Original Article

Synthetic vertebral body implantation Functional outcome in management of spinal disorders

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Abstract:

Background: Synthetic vertebral body replacement has been widely used recently to treat different spinal conditions affecting the anterior column. They arrange from trauma, infections and even tumor conditions
Objective: To assess the functional outcome of this modality in different spinal conditions.
Patients and Methods: twenty-seven cases operated from Oct. 2010 to Dec. 9 cases had spinal fractures, 8 cases with spinal tuberculosis, and 10 cases with spinal tumors. They were followed clinically for a mean period of 36 months.
Results: All the cases approached anteriorly. 5 cases had postoperative infection. No neurological worsening reported. we had dramatic neurological improvement in all spinal tuberculosis cases. Mortality reported in only three case with metastatic spinal tumor during the mean period of follow up.
Conclusion: the outcome of this surgery making it recommended for properly selected patients especially with spinal tuberculosis and tumors.
Keywords: synthetic vertebral body, implantation, spinal fractures, spinal tuberculosis, spinal tumors.

Introduction:

The term "anterior instrumentation" is used for any surgery in which implantation of a stabilization device acting upon the anterior column of the vertebral body according to the two-column concept that was firstly described by F.W. Holdsworth (1).

The surgical approach is usually from anterior depending on the body region involved. However, especially for the lumbar spine, other routes are established such as posterior lumbar inter body fusion (PLIF) or trans foraminal procedures (trans foraminal lumbar inter body fusion, TLIF) (2).

The technique of inter corporal fusion was first described by Smith and Robertson in 1955 for the cervical spines (3), and much earlier for the lumbar spine for treating spinal deformity and Pott's disease by Hibbs and Albee in 1911(4,5), and later by Burns in 1933 for stabilizing spondylolisthesis (6). Cages were designed and first used by G. Bagby and D. Kuslich in the late 1980s; they were initially threaded hollow cylinders filled with bone graft. Nowadays a variety of cage designs are available for implantation using anterior or posterior approaches (7,8).

The replacement of the vertebral body with a synthetic one was relatively new technique which appeared in late 1990s. (9,10,11) It replaced the traditional method with autograft because it provides more fixation and immobilization of the affected segment and hence this will result in earlier mobilization and recovery of the patient. (12).

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Patients and Methods:

We performed this procedure for 27 cases from Oct. 2010 to Dec. 2015. This represent a single author experience. The surgeries were performed in Neurosciences hospital (14 cases), Nursing house hospital (5 cases), al amal hospital (2. Cases) and al Kafeel hospital (1 case), Ibn Sina Hospital (2 cases)

The patients had Fractured vertebrae type A3 (9 cases), Primary spinal tumor (2 cases), secondary spinal metastases (8 cases) and spinal Tuberculosis (TB) 8 cases.

The surgery was done under general anesthesia with the thoracotomy or thoraco-abdominal approach. The affected vertebrae were removed using electrical drill and CO2 Laser. The synthetic vertebral body was implanted and fixed with anterior screws, rods, (see illustrative case1), or plates.

Results:

Twenty-seven patient were operated (14 males, 13 females), age range 16 to 65. Figure7,8. All the cases were approached anteriorly, we had cervical (2 cases), Dorsal (15 cases), Dorso-lumbar (6 cases) and lumbar (4 cases). Figure9.

The pathology according to the site is clarified in Figure 10,11.

All the cases had next day mobilization with physiotherapy. The mean follows up was 36 months.

Postoperatively wound infection reported in 5 cases treated conservatively. No mechanical graft failure reported in our series. Neither neurological deficit nor worsening of existing neurological condition reported in our cases. Neurological functional improvement recorded with all the TB cases and 1 (out of 2 cases) of primary spinal tumor and 5(out of 8

cases) of metastatic spinal tumor. Mortality recorded during the period of follow up in only three cases, all of them were having metastatic spinal tumors.

Illustrative case 1

52 years old male presented with chest pain and progressive paraparesis. MRI revealed T3,4 invasions with tumor extending to the adjacent ribs. Figures 1,2 Thoracotomy was done, three ribs removed with ligation of the azygous vein. Figure 3.CO2 Laser used to remove the affected vertebrae. Figure 4. Pyramish, titanium cylinder implanted with demineralized bone matrix. Figure5. Fixation of the adjacent vertebrae with screws and rods. Figure 6.

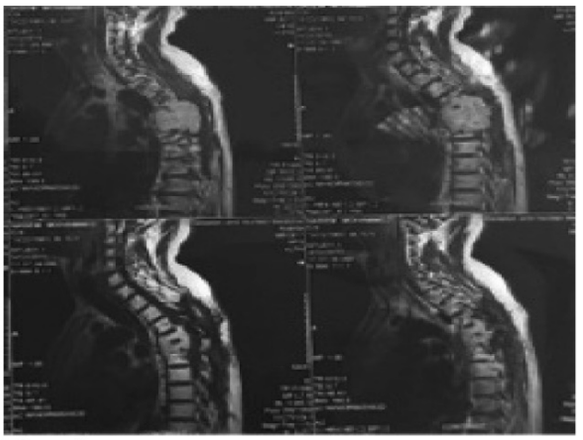

Figure1

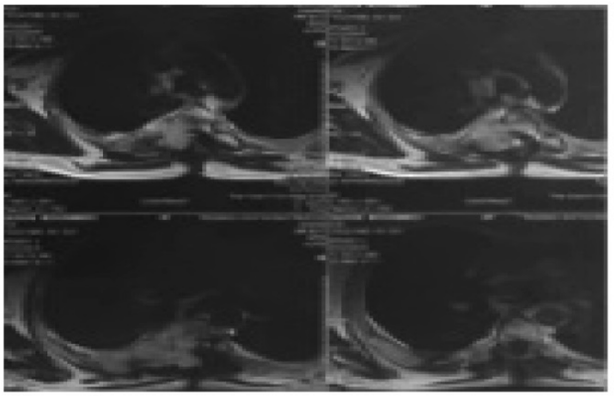

Figure2

Figure 3

Figure4

Figure 5

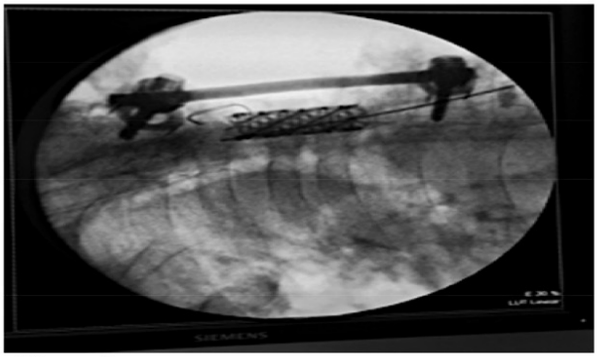

Figure 6

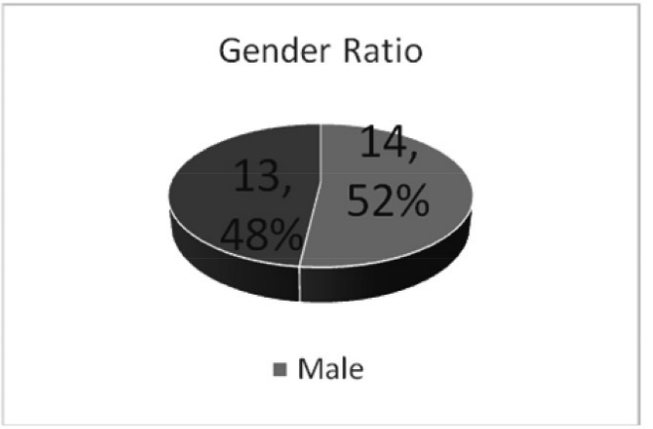

Figure7 Gender distribution

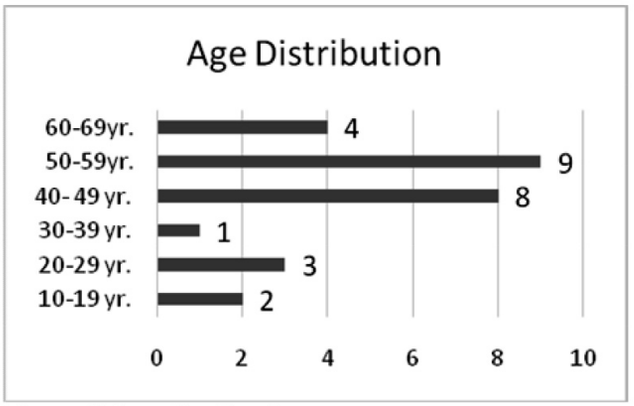

Figure 8 Age distribution.

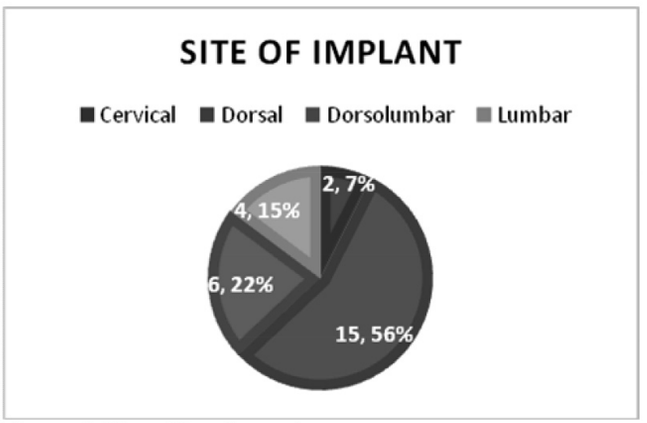

Figure 9 Site of Implantation.

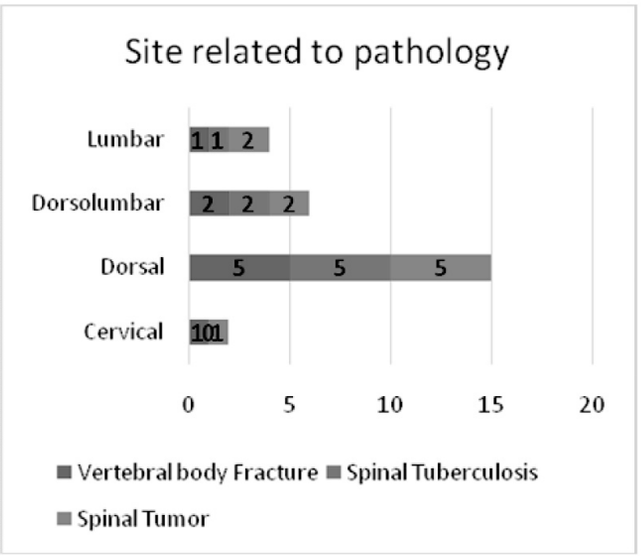

Figure 11 Site related to pathology.

Discussion:

The indications for anterior fusion of the spine are various and may include spondylitis and vertebral burst fractures but they are still controversial, especially for lumbar back pain.

Biomechanical Aspects: It is now well known that a complete discectomy combined with the dissection of the anterior longitudinal ligament renders the spine substantially unstable for all loading conditions. For flexion and lateral bending, inter body devices can restore stability profoundly. However,

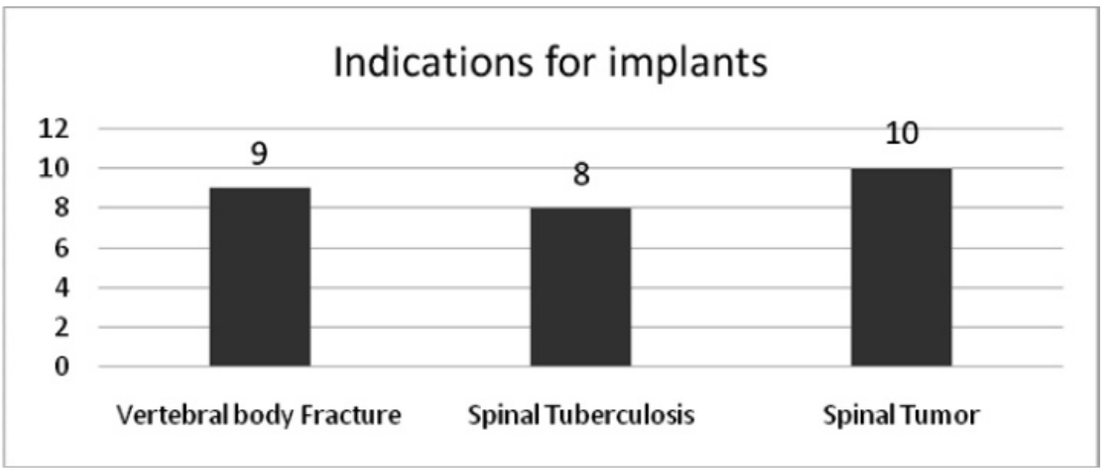

Figure 10 Indication for implants.

the major disadvantage of these devices regardless of the approach (PLIF or ALIF) is the poor control of extension and rotation (13). Spinal instability after multiple-level corpectomy is a challenging task in the biomechanical sense. Indications apply for myelopathy, neoplastic and metastatic tumor growth, chronic spondylitis or severe fracture cases. However, the resulting instability, and thus the demand on the instrumentation, strongly depends on the number of involved levels and the preserved and functioning stabilizers. Pure bi segmental spinal stability after single-level corpectomy in the lumbar spine can theoretically be restored by pedicle screw systems (14). However, in the absence of anterior column integrity, the posterior bridge-construct bears 100 % of the load and will most likely fail even in the presence of a posterior spondylodesis. This phenomenon is well known from unstable burst fractures lacking anterior support (15). Furthermore, biomechanical tests have shown that corpectomy cages alone or in combination with an anterior angle-stable plate fixation are not capable of restoring physiological bi segmental stability. To ensure solid bony fusion it is commonly accepted that normal physiological spinal stability must be exceeded. Similarly, corpectomy in the cervical region is indicated for a variety of spinal pathologies: cervical myelopathy, cervical spine trauma and tumor. The stability after single level corpectomy and cage implantation is comparable to the range of motion (ROM) of the intact spine in all six degrees of freedom (16). Supplemental instrumentation must therefore also be applied. Anterior plating adds significant stability, particularly in rotation, which is only exceeded by posterior systems. Vertebral body replacement in trauma: With the advancement in spinal instrumentation techniques, different modalities of vertebral replacement prostheses were developed, mainly from either Peek or Titanium material. (17) The anterior approach remained the main modality for managing spinal fractures with anterior compression especially the avulsion type. (18) However the neurological recovery following such trauma still disappointing. In our series although this sort of technique enabled us for early mobilization and rehabilitation but only three (33%) of our series were able to walk with sticks following six months of physiotherapy. Vertebral body replacement in TB: Spinal tuberculosis still recognized as a challenging disease to treat, not because of the technical expertise or the time required to cure it, but more so because of the decisions involved to treat it (19) The most dreaded neurological complications in TB spine occur in active stage of disease by mechanical compression, instability and inflammation changes (20) In all our cases there were sever dorsal vertebral collapse with the para-spinal abscess. All the cases managed by anterior approach to evacuate the abscess and remove damaged vertebrae with synthetic replacement. All the cases had dramatic functional recovery which arranged from immediate to 12 months of rehabilitation. Although many centers may advocate the posterior approach for managing such cases (21) but with sever vertebral collapse and anterior compression we still recommend the anterior approach, if the general condition of the patient fit for that. In conclusion surgery has an important role in alleviating pain, correcting deformities and neurological impairment, and restoring function. (22)

Vertebral body replacement in spinal tumors: This is the most important and rewarding indication for vertebral body replacement. Survival showed to be improved for both single metastatic and primary spinal tumors when removed radically. (23) (24) (25). In our series we had two cases of plasmacytoma, 4 cases with metastatic breast carcinoma, one lung tumor, one prostate and two with adenocarcinoma of unknown origin. We had three mortalities in our mean duration of follow up.

Conclusion:

This type of surgical technique although is difficult, long duration, technically demanding, but its outcome is excellent especially for patients with spinal TB and tumors.

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