



**ORIGINAL RESEARCH PAPER**

**Plastic Surgery**

**A CLINICO DEMOGRAPHIC AND OUTCOME BASED STUDY OF SURGICAL MANAGEMENT OF OPEN NEURAL TUBE DEFECTS**

**KEY WORDS:** Neural Tube Defects, Meningomyelocele, Latissimus Dorsi Flap

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**ABSTRACT**

**Background:** Myelomeningocele is the commonest paediatric neurosurgical problem encountered in clinical practice. The problem is the exposed neural tube and impaired circulation of CSF. A good surgery consists of excision of myelocele sac, repair of neural tube defect, watertight closure of the CSF leak and proper cover with durable, tension free soft tissue and skin. These are necessary to prevent infection leading to meningitis, ventriculitis and its associated complication which may end as death also. However none of these measures prevent the subsequent development of hydrocephalus. Plastic surgical assistance is needed many times in giving proper soft tissue coverage and acceptable skin closure in open neural defects. This retrospective study analyses the outcome of various surgical procedures performed for closure of Meningomyelocele defects.

**Material and methods:** This was a prospective follow up study done on 60 NTD babies. This study was done for duration of 4 years ranging from Jul 2015 to Jun 2019 in a tertiary care center. All meningomyelocele cases were primarily treated by the Dept of Neurosurgery. Only those cases where primary closure of the skin defect was not possible were referred to the Dept of Plastic surgery. Each NTD baby was followed up for a mean of 1 year after various types of surgeries.

**Results:** They were 4 cervical, 6 thoracic and 20 lumbar meningomyelocele cases. The duration of follow up ranged from 3 months to 2.5 years with a mean follow up of 1 year. 9 children died in the immediate post OP period due to pneumoniae, sepsis and other causes unrelated to surgery. 2 children were lost for follow up. 19 children remained in the study group. Of the 19 cases of the Myelomeningoceles sought for plastic surgery intervention for closure of defect after neural tube repair, 6 underwent Limberg flap, 6 underwent bilateral bipediced flaps with skin grafts at lateral edges, 1 underwent multiple Z plasties, 1 underwent horizontal bipediced flap closure, another 5 patients underwent reverse latissimus muscle flap and skin grafting. 3 patients with bipediced flap closure developed partial flap necrosis, which were debrided, managed conservatively in 2 cases and skin grafted in 1 case.

**Conclusion:** Large MMC need plastic surgery intervention for closure of defects after neural tube closure. Plastic surgeon has various local and regional flaps like Limberg flap, Z plasty, bipediced fasciocutaneous flaps in his armamentarium for closure of the defects depending on the adjacent tissue laxity, shape of defect, size of defect and experience of the surgeon.

**INTRODUCTION:**

Neural tube defects (NTD) are defects in the brain, spine or spinal cord. The incidence of NTD reported is 3.5 per 10,000 live births in the USA. Spina bifida and anencephaly are the two most common NTD. 300000 babies are born with NTD every year world wide. (1) The global prevalence of myelomeningocele has been reported to be 0.8-1 per 1,000 live births. Meningomyelocele is the most severe form of spina bifida, where the spinal canal fails to close. MMC repair should be performed soon after birth provided that the newborn's general condition is good and signs of meningeal infection are absent. According to the literature the operation is usually performed within the first 48 hours of life. (2) Such delay, whilst not deleterious for neurological function nor for increasing the risk of CSF infection, allows the neurosurgeon to obtain more comprehensive information on the child's clinical condition (including thorough neuroradiological investigation), and for the parents to become better acquainted with the problems related to the malformation in order to give adequately informed surgical consent. (3) Surgery should not be delayed beyond 72 hours of life, as it has been demonstrated that after this time there is a 37% risk of ventriculitis, compared to only 7% when operated upon in a more timely fashion. A delay in surgical repair also exposes the myelodysplastic newborn to the risk of deterioration in neurological and bladder function. (4) Early closure of the defect is considered to be the standard of care. Various surgical methods have been reported, such as primary skin closure, local skin flaps, musculocutaneous flaps, and skin grafts. The aim of this study was to describe the clinical characteristics of myelomeningocele defects and present the surgical outcomes of recent cases of myelomeningocele at

our institution.

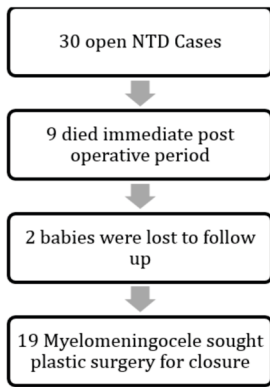
**MATERIALS AND METHODS:**

This was a prospective follow up study done on 30 NTD babies. Ethical clearance from the institution review committee was obtained and study was done after obtaining informed consent. The objective was to find the incidence of various outcomes of surgical management of NTD. Surgery type and outcomes type were also noted along with their clinico demographic profile. This study was done for a duration of 4 years ranging from Jul 2015 to Jun 2019 in a tertiary care center. All meningomyelocele referred to the Dept of Plastic surgery for closure of defects Small meningomyelocele defects which were closed by neurosurgeon primarily were excluded from the study. Various surgeries like Limberg flap, bilateral bipediced flaps with skin grafts at lateral edges, multiple Z plasties, horizontal bipediced flap closure and reverse latissimus muscle flap and skin grafting were considered based on size, position and other complications of meningomyelocele. Each NTD baby was followed for a mean of 1 year (6 months to 2.5 years).

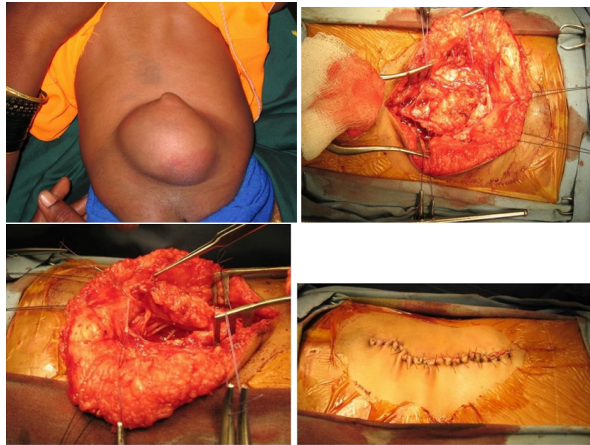
**LD Flap Technique:** A skin incision was made from posterior axillary fold from T7 spinous process to medial margin of latissimus dorsi (LD). LD was exposed. Humoral insertion of the LD was transected and the thorocodorsal vessels were ligated. LD was separated from the underlying chest wall. LD was Flipped over to reach the defect by dividing the aponeurosis origin of it from the thoracic spine. LD was totally inverted to cover the soft tissue defect. Perforators from the posterior intercostal arteries were preserved. Donor site was closed once the LD flap was inset.

**RESULTS**

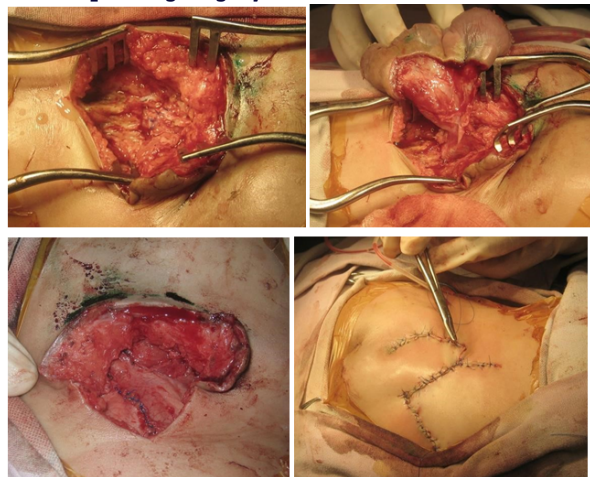
**Figure 1: NTD cases recruitment and follow up**



**Figure 2: Large Meningomyelocele**



**Figure 3: Meningomyelocele opening and latissimus dorsi flap during surgery Case 1**



**Figure 4: Meningomyelocele closure with latissimus flap Case2**

**Table No 1: Clinico demographic profile of babies with NTD in the study**

Site of Meningomyelocele	n	%
Cervical	4	13.3%
Thoracic	6	20.0%
Lumbar	20	66.6%
Total	30	100%

**Table number 2: Type of surgery and outcome in NTD babies**

Limberg flap	No complication	6	31.5%
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bilateral bipediced flaps with skin grafts at lateral edges	partial flap necrosis	3 (2 managed conservatively) (1 managed with skin graft)	15.7%
	No complication	3	15.7%
multiple Z plasties	No complication	1	5.2%
horizontal bipediced flap closure	No complication	1	5.2%
reverse latissimus muscle flap and skin grafting	No complication	5	26.3%
Total Myelomeningocele closure		19	100%

**DISCUSSION:**

In order to prevent wound problems in large MMC repair, we used all of the hairy skin around the MMC defect for closure even though the colour was red or purple, and seemed to be oedematous. Bipediced flaps are commonly used. Incisions were given on the flanks, bipediced flaps were raised, lateral secondary defects were skin grafted.

Horizontal bipediced flaps can also be used but the mobility of flaps is less. It can be used as one more method for closure of the flap.

Limberg flap was used when the defect was of rhomboid shaped. it achieved complete closure without need for skin grafts.

Z Plasty technique is another technique where in the surrounding lax tissue is recruited into midline in the form of transposition of triangular flaps

The most common indication for the use of the reverse latissimus dorsi muscle flap has been a complex defect or a complicated defect, like infected ulcer, post radiotherapy ulcer, CSF leaks. (5) In the present study we have used it for complex wounds with CSF leak. The reverse latissimus dorsi is considered only as an alternative for complex meningomyelocele closure. Ayad *et al.* used the reverse latissimus dorsi flap as a primary reconstruction for large defects.

The reverse latissimus dorsi muscle flaps are based on the perforators from the posterior intercostal vessels and the lumbar vessels. The turnover of the reverse latissimus dorsi muscle flap from upper back to the lower back can cover midline lumbar and sacral defects. The reverse latissimus dorsi muscle flap can be transposed to cover the lumbar or thoracic defects and can be used inside the chest. The superior perforators can be divided for adequate reach of the flap, but the inferior pedicles need to be preserved for the survival of the flap. In case 3 the distal part of the latissimus dorsi flap was not healthy and thus we had to debride part of the flap. We felt the secondary pedicles were not sufficient to vascularise the distal end. Studies have found that the vascularity of the reverse latissimus dorsi flap is reliable. (6)

There is thinning of the skin over the myelomeningocele. There is decreased soft tissue support in the midline if the skin over the defect is thinned by expansion. The use of a muscle cover in addition to the fasciocutaneous flap, over the repaired dura will give additional support as well as act as a vascularized cover over the dura. The layered closure had helped Söyüncü *et al* to decrease the CSF leakage by using omentum and latissimus dorsi flap. (7)

A reverse latissimus dorsi flap can also be used for 3D

coverage and to control bacterial contamination. (5,6) In our experience, complicated acquired defects (like in the fourth case) require muscle to fill the dead space around the fixators as a first layer to cover the implants. Dead space is a potential space for seroma collection and infection. So, with a muscle flap we were able to successfully prevent the formation of seroma and infection.

Large meningomyelocele defects have also been reconstructed with reverse latissimus dorsi flap and skin graft. (8) In one case we decided to leave the wound to heal by secondary intention as the skin necrosis defect was 1 cm in size. We had a healthy muscle covering the dura and hence, we were able to allow for secondary intention without the risk of dura break down and infection.

Latissimus dorsi muscle is a type V muscle flap based on thoracodorsal artery and perforators from the lumbar and posterior intercostal vessels. These perforators are usually present 5 cm from the midline. The perforators were present within 5 cm of the midline in our series. All the flaps except 1 survived without any distal necrosis, even though the distal perforators were intact. The distal 2 perforators are enough for the survival of the muscle for the lower part of the muscle. Hayashida *et al* have published a case report on reverse latissimus dorsi flap based on the 10th perforator. (9) In the above case the reach of the flap was up to the anterior superior iliac spine. In our cases the flaps reached the lower sacrum without tension or compromise on the muscle vascularity in all cases except 1 case. Though many authors have described that the flap can survive with the lower 9th and 10th perforators, we feel distal flap necrosis may be encountered. We do not have a large series as proof, hence further studies would be needed.

The flap reaches down to the lower sacrum, however, one might have difficulty covering the lower part of the sacrum. As an option, the gluteus maximus muscle flap can also be used as described in one of our cases. The most frequent complication of the latissimus dorsi muscle flap is seroma. However, in our series we did not encounter it.

The reverse latissimus dorsi flap is robust with a reliable vascularity. The chances of failure are small. Alternatives include the use of local flaps, which do not have the mopping qualities of the muscle. We can de epithelialise the skin flaps and use it to obliterate the dead space. This may lead to the development of epithelial cysts. Söyüncü *et al* (7) have used latissimus dorsi muscle flap along with omentum with a view that layered closure would decrease chances of CSF leak in recurrent cases of CSF leak.

Free flaps are an option, however the recipient vessels are deep and hard to find. The vessels which could be harvested as recipient are the superior gluteal vessels, inferior gluteal vessels, and intercostal vessels, perforators from the deep femoral system, superficial femoral trunk, and thoracodorsal vessels. The other possible methods of obtaining a recipient are using an interposition vein graft between the distant vessels to the donor vessels, or a carrier vessel may be used and flap transferred in stages. Reverse latissimus dorsi flap has been transferred to the defect and supercharged the flap by anastomosing the thoracodorsal vessels with the inferior gluteal vessels. (10) We have followed up the patients for 6 months; the functional deficit of the shoulder could not be assessed in children. However there was no appreciable difference in movement of the shoulder when compared to the opposite shoulder. In case 4, we did not find any restriction when compared to the opposite shoulder. Case 5 was lost in follow up. Other studies regarding functional assessment have also found no significant shoulder function disability. (11)

Our study had 5 cases; it is not a comparative study. Further studies may be required to compare other flaps with the

reverse latissimus dorsi flap to establish that it is a better choice in complex defects of the back. However, most of the authors in the literature have agreed that reverse latissimus dorsi flap is a choice for reconstruction of the back with CSF leaks, difficult wounds with infection, radiation, etc .

**CONCLUSION:**

In conclusion, we feel that reverse latissimus dorsi muscle flap is a robust flap with reach up to the lower part of sacrum. We recommend it as a definite choice for big complicated meningomyelocele defect or any posterior defect in the lumbar and sacral region. We feel that this flap may be considered as a primary choice for big myelomeningocele defect. However, the role of other flaps like Limberg flap, bipedicle flap, and z plasty can not be underestimated depending on the type of defect, size of defect and experience of the surgeon.

**Conflicts of interest:** Nil

**Funding:** Nil

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