Non-union (type II) odontoid fracture: A case report of a motor vehicle accident

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A case report is presented of a young man injured in a motor vehicle accident who subsequently suffered neck and shoulder pain with no radiation. The pain, aggravated by motion and relieved by neck massage, had persisted for five months. Investigation by plain film radiographs, prior to treatment suggested an odontoid fracture. Tomographic radiographs revealed a type II non-union odontoid fracture. Spinal manipulation was contraindicated and this patient went on to surgical stabilization. A type II odontoid fracture non-union should be ruled out in any patient presenting with a history of a motor vehicle accident with head trauma, before manipulation is considered.

KEY WORDS: odontoid, radiography, tomography, chiropractic, manipulation.

Un cas type est présenté d'un jeune homme blessé dans un accident d'automobile, qui y avait subi subséquemment des douleurs au cou et aux épaules, sans radiculite. La douleur, aggravée par le mouvement et soulagée par des massages au cou, avait persisté durant cinq mois. Une recherche, à l'aide de radiographies préalables au traitement, permit de découvrir qu'il avait une fracture odontoïde sans jonction de type II. Les manipulations vertébrales étaient contre-indiquées et le patient eut recours à une stabilisation par chirurgie. Dans les cas de patients ayant subi un traumatisme cranien suite à un accident d'automobile, on devra s'assurer qu'il n'y a pas de fracture odontoïde sans jonction de type II avant de procéder à des manipulations.

MOTS-CLEFS: odontoïde, radiographie, tomographie, chiropratique, manipulation.

Introduction

Motor vehicle accidents (M.V.A.) by their nature of increased speeds imply excessive trauma. They have further been implicated to be a cause of a higher incident of odontoid fractures.[1,2,3] Fractures of the odontoid have been reported to account for up to 15% of all cervical spine fractures and up to 2% of all spinal fractures.[2,4,5] It has further been reported that odontoid fractures occur in 75% of all cervical fractures in children under seven years of age.[6] A history of an M.V.A. and/or head or neck trauma should induce the examiner to thoroughly investigate the possibility of odontoid fracture.

The classification system introduced by Anderson and D'Alonzo has received the most recent acceptance and classifies an odontoid fracture as type I, type II, or type III.[3] (see figure 1) They found that type II fractures had a 36% incidence of non-union. Classifying odontoid fractures as 'high' or 'low', depending on the site of the fracture above or below the accessory ligament, Schatzer et al. reported non-union as high as 63%. The incidence was higher or lower depending upon the amount of posterior displacement or lack of displacement respectively.[7] Wang et al. reported a non-union of 42% in type II fractures treated conservatively.[8] Thereby, the incidence of odontoid fracture non-union following conservative treatment has been reported to vary from 5% to 63% and has shown the greatest incidence in type II fractures.[1,3,7,8,9]

A thorough examination of a patient with a history of an M.V.A. with head or neck trauma, should include radiographs of the cervical spine. The recommended views are an anterior-posterior, A-P open mouth and lateral radiographs,[1-10] as well as lateral cervical flexion and extension views within the patient's tolerance.[10,11,12] Should a questionable or ill defined lesion appear on these radiographs, further investigative radiographic studies in the form of cervical spine tomography (anterior-posterior open mouth and lateral spot view of C_1-C_2) should be undertaken.[1,2,4,12]

Figure 1: Description of Anderson, D'Alonza odontoid fracture classifications.[3]

Type	Location	Treatment	Stability
I	– oblique fracture line high on the odontoid process, possible avulsion fracture	– does well with immobilization (brace) – good prognosis for union	– stable
II	– junction of odontoid process with C_2 body – transverse fracture line	– conservative treatment may lead to non-union (percentage is higher for non-union if displacement is present) – if non-union develops C_1-C_2 fusion is recommended	– unstable – frequent displacement
III	– fracture site extends caudally into the body of C_2 – referred to as a fracture of the vertebral body (fracture line extends into the superior articular facet of C_2)	– 90% of fractures unite with immobilization and traction – good prognosis for union	– more stable

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Case report

Mr. W.S., a 23 year old male, presented with neck and shoulder pain and a "loss of neck motion". He reported being involved in a M.V.A. five months previously in which he sustained head trauma. The accident had rendered him unconscious for 18-20 hours and he sustained a fractured skull (coronal suture) and a scalp laceration requiring 42 sutures (figure 2). He received Hgb (81 S.I. units) and iron therapy ($FeSO_4$, 300 mg. b.i.d.) for anemia secondary to acute blood loss. He was placed in a hard cervical collar for 6 weeks and advised on the proper care of the laceration and skull fracture. He was cautioned about the signs and symptoms of possible complications and was released from hospital three days later. He expressed concern that although his neck pain had eased somewhat, the discomfort had not totally abated. The pain was located in the upper cervical region inferior to the angle of the jaw, bilaterally. He describes a constant sharpness that did not wake him at night or interfere with eating or talking. He denied any painful radiations to the upper extremities. He had not experienced any headaches except for the first two weeks following the M.V.A. He did not complain of any visual or auditory disturbances. He did however, mention that he had experienced a left arm weakness that persisted for approximately one week after the accident. He further described a generalized posterior neck ache which radiated to the upper dorsal region. Neck pain was aggravated by movement, and reportedly relieved by posterior neck massage. On a scale of 0 to 10, the patient rated the intensity of his neck pain at 6-7.

On examination there was evidence of anterior carriage of the head and a low right shoulder posturally. Cervical range of motion testing revealed the following: Active and passive testing showing left rotation restricted to 10 degrees with considerable generalized neck pain reported. All other motions were full with only mild pain noted. Resisted muscle testing produced pain on right and left lateral flexion in the left and right scaleni muscles respectively. Flexion was productive of pain in the region of the scaleni bilaterally. Left rotation produced mild discomfort in the region of the right scaleni and sternocleidomastoid muscles. There was evidence of hypertonic trapezius and sternocleidomastoid muscles bilaterally.

Passive abduction of the left arm produced pain over the anterior deltoid. Left cervical Kemp's test (extension with combined rotation) produced pain over the mid cervical spine. Right cervical Kemp's test produced pain in the region of the right sternocleidomastroid muscle. The following orthopaedic tests were negative: valsalva manoeuver, kernig's sign, anterior doorbell's test and adson's manoeuver. Maigne's test of joint challenge reproduced pain at T_{1-2}, T_{4-5}. Cranial nerve testing was normal. Deep tendon reflexes were diminished, (1+) for the upper extremity with no sensory or motor deficit evidenced.

Radiographs of the cervical spine suggested a lucent defect at the base of the odontoid process. Motion studies (flexion/extension) further suggested lack of integrity between the odontoid process and the body of C_2 (figure 3). Tomograms showed a type II odontoid fracture with mild anterior displacement (2.5mm). Lack of evidence of callus formation was present suggesting a delayed union (figure 4).

A diagnosis of non-union type II odontoid fracture was made. Mr. W.S. was referred to an orthopaedic surgeon who performed a Gallie posterior fusion of C_1-C_2 (figure 5).

The C_1 segment was stabilized on C_2 and the cervical spine was immobilized with a collar-brace. The post-operative care after removal of the brace has been uneventful. The patient returned for further chiropractic care 3 months following his surgical stabilization. He reported some residual, low grade, neck and upper dorsal discomfort. Treatment in the form of soft tisue massage, trigger point compression, upper dorsal manipulation and non-stress cervical range of motion exercises was instituted. When last seen 5 months post-operatively, cervical ranges of motion were: left and right rotation 75° and 80° respectively, lateral flexion 40° bilaterally, flexion was full and extension was 35°. Mr. W.S. reported the level of pain as a 2 on a scale of 0 to 10.

Discussion

Documentation that a non-union type II fracture of the odontoid may go weeks, even years without any clinically relevant neurological findings is extensive.[1,2,3,8,9] These patients present post-trauma with upper cervical spine tenderness, limited ranges of motion, protective muscle spasm, torticollis and possible episodes of mild motor and sensory weakness. Rupture of the suspensory ligaments could, of course, result in cord compromise and death. The non-union may predispose to a myelopathy due to the resultant instability afforded the atlanto-axial joint. Any subsequent trauma, no matter how minimal, may lead to pressure on the spinal cord. Treatment must be initiated in order to stabilized the segment and therefore an immediate consult should be arranged with an orthopaedic surgeon. If neurological symptoms are noted, an expeditious referral to a neurosurgeon may be more appropriate.

Various causes for the non-union have been postulated but none have been proven. Damage to the blood supply of the dens, has been proposed but remains controversial. Anderson reports that the odontoid has been shown to have a rich blood supply, with many anastomoses and concludes it would be unlikely that injury to some of the blood vessels upon fracture would lead to non-union. Schatzker et al. describe small vessels entering the dens by way of the apical and alar ligaments.[7] Southwick supports the adequate blood supply to the dens concept but, suggests that a fracture of the dens at its junction with the centrum of the body of the axis would lead to damage of the vessels entering at the base of the dens and affecting its boney nutrition.[12] This is further supported by Pepin et al.[2] A type II fracture may therefore create a non-union at this level due to a diminished blood flow at the fracture site while not proceeding to avascular necrosis of the dens due to an adequate blood supply elsewhere. Furthermore, it has been suggested that the type I and type III fractures heal faster because there

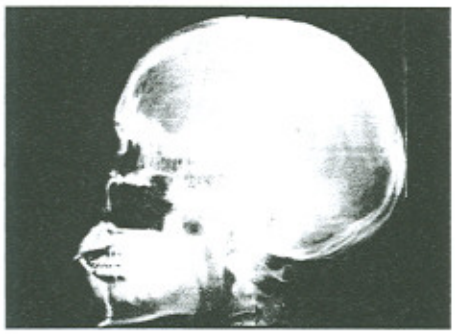

Figure 2a: Radiographic study taken on emergency admission – Lateral skull demonstrating coronal skull fracture

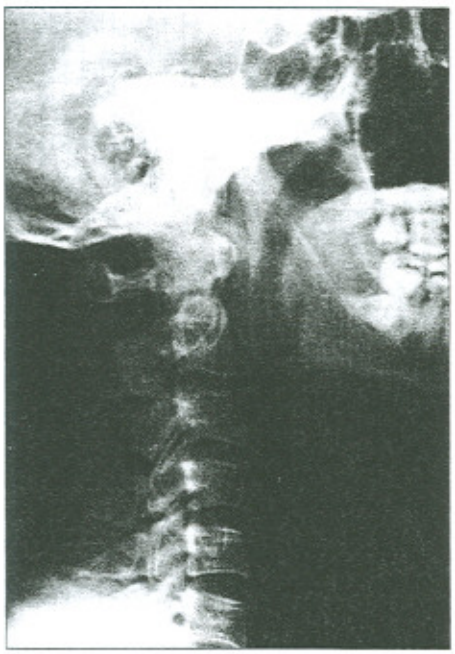

Figure 2b: Radiographic study taken on emergency admission – Lateral Cervical Spine

Figure 2c: Radiographic study taken on emergency admission – A/P open mouth

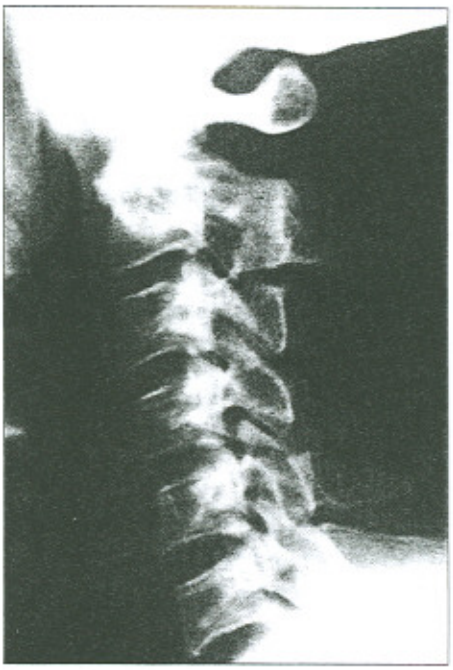

Figure 3a: Plain film Radiographs taken the day of initial chiropractic visit – Lateral cervical spine – showing disruption of spinal laminar line and disruption at base of odontoid

Figure 3b: Plain film Radiographs taken the day of initial chiropractic visit – Flexion/Extension view – indicating displacement of odontoid peg

Figure 3c: Plain film Radiographs taken the day of initial chiropractic visit – A/P Open Mouth – suggesting possible disruption

Figure 4a: Tomographs of C_1-C_2 segment – A/P – clearly showing a type II non-union

Figure 4b: Tomographs of C_1-C_2 segment – lateral – showing anterior displacement

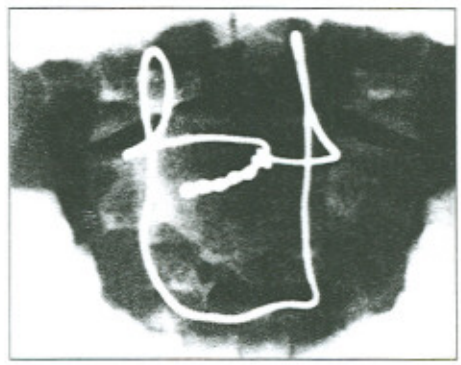

Figure 5b: Post-operative Radiographs showing Gallie Fusions – A/P open mouth

Figure 5a: Post-operative Radiographs showing Gallie Fusions – Lateral

is no disruption of the blood supply to the dens.[1,3,9,12] Southwick suggests, based on Bucholz and Burkhead's study, another cause for the non-union. Due to the anatomical location of the dens it exists almost entirely without synovial cavities. There are few soft tissue attachments to the dens, and as a result no provision is made for an adequate periosteal blood supply. It is suggested that a fracture must then heal by endosteal bone formation from an endosteal blood supply.[12,13] There are no definitive conclusions as to the higher incidence of non-union with a type II fracture, however, it would appear that a fracture between the base of the odontoid and the body of the axis would interrupt the vascular supply entering at that level. The fact that there is an adequate blood supply through the anastamose of vessels entering the dens through the alar and apical ligaments and to the body of axis would suggest that in certain individuals, with a type II fracture, there is adequate perfusion to account for a small percentage developing a union without the need for internal fixation.

A history of head or neck trauma is implicitly tied to the need for radiographic study. Films should be examined closely for disruption of the posterior surface of the dens. It should form a straight line with the posterior surface of the body of the axis. Anterior-posterior examination of the apex, waist and base of the dens should be stressed. Any anterior or posterior displacement should alert the examiner to the probability of fracture. Any angulation of the dens should warrant an investigation. Alteration of the atlanto-dental interspace will alert the examiner to a possible transverse ligament rupture and the existence of a grave situation.[2,4] Southwick reports passive flexion, extension studies as being dangerous and unwarranted due to the possibility of a ruptured transverse ligament. However, he does suggest that if the patient voluntarily flexes and extends on a lateral radiograph it may be of use in determining if displacement is present.[12] Soft tissue swelling into the retrolaryngeal space and displacement of the prevertebral fat stripe may make it difficult to interpret the films. If there is the slightest indication that a fracture is present, further studies are warranted. Tomography is the next step to enable a conclusive diagnosis. Anderson reports that 8 suspected (but inconclusive) odontoid fractures were all confirmed from tomography.[1,2]

Type II odontoid fracture non-union is reported to be best treated by surgical fusion.[9] Conservative treatment with a halo brace or other forms of external fixation has been widely reported as inadequate to produce union.[1,3,9,12]

Wang et al. have reported that type II fractures of the odon-

toid may be managed successfully with conservative treatment, with a union of 80%, should there be no displacement. Displacement accounted for 66% of non-unions while non-displacement results in a 17% non-union rate. Atlanto-axial fusion has had good results with few complications. McGraw and Rusch report 14 of 15 unions after C_1-C_2 fusion, with the one non-union due to an inadequate bone graft.[14] These high results are supported throughout the literature[1,3,7,9-12,14] however, Southwick sites a report where a C_1-C_2 fusion had an 80% rate of non-union, particularly in elderly and poor risk patients. These reports indicate that a type II fracture with a displacement has a greater propensity to non-union than a type II fracture without displacement. It further indicates that conservative (bracing) treatment may suffice in a non-displacing type II fracture. Should there be a non-union or a displaced type II fracture, then a C_1-C_2 fusion is indicated for stabilization.

Treatment after surgery rests in the use of a brace to immobilize the neck. The brace-collar is maintained until there is radiographic and clinical evidence of union. Following the removal of the brace, therapy is warranted to restore ranges of motion. Lee and associates report that following C_1-C_2 fusion patients had nearly a full range of neck movement. They report cervical rotation as 30°-60° and lateral flexion at 25°-40°.[14] In cases where a conservative non-surgical fusion is allowed to progress, Southwick reports there is a greater chance of restoring cervical rotation than if surgical fusion of C_1-C_2 is required.[12] The average length of time to fusion and removal of the brace after surgery or with conservative management is 3 to 4 months.

Conclusion

Non-union of an odontoid fracture (type II) should be suspected in a patient presenting with a previous history of head and neck trauma and symptoms of long standing duration. This type of fracture has by far the greatest percentage of non-union when compared to type I or type III fractures. The fracture should be ruled out through the use of plain film radiographs. Should these prove inconclusive, then tomographs should be employed. Treatment should be left initially to the discretion of an orthopaedic specialist or where neurological symptoms are present, to a neurosurgeon. Once union has been achieved, the chiropractor can assist in hastening the patient's rehabilitative process by employing soft tissue techniques, range of motion exercise and mobilization of the upper thoracic vertebrae.

This was a report of a man who presented with a non-union type II odontoid fracture with 2.5 mm of displacement who went on to eventual C_1-C_2 Gallie fusion. It is readily apparent that it was necessary to have a radiographic study of the cervical spine of this patient, prior to employing any manipulative effort to the cervical spine. The fact that initial radiographs were inconclusive warranted a need to pursue the situation futher until a difinitive diagnosis was attained. A fractured odontoid may create a life threatening instability and minimal trauma alone, not to mention manipulation, could result in a tragic conclusion. Following surgery, chiropractic care may prove useful in reducing post-operative pain of muscular and capsular origin. With soft tissue techniques, range of motion exercises applied to the involved area and manipulative techniques applied to the secondarily involved region, cervical spine ranges of motion may be more easily restored. This patient was fortunate to achieve ranges of lateral flexion and rotation greater than would be expected after a C_1-C_2 fusion within a 5 month time span post-operatively.

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