Background: Open neural tube defects in the spine most commonly are in the lumbo-sacral region. Surgical closure is the treatment, but in primary closure the chances of CSF leak are more. Hence a novel technique of using an advancement flap called the V-Y plasty for closure of these defects(6). Our study compares the outcomes of primary closure and V-Y plasty in the closure of Myelomeningoceles. Methods: A prospective study of the infants who underwent surgical repair for MMC at our hospital from August 2014- January 2018 were included in the study. Total of 22 infants were treated, 9 underwent primary repair and 13 underwent V-Y plasty. Results: The time taken for primary closure was a mean of 120 min, while the advancement flap took longer of 190.7 min. All the 9 who underwent primary closure had CSF leak, 3 developed hydrocephalus, 6 had wound dehiscence, 3 had neurological deficits and 1 died. Of the 13 infants who underwent V-Y plasty 3 had CSF leaks, 1 had hydrocephalus, 5 had neurological deficits and no wound dehiscence or deaths. Conclusion: The aim of surgical repair is to cover the exposed neural tissue, prevent CSF leak and reduce CNS infections. V-Y plasty a plastic surgical technique of advancement flaps with intact pedicles improves the outcome of skin closure once the neural placode is placed in the dura and closed. This reduces the morbidity in a one-time procedure.

KEYWORDS: Myelomeningoceole repair, V-Y plasty, advancement flap, open neural tube defects

INTRODUCTION

Myelomeningocele and meningocele are a regular presentation in a neurosurgical practice, more so if the neurosurgeon is dealing with pediatric patients. They are a type of neural tube defects, where the lateral edges of the neural placode fail to fuse in the midline resulting in a defect.(1,2) These defects can occur along the whole length of the spines but are more commonly seen in the lumbosacral region.

The exact etiology causing the formation of these defects is still unclear. By far, spina bifida is the most common of these defects. The incidence of open neural tube defects is about 0.5–1.0 per 1000 births.(4) Thoracolumbar myelomeningocele (MMC) has an incidence of 0.6–0.8 per 1000 live births,(5,6) whereas cervical MMC, which is rare, is 1 in 5000 live births.(7) Survival rates of these patients are good if the neurological deficits are minimal. These patients present with bilateral lower limb paralysis, urological problems, hydrocephalus, and saddle anesthesia, resulting in decubitus ulcers.

The treatment is primarily surgical closures of the defect, but it has its own set of complications. The main objective for closure is to preserve neural tissue, and...
have a good skin closure which is tension free thereby preventing wound dehiscence and secondary infection.[6]
Our institution is a tertiary caregiving center with referrals coming in regularly. There are many options of repair such as primary closure, multiple plastic surgical maneuvers, and the latest being performed by highly specialized centers, fetal MMC closure. This study aimed at comparing primary closure and closure with an advancement flap, that is, V-Y plasty, and their outcomes.

**Materials and Methods**

Ours is a prospective study conducted from August 2014 to January 2018. Twenty-two infants presented to the Department of Neurosurgery during this period. All the patients included in this study were newborns with either MMCs or meningoceles. MMCs in other age groups were not included. Other types of neural tube defects such as lipomyelomeningocele or lipomeningoceles were not included. Because this study is based on the technique of closure, the distribution among sexes has not been mentioned.

All the patients were admitted to the NICU, and they were nursed in prone position with feeding done through a nasogastric tube. The defect was dressed with Vaseline-based antibiotic ointment, impregnated gauze, and a pad. An urgent magnetic resonance imaging (MRI) of the whole spine and T2-weighted imaging of the brain was performed: spinal imaging to see for any other anomaly and brain imaging to rule out hydrocephalus. Once the defect and its contents are studied, the surgery was planned. Of 22 infants, 9 underwent primary closure and 13 underwent V-Y plasty. Of these 13 infants, 2 underwent unilateral plasty and 11 underwent bilateral V-Y plasty. The parents of the children were informed in detail about the condition of the child, the intended procedure, and the possible complications that can be encountered. Once the parents signed the consent form, preparation for the procedure was initiated.

In the children who had a defect less than 3cm, a primary closure was performed by the neurosurgeon, and in the children who had a defect more than 3cm, a V-Y plasty was performed by the plastic surgeon as a closure technique.

Primary closure was performed in children with defects less than 3 cm. Once the thecal sac was dissected out, the neural placode was placed into the new dura. Then the
edges of the dura were sutured in a watertight manner with absorbable polyglactin (Vicryl) 4-0. No fibrin sealant was used over the dura. The filum terminale was identified and cut to release if any tethering was present. Subcutaneous sutures were taken and skin was closed with nylon sutures.

The children with larger defects were selected for V-Y plasty closure. Once the thecal sac was dissected out, the placode was placed into the new dura. Then a “V”-shaped incision was placed on one side [Figures 1 and 2]. The flaps were approximated in the center without pressure. The rest of the flap was sutured with the angle being made linear, thus forming a Y. The V-Y plasty is a fasciocutaneous advancement flap that reduces the tension at the midline [Figure 3].

**RESULTS**

All the infants who presented to the department with these neural tube defects after being evaluated underwent surgical repair. A total of 22 infants were treated during this period. In all the infants, the thecal sac was dissected so that the dural repair will be conducive having surplus dura, resulting in a spacious canal. No artificial dural substitutes were used. Of 22 infants, 9 underwent primary repair, and the remaining 13 underwent V-Y plasty for closure of the skin. Of the 13 infants, 2 underwent unilateral plasty whereas the remaining 11 had a bilateral plasty. All the defects were closed well on table. The mean operating time for primary closure with MMC repair was 120 min, whereas the time taken for MMC repair with V-Y plasty was 190.7 min.

Postoperatively, all the nine who underwent primary repair had a cerebrospinal fluid (CSF) leak. Three developed hydrocephalus; once the leak stopped, they underwent V-P shunting. One infant died due to infection and resultant meningitis, six had wound dehiscence, and three had neurological deficit. On the other hand, no mortality was observed in 13 infants who underwent V-Y plasty; 3 CSF leaks were detected, but none got infected or any wound dehiscence encountered [Figure 4]. These patients were put on acetazolamide as per pediatric doses and daily dressings were performed. Eventually CSF leaking stopped and the wounds closed well.
healed. In the patients who underwent unilateral V-Y plasty, a bulge under the skin was seen with the normal side being flat [Figures 5 and 6]. One patient developed hydrocephalus, which was shunted at a later date. Neurological deficits were seen in five patients, which presented with bilateral lower limb weakness. In both the groups, bowel and bladder incontinence could not be assessed [Tables 1 and 2].

The mean follow-up period was 23.5 months, the least being 15 months and the maximum being 32 months. At the last follow-up, because the primary closure was performed in the initial cases, four of the five patients who were neurologically intact could walk without support. The remaining one patient needed support as one limb had gone into talipes equinovarus (club foot). In the V-Y plasty group, five infants have crossed the 24-month post op period, of which, two can walk without support, and the remaining needed support: two have developed club foot and one has limb shortening with maldeveloped foot. The children with these foot abnormalities were referred to the orthopedicians for further management.

**DISCUSSION**

Open neural tube defects affecting the lower spine are most commonly seen in the patients with lower socioeconomic status. The exact etiology of this has not been clearly understood, and many factors such as genetics, geography, and nutrition have been attributed. This can be prevented by prenatal folate supplements. MMCs have a direct consequence on
the quality of life of the infant. The standard treatment is surgical repair and closure.

In the recent times, fetal surgery has been performed with good results and minimal neurological deficits,[11] but in only a selected patients.[12] Fetal surgery has also advanced to putting a scope and is called fetoscopic repair of MMCs.[13] But the widely followed procedure is that of open postnatal repair as described by Pang.[14] The aim of surgical repair of MMC is to cover the exposed spinal cord and the nerve roots, to prevent CSF leaks, and to reduce the chances of central nervous system infection, which can occur due to defects created by surgery.[6,15] In our study, we followed the open postnatal repair, but our method was initially a dura closure and then a primary closure of the skin. We faced multiple complications with this method; hence, we decided to do an advancement flap in the form of a V-Y plasty. Musculofasciocutaneous flaps for closure of the defects have been explained by Munro et al.[16] and McDevitt et al.[17] It has been observed to have less complications as listed with an advancement flap than primary closure. The reasons for the relatively good outcome may be as follows[18]:

- Lesser tension at the midline site of suturing
- Robust lumbar and gluteal vascular anastomoses help in better healing
- Pedicle arteries being superior gluteal and thoracodorsal arteries that supply the region
- Wider surface area to absorb the CSF in the event of a leak from the repaired dura

These being the advantages, the procedure of V-Y plasty takes more time, hence putting our little patients to prolonged anesthetic drugs and a prone position. Blood loss is more as cautery is least used to preserve the blood supply. The chances of infection along the large line of incision are far more as the site incision is close to anus and prone to fecal contamination.

We did encounter complication with V-Y plasty, but the morbidity compared to primary repair was less. Because of the faster healing time, the duration of hospital stay was reduced but the presentation of hydrocephalus was early, thereby directing the treatment toward a CSF diversion procedure. Because this is a fasciocutaneous flap, the muscle and its innervations are left intact when compared to musculocutaneous flaps, thereby retaining good function of the muscles. These muscles would help maintain trunk posture and pelvic stability.[15,19] No necrosis at the incision site or wound dehiscence was encountered. Finally, but most importantly, the presence of a skillful plastic surgeon adds a feather to the cap ending up in a neat flap closure procedure.

**Conclusion**

Our study proves that closure technique with an advancement flap has superior results rather than primary closure. The study did not take the defect size as criterion to decide on the technique used; hence, the patients undergoing the procedure are small and delicate, even minimal pressure on the skin edges causes problems such as wound dehiscence, CSF leak, and infections. These can be avoided by spending some more time doing a one-time procedure. By using fibrin sealants like Tisseel, the results and hospital stay can be greatly reduced.

**Declaration of patient consent**

The authors certify that they have obtained all appropriate patient consent forms. In the form the patient(s) has/have given his/her/their consent for his/her/their images and other clinical information to be reported in the journal. The patients understand that their names and initials will not be published and due efforts will be made to conceal their identity, but anonymity cannot be guaranteed.

**Financial support and sponsorship**

Nil.

**Conflicts of interest**

There are no conflicts of interest.

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