Management of Odontoid Nonunion: A Review

M Silas

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Abstract

Odontoid fractures constitute less than a quarter of all fractures of the cervical spine. Almost half of odontoid type II fractures will develop nonunion when treated conservatively. The cause of nonunion is not related to interruption of blood supply to the proximal part of the odontoid. The two most important risk factors for odontoid nonunion are the initial displacement and distraction.

Management of odontoid nonunion is controversial. The consensus is that surgery is the method of choice for treatment of all types of odontoid nonunions. Odontoid nonunion is a potentially hazardous complication. Conservatively treated nonunions can lead to neurological deficits . Patients can develop neurological deficits months or years later. The role of conservative treatment in the management of odontoid nonunion is unknown.

INTRODUCTION

Odontoid fractures account for 10%-16% of all cervical spine fractures([1]). The fracture can follow minimal force, especially in elderly patients. Odontoid fractures are classified according to Anderson and D'Alonso. Type 1 fracture is an avulsion type and is managed non-surgically. Types II and III are therapeutically very important. Type II has a high rate of nonunion: 40%-75% in conservatively treated cases. Many authors believe that the major cause of high nonunion rate in Type II is interruption of blood supply to the proximal part of the odontoid. But this is not true.

Schatzker et al ([2]) showed in experiments using mongrels that interruption of blood supply to the odontoid is not the cause of nonunion. The blood supply of the mongrels' odontoids is similar to that of humans'. Additionally, histological examinations of odontoids removed during surgery failed to demonstrate the presence of avascular necrosis as the cause of nonunion. There must be alternative explanations for the high nonunion rate in Type II odontoid fractures.

Cholavech Chavasiri ([3]) identified risk factors associated with nonunion in conservatively treated odontoid fractures (those treated with Halo vest) : initial displacement and distraction. He considered these two factors as the most important. Other authors have identified the following risk factors for nonunion; fracture gap of more than 1mm , posterior displacement of more than 5mm, and delayed treatment of more than four days. Age and sex are not risk factors. Essentially, almost half of conservatively treated odontoid fractures (especially type II) will develop nonunion.

The purpose of this article is to review the approach to the management of odontoid nonunion.

DECISION-MAKING

Management of odontoid nonunion is controversial. The controversies are; should all cases of odontoid nonunions be managed surgically?, what is the risk of neurology in conservatively treated stable nonunions?, do stable nonunions need surgery at all?, and how does a surgeon decide about the approach in those patients who need surgery?

ODONTOID NONUNION AND MYELOPATHY

Nonunion of the odontoid is a hazardous situation([4]). The natural history of untreated injury is not known([5]). Stable (fibrous) nonunion needs minimal force to cause instability and neurological damage. Odontoid nonunion, whether stable or not, is a potential threat to the spinal cord and the life of the patient. Nonunion of the odontoid can lead to subluxation of the Atlanto-Axial joints. Subluxation can cause spinal cord compression([2], [6],[7]).

Paradis et al([2]) reviewed 29 patients who had odontoid nonunion plus Atlanto-Axial Instability(AAI). A significant number of these patients(76%) had some form of neurology on presentation, mostly due to anterior cord damage. All these patients were initially treated conservatively.

Neurology developed six months to sixty years after the injury. They operated on all these patients and 90% of them improved neurologically.

The general consensus is that all odontoid nonunions must be fixed([8]). Jörg Böhler et al ([9]) emphasized that nonunion of the odontoid is an absolute indication for surgery. Is there a place for nonsurgical treatment for odontoid nonunion?

ODONTOID NONUNION WITHOUT MYELOPATHY

There is no consensus about the role of conservative treatment of odontoid nonunion. Robert Hart et al([10]) followed five elderly patients who had odontoid nonunion. The patients were poor operative risks. Two died from unrelated causes. The remaining three were followed for a period of five years. There was progressive Atlanto-Axial subluxation but the space available for the cord was 14mm-24mm. The actual risk for the development of myelopathy is unknown because the follow-up period was short. The role of conservative treatment in odontoid nonunion remains unknown.

PRE-OPERATIVE EVALUATION

Diagnostic workup of patients with odontoid nonunion is essential for decision-making. Commonly used investigations are , X-rays, Computed Tomography Scan(CT-SCAN) and Magnetic Resonance Imaging(MRI).

(a). X-rays. Antero-Posterior(AP) , open-mouth view, and lateral flexion and extension views are required. Flexion and extension views will assess the stability of the nonunion. The open-mouth is good in assessing Atlanto-Axial subluxation.

(b). CT-SCAN. It will give the following information ([11]); chronicity of the fracture, the size of the fracture gap, space available for the cord, size of the odontoid, and the presence or absence of Atlanto-Axial subluxation or dislocation.

(c). MRI. It can assess the state of both the soft tissue and bone ([11]). The following information can be obtained; the state of the spinal cord, the presence or absence of mechanical compression(during flexion and extension), the space available for the cord, and instability.

Bone scan has no role in the diagnostic workup: it can show increased uptake at the nonunion site for up to two years following the fracture([3]).

The information obtained from the above investigations is important in decision-making and the approach to surgical treatment. Surgical intervention may be done via the following approaches; anterior, posterior and the combination of the two.

ANTERIOR APPROACH

This approach addresses the nonunion directly. It is suitable for selected cases of Types II and III odontoid nonunions([12],[13]). The technique involves odontoid screw fixation. Suitable cases are ; mobile odontoid nonunion([14]), reducible nonunion, large odontoid, either transverse or antero-superior or postero-superior fracture pattern, fracture gap less than 2mm([13]) , and the odontoid not ankylosed to the anterior arch of the Atlas or the clivus([13]). If the MRI showed soft tissue interposition(due to fibrous tissue or transverse ligament) at the nonunion site, the chances of successful outcome using odontoid screw are significantly decreased. There are few cases reported in the English literature using this technique([9],[12],[13],[14]). The results are variable. Apfelbaum et al ([15]) treated 18 patients who had odontoid fractures for more than 18 months. He used anterior odontoid screw technique. He obtained 25% fusion rate (compared to 91% in patients who had fractures of the odontoid less than six months). Esses et al ([13]) treated four patients with this technique and obtained union in all. There is one reported paediatric case treated with this technique([14]). The nonunion healed.

POSTERIOR APPROACH

The significance of odontoid nonunion relates to the potential development of Atlanto-Axial instability leading to posterior cord compression([16]). The type of surgery depends on a number of factors; the surgeon's preference, the space available for the cord, the presence or absence of Atlanto-Axial subluxation.

If there is no Atlanto-Axial subluxation, posterior sub laminar wiring (Brooke's or Gallie fusion) can be used. The outcome of this technique is good in the majority of cases. Atlanto-Axial trans-articular screws is also a viable technique in these cases. If there is Atlanto-Axial subluxation or dislocation, the approach is different especially if the space available for the cord is less than 14mm or there is posterior cord compression.

An attempt should always be made to reduce the subluxation or dislocation([3]). The reduction can take up to two weeks to accomplish. If successful, posterior surgery as described above can be done. If reduction is unsuccessful , occipito-

cervical fusion is done. Posterior laminectomy of the Atlas is done. It is a salvage procedure. There is significant neck stiffness after this operation. Nevertheless, successful arthrodesis can be achieved with this technique. L.Y. Dai et al([7]) treated 50 patients with this technique and was success in obtaining arthrodesis in all. He found no correlation between the amount of Atlanto-Axial displacement or dislocation and the degree of neurological deficits.

ANTERIOR AND POSTERIOR APPROACHES

This technique is not commonly done in odontoid nonunion. The anterior approach involves creating a trough bridging the nonunion site plus bone-grafting. The posterior approach involves sub laminar wiring or the Brooke's technique. Jorg Bohler used this technique is 12 patients. He obtained arthrodesis in all his cases. He argues that in his hands, posterior fusion alone has a 40% nonunion rate. This is reason why he used anterior and posterior approaches. There are no further reports on this technique.

CONCLUSION

Odontoid nonunion is a potentially serious complication. It is a threat to the spinal cord or the life of the patient. The onset of neurology can be delayed up to sixty years following an injury.

The general agreement is that all odontoid nonunions must be treated surgically. The role of non-operative treatment is unknown.

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Author Information

Motsitsi Nkosana Silas, M.MED(ORTH.), F.C.S.
Kalafong Hospital, Department of Orthopaedic Surgery, University of Pretoria