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Anterior Cage Fixation for Dorsal Spine Injuries- One Year Study

Rizwan Masood Butt, Manzoor Ahmed, Abdullah Haroon, Ashraf Shaheen, Capt Bashir, Attiue Rehman, Farukh, Asma Gilani, Azam Niaz and Nazir Ahmed
Department of Neurosurgery, PGMI, Lahore General Hospital, Lahore

SUMMARY

This study was conducted during the year 2004 at Lahore General Hospital, Unit I, department of Neurosurgery. We operated on 37 patients for thoracic cage interbody fixation after trauma. Age range was from 15 to 70 years. Maximum number of cases (41%) was between 21-30 years of age. Male involvement was seen in 29 (79%) patients. Majority (65%) belonged to rural community and agriculture and industry were the major setup of injury. Majority belonged to poor socioeconomic class i.e., 83% (31). Level of injury was 37% upper dorsal spine, Main fracture types were burst fractures, compression fractures and fracture dislocations. Correction of deformity was achieved in majority of cases. Associated chest injuries were seen in 28% cases. Timing of surgery was as early as possible but it ranged from 2 hours to as long as 3 months. Neurological deficit ranged from complete paraplegia to power grade 4. Complications of the procedure are cage displacement in 6%, loosening in 5% and infection in 8%. Neurological status improved in 88% while kyphosis improvement occurred in 77% of the patients. Anterior cage fixation is a safe and effective treatment method for traumatic dorsal spine instability involving vertebral bodies.

Key words: Dorsal spine injury, cage fixation, dorsal spinal fixation, anterior interbody fusion.

INTRODUCTION

Controversy exists about the best treatment of unstable thoracic burst fractures. Objectives of the treatment are correction of kyphosis and canal decompression in case of a neurological deficit. Various conservative and surgical strategies have been tried[1]. Anterior cage fixation is an established procedure. There are controversies about why, how, when to operate and when not to operate.[2]

PATIENTS AND METHODS

Study was conducted at Unit I, Department of Neurosurgery, Lahore General Hospital from January till December of 2004. Some 37 cases of anterior cage fixation has been done in trauma cases. Selection criteria included all patients with traumatic vertebral collapse with or without neurological deficit. Patients with pathological fracture, such as caries or tumours were excluded from the study. Surgery was done through anterior transthoracic approach. Dorsolumbar junction injuries were excluded because these are considered a separate entity needing combined thoraco-abdominal approach.

RESULTS

Age range of these 37 patients was from 15 to 70 years as shown in Table no.1.

Table 1: Age distribution of all the cases of cage fixation for dorsal spinal injury.

Age range in years	Number of Patients(Percentage)
11-20	7 (19%)
21-30	15 (41%)
31-40	10 (27%)
41-50	2 (6%)
51-60	2 (5%)
61-70 yrs	1 (2%)

Sex distribution

According to gender, observations were as follows.

- Male- 29(79%) patients.
- Female- 8(21%) patients.

Setup of trauma

Trauma occurred both in urban and rural communities, agricultural and industrial setups.

- Road side-13(34%) patients.
- Industry-9(25%) patients.
- Agriculture-15(41%) patients.

Economic status

According to social class of the individuals following information was collected.

- Lower economic status -31(83%) patients.
- Middle class-6(17%) patients.
- Upper class- Nil.

Level of injury

- Upper dortsal spine-14(37%) patients.
- Lower dorsal spine-23(63%) patients.

Types of fractures

We observed different types of fractures.

- Burst fracture-19(51%) patients
- Compression fracture-10(28%) patients.
- Fracture dislocation-8(21%) patients.

Associated injuries

Associated injuries were seen in following cases.

- Intrathoraic injury-10(28%) patients.
- Adominal injury- 6(16%) patients.
- Long bones injury- 8(21%) patients.

Neurological deficit at presentation.

Neurological deficit ranged from complete paraplegia to power grade 4.

- Complete deficit-29(79%) patients.
- Incomplete deficit-8(23%) patients.

The decision of surgery was not based upon neurological deficit or its extent rather purely on instability of spine and compression. Any patient with compression or instability was offered surgery and all of them agreed no matter what the neurological status.

Timing of surgery

Our choice was to perform surgery as soon as patient is stable to tolerate the stress. but it ranged from 2 hours to as long as 3 months from the onset of symptoms.

- Within 6 hours-1(2.7%) patient
- Within 1 week- 25(67.5%) patients
- Within 1 month-5(13.5%) patients
- 1-3 months-6 (16%) patients.

Complications of surgery

Complications of surgery included, loosening, infection and displacement.

- Cage displacement-2(6%) patients,
- Loosenig-2 (6%)cases.
- Infection-3 (8%)cases.

We had no cases with iatrogenic visceral, vascular or neural injury.

Results of surgery

- Neurologial improvement-32(87%) patients.
- No neurological improvement - 5(13%) patients.
- Kyphosis improvement- 77% patients.
- Pain relief -27(73%) patients

DISCUSSION

The dorsal spinal injury is a high velocity injury. Patients affected are younger adults which are sole bread earners of their families.

Controversy exists about the best treatment of unstable thoraco-lumbar (TL) burst fractures, indications for surgery and criteria for fusion. Cage used in fixation also raises interesting discussions regarding its material and design. Objectives of surgery are canal decompression and kyphosis correction[1,2]. We as a policy fixate posttraumatic spines if presented within 1 month. The decision was based on patient wishes. All cases with fixed deformity and established complete neurological deficit of more than 1 month duration were excluded.

Zou et al. documented that materials used for implant have been stainless steel, metal alloys and porous tantalum[2]. We have used stainless steel alloy which is MR compatible.

Incidence

All the countries, cities, towns have unique road infrastructure, industrial and rural setups. The incidence of such injuries varies depending on all such factors. Male predominance (77%) is explainable because in our social system women are less frequently involved in hard physical labour outside homes. Majority of the patients belong to lower socioeconomic status. Age range was from 15 to 70 years. Maximum number of cases were between 21-30 years of age. Majority belonged to rural environment (65%). Agriculture ad industry were the major setup of injury. It shows that since we are an agriculture based country. According to types of fracture it was noticed that patients with fracture dislocation had fall from height, while compression fractures happened in road traffic accidents.

Clinical features

Argenson et al. have reported associated thoracic effusions (hemomediastinum, hemothorax) as 26.5 % and scapular injuries to be 20%. The frequency of neurological impairment was seen in 30.4% with complete paraplegia in 20%, local hematoma in 32%[3]. In our cases associated chest injuries were seen in 2 cases.

According to Vialle & Ville, patients with thoracic trauma usually have high-energy injury, and should always be suspected in polytrauma cases with rib cage, sternum, cardiac, or pulmonary injuries. Management is complicated with long hospital stay[4]. In our study all the patients presented with major trauma and average hospital stay has been 1 month (3 weeks to 8 months). Types of fracture have been burst fractures, compression fractures and fracture dislocations. According to Argenson et al compression fractures predominate, (54.2%) than comminuted fractures (20%), flexion-distraction fractures (2.8%), fracture-dislocations (23%). In 35.2% injuries were at multiple levels[3]. We have seen presence of multiple levels was seen in 7% of cases.

Neurological deficit ranged from complete paraplegia to power grade 4.

Complications of thoracic injury include low blood volume shock, atelectasis and pleuritis[5].

Pathological principles

Thoracic fixation has been done for tumors as hemangioblastomas[6], and spondylolisthesis[7,8]. In this study we have used it in trauma only

A multi-step surgical procedure can limit preoperative mortality in patients in critical general condition by avoiding an extended one stage dorsoventral spondylodesis[9,10].

Investigations

There is no controversy regarding investigations. MRI scan is the mainstay and considered better than all the other radiological investigations.

Different management principles

Conservative treatment can achieve only moderate delayed reductions. It is satisfactory for pain reductions[11]. We choose not to manage patients conservatively rather to fix the spine whenever possible.

Timing of surgery has been studied and it is noticed that early stabilization is safe, and results in a reduced overall intensive care unit stay[12]. In our study we tried to operate as early as possible. But it ranged from 2 hours to as long as 3 months since injury. Patients presented late because they got initial treatment from local quakes, general practitioners and primary care hospitals before coming to Lahore general Hospital. Once inside our setup, finances still play a role. People who could manage the expenditure of Rs. 11,000/- for the cage and another 10 thousands for the medicines choose for surgery. There were some patients who could not afford at all and their medicines were arranged from Zakat fund. It caused delay in surgery.

Correction of deformity was achieved in majority of cases (77%). Neurological status improved in majority (88%) of our cases. Complications of surgery are due to, inadequate or wrong level exposure It leads to injury to viscera, neural, or vascular structures. Visceral injury is commonly to lung and gastrointestinal tract. Neural

injury occurs to dura, lumbar plexus, sympathetic fibers and intercostal nerves. Vascular injury is less common. Bone graft itself can fracture, extrude, or make peudoarthrosis. Metallic implant can get loosened, break, displace or malposition. There was no postoperative hemothorax or pneumothorax because all the patients had insertion of chest tube on thoracotomy closure.

Posterior vs. anterior vs. combined approach

Combined approach is done with a bisegmental posterior correction/fixation, followed by anterior corpectomy and titanium cage implantation 7-10 days later. Long term correction of kyphosis and lordosis and the mean regional back pain improved[1].

In a study posterior approach was used with unstable fractures because this permitted a complete decompression down to the posterior wall. The anterior approach was reserved for purely anterior compression, or residual compression after an initial posterior procedure. Cotrel-Dubousset instrumentation with Harrington rods were used and long term reduction was maintained[11]

Posterior bisegmental transpedicular correction/ fixation and staged anterior corpectomy and titanium cage implantation is a safe and reliable surgical option. There is complete decompression, kyphosis correction, immediate stability and maintenance of correction[1]. With rigid pedicle screw instrumentation there is a solid fusion, but there is increase in postoperative morbidity caused by disruption of the posterior musculature[10]. Some centers still prefer bony fusion using Femoral ring allograft. They avoid Titanium cages because of inferior clinical outcome and the tenfold increase in cost[11]. Anterior vertebrectomy, canal decompression, bone graft by iliac or titanium cage, and fixation with Ventrofix system gave good results[12]. According to Sprint et al Titanium cage or a radiolucent cage with footprint and translaminar screws can give poor stability and supplemental pedical screw are needed[13]. Porous tantalum cage packed with autologous bone with supplementary pedicle screws give more reliable fusion than anterior staples[2]. Zou et al. studied vertebrae-implant interface. They showed that the high presence of radiolucencies and fibrous tissue are important in order to achieve bone ingrowth[14].

According to Karim et al. anterior pedical screw fixation and augmentation of Anterior interbody fusion has potential advantages over the standard Anterior interbody fusion[15]. Wang et al. have used Spinous process fixation with some success[16]. Short posterior and only anterior instrumentation systems are associated with delayed kyphosis. Such fixations do not provide enough stability, and correction. Loss and settling of vertebrae can occur[17]. Jenis et al have suggested that different fusion augmentation methods as Autologous growth factors with an appropriate carrier is a reasonable alternative to autograft and expensive bone induction technologies[18]. Finiels are of the opinion that autologous bone graft complication can be avoided by Porous biomaterials[19]. Chen et al. have used cages with Posterior lumbar interbody fusion and got good results[20]. Pape is of the opinion that the internal fixator could be removed without endangering the stability of the fusion and roentogen stereophotogrammetric analysis is reliable indicator of fusion.[21]

We have seen, with a follow up of 6 months that patients have stability and mobility to perform daily activities without pain. We have to see log term complications of cage fixation in our series.

CONCLUSION

Anterior cage fixation is a safe and effective method for traumatic dorsal spine instability involving vertebral bodies.

REFERENCCES

1. Payer M. Unstable burst fractures of the thoraco-lumbar junction: treatment by posterior bisegmental correction/fixation and staged anterior corpectomy and titanium cage implantation. Acta Neurochir (Wien) 148: 2006; 299-306.
2. Zou X, Li H, Teng X, Xue Q, Egund N, Lind M, Bunger C. Pedicle screw fixation enhances anterior lumbar interbody fusion with porous tantalum cages: an experimental study in pigs. Spine 30: 2005; E392-9.
3. Argenson C, Boileau P, de Peretti F, Lovet J,

Dalzotto H. Fractures of the thoracic spine (T1-T10). Apropos of 105 cases. Rev Chir Orthop Reparatrice Appar Mot. 1989; 75: 370-86.

4. Vialle LR, Vialle E. Thoracic spine fractures. Injury 2005; 36(Suppl 2): B65-72.
5. Riggin RS and Kraus JF. The risk of neurologic damage with fractures of vertebrae. J Trauma 1997; 17: 126-33.
6. Steinmetz MP, Claybrooks R, Krishnaney A, Prayson RA, Benzel EC. Surgical management of osseous hemangioblastoma of the thoracic spine: technical case report. Neurosurgery 2005; 57(4 Suppl): E405;
7. McAfee PC, DeVine JG, Chaput CD, Prybis BG, Fedder IL, Cunningham BW, Farrell DJ, Hess SJ, Vigna FE. The indications for interbody fusion cages in the treatment of spondylolisthesis: analysis of 120 cases Spine 2005; 30(6 Suppl):S60-5.
8. Isenberg J, Jubel A, Hahn U, Seifert H, Prokop. Multi-step surgery for spondylosyndesis. Treatment concept of destructive spondylodiscitis in patients with reduced general condition. Orthopade 2005; 34: 159-66.
9. Schinkel C, Greiner-Perth R, Schwienhorst-Pawlowsky G, Frangen TM, Muhr G, Bohm H. Does timing of thoracic spine stabilization influence perioperative lung function after trauma? Orthopade 2006; 35: 331-6.
10. Cain CM, Schleicher P, Gerlach R, Pflugmacher R, Scholz M, Kandziora F. A new stand-alone anterior lumbar interbodyfusion device: biomechanical comparison with established fixation techniques. Spine 2005; 30: 2631 -6.
11. McKenna PJ, Freeman BJ, Mulholland RC, Grevitt MP, Webb JK, Mehdian SH. A prospective, randomized controlled trial of femoral ring allograft versus a titanium cage in circumferential lumbar spinal fusion with minimum 2-year clinical results. Eur Spine J 2005; 14: 727-37.
12. Hasegawa K, Abe M and Washio T. An experimental study on the interface strength between titanium mesh cage and vertebra in reference to vertebral bone mineral density. Spine 2001; 26: 657-63.
13. Spruit M, Falk RG, Beckmann L, Steffen T, Castelein RM. The *in vitro* stabilizing effect of polyetheretherketone cages versus a titanium cage of similar design for anterior lumbar interbody fusion. Eur Spine J 2005; 14:752-8.
14. Zou X, Li H, Bunger M, Egund N, Lind M, Bunger C. Interbody devices: an experimental study in pigs. Spine J. 2004; 4: 99-105
15. Karim A, Mukherjee D, Ankem M, Gonzalez-Cruz J, Smith D, Nanda A. Links Augmentation of Anterior Lumbar Interbody Fusion with Anterior Pedicle Screw Fixation: Demonstration of Novel Constructs and Evaluation of Biomechanical Stability in Cadaveric Specimens. Neurosurgery. 2006; 58: 522-527.
16. Wang JC, Haid RW Jr, Miller JS, Robinson JC. Comparison of CD Horizon Spire spinous process plate stabilization and pedicle screw fixation after anterior lumbar interbody fusion. J Neurosurg Spine. 2006; 4:132-6.
17. Karaeminogullari O, Tezer M, Ozturk C, Bilen FE, Talu U, Hamzaoglu A. Radiological analysis of titanium mesh cages used after corpectomy in the thoracic and lumbar spine: minimum 3 years' follow-up Acta rthop Belg. 2005; 71: 726-31.
18. Jenis LG, Banco RJ, Kwon B. A prospective study of Autologous Growth Factors (AGF) in lumbar interbody fusion. Spine J. 2006; 6: 14-20.
19. Finiels PJ. Interest of porous biomaterials in spinal surgery. Neurochirurgie. 2004; 50: 630-8
20. Chen HH, Cheung HH, Wang WK, Li A, Li KC. Biomechanical analysis of unilateral fixation with interbody cages. Spine 2005; 30: E92-6.
21. Pape D, Fritsch E, Kelm J, Muller K, Georg T, Kohn D, Adam F. Lumbosacral stability of consolidated anteroposterior fusion after instrumentation removal determined by roentgen stereophotogrammetric analysis and direct surgical exploration. Spine. 2002; 27: 269-74.

The Authors:

Rizwan Masood Butt,
Associate Professor
Department of Neurosurgery,
PGMI & Lahore General Hospital,
Lahore

Manzoor Ahmed,
Senior Registrar,
Department of Neurosurgery,
PGMI & Lahore General Hospital,
Lahore

Abdullah Haroon,
Assistant Professor,
Department of Neurosurgery,
PGMI & Lahore General Hospital,
Lahore

Ashraf Shaheen,
Assistant Professor,
Department of Neurosurgery,
PGMI & Lahore General Hospital,
Lahore

Capt. Bashir,
Senior Registrar,
Department of Neurosurgery,
PGMI & Lahore General Hospital,
Lahore

Attiue Rehman,
Associate Professor,
Department of Neurosurgery,
PGMI & Lahore General Hospital,
Lahore

Farukh,
Medical Officer,
Department of Neurosurgery,
PGMI & Lahore General Hospital,
Lahore

Asma Gilani,
Registrar
Department of Neurosurgery,
PGMI & Lahore General Hospital,
Lahore

Azam Niaz,
Registrar
Department of Neurosurgery,
PGMI & Lahore General Hospital,
Lahore

Nazir Ahmed
Professor
Department of Neurosurgery,
PGMI & Lahore General Hospital,
Lahore

Address for Correspondence:

Rizwan Masood Butt,
Associate Professor
Department of Neurosurgery,
PGMI & Lahore General Hospital,
Lahore