Biofeedback
Volume 40, Issue 3, pp. 109–112
DOI: 10.5298/1081-5937-40.3.04

SPECIAL SECTION

Remediation of Enuresis Using QEEG-Guided Neurofeedback Training

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Keywords: enuresis, quantitative electroencephalography (QEEG), neurofeedback, remediation, treatment

Current treatments for bedwetting (enuresis) include alarm therapy, desmopressin acetate therapy, anticholinergic therapy, and imipramine therapy. These treatments do not always eliminate the problem, and the patient often relapses when the treatment is discontinued. Surgery may be indicated for patients with anatomical abnormalities, but the vast majority of patients have normal urinary anatomy. We have found that it is usually possible to eliminate the problem using quantitative electroencephalography (QEEG)-guided neurofeedback. We report here the successful elimination of enuresis in 11 consecutive patients using this approach. Thus far, there have been no failures with this approach.

Introduction

Nocturnal enuresis (bedwetting) is a common problem in children (Cendron, 1999). The spontaneous remission rate is estimated to be approximately 15% per year. Without intervention, only 15% of bedwetting children will become dry each year. Causation is multifactorial. Many children with enuresis are deep sleepers. A small percentage of children are sensitive to foods. Eliminating foods such as citrus and caffeine may benefit them. Some have a low functional bladder capacity and have difficulty during the day. Only a small percentage of cases are caused by specific medical situations (Johnson, 1998). Treatment often utilizes bedwetting alarms to awaken the patient and DDAVP™ (Desmopressin) to reduce urine formation (Paredes, 2002). These approaches do not always remediate the problem, and the problem often recurs when treatment ends. Punishing or shaming the child frequently makes the situation worse. Tricyclic antidepressants may prove successful, but they often cause side effects, and enuresis often recurs when antidepressants are stopped (Evans, 1998).

The first effective non-pharmacological treatment for enuresis was the neurofeedback protocol developed by Barbara Ayers in 2000 (Hammond, 2005). Hammond (2005) reported four cases who responded to this protocol. In their research, electrodes were placed directly below O1 and O2, approximately over Brodmann areas 18 or 17, utilizing a bipolar (sequential) montage, inhibiting 4–7 Hz, and reinforcing 15–18 Hz. These areas are not included in the International 10/20 system, but activity in these areas is measured with raw EEG topographies, e.g., in the Thatcher

Table 1. Amplitude of activity at various relevant sites (eyes open) (microvolts)

Patient	0z	01	02	P3	P4	Pz	Cz
1	0.8	-	-	0.7	0.7	.07	-
2	1.9	1.9	1.9	-	-	-	-
3	1.2	-	-	-	-	-	1.2
4	1.7	1.7	1.5	-	-	1.5	1.5
5	1.0	-	-	-	-	-	-
6	0.7	-	0.5	-	-	-	-
7	1.1	0.8	0.8	-	-	0.8	0.8
8	1.5	1.3	1.3	-	-	1.3	1.3
9	1.0	-	-	-	-	-	-
10	1.9	-	-	-	-	-	-
11	2.3	-	-	-	-	-	-

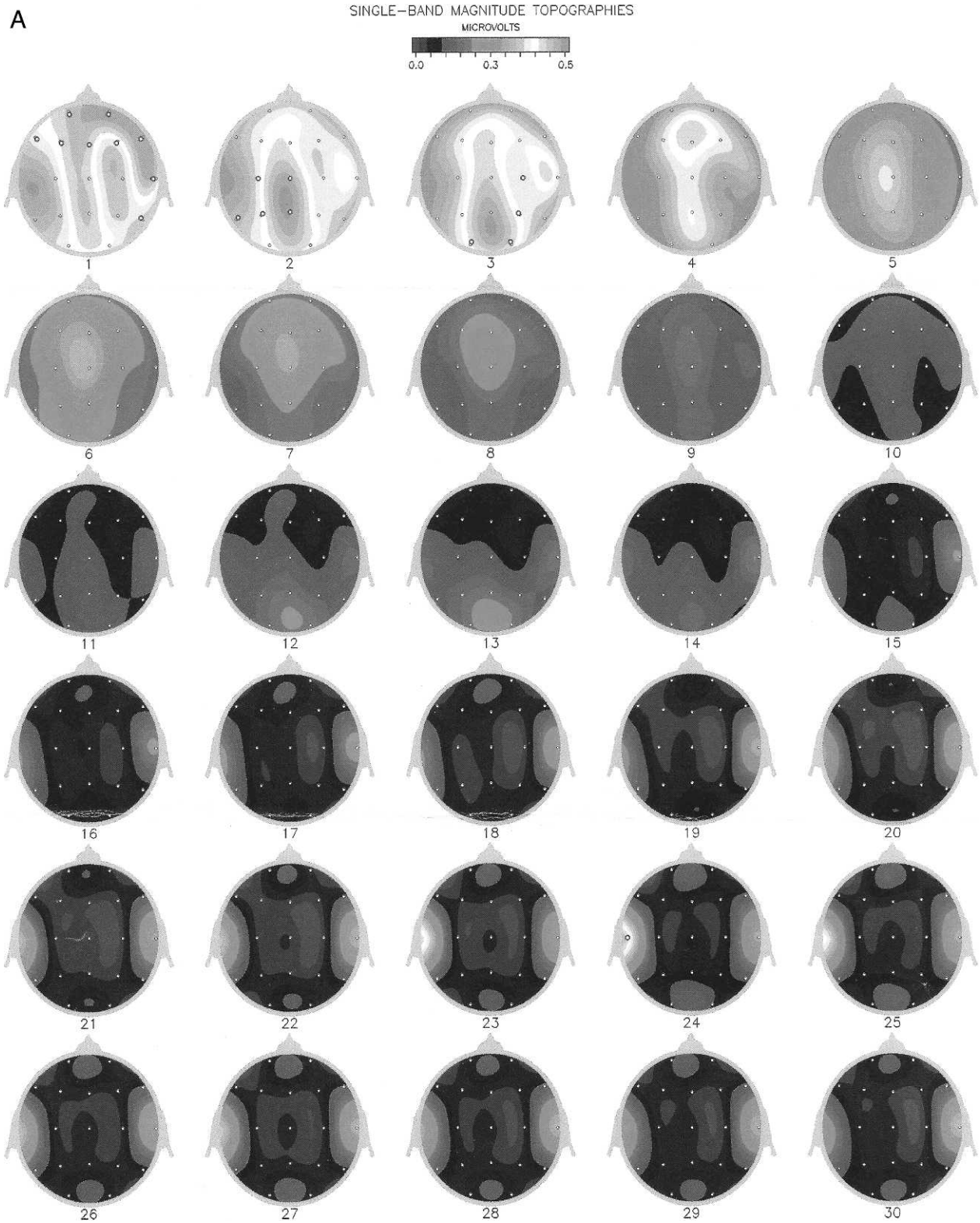

Figure 1. Single band magnitude topography, Thatcher Neuroguide database. The abnormal 1–3 Hz activity at Oz (A) resolved with neurofeedback training to decrease 1–7 Hz and increase 15–18 Hz at Oz (B). This normalization was associated with cessation of enuresis.

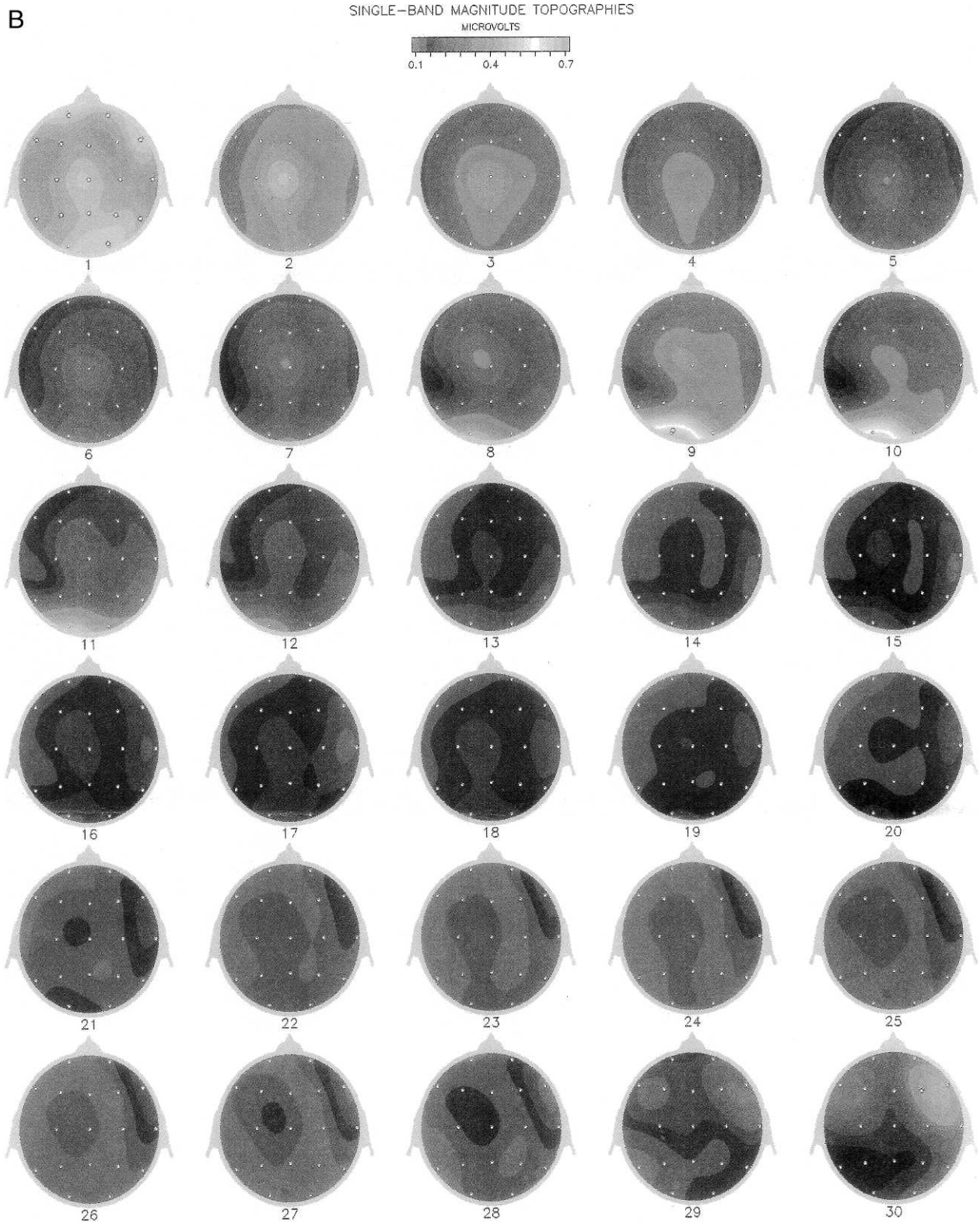

Figure 1. Continued.

Neuroguide database (Applied Neuroscience, Inc., St. Petersburg, FL) with eyes closed and eyes open.

Since typical treatments for enuresis are minimally successful, neurofeedback presents a promising approach.

Materials and Methods

In 100 individuals with normal, good bladder control at night, aged 5–30 (50 males and 50 females), little or no activity was seen at Oz (mid-occipital). Quantitative electroencephalograms (QEEGs) were obtained on them for reasons other than enuresis. Eleven individuals who had enuresis every night aged 4–70 (7 males, and 4 females), also underwent QEEG.

The QEEGs of enuretic individuals revealed 0.8–2.3 microvolts amplitude of low frequency (0–3 Hz) activity at Oz, whereas nonenuretic individuals had 0 microvolts of low frequency activity at Oz. Elevated amplitudes of low frequency activity were often found at adjacent areas (O1, O2, P3, P4, Pz) in the enuretic individuals (Table 1).

Each patient underwent neurofeedback training to decrease 1–7 Hz and increase 15–18 Hz at Oz for 5–7 sessions, 20 minutes per session, two times per week.

Results

All the individuals so trained experienced cessation of their enuresis with no recurrence for 12 months or longer ($p < .001$, Wilcoxon test). Figure 1 shows an example of resolution of excess Oz slow activity (1–3 Hz) on single band magnitude topography, associated with neurofeedback training to reduce such activity (reward decrease in 1–7 Hz, and increase in 15–18 Hz). This subject attained good bladder control.

Discussion

Oz beta training is usually effective in remediating enuresis. The mechanism for this normalization is not clear. It seems likely that cortical control of bladder emptying is defective in enuretic individuals and that cortical control is enhanced by the Oz beta training (Holstege, 2010). The effect occurs relatively quickly and appears to be sustained long-term.

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