Functional kinemri in whiplash patients

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Authors: R. Mikkonen[1], M. Paatelma[1], J. Kettunen[2], K. Lindgren[2]; [1]Vantaa/FI, [2]Helsinki/FI

MeSH: Image Interpretation, Computer-Assisted [E01.158.600]

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1. Purpose / Introduction

The safety of modern cars especially the increased use of seat belts has caused the increase of whip-lash injuries in car crashes. Earlier the traumas of the whole body were more common. Nowadays if the car is not badly crashed and the body is well fixed in the seat of the car, the head is the only free part of the body that moves in the sudden stop of the car. (Fig. 1)

see: [figure 2. movement of the head in the sudden stop of the car.jpg]

In this kind of whiplash injury there will become traumas in the cervical spine and the brain tissue. Fractures of the cervical spine are rare in this kind of situations. The ligaments that stabilize the cervical spine and the skull to the spine can be injured. These ligaments are the anterior and posterior longitudinal ligaments, the capsule of the facet joints, the transverse ligament and the alaria ligaments (Fig. 2). In this study we have concentrated to the CO – CII area and the alaria ligaments.

see: [figure 1.jpg]

Purpose

Vantaan Magneetti Oy, Vantaa, Finland, has done functional kine magnetic resonance imaging since 2003 to whiplash patients. About 150 examinations have been performed. There has been a lot of controversy about the reliability and the significance of the methodology. Therefore we decided to do an age and sex matched study with healthy controls with co-operation of ORTON Rehabilitation Centre in Helsinki, Finland. Though the normal patient studies include the whole cervical spinal column, we wanted to concentrate to the CO – CII area in this study. The purpose was to compare the signal of alaria ligaments and the movements between CI and the dens in the bending of the head between the patients and the controls.

2. Material and methods

Thirty clinical consecutive patients who had had a whiplash trauma and were clinically supposed to have a problem at the level of C0- CII were included in the study. Age and sex matched healthy persons were the control group. Images of four patients could not be found.

The imaging was performed with Philips Gyroscan Intera 1.5 T magnet. The patient was positioned supine and a Flex-L coil was positioned on both sides of the head with stickers. The same manual therapist performed the bending to the left and right to the patients and the controls to ensure that the movements were limited to the level of C0 – CII. He held the position during the whole mri imaging time to control the position and the symptoms. We used an oblique coronal T2pd sequence (TR 3025, TE 11/120, FA 90, sl 2.0, FOV 200, Mtrix 256x256).

The images were analysed by one radiologist with Easy Vision workstation. The analysis was made blinded. The movement of the dens and the signal of the alaria ligaments were analyzed from the oblique coronal images. Statistical differences were computed by ^{2}-test.

3. Results

The movement of the dens was considered to be 1=normal (dens moves towards The opposite CI when bending the head) or 2 = pathological (there is no movement between CI and CII or the movement is towards the same direction as the neck is bent). Patients 1 = 11, 2 = 15; controls 1 = 24, 2 = 6; p=0.004 (Table 1).

Table 1 Movement between CI and CII

Group	Normal	Pathological	Total
Patients	11	15	25
Controls	24	6	30
Total	35	21	56
p=0.004			

The signals of the alaria-ligaments were either normal 2= totally visualized or pathological 1=partly visualized or invisible. Patients 2=2, 1=23; controls 2=23, 1=7; p<0.0005. (Table 2).

Table 2. Signal of the alaria ligaments

Group	Normal	Pathological	Total
Patients	2	23	25
Controls	23	7	30
Total	25	30	55
p<0.005			

Both patients and controls: pathological signal of alarialigaments and pathological movement between CI- CII no = 16, normal signal of alarialigaments and normal movement no=21; p = 0.004. (Table 3)

Table 3. Comparison between the signal of the alaria ligamants and the movement between CI and CII (Patients and controls)

Signal of alarialigaments	Movement between CI and CII		
	Normal	Pathological	Total
Normal	21	4	25
Patological	14	16	30
Total	35	20	55
p=0.004			

Only patients: pathological signal of alarialigaments (no=23) and pathological movement between CI- CII no = 13, normal signal of alarialigaments and normal movement no=1.(Table 4)

Table 4. Comparison between the signal of the alaria ligamants and the movement between CI and CII (Patients)

Signal of alarialigaments	Movement between CI and CII		
	Normal	Pathological	Total
Normal	1	1	2
Pathological	10	13	23
Total	11	14	25
p = 0.859			

Only controls: pathological signal of alarialigaments (no=7) and pathological movement between CI- CII no = 13, normal signal of alarialigaments and normal movement no=20. (Table5)

Table 5. Comparison between the signal of the alaria ligamants and the movement between CI and CII (Controls)

Signal of alarialigaments	Movement between CI and CII		
	Normal	Pathological	Total
Normal	20	3	23
Pathological	4	3	7
Total	24	6	30
p = 0.084			

4. Discussion / Conclusion

The head is the only free part of the body that moves in the sudden stop of the car if the seat belt is used. This is called a whiplash injury.

The x-ray and magnetic resonance imaging are traditionally performed in a static position. A human being is a moving creature that is constantly, almost the whole 24 hours moving even in her/his sleep. It has been observed that the head moves 900 times per day as we are awake. Thus it is natural that many pathological findings can not be seen in normal mr-imaging. The basic movements of the neck are extension, flexion, side bending and rotation. Many of the patient's symptoms occur in the movements of the head and the neck and the cause of the pain can only be better seen in these positions.

The function imaging of the cervical spine is an old method in radiology radiologists and clinicians are familiar with the use of ekstensio and fleksion images in imaging the hypermotility of the intervertebral disc and CI – CII. The information from the x-ray is limited. The bony structures can well be seen in x-ray images but the soft tissue is not visible. In the mr-imaging the alarialigaments can be visualized. The benefit of sidebending is that the opposite alarialigament can be seen straightened and the possible changes in the signal are better seen.

Figure 4a and b. Normal alarialigaments Pd (a) and T2 (b).

see: [fig 3 normal alaria ligaments pd.png]

see: [fig 3 normal alaria ligaments t2.png]

Figure 5. The normal movement between CI and CII by Jiri Dvurak.

see: [normal movement between ci and cii.png]

The normal movement between CI and CII has been shown by Jiri Dvurak. Abnormal movement between CI and CII can be seen in rotational malposition, CI and CII lock, and rupture of alarialigaments. CI and CII malpositoning has to be excluded with transversal images. After excluding that finding the abnormal movement between CI and CII it can be concluded that the alaria ligaments are not functioning normally.

Figure 6. Abnormal movement between CI and CII. Dens stays in the midline though the head is bent to the left.

see: [abnormal movement between ci and cii, when bending to the left dens stays in the midline.png]

The signal on alarialigaments is the other issue that was analyzed. Based on this study it can be concluded that if the signal of the alarialigaments is normal it is a reliable finding, but a pathological signal does not always lead to pathological movement between CI and CII. In this study we had only one patient who had both normal signal in alaria ligaments and normal movement between CI and CII. The differens between the patient and the control group was statistically significant.

Figure 7 a and b. Partly visible alaria ligaments pd (a) T2 (b).

see: [partly visible alaria ligaments pd 2.png] see: [partly visible alaria ligaments t2.png]

Conclusion:

Function kine mri in whiplash patient where the normal bending movement is simulated is a reliable method to find the alaria ligament injuries and movement disturbances between CI and CII related to that.

5. References

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6. Mediafiles:

figure 2. movement of the head in the sudden stop of the car.jpg

Figure 1. Movement of the head in in the sudden stop of the car.

figure 1.jpg

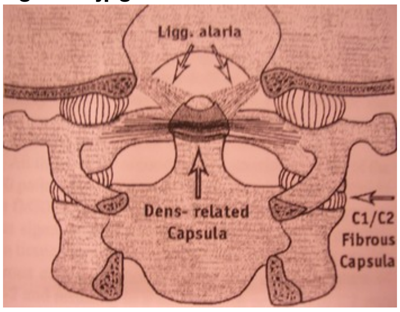

Figure 2: The alaria ligaments

fig 3 normal alaria ligaments pd.png

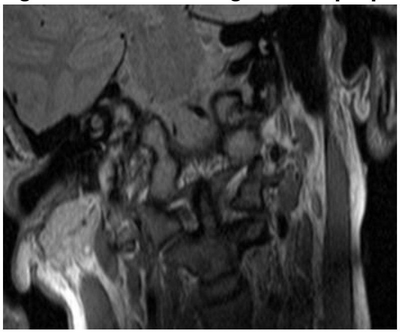

Figure 4. Normal alaria ligaments pd

fig 3 normal alaria ligaments t2.png

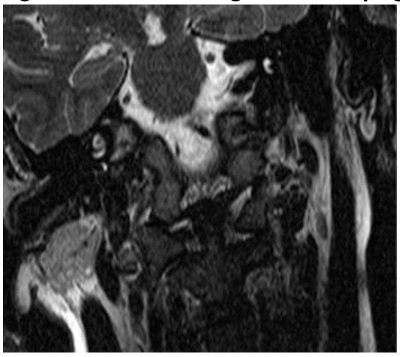

Figure 4b. Normal alarialigaments T2

normal movement between ci and cii.png

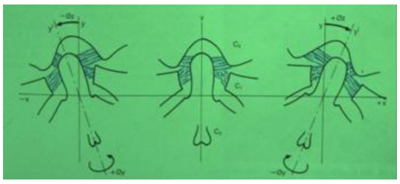

Figure 6The normal movement between CI and CII by Jiri Dvurak

abnormal movement between ci and cii, when bending to the left dens stays in the midline.png

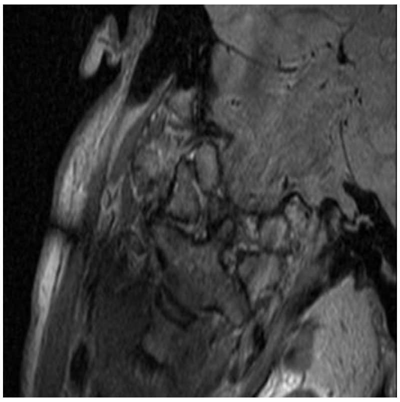

Figure Abnormal movement between CI and CII. Dens stays in the midline though the head is bent to the left.

partly visible alaria ligaments pd 2.png

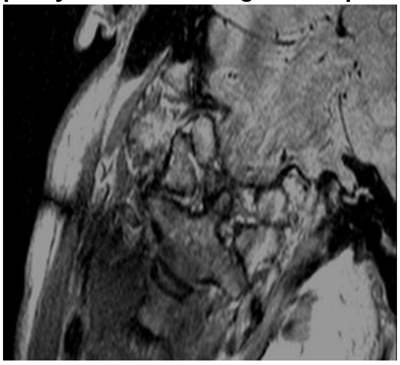

Figure Partly visible alaria ligaments Pd

partly visible alaria ligaments t2.png

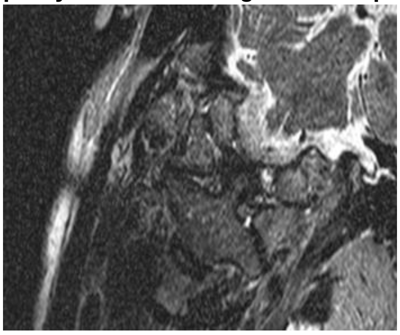

Figure Partly visible alaria ligaments T2.