**CASE REPORT WITH SCOPING REVIEW DISCUSSION**

# Spinal K-Wire Migration Following Acromioclavicular Dislocation Surgical Treatment: A Case Report with Scoping Review Discussion

**Nizar Al Rhaazi[1], Ahmadin Y.R. Susatyo [1], Faesal [2,3], Yunus Abdul Bari [3*]**
[1]General Practitioner, Faculty of Medicine Universitas Airlangga, Surabaya, Indonesia
[2]Orthopedic and Traumatology Department, Anwar Medika, Sidoarjo, Indonesia
[3]Orthopedic and Traumatology Department, Rumah Sakit Universitas Airlangga, Surabaya, Indonesia

**Article Info**
***Article history:***
Received 25-02-2023
Revised 20-04-2023
Accepted 16-05-2023
Published 10-07-2023

***Keywords:***
K-wire migration
Protocol of K-wire
K-wire Complications
Trauma
Human and health

***Corresponding author:**
Yunus Abdul Bari
Yunus@fk.unair.ac.id

**ABSTRACT**

**Background:** Kirschner wire as internal fixation is a common instrument used in any small bone, including on Acromioclavicular Dislocation Surgical Treatment (ADST). Due to the characteristic of the wire, which is less rigid than any other instrument, the wire can sometimes migrate unexpectedly into various locations. Wire migration has been reported sporadically since 1943. However, spinal migration is still underreported. In addition, the mechanism of spinal migration and the evacuation method remains unclear. **Objective:** The purpose of this study was to report a case of K-wire spinal migration to cervical vertebrae C6-C7 following surgical treatment and discuss the case using the results of a scoping review. **Case:** A 51 years-old man with wire migration to cervical vertebrae C6-C7 complained of painful sensations around the left side of the neck and left shoulder, which aggravated with shoulder movement. He underwent left acromioclavicular joint repair surgery three years ago after a motorcycle accident. No other abnormalities were found in either physical or neurological examinations. **Discussion:** In the last 10 years, six cases of spinal migration after ADST have been reported, with less than one case reported a year. The cases' gender was all male, with a mean age of 43.33 years old. The majority of them underwent acromioclavicular fixation in 50% of cases, and the average time from migration to surgery is 71 months. The most common migration is located in the cervical region (66.67%), and the penetrating points are equal in all cases. In the non-bent wire group, an entire migration has been reported. The evacuation technique used in all previous cases was direct access surgery by gently pulling out the wire along its axis under visual control. Various mechanisms contribute to spinal migration, but shoulder movement is arguably the most influential factor. **Conclusion:** Cervical migration post-ADST commonly occurs and may cause severe morbidity.

**How to cite:**
Rhaazi, N.A., Susatyo, A.Y.R., Faesal, Bari, Y.A. 2003. Spinal K-Wire Migration Following Acromio-clavicular Dislocation Surgical Treatment: A Case Report and Scoping Review. Majalah Biomorfologi, 33(2):118-125

**Majalah Biomorfologi (Biomorphology Journal)** p.ISSN:0215-8833, e.ISSN: 2716-0920
doi: 10.20473/mbiom.v33i2.2023.118-125



## Highlights

1. Shoulder movement near the cervical region is suspected to be the risk factor.
2. Shoulder movement plays an important role in the underlying mechanism of post-ADST wire migration.

3. Despite the K-wire being bent, wire migration may still happen, so post-operative X-ray evaluation is vital for early detection.

## BACKGROUND

The use of K-wire for the treatment of shoulder fractures and dislocations offers more advantages than open reduction and internal fixation because inserting K-wire is known to be more simple and easier through atraumatic percutaneous that are associated with lower risk, minimum swell, and less stiffness (Kumar, et al., 2014). Possible complications include vascular and nerve damage, tendon rupture, osteomyelitis, loss of fracture or dislocation reduction, and post-operative wire migration (Palauro, et al., 2019).

However, one of the drawbacks of K-wire is its lack of rigidity, which allows one to migrate from initial insertion to other parts of the human body. The symptoms of wire migration sometimes mimic chronic illnesses or remain asymptomatic. According to some authors, wire migration leads to serious complications, for instance, a study reported chronic cough as a symptom of migration to the right region of the lung (Irianto, et al., 2018), a case reported wire passing through the sigmoid colon (Matsumoto, et al., 2017), another case reported death due to intra-aortic migration of K-wire from the clavicle (Tan, et al., 2016), while there were also reports on hematuria as the wire penetrated bladder (Kumar, et al., 2014) and wire migration that damaged vertebral artery (Mankowski, et al., 2016).

Spinal migration is considered a rare case due to its proximal location over the clavicula or acromioclavicular joint. The mechanism of migration remains unknown despite the activity of muscles that could be the main cause (Palauro, et al., 2019), and there is also a lack of treatment protocols to evacuate the wire, particularly in the spine.

## OBJECTIVE

The purpose of this study was to report a case of K-wire spinal migration following surgical treatment of Acromioclavicular Dislocation Surgical Treatment (ADST) and discuss the case using the results of a scoping review.

## CASE REPORT

A 51 years-old man, a mechanic, presented in the orthopedic outpatient clinic of our hospital with chronic neck pain related to mild effort and shoulder movement. History suggested that in the previous three years, the patient experienced a road traffic accident that required surgical treatment to fix his clavicle with K-wire, which was treated in a peripheral hospital.

Before reaching the 1-year follow-up around 6 months after the surgery was done, the patient complained of severe pain in the neck so that he could not work and sleep well, but he did not undergo the pinning removal operation due to the high wave of COVID-19. Previous X-rays and prior examinations from the peripheral hospital were not available.

Based on the current examination, the patient claimed that shoulder movement causes neck pain. Also, the level of pain has decreased compared to the previous three years. The physical evaluation, both neurological and laboratory, showed normal results, except for the scar located in the left shoulder as a consequence of prior surgical intervention.

A radiograph found an implied wire in cervical vertebrae C6-C7 and the absence of a wire that was originally placed in the acromioclavicular joint. An MRI test was conducted to confirm the location. The wire was located in the interspinous cervical vertebrae of VI-VII and did not damage the spinal canal. The plan is to evacuate the migrated wire through an anterolateral incision approach in the cervical vertebrae C6-C7 region under general anesthesia.

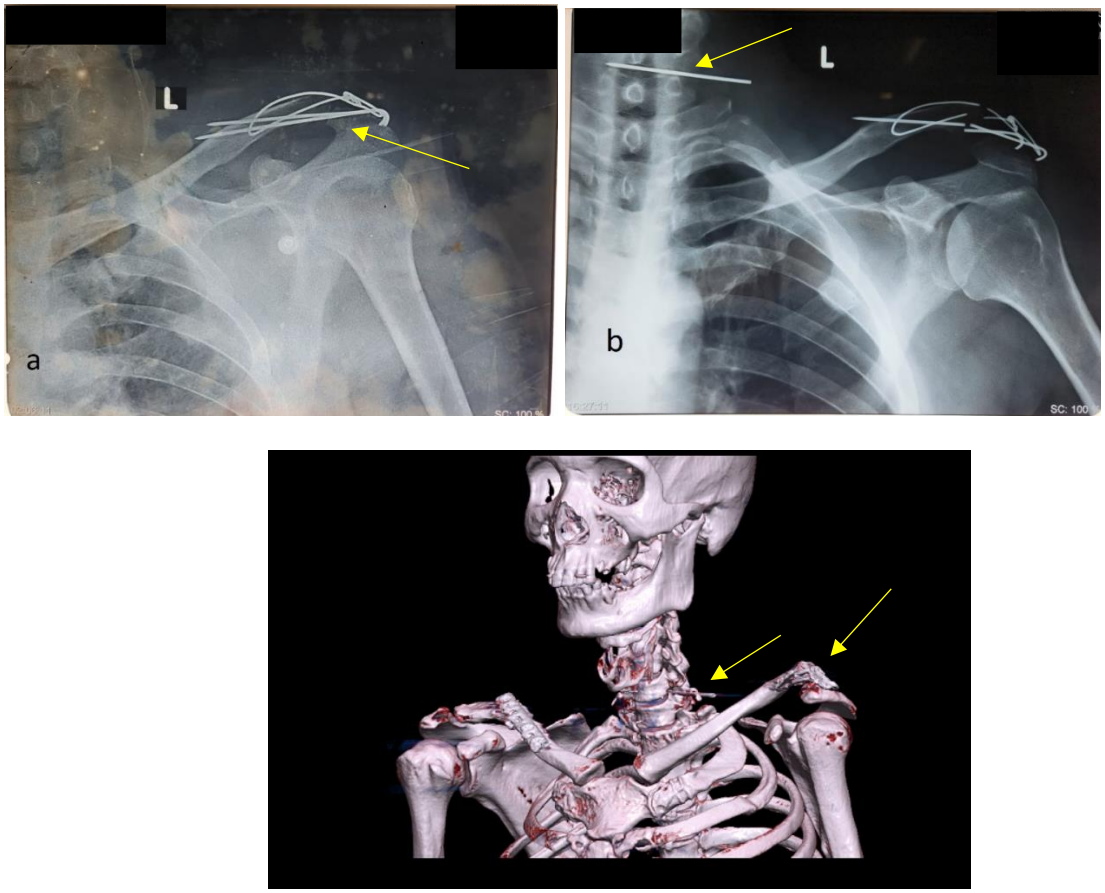


Figure 1. Migration of K-wire. (a) Tension band wire and K-wire post-surgical in the previous three years. (b) Current X-rays picture of K-wire migration to CVI-VII. (c) Latest MRI K-wire located in the interspinous CVI-VII.

## SCOPING REVIEW

This scoping review was conducted according to the Preferred Reporting Items for Systematic Reviews and Meta-Analyses extension for scoping reviews (PRISMA-ScR) guidelines.

### Literature search strategy

The literature search was performed to identify original articles using Pubmed, ScienceDirect, and Web of Science. Studies reporting the spinal Kirschner wire migration after surgical treatment were included. The search term query was formed using the search terms “Kirschner wire”, “Kirschner wire migration”, “spinal migration of Kirschner wire”, “clavicular fracture”, and “acromioclavicular joint dislocation”. The articles are written in English with human subjects and published between 01-01-2013 and 10-05-2023.

### Eligible criteria

Following the removal of the duplicate, we evaluated the remaining study based on our inclusion criteria: (a) Population: patients male or female who underwent surgical treatment of acromioclavicular dislocation or clavicular fracture; (b) The surgical intervention must be K-wire insertion and showed migration to spine; (c) The patients had done surgical removal of the K-wire from spine; (d) Study design: a case report. Studies were excluded according to our exclusion criteria (1) Case reports that use the same data; (2) Review articles, letters, conference abstracts, and editorials; (3) No full text available; (4) Cases that did not fit our review field.

**Data extraction and risk of bias assessment**

This information extracted from the included studies: (a) Study characteristics (authors, years of publication); (b) Study subject characteristics (age, gender); (c) Initial condition (bent wire, clavicle fracture, or acromioclavicular dislocation); (d) The wire migration position and direction of the wire; (e) Treatment given during the evacuation of spinal migration. The two reviewers extracted the data independently, and all the different opinions were discussed in a meeting with the third and fourth reviewers.

The two reviewers assessed the methodological quality of eligible articles using the Joanna Briggs Institute (JBI) critical appraisal tools to minimize the risk of bias. The third and fourth reviewers formally judge the disagreement between the first and second reviewers.

**Result of the scoping review**

Figure 1 illustrates the selection process of this study and how the selected studies were conducted. Initially, we collected 98 studies, which consisted of 23 studies from Medline, 68 from Science Direct, and 7 from Web of Science. Between those studies, we removed the duplicates, resulting in 55 studies. We excluded 28 irrelevant studies based on abstracts and titles. In addition, the remaining studies were assessed further based on exclusion criteria. Finally, six studies were included in our scoping review and analyzed for qualitative synthesis. A quality assessment was performed to minimize the risk of bias using the Joanna Briggs Institute (JBI).

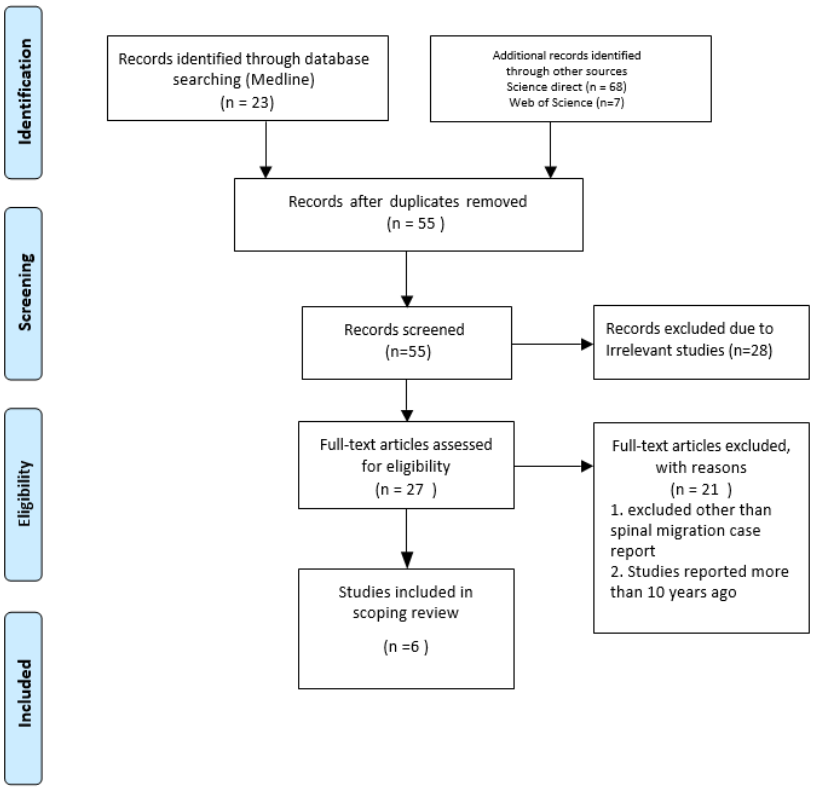


Figure 1. PRISMA diagram.

Over a 10-year period, only six cases of spinal migration were reported. This rare occurrence was supported by the fact that reports occurred less than once a year. All cases were male, with an average age of 43.33 years old. The spinal migration patient initially underwent acromioclavicular fixation in about 50% of cases, clavicula fixation at around 33.33%, and sternum fixation at 16.67%. Patients' average time between surgery and migration was 71 months (ranging from 2 months to 180 months). The reported cases were located mostly (66.67%) in the cervix followed by another occurrence in the

vertebral thoracal region. Penetrating points accounted for the same portion of 33.33% in transversal foramen, neural foramen, and vertebral body.

Table 1. The results of the scoping review (n = 6).

| Number | Reference | Sex /age | Delay | Level | Initial Operation | Bent | Entire Migration | Direction | Treatment |
|---|---|---|---|---|---|---|---|---|---|
| 1 | Li, et al., (2011) | 35/M | 2 | T2-T3/NF | ACJ fixation | No | Yes | Transversal | Thoracoscopy, no exposure of dura |
| 2 | Minić, et al., (2016) | 35/M | 4 | T2/NF | Clavicle fixation | Yes | Yes | Descendant | Direct access, no exposure of dura |
| 3 | Mankowski, et al., (2016) | 34/M | 84 | C6/TF | Clavicle fixation | Yes | No (broken) | Ascendant | Direct access, no exposure of dura |
| 4 | N'da, et al., (2018) | 34/M | 72 | C7/body | ACJ fixation | Yes | Yes | Transversal | Direct access, no exposure of dura |
| 5 | Gulyaev, et al., (2018) | 64/M | 180 | C6-7 /TF | ACJ fixation | Yes | No (broken) | Transversal | Direct access, no exposure of dura |
| 6 | Furuhata et al., (2020) | 68/M | 84 | C5-6/body | Sternum fixation | No | Yes | Ascendant | Direct access, no dura exposure |

Regarding the wire directions, we defined transversal direction as the wire was perpendicular to the spine, ascendant if the wire's distal end points were upward, and descendant as defined when the end of the wire was pointed downward. The majority of K-wire direction is transversal (50%), followed by ascendant (33.33%) and descendant (16.67%). The symptoms may vary based on wire location, and in all cases, the diagnosis requires imaging for early management using an X-ray followed by a CT-scan to confirm the exact location. Bent wire in this study was 66.7%, while non-bended wire was 33.3%. In those non-bended wire groups, all cases reported the entire migration. The bending wire group implied that 50% of them experienced entire migration. In this study, the treatment involved direct access with gentle traction within view.

## DISCUSSION

The use of Kirschner wire to treat small bone fractures and dislocations has shown good results. Not only easy to insert, but the K-wire size is relatively small, which allows it to bend and twist (Palauro et al., 2019). That capability makes it the most suitable surgical instrument to treat small bones in the hand. However, the lack of rigidity can lead K-wire to migrate. Unpredictable migration of fractured K-wires and other medical devices can result in severe consequences, including organ damage and even mortality. Although rare, this complication necessitates surgical preparedness for timely recognition and removal of the fractured wire. The shoulder region is particularly susceptible to K-wire migration during surgical procedures (Sadat-Ali, et al., 2020). K-wire migration after fixation surgery has been reported to occur anywhere between 5.8% and 54% of the time. K-wire migration into organs such as the lung, heart, liver, and esophagus has been reported in a few cases, although the majority of the cases are asymptomatic and do not result in organ injury. It is extremely unusual for K-wires to migrate into the spinal canal (Dorr, et al., 2016; Furuhata, et al., 2020).

In this scoping review, we included six studies from 2013-2023 from several databases. It is concluded that spinal migration is a rare condition because it occurs in less than one case a year. Thus, there is still a lack of study to carefully analyze the complications. Spinal migration can cause severe injury or even death because of the damage to spinal cord, dura mater, and vertebral artery (Gulyaev, et al., 2018). Luckily, the entire bone structure of spine has been preventing the migration that could injure vital parts. Furthermore, the entry point to the spinal canal is only through neural foramen and transverse foramen

(Mankowski, et al., 2016).

The duration between K-wire migration and surgical treatment is different among the cases. In the literature we reviewed, the fastest migration was 2 months from clavicular joint fixation, and the wire was not bent. Among the group of non-bent wires, all the cases experienced migration entirely. This study was consistent with that of Irianto, et al., (2018) who found that not bending the wire increased the likelihood of migration. Rapid reuse of the shoulder is the main purpose of surgical treatment of acromioclavicular joint dislocation and clavicular fracture. Therefore, the immobilization should only last for a short time. The exact cause of wire migration is still unknown. However, it has been postulated that extensive shoulder movement leads to wire migration. We proposed that early migration occurred upon the non-bent wire. Moreover, free shoulder movement allows the wire to experience micro-mobility so that the wire becomes free along with shoulder movement (N'da, et al., 2018).

There are three penetrating points of wire according to the axis between the wire and the spine: transversal, ascendant, and descendant (Ko & Lee, 2019). Although the fact that the reason why migration can happen is still unknown, there are several theories, including muscle activity, free shoulder movement, negative intrathoracic pressure during respiration, bone resorption, gravity, insufficient measures to hold the wire, and capillary action (Zacharia, et al., 2016). According to our study, the number of cases based on the direction of the wire was even. Transversal migration may happen because of shoulder movement, meanwhile, ascending migration also occurs because of shoulder movement and muscle activity. Descending migration may be influenced by intrathoracic pressure, gravity force, and shoulder activity. So, in all cases of spinal migration, shoulder movement plays an important role in the process of migration.

The preferred imaging is an X-ray to assess the presence of spinal wire migration, but when the wire cannot be clearly seen in plain radiography, assessing the risk via CT scan is more preferable to determine the exact location of the wire (Mokhtar, et al., 2020). CT angiography must be done if any major vessel damage is involved (Mankowski, et al., 2016).

The management of surgical treatment depends on the patient's condition, whether it is stable or not (Cameliere, et al., 2013). The pin removal procedure must be immediate and provide wide exposure. To control the removal, visualization of the medial and lateral extents of the wire is mandatory. The lateral end must be gently removed along its axis to evacuate as the initial insertion point (N'da, et al., 2018).

In the years before 1990, the reported cases mostly occurred early and were fatal. People hypothesized that those years were the moment when the surgeon did not bend the wire, so the surgeons have been alerted to bend the wire ever since (Irianto, et al., 2018). As preventive measures, the authors recommended bending the distal part of the K-wire until it is over 90° to prevent migration (Batın, et al., 2016). However, in our study, the bending wire also experienced migration. This safely assumes that bending the wire solely does not completely prevent the migration since there are many contributing factors, such as high-force movement, gravitational force, intrathoracic pressure, and muscle activity (Wang, et al., 2021). Our patient worked as a mechanic, which required him to do heavy work on his shoulder, so we suggested that a lot of muscle activity and shoulder movement may induce wire migration (Pientka, et al., 2016)

Considering the harmful potential of K-wire, X-ray evaluation is also necessary to assess bone healing based on the patient's age and pattern of the injury, which usually takes around 4-6 weeks after surgery unless non-union occurs (Sananta, et al., 2020). Regular radiological follow-up may be needed for patients with foreign bodies at risk of expulsion of vital structures (Tenconi, et al., 2014). It is important to remove the wire as soon as the bone is healed (Batın, et al., 2016). We highly suggest removing the wire at least one year after its insertion. Surgeons must take the missing wire into account since the wire migration may potentially worsen neurological conditions. Therefore, the wire must be removed immediately. It requires vigilance for orthopedics to evaluate wire insertion. Complications following K-wire surgery cannot be ruled out even if there is no physical complaint. To prevent K-wire migration following tension band wiring fixation, it is recommended that the distal ends of the wires be bent and that the wires be removed in the early phase after the bone union (Firoozabadi, et al., 2013)

**Strength and limitations**

This case report provides knowledge about how spinal migration post-ADST occurs and its possible underlying mechanism. The discussion was based on a scoping review conducted to synthesize the findings of the studies from the existing literature. However, in this study, the case had not yet been

treated, so we could not report the outcome. We also only reported one case from one center, so we could not determine the most possible underlying mechanism or the best treatment.

## CONCLUSION

In this case report, we studied how spinal wire migration potentially causes severe injury or even mortality. Complications such as neurological disorders and vascular damage could possibly happen in this case. This was consistent with our scoping review, as K-wire is able to damage nerves and arteries through the transversal and neural foramen. The exact reason why migration happens is still debatable. However, we believe that the excessive use of the free shoulder contributes to migration. Also, regular imaging and immediate evacuation by means of direct access with under-view control must be taken through direct access to prevent further injury.

**Acknowledgment**
The authors would like to thank the patient and Department of Orthopedic and Traumatology, Rumah Sakit Universitas Airlangga, Surabaya, Indonesia, for supporting this case.

**Conflict of Interest**
All authors have no conflict of interest.

**Funding**
None.

**Author Contribution**
NAR and AYRS contribute to conception and design, analysis and interpretation of the data, and drafting of the article. FA and YAB contributes to conception and design, drafting of the article, critical revision of the article for important intellectual content, and final approval of the article.

## REFERENCES

Batın, S., Ozan, F., Gürbüz, K., Uzun, E.,Kayali, C., et al. 2016. Migration of a broken Kirschner wire after surgical treatment of acromioclavicular joint dislocation. Case Reports in Surgery, 2016: 1–3. doi: 10.1155/2016/6804670.

Cameliere, L., Rosat, P., Heyndrickx, M., Le Rochais, J.P., Icard, P. 2013. Migration of a Kirschner pin from the shoulder to the lung, requiring surgery. Asian Cardiovascular and Thoracic Annals, 21(2): 222–223. doi: 10.1177/0218492312450021.

Dorr, M.C., Backes, M., Luitse, J.S.K., de Jong, V.M., Schepers, T. 2016. Complications of Kirschner wire use in open reduction and internal fixation of calcaneal fractures. The Journal of Foot and Ankle Surgery, 55(5): 915–917. doi: 10.1053/j.jfas.2016.04.003.

Firoozabadi, R., Kramer, P.A., Benirschke, S.K. 2013. Kirschner wire bending. Journal of Orthopaedic Trauma, 27(11): e260–e263. doi: 10.1097/BOT.0b013e318290f818.

Furuhata, R.,Nishida, M., Morishita, M., Yanagimoto, S., Tezuka, M., et al. 2020. Migration of a Kirschner wire into the spinal cord: A case report and literature review. The Journal of Spinal Cord Medicine, 43(2): 272–275. doi: 10.1080/10790268.2017.1419915.

Gulyaev, D.A., Godanyuk, D.S., Kaurova, T.A., Krasnoshlyk, P.V.,Maikov, S.V. 2018. Kirschner wire migration into spinal canal after acromioclavicular joint fixation (Literature review and clinical case). Traumatology and Orthopedics of Russia, 24(4): 121–128. doi: 10.21823/2311-2905-2018-24-4-121-128.

Irianto, K.A., Edward, M., Fiandana, A. 2018. K-wire migration to unexpected site. International Journal of Surgery Open, 11: 18–21. doi: 10.1016/j.ijso.2018.04.003.

Ko, H.Y. Lee, K.W. 2019. Contralateral migration of Kirschner wire from right acromioclavicular joint to left side of neck: a case report. Journal of Medical Case Reports, 13(1): 375. doi: 10.1186/s13256-019-2279-1.

Kumar, S., Singh, S.K., Jayant, K., Agrawal, S., Parmar, K.M.,et al. 2014. Forgotten Kirschner wire causing severe hematuria. Case Reports in Urology, 2014: 1–3. doi: 10.1155/2014/305868.

Li, Y., Wang, B., Lv, G., Xiong, G., Liu, W. 2011. Video-assisted thoracoscopic surgery for migration of a kirschner wire in the spinal canal: a case report and literature review. Turkish Neurosurgery. doi: 10.5137/1019-5149.JTN.5300-11.1.

Mankowski, B., Polchlopek, T., Strojny, M., Grala, P., Slowinski, K. 2016. Intraspinal migration of a Kirschner wire as a late complication of acromioclavicular joint repair: a case report. Journal of Medical Case Reports, 10(1): 66. doi: 10.1186/s13256-016-0844-4.

Matsumoto, H., Yo, S., Fukushima, S., Osawa, M., Murao, T., et al. 2017. Forgotten Kirschner wire passing across the sigmoid colon. Clinical Journal of Gastroenterology, 10(2): 154–156. doi: 10.1007/s12328-017-0713-8.

Minić, L., Lepić, M., Novaković, N., Mandić-Rajčević, S. 2016. Symptomatic migration of a Kirschner wire into the spinal canal without spinal cord injury: case report. Journal of Neurosurgery: Spine, 24(2): 291–294. doi: 10.3171/2015.5.SPINE1596.

Mokhtar, A.T., Baghaffar, A., Ramer, S.A., Fraser, J.D. 2020. Migrated fractured sternal wire in proximity to the main pulmonary artery: Case report and review. Journal of Cardiac Surgery, 35(3): 692–695. doi: 10.1111/jocs.14433.

N'da, H.A., Drogba, K.L., Konan, L.M., Haidara, A., Varlet, G. 2018. Spinal kirschner wire migration after surgical treatment of clavicular fracture or acromioclavicular joint dislocation: Report of a case and meta-analysis. Interdisciplinary Neurosurgery, 12: 36–40. doi: 10.1016/j.inat.2017.12.005.

Palauro, F., Stirma, G., Secundino, A., Riffel, G., Baracho, F. 2019). Kirschner wire migration after the treatment of acromioclavicular luxation for the contralateral shoulder – Case report. Revista Brasileira de Ortopedia, 54(02): 202–205. doi: 10.1016/j.rbo.2017.09.017.

Pientka, W. F., Bates, C. M., Webb, B. G. 2016. Asymptomatic migration of a Kirschner wire from the proximal aspect of the humerus to the thoracic cavity. JBJS Case Connector, 6(3): e77. doi: 10.2106/JBJS.CC.16.00032.

Sadat Ali, M., M. Shehri, A., A. Al-Hassan, M., AlTabash, K., Abdul Mohsen, M., et al. 2020. Broken Kirschner wires can migrate: A case report and review of literature. *Journal of Orthopaedic Case Reports*, 10(9). doi: 10.13107/jocr.2020.v10.i09.1884.

Sananta, P., Dradjat, R.S., Julana, R., Pandiangan, R.A.H., Sukmajaya, W.P., et al. 2020. Migration of K-wire into the cavum pleura after the reduction of acromioclavicular dislocation, a case report and review of literature. International Journal of Surgery Case Reports, 74: 192–195. doi: 10.1016/j.ijscr.2020.08.004.

Tan, L., Sun, D.H., Yu, T., Wang, L., Zhu, D., et al. 2016. Death due to intra-aortic migration of Kirschner wire from the clavicle. Medicine, 95(21), p. e3741. doi: 10.1097/MD.0000000000003741.

Tenconi, S., Lococo, F., Rapicetta, C., Ricchetti, T., Paci, M., et al. 2014. Intra pulmonary migration of a Kirschner wire after glenohumeral fixation. Lung, 192(1): 217–218. doi: 10.1007/s00408-013-9524-y.

Wang, P., Chen, C., Liu, B., Wang, X., Jiang, W., et al. 2021. Intracardic migration of Kirschner wire from the right sternoclavicular joint: a case report. BMC Surgery, 21(1): 294. doi: 10.1186/s12893-021-01292-2.

Zacharia, B., Puthezhath, K., Varghees, I. 2016. Kirschner wire migration from subcapital humeral fracture site, causing hydropneumothorax. Chinese Journal of Traumatology, 19(5): 305–308. doi: 10.1016/j.cjtee.2015.12.010.