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Universities: Oslo, Ljubljana, Cambridge**ADVANCES IN URETHRAL® / BLADDER EMG NEUROPHYSIOLOGICAL DIAGNOSTICS IN WOMEN,
MEN & CHILDREN****AIMS OF THE STUDY**

Mandatory clinical and technical aspects for the success of the painless urethral techniques for diagnostics and the therapy possibilities of different lower urinary tract dysfunction have been never studied enough. Some very interesting historical findings from the most prominent world experts in neurology and neurophysiology in the past have misled us completely and gave us no hope for the routine urodynamics. It has been believed, that surface urethral and bladder EMG, needing to be painless and thus routinely applicable in every day urodynamics, were just not right and had no clinical value. Only the needle or wire EMG detection has been what it has been applicable and reliable in the case of the urethra and bladder. They did not know that the technical aspects were not solved satisfactorily in 80's, that this had been the only reason for the noisy urethral surface EMG signal, they were able themselves to detect in the urethra. The rest were trying to use the surface technique, but unfortunately they were instead of using urethral sphincter and urethral wall to detect the EMG from, they used the vaginal or anal entrance. This again was missing the point, as the other muscles having different function lay around and not primarily the urethral and bladder neck closing / delivering musculature, being mostly reflex and autonomously controlled. As we have gained as well new knowledge about the importance of the smooth muscle component beside striated muscle part on one side and on the other side dared to use high quality modern electronic components, the times have changed.

MATERIALS AND METHODS

The neuromuscular subsystem is without any doubts the main active part of the lower urinary tract function. To approach this subsystem when necessary in routine urodynamics and objectively evaluate the reasons for its dysfunction, we have to use the **quantitative user-friendly neurophysiological EMG techniques**. The basic promising findings using **surface urethral EMG** has been known for some tens years (1), and yet nobody had wanted to apply or better to consider the idea and contact us. The main idea® behind, Muscle Activation Function (MAF), which had to be understood first, was given on the ICS in London (2). Since then we have been using this idea more and more elsewhere (3). The final application with better EMG sensor® for the lower urinary tract has been given in 1997 (4), when the real time joint time/frequency analysis of the obtained EMG interference pattern©, introduced the applicability of this surface urethral EMG technique also for portable machinery. The comparatory needle EMG has been performed in each patient, proving that the surface EMG interference pattern gives a better information and idea about the storing/closing function of the urethral wall in men.

RESULTS

Standard urodynamic pressure-flow gas micro tip pressure catheter measuring system has been used. **Figure 1** shows the 4 channels urethral EMG, applied with equidistantly positioned longitudinally strips-electrodes placed on this catheter of size F8. The 4-channel EMG patterns measured within the female urethra in the place of the maximal closing pressure position in an MS female patient during voiding are given. A spastic, hyperactive pattern is found. The bladder-sphincter dissynergia was the cause for the trouble in this female patient, being not able to void normally and ever completely empty the bladder. Further in **Figure 2** the stress incontinent MS patient during voluntary retention and coughing (partially in **Figure 3**) the urinary stream or very weak and too slow activation of the closing fast striated muscle fibres. The frequency analysis in the frequency plot (**Figure 3**, left) demonstrated clearly the absence of the fast frequencies above 120 Hz (first right plot), meaning that the fast striated muscle fibres have been absent and no reflex recruitment, being necessary in the stress situations, the striated reflex neural control had been damaged. On the other side the increase in lower frequencies recruitment demonstrated that the smooth muscles activation.

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Figure 1: Hyperactive urethral sphincters (4 channel EMG interference pattern) in an MS patient with urinary hesitancy during voiding - (down first left picture)

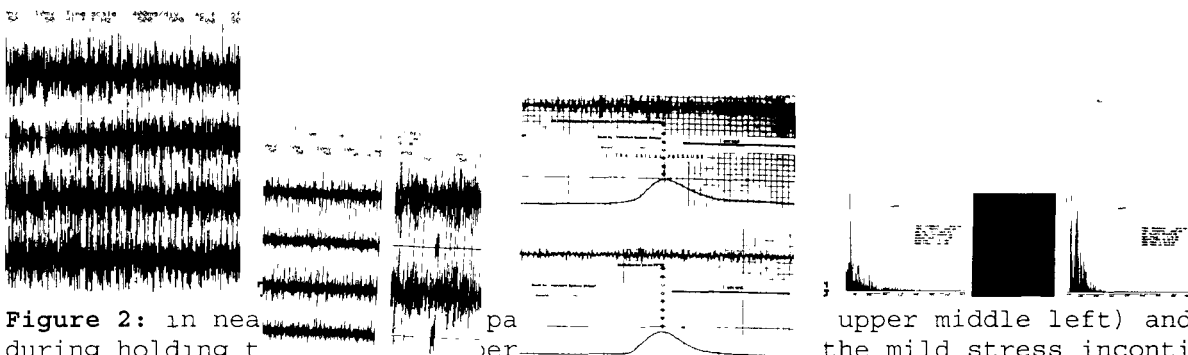


Figure 2: in near normal (upper middle left) and the mild stress incontinent (upper part of the upper right recordings) and normal during coughing (upper part of the upper right recordings)

Figure 3: last upper right photo

DISCUSSION AND CONCLUSIONS

Urethral innovative multi-channel Pt- electrodes sensor® has been equipped with necessary micro tip pressure sensors and everything else has been just technologically known from before (2). The noise free EMG interference pattern of some **micro volts** became for us the main method to judge upon the **neuromuscular function** (3, 4), i.e. striated fast twitch and tonic as well as smooth muscle fibres contribution to the harmony in coordination and proper function of the lower urinary tract during storing, voiding and treatment procedures. But the main clinical findings in men and women, children and babies with different dysfunction in the lower urinary tract had to be reviewed and altogether with the known demands in the technical part, a new, totally new technology had to be developed for the purpose of the new routine, simple and reliable surface EMG technique. 20 years of the hard research and development work described here gives us to judge whether it is worth at last to trust to the **growing clinical expertise** and understanding supporting this technique in Slovenia, England, Norway, Germany, Denmark, Holland and elsewhere. The urodynamics and X-rays video voiding has been in the recent year considerably improved. But the neurophysiology, being the main technique to get the **neuromuscular diagnosis**, has suffered a big lack. The needle EMG has given an insight only in very special cases - i.e. female adults. But the main male patients group with **prostate problems** and urinary obstruction have still not had the right routine technique, which would help to see the presence of the normal and not hyperactive tonic urethral EMG in prostate obstruction cases. The needle EMG is very much lacking in those cases, as it is difficult to position the needle and to split in the EMG signal being detected the tonic and **denervation muscle potentials** or **hyperactive potentials** towards the **voluntary** and **reflex** activation of the sphincter during stress situations, during the bladder filling and during voiding. The so-called **bladder-sphincter dissynergia** has not been measured together with urodynamics on pressure-flow studies routinely, being very important not to operate too many times as false positive, as it is the growing tendency. As **the neuromuscular obstruction** has to be objectively excluded, before we should operate such an obstruction, this will be the case if applying the presented EMG technique. Our method of the **surface painless EMG** is the future, which will be bright for many poor male patients of all ages and status with lower urinary tract disorders. They have got a perfect and nearly foolproof method now. But the **children** population of the **neurogenic bladder** will get the first usable methodology to be applied to find anything about their **neurophysiological information**.

REFERENCES

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