

## IDIOPATHIC SUBJECTIVE TINNITUS TREATED BY AMITRIPTYLINE HYDROCHLORIDE/BIOFEEDBACK

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### ABSTRACT

The efficiency of two treatment modalities for subjective/idiopathic tinnitus (SIT): biofeedback (BF) and amitriptyline hydrochloride (AT) was investigated in 225 randomly selected subjects. Findings show that after 10 weeks of treatment in the BF group, 43.5% of the patients reported an improvement of tinnitus during activity. In the AT group, 27.5% of patients reported subjective improvement of tinnitus at rest although only 15.8% of the AT patients reported improvement during activity. Biofeedback during rest had a significantly better effect on tinnitus disturbance than AT. No objective diminishment of tinnitus loudness was found as a result of any of the treatment modalities. We believe that BF can help tinnitus patients especially during periods of rest and we also suggest trying tricyclic antidepressant drugs such as AT for treatment of tinnitus patients, in small doses, however, to minimize the side effects of this drug.

Subjective tinnitus (ST) is one of the most common and yet most unclear of otologic symptoms.<sup>1-4</sup> ST can accompany any type of hearing loss including both sensorineural as well as conductive hearing loss, and may originate from any part of the auditory pathway.<sup>1,5</sup>

Treatment of ST must be primarily directed to the basic illness diagnosed after a thorough general ear-nose-throat and neurologic evaluation.<sup>6</sup> Severity of ST is evaluated both objectively, by determining the pitch and intensity of the tinnitus,<sup>7</sup> and subjectively as described by the patient. Because of the relatively high incidence of ST and in some patients, the severe personal reaction to it, many different treatments have been suggested, but generally only small to moderate success has been achieved in reducing tinnitus and its

consequences, if any at all.<sup>8</sup> In this study we examined the effect of two treatment modalities: amitriptyline hydrochloride and biofeedback.

### AMITRIPTYLINE HYDROCHLORIDE (AT)

AT is a tricyclic antidepressant drug.<sup>9</sup> The precise mechanism of its antidepressant activity is unclear, but the drug has been shown to block the uptake of various neurotransmitters at the neural membrane. The effect is both anticholinergic and antihistaminic. The anticholinergic action leads to decreased production of endolymph and a release of inhibition in the afferent fibers at the organ of Corti and the olivocochlear bundle. The antihistaminic effect produces a vasoconstriction of the cochlear artery, which decreases the cochlear potential. Therefore, its effect on tinnitus could be either peripheral or central.<sup>10</sup>

### BIOFEEDBACK (BF)

It is widely accepted that tinnitus is a disturbance that is connected to a tension reaction.<sup>11</sup> With the use of BF, the patient learns to gain control of certain physiologic functions of his body with the help of a device that displays the results of this physiologic function electronically.<sup>12</sup> Biofeedback has been used successfully to gain control of migraine, pain, hypertension, and other tension-related diseases.<sup>13</sup> Control of tinnitus through biofeedback was first reported by House and colleagues.<sup>14</sup> In a study of treatment of severe tinnitus by BF, 50% of patients reported an improvement in their condition, and in a different study by the same author,<sup>15</sup> improvement was reported in 77% of patients.

The effectiveness of the different forms of treatment is controversial and no ideal

system has yet been found.<sup>16</sup> The purpose of the study was to compare the effectiveness of two methods of treatment for SIT: BF and AT, with matched control groups. Another aim was to determine the effectiveness of these treatments during activity and rest. The third aim was to make a comparison between the subjective results of the treatment with the objective results.

## MATERIALS AND METHODS

Two hundred and twenty-five subjects suffering from SIT were investigated. Of these, 7 subjects discontinued treatment, and 218 completed it. All subjects underwent a general ear-nose-throat examination and neurologic investigation including a detailed anamnestic questionnaire, physical examination, tonal audiometry, test for speech discrimination, recruitment test, brainstem auditory evoked potentials, and in selected cases, a computed tomographic (CT) brain scan was performed. Patients who suffered from pathologic entities such as Ménière's disease, acoustic neurinoma, or cochlear otosclerosis, were excluded from the study.

Table I.  
Severity Rating for Tinnitus Disturbance

	During Activity
Grade 0	No tinnitus
Grade 1	Mild tinnitus without disturbance
Grade 2	Moderate, disturbs but does not affect activity
Grade 3	Severe, which affects activity
Grade 4	Very severe, making activity impossible
	During Rest
Grade 0	No tinnitus
Grade 1	Mild tinnitus without disturbance
Grade 2	Moderate, which disturbs but does not affect sleep
Grade 3	Severe, which affects sleep
Grade 4	Very severe tinnitus, which causes severe insomnia and spontaneous arousals

Each patient completed a questionnaire in which the patient was required to give a detailed description of the tinnitus. The tinnitus was rated on a scale of 5 degrees of disturbance (0 to 4) during activity and rest, and is shown in Table II.

Tinnitus was also evaluated objectively, by comparing its pitch and intensity to tonal stimuli of audiometers through a matching technique.<sup>6</sup>

Subjects were randomly divided into four treatment groups: Group A—treated with BF, which included 62 subjects, 34 men and 28 women. Age range was 23 to 64 years with a mean of 42.5 years. Group B—treated with AT, included 76 subjects, 39 men and 37 women, whose ages ranged from 26 to 70 with a mean of 44 years. Group C was a control to the BF group, treated by placebo BF and included 40 subjects: 22 men and 18 women, whose ages ranged from 30 to 72 years, with a mean of 46 years. Group D was a control to the AT group, treated by placebo tablets and included 40 subjects: 20 men and 20 women, whose ages ranged from 35 to 69 years with a mean of 52 years.

Each patient received a preliminary explanation as to the types of treatment and a questionnaire on which to mark the degree of tinnitus every week for periods of both activity and rest.

The matching technique was performed before the first treatment and immediately after the last. The subjects treated with BF underwent 10 weekly sessions of 30 minutes each. The BF subjects were treated by electromyogram (EMG) BF using the frontal muscle as described by House.<sup>15</sup>

The base-level muscular tension of every patient was evaluated before treatment. Each subject was constantly reminded of the degree of tension through visual and auditory stimulation of the BF device.

The AT group received 10 mg tablets of AT three times daily for a 10-week period.

The BF control group was connected to the BF device, but the sounds and the visual scale were not connected to their muscle tension but to a tape recorder instead. All other details were the same as in the actual BF group. The AT control group received one placebo tablet three times daily for 10 weeks.

Statistical evaluation was calculated using the Chi-square test to compare the activity and rest periods within the same group, and then compared with each other. The results of the test were considered as significant when the p value was less than 0.05.

**RESULTS**

No significant difference was found in pitch or intensity of tinnitus comparing those before to those after treatment in either group. The comparison of the four patient groups regarding improvement of the degree of tinnitus at rest and activity during 1st, 5th and 10th weekly sessions is illustrated in Figure 1.

After 10 weeks of treatment in the BF group, 43.5% of the patients reported an improvement in the degree of tinnitus at rest, whereas only 24% reported improvement of tinnitus during activity. In the AT group, 27.5% of patients reported improvement of tinnitus at rest, whereas only 15.8% reported improvement during activity. In the control groups only a 2.5% to 5% improvement was reported.

Figures 2 to 5 show the curves of degree of tinnitus disturbance during rest compared with those during activity in the different groups before and after treatment. The most prominent decrease in the degree

of tinnitus disturbance after treatment is noticed in the BF group during the rest period.

Table II shows a statistical comparison among the different groups regarding the degree of improvement of tinnitus disturbance at rest versus activity period.

Table III presents a statistical comparison between the BF and AT treatment groups regarding improvement in degree of tinnitus.

Although a significant difference was found in the tinnitus improvement of the BF and AT groups at rest, but no significant difference was found regarding the same comparison during activity (see Table III).

When the BF and AT treatment groups were compared with their control (placebo) groups regarding improvement of degree of tinnitus, only the comparison between placebo and the AT group during activity was found to be insignificant. The other groups when compared with their placebo were found statistically significant, as follows: (1) BF at rest,  $p < 0.0001$ , (2) BF at activity,  $p < 0.011$ , and (3) AT at rest,  $p < 0.011$ .

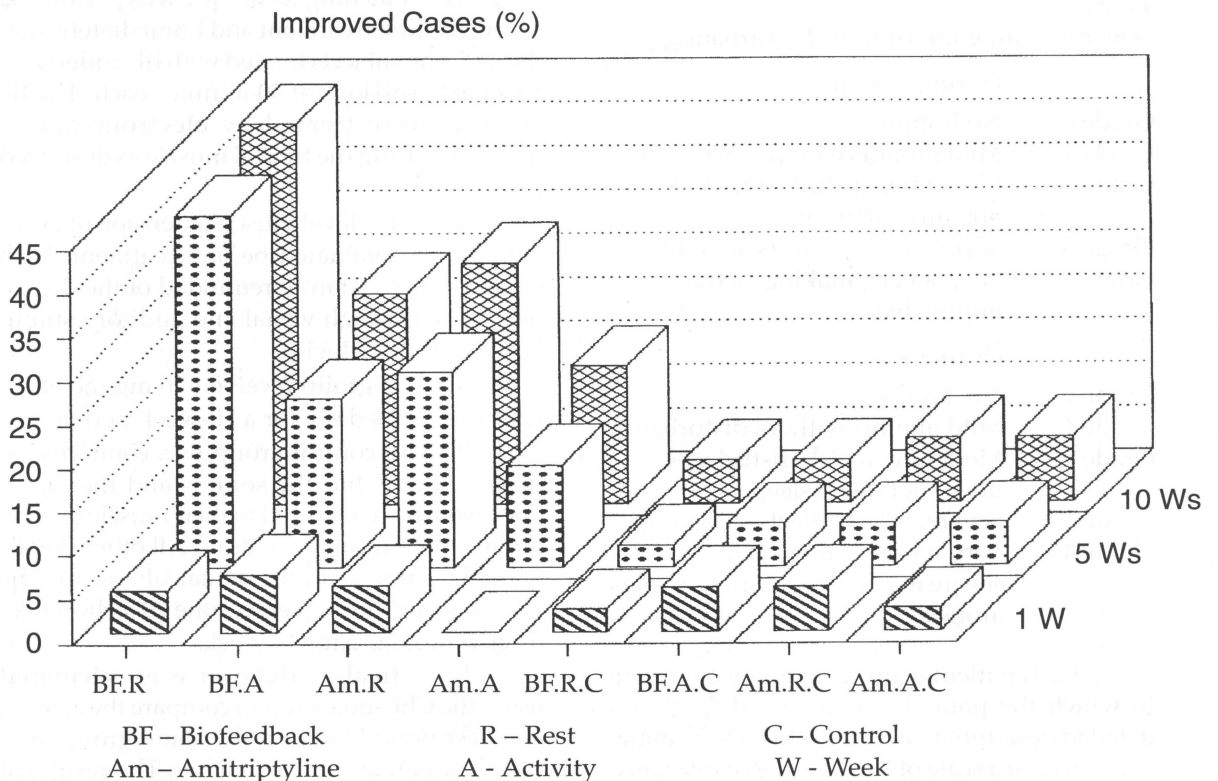


Fig. 1. Biofeedback and Amitriptyline Effect on Tinnitus Patients vs. Control

Table II.  $\chi^2$  findings for treatment effect between rest and activity periods

	BF.R	BF.A	At.R	At.A
Improved	64%	36%	64%	36%
No change	43%	57%	46%	54%
p <	0.02		0.07	

BF – Biofeedback  
R – Rest

Table III.  $\chi^2$ -findings for treatment effect of tinnitus patients (BF vs. At)

	BF.R	At.R	BF.A	At.A
Improved	56%	44%	56%	44%
No change	39%	61%	42%	58%
p <	0.05		0.21	

At – Amitriptyline  
A – Activity

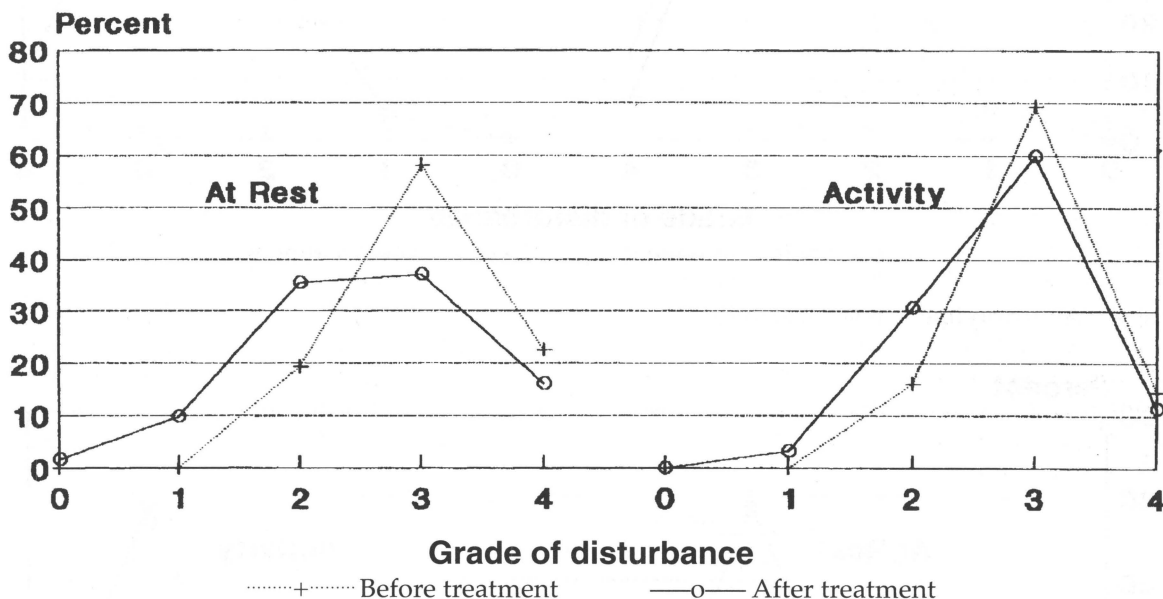


Fig. 2. Biofeedback at rest vs. activity

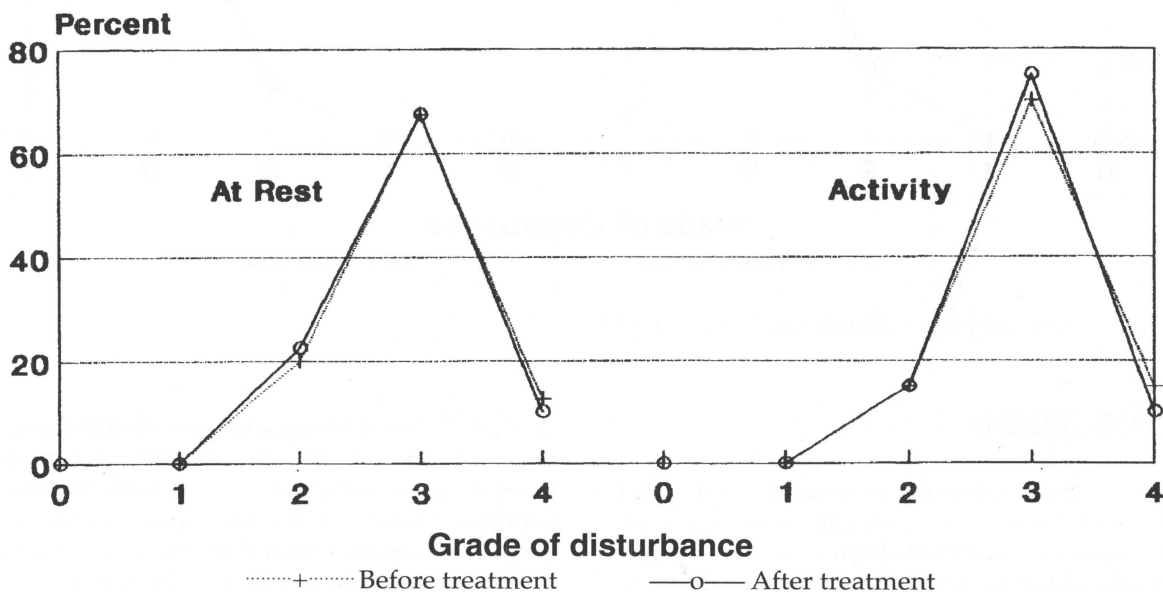


Fig. 3. Biofeedback - Control at rest vs. activity

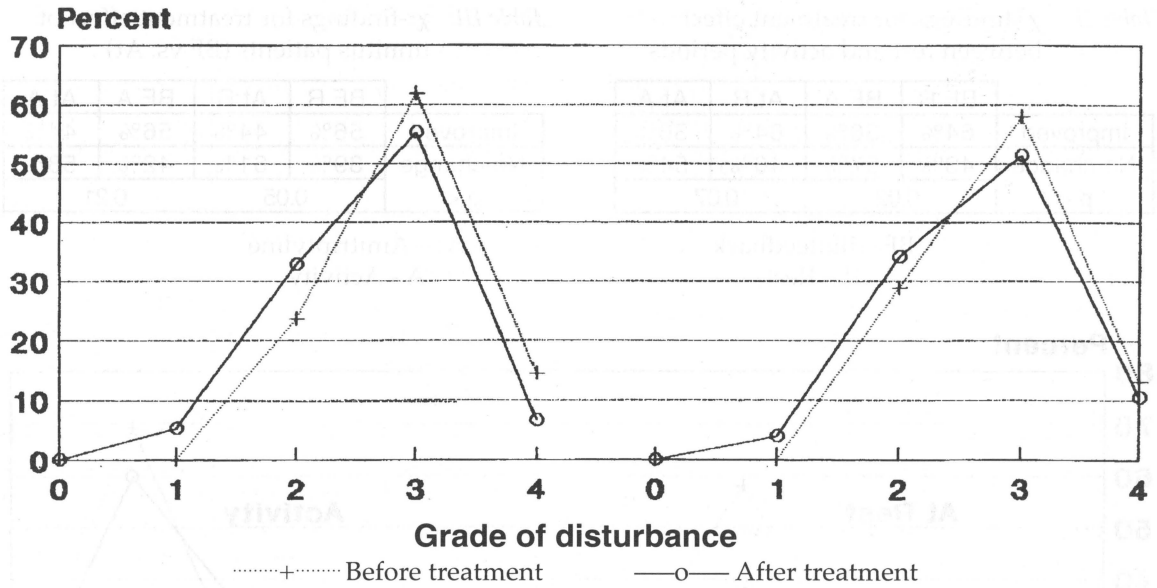


Fig. 4. Amitriptyline at rest vs. activity

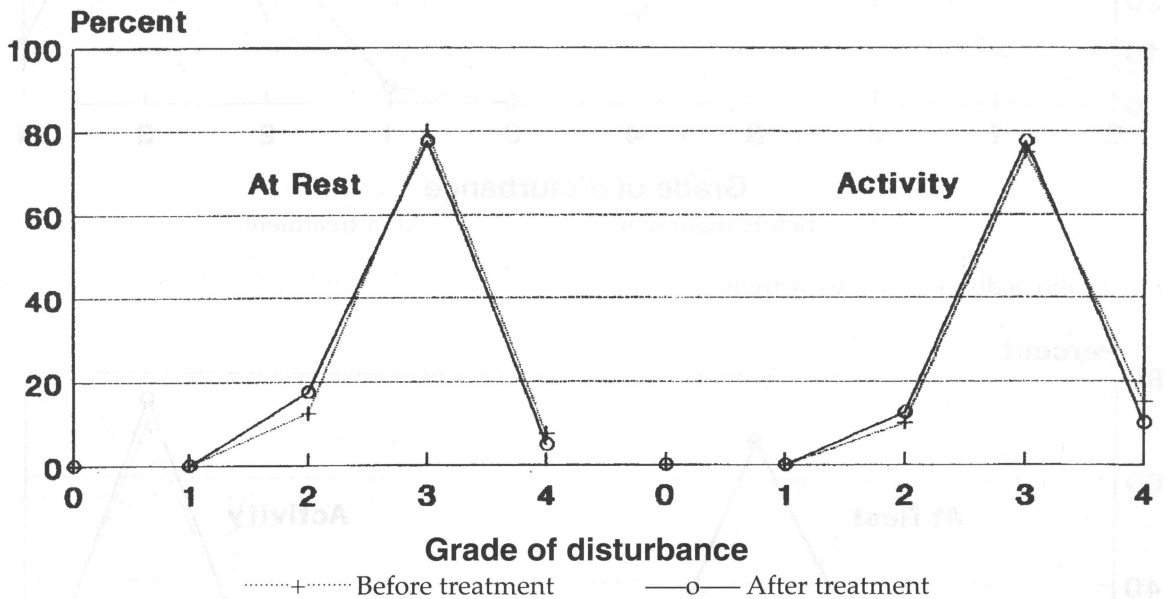


Fig. 5. Amitriptyline - Placebo at rest vs. activity

## DISCUSSION

The treatment of tinnitus until the present does not completely answer one of our greatest unsolved challenges. The results of our study show that treatment of tinnitus by EMG BF is most effective. These results correlate well with those reported by House

in 1978.<sup>15</sup> Our findings also revealed that the best improvement was during the rest period, especially for those with severe tinnitus. Therefore, it is our opinion that BF treatment is mainly suited for those who suffer from severe tinnitus, especially during rest periods, and those who suffer from stress reaction.

The successful results of BF for tinnitus during the rest period could be explained by the fact that BF is an active treatment which patients can practice during their leisure. During activity, it is difficult for patients to practice BF.

The truly important concept is that tension is an integral component of the tinnitus. BF treatment aims to reduce the tension, and thereby lessen the disturbance of ringing. A stress management treatment can be a successful intervention promising relief through a shift of focus away from the tinnitus. Better results than ours were reported in a recent study dealing with BF and chronic tinnitus.<sup>16</sup> All seven treated patients were satisfied with this treatment, even though no objective changes in tinnitus loudness were measured.

AT also had a significant effect on the degree of tinnitus disturbance compared with placebo, but only during the rest period. This treatment modality, as with BF, had a better influence at rest, but it was also not statistically significant, unlike in BF. The better effect at rest could be explained by the sedative effect of AT which improved the ability to rest and sleep.

This sedative effect may interfere with the patient's daily activities. For this reason we treated the patients with much smaller doses (10 mg t.i.d.) of AT than generally used for treatment of patients who suffer from depression (25 to 50 mg t.i.d.). At this lower dosage, these unwanted effects of AT, especially the sedative effect, were minimized. Only seven patients discontinued treatment for this reason.

In another study dealing with tricyclic antidepressant therapy for tinnitus in 19 patients,<sup>17</sup> 42% reported partial improvement of their tinnitus by treatment with this drug, but the results were not very significant because a strong placebo effect was found.

In our study the efficiency of AT regarding improvement of tinnitus disturbance was significantly less than that of BF, but compared with placebo during rest, AT had significantly improved tinnitus disturbance. In our previous study,<sup>18</sup> three treatment modalities for idiopathic tinnitus were investigated: biofeedback, acupuncture, and cinnarizine. We

found that 50% of the patients in the BF group reported some amelioration of the tinnitus, whereas only 10% of other patient groups reported subjective improvement of their tinnitus. In this study dealing with a larger sample of patients, we reinforced the conclusion that BF was a better treatment than drugs for improvement of tinnitus disturbance, especially during rest.

Nevertheless, amitriptyline was more effective than cinnarizine (which is a calcium-channel blocker) for improvement of tinnitus disturbance.

The disproportion of the subjective improvement without any objective improvement is well described in the literature.<sup>11</sup> Those data support the ideas of Goodhill<sup>5</sup> that the most important factor in tinnitus is its individual reaction.

Finally, we believe that biofeedback can help patients suffering from tinnitus, especially during rest, and we also suggest therapy with AT for tinnitus patients, but in smaller doses—no more than 30 mg daily, in order to minimize the side effects of this drug.

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