

# Pedicle screw system plus ACPC perfusion to treat fractures of thoracolumbar vertebrae

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In recent years the pedicle screw system has been widely used in treating thoracolumbar vertebral fractures. The effect to recover the injured vertebrae height, the spinal physiological curve and to decompress vertebral canal has been confirmed. But the problems of internal fixation bending, loosening and breaking, which result in the loss of the vertebral height and spinal angulation deformity, are quite common and cause a lot of difficulties for surgeons. To solve these problems and decrease the sequelae from treating thoracolumbar vertebrae fractures with vertebral pedicle screw system, we have tried using vertebral pedicle screw system plus ACPC perfusion to treat 18 patients with thoracolumbar vertebral fractures. Satisfactory results have been obtained.

## CASE REPORTS

### Clinical data

There were 18 patients (13 male and 5 female) with thoracolumbar vertebral fractures, aged 20-51 years (mean = 36.5 years). Nine patients suffered from falling injury, 6 from traffic accidents injury and 3 were injured by crush of heavy objects. According to Denis' classification, compressive vertebral fractures was in 12 patients and burst injury was in 6. T11 lesion was in 2 patients and T12 lesion in 3; L1 lesion was in 8 patients, L2 lesion in 3 and L3 lesion in 1 patient; one patient had saltatory fracture showing mild compression at T11 and burst fracture in L2. According to ASIA 1992 Criterion for spinal cord nerve

injury, grade A spinal cord nerve injury was in 2 patients, grade B in 3, grade C in 3, grade D in 6 and grade E in 4. X-ray and CT scan examinations showed kyphosis 18°-42° (Cobb method, mean = 22.5°). The loss of the anterior height of the injured vertebrae was 31%-52%, averaging 39.6%. The fractured bone mass of the vertebrae inbursed into the spinal canal, occupying the sagittal diameter of the spinal canal 28%-77% (mean = 48.2%). The operation time was 6 hours to 1 week after injury, averaging 78 hours. Pedicle screw system reduction internal fixation plus ACPC perfusion was carried out; the internal fixation system RF was used in 4 patients and the internal fixation system AF in 14 patients. The ACPC named Autosolidification Calcium Phosphate Cement Powder was produced by Shanghai Rebone Biomaterials CO. LTD. At the same time exploration of the vertebral canal and decompression were performed in 7 cases. The fusion of bone grafting in vertebrae was not done in this series.

### Operation method

The patient was in prone position on the operating table, the RF or AF screw was twisted into the superior and inferior vertebral body of the injured vertebrae through the pedicle of vertebral arch, then the rod was put in with the posture being reduced. Type C arm X-ray machine was used for monitoring till the injured vertebrae and spinal column were reduced. Then the rod at one side was removed, the pedicle of vertebral arch of the injured vertebrae was reamed, the angular between the driller and the sagittal plane being about 20°. The bone hole was enlarged to ensure that the bone hole was within the vertebral body and did not enter the vertebral canal or penetrated the anterior limbi of the vertebral body. The quantity of the ACPC to be perfused depended on the height loss of the injured vertebrae, generally, 3-5 g of the ACPC was

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used. When the ACPC became a bit sticky 20 ml syringe was connected with a short transfusion tube to add pressure, and after the ACPC was completely solidificated, the rod was put in. The same method was used for the other side.

## RESULTS

There was no infection on the incision after operation, and the spinal nerve symptoms did not aggravate either. The patients could walk about with the help of a waist protector 3 weeks after operation. The follow-up time was 10-16 months, averaging 12.6 months. Except that two patients of grade A did not improve their spinal nerve symptoms, others all recovered by 1-3 grades. The spinal rachiokypnosis was 2-6°, with average recovery of 21.1°. The anterior height of the vertebral body recovered by 91%-100% (mean reduction = 98%). The fractured bone mass of posterior limbi of the vertebral body reduced obviously, occupying the sagittal diameter of the vertebral canal 4%-21% (mean reduction = 39.2%). There was no loosening or breaking of the screw or broken rod in internal fixation. No chronic back pain was found, there was no loss in the injured vertebral height in the spinal physiological curve. In one patient small saphenous vein embolism in the left leg occurred one month after operation, for there was varicosis of great saphenous vein in the left leg before the operation.

## DISCUSSION

With development of pedicle screw system, the use of the RF and AF system in clinics anatomical reduction of thoracolumbar vertebrae fractures has become possible. But if the implant becomes lose or the screw breaks, the injured vertebrae with recovered height would collapse again, the patient with severe loss of physiological lordosis would develop rechiokypnosis deformity<sup>1</sup> and suffer from secondary spinal nerve injury and chronic back pain. The complications mentioned above are caused by not only the apparatus themselves but also the collapse degree of and management of the injured vertebrae during operation. The re-loss of obtained physiological radian is due to that the injured vertebrae is unable to endure axial load, which leads to loss or break of the pedicle screw system. As how to manage the injured vertebrae well is concerned, Dick, et al<sup>2,4</sup> assumed that a hole

was drilled through the injured vertebrae, then bone was grafted into it. But this method brings about much trouble and the bone has to be got from other places. Furthermore, the hole can't be filled with the bone mass accurately and evenly, so desirable results can't be achieved. Zou DW, et al<sup>5-6</sup> has reported that for unstable thoracolumbar vertebral fracture, internal fixation plus bone grafting fusion at upper and lower segments of the injured vertebrae is widely used; the disadvantage is that fusion of segments decreases spinal column exercise and accelerates degeneration of the adjacent tissues. Artificial bone can solve these problems, for its solidifying time is long,<sup>7</sup> so there is enough time for modulating and perfusing, with simple grafting method and accurate perfusing. During solidification the ACPC releases little heat<sup>8</sup> that does not cause burn to the surrounding tissues and there is no toxicity. It also has good affinity to the tissues,<sup>9</sup> guiding osteogenesis climbing replacement; the degradation speed is in pace with bone climbing,<sup>10</sup> besides, it has a strong compressive resistance<sup>11</sup> and patients can be loaded early. In this series of the patients implant plus ACPC were used, which avoided losing of the implant, breaking of the screw and fusion of grafted bone between segments. Even at later stage, the vertebral height and spinal physiological curve were ensured. No new complications occurred. But the time of follow-up is not long, so the long-term effect needs to be studied.

1. Good spinal surgical technique and rich experiences of using pedicle screw instruments are required. It is an important to recover the height of the injured vertebrae and spinal physiological curve.

2. The entrance of the hole drilled at the injured pedicle of vertebral arch must be accurate to make the hole tracks of the 2 sides to unite within the vertebral body. After the outer form of the vertebral body recovers, a large space should be left at center (frontal a bit) of the vertebral body to let the pedicle probe enters the space without penetrating the anterior limbi of the vertebral body into the thoracoabdominal cavity. If the spinal canal or thoracoabdominal cavity is penetrated the ACPC must not be used.

3. The ACPC modulated should be neither too dry nor too dilute, if it is too dry the syringe can't enter; if too dilute the ACPC perfused would be washed out by the bleeding blood and can't be solidificated.

4. During ACPC perfusion the pressure should not

be too great, otherwise the fractured bone mass of the vertebral posterior limbi recovered would be squeezed into the spinal canal, which leads to a decrease of discompression effect.

5. After finishing ACPC perfusion for both sides the over propped RF or AF rod should be properly compressed, early appropriate loading is allowed. The stress of implants should be decreased in order to avoid early degeneration of superior and inferior disks of the injured vertebrae.

### Indications

The ACPC is one of the best materials with which thoracolumbar compressive fractures are treated. For burst fractures water perfusion test is suggested during operation; if the water perfusion test through the pedicle of vertebral arch confirms that the circumferential soft tissue of injured vertebrae is intact the ACPC can be used; if pre-operation imaging reveals fractures of pedicle vertebral arch the ACPC must be avoided.

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