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Original article

Inserting pedicle screws in lumbar spondylolisthesis – The easy bone conserving way

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ABSTRACT

Background: Pedicle screw fixation in high grade lumbar listhetic vertebral body has been nightmare for Orthopaedic and spine surgeons. This is because of abnormally positioned listhetic pedicles and non-visualization of pedicle in conventional image intensifier (C-Arm). This results into increased surgical time, more blood loss, radiation exposure and more chances of infection. To overcome this problem, we have devised a new Technique of putting of pedicle screw fixation in listhetic vertebrae.

Methods: Total 20 patients of average age of 42 (25–56) were included during 2010 to 2015. Listhesis was classified according to etiology, Meyerding grading and DeWald modification of Newman criteria used for assessment of severity for spondylolisthesis on standing X-ray lumbosacral spine. Patients satisfying following criteria were considered for surgery. Age more than 20 years, with single involvement of either L4-5/L5-S1, high grade spondylolisthesis ($\geq$ 50% Meyerding grade), unresolving radiculopathy, cauda equina syndrome or pain with and without instability not relieved by 6 months of conservative treatment. According to Meyerding radiographic grading system,10 patients were of type II and 8 of type III and 2 of type IV. Treatment given was pedicle screw fixation, reduction of listhesis vertebra and spinal fusion with our technique. PLT was done in 10 cases and transforaminal lumbar interbody fusion (TLIF) in the other 10 cases.

Results: Mean follow up duration was 2 years (range 1.3–3.3 year). The average preoperative LBP VAS of low back pain were 6.7 and average LP VAS for leg pain 5.7. Postoperatively at final follow up there was reduction of LBP VAS to 2.2 and LP VAS to 0.5. There was rapid reduction in their LBP VAS in first two visits at 4 weeks and in LP VAS in first three visits at 8 weeks. The pain-free walking distance improved significantly. The average pre-operative ODI score was 51.4, improved to 18.6 postoperatively. There was no difference in above scores between PLT and TLIF.

Conclusion: Our surgical technique used for high grade spondylolisthesis is safe, cost-effective, bone-preserving, reliable, and reproducible for high grade Lumber spondylolisthesis.

1. Introduction

In our initial days of lumbar spondylolisthesis surgery, it was very difficult or almost impossible to put screw in the pedicle of displaced listhesis vertebra, as we could not visualise it by Image Intensifier (C-arm) on the anteroposterior view (AP). So patients with listhesis were treated by putting screws in vertebra proximal and distal to listhesis, thus compromising listhesis-reduction, the stability of fixing construct and lessening chance of fusion. Later we started exposing transverse process and articular process and inserting pedicle screws in a free hand manner but pedicle visualisation on anteroposterior (AP) view was still deficient; this lead to at times to inserting one or no screw in listhesis vertebra (LV). On searching Google scholar, Pub med and Cochrane data base we found studies describing anatomical angular direction of pedicle by imaging studies or on cadaveric bones.[1–18] There were articles that used computer-assisted image-guided navigation (IGN) for inserting the pedicle screw using 2Dimensional (2D),

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Table 1
Patient's demographic and clinical profile.

Patients	Age/ sex	Type: I/T/D	Meyerding grade	Surgery	Screw in listhesis Vbr.	Postop						
						Meyerding grade improvement	Slip angle improvement	Complications	Claudication improvement	VAS-LBP pre/post	VAS-LP pre/post	ODI pre/post
1	35/M	I	III	PLT + IF + Dm	2	0	N	None (n)	70–2000 m	8/3	N	60/
2	45/F	D	II	PLT + IF + Dm	2	0	N	None	100–3000 m	7/2	4/1	40/
3	56/M	D	II	PLT + IF + Dm	2	0	N	n	80–3000 m	8/2	6/2	35/
4	26/M	I	III	PLT + IF	2	I	50% improved	Symptomatic hardware	90–2500 m	9/2	6/2	62/
5	32/F	I	IV	PLT + IF + Dm	1	II	40%	Shy bladder, improved after 2 weeks	50–2000 m	10/2	8/2	70/
6	40/M	I	III	PLT + IF	2	0	80%	Superficial infection subsided	80 m–3 km	8/3	4/2	55/
7	55/F	D	III	PLT + IF + Dm	2	0	85%	N	50–2000 m	7/2	6/2	35/
8	37/F	I	III	PLT + IF	2	I	55%	N	100–3000 m	8/3	N	40/
9	34/F	I	III	PLT + IF	2	I	60%	N	Could not measure – 50%	6/2	N	34/
10	29/M	I	IV	PLT + IF + Dm	2	II	35%	N	70–2000 m	8/2	4/2	61/
11	51/F	D	II	PLT + IF + Dm	2	0	84%	N	100–2000 m	6/0	6/1	31/
12	28/F	I	III	PLT + IF + Dm	2	I	65%	N	50–2000 m	8/2	4/2	33/
13	33/F	I	III	PLT + IF	2	I	63%	N	Could not measure	8/2	4/2	34/
14	45/F	D	II	PLT + IF + Dm	2	0	86%	N	100–2000 m	4/0	4/1	29/
15	27/M	I	IV	PLT + IF + Dm	2	II	40%	N	50–2000 m	8/2	4/2	60/
16	55/M	I	III	TLIF + IF + Dm	2	I	85%	N	10–1000 m	8/2	8/2	65/
17	45/F	I	II	TLIF + IF + Dm	2	I	90%	Infection deep-debrided	50–2000 m	8/1	8/1	72/
18	55/F	I	III	TLIF + IF + Dm	2	I	90%	N	15–1500 m	8/2	8/2	82/
19	60/F	I	III	TLIF + IF + Dm	2	I	80%	N	25–2000 m	9/2	6/1	74/
20	48/F	D	II	PLT + IF + Dm	2	I	90%	N	30–2000 m	7/1	6/0	64/

M – male; F – female.
I – isthmic type listhesis; D – degenerative; PLT – posterolateral intertransverse fusion; IF – internal fixation by pedicle screws; Dm – decompression; N – no complication.

3Dimensional (3D), computed tomography (CT) scan preoperatively and intraoperatively whereas others used O-arm fluoroscopy and CT scan post-operatively.[19–25] O-arm and 3D fluoroscopy IGN gave excellent results but they are expensive and may not be affordable for many facilities.[19] There is no article to the best of our knowledge that describes accurate pedicle screw insertion peroperatively in an anatomical deranged spine like lumbar spondylolisthesis using conventional 2D fluoroscopic images by readily available C-arm and without exposing anteriorly displaced posterior elements (Table 1).

2. Material and methods

From May 2010 to December 2015 we conducted a prospective case series at our Hospitals. A total of twenty patients with average age of 42 (25–56) were included. Written and informed consent was obtained from all patients. Etiological classification was done. Severity of slip was estimated by Meyerding grading and DeWald modification of Newman criteria for spondylolisthesis on standing X-ray lumbosacral spine antero-posterior (AP), lateral and oblique radiographs of patients. Ten patients were of type II and 8 of type III and 2 of type IV, according to Meyerding classification; and 8 patients of Meyerding grade II were 4 + 0 and 2 were 4 + 1 respectively and 6 of Meyerding grade III were 6 + 1, 6 + 2, 6 + 1, 6 + 3, two of Meyerding grade III were 7 + 1 and 7 + 3 respectively and 2 of Meyerding grade IV were 9 + 2 two of 9 + 3 according to DeWald modification of Newman criteria. Inclusion criteria for surgery were adult patient $>$ 20 years having focal type II L4–5/L5-S1 anterolisthesis with back pain not relieved by conservative treatment for 6 months, back pain with high grade spondylolisthesis ($\geq$50% Meyerding grade), unresolving radiculopathy, cauda equina syndrome or pain with instability on flexion–extension view.

Magnetic Resonance Imaging was done in all cases preoperatively to rule out foraminal stenosis, disc desiccation, pars defect and root impingement and also to check the status of cord and vertebra. Computer tomography scan was done at 9 months postoperative period to assess the healing of the pars interarticularis defect and consolidation of posterolateral inter-transverse fusion (PLT). Treatment given was pedicle screw fixation, reduction of listhesis vertebra and spinal fusion with our technique. Posterolateral inter-transverse fusion (PLT) was done in 10 cases and transforaminal lumbar interbody fusion (TLIF) in the other 10 cases. The following functional parameters were analysed: visual analogue scale of low back pain (LBP VAS) and leg pain (LP VAS), Oswestry-Disability Index (ODI), and short form 36 (SF-36). The ODI and SF-36 were evaluated preoperatively and postoperatively at 2, 4, 6 weeks and at 12 and 24 months or till last visit of patient. Low back pain and LP VAS was evaluated preoperatively, and on postoperative at 1, 4, 8, 16 weeks, 6 months, 12 months and at 2 years or till last visit of patient. Radiological parameters of therapeutic significance, the pelvic tilt, sacral slope, pelvic incidence, slip angle and lumbosacral angle were evaluated by X-ray preoperatively and at week 1 and 6 and month 6, 12 then 24 or till last follow up visit and by CT scans at 9 month. The fusion rate and surgical complication if any were also assessed.

3. Surgical technique

All surgeries were performed under general anaesthesia. Patients were put in prone position on radiolucent table with hip and knee flexed to 90°. The spine was exposed through standard midline posterior approach to the lumbosacral spine. We prefer inserting screws before performing decompression. The following description follows for an index case of lumbar L 5-sacral S 1 listhesis (Fig. 1a). Initially pedicle screws were inserted in one

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