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THE RELATIONSHIP BETWEEN AGE AND FORCES APPLIED DURING CHEST PHYSIOTHERAPY IN MECHANICALLY VENTILATED CHILDREN. Gregson R1,2,4, Shannon H2, Main E1,2, Dunne C1, Warner J4, Goldman A3, Stocks J2;

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PURPOSE: To assess, via an innovative new method (Novel Pliance®), the variability of forces applied to mechanically ventilated children during chest wall vibrations, and the extent to which these vary according to the age of the child.

RELEVANCE: Chest wall vibrations are commonly used during respiratory physiotherapy treatments. However, this technique remains largely unquantified. In order to understand its effects, it is essential to measure the force and characteristics of techniques involving manual contact between the physiotherapist and child. Moreover, the magnitude of force applied during physiotherapy in this population may be related to differences in age and chest wall compliance.

PARTICIPANTS: Mechanically ventilated children (aged 0-16 years) at Great Ormond Street Hospital for Children were recruited if they were clinically stable, heavily sedated or paralyzed and required chest physiotherapy (assessed by the physiotherapist and the medical team).

METHODS: Prior to physiotherapy, a lightweight, flexible, prototype force-sensing mat (Novel Pliance®) was placed over the area requiring treatment, between the child's chest wall and the therapist's hand. Physiotherapists administered treatments in their usual manner and forces applied through the mat were transmitted to the Pliance® system. Algorithms and an analysis program were devised in Labview™ using the Pliance® force system's summary ASCII format file (comprising time and force data). Force-time profiles, including maximum force and duration of vibration, and the amplitude, number and frequency of oscillations, were calculated for all chest wall vibrations.

ANALYSIS: Average values for the maximum force applied during each vibration were calculated for every treatment session. The median and range of these values between treatments were then reported. The extent to which forces varied according to age was also examined.

RESULTS: Nine senior physiotherapists were recruited to treat 40 mechanically ventilated children (median age: 1.5 years [range 0.2–14yrs], weight: 10kg [4.7–50kg]). Maximum applied forces ranged from 21–165 Newtons (N) (median: 40N) and were strongly associated with age. For every 1 year increase in age there was a 9N increase in Force applied (P < 0.0001) and these correlated significantly (r2=0.72). There was marked variability in the pattern of force-time profiles between physiotherapists with respect to the duration of vibration, and amplitude, number and frequency of oscillations. However this pattern was generally consistent within individual therapists, regardless of the child's age.

CONCLUSIONS: There was considerable variation in the magnitude of forces applied by different physiotherapists and these were significantly related to the age of the child. It is likely that this association reflects modification of treatment in response to differences in chest wall compliance, this being considerably higher during early life. Further research should examine other factors influencing physiotherapist's application of manual techniques, including how applied forces may differ in the treatment of adults.
IMPLICATIONS: The variations in force patterns between physiotherapists raise questions about the relative importance of individual components of chest wall vibrations and how these are anticipated to affect respiratory or physiological

change. Developments to combine force analysis with airflow data could prove invaluable in future intervention trials and for training purposes.

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