Surgical Outcome of Occipitocervical Fixation for Craniocervical Instability

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ABSTRACT

Background: The occipitocervical junction is a unique area between the cranium and the upper cervical spine. Treating pathologies of this region require a good knowledge and understanding of the anatomy, biomechanics of this region and nature of the disease.

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

Material and Methods: This study was conducted at Combined Military Hospital Rawalpindi and Hayatabad Medical Complex, Peshawar from April 2005 to December 2016. All patients with craniocervical instability were included in our study, and those having occipital bone fractures or previously operated patients with same technique were excluded from the study. All patients were compared using lateral static and dynamic X-ray taken before the operation, after the operation, and during last follow-up. The Nurick score was used to assess neurological function pre and postoperatively .The surgical outcome evaluation also included development of complications in the postoperative phase or in follow up period. The demographic details of the patients, clinical features, radiographic findings (pre and postoperative) and clinical outcome using Nurick mylopathy grading system were noted and entered into a structured proforma. All data were entered into a SPSS Version 18 and analyzed. The results were presented in tables and pictures.

Results: A total of 49 cases with craniocervical instability underwent OCF. The mean age of the patients was 40.5 $\pm$1.2 SD years. There were 31 male patients and 18 female patients. 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 were total 7(14.28%) cases having complications, in which 4 (8.16%) patients had wound infection, 2 (4.08%) patients implants failure and 1(2.04%) had vertebral artery injury. However no postoperative neurological deficit was observed.

Conclusions: Occipitocervical fixation is a reasonable option to have spinal stability, achieve bone fusion and to get neurological improvement. The procedure can be complicated by certain conditions but these can safely be handled in experience hands.

Keywords: Craniocervical instability, Occipitocervical fusion, Nurick grading system.

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INTRODUCTION

The occipito-cervical junction Instability is well known neurosurgical condition in which there may be severe sub occipital pain or neurological manifestation due to compressive effect on spinal cord or medulla oblongata leading to progressive functional disability[1-3].Surgery of the craniovertebral junction is a difficult surgery due to complex bony and soft tissue anatomy.[4,5] Craniocervical region instability may be congenital, traumatic, inflammatory i.e. rheumatoid arthritis, infective, degenerative or due to malignancy involving the upper cervical Spine.[6-9]

The craniocervical junction is extremely mobile due to the complex articulation between the atlanto-axial joints and occipital condyles.[10,11] The range of motion of rotation, flexion and extension created from the cranio-cervical junction. The rounded anatomical architecture of occipital condyles is responsible for sagittal movement (flexion-extension).[12,13] The atlanto-axial joint complex is responsible mainly for rotatory movement. These joints are further strengthened by various ligaments.[14-16]

The purpose of surgical treatment is to decompress neural tissue & achieve bony fusion. More than one treatment options are available with spine surgeons to fix such problems. The better way to treat this issue is occipitocervical fusion (OCF), where instrumental fixation & bony fusion both are carried out. The aim of OCF is that the occipitocervical junction will be more stable, displacement reduction, deformity treatment and do release neural structures.

Different methods of OCF such as screw-rod, occipitocervical hook and wiring etc, are routinely done, and the success rate is (89-100%)[3-7]. The strong bio-mechanical fixation due to screw rod fixation gives post op early stability.[2,8,9]

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MATERIAL AND METHODS

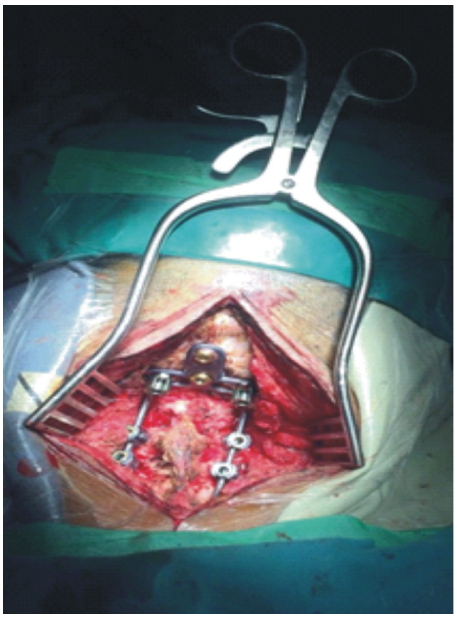
The data of patients with craniocervical instability was reviewed, who presented to Neurosurgery Department Hayatabad Medical Complex Peshawar and Spine Department of Combined Military Hospital Rawalpindi from 3rd April 2005 to 31st December 2016.

The inclusion criteria was, any patient with cranio-cervical instability who underwent occipital cervical fusion using rod and screw construct. All those patients were excluded from the study who had fractures of the occipital bone or who had surgery with the samilar technique. Lateral static and dynamic X-Rays were taken Pre-Operative, post Operative and at the last follow-up. Patients were followed at two weeks in outpatient department for wound complications then followed at 6 weeks, 10 weeks and 6 months for bony fusion and implant failure.

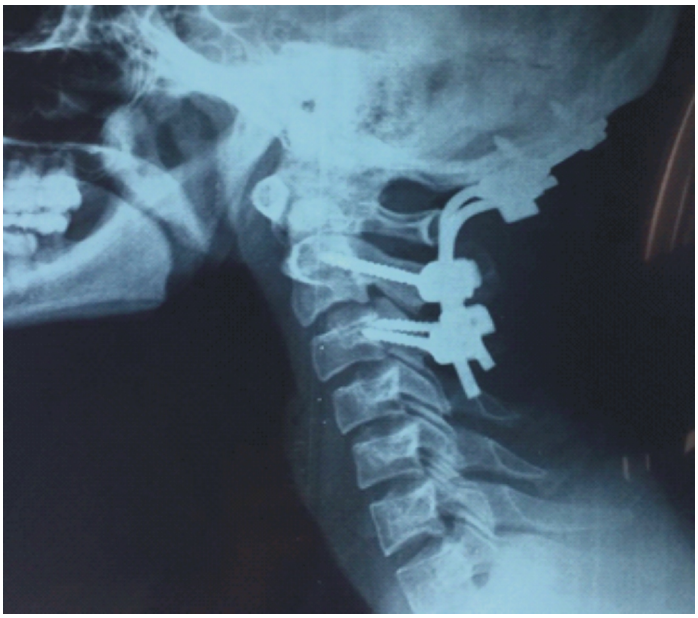
Patient's demographic data was recorded. Detailed clinical examination was performed. Underlying disease process causing instability was recorded. To assess neurological function pre and postoperatively Nurick Scale system was used (Table 1). The data was enterted and analyzed by the latest version of SPSS. The data was wrote down in text, tables, pie charts and graphs.

Surgical & Clinical Management:

During surgery, patient was kept in prone position. Surgical incision was given in midline starting from occipital protuberance to desirable level. After proper opening of the sub occipital and posterior cervical areas, occipital screws, plate and either C2 pedicle screws or C3, 4, 5 lateral mass screws were placed. Rod fixation was then preformed. Decompression was done as per requirement.



Pic 1: Per Operative Look



Pic 2:Post-Op X-Ray

Table 1. Nurick Grading System

Grade	Description
0	Radiculopathy or normal
1	Myelopathy with normal gait.
2	Gait problem but fully employed.
3	Gait problem prevent employement, walks unassisted.
4	Walk with support only.
5	Chair bound or bed ridden.

RESULTS

Occipitive-Cervical fixation was done in 49 patients. Patients mean age was 40.5±1.2years.

Figure 02 and 03 depicts age and gender distribution, respectively.

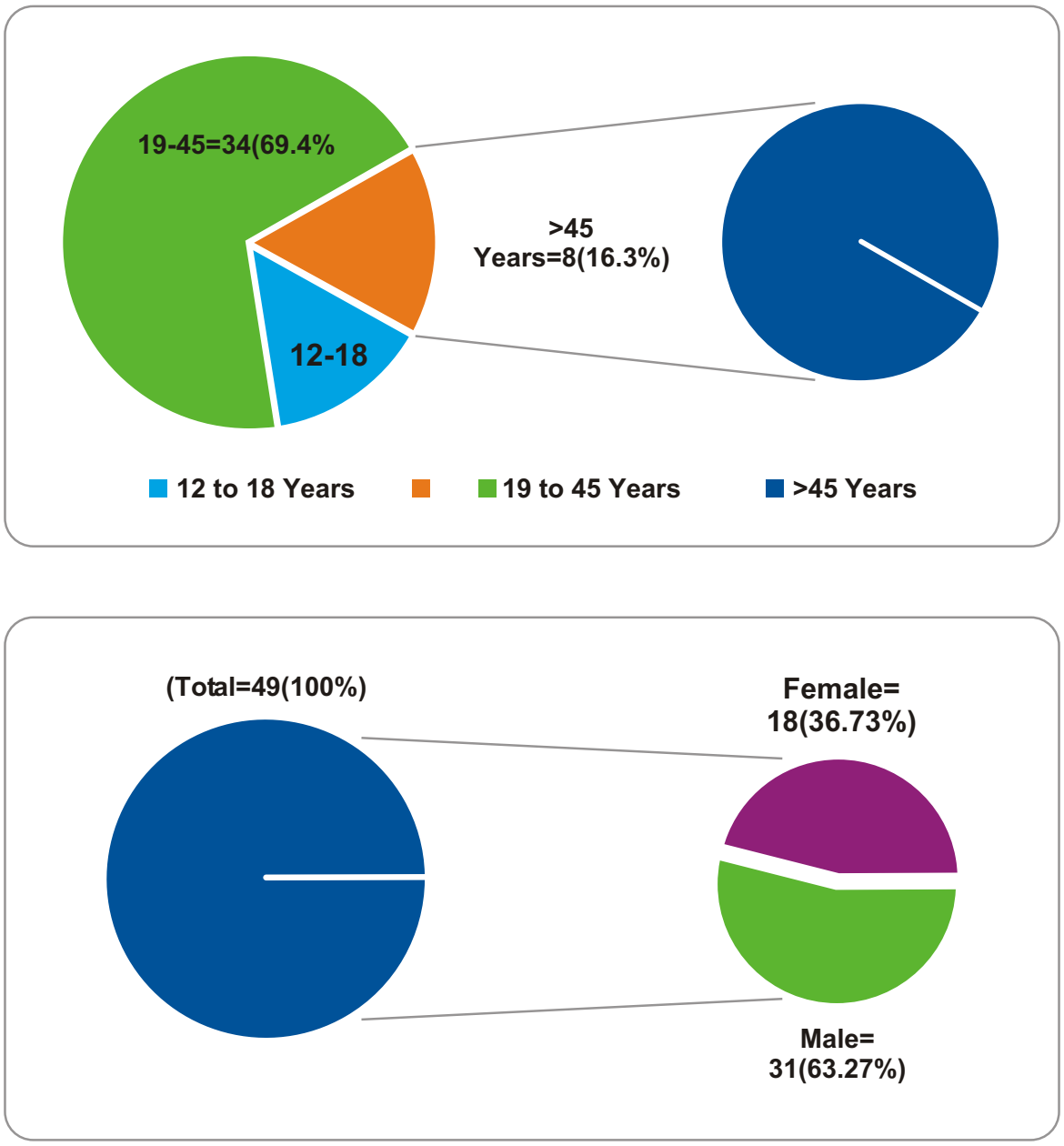
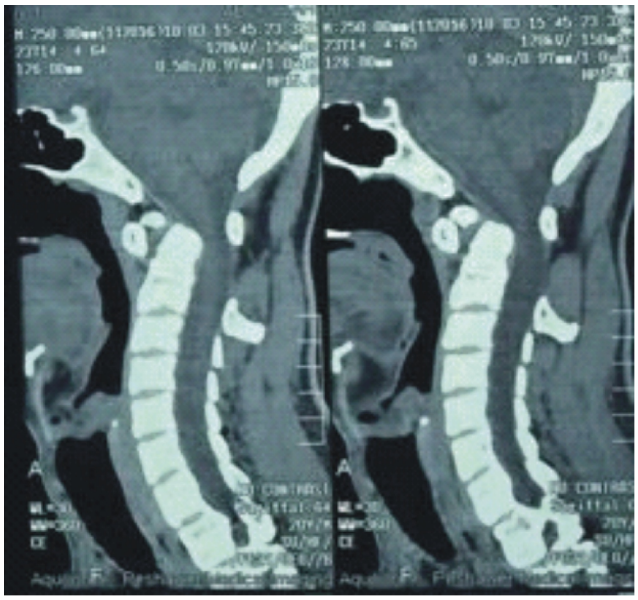


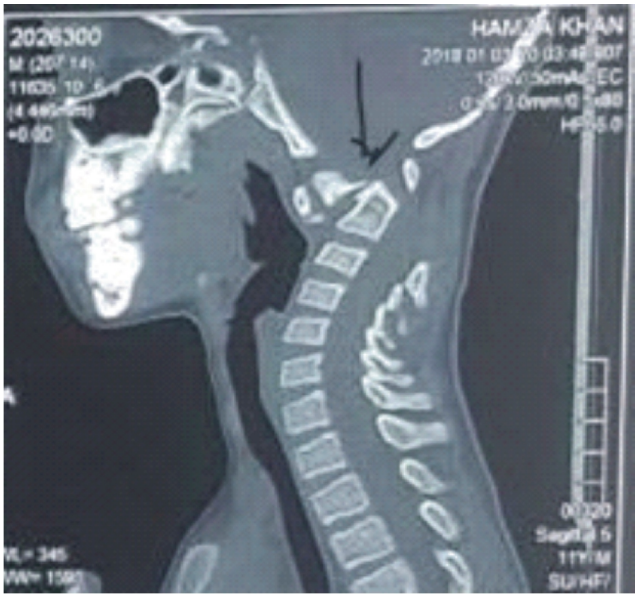
Figure 2 and 3

Out of the total number of patients, female patients were 18 and male were 31, so male to female ratio was 1.72:1.

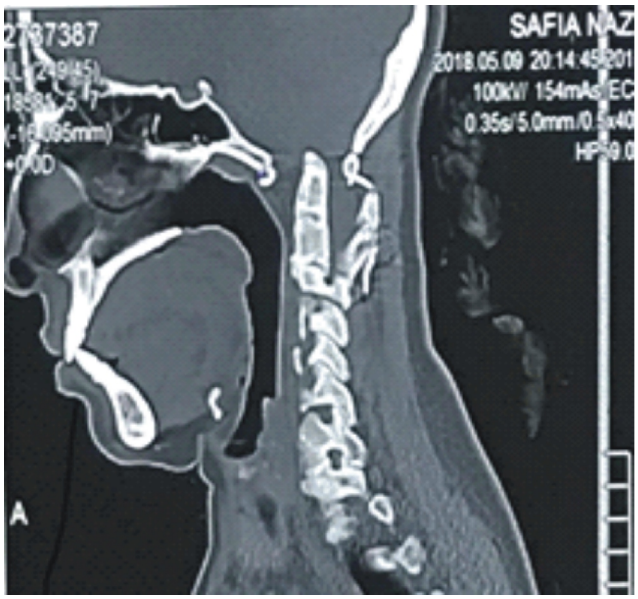
Trauma was the most frequent cause of Cranio-Cervical Instability and was found in 69.39% patients (n-34). Degenerative spine was the second cause and found in 10.2% (n-5) cases. The other uncommon causes were Rheumatoid Athris, Basilar invaginations, tumors, Os odontoideum and tuberculosis. Some causes are shown in picture no 3,4,5,6. Some of the factors involved in causation of cranio-cervical problem are shown in table 02.



Pic no 3=Os odontoidum



Pic 4=Neglected odontoid fracture



Pic 5=Basilar invagination



Pic 6= metastatic tumor

Table No.3: Various etiologies of craniocervical patients.

S. No	Etiology	No	Percentage
1	Trauma	34	69.39%
2	Degenerative spine	5	10.2%
3	Basilar invaginations	4	8.16%
4	Os Odontoideum	3	6.11%
5	Tumors	1	2.04%
6	Rheumatoid Athritis	1	2.04%

Post operatively, most of the patients had improvement in myelopathy symptoms, i-e; 87.75% (n-43). The Pre-operative mean Nurick score was 3.0. At six months follow-up, the mean Nurick score was 2.1. After bony fusion 91.83% (n-45) patients felt relieve in neck pain. Table 02 shows some clinical presentations.

Table No.3: Clinical Presentation

S. No	Presentation		No	Percentage
1	Preoperative Neck pain		42	85.7%
2	Cranial nerve deficits		10	20.4%
3	Motor problems	Unstable gait:	40	81.6%
		Cranial nerve deficits:	10	20.4%
		Shoulder drop:	4	8.2%
		Sphincters:	3	6.1%
4	Parasthesias		16	32.65%

Surgical Complications

Various complications occurred in 14.28% (n-7) cases, wound infection 8.16% (n-4) cases, implants failure in 4.08% (n-2) cases and vertebral artery injury in 2.04% (n-1). Neurological deficit was noted in none of the patient post operatively. Few complications are shown in picture 07 and 08.





Picture 07.Broken C2 pedicle screw and Picture 08. Wound infection after OCF Occipital screw pull out

DISCUSSION

Various etiological factors cause cranio-cervical instability through various mechanisms. Different types of joint erosions and deformity can lead to spinal instability, and one if the reason is rheumatoid arthritis of the cervical spine.[16-19]. Atlanto-occipital dislocation is another reason as well.[17]

Atlanto-axial dislocation or bone destruction may be caused by Cranio-vertebral tuberculosis and may be lead to death, if left untreated. Its fixation by OCF is another indication.[1,20] Anterior decompression and posterior fusion may be required for granulation tissue formation leading to deformity. [21, 22.] Occipito-cervical fixation was done in all our study patients with or without

decompression. All the cases reported feeling good in myopathy complaints. Improvement in myelopathy symptoms after surgery, were noted in 87.75% (n-43). Before surgery the mean preoperative Nurick score was 3.0, and the mean Nurick score was 2.1, after surgery at follow up. In this study 91.83% (n-45) patients felt reduction in neck pain after bony fusion. Kukreja S[11] reported that Myelopathy symptoms improved in 68.8%(n-16) patients by using Nurick Score and 78-95% of patients has improvement in sensory symptoms and showed bone fuson.[4,6,23]

The technique for achieving bony fusion and have better functional results 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 anterior cervical surgery. We have 4 8.16% (n-4) patients wound infection and were treated conservatively and no re-do surgery was required. Three out of these 4 patients were previously operated for the same problem with different method but due to failure of treatment, we re-operated them. But the demaged skin in occipital region has been a weak protection against infection.

A study by Wenning KE[25] reported 13.3% (n-2) infection in their study. Some studies reported wound infection upto 11% (1/9)[6] and 3.8% (1/26)[23], they were treated conservatively with antibiotics without the removal of implants.

In our study we had no continuous CSF leak, though literature has quoted it in range of 25-28%.[4,6]The cranio-cervical unstability is a correctable surgical issue but the best outcome of surgery mostly depends on the instability type, the condition of posterior cervical elements, the impact of decompression, overall health status of the patient, anatomical variability and the surgeon's know-how with specific technique.

CONCLUSION

Occipito-cervical fusion is a better option to achieve stability, reasonable bony fusion, and release of neural tissues and to have a better functional outcome. The complications can be managed successfully in experienced hands.

REFERENCES

1. VaccaroAR, Lim MR, Lee JY. Indications for surgery and stabilization techniques of the occipito-cervical junction. 2005;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: E62832.
3. Joaquim, AF, Tedeschi, H, Chandra, PS. Controversies in the surgical management of congenital craniocervical junction disordersa critical review. Neurol India. 2018;66: 10031015.
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. 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. Matsubayashi, Y, Shimizu, T, Chikuda, H, Takeshita, K, Oshima, Y, Tanaka, S. Correlations of cervical sagittal alignment before and after occipitocervical fusion. Global Spine J. 2016;6:362369.
8. Joaquim, AF, Riew, KD. Axis screw fixationa step-by-step review of the surgical techniques. Arq Bras Neurocir. 2017;36:101107.
9. Wolfia C, Eckardt G, Yoganandan N. Implant attributes: cantilever beam fixation. In: Steinmetz MP, Benzel EC, eds. Benzel's Spine Surgery: Techniques, Complication Avoidance, and Management. 4th ed. Elsevier Churchill Livingstone; 2016:349355.
10. Wu X, Tan M, Qi Y. Posterior decompression and occipitocervical fixation followed by intraoperative vertebroplasty for metastatic involvement of the axis. BMC Musculoskelet Disord 2018;19:11.
11. Kukreja S, Ambekar S, Sin AH. Occipitocervical fusion surgery: review of operative techniques and results. J Neurol Surg B Skull Base 2015;76:3319.
12. Salunke P, Sahoo SK, Sood S, Mukherjee KK, Gupta SK. Focusing on the delayed complications of fusing occipital squama to cervical spine for stabilization of congenital atlantoaxial dislocation and basilar invagination. Clin Neurol Neurosurg. 2016;145:1927.
13. Chang Rong Z, Jianhua W, Jianqiang D. Posterior fossa epidural hematomas: rare but serious complication of occipitocervical fusion surgery. World neurosurgery 2018;115:1059.
14. Yang J, Jia Q, Peng D. Surgical treatment of upper cervical spine metastases: a retrospective study of 39 cases. World J Surg Oncol. 2017;15(1):21.
15. Spierings EL, Braakman R. The management of os odontoideum. Analysis of 37 cases. The Journal of bone and joint surgery British volume. 1982;64(4):422-8.
16. Boden SD, Dodge LD, Bohlman HH, Rechtine GR. Rheumatoid arthritis of the cervical spine. Along

- term analysis with predictors of paralysis and recovery. The Journal of bone and joint surgery American volume. 1993;75(9):1282-97.
17. Clark CR, Goetz DD, Menezes AH. Arthrodesis of the cervical spine in rheumatoid arthritis. The Journal of bone and joint surgery American volume. 1989;71(3):381-92.
18. Clark CR, Keggi KJ, Panjabi MM. Methylmethacrylate stabilization of the cervical spine. The Journal of bone and joint surgery American volume. 1984;66(1):40-6.
19. Shen FH, Samartzis D, Jenis LG, An HS. Rheumatoid arthritis: evaluation and surgical management of the cervical spine. The spine journal: official journal of the North American Spine Society. 2004;4(6):689-700.
20. Kim YJ, Yoo CJ, Park CW, Lee SG, Son S, Kim WK. Traumatic Atlanto-occipital Dislocation (AOD). Korean Journal of Spine. 2012;9(2):85-91.
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. 1992;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.1999;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 1999;24(1):5-9.
25. Wenning KE, Hoffmann MF. Does isolated atlantoaxial fusion result in better clinical outcome compared to occipitocervical fusion? J Orthop Surg Res. 2020;15(1):8.

DATA SHARING STATEMENT: The data that support the findings of this study are available on request from the corresponding author. The data are not publicly available due to privacy or ethical restrictions.

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AUTHOR'S CONTRIBUTION
The following authors full fill authorship criteria as per ICMJE guidelines;

Rehman RU, Qureshi MA: Idea conception, drafting the work, final approval, agreed to be accountable for all the work.
Khalique AB, Afzal MW: Design of the work, data acquisition, critical rivision, final approval, agreed to be accountable for all the work.
Talha M, Ismail SJ: Data analysis, drafting of the work, final approval, agreed to be accountable for all the work.
Ihsanullah: Data interpretation, critical rivision, final approval, agreed to be accountable for all the work.