The traditional pedicle screw fixation technique is described widely used in cervical, thoracic, lumbar, and sacral regions (1,2), which can provide strength biomechanical properties for most spinal surgery. However, there are some drawbacks of traditional pedicle screw fixation. The trajectory is from lateral to medial, and the screw entry point is located on the cross of middle horizon line of transverse process and the middle vertical line or lateral wall of the upper facet (3,4). Therefore, surgeons need considerable paraspinal muscle dissection for traditional pedicle screw fixation.

Additionally, traditional pedicle screw has high risk of screw loose for osteoporotic patients (5). Several alternative techniques were developed to increase the pullout force of traditional pedicle screw fixation for osteoporotic patients, including using screw with larger diameter and bone cement augmentation (6).

Santoni et al. (7) firstly reported lumbar cortical bone trajectory (CBT) screw fixation technique, which is from middle to lateral direction in axial plane and caudocephalad direction in the sagittal plane. Compared to the traditional pedicle screw fixation, CBT screw is shorter and smaller, with the maximized thread to contact with the higher density cortical bone, and not penetrating the vertebral body trabecular bone (8).

There are many studies that proved the morphometric feasibility and biochemical properties of CBT screw fixation in the lumbar spine region (7,9,10), and some clinical studies to investigate the outcomes of this technique in treatment of patients with lumbar spine pathologies (11-13). In lower thoracic spine region (T9-T12), it is Matsukawa et al. that firstly reported (14) the morphometric measurements and feasibility of CBT screw fixation technique on 50 adults’ CT scans. The point of intersection of the lateral two thirds of the superior articular process and the inferior border of the transverse process was used as the screw entry point. Then, the CBT trajectory was designed straight forward in the axial plane angulated cranially targeting the posterior third of the superior endplate (6 o’clock orientation and aimed in the 12 o’clock direction in the pedicle) (Figure 1). After the CT images measured, 24 cadaveric thoracic vertebrae (5 T9, 5 T10, 6 T11, and 6 T12, with 44 pedicles) were further studied.

In CT morphometric measurements of T9–T12 region, parameters were measured (Figure 2): (I) pedicle width (PW); (II) pedicle height (PH); (III) pedicle transverse angle (PTA); (IV) pedicle sagittal angle (PSA); (V) length of screw trajectory (L); (VI) cephalad angle (CA). They found that the PW gradually increased from T9 (6.0±1.1 mm) to T12 (9.1±1.6 mm); the PH gradually increased from T9 (13.0±1.3 mm) to T12 (16.8±1.7 mm); while the transverse and sagittal angles of the pedicle tended to decrease gradually from T9 (7.7±1.9° and 14.9±3.4°) to T12 (4.4±1.71° and 10.4±3.1°). The length of trajectory was from 29.7±4.6 mm (T9) to 32.0±2.1 mm (T12), and the CA

© AME Medical Journal. All rights reserved.

Dong Chen, Wen-Fei Ni, Yan Lin, Xiang-Yang Wang, Ai-Min Wu

Department of Spine Surgery, Orthopedic Hospital, The Second Affiliated Hospital and Yuying Children’s Hospital of Wenzhou Medical University, Second Medical School of Wenzhou Medical University, Zhejiang Spine Surgery Centre, Wenzhou 325027, China

Correspondence to: Ai-Min Wu, MD, PhD. Department of Spine Surgery, Orthopedic Hospital, The Second Affiliated Hospital and Yuying Children’s Hospital of Wenzhou Medical University, Second Medical School of Wenzhou Medical University, Zhejiang Spine Surgery Centre, Wenzhou 325027, China. Email: aiminwu@wmu.edu.cn.


Received: 23 July 2017; Accepted: 02 August 2017; Published: 24 August 2017.

doi: 10.21037/amj.2017.08.09

View this article at: http://dx.doi.org/10.21037/amj.2017.08.09
from 21.4±3.3° (T9) to 27.6±3.9° (T12).

Then, they compared the maximum insertional torques of CBT screw fixation and the traditional pedicle screw fixation on 24 lower thoracic vertebrae, and found that CBT screw (diameter: 5.5 mm; length: 35 mm) had the maximum insertional torque of 1.02±0.25 Nm, which is significantly better than the traditional pedicle screw (diameter: 6.0 mm; length: 40 mm) of 0.66±0.15 Nm.

This study proved the feasibility of CBT screw fixation in lower thoracic region, and gave us amount of valuable data to guide the clinical performance. However, there were still some problems, the PW of T9 was 6.0±1.1 mm, this means lots of patients had the PW less than 5.5 mm, Zhuang et al. (15) reported that the percentage of PW lesser than 4.5 mm is 34.75% at T9 in female population, and 40.91% in female who is less than 160 cm. Therefore, the screw with diameter of 5.5 mm may penetrate out the cortical bone. The other caution need to take is that the lamina width of T12 is very small, which may have high risk of lateral pars fractures.

Xuan et al. (16) reported to insert the 4.5 mm diameter CBT screws via pedicle or pedicle rib unit in lower thoracic spine. They found the 4.5 mm diameter CBT screws can be placed at T11 and T12 via pedicle only, but need via pedicle rib unit at T9 and T10 in some patients because the screw penetrated the outer wall of pedicle cortex, especially in females. They (17) also provided the anatomic data of performing 4.5 to 5.5 mm CBT screws fixation via pedicle or pedicle rib unit in the pediatric thoracic spine. The above two studies add the additional evidence and novel concept to CBT screws fixation in lower thoracic spine to Matsukawa et al. (14).

The aim of using CBT screw fixation is to improve the stability and pullout strength. Matsukawa et al. (14) only reported the insertional torque, further biomechanical tests including cyclic moments (flexion/extension/lateral bending/axial rotation) loading test in six freedom machine, fatigue test and pullout test of CBT screw in lower thoracic spine need to be conducted. Moreover, the clinical studies should also be conducted further to prove its safety and efficacy.

**Acknowledgements**

**Funding:** This work was funded by the National Natural Science Foundation of China (81501933, 81371988), Wenzhou Municipal Science and Technology Bureau.
Footnote

Conflicts of Interest: The authors have no conflicts of interest to declare.

References


doi: 10.21037/amj.2017.08.09