Pediatric stone disease: modern methods of assessing.

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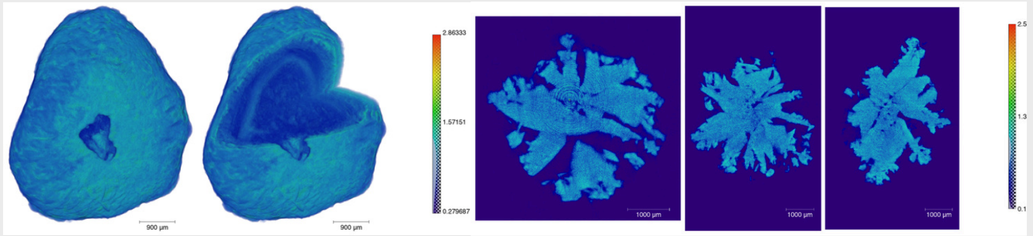
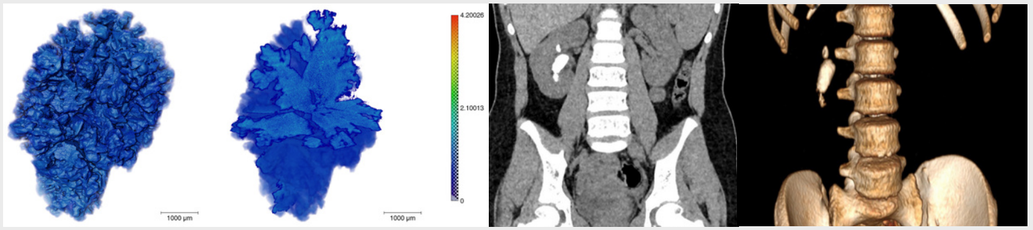
Backgroud

Urolithiasis in children has an incidence of 5–10% and is characterized by a chronic course with a high recurrence rate. Effective management of this condition necessitates a comprehensive approach, including the selection of an optimal targeted metaphylaxis strategy to minimize the risk of recurrent stone formation. In this context, advanced analytical techniques such as Raman microscopic spectroscopy, X-ray fluorescence analysis, and X-ray microtomography hold significant promise for the detailed characterization and differentiation of renal stone composition, thereby facilitating more precise and individualized treatment strategies.



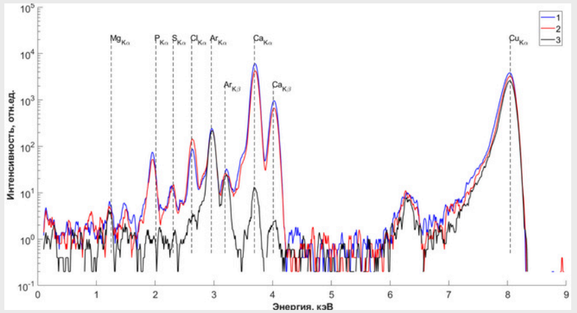


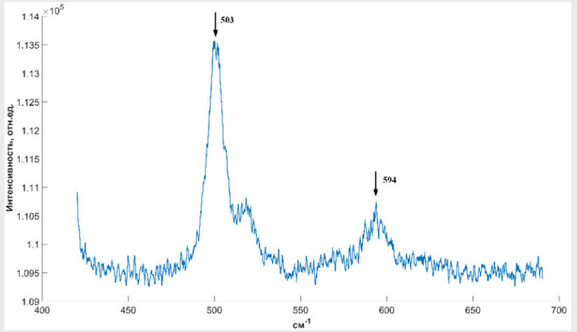
Methods

This study included six pediatric patients diagnosed with urolithiasis who required surgical intervention. Following lithoextraction, the excised calculi were subjected to a comprehensive structural and compositional analysis. Microtomographic imaging was performed using the X-ray microtomograph, while elemental composition analysis was conducted via X-ray fluorescence spectrometry. Additionally, phase composition was assessed through Raman spectroscopy.

Results

Microtomographic reconstructions revealed that 66.6% of the analyzed renal stone samples contained internal voids, whereas the remaining 33.3% exhibited a loose structure, likely formed by the aggregation of multiple smaller calculi. X-ray fluorescence analysis, conducted at various points on the samples, indicated that 16.7% of the stones contained high sulfur content with minimal calcium presence, whereas 83.3% were predominantly calcium-based. Phase analysis by Raman spectroscopy identified oxalate peaks in 33.3% of cases.





Implications

The integration of Raman spectroscopy, X-ray fluorescence analysis, and microtomography enables high-resolution visualization and detailed compositional assessment of renal stones in pediatric urolithiasis. Given its ability to provide precise structural and elemental characterization, this multimodal approach represents a valuable tool for optimizing diagnostic accuracy and informing targeted treatment strategies in affected children.