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Research on the Application of Auxiliary Instrumental Breathing Training in Trumpet Performance Techniques

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Abstract: *Air control constitutes the fundamental core of brass instrument performance. As a representative high-pitched brass instrument, the trumpet imposes stringent requirements on the stability, sustainability and flow velocity of breath. The physical capacity of the respiratory system directly determines performers' timbre quality, upper pitch limit, endurance for sustained tones and stage expressiveness. Taking the dual-tube float-type instrumental breathing trainer as the research object, this paper conducts an in-depth investigation from the perspectives of mechanical structure, hydrodynamic principles and instrumental-adapted training routines. Integrating instrumental acoustics, sports anatomy and fluid mechanics theories, this study optimizes the systematic framework of breath training for brass instrumentalists, and delivers quantifiable, visual and operable practical schemes for professional trumpet teaching and targeted breath training.*

Keywords: *Trumpet Performance; Brass Instrument Breathing; Combined Thoracic-Abdominal Breathing; Breath Training; Fluid Resistance; Respiratory Training Equipment*

1. Introduction

The sound production of the piano relies on mechanical string striking, while string instruments generate vibration through bow friction against strings. In contrast, the trumpet lacks an independent power structure: all musical tones are produced by human exhaled airflow striking the performer's lip embouchure. The airflow enters the sealed brass tubing column to form air resonance, and sound is ultimately released through the bell of the instrument[7]. The human respiratory system functions as the power source of the trumpet; the flow rate, pressure and velocity of exhaled air directly govern three core performance elements: pitch, dynamics and timbre. Switching piston valves and tubing lengths alters fundamental pitches, and the excitation of different harmonic series demands entirely distinct airflow pressure thresholds. Low registers only require gentle airflow with low pressure and large flow volume; middle registers demand steady medium air pressure. For high harmonics above A in the second octave, concentrated, high-pressure and high-velocity directional airflow is mandatory to achieve stable vibration. When respiratory capacity is insufficient and diaphragmatic support is weak, airflow pressure fails to reach the threshold required for high notes, frequently resulting in cracked tones, flat intonation and hollow, diffuse timbre during performance [2].The fully sealed brass tubing of a trumpet generates steady aerodynamic resistance to exhaled air during play. Respiratory muscle stamina determines the boundary of playing technique. Reliable lip vibration, fingering and tonguing are unattainable without scientific breath control.

2. The Significance of Breath Control in Trumpet Performance

2.1 Breath Control Determines Timbre Hierarchy and Artistic Expression of Trumpet

Timbre serves as the core carrier of artistic expression for trumpet playing. Brilliant, bright marching timbres, soft and restrained lyrical piano tones, and thick, dramatic fortissimo sounds are all realized by regulating airflow conditions; the lip embouchure merely acts as a vibration medium and cannot independently modify timbre texture[1]. Performers with coordinated respiratory muscles and uniform, stable exhalation maintain constant lip vibration frequency, yielding full, clean timbre free of air leakage, excessive tension or shrill noise. In contrast, practitioners adopting shallow thoracic breathing produce fluctuating airflow and compensate by squeezing air with throat and jaw muscles, resulting in thin, dry timbre, piercing high notes and muddy low tones.

Upbeat rhythmic passages require forceful exhalation, while slow movements demand gentle airflow. For lyrical melodies in Romantic works, continuous soft airflow is needed to produce sustained pianissimo or mezzo-piano tones. March-style ceremonial pieces require powerful airflow to emphasize accents and syncopation. Contemporary atonal trumpet works feature wide pitch ranges and frequent dynamic shifts, necessitating differentiated airflow intensities to deliver layered musical expression. Scientific combined thoracic-abdominal breathing allows musicians to manipulate tone color through abdominal and waist muscle contraction without excessive tension in the shoulders, neck and larynx, minimizing compensatory muscle strain and expanding expressive possibilities.

2.2 Standardized Breathing Patterns Prevent Occupational Injuries in Brass Performance

Improper breathing techniques are a primary cause of physical strain among brass instrumentalists. A large proportion of beginner trumpet players rely on shallow thoracic breathing, inhaling limited air only by expanding the chest. During performance, they compensate by squeezing airflow with shoulder, neck and jaw muscles, which chronically induces shoulder stiffness, laryngeal congestion, tinnitus and jaw tension. Some performers adopt breath-holding exertion, locking the abdominal cavity and subjecting internal organs to sustained high thoracic pressure, often triggering chest tightness and gastrointestinal discomfort [5].

Combined thoracic-abdominal breathing centers force generation on the diaphragm, transversus abdominis and external intercostal muscles. Inhalation synchronously expands the waist, abdomen and bilateral ribs while keeping shoulders relaxed and lowered, storing far more air per breath than shallow thoracic breathing. Reduced ventilation frequency slows muscular fatigue. Performers with robust breath support can sustain lengthy passages of long tones and intensive tonguing without rapid lip or abdominal exhaustion, effectively mitigating brass-related occupational strain and extending professional performance careers.

2.3 Respiratory Capacity Acts as a Bottleneck for Advanced Trumpet Technique

Trumpet training presents distinct hierarchical technical thresholds. The elementary stage focuses on basic intonation and single tonguing; the intermediate stage requires mastery of sustained tone endurance, dynamic gradation and octave leaps; the advanced stage demands control of sustained high notes, double/triple tonguing and soft high register playing. The root cause of stalled technical progression for most learners lies not in insufficient lip vibration or fingering proficiency, but in respiratory capacity failing to match the airflow requirements of advanced repertoire[8].

Continuous high-pitched long tones rely on stable, sustained high-pressure airflow. Poor endurance of respiratory muscles leads to airflow attenuation in the latter half of sustained notes, accompanied by collapsed timbre and descending intonation. Rapid cyclic double tonguing requires short, uniform, high-frequency airflow circulation; slow responsiveness of respiratory muscles blurs articulation and disrupts rhythmic precision. Soft high notes demand minimal flow volume yet consistent high pressure, a nuanced adjustment impossible to achieve with shallow breathing. Therefore, systematic, targeted breath training is indispensable for technical advancement.

3. Conventional Trumpet Breath Training Methods and Their Limitations

3.1 Static Fundamental Breath Training without Instrumental Assistance

Static breath training is conducted separately from the trumpet and lays a foundational framework for standardizing respiratory muscle activation, covering three categories: combined thoracic-abdominal breathing, uniform sustained exhaling and progressive dynamic airflow training. Practitioners maintain an upright, relaxed posture with drooping shoulders; during exhalation, the waist and abdomen expand outward to avoid shallow breathing marked by raised chest and tilted head. Uniform airflow simulation replicates the exhalation mode of trumpet long tones to build sustained diaphragmatic support. Alternating strong and weak blowing mimics crescendo and decrescendo phrasing in musical scores.

This training method boasts unrestricted venue and equipment requirements, enabling fragmented practice to correct faulty breathing habits for beginners. Nevertheless, it exhibits prominent drawbacks:

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training occurs without sealed airflow resistance, decoupling practice conditions from real brass performance environments. Airflow output cannot be quantified, making it difficult for learners to identify improper exertion autonomously, and reducing the conversion efficiency of training gains to practical performance techniques.

3.2 Traditional Instrument-Assisted Breath Training for Trumpet

The mainstream breath training paradigm for brass players involves instrumental practice, including lip buzzing, mouthpiece vibration exercises, full-instrument long tone drills and dynamic graded long tone practice. Lip buzzing eliminates interference from brass tubing on airflow uniformity, allowing learners to focus solely on consistent exhalation. Long tone training consists of continuous 8–16 beat sustained notes under standard performance posture, building fulcrum strength to counter tubing resistance. Mouthpiece buzzing isolates tubing resistance and serves as a critical transitional stage connecting pure breath training to complete brass playing, clarifying the correlation between airflow and lip vibration[4].

Instrument-assisted training aligns closely with real performance contexts, enabling direct transfer of training outcomes to musical performance. However, prolonged playing easily induces lip fatigue, restricting extended specialized training targeting respiratory muscles alone. Most importantly, this approach lacks visual measurable indicators; airflow stability and capacity cannot be quantitatively recorded or evaluated.

4. Physical Principles of the Dual-Tube Float-Type Instrumental Breathing Trainer

Customized for brass and vocal majors, this airflow training device contains no electronic components and realizes visual, graded resistance breath training purely through fluid mechanics and buoyancy principles. Its structure consists of a sealed, pressure-resistant transparent cylinder, two detachable guide tubes of different specifications, high-density lightweight floating balls, a sealed rubber ring base and a portable storage pouch. Three core physical principles satisfy the specialized training demands of instrumentalists.

4.1 Float Buoyancy Principle: Visual Quantification of Abstract Airflow

The trainer's cylinder forms a fully sealed space with only the upper guide tube serving as the single airflow inlet and outlet, inside which lightweight floating balls are placed. When practitioners exhale uniformly into the tube, continuous airflow enters the sealed chamber and generates upward thrust. Higher airflow volume and velocity lift the float to a greater height, while weak airflow causes the float to descend.

The fluid thrust formula is expressed as:

$$F = \rho s v^2 \tag{1}$$

Given fixed air density ρ and pipeline cross-sectional area s, the suspension height of the float is solely determined by exhalation velocity v. The transparent cylinder enables learners to directly observe airflow stability in real time[3].

Conventional breath practice lacks visual reference, frequently resulting in uneven exertion without objective feedback. The float's visual feedback mechanism converts intangible airflow into a measurable height metric. Learners automatically stabilize exhalation velocity to maintain a consistent float height, establishing unified evaluation criteria for airflow and compensating for the inability to quantitatively assess performance in static breathing and instrumental long tone training.

4.2 Graded Dual-Tube Resistance Fluid Principle: Simulating Aerodynamic Resistance Across Trumpet Registers

Its core design features an outer large-diameter guide tube and an embedded small-diameter tube with disparate inner diameters generating differentiated airflow resistance, replicating the aerodynamic resistance of brass tubing during low, middle and high register trumpet performance. According to the pipeline fluid resistance formula:

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$$R = \frac{8\mu L}{\pi r^4} \tag{2}$$

where air viscosity coefficient μ and pipeline length L remain constant, pipeline resistance increases exponentially as tube radius r decreases[3].

The wide-diameter tube features low ventilation resistance, requiring only gentle low-pressure airflow to stabilize the float, corresponding to low and middle register trumpet playing with short tubing and minimal aerodynamic counterforce. The narrow-diameter tube drastically elevates airflow resistance, demanding sustained concentrated high-pressure abdominal exhalation to maintain float suspension, matching performance requirements for high harmonics above A in the second octave. Extended tubing in the high register creates significantly elevated air column resistance, which necessitates pressurized airflow to excite harmonics. The dual-tube graded resistance design enables free switching between low-resistance endurance training and high-resistance pressurized support training, covering airflow demands across the full trumpet range with a single device.

4.3 Sealed Cylinder Pressure Simulation Principle: Replicating the Closed Air Column Environment of Brass Tubing

The trumpet's brass tubing forms a closed air column structure. During performance, exhaled airflow enters the sealed tubing and generates stable internal pressure, requiring performers to continuously counteract chamber pressure to sustain airflow output. Open static breathing eliminates sealed resistance, creating a disconnect between muscular exertion patterns during training and actual playing, splitting breath control logic between practice and performance.

The trainer adopts a fully sealed cylinder structure with only one guide tube as the airflow channel. Exhaled air cannot escape rapidly, forming persistent stable internal pressure consistent with the pressure environment inside trumpet tubing. Practitioners exert force via the diaphragm to counteract internal chamber pressure during training, aligning respiratory muscle activation and fulcrum support patterns perfectly with trumpet playing, thereby drastically improving the conversion efficiency of breath training to performance techniques.

4.4 Structural Design Adapted to Long-Term Specialized Instrumental Training

The cylinder is constructed from high-strength pressure-resistant transparent plastic to withstand sustained internal pressure during extended continuous practice. Leak-proof silicone gaskets on the upper and lower bases prevent air leakage that would distort float height readings and compromise measurement accuracy. Switching between wide and narrow guide tubes takes merely ten seconds, facilitating seamless transitions between training modes. Equipped with a portable storage bag, the trainer can be transported to classrooms, rehearsal halls and stage wings for venue-independent practice. Entirely mechanical with no electronic components or charging requirements, the device boasts a long service life and low recurring training costs, suitable for daily high-frequency specialized breath training by brass majors.

5. Practical Training Protocols for the Dual-Tube Breathing Trainer in Trumpet Performance

Four standardized instrumental training models are developed by integrating six trumpet performance elements (low register, middle register, high register, progressive dynamics, tonguing intensity and wide interval leaps) with the aerodynamic resistance of wide and narrow guide tubes. The following content focuses on universal professional technical analysis without individualized case descriptions.

5.1 Low-Resistance Wide Tube Mode: Endurance Training for Low and Middle Register Fundamental Breath

The wide tube delivers low airflow resistance, suited for breath training covering the first octave to the second octave middle and low registers. It targets junior beginners, pre-practice breath warm-ups and learners deficient in sustained tone endurance.

5.1.1 Uniform Sustained Tone Simulation Training

Adopt standardized combined thoracic-abdominal breathing, fully expanding the waist, abdomen

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and bilateral rib cages during inhalation. The performer exhales uniformly into the wide tube to stabilize the float at the midpoint of the cylinder, maintaining suspension without falling for progressively extended durations of 15s, 25s and 40s per set. This exercise strengthens long-term diaphragmatic endurance, mitigating insufficient airflow and flat timbre in the latter half of middle register sustained notes and replicating uniform airflow requirements for lyrical long tones in repertoire.

5.1.2 Gradational Dynamic Exhalation Training for Soft Playing

During exhalation through the wide tube, gradually reduce airflow velocity to lower the float steadily to the bottom of the cylinder, hold for 5 seconds, then uniformly increase airflow to lift the float back to the midpoint in repeated cycles. This drill simulates piano-to-forte dynamic transitions in musical scores, resolving common issues including hollow soft timbre and rigid decrescendo control in trumpet playing.

5.2 High-Resistance Narrow Tube Mode: Specialized Pressurized Airflow Support Training for High Registers

The narrow tube drastically increases airflow resistance, replicating the high-resistance tubing environment for high harmonics above A in the second octave and serving as core specialized training to break through high-note technical bottlenecks.

5.2.1 Sustained High Note Support Training

Execute deep combined thoracic-abdominal breathing with expanded abdominal waist tension. The performer exhales evenly into the narrow tube to maintain the float at the upper section of the cylinder, starting with 10-second holding intervals and gradually extending the duration to 20–30 seconds per set. Throughout the drill, the performer avoids shoulder shaking, neck elevation or jaw retraction, relying solely on diaphragmatic-abdominal tension to counteract tube resistance. This practice reinforces powerful diaphragmatic fulcrum support, addressing problems including falsetto timbre, shrill high notes, flat intonation and limited upper register range.

5.2.2 Crescendo Airflow Training for High Registers

Stabilize the float at the midpoint of the narrow tube during initial exhalation, then slowly elevate abdominal airflow pressure to lift the float uniformly to the cylinder's top without airflow interruption or float descent. This exercise mimics crescendo high note passages in repertoire and alleviates excessive lip squeezing and shrill timbre during high register dynamic intensification.

5.3 Alternating Wide and Narrow Tube Training: Coordination Drills for Large Interval Leaps Between High and Low Registers

Trumpet repertoire frequently features octave and tenth interval leaps, demanding instantaneous conversion between low and high airflow pressure and imposing rigorous requirements on rapid coordination of respiratory muscles. Alternating tube training targets disjointed register transitions and unstable intonation during wide leaps.

Training protocol: Exhale evenly through the wide tube for 5 seconds to stabilize the float at the midpoint; immediately switch to the narrow tube, increase abdominal exhalation intensity to lift the float to the upper position and hold for another 5 seconds; revert to the wide tube, reduce tension and relax airflow to lower the float back to the midpoint. The performer completes 10 cycles per group, with 3–5 daily repetitions. This drill enhances dynamic control of respiratory muscle tension, enabling seamless register transitions without mid-phrase air replenishment and smoothing pitch shifts between high and low ranges.

5.4 Comprehensive Cyclical Combined Training: Full-Dimensional Airflow Simulation for Complete Repertoire

A standardized 20-minute integrated training routine is recommended for daily intensive breath conditioning, integrating endurance, high register control, dynamic gradation and tonguing strength practice:

1) Two sets of uniform sustained long tones via wide tube (30 seconds per set) to activate fundamental respiratory fulcrum muscles;

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2) Three cycles of wide tube dynamic alternation to refine delicate airflow control for soft playing;

3) Three sets of pressurized high register long tones via narrow tube (20 seconds per set) to reinforce high-note fulcrum strength;

4) Ten cycles of alternating wide and narrow tubes to build coordination for high-low airflow transitions;

5) Thirty short pulsed exhales through the narrow tube to enhance articulation power for high register staccato;

6) Conclude with two minutes of slow uniform exhalation through the wide tube to relax respiratory muscles and alleviate abdominal tension.

6. Conclusion

Breath forms the foundational technique of trumpet performance. Conventional static breathing and instrumental long tone training suffer from inherent limitations including unquantifiable airflow output, unidirectional aerodynamic resistance and disconnection between training environments and sealed brass tubing conditions[6]. The dual-tube float-type instrumental breathing trainer simulates the sealed airflow state of brass performance through three physical mechanisms: float buoyancy, multi-stage pipeline resistance and closed chamber pressure. Interchangeable wide and narrow guide tubes differentiate training resistance for low/middle register low-velocity airflow and high register high-pressure airflow, converting abstract breath control into visual, standardized and quantifiable specialized training. The device covers four core training modules: low-middle register endurance, high-pressure high register support, high-low register transition coordination and articulation explosive power, fully matching all airflow application scenarios in trumpet performance.

Incorporating this breathing trainer as a standardized daily practice component alongside static fundamental breathing drills and repertoire-based breath exercises can effectively expand lung capacity, boost sustained abdominal breathing endurance and improve precise airflow modulation. This integrated training regimen enhances tone production, extends playable upper pitch ranges and mitigates physical strain induced by instrumental performance. Furthermore, instrumental instructors can accurately identify students' faulty respiratory activation patterns based on visual float height indicators provided by the device, designing differentiated hierarchical training schemes tailored to varying proficiency levels. This equipment opens a new quantifiable pathway for trumpet performance pedagogy and systematic specialized breath training

References

[1] Chen J H. Research on Respiratory Mechanisms and Training for Brass Instrument Performance[M]. Shanghai Music Publishing House, 2018.
[2] Zhao X. Physiological Analysis of Airflow Control in Trumpet Performance[J]. China Music Education, 2021(08):56-60.
[3] Yang L. A Preliminary Study on the Application of Fluid Mechanics in Wind Instrument Breath Training[J]. Symphony (Journal of Xi'an Conservatory of Music), 2022,41(02):112-117.
[4] Pearson B. Fundamental Teaching Methodology for Brass Performance[M]. People's Music Publishing House, 2019.
[5] Wang H T. Standardized Training Protocols for Combined Thoracic-Abdominal Breathing in Trumpet Performance[J]. Northern Music, 2023(11):89-92.
[6] Liu J. Research on Adaptive Modification of Pulmonary Function Training Equipment for Instrumental Performance[J]. Home Drama, 2024(03):104-106.
[7] Schulz G. Acoustic Principles of Wind Instruments[M]. Posts & Telecom Press, 2020.
[8] Li M Y. Research on Differential Airflow Pressure Training for High and Low Registers of Brass Instruments[J]. Yellow River Sound, 2023(16):78-81.