Radiological predictors of neurological compromise in adults with filum terminale lipoma

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The appropriate management of adults with filum lipoma (FL) with normal neurological status remains unclear.[1,2] Factors such as younger age at presentation, low-lying conus medullaris (CM), thick FL, and the proximity of fat to the CM has not been consistent in the literature in predicting the development of neurological deficits.[1-3] The objective of the present study was to evaluate radiological features that may predict neurological abnormalities in patients with FL to provide guidance for patient management.

The present study was a retrospective chart review conducted in King Khalid University Hospital, Riyadh, Kingdom of Saudi Arabia. This is a tertiary neurosurgery hospital where patients are treated from all around the country. The institution's ethics board committee approved the study. Cases were identified through a computerized search of the hospital's radiology database between January 2003 and January 2010, inclusive. Search terms included lumbar MRI with filum lipoma, fatty infiltration, or high signal intensity. Exclusion criteria were pediatric age (younger than 18 years of age), myelomeningocele, lipomeningocele, and spina bifida. Two neuroradiologists who were blinded to the clinical data reviewed the MRI studies of all identified cases. A detailed review of the medical records was performed for the included cases.

Data variables. Neurological compromise was considered to be present if there were any abnormality in the motor, sensory, or sphincter functions (in the form of neurogenic bladder). The transverse and craniocaudal diameters of the FL were identified using sagittal and axial scans of T1-weighted MRI. The transverse diameter was measured at the point of the greatest diameter on the axial and sagittal MRI. The lower end of CM was determined on sagittal MRI scans and confirmed on the axial scans. The number of segments involved with lipoma, and the anatomical involvement of CM with lipoma was identified in each case.

Statistical analysis. Statistical analysis was performed using the Statistical Package for Social Sciences (SPSS Inc., Chicago, IL, USA) version 19 software. Descriptive statistics in the form of mean, median, range and standard deviation (SD) were presented. Fisher's exact test was used to compare nominal variables between groups. Mann-Whitney non-parametric test was used to compare quantitative variables. Statistical significance was set at $p<0.05$.

Patient demographics and clinical features. Of the 3853 lumbar MRI studies performed during the study period, only 9 cases (0.23%) met the selection criteria. The mean age was 42.4±7years (median 44 years, range 27-51 years), and there were more male patients (66.7%). A detailed clinical assessment of the 9 cases is presented in **Table 1**. Two patients experienced urination difficulties. Both had a low-lying spinal cord (CM below the L1-L2 disc space level) and lipoma reaching into the CM on MRI (**Figures 1A and 1B**). The remaining 7 patients did not have any sphincter disturbances, a low-lying spinal cord, or lipoma on the CM. Two of the 7 cases had neurogenic claudication attributed to degenerative spinal stenosis, and one had sciatica secondary to degenerative disc disease. None had any musculoskeletal abnormality.

Filum lipoma characteristics on MRI. Patients with sphincter dysfunction had more fat thickness considering their mean transverse diameter on MRI (6.5±0.7 mm versus 2.4±0.8, $p=0.04$). The craniocaudal length of the FL was not significantly different in patients with and without sphincter dysfunction (16.5±12 mm versus 62.7±56.8, $p=0.376$). The presence of sphincter dysfunction was associated with low-lying spinal cord (below the L1-L2 level) and lipoma involving CM ($p=0.028$ each). Neither age ($p=0.106$), nor gender ($p=0.583$) was associated with sphincter dysfunction.

The cranial extent of the FL was found at L2 in 33% of the patients, and caudally to S1 in 44% of the patients. The lower end of the spinal cord was at the L1-L2 level in 6 patients, and at the L2 and L3 level in 2 patients. The lipoma demonstrated anatomical continuity with the CM in only 2 patients who experienced urinary symptoms and had low-lying spinal cords (below the L1-L2 level).

The FL was found in 0.23% of our lumbosacral MRI series, which is comparable to figures (0.24-5%) previously reported.[1,3,4] Higher rates are probably related to the accuracy of radiology reporting and the MRI machine used. Recent advances in MRI technology with higher resolution are expected to identify more cases. The current study demonstrated that the development of neurological symptoms (mainly neurogenic bladder) is related to the proximity of the lipoma to the CM, a low-lying spinal cord, and the thickness of the fat content.

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Table 1 - Summary of characteristics in adult patients with filum lipoma.

Age (years)/ gender	Reason for MRI	Sphincter dysfunction	Neurological or MSK abnormalities	FL - MRI level and dimensions (TR, CC) mm	Lower end of spinal cord	Attachment to conus medullaris	Surgery	Remarks
51/M	Back pain, urination difficulty	Yes	No	L2-L3 6, 8 mm	Low	Yes	Yes (de-tethering)	Improved urination difficulty postoperatively
47/F	Back pain, urination difficulty	Yes	No	L3-L4 7, 25 mm	Low	Yes	Yes (de-tethering)	Improved urination difficulty postoperatively
39/M	Fall with low back pain	No	No	L1 4, 8 mm	Normal	No	Micro-discectomy	
41/M	Low back pain	No	No	L2-L5 2, 100 mm	Normal	No	No	
42/M	Low back pain	No	No	L2-S1 2.8, 122 mm	Normal	No	No	
47/M	Low back pain	No	No	L4/L5 2.3, 22 mm	Normal	No	No	
27/F	Low back pain	No	No	L2 2.5, 25 mm	Normal	No	No	
49/M	Low back pain	No	No	L2/L3 1.4, 19 mm	Normal	No	No	
44/F	Low back pain	No	No	L1-S1 2, 143 mm	Normal	No	No	

TR - Transverse, CC - Cranio-caudal, MSK - Musculoskeletal, FL - Filum lipoma, MRI - Magnetic resonance imaging, M - Male, F - Female
Level of spinal cord is considered low if below L1/L2 disc space

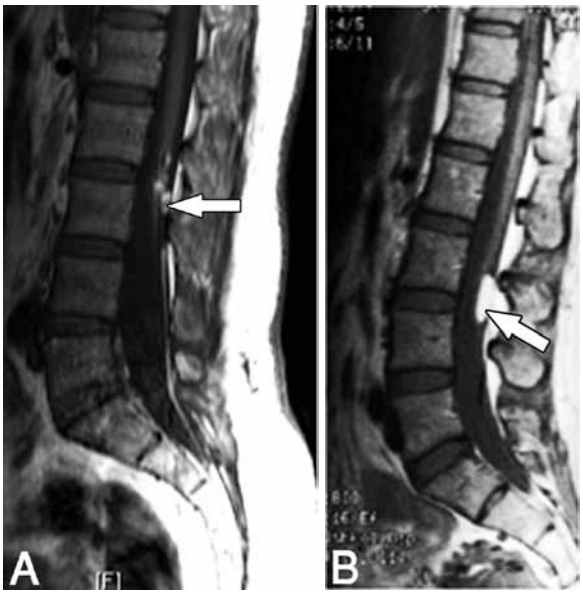

Figure 1 - Sagittal T1-weighted MRI of the lumbosacral spinal in **A**) a 51-year-old man with urination difficulty showing lipoma (arrow) of the filum terminale attached to the conus medullaris. Note the conus medullaris ends opposite to the inferior end plate of L2. **B**) A 47-year-old woman with urination difficulty showing a focal, well-defined, high signal intensity lesion (lipoma; arrow) attached to the conus medullaris. Note the lower end of the spinal cord below the inferior end plate of L2.

Tethering of the spinal cord (low CM) in association with FL was correlated with neurological compromise in a study by Okumura et al.[3] Fat may alter the properties of the filum resulting in traction and local ischemia during growth, or may produce local pressure resulting in distal spinal cord dysfunction.[2,5] It is controversial whether proximity of fat to CM is a significant factor in the development of neurological compromise. Animal studies have observed that neural elements could be involved in the abnormality involving the migration process of mesodermal migration precursor cells during secondary neurulation and differentiation of the caudal cell mass.[2] Bulsara et al[2] studied 36 patients and found that the presence of fat in the filum within 13 mm from the CM was the most predictive of neurological deficit.[2] However, Al-Omari et al[1] did not find any correlation between neurological presentation and the distance of fat from CM in their prospective study involving 37 patients with FL. When the FL is isolated with no other abnormality, patients did not demonstrate symptoms of neurological compromise. This was shown in the current study and similar previous studies.[1]

Although the current study showed a significant association between thick FL and neurological compromise, this effect is difficult to separate from

the association of lipoma extending into the CM and low-lying spinal cord. The latter findings are probably more relevant and supported by the literature.[2,5]

The current study should be interpreted within the context of its retrospective design and small sample size. Cases were identified from the radiology reports, which is subject to variability depending on their accuracy. Additionally, the search criteria could potentially miss cases. Larger, multicenter studies of a prospective design are needed to distinguish the significance of the association between neurological compromise and the thickness of FL and its proximity the CM.

In conclusion, neurological compromise was more likely in patients with lipoma associated with CM and low-lying spinal cord. Patients with these abnormalities might benefit from surgical intervention. Patients with isolated FL tend to have a benign course and are unlikely to require surgical intervention.

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