EDITORIAL

The design of flaps for coverage of large myelomeningocele defects

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Kankaya and colleagues describe the use of combination flap designs to cover large myelomeningocele (MMC) defects.¹ A principal advantage of rotational flap design is the ability to primarily close the donor defect, typically without requiring skin grafts, and a well-established paradigm important in effective flap design using flaps is that suitable donor laxity must exist in the vicinity of the reconstructive defect. The geometry of each flap is designed to take advantage of the available tissue laxity, transferring it to an area of deficiency to allow coverage of the target defect.

The methodology presented here in the 4-flap butterfly design ingeniously makes use of available tissue laxity over a very large donor area (essentially, nearly the entire back) by subdividing large MMC defects into smaller sub-defects. This idea is not in itself entirely without precedent, with multiple prior descriptions of combination local flap designs to cover large defects. However, a cautionary note should nonetheless be made in that, for the spina bifida population, flaps ideally should be designed with the future in mind. Lesions of the size that require complex coverage are more likely to be associated with higher spinal levels of neurological dysfunction. These children have a higher likelihood of being wheelchair bound and insensate in dependent areas and, therefore, are at significant risk later in life for development of pressure ulceration, often in the areas previously repaired, and especially over kyphotic prominences. Accordingly, a subpopulation of patients undergoing neonatal flap repair of MMC will later require additional flaps for repair of pressure ulcers. Flap designs in the neonatal period should be planned to allow a wide range of future flap options, rather than utilizing small or limiting geometries. Reconstructive surgeons are well advised to avoid the allure of clever flap designs that offer only a “one-shot deal,” with scars that preclude reliable vascularity for subsequent flap needs.

This concern comes to mind particularly in the case of the 2-flap yin-yang design diagrammed in Fig. 1C and in the photographs in Fig. 6. This advice is relevant even when using more “mundane” or well-worn flap options,

such as longitudinal bipediced flaps, with skin grafting of donor sites (i.e., relaxing incisions). Such flaps should be designed to be as wide as feasible, especially in patients at high risk of wound breakdown, in order to avoid limiting subsequent flap possibilities. We would argue that the case depicted in Fig. 6 could have been treated using a more traditional approach with unilateral or bilateral bipediced flaps and skin grafting of donor sites, due to the concerns noted above. Despite the attractiveness of primary closure of donor sites that is possible using the yin-yang dual flap design, the sacrificing of later flap options for recurrent ulcers is, in our opinion, a high price to pay for the benefit of avoiding the need for skin grafts.

For the same reason, we would therefore respectfully point out one potential flaw for consideration in the algorithm presented with respect to the 2-flap design advocated for medium-sized defects. The algorithm presents decision making about designs at least partly in terms of a ratio between total surface area of the defect and of the “donor area,” which is understood to mean the large rectangle depicted in Fig. 1. In the case of the 2-flap design, the actual donor area that gives available laxity to carry out the closure does not appear to correspond closely to this large rectangle. In particular, this design draws on some vertical laxity along each side of the back, to allow V-Y advancement of the lateral tip of each flap, but it does not take any advantage of transverse laxity along the top or bottom of the back. The ratio of defect size to the full rectangle therefore appears to have little relation to whether suitable laxity exists to carry out the design. If one were planning to carry out the 2-flap design, one would be better advised to determine the apparent laxity of tissue that can be pinched up in a vertical direction along each flank.

The 4-flap butterfly design, in contrast, does truly recruit transverse laxity across the upper and lower back in essentially the full area of the large initial rectangle. In this scenario, the ratio of wound to donor area is clearly more relevant, and we agree with these authors’ conclusion that simple assessment of defect dimensions is insufficient. We feel that their introduction of quantitative evaluation of the

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available donor area contributes an important concept to the understanding of and treatment planning for these large defects.

The algorithm also highlights an important factor in decision making about flap designs for MMC repair: irrespective of defect area, kyphosis must be taken into account, as it may significantly increase the difficulty of coverage. These authors correctly advocate moving to more aggressive methods in the presence of kyphosis.

The majority of flaps used for closure of MMC defects tend to consist of skin flaps, including subcutaneous tissue, but excluding deep fascia, which is generally felt to improve flexibility. Most also are based on a random vascular pattern, dependent for vascularity on the subdermal plexus contained in a skin pedicle of suitable width, rather than on named arteries or specific muscle-perforator vessels. Description of flaps in this article suggests a true fasciocutaneous design, possibly resulting in a more robust intra-flap vascularity by avoiding disruption of vascular connections within the thin subcutaneous plane. Especially in the 4-flap butterfly design, the vascular base of each flap is situated medially, over paraspinous muscle perforators. Planning of flaps in a perforator, rather than random, design is well established to result in significantly improved reliability of large flaps, another important advantage of the design described here.

Muscle and musculocutaneous flaps generally have robust tissue characteristics and excellent vascularity. These may have a role in subsets of patients, but as these authors correctly warn, latissimus dorsi function is very important to wheelchair transfer ability, and its sacrifice may have important negative consequences for MMC patients, many of whom will be paraplegic. These considerations generally tend to limit the applicability of muscle flap designs for MMC repair.

With the note of caution in mind about later reconstructive needs, it is essential to acknowledge the priority of achieving secure closure of the important defect that the surgeon actually faces today over the potential problems of tomorrow. Options for repair of very large defects are very limited; secure closure of defects as large as some of those pictured in the accompanying figures is challenging by any means. Regardless of the issues raised for discussion here, the technique described by these authors appears to add an important tool to the armamentarium of the reconstructive surgeon treating MMC. The article also highlights another important factor in the treatment of these complex patients: it serves as an example of effective collaboration between pediatric neurosurgical and plastic and reconstructive specialties. We believe that cultivation of an effective and collaborative relationship between surgeons of both specialties allows for effective planning and the best chance of achieving optimal outcomes for patients with complex MMC defects.

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Reference

1. Kankaya Y, Sungur N, Aslan ÖÇ, Ozer K, Ulusoy MG, Karatay M, et al: Alternative method for the reconstruction of meningocele defects: V-Y rotation and advancement flap. *J Neurosurg Pediatr* [epub ahead of print February 13, 2015]. DOI: 10.3171/2014.12.PEDS14133]

Response

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In patients with MMC, the first goals of reconstruction are excision of the sac, water-tight repair of the neural tube, and closure of the resultant defect with a reliable tissue. Many flap options have been successfully used for the reconstruction of these defects. As Drs. Wellons and Braun also defined, during the planning of these flaps, it is very important to keep in mind the possible future flap needs of this group of patients and we totally agree with their emphasis of this issue.

In our study, there were two basic aims to discuss. One of them was to define the use of the binary and quadruple combinations of the V-Y rotation and advancement flap, which we believe is quite safe and easy to perform for the reconstruction of MMC defects. The second aim of the study was to generate an algorithm based on objective criteria in order to facilitate preoperative planning of appropriate reconstruction for the closure of MMC defects of any size. Meningocele defects were classified as small, medium, and large in this algorithm. Since the defect size is associated with the dimensions of the available donor area, use of this algorithm makes it easier to select the best flap design for closure of the defect.

In order to respond to the concerns raised by Drs. Wellons and Braun regarding potential drawbacks of our work and clarify the study, we would like to emphasize a few points. First of all, of course, many different flap alternatives can be performed instead of the binary V-Y rotation and advancement flap we used for the reconstruction of medium-sized defects. At this point, we believe that binary V-Y rotation and advancement flap do not have any additional restrictive effect in comparison with alternative flap designs. Binary V-Y rotation and advancement flap protects the donor site on the other axes. Moreover, it is possible to reuse these flaps later by widening their rotation and advancement properties.

Another important point concerning this study is that, in the reconstructions performed with binary V-Y rotation and advancement flap, we do not have the aim of using the laxity of the donor area in all axes. Similarly, there is no relation between the algorithm and the use of donor site laxity. The basic aim of the algorithm is to define the defect dimensions through objective criteria, not to provide an absolute decision regarding the use of binary or quadruple V-Y rotation and advancement flaps for certain defect sizes.

As we all know, MMCs constitute a special group of pathological conditions that necessitate treatment and follow-up by qualified specialists. For this reason, it is necessary to use a multidisciplinary approach. At this point, we believe that V-Y rotation and advancement flap and its combinations can be a good alternative for the reconstruction of MMC defects. In addition, the algorithm can be helpful for reconstructive surgeons when planning repair.