Clinical Article

Online ISSN : 2314-8969
Print ISSN: 2314-8950

Egy Spine J 21:14-23, 2017

www.esa.org.eg

Pedicle Screw-Related Complications in Thoracolumbar and Lumbosacral Spine Surgery

Ahmed Elsawaf MD, Mohammed Hasanein MD, Salem Faisal MD.

Department of Neurosurgery, Faculty of Medicine, Suez Canal University, Ismailia, Egypt.

Received on:
September17th, 2016
Accepted on:
November22nd, 2016

Abstract

Background Data: Pedicle screw instrumentation of the thoracolumbar and lumbosacral spine is a well-known technique used to achieve rigid fixation for a wide variety of spinal disorders. However, it is technically demanding and may be associated with potential operative risks and complications.

Study Design: A retrospective clinical case study.

Purpose: To determine the incidence of complications related to pedicle screw fixation of thoracolumbar and lumbosacral spine, and if it affects the final decision of the surgeons.

Patients and Methods: The reported complications in 108 transpedicular thoracolumbar and lumbosacral fixation procedures were analyzed. All medical files, operative notes, and radiographs were examined.

Results: Varied complications were observed in 35.2% of patients during and after surgery. General complications were found in 13.8%, most were trivial. Infection rate was 4.6%, all cured with antibiotics except one patient who required screws removal. Neurological complications were noted in 2.7% of patients. Transient root paresis developed in 1 patient due to pedicle wall perforation. Radicular pain was noted in one patient secondary to irritation from misplaced screw. Dural tears were reported in 0.9% of our patients during screws insertion. None of

patients developed permanent deficit. Device-related complications occurred in 18.5% of patients, 55% of them occurred at thoracolumbar junction. Screw false passage was seen intra-operatively in 4.6%, pedicle fracture in 0.9%. Misplaced screw was reported in 5.5% and screw breakage in 3.7% of patients. Screw breakage occurred mainly in multi-level procedures which did not involve anterior column restoration (P<0.001).

Conclusion: Pedicle screws instrumentation is associated with significant complication rate. However, most complications are trivial and can be avoided through applying careful operative techniques and awareness of spinal anatomy. (2016ESJ118)

Keywords: Thoracolumbar, lumbosacral, Instrumentation, Complications, Pedicle screw fixation

Introduction

Pedicle screws instrumentation can be considered the gold standard in internal spinal fixation. Harrington and Tulloswere[7] in 1969 were the first who reported a technique of transpedicular screw fixation, then Roy-Camille popularized the first practical method of pedicle screw fixation.[10] Afterwards, transpedicular screw fixation has been widely used in the field of spine surgery owing to its unique biomechanical properties in comparison to other methods of spinal fixation.[8] Insertion of pedicular screw is based mainly on identification of the anatomical landmarks of the posterior arch of the vertebra. To be ideal, pedicle screw should have a maximum diameter and length without breaching the cortical layer of the pedicle or the vertebral body.[2,25] Fluoroscopic guidance is used to localize the pedicle and assure insertion of screw in the desired position.[1]Pedicle screws guaranty a rigid fixation with enhanced segmental control. It is more advantageous than non-pedicle fixation devices in the aspect that it offers a better restoration of the spinal sagittal contour and makes a shorter fusion feasible, saving more motion segments, and offers a more reliable fixation in the osteoporotic patients, and in patients with previous laminectomy.[22]

With continued clinical and biomechanical experiences, pedicle screws underwent improvement in design, which had led to easiness in its application, with minimal implant failure rates. Despite these advances over the last few decades, pedicle screws placement is still technically challenging, and associated with some risk even with experienced hands, owing to their proximity to important neural and vascular structures.[5,19] Malposition of a pedicle screw (for example) is a commonly reported complication in literature, with an incidence of 0%-42%.[9] Malpositioned screw can lead to relevant complications such as nerve root irritation, pedicle fracture, vascular injury, cerebrospinal fluid leak, and visceral injury.[12,13,17]

In this study, we retrospectively analyzed the data concerning complications of pedicle screw insertion in patients operated on by the same team of surgeons using a standardized technique at our institution. The goal was to analyze the complications seen while using pedicle screws for the treatment of different spinal disorders.

Patients and Methods

In the period from June 2014 to June 2015, we were able to track 108 consecutive patients who had been submitted to transpedicular thoracolumbar and lumbosacral fixation procedures. Data was collected from medical records, operative notes, radiographs, and outpatient follow-up charts and was retrospectively analyzed. The mean age of the patients at the time of operation was 49 (range

38-62) years. Forty six (43%) patients were men and 62 (57%) were women. Patients enrolled in this study had been followed-up for at least one year (range 12-36 months). Spinal fixation also was supplemented with postero-lateral or interbody fusions using autologous bone (either from the iliac crest, or local laminar bone) in 37 patients (34 %). In 19 patients (17.5%), posterior lumbar interbody fusion (PLIF) with lumbar cages was performed. All patients received per-operative 3rd generation cephalosporin antibiotics. We included patients with symptomatic spondylolisthesis, degenerative disc disease, post-laminectomy syndrome, thoracolumbar and lumbar fractures. We excluded patients with spinal infections, oncologic disorders, and deformities.

Complications were grouped into three categories: 1) General complications: medical complications, infection, DVT; 2) Neurological complications: (either related to manipulations, pedicular screws, hematomas) radicular injury, radicular pain, or dural tear: and 3) Device-related complication: screw malposition, screw or rod breakage, screw pull out, system failure, and loss of correction.

Statistical analysis was done using the Pearson Chi-square test.

Results

Over all 108 patients submitted to spinal fixation in our institution and have been enrolled in this study. Patients' population included 46 patients with spondylolisthesis, 33 patients with thoracolumbar trauma, 20 patients with post-laminectomy syndrome, and 9 patients with LCS. (Table 1)

Total levels of fixation were 346 levels; (692 screws were inserted). The reported levels of fixation in this study were as follow; S1: 34 patients, L5: 70 patients, L4: 63 patients, L3: 33 patients, L2: 34 patients, L1: 36 patients, D12: 36 patients, D11: 31 patients, and D10: 9 patients. (Table 2)

We had one level fixation in 28 patients, two-level fixation in 35 patients, three-level fixation in 40 patients, and four-level fixation in 5 patients. The distribution of the fixed levels in correspondence to each vertebra is discussed in table 2. Three-level fixation was the most common in our study (20 patients) and was used in thoracolumbar fractures.

Reported medical co-morbidities in this study were as follow; 29 patients (27%) were hypertensive, 22 patients (20%) had diabetes mellitus, 33 were (30.5%) smokers, obesity was obvious in this study; (61 patients were overweight [56 %], and 32 patients were obese [30%]), ischemic heart disease was shown in 9 patients (8%), all of them were above 45 years old and were stable. Triple disease (DM, HTN and IHD) was shown in 7 patients (6.5%). (Table 2)

Complications of different types and severity were collectively reported in 38 out of 108 patients (35.2%). More than one complication had been reported in some patients. We categorized reported complications in our study into three groups:

General Complications:

The total number of reported general complications was shown in 15 patients (13.8%). The majority of these complications were treated while patients were still admitted in the hospital. Excessive intra-operative bleeding (over one liter) occurred in 3 patients (2.7%); blood loss was replaced immediately without further sequelae.

Medical complications developed postoperatively in five patients (4.6%); three of them had thoracolumbar fractures. Of these 5 patients; 2 patients developed chest infection

(both suffered neurologic impairment), one patient developed deep venous thrombosis (he had associated fracture femur), one patient developed ileus (obese female), and finally an elderly patient developed urinary tract infection.

Iliac crest pain developed at donor graft site in two patients (1.8%) for several weeks after surgery, and both responded to analgesics. Wound infection was reported in 5 patients (4.6%). Of these, 4 patients developed superficial wound infection in the form of abnormal fluid discharge from the skin incision, three of them responded to frequent dressing and systemic and topical antibiotics. The fourth patient who had fixation for thoracolumbar trauma required wound debridement and copious irrigation without removal of the implants. One patient developed deep wound infection for 15 months after his surgery in the form of recurring wound discharge which did not respond to antibiotics. His wound was explored and a missed piece of gauze embedded deeply beneath muscles was found. The implants were loose and were removed; wound was debrided, irrigated and closed after drain. He responded well to systemic antibiotics.

Neurological Complications:

Partial nerve roots injury was reported in one patient (0.9%).The patient developed partial foot drop. His injury was due to perforation of L5 pedicle during reduction of L4-L5 spondylolisthesis. His weakness subsided over a 5 weeks period. Radicular pain was noted in one patient with medially misplaced L3 pedicle screw; this pain subsided completely after screw readjustment accurately. None of our patients developed permanent neurological deficit. Dural tear was reported in one patient (0.9%). It happened during instrumentation after slippage of screw driver while tightening the screw nut. Water-tight primary repair was done immediately with no clinical sequences.

Device-related Complications:

Device-related complications were the commonest encountered variety of complications through this study. Eleven device-related complications were reported at the thoracolumbar area while 9 device related complications were reported at the lumbosacral area.

Intra-operative screw false passages were noted in 5 patients (4.6%); violation of lateral pedicular wall (N=3), of medial pedicular wall (N=1), and of inferior pedicular wall (N=1). However, all screws trajectories were corrected immediately without any neural damage.

Lumbar pedicle fracture occurred intra-operatively in one patient (0.9%), due to mismatch between pedicle size and screw diameter. In this patient, the fractured pedicle was skipped, and the adjacent upper level was involved in fixation. Screw misplacement outside the pedicle (on routine postoperative radiographs) was noted in 6 patients (5.5%), this was an indication for further post-operative CT-scan study. Misplaced trajectory was medial in 2 patients, lateral in 3 patients, and superior in one patient. Most of these patients did not develop symptoms relevant to mal-positioned screws, except one patient who developed immediate postoperative radicular pain due to medially misplaced L3 pedicle screw (reported above). Penetration of the anterior cortex of vertebral body was seen in two patients, with no evidence of visceral injury.

Seven screw breakages were reported in four patients within 8 to 18 months postoperatively. Screw breakage occurred mainly in multi-level fixation surgery. Three patients had thoracolumbar surgery and one had lumbosacral surgery. This led to loss of

postoperative deformity correction (on lateral radiographs) ranged from 5˚ to 12˚ but with accepted sagittal profile. We did not find correlation between misplacement of screws or screws breakage, and the loss of correction on postoperative radiographs (P>0.05). We had revised 2 patients of the four with broken screws; the 1st patient had two screws fractures and the second had only one screw fracture. The two patients complained of back pain which was attributed to the screw fracture, they insisted for screws revision. The fractured screws were only replaced by new ones. (Figure 1) The other two patients with screw breakage refused the revision.

Lastly, screw loosening occurred in two patients; they were suffering infrequent subtle back pain. The two patients had a degenerative pathology; one patient was operated for spondylolisthesis and the other one had post-laminectomy instability. For one of them, screws replaced with larger diameter screws 8 months after surgery and the back pain improved after revision. The other patient needed no surgery and improved by simple medical treatment.

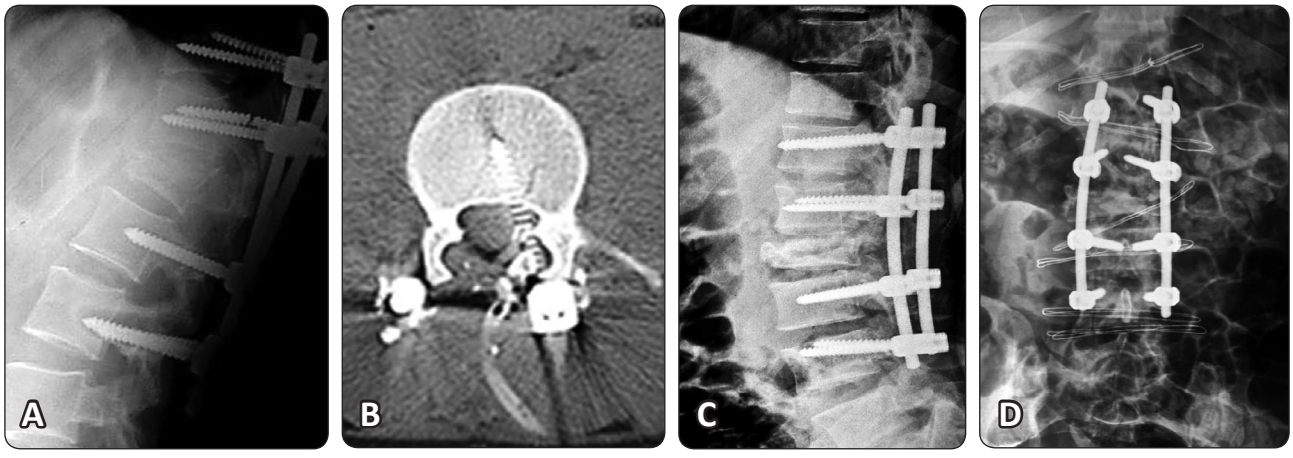

Figure1. (A) Lateral radiograph of the thoracolumbar junction, in a 37 years old male patient with L-1 burst fracture, taken 18 months postoperatively. There was breakage of D12 screw with loss of correction. The breakage point was near the screw/rod junction. (B) Immediate postoperative CT scan in a 29 patient with L2 burst fracture operated for spinal fixation. CT scan demonstrated medial misplacement of a left lumbar pedicle screw. The patient developed radicular pain. Pain disappeared after screw removal and replacement with another one in the correct position. Postoperative (C) lateral and (D) AP image consequently after repositioning of wrongly placed screw for the same patient. The radicular pain improved immediately after screw repositioning.

Table 1. Distribution of Spinal Disorders in 108 Patients.

Spinal Disorder	Patients No.	%
Lumbar spondylolisthesis	43	39.8%
Thoracolumbar trauma	33	30.7%
Post- laminectomy Instability	12	11%
Lumbar canal stenosis	9	8.3%
Recurrent disc herniation	8	7.4%
Spondylolysis	3	2.8%
Total patients	108	100%

Table 3. Distribution of Complications in 108 patients.

Complication	Patients No.	%
General	15	13.8%
Neurological	9	8.3%
Device related	20	18.5%

Table 4. General Complications of Pedicle Screws Fixation

Complication	Patients No.		%
Excessive bleeding	3		2.7 %
Chest infection	2		1.9 %
DVT	1		0.9 %
Ileus	1		0.9 %
UTI	1		0.9 %
Donor graft pain	2		1.9 %
Infection	5	4 superficial	4.6 %
		1 deep	

Table 5. Neurological Complications of Pedicle Screws Fixation.

Complication	Patients No.	%
Radicular injury	1	0.9 %
Radicular pain	1	0.9 %
Dural tear	1	0.9 %

Table 6. Device Related Complications of Pedicle Screws Fixation.

Complication	Patients No.	%
Intra-operative false passage	5	4.6 %
Lumbar pedicle fracture	1	0.9 %
Postoperative screw misplacement	6	5.5 %
Penetration of anterior vertebral body	2	1.8 %
Screw breakage	4 (7 screws)	3.7 %
Screw loosening	2	1.8 %

Table 2. Demographics of the study population

Variables			Patients No.
Sex		Male	46
Female			62
Frequency of fixation by level		D10	9
D11			31
D12			36
L1			36
L2			34
L3			33
L4			63
L5			70
S1			34
Fixation according to Number of levels		I-level fixation	28
II-level fixation			35
III-level fixation			40
IV-level fixation			5
Distribution of levels	I-level fixation	L5-S1	9
		L4-L5	17
		L3-L4	2
	II-level fixation	L4-L5-S1	13
		L3-L5	15
		D11-L1	2
		D12-L2	5
	III-level fixation	L3-S1	8
		L2-L5	4
		D10-L1	8
		D11-L2	20
	IV-level fixation	L2-S1	4
		D10-L2	1
Medical co-morbidities		Hypertension	29
Diabetes			22
Smoking			33
Obesity			13
Ischemic heart			9

Discussion

Pedicle screw fixation is a well-known technique. It is considered now the cornerstone for surgeries of many disorders affecting thoracic and lumbo-sacral spine. Advances in operative techniques and implant designs have improved screws application in different spinal disorders.[21] Despite that, there is a potential risk of complications related to pedicle-screw insertion for various degenerative and traumatic spinal disorders.[14,26] In this study, the overall complications rate was high (35.2%). However, it is congruent with many studies that have reported similar figures.[4,18,20] Add more, most of these complications were insignificant, and unrelated to a poor clinical outcome. There were 15 patients (13.8%) who had general complications, three patients (2.7%) had neurologic complications, and 20 patients (18.5%) had device-related complications.

Whitecloud et al,[26] studied the complications with variable pedicular fixation systems, and reported an overall rate equals 45% for major and minor complications, most of the complications in his study were minor and resolved before discharge. Yuan et al,[28] also stated that the use of spinal instrumentation was associated with higher rate of neurologic complications, infection, and instrumentation failure. In a more comprehensive review, Yahiro,[27] analyzed 101 articles reporting the results of 5,756 patients treated with pedicular fixation for a wide variety of spinal disorders, and reported a rate of 9.6% for instrumentation problems, and 2.8% for neural injuries.

In the current study, the rate of general and medical complications was 13.8%. However, most did not affect the final outcome, and were managed fairly. Some of these complications might be related to the longer time consumed in application of fixation systems, therefore, increased the amount of blood loss, and possibility of infection. The infection rate in current study was 4.6% in spite of the regular preoperative administration of prophylactic antibiotics. However, this rate is in keep with several previous studies where infection rates ranged from 1 to 8%.[15,21]

Vaccaro stated that infection was a major concern in any spine surgery especially in instrumented fusions.[23] Infections after spinal fixation may be linked to tissues over-cauterization, and the use of fluoroscopic assistance in the operating room. Most infections were treated with debridement and parentral antibiotics, except in one case which needed screws removal. Generally, infection can be prevented by proper sterilization of operative field, careful handling of tissues, and administration of extra doses of antibiotics in lengthy procedures.[23]

The risk of neurological complications after spinal arthrodesis is considerable.[4] Despite transient neurapraxia is a commonly seen complication, the incidence of a permanent neurological deficit is exceptional.[16] In current study, incidence of neural injury was 2.7%. Aside from dural tears, one case developed partial root paresis at L4 and S1 roots. Pain resolved over few weeks, and needed no reoperation, or developed permanent neurological deficit. Most dural lesions were unrelated directly to screws placement, but occurred during neural canal decompression, these were not included in our study because they were not correlated to screw placement. Only one has occurred due to slippage of instrumentation. All were repaired immediately without subsequent CSF leakage.

Device-related complications were observed in 18.5% of patients, over half of them occurred at thoracolumbar area (55%). Screw misplacement was the commonest noted device-related

problem; intra-operative false passage was noted in 4.6% of patients, and screw misplacement (on postoperative radiographs) was noted in 5.5% of patients. Accurate placement of pedicle screws is technically challenging, especially in thoracic spine, owing to the relatively small pedicles, complex anatomy, and proximity to vital structures. Misplaced pedicle screws, which perforate the pedicle cortex, increase the risk of neural injury, dural lesions, vascular or visceral complications, and correlated with poor surgical outcome.[11,19,24]

Review of literature revealed that rates of pedicle screw misplacement ranged from 1.1% to 28.8%,[6] they had a satisfactory outcome after primary operations in 67% and after revisions in 46%. Nerve root injuries due to screw placement occurred in 4% (2% permanent and 2% transient). Instrumentation-induced foraminal stenosis developed in 2%. They concluded that proper surgical technique could avoid these complications. In a case series comprised 148 patients, Okuyama et al,[18] found no cases with permanent neurological deficit secondary to pedicle screws, but transient neural palsy was found in a 8% of the series. On the other side, Pihlajamaki et al,[20] studied complications of transpedicular fixation in 102 patients, and reported three cases developed permanent foot drop, secondary to screw misplacement in one patient, they mentioned that screw breakage or loosening was more common in patients with multilevel fusions ($P<0.001$). They also advised that screws of 5 mm diameter should not be used for sacral fixation. Fortunately, none of our patients developed permanent neurological sequelae related to misplaced pedicle screws. Screw breakage was exclusively noted in four patients; three patients were subjected to multi-level thoracolumbar fixation, and a fourth patient, had a L5-S1 spondylolysis, undergone fixation and postero-lateral fusion. None of these patients had undergone anterior column reconstruction. Enker et al,[3] discussed the substantial role of anterior column restoration in support and maintenance of instrumentation life, as about 80% of load transfer runs through the anterior column.

Conclusion

Pedicle screw instrumentation is a save procedure for management of different spinal disorders despite the significant complication rate. Most complications are clinically irrelevant, and can be minimized through judicious use of pedicle screws for specific indications, and mindful awareness of spine anatomy and surgical pitfalls.

References

1. Amato V, Giannachi L, Irace C: Accuracy of pedicle screw placement in the lumbosacral spine using conventional technique: computed tomography postoperative assessment in 102 consecutive patients. J Neurosurg Spine 12:306-13, 2010
2. Cho W, Cho S, Wu C: The biomechanics of pedicle screw based instrumentation. J Bone Joint Surg Br 92:1061-65, 2010
3. Enker P, Steffee A: Interbody fusion and instrumentation: Clin Orthop 300:90-101, 1994
4. Esses S, Sachs B, Dreyzin V: Complications associated with the technique of pedicle screw fixation, a selected survey of ABS members. Spine 15:2231-39, 1993
5. Gaines R: The use of pedicle screw internal fixation for the operative treatment of spinal disorders. J Bone Joint Surg Am 82:1458-1476, 2000
6. Hadjipavlou A, Enker P, Dupuis P: The causes of failure of lumbar transpedicular spinal

instrumentation and fusion: A prospective study. Int Orthop 20:35-42, 1996

7. Harrington P, Tullos H: Reduction of severe spondylolisthesis in children. South Med J 62:1-7, 1969
8. Heim S: Trans-pedicle instrumentation in the degenerative spine. Clin Orthop 337:97-110, 1997
9. Hicks J, Singla A, Shen F: Complications of pedicle screw fixation in scoliosis surgery: a systematic review. Spine 35:E465–E470, 2010
10. Kosmopoulos V, Schizas C: Pedicle screw placement accuracy: a meta-analysis. Spine 32:E111-120, 2007
11. Kuniyoshi A, Yasuhiro S, Manabu I, Kiyoshi K: Complications of Pedicle Screw Fixation in Reconstructive Surgery of the Cervical Spine. Spine 25: 962-9, 2000
12. Li G, Passias P, Kozanek Ml: Complications associated with thoracic pedicle screws in spinal deformity. Eur Spine J 19:1576-84, 2010
13. Lonstein J, Denis F, Perra J: Complications associated with pedicle screws. Bone Joint Surg Am 81:1519-28, 1999
14. Masashi U, Jun T, Shota I, Hiroyuki K: Pedicle screw loosening after Posterior Spinal Fusion for Adolescent Idiopathic Scoliosis in Upper and Lower Instrumented Vertebrae Having Major Perforation. Spine 42(24):1895-1900, 2017
15. Masferrer R, Gomez C, Karahalios D: Efficacy of pedicle screw fixation in the treatment of instability and failed back surgery: a 5-year review. J Neurosurg 89:371-377, 1998
16. Matsuzaki H, Tokuhashi Y, Matsumoto F: Problems and solutions of pedicle screw plate fixation of lumbar spine. Spine 15:1159-1165, 1990
17. Nottmeier E, Seemer W, Young P: Placement of thoracolumbar pedicle screws using three-dimensional image guidance: experience in a large patient cohort. J Neurosurg Spine 10:33-9, 2009
18. Okuyama K, Abe E, Suzuki T: Posterior lumbar interbody fusion. A retrospective study of complications after facet joint excision and pedicle screw fixation in 148 cases. Acta Orthop Scand 70:329–334, 1999
19. Panjabi M, Takata K, Goel V: Thoracic human vertebrae. Quantitative three-dimensional anatomy. Spine 16:888-901, 1991
20. Pihlajamäki H, Myllynen P, Böstman O: Complications of transpedicular lumbosacral fixation for non-traumatic disorders. J Bone Joint Surg Br 79:183-189, 1997
21. TangJ: Position and complications of pedicle screw insertion with or without image-navigation techniques in the thoracolumbar spine: a meta-analysis of comparative studies. J Biomed Res 28(3):228–239, 2014
22. Vaccaro A, Rizzolo S, Balderston R: Placement of pedicle screws in the thoracic spine. Part II: An anatomical and radiographic assessment. J Bone Joint Surg Am 77:1200-06, 1995
23. Vaccaro A, Garfin R: Pedicle-Screw Fixation in the Lumbar Spine. J American Academy of Orthopedic Surgeons 3(5):263-274, 1995
24. Wang MC: Calculating risks: the power and pitfalls of registry data. Spine J 13(10):1180-2, 2013
25. Weinstein J, Rydevik B, Rauschning W: Anatomic and technical considerations of pedicle screw fixation. Clin Orthop 284:34-46, 1992
26. Whitecloud T, Butler J, Cohen J: Complications with the variable spinal plating system. Spine 14:472-476, 1989
27. Yahiro MA: Comprehensive literature review. Pedicle screw fixation devices. Spine 19:2274-8, 1994

28. Yuan H, Garfin S, Dickman C: A historical cohort study of pedicle screw fixation in thoracic, lumbar, and sacral spinal fusions. Spine 19(20 Suppl):2279-2296, 1994

Address reprint request to:

Ahmed Elsawaf, MD.
Department of Neurosurgery, Faculty of Medicine, Suez Canal University Hospital, Ismailia, Egypt. - E-mail: ahmed_alsawaf@yahoo.com

الملخص العربي

المضاعفات ذات الصلة باستخدام المسامير العنيقيه في جراحة العمود الفقري الظهري - قطني والعمود الفقري القطني - عجزي

البيانات الخلفيه: ان جراحات تثبيت العمود الفقري الصدري والعمود الفقري القطني العجزي باستحام المسامير العنيقيه هي تقنية معروفة وتستخدم لتحقيق درجة تثبيت قوية لمجموعة واسعة من اضطرابات وامراض العمود الفقري. ومع ذلك، فإنها تتطلب درجه عاليه من الناحية الفنية ويمكن أن تترافق مع المخاطر والمضاعفات المحتملة.

تصميم الدراسه: دراسة الحالة السريرية بأثر رجعي.

الغرض: لتحديد حدوث وتأثير المضاعفات المتعلقة بالتثبيت الجراحي باستخدام مسامير عنيقيه لتثبيت العمود الفقري القطني، وإذا كان ذلك يؤثر على القرار النهائي للجراحين.

المرض والطرق: في هذه الدراسة تم تحليل مضاعفات 108 مريضا قاموا باجراء جراحي لتثبيت فقاري عنيقي ظهري قطني وتثبيت القطنية العجزية. وتم فحص جميع الملفات الطبية والمذكرات التنفيذية والصور الشعاعية.

النتائج : وقد لوحظت مضاعفات متنوعة في 35.2٪ من المرضى أثناء وبعد الجراحة. تم العثور على مضاعفات عامة في 13.8٪، وكان معظمها بسيطه, وكان معدل الإصابة بالعدوي 4.6٪، وكل الحالات قد عولجت بالمضادات الحيوية باستثناء مريض واحد الذي تطلب إزالة المسامير. وقد لوحظت المضاعفات العصبية في 2.7٪ من المرضى: الام عصبية عابرة ظهرت في واحد من المرضى بسبب ثقب جدار العنيقيه. كما لوحظ ايضا ألم جذري في مريض واحد ثانوي لتهيج العصب بسبب تركيب المسمار في غير محله، وحدث قطع بالام الجافية في 0.9٪ من المرضى، ومعظمها لا علاقة لها مسامير الإدراج. ولم يصب أي من المرضى بعجز دائم. وقعت مضاعفات ذات الصلة بالجهاز في 18.5٪ من المرضى، و55٪ منهم وقعت في الفقرات الصدريه القطنيه. تم تحديد ممر خاطئ للمسمار داخل الجراحة في 4.6٪، كسر عنيقي في 0.9٪، مسمار في غير محله في 5.5٪، وكسر المسمار في 3.7٪ من المرضى. حدث كسر المسمار أساسا في إجراءات متعددة المستويات التي لم تنطوي على استعادة العمود الأمامي (P<0.01).

الاستنتاج: ينتج عن استخدام المسامير العنيقة معدل مضاعفات كبيرة. ومع ذلك، فإن معظم المضاعفات ليست ذات صلة بالمسامير ذاتها, ويمكن التغلب عليها من خلال تطبيق تقنيات دقيقه بغرفة العمليات، والوعي التشريح بالعمود الفقري.