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Evaluation of the anatomic causes for failure of optimum fixation of anterior cervical plate

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Abstract

The anterior cervical spine surgical procedures invariably need anterior fixation of the vertebral bodies with cervical plates which has a locking mechanism to prevent screw back out. The author encountered the situations in approximately 20 % of his cases where he failed to lock the plate. The cause of failure were evaluated by studying the morphometry of the typical cervical body and it has been found that width of one third of the vertebral bodies were less than the distance between two screw holes, needing medialisation of screws which do not let the locking mechanism to work. The authors recommended manufacture and use of smaller plates for smaller individuals.

Keywords: anterior locked cervical plating

Introduction

The anterior cervical plating is one of the major step in achieving fusion in anterior cervical spine surgeries for various pathologies ranging from trauma, acute cervical disc prolapse, chronic compression arising out of disc prolapsed, ossification of posterior longitudinal ligament, tumours or tuberculosis^[1, 2]. The author has performed approximately 100 anterior cervical spine fusion surgeries in last five years and in 20 of these cases, the author has failed in locking the plate posing risk of failure in these fixations.

The anatomical reasons for this high number of failure in locking the plate was studied by involving the anatomist for assisting in revisiting the anatomical parameters needed for anterior cervical spine fixation.

Material Method

The body of the typical cervical spine vertebrae were morphometrically studied for anterior width of the vertebral body on which the cervical plate is placed.

The cervical spine locking plates were collected from various suppliers and the following dimensions of the plate were noted

The maximum width of the plate
 Distance between the two screws.

The dimensions of the typical bodies of cervical spine vertebrae were matched with the vertebrae having transverse width less than the cervical spine plate and the trajectory of the intended screw was assessed.

Observations and discussion

We had 32 vertebral bodies of typical cervical vertebrae to study. We collected cervical spine plates from six different manufacturers to study.

The width of the anterior cervical vertebrae is as tabulated below:

Table 1: Width of the anterior cervical vertebrae

Anterior width of vertebra (mm)	9	10	11	12	13	14	15	16	17	18
Number of vertebrae	1	1	1	7	5	9	3	4	0	1

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Table 2: Outer width of cervical plate

Outer maximum width of plate (mm)	16	17	18
Number of plates	1	2	3



Fig 1: Different plates with scale

Table 3: Distance between two screw holes

Distance between two screw holes(mm)	11	12	13
Number of plate	1	3	2

The anterior width of the body of cervical spine vertebrae is the gently convexed surface which provides the attachment for anterior longitudinal ligament. Lateral to the attachment of the anterior longitudinal ligament is the anterior lateral surface of the body which provides attachment to the longus colli muscle. Medial portion of the longus colli attachment needs slight erasing to have more vertebral body surface available for screw placement.

We placed the 16, 17, and 18 mm wide plates at the anterior surface of typical cervical vertebrae. The needed trajectory for the purchase of the screw in the vertebral body was assessed. The smaller the body, more medial inclination was needed to avoid lateral perforation of vertebral body or slipping of the screw laterally. On placing the screw tangentially, the screw head stayed prouder than the plate surface. The locking mechanism need the cam to be rotated 180 degree for locking mechanism to act. The cam can rotate only if the hinderance from screw head is not there. Once the screw is prouder than the plate, the cam cannot move over the screw head and hence cannot lock the plate. The unlocked screw is at the risk of backing out.



Fig 2, 3: Plate position and screw Trajectory



Fig 4: Cam rotated over screw heads

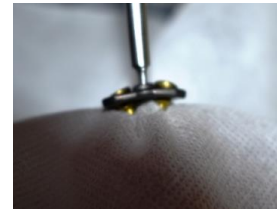


Fig 5: Inability of cam to rotate over proud screws

This problem of prouder screw at plate screw interface was not there if the screw is put straight without angulating it medially, but the smaller vertebral bodies necessitates screws medialisation.

From this study we could understand the reason for incidence of slippage of screws laterally. These screws were medialised and in them there erupted the problem of proud screw heads at plate screw interval, not allowing the locking mechanism to work. The incidence of failure to lock matched with the corresponding smaller number of vertebrae as we have 10 out of 32 vertebrae be smaller than the distance between the two screws which was less in only in one with width of 11 mm where as in 5 other kinds of plates the distance was 12 and 13 mm.

Considering this mismatch and compulsive medialisation of screws for avoiding lateral slippage or lateral perforation, it is proposed that for the smaller vertebrae of the patients of this region the surgeons should have availability of smaller plates whose width corresponds to the width vertebral bodies. With this change the incidence of failure in locking can be avoided.

The various published studies has reported the transverse distance of the bodies to be ranging from 14.3 mm to 22 mm, but in our study the transverse width has been from 9 mm to 18 mm [3, 4, 5]. The major reason for having smaller dimensions is because we have included the area anteriorly available for plate positioning, the maximum transverse distance and not the maximum width of vertebra at base of the body [6].

The limitation of this study is the smaller number of the dry human vertebrae which were available with us for the study and the same study will be revalidated with more number of vertebrae as well as with the morphometric values drawn with the help of CT scan.

Conclusion

This study will be of value to the implant manufacturers as well as to the surgeons operating upon the anterior cervical spine to modify their approach and implant accordingly for better fixation and avoiding the risks associated with failure to lock the anterior cervical plate.

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