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*Case Report*

# Occipital dermal sinus associated with infectious teratoma in an adult patient affected by Klippel–Feil syndrome: Rare case report and literature review

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## ABSTRACT

**Background:** The Klippel–Feil syndrome (KFS) is a rare congenital anomaly characterized by the fusion of cervical vertebrae, which may be associated with other malformations, such as dermoid tumors and teratoma. Some theories explain the embryology of these associations. Another condition that may be present is the dermal sinus (DS), communication between intracranial tumors and the subcutaneous tissue, and predisposing infections. This case report aims to describe an association between these three pathologies as well as correlate them from the literature. This report was based on medical records retrospectively reviewed associated with the systematic bibliographical consultation using indexed databases based on inclusion and exclusion methods.

**Case Description:** An adult male patient, 24 years old, was admitted to our service, presenting fever and meningeal irritation as initial symptoms. In the patient's clinical history, he was diagnosed with an occipital DS in his childhood, which was previously instructed to be operated on by another neurosurgical team, but the patient chose not to perform the procedure. The magnetic resonance imaging investigation showed a DS associated with a cerebellar infected mass with 2 cm on its main diameter. The patient was treated with preoperative antibiotic therapy and underwent gross total surgical resection of the tumor as well as DS correction, confirmed in the histopathological examination as a teratoma. After surgery, further computed tomography scan analysis showed the presence of cervical vertebrae fusion, compatible with KFS diagnosis.

**Conclusion:** The association between KFS, cerebellar teratoma, and DS has not yet been described in the literature, with only the association of the first two being extremely rare.

**Keywords:** Dermal sinus, Klippel–Feil syndrome, Teratoma

## INTRODUCTION

Klippel–Feil syndrome (KFS) is characterized by the classic triad consisting of limitation of movement, low scalp implantation, and short neck.[6] This abnormality is considered to originate during the differentiation of the formation of mesodermal somites in the 4th week of gestation. It has recently been associated with mutations in the GDF3 and GDF6 genes.[1,14] The syndrome

classifies the disease into three morphological types, with Type 1 characterized by a massive fusion of several cervical and/or thoracic vertebrae, Type 2 when there is a fusion of 1 or 2 intervertebral spaces, with hemivertebrae, fusion atlantooccipital and associations with other cervical abnormalities, and Type 3 when it affects low thoracic or lumbar vertebrae.[4,14]

The dermal sinus (DS) is defined as an epithelium-lined tract that results from incomplete separation of the cutaneous ectoderm from the underlying neuroectoderm. Although DS is an easily identifiable and curable lesion, its pathological importance resides in the risk of intracranial infection[7] and the variable association with dysembryogenic tumors (dermoid and epidermoid lineage) and neurological syndromes,[10] such as KFS.

Teratomas originate from failures in the differentiation of embryonic cells, thus being developed during prenatal life. They usually have a good prognosis, but it depends on several clinical factors such as location, gender, age at diagnosis, and histology. They comprise between 0.5% and 1.5% of all intracranial tumors, with a preference for locations close to midline structures, such as the pineal gland and neurohypophysis. Cerebellar teratomas are extremely rare, with few cases described in the literature so far.

KFS has an incidence of 1:40,000–42,000 births, and DS affects <1% of the neonatal population. In the literature, there are already descriptions of cases of dermoid associated with KFS, as well as KFS and teratomas, despite few identified cases. The association of DS, infected teratoma, and KFS with initial symptoms in adulthood has not yet been described in the literature.[14] The authors' objective was to report a rare case of DS associated with cerebellar teratoma and KFS in the same patient, as well as our results in the histological and immunohistochemical analysis described in the literature, aiming to improve the characterization of the association between these pathologies.

## CASUISTIC AND METHODS

### Bibliographic research

A bibliographic search was carried out in the MEDLINE, LILACS, and PubMed-indexed databases, with the following descriptors: "Dermal Sinus," "Teratoma," and "Klippel–Feil Syndrome," using the Boolean operator "AND." The descriptors were interspersed during the database search to increase the number of identified cases. Language was selected as a selection criterion, preferably choosing articles in Portuguese, Spanish, or English and only articles based on studies with human beings. No year limitation was added during the search. Fifty-five articles were found, and 15 were selected for literature review.

### Histological study

The surgical samples were fixed with 10% formaldehyde and were cut in the central region for the process of paraffin embedding after 24 h. The paraffin blocks were cut lengthwise with a thickness of 4 μm for mounting slides that the Hematoxylin stained–Eosin technique aiming to analyze the histological changes of the specimens. The histological analysis objected to determining the presence of tumor, necrosis, pleomorphism, mitosis, fibrosis, and characterization of cells.

### Immunohistochemical analysis

The specimens embedded in paraffin also underwent to immunohistochemical staining technique using the avidin-biotin peroxidase complex method (Dako, Glostrup, Denmark) with diaminobenzidine as the chromogen and the primary antibodies: epithelial membrane antigen, synaptophysin, glial fibrillary acidic protein (GFAP), cytokeratin (CAM 5.2), S-100 protein, and Ki-67. Finally, the slides were mounted with Permount (Fisher Scientific, Pittsburgh, USA).

## CASE REPORT

### Clinical history and neurological examination

An adult patient, a male 24 years old, was admitted to our service, presenting fever as an initial symptom. On neurological examination, we showed the presence of meningeal irritation associated with phlogistic signs and continuous solution of skin in the occipital region while no other clinical abnormality was detected. In the patient's past clinical history, he was diagnosed with an occipital DS in his childhood, which was previously instructed to be operated on by another neurosurgical team. However, the patient refused to perform the procedure. A lumbar puncture of the cerebrospinal fluid showed suggestive bacterial meningitis (protein elevated, polymorphonuclear leukocytes, and low glucose) in the biochemical and cytological analysis.

### Neuroimaging investigation

The magnetic resonance imaging (MRI) investigation showed the previously diagnosed DS associated with a cerebellar mass with 2.0 cm on its main diameter. The cerebellar mass presented as an enhanced, heterogeneous, partially hyperintense posterior fossa lesion with moderate mass effect on axial and sagittal contrast-enhanced T1-weighted MRI [Figure 1].

### Surgery

The patient was treated with antibiotic therapy for ten days preoperatively. After the preoperative trichotomy, it is

possible to see the DS skin defect [Figure 2a]. We performed a midline occipital craniotomy in the ventral position that showed the communication of the DS through the skull bone in the occipital region [Figure 2b]. After performing the craniotomy and identifying the landmarks [Figure 2c], a successful gross total resection was performed [Figure 3a], and it was removed in block stepwise by microsurgical technique. The tumor mass showed slight adherence to the cortex. The tumor was rubbery, vascular, and well-demarcated from the surrounding brain. Finally, the DS correction was performed [Figure 3b].

### Pathological examination

The conventional H&E (×100) showed a chronic granulomatous inflammatory process with the presence of body giant cells [Figure 4a] and an immune response of a strange body showed in detail when the body giant cell phagocyting the hair [Figure 4b]. There was no evidence of infiltrative growth, and a small rim of reactive glial tissue was visible at parts of the tumor margins. Immunohistochemical expression using antibodies against GFAP confirmed the presence of glial tissue [Figure 5]. Thus, a dermoid cyst was ruled out, and a mature infected teratoma was diagnosed.

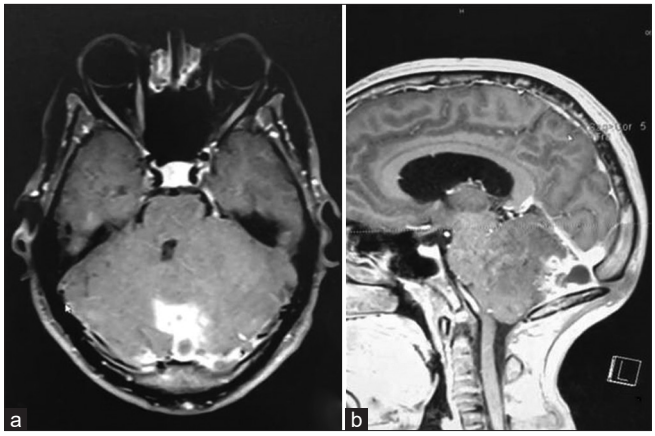

**Figure 1:** (a) Preoperative contrasted T1-weighted MR1 in axial plane. (b) Preoperative contrasted T1-weighted MR1 in sagital plane.

### Postoperative

The postoperative period was uneventful; neurological examination did not reveal any additional deficits, and imaging control did not show any residual or recurrent tumor [Figure 6]. After surgery, further computed tomography (CT) scan analysis showed the presence of cervical vertebrae fusion, compatible with KFS diagnosis [Figure 7]. At present, the patient is doing well after five years postoperatively, without any signs of recidive.

## DISCUSSION

KFS is a congenital condition that was first described in 1912. The prevalence of this syndrome has been reported to be high (1 in 172 live births),[12] however, underdiagnoses are noted since most cases have been described in the literature as incidentally found in magnetic resonance imaging. This anomaly may be associated with other anatomical abnormalities such as cleft palate, renal agenesis, malformation of the aortic arch, spina bifida, and other structural alterations in the brain.[3]

Embryologically, during the 1st week of gestation, the formation of the neural tube occurs, which is a structure responsible for the formation of the central nervous system. Between the 3rd and 8th weeks of embryonic life, the formation of segmental cervical sclerotomes occurs; at this stage, defects may occur, and a hypothesis proposes that KFS may be a type of failure in the proper separation of the cervical sclerotomes during embryonic development. These sclerotomes must separate correctly to form the individual

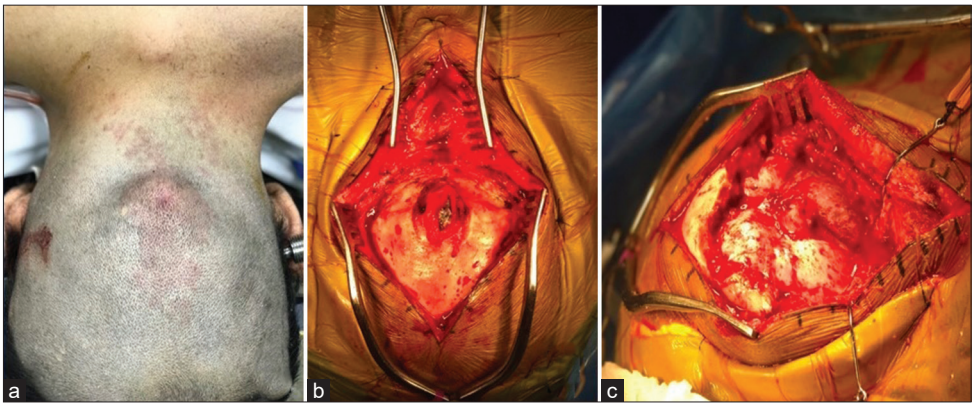

**Figure 2:** (a) Preoperative occipital region after trichotomy. (b) Communication of dermal sinus through the skull bone in the occipital region. (c) Craniectomy and surgical view of the confluence of posterior fossa vein sinuses.

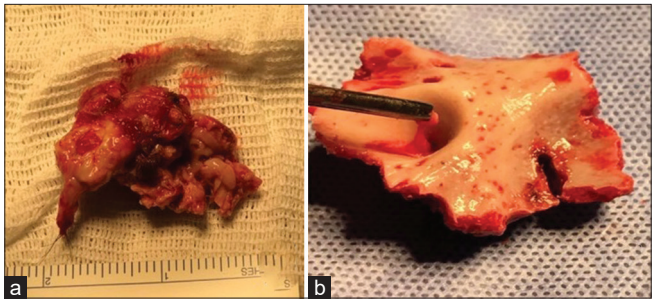

**Figure 3:** (a) Teratoma. (b) Surgical view of dermal sinus through the occipital bone.

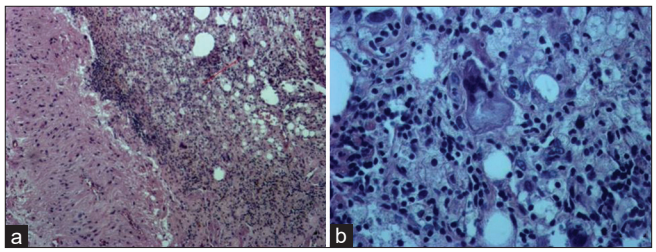

**Figure 4:** (a) Photomicrographs of hematoxylin-and-eosin (100×) showing chronic granulomatous inflammatory process with the presence of body giant cells. (b) Photomicrographs of hematoxylin-and-eosin (400×) showing in detail the body giant cell phagocyting the hair.

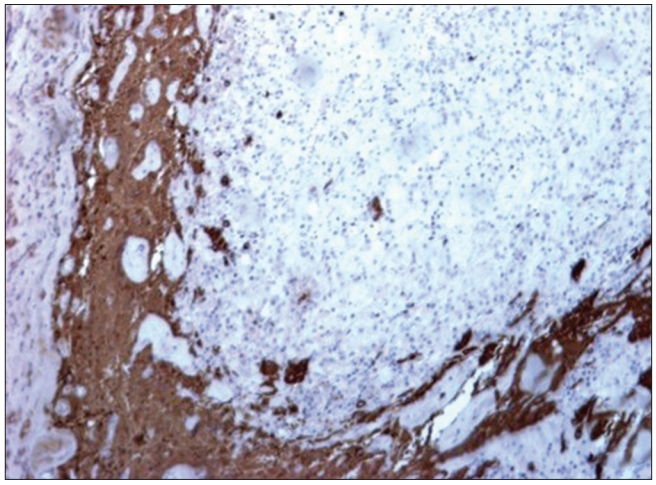

**Figure 5:** Photomicrographs of immunohistochemistry (×400) showing an increase in the expression of Glial fibrillary acidic protein (GFAP).

vertebrae and associated structures, such as the muscles and ligaments of the cervical spine.[1] Another explanation proposes that this anomaly may arise due to the shortening of the cervical spine that occurs during the formation of the cephalic and cervical flexures of the brain. This shortening is related to somite fusion and can lead to altered tissue tension.

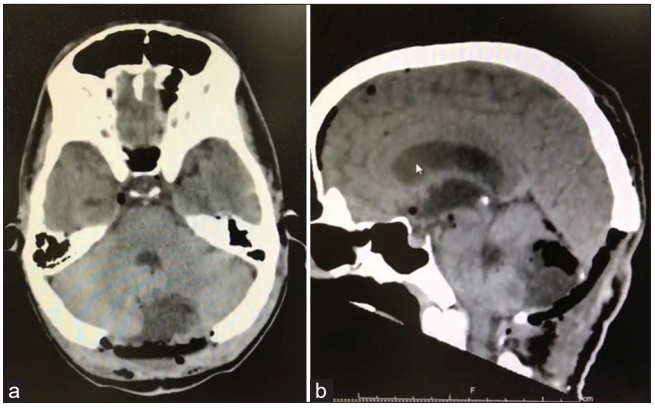

**Figure 6:** (a) Postoperative computed tomography in the axial plane. (b) Postoperative computed tomography in the sagital plane.

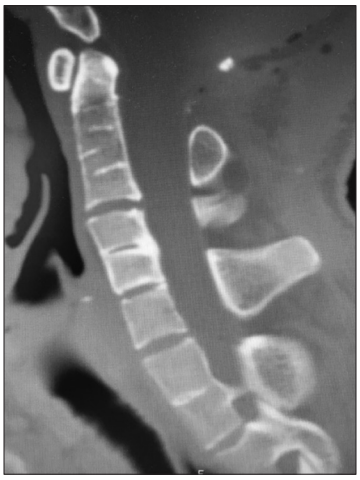

**Figure 7:** Computed tomography of the cervical spine showing the presence of vertebrae fusion.

As a result, immature dermal elements can become trapped and fail to develop properly between the 3rd and 5th weeks of embryonic life; as a consequence, dermoid tumors can form in the subtentorial midline of the posterior cranial fossa. These tumors may expand if the cutaneous tract persists and contains hair, epithelial debris, and sebaceous material.[1,15] Thus, the literature shows that the association between dermoid tumors in the posterior fossa and KFS is well known. However, the connection between cervical fusion anomaly with teratomas is rarely reported.

Intracranial teratoma is a rare type of tumor that makes up only 0.3–0.9% of all intracranial tumors and tends to present in midline sites such as the pineal gland and suprasellar regions. Teratomas usually occur in the first two decades of life; however, few cases have been reported in adults.[2,3] Thus, among many particularities,

**Table 1:** Clinical summary of two cases of patients with teratoma associated with Klippel–Feil syndrome.

| Author, year | Age, Sex | Clinical presentation | Vertebrae | Teratoma location | Treatment | Histopathological | other Anomalies | Outcome |
|---|---|---|---|---|---|---|---|---|
| Adorno *et al*. 2015[1] | Male, 72 | Gait and balance disorders, paresthesia. Short neck with hair low at the back of the head. | C3-C4 | Fourth ventricle. | Suboccipital craniectomy. | Teratoma, partially cystic, with areas of pseudo-cartilage and hairy formations and bites. | Not mentioned. | The postoperative period was uneventful, with neurological improvement. |
| Edward *et al*. 2017[3] | Woman, 38 | Headache, nasal obstruction, nausea and vomiting. Webbed neck, cleft lip, and cleft palate. | C2-C3 | The base of the skull of the sphenoid. | Endoscopic endonasal resection. | Benign mature teratoma. | Cleft lip and palate. | After 3 years of the surgery, he presented well. |

**Table 2:** Clinical summary of the 14 cases of Klippel–Feil syndrome and tumor dermoid plus dermal sinus.

| Author, year | Age, sex | Clinical presentation | Location | Treatment | Outcome |
|---|---|---|---|---|---|
| Turgut, 2009[15] | 6 Females (1–61 years old) 6 Males (2–36 years old) | 3 Raised intracranial pressure. Progressive headache, diplopia, dizziness Occipital lump, Recurrent meningitis, Short neck | 9 Cerebellar worm 2 Cerebellar hemisphere 1 Cerebellar vallecula | 7 Total resection 2 Partial resection 2 Cyst punch and resection 1 Not stated | 4 Asymptomatic 3 No follow-up 1 Not stated 1 No residual tumor 2 I do not receive |
| Ramzam, 2010[11] | 1 Female, 5 years old | Her neck was short, and her hairline was low; cerebellar signs were evident on the right side | Inermis and right cerebellar hemisphere | Sub-occipital craniectomy | After 3 months of follow-up, he found himself well |
| Madhugiri and Bhagavatula, 2013[10] | 1 male, 40 years old | Generalized convulsions, headache, and vomiting. Short stature and short neck | Rear ditch | Median sub-occipital craniectomy | Four years after surgery, the patient remained neurologically stable |

the occurrence of teratoma in the posterior fossa in an adult is a rare feature of this case. It is composed of nongerminomatous germ cells that present different types of tissues derived from the endodermal, mesodermal, and ectodermal layers.[1] Its biological behavior depends on interdependent clinical and epidemiological variables, such as age at diagnosis, patient gender, tumor site, and histology, which correlate with different cytogenetic and molecular biological alterations.[5,8]

During the database search, only two reports involving KFS-associated teratoma were found, with different locations; one located in the fourth ventricle and the other located at the base of the skull [Table 1]. As seen, the association between the KFS in the presence of posterior fossa dermoid tumors is well established, and the presence of DS is another finding in some of these cases;[9,11] on average, 14 cases have been reported in the literature showing this triple correlation [Table 2]. Of these 14, all had a fusion of vertebrae, found by image examinations, and short neck, both KFS manifestations; all selected cases had a later fossa location and had a dermal breast. In addition, most were subjected to surgical treatment; in two cases, sub-craniectomy was performed, seven cases reported total resection, two cases of partial resection without specifying the technique, two cases of puncture and resection, and one was not described.[3] In contrast, among the provided results, only two cases associate KFS with teratoma. This highlights the rarity of such occurrences. This report presents the case of a patient presenting a teratoma located in the posterior subtentorial fossa, associated with Klippel Feil's anomaly and the DS, an atypical location when correlated with the findings. As far as

we know, this is the first case in the literature that presents this condition.

Congenital DS arises from incomplete separation of surface ectoderm and neural ectoderm, resulting in focal segmental adhesion.[13] The prevalence is reported as 1 in 2500 live births,[4] although it includes cases before the use of MRI for diagnosis, making the true prevalence uncertain. The patient in the reported case had DS since childhood; at the time, neurosurgery indicated surgical correction, which was not performed; at the age of 24, he opened a picture of meningeal irritation and then performed a lumbar puncture diagnosing meningitis. Studies prove that in the recurrence of meningitis in children, it is necessary to investigate the presence of congenital dermal sinuses, as there is an evident communication between the intracranial tumor and the subcutaneous tissue, thus being a gateway for infections.[15] Their presence is often associated with the diagnosis of dermoid cysts; however, as reported in some cases, teratomas can also occasionally present with a DS as a cutaneous presentation.[2] Our case describes a teratoma associated with the DS.

## CONCLUSION

The association between KFS, cerebellar teratoma, and DS has not yet been described in the literature, and the association of the first two is rare, with a reduced number of reported cases. Patients who present KFS or alterations in the posterior fossa need to be investigated for the early diagnosis of other possible associated congenital lesions, looking for alterations from the posterior fossa to the complete cervical spine. As well as patients with a history of recurrent meningitis, they should be investigated to assess whether they have a DS and other associated congenital pathologies. There is no established single treatment, requiring a careful and individualized assessment of each case.

### Ethical approval

Institutional Review Board approval is not required.

### Declaration of patient consent

The authors certify that they have obtained all appropriate patient consent.

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Nil.

### Conflicts of interest

There are no conflicts of interest.

### Use of artificial intelligence (AI)-assisted technology for manuscript preparation

The authors confirm that there was no use of artificial intelligence (AI)-assisted technology for assisting in the writing or editing of the manuscript, and no images were manipulated using AI.

## REFERENCES

1. Adorno A, Alafaci C, Sanfilippo F, Cafarella D, Scordino M, Granata F, *et al*. Malignant teratoma in klippel-feil syndrome: A case report and review of the literature. J Med Case Rep 2015;9:229.
2. Bohara M, Yonezawa H, Karki P, Bakhtiar Y, Hirano H, Kitazono I, *et al*. Mature posterior fossa teratoma mimicking dermoid cyst. Brain Tumor Pathol 2012;30:262-5.
3. Edward JA, Psaltis AJ, Williams RA, Charville GW, Dodd RL, Nayak JV. Endoscopic resection of skull base teratoma in klippel-feil syndrome through use of combined ultrasonic and bipolar diathermy platforms. Case Rep Otolaryngol 2017;2017:6384586.
4. Foster MT, Moxon CA, Weir E, Sinha A. Dermal sinus tracts. BMJ 2019;366:l5202.
5. Gobel U, Calaminus G, Engert J, Kaatsch P, Gadner H, Bökkerink JP, *et al*. Teratomas in infancy and childhood. Med Pediatr Oncol 1998;31:8-15.
6. Gruber J, Saleh A, Bakhsh W, Rubery PT, Mesfin A. The prevalence of klippel-feil syndrome: A computed tomography-based analysis of 2,917 patients. Spine Deform 2018;6:448-53.
7. Gumerlock MK, Spollen LE, Nelson MJ, Bishop RC, Cooperstock MS. Cervical neurenteric fistula causing recurrent meningitis in klippel-feil sequence: Case report and literature review. Pediatr Infect Dis J 1991;10:532-5.
8. Harms D, Zahn S, Gobel U, Schneider DT. Pathology and molecular biology of teratomas in childhood and adolescence. Clin Pediatr 2006;218:296-302.
9. Hinojosa M, Tatagiba M, Harada K, Samii M. Dermoid cyst in the posterior fossa accompanied by klippel-feil syndrome. Childs Nerv Syst 2001;17:97-100.
10. Madhugiri VS, Bhagavatula ID. Congenital anomalies at the craniovertebral junction-posterior fossa region: Report of two cases. J Neurol Surg A Cent Eur Neurosurg 2013;74: e279-83.
11. Ramzan A, Khursheed N, Rumana M, Abrar W, Ashish J. Posterior fossa dermoid with klippel-feil syndrome in a child. Pediatr Neurol 2011;45:197-9.
12. Samartzis DD, Herman J, Lubicky JP, Shen FH. Classification of congenitally fused cervical patterns in klippel-feil patients: Epidemiology and role in the development of cervical spine-related symptoms. Spine (Phila Pa 1976) 2006;31:E798-804.
13. Song Y, Xia Z, Qiu S, Gao P, Yang B, Bao N. Surgical treatment of congenital dermal sinus: An experience of 56 cases. Pediatr Neurosurg 2021;56:416-23.
14. Thomsen MN, Schneider U, Weber M, Johannisson R, Niethard FU. Scoliosis and congenital anomalies associated

with klippel-feil syndrome types I-III. Spine (Phila Pa 1976) 1997;22:396-401.
15. Turgut M. Klippel-feil syndrome in association with posterior fossa dermoid tumour. Acta Neurochir (Wien) 2009;151: 269-76.

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