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Treatment of Large Thoraco-Lumbar Neural Tube Defects

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1. Introduction

Myelo-meningocele (MMC) is the most complex congenital malformation of the CNS that is compatible with life. Although the incidence of the MMC is decreasing, it remains one of the most common birth defect of the central nervous system, with an incidence of 0.5 to 1 per 1000 pregnancies in the USA and higher in some other part of the world, particularly developing countries. An MMC is typically closed within 24-48 hours after birth, and the goal of surgery is to close the neural placode in to a neural tube to establish a micro environment conducive to neural function.

Although MMC closure consist of the soft tissue and skin adjacent to be the defect, but repair of MMC larger than 5 cm in diameter is almost never easy. For this reason, increasing attention has been directed at soft tissue closure with multiple anatomic layers .

In 1956, Soderby and Sutton described the repair of MMC defect by plastic surgery. Desprez in 1971 reported the use of composite skin - muscle flaps for closure of large MMC. In 1977, Nelson described the use of delayed bipedicle flaps. In the same year, David and Adendorff used a large rotation flap raised across the midline MMC. In 1978, McGraw firstly described use of a posterior - advancement Lattissimus dorsi, myocutaneous flap to repair MMC.

In this chapter, we review the repair of large MMC defects by several methods described recently in literature.

2. Skin and fasciocutaneous flaps

2.1 Bilateral fasciocutaneous flap

The fasciacutaneous flap closure is supported by a rich vascular network with three main dominant vascular territories as bellow:

1. A prominent transverse segmental vascular pattern originating from the muscular perforator and lateral cutaneous branches of the lower intercostal arteries.
2. The parascapular and scapular fascial branches of the circumflex scapular artery.
3. Lateral extension of the superficial circumflex iliac arteries.

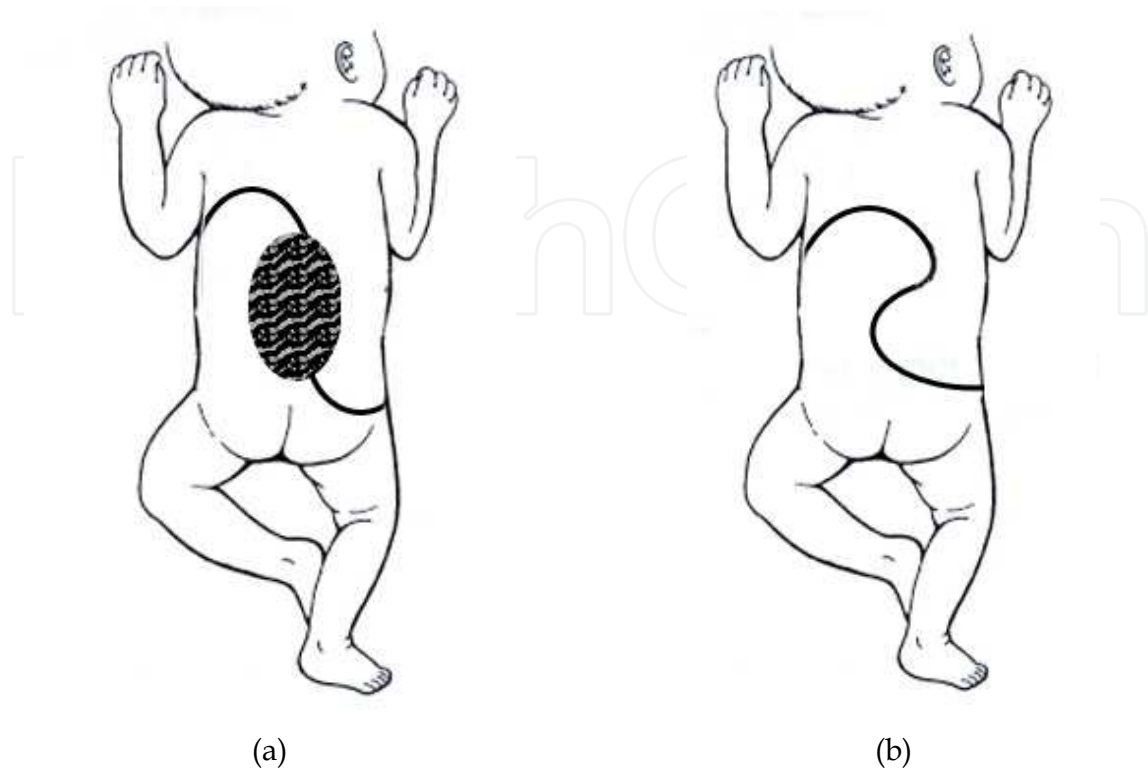


Fig. 1. (a) (b) Bilateral Fascio Cutaneous Flap

In this technique, after the closure of neural defect by neurosurgery, two fasciocutaneous equilateral rotation flaps at both sides of defect are elevated. Elevation of the flaps is begun in superior -inferior direction, lifting the skin and the underlying fascia by sharp dissection. Once the flaps have been elevated, they are rotated and transposed across the midline to close the skin defect (figure 1a and b). The flaps are planned in such a way that the direction of rotation of one flap is against the other flap, and the design is oriented according to the skin reserve vector to accomplish closure with minimal tension. After elevating the flaps, they are sutured to each other. Skin and sub cutaneous tissue are closed by 5.0 prolene and 4.0 PDS respectively. There is no need of drainage in most instances.

2.2 Delayed repair of large MMC

In this technique, the skin is incised in the midline proximal to the MMC. The incision is carried circumferentially around the neural placode and the overlying skin is saved as much as possible. About a 1cm width of dura mater beneath the skin is left to ease the subcutaneous suturing.

2.3 Limberg skin flap (1)

In this technique, a rhomboid defect is created around the MMC and a rhomboid flap is harvested cranially to the defect. After neural tube closure, a line perpendicular to the long axis of the defect is made (figure 2a and b).

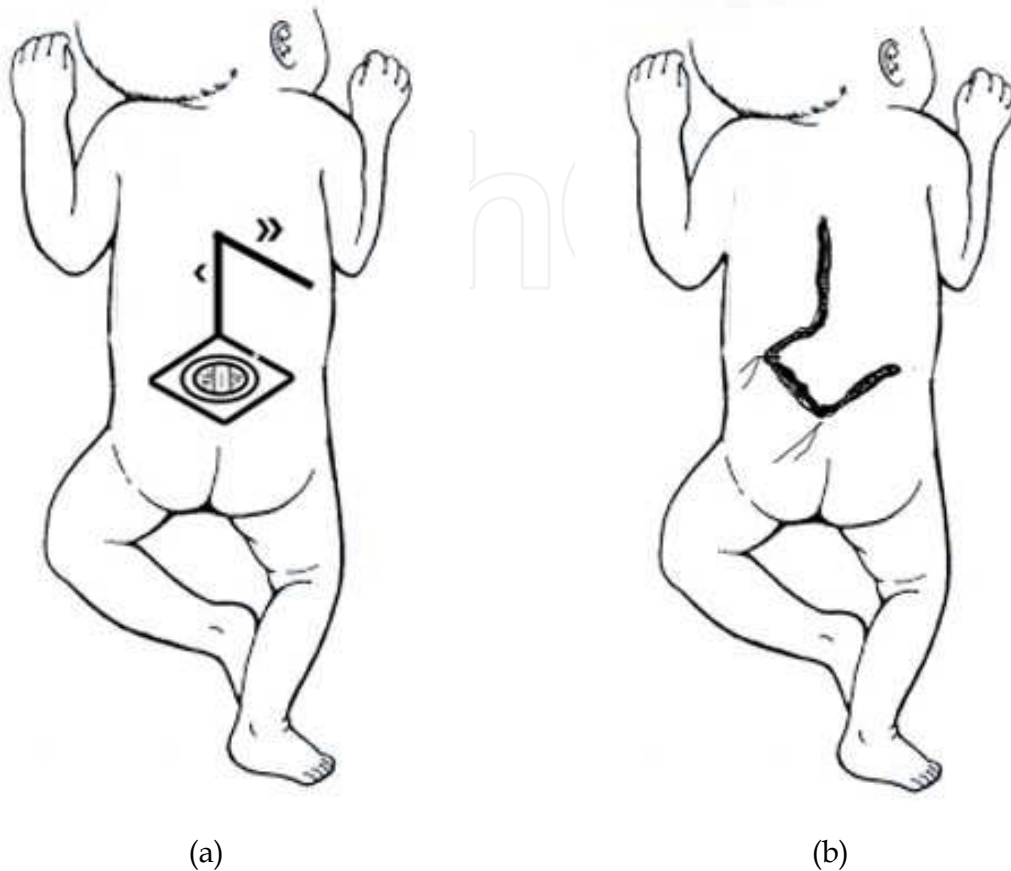


Fig. 2. (a) (b) Limberg Skin Flap

The length of the line is equal to the length of one side of the rhombus. Subsequently, a second line at a 120 degree angle is drawn, making it parallel to a side of the rhomboid. The Limberg flap is then dissected at the level of the lumbar fascia. After flap dissected, the Limberg flap is rotated and adjusted to MMC defect and tension - free skin closure is performed.

2.4 Double 2-rhomboid technique

In this technique, after neurosurgical repair, the skin defect is surgically converted to the shape of the rhombus.

Equilateral 2-plasty flaps are elevated at the side of the rhombus and transposed across the defect.

2.5 Bilobed flap

The flap is based superiorly and laterally to the area to be covered. The first lobe crosses the midline above the defect, and the second lobe goes up the midline perpendicular to the first lobe (fig3a and b).

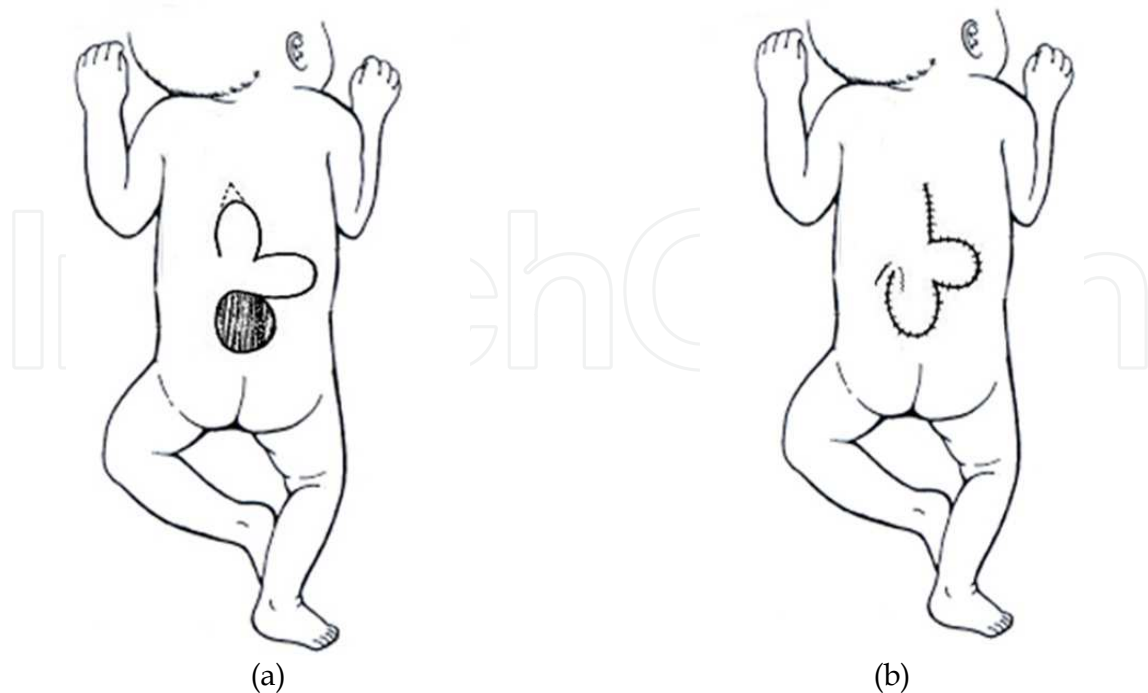


Fig. 3. Bilobed flap

2.6 The repaired of MMC with tissue expanders (2-3)

The use of tissue expander in large MMC defect a relatively is new approach. In this technique, vertical incision is performed on the flanks. The expander pockets are dissected subcutaneously above the fascia parallel to MMC mass. The tissue expanders are inserted in to the pocket and suction drainage is established. The first saline injection is done on the 20th post operative day and this is continued on the outpatient basis at a rate of 15-25ml of saline weekly for six to eight weeks. When expansion is complete, the second stage operation is performed. Incisions, as long as the MMC defect and parallel to the margins are placed bilaterally over the expanded skin. The tissue expanders are removed and the capsule over the fascial portion is dissected suprafascially starting laterally and leaving a pedicle medially. Then neural tube is closed and the dissected capsule is turned over and sutured over the repaired dural defects. The expanded skin flaps are transferred to cover the defect using 2-plasty flaps.

2.7 Proximally based fasciocutaneous flank flap (4,7)

In this technique skin is closed by proximally based left side flank flap (figure 4). After measurement of defect dimensions, the flap length equal to 1.5 the width of the defect and flap width equal to the length of the defect. Drawing of the flap boundaries and dissection are started from distal to proximal under the thoracolumbar fascia. Flap is transposed to the defect with tension-free skin closure. Donor site is closed primarily or with split thickness skin graft from adjacent gluteal area.



Fig. 4. Proximally based Fasciocutaneous Flank Flap

3. Muscle and musculocutaneous flaps

3.1 Bilateral Lattissimus dorsi Flap (5,9)

The lattissimus dorsi (LD) muscle is the largest and one of the most versatile flaps, available for MMC closure.

The large size allows it to be used to cover large MMC defects. The dominant vascular pedicle to the LD muscle from the subscapular -thoracodorsal vascular axis makes this muscle suitable for rotational and advancement flaps.



Fig. 5. Bilateral Lattissimus dorsi Flap (Design)

In this technique, patient is positioned prone and the designs of flaps are made (figure 5). Then, two triangular V-Y flaps are incised (figure 6) on each side of the defect. The tip of the triangle is extended to the posterior axillary line. The incision is started at the caudal line of the triangle and thoracolumbar fascia is freed from paraspinous muscles. The cranial border of the skin island is deepened to the muscle fascia and under the muscle, to create a proximally based muscle pedicle. The LD flaps, based on the thoracodorsal arteries are elevated bilaterally and advanced toward the midline with moderate tension (figure 7) and sutured together. The donor site are closed in a V-Y fashion. post operatively, patients are positioned prone for seven days.



Fig. 6. Bilateral Lattissimus dorsi Flap (incisions)

3.2 LD + Gluteal myocutaneous flap (8)

In this technique during the neurosurgical closure of the dural defect, undermining of the skin is avoided. Following the tube closure, flap dissection is begun by incising the thoracolumbar fascia over the paraspinous muscles and carrying the dissection under the LD to its free border laterally. The perforating vessels are cauterized and divided for medial advancement. The LD is freed from its attachments to the external oblique and serratus posterior muscles by sharp dissection. Dissection is continued inferiorly deep to the lumbar fascia, including the fascia overlying the gluteus maximus muscles, but without raising the muscles. Dissection is carried out laterally and inferiorly as necessary to achieve tension free closure of the defect. After dissection, the reconstruction of the defect is achieved through enblock medial advancement of the bilateral interconnected LD myocutaneous, and gluteal region fasciocutaneous units.

3.3 Lower trapezius myocutaneous flap (6)

It is shown that there are two main patterns of vascular supply of the trapezius and that the muscle is principally supplied by three vascular sources.

1. The transverse cervical artery
2. The dorsal scapular artery
3. Posterior intercostal arterial branches

In this technique, the skin island is located at the inferior aspect on the trapezius muscle. It is designed between the vertebral column and the scapula with its vertical axis extending between the mid scapula and the inferior origin of the muscle.

The skin is incised to the posterior surface of the trapezius muscle. In elevating the skin paddle laterally, it is important to include the fascia overlying the LD muscle and then to dissect from lateral to medial under the fascia. This method automatically leads to the lateral border of trapezius.

The medial muscle fibers of origin are divided and the flap(s) is elevated toward the MMC defect. This flap can be elevated to the level of the base of the neck. Flap(s) is sutured on MMC defect with routine technique.

3.4 Reversed LD muscle flap (10)

The reversed LD muscle flap is based on perforators of the 9th, 10th and 11th posterior intercostal vessels.

They pierce the lumbar fascia and overlying sacrospinalis muscle to enter the LD muscle.

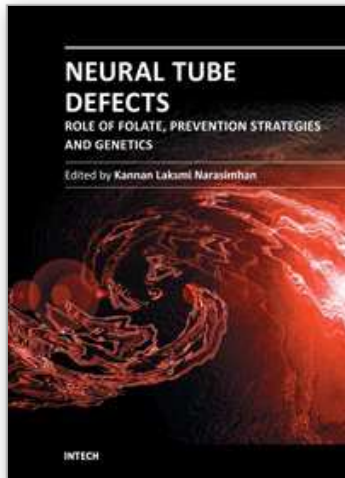
In this technique, incisions are extended obliquely from the axilla to the defect, then dissection continued and the muscle insertion is identified and divided. Then the deep lateral surface of the muscle is identified and dissections continued towards the posterior trunk midline, with preservation of the segmental pedicle from the posterior intercostal arteries. For adequate and tension-free turnover of muscle to the defect, superior muscle fibers of origin and the superior segmental pedicle are divided. Turning over is done along the oblique line connecting the segmental pedicle. Partial thickness skin graft is then harvested from the thigh and applied on the muscle.

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Neural Tube Defects - Role of Folate, Prevention Strategies and Genetics

Edited by Dr. Kannan Laksmi Narasimhan

ISBN 978-953-51-0317-2

Hard cover, 200 pages

Publisher InTech

Published online 16, March, 2012

Published in print edition March, 2012

The book Neural Tube Defects - Role of Folate, Prevention Strategies and Genetics has several eminent international authors and the book is a resource for anybody who is interested in this very important subject. The authors are distinguished and the chapters are a product of their extensive research.

How to reference

In order to correctly reference this scholarly work, feel free to copy and paste the following:

Mehrdad Hosseinpour (2012). Treatment of Large Thoraco-Lumbar Neural Tube Defects, Neural Tube Defects - Role of Folate, Prevention Strategies and Genetics, Dr. Kannan Laksmi Narasimhan (Ed.), ISBN: 978-953-51-0317-2, InTech, Available from: <http://www.intechopen.com/books/neural-tube-defects-role-of-folate-prevention-strategies-and-genetics/treatment-of-large-thoraco-lumbar-neural-tube-defects->

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