

Reviewer #1:

Scientific Quality: Grade C (Good)

Language Quality: Grade B (Minor language polishing)

Conclusion: Major revision

Specific Comments to Authors: It is an interesting topic in osteoporotic vertebral compression fracture. This case report provided a solution for internal fixation of cemented vertebrae after vertebroplasty and has clinical application value. The case are well presented. The discussion well-articulated with the case. However, there are some concerns that need to be addressed. 1.As the authors mentioned, the use of hybrid screws has increased the difficulty of rod placement. To avoid it and for the perspective of increasing the strength of the instrumentation, why not use CBT screws in all segments ? 2.Is there any impact on the strength of the hybrid instrumentation compared with traditional pedicle screws fixation ? 3.Indications for the technique used in this case need to be discussed. Usually, part of the CBT screw needs to be inserted into the vertebral body. If there is a large amount of cement fulfilling all the vertebral body, can CBT procedure be used? Is there any requirement for cement injection volume with this technique? 4.Elderly patients has a high risk of failure after lumbar instrumentation, especially those over 80 years of age with osteoporosis, cement screws can be used to enhance fixation. Have the authors considered the risk of implant failure without the cement enhancing technique? 5.In Case Description, maybe It's better to change "L3 neuron" to "L3 nerve", so as to the following parts of the article.

Response to reviewer:

Thank you for seriously reviewing this manuscript.

1.As the authors mentioned, the use of hybrid screws has increased the difficulty of rod placement. To avoid it and for the perspective of increasing the strength of the instrumentation, why not use CBT screws in all segments ?

Even though cortical bone trajectory (CBT) can increase 30% pullout force compared with traditional trajectory (TT) ¹, its entire stabilization isn't significantly superior to TT. In some situations, CBT-rod fixation was weaker than TT-rod fixation². A study reported that CBT technique is not suitable for long segment pathologies. Meanwhile, they do not recommend this alternative trajectory for widespread use in pedicle fixation³. This alternative fixation technique provides the surgeon with additional options in some special clinical cases. In our present case, CBT was implanted in the vertebral body which was filled with bone cement. We utilized a hybrid screw technique in which CBT and TT were used in the same set. The rod placement may be difficult. Therefore, we concluded two tips to decrease the rod curvature and simplify assembly to make it easier.

1.Santoni BG, Hynes RA, McGilvray KC, Rodriguez-Canessa G, Lyons AS, Henson MA, Womack WJ, Puttlitz CM. Cortical bone trajectory for lumbar pedicle screws. Spine J 2009; 9: 366-373 [PMID: 18790684 DOI: 10.1016/j.spinee.2008.07.008]

2.Perez-Orribo L, Kalb S, Reyes PM, Chang SW, Crawford NR. Biomechanics of lumbar cortical screw-rod fixation versus pedicle screw-rod fixation with and without interbody

support. Spine (Phila Pa 1976) 2013; 38: 635-641 [PMID: 23104197 DOI: 10.1097/BRS.0b013e318279a95e]

3.Mobbs RJ. The "medio-latero-superior trajectory technique": an alternative cortical trajectory for pedicle fixation. Orthop Surg 2013; 5: 56-59 [PMID: 23420749 DOI: 10.1111/os.12027]

2.Is there any impact on the strength of the hybrid instrumentation compared with traditional pedicle screws fixation ?

A study reported that implantation CBT in the fixation proximal segment, which reduces muscle dissection and retains joint facet capsule, decreases the risk of adjacent segment degeneration¹.

Here, we implanted CBT in the cemented vertebrae to solve the situation that TT cannot be implanted in the routine method.

CBT can increase 30% pullout force². Aside from that, hybrid screws implantation can strengthen the construct stabilization because of different directions implantation in the space structure. We believe that the hybrid construct at least achieves TT stabilization.

However, it is still a lack of related biomechanical study so far. In the future research, we will try to conduct a related research.

1.Kaye ID, Prasad SK, Vaccaro AR, Hilibrand AS. The Cortical Bone Trajectory for Pedicle Screw Insertion. JBJS Rev 2017; 5: e13 [PMID: 28857932 DOI: 10.2106/JBJS.RVW.16.00120]

2.Santoni BG, Hynes RA, McGilvray KC, Rodriguez-Canessa G, Lyons AS, Henson MA, Womack WJ, Puttlitz CM. Cortical bone trajectory for lumbar pedicle screws. Spine J 2009; 9: 366-373 [PMID: 18790684 DOI: 10.1016/j.spinee.2008.07.008]

3.Indications for the technique used in this case need to be discussed. Usually, part of the CBT screw needs to be inserted into the vertebral body. If there is a large amount of cement fulfilling all the vertebral body, can CBT procedure be used? Is there any requirement for cement injection volume with this technique?

As the reviewer's suggestion, I will add some explanations about indication for this technique.

The CBT screws have four points of fixation: between the dorsal cortex and the site of insertion, on the posteromedial and anterolateral pedicle walls, and on the marginal region of the vertebral body wall. We can implant CBT screw when the bone cement did not occupy cortical bone trajectory. We can perform preoperatively CT to evaluate and program the screw implantation trajectory.

Injected bone cement mostly occupied anterior and medium part of vertebral body, and rarely in the posterior of vertebral body. The CBT screws can be implanted if the pedicles and screw

trajectory were not invaded with bone cement, which has a little relation with previous bone cement volume.

4. Elderly patients have a high risk of failure after lumbar instrumentation, especially those over 80 years of age with osteoporosis, cement screws can be used to enhance fixation. Have the authors considered the risk of implant failure without the cement enhancing technique?

I agree with you. For most elderly patients, especially those over 80 years of age with osteoporosis, we usually use cement screws to enhance fixation. Bone cement augmented screw can increase 150% pull-out force¹. In this patient, we did not consider using cement screw. The reasons were:

According to DXA result, this patient's hip BMD was -1.1 which was diagnosis as osteopenia. (we cannot refer directly to lumbar BMD because of the bone cement filling).

DXA Results Summary:

Region	Area (cm ²)	BMC (g)	BMD (g/cm ³)	T-Score	PR (%)	Z-Score	AM (%)
Neck	5.96	4.77	0.800	-0.9	88	1.3	124
Tron	9.58	7.07	0.739	-0.1	99	1.6	131
Inter	19.95	18.79	0.942	-1.5	82	0.1	101
Total	35.48	30.63	0.863	-1.1	87	0.6	110
Ward's	1.14	0.61	0.533	-2.2	62	0.4	114

Total BMD CV 1.0%, ACF = 1.012, BCF = 0.987, TH = 7.471
WHO Classification: Osteopenia
Fracture Risk: Increased

DXA Results Summary:

Region	Area (cm ²)	BMC (g)	BMD (g/cm ³)	T-Score	PR (%)	Z-Score	AM (%)
Neck	15.52	14.30	0.921	-0.4	95	1.0	115
Tron	20.10	33.88	1.686	5.2	163	6.5	192
Total	35.62	48.18	1.352	3.0	135	4.4	160

Total BMD CV 1.0%, ACF = 1.012, BCF = 0.987, TH = 10.387
WHO Classification: Normal
Fracture Risk: Not Increased

We implanted TT screws which were parallel to upper-endplate in L2 and L5. In the process of screwing into vertebral pedicle, we felt the larger implantation torque which can provide enough stability.

Therefore, we did not consider cement screws to enhance fixation.

Moreover, bone cement will increase related complication risk including monomer toxicity, polymerization heat, leakage and pulmonary embolism². Meanwhile, the bone cement augmentation may increase revision difficulty in the future. Therefore, some surgeons preferred to longer segmental fixation rather than bone cement augmentation.

1. Pfeifer BA, Krag MH, Johnson C. Repair of failed transpedicle screw fixation. A biomechanical study comparing polymethylmethacrylate, milled bone, and matchstick bone reconstruction. Spine (Phila Pa 1976) 1994; 19: 350-353 [PMID: 8171370 DOI: 10.1097/00007632-199402000-00017]

2. Santoni BG, Hynes RA, McGilvray KC, Rodriguez-Canessa G, Lyons AS, Henson MA, Womack WJ, Puttlitz CM. Cortical bone trajectory for lumbar pedicle screws. Spine J 2009; 9: 366-373 [PMID: 18790684 DOI: 10.1016/j.spinee.2008.07.008]

5. In Case Description, maybe It's better to change "L3 neuron" to "L3 nerve", so as to the following parts of the article.

It's better to change "L3 neuron" to "L3 nerve". I have corrected it in the manuscript. Thank

you.