Simple technique for removing broken pedicular screw with plain and serviceable screwdriver

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Received: 1 January 2008 / Revised: 18 February 2008 / Accepted: 1 March 2008 / Published online: 15 March 2008
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Abstract Removing the broken pedicular screw after spinal hardware failure is usually problematic. A specially designed simple screwdriver and easy removal technique of broken pedicular screw with this screwdriver are described in this article.

Keywords Broken screw · Pedicle

Introduction

Nearly, one quarter of hardware failure after transpedicular screwing is related to screw breakage [2, 3]. Removing process of a broken pedicle screw is an important issue in spinal surgery. It should be technically easy and noninvasive to pedicle, because any damage to pedicle, during removal of the broken screw, may weaken the pedicle, and this weakness in turn may decrease the success of reinstrumentation. Previously, some techniques were described for removal of broken pedicular screws [1, 2, 4–6].

Technique

With the aim of the broken pedicular screw removal, a special screwdriver was designed by the senior author (AS) (Fig. 1a). The screwdriver is made of chrome, and has two reciprocally located parallel tips. The distance between these two tips is 6 mm at the most distal end, and this distance decreases to 3 mm at the base of these tips. The

medial face of these tips is sharply designed. The decreasing distance between these two tips towards their bottoms is designed for the application of this screwdriver for screws in different diameters.

During the surgery, after paravertebral dissection, the hardware is exposed and the rods accompanying the pedicle screws are removed. The upper part of the broken screw is removed as usual. The main stage of the technique involves the removal of distal part of the broken screw. To accomplish this, firstly the upper surface of the remaining broken screw is exposed. To expose this surface, some effort of drilling or curettage of the neighboring pedicle can be performed. After exposure of the upper surface of the broken distal pedicle screw, two reciprocally located notches are formed at the edges of this surface by a diamond drill that is 2 mm in diameter (Fig. 1b). Then, screwdriver tips are locked to these notches and turned in counter clockwise direction to extract the broken screw (Fig. 1b).

Discussion

Previously, different techniques were introduced for removal of broken pedicular screw [1, 2, 4–6]. McGuire introduced a screw extractor, which removes the broken screw via a drilled central pilot hole on it [4]. This technique needs a deep drilling inside the broken screw for the application of screw extractor. Moreover, initial locking of screw extractor to broken screw is usually difficult and some additional efforts such as tacking of the screw extractor towards broken screw may be needed, which brings the risk of moving the broken screw deeper. Duncan and MacDonald made a pilot hole in pedicle at the periphery of the broken screw and touched the broken screw with clockwise drill bit in brief pulses, for counter

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Fig. 1 **a** Technical drawings and the photograph of the screwdriver are seen; *numbers* in drawing correspond to distance in millimeter. **b** Drilled uppermost surface of broken screw, and application of screwdriver tip to this drilled broken pedicle screw is seen in different planes

clockwise movement of broken screw, thus removing the broken screw [2]. This technique involves additional resection of pedicle during construction of a pilot hole, and this process may weaken the pedicle. Di Lorenzo et al. and Weng et al. summarize screw retrieval instruments that are

specially designed screw heads, which grasp broken screw and remove it by counter clockwise movement with the help of friction and grasping, respectively [1, 6]. These techniques may require wide bone removal of pedicle at the periphery of broken screw to be able to grasp it by these

retrieval instruments. Miyamoto et al. summarize a very practical technique for broken pedicle screw removal, and this technique involves drilling the upper surface of the broken screw at its center to form a cleft, and this cleft is used for the application of minus screwdriver that would rotate counter clockwise to retrieve broken screw [5]. This technique was also experienced by us occasionally, but the available diamond drill for constructing such a cleft is 2 mm in diameter, and such a cleft is too thick for screws with smaller diameter. For example, a cleft of 2 mm thickness, large cleft with thin accompanying edges at either sides of the cleft (1 mm in thickness), constructed on the upper surface of a broken screw that is 4 mm in diameter means that such thin edges may not bear to counter clockwise rotation of minus screwdriver, and thus it would bend. Moreover, the base of central cleft accomplished on the upper surface of a broken screw is usually not so flat and so not suitable for lodging of minus screwdriver. Because of such disadvantages, prior to designing our screwdriver, we used an alternative technique of bilateral drilling uppermost of broken screw sides and counter clockwise rotation of broken screw with clamping the middle tip of laterally drilled surface with surgical clamp. But this method also usually necessitates large bone removal of pedicle around the broken screw tip for application of clamp, and clamp failure during retrieving is a major problem.

In our technique, during removal of distal broken screw part, major drilling in neighboring pedicle is not needed, because exposure of upper surface of that broken screw part is enough for drilling the reciprocal notches for settlement of screwdriver. This is an advantage for preserving

rest of the pedicle for reinstrumentation, but drilling deep in pedicle over the screw pieces should be cautious to prevent uncontrollable movements that will pose major risk to adjacent dura mater and neural tissue. Surgical microscope may also be preferred for better visualization.

Shortly, the screwdriver mentioned in this technique is a very practical instrument that can be used for screws of different diameters, and this technique does not require major drilling of either broken screw or pedicle. The technique does not need long time, it is very practical, and is found to be very easy and satisfactory in our three cases having hardware failure due to broken pedicular screw. Shortly, we recommend this easy technique and instrument for removal of broken pedicle screws.

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