

# ORIGINAL ARTICLE

## Paul of Aegina (ca 625-690 AD), His Work and His Contribution to the Treatment of Spine Disorders: The First Routine Laminectomy in the Recorded History

### Abstract

The purpose of this historical review is to summarize the work of Paul of Aegina and especially his contribution to the treatment of Spine disorders and trauma. A major review of the literature was undertaken with emphasis on the treatise of Paul himself as well as those of later scholars and historians.

Paul expanded the horizons of surgery of his time, using his talent to perform very complicated surgery with favorable outcomes in a variety of diseases in many fields of medicine. This review will focus especially on his use of laminectomy for spinal decompression and how his successful results led him to establish his method as a routine and safe method for the treatment of spinal stenosis.

However, our knowledge of his full work is at least incomplete and, from all we know, he does not seem to mention the long term effect that such an operation has on spine stability and movement.

**Keywords:** Paul of Aegina, Laminectomy, Spine Surgery, Spine Deformity, Spine Trauma

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## Introduction

This review is aimed at summarizing the work of Paul of Aegina with special reference to his methods of treatment for Spine disorders and trauma. A major review of the literature was undertaken with emphasis on the treatise of Paul himself as well as those of later scholars and historians. An effort was made to find the most significant parts of his contribution to surgery and medicine, with a special interest in spine surgery.

Therefore, this review emphasizes the role of Paul of Aegina in the history of surgery and his influence on the subsequent medicine and surgery of Islam, proving that he was not only a carrier of the knowledge discovered by his predecessors (Hippocrates, Galen, etc.), but also he expanded the horizons of surgery of his time, using his talent to perform very complicated surgery with favorite outcomes in a variety of diseases in many fields of medicine. This review will mainly focus on his use of laminectomy for spinal decompression and how his successful results led him to establish his method as a routine and safe method for the treatment of spinal stenosis.

## Paul's Biography

Paul was born on the island of Aegina in Saronic Gulf, just outside Athens. Little is known of his early life. He studied medicine in Alexandria, Egypt. There, he acquired a deep knowledge of Greek medicine as depicted by the work of Hippocrates, Galen and their successors and the discipline and innovative ideas of the whole Alexandrian School of thought. He traveled extensively in the Middle East. He came in contact and was highly influenced by the Arabic medicine, which, at the time, was very advanced. Paul's most significant talent was an unusual skill in surgery combined with an acute power of observation and recording of his medical experience<sup>1</sup>.

His most significant medical and surgical work was the *Epitome of Medicine*, which comprised seven books on a variety of treatises on medical and surgical subjects. This work was heavily based on the Hippocratic medical tradition with many influences and personal innovations<sup>2,3</sup>.

Paul of Aegina had a great knowledge of the ancient writers, referring to them in his work widely while enriching their teachings with his own findings and observations especially as far as the surgical techniques part is concerned. He lived

1- Missios, 2014: 244-9.

2- Goodrich, 2004: 1-13.

3- LeVay, 1990.



and studied in Byzantine Empire, but during his lifetime with extensive travelling, he came in contact and was influenced by the Arabic culture and civilization and its advanced medical knowledge. His work was translated into Arabic in the 9th century and it represents a connection between Greek Hippocratic traditions and Islamic medicine. He is one of the last of the great Greek physicians and writers. His work survived for centuries, remaining as a practical compendium and guide for the practice of medicine and surgery, based on the Hippocratic and Galenic traditions<sup>1,4</sup>.

The first publication of his work in Greek took place in Venice in 1528, and Latin translations followed in 1551 and 1567. Francis Adams published on behalf of the Sydenham Society of London an English translation in 1843 with an extensive commentary. A French translation by René Briau was edited in 1855<sup>2,5</sup>.

#### **Paul and Overall Contribution to Medicine and Surgery**

Paul of Aegina describes all his knowledge, the basis of his practice, his experience and innovations in a compendium “Epitome of Medicine” (Figure 1). This compendium is divided into 7 books and 519 chapters<sup>1,4</sup>.



*Figure 1. Paul of Aegina (625-690): Medieval Portrait*

The first book treats subjects of Hygiene and the preservation from nutrition issues for specific patient categories and their dietary needs. In the Second part, he explained the whole doctrine of different kinds of fever and conditions related to

4- Paulus of Aegineta, 1844-1847.

5- Er, 2013: 692-5.





them as aetiological factors or co-existent conditions like excrementious discharges, critical days and concluding with certain symptoms which are sometimes the consequences of fever. The third book deals with “topical affections from the crown of the head to the nails of the feet” and discusses conditions of general pathology from brain infections and epilepsy to ileus, pleurisy and gonorrhoea. The fourth book discusses dermatological conditions such as herpes, gangrene, ulcers and leprosy, all related to dermatological manifestations as well as parasitic worms<sup>2,4</sup>.

The fifth book is a compendium of toxicology discussing treatment for poisons such as hemlock, poppy, mandrake and wolfsbane, and bites of venomous animals such as wasps, spiders, scorpions and vipers for human. Among other things, it treats deleterious substances and the preservatives from them<sup>1,4</sup>.

The Sixth book is a real monument to the surgery of the era. It contains literally every significant surgical knowledge related to inner organs, soft tissue, skin and bones of early and medieval practitioners. It contains a number of ophthalmological, neurosurgical, general and orthopedic procedures<sup>6-9</sup>.

Finally, the seventh book is devoted to pharmacology reciting ointments, antidotes, emetics and purgatives<sup>2</sup>.

In his work, Paul presented innovative techniques of tracheotomy, tonsillectomy, catheterization of the bladder, lithotomy, inguinal hernia repair, abdominal paracentesis for ascites and many other surgical procedures including reduction of breast size<sup>6</sup>. In addition, he presented novel techniques for the surgical reconstruction of the preternatural fingers<sup>10</sup>, the early correction of pediatric strabismus<sup>11</sup>, the treatment of perianal fistulae<sup>12</sup>, plastic surgery<sup>13</sup>, the management of humeral fractures<sup>14</sup>, the management of uterine cancer<sup>15</sup> and penile tumors<sup>16</sup>. Furthermore, he made a devoted effort to teach surgery to others<sup>17</sup>, to treat traumatic injuries<sup>18</sup> and perform post-mortem cesarean sections and embryotomies<sup>19</sup>. His work is a bridge between medicine of ancient times and that of the Middle Ages. He influenced subsequent authors of medical and surgical texts like Rhazes, Haly Abbas, Albucasis, Avicenna and Fabricius<sup>6,20</sup>.

What will be presented henceforth is his treatment of spine injuries by means of surgical decompression with a laminectomy technique he developed.

- 6- Gurunluoglu, 2003: 18-25.
- 7- Lascaratos, 2003: 1165-9.
- 8- Salazar, 1998: 170-87.
- 9- Tsoucalas, 2016;23: 102-3.
- 10- Tsoucalas, 2017: 211-16.
- 11- Tsoucalas, 2016;24: 136-7.
- 12- Tsoucalas, 2012: 241-2.
- 13- Kalatzis, 2006: 536-40.
- 14- Brorson, 2009: 1907-14.
- 15- Karamanou, 2015: 1645-8.
- 16- Papadakis, 2015;20: 653-57.
- 17- Scarborough, 2010: 235-60.
- 18- Ghannae Arani, 2012: 301-4.
- 19- Do Sameiro Barroso, 2013: 75-88.
- 20- Pormann, 2004: 1-337.



### **Spine Surgery and Laminectomies Performed by Paul of Aegina**

Paul gives a detailed account of the dislocations of the spine. He identifies the severity of such injuries and their high morbidity and mortality rate<sup>21</sup>. In accordance with the Hippocratic and Galenic traditions, he recognizes three types of spine dislocations and subluxations: anterior, posterior and sideways<sup>21,22</sup>.

In addition, he warns against the violent reduction of such subluxations e.g. upon a ladder, just like his predecessors. He attributes the detrimental results of such an action to nerve injury provoked by such a dislocation. As a result, he describes the complication of nerve injury with urine retention, coldness of the body, involuntary discharge of excrements and death if the injury occurs in the cervical spine<sup>3,5</sup>.

Furthermore, he distinguishes spinal deformities of traumatic aetiology from those occurring during adolescence and development. For the latter, he supports the traditional use of traction on a flat board for a period of time, and extension of the spine, as in the work of Hippocrates and Galen<sup>3,21,22</sup>. These reduction techniques are also described by Oribasius around the same era; whereas, the complications of spinal dislocations seem to come from the work of Celsus.

As far as Paul's surgical technique and method are concerned, from his earliest surviving manuscript one can find samples and descriptions of numerous instruments which he designed and used for spine operations. A number of different elevators, raspatories and bone bitters are described<sup>4,23</sup>.

Most significant are his views in the treatment of spine lamina fractures. Paul uses information that he attributes to Celsus in order to describe burst fractures with high morbidity and mortality if they involve the cervical spine. In these cases, he recommends the extraction of the broken part of the cervical vertebra which compresses the chord by the use of an incision which is pretty unspecific as far as the landmarks and surgical anatomy are concerned<sup>1,4</sup>.

For the diagnosis of fractures of the spinal processes, he uses simple observation and palpation with the finger of the deformed spine after injury. He describes the use of an incision and extraction of the fragment followed by the closure of the wound with sutures. Therefore, in lamina fractures, Paul recommended early decompression through a laminectomy to secure the spinal cord, and he was the first surgeon in history to perform such an operation on a routine basis,

21- Marketos, 1999; 24(13): 1381-7.

22- Marketos, 1999; 24(22): 2358-62.

23- Papadakis, 2015.



apparently satisfied with its results<sup>3,4,6</sup>.

He used similar diagnosis and treatment to fractures of the Os sacrum, especially of coccygeal fractures. The diagnosis was made with rectal palpation, and he recommended extraction of the bonny part through an incision and compressive application of bandages<sup>4,6</sup>.

In addition, Paul had an improved sense of the requirements for a surgical technique such as the above. He mentions the use of wine to lavish the operating trauma; although the notion of antisepsis did not yet exist, he used compression during trauma dressing to prevent bleeding<sup>4,22,23</sup>.

Although he recognizes the value of laminectomy and spinal decompression, he does not seem to take into account the long term effects of such an operation in spinal stability. In modern spine surgery, the use of instrumentation or other implants is a common trend to restore spine stability and architecture. The early biomechanics of the human spine described as a chain by Hippocrates and Galen, does not seem to affect his support of spine decompression by means of laminectomy in injured patient<sup>7,8</sup>.

### **Conclusion**

In conclusion, one can easily identify the surgical talent and the boldness of Paul of Aegina compared to the medical and surgical trends of his era. In his work, he uses methods and techniques which would not be used effectively until after the Renaissance in Western Europe. However, our knowledge of his full work is at least incomplete. Although he established laminectomy and spinal decompression as a sound treatment method for spinal process fractures, he does not seem to mention the long term effect that such an operation has on spine stability and movement.

### **Conflic of Interest**

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