Current Concepts in the Management of Type II Odontoid Fractures

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ABSTRACT

Introduction: Fracture of the odontoid and particularly type II, is the commonest injury in the upper cervical spine. In the past, it was presumed to cause by high velocity road traffic accidents. But now, with the increase in the number of two-wheeler vehicles and sub-standard conditions of Indian roads, this type of injury is common. It is usually caused by hyper-extension of the neck but, can be caused by hyper-flexion. The surgical management has remained controversial.

Material and methods: Data was collected from four centres in Maharashtra- India. In one centre, the treatment was posterior C1-C2 stabilization with screws and plate. In centre two, odontoid fracture line was fixed by anterior screws. In the third centre, Magerel technique was used. The fourth centre believed in direct anterior screw and plate fixation of the fracture line.

Analysis: The number of patients operated upon, were too less in each centre to analyse and compare with each other. As a result, use of software analysis was not felt necessary which is in fact the need to assess the best technique which can be used to treat this fracture.

Results: No definite conclusion could be arrived at by studying the pattern of treatment in these four centres.

Conclusion: Way back in 2009, an attempt was made to do a multi-centre retrospective analysis. There was no definite conclusion and even in the present study, no definite conclusion is derived.

keywords: Better bony fusion with screw and plate, Fracture odontoid, Surgical management, Varied approaches.

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INTRODUCTION

It was felt necessary to write this review for several reasons. In fact, in 2005, Jaiswal et al1 from Sanjay Gandhi Postgraduate Institute in Lucknow, India published a brief and yet precise review in the Journal of Neurotrauma in India outlining the principles prevalent at that time.

Since then, several surgical techniques have been popularized depending on the familiarity of the surgeon with the surgical procedure. In India, the two-wheeler population is rising alarmingly and given the quality of Indian roads and indiscipline while driving (Fig. 1), it is now common to see trauma occurring due to two-wheeler road traffic accidents.

Much against the accepted concept that in the younger generation, this injury is caused during motor vehicle collisions due to driving at high speed on motorways, we now see several patients engaged in two-wheeler accidents even while driving slowly on our roads (Fig. 2).
The three cases admitted to this corporate hospital during the last 1 year (most trauma patients are admitted to General Hospitals) were due to two-wheeler road traffic accidents.

With increasing number of vehicles on the road, injury to the cervical spine has become very common.

CAUSES

In younger patients, where this injury is common, the fractures are usually the result of vehicles involved in road traffic accidents. In our country, the factors mentioned earlier or sometimes falling from a height, such as trees or falling into a well are some of the common causes of fractured odontoid. The mechanism is different in the elderly population (above 60 years). The number of senior citizens is ever-increasing. Trauma in the elderly usually occurs in the house itself and results from low-velocity trauma, such as fall from a standing position or slipping in the bathroom.

High-velocity trauma results in hyperflexion injury (Figs 3 and 4), whereas low-velocity trauma results in hyperextension of neck with posterior displacement of fractured odontoid (Figs 5 and 6).
the odontoid peg into three varieties, type II fracture is the commonest and it can be very unstable.\(^2\)

The commonest cause of type II fracture is hyperflexion of the neck leading to fractured odontoid and anterior displacement of C1 arch. This injury is very common on Indian roads when a two-wheeler passenger falls off the vehicle. It may be associated with atlantoaxial subluxation (Fig. 9).

Hyperextension occasionally produces this type of injury. Clinically, we see approximately 25 to 40% of all such patients as the remaining cases involved in road traffic accidents prove to be fatal at the time of accident due to other mechanisms involved in trauma to the spine and the spinal cord.\(^3\)

The transverse ligament (Fig. 10) is responsible for supporting the dens to the anterior arch of C1. Many times, it gets disrupted\(^1\) leading to instability or AAD.

**CLINICAL FEATURES**

Patients present with restriction of rotatory movements of the atlanto-axial (AA) joint along with pain in the upper part of the cervical spine located more particularly on one side. While displaced odontoid can compress the cervical spinal cord, 82% of patients have no neurological defects.\(^3\)
Today, in fact, the management has remained most controversial. One school believes in conservative management (Fig. 11), but their results vary significantly.4-7 While in some, the conservative management with external halo brace proves ineffective, others felt it gave 83% success rate.4

Some of the factors against achieving fusion with conservative management are (i) old age; (ii) osteoporosis; (iii) degree of displacement of dens (Fig. 12); (iv) associated concomitant C1 to C2 fractures; and (v) preexisting pathological condition. Fractures with 4 mm or more displacement in patients above the age of 40 years are associated with 88% chance of nonunion.4 This figure could be higher in patients above the age of 65 years. Two-wheeler road traffic accidents, which are common in our country and frequent in the young generation, can cause significant displacement of the fractured portion of the odontoid.

Presently, it is the consensus that all type II fractures should be treated surgically unless they are unfit for general anesthesia.

**SURGICAL MANAGEMENT**

Controversy still arises as to which approach to choose. Several options are available, but as of today, there is no consensus regarding the best option. It has been observed that the best choice depends on the familiarity of the surgeon with a given technique. There are not many comparison trials or multicentric studies. Posterior techniques have the option of additional augmentation with bone grafts. But, there is no denying the fact that certain surgical options allow for early mobilization of
the patients. This is very important particularly in the elderly population with comorbidities. Early mobilization decreases heart and pulmonary complications.\textsuperscript{8,9}\nIt is interesting to note that with the limited statistics available, pseudoarthrosis is substantially lower in the operated group.\textsuperscript{9,10}

**ANTERIOR APPROACH AND SCREW FIXATION OF FRACTURED SEGMENT**

Some surgeons believe in anterior Cloward\textsuperscript{11} (Fig. 13) approach and passing a screw through the lower surface of C2 vertebral body.

Anterior fixation of fractured odontoid with screw was first described by Nakanishi\textsuperscript{12} and Bohler.\textsuperscript{13} Anterior direct screw stabilization has shown good results in young patients with noncomminuted fractures as they can be easily realigned. One or two screws can be used. However, it has been felt convenient to use only one screw, as it was proven that using two screws did not show superior results.\textsuperscript{14,15} On the contrary, good fusion and excellent outcome have been achieved by using one cannulated screw.\textsuperscript{16,17}

**TYPES OF SCREWS**

There are several types of screws. Cortical or cancellous; nonself-tapping or self-tapping; fully or partially threaded; cannulated or noncannulated.

A cannulated screw helps to guide it over the guiding pin. Nonself-tapping is a better and stronger screw purchase. Partially threaded screws provide a lag compression and help to unite the fracture by compressive force.\textsuperscript{18}

Anterior single cannulated screw fixation has shown good results in several studies.\textsuperscript{14-17,19}

**POSTERIOR APPROACH**

Some surgeons like Goel and Laheri\textsuperscript{20} believe only in posterior lateral mass and pedicle screws with plate, with or without putting bone chips or metallic spacer in the C1 to C2 joint (Fig. 14).

**Alternate Procedure**

Many use Harm’s technique of screws and rods instead of screws and plate. They find it more convenient, particularly ones with polyaxial heads (Fig. 15).
Posterior Magerl Technique

Yet few other surgeons believe in posterior lateral mass screws passing through the joint (Magerl technique) (Fig. 16).

A RECENT THOUGHT

A recent thought introduced by Patkar\(^2\)\(^1\) believes in an anterior submandibular retropharyngeal approach and plating the fractured segment with screws and plate. However, onlay cancellous chips auto bone grafting is not possible (Figs 17 and 18).

In the past, I used to excise the fractured odontoid by transoral approach or used posterior Brook’s approach with Codman sofwire or simply used Ransford contoured ring to do an occipito C1 to C2 stabilization. However, these procedures are no more practiced for fractures of the odontoid (Figs 19 to 21).

Procedures like Brooks, Gallie’s, or Sonntag (Figs. 22 to 24) are not commonly practiced today, although it was popular during my heydays.

RESTRICTION OF NECK MOVEMENTS

Much against common belief, there is restriction of neck rotational movements\(^2\)\(^2\) with anterior technique as it is in posterior technique.

Posterior technique gives good fusion,\(^5\) but it is achieved at the cost of restriction of AA rotation and some restriction of flexion/extension.\(^6\)\(^,\)\(^8\)

But it is interesting to note that results of restriction of movements with anterior or posterior techniques are comparable. It is not possible to make a choice between anterior or posterior techniques depending on restriction of neck movements, particularly the rotatory movement, which is contributed to the extent of 50% by this single joint.

DISCUSSION

Given the pros and cons of anterior and posterior approaches, the problem, i.e., faced today is to choose...
the appropriate approach to treat this fracture. Which technique is better? In the posterior approach, there are several operative procedures like Goel’s technique, Harm's technique, Magerl technique, and even the good old Sonntag technique. In my mind, this is not a bad choice. On the contrary, Dr Patkar introduces anterior direct retropharyngeal approach and uses screws and plates to fix the joint. He has shown good fusion in the absence of onlay bone grafting. He has a point. Directly fixing the joint line without involving any motion segments saves the much-needed rotatory movements of the neck, which is a big advantage. Now, we are involved in minimally invasive spinal surgery, which includes endoscopic and percutaneous procedures. The aim is to disturb the normal anatomy and physiology as minimal

Fig. 18: Plating of fractured odontoid with screws and additional lateral mass screws on either side

Fig. 19: Transoral excision of odontoid

Fig. 20: Posterior Sonntag method of fusion for fractured odontoid

Fig. 21: Contoured Ransford loop posterior occiput—C1 to C2 stabilization
as possible. It is also meant to provide as much comfort to the patient without comorbidities and without any complications. The modern surgery is also meant to preserve as much function as is possible. Could this be then the surgery of the future for a given case of fractured odontoid type II? In 2000, Julien TD et al. attempted to do evidence-based analysis and his conclusion was “there is insufficient evidence to establish a standard or guideline”. It looks like that even with advances in technology, better understanding of this fracture and advances in technicalities of surgical approaches have made life more comfortable to the patient with less morbidity. The old adage of achieving excellent bone fusion and good long-term outcome with onlay bone grafting with posterior surgical approaches does not appear to carry much meaning in the present context.

Despite all the developments and improvements in our understanding of the topic, the evidence still inadequate in 2017 as to which is the best surgical approach to treat a given patient with traumatic fracture of odontoid type II.

REFERENCES