MECHANICAL PROPERTIES ASSESSMENT OF CHILD TRUNK

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INTRODUCTION

The biofidelity of child car crash dummies has to be improved. The reliability of identification or validation of injury mechanisms is still the major issue of child models. Studies on child cadavers are rare [1] and the tolerances of the child body are not well known. As a preliminary approach, the aim of this study was to determine the loading level of child trunk during physiotherapy treatments.

METHODS

Children suffering soft respiratory diseases were treated by therapeutic maneuvers performed by a physiotherapist, on medical prescription. Nine children aged from 1 month to 7 years (3 girls, 6 boys, mean 1.3 years) were considered. Data recorded were the displacement of the upper face of the practitioner's hands (using 2 synchronized video cameras) and the applied load (using a force plate into the practitioner table, under the child trunk). This measurement method allowed quantifying the applied loading without any change of the usual maneuvers. In these conditions, this protocol was approved by the ethical committee of INRETS.

An automatic tracking was performed on targets stuck on the physiotherapist hands for each film (Figure 1). By using a DLT algorithm [2], the 3D displacement of targets barycenter during applied trunk compression was available. An average error of 1,2mm was evaluated on the displacement [3]. The anteroposterior deflection of the thorax and load were considered. The maxima of the applied displacement and the recorded load were studied according to the age and trunk circumference.

Figure1: Physiotherapist treatment.
Three targets were glued on each hand.

RESULTS AND DISCUSSION

A characteristic load curve is shown on Figure 2. Table 1 details the mean maximum load and estimated deflection applied to thorax for different age groups.

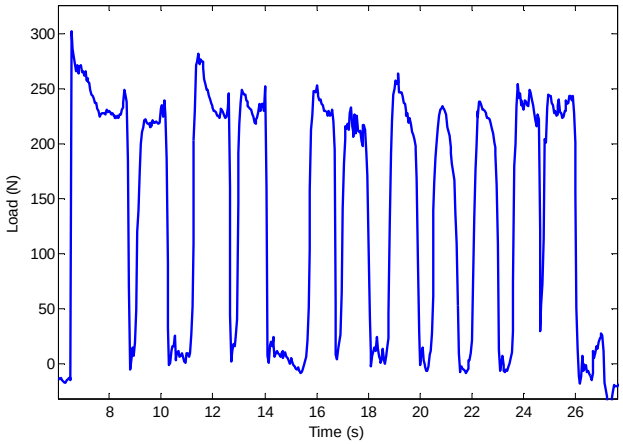

Figure 2: A characteristic load curve.

The loading conditions of physiotherapy treatments are clearly lower than during a real car crash. But the recorded levels highlighted the capacity of the child trunk to resist to some dynamic compressions.

CONCLUSIONS

This study has allowed obtaining the maximum deflection and the load that could be applied to children trunk with no injury. The load and displacement recorded during physiotherapy treatments will be analyze in depth, specifically to identify the shared loading domain between respiratory kinesiology and during a car accident. However, these results obtained on living children gave additional data in order to enhance the biofidelity of child models and improve the child safety in road accident. A larger population would have strengthened the results.

ACKNOWLEDGEMENTS

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REFERENCES

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2. Abdel-Aziz YI, et al., Proceedings of the Symposium on Close Range Photogrammetry, 1971.
3. Goubel C, et al. Proceedings of APSN Workshop on Biomechanical Experiment, September 21, 2004.

Table 1: Recorded data according to age group – Mean (SD)

Age group (year)	**0-0.5 (n=5)**	**1-1.5 (n=3)**	**7 (n=1)**
Max. Load (N)	232.4 (38.3)	319.1 (34.8)	448.7
Estimated deflection (mm)	24.2 (2.4)	32.1 (1.0)	35.9
Trunk circumference (mm)	424 (55.4)	503.3 (37.9)	600