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Bilateral latissimus dorsi myocutaneous advancement flap for coverage of thoracolumbar myelomeningocele

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Abstract

Background and objective: The myelomeningocele is the most common form of neural tube defect, the early efficient and durable coverage and repair of the dural sac with well-vascularized soft tissue is important for neurological functional outcome and prevention of infection. The latissimus dorsi myo-cutaneous advancement flap is promising in this respect. The objective of the study was to assess the durability and advantages of bilateral latissimus dorsi myo-cutaneous advancement flap for coverage of medium to large -sized thoracolumbar myelomeningocele defects.

Methods: A retrospective study was carried out from 2012-2022, in Erbil (the capital of Kurdistan region, Iraq) at Rozhawa and Erbil Teaching Hospital. Ten infants (four males, and six females), all of them had medium to large thoracolumbar myelomeningocele defects, all managed operatively by two team approach of neurosurgeons and plastic surgeons under general anesthesia, using a bilateral latissimus dorsi myo-cutaneous advancement flap, the defect was closed.

Results: Ten patients were included in the study. Their mean age (SD) was 21.6 (8.3) days, and the age range was 10-35 days. More than half (60%) of the patients were females. The sites of the operation were (thoracic 50%, lumber 40%, and thoraco-lumber 10%). The size was medium in 60% of patients and large in (40%), and the time of the operation was less than two hours in 50% of the patients. Three patients (30%) developed complications, one developed simple edge necrosis, and two developed CSF leakage, and the success rate was 100%.

Conclusion: There are numerous benefits to using a bilateral latissimus dorsi myo-cutaneous advancement flap in comparison to alternative techniques for covering moderate to large thoracolumbar myelomeningocele abnormalities.

Keywords: Thoracolumbar myelomeningocele; Durable coverage; Latissimus dorsi muscle.

Introduction

Neural tube defect is the second most common congenital anomalies of central nervous system after congenital heart diseases.(1)

Failure of fusion and folding of lateral edge of neural plates at first four week of gestation result in neural tube defect; the myelomeningocele is the most common form of neural tube defect. And till now the cause of myelomeningocele is poorly understood, though some factors been associated like genetic, geographic, folic acid deficiency and law socioeconomic status.(2,3) As much as possible the early closure of myelomeningocele after birth will decrease the risk of infection and sepsis also protect the exposed neural structures from desiccation and further injury.(4)

The efficient and durable coverage and repair of dural sac with well vascularized soft tissue is important for neurological

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functional outcome and prevention from infection thenafter.[4,1)]

Many surgical techniques have been evolved through history specially in the past decades ,reaching the invention of intrauterine repair at highly specialized centers.[1)] Most of the cases can be closed by primary or local skin flap within 48-72 hours after birth specially if defect is small sized , but when the defect is large the closure and management of those defects will be challenging because of lack of amount of tissue available in infants that will face the high chance of dehiscence, and the team work at that time will be required from neurosurgeon, plastic surgeon and physiotherapist for effective management.[4-6)] Many methods have been described for closure of those large defects and in general the muscle flaps get superiority option over skin flaps because of their better blood supply so that its more resistant to infection and better white blood cells function, less chance of dehiscence, better obliteration of dead space that will decrease possibility of CSF leakage and more durable coverage and padding.[1,2,4,7)]

The latissimus dorsi muscle is a large, flat, muscle on the back that aid in upper limb adduction and externa rotation mainly, it's a type V muscle according to Mathes and Nahai classification and it's an expendable muscle that can be used as a muscle only, musculocutaneous and free flap.[4)]

Myocutaneous advancement flap has many advantages in closure of thoracolumbar myelomeningocele defects. Because it has a reliable blood supply, dissection is straight forward, preserving latissimus dorsi function, relatively short operation time and less blood lossin compare to other flaps for myelomeningocele management.[1,7)]

And to our knowledge this research has not been done in Kurdistan governorate and Iraq.

Methods

The study is retrospective descriptive study carried out from 2012-2022, in Erbil at Rozhawa and Erbil Teaching Hospital private hospitals. Ten infants were included all of them had large lumber Myelomeningocele defects ranging from (5*5 cm to 9*6.5 cm) all managed operatively with bilateral latissimus dorsi advancement flap, (6) males (60%), and (4) females (40%), with age range (10-35) days old, and exclusion of small myelomeningocele defects done with defects other than thoracolumbar area, that all of the cases were preoperatively assessed and prepared regarding size, site, associated CNS anomaly, medical compatibility, maturity, and investigations needed.

Surgical procedures:

The procedures preceded by explaining the detailed information to all patient's parents and informed consent taken from them.

Then the procedure started under general anesthesia, with two team of plastic surgeons and neurosurgeons.

After intubation, the patient put in prone position, the neurosurgeon started with dissecting the neural elements from cutaneous elements, a subarachnoid space is reformed, and a watertight dural closure is secured as shown in Figure 1. The CSF is drained through an incision in the epidermal-arachnoid junction, a circumferential incision of the dura is completed, and the epidermal-arachnoid membrane is excised flush with the neural plaque. The neural plaque folded inward for reforming the arachnoid surface. The dura mater is dissected laterally to the dura-dermis fusion line. Then by plastic surgery team the.

Dissection of the bilateral latissimus dorsi musculocutaneous flaps is started from lateral to the Para spinous muscles by separating the thoracolumbar fascia from the overlying latissimus dorsi muscles. The posterior edge of latissimus dorsi muscle is ill defined but it's easier to identify it superiorly near trapezius muscle once identified the sub muscular dissection proceeded carefully to avoid dissecting beneath external oblique,

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as it may injure the peritoneum, the posterior perforators of latissimus dorsi all divided to allow advancement easily, the latissimus dorsi origin from iliac crest will be separated ,sometimes it's done in early of dissection because it will ease the dissection and exposure of anterior surface, then the muscle completely freed from fascial attachments to the chest wall as shown in Figure 2.

Figure 1 Shows dural repair and lumbosacral meningocele defect

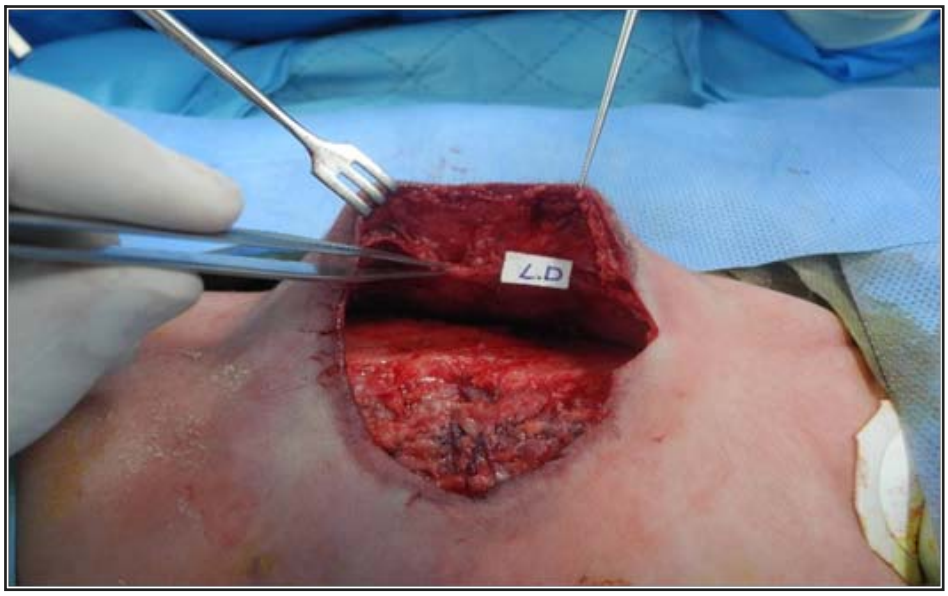

Figure 2 Flap harvesting that shows medial edge of latissimus dorsi muscle

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once the dissection completed bilaterally then the musculocutaneous units will be advanced toward midline for fully coverage and closure by layered suturing of muscle then deep fascia and then skin as shown in Figure 3 and 4 .

After operation the patients transferred to the neonatal care units supported with calculated fluid, analgesia and antibiotic.

They were discharged from hospital around 2 days' post operatively on well-equipped instructions, medications, first dressing done after 5 days from discharge follow up visits that ranged from three months to one year.

Statistical analysis:

Data had been entered and analyzed by the statistical Package for Social Sciences (SPSS, version 26). Means and standard deviations (SDs) had been used to summarize the numerical variables. Frequencies and percentages were used to present the categorical variables a *P* value of ≤0.05 was considered as statistically significant.

Figure 3 Shows advancement of the flap bilaterally with repair of latissimus dorsi muscle at midline

Figure 4 Shows tension free closure of the skin

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Results

Ten patients were included in the study. Their mean age (SD) was 21.6 (8.3) years, the median was 21 years, and the age range was 10-35 years. Around half (40%) were aged 10-19 years, and another 40% were aged 20-29 years. More than half (60%) of the patients were females (Table 1).

The site of the operation was in the thoracic region in 50% of cases, and in the lumber region in 40% of the operations, and it was in the thoraco-lumber region in one operation (10%). The size was medium in 60% of patients, and the bilateral LD flap was done in all the operation (Table 2).

Table 1 Age and gender distribution of patients

	No.	%
Age (years)		
10-19	4	40.0
20-29	4	40.0
30-39	2	20.0
Gender		
Male	4	40.0
Female	6	60.0
Total	10	100.0

Table 2 Operation details

	No.	%
Site		
Thoracic	5	50.0
Lumber	4	40.0
Thoraco-lumber	1	10.0
Size		
Medium	6	60.0
Large	4	40.0
Procedure		
Bilateral LD flap	10	100.0
Total	10	100.0

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Three patients (30%) developed complications, one developed simple edge necrosis, and two developed CSF leakage. No secondary procedure was needed, and the success rate was 100% (Table 3).

Figure 5 shows A 7 days old infant with thoracolumbar myelomeningocele underwent operation for repair and closure with bilateral latissimus dorsi myocutaneous advancement flap.

Table 3 Operation outcomes

	No.	%
Complications		
No	7	70.0
Yes	3	30.0
Type of complications (n = 3)		
Simple edge necrosis	1	33.3
CSF leakage	2	66.7
Secondary procedure		
No	10	100.0
Results		
Success	10	100.0
Total	10	100.0

Figure 5 A 7 days old infant with thoracolumbar myelomeningocele underwent operation for repair and closure with bilateral latissimus dorsi myocutaneous advancement flap. **A**, pre-operative infant with myelomeningocele about (6-5) cm. **B**, dissection of neural element from cutaneous elements then water tight closure of dura ensured. **C**, dissection of latissimus dorsi flap advanced bilaterally and closure ensured easily. **D**, post of patient about one month after surgery.

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Figure 6 shows a 2 weeks old baby with lumber myelomeningocele underwent operation for repair by bilateral latissimus dorsi myocutaneous advancement flap.

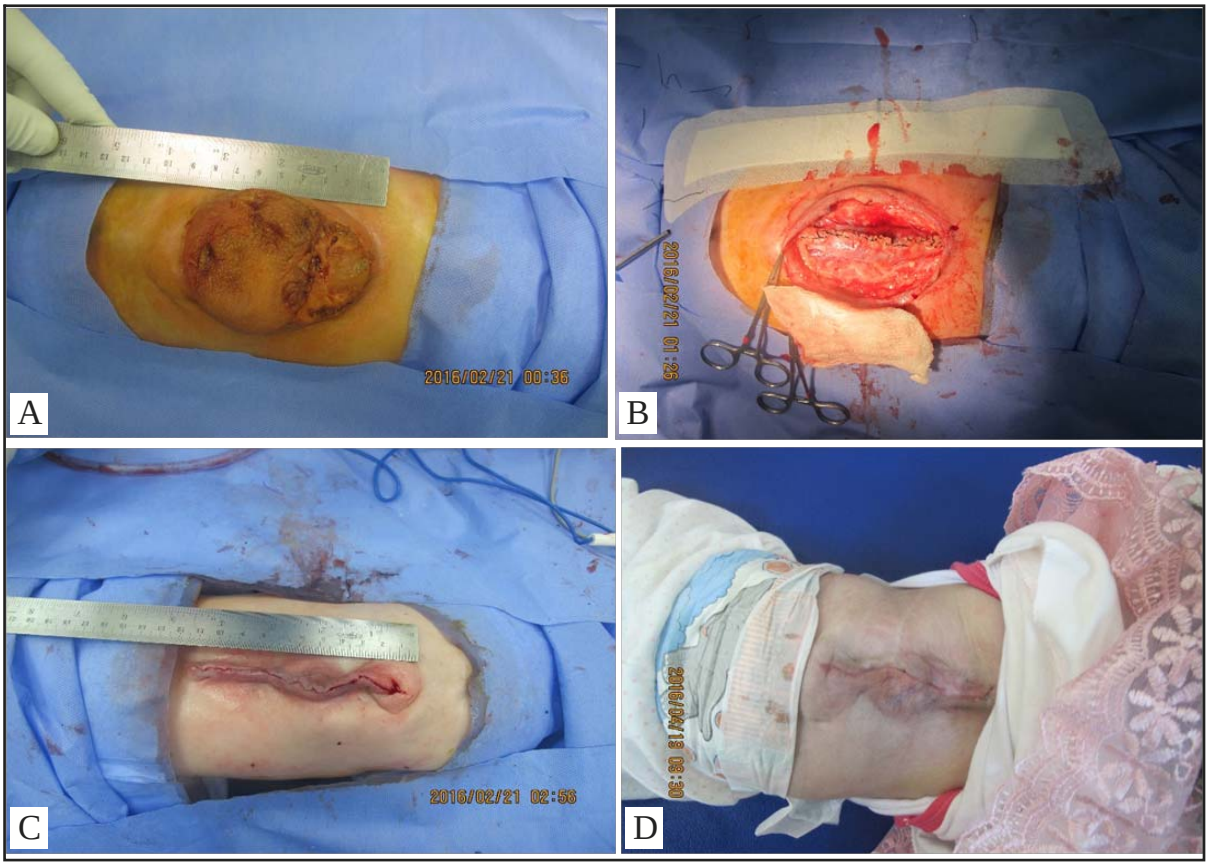

Figure 6 A 2 weeks old baby with lumber myelomeningocele underwent operation for repair by bilateral latissimus dorsi myocutaneous advancement flap. **A**, preoperative myelomeningocele about (9-6.5) cm. **B**, dissection and clearance of neurocutaneous elements with water tight closure of dura. **C**, primary closure of the defect by bilateral latissimus dorsi myocutaeous advancement flap. **D**, follow up of baby after 2 months from operation

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Figure 7 shows a two weeks old baby with lumber myelomeningocele underwent. repair and closure by bilateral latissimus dorsi myocutaneous advancement flap.

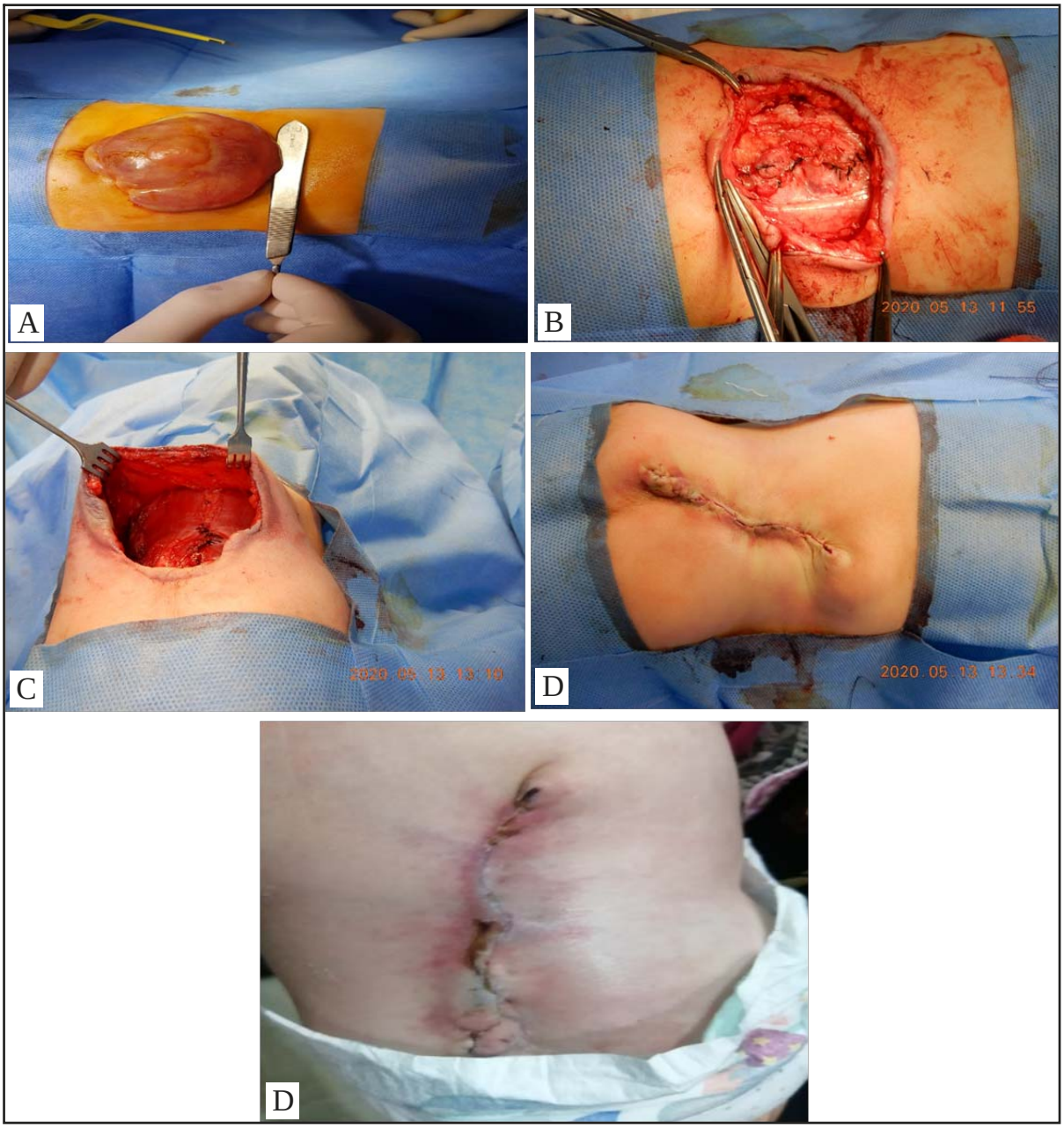

Figure 7 A two weeks old baby with lumber myelomeningocele underwent repair and closure by bilateral latissimus dorsi myocutaneous advancement flap. **A**, preoperative defect about (7-5) cm. B, dissection and clearance of neurocutaneous elements and water tight closure of dura. **C**, raising latissimus dorsi myocutaneous flap. **D**, primary closure of the defect with bilateral latissimus dorsi myocutaneous advancement flap. **E**, follow up picture after 3 weeks from operation.

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Discussion

Meningocele is the most common form of neural tube defect, which results from failure of the closure of the spinal tube at the first months of gestation. Severity ranged from anencephaly to occult spina bifida and neurological functional deficiency variable according to the level and degree of the lesion. Though the incidence is declining progressively thatmay be due to the better antenatal care nowadays and supplementation of folic acid in early pregnancy, and the morbidity of myelomeningocele has been improved by involving the multidisciplinary team and early closure with the invention of the valved shunt system. In general, three-quarters of the cases of myelomeningocele aresmall-sized defects that most of them can be closed primarily or by local tissue arrangement, like simply by undermining and tension-free closure in the midline after a secured closure of the Dural layer, and the defects have larger than 5-8 cm require a multidisciplinary approach and more complex way of closure.[4,6]

The coverage and repair of myelomeningocele goal is to achieve a tension-free closure and durable soft tissue coverage of the defect, steady wound healing, and decreased possibility of CSF leakage.[1]

The skin flaps can be used for the closure of large defects in the form of advancement, local transposition, bipedicle, Z plasty, rotation, and limberge flap. But there are some drawbacks to using the skin flaps as they require an extensive dissection of skin that may lead to necrosis, and some may require a lateral relaxing incision that heals by secondary or skin grafting, in general, the skin flaps will not give much padding as the muscle flaps do, and they lack the capability of obliterating dead space as the muscle flaps.[2]

So, for comparison, the muscle flaps have many advantages, like it provides good padding, obliteration of dead space, a robust blood supply that decrease the rate of infection by the good reach of antibiotic, and better function of white blood cells.[4,5,8]

Many authors experienced variable muscle flaps throughout history like Mustarde, who suggested closure of myelomeningocele by Para-spinous musculo-osseos tissue for coverage of neural tube defects.[4,9] Mooe et al, used a bilateral bipedicled advancement flap for the closure of myelomeningocele.[4,6] McCraw et al, explained the use of latissimus dorsi myocutaneous flap bilaterally without lateral relaxing incisions for the thoracolumbar defect.[9] Ramires et al, suggested a method for repair of large thoracolumbar and lumbosacral defects by using latissimus dorsi and gluteus Maximus myo-cutaneous advancement flap and suturing in the midline.[4,9] Hayashi et al, used latissimus dorsi V-Y flap.[4,6] Reverse latissimus dorsi pedicle flap was used by many authors for the reconstruction of lumber defects. El-khatib used a bilateral bipedicle latissimus dorsi myo-cutaneous flap for closure of myelomeningocele in large defects with a bilateral incision in the posterior axillary fold and defect of this post axillary incision repaired by a skin graft.[4,10]

In our procedure the closure of thoracolumbar myelomeningocele by bilateral latissimus dorsi myo-cutaneous advancement flap has many advantages compared to many other muscle flaps and skin flaps like the ease of dissection, although it is mentioned in the literature that musculocutaneous and perforator flaps are associated with prolonged time and a larger amount of blood loss but in our study we had a minimal blood loss that none of our patients were in need for blood transfusion intra and post-operatively, that may be associated with meticulous dissection and using of cautery, comparable to the same result of reverse turnover latissimus dorsi flap done by Zakaria et al.[4] The mean operation time of our study was more than the time taken to make cutaneous limberg flap by Mukesh

et al, that took 43.25 - 59.5 minutes.[3] It was less than the time taken by Jung-hwan et al, that took an average of 190.9 minutes for direct and 220.0 minutes for limberg flaps.[2] And Zakaria et al took 90 to 110 min.[4] The mean operationtime of our study was109 minutes, there was the preservation of latissimus dorsi function, single midline incision which helped exposure for possible secondary spinal surgeries in the future with durable coverage of large defects and less chance of dehiscence, and from those cases that we had included all were successful with one case had simple edge necrosis that was managed by trimming and direct closure thereafter, and two cases with CSF leakage that stopped spontaneously.

Conclusion

The bilateral latissimus dorsi myo-cutaneous advancement flap for coverage of moderate to large size thoracolumbar myelomeningocele defects has many advantages like ease of dissection, minimal blood loss, less time required for the procedure, preservation of latissimus dorsi function, single midline incision with durable coverage of large defects and less chance of dehiscence.

Competing interests

The authors declare that they have no competing interests.

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