Choice of treatment of odontoid fractures

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This paper presents a discussion of the diagnosis and treatment of odontoid fractures, based upon the authors’ experience with this entity over the last 10 years. Conservative therapy and surgical fusion are compared with respect to efficacy and duration of hospitalization. Arthrodesis is recommended for consideration in the initial treatment of all unstable odontoid fractures.

KEY WORDS odontoid fracture □ spine fracture □ cervical spine □ spine fusion

We believe that surgical fusion should be considered in the initial treatment of all types of odontoid fractures. There seems to be a strong tendency to avoid the surgical alternative when counseling patients with these fractures about initial treatment choices. Certain factors, including the age of the patient, the location of the fracture, and the amount of the displacement are frequently used to select patients with odontoid fractures in whom conservative therapy is likely to succeed. Other factors, including the duration of hospitalization, duration of disability, and degree of discomfort and inconvenience should also be considered in selecting treatment.

We discuss our results in 30 patients with odontoid fractures treated between 1969 and 1979. The initial treatment was skeletal traction in 14, cervical fusion in nine, and traction with a halo apparatus in four and with a Somi neck brace in three.

Summary of Cases

We were able to locate the records of 30 patients whose odontoid fractures were treated at Baptist Memorial Hospital in Memphis, Tennessee, between 1969 and 1979. Fourteen patients were treated primarily with skeletal traction. Ten of these had a fracture at the base of the odontoid, and four a fracture extending into the body of C-2. Three fractures were displaced, all more than 5 mm. The ages of these patients ranged from 19 to 86 years, with an average of 43 years. The average hospital stay in this group was 43 days, the mean stay 46 days. Follow-up cervical radiographs revealed bone fusion in 11 of these cases. The follow-up time averaged 7 months from the time of the fracture. One 88-year-old patient died of pulmonary complications 4 days after admission. Two patients had non-union of their fracture and required subsequent fusion; follow-up radiographs of the cervical vertebrae revealed bone union, in one case 6 months and in the other 13 months after the fusion procedure.

Nine patients were treated initially with cervical fusion. Eight of these patients had a C1-2 fusion, and the ninth underwent fusion of C-1 through C-3. Of these patients, five had a fracture of the odontoid base, three had fractures extending into the body of C-2, and one fracture involved the tip of the odontoid above the superior articular facets of C-2. The ages of patients undergoing cervical fusion ranged from 17 to 80 years, with an average of 41 years. The average hospital stay in this group was 18 days, the mean stay 20 days. Follow-up x-ray films revealed a stable fusion in eight patients at examination an average of 21 months after fusion. The ninth patient was lost to follow-up review.

Four patients were treated with a halo apparatus. All had a fracture of the base of the odontoid process, one of which was displaced 2 mm. Follow-up x-ray films were obtained an average of 7 months after the fracture and demonstrated union in all four. These patients were hospitalized an average of 13 days and remained in the halo apparatus an average of 52 days. Two of these patients asked to have the apparatus removed earlier than was thought necessary because of discomfort.

Three patients were treated with a Somi neck brace. One of these patients had suffered an accident 3 months prior to discovery of a nondisplaced, slightly
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angulated fracture of the base of the process. Follow-up examination 1 year later revealed bone fusion. The second patient presented with progressive weakness in his lower extremities. Radiographs revealed a fracture through the base of the odontoid, with 5 mm of subluxation. A cervical myelogram revealed no impingement on the spinal cord. This patient has remained stable while wearing a neck brace. The third patient was lost to follow-up review.

Discussion

Atlantoaxial dislocation is caused by failure of either the transverse atlantal ligament or the odontoid process. Transverse ligament failure may be caused by mongolism, Klippel-Feil malformation, pharyngitis, granulomatous disease, or rheumatoid arthritis. Trauma, including both flexion and extension injuries, may cause odontoid fractures which are reported to comprise 7% to 14% of all cervical fractures.3,7,21 In the early 20th century, odontoid fractures were thought to be almost uniformly fatal.10 Later estimates dropped to a 50% mortality, and more recent figures vary from 4% to 8%.3,13,21 These latter figures may be misleading; some patients with atlantoaxial fracture-dislocation may never reach the hospital because of a rapidly fatal injury to the brain stem and spinal cord. However, this seems more of a possibility than a reality, since Böhler8 reported in his autopsy series only one case of fatal quadriplegia from odontoid fracture.

A review of the literature reveals a variety of opinions as to the treatment of odontoid fractures. Several authors believe that all fractures should be fused to avoid the potential grave consequences of dislocation.1,11,16,26 Schatzker, et al.26 found a 64% rate of non-union with conservative treatment; “non-union” was defined as “a defect in the dens with contiguous sclerosis of both fragments” or “movement of the dens fragment on flexion extension radiographs.” They recommended posterior atlantoaxial fusion in all patients. Hentzer and Schalimetzek16 found a non-union rate of 50% with conservative treatment, and therefore believed that early operative treatment is indicated. Alexander and Davis1 and Crutchfield and Schultz11 recommended fusion for all dislocations of the atlas and axis.

Internal fixation usually involves the fusion of either the first two or the first three cervical vertebrae.1,4-5 Another technique involves the use of wire fixation and methyl methacrylate fusion.14 Simple wire fixation without fusion is probably inadequate.19,24 Internal fixation generally has resulted in adequate stabilization in 80% to 100% of cases, although one author reported only 20%.1,4,5,14 All of our patients had adequate stabilization following wire fixation and autogenous bone grafting. Operative morbidity involves infection and wire breakage.4 Deep venous thrombosis is a theoretical complication reported in 43% of one series of postoperative neurosurgical patients.17 The operative mortality is low; we could find only one series with such an event.14 In our series, we did not have any operative mortality or morbidity.

Certain authors believe external immobilization should be the initial treatment in all patients, and that fusion is rarely necessary.3,6,7,21,27 For Amyes and Anderson,3 fibrous union, or pseudoarthrosis, was an acceptable result if stability was demonstrated on flexion-extension cervical radiographs. Their incidence of non-union was 5% (three of 63 patients). Blockey and Purser6 found that 22 of 35 patients treated conservatively had non-union. Nevertheless, they recommended 12 weeks of initial conservative treatment, with operative fusion for patients with unstable fibrous union. Böhler7 reported union in 35 of 37 cases treated conservatively and stated that “only in exceptional cases is primary operative intervention indicated.” Nachemson21 considered all 18 of his patients to have acceptable results with a conservative approach.

A conservative approach involves 6 to 10 weeks of skeletal traction using either Gardner Wells or Crutchfield skull tongs and 5 to 10 lb of traction. This is frequently followed by some form of neck bracing for a variable period of time. Decubitus ulcers, osteomyelitis, pin-site infection, cervical spine distraction, redislocation, pulmonary insufficiency, and deep venous thrombosis are possible complications.3 When spinal cord injury occurs, deep vein thrombosis and pulmonary embolism may be especially significant, particularly in the first few weeks following injury.22 Mortality may occur from associated injuries, redislocation, or pulmonary insufficiency.2,12,21 Our one mortality resulted from bronchopneumonia in a conservatively treated elderly patient.

Factors that influence the rate of non-union may be used to define the roles of arthrodesis and external immobilization for odontoid fractures. Amyes and Anderson3 found that the characteristics of the fracture are important. While an oblique fracture through the upper part of the odontoid (Type I) and a fracture that extends into the body itself (Type III) seemed usually to unite with conservative treatment, fractures through the odontoid base (Type II) often did not. However, Apuzzo, et al.,5 noted that many of their patients who were considered to be conservative treatment failures had Type III fractures. These authors also found that displacement of the odontoid fragment, especially if greater than 4 mm, is an important factor that increases the incidence of non-union. Moreover, they found that non-union was three times as common in their patients over 40 years of age (53%) as for those under 40 years (17%).5 Thus, Type I and Type III fractures, fractures displaced less than 4 mm, and fractures in patients less than 40 years of age are thought to be likely to heal with external immobilization alone.
The halo apparatus has been suggested by Cooper, et al., as treatment for the above group of patients. This device has been reported ineffective in Type II fractures, however. Ekong, et al., found that their patients without spinal cord injury who were treated with this apparatus were hospitalized an average of 27 days, whereas those with spinal cord injury stayed an average of 70 days. This seems to refute the alleged advantage of the halo apparatus in allowing early discharge from the hospital. Moreover, this apparatus may result in moderate stiffness of the cervical spine.

Complications of this treatment modality include pinsite infection, pressure sores, redislocation, bronchopneumonia, pulmonary embolism, and skull perforation with subsequent intracranial abscess. Mortality has been reported from associated injuries, bronchopneumonia, and pulmonary embolism. We had no complications in our small group of patients treated with the halo apparatus.

One final factor greatly influences the management of atlantoaxial subluxation: rheumatoid arthritis frequently results in either transverse atlantal ligament or odontoid process incompetence. Rheumatoid arthritis is associated with increased failure of operative fusions. Because of this, surgical indications are restricted to the presence of a neurological deficit or severe cervical or radicular pain unresponsive to conservative measures. Severe cervical subluxation, which is thought to seriously threaten neural structures, is another possible indication for surgery. Occipitocervical fusion seems to be superior to atlantoaxial fusion in providing adequate stabilization. No rheumatoid arthritis patients were included in our series.

We believe that arthrodesis is superior to either skeletal traction or halo immobilization in treating odontoid fractures. Review of our results reveals that surgical treatment is effective in stabilizing an odontoid fracture, whereas conservative therapy will result in an occasional failure. The halo apparatus was effective for all four individuals in whom it was used. Inspection of our case material reveals that age of the patient, type of fracture, and displacement influenced neither the modality nor the results of treatment. There are, however, significant differences in the duration of hospitalization and subsequent recovery period. The patient’s subjective preference of mode of treatment, whether C1–2 fusion with discharge from the hospital within an average of 18 days and a rapid convalescence, skeletal traction with an average hospital stay of 43 days and a convalescence of at least equal length, or the social inconvenience of halo apparatus for 8 to 12 weeks should be taken into account.

Conclusions

Surgical therapy is at least as effective as skeletal traction or external immobilization for the treatment of odontoid fractures. With surgical therapy both the hospital stay and the subsequent recovery period are shortened considerably. We believe that arthrodesis should be considered in the initial treatment of all types of unstable odontoid fractures.

References

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