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ANALYSIS OF KINEMATICS AND DISABILITY IN CERVICAL SURGERY PATIENTS

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SUMMARY
The present study investigates the 3dimensional cervical kinematics and possible associated disabilities in cervical decompression and fusion surgery patients. The results indicate that ACDF-surgery can affect cervical kinematics but these effects were not related to neck disability as measured by the Neck disability index (NDI).

INTRODUCTION
The effects of the Anterior Cervical Decompression and Fusion (ACDF) procedure on both the cervical spine Range Of Motion (ROM) and disability haven't been studied in detail [1,2,3].
The aim of this study was to compare the kinematics of active cervical spine movements performed in the frontal and horizontal planes between a group of patients who underwent ACDF and a group of healthy subjects. Furthermore the Neck Disability Index (NDI) was reported by the patients after surgery in order to investigate the correlation between the disability and kinematic changes.

METHODS

Data from 50 patients who underwent ACDF and 50 healthy subjects were acquired by using the Flock of Birds (FoB), a non-invasive, electromagnetic, six degrees-of-freedom tracking device (figure 1). The movements on the main axis and the coupled movements were analyzed by eleven parameters: the Cross-Correlation, the Ratio, the Range of Motion (ROM), the Root Mean Square of the Jerk (RMSJ) [4] and the Standard Deviation of the Error (STDERR) [5] of the three motion components. In addition the patients reported NDI after surgery. The data were compared with both parametric and non parametric tests due to the different distribution among all the data collected.

RESULTS

A significant inverse correlation ($p<0,05$) was found between age, ROMy and ROMz, respectively the rotation and lateral bending movements,,. There was a significant difference ($p<0,05$) between the groups in axial rotation for nine out of the eleven parameters. There was a significant difference ($p<0,05$) between the groups in the lateral bending for seven out eleven parameters (table 1). No significant correlation was found between age and NDI score or between kinematics and NDI score.

CONCLUSION

The age had an inverse correlation with ROM of the main motion component for the axial rotation and lateral bending. The ACDF procedure seemed to affect ROM on the axis of the main motion in both the axial rotation and lateral bending. It also demonstrated to have a negative effect on quality of the movements. No correlation among NDI score, age and the cervical spine kinematics was found.

Figure 1: the experimental set-up

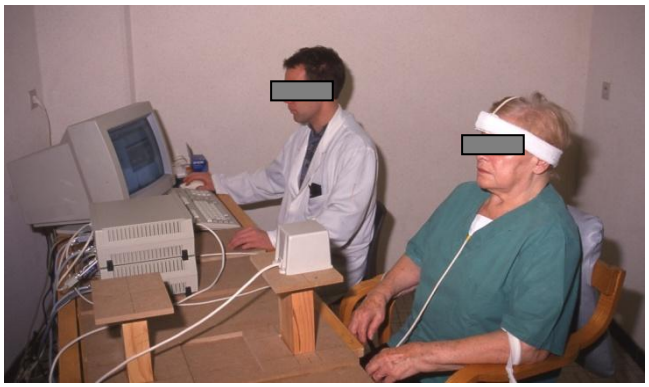

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Table 1: cervical kinematics during active axial rotation

	control (n=50)		experimental (n=41)			artrodesis multi-level (n= 14)			arthrodesis sinle- level (n=27)		
Axial rotation											
	Mean	*SD*	Mean	*SD*	*sign*	Mean	*SD*	*sign*	Mean	*SD*	*sign*
Crosscorrelation	0,50	*0,71*	0,43	*0,73*	*ns µ*	0,35	*0,85*	*ns µ*	0,46	*0,67*	*ns µ*
Ratio	16,59	*10,71*	12,23	*7,89*	*ns*	11,60	*7,89*	*ns*	12,55	*8,01*	*ns*
flexion-extension component	6,89	*2,63*	11,01	*4,20*	*	10,81	*5,04*	**	11,12	*3,80*	*ns*
axial rotation component	126,84	*20,24*	106,86	*18,68*	*** £*	95,81	*14,83*	** £	112,59	*18,08*	** £
lateral bending component	12,42	*7,04*	13,63	*6,88*	*ns*	12,48	*5,96*	*ns*	14,23	*7,35*	*ns*
variability of lfexion-extension	0,41	*0,19*	0,73	*0,44*	**	0,58	*0,31*	*	0,80	*0,48*	**
variability of axial rotation	2,29	*1,01*	3,09	*1,37*	**	3,53	*1,45*	*	2,87	*1,30*	*
variability of lateral bending	0,77	*0,35*	1,11	*0,55*	*** £*	0,99	*0,37*	*ns*	1,17	*0,62*	*** £*
Jerk on flexion-extension	0,87	*0,54*	1,64	*0,91*	**	1,62	*1,04*	**	1,65	*0,86*	*
Jerk on rotation	1,11	*0,48*	2,71	*1,61*	**	2,85	*2,08*	**	2,64	*1,35*	**
Jerk on lateral bending	1,08	*0,46*	2,52	*0,78*	*** £*	2,49	*0,56*	** £	2,54	*0,88*	** £
	control (n=50)		experimental (n=41)			artrodesis multi-level (n= 14)			arthrodesis single-level (n=27)		
Lateral bending											
	Mean	*SD*	Mean	*SD*	*sign*	Mean	*SD*	*sign*	Mean	*SD*	*sign*
Crosscorrelation	0,86	*0,38*	0,68	*0,60*	*ns µ*	0,64	*0,61*	*ns µ*	0,70	*0,61*	*ns µ*
Ratio	0,34	*0,19*	0,43	*0,36*	*** £*	0,50	*0,41*	* £	0,40	*0,34*	* £
flexion-extension component	8,69	*3,85*	9,52	*4,53*	*ns*	9,25	*5,23*	*ns*	9,66	*4,23*	*ns*
axial rotation component	19,63	*8,42*	24,21	*14,74*	**	23,53	*13,66*	**	24,56	*15,52*	**
lateral bending component	64,13	*20,71*	60,07	*18,06*	** £	46,94	*13,10*	** £	66,87	*16,59*	** £
variability of lfexion-extension	0,57	*0,42*	0,56	*0,32*	*ns*	0,54	*0,37*	*ns*	0,57	*0,30*	*ns*
variability of axial rotation	0,55	*0,26*	0,87	*0,56*	** µ	0,76	*0,39*	** µ	0,92	*0,63*	** µ
variability of lateral bending	1,63	*0,59*	2,49	*1,48*	** £	2,26	*1,12*	** £	2,61	*1,64*	** £
Jerk on flexion-extension	0,65	*0,45*	1,31	*1,24*	**	1,16	*0,72*	**	1,39	*1,44*	**
Jerk on rotation	1,03	*0,52*	2,58	*0,71*	*	2,64	*0,66*	*ns*	2,54	*0,74*	*
Jerk on lateral bending	0,69	*0,33*	2,11	*1,17*	**	2,52	*1,68*	**	1,90	*0,75*	**

£ : Ancova µ : Mann-Withney U-test sign: level of significance: with ** : p< 0,01 and *: p<0,05
means and standard deviations are expressed in °
Jerk is an absolute value (smaller values indicates a more smooth movement)