ORIGINAL ARTICLE

Outcome of hemivertebra resection in congenital thoracolumbar kyphosis and scoliosis by posterior approach

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Abstract

Objective: To find out the long term outcome of deformity correction by hemivertebra resection in congenital thoracolumbar spinal deformities by a single posterior approach.

Methods: This is a retrospective study carried out at the Department of Spine Surgery, Combined Military Hospital, Rawalpindi, Pakistan from April 2006 to April 2013. All operated patients having single level hemivertebrae of thoracolumbar spine with at least two years follow up were included. Data was analyzed using SPSS ver. 17.

Results: There were 24 patients with mean age of 17 years (SD=8.41). Male to female ratio was 9(37.5%): 15(62.5%). Mean operation time was 4.23 hours (SD=1.2). Mean blood loss was 787 ml (SD=479). Mean follow up was for 5 years and 7 months (SD=30 months). Mean pre-op scoliosis was 51 degrees (SD=22), which improved to 20 degrees (SD=15) on last follow up (61% improvement). Mean pre-op kyphosis was 42 degrees (SD=35), which improved to 13 degrees (SD=15) on last follow up (69% improvement). Mean pre-op sagittal shift was 22mm (SD=24.9), which improved to 6mm (SD=9.37) on last follow up (73% improvement). Mean pre-op coronal shift was 34mm (SD=27.1), which improved to 8mm (SD=8.58) on last follow up (76% improvement). Five patients had complications. One proximal junctional kyphosis, one implant failure, one transient deficit and two wound infections.

Conclusion: Posterior resection of hemivertebrae for congenital thoracolumbar deformities gives excellent correction of deformity in experienced hands and has acceptable complication rate.

Keywords: Hemivertebra resection, Congenital, Kyphosis, Scoliosis, Posterior approach. (JPMA 65: S-142 (Suppl. 3); 2015)

Introduction

Hemivertebrae develop at 4-6 weeks of gestation due to failure of formation.[1] They may be associated with contra lateral bars which are due to failure of segmentation at same time of gestation. Both these deformities if left untreated in childhood lead to severe kyphoscoliosis in later life. There are four main methods of treatment of hemivertebra described in literature; insitu fusion, convex hemiepiphysiodesis, fusion less surgery and resection of hemivertebra. Out of all these, resection of hemivertebra gives the best immediate measureable outcome.[2]

Techniques of hemivertebra resection include; anterior, posterior and combined techniques. Anterior and combined techniques carry more morbidity and complication rates, however almost similar amount of curve correction can be achieved by all techniques. Posterior technique requires more surgical experience however it can be completed in less time and gives better fixation options. Initially only anterior or combined techniques were described but now more literature is coming up in support of posterior technique.[3,4]

We have studied hemivertebra resections done in our department for single level disease at thoracolumbar level by a single posterior approach in all patients with at least two years follow up which is presented here.

Patients and Methods

This retrospective review study was carried out at the department of spine surgery, CMH Rawalpindi, Pakistan. Data was retrieved from spine database of the department by querying on hemivertebra resection by posterior approach at thoracolumbar spine level with complete follow up for at least two years. Patients with multi-level hemivertebrae and incomplete follow up were excluded. 24 matching primary operations were found between April 2006 and April 2013 (7 years). Operation notes were reviewed for surgery details, operation time and blood loss. Pre-op and last follow up x-rays were reviewed for calculation of Cobb's angles for scoliosis and kyphosis. Sagittal balance was calculated by dropping a plumb line from middle of 7th cervical vertebra (C7) body and noting its distance in mms from posterosuperior corner of 1st sacral vertebral body. Coronal balance was calculated in mms between C7 plumb line and central sacral vertical line.

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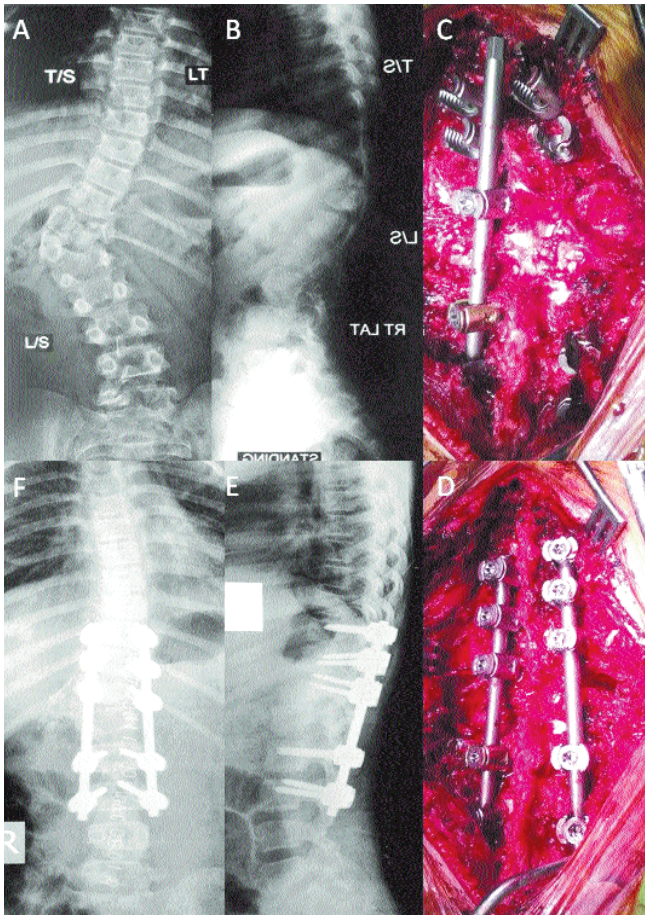

Figure-1: 10-year-old girl with thoracolumbar junctional kyphoscoliosis due to a hemivertebra. A & B show pre-op AP and Lat x-rays. C shows on exposure of hemivertebra, pedicle screw fixation and application of temporary rod before resection of hemivertebra. D shows complete resection of hemivertebra and final fixation after correction of deformity. E & F show post-op AP and Lat x-rays showing complete correction of kyphoscoliosis.

Operation technique: All operations were performed in prone position under general anaesthesia. Midline incision was made from two levels above to two levels below the hemivertebra. In lumbar spine pedicle screws were placed one level above and one level below the hemivertebra. In thoracic spine and at thoracolumbar junction pedicle screws were placed 1-3 levels above and 1-2 levels below the hemivertebra depending upon local fixation circumstances. Hemivertebra was fully exposed. Laminectomy and partial facetectomies was performed at level of hemivertebra to identify dural sleeve and to trace nerve roots above and below the hemivertebra. Temporary contra lateral rod was fixed to stabilize the spine. Discs above and below the hemivertebra were removed. Complete resection of hemivertebra was performed. Ipsilateral rod was applied and gap was closed by compression on ipsilateral side and loosening rod on contra lateral side (Figure-1 and 2).

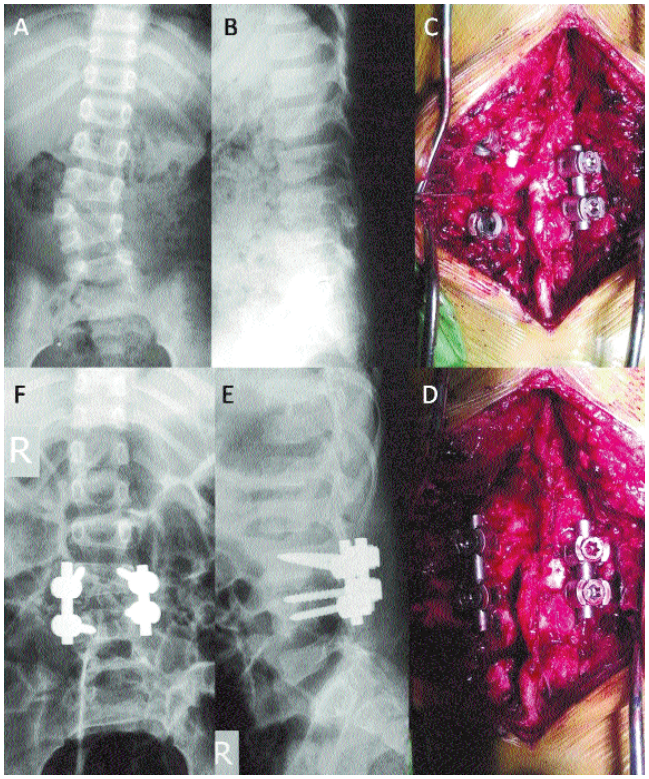

Figure-2: Eight years old boy with hemivertebra at LV3. A & B show pre-op AP and Lat x-rays. C shows on exposure of hemivertebra, pedicle screw fixation and application of temporary rod and resection of hemivertebra. D shows final fixation after correction of deformity. E & F show post-op AP and Lat x-rays showing complete correction of deformity.

Implants used: Pedicle screw fixation was used in all patients. 3.5mm AO screws and stainless steel wire was used in two patients. 4.5mm AO screws and stainless steel wire was used in two patients. M7 pedicle screw system by Medtronics was used in one patient. M8 pedicle screw system by Medtronics, USA, was used in 10 patients. Polynices pedicle screw system by Kanghui, China, was used in nine patients. Follow up was done after surgery at two weeks, six weeks, three months, six months and yearly. Pre-op and last follow up data was used for all calculations.

Statistical analysis was done using SPSS version 17. Frequencies were calculated for all numerical data. Paired sample T-test was applied for finding out significant difference between pre-op and last follow up angles and translations. P value of < 0.001 was taken as significant.

Results

There were 24 patients with mean age of 17 years (SD=8.41). Male to female ratio was 9(37.5%):15(62.5%).

Table: Patient details.

Sno	Age	Gen	FU	Level	prS	poS	prK	poK	prSB	poSB	prCB	poCB	opT	BL
1	44	M	24	T12	30	0	50	5	0	0	0	0	2.5	250
2	18	M	26	T10	70	30	65	25	50	10	30	10	4	1000
3	14	F	26	T2	47	30	10	10	0	0	25	5	3	350
4	8	M	26	L3	20	0	10	-10	10	0	5	0	3	200
5	10	F	27	T12	50	0	25	0	0	0	20	0	3.5	250
6	13	M	35	T11	40	15	30	10	0	0	20	5	3	500
7	7	F	38	T4	35	10	130	40	70	30	30	10	3	300
8	6	F	38	T5	40	15	135	40	60	25	35	15	3.5	750
9	16	M	50	L3	40	10	20	-10	0	0	50	5	3	500
10	8	F	55	T8	60	30	40	20	40	10	30	10	4	450
11	21	M	68	T10	50	40	30	20	0	0	0	0	3.5	900
12	14	F	73	T12	0	0	55	10	70	10	0	0	4	500
13	20	M	77	T11	50	20	40	15	50	0	10	0	4	700
14	14	F	84	T9	46	10	10	10	0	0	30	0	4	200
15	18	F	87	T8	40	15	10	10	0	0	70	10	4.5	900
16	19	F	89	T8	70	30	20	10	0	0	60	10	5	850
17	20	F	89	T6	70	40	25	7	10	5	50	20	6.5	1000
18	15	F	89	T10	58	20	0	0	25	5	0	0	5	800
19	21	M	93	T7	60	25	30	15	0	0	100	30	5	1000
20	21	F	93	T9	90	40	38	18	35	22	75	15	6	1500
21	35	F	96	L3	28	0	28	-10	28	0	47	10	4	1000
22	22	F	107	T12	70	35	80	30	10	20	38	20	6	1500
23	19	M	108	T12	100	45	70	20	50	15	70	22	6.6	2000
24	18	F	108	L1	48	30	66	40	30	0	18	0	5	1500
Mean	17		67		51	20	42	13	22	6	34	8	4.2	787
SD	8.41		30		22	15	35	15	24.9	9.37	27.1	8.58	1.2	479

FU = follow up in months, prS = pre-op scoliosis in degrees, poS = post-op scoliosis in degrees, prK = pre-op kyphosis in degrees, poK = post-op kyphosis in degrees, prSB = pre-op sagittal balance in mms, poSB = post-op sagittal balance in mms, prCB = pre-op coronal balance in mm, poCB = post-op coronal balance in mm, opT = operation time in minutes, BL = blood loss in ml.

15 patients had thoracic hemivertebrae (T2-T11). Six patients had thoracolumbar-junction level hemivertebrae (T12-L1). Three patients had lumbar hemivertebrae (L2-L4). One patient had grade 4/5 power in lower limbs before surgery. Rest of the patients had complete power in lower limbs before surgery. Mean operation time was 4.23 hours (SD=1.2). Mean blood loss was 787 ml (SD=479). Mean follow up was for 5years and 7months (SD=30 months).

Mean pre-op scoliosis was 51 degrees (SD=22), which improved to 20 degrees (SD=15) on last follow up (61% improvement, p value <0.001). Mean pre-op kyphosis was 42 degrees (SD=35), which improved to 13 degrees (SD=15) on last follow up (69% improvement, p value <0.001). Mean pre-op sagittal shift was 22mm (SD=24.9), which improved to 6mm (SD=9.37) on last follow up (73% improvement, p value = 0.001). Mean pre-op coronal shift was 34mm (SD=27.1), which improved to 8mm (SD=8.58) on last follow up (76% improvement, p value < 0.001) (Table).

Five patients had complications. One patient developed proximal junctional kyphosis, she was eight years old when resection of hemivertebra was done at T8 level. Five years after surgery she presented with deformity above level of fixation with back pain. She underwent osteotomy at level of kyphosis (T6) and extension of instrumentation up to T4. She had complete correction of deformity and resolution of back pain.

One patient presented with sudden onset of back pain and swelling at level of surgery, one year after operation. X-rays revealed breakage of one of the rods. There was solid fusion so only implants were taken out and patient had resolution of pain. One patient woke up with grade 3/5 power in lower limbs. Urgent MRI did not show any compressive pathology. He completely improved in three months. Two patients developed wound infections necessitating antibiotics for six weeks, wound debridement and washout. Both healed without need for removal of implants.

Discussion

Fully segmented hemivertebra has growth potential at both of the end plates. Continuous asymmetric growth

with age leads to development of gross spinal deformity depending upon the location of the hemivertebra.[5] With continued growth compensatory curves develop above and below the primary curve. If the primary curve is not addressed early in life secondary curves also become structural. There are many ways of addressing this problem but the most sure one is to take out the hemivertebra, balance the spine and fix it in position such that there is no chance left for asymmetric growth.[3,6]

Initially a combined approach was described for hemivertebra resection. This approach needs more operation time, has higher risk of complications and keeps patient in hospital for longer period of time. A single posterior approach is more demanding but saves time and has lesser rate of complications.[7] Initially it was thought that posterior approach is safe only in lumbar spine below the level of the conus but recently many authors describe this approach in thoracic spine as well with equal safety.[8-10] We are also doing it at all levels of thoracolumbar spine as shown by our study.

Our study has shown that hemivertebra resection by a single posterior approach could correct scoliosis by 61%, kyphosis by 69%, sagittal balance by 73% and coronal balance by 76%. All these values were highly significant. There were few complications and all were rectified easily. Mean operation time was 4.23 hours (SD=1.2) and blood loss was 787 milliliters (SD=479). Other authors have shown similar results. There are some papers which show better correction of deformity but they have a younger patient group as compared to our patients. It is well known that with increasing age deformity becomes more rigid and lesser degree of correction can be achieved after resection of hemivertebra.[11]

Studies have shown that normal sized spinal canal diameter develops by the age of one year, hence pedicle screw fixation in young children should not cause spinal stenosis. Furthermore younger pedicles are more flexible and can accommodate pedicle screws which are relatively bigger in size as compared to the pedicles. Short segment fixation is recommended in younger patients such that growth is not affected. Three rod technique has been described to decrease load on the pedicle screws by using laminar hooks and rod for compression after hemivertebra resection.[12,13]

Hemivertebra resection is a better option than long segment fusions in adults as well, provided secondary curves have not become structural and are still flexible on bending films.[14,15] This has been proven by our study and some other studies as well. However degree of deformity correction after hemivertebra resection is less in adults as compared to the children. Complication rate, operation time and blood loss is more in adults. Rate of pedicle screw cut out is more in children as compared to adults due to small pedicle size and weak bones. Maximum cut outs occur on the convex side during compression.[12] These cut outs can be prevented by complete removal of the discs with annulus, release of all the tethers on concave side, osteotomy of the contra lateral bar and fused ribs in the concavity of the curve.

Major neurological complications are rarely reported in literature after this procedure, however minor root palsies may occur and mostly recover.[15,16] Other complications include, wound infection, pseudoarthrosis and junctional deformity in growing children. One limitation of our study is large gap in age groups from 6 to 44 years and it needs further study to find out the outcome in young vs old patients after hemivertebra resection by posterior approach.

Conclusion

Our study has shown that excellent correction of deformity can be achieved by a single posterior approach for hemivertebra resection in congenital scoliosis at all levels in thoracolumbar spine with minimal risk of complications provided surgeon is experienced and all the facilities for spinal surgery are available.

Reference

1. Loder RT, Hernandez MJ, Lerner AL, Winebrener DJ, Goldstein SA, Hensinger RN, et al. The induction of congenital spinal deformities in mice by maternal carbon monoxide exposure. J Pediatr Orthop 2000; 20: 662-6.
2. Arlet V, Odent T, Aebi M. Congenital scoliosis. Eur Spine J 2003; 12: 456-63.
3. Yaszay B, O'Brien M, Shufflebarger HL, Betz RR, Lonner B, Shah SA, et al. Efficacy of hemivertebra resection for congenital scoliosis: a multicenter retrospective comparison of three surgical techniques. Spine (Phila Pa 1976) 2011; 36: 2052-60.
4. Ruf M, Harms J. Hemivertebra resection by a posterior approach: innovative operative technique and first results. Spine (Phila Pa 1976) 2002; 27: 1116-23.
5. Onimus M, Michel CR. [The resection of lumbosacral hemivertebrae (author's transl)]. Chir Pediatr 1978; 19: 119-21.
6. Jeszenszky D, Fekete TF, Kleinstueck FS, Haschtmann D, Bognar L. Fusionless posterior hemivertebra resection in a 2-year-old child with 16 years follow-up. Eur Spine J 2012; 21: 1471-6.
7. Sun W, Zhang JG, Qiu GX, Wang SR, Zhao YJ, Zhao LJ. [Comparison of two techniques in hemivertebra resection: anterior-posterior approach versus posterior approach]. Zhonghua Yi Xue Za Zhi 2012; 92: 756-9.
8. Obeid I, Bourghli A, Vital JM. Thoracic hemivertebra resection by posterior approach for congenital scoliosis. Eur Spine J 2013; 22: 678-80.
9. Bollini G, Docquier PL, Viehweger E, Launay F, Jouve JL. Thoracolumbar hemivertebrae resection by double approach in a single procedure: long-term follow-up. Spine (Phila Pa 1976) 2006; 31: 1745-57.

10. Mladenov K, Kunkel P, Stuecker R. Hemivertebra resection in children, results after single posterior approach and after combined anterior and posterior approach: a comparative study. Eur Spine J 2012; 21: 506-13.
11. Ruf M, Jensen R, Letko L, Harms J. Hemivertebra resection and osteotomies in congenital spine deformity. Spine (Phila Pa 1976) 2009; 34: 1791-9.
12. Zhang J, Shengru W, Qiu G, Yu B, Yipeng W, Luk KD. The efficacy and complications of posterior hemivertebra resection. Eur Spine J 2011; 20: 1692-702.
13. Hedequist D, Emans J, Proctor M. Three rod technique facilitates hemivertebra wedge excision in young children through a posterior only approach. Spine (Phila Pa 1976) 2009; 34: E225-E229. doi: 10.1097/BRS.0b013e3181997029.
14. Polly DW Jr, Rosner MK, Monacci W, Moquin RR. Thoracic hemivertebra excision in adults via a posterior-only approach. Report of two cases. Neurosurg Focus 2003; 14: 1-4. doi: 10.3171/foc.2003.14.2.10.
15. Holte DC, Winter RB, Lonstein JE, Denis F. Excision of hemivertebrae and wedge resection in the treatment of congenital scoliosis. J Bone Joint Surg Am 1995; 77: 159-71.
16. Jalanko T, Rintala R, Puisto V, Helenius I. Hemivertebra resection for congenital scoliosis in young children: comparison of clinical, radiographic, and health-related quality of life outcomes between the anteroposterior and posterolateral approaches. Spine (Phila Pa 1976) 2011; 36: 41-9.