Commentary

Habituation Following Tinnitus Retraining Therapy in Tinnitus Sufferers

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Abstract

Introduction: This study evaluated the efficacy of tinnitus retraining therapy (TRT) in habituating patients with tinnitus. Materials and Methods: This is a retrospective review of patients who underwent TRT in a tertiary referral Otorhinolaryngology unit. Patients were followed up with structured interviews with the aid of questionnaire forms. Habituation following TRT was evaluated. Results: A total of 702 patients were included (55% male, 45% female). Habituation of reaction to tinnitus and habituation of perception were analysed. Average duration of follow up was 33 months. In total, 68% of patients described improvement in annoyance following TRT. Of these patients, 80% of them described habituation of perception as well. There was no statistical difference in gender and age between patients who did and did not respond to TRT. However, duration of treatment was significantly longer in patients who habituated (P <0.05). Patients who adopted treatment strategies recommended based on Jastreboff's TRT categories were also found to have higher success rates compared to those who refused. Conclusion: The goal of TRT is to achieve habituation of reaction to tinnitus. Habituation of perception is often a secondary result of sufficiently habituated response. From our study, more than two thirds of patients with tinnitus achieved habituation of reaction and of these, the majority also habituated to awareness of the tinnitus.

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Introduction

Tinnitus is a common otologic symptom that can be defined as the perception of noise in the absence of a sound stimulus. Tinnitus is experienced by up to one third of all adults at some time. However, only a small number will seek medical attention. The severity of the tinnitus, degree of annoyance, interference with work and everyday activities vary considerably from patient to patient, and it is believed that it is the patient's reaction to the sound that determines the degree of distress caused.

In the past, many treatment modalities have been tried for tinnitus with variable success. These include counselling, medications such as antidepressants, anticonvulsants, antianxiety, local anaesthetics and vasodilators, surgery, masking techniques, psychologic approaches, biofeedback, acupuncture, hyperbaric oxygen chamber therapy, and temporomandibular joint treatment.[1-5]

Tinnitus retraining therapy (TRT) is a form of treatment popularised by Jastreboff in the 1990s for the treatment of persistent tinnitus.[5,6] It aims to remove the negative impact of tinnitus and decreased sound tolerance on a patient's life by inducing and sustaining habituation. The neurophysiological model of tinnitus provides the theoretical basis for TRT. The extensive neuroplasticity of the brain is believed to allow retraining of the brain for habituation to occur via modification of the neural connections linking the auditory system with the limbic and autonomic nervous system.

Habituation of reaction is the primary goal. Patients may still be aware of their tinnitus, but they are no longer bothered or distressed by it. Habituation of perception occurs frequently as a secondary phenomenon in patients who have achieved sufficiently strong habituation of reaction. Without prior habituation of reaction in patients with negative connotations towards the tinnitus however, habituation of perception is unlikely to occur and symptoms frequently recur.[5]

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Table 1. Summary of Strategies Used in Tinnitus Retraining Therapy

Habituation of Reaction	Sound therapy
Directive counselling • Review and explain test results • Educate on hearing anatomy and physiology • Explain how the brain handles sensory information and its relationship to tinnitus • Neutralise negative belief • Address questions and concerns • Treatment recommendation	• Golden rule: Avoid silence • Sound can be provided by - Sound generator - Hearing aid - Environment (eg sounds of nature, music, radio, television, etc)

The 2 main components of TRT are counselling and sound therapy. The aetiology of tinnitus is demystified and strategies on inducing habituation and minimising aversive reactions to the tinnitus are taught (Table 1). Sound therapy is essential in reducing the impact of tinnitus and sound enrichment strategies include use of environmental sounds, noise generators and/or hearing aids. Recommendations on use of the different devices depend on factors such as the severity of tinnitus, presence of hearing loss and/or presence of hyperacusis. In our unit, TRT has been used as the standard treatment for tinnitus for over the past 10 years. The Tinnitus team comprises a consultant neuro-otologist (our senior author, YMC), 2 tinnitus nurse counsellors and a group of audiologists. We recently performed a retrospective review to evaluate the efficacy of TRT in achieving habituation of reaction and perception in our local population of tinnitus sufferers. And, we also attempted to identify factors that would predict success with TRT.

Materials and Methods

Patients that were referred to the Tinnitus clinic and underwent TRT were studied prospectively over a 13-year period (1997 to 2010). Patients' complaints were identified and the impact of tinnitus on the patient's life and emotional status were assessed using structured interviews with the aid of questionnaire forms developed by Jastreboff.[7] Pure tone audiograms were performed for all patients to assess for the presence of hearing loss. Hearing loss is defined as hearing threshold levels worse than 25 decibels (dB) (mild 26 to 40 dB, moderate 41 to 55 dB, moderately to severe 56 to 70 dB, severe 71 to 90 dB, profound >90 dB).[8] The information obtained was used to guide counselling and TRT approach, as well as to form a reference base for assessment of treatment outcome.

The recommendation for device fitting and the type of instrument required was selected according to Jastreboff's TRT categories.[5,6] Category 0 consists of patients with relatively weak or recent (less than 2 months duration) tinnitus. These patients usually do not have significant hearing loss or hyperacusis. Sound therapy is implemented by using tabletop sound machines and there is usually no need for wearable sound generators.

Category 1 consists of patients with disturbing tinnitus without any associated significant hearing loss or hyperacusis. In these patients, it is recommended for sound therapy to be implemented by using a tabletop sound machine and a wearable sound generator, which is set at ''mixing'' or ''blending'' point. At this level, the tinnitus is partly masked such that both tinnitus and sound from the sound generator are still heard but the tinnitus is reduced in apparent loudness. Sound generators are used as long as possible during the waking hours and the level of sound stays the same throughout the day.

Category 2 patients have significant hearing loss and tinnitus without hyperacusis. Combination instruments that consist of a high quality hearing aid and a sound generator are recommended. These provide both amplification of enriched background sounds as well as decrease the impact of straining to hear. If combination instruments are not possible, then enriched background sounds, further amplified by hearing aids, is recommended.

Category 3 patients have significant hyperacusis with or without tinnitus and hearing loss. Sound generators are used when there is no associated hearing loss, while combination instruments are used when hearing loss is present. The sound of instruments is set at a comfortable level that does not induce annoyance and the level of sound can be changed when the patient moves to a noisier environment.

Category 4 patients typically exhibit hyperacusis as the main complaint and exhibit worsening of hyperacusis or tinnitus following prolonged sound exposure. Sound generators are recommended as a main part of sound therapy in this category and usually response to treatment is slow.

Devices used in our unit include hearing aids the Viennatone® (Silent Star I model, GN Resound Ltd) and the Marsona® (Marpac Corp.). The Viennatone® is a small device worn behind the ear and generates a broadband sound, the level of which can be controlled by the user. The Marsona® is a tabletop sound machine with realistic environmental sounds that is recommended as an aid for environmental sound enrichment.

Habituation treatment is usually recommended for one and half year and up to 3 years, following which patients may be weaned off devices, if any.

To classify a patient as showing 'significant improvement', the following criteria were set by Jastreboff: (i) at least one activity previously prevented or interfered with is no

longer affected or all activities show improvement; (ii) tinnitus awareness is decreased by at least 20%, the impact of tinnitus on life is decreased by at least 20%, and tinnitus annoyance is decreased by at least 20%; (iii) evaluation was performed after at least 6 months of treatment and is repeated at least once, with the last assessment performed not later than 3 years after initiation of treatment; (iv) an improvement in more than one category (awareness, annoyance, quality of life).[5,7]

Results

Seven hundred and two patients were studied (55% male, 45% female). Average age at presentation was 51 years (range, 15 to 88 years). Patients suffered with tinnitus for variable durations (mean, 46 months; median, 12 months; range, 4 days to 50 years). Tinnitus severity, degree of annoyance and effect of tinnitus on life were scored on a visual analogue scale of 0 to 10. Mean tinnitus severity at presentation, degree of annoyance and effect on life scores were 6, 6 and 5 respectively. Average duration of follow up was 33 months.

Following TRT, 475 (68%) patients described improvement in annoyance (habituation of reaction). Excluding patients that did not quantify the degree of improvement (n = 122), 60% of patients described improvement of more than 20% (mean and median improvement, 80% and 90% respectively). Eighty percent of patients that achieved habituation of reaction also had significant improvement in awareness of the tinnitus (habituation of perception).

Comparing patients who did and did not respond to TRT (Table 2), there was no statistical difference in terms of gender or age. Duration of treatment was however found to be significantly longer in patients who habituated (responders, mean 18 months, median 12 months; non-responders, mean 9 months, median 6 months; P <0.0001).

Patients were grouped according to Jastreboff's TRT categories (categories 0, 1, 2, 3 and 4) and subanalysed (Table 3). Improvement in habituation of reaction was seen in 71% of patients in category 0, 68% of those in category 1, 64% of those in category 2, 74% of those in category 3 and 100% of those in category 4.

Not all patients in the individual categories adopted recommended treatment strategies and success rates between patients who used the different treatment modalities were compared (Table 4, Fig. 1). In category 0, all except 1 patient used only environmental sound enrichment strategies. In category 1, patients who used the Viennatone® in addition to environmental sound enrichment achieved higher improvement rates in habituation (83%) compared to patients who only used environmental sound enrichment strategies (64%). In category 2 where patients had hearing loss in addition to tinnitus, a higher improvement rate was seen in patients who used hearing aids (73%) compared to those patients who refused hearing aids and relied on sound enrichment alone (55%). In category 3, patients using sound enrichment strategies had similar improvement rates (79%) compared to those who used the Viennatone® as well (73%). Of the 4 patients in category 3 who used hearing aids, only 25% of them improved. There were only 3 patients in category 4 and all improved with sound enrichment alone or in combination with the Viennatone®.

Table 2. Comparison Between Responders and Non-responders with Tinnitus Retraining Therapy

	Responders	Non-Responders	
Gender (% male)	51%	56%	
Age (mean)	50 years	52 years	
Duration of treatment (months)			
Mean	18	9	
Median	12	6	P <0.0001
Range	0.25 to 127	0.07 to 88	

Table 3. Improvement (Habituation of Reaction) in Patients in the Different Jastreboff Tinnitus Retraining Therapy Categories: Mean Tinnitus Severity, Annoyance and Effect on Life Scores (Visual Analogue Scale from 0 to 10) at Presentation Are Also Shown

CAT	Characteristics	Recommended device	N	Habituation of reaction (ALL)	Habituation of reaction (≥20%)	Severity (S)/ Annoyance (A)/ Effect on Life (L) scores
0	Weak tinnitus	None	52	37 (71%)	20 (57%)	S 4/10, A 3/10, L 1/10
1	Bothersome tinnitus	SG	343	232 (68%)	182 (62%)	S6/10, A 6/10, L 6/10
2	Tinnitus with hearing loss	HA + SG	210	134 (64%)	87(52%)	S 6/10, A 6/10, L 6/10
3	Hyperacusis ± hearing loss	SG ± HA	94	70 (74%)	55 (67%)	S7/10, A 7/10, L 7/10
4	Symptoms exacerbated by sound	SG ± HA	3	3 (100%)	3(100%)	S 7/10, A 6/10, L 5/10

SG: Sound generator; HA: Hearing aid

Table 4. Comparison of Success Rates Between Patients Who Used Different Treatment Modalities in Each Jastreboff Tinnitus Retraining Therapy Category

CAT 0	n	Habituation of reaction (ALL)		Habituation of reaction (≥20%)	
Environmental sound enrichment alone	51	37 (73%)		20 (59%)	
Viennatone	1	0 (0%)	*P* = 0.29		*P* = 1.00
Hearing aid	0				
CAT 1	**n**	**Habituation of reaction (ALL)**		**Habituation of reaction (≥20%)**	
Environmental sound enrichment alone	271	174 (64%)		139 (58%)	
Viennatone	69	57 (83%)	*P* = 0.004	42 (78%)	*P* = 0.18
HA	0				
CAT 2	**n**	**Habituation of reaction (ALL)**		**Habituation of reaction (≥20%)**	
Environmental sound enrichment alone	116	64 (55%)		42 (45%)	
Viennatone	0		*P* = 0.007		*P* = 0.09
HA	97	71 (73%)		47 (64%)	

Table 4. Comparison of Success Rates Between Patients Who Used Different Treatment Modalities in Each Jastreboff Tinnitus Retraining Therapy Category (Con't)

CAT 3	n	Habituation of reaction (ALL)		Habituation of reaction (≥20%)	
Environmental sound enrichment alone	64	50 (79%)	*P* = 0.08	39 (71%)	*P* = 0.07
Viennatone	26	19 (73%)		16 (70%)	
HA	4	1 (25%)			
CAT 4	**n**	**Habituation of reaction (ALL)**		**Habituation of reaction (≥20%)**	
Environmental sound enrichment alone	2	2 (100%)		2 (100%)	
Viennatone	1	1 (100%)	*P* = 1.00	1 (100%)	*P* = 1.00
HA	0				

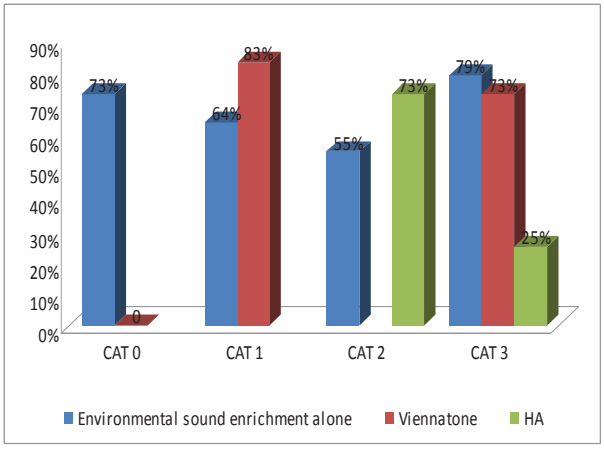

Fig. 1. Bar table illustrating success rates ('Habituation of reaction to tinnitus') of patients using different treatment modalities in each Jastreboff Tinnitus Retaining category.

Discussion

TRT is a clinical implementation of the neurophysiological model of tinnitus proposed by Jastreboff.[5,6] Tinnitus sufferers are believed to have an exaggerated reaction to the presence of tinnitus, and it is this reaction that creates distress. In these patients, activation of the limbic system and autonomic system are stimulated every time tinnitus is detected. In our group of patients, mean tinnitus severity at presentation, degree of annoyance and effect on life scores were high at 6 , 6 and 5 respectively. This is not surprising as our institution is the tertiary centre for tinnitus referrals and patients with more severe tinnitus are seen. As there is no objective measure for measuring tinnitus, the evaluation of any tinnitus treatment outcome is based on subjective evaluation of the problem. A multi-dimensional evaluation on changes and increased involvement in life activities that were previously prevented or interfered with by tinnitus, is necessary to assess the effectiveness of treatment. There is however no uniform set of questions, and various institutions use different sets of questionnaires. The Tinnitus Handicap Inventory (THI) is one such questionnaire that is self-administered and commonly used to assess the degree of distress suffered by the tinnitus patient.[9] For patients undergoing TRT however, Jastreboff developed a separate series of questionnaires that would allow assessment of the impact of tinnitus and hyperacusis on a patient's life, allow observation of changes during TRT, allow estimation of the presence and extent of habituation, and allow its use, with

minimal modification, worldwide.[5,7] In our practice, both THI and Jastreboff's questionnaires are used but for the purpose of this study looking at habituation of our tinnitus patients, only the results from Jastreboff's questionnaires are presented.

As mentioned previously, the goal of TRT is to retrain the system such that habituation of reaction to the tinnitus, and secondarily habituation of perception, occurs. TRT, although not a cure for tinnitus, provides relief in a significant proportion of sufferers. There are currently no large randomised controlled trials on TRT but its effectiveness has been well-demonstrated and improvements in over 80% have been reported.[5,10,11] Herraiz et al[10] recently demonstrated a statistical improvement in TRT patients compared with a waiting list non-treated group when considering patients' self-evaluation, Tinnitus Handicap Inventory, and visual analogue scores. From our study, the overall success rate in terms of habituation of reaction to tinnitus was 69% and success rates when considering the different Jastreboff TRT categories ranged from 64% to 100%. As a secondary phenomenon, it was also found that 80% of patients who successfully became less bothered by their tinnitus, also became less aware of their tinnitus.

Factors affecting TRT responses are under investigation. From this study, gender and age did not appear to affect outcomes. Duration of therapy however, was significantly different between responders and non-responders. In our population of tinnitus sufferers, those that failed with TRT had significantly shorter duration of therapy (median 6 months vs 12 months). Duration of TRT required for tinnitus improvement has not previously been ascertained although it is suggested that improvement can usually be seen by 3 months with definite improvement by 6 months and the majority achieving high levels of tinnitus control at 12 months.[5,6,12] McKinney et al[13] observed in their study that the highest level of improvement appeared to occur only after 6 months. Jastreboff believed that although clear results can be seen after 12 months, it is recommended that treatment last at least 18 months to prevent relapses.[5] It may therefore be that our patients that failed had inadequate treatment duration as suggested by previous studies. Other possibilities may be that 'non-responders' discontinued treatment because they had subsequently improved on telephone counselling (a service provided by our TRT counsellors) and did not return for follow up or that they discontinued treatment as they perceived themselves to be not responding. The process of habituation is slow and gradual and it has been observed that there is occasionally a transient perception of tinnitus worsening about 3 to 4 weeks after initiation of treatment.[5] It is therefore of paramount importance that patients are adequately counselled to pre-empt them about the possibility of tinnitus 'worsening' at the initiation of treatment and that significant time commitment is needed to achieve and maintain success.

A prospective non-randomised study by Herraiz et al[14] found that the most important factor for failure to improve with TRT was patient refusal to use devices (hearing aids, noise generators) when this was deemed necessary. In our study, this was also observed. Patients with bothersome tinnitus (category 1) were recommended sound generators and those that agreed to use Viennatones®, had better success rates compared with those using environmental sound enrichment strategies only. Patients with hearing loss associated with tinnitus (category 2) were recommended hearing aids, and again, those with hearing aids fitted, achieved better outcomes. In category 3 patients, the use of Viennatones® appeared to have similar success outcomes as those using environmental sound enrichment strategies alone. The use of hearing aids in these patients with hyperacusis and hearing loss however, did not appear to be as beneficial. It may be that in these patients, the symptom of hyperacusis was not adequately managed before fitting of the hearing aid. The amplification of sound and noise by the hearing aid may have contributed to the patient's annoyance and resulted in failure. It is therefore important that in such patients with hyperacusis, an individualised TRT programme with adequate counselling and appropriate sound therapy with careful setting of sound levels in sound generators or hearing aids to levels comfortable for the patients, are implemented for success.

Conclusion

TRT has been demonstrated to be an effective means for tinnitus control in our local population of tinnitus sufferers. Adequate counselling including expected duration of therapy needed before achieving results should be highlighted early on in the counselling process. Advice on use of devices when deemed necessary should also be strongly emphasised to patients in order to ensure higher chances of success.

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