Journal of Bodywork & Movement Therapies 23 (2019) 448–451

Contents lists available at ScienceDirect

Journal of Bodywork & Movement Therapies

journal homepage: www.elsevier.com/jbmt

Case Report

Neurogenic hallux valgus. A rare complication of spinal surgery

N.K. Sferopoulos*

2nd Department of Orthopaedic Surgery, Aristotle University of Thessaloniki, "G. Gennimatas" Hospital, 546 35, Thessaloniki, Greece

ARTICLE INFO

Article history:
Received 2 May 2019
Accepted 4 May 2019

ABSTRACT

Introduction: Post-surgical lumbar spine syndrome is the result of failed or unsuccessful back surgery. It is defined as failure to relieve pain and disability in the lower back and extremities following surgery. This case report suggests inclusion of neurogenic hallux valgus to the list of potential complications following failed lumbar spine surgery.

Case report: A severe unilateral hallux valgus deformity with an irreducible dislocation of the metatarsophalangeal joint due to complete wasting of the abductor hallucis muscle was diagnosed in a 73-year-old woman admitted for a hip fracture. The patient reported that the deformity developed after a failed lumbar spine surgery, which included decompression and stabilization of L2-S1 with posterior instrumentation 6 years previously. The deformity progressively deteriorated over a 3-year-period. Three months following the hip fracture surgery, the patient went through a neurological examination and an electrophysiological study. The findings indicated that the left hallux valgus deformity most likely developed because of the abductor hallucis muscle wasting due to S1 nerve root injury secondary to the failed lumbar spine surgery.

Conclusion: Post-surgical lumbar spine syndrome may be a reasonable causative etiology of a severe unilateral hallux valgus deformity with an irreducible dislocation of the metatarsophalangeal joint due to complete wasting of the abductor hallucis muscle secondary to S1 nerve root injury.

1. Introduction

Hallux valgus deformity may be due to a wide range of primary or secondary predisposing factors. The former may include several potential extrinsic or intrinsic etiological factors. Muscle dysfunction has been reported as an important intrinsic risk factor. The abductor and the adductor hallucis muscles are the dynamic stabilizers around the first metatarsophalangeal joint. Imbalance between them, with the adductor overpowering the abductor, may have the effect of pulling the proximal phalanx laterally, initiating the development or accelerating the progression of hallux valgus. Electromyographic studies have confirmed a reduction in abductor hallucis muscle activity in people with hallux valgus, however, it is unknown whether it occurs before or after the deformity. Muscle biopsy has been used to examine the histology and ultrastructure of the intrinsic muscles about the great toe revealing abnormal findings in the patient group. The latter may be associated with several systemic conditions, including a range of inflammatory joint diseases, with ligamentous laxity, with neuromuscular disorders, including cerebral palsy, poliomyelitis and Charcot-Marie-Tooth disease, and with iatrogenic malfunction usually due to the surgical removal of the tibial sesamoid (Iida and Basmajian, 1974; Inman, 1974; Shimazaki and Takebe, 1981; Hoffmeyer et al., 1988; Uchiyama et al., 2005; Schuh and Hönle, 2006; Menz, 2008; Perera et al., 2011; Kim et al., 2013). Neurogenic hallux valgus complicating failed lumbar spine surgery has not been previously reported.

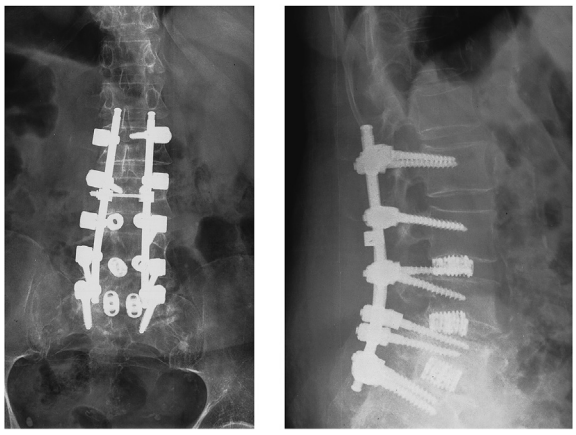
A rare case of neurogenic hallux valgus is presented. The deformity most likely developed because of abductor hallucis muscle wasting due to S1 nerve root injury secondary to a failed lumbar spine surgery. The clinical, imaging and electrophysiological findings are presented and discussed.

2. Case report

A 73-year-old woman was admitted with a displaced fracture of the left femoral neck after a fall. History taking revealed that the patient had undergone lumbar spinal surgery, including decompression laminectomy and instrumented posterolateral spinal fusion from L2 to S1 (Fig. 1a and b), 6 years earlier, for multilevel lumbar canal stenosis. According to the patient, her symptoms,

* P. Papageorgiou 3, 546 35, Thessaloniki, Greece.
E-mail addresses: sferopoulos@yahoo.com, nsferopoulos@gmail.com.

https://doi.org/10.1016/j.jbmt.2019.05.003
1360-8592/



a b

Fig. 1. Anteroposterior (a) and lateral (b) radiographs showing L2-S1 decompression and fusion with posterior instrumentation.

including severe left-sided lumbar pain that radiated to the left buttock, posterior thigh, leg and to the lateral foot, worsened right after surgery. Additionally, a mild left hallux valgus deformity appeared 6 months after the spinal surgery. The patient was evaluated with lumbar spine imaging studies, including radiographs, computed tomography (CT) and magnetic resonance imaging (MRI), 10 months post-operatively. The findings indicated that some of the pedicle screws were inaccurately positioned. An abnormal sign of fluid collection around the screws on the left side was also noted in the MRI associated with nerve root swelling at the left L4, L5, and S1 neural foramens.

The patient had a revision spinal surgery one year after the primary intervention. Revision surgery included replacement of the misplaced pedicle screws and posterolateral lumbar fusion from L1 to S1 with posterior instumentation (Fig. 2). After that, the patient's left lumbar and leg pain was totally relieved. However, the hallux valgus deformity on the left side progressively deteriorated over the next 3 years leading to a severe irreducible dislocation of the first metatarsophalangeal joint. The radiological findings of both metatarsophalangeal joints were evaluated on the anteroposterior standing radiograph. Mild symmetrical degenerative changes were evident on both sides but the hallux valgus deformity was greatly disproportionate showing an incongruent, severely dislocated metatarsophalangeal joint of the left great toe (Fig. 3). No history of pain associated with the hallux valgus deformity was reported.

Physical examination on admission indicated that the left hallux was severely pronated and deviated over the toes, resulting in an underlying deformity of the toes. The prominence of the medial eminence was severely pronounced. The first metatarsophalangeal joint was rigid, with no mobility at all, and irreducible. Complete wasting of the left abductor hallucis muscle was noted (Fig. 4a and b). The deformity was classified as severe considering the degree of the intermetatarsal angle (IMA) and the hallux valgus angle (HVA) on the weight bearing anteroposterior radiograph of the foot.

The patient had a successful hip hemiarthroplasty. Three months post-surgery she was reevaluated. Neurological examination reported absence of pyramidal signs or sensory symptoms in the lower extremities. Dorsiflexion and plantarflexion of the foot and toes were normal. Deep tendon reflexes were absent on the left side. Complete wasting of the left abductor hallucis muscle was mentioned. Electrophysiological studies followed. Nerve conduction studies were normal. Electromyographic examination documented findings of chronic neurogenic lesion in the left gastrocnemius, while anterior tibialis was found normal. Clinical and electrophysiological findings were considered indicative of a chronic S1 radiculopathy.

The patient suffered from severe depression and died eight months following the hip surgery.

3. Discussion

The abductor hallucis is an intrinsic muscle of the foot participating in the abduction, plantar flexion and invertion of the great toe. It is attached proximally on the tuberosity of the calcaneus, the flexor retinaculum, and the plantar aponeurosis. It ends distally in a common tendon with the medial head of the flexor hallucis brevis attaching on the medial surface of the base of the first proximal phalanx and its related sesamoid bone. Anatomical variations of its distal insertion include the medial side of the articular capsule of the first metatarsophalangeal joint, the medial side of the extensor hallucis longus tendon, and others less frequently mentioned. A specific pattern of distal insertion of the abductor hallucis muscle in hallux valgus was not found. The muscle belly is located in the medial border of the foot and contributes to form the prominence that is observed on the region. Its muscle body, relatively thick

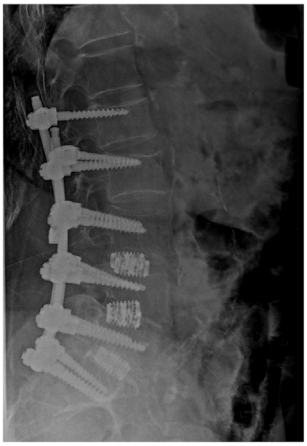


Fig. 2. Lateral radiograph following the revision surgery showing L1-S1 spinal fusion with posterior instrumentation.

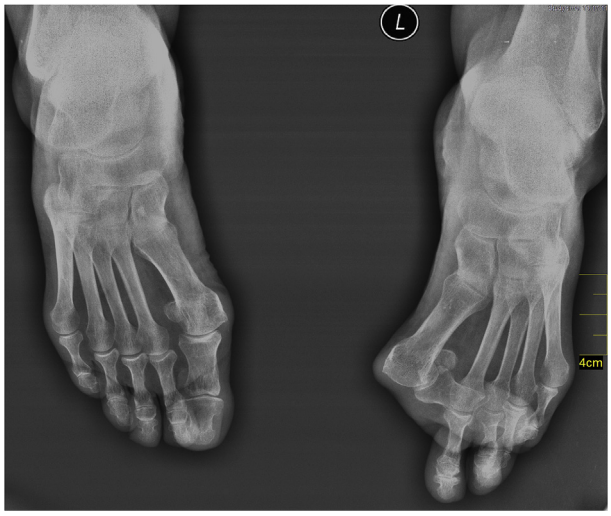


Fig. 3. Anteroposterior standing radiograph showing a severe left hallux valgus deformity with dislocation of the left first metatarsophalangeal joint.

a

b

Fig. 4. Clinical picture of the severe hallux valgus deformity (a), and the gross wasting of the abductor hallucis muscle (b) on the left side.

behind, flattens as it goes forward. It contributes to maintain normal first metatarsophalangeal joint alignment, by being the only force resisting the progressive valgus deformity. It also acts as a dynamic elevator of the medial arch of the foot. The muscle is innervated by a branch of the medial plantar nerve (S1, 2) and supplied by a branch of the medial plantar artery (Young et al., 1983; Brenner, 1999; Wong, 2007; Standring, 2008; Agawany and Meguid, 2010).

Muscle imbalance, indicated by markedly decreased activity of the abductor hallucis muscle when compared with the adductor hallucis muscle, was evident on electomyographic examination of patients with hallux valgus. However, the differential diagnosis between a primary lesion and a secondary that was due to the hallux valgus deformity itself was impossible (Grode and McCarthy, 1980; Arinci Incel et al., 2003). On the other hand, no evidence of shortening or overactivity of the adductor hallucis muscle or tendon has been proved, although successful treatment of the hallux valgus deformity was reported in a patient after botalium toxin A injection into the muscle (Haines and McDougall, 1954; Radovic and Shah, 2008). The use of ultrasound imaging has been proved reliable, irrespective of the type of used equipment, to evaluate the muscle parameters (Cameron et al., 2008; Hing et al., 2009).

Increasing age is associated with a greater reduction in the size of the abductor hallucis muscle in people with hallux valgus (Aiyer et al., 2015). Muscle size is considered an important determinant of muscle strength. Therefore, early interventions designed to increase its strength may be beneficial for patients with hallux valgus (Stewart et al., 2013). Hallux valgus poses a significant health problem, since it is associated with big toe pain, poor balance, immobility, and risk of falling. The relationship between hallux valgus and first metatarsophalangeal joint osteoarthritis, i.e. that they are coexisting conditions or that hallux valgus is a precursor of first metatarsophalangeal joint osteoarthritis, has not been proved. In older people with long-standing hallux valgus marked arthritic degeneration of the metatarsal head is evident. The progression of hallux valgus is slow, and in patients with a significant deformity it has probably been present for many years and it is likely to have been well tolerated by the patient (Turan, 1990; Coughlin and Jones, 2007; Roddy et al., 2008).

The atrophy of intrinsic foot muscles, including abductor hallucis, commonly seen in diabetic patients, is secondary to peripheral motor neuropathy (Greenman et al., 2005).

The post-surgical spine syndrome, also called post-laminectomy pain or failed back surgery syndrome refers to patients with persistent pain and disability following spine surgery. A wide variety of risk factors have been identified. Multiple etiologies have also been proposed to be causative of the syndrome (North et al., 1991; Fritsch et al., 1996; Ordia and Vaisman, 2011; Shapiro, 2014; Baber and Erdek, 2016).

Neurologic complication rates after either cervical spine surgery (Sakaura et al., 2003) or pedicle screw fixation in thoracic, lumbar, and sacral posterior spinal fusions (Yuan et al., 1994; Vaccaro and Garfin, 1995; Gautschi et al., 2011; Yavin et al., 2017) have been evaluated. However, the authors could not directly relate events, such as nerve root irritation or injury, spinal cord injury, and vascular injury to inaccurate screw positioning (Haaker et al., 1997). In adult spinal deformity surgery, including lumbar spine fusion and revision surgery, the incidence of the post-surgical lumbar root palsy is higher with increasing complexity of surgery and with increasing number of fusion levels (Pateder and Kostuik, 2005). Several retrospective studies have also demonstrated higher accuracy rates and increased safety for navigated pedicle screw placement than for free-hand techniques (Mason et al., 2014).

The reported patient had evidence of multiple left nerve root injury (L4-L5-S1) based on the electrodiagnostic studies and the imaging findings at the time of the revision spinal surgery. After the revision surgery the clinical symptoms were totally relieved. Since no sign of L4 and L5 nerve root injury was detected in our patient during the evaluation that was performed 3 months after her hip fracture surgery, it is reasonable to think that the initial L4 and L5 root injuries improved significantly after the revision spinal surgery. However, the left S1 nerve root injury progressed and became chronic causing chronic neurogenic changes of the gastrocnemius, loss of reflexes and atrophy of the abductor hallucis muscle. The latter, most likely, caused an irreducible complete lateral dislocation of the metatarsophalangeal joint of the great toe. In addition, the unilateral localization of the deformity, its fast deterioration, the severe degree of the fixed deformity, the lack of pain, as well as the absence of radiographic findings of arthritic degeneration of the first metatarsophalangeal joint were not consistent with a common natural history of hallux valgus in an ageing woman. Although the pathogenesis of the wasting of the abductor hallucis muscle in the reported patient may not be sufficiently proved, it may be prudent to consider the failed lumbar spine surgery as a reasonable causative etiology of the S1 nerve root injury.

Evaluating the value of this case report, a limitation should be considered referring to the candidate bias of the clinical evaluation, which may occur since the whole estimation was performed by a single author.

In conclusion, post-surgical lumbar spine syndrome may be a reasonable causative etiology of a severe unilateral hallux valgus deformity with an irreducible dislocation of the metatarsophalangeal joint due to complete wasting of the abductor hallucis muscle secondary to S1 nerve root injury.

4. Conflicts of interest

The author certifies that he has no commercial associations (such as consultancies, stock ownership, equity interest, patent/licensing arrangements, etc) that might pose a conflict of interest in connection with the submitted article. The author received no financial support for this study.

Permission to use patient data and images has been obtained from the patient's daughter.

References

Agawany, A.E., Meguid, E.A., 2010. Mode of insertion of the abductor hallucis muscle in human feet and its arterial supply. Folia Morphol. (Warsz) 69, 54–61.

Aiyer, A., Stewart, S., Rome, K., 2015. The effect of age on muscle characteristics of the abductor hallucis in people with hallux valgus: a cross-sectional observational study. J. Foot Ankle Res. 30 (19), 8. https://doi.org/10.1186/s13047-015-0078-5.

Arinci Incel, N., Genç, H., Erdem, H.R., Yorgancioglu, Z.R., 2003. Muscle imbalance in hallux valgus: an electromyographic study. Am. J. Phys. Med. Rehabil. 82 (5), 345–349. https://doi.org/10.1097/01.PHM.0000064718.24109.26.

Baber, Z., Erdek, M.A., 2016. Failed back surgery syndrome: current perspectives. J. Pain Res. 9, 979–987. https://doi.org/10.2147/JPR.S92776.

Brenner, E., 1999. Insertion of the abductor hallucis muscle in feet with and without hallux valgus. Anat. Rec. 254 (3), 429–434. https://doi.org/10.1002/(SICI)1097-0185(19990301)254:3<429::AID-AR14>3.0.CO;2-5.

Cameron, A.F., Rome, K., Hing, W.A., 2008. Ultrasound evaluation of the abductor hallucis muscle: reliability study. J. Foot Ankle Res. 25 (1), 1. https://doi.org/10.1186/1757-1146-1-12, 12.

Coughlin, M.J., Jones, C.P., 2007. Hallux valgus: demographics, etiology, and radiographic assessment. Foot Ankle Int. 28 (7), 759–777. https://doi.org/10.3113/FAI.2007.0759.

Fritsch, E.W., Heisel, J., Rupp, S., 1996. The failed back surgery syndrome: reasons, intraoperative findings, and long-term results: a report of 182 operative treatments. Spine (Phila Pa 1976) 21 (5), 626–633.

Gautschi, O.P., Schatlo, B., Schaller, K., Tessitore, E., 2011. Clinically relevant complications related to pedicle screw placement in thoracolumbar surgery and their management: a literature review of 35,630 pedicle screws. Neurosurg. Focus 31 (4), E8. https://doi.org/10.3171/2011.7.FOCUS11168.

Greenman, R.L., Khaodhiar, L., Lima, C., Dinh, T., Giurini, J.M., Veves, A., 2005. Foot small muscle atrophy is present before the detection of clinical neuropathy. Diabetes Care 28 (6), 1425–1430.

Grode, S.E., McCarthy, D.J., 1980. The anatomical implications of hallux abducto valgus: a cryomicrotomy study. J. Am. Podiatry Assoc. 70 (11), 539–551. https://doi.org/10.7547/87507315-70-11-539.

Haaker, R.G., Eickhoff, U., Schopphoff, E., Steffen, R., Jergas, M., Krämer, J., 1997. Verification of the position of pedicle screws in lumbar spinal fusion. Eur. Spine J. 6 (2), 125–128.

Haines, R.W., McDougall, A., 1954. The anatomy of hallux valgus. J. Bone Jt. Surg. Br. 36 (2), 272–293.

Hing, W.A., Rome, K., Cameron, A.F., 2009. Reliability of measuring abductor hallucis muscle parameters using two different diagnostic ultrasound machines. J. Foot Ankle Res. 16 (2), 33. https://doi.org/10.1186/1757-1146-2-33.

Hoffmeyer, P., Cox, J.N., Blanc, Y., Meyer, J.M., Taillard, W., 1988. Muscle in hallux valgus. Clin. Orthop. Relat. Res. 232, 112–118.

Iida, M., Basmajian, J.V., 1974. Electromyography of hallux valgus. Clin. Orthop. Relat. Res. 101, 220–224.

Inman, V.T., 1974. Hallux valgus: a review of etiologic factors. Orthop. Clin. North Am. 5 (1), 59–66.

Kim, M.H., Kwon, O.Y., Kim, S.H., Jung, D.Y., 2013. Comparison of muscle activities of abductor hallucis and adductor hallucis between the short foot and toe-spread-out exercises in subjects with mild hallux valgus. J. Back Musculoskelet. Rehabil. 26 (2), 163–168. https://doi.org/10.3233/BMR-2012-00363.

Mason, A., Paulsen, R., Babuska, J.M., Rajpal, S., Burneikiene, S., Nelson, E.L., Villavicencio, A.T., 2014. The accuracy of pedicle screw placement using intraoperative image guidance systems. J. Neurosurg. Spine 20 (2), 196–203. https://doi.org/10.3171/2013.11.SPINE13413.

Menz, H.B., 2008. Foot Problems in Older People. Churchill Livingstone-Elsevier, Edinburgh.

North, R.B., Campbell, J.N., James, C.S., Conover-Walker, M.K., Wang, H., Piantadosi, S., Rybock, J.D., Long, D.M., 1991. Failed back surgery syndrome: 5-year follow-up in 102 patients undergoing repeated operation. Neurosurgery 28 (5), 685–690. ; discussion 690-691.

Ordia, J., Vaisman, J., 2011. Post-surgical spine syndrome. Surg. Neurol. Int. 2, 132. https://doi.org/10.4103/2152-7806.85475.

Pateder, D.B., Kostuik, J.P., 2005. Lumbar nerve root palsy after adult spinal deformity surgery. Spine (Phila Pa 1976) 30 (14), 1632–1636, 15.

Perera, A.M., Mason, L., Stephens, M.M., 2011. The pathogenesis of hallux valgus. J. Bone Joint Surg. Am. 93 (17), 1650–1661. https://doi.org/10.2106/JBJS.H.01630, 7.

Radovic, P.A., Shah, E., 2008. Nonsurgical treatment for hallux abducto valgus with botulinum toxin A. J. Am. Podiatr. Med. Assoc. 98 (1), 61–65.

Roddy, E., Zhang, W., Doherty, M., 2008. Prevalence and associations of hallux valgus in a primary care population. Arthritis Rheum. 59 (6), 857–862. https://doi.org/10.1002/art.23709.

Sakaura, H., Hosono, N., Mukai, Y., Ishii, T., Yoshikawa, H., 2003. C5 palsy after decompression surgery for cervical myelopathy: review of the literature. Spine (Phila Pa 1976) 28 (21), 2447–2451. https://doi.org/10.1097/01.BRS.0000090833.96168.3F, 1.

Schuh, A., Hönle, W., 2006. Pathogenesis of hallux valgus. MMW - Fortschritte Med. 30 (48), 31–32, 148.

Shapiro, C.M., 2014. The failed back surgery syndrome: pitfalls surrounding evaluation and treatment. Phys. Med. Rehabil. Clin. North Am. 25 (2), 319–340. https://doi.org/10.1016/j.pmr.2014.01.014.

Shimazaki, K., Takebe, K., 1981. Investigations on the origin of hallux valgus by electromyographic analysis. Kobe J. Med. Sci. 27 (4), 139–158.

Standring, S., 2008. Gray's Anatomy: the Anatomical Basis of Clinical Practice. Churchill Livingstone-Elsevier, Edinburgh.

Stewart, S., Ellis, R., Heath, M., Rome, K., 2013. Ultrasonic evaluation of the abductor hallucis muscle in hallux valgus: a cross-sectional observational study. BMC Musculoskel. Disord. 28 (45), 14. https://doi.org/10.1186/1471-2474-14-45.

Turan, I., 1990. Correlation between hallux valgus angle and age. J. Foot Surg. 29 (4), 327–329.

Uchiyama, E., Kitaoka, H.B., Luo, Z.P., Grande, J.P., Kura, H., An, K.N., 2005. Pathomechanics of hallux valgus: biomechanical and immunohistochemical study. Foot Ankle Int. 26 (9), 732–738. https://doi.org/10.1177/107110070502600911.

Vaccaro, A.R., Garfin, S.R., 1995. Pedicle-screw fixation in the lumbar spine. J. Am. Acad. Orthop. Surg. 3 (5), 263–274.

Wong, Y.S., 2007. Influence of the abductor hallucis muscle on the medial arch of the foot: a kinematic and anatomical cadaver study. Foot Ankle Int. 28 (5), 617–620. https://doi.org/10.3113/FAI.2007.0617.

Yavin, D., Casha, S., Wiebe, S., Feasby, T.E., Clark, C., Isaacs, A., Holroyd-Leduc, J., Hurlbert, R.J., Quan, H., Nataraj, A., Sutherland, G.R., Jette, N., 2017. Lumbar fusion for degenerative disease: a systematic review and meta-analysis. Neurosurgery 80 (5), 701–715. https://doi.org/10.1093/neuros/nyw162.

Young, A., Getty, J., Jackson, A., Kirwan, E., Sullivan, M., Parry, C.W., 1983. Variations in the pattern of muscle innervation by the L5 and S1 nerve roots. Spine (Phila Pa 1976) 8 (6), 616–624.

Yuan, H.A., Garfin, S.R., Dickman, C.A., Mardjetko, S.M., 1994. A historical cohort study of pedicle screw fixation in thoracic, lumbar, and sacral spinal fusions. Spine (Phila Pa 1976) 19 (20 Suppl. l), 2279S–2296S.