

A Simple and Effective Technique for Removing Broken Pedicle Screws

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Research Article

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Abstract

Background: Different methods and tools had been developed to remove the broken pedicle screws. Removing a broken pedicle screws was not always easy. We reported a simple and effective technique to remove the broken pedicle screws in this study.

Methods: The Institutional Review Board of the Fengdu people's Hospital of Chongqing approved the study. A total of 34 patients (aged 47.76 ± 8.12 years) accepted first operation because of thoracolumbar fractures in our department and other departments were analyzed retrospectively. They accepted secondary surgery to remove the spinal instrumentations when they obtained bone fusion or bone healing from March 2017 to March 2020. We applied a high speed drill (with 2mm diameter), a three rhomboid pointed cone, an acutenaculum, and a larger forceps to remove the broken pedicle screws.

Results: The spinal segment of broken pedicle screws was consist of L2 (3 cases), L3 (8 cases), L4 (17 cases), L5 (6 cases). The location of the broken pedicle screws was within the scope of pedicle. There were no complications about broken pedicle screws, such as injury of nerve roots, severe low back pain, and spinal cord injury. The average time of removing the broken pedicle screws was 13.79 ± 3.52 minutes. The mean blood loss of surgery was 72.06 ± 28.05 milliliters. No other complications happened during surgery.

Conclusion: A simple and effective technique for removing broken pedicle screws is reported. This technique reserves the original nail road of pedicle, does not destroy the pedicle cortex, and averts producing the debris of spinal instrumentations.

1. Introduction

The technique of spinal transpedicular screw fixation had been widely performed to treat spinal fractures, degenerative diseases, instability, tumor, deformity, and spondylolisthesis because it was applied to stabilize the spinal three columns [1]. However, the complications of the transpedicular screw fixation were under concern. The rates of broken pedicle screw were reported ranging from about 3–7.1% [1–5].

It was a challenge to remove the broken pedicle screws when screw breakage occurred. Several techniques for extraction of broken pedicle screws had been reported in the literatures. However, most of these techniques require special instrument to burnish the broken pedicle screws [6–11]. Moreover, producing the debris of spinal instrumentations was a risk of tissue reaction [6, 8–9, 11]. So, we employed the usual instruments to remove the broken pedicle screws in this report in order to evaluate the effects of this technique retrospectively.

2. Materials And Methods

The Institutional Review Board of the Fengdu people's Hospital of Chongqing approved the study. All of the participants provided their written informed consent to participate in this study before their data were

stored in the hospital database and used for research purposes. All methods were carried out in accordance with relevant guidelines and regulations of the Fengdu people's Hospital of Chongqing.

2.1 Patients selection

Medical records of hospitalized patients diagnosed with thoracolumbar fractures and accepted secondary surgery to remove the spinal instrumentations when they obtained bone fusion or bony healing in our department from March 2017 to March 2020 were analyzed retrospectively. Twenty of them came from other departments when they accepted the first surgery.

Inclusion criteria:1) Preoperative diagnosis of thoracolumbar fractures obtained bone fusion or bony healing and needed removing instrumentations when the patients asked to remove the implants;2) At least one of the broken pedicle screws;3) The broken pedicle screws located within pedicle;4) The clinical and imaging data were complete.

Exclusion criteria:1) Spinal tuberculosis or malignant tumor or inflammatory or degenerative diseases;2) The broken pedicle screws located in vertebral body.

2.2 Preoperative management

All patients underwent X-ray or CT examination to evaluate spinal instrumentations and bone fusion or bone healing. Surgery was taken when the basic diseases such as diabetes, coronary heart disease, hypertension were under control.

2.3 Surgical methods and techniques

The patients were placed in prone position after general anesthesia. Subperiosteal dissection of the bilateral paraspinal muscles or intermuscular approach was performed via a posterior median approach. The tools for removing broken pedicle screws were showed in Fig. 1. After removing the rods and non-broken pedicle screws, we used a high speed drill (with 2mm diameter) to grind the osteophyte in order to expose the stem of the broken pedicle screws at the basal part of pedicle.(Fig. 2A).In this procedure, we did not need to grind the broken pedicle screws in order to avoid debris of the screws. Then, a three rhomboid pointed cone was used to wipe out the bone surrounding the stem of the broken pedicle screws.(Fig. 2B). Next, we employed an acutenaculum to rotate the stem of the broken pedicle screws counterclockwise.(Fig. 2C). Lastly, a larger forceps was used to remove the broken pedicle screws completely. (Fig. 2D).

2.4 Outcome indexes

Operative time of removing the broken pedicle screws and operative blood loss were recorded in the surgery. Complications were recorded during the surgery. The X-ray was carried out to observe the morphology of pedicle.

2.5 Statistical analysis

SPSS 19.0 software was used for statistical analysis. Quantitative data was expressed in mean \pm standard deviation. We did not make a contrast among these data in our study.

3. Results

3.1 Clinical outcomes

A total of 34 patients were included in this study. All of the patients had only one broken pedicle screws located in the distal fragment pedicle. The surgery time of extraction of broken pedicle screws was short and the blood loss was less relatively. There was no other surgery complication during the operational process. (Table 1).

Table 1. Patients data

Items	L2(n=3)	L3(n=8)	L4(n=17)	L5(n=6)
Gender(Male/Female)	1/2	3/5	10/7	3/3
Position(Pedicle/ vertebral body)	3/0	8/0	17/0	6/0
Age(year, mean \pm SD)	54 \pm 5	49.38 \pm 5.40	46.76 \pm 7.92	44.67 \pm 11.88
surgery time(minute, mean \pm SD)	14.67 \pm 1.15	13.38 \pm 2.62	13 \pm 1.66	16.17 \pm 7.31
blood loss(milliliter, mean \pm SD)	50	68.75 \pm 25.88	70.59 \pm 25.36	91.67 \pm 37.64
Complication(Yes/No)	No	No	No	No

L₄/lumbar

3.2 Imaging outcomes

The images appeared that the morphology of pedicle was complete after removing the broken pedicle screws. There was also no debris of spinal instrumentations. Typical cases were showed in Figs. 3-4.

4. Discussion

There is a controversy about removal of broken pedicle screws. Successful bone union or bone healing did not prevent screw breakage. In one study, Chen et al [1] reported that 69% of the 16 patients of broken pedicle screws had solid fusion and screw breakage of 75% of the 16 patients took place on the caudal side. Therefore, we suggest that it is better to remove the spinal instrumentations for preventing screw breakage as long as obtaining bone healing. Moreover, when surgeons consider that it may be developing a disease needed revision surgery or reoperation because of other diseases in the future, removal of the broken pedicle screws is needed theoretically.

However, it can be a challenge to remove the broken pedicle screws although some techniques have been developed for management of broken pedicle screws. Miyamoto [6] and Kil [8] et al described a simple

and new method for removing broken pedicle screws. Their method did not enlarge the screw hole around the broken screw or use any special devices, but some small fragments of metal may be residual surrounding the tissue, as well as other studies in the literatures [9, 11]. Di Lorenzo [7] and Weng [10] et al offered a technical application for removing broken pedicle screws but the diameter of pedicle hole was enlarged.

Our study indicated that a simple and effective technique for removing broken pedicle screws was applied. The blood loss of surgery was less relatively and the surgery time of extraction of broken pedicle screws was short, although no comparative analysis was done. The position of broken pedicle screws was located in the distal fragment pedicle, which was similar to the previous study [1].

There were some drawbacks in our study as well. Firstly, the morphology of pedicle was merely evaluated by X-ray. CT is better to observe the integrality of pedicle. Secondly, there was no comparative study.

In conclusion, this technique was mainly appropriate for broken pedicle screws located in pedicle but not in vertebral body in our experience. It reserves the original nail road of pedicle screw, and does not destroy the pedicle cortex. Otherwise, it averts producing the debris of spinal instrumentations. The pedicle was complete in our typical cases. Therefore, the method has no effect on revision surgery or re-operation via spinal transpedicular screw fixation.

Declarations

Ethics approval and consent to participate

The Institutional Review Board of the Fengdu people's Hospital of Chongqing approved the study. All of the participants provided their written informed consent to participate in this study before their data were stored in the hospital database and used for research purposes. All methods were carried out in accordance with relevant guidelines and regulations of the Fengdu people's Hospital of Chongqing.

Consent for publication

Not applicable.

Availability of data and materials

The datasets generated during and analyzed during the current study are not publicly available due to them containing information that could compromise research participant privacy/consent, but are available from the corresponding author on reasonable request.

Competing interests

The authors declare to have no competing interests.

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Authors' contributions

Qian-xing Deng: Conceptualization, Data curation, Formal analysis, Supervision, Validation, Methodology, Writing - original draft, Writing - review & editing.

Hong-wu Fan: Conceptualization, Methodology, Resources, Writing - review & editing.

Rong Zhang: Data curation, Formal analysis, Methodology, Resources, Writing - review & editing.

Jian-quan Yu: Data curation, Methodology, Resources, Software, Writing - review & editing.

Yong Tao: Formal analysis, Software, Writing - review & editing.

Peng Zhan: Formal analysis, Resources, Software, Writing - review & editing.

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Not applicable.

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Figures



Figure 1

A high speed drill (with 2mm or 4mm diameter) and a three rhomboid pointed cone showed in picture A. An acutenaculum and a larger forceps in picture B.

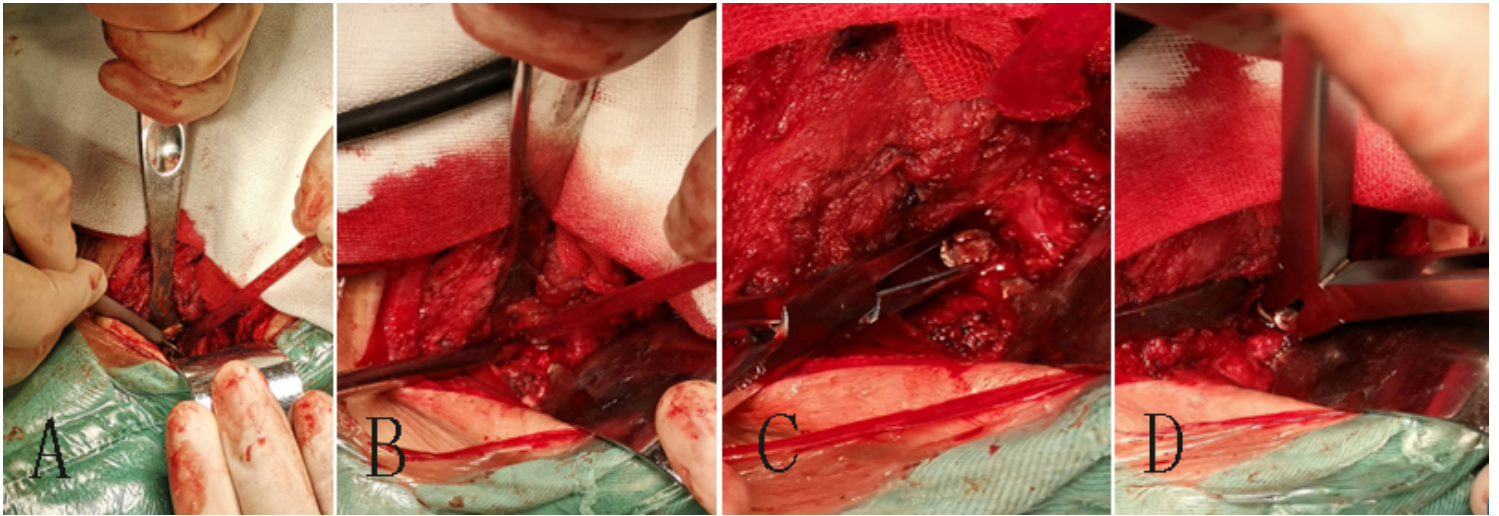


Figure 2

A high speed drill (with 2mm diameter) to grind the osteophyte in order to expose the stem of the broken pedicle screws at the basal part of pedicle (A). Then, a three rhomboid pointed cone was used to wipe out the bone surrounding the stem of the broken pedicle screws (B). Next, we employed an acutenaculum to rotate the stem of the broken pedicle screws counterclockwise (C). Lastly, a larger forceps was used to remove the broken pedicle screws completely (D).

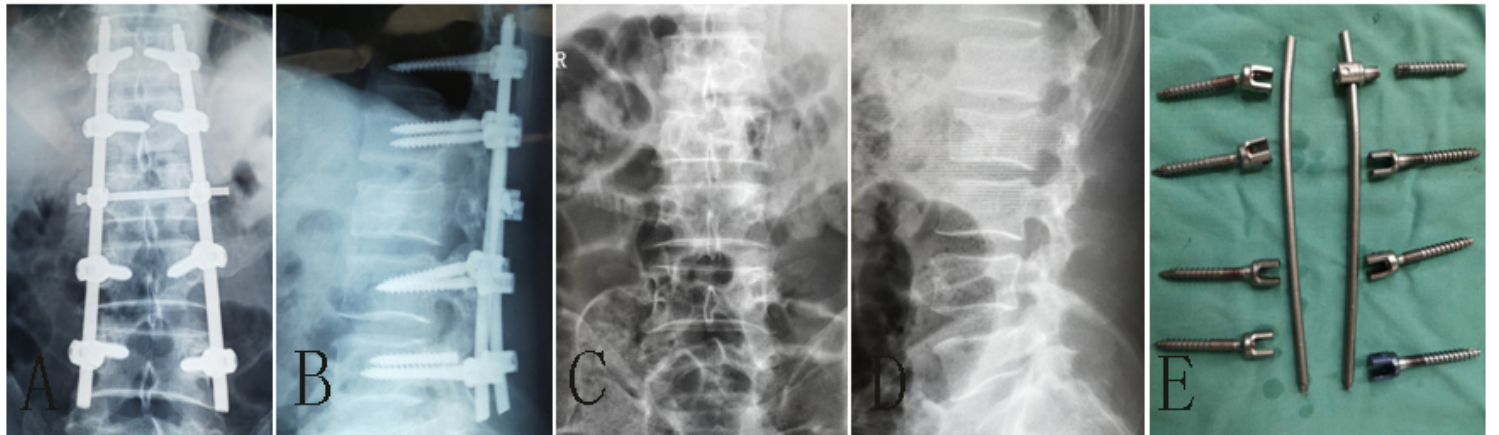


Figure 3

A 51 years old man underwent the removal of broken pedicle screws located in L4 (A-E). The pedicle was reserved completely after operation (C and D).

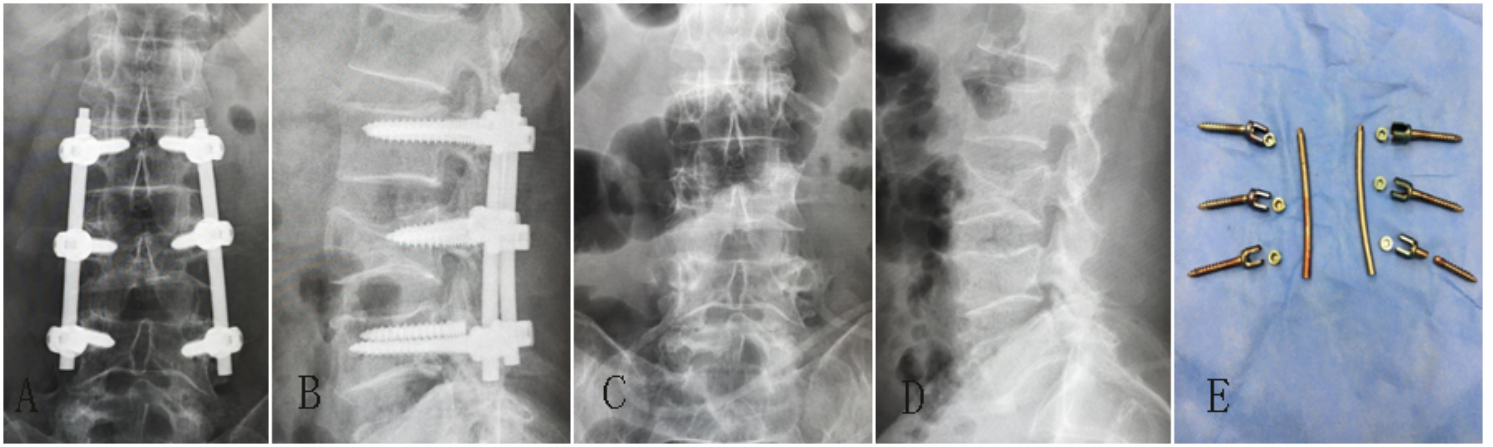


Figure 4

A 48 years old man underwent the removal of broken pedicle screws located in L4 (A-E). The pedicle was reserved completely after operation (C and D).