

Case Report:

Bilateral C5 Palsy Following A Circumferential Surgery for Cervical Spondylotic Myelopathy: A Case Report and Review



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ABSTRACT

Background and Importance: The development of C5 root palsy is a well-known potential complication of cervical spine surgeries for the correction of cervical spondylotic myelopathy. It typically occurs unilaterally, but on extremely rare occasions, bilaterally. The value of intraoperative neurophysiologic monitoring in detecting iatrogenic acute versus delayed onset C5 palsy, the rarity of bilateral C5 palsy, and its optimal management require further discussion.

Case Presentation: A 49-year-old woman with quadriparesis due to cervical spondylotic myelopathy is presented. She underwent circumferential 360° cervical spine surgery. This operation was subsequently complicated by a delayed bilateral C5 palsy, despite normal transcranial Motor Evoked Potentials (MEPs). With the utilization of conservative treatment, the complete resolution of this complication took roughly eight months.

Conclusion: Bilateral C5 palsy is an infrequent consequence of multilevel cervical spine surgeries. Although intraoperative monitoring of transcranial electrical stimulation-induced MEPs has high sensitivity and specificity in foreseeing the acute-onset C5 palsy, it cannot predict delayed-onset palsy. Including the current case, only seven cases have been reported in the medical literature. Overall, conservative management in adherence to rigorous physical therapy may be an acceptable treatment.

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Highlights

- Bilateral C5 palsy is a debilitating postoperative complication of cervical decompression surgery.
- Although the prognosis is typically good, patients may be unable to perform basic activities of daily living for an extended period before acceptable recovery.

Plain Language Summary

The improvement and development of C5 root palsy is an important and commonplace potential complication of cervical spine surgeries for the correction of cervical spondylotic myelopathy. Correspondingly, it often happens unilaterally, but on extremely rare occasions, bilaterally. The value of intraoperative neurophysiologic monitoring in detecting iatrogenic acute versus delayed onset C5 palsy, the rarity of bilateral C5 palsy, and its optimal management need further discussion. In this account, a 49-year-old woman with quadriplegia due to cervical spondylotic myelopathy is reported. She underwent circumferential 360° cervical spine surgery. This operation was subsequently complicated by a delayed bilateral C5 palsy, despite normal transcranial Motor Evoked Potentials (MEPs). Importantly, with the utilization of conservative treatment, the complete resolution of this complication took about eight months. Conclusively, bilateral C5 palsy is an infrequent outcome of multilevel cervical spine surgeries. Even if intraoperative monitoring of transcranial electrical stimulation-induced MEPs has high sensitivity and specificity in foreseeing the acute-onset C5 palsy, it can not anticipate delayed-onset palsy. Comprising the current case, only seven cases have been reported in the medical documentation. Altogether, conservative management in adherence to rigorous physical therapy can be considered as an acceptable and reliable treatment.

1. Background and Importance

Bilateral C5 palsy is a rare but debilitating complication of multilevel cervical spine surgeries to correct Cervical Spondylotic Myelopathy (CSM) [1–5]. The incidence of this complication which negatively affects the overall quality of a patient's life, varies from 0% [6, 7] to 1.4% [8]. David and Rao reported the first example of a bilateral C5 palsy with detailed information in 2006 [9]. Since then, six additional cases, including the current case, have been reported [10–14].

2. Case Presentation

The initial imaging evaluation of a 49-year-old woman with spastic quadriplegia (Modified Japanese Orthopedic Association [mJOA] score of 12) led to the diagnosis of a multilevel CSM. Her cervical MRI demonstrated a multilevel anterior spinal cord compression, predominantly at the C6–C7 level, within the background of a developmental cervical canal stenosis (Figure 1). She subsequently underwent a C6–C7 Anterior Cervical Disk Fusion (ACDF). This procedure was then followed by a 4-level laminectomy and a C2 to T1 screw rod instrumentation fusion (Figure 2). Intraoperative neuromonitoring, including SSEPs (Somatosensory Evoked Potential) and Motor Evoked Potentials (MEPs), remained

stable throughout the procedure. Immediately after the patient's arousal in the recovery room, she could rise her hands, indicating the newfound integrity of the C5 roots. However, on the second postoperative day, partial paralysis of the deltoid and biceps brachii became evident on both sides of her body. This unexpected alteration was discovered to be compatible with bilateral C5 palsy. By the third postoperative day, the disorder was found to be complete. In the following days, despite the improvement in myelopathic clinical features, her complication did not resolve, and she was ultimately discharged home (Figure 3). At home, after the initiation of routine physical therapy, muscle strength in her deltoids and biceps improved gradually on both sides (Figure 4). However, the complete recovery from this debilitating complication took roughly eight months from start to end (Figure 5). At its summation, her mJOA score became 16.

3. Discussion

Bilateral C5 motor palsy is a rare complication of all multilevel cervical spine decompression surgeries for a CSM [9–14]. It may become evident immediately following surgery [9, 10, 13]. It can also transpire later, though usually within a few days after the operation [11, 12, 14]. Patients with this complication typically present with weakness of the deltoids and biceps on both sides

Table 1. Seven reported cases of bilateral C5 palsy with detailed information

Author(s)	Year	Sex	Age	Procedures	Outcomes
David et al. [9]	2006	M	48	3-Level Anterior Cervical Disk Fusion (ACDF) + plate	Complete recovery
Jeon [10]	2015	F	61	Multilevel ACDF+ laminectomy+ instrumentation	Incomplete recovery
Kudo et al. [11]	2016	M	71	Laminectomy + instrumentation	Incomplete recovery
Kim et al. [12]	2017	F	56	Laminectomy + instrumentation	Incomplete recovery
Andelman et al. [13]	2017	M	57	3 level ACDF + plate	Complete recovery
Chow [14]	2020	M	68	Laminectomy C3-C5, Lateral mass screw C3 to C6	Incomplete recovery
Current case	2021	F	49	Laminectomy, C2 to T2 pedicle screw	Complete recovery



of the body [9-14]. About half the affected patients will experience numbness or intractable pain within the shoulder girdle in addition to the aforementioned muscle weakness. The information about these seven cases is presented separately in Table 1.

Predisposing anatomical facts

The unisegmental innervations of the deltoid muscle will make C5 palsy more clinically evident [1-8]. The shorter C5 root and its horizontal trajectory than the other cervical roots leave it more vulnerable to traumas and the possible backward shifting of the spinal cord [1-8].

Predictive radiological factors

Considering some preoperative radiological parameters, including a kyphotic neck, a developmentally narrow canal, and a narrow C4-C5 foramen, postoperative C5 palsy can be reasonably expected [12, 15]. According to Lubelski [16], for every 1 mm increase in anteroposterior diameter and corresponding foramen diameter, the odds of developing C5 palsy decreases by 69% [15]. Ossification of the posterior longitudinal ligament and the presence of spinal cord myelopathy at the C4-C5 level have been mentioned as other predictors of C5 palsy [15, 17-19].

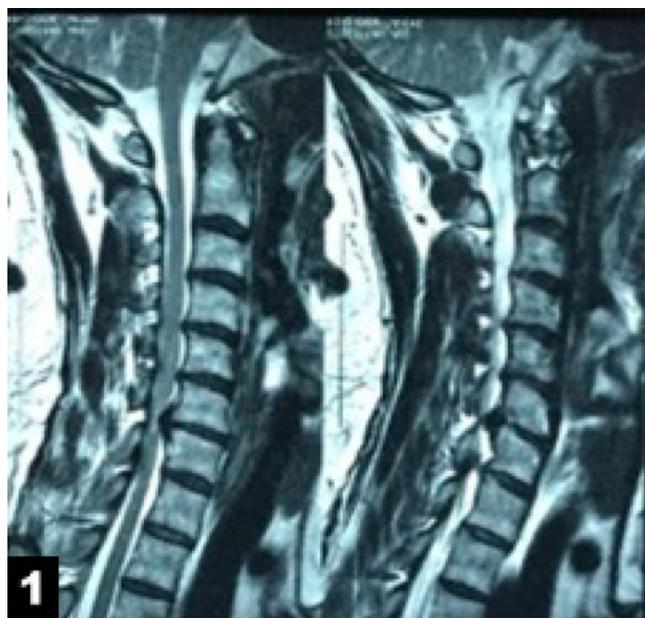


Figure 1. Cervical T2-weighted sagittal MRI showing C6-C7 protruded disk and multilevel spondylosis, Note the congenital narrow canal



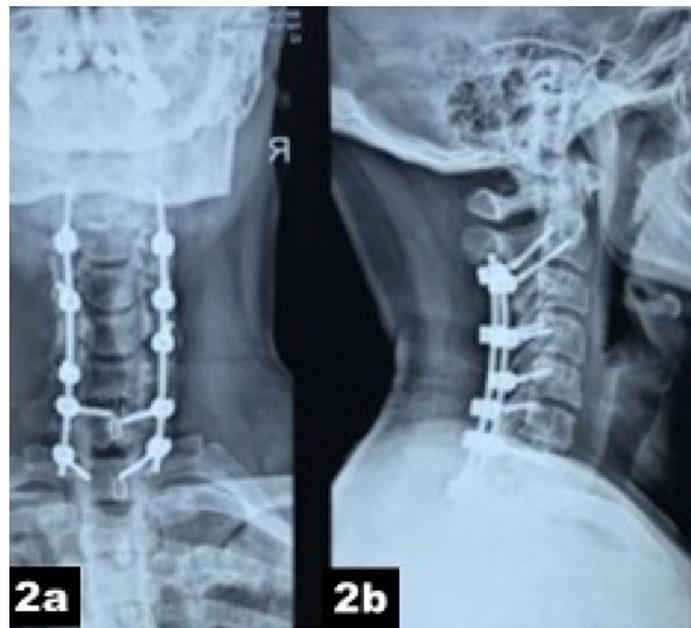


Figure 2. Postoperative AP and lateral cervical X-ray: (a & b) showing C3 to C6 laminectomy and C2 to T1 screw rod fixation



Intraoperative factors

The exact cause of C5 palsy is uncertain. It may be due to an intraoperative spinal cord trauma, a possible iatrogenic C5 root injury, excessive lordosis with instrumentation, or the tethering of this nerve from the backward shifting of the spinal cord. It might also result from a

poor reperfusion scenario due to widened laminectomy [1-8, 15, 17, 18].

Prevention

The application of intraoperative transcranial motor neuromonitoring may lower the risk of early-onset C5



Figure 3. Postoperative photographs after 3 weeks with complete C5 paralysis, unable to rise the upper limbs



Figure 5. Patient's photograph at 8 months follow-up showing complete C5 recovery



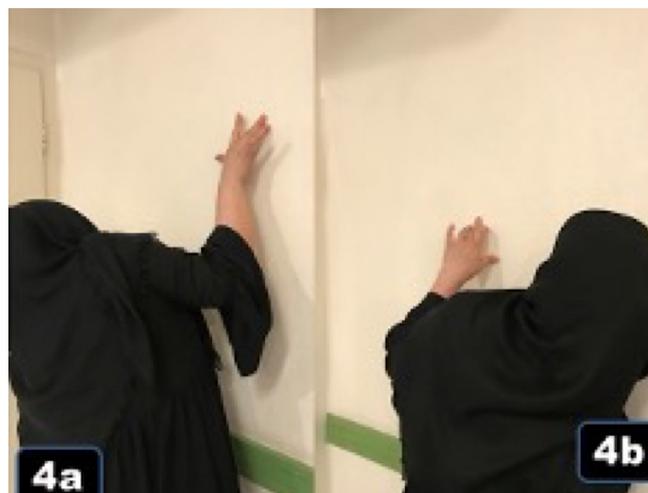


Figure 4. Patient's photograph at 3 months follow-up, trying to rise her hands



palsy observed immediately upon emergence from the anesthesia [20-22]. According to Bhalodia et al., the sensitivity and specificity of transcranial MEP monitoring for identifying acute-onset deltoid weakness are 100% and 99%, respectively [23]. The sensitivity and specificity of TES-MEPs (transcranial electrical stimulation motor-evoked potentials) have been 100% and 98.4% in the Oya et al. series [24]. With the appearance of an intraoperative change in transcranial MEPs, immediate additional wide foraminotomy and the administration of steroids and, in particular, dexamethasone may help reverse any evolving injury [25-27].

Seldom, postoperative segmental motor paralysis after cervical laminoplasty may occur even if there are no abnormal findings during intraoperative monitoring [28]. However, there is no clear evidence that with intraoperative MEP, one can prevent or predict late-onset C5 palsy [29]. Furthermore, with the avoidance of excessive lordosis and an extensive laminectomy [15, 17-19], the surgeon may minimize the occurrence of this debilitating complication. The benefit of a C4-C5 foraminotomy in preventing C5 palsy has remained poorly understood [25-27].

Quality of life

Bilateral C5 root palsy negatively impacts the quality of life and can significantly reduce the capacity for self-care [9-14, 16]. Patients with this complication are usually unable to perform the basic activities of daily living and hence require appropriate home services. Ultimately the overall cost of medical care will increase for those affected [16].

Treatment

There is an overwhelming recommendation to treat unilateral C5 palsy conservatively as "most patients make a full recovery within two years" [1-8]. This same strategy can also be employed when assessing bilateral cases of C5 palsy [9-14]. Rigorous physical therapy consisting of a muscle strengthening routine and range of motion exercises for the shoulders and elbows is paramount. This objective is best accomplished at a rehabilitation hospital during the early postoperative period and on an outpatient basis after that [9-14].

Outcome

With respect to the rarity of this specific clinical scenario, minimal evidence regarding the natural history of this complication exists. Our review shows that less than half of the patients with this diagnosis display a complete recovery [9-13]. However, it appears that similar to unilateral cases, the recovery rates may largely depend on the magnitude of the postoperative C5 disorder, although this is certainly not a rule [9-14].

4. Conclusion

Regarding the high financial cost, psychological implications, decreased quality of life, and the reduced capacity of self-care, surgeons should be aware of the proper management of this debilitating complication.

Ethical Considerations

Compliance with ethical guidelines

Written consent was obtained from the patient to publish the history and corresponding radiological images.

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Authors' contributions

Conceptualization and Methodology: Abolfazl Rahimizadeh, Sam Hajaliloo Sami, and Naser Asgari; Data collection: Abolfazl Rahimizadeh, Mahan Amirzadeh, Shahrzad Rahimizadeh, and Sam Hajaliloo Sami; Data analysis and interpretation: Abolfazl Rahimizadeh, Shaghayegh Rahimizadeh, and Naser Asgari; Writing – original draft: Abolfazl Rahimizadeh, Shahrzad Rahimizadeh, Naser Asgari; Data analysis: Walter L. Williamson; Reviewing submitted version of manuscript: Abolfazl Rahimizadeh, Walter L. Williamson, and Naser Asgari; Approving the final version of the manuscript: Abolfazl Rahimizadeh, Sam Hajaliloo Sami, Walter L. Williamson, and Naser Asgari.

Conflict of interest

The authors declare that they have no known competing financial interests or personal relationships that could have influenced the work reported in this paper.

References

- [1] Gu Y, Cao P, Gao R, Tian Y, Liang L, Wang C, et al. Incidence and risk factors of C5 palsy following posterior cervical decompression: A systematic review. *PLoS ONE*. 2014; 9(8):e101933. [DOI:10.1371/journal.pone.0101933] [PMID] [PMCID]
- [2] Guzman JZ, Baird EO, Fields AC, McAnany SJ, Qureshi SA, Hecht AC, et al. C5 nerve root palsy following decompression of the cervical spine: A systematic evaluation of the literature. *Bone and Joint Journal*. 2014; 96-B(7):950-5. [DOI:10.1302/0301-620X.96B7.33665] [PMID]
- [3] Sakaura H, Hosono N, Mukai Y, Ishii T, Yoshikawa H. C5 palsy after decompression surgery for cervical myelopathy: Review of the Literature. *Spine*. 2003; 28(21):2447-51. [DOI:10.1097/01.BRS.0000090833.96168.3F] [PMID]
- [4] Shou F, Li Z, Wang H, Yan C, Liu Q, Xiao C. Prevalence of C5 nerve root palsy after cervical decompressive surgery: A meta-analysis. *European Spine Journal*. 2015; 24(12):2724-34. [DOI:10.1007/s00586-015-4186-5] [PMID]
- [5] Wang T, Wang H, Liu S, Ding WY. Incidence of C5 nerve root palsy after cervical surgery: A meta-analysis for last decade. *Medicine*. 2017; 96(45):e8560. [DOI:10.1097/MD.00000000000008560] [PMID] [PMCID]
- [6] Katsumi K, Yamazaki A, Watanabe K, Ohashi M, Shoji H. Analysis of C5 palsy after cervical open-door laminoplasty: Relationship between C5 palsy and foraminal stenosis. *Journal of Spinal Disorders and Techniques*. 2013; 26(4):177-82. [DOI:10.1097/BSD.0b013e31823db346] [PMID]
- [7] Chang PY, Chan RC, Tsai YA, Huang WC, Cheng H, Wang JC, et al. Quantitative measures of functional outcomes and quality of life in patients with C5 palsy. *Journal of the Chinese Medical Association*. 2013; 76(7):378-84. [DOI:10.1016/j.jcma.2013.03.008] [PMID]
- [8] Kaneyama S, Sumi M, Kanatani T, Kasahara K, Kanemura A, Takabatake M, et al. Prospective study and multivariate analysis of the incidence of C5 palsy after cervical laminoplasty. *Spine*. 2010; 35(26):E1553-8. [DOI:10.1097/BRS.0b013e3181ce873d] [PMID]
- [9] David KS, Rao RD. Bilateral C5 motor paralysis following anterior cervical surgery—a case report. *Clinical Neurology and Neurosurgery*. 2006; 108(7):675-81. [DOI:10.1016/j.clineuro.2005.04.005] [PMID]
- [10] Jeon HS, Kim KN. Delayed bilateral C5 palsy following circumferential decompression and fusion in patient with cervical spondylotic myelopathy. *Korean Journal of Spine*. 2015; 12(3):200-3. [DOI:10.14245/kjs.2015.12.3.200] [PMID] [PMCID]
- [11] Kudo Y, Toyone T, Shirahata T, Ozawa T, Matsuoka A, Jin Y, et al. A case of successful foraminotomy for severe bilateral C5 palsy following posterior decompression and fusion surgery for cervical ossification of posterior longitudinal ligament. *Case Reports in Orthopedics*. 2016; 2016:1250810. [DOI:10.1155/2016/1250810] [PMID] [PMCID]
- [12] Kim SW, Gronen F, Uhl E, Schöller K. Successful conservative treatment of a bilateral C5 palsy following posterior cervical decompression and fusion surgery for ossification of posterior longitudinal ligament. *Journal of Spinal Studies Surgery*. 2017; 1(1):22-4. <https://www.jsss-journal.com/article.asp?issn=WKMP-0149;year=2017;=24;aulast=Kim>
- [13] Anselman SM, McAnany SJ, Qureshi SA, Hecht AC. Bilateral C5 motor palsy after anterior cervical decompression and fusion: A case report and review of the literature. *International Journal of Spine Surgery*. 2017; 11(2):14. [DOI:10.14444/4014] [PMID] [PMCID]
- [14] Chow YM. Bilateral C5 palsy after posterior cervical spine decompression surgery: A case report and literature review. *Bali Journal of Anesthesiology*. 2020; 4(3):129-31. [DOI:10.4103/BJOA.BJOA_49_20]
- [15] Epstein N, Hollingsworth R. C5 nerve root palsies following cervical spine surgery: A review. *Surgical Neurology International*. 2015; 6(Suppl 4):S154-63. [DOI:10.4103/2152-7806.156556] [PMID] [PMCID]
- [16] Miller JA, Lubelski D, Alvin MD, Benzel EC, Mroz TE. C5 palsy after posterior cervical decompression and fusion: Cost and quality-of-life implications. *The Spine Journal*. 2014; 14(12):2854-60. [DOI:10.1016/j.spinee.2014.03.038] [PMID]
- [17] Pennington Z, Lubelski D, D'Sa A, Westbroek E, Ahmed AK, Goodwin ML, et al. Preoperative clinical and radiographic variables predict postoperative C5 palsy. *World Neurosurgery*. 2019; 127:e585-92. [DOI:10.1016/j.wneu.2019.03.211] [PMID]

- [18] Radcliff KE, Limthongkul W, Kepler CK, Sidhu GD, Anderson DG, Rihn JA, et al. Cervical laminectomy width and spinal cord drift are risk factors for postoperative c5 palsy. *Journal of Spinal Disorders and Techniques*. 2014; 27(2):86-92. [DOI:10.1097/BSD.0b013e31824e53af] [PMID]
- [19] Blizzard DJ, Gallizzi MA, Sheets C, Klement MR, Kleeman LT, Caputo AM, et al. The role of iatrogenic foraminal stenosis from lordotic correction in the development of C5 palsy after posterior laminectomy and fusion. *Journal of Orthopaedic Surgery and Research*. 2015; 10:160. [DOI:10.1186/s13018-015-0297-2] [PMID] [PMCID]
- [20] Clark AJ, Ziewacz JE, Safaee M, Lau D, Lyon R, Chou D, et al. Intraoperative neuromonitoring with MEPs and prediction of postoperative neurological deficits in patients undergoing surgery for cervical and cervicothoracic myelopathy. *Neurosurgical Focus*. 2013; 35(1):E7. [DOI:10.3171/2013.4.FOCUS13121] [PMID]
- [21] Fan D, Schwartz DM, Vaccaro AR, Hilibrand AS, Albert TJ. Intraoperative neurophysiologic detection of iatrogenic C5 nerve root injury during laminectomy for cervical compression myelopathy. *Spine*. 2002; 27(22):2499-502. [DOI:10.1097/00007632-200211150-00014] [PMID]
- [22] Bose B, Sestokas AK, Schwartz DM. Neurophysiological detection of iatrogenic C-5 nerve deficit during anterior cervical spinal surgery. *Journal of Neurosurgery: Spine*. 2007; 6(5):381-5. [DOI:10.3171/spi.2007.6.5.381] [PMID]
- [23] Bhalodia VM, Schwartz DM, Sestokas AK, Bloomgarden G, Arkins T, Tomak P, et al. Efficacy of intraoperative monitoring of transcranial electrical stimulation-induced motor evoked potentials and spontaneous electromyography activity to identify acute- versus delayed-onset C-5 nerve root palsy during cervical spine surgery: Clinical article. *Journal of Neurosurgery: Spine*. 2013; 19(4):395-402. [DOI:10.3171/2013.6.SPINE12355] [PMID]
- [24] Oya J, Burke JF, Vogel T, Tay B, Chou D, Mummaneni P. The accuracy of multimodality intraoperative neuromonitoring to predict postoperative neurologic deficits following cervical laminoplasty. *World Neurosurgery*. 2017; 106:17-25. [DOI:10.1016/j.wneu.2017.06.026] [PMID]
- [25] Katsumi K, Yamazaki A, Watanabe K, Ohashi M, Shoji H. Can prophylactic bilateral C4/C5 foraminotomy prevent postoperative C5 palsy after open-door laminoplasty?: A prospective study. *Spine*. 2012; 37(9):748-54. [DOI:10.1097/BRS.0b013e3182326957] [PMID]
- [26] Baba I. Risk factors and prevention for C5 nerve root palsy after expansive open door laminoplasty for cervical spondylotic myelopathy and OPLL with microcervical foraminotomy by operating microscope. *Rinsho-Seikeigeka*. 1995; 30:499-505. [Link not found].
- [27] Dombrowski ME, Morales-Restrepo A, Fourman MS, Vaudreuil N, Lee JY. Prophylactic perioperative dexamethasone decreases the incidence of postoperative C5 palsies after a posterior cervical laminectomy and fusion. *Spine Journal*. 2019; 19(2):253-60. [DOI:10.1016/j.spinee.2018.05.031] [PMID]
- [28] Nakamae T, Tanaka N, Nakanishi K, Kamei N, Izumi B, Fujioka Y, et al. Investigation of segmental motor paralysis after cervical laminoplasty using intraoperative spinal cord monitoring with transcranial electric motor-evoked potentials. *Journal of Spinal Disorders and Techniques*. 2012; 25(2):92-8. [DOI:10.1097/BSD.0b013e318211fc4e] [PMID]
- [29] Spitz S, Felbaum D, Aghdam N, Sandhu F. Delayed postoperative C5 root palsy and the use of neurophysiologic monitoring. *European Spine Journal*. 2015; 24(12):2866-71. [DOI:10.1007/s00586-015-4252-z] [PMID]

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