidities were hypertension, asthma, and anaemia, and 50% of the patients had one or more of these co-morbidities.

Surgical and Post Surgical Treatment Characteristics

The treatment and staging-related data are shown in [Table 1](#).

All patients had low rectal cancers and underwent ELAPE (n=24 88.9%)/laparoscopic-assisted APR (n=3 11.1%) as their primary resection surgery, and a majority received neoadjuvant chemoradiother-

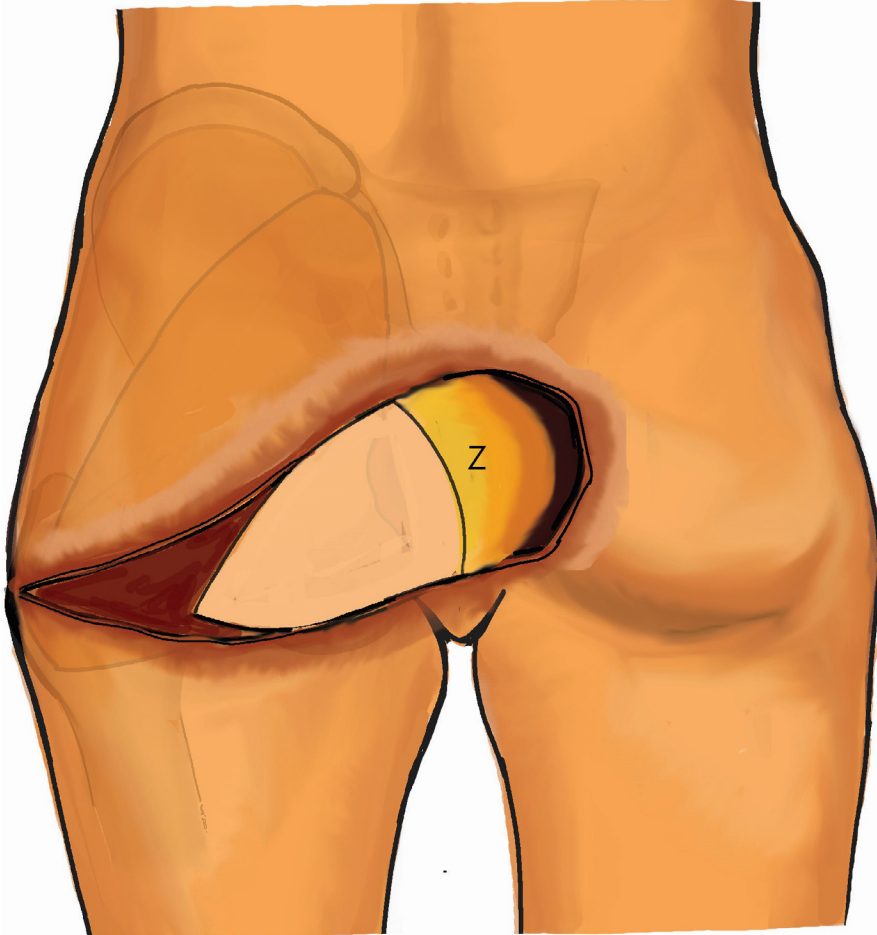


Figure 3. Flap mobilisation:
Z denotes the de-epithelised portion of flap.

apy. For reconstruction, 20 (74%) patients had a unilateral IGAP flap, whereas 7 (4 female and 3 male) (26%) patients had bilateral IGAP flaps.

Table 2 shows the overall picture of the complications encountered.

Our series had an early minor complication rate of 25.92% (n=7) and an early major complication rate of 14.8% (n=4). Five patients (18.5%) of the seven had minor wound dehiscence which completely healed at the 3-month follow-up. One patient each had superficial abscess and cellulitis. Amongst the early major complications, two patients (7.4%) had a large wound dehiscence which required wound debridement and closure and VAC application, and these wounds eventually healed at the 3-month follow-up. Two patients had sinus formation which required surgical intervention, and in one patient, this sinus was persistent at 3-month follow-up but had eventually healed at the 1-year follow-up.

All non-perineal complications (n=4, 14.8%) were seen in the immediate postoperative period, which included adhesions in 1 patient, parastomal hernia in 2 patients, and incisional hernia in 1 patient. These complications required surgical intervention by the general surgical team.



Figure 4. Flap inset: Unilateral
Unilateral flap inset by mobilisation of skin margins.

Quality-of-life parameters

The following indicators were included in assessing the quality of life of the patient post-surgery - the ability to sit comfortably, perineal pain, perineal hernia, and disease recurrence. These parameters were recorded at the 6 month and 1 year follow up.

These results are tabulated in [Table 3](#). A total of 17 patients (62.9%) had good tolerance to sitting with these flaps at 6 months, and this continued to improve (77.7%) at the 1-year follow-up. Half the number of patients (55.5%) complained of perineal pain at 6 months, and this also continued to improve with scar management and pain control at the 1-year follow-up.

However, 4 patients had a perineal hernia in their long-term follow-up which required a secondary procedure. All patients were female (two-tailed p-value 0.0407; significant). The perineal hernias were identified in 1 patient at the 6-month follow-up and 3 patients at 1-year follow-up. Amongst the 4 patients, one had a bilateral and three had unilateral flaps.

A total of 18 patients (66.6%) reported that the reconstruction was also aesthetically pleasing.

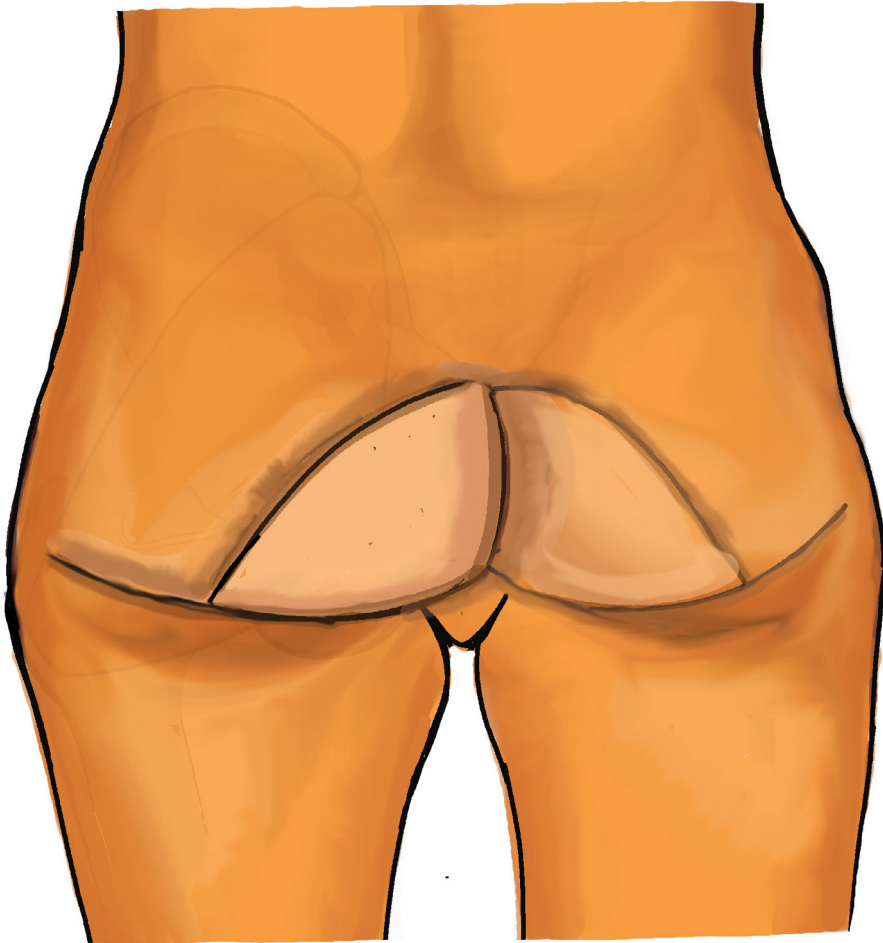


Figure 5. Flap inset: Bilateral

Bilateral flap inset to the contralateral IGAP skin paddle after bilateral IGAP flap elevation for large- volume abdominoperineal defect.

Discussion

In our study, all patients had an ELAPE or a laparoscopic-assisted APR as their primary surgery. ELAPE has been now adopted as an oncologically superior operation over the APR, but these operations lead to considerably large perineal wounds. These wounds are not amenable to primary closure, and if attempted, they have a high rate of wound complications.

Various options described and adopted for the closure of these perineal wounds include direct closure, random pattern V-Y advancements, mesh reconstruction, myocutaneous flaps - Gluteus Maximus (GLM), Rectus Abdominis Myocutaneous (VRAM) or Gracilis Myocutaneous (GM) flap, and fasciocutaneous perforator flaps such as IGAP and superior gluteal artery perforator flap (SGAP).

Our series is one of the largest series of immediate IGAP flap reconstruction following an ELAPE published. As described by Hainsworth et al.,² these flaps are robust and are suitable in patients who have undergone neoadjuvant chemoradiotherapy.

Though the myocutaneous flaps, such as VRAM, have shown a reduction in perineal wound complications such as wound dehiscence, wound infections in comparison with direct closure and reduced

Table 1
Patient demographics, Staging of the disease, Treatment related data.

	Patient numbers (percentages in brackets)
Number of patients	27
Demography	
Female	14(51.85%)
Male	13(48.14%)
Age	Mean 71.88 years (SD 12.56)
Male	Mean 72.38 years (SD 13.53)
Female	Mean 71.42 years (SD 12.08)
Smoking history	
Yes	14(51.85%)
No	13(48.14%)
Treatment related	
Tumor grade	
T0	1(3.7%)
T1	1(3.7%)
T2	5(18.5%)
T3	13(48.14%)
T4	7(25.9%)
Duke staging	
Duke A	5(18.5%)
Duke B	9(33.33%)
Duke C	8(29.6%)
Not documented	5(18.5%)
Neoadjuvant chemoradiotherapy	
Yes	25(92.6%)
No	2(7.4%)
Primary surgery	
ELAPE	24(88.9%)
Lap-assisted APR	3(11.1%)
Reconstruction with IGAP	
Unilateral	20(74%)
Bilateral	7(26%) (4 females and 3 males)
Length of hospital stay	
Less than 2 weeks	9(33.33%)
More than 2 weeks	18(66.67%)

hospital stay, they do have higher instances of flap necrosis, donor site complications, and incompatibility with laparoscopic APR.^{14,15}

Myocutaneous flaps in pre-irradiated wound beds have a 35% to 51% wound healing issue.^{3-5,16-18} In our patient cohort, 92.6% received preoperative neoadjuvant chemoradiotherapy with an overall wound healing complication rate of 40.74% and hence comparable to previously published rates for myocutaneous flaps as mentioned above. Interestingly, the 2 patients who did not receive the neoadjuvant chemoradiotherapy had an uneventful postoperative recovery.

As with any perforator flap, the donor site morbidity of IGAP flaps is lower than that for myocutaneous flaps.⁸ IGAP flaps do not lead to hernias, nor do they hinder stoma formation in comparison with the VRAM flaps.² Whilst most denervated muscle flaps help fill the soft tissue defect at the time of the operation - they atrophy over time and can lead to higher incidence of perineal herniation. With IGAP flaps, the medial part of the flap can be de-epithelised, and the dermo-adipofascial component has been used to fill the soft tissue defect which will provide a lasting solution and also lower the need for mesh repair as well as the incidence of perineal hernias.⁷ Baird et al. noted that pelvic dead space obliteration with bulky non-irradiated tissue was essential to reduce the morbidity related to complications such as abscess, sepsis, perineal hernia, and bowel obstruction

Perineal complications are common in post-ELAPE reconstructions. Most of these are minor complications. Christensen et al.¹ have shown an overall complication of 6% for gluteal flaps whilst incorporation of mesh has shown this to increase to 17%. Anderin et al.⁶ who used gluteus maximus

Table 2

Complications classified as Early Minor and Major Perineal complications (within 30 days of procedure) and Non Perineal Complications.

	Patient numbers (percentages in brackets)
(A) Early minor perineal complications	7(25.92%)
Minor wound dehiscence	5(18.5%)
Superficial abscess	1(3.7%)
Cellulitis	1(3.7%)
(B) Early major perineal complications	4(14.8%)
Large wound dehiscence	2(7.4%)
Sinus formation	2(7.4%)
(C) Non-perineal complications	
Adhesions	1
Parastomal hernia	2
Incisional hernia	1

Table 3

Quality of Life parameters and long term outcomes.

Quality of life parameters	Patient numbers (percentages in brackets)
(A) Tolerance to sit	
Comfortable at 6 months follow-up	
Yes	17(62.9%)
No	10(37.1%)
Comfortable at 1-year follow-up	
Yes	21(77.7%)
No	6(22.2%)
(B) Perineal pain	
At 6 months	
Yes	15(55.5%)
No	12(44.5%)
At 1 year	
Yes	11(40.74%)
No	16(59.25%)
(C) Subjective aesthetics patient reported	
Aesthetic	18(66.6%)
Non-aesthetic	9(33.3%)
(D) Perineal hernia	4(14.8%) All female patients
(E) Recurrence during follow-up period	5

Table 4

Perineal hernia distribution

	Perineal hernia	Non-perineal hernia	Total
Male	0	14	14
Female	4	9	13
Total			27

Fisher's exact test. The two-tailed P-value is 0.0407. The association between rows (groups) and columns (outcomes) is considered to be statistically significant.

muscle flaps have reported perineal complication rates of 41.5%. Comparatively, IGAP flaps in our series have shown an early minor complication rate of 25.92% and an early major complication rate of 14.8% and an overall complication rate of 40.74%.

In our study, we have given a special emphasis on the outcome of these patients on long-term follow-up. We focussed on QOLP such as ability to sit comfortably, perineal pain, perineal aesthetics as reported by patients and also perineal hernia & recurrence which were assessed clinically. The majority of patients had no discomfort in sitting at 6 months, and this improved at the 1-year follow-up. This trend of improvement was similar in the case of perineal pain. Perineal aesthetics were assessed

subjectively on a patient-reported basis, and most patients were satisfied with the aesthetic outcome. There is a very limited literature on patient outcomes following the reconstruction of perineum following ELAPE. Boccola et al.¹³ have assessed perineal aesthetics in their limited study through subjective questioning and have reported high degrees of patient satisfaction in aesthetic outcomes with IGAM flaps.

Perineal hernias are a significant problem in these patients. Though most are asymptomatic, they can manifest with pain, urinary and bowel obstruction which can adversely affect quality of life.^{9–12} We have had 4 female patients with these hernias on long-term follow-up with all patients identified between 6–12 months post-initial surgery with a mean of 8 months. This can be attributed to the wider female pelvis. Fasciocutaneous gluteal flaps alone have been described to have a higher rate of perineal hernias compared to mesh reconstructions according to Christensen et al.¹ Incorporating a combined mesh with a fasciocutaneous IGAP flap for reconstructing these defects might be an interesting avenue for further study.

This study had a few limitations in that it was not a randomised control study between myocutaneous flap and IGAP flaps, but we compared our results with published results. Also, in terms of QOLP, further study using quantitative scoring systems with validated questionnaires can provide a better understanding of long-term outcomes for these patients.

Conclusion

IGAP flaps are a reliable mode of reconstruction of post-ELAPE defects. Though these flaps have their limitations such as change of position of patient intraoperatively, longer duration of surgery due to the inability to simultaneously harvest the flap, and higher perineal hernia rate, they do have distinct advantages such as low donor site morbidity; ease of harvest; lesser chance of flap atrophy; and good response in terms of QOLP, such as tolerance to sit, perineal pain, and perineal aesthetics. The rate of perineal hernia could be potentially alleviated by the concomitant use of a mesh, and further studies in this regard are necessary. Further patient-reported outcome studies with regard to the QOLP will also help reinforce the utility of these flaps in perineal reconstruction.

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Ethical Approval

Not required.

Conflict of Interest

The authors declare that they have no conflict of interest.

References

1. Christensen HK, Nerstrøm P, Tei T, Laurberg S. Perineal repair after extralevator abdominoperineal excision for low rectal cancer. *Dis Colon Rectum*. 2011 Jun;54(6):711–717 PMID: 21552056. doi:10.1007/DCR.0b013e3182163c89.
2. Hainsworth A, Al Akash M, Roblin P, Mohanna P, Ross D, George ML. Perineal reconstruction after abdominoperineal excision using inferior gluteal artery perforator flaps. *Br J Surg*. 2012 Apr;99(4):584–588 Epub 2012 Jan 9. PMID: 22231559. doi:10.1002/bjs.7822.
3. McMenamin DM, Clements D, Edwards TJ, Fitton AR, Douie WJP. Rectus abdominis myocutaneous flaps for perineal reconstruction: modifications to the technique based on a large single-centre experience. *Ann R Coll Surg Engl*. 2011;93:375–381.
4. Bullard KM, Trudel JL, Baxter NN, Rothenberger DA. Primary perineal wound closure after preoperative radiotherapy and abdominoperineal resection has a high incidence of wound failure. *Dis Colon Rectum*. 2005;48:438–443.
5. de Haas WG, Miller MJ, Temple WJ, et al. Perineal wound closure with the rectus abdominis musculocutaneous flap after tumor ablation. *Ann Surg Oncol*. 1995;2:400–406.
6. Anderin C, Martling A, Lagergren J, Ljung A, Holm T. Short-term outcome after gluteus maximus myocutaneous flap reconstruction of the pelvic floor following extra-levator abdominoperineal excision of the rectum. *Colorectal Dis*. 2012 Sep;14(9):1060–1064 PMID: 21981319. doi:10.1111/j.1463-1318.2011.02848.x.

7. Baird WL, Hester TR, Nahai F, Bostwick 3rd J. Management of perineal wounds following abdominoperineal resection with inferior gluteal flaps. *Arch Surg*. 1990;125(11):1486–1489.
8. Holm T, Ljung A, Haggmark T, Jurell G, Lagergren J. Extended abdominoperineal resection with gluteus maximus flap reconstruction of the pelvic floor for rectal cancer. *Br J Surg*. 2007;94(2):232–238.
9. Aboian E, Winter DC, Metcalf DR, Wolff BG. Perineal hernia after proctectomy: prevalence, risks, and management. *Dis Colon Rectum*. 2006;49:1564–1568.
10. Beck DE, Fazio VW, Jagelman DG, Lavery IC, McGonagle BA. Postoperative perineal hernia. *Dis Colon Rectum*. 1987;30:21–24.
11. Dulucq JL, Wintringer P, Mahajna A. Laparoscopic repair of postoperative perineal hernia. *Surg Endosc*. 2006;20:414–418.
12. So JB, Palmer MT, Shellito PC. Postoperative perineal hernia. *Dis Colon Rectum*. 1997;40:954–957.
13. Boccola MA, Rozen WM, Ek EW, Grinsell D, Croxford MA. Reconstruction of the Irradiated Extended Abdominoperineal Excision (APE) Defect for Locally Advanced Colorectal Cancer. *Journal of Gastrointestinal Cancer*. 2010;42(1):26–33. doi:10.1007/s12029-010-9224-2.
14. Butt HZ, Salem MK, Vijaynagar B, Chaudhri S, Singh B. Perineal reconstruction after extra-levator abdominoperineal excision (eLAPE): a systematic review. *International Journal of Colorectal Disease*. 2013;28(11):1459–1468. doi:10.1007/s00384-013-1660-6.
15. Chan S, Miller M, Ng R, Ross D, Roblin P, Carapeti E, et al. The use of myocutaneous flaps for perineal closure following abdominoperineal excision of the rectum for adenocarcinoma. *Colorectal Dis*. 2010;12:555–560.
16. Buchel EW, Finical S, Johnson C. Pelvic reconstruction using rectus abdominis musculocutaneous flaps. *Ann Plast Surg*. 2004;52:22–26.
17. Chessin DB, Hatley J, Cohen AM, Mazumdar M, Cordeiro P, Mehara B, et al. Rectus flap reconstruction decreases perineal wound complications after pelvic chemoradiation: a cohort study. *Ann Surg Oncol*. 2005;12:104–110.
18. Bell SW, Dehni N, Chaouat M, Lifante JC, Parc R, Tiret E. Primary rectus abdominis myocutaneous flap for repair of perineal and vaginal defects after extended abdominoperineal resection. *Br J Surg*. 2005;92:482–486.