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# EFFECTS OF ANKLE INCLINATION ON ABDOMINAL AND PELVIC MUSCLES ELECTROMYOGRAPHIC ACTIVITY AT REST AND DURING MAXIMAL PELVIC FLOOR MUSCLE CONTRACTION IN SUPINE POSITION IN WOMEN WITH AND WITHOUT STRESS URINARY INCONTINENCE

Hypothesis / aims of study
Urinary continence is maintained thanks not only to pelvic floor muscle integrity but also to the coordination between pelvic floor and abdominal muscles enabling women to guarantee the continence status in situation with high urethral pressure levels. The increase in the intra-abdominal pressure chancing position, coughing, sneezing, laughing, is usually opposed by pelvic floor muscle activation and co-activation of the abdominal muscles. In fact an abdominal muscle co-activation seems to contribute to the generation of a strong pelvic floor contraction; moreover the synergic activation of pelvic and abdominal muscles is important in order to generate a suitable closure urethral pressure. A good coordination between abdominal muscles and pelvic floor muscles probably might compensate a weakness of the pelvic floor muscle tone. Several studies reported that the synergic activation of pelvic and abdominal muscles increases the ability of women to better contract pelvic floor muscles. Pelvic floor muscle (PFM) training is the first line treatment for female stress urinary incontinence (FSUI). Actually it is not well known which is the best position to facilitate PFM activity (PFMa). No data are available on the effect of ankle inclination on PFMa in the supine position according to abdominal influences. We carried out this study to assess this aspect in women with and without FSUI.

Study design, materials and methods
A total of 66 women were selected: 35 (group B) complained of FSUI, and 31 (group A) were healthy volunteers. Exclusion criteria were: musculoskeletal problems; previous major abdominal or pelvic surgery; severe diseases; diabetes mellitus, a body mass index (BMI) >30 kg/m2; intraureterine device implantation; pelvic organ prolapse, menopause. An electromyographic (EMG) biofeedback instrument using surface electrodes was employed to measure changes in PFMa and abdominal muscle activity (AMa). During EMG recordings, each subject was asked to perform PFM 5s-contractions while assuming the following different supine positions: ankles relaxed in a neutral position (NP), hips and knees at right angle (RA), ankles dorsiflexed at 0°(s0DS), 5° (s5DS), 10° (s10DS), and 15° (s15DS), and ankles plantar flexed at 5°(s5PS), 10°(s10PS) and 15° (s15PS). The following electromyographic parameters have been evaluated: rPFMa (resting PFMa), rAMa (resting AMa) (expressed in μV); maximal contractions taking into account both the maximum peak (mPFMa and mAMa, expressed in μV), and the area under the contraction curve (amPFMa and amAMa, expressed in μV*sec). PFMa and AMa have been recorded simultaneously. For statistical analysis a standard normal cumulative distribution has been used. Electromyographic activity has been reported in terms of mean values and standard deviations (SD) ( ($p<0.05$).

Results
Continent women were younger than incontinent ($P<0.001$). Table I shows study population's clinical and demographic characteristics.

**Table I. Study population clinical and demographic characteristics**

| Characteristics | Group A (n°31) | Group B (n°35) |
|---|---|---|
| Age (years): mean (range) | 26 (18-35) | 40 (28-49) |
| Parity: mean (range) | 0 (0-0) | 2 (0-3) |
| Voiding symptoms: number of subjects (%) | 0 (0.0%) | 0 (0.0%) |
| Nocturia: number of subjects (%) | 0 (0%) | 4 (11.4%) |
| BMI (kg/m2): mean (range) | 22 (19-27) | 24 (19-30) |
| Symptoms duration (years): mean (range) | 0 (0-0) | 10 (3-19) |

Table II shows mean values and SD of rPFMa, mPFMa and amPFMa in the 9 analysed positions, according to the different groups.
**Table II. Mean values and SD of rPFMa, mPFMa and amPFMa.* Significant differences between group A and group B.**

| Position | rPFMa (DS) μV | mPFMa (DS) μV | amPFMa (DS) μV*s |
|---|---|---|---|
| **Group A** | | | |
| NP | 14 (13) | **373 (201)*** | **697 (332)*** |
| RA | 16 (9) | **241 (122)*** | **543 (227)*** |
| s0DS | 17 (11) | **290 (148)*** | **578 (272)*** |
| s5DS | **14 (10)*** | **310 (173)*** | **588 (307)*** |
| s10DS | 17 (15) | **319 (175)*** | **598 (306)*** |
| s15DS | 16 (13) | **271 (151)*** | **548 (265)*** |
| s5PS | 14 (13) | **290 (172)*** | **589 (318)*** |
| s10PS | 12 (12) | **305 (171)*** | **601 (299)*** |
| s15PS | 13 (13) | **293 (147)*** | **583 (245)*** |
| **Group B** | | | |
| NP | 13 (6) | **225 (139)*** | **432 (242)*** |
| RA | 18 (9) | **184 (74)*** | **376 (138)*** |
| s0DS | 18 (8) | **184 (91)*** | **361 (189)*** |

| | | | |
|---|---|---|---|
| s5DS | **20 (12)*** | **193 (107)*** | **358 (181)*** |
| s10DS | 16 (6) | **196 (108)*** | **372 (197)*** |
| s15DS | 17 (8) | **189 (95)*** | **379 (203)*** |
| s5PS | 15 (6) | **199 (109)*** | **403 (222)*** |
| s10PS | 14 (5) | **190 (98)*** | **379 (189)*** |
| S15PS | 13 (4) | **197 (93)** | **403 (199)*** |

In group B rPFMa in dorsiflexion (DS) was always higher than plantar flexion (PS). Similar results were observed in continent women. Concerning mPFMa no significant difference was found in group B between dorsiflexion and plantar flexion. In contrast mPFMa in NP was significantly higher than s0DS (p=0.001), s5DS (p=0.007), s15DS (p=0.002), s5PS (0.050), s10PS (p=0.015), RA (p=0.008). Similar results were observed in group A. In this group mPFMa was significantly lower in RA than in DS and PS, regardless inclination degree.
Concerning the Ama, the only significant difference between the two groups was recorded in s5DS (18±5μV in group B versus 15±7μV in group A).

Interpretation of results
PFM basal tone was always greater in incontinent women reaching a significant difference in 5DS. Resting PFMa in 10PS and 15 PS was greater in the incontinent group (p<0.020 and p<0.030, respectively). The maximal PFMa in any posture was greater than that during the rest periods (p<0.001). Concerning the resting PFMa, in both s0DS and RA it showed the greatest values, and in both 0DS and 5DS it was significantly greater than in PS (p<0.010). No EMG differences were found between DS, RA and NP. Concerning the maximal PFMa, no EMG differences were found between DS and PS. In contrast, a maximal PFMa was greater in NP than in RA, PS and DS, regardless angle inclination. Similar results were found concerning the AM activity.

Concluding message
The most effective mPFMa would seem to be obtained in both PS and NP; in this latter position PFM basal tone was markedly reduced. In contrast, in RA and DS basal tone was increased with a mPFMa significantly lower. Thus, in supine position an ankle dorsiflexion at 0° may improve PFM tone, whilst ankles relaxed in a neutral position may facilitate a better maximal PFMa.


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|---|---|
| ***Specify source of funding or grant*** | **NONE** |
| ***Is this a clinical trial?*** | **No** |
| ***What were the subjects in the study?*** | **HUMAN** |
| ***Was this study approved by an ethics committee?*** | **No** |
| ***This study did not require eithics committee approval because*** | **subjects enrollment was performed within a standard set of pelvic floor muscle training** |
| ***Was the Declaration of Helsinki followed?*** | **Yes** |
| ***Was informed consent obtained from the patients?*** | **Yes** |