

Comparison of the conventional uroflowmetry and a novel mobile acoustic uroflowmetry in children: A pilot study

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BACKGROUND

• The standard uroflowmetry requires a patient to arrive with a fairly full bladder; however, some patients fail to hold their bladder last minute before the test and are unable to perform the test. Therefore, it would be more convenient to find another testing methodology replaceable to the conventional uroflowmetry. Previous research shows that once the sonouroflow system was developed. This study examined if the uroflowmetry graph matches with the sound generated by the urine stream hitting the urine collection receptacle. A moderate correlation was observed in voided volume (Pearson's correlation coefficient 0.68) and the average flow rate (Pearson's correlation coefficient 0.57) between conventional uroflowmetry and sonouroflowmetry. However, a weak correlation (Pearson's correlation coefficient 0.38) between the maximum flow rate using conventional uroflowmetry and sonouroflowmetry was documented. Though their system also records the sound to calculate the urine flow, it applies a different technique with our research. Sonouroflow treated the urine flow as one single session and only analyzed the Sound Pressure Level signal. This research plans to divide the one session into more than several hundred individual sessions. Furthermore, the research will apply not only to the Sound Pressure Level but also various signal processing methods in time domain and frequency domain to perform analysis and prediction.

PURPOSE

•The purpose of this protocol is to perform the uroflowmetry by using sound. It aims to help the uroflowmetry much simpler and more accessible (people can do the test anytime anywhere) than performing the conventional test method.

METHODS

• A novel mobile acoustic uroflowmetry application represents a non-invasive method to estimate the urine flow by recording the voiding sounds with a smart phone. After institutional review board approval, male pediatric patients who were prescribed uroflowmetry testing were prospectively recruited and the voiding sound was recorded during standard uroflowmetry measurements. The urine flow rate was calculated as the voiding sound was recorded and processed. Cases with voided volume <20mL or with recording problems, were excluded. Pearson's correlation coefficient (PCC, r) was used to compare the maximal flow rate (Q_{max}), average flow rate (Q_{avg}), voiding time (VT) and voided volume (VV) estimated by the standard uroflowmetry with those calculated via acoustic uroflowmetry.

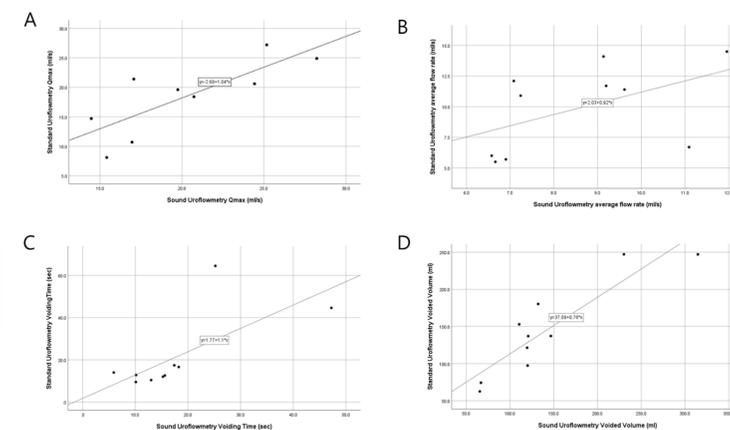


Figure 1. Scatter plot demonstrating correlation between standard and sound uroflowmetry data regarding maximal flow rate (Q_{max}) (A); average flow rate (B); voiding time (C); and voided volume (D). Correlation

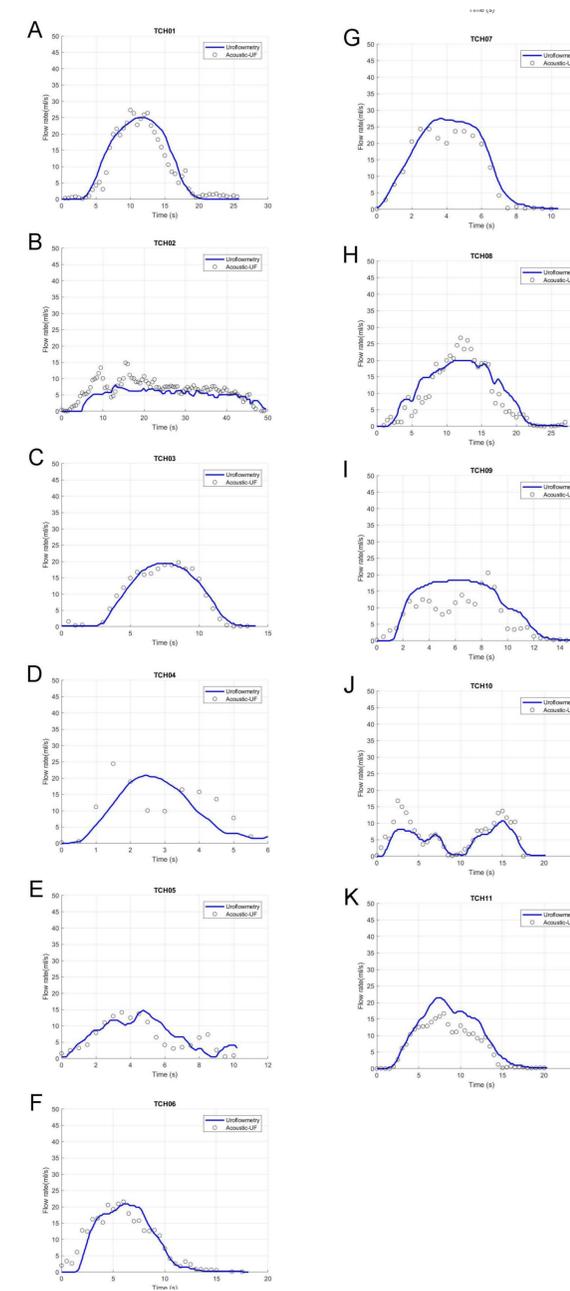


Figure 2. Comparison of flow curves from standard uroflowmetry (Blue line) and sound uroflowmetry (Black dot) in patient number 1 to 11 shown as A to K.

RESULTS

A total of 11 male patients were analyzed. Median age was 8 years (4–18).

An excellent correlation was observed between the two methods for Q_{max} (r = 0.798, p = 0.006), VT (r = 0.704, p = 0.023) and VV (r = 0.902, p < 0.001) but not for Q_{avg} (r = 0.503, p = 0.138) (Figure 1).

Flow patterns recorded by acoustic uroflowmetry and conventional uroflowmetry showed a good visual correlation. (Figure 2).

Median Q_{max}, Q_{avg}, flow time and voided volume were 20.1 (8.1-27.2) mL/s, 11.2 (5.5-14.5) mL/s, 12.5 (9.3-44.6) sec, 137.1 (62.6-247.1) mL, respectively.

CONCLUSION

This study shows that acoustic uroflowmetry is comparable to standard uroflowmetry with a good correlation in male pediatric patients. Further validation study on its performance in different toilet settings is necessary for broader use.

REFERENCES

- Shapiro E. Urodynamics in children. Rev Urol. 2012;14(1-2):36-8.
- Krhut J, Gartner M, Sykora R, Hurtik P, Burda M, Lunacek L, et al. Comparison between uroflowmetry and sonouroflowmetry in recording of urinary flow in healthy men. Int J Urol. 2015;22(8):761-5.