

Case Report

Spontaneous C1 anterior arch fracture as a postoperative complication of foramen magnum decompression for Chiari malformation type 1

Yoshitaka Hirano, Atsushi Sugawara¹, Junichi Mizuno, Masaaki Takeda, Kazuo Watanabe, Kuniaki Ogasawara¹

Center for Spine and Spinal Cord Disorders, Southern Tohoku General Hospital, 1-2-5, Satonomori, Iwanuma, Miyagi 989-2483, ¹Department of Neurosurgery, Iwate Medical University, 19-1, Uchimarui, Morioka, Iwate 020-8505, Japan

E-mail: *Yoshitaka Hirano - mth10yhirano@flute.ocn.ne.jp; Atsushi Sugawara - asuga@iwate-med.ac.jp; Junichi Mizuno - mizuno@minamitohoku.jp; Masaaki Takeda - mstktkd1972@nifty.com; Kazuo Watanabe - dr-kazu@mt.strins.or.jp; Kuniaki Ogasawara - kuogasa@iwate-med.ac.jp

*Corresponding author

Received: 12 May 11

Accepted: 14 September 11

Published: 12 October 11

This article may be cited as:

Hirano Y, Sugawara A, Mizuno J, Takeda M, Watanabe K, Ogasawara K. Spontaneous C1 anterior arch fracture as a postoperative complication of foramen magnum decompression for Chiari malformation type I. *Surg Neurol Int* 2011;2:138.

Available FREE in open access from: <http://www.surgicalneurologyint.com/text.asp?2011/2/1/138/85979>

Copyright: © 2011 Hirano Y. This is an open-access article distributed under the terms of the Creative Commons Attribution License, which permits unrestricted use, distribution, and reproduction in any medium, provided the original author and source are credited.

Abstract

Background: C1 fracture accounts for 2% of all spinal column injuries and 10% of cervical spine fractures, and is most frequently caused by motor vehicle accidents and falls. We present a rare case of C1 anterior arch fracture following standard foramen magnum decompression for Chiari malformation type 1.

Case Description: A 63-year-old man underwent standard foramen magnum decompression (suboccipital craniectomy and C1 laminectomy) under a diagnosis of Chiari malformation type 1 with syringomyelia in June 2009. The postoperative course was uneventful until the patient noticed progressive posterior cervical pain 5 months after the operation. Computed tomography of the upper cervical spine obtained 7 months after the operation revealed left C1 anterior arch fracture. The patient was referred to our hospital at the end of January 2010 and C1–C2 posterior fusion with C1 lateral mass screws and C2 laminar screws was carried out in March 2010. Complete pain relief was achieved immediately after the second operation, and the patient resumed his daily activities.

Conclusion: Anterior atlas fracture following foramen magnum decompression for Chiari malformation type 1 is very rare, but C1 laminectomy carries the risk of anterior arch fracture. Neurosurgeons should recognize that fracture of the atlas, which commonly results from an axial loading force, can occur in the postoperative period in patients with Chiari malformation.

Key Words: Anterior atlas fracture, C1 laminectomy, C1–C2 posterior fusion, Chiari malformation type 1, foramen magnum decompression

Access this article online

Website:
www.surgicalneurologyint.com

DOI:
10.4103/2152-7806.85979

Quick Response Code:



INTRODUCTION

C1 fracture accounts for 2% of all spinal column injuries and 10% of cervical spine fractures,^[3,5] and is

most frequently caused by motor vehicle accidents and falls. C1 anterior arch fracture probably results from the flexion force associated with axial loading.^[4] Spontaneous disruption of the C1 anterior arch following

foramen magnum decompression and C1 laminectomy is extremely rare, with only two reported cases to date.^[10] Interruption of the integrity of the C1 posterior arch, iatrogenically or otherwise, was speculated to have increased the risk of C1 anterior arch fracture.^[10]

We present a case of spontaneous C1 anterior arch fracture following standard foramen magnum decompression for Chiari malformation type 1.

CASE REPORT

A 63-year-old man had suffered from dysesthetic pain in his right upper extremity and cough-induced headache for 30 years. He was followed up under a diagnosis of syringomyelia at his local practitioner until he noticed mild motor weakness of his right hand in 2006. He was referred to Iwate Medical University in 2009. A diagnosis of Chiari malformation type 1 with syringomyelia was established. A standard foramen magnum decompression (suboccipital craniectomy and C1 laminectomy) was carried out on 4 June 2009. His postoperative course was uneventful until the patient noticed progressive posterior cervical pain 5 months after the operation. Computed tomography (CT) of the upper cervical spine revealed left C1 anterior arch fracture [Figure 1]. Since preoperative CT showed intact C1, it is evident that the C1 anterior arch fracture has spontaneously developed following foramen magnum decompression with C1 laminectomy. The patient was referred to our hospital at the end of January 2010. Cervical radiography showed slight instability at the C1–C2 level [Figure 2]. C1–C2 posterior fusion was carried out in March 2010. Bilateral C2 crossing laminar screws were first inserted with the assistance of a navigation system (Stealth Station; Medtronic Sofamor Danek, Memphis, Tennessee, USA).

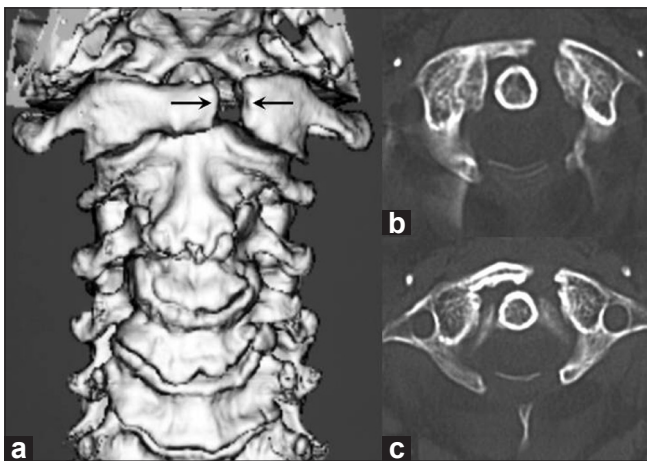


Figure 1: Computed tomography scans of the upper cervical spine obtained 7 months after the initial operation revealing left C1 anterior arch fracture. (a) Three-dimensional computed tomography scan clearly demonstrating the anterior atlas fracture (arrows), and (b, c) consecutive axial computed tomography scans of the C1 showing that the translation is about 5 mm

We considered crossing laminar screws for C2 to be safer for this patient because of the narrow passage of bilateral C2 pedicles. C1 lateral mass screws were then inserted under fluoroscopic guidance. The screws at C1 and C2 were connected with rods combined with lateral offset at the left and right sides, respectively (VERTEX-MAX system; Medtronic Sofamor Danek). Beta-tricalcium phosphate granules^[2,8] mixed with local bone chips were placed between the lateral masses of C1 and C2 for better bony fusion [Figure 3]. Postoperative studies showed adequate placement of the implants with good cervical alignment and stability [Figure 4]. Complete pain relief was achieved immediately after the second operation, and the patient resumed his daily activities as a tobacco farmer.

DISCUSSION

The present case is the third reported case of the anterior atlas fracture following foramen magnum decompression for Chiari malformation type 1. The previous two cases^[10] are similar to ours in terms of development of the symptom: progression of posterior neck pain several months after posterior decompression surgery. Postoperative pain around the nuchal region is a common symptom of patients with Chiari malformation, but pain induced by motion should be carefully investigated, since this may indicate instability. Regular follow-up cervical radiography including flexion and extension studies is essential. Additional CT or magnetic resonance imaging examinations should be considered in patients with symptomatic instability at C1 and C2 for evaluation of bony and ligamentous abnormalities.

The mechanism causing postoperative spontaneous fracture of the C1 anterior arch remains unclear, but we suspect that an excessive axial load force was transmitted to the C1 anterior arch due to the lack of the C1 posterior arch and its associated musculoligamentous structures following foramen magnum decompression

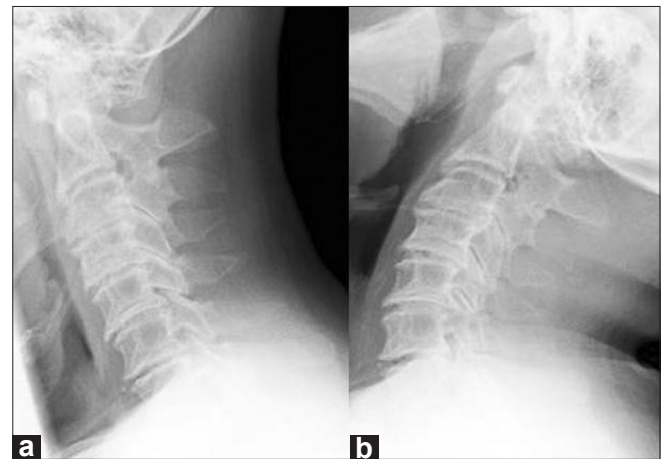


Figure 2: Lateral cervical radiographs (a: flexion, b: extension) showing slight instability at C1–C2. The atlanto-dental interval is 3 mm at flexion and reduced at extension

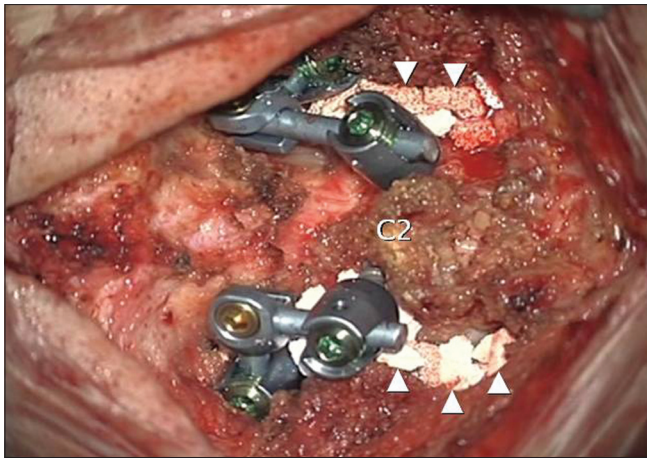


Figure 3: Final operative view of the C1–C2 posterior fusion. Bilateral C1 lateral mass screws and C2 crossing laminar screws are connected to rods with lateral offset. Beta-tricalcium phosphate granules (arrowheads) combined with local bone chips are placed between the lateral masses of C1 and C2

and C1 laminectomy. Similarly, in the case of an anterior bifid anomaly of C1, C1-sparing foramen magnum decompression or posterior decompression with fusion should be considered.^[1] Standard surgical tactics for Chiari malformation include suboccipital craniectomy of 3 cm by 3 cm and C1 laminectomy,^[9] which were performed in this case as well. The length of bed rest or the type of external orthosis might have led to the development of C1-2 instability, resulting in C1 anterior arch fracture. Disruption of the posterior arch is very likely to be involved in the development of the anterior arch fracture, but other unknown factors may also be important.

The C2 crossing laminar screw is a useful device in posterior cervical fusion. A biomechanical comparison of C2 crossing laminar screws with transarticular or pedicle screws has demonstrated equivalent rigidity in flexion, extension, and rotation.^[6] Use of the C2 crossing laminar screw is a newer technique and further study is required before widespread implementation,^[7] but the technique is straightforward and carries little risk of injury to the neural and vascular structures.^[11,12] Navigation systems are widely available nowadays and seem to be almost indispensable for inserting the crossing laminar screws into the most appropriate position.

In conclusion, C1 laminectomy may carry the risk of developing postoperative spontaneous C1 anterior arch fracture, although the incidence is very low. Neurosurgeons should recognize that fracture of the atlas, which commonly results from an axial loading force, can occur in the postoperative period in patients with Chiari malformation.

ACKNOWLEDGMENTS

The authors express their sincere gratitude to Professor Satoshi

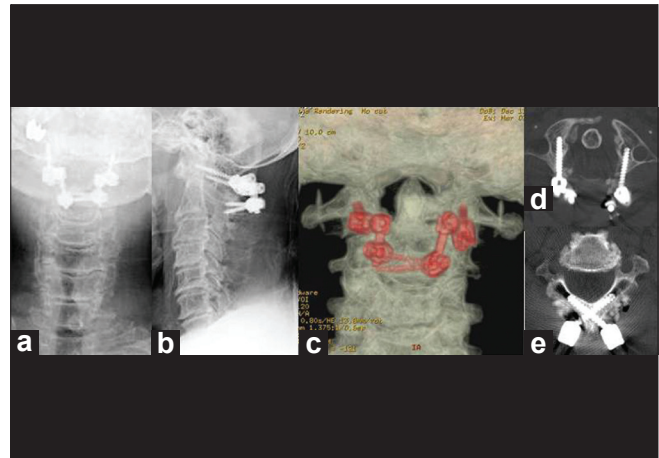


Figure 4: Postoperative cervical radiographs (a: antero-posterior view, b: lateral neutral view) showing adequate placement of the implants with good cervical alignment. (c) Three-dimensional computed tomography scan showing the overview of the implants. Axial computed tomography scans at (d) C1 and (e) C2 demonstrating appropriately inserted C1 lateral mass screws and C2 laminar screws

Tani, M.D. (Department of Neurosurgery, The Jikei University School of Medicine) and Professor Kazutoshi Hida, M.D. (Department of Neurosurgery, Hokkaido University Graduate School of Medicine) for advanced discussion on this patient.

REFERENCES

- Ahmed R, Traynelis VC, Menezes AH. Fusions at the craniovertebral junction. *Childs Nerv Syst* 2008;24:1209-24.
- Epstein NE. Beta tricalcium phosphate: Observation of use in 100 posterolateral lumbar instrumented fusions. *Spine J* 2009;9:630-8.
- Fowler JL, Sandhu A, Fraser RD. A review of fractures of the atlas vertebra. *J Spinal Disord* 1990;3:19-24.
- Klein GR, Vaccaro AR. Cervical spine trauma: upper and lower. In: Vaccaro AR, Betz RR, Zeidman SM, editors. *Principles and Practice of Spine Surgery*. Philadelphia, PA: Mosby; 2003:441-462.
- Landells CD, Van Peteghem PK. Fractures of the atlas: Classification, treatment and morbidity. *Spine (Phila Pa 1976)* 1988;13:450-2.
- Lapiswala SB, Anderson PA, Oza A, Resnick DK. Biomechanical comparison of four C1 to C2 rigid fixative techniques: anterior transarticular, posterior transarticular, C1 to C2 pedicle, and C1 to C2 interlaminar screws. *Neurosurgery* 2006;58:516-21.
- Menendez JA, Wright NM. Techniques of posterior C1-C2 stabilization. *Neurosurgery* 2007;60(1 Suppl 1):S103-11.
- Ohyama T, Kubo Y, Iwata H, Taki W. Beta-tricalcium phosphate as a substitute for autograft in interbody fusion cages in the canine lumbar spine. *J Neurosurg* 2002;97(3 Suppl):350-4.
- Okuda Y, Hida T, Isoshima A, Nagashima H, Tani S, Abe T. Variation of foramen magnum decompression for the treatment of syringomyelia determined by intraoperative CSF flow dynamics study. In: Tamaki N, Batzdorf U, Nagashima T, editors. *Syringomyelia Current Concepts in Pathogenesis and Management*. Tokyo, Japan: Springer-Verlag; 2001. p. 180-7.
- O'Shaughnessy BA, Salehi SA, Ali S, Liu JC. Anterior atlas fracture following suboccipital decompression for Chiari I malformation – report of two cases. *J Neurosurg Spine* 2004;1:137-40.
- Wang MY. C2 crossing laminar screws: Cadaveric morphometric analysis. *Neurosurgery* 2006;59(1 Suppl 1):ONS84-8.
- Wang MY. Cervical crossing laminar screws: Early clinical results and complications. *Neurosurgery* 2007;61(5 Suppl 2):311-6.