SURGICAL OUTCOME OF OCCIPITOCERVICAL FIXATION FOR CRANIOCERVICAL INSTABILITY

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ABSTRACT

OBJECTIVES

To evaluate the efficacy of Occipitocervical Fixation (OCF) in patients with craniocervical instability in two tertiary care hospitals.

METHODOLOGY

This retrospective case series study was conducted at Hayatabad Medical Complex, Peshawar, from April 2017 to December 2020. A non-probability sampling technique was used, and size was calculated via online software with a 95 % confidence level and 5% margin of error. All patients with craniocervical instability were included in our study, and those having occipital bone fractures or previously operated patients with the same technique were excluded from the study. The Nurick score was used to assess neurological function pre-and postoperatively. The demographic details of the patients, clinical features, radiographic findings (pre- and postoperative), and clinical outcomes using the Nurick myelopathy grading system were noted and entered into a structured proforma. All data were entered into SPSS Version 18 and analyzed. The results were presented in tables and pictures.

RESULTS

A total of 26 cases with craniocervical instability underwent OCF. The mean age of the patients was 40.5 $\pm$ 1.2 SD years. There were 10 male patients and 16 female patients. The majority of patients showed improvements in myelopathic symptoms after the operation. The mean preoperative Nurick score was 3.0. At the end of follow-up after surgery, the mean Nurick score was 2.1. There was a total of 7(14.28%) cases having complications, of which 4 (8.16%) patients had wound infection, 2 (4.08%) patients had implant failure, and 1(2.04%) had vertebral artery injury. However, no postoperative neurological deficit was observed.

CONCLUSION

Occipitocervical fixation is a reasonable option to have spinal stability, achieve bone fusion and get neurological improvement. Certain conditions complicate the procedure, but experienced hands can safely handle these.

KEYWORDS: *Craniocervical Instability, Occipitocervical Fusion, Nurick Grading System*

INTRODUCTION

The occipitocervical junction Instability is a well-known neurosurgical condition in which there may be severe suboccipital pain or neurological symptoms and signs due to compression of the spinal cord or medulla oblongata leading to progressive functional disability.[1] The surgical approach to this region is challenging due to complex bony and soft tissue anatomy. Craniocervical region instability may be congenital, traumatic, inflammatory, i.e. rheumatoid arthritis, infective, degenerative or due to malignancy involving the upper cervical spine.[2] The surgical intervention aims to restore spinal alignment, decompress neural tissue and achieve bony fusion. Various surgical procedures are in the armamentarium of spine surgeons to treat this pathology, as until this date, no uniformity exists in treating this pathology. One of the best ways to treat this condition is occipitocervical fusion (OCF), in which both bony fusion and instrumental fixation are done. The purpose of OCF is to give stability to occipitocervical junction, reduce displacement, correct the deformity and decompress neural structures. Instrumental fixation gives immediate mechanical stability, improves bony fusion rate, decreases postoperative external immobilization requirements, and shortened rehabilitation time is also shortened.[1] Various techniques of OCF, such as screw-rod, occipitocervical hook and wiring, are currently available, and they all have been shown to have high fusion rates (89-100%).[3,4,5,6,7] Screw-rod fixation allows for strong biomechanical fixation and gives immediate stability after surgery However, like any surgical procedure, certain complications may also occur during OCF, which include vertebral artery injury, dural tear causing cerebrospinal fluid (CSF) leakage, wound infection, injury to neural tissue, implant failure and failure of bony fusion.[2,8,9] Occipitocervical fusion for craniocervical instability is a challenging procedure performed in very few centres in Pakistan. In addition, this procedure needs a highly equipped Operation theatre and expert Neurosurgeon. It aims to observe its outcome, compare results with national and international studies, and suggest its usefulness.

METHODOLOGY

We retrospectively reviewed a series of consecutive patients with craniocervical instability in the neurosurgery department of Hayatabad Medical Complex Peshawar from April 2017 to December 2020. A non-probability purposive sampling technique was used, and the sample size was calculated via online software with a 95% confidence level and 5% margin of error. All patients having craniocervical instability who underwent occipital cervical fusion using rod and screw construct were included in our study. Patients having occipital bone fractures or previously operated patients with the same technique were excluded from this study. Lateral static and dynamic X-rays were taken in all patients before the operation, after the operation and during the last follow-up. We retrospectively reviewed all charts/files for demographic profiles and pre-and postoperative assessments of neurologic status. All data were entered into SPSS Version 18 and analyzed. The results were presented in tables and pictures. The surgery was performed with the patient in the prone position. A midline incision was given in all patients, from the external occipital protuberance to the desirable cervical area. After adequate exposure of the suboccipital and posterior cervical areas, occipital screws and plate and either C2 pedicle screws or C3, 4, and 5 lateral mass screws were placed. Rod fixation was then performed. Decompression was done as needed. The patients were observed for postoperative complications in early and late follow-up periods.

RESULTS

A total of 26 cases with craniocervical instability underwent OCF. The mean age of the patients was 40.5 ±1.2 SD years.

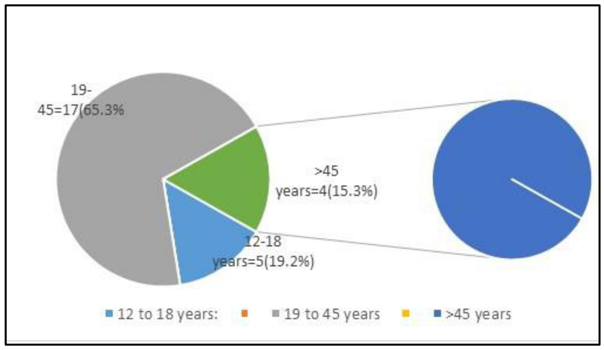

Figure 1: Age Distribution

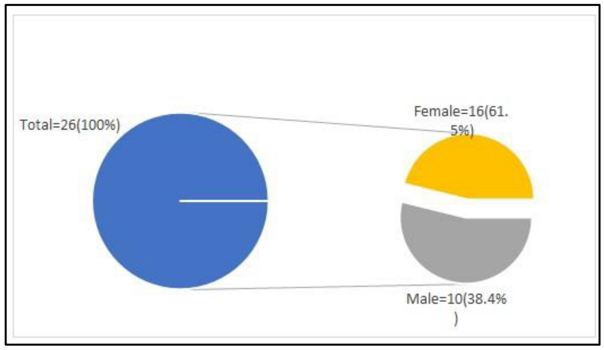

Figure 2: Gender Distribution

Figure 3: Operative and Postoperative X-Ray of Implants

Table 1: Shows the Various Etiologies of Craniocervical Patients

Etiology	No	%age
Trauma	16	61.5
Degenerative spine	04	15.3
Basilar invaginations	03	11.5
Os Odontoideum	02	7.6
Rheumatoid Arthritis	01	3.84

Most patients showed improvements in myelopathy symptoms after the operation, i.e. n=43(87.75%). The mean preoperative Nurick score was 3.0. At the end of follow-up after surgery, the mean Nurick score was 2.1. Neck pain was relieved in 45 (91.83%) patients after bony fusion. Various clinical presentations are given in Table 2.

Table 2: Clinical Presentation

Presentation	No	%age
Preoperative Neck pain	21	80.7%
Cranial nerve deficits	05	19.2%
Motor problems	Unstable gait	20
	Cranial nerve deficits	05
	Shoulder drop	02
	Sphincters	01
Parasthesias	08	30.7%

Surgical complications

Various complications occurred in 7(14.28%) cases. 4 (8.16%) patients had wound infection, 2 (4.08%) patients suffered implant failure, and 1(2.04%) had vertebral artery injury. However, no postoperative neurological deficit was observed. Figure 2: show some of the complications.

Figure 4: Broken C2 Pedicle Screw and the Occipital Screw Pulls Out and Wound Infection After OCF

DISCUSSION

Foerster, in 1927, was the first person to report OCF and use nasal bone as a graft. A great deal of modification has occurred since then regarding implant use and graft source.[10] Various etiological factors cause craniocervical instability through various mechanisms. Os odontoideum forms a separate bone structure due to abnormal fusion between the odontoid process of the second cervical vertebra and the body. Without a united odontoid process, the atlanto axial movements appear to be supported only by ligaments, resulting in atlantoaxial instability.[11] According to some authors, in minimally symptomatic or asymptomatic patients with Os odontoideum without C1-2 instability, good treatment outcomes can be obtained using conservative management without surgical treatment.[12,15] Rheumatoid arthritis of the cervical spine leads to a spectrum of joint erosions and deformities resulting in spinal stability.[16,17,18,19] Atlanto-occipital dislocation is another indication of OCF because it can lead to death without treatment.[1,20] Craniovertebral tuberculosis may lead to Atlanto axial dislocation or bone destruction and granulation, which may require anterior decompression and posterior fusion.[21,22] Occipitocervical fixation has been done in all our study populations with or without decompression. Improvement in the myelopathy symptoms can be seen in most of the patients enrolled in the study population. Most patients show improvement in myelopathy symptoms after the operation, i.e. n=43(87.75%). The mean preoperative Nurick score is 3.0. At the end of follow-up after surgery, the mean Nurick score is 2.1. Neck pain subsided in 45 (91.83%) patients after bony fusion in our study. Choi SH[9] reported in his research improvements in myelopathy symptoms in 68.8% (11/16) of the subjects using the Nurick score, and sensory symptoms were reduced by 78-95% in patients who showed bone fusion.[4,6,23] This surgical procedure to produce bony fusion and to achieve good functional outcomes can be complicated by infection (superficial and deep), dural tear, CSF leakage, screw failure, vascular injury and failure to relieve patient symptoms.[3,4,6] Wound infection in posterior spinal surgery has been relatively more common than in anterior cervical surgery. In the present study, 4 (8.16%) patients suffered wound infection. We treated all these patients conservatively; no revision was required. We noticed that three out of these 4 patients were previously operated on for the same instability in a different way, but due to failure of treatment, we reoperated them. However, the scarred skin in the occipital region is weakly protected against infection. A study by Choi SH reported 13.3% (2/16) infection in their study.[9] In other studies, wound infection was 11% (1/9) and 3.8% (1/26).[6,23] In both these studies, they treated infection with antibiotics without removing implants. We see implant failure in two 2 (4.08%) patients. This was probably due to a scanty amount of graft placement. In the literature review, we observe implant failure in various frequencies, e.g. it was 7% (1/16) in one study and 4.2% (1/24) in another study.[4] Choi SH reported screw failure in 12.5% (2/16) of the subjects and screw loosening in 6.3% (1/16).[23,9] The thickness of screw purchase has got a significant role in occipital screw pullout strength. Likewise, the pullout strength of a bicortical screw purchase is 50% more than unicortical screw purchase.[24] Vertebral artery injury while passing a C2 pedicle screw or C1C2 trans articular screw fixation is a well-recognized complication, and various authors have reported various ranges. In our study, 1(2.04%) patient had vertebral artery injury, which we came across while dissection around CV2. We controlled it with pressure and did not proceed with a pedicle screw on this side. A subsequent angiogram revealed no issue with vertebral artery anatomy. The incidence of vertebral artery injury was 6.3% in the Choi SH[9] report, slightly higher than ours, but their study population is less than ours. True incidence requires more extensive studies with big cohorts. Our study did not find any persistent CSF leak after surgery, though literature has quoted it in the range of 25-28% in some studies.[4,6] The craniocervical instability is a treatable surgical entity. However, the best type of surgery largely depends on the instability type, the status of posterior cervical elements, the amount of decompression, the general condition of the patient, anatomical variation and the surgeon's experience with a particular approach. Our study has few patients and arrives at the best surgical treatment. More studies are needed to recommend any specific surgical approach for any specific disorder of the craniocervical junction causing instability and neurological complications.

LIMITATIONS

It was confined to a limited number of patients with a short follow-up period. Secondly, only Hayatabad Medical Complex was taken as the study place. Including other hospitals from the same locality could have given a better idea about this procedure's effectiveness.

CONCLUSIONS

Occipitocervical fusion is a reasonable option to have stability, achieve bony fusion, decompress neural tissues, and achieve a good functional outcome. Most of the complications can be managed safely by experienced hands.

CONFLICT OF INTEREST: None

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REFERENCES

1. Vaccaro AR, Lim MR, Lee JY. Indications for surgery and stabilization techniques of the occipital-cervical junction. 2019; 36 Injury Suppl 2:B44-53.
2. Ando K, Imagama S, Ito Z, Kobayashi K, Yagi H, Shinjo R, et al. Minimum 5-year follow-up results for occipitocervical fusion using the screw-rod system in craniocervical instability. Clin Spine Surg. 2017; 30: E628–32.
3. Joaquim, AF, Tedeschi, H, Chandra, PS. Controversies in the surgical management of congenital craniocervical junction disorders-a critical review. Neurol India. 2018; 66: 1003–1015.
4. Martinez-del-Campo E, Turner JD, Rangel-Castilla L, Soriano-Baron H, Kalb S, Theodore N: Pediatric occipitocervical fixation: radiographic criteria, surgical technique and clinical outcomes based on experience of a single surgeon. J Neurosurg Pediatr 2016;18: 452-462.
5. Goel A, Sathe P, Shah A. Atlantoaxial fixation for basilar invagination without obvious atlantoaxial instability (group b basilar invagination): outcome analysis of 63 surgically treated cases. World Neurosurg 2017; 99: 164-70.
6. Yi HJ, Hong JT, Lee JB, et al. Analysis of risk factors for posterior C1 screw-related complication: a retrospective study of 358 posterior C1 screws. Open Neurosurg (Hagerstown) 2019; 17: 509-17.
7. Motosuneya T, Hirabayashi S, Yamada H, Sakai H. Occipitocervical fusion using a hook and rod system between cervical levels C2 and C3. Journal of clinical neuroscience: official journal of the Neurosurgical Society of Australasia. 2019; 16(7):909-13.
8. Cunningham BW, Mueller KB, Mullinix KP, Sun X, Sandhu FA. Biomechanical analysis of occipitocervical stabilization techniques: emphasis on integrity of osseous structures at the occipital implantation sites. Journal of Neurosurgery: Spine. 2020 Apr 10;33(2):138-47.
9. Upadhyaya M, Jain S, Kire N, Merchant Z, Kundnani V, Patel A. Surgical, clinical, and radiological outcomes of occipitocervical fusion using the plate–screw–rod system with allograft in craniocervical instability. Journal of Craniovertebral Junction & Spine. 2019 Oct;10(4):216.
10. Meynard A, Fréchède B, Pommier B, Mitton D, Barrey C. Biomechanical Comparison of Facet Versus Laminar C2 Screws. Neurosurgery. 2023 Oct 1;93(4):910-7.
11. Shasti M, Moshirfar A, Gum JL, Jazini E. Occipitocervical fusion: A review and current concepts. InSeminars in Spine Surgery 2020 Mar 1 (Vol. 32, No. 1, p. 100783). WB Saunders.
12. Clements WD, Mezue W, Mathew B. Os odontoideum--congenital or acquired?--that's not the question. Injury. 2015;26(9):640-2.
13. Goel A, Patil A, Shah A, Dandpat S, Rai S, Ranjan S. Os odontoideum: analysis of 190 surgically treated cases. World neurosurgery. 2020 Feb 1;134:e512-23.
14. Cho S, Shlobin NA, Dahdaleh NS. Os odontoideum: A comprehensive review. Journal of Craniovertebral Junction & Spine. 2022 Jul;13(3):256.
15. Helenius IJ, Bauer JM, Verhofste B, Sponseller PD, Krengel WF, Hedequist D, Cahill PJ, Larson AN, Pahys JM, Anderson JT, Martus JE. Os odontoideum in children: treatment outcomes and neurological risk factors. JBJS. 2019 Oct 2;101(19):1750-60.
16. Boden SD, Dodge LD, Bohlman HH, Rechtine GR. Rheumatoid arthritis of the cervical spine. A long-term analysis with predictors of paralysis and recovery. The Journal of bone and joint surgery American volume. 2018;75(9):1282-97.
17. Shlobin NA, Dahdaleh NS. Cervical spine manifestations of rheumatoid arthritis: a review. Neurosurgical Review. 2021 Aug;44(4):1957-65.
18. Clark CR, Keggi KJ, Panjabi MM. Methylmethacrylate stabilization of the cervical spine. The Journal of bone and joint surgery American volume. 2014;66(1):40-6.
19. Fields MW, Lee NJ, Hong DY, Para A, Boddapati V, Mathew J, Kim JS, Lombardi J, Lehman RA, Riew KD. Cervical spinal fusion in adult patients with rheumatoid arthritis: A national analysis of complications and 90-day readmissions. Spine. 2021

Jan 1;46(1):E23-30.
20. Chang DG, Park JB, Song KJ, Park HJ, Kim WJ, Heu JY. Traumatic atlanto-occipital dislocation: analysis of 15 survival cases with emphasis on associated upper cervical spine injuries. Spine. 2020 Jul 1;45(13):884-94.
21. Qureshi MA, Afzal W, Khalique AB, Pasha IF, Aebi M. Tuberculosis of the craniovertebral junction. European spine journal: official publication of the European Spine Society, the European Spinal Deformity Society, and the European Section of the Cervical Spine Research Society. 2013;22 Suppl 4:612-7.
22. Lal AP, Rajshekhar V, Chandy MJ. Management strategies in tuberculous atlanto-axial dislocation. British journal of neurosurgery. 2018;6(6):529-35.
23. Abumi K, Takada T, Shono Y, Kaneda K, Fujiya M. Posterior occipitocervical reconstruction using cervical pedicle screws and plate-rod systems. Spine. 2016;24(14):1425-34.
24. Haher TR, Yeung AW, Caruso SA, Merola AA, Shin T, Zipnick RI, et al. Occipital screw pullout strength. A biomechanical investigation of occipital morphology. Spine. 2017;24(1):5c-C9.

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2. ***Shahid Ayub –*** *Critical Revision; Supervision; Final Approval*