Dens fractures in the elderly

Results of anterior screw fixation in 19 elderly patients

Ulrich Berlemann and Othmar Schwarzenbach

Type 2 dens fractures in the elderly may be regarded as fragility fractures due to osteoporosis and are prone to nonunion with closed treatment. We investigated the outcome of direct anterior screw fixation of these fractures in 19 patients over 65 years of age. The type of injury, radiological appearance over time and the clinical outcome were analyzed, with an average follow-up of 4.5 years. Surgery and postoperative treatment were tolerated well in all patients. In 16 cases, bony union was achieved after 3–6 months. 2 pseudarthroses, which required no treatment, occurred. At follow-up, 15 patients had no symptoms. 10 of the patients had diminished rotation. We conclude that anterior screw fixation is a successful therapy in most cases of type 2 dens fractures in the elderly.

Department of Orthopaedic Surgery, Inselspital, University of Berne, Freiburgstrasse, CH-3010 Berne, Switzerland
Tel. +41 31 632-2111. Fax -3600
Submitted 96-08-15. Accepted 97-03-08

The type 2 dens fracture, according to the classification of Anderson and D'Alonzo (1974), occurs at the junction of the dens with the central body of the axis. This is difficult to treat, with a substantial risk for nonunion. In the elderly, external immobilization of several weeks is associated with a high morbidity and mortality (Hanigan et al. 1993) and it frequently results in pseudarthrosis (Korres et al. 1989). The instability between C1-C2 that follows nonunion may cause late myelopathy, with neurological deficits. Internal fixation of dens fractures has therefore been proposed. The classical option is the posterior C1-C2 arthrodesis (Brooks and Jenkins 1978). High rates of bony unions have been reported, but due to the solid C1-C2 fusion, the range of rotation in the cervical spine is severely limited. More recently, anterior stabilization using cannulated screws has been advocated, with high success rates in younger patients. However, other authors have expressed reservations with regards to this kind of surgery in elderly patients because of the frequency of associated injuries and impaired general medical condition (Anderson and D'Alonzo 1974, Lieberman and Webb 1994).

We therefore investigated the long-term results of anterior screw fixation of dens fractures in patients aged over 65 years.

Patients and methods

19 patients (9 women) having an average age of 75 (65–87) years at the time of surgery were treated between 1985 and 1995 because of a dens fracture (Table). 2 other patients who died soon after the injury were not included in the study. All hospital and outpatient records as well as the radiographs were reviewed. Most patients had been examined at 6 weeks, 3–4 months, and 6 months after surgery.

17 patients were contacted for this study. 7 of them were reviewed in our outpatient department, 8 answered a questionnaire and in 2 cases information and radiographs were obtained from external physicians. The average clinical follow-up was 4.5 (1–11) years and the radiographic follow-up was 2.5 (0.3–11) years. 2 patients had died, 4 months and 5 years after surgery, from unrelated causes. Their records and radiographs were also reviewed after 4 months and 1 year, respectively.

The mechanism and pattern of injury, initial neurological status, as well as associated injuries, preexisting systemic diseases, and surgical risk factors, time of diagnosis and surgical intervention were recorded. Analysis of the radiographs included the type of fracture, initial displacement, reduction postoperatively, time to union and loss of reduction over time. The follow-up evaluation concentrated on the patient's complaints, cervical range of motion, return to normal activities and signs of neurological complications. Motion was measured by goniometer and rated according to the normal values given by Dvorak et al. (1992).

In 18 patients, the injury was sustained from falls, 11 of which were of low energy, e.g., fall from a chair. Patient 17 was involved in a motor vehicle accident.

Summary of patient data and characteristics

No.	Gender	Age at operation	Mechanism of injury	Additional fractures	Follow-up	Complications	Time to bony union	ROM limitation
1	F	87	Extension	None	1 y	Postop. stridor	3 mo	None
2	F	82	Not known	None	1 y 6 mo	None	3 mo	None
3	F	79	Flexion	None	2 y 2 mo	UTI	6 mo	None
4	F	70	Lat. flexion	None	4 y 7 mo	None	4 mo	Rotation
5	M	86	Extension	None	1 y	Pneumonia	3 mo	None
6	M	82	Not known	C1 arch	5 y	None	3 mo	None
7	M	71	Extension	Radius, shoulder	8 y 6 mo	None	4 mo	None
8	M	65	Extension	None	4 mo	None	None	Rotation
9	F	78	Not known	C1 arch, tibia	5 y 7 mo	None	3 mo	None
10	M	74	Lat. flexion	C1 arch, ribs	4 y 2 mo	Apnoic episodes	4 mo	General
11	F	69	Not known	Radius	7 y 1 mo	None	None	Rotation
12	F	65	Not known	None	10 y 8 mo	Hematoma	3 mo	General
13	M	73	Flexion	C1 arch	1 y 3 mo	None	3 mo	General
14	M	74	Flexion	None	5 y 4 mo	None	None	None
15	M	69	Flexion	None	5 y 1 mo	None	4 mo	Rotation
16	F	84	Extension	None	4 y 3 mo	None	3 mo	None
17	F	71	Not known	None	4 y 9 mo	None	3 mo	General
18	M	64	Flexion	None	5 y 7 mo	None	6 mo	General
19	M	72	Not known	T5, scaphoid	3 y 7 mo	None	3 mo	Rotation

UTI urinary tract infection. ROM range of motion

All patients sustained type 2 injuries according to Anderson and D'Alonzo (1974), of which 4 were combined with a fracture of the C1 arch. According to Clark and White (1985), the displacement was severe in 13 cases, with a maximum of 15 mm displacement and 45° angulation. All but 2 fractures were displaced posteriorly and all but 1 in extension.

5 patients sustained associated fractures: distal radius (2), tibia (1), shoulder (1), thoracic spine (1), ribs (1), and scaphoid (1). In case 10, a significant head injury with frontobasilar intracranial bleeding occurred. 3 patients sustained minor skin lacerations to the head and/or minor contusions.

14 patients had no initial neurological deficit. 3 patients suffered a brief loss of consciousness. Patient 18 presented with a short period of diffuse dysesthesia in all extremities directly after the trauma and patient 12 complained of hypesthesia in the C6 dermatome bilaterally, which resolved after treatment.

All patients lived independently prior to injury, but 3 had significant cardiac or pulmonary disease, including cardiomyopathy and anticoagulant therapy following cardiac valve replacement.

The diagnosis was made within 24 hours in 16 patients. In 2 patients the diagnosis was initially overlooked and was made only after 1 week. 1 patient did not seek medical treatment until 2 weeks after the injury, 6 initially had only mild symptoms.

The patients were operated on within 1 day of the injury in 12 cases, 4 days in 3 and 2 weeks in 4 cases. 2 patients were initially treated with a Minerva type of plaster, but they did not tolerate the treatment. The duration of surgery ranged between 45 minutes and 2 hours. The surgical technique followed the recommendations by Etter et al. (1991) using 2 cannulated screws and double-image intensification at perpendicular planes in 18 patients. In 1 patient, the technique was similar, but the screws used were not cannulated.

5 postoperative complications were noted. 1 hematoma required revision and 1 patient suffered from postoperative episodes of apnoe, also due to the cerebral contusion. All complications resolved without serious sequelae.

The patients were mobilized within 2 days. 18 were supplied with a soft (12) or hard (6) collar, depending on the surgeon's preference. The patients with the additional C1 arch fracture were stabilized in a hard collar (3) or a Minerva type of plaster (1). These external supports were left for a minimum of 6 weeks. Depending on the radiographic findings, gentle mobilization of the cervical spine was allowed between 6 and 12 weeks postsurgery.

Results

An anatomical reduction of the dens was achieved in 16 cases. In 2 patients the dens fragment was left in slight posterior displacement (3 mm in case 3) or tilt (10° in case 13). In case 1, the dens was overcorrected. In 3 patients, the postoperative radiograph revealed distraction at the fracture site (cases 6, 8, 14, Figure 1).

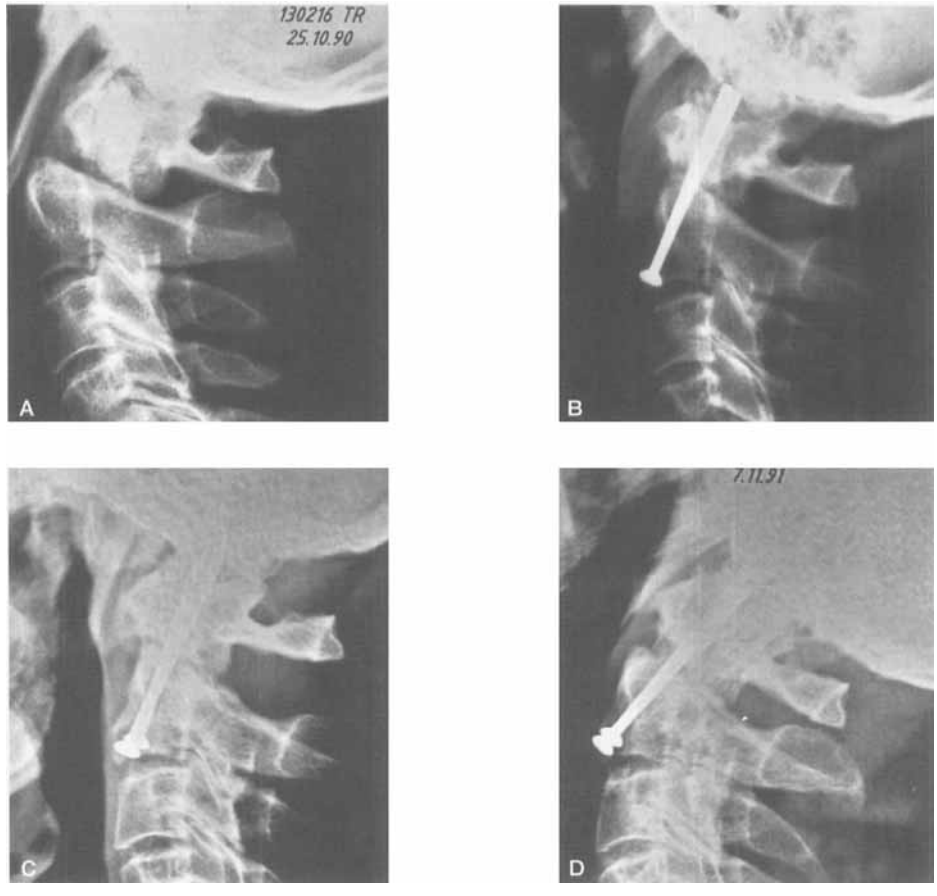

Figure 1. Patient 14. Type 2 fracture with the dens displaced posteriorly (A). The fracture is reduced but left in distraction (B). A pseudarthrosis developed with residual instability in flexion/extension (C, D). The patient is asymptomatic.

The position of the dens was maintained in 13 patients. In 6 cases, the reduction was lost (maximum 4 mm and 10°), in 1 of whom the dens fragment returned to its preoperative position (case 4, Figure 2). 16 fractures united within 3–6 months. In 2 cases, pseudarthrosis was diagnosed, but as the patients were free of symptoms, no further surgical intervention was found necessary, in spite of residual instability in 1 case (Figure 1). In 1 patient, the fracture had not healed by 4 months when he died from unrelated causes. It was often noted that the anterior cortex of the dens healed more slowly than the posterior part.

At follow-up, cases 17 and 18 complained of occasional pain in the cervical spine, requiring analgesics, but 17 patients had no pain. All patients returned to normal activities, considering age and condition. There was no neurological impairment. 9 patients had full range of rotation, and in 10 patients the rotation was reduced by 25–50%. In 5 of these cases, the range of spinal motion in other planes was also decreased.

Discussion

In contrast to the younger population, minor trauma causes type 2 dens fractures in the elderly (Böhler 1982). Dens fractures in the elderly may therefore be regarded as osteoporotic fragility fractures (Amling et al. 1994). We also found that there were only a few associated injuries and that the neurological symptoms were usually mild (Hanigan et al. 1993). Since patients had few, if any, complaints, the diagnosis could easily have been missed, as in 2 of them. Therefore any elderly patient with even a minor trauma to the head or neck should be suspected of having cervical spine damage (Lieberman and Webb 1994).

A dens fracture presents a difficult clinical problem in elderly patients. The tolerance towards rigid external immobilization with a halovest may be limited (Pepin et al. 1985), as in 2 of our patients. Furthermore, motion of the cervical spine, even in a properly placed halo device may be considerable (Koch and

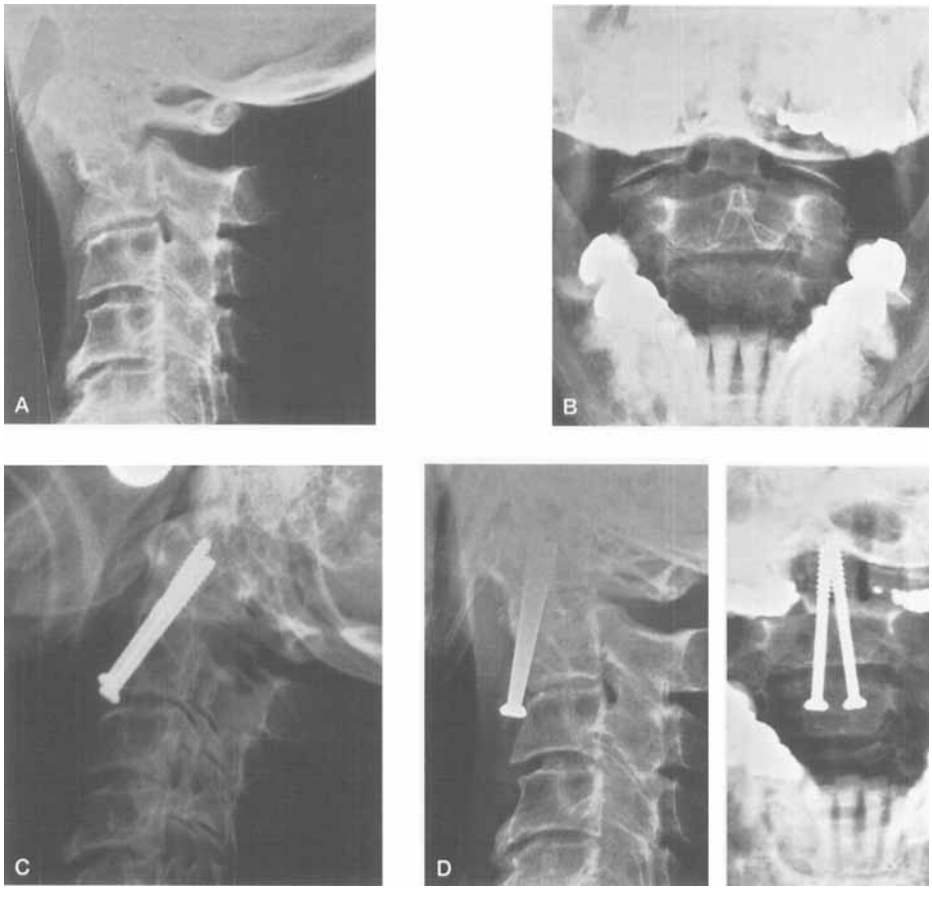

Figure 2. Patient 4. Type 2 fracture with the dens displaced anteriorly and in flexion (A, B). The fracture was reduced anatomically, but the entry point of the screw was placed too proximally (C). The insufficient stability lead to a complete loss of reduction after 8 weeks with bony union over time (D). The patient complains of occasional symptoms from her upper cervical spine and limited ability to turn.

Nickel 1978), something which could explain the observed nonunion in most patients over 60 years of age (Schatzker et al. 1971, Ekong et al. 1981). Even though a stable fibrous union may give an acceptable result in the elderly (Hanigan et al. 1993, Lieberman and Webb 1994), residual C1-C2 instability may cause pain and late myelopathy. Therefore a pseudarthrosis of the dens has been regarded as an unacceptable result (Schatzker et al. 1971).

The indications and outcome of surgical treatment for dens fractures in the elderly remain controversial. Posterior fusion of C1-C2 usually results in a high rate of bony union. However, particularly in the elderly and high-risk patients, unsatisfactory results with a considerable morbidity and mortality have been reported (Fried 1973). Furthermore, cervical rotation will be severely impaired after C1-C2 arthrodesis because 50% of the rotation of the cervical spine takes place at the atlantoaxial joint. Anterior direct fracture stabilization has shown encouraging results in young patients (Aebi et al. 1989, Esses and Bednar 1991). In our clinic, those findings led us to widen the indications for this kind of fixation in the elderly as well.

Our study does not include a control group since virtually all type 2 fractures presenting in the mentioned time period underwent anterior screw fixation. Chiba et al. (1996) analyzed a group of 62 type 2 fractures in patients of all ages and compared different treatment protocols. They concluded that anterior screw fixation was the best therapy, but emphasized the need for bone of reasonable quality for adequate screw fixation. In the elderly, this is somewhat contradictory as osteoporotic changes are partly responsible for the fractures. However, in our cases it was possible to achieve good screw fixation in the cortex of the upper posterior dens.

Minimal additional external immobilization was necessary in our patients. According to Ersmark and

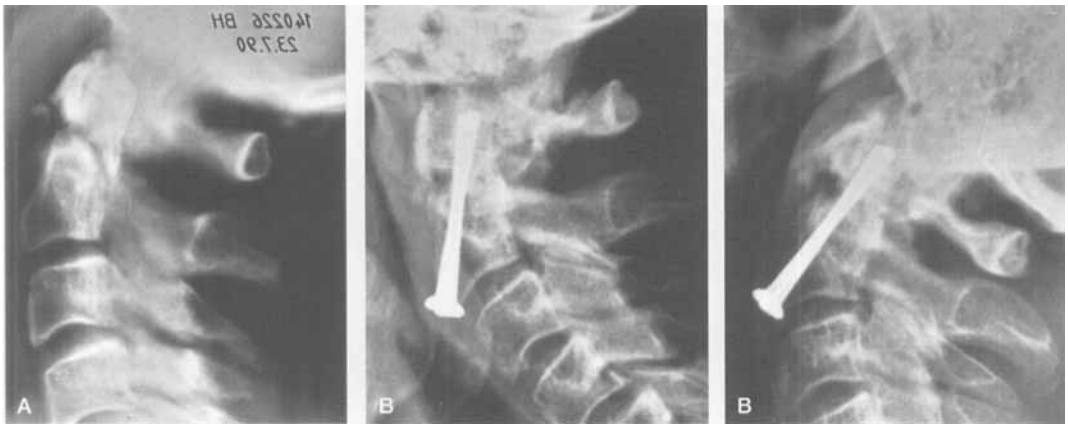

Figure 3. Patient 7. Type 2 fracture with a small anterior cortical defect (A). The anterior cortex failed to heal, but a stable result was achieved (B). The patient is asymptomatic.

Kalen (1987), there is a relation between the rigidity of the fixation and eventual loss of motion. Jeanneret et al. (1991) showed in a CT controlled study, that in almost half of their dens fracture cases with anterior screw fixation, rotation was preserved. This seems to be confirmed by our findings.

There are some critical surgical and technical issues which have to be considered. Before surgery, the fracture must be reduced using traction by Mayfield tongs allowing good reduction in the sagittal plane controlled by fluoroscopy with 2 orthogonal C-arms. A very rigid cervical spine, as is sometimes the case in elderly patients, may make reduction with clearance of the sternum impossible. Consequently, there may not be enough access for anterior fixation. This occurred in 1 patient, not included in this series, who subsequently underwent posterior C1-C2 fusion. Care must be taken concerning the entry point of the screw in the body of C2; an entry too proximal into the anterior surface of C2 may result in an unstable fixation of the screw in the C2 body (Figure 2). A too posterior screw direction with resultant possible hyperextension malalignment of the fracture could lead to delayed healing of the anterior cortex (Etter et al. 1991). Although persistent hyperextension of the fracture was apparent in only 2 of our postoperative radiographs, delayed or even failed healing of the anterior cortex was observed in about half of the cases. This indicates the precense of other factors, such as severe injury to the local bone trabeculae with defects in the anterior cortex (Figure 3) or a compromised anterior blood supply (Schatzker et al. 1971, Southwick 1980).

Especially in the elderly, a screw entry point relatively distal to the anterior portion of the C2-C3 disc seems necessary to provide good fixation. Later on, osteophytes may be observed in this segment (Figure 4), but this does not seem to cause any problems.

The importance of the direction of the fracture has also been emphasized. An oblique fracture from cranioposterior to caudoanterior leaves only a small part of the C2 body for the anchorage of the screw (Aebi et al. 1989) and compression might lead to anterior displacement of the fragment. Care must also be taken not to distract the fracture site when the screw is inserted (3 cases in our series). This could contribute to pseudarthrosis (1 case, Figure 1) and loss of reduction (2 cases).

References

Aebi M, Etter C, Coscia M. Fractures of the odontoid process—treatment with anterior screw fixation. Spine 1989; 14 (10): 1065-70.

Amling M, Wening V J, Pösl M, Grote HJ , Hahn M, Delling G. Die Struktur des Axis—Schlüssel zur Ätiologie der Densfraktur. Chirurg 1994; 65: 964-9.

Anderson L D, D'Alonzo R T. Fractures of the odontoid process of the axis. J Bone Joint Surg (Am) 1974; 56 (8): 1663-74.

Brooks A L, Jenkins E B. Atlanto-axial arthrodeses by the wedge compression method. J Bone Joint Surg (Am) 1978; 60 (2): 279-83.

Böhler J. Anterior stabilization for acute fractures and nonunions of the dens. J Bone Joint Surg (Am) 1982; 64 (1): 18-27.

Chiba K, Fujimura Y, Toyama Y, Fujii E, Nakanishi T, Hirabayashi K. Treatment protocol for fractures of the odontoid process. J Spinal Disord 1996; 9 (4): 267-76.

Clark C R, White A A. Fractures of the dens—a multicenter study. J Bone Joint Surg (Am) 1985; 67 (9): 1340-8.

Dvorak J, Antinnes J A, Panjabi M M, Loustalot D, Bonomo M. Age and gender-related normal motion of the cervical spine. Spine 1992; 17 (10): 393-8.

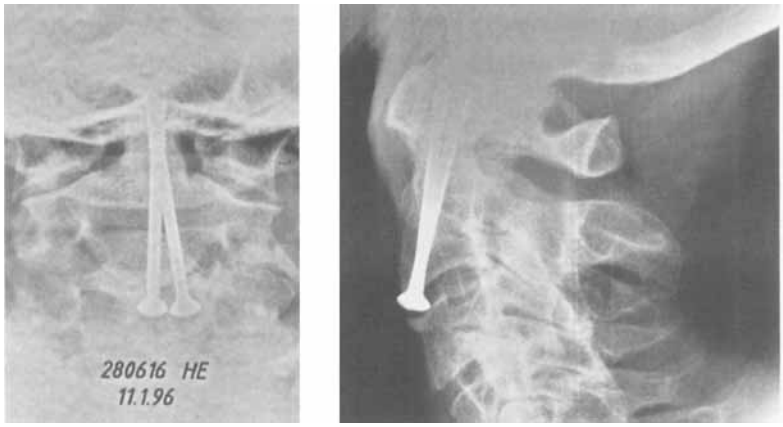

Figure 4. Patient 2. The positioning of the screws within the anterior portion of the C2-C3 disc space lead to osteophytic degeneration. The patient is asymptomatic.

Ekong C E U, Schwartz M L, Tator C H, Rowed D W, Edmonds V E. Odontoid fracture: management with early mobilization using the halo device. Neurosurgery 1981; 9 (6): 631-7.

Ersmark H, Kalen R. Injuries of the atlas and axis—a follow-up study of 85 axis and 10 atlas fractures. Clin Orthop 1987; 217: 257-60.

Esses S I, Bednar D A. Screw fixation of odontoid fractures and nonunions. Spine 1991; 16 (10): 483-5.

Etter C, Coscia M, Jaberg H, Aebi M. Direct anterior fixation of dens fractures with a cannulated screw system. Spine 1991; 16 (3): 25-32.

Fried L C. Atlanto-axial fracture dislocations. Failure of posterior C1 to C2 fusion. J Bone Joint Surg (Br) 1973; 55 (4): 490-6.

Hanigan W C, Powell F C, Elwood P W, Henderson J P. Odontoid fractures in elderly patients. J Neurosurg 1993; 78: 32-5.

Jeanneret B, Vernet O, Frei S, Magerl F. Atlantoaxial mobility after screw fixation of the odontoid: a computed tomographic study. J Spinal Disord 1991; 4 (2): 203-11.

Koch R A, Nickel V L. The halo vest: an evaluation of motion and forces across the neck. Spine 1978; 3 (1): 103-7.

Korres D S, Stamos K, Andreakos A, Hardouvelis C, Kouris A. Fractures of the dens and risk of pseudarthrosis. Arch Orthop Trauma Surg 1989; 108: 373-6.

Lieberman I H, Webb J K. Cervical spine injuries in the elderly. J Bone Joint Surg (Br) 1994; 76 (6): 877-81.

Pepin J W, Bourne R B, Hawkins R J. Odontoid fracture, with special reference to the elderly patient. Clin Orthop 1985; 193: 178-83.

Schatzker J, Rorabeck C H, Waddell J P. Fractures of the dens: an analysis of thirty-seven cases. J Bone Joint Surg (Br) 1971; 53 (3): 392-405.

Southwick W O. Current concept review. Management of fractures of the dens (odontoid process). J Bone Joint Surg (Am) 1980; 62 (3): 482-6.