



# Elderly patients are at increased risk for mortality undergoing surgical repair of dens fractures



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## ABSTRACT

**Objective:** Dens fractures are common cervical injuries in advanced aged patients. The presented study was undertaken to analyze the clinical results and risks of surgically treated patients with dens fractures over 70 years.

**Methods:** Data of 28 patients (17 female, 11 male) over 70 years treated from September 2004 to October 2009 were recorded. Clinical and radiological parameters were obtained including type of fracture, associated cervical and/or other injuries, comorbidities, symptoms, neurological condition, surgical strategy, postoperative course and complications.

**Results:** 89% were in a good neurological condition before surgery (ASIA E or D). In most cases, surgery was performed at an early stage after trauma (21 patients within 5 days). Ventral screw fixation was the preferred surgical strategy (64%). A slight worsening of neurological functions immediately after operation was only seen in one patient. Five patients died in the early and 2 in the late postoperative course which means a treatment mortality of 25%. Among the surviving patients two had general medical complications.

**Conclusion:** Type II dens fractures are a common fracture of elderly patients. Our results are good concerning the neurological functions. Surgical and general medical complications were acceptable. However, the study also underlines that mortality rate is high and therefore treatment options should be well-considered in this high risk group.

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## 1. Introduction

Dens fractures count to nearly 20% of all cervical fractures. Among these 65–74% are type II-fractures according to Anderson and D'Alonzo [1]. They are the most common cervical fractures of patients over 70 years. In patients over 80 years they are more frequent than all cervical fractures together [2].

Typical trauma mechanism in the elderly patients is falls or pitching of the head leading to extension injuries and dorsal dislocation [2]. Instability might injure directly or decelerated the spinal cord [3].

Nonunion rate of type II-dens fractures is significant [4]. There are some factors which are known to be associated with an increased risk of nonunion such as advanced age, delayed

treatment, anterior dislocation more than 4 mm and posterior dislocation [5] as well as reduced halo vest tolerance in nonoperatively treated elderly patients [5]. Furthermore, a mortality rate of 26–47% has been reported for these nonoperatively treated patients due to respiratory-related complications caused by prolonged periods of immobilization [6]. Based on the existing comorbidity in elderly patients, the morbidity and mortality rates are high for both, operative and nonoperative treated patients [7].

Surgical techniques include posterior atlantoaxial fusion with different devices (transarticular screws, laminar clamps, sublaminar wiring) and anterior screw fixation [6]. Posterior fixation has a high rate of union (80–100%) [8], but results in a decrease of the rotational range of the cervical spine [9]. Anterior screw fixation has a high fusion rate (84–96%) and additionally preserves axial rotation [6]. Further advantages are shorter surgery time and no graft harvesting is needed. However, this technique can be limited by anatomic contraindications including a disrupted transverse ligament, in cases of fractures with cranial-posterior to caudal-anterior direction and in patients with emphysema of the thorax [10]. Problems of surgical fixation in advanced aged patients are

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**Table 1**

Number of patients in the different ASIA groups (modified) pre- and postoperatively. Overall mean score was 4.57 and 4.55, respectively.

Modified ASIA score	Preoperative	Postoperative
A = complete: No motor or sensory function is preserved (1 point)	2	2
B = incomplete: Sensory but no motor functions preserved below the level of injury (2 points)	0	0
C = incomplete: Motor function is preserved below the level of injury and more than half of key muscles below the neurological level have muscle grade less than 3 (3 points)	1	1
D = incomplete: Motor function is preserved below the level of injury, and at least half of key muscles below the neurological level have a muscle grade of 3 or more (4 Points)	2	3
E = normal: Motor and sensory functions are normal (5 points)	23	22
Overall mean score	4.57	4.55

osteopenia- and respiratory-related morbidity [6]. Thus, despite a normal neurological condition without deficits in many cases the treatment of these elderly patients bears an increased risk, surgically and medically.

This study was conducted to evaluate morbidity and mortality of patients older than 70 years undergoing anterior or posterior surgery for dens fractures at our department.

## 2. Materials and methods

### 2.1. Patients

For this analysis medical reports of patients with dens fractures treated surgically at our hospital from October 2004 to September 2009 were reviewed retrospectively. A total number of 28 patients over 70 years were included into this study. 17 (61%) were female and 11 (39%) male with a mean age of 81.1 years (range 71–94 years). In most cases trauma mechanism was fall. In 25 patients (89.3%) diagnosis was made within 2 days after trauma, among these in 19 patients at day 1 after trauma. In the remaining three cases diagnosis was made 1 month, 6 weeks and 4 months after trauma. A type II-fracture (Anderson and D'Alonzo) was seen in 27 patients (96%) and a mix fracture of type II/III was diagnosed in one patient (4%). Associated cervical injuries or fractures were present in 11 (39%) patients, mostly affecting C1. Additional injuries were nose fracture ( $n = 2$ ), radius fracture ( $n = 1$ ), L3-fracture ( $n = 1$ ), TH7-fracture ( $n = 1$ ) and rib-fracture ( $n = 1$ ). 11 (39%) patients had cardiopulmonary comorbidities, in 5 (18%) patients osteoporosis was documented and in 8 (29%) patients no significant comorbidities were recorded. Concerning the anaesthesiological risk in 22 patients an ASA (American Society of Anesthesiologists) score 3, in 5 patients ASA score 2 and in one patient ASA score 4 was documented. ASA 1 and 2 were classified to low-risk and ASA 3–5 to high-risk patients.

### 2.2. Diagnostics and surgical procedure

Clinical symptoms and the neurological condition were classified according to a modified ASIA-classification (American Spinal Injury Association). We assigned each grade points with 5 points for the best neurological function (ASIA E) and 1 point for the worst grade (ASIA A) (Table 1). Preoperative neuroimaging procedures included computed tomography (CT) with coronal and sagittal reconstructions in all patients in order to classify the type and extension of fracture and position of the facet joints. In 18 patients X-rays were performed and four patients additionally underwent

preoperative magnetic resonance imaging (MRI) to evaluate ligament lesions, epidural haemorrhages and spinal cord lesions.

Preoperative extension therapy (Gardner-Wells) was performed in 12 cases (43%) in order to achieve a better reposition of the fracture. Anterior screw fixation [11] with a single screw was performed in 18 patients (Fig. 1). In the remaining 10 cases posterior stabilization techniques were performed. Posterior stabilization was used in cases when anatomic conditions made an anterior approach not possible or when the patient was admitted to our hospital 3 days or later after the trauma. Dependant on the complexity of the fracture, anatomical conditions and the bone quality dorsal fixation was achieved either with wiring and bone graft/PMMA (Figs. 2 and 3) or with Ransford loop (C0–C3/4).

### 2.3. Follow up

During follow up patients were evaluated clinically and radiologically. Patients were seen prospectively either at our department or by external physicians. Long-term radiological follow up was possible for only 7 patients with a mean of 41.4 months (range 24–66 months). In order to determine fusion rate of the fracture X-rays were performed in these 7 patients. An experienced neuroradiologist evaluated X-rays. Bony and fibrous union of the fracture were classified as stable and non-union as instable. The other patients who could not be evaluated physically for follow up examination were questioned by telephone.

## 3. Results

### 3.1. Clinical symptoms and neurological state

Predominant preoperative symptom was pain in 24 patients (86%), 5 (18%) had neurological deficits and one patient (4%) had no symptoms. Preoperative neurological score according to the ASIA-classification was class E in 23 patients, class D in 2 patients, C in one patient and class A in 2 cases.

Ventral screw fixation was performed in 18 patients (64.3%). 10 patients were operated by a dorsal approach (reasons see above). Among these, in 7 cases C1/2 fixation with wiring and bone graft ( $n = 5$ ) or PMMA ( $n = 2$ ) was performed and in one of these 2 patients (PMMA-group) with additional transarticular screw fixation. In 3 patients dorsal C0–C3/4 fixation with a Ransford loop was performed.

Early postoperative neurological state was the same in all patients except in one case who had a worsening from ASIA E to D. Overall mean pre- and postoperative ASIA score was 4.57 and 4.55, respectively (Table 1).

### 3.2. Clinical and radiological follow up

On the whole 7 patients were examined clinically and radiologically for long-term follow up (mean 41.4 months, range 24–66 months). All patients had no new neurological deficit. X-rays showed stable bony union in 3 patients and stable fibrous union in 4 patients. Further 7 patients were questioned by telephone. They were clinically unchanged and neurologically stable without any signs for instability. From the remaining 14 patients 7 died in the postoperative course (see below), 4 died to other reasons and 3 were lost to follow up.

### 3.3. Complications, mortality

Surgical complications included dislocation of the dorsal wiring in one patient and break of the ventral screw in another case (Fig. 4). Both patients underwent reoperation and were treated by dorsal C0–C3/4 fixation. One patient (4%) had wound healing problems

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