

Technical Report

# Modified closing-opening wedge osteotomy for the treatment of sagittal malalignment in thoracolumbar fractures malunion

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## Abstract

**BACKGROUND CONTEXT:** Many techniques have been described for the surgical treatment of rigid posttraumatic thoracolumbar kyphosis, but none is well adapted to the modified shape of the wedged vertebra.

**PURPOSE:** The study aimed to describe the modified closing-opening wedge osteotomy (MCOWO), a new osteotomy technique that adapts to the triangular shape of the wedged apical vertebra of the deformity.

**STUDY DESIGN:** A retrospective assessment of the degree of correction before and after the MCOWO was carried out.

**PATIENT SAMPLE:** Ten patients presenting rigid posttraumatic thoracolumbar kyphosis were enrolled in this study.

**OUTCOME MEASURES:** We used preoperative and postoperative whole spine radiographs to assess the sagittal plane parameters, and computed tomography scan for measurement of the vertebral segment height at the osteotomy level, spinal cord length, aorta length, and fusion rate.

**METHODS:** Ten patients underwent the MCOWO at T12 or L1. The procedure involves removing the postero-superior triangular corner of the wedged vertebra and transforming it to a shape similar to a trapezoid.

**RESULTS:** The patients' mean age was 36.6±7.5 years, the mean time between the fracture and the surgery was 12.2±5.6 months, and the mean follow-up was 30.6±5 months. In all patients, statistically significant improvement was observed in the sagittal plane after surgery. The thoracolumbar angle improved from 52±6° preoperatively to 7.1±5.7° at the last follow-up. Mean osteotomy angle was 38.1±2.6°, mean spinal cord shortening was 1.2±0.2 cm, and mean aorta lengthening was 2.3±0.4 cm. All the patients showed complete fusion at 2 years, and none required revision surgery. Two patients presented a temporary unilateral weakness that recovered completely within 3 months after the surgery.

**CONCLUSIONS:** The MCOWO is an interesting procedure for patients with posttraumatic thoracolumbar kyphosis. The modified osteotomy is adapted to the modified shape of the compressed vertebra. Spinal cord shortening and aorta lengthening were well tolerated in all patients. © 2015 Elsevier Inc. All rights reserved.

## Keywords:

Aorta lengthening; Kyphosis; Sagittal malalignment; Spinal cord shortening; Spine osteotomy; Thoracolumbar fracture

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## Introduction

Thoracolumbar malunion is a classical complication of thoracolumbar compression fractures, and a frequent etiology of secondary kyphotic deformity of the thoracolumbar junction. Thoracolumbar malunion is usually the result of either a single or multiple-level fractures of the thoracolumbar junction that has been treated conservatively, but with the anterior wedge worsening progressively over time.

In some cases, when the secondary kyphosis is detected early, and the fracture has not completely healed, it could be corrected by a simple posterior surgical fusion that may require an anterior complementary disc grafting if the correction is done mainly by anterior opening of the discs. But in most cases, the thoracolumbar kyphosis is discovered after the fracture's bone has healed completely and a fixed deformity has taken place. In this case, posterior classical fixation and fusion is not enough. Thus, rigid deformity correction techniques, such as osteotomy, should be used. Many options described in the literature are available for the surgical treatment of rigid thoracolumbar kyphosis [1].

In this paper we describe a new technique for the correction of sagittal malalignment after a thoracolumbar kyphosis due to a fracture malunion. We used a posterior-only approach called a modified closing-opening wedge osteotomy (MCOWO). Risks, complications, and radiographic outcomes of this technique were assessed on a series of 10 patients who presented with a painful, rigid thoracolumbar kyphosis.

## Materials and methods

Ten consecutive patients with rigid thoracolumbar kyphosis secondary to an old fracture underwent posterior-only correction and fusion with the use of the MCOWO in a 2-year period (2010–2012). The procedure involved two spinal surgeons in two institutions. Of the 10 patients, 7 had a T12 fracture, and 3 had an L1 fracture. The MCOWO technique

was indicated in patients with non-flexible deformity who presented with a local kyphosis of more than 30° on dynamic views and degenerated discs around the fracture. An independent spinal surgeon conducted a retrospective study of this series; the radiographs, computed tomography scans, risks, and complications were analyzed.

The series included 8 men and 2 women, with a mean age of 36.6 years (range: 26–50 years); the mean duration of the thoracolumbar fracture was 12.2 months (from 6 to 24 months). None of the patients had a previous spinal surgery.

### Osteotomy principle

The principle of this type of osteotomy is based on geometry, mainly that of the triangle, which is the shape of a fractured vertebra. Osteotomy aims to transform this triangle to a shape as close as possible to a trapezoid, a quadrilateral with two parallel segments, and a trapezoid can be extracted from a triangle by removing a triangular corner of the triangle, which, in the case of a wedged vertebra, consists of removing its postero-superior triangular corner (Fig. 1).

### Surgical technique

The patient is installed in a prone position, on four cushions. During the surgery, we use transcranial motor evoked potentials, somatosensory evoked potentials, and free running electromyography (EMG) of the lower extremities as well as evoked EMGs with pedicle screw stimulation.

The operative field is exposed from three levels above to three levels below the osteotomy site; a posterior cutaneous midline incision is made. The spine is exposed subperiosteally, going laterally to the transverse processes in the lumbar spine and to the costotransverse junction in the thoracic spine. Resection of the inferior articular processes at all levels is performed bilaterally to provide maximum flexibility to the spine. Next, we use the free-hand technique to place the pedicle

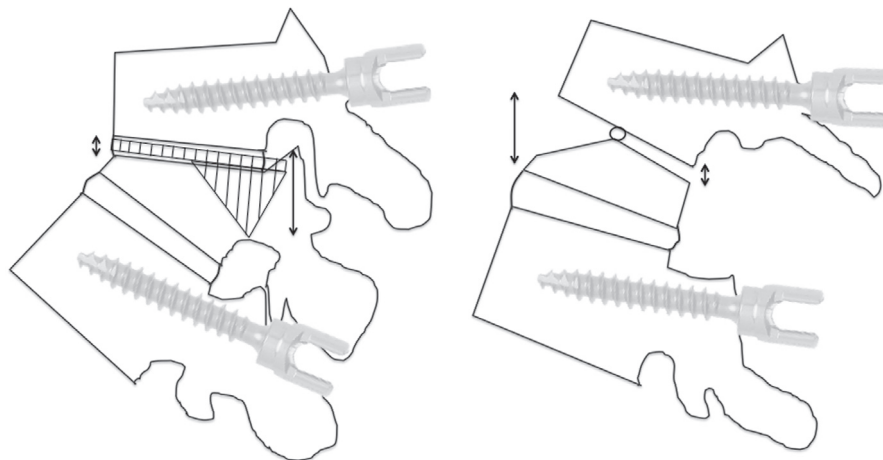


Fig. 1. Schematic illustration of the modified closing-opening wedge osteotomy (MCOWO). (Left) The highlighted area shows the extent of bony resection of the vertebral body and upper disc. (Right) After closure of the osteotomy, the anterior column is opening and the middle column is closing (black arrows), with a hinge point around the center of the upper disc space (open circle).

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