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Klippel-Feil syndrome and associated congenital abnormalities: evaluation of 23 cases

Klippel-Feil sendromu ve eşlik eden doğumsal anomaliler: 23 olgunun incelenmesi

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Amaç: Bu çalışmada Klippel-Feil sendromlu erişkin olgular gözden geçirildi.

Çalışma planı: Çalışmaya Klippel-Feil sendromlu 23 erkek hasta (ort. yaş 20.5, dağılım 19-27) alındı. Tüm hastalar ortopedik klinik muayene yanında, servikal fleksiyon ve ekstansiyonda ve normal ön-arka ve yan grafiler, dorsolomber ve lumbosakral ön-arka ve yan grafiler; abdominal ultrasonografi; ürolojik muayene; elektrokardiyografi, ekokardiyografi ve kardiyolojik muayene; pür ton odyometri, konuşma odyometrisi, timpanometri ve kulak burun boğaz muayeneleri; nörolojik ve psikiyatrik muayeneler ile incelendi. Yedi hastada temporal bilgisayarlı tomografiye, üç hastada servikal manyetik rezonans görüntülemeye başvuruldu.

Sonuçlar: Hastaların hepsinde skolyoz, servikal füzyon (2-5 vertebra arasında), düşük ense çizgisi ve kısa boyun vardı. Bir hastada lomber vertebralarda da füzyon görüldü. Bir hastada tek taraflı renal agenezi; dokuz hastada çeşitli derecelerde işitme kaybı; beş hastada kardiyak sorun saptandı. Bir hastada epilepsi, bir hastada dikkat çekecek kadar ileri düzeyde, bir hastada ise hafif düzeyde ayna hareketi vardı.

Çıkarımlar: Klippel-Feil sendromlu olgular, servikal vertebra füzyonu dışında diğer sistem patolojileri açısından da değerlendirilmelidir.

Anahtar sözcükler: Anomali, multipl; servikal vertebra/anormallik; Klippel-Feil sendromu/komplikasyon.

Objectives: The purpose of this study was to review adult patients with Klippel-Feil syndrome.

Methods: The study included 23 male patients (mean age 20.5 years, range 19 to 27 years) with Klippel-Feil syndrome. Besides orthopedic clinical evaluations, all the patients were assessed by anteroposterior and lateral cervical flexion/extension and thoracolumbar radiographies, abdominal ultrasonography, and were subjected to systemic examinations to detect any urological, cardiological, otorhinolaryngological, neurological, and psychiatric findings. Temporal computed tomography was performed in seven patients, and cervical magnetic resonance imaging in three patients.

Results: Scoliosis, fusion of the cervical vertebrae (between 2-5 vertebrae), low hairline and short neck were found in all the cases. Lumbar fusion was detected in one patient. Other findings included renal agenesis (n=1), different types of hearing loss (n=9), cardiac pathologies (n=5), epilepsy (n=1), and marked (n=1) or mild (n=1) mirror movements.

Conclusion: Patients with Klippel-Feil syndrome should be assessed for associated systemic abnormalities besides cervical fusion.

Key words: Abnormalities, multiple; cervical vertebrae/ abnormalities; Klippel-Feil syndrome/complications.

Klippel-Feil syndrome is the congenital fusion of cervical vertebrae. It may be seen as the fusion between two vertebras or of all cervical vertebras. Congenital cervical fusion occurs as a result of failure in normal segmentation of cervical summits. Cause of this failure is unknown and occurs at sec-

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ond-eight weeks of gestation. Incidences are estimated to be approximately one out of 40000-42000 births and are seen more frequently in females.[1-4]

Classical clinical triad of Klippel-Feil syndrome is lower neckline, short neck and restriction of head and neck movements. This classical triad is seen about 40-50% and the most common finding is restriction of movements with a ratio of 50-76%.[2-5] In patients with moderate involvement, this classical triad may not be seen and marked restriction of neck movements may not be present in patients with advanced cervical involvement. Skeletal system abnormalities such as scoliosis and/or kyphosis (60%), Sprengel deformity (30%) and torticollis, urinary system abnormalities (35%), loss of hearing (30%), facial asymmetry and flattening of neck (20%), synkinesis or mirror movements (20%), congenital heart diseases (4.2-14%) may be seen with Klippel-Feil syndrome. Brain stem anomalies, congenital cervical stenosis, adrenal aplasia, pitosis, lateral rectus muscle paralysis facial nerve paralysis, syndactilia, diffuse or focal hypoplasia in upper extremities may also be seen.[1-4]

The objective of this study is to look over cases with Klippel-Feil syndrome who has reached to 20-25 years of age, to put forward which systems should be considered while a case with Klippel-Feil syndrome is evaluated and to discuss the necessity of treatment.

Patients and method

23 patients (23 males; mean age 20.5. distribution 19-27) with Klippel-Feil syndrome who applied to our outpatient clinics of orthopedics have been examined between October 2000 and July 2002

All patients have been subjected to orthopedic clinical examination, cervical flexion and extension lateral, normal antero-posterior and lateral x-rays , abdominal ultrasound, urological examination, electrocardiography, echocardiography and cardiologic examination, pure tone audiometry, speech audiometry, tympanometry and ENT (ear-nose-throat) examination, neurological examination, psychiatric examination and analyses. Also, temporal computed tomography on seven patients and cervical magnetic resonance imaging (MRG) on two patients have been performed.

During normal orthopedic examinations of patients, neck movements, neckline levels, torticollis and scoliosis and presence of extremity abnormalities have been especially recorded.

Results

A scoliosis has been determined on whole of patients. Scoliosis were at cervico-thoracic region and there were congenital scoliosis with average Cobb angle of 20° in group type 1 (n=21), 15° Cobb angle in group type 2 (n=l) and 10° Cobb angles in group type 3. Cervical fusion (on 2-5 vertebras), low neckline and short neck have been determined on all patients (Figure 1).

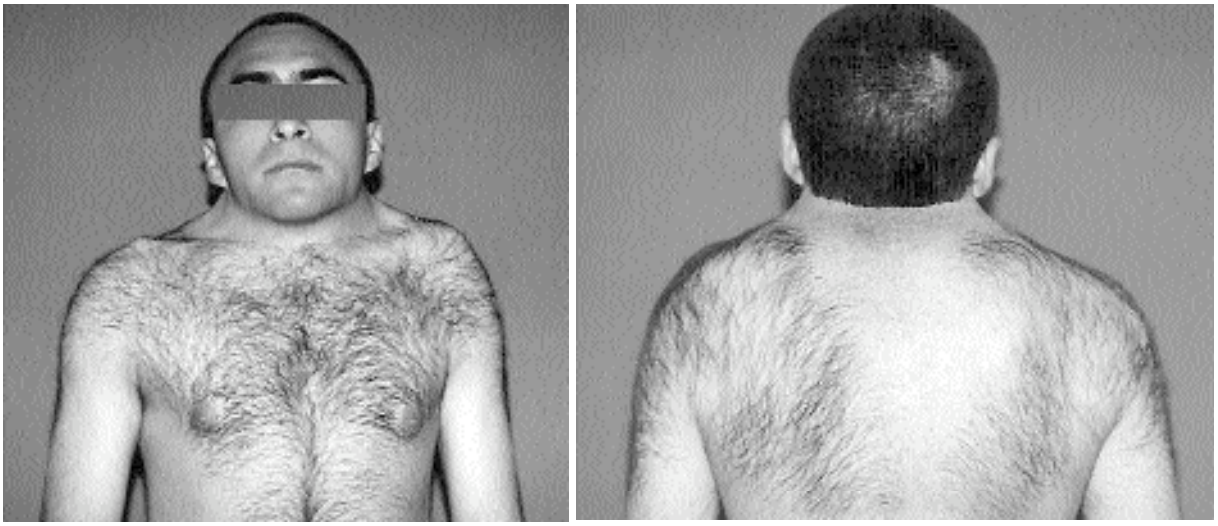

Figure 1. Front and back view of a case with Klippel-Feil syndrome. Short neck and low neckline takes the attention.

Head and neck movements were restricted less than 50% of range of motion for flexion-extension, right-left tilt and rotations in six patients, while there were restrictions more than 50% of range of motion in nine patients. Especially rotational restrictions in seven patients with torticollis were more marked.

On seven patients (30%) torticollis and a facial asymmetry de to this have been determined and Sprengel deformity have been determined on five patients (21.7%).

There were fusions of lumbar vertebras in one patient. There were developmental retardations on upper extremities, more marked in bilateral radius and ulna tilt, thickening and shortening style, and this is the one having most severe clinical picture.

There have been unilateral renal agenesis in one patient, asymptomatic renal cyst in another patient, mild conduction type loss of hearing in four patients, sensory-neural hearing loss of mild degree in two patients and of advanced degree in one patient, combined total loss of hearing in two patients, minimal mitral insufficiency in two patients, aortic insufficiency in one patient, and mitral valve prolapse, mitral insufficiency and aortic insufficiency concomitantly in another patient. Operated atrial septal defect and mitral valve prolapse have been determined concomitantly in another patient. There was epilepsy in one of patients and two patients had undergone shunt operations for hydrocephaly. There was mirror movement at an advanced level in one patient and at a mild level another patient. Psychiatric questionnaire forms were applied to those two patients.

On family trees obtained by expressions of patients, while one patient describes one individual in their relatives having similar disease, other patients have expressed that they didn't have any family members with similar disease.

Discussion

Classical clinical triad of Klippel-Feil syndrome is short neck, low neckline and restriction in neck movements. If there are fusion in less than three vertebras or if there is involvement of lower cervical vertebras, restriction of neck movements may be seen less. A torticollis accompanying the disease may mask the shortness of neck.

Patients with Klippel-Feil syndrome can be divided into three groups according to locations of vertebral fusions. In type 1, there are fusion of all or almost all of cervical vertebras and upper thoracic vertebras. In Type 2, there is fusion in double or triple segments. In Type 3, lower vertebral fusion accompanies to cervical vertebral fusion. While type 1 and 3 show an autosomal recessive trait, type 2 is rather autosomal dominant. Although Type 2 is observed more associated with skeletal abnormalities, skeletal system anomalies show more severe outcome.[1,4,6,7] While our 21 cases are included in type 1, one patient was determined to be type 2 and one patient to be type 3 (Figure 2-4). While other types of skeletal system abnormalities haven't been more marked, the patient with type 3 has been the one with most severe picture, and there were also lumbar fusion and marked upper extremity anomalies. Clarke et al.[8] have classified Klippel-Feil syndrome according to position of cervical vertebral fusion, status of familial trait and its characteristics. There are 4 classes in this classification (KF 1,2,3,4). There are C1 fusion and marked autosomal recessive trait in KF1. There is absolutely a fusion of C2-3 in KF2 and shows an autosomal dominant trait. C3 fusion is marked in KF3 and trait is reduced penetration type or autosomal recessive. Eye anomalies accompanying the cervical fusion are significant in KF4 and there is an X-linked trait.

If a hyper-mobility occurs on vertebras not having fusion, symptoms of cervical vertebra may appear. Neurological sequels may be present. If progressive and persistent instabilities occur, spasticity, weakness, hyperreflexia, quadriplegia and sudden deaths due to traumas may be seen when spinal cord is affected. Necessity for treatment is rather due to pathologies that may result from deformities and accompanying systemic manifestations. Existence or potential for any neurological deficit may raise a requirement for treatment. In anomalies of occipitocervical passage, high morbidity and mortality rates have been frightening. Because cervical cord and brain stem are very close to each other.[9]

Use of a halo is mostly required for starting of head tilt to the right or left side or for any rotation. A correction may be performed simultaneously with halo. Both skull position and upper cervical column may be corrected. If right-left tilt of skull shows an

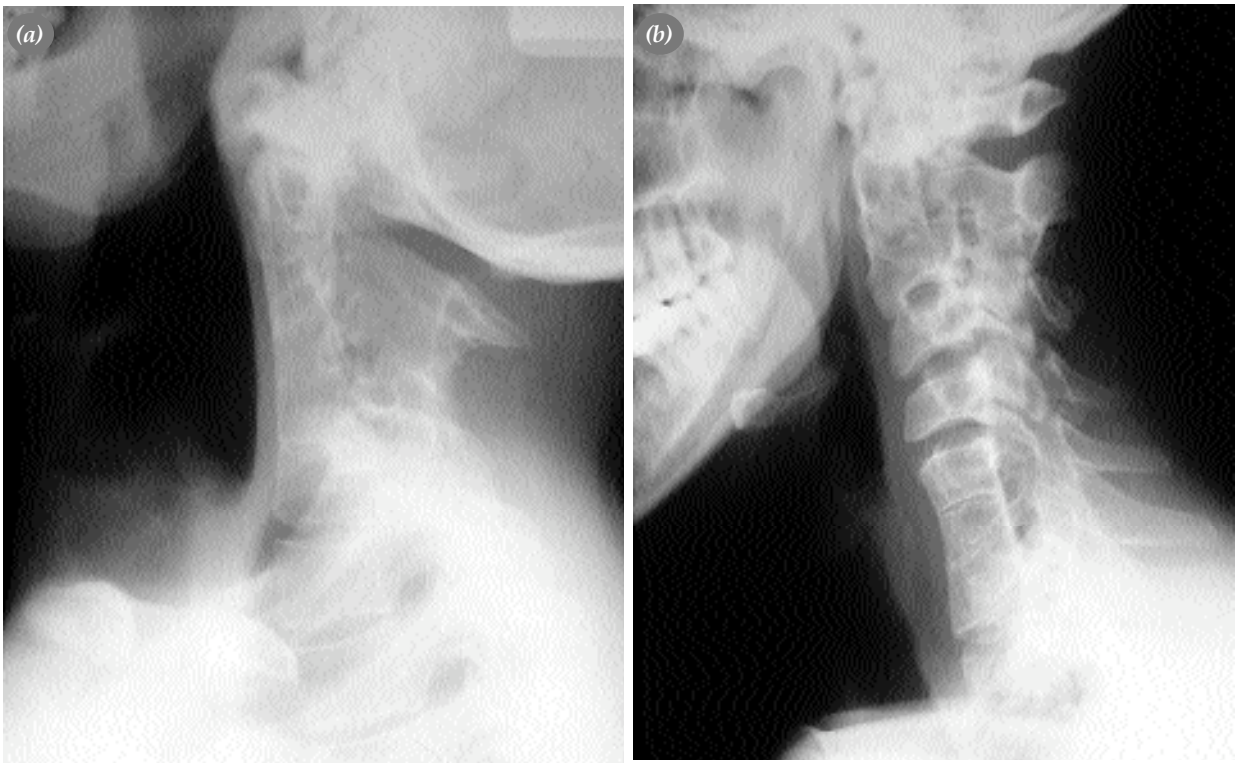

Figure 2. **(a)** Lateral cervical X-ray of a case with Type 1 Klippel-Feil syndrome **(b)** Lateral cervical X-ray of a case with Type 2 Klippel-Feil syndrome

increase or it couldn't be corrected passively, surgery may be required. Surgical fusion may be applied in this case. A simultaneous halo support may also be done. Anterior or posterior fusion may be applied according to head tilt or the problem.[3,4,9]

Pizzutillo et al.[10] has insisted on these risks and have examined openings of cervical vertebras by mobile flexion and extension graphs. Though it is rare, they have pointed out that surgical fusion may be required especially in young patients with instability on cervical vertebras. But Nagashima et al.[11] have examined a patient having severe hypermobility on cervical vertebras and has shown that the patient didn't have any neurological problem for 40

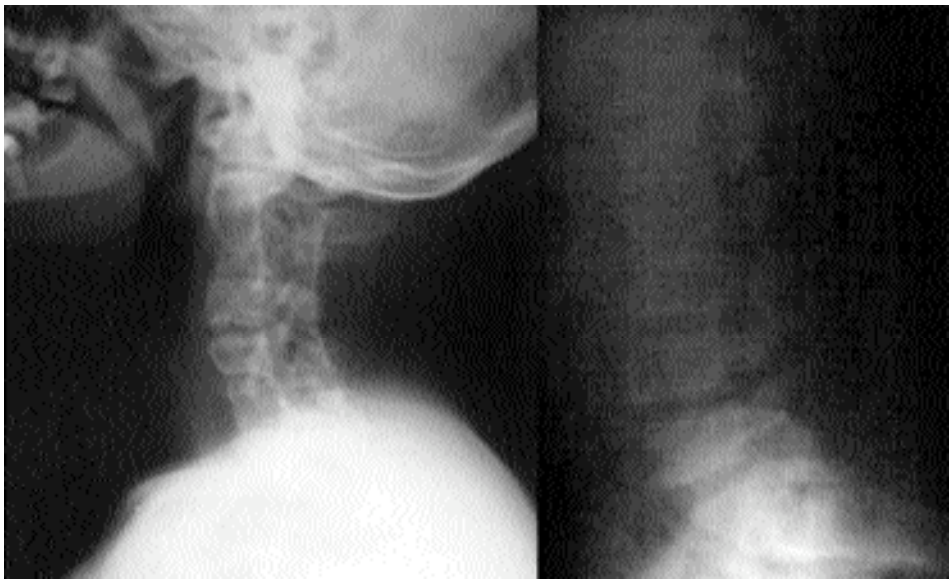

Figure 3. Lateral cervical and lumbosacral X-rays of a case with Type 2 Klippel-Feil syndrome

years. As a result, they have recommended that even prophylactic fusion shouldn't be performed unless patients have neurological problems – due to disc problems that mat appear later – even in patients with severe hyper mobility. In another case presentation, a 16 years-old patient has been operated who gave severe neurological symptom with extension of the neck and complaints have been corrected. In this case presentation, Ha11 et al. recommends surgery in instabilities going with neurological symptoms. It has been reported that there is great ease in putting forward the instability by MRG and other accompanying problems such as stenosis and cord compressions may be determined in this type patients: [13] No instability or neurological problem due to hyper mobility has been seen in our cases, which can be determined by radiological examinations. So, any surgical treatment hasn't been considered in our patients.

Konstantinou et al. [14] have determined a fusion between C1 and T3 and bilateral cervical ribs on graphs taken due to pain, numbness, coldness, discoloration and weakness on upper extremity of a patient. Once diagnosis of bilateral thoracic outlet has been made, excision of ribs has been made surgically. Although cervical rib is widely seen together with Klippel-Feil syndrome, no symptomatic cervical ribs were seen in our cases.

In the study of Theiss et al.[15], 32 patients with Klippel-Feil syndrome have been followed up more than 10 years and their results have been reported. It has been reported that only seven of those patients had pains of upper extremities and neck due to cervical fusions. In their study, they mentioned about the relation of pain severity with level of fusion and protrusion of the fusion.

Thomsen et al.[6,7], in their study of 57 patients with average of 12 years of age at the time of first examination, have observed 70% scoliosis, 26% Sprengel deformity and 9% upper extremity anomalies. And they also identified auditory abnormalities in 5% of patients. At the same time, they reported that there were single level fusion in 69%, two-level fusion in 28% and three-level fusion in 3%. They found the classical triad of Klippel-Feil syndrome in 74% of patients. They have pointed out that there is a correlation between degree of scoliosis and Klippel-Feil syndrome type 1, 2, 3. We determined a ratio of 100% scoliosis, 21.7% Sprengel deformity, 4.3% upper extremity anomaly and 39.1% hearing loss. There has been classical triad in all of our cases.

50 patients with Klippel-Feil syndrome have been examined in Hensinger et al.[2] study and accompanying major syndromes have been described. It has been reported that number of patients showing the classical triad of Klippel-Feil syndrome is less than 50% in this study. Facial asymmetry, torticollis and widening on the neck have been determined in 20% of patients and Sprengel deformity has been found in 21 patients. Hensinger et al. has pointed out that relation between Sprengel deformity and Klippel-Feil syndrome has been resulted from developmental disorder at the same region in maternal uterus. In the same study, intravenous pyelography has been made for patients and renal anomalies have been determined in 16 patients. Severe cardiac problems have been determined in seven patients, primarily patent ductus arteriosus and ventricular septal defect. Auditory problems have been determined in six patients and mirror movement in nine patients. Similarities are observed between Hensinger et al. study and our study for accompanying other system pathologies. But they aren't consistent completely for the aspect of classical findings and skeletal anomalies.

Paksoy et al.[16] has showed presence of persistent trigeminal artery (PTA) in a case with Klippel-Feil syndrome. They reported existence of fusion between C2 and C3 and a PTA between internal carotid and basilar arteries on MRG angiography in a 43 year-old patient presenting with dizziness, pain and restriction of neck movements. Paksoy et al. have reported that accompaniment of spinal tumors to cranio-vertebral junction anomalies and Klippel-Feil syndrome has been previously described, but they said presence of PTA isn't seen frequently. In our study, patients haven't been investigated for PTA. And no patients were met having similar complaints.

In this study, it has been aimed to describe that there may also be other system pathologies other than cervical vertebral fusion in individuals with Klippel-Feil syndrome whom orthopedists may see in a routine outpatient clinic. We believe that our

findings would help for making a correct typing, for investigating all systems and accompanying pathologies and for making early treatment when required, especially when compared with children with Klippel-Feil syndrome, though our study includes only adult subjects and number of cases is high.

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