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PROGNOSIS OF ODONTOID FRACTURES

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The occurrence of seven odontoid fractures at Charity Hospital during 1967–68 led us to review our records. We surveyed all the charts of patients sustaining cervical vertebral fractures from 1942 at New Orleans' Charity Hospital and from 1953 at New Orleans' Veterans Administration Hospital. From these charts 50 odontoid fractures were found. This study was made to ascertain the characteristics, complications and prognosis of fractures of the odontoid process.

The precise incidence of nonunion of odontoid fractures does not emerge from the literature surveyed. Osgood & Lund (1928) stated in their review of the literature that roentgenograms of the end result have been unsatisfactory in the approximately 55 reported patients prior to the report of their patient. Review of other studies has not clarified the incidence of nonunion. Blockey & Purser (1956) found that 22 of 35 fractured odontoids failed to achieve bony union. Amyes & Anderson (1956) stated that only 3 of 58 failed to heal. Rogers 1957) reported that 4 of his 9 odontoid fractures developed a nonunion. The total of these series results in a combined nonunion incidence of 28.4 per cent (29/102).

The mortality rate with respect to odontoid fractures has not been definitely ascertained. Various studies give contradictory information. Osgood & Lund (1928) found that of the 56 patients reported up to that time, 29 died, a mortality rate of 52 per cent. Amyes & Anderson (1956) had a mortality rate of only 8 per cent or 5 in 63. Jefferson (1920) had 13 odontoid fractures with an associated atlas fracture. Only one of the 13 survived. Blockey & Purser (1956) had only one death in their 11 odontoid fractures, and this was due to a myocardial infarction more than four years after the accident. None of Rogers' 9 patients died. The total of these series results in a combined mortality rate of 30.9 per cent (47/152).

MATERIAL

The records of 50 patients with odontoid fractures seen at the Charity Hospital from 1942 and the Veterans Administration Hospital from 1953 to June 1968 were analyzed in relation to (1) age and sex, (2) mechanism of injury, (3) associated injuries, (4) type of displacement, (5) neurologic complications, (6) treatment, (7) result, and (8) length of follow-up.

Excluding 9 patients seen at the Veterans Administration Hospital, the male-female ratio in the remaining 41 patients was 9:1.

The ages of the patients ranged from 15 to 66 years, with the highest incidence occurring in the third and fourth decades (42 per cent).

The mechanism of injury was an auto accident in 62 per cent and a fall in 24 per cent of the patients. In all but one patient it was reported that there was direct trauma to the head or face instead of the neck.

Other than vertebrae, the most commonly associated injuries were mandibular and scapular fractures. Four patients had mandibular fractures, 3 patients had scapular fractures, 3 patients had rib fractures, 3 patients had clavicular fractures, and 3 patients had ankle fractures. One patient had bilateral clavicular and scapular fractures.

The odontoid fracture was displaced in 14 patients (28 per cent). The displacement was anterior in 6 patients, posterior in 4 patients, lateral in 2 patients, anterior and lateral in one patient, and posterior and lateral in the remaining patient. Transient neurologic involvement was seen in 2 patients with displaced fractures. The fracture healed in 7 patients and progressed to nonunion in 3 patients. One patient had cervical arthrodesis. Three patients were lost to subsequent follow-up.

In our entire series of 50 patients, 8 patients developed neurologic complications (16 per cent). Seven of the 8 patients presented initially with neurologic involvement. In 4 patients this complication proved temporary, 2 patients had permanent neurologic residuals, and 1 patient died. The odontoid fracture was displaced in 2 of the 8 patients. The fracture healed in 4 patients and progressed to nonunion in 2 patients. One patient had cervical arthrodesis. Four of the 8 patients with neurologic deficits had initial weakness of one or both extremities on one side. Two of the 4 were left with permanent weakness. Three of the 8 patients had initial paresthesias, all of which were temporary.

TREATMENT

Of our 50 patients, 40 were treated conservatively. Six were lost to follow-up. Three had surgical fusions within the first month. There was one death due to a respiratory arrest twenty days after the accident.

Of the 40 conservatively treated, the fracture healed in 32 patients and progressed to nonunion in 8 patients for a nonunion incidence of 20 per cent. Three of the 8 nonunions had had no immobilization. One patient had 15½ weeks of immobilization after no treatment for the first three days. Another patient was immobilized for 14 weeks after a lapse of six months following the accident. One had six weeks of immobilization, and two had approximately 19 weeks of immobilization. Twenty-eight of the 32 patients that healed had union in twenty or less (87.5 per cent).

Union was determined by clinical and radiological confirmation. One wonders if the two cases that achieved union in 7 and 7½ respectively would have had this diagnosis if laminagrams of the odontoid were done.

Seventeen patients on whom the final results are known did not have immediate immobilization. Delay in institution of immobilization ranged from two days to seven years. Thirteen of the patients went on to bony union. All 13 were immobilized within five months after the accident occurred. Seven of the 13 were immobilized within one week of the accident, one within 10 days, one within 15 days, one within 4 weeks, one within one month, one within 3 months, and one within 21 weeks. There were 4 patients in whom nonunion occurred. One had no immobilization for 7 years, the second had no immobilization for the first 6 months, the third had intermittent immobilization due to the intractability of the patient, and the fourth was not immobilized for the first 3 days.

The mean for the 32 patients who achieved union was 16.08 weeks of immobilization with a corresponding standard error of 1.2 weeks. For these 32 patients upper 90 and 95 per cent tolerance limits were calculated and found to be 25 and 28 weeks respectively. These limits indicated that on the average 90 to 95 per cent of all odontoid fractures will heal within the period bounded by the upper 90 and 95 per cent limits under repeated sampling.

The length of follow-up on the 50 patients ranged from less than a month to 79 months. The average time of medical supervision for

these patients was 13.3 months. Thirty-one patients were followed for less than one year, and only 8 had follow-up of two years or more.

DISCUSSION

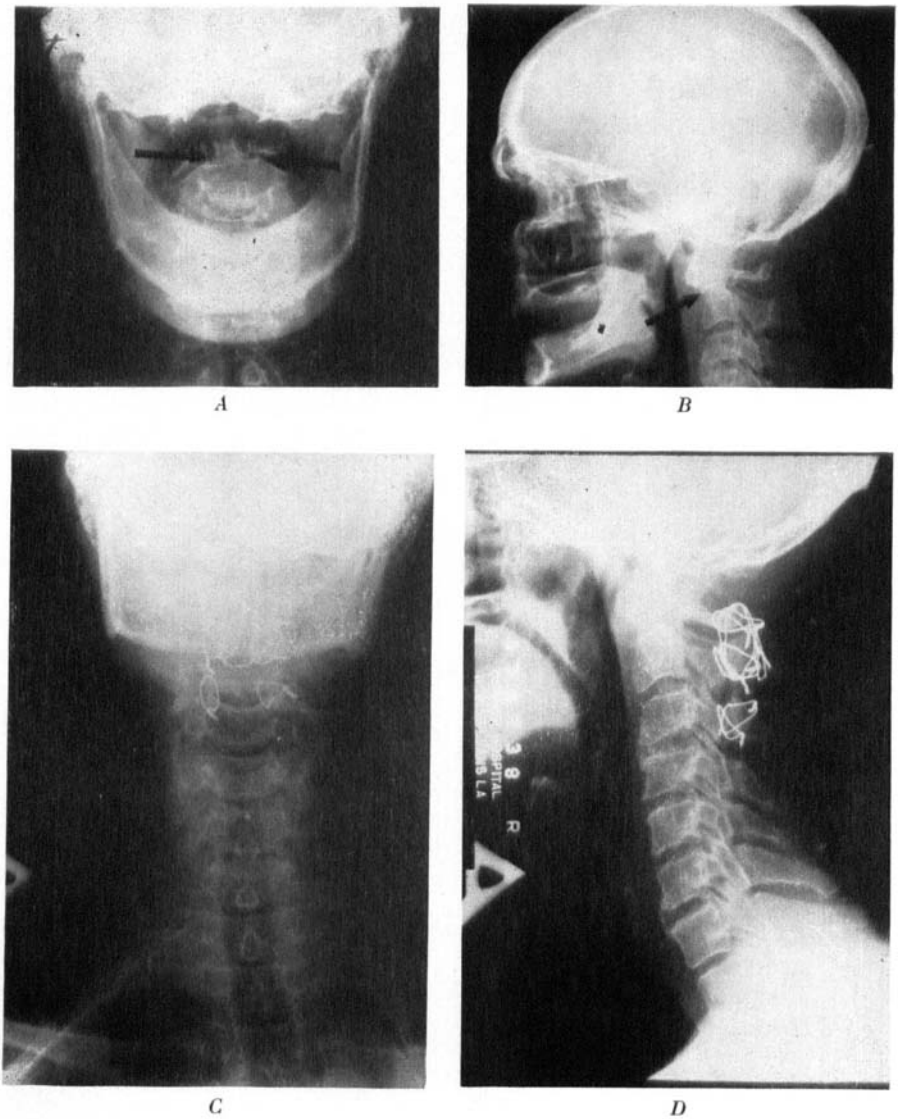
The authors were able to review only those charts which had been coded. The coding system was started in Charity Hospital in 1942 and in the Veterans Administration Hospital in 1953. We found no odontoid fractures at Charity Hospital prior to 1948 and only two before 1960 at the Veterans Administration Hospital. One may conclude that either the coding was improper or the diagnosis was not made. The fracture is more common than one realizes, but the coding problem (odontoid fractures are coded under fractures of cervical vertebrae) has prevented the collection of a large enough series to have statistical significance.

After analyzing the mechanism of injury there is no reason to conclude that blows to the occiput are more common than blows to the face. While most agree that posterior displacement of odontoid fractures is rare we had 4 displaced posteriorly and 6 displaced anteriorly. Since 62 per cent of the patients were involved in car accidents, we would assume that the part of the car involved in the accident would determine whether there was a blow to the face or occiput. Therefore, we are unable to explain the uniqueness of the posterior displacement in previous series unless we assume that these patients died at the scene of the accident and/or the diagnosis was not made.

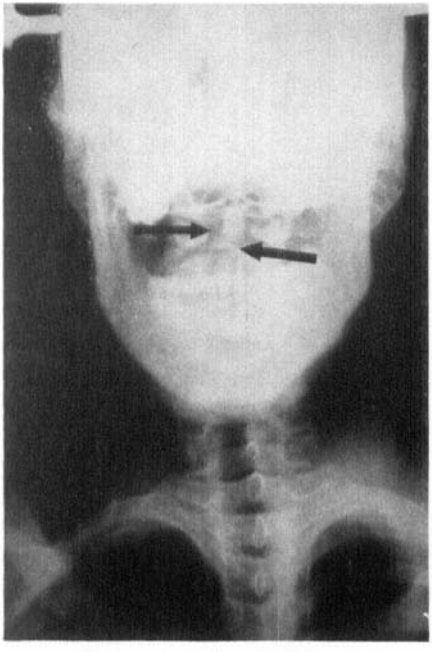
The authors, after analyzing the mechanism of injury, are in agreement with Wusthoff's conclusions that injury is to the head or face, and not the neck. In 49 out of 50 cases it was reported that there was direct trauma to the head or face instead of the neck.

From our previous experience it is evident that in order to achieve bony union of an odontoid fracture it must be immobilized. Of the 17 patients who did not have immediate immobilization 14 were immobilized within 5 months or less of the accident, and 13 of these patients achieved union. The results on these patients suggest that whereas immobilization is necessary, union can occur even following delayed treatment.

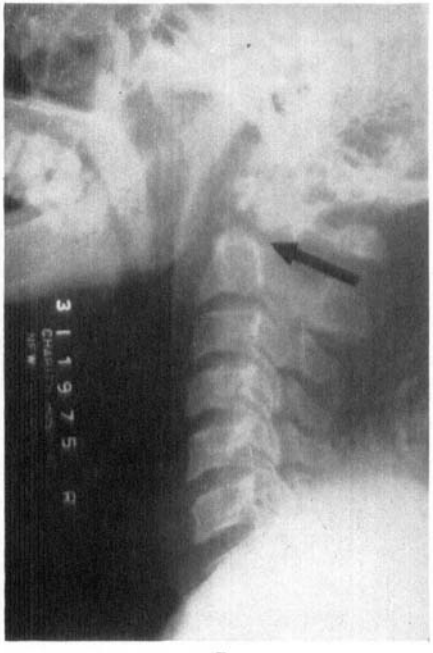
Five patients had an operative fusion. Three patients were fused soon after the fracture (one month or less) and all went on to union (Figures 1A, B, C and D). Two patients with nonunion undergoing



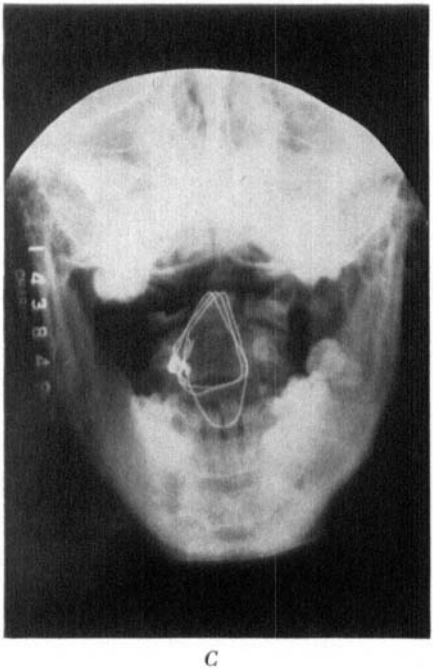
Figures 1A, B, C and D. Patient no. 39 is a 46-year-old male whose admission x-rays (A and B) show anterior and lateral displacement. The patient had a posterior C 1, 2, 3 cervical fusion 2 weeks after sustaining the fracture. Figures C and D, which show union, were taken 8 weeks after surgery.



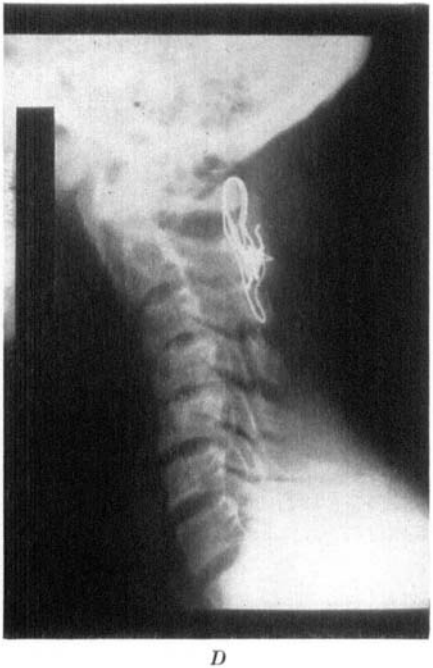
A



B



C



D

fusion attained stability, but the odontoid fracture failed to heal (Figures 2A, B, C and D).

Cervical fusion should involve cervical vertebrae one and two only. Sufficient stability is attained so that a cervical fusion of cervical vertebrae one, two, and three is not necessary. Cervical fusion is indicated for nonunion of odontoid fractures, unstable odontoid fractures immobilized for less than 20 weeks with progressing neurologic deficit, and for instability of cervical vertebrae one and two. A relative contraindication to arthrodesis is an ununited fracture which has been immobilized for less than 20 weeks without neurologic deficit.

Of the 8 patients who developed nonunion of their fractures, 3 had associated major injuries and 5 did not. Their ages at the time of the accident were 16, 21, 29, 53, 55 and 66. One of the 8 sustained repeated injuries to his head and neck since the age of 9, and since the diagnosis was not made until the patient was 50, the age at which the fracture occurred cannot be ascertained. From these data we cannot state that age or associated injuries had any bearing on incidence of union.

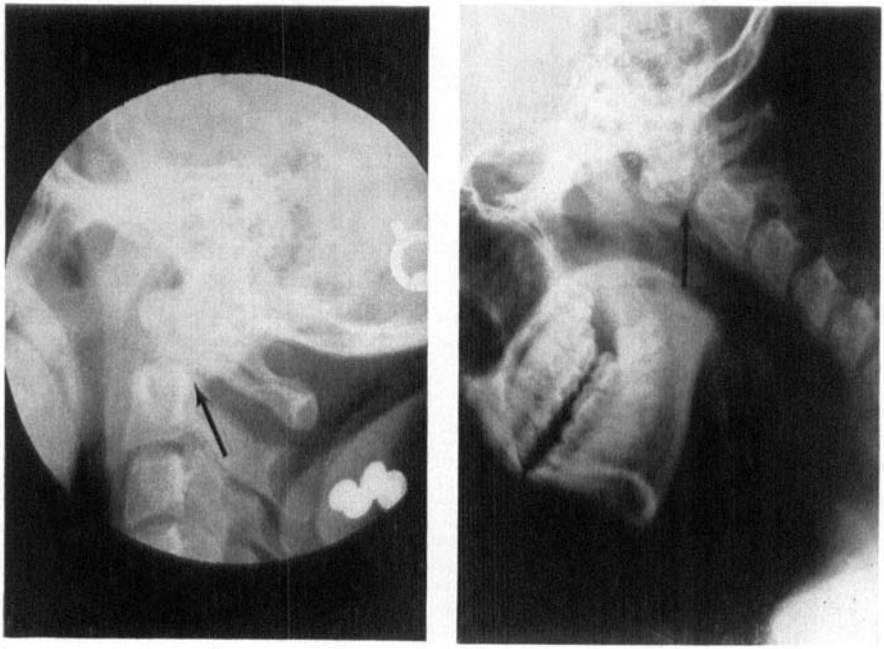
Comparison of the nonunion rate of these fractures with displacement (30 per cent) and those with no displacement (16.7 per cent) shows a higher incidence of nonunion for the displaced fractures.

There were 8 patients with neurologic involvement, but in only 2 patients was the fracture displaced. It is certainly possible that all of these 8 were initially displaced with 6 being reduced prior to having roentgenograms.

A thorough neurologic examination including evaluation of reflexes, muscle strength, presence or absence of pathologic reflexes, and sensation should be done. In addition the quality of respiration should be noted. The neurologic deficit should be initially treated with traction. If sufficient immobilization has not been obtained and the neurologic deficit is progressing cervical arthrodesis is indicated.

The main questions still to be answered are: How long does it take the fracture to heal, and when should one consider doing a fusion?

Figures 2A, B, C and D. Patient no. 20 is a 29-year-old male whose admission x-rays (A and B) show posterior and lateral displacement of the fracture. He was immobilized for 19 weeks with traction and Minerva jacket and then placed in a 4 poster brace for an additional 17 weeks. 36 weeks after the accident he had a posterior C 1 2, 3 fusion. Post-operatively he was immobilized in a Minerva jacket for 15½ weeks. Figures C and D show the fracture site to be ununited.



A B

Figures 3A and B. These x-rays are of a patient in his 20's who had an undisplaced odontoid fracture. He was treated with 12 days of traction and then placed in a 4 poster neck brace. Figure 3A shows anterior displacement and Figure 3B shows posterior displacement while in the brace.

87.5 per cent of those fractures that achieved union did so within 20 weeks or less. Since our series had a nonunion incidence of 20 per cent, the authors feel that immobilization with traction and/or Minerva jacket for 20 weeks is sufficient to attain bony union if union is going to occur. Since 2 of the 8 nonunions had severe neurologic sequelae, the authors feel that if after 20 weeks of immobilization union has not been achieved cervical fusion is indicated. We have not included as immobilization the wearing of a brace, since this can be removed by the patient, and even if worn, does not provide adequate immobilization as some of the x-rays in this article clearly show (Figure 3A and B). For the above reason we have not included brace immobilization when calculating how long the patients were actually immobilized, unless the patient was immobilized with only traction and neck brace.

SUMMARY

Tabulation of cases reported in the literature reveal a nonunion rate of 28.4 per cent (29/102) and a mortality rate of 30.9 per cent (47/152) for odontoid fractures.

Analysis of the fifty odontoid fractures in the current series revealed:

1. 42 per cent occurred in the third and fourth decades.
2. 49 of the 50 patients reported direct trauma to the head or face instead of the neck.
3. The most common associated injuries were mandibular and scapular fractures.
4. Displacement of the fracture occurred in 14 patients (28 per cent).
5. Neurologic complications occurred in 8 patients (16 per cent).
6. Nonunion occurred in 8 of the 40 patients treated conservatively (20 per cent).
7. 28 of the 32 fractures (87.5 per cent) that healed with conservative treatment had union in 20 weeks or less.
8. 13 of 17 fractured odontoids which did not have immediate immobilization achieved union.
9. Nonunion rate for displaced odontoid fractures (30 per cent) was higher than for nondisplaced fractures (16.7 per cent).
10. The authors recommend immobilization of odontoid fractures with traction and/or Minerva jacket for 20 weeks. If after 20 weeks of immobilization union has not been achieved cervical fusion is indicated.

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