Severe Tinnitus: What Are We Treating?

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Introduction

The presence of internal noises within the auditory system appears to be very common. Over 90% of people report that they are aware of internal tinnitus type noises when external sound is reduced, as in noise reducing audiological test booths. Twenty to thirty percent of the population become aware of tinnitus at some stage during their lives. The majority of people who become aware of tinnitus report minimal tinnitus related distress and rapidly habituate to its presence. However, for a small percentage of people, the perceived noises can become a source of significant distress. Why is it that some people become highly distressed when others, who are ostensibly experiencing the same phenomenon, adapt without effort?

Whilst tinnitus is a common experience, only 6% of people who become aware of tinnitus report significant tinnitus related distress and of these only a small percentage seek treatment. A survey of morbidity and treatment in Australian general medical practice (1992) found that tinnitus was the major presenting symptom in only 1.4 of every 1000 clinical encounters. Tinnitus complaint was found to increase with age, with peak prevalence between the ages of 45-64 years. Tinnitus has been associated with a large range of conditions, which affect both the peripheral and central structures in the hearing system. People with hearing loss frequently report tinnitus. However, many people experience hearing loss without tinnitus, and many people experience tinnitus without the presence of measurable hearing loss.

Traditional audiological measures applied as a means of quantifying the physical dimensions of tinnitus, such as pitch matching, loudness matching and minimum masking level (MML) are only weakly related to self-reported levels of tinnitus loudness, annoyance and coping ability. Distressed clients do not differ significantly from non-distressed clients in the audiological characteristics of their tinnitus.. Some of the more recent sound based therapies have utilised change in the MML as an indicator of therapeutic effect, which is controversial, as the MML is poorly correlated with tinnitus distress. The audiological measures of tinnitus do not appear to encapsulate many aspects of the experience of tinnitus, which relate to the level of distress and the need for assistance. This suggests that factors other than the perceived characteristics of the tinnitus contribute substantially to the reported level of tinnitus related distress.

The distress associated with tinnitus appears to be related to an individual's psychological response to the tinnitus, rather than to the sensory characteristics of the tinnitus noise(s). Many people reporting distressing tinnitus experience multiple symptoms of psychological distress, such as depression, anxiety, insomnia, irritability, inability to relax, fear and worry. Some report suicide attempts. However, clinical programs are not swamped by large numbers of highly distressed tinnitus sufferers. The low rate of help seeking probably reflects the fact that only a small percentage of the population are aware of tinnitus at any one time and, of these, only a small proportion will be experiencing emotional or physical distress from a variety of sources which they may ascribe to the presence of tinnitus and therefore seek help.

Theories of adaptation to tinnitus

Three theoretical models have been proposed as possible explanations of the processes influencing adaptation to tinnitus: the Habituation Model (Hallam, 1984); the transactional theory of the Stress-Coping Model (Lazarus & Folkman, 1984); and the Neurophysiological Model (Jastreboff & Hazell 1993). In the Habituation Model adjustment to tinnitus is believed to occur in human beings in a similar manner to the process of habituation to repetitive stimuli observed in animals. One of the major influences in the process of habituation to tinnitus is the level of physiological or emotional arousal that the individual is experiencing at that time.

In the Stress-Coping Model adjustment to a chronic stressor is perceived as primarily a cognitive process. Stress/arousal is perceived to be the result of actively engaging in adaptational efforts when the coping resources available to manage a stressor are challenged. From this perspective, people who suffer from tinnitus could be deficient in certain coping skills, or may be adopting approaches to

coping/management that lead to the maintenance of tinnitus related distress.

In the Neurophysiological Model tinnitus is a perceived to be a physiological disorder of the auditory system, not a psychological disorder, in which all levels of the auditory pathways and several non-auditory systems, such as the limbic system, are contributing to the emergence of tinnitus. People with distressing tinnitus are believed to have abnormal gain within the auditory pathways, indicated by the minimum masking level (MML) of tinnitus, which distinguishes them from people who have spontaneously habituated to tinnitus. Tinnitus distress is perceived to be the product of an overactive autonomic nervous system coupled with a failure to habituate to internal stimuli.

In all three models of tinnitus, secondary cognitive processes are believed to significantly influence the degree of reaction once the sound is detected. In both the Habituation Model and the Stress-Coping Model, cognitive processes are proposed as the means by which tinnitus may be redefined as a neutral stimulus, and the process of adjustment facilitated. Therapeutic interventions, based on the habituation model focus on strategies to reduce either the level of general arousal, or stimulus associated arousal. These may include information, cognitive therapy aimed at challenging cognitive distortions and maladaptive appraisals of tinnitus associated events, exposure therapy, and relaxation therapies. In the Stress-Coping Model, the appropriate application of coping strategies is hypothesised as being the means by which the appraisal of threat, and therefore the level of emotional reaction to the presence of tinnitus, can be modified. This may include: information about the nature of the condition; counselling aimed at challenging cognitive distortions and maladaptive appraisals of tinnitus associated events; and training in the use of problem-focused and emotion-focused coping behaviours. Tinnitus treatment, based on the Neurophysiological Model, termed Tinnitus Retraining Therapy -TRT focuses on retraining of the conditioned responses utilising both directive counselling to modify the response to tinnitus, and long-term, low level, white noise (LTWN) stimulation to modify perception of the tinnitus. The directive counselling component of TRT does not appear to differ significantly from informational counselling applied in a number of previous studies. The white-noise stimulation was hypothesised to significantly enhance the effectiveness of the directive counselling. However, clinical data published to date has failed to demonstrate the differential efficacy of the white-noise component of TRT therapy.

Evaluation Study

A detailed study was carried out at La Trobe University to try and tease out the key factors leading to people becoming distressed by tinnitus. One hundred subjects completed: a history questionnaire; a range of psychological measures designed to assess dimensions of the individuals' reaction to tinnitus and to stress and an audiometric test battery. The selection of the variables included was based on the three theoretical models of adjustment to tinnitus. The contribution of these variables to the process of adjustment to tinnitus was examined in a regression equation. As can be seen in Table 1, a combination of variables including the number of associated symptoms, the audiological measures of tinnitus, the total level of life stress, and the coping behaviours being applied, accounts for a significant proportion of the variance in the Tinnitus Reaction Questionnaire (TRQ) score ($F = 13.41$, $p = .0001$).

Three variables, tinnitus frequency match (TFM), the use of emotion focused coping behaviours (WCCL Emotion) and the level of overall stress in the subjects lives (DSP Total Stress), were found to have significant levels of unique variance, therefore a hierarchical regression was performed to examine the relative contribution of these variables to the predicted variance of the TRQ. The frequency of tinnitus (TFM) was found to predict 5.4 % of the variance in the TRQ. The level of life stress, as measured by the DSP Total Stress score, was found to predict a further 26.1% of the variance in the TRQ. The WCCL-R Emotion-focused coping score was found to predict a further 22.1% of the variance of the TRQ. In total the three variables TFM, DSP Total, and WCCL-Emotion-focused coping, were found to account for 53.6 % of the variance in the TRQ score.

The results of the multiple regression analysis indicate that life stress, not directly related to the presence of the tinnitus, contributes substantially to the level of tinnitus distress. Subjects reported using a range of coping strategies to help manage tinnitus. The widespread use of coping strategies suggests that the subjects are experiencing moderate to high levels of arousal, as suggested by the Habituation Model, in that the subjects are stimulated to apply coping strategies even if the strategies chosen are not particularly successful. The level of arousal is in response to stress

influences in the individuals' life, not the characteristics of the tinnitus.

The types of coping strategies being applied appear to be influenced by the individual's appraisal of the nature of the tinnitus problem. A majority of subjects believed that tinnitus was "something that must be accepted or gotten used to" and tended to use strategies intended to minimise the emotional impact such as denial, avoidance and wishful thinking. The predominant use of emotion-focused coping strategies was associated with higher levels of tinnitus related distress. This suggests that coping behaviours, as hypothesised in the Stress-Coping Model, have a significant influence on the perception of manageability of tinnitus. The stimulus related factors such as associated symptoms and the audiological measures of the characteristics of tinnitus did not appear to be contributing substantially to the level of tinnitus distress. Changes in the audiological measures were not associated with change in the level of tinnitus related distress. Tinnitus distress was found to be related to the level of life stress, with over 50 % of the variance in tinnitus distress being explained by a combination of life stress factors and coping behaviours elicited in response to the stress. Increased adjustment to tinnitus was not associated with a decline in the level of stress in other aspects of the subjects' lives, suggesting that the tinnitus distress was a symptom rather than the primary cause of stress in these subjects' lives.

All subjects in the La Trobe study were then provided with information, and training in the use of a range of tinnitus management strategies and were reviewed twelve months later. Subjects were queried on their use, and perception of the relative efficacy, of the various management approaches they were taught or given information about (Table 2). The majority of subjects made no change to their use of medication, or change in their diet. The majority of subjects reported using the mental distraction techniques and the environmental sound masking techniques. A significant minority of subjects found these techniques to be very useful in assisting management of their tinnitus. However, many subjects were not prepared to use either form of distraction technique, either the cognitive (mental) or behavioural (environmental sounds) strategies. The majority of subjects did not use the sleep management techniques, which is not surprising, as 55% reported no sleep problems. The majority of subjects reported using stress management techniques, of which 25% of subjects reported appreciable benefit

Thirty subjects were also fitted with an ITC white noise generation device, of these; twenty-seven remained in the study at the end of twelve months. Forty percent of subjects, who used the noise generator for the full twelve months, reported benefit. Sixty percent of subjects reported that the white noise stimulation made no difference, or made their tinnitus worse. Sixty-nine percent of subjects who persisted with the use of the noise device for twelve months reported improved ability to cope with their tinnitus, suggesting that the use of a therapeutic noise device has a positive influence on tinnitus perception for subjects who initially had a low ability to cope with tinnitus. However, the means by which the therapeutic noise was influencing tinnitus perception is not clear as there was no corresponding positive changes in the characteristics of the tinnitus,. One possible explanation for the reported benefit of therapeutic noise is that some tinnitus sufferers perceived use of a device as a means of actively regaining control over their tinnitus. The finding that the majority of subjects who reported benefit preferred using active problem-solving strategies tends to support this interpretation.

Discussion

After attending tinnitus management training, many subjects reported change in the use of coping behaviours. Overall, subjects in this investigation reported increased use of problem solving strategies. However, the use of emotion regulation strategies to moderate tinnitus reaction did not change. The increased use of problem-solving strategies appears to have been associated with improved ability to cope with tinnitus, as those subjects who maintained or increased their use of problem-solving strategies reported an increased coping ability. This suggests that training in problem-solving strategies is an important component of tinnitus management training. Training which leads to increased awareness of problem-solving strategies for tinnitus may assist tinnitus sufferers by addressing a commonly reported "sense of helplessness" at not being able to influence or modify the perception of tinnitus.

Tinnitus distress appears to be a symptom of increased arousal bought about by high levels of general life stress, rather than tinnitus being the cause of the high levels of arousal. Heightened arousal levels appear to influence a number of other hearing related pathologies, such as hyperacusis, acoustic shock injury, and

posttraumatic stress disorder, and may be influencing the nature of the reported symptoms. In part these conditions appear to involve a heightened sensitivity of centrally mediated protective reflexes in the middle ear. The major influence appears to be anticipatory anxiety, initiated by an extremely distressing acoustic event or repeated exposure to a noxious acoustic stressor, causing a. conditioned association to develop between an auditory stimulus and distress, which in these conditions appears to lead to a lowering of the threshold of the acoustic startle response. The fluttering sensation, feelings of fullness and sometimes ear pain, described by people with hypersensitivity to normal environmental sounds, or those exposed to repeated acoustic shocks, may be a physical correlate of the lowered threshold of the startle response.

What are the implications of these studies for our understanding of tinnitus?

- Firstly nearly everybody has noises in their auditory system, and given certain circumstances nearly everyone can become aware of their presence.
- There are no scientifically proven treatments that can eradicate tinnitus.
- Awareness of the presence of tinnitus does not necessarily lead to people becoming distressed.
- People who become distressed by tinnitus do not have a quality to their noises that is significantly different from people who are not distressed.
- People who become distressed have more stress in their lives, and it is the presence of this life stress that has a major influence on development of tinnitus related distress.
- People who are distressed by tinnitus may have catastrophic beliefs about the significance of these noises to their physical and mental health.
- People who are distressed apply a range of coping strategies, some which appear more successful than others.

What do these findings imply for the content of tinnitus management programs?

- Information and understanding helps facilitate tinnitus management
- Counselling is necessary to identify and challenge inaccurate and at times catastrophic beliefs about the perception of noise in the auditory system.
- Training in coping strategies has a significant benefit.
- Therapeutic noise helps in some cases, but as a management strategy rather than a form of treatment.
- Subjects reporting extreme distress require referral for in depth psychological or psychiatric counselling.

In general there is no cure for tinnitus, so the tinnitus sufferer has to adjust to the presence of tinnitus. Tinnitus management therapy can be described as a combination of cognitive and behavioural strategies. Cognitive, in the sense that maladaptive beliefs about the nature and meaning of tinnitus are being identified and challenged, and behavioural, in the sense that strategies are being learned which enable the individual to inhibit the distress responses, which have become associated with perception of tinnitus. The successful outcome of tinnitus therapy can more realistically be described as learned inhibition, as what is being modified through therapy is the association between the perception of tinnitus and the distress reaction, not the perception of tinnitus itself.

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Table 1.
Standard Multiple Regression Analysis of the Variables, Number of Associated Symptoms, Audiological Measures, Coping Behaviour and Life Stress on the Level of Tinnitus Distress (TRQ -1), n = 96.

Variables	Beta Coefficients		t-ratio	p
Symptom History Measure				
No. Symptoms	1.871	.12	1.668	.09
Audiological Measures				
PTA	-.042	-.033	.442	.66
TFM	-.001	-.163	2.195	.03
TIM tf	-.047	-.015	.166	.87
TIM 1Khz	.31	.143	1.564	.12
MML	.079	.083	1.178	.24
Coping Behaviour Measures				
WCCL Emotion	.939	.453	5.124	.0001
WCCL Problem	.035	.015	.178	.86
WCCL Social Sup	.79	.159	1.813	.07
Life Stress				
DSP Total Stress	.194	.246	3.072	.003

Multiple Regression: TRQ-1 by 10 variables
Shared variance = 38.2%. R2 = 61.2%
R2 (adj.) = 56.6%. df = 10. F = 13.41 p = .0001

Table 2.
Reported Use of the Management Strategies Taught in the Education Program and percentage of Subjects who Reported 'quite a bit' or 'a lot' of Benefit.

Management Strategy	% applying strategy	% reporting benefit
Change in use of medication	8	19
Change in diet	3	36
Use of mental distraction	69	27
Use of environmental sound masking	58	35
Use of stress management Technique	70	25
Use of sleep management Technique	13	27