Original article / Short review

Nocturnal enuresis in children- Literature review and anatomical rationale for a squatting -based pelvic floor regime

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Abstract: *Aim* To analyse whether the squatting-based pelvic floor regime based on the Integral Theory System would assist children with nocturnal enuresis. *Methods* A literature review and an analysis of the anatomical rationale for a squatting-based regime was made with regard to an RCT between two groups, a squatting-based regime based on the Integral Theory System and a placebo. CONSORT were guidelines to be followed as regards randomization, blinding and independent assessment of results. Statistically, it was determined that 48 patients would give 90% power with a CI of 95% allowing a 9% placebo effect. *Results and conclusions* The literature review of existing practice revealed no insights which could influence the proposed study. The origin of bed-wetting was said to be essentially unknown. Analysis of the xrays, however, confirmed that the squatting-based regime of the Integral System would act on the same pubourethral and uterosacral ligaments which are repaired surgically using tapes, and which give high cure rates for bladder, bowel and chronic pelvic pain dysfunctions. It was also reasoned that the main difference between adults and children with reference to the Integral Systems's pelvic floor regime was that children are in a collagen formation mode, which should reinforce the ligaments in a better way than in adults, with superior results to those obtained already in premenopausal adult women.

Keywords: Nocturnal enuresis; Squatting; Integral theory; Pelvic floor regime.

INTRODUCTION

Enuresis or "wet bed" syndrome represents an important percentage of the daily consultation of the pediatrician and the pediatric urologist. It is estimated that between 15 and 20% of children at 5 years of age wet the bed. [1]

Nocturnal enuresis was rarely mentioned in the old literature, given the little importance that was then assigned to the sufferings of children.

Probably the first reference to enuresis was published in Ketham's Fasciculus Medicinae, a text of general medicine and one of the first medical books produced by the printing press in Venice in 1491: "Enuresis is the involuntary emission of urine during sleep".)

However, when the symptom lasted until adolescence and maturity, the obvious social disconfort pressed to find a solution. In the Children's Book, Thomas Phaires discusses "urinating the bed**.**[2]"

Shakespeare's son-in-law, physician John Hall relates in a 1657 publication the cure of enuresis, of a 15-year-old boy by a homemade preparation in base to dried chicken and eggs every morning[3].

After millennia of darkness on the subject, during the last century, there has been a particular interest on the subject since the "wet bed" ceased to be considered more a domestic problem than a disease. Thus, different specialties considered the topic from their own unique point of view, particularly the psychologists and psychiatrists who see the problem of the wet bed as a behaviour disorder[4].

This concept still persists in popular belief although to a lesser extent. As early as 1937, Burns wrote in Growing Child: "... that the neurotic attitude of an enuretic child is an effect of enuresis rather than a cause".

The point of view of our modern urology estimates that enuresis should be considered in the broad context of voiding dysfunctions.

Neurophysiology and urodynamics of the lower urinary tract have contributed greatly to the knowledge of the process of urination and continence. The concept of complete elimination (evacuation) and its dysfunctions[5] add interesting data to our clinical knowledge.

The failure to awaken when the bladder is full is an obvious factor that was very well studied in the past decade, as well as the hormonal regulation of nocturnal polyuria[6].

Multiple publications deal with different aspects related to enuresis: decreased functional bladder capacity[7-9], the prevalence of micturition diurnal symptoms and bladder instability[10], ingenious alarm devices for the treatment of enuresis[11,12] and others.

Different classifications of enuresis were also proposed, taking as parameter one or the other aspect that make up this broad clinical spectrum called enuresis or wet bed. The most popularized classification is that of primary enuresis, when I never stop wetting the bed and secondary enuresis when an interval of at least 6 months passed dry. Other classifications recognize four etiological areas: psychological (environmental, emotional and as a consequence of the disorder, impact on their self-esteem), neurological (sleep disorders, DAHA, where enuresis appears with an important index in comorbidity)[13], hormonal (polyuria, disorders in the production of antidiuretic hormone) and functional urology (retentionist habit, voiding incoordination, overactive bladder)[14].

It is very important to mention the report of the Standardization Committee of the International Society for Pediatric Continence, which unifies the terminology in this area[15]. It defines enuresis as synonymous with intermittent nocturnal incontinence, there being ample evidence that children with enuresis they present symptoms of dysfunction of the urinary tract under different clinical, therapeutic and pathogenetically of children without these symptoms. For this reason, unequivocal classification is essential in two subgroups: monosymptomatic and non-monosymptomatic enuresis. The previous division based on the presence or absence of diurnal incontinence is only inadequate since other diurnal symptoms (constipation, urinary infection, etc.) may also be indicative of voiding dysfunction.

Another vision, based on the Integral Theory of Female Incontinence[16] proposed by Prof. Peter Petros of Sydney Australia. maintains that the enuresis could be conditioned by a congenital laxity of the ligaments, at the level of the ligaments that support the urethra.

EPIDEMIOLOGY. PREVALENCE OF NOCTURNAL ENURESIS

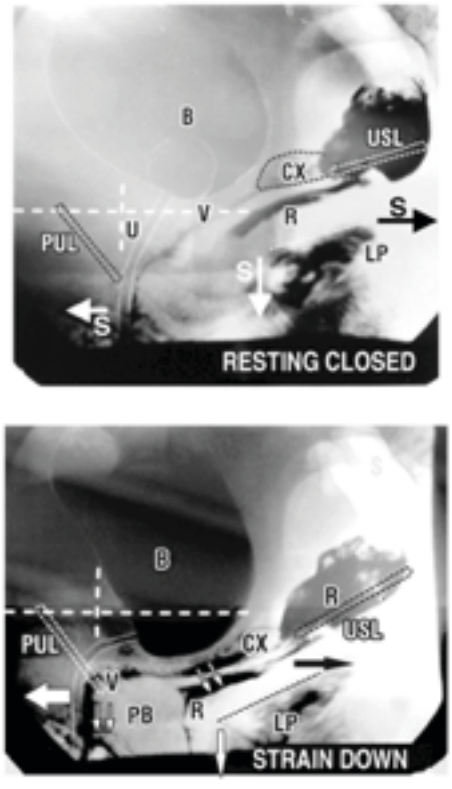
In a study on child development conducted by Feeham et

al in 1990, 1,139 children were born in a year in Dunedin, New Zealand, and 92% were followed 6 years later. It was found that primary enuresis remits with age with an annual rate of around 15%. At 7 years, the prevalence is significant since most children, now schoolchildren, add more problematic social consequences[17]. In this age, the prevalence is between 6 and 10%. The similarity of these prevalence rates in populations from all over the world is remarkable[18]. Jon Heron, published in May 2008 an interesting work on a cohort of 11,000 children in the United Kingdom, studying the trajectories of daytime incontinence and soiling (evacuation dysfunction syndrome) and its importance in understanding the development of urinary and fecal control and identify risk groups[19].

A study conducted by Hirasing in 1997 on the prevalence of wet bed in adults aged 18-64 years, on the other hand, is interesting. A total prevalence of 0.5% was found, referring to a large untreated population. Assuming a prevalence of enuresis of 8% at 7 years in boys, the results can be transferred and show that the risk of a child enuretic remains symptomatic for the rest of his life is 3%, if not treated during childhood, cited by Hjalmas et al in 2004)[20].

Night enuresis is a genetic and heterogeneous disorder. Genetic factors are important while environmental factors exert major modifying effects on the phenotype (21). Empirical family studies have repeatedly shown a high rate of affected children (39% if the father was enuretic, 23% of mothers and 46% of parents). Bakwin in 1973 showed that if a father was enuretic, children have a 40% chance of being. If both parents this figure rises to 70%[21].

Fig 1. Three directional muscle actions pull against pubourethral (PUL) and uterosacral (USL) suspensory ligaments Broken lines represent bony vertical and horizontal co-ordinates .
Radioactive dye has been inserted into the bladder "B", vagina "V", rectum "R" and levator plate "LP"
Upper xray image Three slow twitch muscle forces "S" maintain continence.
Lower xray image On straining, three fast twitch muscles pull forwards and backwards against the puborethral ligaments "PUL" (arrows) and downwards against the uterosacral ligaments "USL" (downward arrow). The downward vector pulls down the anterior border of LP to "kink" the urethra at bladder neck.



ETIOLOGY OF ENURESIS: GENETICS

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Hypothesis

That a squatting based pelvic floor regime would help children with nocturnal enuresis (bed wetting).

The background to the hypothesis was Patricia Skilling's squatting -based pelvic floor regime which gave excellent results in studies in premenopausal women, Tables 1&2[22-24].

With reference to fig 1, squatting exercises strengthen the 3 involuntary muscles, m.pubococcygeus (forward arrow), m.levator plate (backward arrow) and m.longitudinal muscle of the anus (downward arrow), which in turn pull against the pubourethral ligaments (PUL) anteriorly and the uterosacral ligaments (USL) posteriorly, fig 1[25-27].

This contrasts markedly with the "squeezing-based" Kegel exercises which are based on voluntary upward contraction of the puborectalis muscle 'PRM' fig 2[26,27].

Why the Integral Theory System for pelvic floor rehabilitation was developed

It was evident from radiological studies[16], that the organ and muscle movements observed during Kegel exercises

Fig 2. Same patient as fig1. Broken lines represent bony vertical and horizontal co-ordinates .
Note how "squeezing" ('Kegel muscle') lifts all the organs upwards and forwards with reference to the bony co-ordinates.

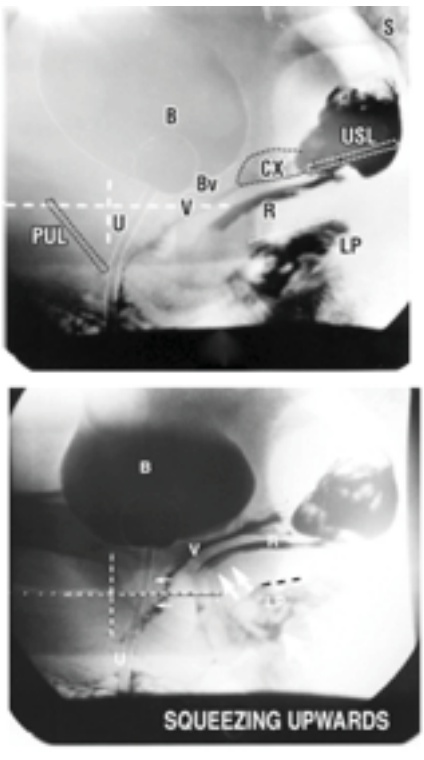

Table 2	
Fate of Individual Symptoms (n=78)	
condition	>50% improvement
stress incontinence (n=69)	57 (82%)
urge incontinence (n=44)	33 (68%)
frequency only (n=12)	10 (83%)
nocturia (n=32)	29 (90%)
pelvic pain (n=17)	13 (76%)

Table 1	
Fate of Individual Symptoms (n=60)	
condition	>50% improvement
stress (n=42)	78%
urge (n=39)	61%
frequency (n=53)	62%
nocturia (n=24)	75%
pelvic pain (n=20)	65%
leakage (n=50)	68%
bowel problems (n=28)	78%

(squeezing upwards) were very different from coughing and straining. It was evident that the pubourethral (PUL), and uterosacral ligaments (USL), were major insertions for the 3 directional muscle forces. It was already known that simultaneous surgical reinforcement of PUL by a midurethral sling, and USL by a posterior sling[25], gave high cure rates for symptoms of stress incontinence (SI), urgency, frequency, abnormal emptying, and chronic pelvic pain.
It was reasoned that using exercises such as squatting and straining would strengthen the natural closure muscles, and their ligamentous insertions, PUL and USL. It was also reasoned that if the Theory was valid, not only SI, but a much wider range of symptoms such as urgency, frequency, abnormal emptying, and pelvic pain should
also be curable simply by including squatting type exercises. Th is proved to be so. The methods and results of the 1st and 2nd applications of the Integral Theory System PFR[22-24] are detailed below in Tables 1&2.

PROPOSED METHODOLOGY

To follow the CONSORT guidelines with regards to randomization, blinding and independent assessment of the results. An RCT with two groups, experimental and placebo of 46 patients would give a power of 90% with confidence interval of 95% allowing a 9% placebo effect. The primary exercise regime (24 patients) would, as a minimum, be based on squatting, 10 times morning and evening, with adoption of a "squatting culture", encouraging the child to perform all its activities in the squatting position. The placebo group had 24 patients.
Assessment was to be with an independent doctor plus the signed testimony of the parent as to whether the child was dry or not at assessment at 4 months.

RESULTS AND DISCUSSION

The literature review of existing practice revealed no insights which could impact on the proposed study. The origin of bed-wetting was said to be essentially unknown. Analysis of the xrays, however, confirmed that the squatting-based regime of the Integral System would act on the same pubourethral and uterosacral ligaments which are repaired surgically using tapes, and which give high cure rates for bladder, bowel and chronic pelvic pain dysfunctions[27].
It was also reasoned that the main difference between adults and children with reference to the Integral Systems's pelvic floor regime was that children are in a collagen formation mode, which should reinforce the ligaments in a better way than in adults, with superior results to those in Tables 1&2.

CONCLUSIONS

The analysis was very positive for the initiation of a squatting based pelvic floor regime for children with nocturnal enuresis with prospects of a higher cure rate than that achieved in adults.

Conflicts

Peter Petros: Principal author of the Integral Theory
Angel Fernandez Garcia: None

REFERENCES

1. Moffat M. Nocturnal enuresis. Is there a rationale for treatement? Scan J Urol Nephol Suppl 1994;163: 55-67.
2. Phaires T. On pissing in the bed - and elsewhere. The Lancet 1977; 310: 1214-1215.
3. Hall J. Select Observations on English Eminent Persons in Desperate Diseases. Ed. James Cook. Printed by J.D.for Benjamin Shirley P.11, London, 1679.
4. Miller K. Concomitant non pharmacologic therapy in the treatment of primary nocturnal enuresis. Clinical Pediatrics 1993; (Special Edition): 2-37.
5. Bloom DA, Seeley WW, Ritchey ML, Mc Guire EJ. Toilet habits and continence in children: an opportunity sampling in search of normal parameters. J Urol 1993; 149: 1087-1090.
6. Moffatt MEK, Harlos S, Kirshen AJ, Burd L. Desmopressin acetate and nocturnal enuresis: how much do we know? Pediatrics 1993; 92: 420-425
7. Norgaard JP, Pedersen EB Djurhuus JC. Diurnal antidiuretic hormone levels in enuretics. J Urol 1985; 134: 1029-1031.
8. Hansen MN, Ritting S, Siggaard C, Kamperis K, Hvistendahl G, et al. Intraindividual variability in nighttime urine production and functional bladder capacity estimated by home recording in patients with nocturnal enuresis. J Urol 2001; 166 (6) 2452-2455.
9. Rushton Hl, Belman AB, Zaontz MR, Skoog SJ, Sihelnik S. The influence of small functional bladdler capacity and other predictors on the response to Desmopressin in the management of monosymptomatic nocturnal enuresis. J Urol 1996; 156 (suppl 2): 651-655.
10. Chandra M, Saharia R, Hill V, Shi Q. Prevalence of diurnal voiding syntoms and difficult arousal from sep in children with nocturnal enuresis. J Urol 2004; 172(1): 311-316.
11. Woo SH, Park KH. Enuresis alarm treatment as a second line to pharmacotherapy in children with monosymptomatic nocturnal enuresis. J Urol 2004; 171(6): 2615-2617.
12. Hvistendahl GM, Kamperis K, Rawashdeh YF, Ritting S, Djurhuus JC. The effect of alarm treatment on the functional bladder capacity in children with monosymptomatic nocturnal enuresis. J. Urol. 171 2004; (6): 2611-2614.
13. Astbury J,Orgill AA, and Bajuk B. Relatonship between two years behaviour and neurodevelopment outcome at five years of very low birthweight survivors. Developmental Medicine and Neurology 1987; 29 (3): 370-379.
14. García Fernández A, Palacio MM, Santo R, Llorens V,Abadía GP. Coordinated voiding resolves the symptoms of bladder instability in children. BJU 2000; 84 (suppl 4): 12-
15. Neveus T, von Gotard A, Hoebeke P,Hjalmas K, Bauer S. et al "The standardization of terminology of lower urinary tract function in children adolescents: Report from de Standardisation Committee of the International Children´s Continence Society. J Urol 2006; 176: 314-324.
16. Petros PE & Ulmsten UU An Integral Theory of female urinary incontinence. Acta Obstetricia et Gynecologica Scandinavica, 1990; Supplement 153; 69: 1-79.
17, Feehan M, McGee R, Stanton W, Silva PA. A 6 year follow-up of childhood enuresis: prevalence in adolescence and consequences for mental health. J Paediatr Child Health 1990; 26:75–9.
18. Lee SD, Sohn D, Lee JZ, Park NC, Chung MK. An epidemiological study of enuresis in Korean Children. BJU Internat 2000; 85: 869.

19. Heron J, Joinson C, Croudace T, von Gontard A. Trajectories of Daytime Wetting and Soiling in a United Kingdom 4 to 9-Year-Old Population Birth Cohort Study. J Urol 2008; 179(5): 1970-1975.
20. Hjalmas K, Arnold T, Bower W, Caione P, Chiozza LM, von Gontard A, et al. Nocturnal enuresis: an international evidence based management strategy J Urol 2004; 171(6): 2545- 2561
21. Hublin C, Kaprio J, Partinen M, Koskenvuo M. Nightmares: Familial aggregation and association with psychiatric disorders in a nationwide twin cohort Am J Med Genet/Neuropsychiatric Genetics, 1999; 88: 329-336
22. Petros PE and Skilling PM Pelvic floor rehabilitation according to the Integral Theory of Female Urinary Incontinence. First report, European Journal of Obstetrics & Gynecology and Reproductive Biology 2001; 94: 2, 264-269
23. Petros PE and Skilling PM The physiological basis of pelvic floor exercises in the treatment of stress urinary incontinence. Br J Obstet Gynaecol 1999;106:615-616
24. Skilling PM,·Petros PE Synergistic non-surgical management of pelvic floor dysfunction: second report. Int J Urogyne 2004; 15: 106-110
25. Petros PE and Ulmsten U Role of the pelvic floor in bladder neck opening and closure: I muscle forces. Int J Urogynecol and Pelvic Floor 1997; 8: 74-80
26. Petros PE and Ulmsten U Role of the pelvic floor in bladder neck opening and closure: II vagina. Int J Urogynecol and Pelvic Floor. 1997; l8: 69-73
27. Liedl B, Inoue H, Sekiguchi Y et al. Is overactive bladder in the female surgically curable by ligament repair? Cent European J Urol. 2017; 70: 51-57.

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