3D SCANNING OF OBJECTS CAUSING FOREIGN BODY INJURIES IN CHILDREN: AN INNOVATIVE APPROACH TO INJURY PREVENTION

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SCAN ME

BACKGROUND: Foreign body (FB) injuries represent a significant cause of emergency department visits, particularly in children (1). Among these injuries, nearly 60% are food related, with choking being a primary concern. However, non-food FB also pose considerable risks, with items such as button batteries, toys, and small household objects frequently involved (2). These injuries can result in severe complications, making it crucial to identify hazardous objects and implement effective prevention strategies. However, existing research tends to focus more on clinical outcomes rather than providing a detailed profile of the objects involved. This highlights the need for systematic data collection regarding objects' shape, size, and material to better understand and mitigate risks in the future. The present study aims to characterize FB injury cases collected in a large international FB injury database in children under 14 years of age.

Risk Profiling of Non-Food Foreign Objects:

To effectively prevent FB injuries, it is essential to understand the specific characteristics of objects that can cause significant harm.

- Shape and Detail Analysis: Objects with sharp edges or protrusions are associated with a higher risk of perforations or cuts.
- Size Assessment: Determining whether the object is small enough to be swallowed or can obstruct the airways is critical for choking risk.
- Consistency and Material Evaluation: Hard or brittle materials increase the risk of internal damage or complications if inhaled or lodged.
- Potential Complications: By analyzing injuries linked to different object characteristics, prevention can be prioritized based on the severity of outcomes.

OBJECTIVES: The primary objective of this study is to enhance the understanding of FB injuries in children by systematically profiling the characteristics of non-food FB that pose the highest risks. Through the use of advanced 3D scanning technology, we aim to create a comprehensive database that links object features (shape, size, material) with clinical outcomes. This will help the development of risk assessment models and prevention strategies, to reduce the incidence and severity of FB injuries.

2004 start as EU-DG-Commission funded initiative

2008 revewed for project continuation

In 2012 got expression of permanent interest from DG-Commission

Today Project is an independent UNIPD –sustained effort

MATERIAL AND METHODS: The project is based on the Susy Safe registry (3), one of the largest registries worldwide of FB injuries in children under 14. The registry was established almost 20 years ago and is based on a network of physicians, including pediatricians, ENT specialists, pulmonologists, and general practitioners from all over the world. Furthermore, it also allows non-medical health professionals to register FB cases voluntarily. It collects almost 36,000 FB cases, and, for each case, information on child socio-demographic characteristics, FB characteristics, clinical management, and outcomes.

Scanning protocol

In the investigation of FB injuries, precise documentation of the objects involved is critical for risk profiling. The following protocol outlines the steps for preparing and scanning these FB to produce accurate 3D models and data for in-depth analysis.

1. Pre-Scanning Preparation

Each object involved is carefully measured and photographed prior to scanning. This is essential for capturing the object's original state and it's a reference for later comparative analyses, to assess factors that may have contributed to the incident.

2. *Setup and Image Capture*

To ensure clear and detailed imagery, a plain background is used to maximize contrast. These images help ensure that important features, such as shape or potential points of entry or exit, are well-documented before the scanning process begins.

3. *Object Preparation*

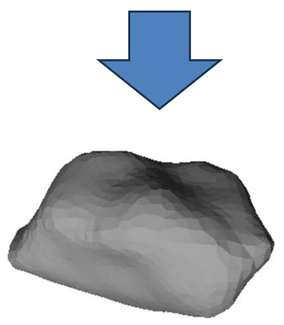
Proper mounting of the object is crucial to avoid any movement during scanning, using either a clamp plate or modeling paste for secure positioning. A fine layer of spray is applied evenly to enhance visibility during scanning, for better texture capturing.

4. *Scanning Process*

The scanner is calibrated on the type of object being analyzed, for high accuracy. A high-definition scan is performed, with adjustments to the scan plane and lighting; for more irregular objects, multiple scans from different angles are conducted.

5. *File Saving Protocol*

After the scan, data is saved in multiple formats. Photographs are stored as .jpg files, while the 3D scans are saved in .stl format. Relevant clinical and incident data are recorded to provide a comprehensive case file, essential for follow-up reports.



RESULTS: To date, about 500 cases were collected and we are actively building a database that links clinical information with the detailed characterization of the objects involved in FB injuries. Presented here are two examples of 3D scans of objects removed from nasal cavities (a stone and a small toy fragment, removed from the nose of a two-year-old girl).

CONCLUSIONS: Our database systematically links clinical outcomes to object characteristics such as shape, size, and material. This enables a comprehensive risk assessment. These 3D images allow us to visualize critical object features (like size, shape, sharpness, surface irregularities, and potential areas of impact) helping to develop more accurate injury risk profiles. This precise visualization supports ongoing efforts to improve preventive measures and guide clinical decision-making.

References:

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