Fatty Filum Terminale on MRI
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Citation

Abstract
Background: Fatty filum terminale is sometimes demonstrated on MRI incidentally. It is considered as one of the causes in tethered cord syndrome (TCS). Location and the size of fatty filum are considered as the important factors for TCS. But there was no report on the disc degeneration according to the tension of fatty filum.

Purpose: To discuss the fatty filum terminale which is incidentally demonstrated on MRI concerning the causes of TCS

Study Design/Setting: Relations between MRI findings (location, size of fatty filum and the disc degeneration) and clinical symptoms

Methods: Lumbar MR images in 535 patients were reviewed. Fatty filum terminale was found in seven patients using magnetic resonance images (MRI: GE, Signa excite, 1.5T). The location, size of fatty filum terminale and the clinical symptoms were evaluated in 7 patients. The disc degenerations were also evaluated in 7 patients.

Results: Fatty filum terminale was found in 7 of 535 patients (1.3%) on MRI. The distance between the tip of conus and the fatty filum was 23.3mm (6-45mm). The mean diameter of the fatty filum was $\phi$2.57 (1-4) mm. Six of seven patients had disc degeneration on MRI. And the fatty filum were observed as a slacken strand on MRI. There were no clinical symptoms related to fatty filum terminale with degenerated discs.

Conclusion: The fatty filum terminale may cause TCS even in elder patients. Thus the attention should be paid to the location and the diameter of the fatty terminale if it is demonstrated on MRI. And also we suggest that the attention should be paid the disc generations and the tension of terminale itself.

INTRODUCTION
The tethered cord syndrome (TCS) with tight filum terminale causes neurogenic disturbances of the bladder and lower extremities ($1$) ($2$) ($3$) ($4$) ($5$) ($6$) ($7$) ($8$) ($9$) ($10$) ($11$) ($12$) ($13$) ($14$) ($15$) ($16$) in childhood, thus it is often diagnosed and treated by pediatric neuro-surgeons and urologists. On the other hand some authors reported the adult onset TCS with urinary disturbances ($17$) ($18$) ($19$) ($20$) in the presence of the tethering with fatty filum terminale ($21$). Fatty filum terminale is disregarded if the neurological dysfunctions are not observed in childhood. The fatty filum terminale is incidentally found in 0.24-1.0% of lumbar MRI examinations ($22$). The clinical significance of a fatty filum remains unclear ($23$). They reported the location and the diameter of fatty filum as one of the important factors regarding adult onset TCS. In elder patients the filum is often slack because of the loss of disc height with degenerations. Fatty filum terminale may less influence on tethering if disc degeneration exists.

PATIENTS AND METHODS
Lumbar Magnetic resonance Images (MRI:GE Signa Excite 1.5T) of 535 patients, which were performed between June 2002 and May 2006, were reviewed. The mean age of the patients was 62.0 years old. 298 patients were female and 237 were male. Fatty filum terminale was found in 7 patients on MRI. The clinical symptoms of the 7 patients were reviewed. The location of conus medullaris, the diameter and
the location of the fatty filum were evaluated on MRI. And disc degeneration was also evaluated in 7 patients according to DeCandido's classification (4).

RESULTS

Fatty filum terminale was found in 7 of 535 patients (1.3%) on MRI. Four patients were female and the others (three) were male (Table 1).

**Figure 1**

Table 1: Clinical symptoms and MRI findings

<table>
<thead>
<tr>
<th>Case</th>
<th>Age</th>
<th>Diagnosis/Complaint</th>
<th>Level of Conus</th>
<th>DistanceFilum</th>
<th>Disc Degeneration</th>
<th>Clinical Symptom</th>
</tr>
</thead>
<tbody>
<tr>
<td>Case 1</td>
<td>67</td>
<td>Female</td>
<td>L4/5</td>
<td>23.3mm</td>
<td>2.57</td>
<td>L2, 45mm away from conus medullaris, Φ4mm</td>
</tr>
<tr>
<td>Case 2</td>
<td>59</td>
<td>Male</td>
<td>L3/4</td>
<td>23.3mm</td>
<td>2.57</td>
<td>L2, 45mm away from conus medullaris, Φ4mm</td>
</tr>
<tr>
<td>Case 3</td>
<td>78</td>
<td>Male</td>
<td>L2/3</td>
<td>23.3mm</td>
<td>2.57</td>
<td>L2, 45mm away from conus medullaris, Φ4mm</td>
</tr>
<tr>
<td>Case 4</td>
<td>53</td>
<td>Male</td>
<td>L1</td>
<td>23.3mm</td>
<td>2.57</td>
<td>L2, 45mm away from conus medullaris, Φ4mm</td>
</tr>
<tr>
<td>Case 5</td>
<td>70</td>
<td>Male</td>
<td>L3/4</td>
<td>23.3mm</td>
<td>2.57</td>
<td>L2, 45mm away from conus medullaris, Φ4mm</td>
</tr>
<tr>
<td>Case 6</td>
<td>57</td>
<td>Male</td>
<td>L2/3</td>
<td>23.3mm</td>
<td>2.57</td>
<td>L2, 45mm away from conus medullaris, Φ4mm</td>
</tr>
<tr>
<td>Case 7</td>
<td>64</td>
<td>Female</td>
<td>L1</td>
<td>23.3mm</td>
<td>2.57</td>
<td>L2, 45mm away from conus medullaris, Φ4mm</td>
</tr>
</tbody>
</table>

There were no significant differences of sex. The average age of the 7 patients was 57.3 (30-84) years old. All the fatty filum was demonstrated on lumbar MRI incidentally. The diagnosis/symptoms of the patients were lumbar compression fractures in two patients (case 3,5), lumbar disc hernia in two (case 1,6), degenerative lumbar scoliosis (case 2) and acute low back pain (case 4,7). The level of the conus medullaris was located between L1 and L2. No apparent low conus medullaris was found on MRI in the 7 patients. The distance between the tip of conus and the fatty filum was 23.3mm (8-45mm). The mean diameter of the fatty filum was 2.57(1-4) mm. Thicken fatty filum was found in 2 patients (case 1,5). The disc degenerations were found in all 6 patients except Case 4. All the clinical symptoms of the patients seemed to be related to the diagnosis not to the fatty filum. There were no significant relations to the clinical symptoms in the location, the distance and the diameter of the conus medullaris.

**CASE 1. FEMALE 67 Y.O. ; LEFT THIGH PAIN**

She presented with low back pain and left thigh pain for three months. The x-ray showed spondylotic changes in L4/Sis .MRI (GE Signa Excite 1.5T) revealed lumbar disc hernia in L2/3. And also MRI scan demonstrated fatty fila (Fig1.a,b,c) as a curved and slack strand with high intensity (L3-S, 45mm away from conus medullaris, Φ4mm) on T1 weighted image in the thecal sac (Fig2. a,b).
The diameter of the fatty fila was 4mm. All the discs in lumbar spine were degenerated and lost the disc heights (Grade 3). And MRI revealed the disc hernia at L2/3 on the left side (Fig.1c). It seemed to be the cause of the left thigh pain.
CASE 2. FEMALE 84 Y.O.; PERSISTENT LOW BACK PAIN

She complained persistent low back pain. She had degenerative lumbar scoliosis. MRI showed a strand (L2-S, 15mm away from conus medullaris, Φ2mm) on T1 coronal view in lumbar thecal sac (Fig3.a). The diameter was 2mm. And on axial view the strand was observed as a spotty lesion at L4 level and two at L5 level on T1 weighted image with high intensity (Fig3.bc). All the discs were degenerated on MRI (Grade 2-3). The clinical symptoms were related to the lumbar scoliosis.
CASE 3. MALE 76 Y.O. ; ACUTE SEVERE LOW BACK PAIN

He presented with the acute low back pain. X-ray showed the L3 compression fracture (Fig.4ab). And MRI revealed not only the L3 vertebral compression fracture, but also fatty terminale (L3-S, 30mm away from conus medullaris, Φ3mm) in the thecal sac (Fig.5.ab). The fatty filum terminale was slack on MRI(Fig.5a). The clinical symptoms were low back pain related L3 compression fracture.
Fatty Filum Terminale on MRI

Figure 12

Figure 13
DISCUSSION

Tethered Cord Syndrome (TCS) is commonly seen in childhood associated with diastematomyelia and myelomeningocele derived from the tethering of filum terminale in the thecal sac (7,8,9). TCS is classically defined as having the tip of the conus medullaris below the L2. Filum terminale exists in normal spine without any neural disorders. When tethering occurs due to an inelastic structure anchoring the caudal end of the spinal cord, the filum terminale causes neurogenic disturbances of the bladder and lower extremities. Some authors reported the adult onset TCS due to the damage of conus medullaris with inelastic and fatty filum terminale (6,7,8,15,16). TCS is diagnosed with clinical symptoms with fatty filum terminale or lipoma in thecal sac that are demonstrated on MRI in more than 90%. On the other hand fatty filum terminale was found in 0.24-1.0% of lumbar MRI examinations (3). Thus the thickened fatty filum terminale (more than 2mm) are considered as one of the causes of the tethering (3,5,10). However, many authors (1,3,5,7) reported TCS with normal level of conus medullaris and/or without thicken terminale (less than 2mm). Fat in the filum may represent mesodermal cells that did not properly migrate to their normal position (2) in the process of canalization. The presence of fatty tissue may alter the developmental properties of the filum and may predispose patients to cord tethering (12). Bursara et al. reported the correlation between the fat and the neural dysfunctions with MRI. They concluded that fat in the filum
terminale within 13mm of the conus medullaris was most predictive of neurological deficits (3). And TCS in adults is caused by the anoxia due to over-stretching of the conus medullaris (1,7,14). Momentary stretching of the conus, narrowing of the spinal canal and direct blow to the back may aggravate the neurological dysfunction in the presence of the tethering (16). The neurological disturbances may be caused the tethering with fatty filum terminale, but the filum that is found incidentally in elder patients may not influence the function of the cauda equina and nerve roots because there is loss of disc heights in elder patients with disc degenerations. On MRI showed the slack fatty filum terminale in our cases with disc degenerations. Fatty filum terminale may cause TCS when the fatty filum terminale exists close to the conus medullaris with loss of its elasticity. Therefore we suggest the attention should be paid not only to the location conus medullaris and the diameter of the fatty terminale if it is demonstrated on MRI, but also to the disc generations and the tension of terminale itself.

References
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