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Tri-axial Accelerometric Analysis of Dynamic Patterns of Mandibular Movements

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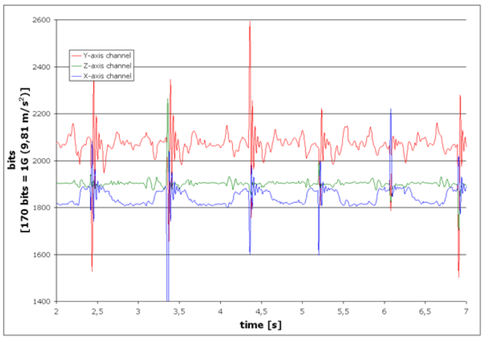
Introduction

Accelerometric analysis represents a simple and unique method for acquiring specific dynamic data of mandibular movement which can be used for determining physiological as well as pathological dynamics' patterns.

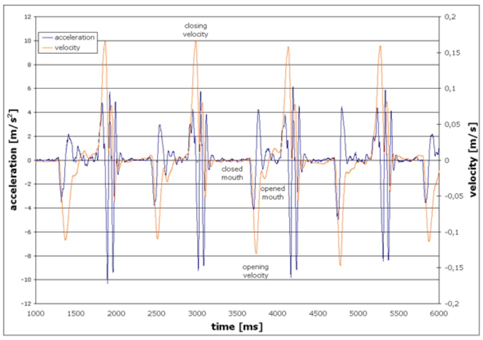
Material and Methods

This pilot study included a healthy subject without any signs or symptoms of temporomandibular disorders which was determined using RDC/TMD examination protocol and computerized analysis of dental occlusion (T-Scan ®II, Tekscan, USA). Accelerations were measured by tri-axial MEMS wireless acceleration sensor (GLinkTM, Microstrain, USA) with range of ±10G and freely selected sweep rate of 1 kHz. Sensor was mounted on custom-made holder firmly fixed to subject's mandibular teeth to avoid soft tissues' movement artefacts. Acquisition of acceleration data was performed during mouth opening-closing cycles (OC), protrusive (P) and right and left laterotrusive movements (RL, LL) with predetermined pace and amplitude. By means of accelerometric data mean vertical and horizontal velocities of the mandible during movements were calculated. The comparison of acceleration values during mandibular movements was performed using analysis of variance (ANOVA) and pair wise comparisons (post-hoc Scheffe test).

Results



Raw tri-axial accelerometric data recorded during mandibular opening-closing cycles.



Y-axis channel (vertical) acceleration and velocity graphs of mandibular opening-closing cycles.

Raw tri-axial accelerometric data recorded during mandibular opening-closing cycles are showed in Figure 1. Similar data were recorded during left and right laterotrusive as well as during protrusive movements of mandible. Analysis of acceleration and calculated velocity data during protrusive and laterotrusive movements also reveal regular, repetitive and recognizable patterns. Acceleration and calculated respective velocities in Y-axis (frontal plane) of opening and closing cycles demonstrate smooth, repetitive and distinctive patterns of mandibular movements (Figure 2). For the purpose of this study Y-axis (vertical) accelerometric values for different mandibular movements (Table 1) were analysed. The analysis of variance showed that acceleration values of performed mandibular movements were significantly different ($P<0.05$). The post-hoc Scheffe tests (Table 2) showed that differences were found between OC and three other mandibular movements (RL, LL and P) ($P<0.05$). There was no significant difference between RL and LL ($P>0.05$).

	Mean	SD	SE	95% Confidence Interval for Mean	
				Lower Bound	Upper Bound
OC	4,79	3,56841	0,79792	3,1199	6,4601

RL	1,192	0,79923	0,17871	0,8179	1,5661
LL	1,0915	0,70327	0,15726	0,7624	1,4206
PR	2,985	1,00625	0,225	2,5141	3,4559

Table 1: Descriptive statistics for acceleration values [m/s2] in Y-axis for different mandibular movements (OC, LL, RL and PR).

		Mean	**Sig.**	**95% Confidence Interval for Mean**	
				Lower Bound	**Upper Bound**
OC	**RL**	3,598	<0,001	1,8542	5,3418
	LL	3,6985	<0,001	1,9547	5,4423
	PR	1,805	0,039	0,0612	3,5488
RL	**OC**	-3,598	<0,001	-5,3418	-1,8542
	LL	0,1005	0,999	-1,6433	1,8443
	PR	-1,793	0,041	-3,5368	-0,0492
LL	**OC**	-3,6985	<0,001	-5,4423	-1,9547
	RL	-0,1005	0,999	-1,8443	1,6433
	PR	-1,8935	0,028	-3,6373	-0,1497
PR	**OC**	-1,805	0,039	-3,5488	-0,0612
	RL	1,793	0,041	0,0492	3,5368
	LL	1,8935	0,028	0,1497	3,6373

Table 2: Comparison of acceleration values [m/s2] in Y-axis for different mandibular movements (ANOVA and post-hoc Scheffe test).

Conclusions

Acceleration and velocity during mouth opening-closing cycles demonstrate repetitive and distinctive dynamics patterns. They are significantly different ($P<0.05$) from patterns of protrusive and laterotrusive movements which also demonstrate repetitive and regular form. Those data could be used as the basis for time and spectral domain attribute description of regular and pathological mandibular movements. Accelerometric measurements could be applicable as diagnostic tool in analysis of mandibular movements.

Literature

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Abbreviations

Abreviations in Table 1 and Table 2:

OC opening-closing
RL right laterotrusion
LL left laterotrusion
PR protrusion
SD Standard deviation
SE Standard error

This Poster was submitted by Dr. Ivica Pelivan.

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