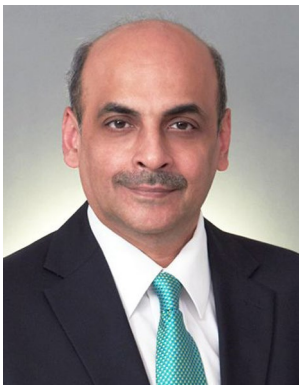
European Spine Journal (2019) 28:1833–1836
https://doi.org/10.1007/s00586-018-5618-9

EXPERT'S COMMENT

Expert's comment concerning Grand Rounds case entitled "Low energy chronic traumatic spondylolisthesis of the axis" by C. J. Dunn, S. Mease, K. Issa, K. Sinha, A. Emami (Eur Spine J; 2017: DOI 10.1007/s00586-017-5206-4)

Atul Goel[1]

Received: 5 April 2018 / Accepted: 12 April 2018 / Published online: 28 April 2018
© Springer-Verlag GmbH Germany, part of Springer Nature 2018



The authors have successfully treated a case of Hangman's fracture by resorting to anterior fixation that involved C2–3 vertebral body fixation and posterior fixation that involved insertion of C1 screws and C3 screws that were stabilized by rods [1]. All that ends well is done well.

However, there are other ways to bell a cat. I will discuss my personal surgical strategy in cases with Hangman's fractures in general and in the case in discussion in particular. Literature is unclear about the nature and extent of the fixation that is necessary and about the most suitable surgical technique.

Hangman's fractures essentially involve fractures of C2 pedicle and listhesis of C2 over C3 vertebra. The general understanding is that both C1–2 and C2–3 joints are unstable. Stabilization of both these joints has been generally identified to be mandatory in such a situation. Irrespective of whether the fracture line traverses the articular surface, the fracture of the pedicle disrupts the superior facet of axis and the atlantoaxial articulation. Inferior facet of the axis and the C2–3 articulation may not be affected.

The primary issue is fracture of the C2 pedicle, and the extent of misplacement/displacement of the fracture segments determines the nature of spinal deformity. The fracture results in malalignment of C1–2 facets and listhesis of C2 body over C3 body. Traction almost always restores alignment of the fractured segments and of the regional anatomy. Such realignment was observed by the authors even in the situation wherein there was spondyloptosis of the C2 over C3.

In my scheme of surgical management, anterior cervical surgery does not play any role. The surgical procedure is posterior, single stage, and under cervical traction. Wide exposure of the C1–2 and C2–3 articulations is mandatory. Disabling these two joints by denuding of articular cartilage and stuffing of bone graft pieces in the joint cavity forms the initial surgical step. Electric/pneumatic drill is used to make a hole in the C2 pedicle across the fracture segments. In my experience, intra-operative traction and subsequent placement of the screw and its tightening has always resulted in bringing the two fractured segments together in alignment [2– 4].

It appears that although restoration of anatomical alignment of the region is important, the success of the operative procedure is determined by the strength of stabilization of the entire region. As the issues at stake are significant, the operative procedure has to be elaborate and complete and nothing can be left for chance or speculation.

For obtaining C1–2–3 fixation, a number of permutation and combinations can be used. Figure 1 shows a single three-holed plate, with holes for C1, C2, and C3 screws. Figure 2 shows fusion of C1–2 region with plate and screws and C2–3 fixation using transarticular technique of screw insertion.

✉ Atul Goel
atulgoel62@hotmail.com

[1] Department of Neurosurgery, Seth G.S. Medical College and K. E. M Hospital, Parel, Mumbai 400012, India

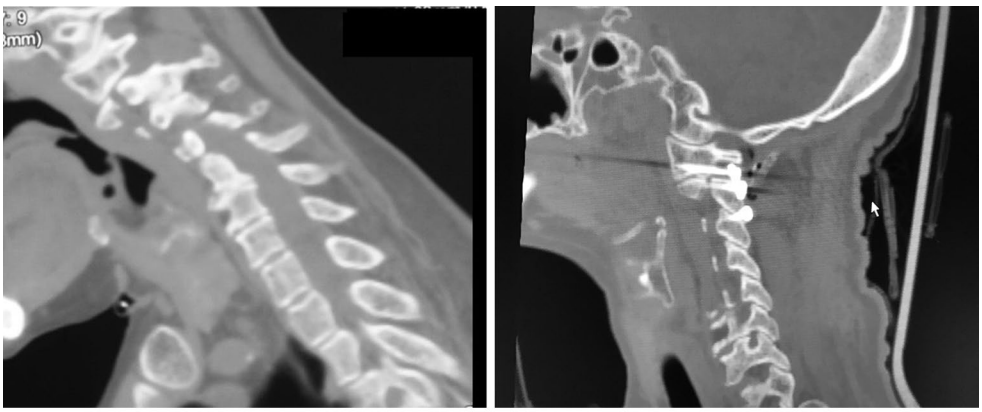
Fig. 1 Postoperative CT scan showing fixation using one plate with hole for screw insertion in the C1 facet, C2 pars-pedicle-facet and in C2–3 in a transarticular fashion

Fig. 3 A two-holed plate is used. C1 facetal screw and C2–3 transarticular screw insertion is seen

Figure 3 shows the use of one long plate with two holes; rostral hole is used for C1 screw, and inferior hole is used for screw that traverses C2–3 joint in a transarticular fashion.

Bone graft is placed in the joint cavities of C1–2 and C2–3 articulation and in the midline after appropriately preparing the host bone area of arch of atlas and laminae and spinous processes of C2 and C3. For the fusion to be successful, it is crucial to section all the large and strong muscles attached to the spinous process of C2 vertebra in particular.

Dramatic neurological recovery in the immediate postoperative period is the usual observation. Restriction of



(a) **(b)**

Fig. 2 **a** CT scan showing fracture of the C2 pedicle. **b** CT scan showing C1–2 fixation using plate and screws. Transarticular C2–3 screw insertion is seen

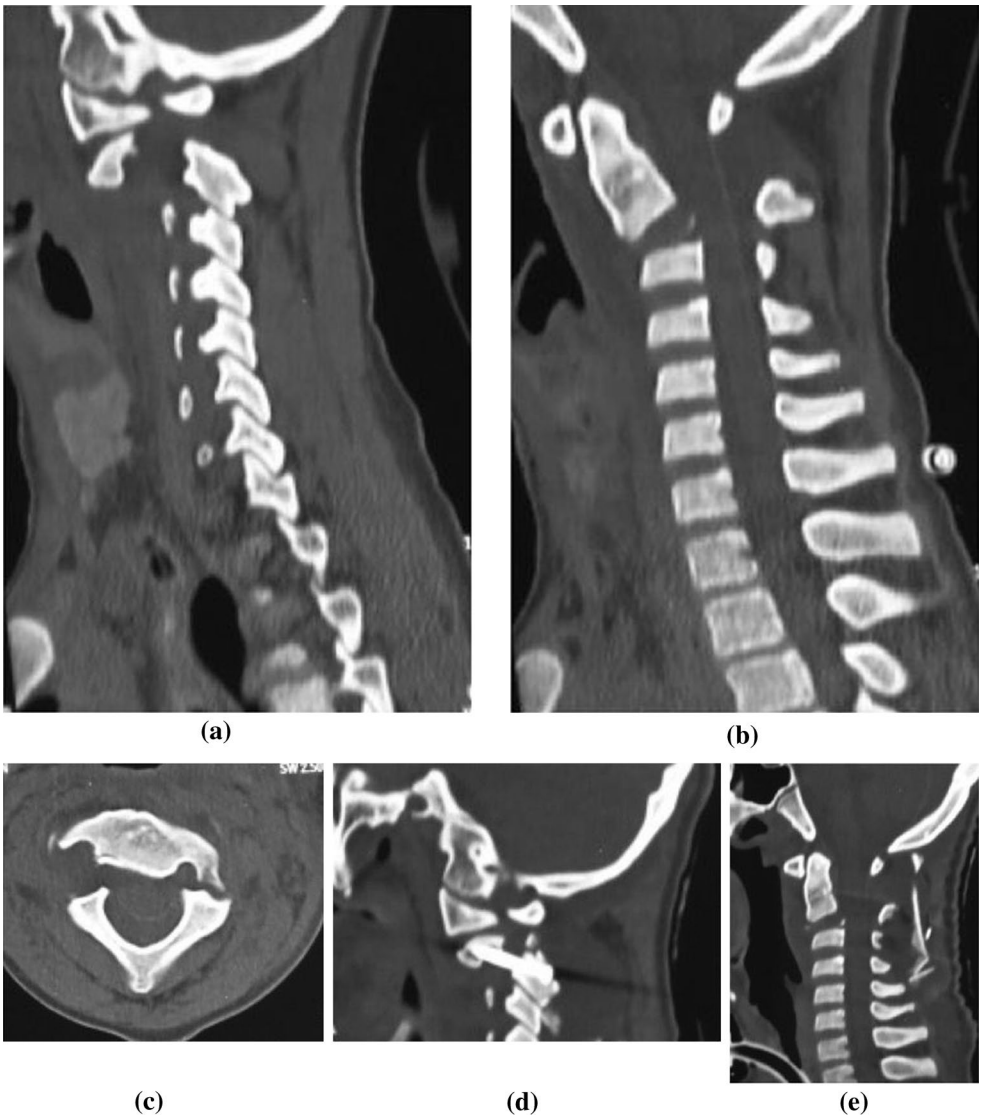


Fig. 4 **a** CT scan showing fracture of pedicle of C2 and distraction of fracture segments. **b** CT scan showing listhesis of C2 over C3. **c** Axial image showing fracture of C2 pedicles on both sides. **d** Fixation using only one large C2 screw that traverses across the fracture segments. **e** Postoperative CT scan showing alignment of the C2–3 bodies

the neck movements following two crucial joint fixations is suitably compensated by the rest of the cervical spinal segments and is well tolerated by the patients.

Fixation of the C2–3 joint can be debated, as essentially this joint may not be involved and can be anatomically and functionally intact. The other question is whether fixation of atlantoaxial joint is necessary or can it be avoided to save this most mobile joint of the body.

Theoretically, it is possible that only alignment of the fractured segments of C2 pedicle is done using a single screw on both sides and the joints, both C1–2 and C2–3, are not handled. Such a maneuvering can retain the movements of both C1–2 and C2–3 joints after the fusion has occurred. Such treatment is possible and probably most rational and was successfully adopted by us in our recent case (Fig. 4). However, the validity of such a technique will have to be assessed with more experience.

It needs to be assessed if C2–3 joint fixation is feasible without manipulating the C1–2 joint. Preserving the function of C1–2 joint can be crucially important for executing

Fig. 5 CT scan showing fixation of C2–3 facets

a wide range of neck movements. We have attempted such a technique successfully in one patient (Fig. 5).

My current recommendation will be to fuse C1–2–3 joints. However, other options need to be suitably studied to evaluate whether either C1–2 or C2–3 or both these joints can be saved in the treatment of Hangman's fractures.

Compliance with ethical standards

Conflict of interest The authors has no conflicts of interest to disclose.

References

1. Dunn CJ, Mease S, Issa K, Sinha K, Emami A (2017) Low energy chronic traumatic spondylolisthesis of the axis. Eur Spine J. https://doi.org/10.1007/s00586-017-5206-4
2. Goel A, Laheri VK (1994) Plate and screw fixation for atlantoaxial dislocation. (Technical report). Acta Neurochir (Wien) 129:47–53
3. Goel A (2017) Caudally directed and inferior facetal and transfacetal screws for C1–C2 and C1–2–3 fixation. World Neurosurg 100:236–243
4. Goel A, Jain S, Shah A, Patil A, Vutha R, Ranjan S, More S (2018) Atlantoaxial Fixation for Odontoid fracture: analysis of 124 surgically treated cases. World Neurosurg 110:558–567