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Multimodal physiotherapy management of Klippel-Feil Syndrome with cervical radiculopathy in an adolescent: A case study

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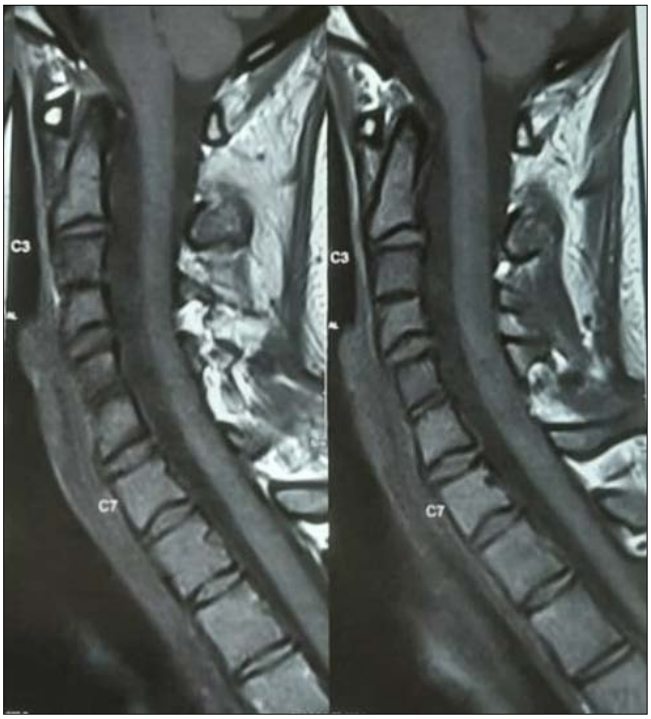
Abstract
Background: Congenital fusion of cervical vertebra, most commonly known as Klippel-Feil syndrome, a rare deformity of spine which results from failed segmentation of the cervical somites while early embryonic development. Symptoms usually arises in adolescent or early adult phase of life due to increase in activity demands. Earlier this condition was managed usually using pharmaceutical management and rest.
Case Presentation: An 18 year old female students complaining of radiating pain, frequent headaches and difficulty in daily activities.
Purpose: This study aims to find effectiveness of multimodal approach of physical therapy in managing symptoms.
Method: Patient was treated using active release technique, deep neck flexor training and neurodynamic mobilisation along with scapular and upper limb strengthening. Intervention was given for 6 weeks.
Result: Pain was significantly reduced. There was improvement seen in range of motion, deep neck flexor endurance and functional activity.
Conclusion: Patient showed improvement in deep cervical muscle endurance and activities in daily living. Pain reduced significantly. Multimodal approach was found to be effective.
Implication: This multimodal approach serves as an alternative to pure pharmacological management to address secondary complaints of Klippel-Feil syndrome.

Keywords: Klippel-Feil syndrome, radiculopathy, Active Release Technique, deep neck flexor, neurodyanamic mobilisation

Introduction
Congenital fusion of cervical vertebra, most commonly known as Klippel-Feil syndrome, a rare deformity of spine which results from failed segmentation of the cervical somites while early embryonic development. Though it is congenital in origin, symptoms arise in second or third decade of life. In early adulthood around second decade when the spine reaches biomechanical maturity the non-fused segments become hypermobile to compensate for fused segments [1]. The fusion of particular segment leads to restriction of cervical motions which causes hypermobility of adjacent upper vertebrae and accelerates degenerative changes in lower vertebrae. These changes are factors which give rise to pain and neurological problems [2]. Klippel-Feil Syndrome is found predominantly in females with incidence approximately 1 in 40,000 to 42000 newborns [3].Patient complains are usually preceded by any traumatic event or any task which places increased biomechanical demands on spine which is not typically performed by the individual [4].
Klippel-Feil syndrome leads to wide range of spinal and extra spinal abnormalities. These abnormalities leads to restricted range of motion of cervical spine, headaches frequent neck pains. If overlooked can progress to chronic conditions and resent in deformities instability degeneration with progressive neurological deficits and stenosis [1].
Neck pain is common complaint which is a lead cause of disability clinically and early diagnosis can help to start proper treatment at correct time and one can delay the degenerative process. We can also incorporate lifetime lifestyle changes at earliest to have pain relief and prevent the episodes in future. Traditionally these patients were managed with pharmacological treatment, in this study we try to explore a multimodal conservative approach by integrating active release technique, strengthening exercises and neuro dynamic exercises to provide a comprehensive framework to manage the secondary complications of congenital fusion. Hence, purpose of this study was to highlight how conservative treatment can bring improvement in the symptoms in the patients with Klippel-Feil syndrome.

Clinical presentation
A 18 year female student right hand dominant presented with a complain of pain on right side of neck , right upper back, over outer aspect of right forearm and over right wrist joint and frequent headaches since 5 years. At 13 years of age she visited a general physician due to pain in the upper back and neck region, where she was advised to take some medications and perform some yoga asana. At 17 years of age she felt pain near the same area of concern and swelling over the upper back for which she visited an Orthopaedic who gave medications and rest was advised. In February 2025, while she was appearing for her board exams she started experiencing pain over right forearm, upper back and right neck region, minor swelling was noted in the wrist accompanied by numbness and burning sensation over

overall hand and forearm and even complained of episodes of dizziness in the exam hall. As she wanted a writer for rest of the exams she visited to an Orthopaedics who advised her to do investigations (MRI). MRI suggested congenital fusion of C3-C4 vertebrae and partial fusion of C4-C5 vertebrae. After the investigations she consulted the Orthopaedic at Multi-specialty Hospital, where he prescribed her painkiller and Vertin16 for Vertigo. Then she was referred to the Neurologist at same Hospital, who further referred her to physiotherapy department.



Pain

Patient had sharp shooting pain on Right side of neck, right upper back, over outer aspect of right forearm and over right wrist joint. Onset was gradual, activities like writing, doing household chores, playing badminton aggravated the pain while rest and icing provided relief. Irritability was high with intensity vas 0/10 on rest and 8/10 on activity.

On observation patient had right shoulder elevation, slight forward head posture with protracted shoulder. Right scapula was slightly higher than the left.

On palpation

Grade 1 tenderness was present over c3 to c7 spinous process.

Trigger Points- Upper Trapezius, Rhomboids, Levator Scapulae, Scalenes, Biceps Brachii, Infraspinatus, Brachioradialis and Sub-occipital muscles.

Neurological- superficial sensation diminished at C4, C5, C6, C7 level. Deep and cortical sensations intact. Reflexes intact. Myotomes not affected.

Active range of motion

Movement	Right	Left
Flexion	0-35 [0]	
Extension	0-38 [0]	
Lateral flexion	0-30 [0]	0-35 [0]
Rotation	0-50 [0]	0-55 [0]

Range of motion of shoulder joint was within normal limit.

Strength

Muscle	Right	Left
Biceps brachii	5/5	5/5
Upper trapezius, serratus anterior, deltoid, brachioradialis, triceps and brachialis	4/5	5/5
Middle trapezius, teres major and minor, rhomboids, supraspinatus and infraspinatus	3+/5	4/5
Lower trapezius and latissimus dorsi	3/5	3/5

Deep neck flexor endurance- 24 seconds

Special test: spurlings was positive.

Craniocervical flexion test was positive with rotation to left.

MNT1 showed covert response.

Outcome measure: Neck Disability Index- 56% severe disability.

Treatment

Primary goal of the treatment was to reduce pain and to improve muscle performance and functional capacity. Patient was educated regarding the condition and importance ergonomic changes in her lifestyle. Patient was educated about proper posture during various activities, like while reading or using computer the desktop/ screen should be at eye level to avoid stress on neck, even the patient can use writing boards or inclined boards as support while writing in acute stage.

The treatment was started with active release technique applied to sub occipital muscle, upper trapezius, levator and rhomboid muscle followed by icing for 10 minutes. Active release technique was performed first by applying ischemic compression to trigger point with simultaneous contraction and lengthening of the same muscle. Patient performs 5-10 repetitions. Active release technique was provided thrice a week.

It was followed by activation and training of deep neck flexors using pressure biofeedback. Patient was in crook line position. The pressure biofeedback cuff is placed under the neck. The neck is in neutral position. The patient is asked to perform nodding movement at 5 incremental pressure levels that is 22,24,26,28 and 30 mm of hg. Each pressure level is held for 10 seconds. Between each increment of pressure level the 10 second rest was given 20 minutes of such intervention was given in each session. It was further progressed with limb loading exercises for cervical spine in supine with shoulder flexion and diagonal patterns followed by diagonal patterns with theraband in standing.

Scapular muscle (middle trapezius, rhomboids, lower trapezius and serratus anterior) activation followed by training of muscles against gravity combined with upper limb strengthening of shoulder and elbow muscle 10 repetitions. Scapular muscle strengthening was further progressed in prone position on swiss ball with resistance and rowing exercises.

Neural glide for median nerve in supine – 10-15 repetitions 3 set. Sliders were given followed by tensioner.

The protocol was carried out 6 weeks.

Clinical Course

The patient was discharged after 6 weeks. The pain subsided to 3/10 on activity. Frequency of headaches reduced. Deep neck muscle endurance improved to 35 seconds. Rotation of neck improved to 60 and 65 for right and left respectively.

Lateral flexion improved to 40 and 45 degrees for right and left respectively. Neck Disability Index score improved to 31%. She can concentrate more on studies and can help mother in household chores.

Discussion

Klippel-Feil syndrome, predominantly seen in females remains asymptomatic until the adulthood or young adolescence period. Due to any traumatic event or daily strenuous activity places increased demands on the structure and causes pain and disability. This case study demonstrates significant reduction in pain intensity, improvement in strength and functional activity. This study shows that the multimodal conservative approach is effective in patients where the underlying fusion is permanent but the secondary complains are manageable.

Cervical deep muscle training was also incorporated in the protocol. Training deep muscle plays a key role providing stability to spine and this protecting it [2].

The protocol includes exercises for scapular strengthening and upper extremity which are effective in reducing pain and disability. Ergonomic advice to prevent sustained posture in order to reduce load helped in alleviating pain [4].

Active release technique effectively addressed the soft tissue complains like trigger point, which in turn helped to reduce pain. Soft tissue release specifically to suboccipital muscle reduced patient's headache. Further Integrating Neural Mobilisation proved to be effective in treating radiating pain.

Conclusion

This case demonstrate that a comprehensive multimodal patient tailored framework significantly improves function and reduces the complaint of patient with Klippel-Feil syndrome. A reduction in pain intensity from 8/10 to 3/10 during activity. Improved cervical range of motion and deep neck muscle endurance (increasing to 35 seconds). A meaningful decrease in Neck Disability Index (NDI) scores and headache frequency.

While congenital fusion cannot be reversed, addressing the secondary complaints by focusing on compensatory pattern and imbalance improve patient’s pain, activity of daily living and reducing discomfort. This multimodal approach serves as an alternative to pure pharmacological management to address secondary complaints of Klippel-Feil syndrome.

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