Odontoid fracture type II treatment

Odontoid fracture type II treatment become increasingly common in the aging population.

Treatment remains controversial. No agreement has been reached after many attempts to identify factors that will predict which type II fractures are most likely to heal with immobilization and which will require operative fusion.

Critical review of the literature reveals a paucity of well designed studies. A wide range of nonunion rates with immobilization alone (5–76%) is quoted: 30% is probably a reasonable estimate for overall nonunion rate, with 10% nonunion rate for those with displacement <6 mm. Possible key factors in predicting nonunion include:

1. degree of displacement: probably the most important factor
   a) some authors feel that displacement >4 mm increases nonunion
   b) some authors use ≥6 mm as the critical value, citing a 70% nonunion rate in these regardless of age or direction of displacement

2. age:
   a) children <7 yrs old almost always heal with immobilization alone
   b) some feel that there is a critical age above which the nonunion rate increases, and the following ages have been cited: age >40 yrs (possibly ≈ doubling the nonunion rate), age >55 yrs, age >65 yrs, yet others do not support increasing age as a factor.

Establishing a clear treatment paradigm for octogenarians hampered by a literature replete with level III articles.

Conservative treatment

see Odontoid fracture type II conservative treatment.

Surgical treatment

Indications

Surgical treatment (instead of external immobilization) is recommended for odontoid Type II fractures in patients ≥7 years age with any of the following:

1. displacement ≥ 5mm 2. instability at the fracture site in the halo vest (see below) 3. age ≥50 years: increases nonunion rate (with halo) 21-fold 4. nonunion (see Table 64.11 for radiographic criteria) including firm fibrous union, especially if accompanied by myelopathy 5. disruption of the transverse ligament: associated with delayed instability

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Options

Common surgical option is an anterior odontoid screw. Some of the fractures are not suitable for anterior odontoid screw (anterior oblique, displaced distal fragments and those with atlantoaxial instability...).

These are usually offered posterior transarticular screws (Magerl's) or posterior atlantoaxial screw rod/plate fixation (Goel-Harms technique). Posterior surgery involves atlantoaxial fixation with an indirect attempt to reduce and fuse the fracture.

In cases of Chronic Type II odontoid fractures and in patients with transverse ligament disruption, Shilpakar et al. prefer to undertake posterior transarticular facet screw fixation supplemented by bone graft and interspinous C1-2 wiring.

No significant differences were found between bending and torsional stiffnesses for the one-screw and two-screw specimens. No significant differences were found between one- and two-screw fixation when compared with primary C1-C2 wiring in torsion. One- or two-screw fixation was as stiff as primary C1-C2 wiring in bending. One or two screws offers similar stability for fixation for a dens fracture. One- and two-screw fixation is at least as stiff as primary C1-C2 wiring in torsion and one- or two-screw fixation is stiffer than primary C1-C2 wiring in bending.

Anterior approach

see Odontoid screw.

see Anterior retropharyngeal plate screw fixation with bilateral anterior transarticular screws.

Posterior approach

Commonly used procedures involve wedging a bone graft between posterior arch of C1 and the C2 lamina with sublaminar wiring. The well-described different methods for this C1-2 posterior fusion procedure are the Gallie, Brooks, Sonntag techniques. These procedures have a satisfactory fusion rate of about 74 percent. The demerit of this procedure is that it causes elimination of the normal C1-2 rotatory motion (which accounts for more than 50% of all cervical spine rotatory movements) and reduced cervical spine flexion-extension by 10 percent.

Another excellent alternative technique for odontoid fracture is the posterior C1-2 transarticular screw fixation (Magerl’s procedure) using unilateral or bilateral screws. This provides an excellent spinal rotational spinal stability. This is an indirect method of stabilizing the fracture (in which the normal anatomical configuration is disrupted). Preoperative CT evaluation is mandatory to avoid vertebral artery injury in this procedure. This technique can be supplemented with metal plate for occipitocervical stabilization. Alternatively, Jain’s technique of occipitocervical fusion, Goel’s plate and screw lateral mass fixation, or a Ransford’s contoured rod technique may be utilized.

Posterior surgery has a risk of injury to the vertebral arteries, hemorrhage from the paravertebral venous plexus and the C2 root ganglion.
Case series

2017

A direct anterior submandibular retropharyngeal approach with open reduction and fixation (ORIF) using a customized variable screw placement (VSP) plate was used to realign and fix the fracture fragments in compression mode under direct vision. Twenty patients of type-II odontoid fractures (unsuitable for anterior odontoid screw) underwent an anterior retropharyngeal approach with anterior variable screw position (VSP) plate and screw fixation and eight amongst them, who had associated atlantoaxial instability underwent additional bilateral anterior transarticular screws.

All patients treated by this technique had 100% fracture site bone union without any implant failure. Longest follow-up has been for 3 years.

Anterior retropharyngeal approach allows direct fracture fragment realignment under vision with an opportunity to fix in compression mode using the VSP plate, which ensures early fusion across the type-II odontoid fracture. Any associated instability can be treated by additional bilateral anterior transarticular screws. The approach is simple and safe without any risk to the vertebral arteries and biomechanically appealing.

2016

In the study by Graffeo et al., the authors evaluated 111 patients over the age of 79 (average age: 87) with type II odontoid fractures undergoing nonoperative (94 patients) vs. operative intervention (17 total; 15 posterior and 2 anterior). They studied multiple variables and utilized several scales [abbreviated injury scale (AIS), injury severity score (ISS), and the Glasgow coma scale (GCS)] to determine the outcomes of nonoperative vs. operative management.

Graffeo et al. concluded that there were no significant differences between nonoperative and operative management for type II odontoid fractures in octogenarians. They found similar frequencies of additional cervical fractures, mechanisms of injury, GCS of 8 or under, AIS/ISS scores, and disposition to “nonhome” facilities. Furthermore, both appeared to have increased mortality rates at 1-year post injury; 13% during hospitalization, 26% within the first post-injury month, and 41% at 1 year.

In the editorial by Falavigna, his major criticism of Graffeo's article was the marked disparity in the number of patients in the operative (17 patients) vs. the nonoperative group (94 patients), making it difficult to accept any conclusions as “significant”. He further noted that few prior studies provided level I evidence, and that most, like this one, were level III analyses that did not “significantly” advance our knowledge as to whether to treat octogenarians with type II odontoid fractures operatively vs. nonoperatively.

Twenty-one of 22 patients who underwent posterior C1-C2 temporary fixation of an odontoid fracture achieved fracture healing and regained motion of the atlantoaxial joint. The functional outcomes of these 21 patients were compared with that of a control group, which consisted of 21 randomly enrolled cases with posterior C1-C2 fixation and fusion. The differences between the 2 groups in the visual analog scale score for neck pain, neck stiffness, Neck Disability Index, 36-Item Short Form.
Significantly better outcomes were observed in the temporary-fixation group for visual analog scale score for neck pain, Neck Disability Index, and neck stiffness. The outcomes in the temporary-fixation group were superior to those in the fusion group in all dimensions of the 36-Item Short Form Health Survey. There were no significant differences in fracture healing rate and time to fracture healing between the 2 techniques.

Functional outcomes were significantly better after posterior C1-C2 temporary fixation than after fusion. Temporary fixation can be used as a salvage treatment for an odontoid fracture with an intact transverse ligament in cases of failure of, or contraindication to, anterior screw fixation.

Data of twenty patients who underwent posterior temporary-fixation due to Anderson-D’Alonzo type II odontoid fractures with intact transverse ligament were retrospectively reviewed. Another twenty patients undergoing anterior screw fixation were randomly selected as the control group. The range of motion (ROM) in rotation of C1-C2 measured on functional computed tomography (CT) scan and outcomes evaluated by the visual analog scale (VAS) for neck pain, neck stiffness, patient satisfaction, and neck disability index (NDI) were compared between two groups at the final follow-up.

At the final follow-up, 19 cases in each groups achieved fracture healing. Total C1-C2 ROM in rotation on both sides in the posterior temporary-fixation group was 32.4 ±12.5°, smaller than 40.0 ±13.0 in the anterior fixation group. However, there was no statistical difference between two groups. And there was no significant difference between two groups in functional outcomes evaluated by VAS for neck pain, neck stiffness, patient satisfaction and NDI.

Posterior temporary-fixation can spare the motion of C1-C2 and achieve same good clinical outcomes as anterior screw fixation in the treatment of Anderson-D’Alonzo type II odontoid fractures. It was an ideal alternative strategy to anterior screw fixation.

The treatment of type II odontoid fractures in elderly patients is controversial.

Anterior screw fixation is a well-recognized technique that is used to stabilize Type IIB fractures of the odontoid process in the elderly. However, advanced age and osteoporosis are 2 risk factors for pseudarthrosis. Kyphoplasty has been described in the treatment of lytic lesions in C-2. Terraux et al. decided to combine these 2 techniques in the treatment of unstable fractures of the odontoid.

Two approximately 90-year-old patients were treated for this type of fracture. Instability was demonstrated on dynamic radiography in one patient, and the fracture was seen on static radiography in the other.

Clinical parameters, pain, range of motion, 36-Item Short Form Health Survey (SF-36) score (for the first patient), and radiological examinations (CT scans and dynamic radiographs) were studied both before and after surgery. After inflating the balloon both above and below the fracture line, the authors applied a high-viscosity polymethylmethacrylate cement. Some minor leakage of cement was noted in both cases but proved to be harmless. The screws were correctly positioned. The clinical result was excellent, both in terms of pain relief and in the fact that there was no reduction in the
SF-36 score. The range of motion remained the same. A follow-up CT scan obtained 1 year later in one of the patients showed no evidence of change in the materials used, and the dynamic radiographs showed no instability. This combination of kyphoplasty and anterior screw fixation of the odontoid seems to be an interesting technique in osteoporotic Type IIB fractures of the odontoid process in the elderly, with good results both clinically and radiologically.3


