

Expert's comment concerning Grand Rounds case entitled “Salvage of failed odontoid fixation through anterior C1/C2 transarticular screws” (by Khalid M. I. Salem et al.)

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This case [1] offers different aspects of learning:

1. The primary diagnosis, which was delayed,
2. the evaluation of the fracture type,
3. the primary chosen surgical technique and
4. the anterior transarticular C2–C1 screw fixation as an alternative to the existing posterior or bilateral lateral techniques.

A 66-year-old patient with a history of a precedent neck injury 2 years ago and who fell with a bicycle and complains of neck pain, transient upper and lower limb numbness lasting for 20 min and who has a laceration of the forehead as a direct expression of being hit with his head against concrete, would have needed absolutely an imaging of the cervical spine. The mechanism of injury and the mechanical impact combined with an “irritation” of the spinal cord suggest with a high probability a relevant neck

injury, specifically of the upper cervical spine until the opposite has been proven. It took 4 days until an X-ray has been finally done, which confirmed the suspicion of a structural cervical injury: hyperextension injury with the dislocated odontoid process posteriorly in retrograde oblique inclination towards the cervical spinal cord. The neurological findings with altered sensation in the right upper and lower limbs and with right upper and lower limb weakness of 4/5 in all myotomes and normal rectal examination suggested definitely a high up compression of the spinal cord and is not typical for a simple odontoid fracture. The authors describe under “case presentation” a C1/C2 displacement, the Fig. 1 CT presents a posterior dislocated and tilted odontoid process with a sclerotic C1 arch closely linked to the odontoid process with minor osteophytes, implying that there must be also a dislocation in the C1/C2 joints in combination of the odontoid fracture and possibly a previous injury in this region. As a result, there must be a certain C1/2 instability, accompanying a fully posteriorly displaced and tilted odontoid process. Considering the CT scan, there is a high probability that the tip of the odontoid is to a certain degree fixed to the posterior aspect of the anterior arch of C1 (sclerosis and osteophytes).

This constellation would significantly increase the lever arm on a single anterior screw fixation of the odontoid process, specifically since the fracture is at the transition from a type II to a type III fracture according to the D’Alonzo-Anderson classification. Unfortunately, we do not have sagittal CT reconstructions through the lateral masses of C1/C2, nor do we have frontal reconstructions to precisely classify the fracture and the real damage to the joints of C1/C2. This latter discussion answers to a certain degree the initially exposed learning points 2 and 3. An anterior single screw fixation of the odontoid fracture is the

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most elegant surgical technique in case the surgeon succeeds to reduce the fracture anatomically through positioning and manipulation and to put the screw centrally in the odontoid process with a good purchase of the cortical bone on the top of the process and solid anchorage of the proximal part of the screw in the body of C2. The post-operative image suggests a good position of the screw in the frontal plane; the lateral plane, however, demonstrates a possibly too posterior entry of the screw through the endplate of C2 and an insufficient reduction of the displaced odontoid plug. The anterior C1 arch is in line with the posterior wall of the body of C2, still representing a significant posterior dislocation of the odontoid process, which is still tilted posteriorly. This may impose a too high load on the short proximal screw shaft anchored in the vertebral body of C2, which may have even some comminution (according to the authors the fracture type is a type 2B). From the documentation available, it cannot be concluded, whether the fracture has ever been reduced anatomically before it has been fixed with a single screw, and how far comminution was present in the body of C2. The radiological analysis of the fracture as well as the clinical picture with spinal cord symptomatology, suggesting at least a dynamic compression of the cord, due to a relevant instability, would have made it possibly prudent to choose right from the beginning a more solid fixation of the C1/C2 complex.

In the revision surgery due to this re-dislocation of the fixed odontoid fracture, the authors have then chosen the combination of the anterior odontoid screw and the two anterior transarticular screws fixation of the C1/C2 joints. This is an extremely elegant and straightforward surgery for pathologies of the C1/C2 segment.

This surgery has been described by Reindl et al. in 2003 [2] in an elderly female patient we operated in the year 2000 due to a polytrauma with a pelvic fracture and a combined odontoid fracture and C1/C2 joint injury. We used the combination of an odontoid screw fixation by single screw and two anterior transarticular screws, because the patient seemed to us being unable to be positioned in prone position due to the complex accompanying injury patterns. We thought we were the first to describe this technique by a minimally invasive anterior approach by means of the cervical Synframe. We later compared this technique in a biomechanical laboratory experiment against the classical posterior transarticular screw fixation according to Magerl and found no difference in terms of stability between these two techniques [3]. Only later we found out, that Apostolides et al. [4] described in 1997 this technique under “triple anterior screw fixation”; however,

they did in reality an anterior C2–C1-occiput condyle screw fixation, a technique which later has also been described by Dvorak [5, 6].

Also Vaccaro et al. described the technique already in 1999 in a case report with a salvage procedure [7], but has not been cited until recently and which we were not aware of in 2000, when we first applied this technique, nor did we know the work of Lu et al. [8], who described the anatomical bases of the anterior C2–C1 screw fixation already in 1998.

Meanwhile, the anterior C2–C1 screw fixation of the articular masses of C2 and C1 has become a routine procedure, not only in trauma, but more so in degenerative diseases of the upper cervical spine, specifically in the C1/C2 arthritis with excellent results. This surgery combines an efficient direct stable immobilization of the C1/C2 joints with a minimally invasive access with almost no blood loss and muscular damage in a simple supine positioning on the operating table with the head held in a Mayfield clamp. Until today, we have neither seen an infection, nor a screw pullout or early screw breakage, although we do not formally freshen and fuse the C1/C2 joints.

Conflict of interest None.

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