Journal of Bodywork & Movement Therapies xxx (xxxx) xxx

Contents lists available at ScienceDirect

Journal of Bodywork & Movement Therapies

journal homepage: www.elsevier.com/jbmt

PREVENTION & REHABILITATION: **plus provided doc head**

Alexander Technique classes improve pain and performance factors in tertiary music students

Janet Davies

Sydney Conservatorium, University of Sydney, Macquarie St, Sydney, NSW, 2000, Australia

ARTICLE INFO

Article history:
Received 31 December 2018
Received in revised form
2 April 2019
Accepted 6 April 2019

Keywords:
Alexander Technique
Muscle tension
Music performance
Music students' PRMDs
Musicians' posture
Prevention of playing-related pain

ABSTRACT

Background: Professional and student instrumental musicians experience high rates of playing-related pain (PR pain) and other playing-related musculoskeletal disorders (PRMDs). This significant occupational health risk signals an urgent need for preventive education at the college level. During tertiary studies however, music students may be more focused on musical skill development than health outcomes. Alexander Technique (AT) is reputed to be beneficial for factors relating to both PR pain and the improvement of performance quality in musicians, therefore AT training for music students could be relevant for prevention.

Objectives: To examine the effects of AT classes for tertiary music students on PR pain, associated risk factors for PR pain, and factors associated with improvements in music performance quality.

Methods: Responses were collected from 23 volunteer music performance students at an Australian University who undertook weekly AT classes for one semester using a curriculum specifically designed for music students.

Results: The majority of participants rated AT classes as beneficial for all factors, particularly reduction of PR pain, posture, ability to release excess muscle tension, improvements in instrumental technique, and improvements in performance level. Benefits to practice effectiveness and a reduction in non-playing-related pain, stress levels and performance anxiety were also reported.

Conclusions: Purpose-designed AT classes may contribute to the management of PR pain and pertinent risk factors in music students, thus further investigation of the potential role of AT classes in pain prevention programs is warranted. Reports of benefit across a range of performance-related skills strengthen relevance to music practice and performance.

1. Introduction

It is well documented that playing-related pain (PR pain) and other playing-related musculoskeletal disorders (PRMDs) are common among professional instrumental musicians, with research over the last three decades highlighting alarming incidence and prevalence (Bejjani et al., 1996; Kok et al., 2015). Tertiary student musicians show patterns of pain and muscle tightness similar to professionals (Ioannou and Altenmüller, 2015; Kok et al., 2013), with symptoms being most likely to occur in the neck, back and upper limbs, and the exact locations often found to be instrument-specific (Ioannou and Altenmüller, 2015; Kreutz et al., 2008). Additionally, music students experience more pain than students of other disciplines (Kok et al., 2013; Miller et al., 2002; Steinmetz et al., 2012). There is evidence that problems can begin in childhood and are a direct result of playing (Cygańska et al., 2017; Nawrocka et al., 2014). Thus it is crucial that musicians-in-training receive effective injury prevention tools before entering the profession.

Research with college musicians indicates that risk factors associated with PRMDs are consistent with those for professionals: gender (female), instrument (strings), stress, performance anxiety, and previous injury (Baadjou et al., 2016; Miller et al., 2002). Other key risk factors are those consistently identified by students and professionals as contributing to PRMDs in their own experience: heavy playing loads, including long playing or practice sessions, and sudden increases in playing hours (Ackermann and Adams, 2004; Ackermann et al., 2012; Davies and Mangion, 2002; Ioannou and Altenmüller, 2015; López and Martínez, 2013), as well as excess playing-related muscle tension, poor posture, poor technique, muscle fatigue, and stress (Ackermann et al., 2012;

E-mail address: jdavies@usyd.edu.au.

https://doi.org/10.1016/j.jbmt.2019.04.006
1360-8592/

Davies and Mangion, 2002; López and Martínez, 2013; Shoebridge et al., 2011), with muscle tension and stress being identified as primary predictors in multivariate analyses in at least two studies (Davies and Mangion, 2002; Shoebridge et al., 2011). The findings regarding these predictors suggest that effective prevention should attempt to avert the build-up of playing-related muscle tension and stress in players in situ, potentially reducing the cumulative effects of high playing loads and the intensity of impact of stressful work or study environments.

Alexander Technique (AT) has been used in music education for over half a century, and has a strong presence in tertiary music institutions worldwide (Rennie-Salonen and de Villiers, 2016; Williamon and Buckoke, 2007). However, of the few studies of its effects in music student populations, the majority are inconclusive (Klein et al., 2014), and there are none to our knowledge which comprehensively investigate the effects of a purpose-designed series of AT classes on a broad range of relevant factors. Therefore, the goals of the present study were to examine the self-reported effects of AT classes specifically for music students on:

- PR pain levels
- associated risk factors for PR pain (poor posture, excess muscle tension, stress, performance anxiety)
- students' perceptions of any attendant changes in the quality of their technique, practice and performance.

1.1. Alexander Technique

The Australian actor FM Alexander (1869–1955) developed a novel paradigm where pain, excess muscle tension, poor posture, poor coordination, stress and anxiety were not viewed as discrete phenomena, but as part of a general *misuse of oneself* (Alexander, 1985), in which suboptimal patterns of neuromuscular behaviour had become habitual and unconscious, particularly regarding muscular and mental 'over-efforting'. For musicians, such habits may be present before an instrument is picked up and then exacerbated by playing. Showing considerable prescience, Alexander rejected the Cartesian notion of mind-body dualism, calling the 'the division of the human organism into mental and physical …. a purely verbal trick' (Brown, 1992, p.41), and his work bears very little resemblance to any current exercise system or commonly held notion of posture correction using muscular stretching or strengthening. Instead, Alexander described his constructive *use of the self* as an active method of 'psychophysical re-education' (Alexander, 1985), and as such, AT training may have more in common with the concept of neuroplasticity than with any physical therapy. AT also differs from other modalities which attempt to influence both physical structure and function (such as exercise, yoga, Pilates or Feldenkrais) in that it does not require a practice regime separate to musicians' daily playing activities.

The principles discovered and documented by Alexander are described in his four books (Alexander, 1985, 1987; Brown, 1992), as well as in Cacciatore et al. (2005), Hamel et al. (2016), Davies (2019) and Rosenthal (1987). They are summarised briefly here. Thought to be fundamental to optimal sensory-motor control (or *use*) for any endeavour is the *primary control*, a specific relationship (rather than position) of the head-neck-spine axis to the rest of the body and gravity (Alexander, 1985). This relationship is achieved through *inhibition,* the ability to recognise harmful neuromuscular patterning associated with particular tasks, and the conscious quieting of these responses, beginning with the neck muscles (Alexander, 1985). The practice of inhibition is thought to increase the reliability of both kinaesthetic and proprioceptive input. Alexander's *directions*[1] (Alexander, 1987) are then employed in order to achieve a redistribution of muscle tone and maintenance of the expansion of the skeletal frame. This resultant 'good tension' or postural tone is thought to effectively support compressive forces both from gravity and various activities (Cacciatore et al., 2014). Faulty internal body schema ('body maps') are also retrained (Conable and Conable, 1998), as well as any erroneous concepts of posture and movement, resulting in a more accurate felt sense of optimal functioning in gravity. For musicians, balanced alignment or posture becomes a sensitive interaction of the whole body with gravity and the instrument, and a dynamic responsiveness to varying needs for muscle tone, flexibility and strength. Since AT training aims to improve the musician's *use of the whole self* (Alexander, 1985) through the inhibition of stressful reactions and the development of constructive thought and movement patterns (Alexander, 1987), such strategies potentially change the way the practice and playing of music are approached, which may in turn affect the quality of performance outcomes, such as tone, technique, poise and musicality (Kleinman and Buckoke, 2013; Rosenthal, 1987).

The literature suggests that AT training may be effective across a range of outcomes pertinent to the prevention of musicians' injuries and the improvement of musical performance quality. AT has been shown to contribute to the relief and management of chronic back pain (Little et al., 2008; Vickers et al., 1999) and neck pain (MacPherson et al., 2015), to improve respiratory function (Austin and Ausubel, 1992) and postural and movement coordination (Cacciatore et al 2005, 2014), to reduce excess muscular co-contraction (Preece et al., 2016), and to result in more dynamic, toned, and adaptable postural responses with less stiffness (Cacciatore et al., 2011; Hamel et al., 2016). A broad range of secondary outcomes has also been reported, including learning 'tools for prevention' (Yardley et al., 2010), increased self-efficacy (Little et al., 2008; Wenham et al., 2018), the ability to manage panic and stress (Stallibrass et al., 2005), and benefits to energy levels, balance, body awareness and self-confidence (Dennis, 1999).

Regarding AT with musicians, a systematic review by Klein et al. (2014) found previous research to be inconclusive regarding performance, posture and respiratory function; however, significant improvements in performance anxiety markers were noted, including heart rate variance, self-rated anxiety (Valentine et al., 1995), and blood pressure, with an effect comparable to beta-blockers (Nielsen, 1994). Benefits to positive attitude, musical and technical quality (Valentine et al., 1995) and executive skill function (Mozeiko, 2011) were also shown. More recently, a study with pianists by Loo et al. (2015) found AT beneficial for self-reported muscle tension. Though not directly testing AT, an investigation by Loram et al. (2017) demonstrated that focusing on quieting the activity of neck muscles (Alexander's first principle (Alexander, 1985)) during violin playing, generated more efficient global coordination, with less destabilisation of the centre of mass, less unnecessary movement and less arousal of the sympathetic nervous system.

Research investigating the effects of AT on PRMDs is scarce. However, a study evaluating the efficacy of an exercise program and an AT course specifically designed to address the occupational needs of orchestral players, the Sound Practice Posture Trial (SPPT) (Ackermann et al., 2014; Chan, 2014), reported significant improvements in the AT group compared to control and exercise groups across factors thought to influence PRMDs, including rate of perceived exertion (RPE) compared to controls, and ease of movement, playing-related stress, and posture compared to the exercise group (Chan, 2014). The AT group also showed significant

[1] 'neck release, head forward and up, back lengthen and widen'.

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improvements compared to exercise in factors relating to benefits in performance situations, such as techniques to support playing, concentration, confidence, and overall playing capacity. An additional finding of this study was that the benefits of AT training may be under-recognised amongst musicians who have not experienced it, since the players' reports of actual effect post-intervention exceeded their pre-intervention anticipated effect for 10 of 12 factors. However, as measured in this study, AT did not significantly reduce frequency or severity of PRMDs, whereas the exercise group showed a significant decrease in both frequency and severity relative to controls, and a significant reduction in severity of PRMDs compared to AT. The effects of the AT intervention on PRMDs in this study were thought to merit further investigation, primarily due to the possibility of variations in participant exposure to playing load across the two intervention groups. As previously noted, playing load is the variable reported by both student and professional musicians as the greatest contextual risk factor for PRMDs.

2. Methods

A modified version of the curriculum developed for SPPT (Chan, 2014; Davies, 2011) was used in the present study to allow comparison of results for the student group with those for professional orchestral players. The course content emphasised the direct and detailed application of AT to playing instruments through the targeting of common tension issues experienced during specific playing postures and movements. It also included education in correct anatomical concepts (Conable and Conable, 1998) as well as the author's own material specifically designed for working with musicians.

Data collection was divided into three sections. To determine the extent to which the 23 music performance students were a representative group, Section A of the questionnaire was administered pre-program, and included questions on frequency, severity and impact of current and past pain and other musculoskeletal symptoms (such as numbness, tingling, tightness, weakness) specifically related to playing instruments. The questionnaire paralleled that administered to students and professionals in earlier studies (Davies, 1996; Davies and Mangion, 2002).

Section B of the questionnaire was administered post-program. Participants were asked to rate on a scale of 0 = *not* beneficial to 3 = *very* beneficial the effects of AT classes on specific health and performance outcomes. For the pain outcomes in Section B, it was decided to directly question participants about their subjective experiences of the effects of AT on their PR pain due to the previously mentioned difficulty of creating a reliable baseline where all participants had equal playing loads. The PR pain outcome variable also diverged from the customary definition of PRMDs (Rennie-Salonen and de Villiers, 2016) in that it did not specifically include symptoms other than pain (such as numbness and tingling), and did not prescribe that symptoms had to be severe enough to interfere with playing at the usual level. However, PR pain was distinguished from non-playing-related pain (non-PR pain), which was also measured. Previously reported outcome measures from the literature such as 'learning techniques to support playing' and 'ease of movement' (Chan, 2014) were modified to achieve greater specificity, so that participants were asked directly if they had learnt how to release tension, if their practice effectiveness had increased, and if their instrumental technique and performance level had improved.

Section C of data collection comprised evaluations via questionnaire of pre- and post-test audiovisual recordings by the participants and their teachers. The results of Section C are reported in a separate paper: *Alexander Technique classes for tertiary music students: student and teacher evaluations of pre- and post-test audiovisual recordings* (Davies, 2019).

The University of Sydney Human Ethics Committee approved the research, and all participants gave written, informed consent.

3. Results

3.1. Class participants

Twenty-three students who were enrolled in tertiary music performance degrees at Sydney Conservatorium, NSW, Australia, volunteered to participate in 14 weekly Alexander Technique classes. Six participants were male and 17 were female, with 18 undergraduate students and five postgraduate students. The age range was from 16 to 27, with the mean age 20.6 (SD = 3.2). Seventy percent (n = 16) of participants had no experience of AT and 30% (n = 7) had some previous experience, ranging from minimal (a workshop or one lesson, n = 3) to greater exposure (1–3 semesters of AT classes, n = 4). Table 1 shows the instrument distribution among participants.

The class attendance rate was 88%, with the mean number of classes missed being 1.7 of 14 (SD = 2.2, range 0–8) and seven students attending all classes. The main reason given for missing classes was scheduling conflict. One participant (female violinist) withdrew from the course after week three because her teacher felt she had too much new information to process in addition to the new techniques he was teaching. Another participant (female cellist) was lost to follow-up. Thus, 23 participants completed the pre-program questionnaire (Section A), 22 participants completed the course, and 21 (six male, 15 female) completed the post-program questionnaire (Section B).

3.2. Section A - Playing-related pain and other symptoms

Thirteen students (57%) had PR pain or other PR musculoskeletal symptoms at the time of filling in the survey. The number of years experiencing PR pain/symptoms ranged from one to seven, with a mean of 3.7 years (SD = 2.0). The number of pain sites ranged from zero to six (mean = 2.7, SD = 1.7). The most commonly affected areas were hands (including wrist, thumb, fingers) (n = 13 participants), shoulders (n = 11), back (n = 8), and neck (n = 6).

Table 2 shows that the majority of participants (65%) had experienced mild PR muscular pain either quite frequently or very frequently. Only one participant had never had mild pain, however the same student responded affirmatively to having 'gotten sore' from playing occasionally. Thirteen students (57%) had never experienced severe pain, however eight had experienced severe pain on occasion.

Table 1
Instruments played.

INSTRUMENT	*n*	%
STRINGS		
Violin	3	
Viola	3	
Cello	4	
Total	10	44
WIND		
Flute	2	
Clarinet	2	
Total	4	17
KEYBOARD		
Piano	8	35
OTHER		
Conducting	1	4
TOTAL	23	100

Please cite this article as: Davies, J., Alexander Technique classes improve pain and performance factors in tertiary music students, Journal of Bodywork & Movement Therapies, https://doi.org/10.1016/j.jbmt.2019.04.006

Table 2
Frequency and severity of playing-related pain or symptoms.

	Never = 0		Occasionally = 1		Quite frequently = 2		Very frequently = 3			
	n	%	*n*	%	*n*	%	*n*	%	Mean	SD
1. Have you ever felt sore from playing your instrument?	0	–	11	48	11	48	1	04	1.57	.59
2. As a result of playing, have you ever experienced:										
mild muscular pain?	1	04	7	30	11	48	4	18	1.78	.80
quite a bit of muscular pain?	4	17	13	57	4	17	0	–	1.00	.63
severe muscular pain?	13	57	8	35	0	–	0	–	.38	.50
3. As a result of playing, have you ever had:										
muscle stiffness or *tightness*?	0	–	5	22	13	56	5	22	2.00	.67
numbness or *pins & needles*?	9	39	13	57	1	04	0	–	.65	.57
muscle weakness or *loss of control*?	14	61	5	22	3	13	0	–	.50	.74
swelling?	20	87	1	04	1	04	0	–	.18	.66

All participants had experienced PR muscle stiffness or tightness at some time, but the majority had never experienced swelling. Eight participants had experienced muscle weakness and loss of control (three quite frequently), and more than half had experienced numbness or pins and needles occasionally.

The impact of lifetime PRMDs is shown in Table 3.

3.3. Section B - Effects of AT classes

Table 4 shows that all participants reported some degree of benefit from AT classes for PR pain levels as well as posture, ability to release tension, instrumental technique and stress, with the majority describing the classes as very beneficial for posture and tension, quite-to-very beneficial for PR pain, instrumental technique and performance level, and slightly-to-quite beneficial for practice effectiveness, non-PR pain, stress and performance anxiety. The mean score for total benefit was 2.10 (SD = 0.54) out of a possible 3.00.

Thirteen participants (62%) offered additional comments. Apart from reporting specific areas of personal gain, two main themes emerged: firstly that success in pain management had resulted from clarity concerning how to work effectively on body awareness, tension and posture; and secondly, because of the useful nature of the AT course content 'even to non-injured participants', it should be available to all music students.

4. Discussion

With the results from Section A showing that 65% of the students in the present study had experienced mild PR pain quite-to-very frequently, the lifetime prevalence of PRMDs appears similar to other recent studies (Ioannou and Altenmüller, 2015; López and Martínez, 2013; Stanek et al., 2017; Steinmetz et al., 2012). The point prevalence of 57% parallels research from Kok et al. (2013) and Davies (1996). The fact that many students were frequently obliged to take time off playing yet were not seeking professional help also confirms existing literature (Davies, 1996; Ioannou and Altenmüller, 2015). The persistently high prevalence of PRMDs worldwide suggests that effective management and prevention is not yet being consistently implemented in music education and the professional music environment.

Results from Section B suggest that an AT curriculum specifically designed for music students is likely to be beneficial across a range of factors influencing both health and performance, confirming previous findings regarding improvements for musicians in posture, stress, performance level (Chan, 2014), tension (Loo et al., 2015; Valentine et al., 1995), and performance anxiety (Nielsen, 1994; Valentine et al., 1995). The present study is the first where effects for PR pain, non-PR pain and instrumental technique have been clearly demonstrated. The small study sample means that the results must be viewed cautiously, however further work in the area is warranted. The reported positive benefits of the classes reflect the emphasis of the course, which was the application of AT at the instrument in the context of optimal whole-body coordination, including detailed work on releasing tension in breathing, use of the fingers, hands and arms, positioning at the instrument, and various playing situations. Though the factors contributing to PR pain cannot be clearly separated from general postural, tension and stress conditions experienced over the lifetime in non-playing activities, AT may be most effective in managing musicians' problems in playing settings, where the application of AT principles is likely to be prioritised by musicians if direct benefits to playing are experienced.

The findings of this study potentially support the AT paradigm that during playing, pain, excess muscle tension, stress, playing posture and instrumental technique are strongly interrelated, resulting in complex patterns of misuse which can generate interferences to global and specific coordination, and which may be

Table 3
Impact of playing-related pain or symptoms.

	Never = 0		Occasionally = 1		Quite frequently = 2		Very frequently = 3			
	n	%	*n*	%	*n*	%	*n*	%	Mean	SD
4. Have you ever had pain caused by playing which:										
a) interfered with your ability to play at your normal level	4	17	15	66	4	17	0	–	1.00	.60
b) persisted long after you finished playing?	7	30	12	52	4	18	0	–	.87	.69
c) made non-playing activities difficult?	12	52	8	35	3	13	0	–	.61	.72
5. Because of playing-related pain, have you ever had to:										
a) reduce your playing time	4	17	10	44	8	35	1	4	1.26	.81
b) stop playing altogether	9	39	12	52	2	9	0	–	.70	.64
c) cancel performances, auditions etc	21	91	2	09	0	–	0	–	.09	.29
d) refuse playing opportunities	20	87	3	13	0	–	0	–	.13	.34
e) consult a professional for treatment	12	52	5	22	6	26	0	–	.74	.86

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Table 4
Effects of AT classes.

FACTOR/ELEMENT	N/A I never had this problem		Unsure		Not Beneficial = 0		Slightly Beneficial = 1		Quite Beneficial = 2		Very Beneficial = 3			
	n	%	*n*	%	*n*	%	*n*	%	*n*	%	*n*	%	Mean	SD
1. Posture							1	5	6	29	13	62	2.60	.60
2. Ability to release tension							1	5	8	38	12	57	2.52	.60
3. Playing-related pain levels							4	19	8	38	9	43	2.24	.77
4. Instrumental technique							6	29	6	28	9	43	2.14	.85
5. Performance level	5	24			1	5	3	14	5	24	7	33	2.13	.96
6. Practice effectiveness					1	5	6	28	9	43	5	24	1.86	.85
7. Non-playing-related pain	1	5	5	24	1	5	4	19	5	24	4	19	1.86	.95
8. Stress levels	2	9					7	33	9	43	3	14	1.79	.71
9. Nerves, performance anxiety	5	24	1	5	2	9	5	24	6	29	2	9	1.53	.92

constructively altered by applying AT principles directly to the playing. Though improvements to posture were the participants' most highly rated factor in Section B of the questionnaire, class participants were not directly taught 'better posture', but were instead taught how to improve their neuromechanical coordination in all activities, including sitting, standing, moving and playing. Thus reported beneficial changes to posture and other variables were most likely attributable to participants having learnt the ability to inhibit habitual reactions, reduce excess muscle activation (particularly in the head/neck region), redistribute muscle tone, and access precisely focused strength (Cacciatore et al., 2005, 2011; Hamel et al., 2016).

The present study showed a marked difference in scores for PR pain and non-PR pain, again reinforcing the need to apply AT directly to specific instrumental challenges for a benefit to the pain associated with playing. The fact that five players were unsure about a benefit for non-PR pain indicates that the exact source of pain experienced when not playing is often unclear for musicians. Further, non-PR pain may have been more benefited if class time had been spent working with non-playing activities, for example computer use, sports, and lifting and carrying instruments. Likewise, in longer and more comprehensive courses, the AT tools could have been more specifically applied to the physiological and psychological concomitants of stress and performance anxiety. With ongoing classes students would also most likely develop the ability to apply AT principles independently and more broadly once basic skills were familiar.

Relative to the orchestral musicians in SPPT, whose classes used a very similar purpose-built curriculum, the majority of scores for self-reported benefits were comparable, including mean scores for posture, technique and performance which showed a moderate-to-large effect, and stress which showed a slight-to-moderate benefit. The effect of AT on the ability to release tension was not measured in the SPPT, but benefit could be inferred from the positive results for RPE (rates of perceived exertion) and ease of movement (Chan, 2014). However, AT classes were found to have a positive effect for PR pain in the current study, contrasting with the outcomes for PRMDs in SPPT. Possible reasons for the discrepancy in results could be related to the pain measures used. The definition of PRMDs used in SPPT only included pain and symptoms that interfered with playing, not taking into account mild pain that was included in the present study and is relevant in that it may herald the development of more severe problems. It is also possible that the pain outcome measures in SPPT failed to control for the wide variations in playing loads experienced by the players during the data collection phase. Rates of PRMD frequency and severity were recorded as experienced during the previous seven days, and for such a time frame there could have been variability in the arduousness of repertoire,[2] the number of calls,[3] and the amount of playing done outside the primary employment situation. The length of calls would also have varied considerably for opera and symphony players, as would stressful work conditions such as excessive noise levels and space constraints. Data was collected from both opera and symphony players, casual and permanent players and a mix of instrument groups, string players being the most likely to play continuously during rehearsals and performances. Another reason for the divergence in results may have been the group retention rates. Only data from participants who had attended at least 12 of 16 classes were reported in SPPT. Data from those who had chosen not to continue attending was excluded. Insufficient attendance for data inclusion accounted for 43% of the exercise group and 29% of the AT group.

5. Strengths, limitations and further research

Limitations of the study include the possibility that participants may have exaggerated their positive responses due to expectation bias or the desire to please the researcher. This can be the case with any non-blinded study that is designed and implemented by an expert in the field under scrutiny. There is also the possibility of spontaneous or random improvements in pain status and performance factors over the course of the AT classes, or that improvements resulted from students' instrumental lessons rather than AT. This could be accounted for in future studies by the inclusion of a control group. Nevertheless, the assessment that positive changes were most likely the result of AT is supported by findings from student and teacher evaluations of pre- and post-AT class video-recordings, reported elsewhere in Davies (2019).

Strengths of this research were that the AT course content was designed to target specific tension issues associated with playing instruments, and that the assessment tool included a comprehensive range of skills relevant to music students. The AT course curriculum and some of the outcome measures had been used in previous studies, providing a basis for comparison. For future studies, larger study samples, with follow-up of effects at three, six and/or 12 months would give further indication as to whether benefits were consistent and were maintained in the long term. Future course content could include curriculum items specifically targeting stress, performance anxiety and non-PR pain in order to attain a more precise measure of the effect of AT training on these factors.

The positive results for PR pain in this study warrant further

[2] e.g. Strauss' Rosenkavalier compared to Handel's Partenope.

[3] may have varied between 0 calls to up, to 10, casual players often doing more than permanent players.

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investigation into the potential of AT to contribute to PR pain prevention programs for both student and professional musicians. Another valuable area for research would be the comparison of the effects of AT on playing-related pain and performance factors with other modalities. Preferably such future studies would use randomised controlled design.

6. Conclusions

This study assessing the impact of AT training for student musicians from a variety of perspectives adds new evidence to a currently limited field of research. The investigation confirms previous literature showing that student musicians suffer high rates of PR pain and other musculoskeletal disorders (PRMDs). It is the first study to demonstrate that purpose-designed AT classes for music students may beneficially influence PR pain and the associated risk factors poor posture, excess muscle tension, stress and performance anxiety. Reports of improvements to instrumental technique, performance level and practice effectiveness indicate the relevance of AT training to musical skill development. More research is needed to corroborate these results and confirm the possible significance of AT training for PR pain prevention.

Ethics

The study was approved by the University of Sydney Human Ethics Committee.

Funding

This research did not receive any specific grant from funding agencies in the public, commercial, or not-for-profit sectors.

Acknowledgements

The author gratefully acknowledges the generosity of Ms Ann Shoebridge, Dr Peter Petocz and Dr Frank Decker for assistance in preparing the manuscript, Professor Anna Reid and the Sydney Conservatorium faculty for supporting the research, and the music students who gave their time to participate in the study.

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Please cite this article as: Davies, J., Alexander Technique classes improve pain and performance factors in tertiary music students, Journal of Bodywork & Movement Therapies, https://doi.org/10.1016/j.jbmt.2019.04.006

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Please cite this article as: Davies, J., Alexander Technique classes improve pain and performance factors in tertiary music students, Journal of Bodywork & Movement Therapies, https://doi.org/10.1016/j.jbmt.2019.04.006