Buttock Reconstruction in Sarcoma Surgery: An Esthetic Sigmoidplasty Closure for Large Circular Defects Using Double Opposing Skin Flaps

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Background: Large defects arising from extirpation surgery of buttock sarcomas requiring adjuvant radiotherapy are best closed with flap surgery. The traditional solutions are derived from an approach to pressure sores, which were designed for the ischial, sacral, or trochanteric areas, and have now been adapted for true buttock defects. This invariably destroys the esthetics of the buttock. We describe a novel technique of sigmoidplasty, which preserves most of the esthetic features.

Methods: We report on a retrospective review of 11 consecutive buttock sarcomas managed at our institution between 2009 and 2014, focusing on those for which the described reconstruction method was used (N = 5).

Results: The immediate outcome was very good. In 1 patient, partial loss of 1 of the flaps and the management thereof resulted in a minor contour deformity. In general, the buttock volume was significantly decreased but the shape was preserved. This was obtained without secondary donor defect and with minimal contour irregularity. Long-term follow-up remained pleasing, and all patients were satisfied with the outcomes.

Conclusions: The described technique of buttock defect closure satisfies the oncoplastic principles of tumor surgery with the added benefit of superior esthetics. We suggest that it is a versatile adjunct to the reconstructive surgeon’s armamentarium for buttock reconstruction after sarcoma excision, particularly when the gluteal artery perforator systems are unavailable. (Plast Reconstr Surg Glob Open 2016;4:e1039; doi: 10.1097/GOX.0000000000001039; Published online 13 October 2016.)

INTRODUCTION

Soft tissue defects in the buttock region lend themselves to a reconstructive ladder approach. However, an elevator concept is most appropriate in buttock reconstruction after wide local excision of soft tissue sarcomas. Functionally, good quality tissue has to be provided for adjuvant radiotherapy purposes. The use of local tissue is the ideal for like-with-like replacement, but donor site availability may be a limiting factor. The traditional surgical procedures (eg, fasciocutaneous V-Y flap,\(^1,2\) gluteus maximus,\(^3,4\) inferior gluteal artery perforator\(^5\) and superior gluteal artery perforator\(^6\) flaps, gluteal/posterior thigh flap,\(^7\) tensor fascia lata flap,\(^8,9\) and fasciocutaneous infragluteal flap\(^9\)) may satisfy this need. These flaps have been developed for free-flap harvest and pressure sores. Flaps for pressure sores and free tissue transfer are anatomically predictable. On the contrary, during sarcoma surgery, these options may not be usable or may have an adverse esthetic outcome.

The aim of the study was to present a technique for reconstructing large circular defects of the buttock after sarcoma excisional surgery by double opposing buttock flaps transfer and closure by a sigmoidplasty (name derived from the sigma-shaped closure line). The objective was to present the surgical outcome of our clinical cases and review the literature to develop an understanding of the vascularity of the flaps.

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MATERIALS AND METHODS

To elucidate the cases that are discussed, it is deemed necessary to first pay attention to the materials used and the surgical method applied.

Surgical Technique

With reference to Figure 1, 2 opposing cutaneous flaps on either side of the circular defect are designed. To preserve the esthetics of the buttock and maximize utilization of the laxity of the surrounding tissues, the design orientation is vital. The movement of the flap is a combination of transposition, rotation, and advancement, which serves to decrease the size of the circular defect as the flap translation progresses.

Our preferred design, if feasible, is a laterally based inferiorly positioned flap and a medially based superiorly positioned flap. The outline of the flaps will be portions of the edge of the circle, the natal cleft skirting the anus and the infragluteal crease for the inferior flap and the superior flap, and lateral extent of the gluteal mound for the superior flap. This configuration leads to the best cosmetic outcome; however, certain factors like the position of the defect, or comorbidities of the patient may require a modification of the design (as in case example 3) in order for the inferior flap to be based medially. This allows a suture line further away from the anal verge, and bases the flaps on alternate blood supply, but has inferior esthetic results.

The extent of the peripheral incision and flap elevation and the movement of the flaps need to be balanced to maintain blood supply and to obtain tension-free closure. As a general guideline, if the ideal of each flap making up 50% of the total defect is not available, then the flaps are designed so that the width of each flap is at least 33% of the diameter of the defect. Because flap harvest is from a relatively more convex section of the buttock, it produces a larger skin surface once flattened. It is also important to note that in general, because of the flexion capacity of the hip, the skin of the buttock is a significant store of skin extensibility for use in buttock reconstruction. The flap width:length ratio is of secondary concern due to the perforator supply, but in our series it ranged from 1:2.5 to 1:3.5. The base attachment of the flap is not dissected to isolate perforators, not unless further flap movement is required. The inferior flap is elevated until the territorial perforator supply of the inferior gluteal artery. The superior flap, depending on its medial or lateral blood supply base, is elevated until the lumbosacral paravertebral or the superior gluteal perforator territory. The plane of elevation of the flaps over the gluteus muscle is at the muscle–fat interface and over the ischiorectal fossa at 2 cm subcutaneous thickness. The primary defect is closed by suturing the flaps centrally. This is followed by donor site closure by adjusting placement of suture bites for the displaced surrounding skin and flap to avoid undue tension. A 6 mm drain is placed for the first 24 hours.

Fig. 1. The sigmoidplasty design. After flap design, the flaps are elevated, the base is advanced, and the tips are rotated and transposed to meet in the centre of the defect.
Postoperatively the patient is kept in a prone position for about 5–7 days. The patient is allowed to progress to sleeping on the side provided the hip is kept extended. Thereafter the patient is mobilized, but not allowed to sit or flex the hip beyond 15–20 degrees for 3 weeks. Perineal care after toileting needs to be meticulous during the first few days, and keeping bowel motion soft is important.

Case Series

A retrospective review was done on all the buttock sarcoma cases managed by the Plastic Surgery and Oncology Combined Sarcoma Clinic at Inkosi Albert Luthuli Central Hospital, Durban, South Africa. A total of 11 patients with buttock sarcomas and sarcoma-like tumors (eg, dermatofibrosarcoma protuberans with fibrous sarcomatous change) were surgically managed from January 2009 to December 2014. We then excluded those for whom different reconstruction options had been chosen, focusing on the 5 patients that had had reconstructions using the described technique (Table 1).

All procedures were performed by the senior author (M.D.). The authors did a follow-up esthetic assessment of the outcome in terms of shape, volume, and contour deformity, and the subjects were interviewed during follow-up using a structured questionnaire (Fig. 2).

Structured Questionnaire

During follow-up, all patients were interviewed using a structured questionnaire, rating their satisfaction with the reconstruction option, the outcome, appearance while dressed, appearance while naked, and comfort during sitting and during activities of daily living.

The questionnaire is a custom designed form, as no validated measuring instruments for buttock reconstruction could be identified in the literature.

It is made up of 4 different sections: section 1 dealing with their overall experience with the reconstruction, section 2 with the esthetic appearance of the reconstruction, section 3 with their experience of pain when sitting, and the last section with the effect on their activities of daily living.

There are open-ended questions, where the participants could give examples, and questions rated on a Likert scale, where they would rate options, for example, how satisfied they were with the reconstruction, with choices ranging from not satisfied at all to extremely satisfied.

Ethical approval was obtained from the University of KwaZulu-Natal Biomedical Research Ethics Committee (reference: BE289/13).

CASE EXAMPLES

Three cases are discussed as examples, as they illustrate key concepts and some of the benefits and drawbacks of the procedure.

Case Example 1

A 39-year-old male patient presented with a large unilateral leiomyosarcoma of the right buttock. The patient received neo-adjuvant chemotherapy, and adjuvant radiotherapy to a total dose of 50 Gy. After tumor extirpation, a circular defect of 11 cm × 12 cm, covering almost 50% of the unilateral buttock, required reconstruction (see figure, Supplemental Digital Content 1, which illustrates the flap technique: http://links.lww.com/PRSGO/A256).

This was the first case for which the sigmoidplasty technique was chosen for reconstruction and performed (2009). There were no complications. On follow-up 1 month later, a relatively good cosmetic outcome was noted, with a mild standing cone in the upper gluteal cleft. In this case, which was the first one on whom we attempted the technique, we had designed the inferior flap as a medially based flap. After reviewing the case, we decided to design the inferior flap as a laterally based flap in future, to improve the esthetic outcome. Follow-up after almost 6 years showed no tumor recurrence and a stable reconstruction result, but with some of the stigmata of a radiated wound bed.

Case Example 2

A 25-year-old female patient presented with a large unilateral leiomyosarcoma of the right buttock, and after extirpative surgery, she was left with a unilateral buttock defect of 10 cm × 10 cm. The sigmoidplasty closure was performed. Care was taken to place the first limb in the gluteal cleft and along the gluteal fold, mirrored by the opposing flap (Figs. 3, 4). The inferior flap thus was based laterally. There were no complications. The follow-up of the patient showed an excellent cosmetic outcome, with preservation of the esthetic appearance of the buttocks—with decreased buttock volume but preserved shape.

At the 12-month follow-up, a CT scan showed a deep-seated parascapal recurrent tumor extending to the pelvic outlet and into the ischiorectal fossa. Another wide local excision was required. The overlying scar, subcutaneous tissue, and the gluteus maximus muscle, with the hemipelvic diaphragm and lateral part of the sacrum, were excised. The pelvic diaphragm was reconstructed with acellular dermal matrix. The flaps were re-elevated and recycled, resulting in a massive loss of unilateral buttock tissue volume rendering a poor final esthetic outcome despite favorable suture lines and good quality skin cover. The patient went on to receive adjuvant radiotherapy.

Table 1. Buttock Reconstruction with Sigmoidplasty Data

| Patient No. | Age at Presentation (in Years) | Sex   | Defect Size (Length × Width × Depth in cm) | R0 Resection Obtained | Months of Follow-up |
|-------------|------------------------------|-------|------------------------------------------|-----------------------|---------------------|
| 1           | 39                           | Male  | 11 × 10 × 4                              | Yes                   | 70                  |
| 2           | 33                           | Female| 24 × 8 × 7                               | Yes                   | 35                  |
| 3           | 56                           | Female| 15 × 13 × 7                              | Yes                   | 12                  |
| 4           | 26                           | Female| 11 × 11 × 11                             | Yes                   | 42                  |
| 5           | 25                           | Female| 10 × 10 × 4                              | Yes                   | 36                  |
Case Example 3

A 26-year-old HIV-positive (CD4 688 cells/mm³), female patient presented with a large unilateral leiomyosarcoma of the left buttock. After neo-adjuvant chemotherapy, the tumor was excised with a 3 cm clinical border, yielding a soft tissue defect of 10 cm × 12 cm. It was decided to use a sigmoidplasty design, but to reverse the markings; that is, not to place the scar in the gluteal cleft and fold due to the close proximity to the anus and the increased infection risk posed by the patient’s compromised immune status. The flaps were otherwise raised and transposed as per standard description. The patient developed surgical-site infection with necrosis of the distal 30% of the superiorly based flap. This was treated with surgical debridement, negative pressure wound therapy, readvancement, and secondary closure, which resulted in a standing cone/dog-ear deformity. The patient elected not to have it revised (Fig. 5).

RESULTS

The target group comprised 5 patients with an age distribution of 25–56 years (median age 33). The follow-up for tumor surveillance ranged from 12 to 70 months and averaged 39 months (Table 1).

At the 2-year follow-up, the reconstructive esthetic outcome was reasonably pleasing in all the cases because...
the overall shape was preserved. Patient satisfaction in all cases was very high, with all patients reporting that no one could tell they had had surgery when in their normal daily clothing. The buttock volume was significantly decreased, although it did not detract the attending surgeons or the patient from being satisfied with the result. This outcome was obtained without secondary donor defect in all cases, but a minor contour deformity originating from the partial flap loss in case example 3 did occur.

**DISCUSSION**

Reconstruction of defects in the sacral region is a common problem, which most plastic surgeons are challenged with on a regular basis. We have many well-described standard approaches, developed from years of cumulative experience in dealing with pressure sores, trauma and other injuries to the area. In contrast to reconstruction of a large sacral soft tissue defect, options for reconstruction of a large gluteal soft tissue defect have seldom been discussed in the literature.\textsuperscript{11,12} In many of the sacral-area reconstruction cases, the patients are looking for improvement in quality of life, or simply a closed wound situation. However, the scenario we present is for esthetic reconstruction of the gluteal area in very young patients, who expect not only reconstruction, but a good esthetic outcome, in the face of a reconstruction that is sometimes a lot more chal-

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Fig. 3. Case 2. Patient 5. A, Tumor on presentation. B, Markings for sigmoidplasty; note the inferior limb is hidden in the gluteal fold on the right. C, Defect after tumor resection. D, Transposition and advancement of sigmoidplasty flaps. E, Flap inset. F, Follow up 3 months after operation shows some buttock volume loss.

Fig. 4. The image presents a good outcome with preservation of buttock esthetics.
lenging than what we routinely deal with in the pressure sore scenario.

Buttock reconstruction after sarcoma resection presents a unique challenge because many of our usual excellent options become nonviable. Unlike malignancies arising from the skin, which are usually confined to the skin and subcutaneous tissues, sarcomas frequently originate from the deep soft tissues or muscle. The depth of the defect becomes almost as important as the peripheral wide local excision margin; therefore, a significant 3-dimensional volume loss occurs. The true resection zone thus may be large, and the excision may compromise blood supply to perforator-based flaps such as superior gluteal artery perforator and inferior gluteal artery perforator flaps. If this should be the case, the surgeon usually would be forced to default to regional or free-flap options.

We acknowledge that esthetic reconstruction of similar defects usually is possible using free tissue transfers; however, the technique described offers a useful tool, especially in resource-challenged settings like developing countries, where the equipment or expertise for free tissue transfer might not be available, or simply the costs of long theatre times, CT scans for identifying target vessels or suitable perforator territories, and postoperative intensive care unit stay proves challenging.

Our technique has the unique advantage in that it harnesses some of the lesser-known perforator territories, namely the lumbosacral system, the lateral circumflex system, and the ischiorectal fat pad perforators. The group of perforators does not need to be isolated, although their territories can be recruited by designing the base of the flap on them. Once again, this is of paramount importance in resource-challenged areas, where the access to technology like CT or Doppler mapping of perforators is not readily available. The flaps therefore are elevated and transferred with relative ease, without the need to island the flaps on the individual perforators. This leads to significant time and cost savings. The lumbosacral perforator system is a very rich blood supply and should not be a neglected donor source. Ischiorectal perforators can be recruited by inverting the typical design (case example 3).

Buttock esthetics are of critical importance to a large percentage of patients. Esthetic subunits, roundness, and volume contribute to the esthetic appearance. Gluteal esthetics were largely codified in 2006 by Cuenca-Guerra et al. by analyzing over 2400 photographic images. Four of the most recognizable characteristics of an esthetically pleasing gluteal region are:

1. Two mild lateral depressions that correspond to the femoral greater trochanter.
2. A short infragluteal fold lying in the horizontal crease under the ischial tuberosity, which does not extend beyond the medial two-thirds of the posterior thigh.
3. Two supragluteal fossettes (or dimples) on either side of the medial sacral crest which correspond to the posterior superior iliac spines.
4. A V-shaped crease (sacral triangle), which arises from the proximal end of the gluteal crease and extends toward the sacral fossettes.

In the authors’ opinion, the flap design and incision lines do not violate these characteristics. The movement of the flaps and the scar outline preserve the major esthetic relationship of the mound to the esthetic unit outline. The central and lateral scar that was formed, in our opinion, does not seem to detract much from the perceived esthetics. It also appears that there is ample volume “hidden” in the buttock region, to the extent that sacrificing 50–60% of 1 buttock does not compromise the appearance (in our experience). Even though total volume is less on the operated side, the surgical design and flap movement redistribute the residual buttock volume and recreate buttock contours. Despite the volume discrepancy between the 2 sides, it is the apparent symmetry due to the volume redistribution, which is esthetically pleasing (eg, case example 2).

In case examples 2 and 3, flaps had to be re-elevated and advanced. This is certainly a distinct advantage in managing flap-tip necrosis and tumor recurrence in providing a simple solution. The closure lines remain acceptable, although there is a significant trade-off for volume. Secondary correction of volume can be offered by importing tissue by fat injection or flap transfer restoring the esthetics. The safety concerns of stem-cell introduction with the fat to a tumor bed, though, need further elucidation. Clearly, in case example 2, importing a free flap to add volume at the time of the second wide local excision would have maintained or even improved esthetics. At that stage, however, functional reconstruction was our only aim.

Although it would seem that double opposing flaps, or so-called Yin-Yang flaps are almost communal knowledge among plastic surgeons, a PubMed, Medline, and Embase search for the terms “Yin-yang”, “Double opposing”, or “Double-opposing” yields only 1 reference to the buttock area,16 for double V-Y advance flaps, and no references to the Yin-Yang type of movement we describe. Similar flap designs and movement have been described for other areas of the body,17,18 but to our knowledge, it has not been reported for use on the buttock area.

SHORTCOMINGS

There are several shortcomings in this study that we acknowledge.

The small cohort size somewhat limits generalizability and conclusions regarding defect size amenable to coverage. There is no validated measuring instrument for outcome after buttock reconstruction, which makes it difficult to compare 1 method of reconstruction with another. This is an area for future research.

The volume loss of the buttock area was not precisely quantified; it was based on clinical observation by the researchers. This was mainly due to financial constraints and lack of access to resources in the Third-World setting.

Although we are of the opinion that the flaps harness some of the lesser-known perforator territories, namely the lumbosacral system, the lateral circumflex system, and the ischiorectal fat pad perforators, we did not have the funding to illustrate this on radiological studies. It would be useful to illustrate this in a further study.

CONCLUSIONS

The double opposing flap design for large circular buttock defects produces an esthetically pleasing sigmoid-plasty closure. It satisfies oncoplastic tumor surgery principles, and functional buttock padding is not detrimentally compromised. Furthermore, it avoids extended operating time as seen with perforator and free flaps.

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