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PROJECT OF PLAYFUL AND AUTOMATIZED ASSESSMENT OF MOTOR FUNCTION IN PATIENTS WITH NMD: MFM-DIGITAL STUDY

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CONTEXT: MFM ASSESSMENT[1,2]

The **Motor Function Measure** (MFM) is a validated and sensitive tool composed of 32 items, applicable to ambulant and non ambulant patients with **neuromuscular disorders** (NMD). It is currently used as outcome measure in clinical studies.

By using digital technologies, we want to create an automatized MFM assessment. The objectives are to improve the MFM reliability and its acceptability by including the assessment in a serious game.

Feasibility studies assessing the relevance of digital systems to capture postures and motions during a MFM test have shown that on 32 items of the MFM, 14 could be captured by the **Kinect** and 3 by a **digital tablet**. Here we present studies to the conception of the assessment with digital tools.

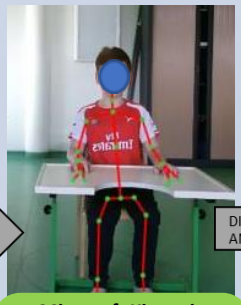
MATERIAL and METHOD

- **Patients with Spinal Muscular Atrophy** (SMA) type 2 or 3 (study1: 10 from the Escale department and study2: 14 from the NatHis-SMA study - NCT02391831) were included in the **MFM-Kinect study**. 14 items were scored by a therapist through standard MFM completion and from a blind scoring based on digital data coming from Kinect.
- **Patients with a NMD** from 5 neuromuscular disorder departments were included in the **MFM-Tablet study**. Items 18, 19 and 22 were scored by a therapist through standard MFM completion on paper or using a digital tablet application.

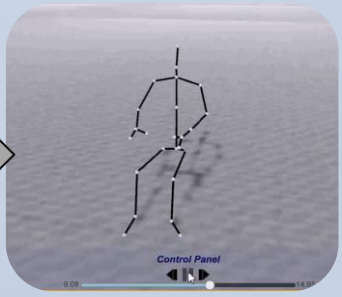
MFM-KINECT ANALYSIS PROCESS

e.g. item 15: Place both hands on the head

CAPTURE



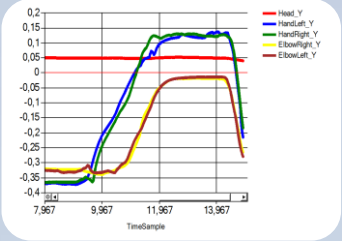
DIGITAL ANALYSIS



Conventional MFM test & Kinect: The therapist could stay on the patient side. Item is scored by therapist in real-time.

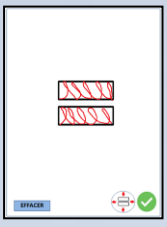
Microsoft Kinect is able to identify a silhouette and its articulations in a 3D space (digital skeleton) without any markers

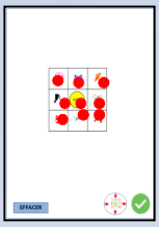
Interface mods **KiMe2** a software developed by the G-SCOP laboratory to record Kinect data and analyze items.



Kinect data recorded are converted into biomechanical observables on **kinematic graphs and 3D reconstruction** allowing the item scoring using different data (angles, distances…)

ITEMS STUDIED IN THE MFM-TABLET





Item 18: trace the edge of a CD

Item 19: draw loops inside the frame

Item 22: place finger on each case

RESULTS MFM-KINECT

119/140 records were interpretable. Some digital data were not analyzed because of capture problems with **distortion skeleton.** For example, patients with small amplitude movements or sitting on a wheelchair were hardly capture.

On **interpretable records**, a great **agreement** between items scoring by a therapist and items blind scoring on captured digital data were found (**75.6%**).

Differences between both studies concern as well concordance than interpretable capture.

Patients' characteristic	Study 1	Study 2
MFM test records (N)	10	14
Age (year) – median [IQR*]	10.7[10-11.5]	20.7[8.2-23.5]
SMA Ambulant/non ambulant	5/5	2/12
MFM total score (%) - median [IQR]	58.3[28.9-78.6]	58.3[46.6-62]

* Interquartile Range

MFM-Kinect results	Study 1	Study 2
Kinect records (N)	83	57
Error of capture (%): impossible analysis	7.2	26.3
Identical scoring (%): therapist vs digital data analysis	81.8	64.3

RESULTS MFM-DIGITAL TABLET

99 patients were included in the MFM-tablet study, with 25 DMD, 17 SMA, 15 Myotonic Dystrophy, 13 Progressive Muscular Dystrophy, 9 Neuropathies and 20 others.

Median age of patients were 16,1 year [IQR: 11,3 -43,9] and median of % MFM total score were 77,1 % [IQR: 53,1 – 85,4].

The **agreement** between scoring on paper vs tablet is excellent (κ> 0.81) for items 18 and 22, good (κ =0.61-0.8) for item 19.

	% identical score between paper *vs* digital tablet	Weighted Kappa Coefficient
ITEM 18	91.9	0.93
ITEM 19	73.7	0.70
ITEM 22	97.0	0.95

DISCUSSION and CONCLUSION

Results are encouraging to support the development of an automatized MFM. Additional work is needed to improve Kinect capture for weaker patients and to find new digital technologies able to capture additional items. In study 2, MFM-Kinect protocol was included in a long list of tests during NatHis-SMA, which could explain result differences between studies.

The MFM-tablet results validate the use of a tablet during the completion and give us the possibility to included it easily in a game, particularly for children who showed a greater interest for the tablet application.

The next steps are to implement algorithms to provide an automatized scoring based on digital data to help the therapist to score and to turn the assessment in a playful scenario in order to improve engagement of children.

[1] Bérard C. et al. A Motor Function Measure for Neuromuscular Diseases. Construction and validation Study. Neuromuscul Disord NMD. juill 2005;15(7):463-70.

[2] www.mfm-nmd.org

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