

## Effect of sacral surface electrical stimulation on the prostatic urethra

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### Abstract

*The purpose of this study was to clarify the morphologic change of the prostate after sacral surface electrical stimulation (ssES) in the healthy subjects by using Magnetic Resonance Imaging.*

*Subjects were seven healthy males and all of them did not have any prostatic diseases.*

*Electrical stimulation for 15 min was applied on the skin just above the posterior sacral foramens of the S2-4(sacral surface electrical stimulation) in all subjects. The morphologic change of the prostate after ssES was investigated by magnetic resonance image.*

*Diameters of prostatic urethra (DPU) were significantly expanded after ssES.*

*SsES has an influence on decreasing muscle tension of the prostate smooth muscle tissue. SsES causes an inhibition of the parasympathetic pelvic neurons and/or a facilitation of the sympathetic hypogastric neurons in the spinal cord via electrically induced afferent volleys from the pudendal nerve.*

### 1. INTRODUCTION

There are some reports on application of ssES for the pelvic organs such as the uterus and the bladder. According to those reports the smooth muscle in uterus and bladder can be well controlled by ssES. These effects of ssES suggest centripetal stimulation to spinal cord via the pudendal nerve modulates some spinal reflexes. However, influence of ssES upon the prostate remains unclear.

The purpose of this study was to clarify the morphologic change of the prostate after sacral surface electrical stimulation in the healthy subjects by using Magnetic Resonance Imaging.

### 2. METHODS

Subjects were seven healthy males and all of them did not have any prostatic diseases.

Stimulation electrodes (LINTEC Co. Ltd, Tokyo) were attached on the skin just above the posterior sacral foramens of the S2-4. Cyclic stimulation pattern with 10 sec stimulation and 5 sec rest for 15 min was used. Bipolar rectangular pulses with 0.2 msec duration were applied to the subjects through a portable low frequency treatment device (LINTEC Co. Ltd, Tokyo). The stimulation frequency was 30 Hz and the stimulation voltage was set to the intensity just under pain threshold in each subject.

Pelvic sagittal T2-weighted FSE image (T2WI) was obtained by using a 0.2-T permanent magnet system (Signa profile, General Electric Co, USA) before and after cyclic stimulation.

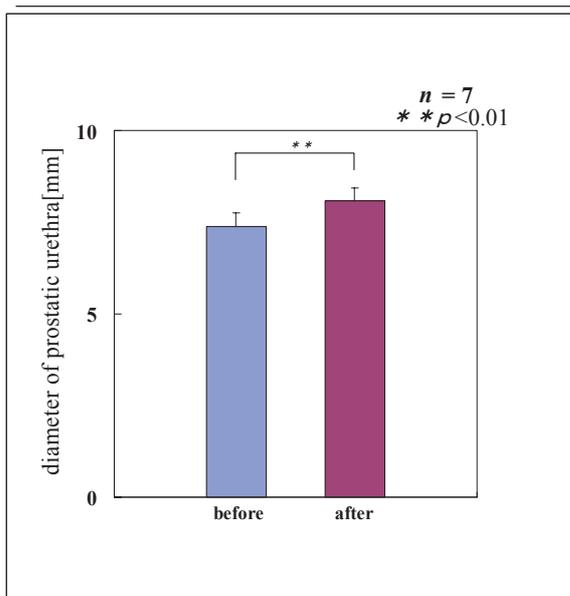
Diameter of prostatic urethra (DPU) and saggital area of bladder (SAB) before and after ssES were measured with T2WI.

Paired *t*-test was performed to compare differences between before and after ssES in DPU and SAB. Values with  $p < 0.05$  were defined to indicate a statistically significant difference.

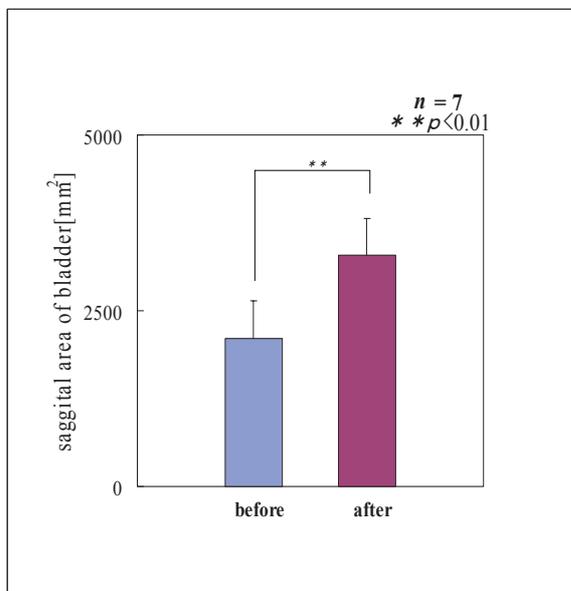
### 3. RESULTS

Figure 1 shows the mean value of DPU obtained with T2WI in each subject. DPU was significantly expanded after applying ssES ( $p < 0.01$ ).

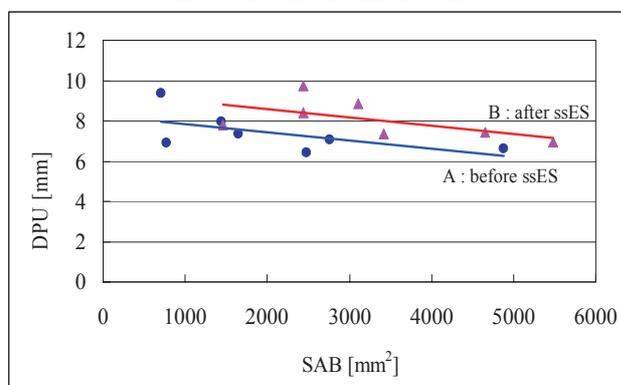
Figure 2 shows the mean value of SAB obtained with T2WI in each subject. SAB was significantly increased after applying ssES ( $p < 0.01$ ).



**Figure 1.** The mean value of diameter of prostatic urethra before and after sacral surface electrical stimulation



**Figure 2.** The mean value of the saggital area of bladder before and after sacral surface electrical stimulation



**Figure 3.** the relation between diameter of prostatic urethra and saggital area of bladder before (●) and after (▲) sacral surface electrical stimulation

Figure 3 shows the relation between DPU and SAB before and after ssES in each subject. There was a clear correlation between DPU and SAB before ssES and after ssES respectively (spearman's rank correlation coefficient : A ;  $r = -0.643$ , B ;  $r = -0.643$ ). DPU was decreased with the increase of SAB. These correlations were approximated by linear lines (A ;  $y = -0.0004x + 8.32$ , B ;  $y = -0.0004x + 9.31$ ).

#### 4. DISCUSSION AND CONCLUSIONS

According to figure 1 and 2, both DPU and SAB increased after ssES. However, it is suspected that enlargement of the bladder affects DPU. The line A in Figure 3 indicates that DPU is decreased with the increase of SAB. It means enlargement of the bladder reduces DPU. On the other hand, the size of DPU after ssES shifted to the upper side on a parallel with before ssES as shown in Figure 3. DPU increased after ssES in all subjects though DPU is expected to decrease when the size of bladder enlarges naturally.

Therefore, the result shown by Figure 1 implies that ssES influenced the expansion of prostatic urethra. Furthermore, this result suggests that ssES has an effect on decreasing muscle tension of the prostate smooth muscle tissue.

We reported that ssES was decreased muscle tension of the myometrium and controlled the uterine peristaltic movement [1]. Moreover, we reported that a change of urethra internal pressure synchronized with ssES [2]. According to these reports, ssES causes an inhibition of the parasympathetic pelvic neurons and/or a facilitation of the sympathetic hypogastric neurons in the spinal cord via electrically induced afferent volleys from the pudendal nerve. The prostate is dominated by same neural systems as those of the uterus and the bladder. Therefore, it is valid to consider that the neurophysiological background of the effect of ssES on the prostate is similar to it on the uterus and the bladder.

#### • Referenc

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- [2]Yokozuka M., Namima T., Nakagawa H., Ichie M., Handa Y., Effects and indications of sacral surface therapeutic electrical stimulation in refractory urinary. *Clinical Rehabilitation* 18:899-907,2004