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Original Article

Double insurance transfacetal screws for lumbar spinal stabilization

Atul Goel, Aimee A. Goel[1], Savni R. Satoskar[2], Pooja H. Mehta[3]

Department of Neurosurgery, Seth G.S. Medical College and K.E.M Hospital, Parel, Mumbai, India. [1]Medical Student University College London, United Kingdom, [2]Intern, Seth G.S. Medical College and K.E.M Hospital, Parel, [3]Intern, D.Y. Patil Medical College, Nerul, Navi Mumbai, India.

Corresponding author: Dr. Atul Goel, Department of Neurosurgery, King Edward VII Memorial Hospital and Seth G.S. Medical College, Parel, Mumbai – 400 012, India. E-mail: atulgoel62@hotmail.com

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Abstract

Aim: The authors report experience with 14 cases where two screws or "double insurance" screws were used for transfacetal fixation of each joint for stabilization of the lumbar spinal segment. The anatomical subtleties of the technique of insertion of screws are elaborated. **Materials and Methods:** During the period March 2011 to June 2014, 14 patients having lumbar spinal segmental instability related to lumbar canal stenosis were treated by insertion of two screws into each articular assembly by transfacetal technique. After a wide surgical exposure, the articular cartilage was denuded and bone chips were impacted into the joint cavity. For screw insertion in an appropriate angulation, the spinous process was sectioned at its base. The screws (2.8 mm in diameter and 18 mm in length) were inserted into the substance of the medial or inferior articular facet of the rostral vertebra via the lateral limit of the lamina approximately 6–8 mm away from the edge of the articular cavity. The screws were inserted 3 mm below the superior edge and 5 mm above the inferior edge of the medial (inferior) facets and directed laterally and traversed through the articular cavity into the lateral (superior) articular facet of the caudal vertebra toward and into the region of junction of base of transverse process and of the pedicle. During the period of follow-up all treated spinal levels showed firm bone fusion. There was no complication related to insertion of the screws. There was no incidence of screw misplacement, displacementor implant rejection. **Conclusions:** Screw insertion into the firm and largely cortical bones of facets of lumbar spine can provide robust fixation and firm stabilization of the spinal segment. The large size of the facets provides an opportunity to insert two screws at each spinal segment. The firm and cortical bone material and absence on any neural or vascular structure in the course of the screw traverse provides strength and safety to the process.

Key words: Facets, lumbar canal stenosis, lumbar instability, transfacetal screws

INTRODUCTION

Spinal stabilization techniques have remarkably improved in the last few decades. Although the ease, safety and firmness of the pedicles provide a most viable and popular method of lumbar stabilization using polyaxial screws and rods, transfacetal screw insertion have their unique advantages that seem to have been underexploited for surgical treatment. The firmness of bones of the facet, large size and vertical orientation of the joint provides ease of insertion and safety to the procedure. Possibility of opening the joint, denuding of articular cartilage, insertion of bone graft within the joint cavity and fixation of the joint at the point of fulcrum of spinal movements provide biomechanical advantage to the technique. We present the technical subtleties of the transfacetal screws and present our experience in using two screws for each facet.

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MATERIALS AND METHODS

During the period March 2011 to June 2014, we treated 14 cases having lumbar canal stenosis with "double-insurance" transfacetal screws. The ages of the patients ranged from 40 to 65 years (average being 54 years). All patients had classical clinical features of lumbar canal stenosis. There was no neurological deficit in any case. The patients were treated with our current philosophy of "only fixation" in such cases.[1] No bone decompression of any kind was done and the operation was aimed at arthrodesis of the treated segments.[1-6] The operation was carried out at one level in 1 case, at two levels in 3 cases, at three levels in 6 cases, at four levels in 3 cases and at five levels in 1 case. Out of the 84 joints treated, "double insurance" screw implantation was carried out in 74 joints. Single screw implantation was carried out in rest of the 10 articular joints. Single screw insertion was done in all these cases due to facetal disruption due to selection of inappropriate screw placement site and mistaking facetal osteophyte as a part of the substance of facet.

Anatomical issues: Junior authors AAG, SRS and PHM evaluated the anatomical parameters. The facet joint of the lumbar spine is positioned at an approximate angle of 90 to 110° from the transverse body plane. The medial facet of the articulation is the inferior facet of the rostral vertebra and the lateral facet of the articulation is the superior facet of the caudal vertebra. The variations in the angle of the joint at the various levels of the lumbar spine are elaborated in Table 1. The site of insertion of the upper or superior screw in the inferior facet of the rostral vertebral is 3 mm below the superior edge and 6 mm medial to articular edge of the facet. The lower or inferior screw is inserted in line with the inferior edge of the lamina, approximately 5 mm above the inferior edge and 8 mm medial to the articular edge of the facet. The screws are directed toward the superior or lateral facet of the caudal vertebra at an angle of 65 degrees lateral and 35 degree inferior from the transverse or a horizontal plane for the superior screw and at an angle of 65 degree lateral and 20 degree inferior for the inferior screw. The proposed site and angle of screw insertion leads the screw to travel from trans-facetal course toward the junction of the base of the transverse process and pedicle. The average sizes of the screws used were 2.8 mm in thickness and 18 mm in length. The angles of insertion of the superior screw vary from approximately 65 degrees at L1-L2 level and L2-L3 levels to 55 degrees at L3-L4 level and 46 degrees at L4-L5 level in the sagittal plane, approximately 34 degrees at L1-L2, L2-L3 and L3-4 levels and 38 degrees at L4-5 level in the transverse plane and approximately 22 degrees at L1- L2 level and L2-L3 levels, 30 degrees at L3-L4 level and 38 degrees at L4-l5 level in the coronal plane. The angles of insertion of the inferior screw vary from approximately 60 degrees at L1- L2 level and L2-L3 levels to 52 degrees at L3-L4 level and 43 degrees at L4-L5 level in the sagittal plane, approximately 17 degrees at L1-L2, L2-L3 and L3-4 levels and 18 degrees at L4-5 level in the transverse plane and approximately 37 degrees at L1- L2 level and L2-L3 levels, 42 degrees at L3-L4 level and 53 degrees at L4-l5 level in the coronal plane [Table 1].

The patient is placed prone for surgery and the operation table is appropriately angulated to obliterate the lordosis and to make the low back region flat or in flexed position. The site of surgery is confirmed with visual identification parameters and with fluoroscopic evaluation. After a midline skin incision, the exposure of the spine is widened laterally to expose the facets and the articular joint cavity. Apart from the radiological and clinical parameters, the status of the facet joints determined the levels of spinal segmental fixation. Apart from other criteria, the facets joints that were visually identified to be unstable had open joint cavity and the articular surface was mal-aligned. Personal experience in handling the joints and in assessing the degree of stability was crucial in making the decision regarding the need for fixation. The facetal exposure is first obtained at all the levels and their status was confirmed before any instrumentation is carried out. Using sharp dissection, the medial (or inferior facet of rostral vertebra) facet is widely exposed at the proposed treatment level. A 6 mm wide osteotome is inserted into the joint cavity with its flat edge that is then turned in a screwing fashion to denude the articular cartilage. Spinous process is sectioned at its base and is denuded of all soft tissues. The bone of the spinous process is subsequently used as a graft material. Small and thin pieces of bone graft are then impacted into the joint cavity. Guide holes are first made employing power driven drill and the screws are then inserted as per the discussed parameters. [Figure 1] Bone graft material obtained by grinding the spinous process into small pieces is then placed over the facets and lamina after appropriately preparing the host bone.

Postoperatively, the patients were mobilized with the caution to avoid exercises and heavy work for a period of about 3 months. A lumbar belt was advised during this period. After 3 months, all activities including sports were permitted.

Table 1: Angle of screw insertion as measured on cadaveric dry bones

Vertebral level	Angle with sagittal (vertical) plane		Angle with transverse (horizontal) plane		Angle with coronal plane	
	Superior screw	Inferior screw	Superior screw	Inferior screw	Superior screw	Inferior screw
L1-L2	65.15	60.68	34.75	17.38	22.73	37.55
L2-L3	65.15	60.68	34.75	17.37	22.73	37.73
L3-L4	55.03	52.48	34.25	16.62	30.53	42.43
L4-L5	45.98	43.73	38	18.75	38.28	52.78

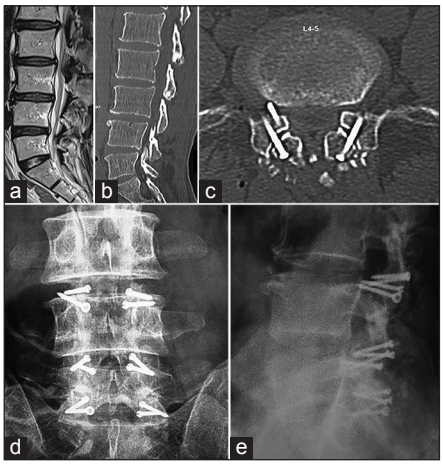

Figure 1: Images of a 52-year-old male (a) T2 weighted MRI shows evidence of lumbar canal stenosis (b) CT scan showing canal stenosis (c) Post-operative axial CT scan showing transfacetal screws (d) Antero-Posterior view of post-operative X-ray showing double insurance screw at 3 levels (e) Lateral view showing the screws

RESULTS

During the average follow-up period of 3 months (range 3 to 39 months), all the treated levels had successful segmental bone fusion. There was no instance of screw back out, implant rejection or infection.

DISCUSSION

Despite its description in 1944, the transfacetal or transarticular screws have not been a popular choice for lumbar spinal fixation.[7] There are only few papers that discuss the technical issues and the advantages (or disadvantages) of using such screws.[8] The popularity of screw-rod systems for stabilization is related to the firm purchase of screws into the large and firm pedicles and ease and safety of the technique. There have been a few studies that validate the biomechanical strength of transfacetal screws. Vanden Berghe *et al,* found similarities in biomechanical strengths of pedicle screw fixation and facet fixation.[9]

A number of technical variations have been discussed regarding implantation of transfacetal screws. Magerl[10] discussed the translaminar transfacetal method of screw insertion. Rajasekaran and Babu discussed translaminar facetal screw insertion via the contralateral side. In this technique the screw is inserted at the base of opposite lamina and then travels through the substance of the lamina before its transfacetal course.[8] Jang *et al.,* presented a percutaneous method of placement of translaminar facetal screws after lumbar interbody fusion procedure.[11] Shin *et al.,* reported the use of fluoroscopy for assisting percutaneous screw placement.[12]

Transfacetal screws have their own advantages for segmental spinal fixation that clearly seem to have been under exploited. The facetal articulation is the site of or a fulcrum of major movements at the level. The facet joint is the only true joint of the spine and the primary site of all major spinal movements. Like elsewhere in the spine, fixation of the site of fulcrum of movements rather than at a site remote from the center of activity has distinct biomechanical advantages. The possibility of opening of the joint, denuding of articular cartilage and introduction of bone chips within the articular cavity provide unique advantages of stability to the construct and an additional opportunity for bone fusion. The screw travels laterally and away from the dural tube under direct vision and thus avoids injury to the neural structures. The lateral course is away from the nerve root. The remarkable ease of the technique and the possibility of performing the screw fixation under direct vision provide a superior edge to the transfacetal fixation method. Sectioning of the spinous process at its base provide a suitable angle for screw insertion and the possibility of maneuvering its angulation. The amount of metal used for fixation is significantly less when compared to pedicular polyaxial screw-rod method of fixation. The time taken for insertion of the screws is almost equal to the time taken for making of guide hole and insertion and tightening of screws. The safety, unparalleled ease, quick conduct of procedure and the clear biomechanical advantages provide transfacetal screw insertion distinct superiority as a fixation technique. The possibility of insertion of two screws in each facet or "double insurance" screw insertion technique provide additional strength to the technique. Our successful clinical results in all patients provide validity to the technique.

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