Pediatric Otolaryngology in the United States: Chevalier Jackson’s Legacy for the 21st Century

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No sponsorships or competing interests have been disclosed for this article.

Abstract
Chevalier Jackson and his disciples in pediatric bronchology and esophagology strove to conquer the 3 great illnesses of the early 20th century: lye ingestion with esophageal cicatrix formation, foreign-body aspiration, and tuberculosis. Jackson’s successes and legacy were based on teaching through the use of clinical drawings and his improvements in instrumentation, which have saved generations of children. Clinical specialization and meticulous teamwork protected children’s airways from the ravages of diphtheria. Jackson observed the mechanics of respiratory pulmonary function and gained a better understanding of the causes of pulmonary wheezes. A recent biography, Swallow, tells of Jackson’s life and his important contributions to the care of all children.

Keywords
pediatric otolaryngology, Chevalier Jackson, Gabriel Tucker Sr, bronchology, esophagology

Received September 20, 2011; accepted September 23, 2011.

In Swallow, a recent biography of Chevalier Jackson, author Mary Cappello provides insight about the early contributions of Chevalier Jackson to pediatric otolaryngology.¹ Jackson was an early advocate for medical specialization, and he left a legacy of seminal advances in medical knowledge through careful clinical documentation. Jackson also designed and improved the instrumentation for bronchoscopy and esophagoscopy with distal illumination. Most importantly, he emphasized the concept of teamwork to enhance the safety of procedures that treat pediatric conditions.

Jackson’s skills and scholarship permitted, for the first time in medical history, the surgeon to view the proximal and distal aerodigestive tract of living children for correct diagnosis and treatments. Jackson possessed the foresight to protect young children by advocating for federal regulation of hazards in the environment that could cause injury and death.

Jackson’s heritage includes families of physician-scientists trained or inspired by him to concentrate their life’s work to improve the understanding of all ear, nose, and throat disorders, especially for children.

Chevalier Jackson
Jackson’s birth (1865) coincided with the end of the great Civil War. Jackson’s father, William Stamford Jackson, struggled to support his young family while employed as a machinery repairman in a foundry located in Pittsburgh, Pennsylvania. Jackson’s mother, Ann Morange, was of French ancestry with an artistic bent. Both parents helped to develop young Jackson’s fundamental talents as a craftsman and artist. Jackson’s great powers included mechanical instrumentation, clinical observation, and later, “artistic” documentation. The synergisms coupled design and documentation, which created Jackson’s leadership in the endoscopic fields of bronchology and esophagology.²

Jackson studied at Jefferson Medical College, where Professor Jacob Solis-Cohen loaned him textbooks by Sir Morell Mackenzie of the United Kingdom in the fields of bronchology and esophagology. Jackson’s zeal was ignited, and he visited Mackenzie’s clinic and spent 1 year studying under him.

Bronchology
In 1888, Jackson returned to his home in Pittsburgh and confined his practice to specialization in diseases of the throat and bronchology, especially young children. Jackson observed that just prior to respiratory arrest, children became restless and were often ashen gray in appearance from poor cardiac perfusion. His clinical observations

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included “in-drawing of the muscles around the clavicles, inter-costo-rib spaces and epigastrium,” noted in children who had developed diphtheria. Diphtheria toxins create thick areas of mucosal injury in the hypopharynx and result in asphyxiation when mucosa dislodges into the trachea.3,4

Tracheotomy was needed to save these young children from a certain death. The alternative treatment was transoral placement of an O’Dwyer tube to hold open the airway using a Mosher forceps. Jackson obtained vast experience in intubations placing either the O’Dwyer tube or a tracheotomy.3

Jackson designed a new bronchoscope with Henry Pilling. Pilling manufactured a battery-powered light carrier that coupled to the bronchoscope to supply light to the distal end.

By 1930, the British Medical Journal recorded a tribute to Jackson, comparing him to the American inventor Elias Howe.1

Howe showed the world that the eye of the needle ought to be at its point; similarly Chevalier Jackson would perhaps be remembered longest as the man who taught the world to place the light of the bronchoscope at its tip. It might be that the memory of his other achievements had grown dim, as they merged into the ever-growing stream of medical knowledge, Chevalier Jackson would for all time be known for his bronchoscope.

Jackson’s own words ring prophetic: “A new era has dawned. The day of inferential diagnosis of diseases of the human larynx is passed. The larynx of any human being—newborn to the century old, can be examined . . . in the entirety.”5

**Esophagology**

As early as 1890, 2 years after joining the University of Pittsburgh, Jackson extended the earlier work of Gustav Killian and developed an esophagoscope that was worthy of its name.5

Jackson displayed his keen artistic talents and was able to observe and quickly draw from memory what was observed through the endoscope. These strikingly graphic illustrations were the first to document the normal and diseased esophageal and tracheal anatomy. Jackson recognized the major contributions of Killian’s work by dedicating to him the textbook on diseases of the larynx.5

The medical and social issue that was of particular interest and concern to Jackson was esophageal burn injuries in children. The problem had reached mammoth proportions since lye—a strong alkali mixture—was used to unlog kitchen drains. Lye was often stored in glass bottles, and the mixture resembled milk in color and texture. Commonly, young children would ingest lye accidentally, which caused extensive corrosive injuries to the digestive tract and esophageal cicatrix.

In the late 19th century, children with esophageal lye burns were supported during the acute injury phase, but many died later from esophageal perforation. The earliest method was a transoral, prograde dilatation with whale bones and candle wax. Soon, a method to harden and mold rubber was developed by Goodyear and quickly replaced the whale bones. This prograde esophageal dilatation method remained extremely hazardous and prone to perforations in these children. Indeed, in 1884, the French surgeon Armand Trousseau remarked that “sooner or later all cases of strictures of the esophagus die of the bougie.”6,6

Jackson recognized that all children with esophageal strictures had chronic malnutrition and were prone to early death. Jackson’s recommendations for a safer esophagoscopy included these astute observations. First, the normal esophagus has multiple points of natural narrowing and these include the upper esophageal crico-pharyngeal muscle, the indentation from the aortic arch, the anterior compression from the left bronchus, and the sling created when the esophagus penetrates the diaphragm. When multiple strictures are added to these intrinsic areas of narrowing, the dangers of the pro-grade manner are obvious.4

Jackson realized that the prevention of lye-induced esophageal injuries in children had now reached greater importance. In 1927, the American Medical Association worked closely with Chevalier Jackson to promote legislation that led to the first Federal Caustic Act of the United States. President Coolidge signed this into law after congressional approval.

**Gabriel Tucker Sr**

About 3 years after Jackson’s appointment to Jefferson Medical College, Gabriel Tucker Sr returned to his alma mater and joined the faculty. Tucker and Jackson worked together, first stabilizing the children with acute esophageal lye burns by gastrostomy and hypodermoclysis, which combined open gastrostomy for children, who were required to sit upright and constantly spit saliva into a stomach tube to prevent dehydration and electrolyte loss.

By 1924, Tucker developed and published his technique for retrograde bougienage of the esophageal stricture with filiform bougies.6 The dilators were sequenced in a precisely graded series to gently dilate the esophagus from the diaphragm to the hypopharynx. The Tucker retrograde bougienage treatment of esophageal burn injuries transformed the safety and quality of this common injury and has remained the standard of care throughout the world for 87 years.6

**Instrumentation**

Jackson also focused on foreign body injury and designed specialized instruments (forceps) and techniques for safe removal through bronchoscopes and esophagoscopes. Jackson and 2 associates, Tucker Sr and Louis Clerf, MD, recognized the importance of forceps to correctly and gently grasp hazardous foreign objects within the aerodigestive tract. Speed,
safety, and teamwork were essential ingredients because procedures were performed without general anesthesia until the 1940s. An assistant held the patient’s head and wedged a bite block into the side of the oral cavity, and a second assistant controlled the shoulders and torso as the endoscopist worked quickly with the best of the instruments produced (Figure 1).

Telescopes

The next major advancement in the examination of the pediatric aerodigestive tract occurred in Birmingham, UK. Professor Harold Hopkins realized that loss of light intensity could be greatly reduced with a rod-lens system sheathed within a metal tube. The light source could be relocated to the proximal end of the bronchoscope while retaining the image to the lens of the eye from the distal end of the scope. This system was a complete paradigm shift that has transformed all of surgery and endoscopic care.

Conclusion

The talents and dedication of Chevalier Jackson gave birth to a legacy of otolaryngologists who have contributed to furthering the depth of knowledge and skills within this profession. We have focused on 2 families of physicians who have provided seminal leadership within otolaryngology. Numerous other families have contributed and followed this Jackson tradition (Table 1).

We should all learn and be inspired by the physicians from our past heritage. We have enjoyed the richness of this history and encourage our current residents in training and fellow otolaryngologists to read Swallow and embrace the legacy of Chevalier Jackson for themselves and the multitude of individuals that they will influence.

Author Contributions

John A. Tucker, preliminary research, approved the final article; Brian K. Reilly, helped with research, drafted the article, approved the final article; Sean T. Tucker, helped with research, drafted the article, approved the final article; James S. Reilly, corresponding author, helped with research, drafted the main article.

Disclosures

Competing interests: None.
Sponsorships: None.
Funding source: None.

References


Table 1. Otolaryngology Legacy from Jackson*

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*Superscript numbers indicate otolaryngologist’s medical school: (1) Columbia University, New York, NY; (2) Cornell University, New York, NY; (3) Jefferson Medical College, Philadelphia, PA; (4) Johns Hopkins University, Baltimore, MD; (5) Temple University, Philadelphia, PA; (6) University of Colorado, Denver; (7) University of Pennsylvania, Philadelphia, PA; (8) University of Pittsburgh, Pittsburgh, PA.