

Primary Closure and Local Flap Reconstruction in a Neonate with Giant Meningoencephalocele: A Case Report and Technical Considerations

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ABSTRACT

Introduction: Meningoencephalocele is a rare congenital neural tube defect characterized by herniation of the meninges and brain tissue through a skull defect. Giant occipital lesions in neonates pose major surgical and reconstructive challenges owing to fragile tissues, limited physiological reserve, and a high risk of cerebrospinal fluid (CSF) leakage and infection. Although neurosurgical principles are well established, optimal soft-tissue reconstruction in neonates remains underreported. We describe a multidisciplinary, reconstruction-focused approach to neonatal occipital meningoencephalocele.

Case Description: An 11-day-old female neonate presented with a large midline occipital mass noted since birth—soft, fluctuant, and skin-covered, without neurological deficit or infection. Imaging confirmed an occipital skull defect with herniation of the meninges and brain tissue. After multidisciplinary evaluation, staged surgery was performed: neurosurgical excision of non-functional herniated tissue with watertight dural closure, followed by scalp reconstruction using a local occipital rotation flap for tension-free coverage. The post-excisional defect measured approximately 8 × 6 cm and the total operative time was approximately 180 minutes. No intraoperative complications occurred, and the neonate showed stable wound healing without CSF leakage, dehiscence, infection, or neurological deterioration during early follow-up.

Conclusion: A staged, multidisciplinary strategy combining precise neurosurgical repair with appropriate local flap reconstruction can achieve safe closure, protect neural structures, and provide durable functional and aesthetic outcomes in neonates with occipital meningoencephalocele. Early integration of plastic surgery for tension-free, well-vascularized coverage is central to preventing wound and CSF complications.

Meningoencephalocele, Neonate, Occipital Defect, Scalp Reconstruction, Local Flap, Multidisciplinary Approach

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INTRODUCTION

Meningocephalocele is an uncommon but clinically significant neural tube defect characterized by the herniation of the meninges, cerebrospinal fluid, and variable amounts of brain through a congenital skull defect. Its incidence is heterogeneous worldwide, with overall encephalocele rates ranging from 0.8–4 per 10,000 live births, with regional hotspots in parts of Asia, while skull-base and giant occipital variants are distinctly rarer [1]. Embryologically, these lesions arise from the failure of neural tube closure during early

neurulation (closure of the cranial neuropore around day 25 of embryogenesis), and their natural history is frequently complicated by concomitant intracranial abnormalities, such as hydrocephalus, Chiari malformations, and cortical dysplasia [2]. The amount and functional significance of herniated neural tissue (for example, occipital versus parietal involvement) are major determinants of long-term neurodevelopmental outcomes [3].

The fundamental aims of surgical management are consistent and limited in number: protecting and preserving viable neural tissue, establishing and maintaining a watertight barrier to prevent CSF leakage and ascending infection, and optimizing preservation of neurological function [4]. Achieving these goals requires timely neurosurgical intervention with careful intradural repair, reliable duraplasty, and reconstruction of the bony and meningeal defect, combined with strategies to prevent and manage hydrocephalus [5]. In neonates, these objectives must be balanced against physiologic fragility—limited blood volume, thermoregulatory vulnerability, and airway challenges posed by large occipital masses—which influence anesthesia, positioning, and intraoperative decision-making [6]. Despite detailed descriptions of neurosurgical techniques for sac reduction, dural closure, and cranial reconstruction, the reconstructive soft-tissue problem in neonates often receives comparatively less focused attention. Large defects commonly outstrip local tissue availability, and neonatal skin and subcutaneous tissue behave differently from those of older children or adults (increased fragility, immature inflammatory response, rapid but delicate healing) [7]. The choices of flap design, need for multilayer closure, preservation of perforator vasculature, and the trade-offs between operative time and staged procedures are under-reported relative to neurosurgical steps [7-9]. Moreover, considerations such as minimizing anesthesia time, preventing pressure injury to the sac during airway management, and selecting reconstruction strategies that reduce CSF leak and donor-site morbidity are practical gaps that materially affect outcomes [6].

This case report presents primary closure with local flap reconstruction in a neonate with a giant meningoencephalocele and frames the technical considerations that guided decision-making. By detailing preoperative planning, intraoperative technique (including skin incision design, flap selection, and multilayer dural and soft-tissue closure), perioperative anesthesia, and postoperative care, we aim to highlight reconstructive principles that support the core neurosurgical goals of neural protection and infection prevention while minimizing physiologic stress. The report intends not only to document a successful multidisciplinary approach in a high-risk neonatal patient but also to stimulate greater emphasis in the literature on tailored reconstructive strategies that address the unique anatomic and physiologic constraints of this vulnerable population.

CASE DESCRIPTION

An 11-day-old female neonate was referred to a tertiary care center with a primary complaint of a large mass located at the occipital region of the scalp, which was present since birth. According to the parents, the mass was noticed immediately after delivery and became progressively more prominent during the early postnatal period. The lesion was soft on palpation and covered by thin but intact skin, without erythema, ulceration, or discharge. The infant appeared more irritable than age-matched neonates but maintained adequate feeding. There was no history of seizures, projectile vomiting, altered level of consciousness, or other signs suggestive of raised intracranial pressure.

The clinical history revealed no episodes of trauma, bleeding, or infection involving the mass. The patient was born at term via cesarean section, the indication being a prenatally detected cranial mass. The birth weight was appropriate for gestational age, and the Apgar scores were within normal limits. The maternal history was notable for suboptimal antenatal care, particularly during the first trimester, and inconsistent intake of folic acid supplementation before and during early pregnancy. The mother reported an episode of severe nausea and vomiting accompanied by fever during the first trimester, which was not medically evaluated. There was no family history of congenital anomalies, neural tube defects, or hereditary disorders. On physical examination, the patient was alert, with a strong cry and appropriate responsiveness to stimuli. Vital signs were within normal ranges for a neonate: heart rate approximately 140 beats per minute, respiratory rate 40 breaths

per minute, axillary temperature 36.7°C, and oxygen saturation 98% on room air. General examination demonstrated good overall condition, warm skin with adequate turgor, and no signs of systemic infection.



Figure 1. Preoperative clinical appearance of a giant midline occipital meningoencephalocele in an 11-day-old neonate. The lesion is a spherical, skin-covered, soft, and fluctuant mass measuring approximately 8–10 cm in diameter, without pulsation, ulceration, or discharge.

Examination of the head revealed a spherical mass in the midline occipital region, measuring approximately 8–10 cm in diameter (Figure 1). The mass was covered with intact skin of normal coloration, had a soft-elastic consistency, was fluctuant on palpation, and demonstrated no obvious pulsations. The anterior fontanelle was flat and non-tensed. Neurological examination revealed intact primitive reflexes appropriate for age (Moro, grasp, and sucking reflexes). The muscle tone was symmetrical, with no focal neurological deficits or clinical signs of increased intracranial pressure. Ophthalmological examination revealed isocoric pupils with intact bilateral light reflexes. Otolaryngological evaluation showed no structural abnormalities, and cardiovascular examination demonstrated regular heart sounds without pathological murmurs and good peripheral perfusion. Ancillary investigations were performed to assess the associated anomalies and surgical readiness. Transthoracic echocardiography revealed normal cardiac anatomy and function, with no evidence of congenital heart disease. Serial laboratory tests, including complete blood count, serum electrolytes, renal function tests, and inflammatory markers, were all within normal limits. Cranial imaging with computed tomography and magnetic resonance imaging revealed a defect in the occipital bone with herniation of the brain tissue and meninges into an extracranial sac, consistent with a diagnosis of occipital meningoencephalocele. Based on the clinical presentation, physical findings, and radiological features, the patient was diagnosed with congenital occipital meningoencephalocele without evidence of infection or significant neurological deficits. Following a multidisciplinary discussion involving neurosurgery, plastic and reconstructive surgery, anesthesiology, and neonatology, a staged collaborative surgical intervention was planned.

The patient underwent comprehensive preoperative evaluation by a multidisciplinary team. Preoperative CT/MRI imaging was used to assess the occipital bony defect, estimate the volume of herniated tissue, and plan incision lines and flap design. Under general anesthesia, the neonate was positioned prone with specialized padding to avoid excessive pressure on the meningoencephalocele sac, while strict attention was given to thermoregulation, fluid balance, and blood loss. The first stage consisted of neurosurgical excision of the sac, including resection of non-functional herniated neural tissue, repositioning of viable neural structures, and watertight closure of the dural defect using continuous sutures, with duraplasty performed when necessary to prevent CSF leakage. Following sac excision, a soft-tissue occipital defect measuring approximately 8 × 6 cm was identified, and primary closure was deemed unsafe due to excessive tension. Reconstruction was therefore performed by the plastic and reconstructive surgery team using a local occipital rotation flap elevated in the subgaleal plane with preservation of local perforators. The flap was designed with an approximately 1:1 flap-to-defect width ratio to achieve tension-free coverage, and the donor site was closed primarily. Layered

wound closure was completed using absorbable sutures, with the final skin suture line positioned away from the dural repair. The total operative time was approximately 180 minutes. Postoperatively, the patient was monitored in the neonatal intensive care unit, and no early complications such as wound dehiscence, CSF leakage, or infection were observed (Figure 2).



Figure 2. Early postoperative view following staged neurosurgical excision, watertight dural closure, and scalp reconstruction with a local occipital rotation flap, demonstrating tension-free soft tissue coverage without dehiscence or CSF leakage.

DISCUSSION

Reconstructing a giant meningoencephalocele in a neonate requires an understanding of the unique biological and physiological context of newborns, which differs fundamentally from that of older children and adults. Neonatal skin, even in term infants, demonstrates incomplete structural maturation. At approximately 30 weeks' gestation, the stratum corneum contains only a few cell layers, and even at term, the epidermal and dermal layers remain roughly 60% as thick as those of adults. This immaturity results in reduced tensile resistance, greater susceptibility to pressure-related injury, and incomplete barrier function during the early postnatal period [10]. The practical consequences of reconstructive surgery include a significantly lower tolerance for mechanical stress at the wound edges and an increased risk of desiccation, bacterial colonization, and thermal instability. In neonatal cranial reconstruction, closure should be planned assuming limited skin tensile tolerance; any approximation producing edge blanching, excessive traction, or reliance on skin elasticity alone should prompt immediate consideration of local flap advancement rather than primary closure.

In the present case, a neonate with a giant occipital meningoencephalocele underwent early repair using primary closure supplemented by local flap advancement to achieve tension-free coverage. Preoperative assessment revealed physiologic vulnerabilities typical of neonates, including limited soft-tissue reserve and compromised nutritional parameters (hypoalbuminemia), which were addressed perioperatively. Despite these challenges, reconstruction achieved stable coverage without wound dehiscence, CSF leakage, or early infectious complications. Wound-healing biology in neonates also differs in speed and quality. While the inflammatory, proliferative, and remodeling phases occur in sequence, collagen architecture develops more slowly and with less organization than in older individuals [11]. Early collagen deposition is dominated by type III collagen, and remodeling into stronger type I collagen is delayed [12]. Quantitative data highlight the fragility of neonatal wounds: tensile strength reaches only about 3% in the first postoperative week, approximately 30% by three weeks, and does not approach mature strength until nearly three months. Compounded by postoperative edema and inflammatory swelling (which peak in the first 48–72 hours), this makes neonatal closures particularly vulnerable to dehiscence even when they appear stable intraoperatively [13]. Because neonatal wounds possess minimal tensile strength during the first postoperative weeks, reconstructive strategies should avoid closures dependent on early mechanical stability and instead distribute tension across a broader tissue envelope using flap-based designs. Physiologic homeostasis during neonatal

surgery further amplifies the reconstructive challenge. The neonatal thermoregulatory system is easily overwhelmed under anesthesia: volatile agents suppress brown-fat thermogenesis, widen the thermoneutral zone, and predispose to rapid heat loss. Even brief hypothermia can induce pronounced catecholamine surges, increased oxygen consumption, lactic acidosis, and hemodynamic instability [14,15]. Fluid physiology is also distinct. Baseline neonatal albumin levels are lower, around 2.5 g/dL, reducing plasma oncotic pressure and promoting interstitial edema [16]. This edema compromises microvascular perfusion in flaps and around suture lines, especially when tension is present. The neonatal endocrine–inflammatory stress response, characterized by abrupt spikes in cortisol and catecholamines, further contributes to transient capillary leak and tissue swelling [17]. Reconstructive planning should therefore prioritize techniques that minimize operative time and tissue manipulation while maintaining strict thermal control and judicious fluid management.

Under these conditions, the foundational principles of plastic surgery become essential rather than optional. Tension-free closure is not merely aesthetically preferable but biologically mandatory. High-tension approximation exerts compressive forces on the microcirculation, impairs fibroblast migration, and disrupts collagen deposition. Mechanically stressed tissues are more prone to ischemia and necrosis, particularly in neonates whose dermal vascular networks are smaller and more fragile [18]. In meningoencephalocele, the consequences of wound failure are particularly severe: dehiscence may expose neural tissue, create pathways for CSF leakage, and significantly increase the risk of meningitis or ventriculitis [19]. Any closure requiring high-tension approximation, repeated suture adjustment, or producing localized ischemic changes should be abandoned in favor of a tension-free, multilayer reconstructive approach. The reconstructive options span a wide spectrum. Primary closure remains feasible for small defects, with some series reporting success in up to three-fourths of myelomeningocele cases and over 80% for defects averaging approximately 9.4 cm²; however, it becomes unsafe when significant tension is required [20]. The Limberg flap and modified rhomboid variants offer broader applicability for moderate-sized defects, with documented survival even for defects approaching 64 cm², though published complication rates range from approximately 14% to 21% [21]. The keystone-design perforator island flap (KDPIF) has emerged as a particularly advantageous option for large dorsal defects: its geometry redistributes tension across a wider zone, preserves perforators, and provides robust perfusion, with reported closure of defects up to 100 cm² and operative closure times of about 43–115 minutes depending on configuration [22,23]. For anterior defects, regional flaps such as the pericranial flap remain essential owing to their vascularity and compatibility with cranial-base anatomy [20]. In contrast, tissue expansion is rarely feasible acutely, and free flaps are functionally impractical in neonates due to prolonged anesthesia, vessel-caliber limitations, and high complication and transfusion rates [24]. In acute neonatal settings, perforator-preserving local flaps should be the primary option for large defects, reserving primary closure for small, tension-free defects.

Primary skin closure after dural repair carries an unacceptably high complication burden for moderate-to-large neonatal defects. In a prospective series of 22 infants, all nine treated with primary closure developed postoperative CSF leaks, two-thirds suffered wound dehiscence, one-third developed hydrocephalus, and mortality occurred; by contrast, 13 infants managed with V–Y advancement flaps had a markedly lower CSF-leak rate (23%), no wound dehiscence, and no mortality, demonstrating that flap reconstruction substantially improves short-term safety in larger defects [25]. The mechanistic basis is straightforward: neonatal skin and subcutaneous tissues lack sufficient laxity, and linear closure directly over a dural repair leaves the cutaneous suture line vulnerable to any minor dural seepage. Perforator-preserving local flaps are the workhorse solutions for dorsal neonatal defects. The KDPIF is now widely favored because it recruits multiple perforators, redistributes tension broadly, preserves donor-site function, and closes defects up to 100 cm² with low major-complication rates and relatively short closure times (43–115 minutes depending on configuration) [20]. V–Y advancement plasty also reduces CSF leakage by creating thicker soft-tissue buffering between the dura and skin; although operative times may be longer (~190 minutes in some series), V–Y flaps delivered dramatic reductions in leakage and dehiscence in comparative cohorts [25]. Bilateral bipediced fasciocutaneous flaps and dorsal intercostal artery perforator (DICAP) propeller flaps are useful alternatives for very large or thoracolumbar defects, offering dual vascular pedicles or a long arc of rotation, respectively, with low distal

necrosis and acceptable CSF-leak rates [26]. Successful neonatal flap reconstruction rests on three operative pillars: deliberate perforator mapping and preservation, geometric tension redistribution, and fascial/subcutaneous preservation to maintain vascular plexuses [20]. Preoperative handheld Doppler mapping marks perforators centrally within the planned flap, and KDPIFs are designed to include multiple perforators rather than a single dominant vessel to provide robust perfusion despite small neonatal vessel caliber. Flap elevation in a subfascial plane preserves the fascial vascular plexus and avoids musculocutaneous sacrifice [6]. Tension redistribution follows simple, reproducible rules: unilateral KDPIFs use a 1:1 flap-to-defect width ratio, while bilateral designs effectively create a combined 2:1 width for symmetric, low-tension closure [20]. Critical technical details include offsetting the final skin suture line slightly lateral to the dural repair to reduce direct dural-to-cutaneous CSF transmission and accounting for three-dimensional deformity by increasing flap size by ~10–20% [25].

Systemic factors—particularly nutritional status and serum albumin—play a decisive role in postoperative durability. Hypoalbuminemia reduces oncotic pressure, increases tissue edema, restricts oxygen diffusion, diminishes collagen synthesis, and weakens immune function; the risk of wound complications increases markedly when albumin falls below 3.5 g/dL and increases sharply near 2 g/dL [27]. Serum albumin should therefore be assessed preoperatively in all neonates undergoing major reconstruction, and perioperative correction should be actively pursued. Ultimately, the success of reconstruction in neonatal meningoencephalocele relies on an integrated multidisciplinary team (MDT). Neurosurgeons ensure careful neural reduction and watertight dural closure; plastic surgeons design flap strategies that respect local vascularity and mechanical limits; pediatric anesthesiologists safeguard thermoregulation, hemodynamic stability, and metabolic demands; and neonatologists optimize nutrition, electrolyte status, albumin correction, and infection surveillance. Evidence indicates that MDT coordination lowers rates of CSF leaks, infection, and wound dehiscence while reducing operative time and improving long-term outcomes [28]. Formal involvement of plastic surgery at the preoperative planning stage should be standard in neonatal meningoencephalocele repair, regardless of whether reconstruction is ultimately performed by neurosurgery. This discussion is based on the scientific literature available for the present case rather than a formal systematic review, and some quantitative data are extrapolated from mixed neural-tube-defect cohorts—particularly myelomeningocele series—rather than from studies focused solely on neonatal cranial meningoencephalocele. Many available reports involve small samples and heterogeneous techniques, which may limit the generalizability of specific complication rates. Despite these limitations, the biological principles and reconstructive considerations discussed remain highly relevant to neonatal cranial reconstruction and are supported by consistent trends across the cited literature.

CONCLUSION

This case highlights the importance of staged multidisciplinary management of neonatal occipital meningoencephalocele. Successful outcomes depend on meticulous neurosurgical excision, watertight dural repair, and reconstructive planning that accounts for neonatal tissue biology and physiology. Early integration of reconstructive surgery enables tension-free, well-vascularized soft-tissue coverage, reducing wound complications and CSF leakage while optimizing functional and aesthetic results. This collaborative management should be standard for complex neonatal cranial defects.

DECLARATIONS

This report describes a single case without a control group, which limits generalizability, and the short follow-up period restricts the assessment of long-term effectiveness. Variations in patient characteristics were not explored. Further studies with larger samples and more robust designs are needed to validate these observations comprehensively.

CONSENT FOR PUBLICATION

The Authors agree to be published in the Journal of Society Medicine.

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COMPETING INTERESTS

The authors declare no conflicts of interest in this case report.

AUTHORS' CONTRIBUTIONS

R.A. was responsible for patient management, data acquisition, reconstructive planning, and drafting the initial manuscript. I.H. performed the neurosurgical management and contributed to the acquisition and interpretation of clinical data. S.R. provided clinical supervision, led the reconstructive strategy, and critically revised the manuscript for important intellectual content. All authors reviewed and approved the final version and agreed to be accountable for all aspects of the work.

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REFERENCE

1. Madaree A, Morris WMM. A clinicopathological classification of encephaloceles based on 207 patients. *JPRAS Open*. 2023;36:8-18.
2. Padmanabhan R. Etiology, pathogenesis and prevention of neural tube defects. *Congenit Anom (Kyoto)*. 2006;46(2):55-67.
3. Perrotta M, Gasparroni G, Chiavaroli V, Massimi L, Cognigni R, Sabatini L, et al. A case report of confusing meningoencephalocele. *Clin Case Rep*. 2021;9(1):109-112.
4. Thompson HM, Schlosser RJ, McCarty Walsh E, Cho DY, Grayson JW, Karnezis TT, et al. Current management of congenital anterior cranial base encephaloceles. *Int J Pediatr Otorhinolaryngol*. 2020;131:109868.
5. Hallak B, Kurzbuch AR, Fournier JY, Bouayed S. Spontaneous transthemoidal meningoencephalocele presenting in the form of recurrent unilateral nasal discharge: discussion of the diagnosis and endoscopic surgical management. *BMJ Case Rep*. 2020;13(5):e234964.
6. Kushida-Contreras BH, Gaxiola-García MA. Myelomeningocele defect reconstruction with keystone flaps: vascular rationale for the design and operative technique. *Arch Plast Surg*. 2021;48(3):254-260.
7. Fluss R, Lally A, Kim J, Kobets AJ. Multispecialty view on the management of basal transthemoidal encephaloceles and meningoceles in the neonate. *Interdiscip Neurosurg*. 2025;40:102006.
8. Ramasastry SS, Cohen M. Soft tissue closure and plastic surgical aspects of large open myelomeningoceles. *Oper Tech Plast Reconstr Surg*. 2000;7(2):68-76.
9. AlEnezi AY, Aljawad M, Baltayour AW, Alotaibi SA, Alzahri MS. Frontal meningoencephalocele with cerebrospinal fluid rhinorrhea: a case report. *Cureus*. 2023;15(10):e46343.
10. Visscher MO, Carr AN, Winget J, Huggins T, Bascom CC, Isfort R, et al. Biomarkers of neonatal skin barrier adaptation reveal substantial differences compared to adult skin. *Pediatr Res*. 2021;89(5):1208-1215.
11. Ciprandi G, Crucianelli S, Grussu F, Spuntarelli G, Faustino S, Marino M, et al. Meeting the challenges in pediatric wound care: our 15-year experience with dialkylcarbonyl chloride-coated dressing technology in acute and chronic wounds. *Chronic Wound Care Manag Res*. 2022;9:23-33.
12. Mathew-Steiner SS, Roy S, Sen CK. Collagen in wound healing. *Bioengineering (Basel)*. 2021;8(5):63.
13. Yates CC, Hebda P, Wells A. Skin wound healing and scarring: fetal wounds and regenerative restitution. *Birth Defects Res C Embryo Today*. 2012;96(4):325-333.

14. Fidler F. Anaesthesia for premature infants and newborns – what’s important? *Anästh Intensivmed.* 2022;63:199-216.
15. Waldron S, MacKinnon R. Neonatal thermoregulation. *Infant.* 2007;3(3):25-27.
16. Henry BM, Borasino S, Ortmann L, Figueroa M, Rahman AKMF, Hock KM, et al. Perioperative serum albumin and its influence on clinical outcomes in neonates and infants undergoing cardiac surgery with cardiopulmonary bypass: a multi-centre retrospective study. *Cardiol Young.* 2019;29(6):761-767.
17. Yuki K, Matsunami E, Tazawa K, Wang W, DiNardo JA, Koutsogiannaki S. Pediatric perioperative stress responses and anesthesia. *Transl Perioper Pain Med.* 2017;2(1):1-12.
18. Gong F, Wan B, Qi P, Wei Z. Biomechanical mechanism and clinical management progress of surgical wound tension. *Front Surg.* 2025;12:1674382.
19. Barber SM, Fridley JS, Konakondla S, Nakhla J, Oyelese AA, Telfeian AE, et al. Cerebrospinal fluid leaks after spine tumor resection: avoidance, recognition and management. *Ann Transl Med.* 2019;7(10):217.
20. Putri NM, Tunjung N, Sadikin PM. Closure of meningocele defects using various types of keystone-design perforator island flaps. *Arch Plast Surg.* 2021;48(3):261-268.
21. Shim JH, Hwang NH, Yoon ES, Dhong ES, Kim DW, Kim SD. Closure of myelomeningocele defects using a Limberg flap or direct repair. *Arch Plast Surg.* 2016;43(1):26-31.
22. Hantash SA, El-Ghazaly MH, Mahmoud WH, Khedr MM. Keystone flap for coverage of myelomeningocele defects: a simple solution to a complex reconstructive problem. 2025;15(4):124-136.
23. Obande JO, Bitrus PT, Obande EI. The timing of primary neurosurgical repair and wound-site infection in children with myelomeningocele. 2024:137-148.
24. Bhatia V, Kalra D, Singh M, Bodra C, Joshi H, Gohil R, et al. Rapid intraoperative tissue expansion for closure of lumbosacral meningocele. *Clin Stud Med Case Rep.* 2024:1-4.
25. Lobo GJ, Nayak M. V-Y plasty or primary repair closure of myelomeningocele: our experience. *J Pediatr Neurosci.* 2018;13(4):398-403.
26. Goktekin T, Tasdelen B. Comparison of dorsal intercostal artery perforator propeller flaps and bilateral rotation flaps in reconstruction of myelomeningocele defects. *Turk Neurosurg.* 2019;29(1):83-89.
27. Sultana M, Sultana N, Mostafa B, Khair AB, Islam S. Association of serum albumin level with wound healing after caesarean section. 2024:263-272.
28. Li Z, Tang X, Fu J, Pan D, Wang T, Zhang Z. Case report: a complex multidisciplinary surgical approach for a pediatric patient with congenital meningoencephalocele. *J Craniofac Surg.* 2025;36(6):e796-e799.
29. Risa Anggia, Imam Hidayat, Syamsul Rizal. Primary closure consideration and local flap reconstruction in a neonate with giant occipital meningoencephalocele: a case report and technical considerations. *Journal of Society Medicine.* 2026;5(4):5-120.