



Girolamo Fabrici d'Acquapendente and the *Oplomochlion*: The Several Applications of an Effective Rehabilitation Tool



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ABSTRACT

Girolamo Fabrici d'Acquapendente (1533-1619) was an Italian anatomist, surgeon and physiologist and a protagonist of the scientific revolution of the Renaissance. He made anatomy a scientific discipline and is justly considered a precursor of modern orthopaedics. He invented and used several external corrective devices for the treatment of congenital and acquired deformities of the limbs and spinal column, especially those following tubercular infection and rickets, torticollis, vertebral caries kyphosis, scoliosis, and rachitic deformities of the leg, but also congenital dislocation of the hip and congenital club-foot. He ascribed the pathogenesis of the equinovarus supinated foot to the position taken by the foot of the fetus during intrauterine life. The *Oplomochlion*, shown in the *Operationes chirurgicae* and attributed to Fabrici, is actually a collection of very diverse orthotic, prosthetic and surgical metal instruments invented by Fabrici and arranged with a demonstrative purpose and a topographic criterion, as if on an exhibition dummy.

Key Indexing Terms: *Oplomochlion*; Girolamo Fabrici d'Acquapendente; Renaissance; orthoses; congenital-acquired deformities; fractures. [Am J Med Sci 2020;359(1):1–7.]

GIROLAMO FABRICI D'ACQUAPENDENTE

Girolamo Fabrici d'Acquapendente, an illustrious Paduan anatomist, was born in Acquapendente in 1533 (Figure 1a). His family was noble, but impoverished; for this he was helped financially during his university studies by the Loredan family. Having graduated in medicine in Padua, in 1600 he was appointed “*professor superordinarius*” of anatomy in the same university, a merit never before enjoyed by any professor.¹ His professional life was characterized by intense activity on 3 fronts: teaching, research and the practice of medicine.² We know from his will that he had 2 sons with whom he was not on good terms; on the contrary, he was very fond of his granddaughter Semidea who he hosted in his house. He died in 1619 in Padua, where he was buried in the church of San Francesco.^{3,4}

Girolamo Fabrici d'Acquapendente was one of the main architects of the scientific revolution that took place at the turn of the 16th and 17th centuries.^{5,6} He is considered a key figure in the history of Renaissance medicine: he fully adopted the method of “anatomy” based on

cadaveric dissections. A visible emblem of this was his brilliant idea of having the first permanent anatomical theatre built in 1594 (Figure 1b), still preserved in the Palazzo del Bo in Padua (Figure 1c). This structure revolutionized the teaching of anatomy so that the lessons could take place more frequently and in a more practical fashion. The theatre is the symbol of the experimental scientific method which, at the time of Renaissance was taking hold in all areas of science.⁷ Fabrici was the first anatomist to recognize the importance and effectiveness of systematic anatomical representation in teaching; indeed, all the works of the Paduan author are extensively illustrated with magnificent anatomical figures in color (Figures 2 and 3). The Fabrici Anatomy Paintings turned out to be original when compared to other Renaissance anatomical illustrations. In fact, in Acquapendente's figures the details are depicted in their correct proportions and the colors are as faithful as possible to the real ones; moreover, the background is black in order to bring out the details of the organs represented.^{8,9} Fabrici also distinguished himself in the surgical field: in his

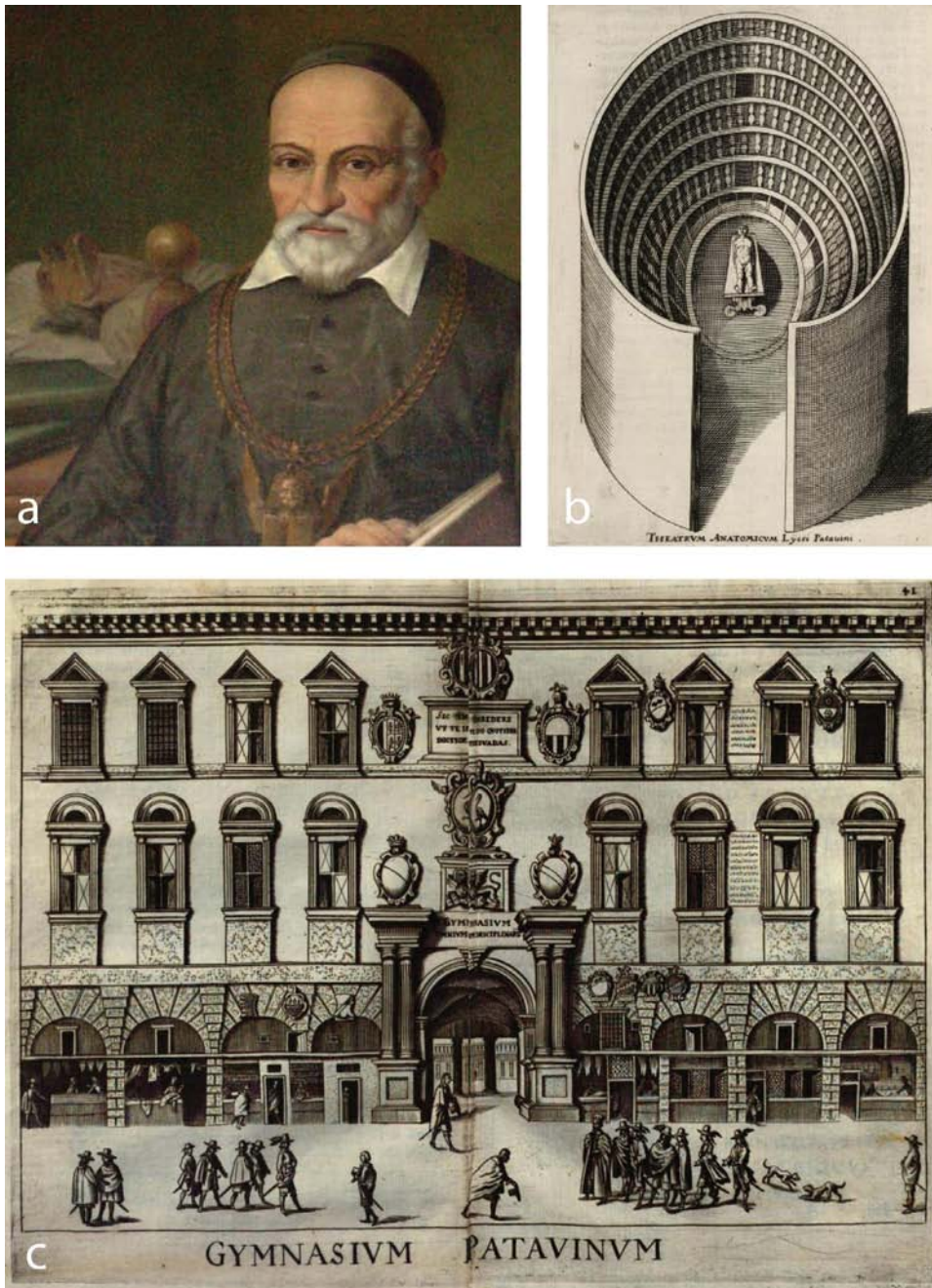


FIGURE 1. a, Oil portrait of Girolamo Fabrici d'Acquapendente, (1533-1619), by Vincenzo Pasqualoni, 1856. b, Permanent anatomical theatre of Padua built in 1594. From Giacomo Filippo Tomasini. *Gymnasium patavinum. Udine* (1654). c, Palazzo del Bo in Padua. From Giacomo Filippo Tomasini. *Gymnasium patavinum. Udine* (1654).

Operationes chirurgicae he explains the techniques used to reduce and immobilize fractured limbs and dislocations. He also describes his completely innovative and original methods for correcting congenital and acquired deformities of the trunk and limbs through the use of machines and instruments designed by him. Fabrici can rightly be considered a precursor and the father of orthopedics. Carlo Burci's judgment is telling, according to which

Acquapendente "set the first foundations of orthopaedics; he exhibits tools, machines and appliances."¹⁰

THE OPLOMOCHLION

The *Oplomochlion*, considered a sort of "orthopedic man," as Pazzini defined it in 1940,¹¹ has always been regarded by everyone as the most innovative instrument

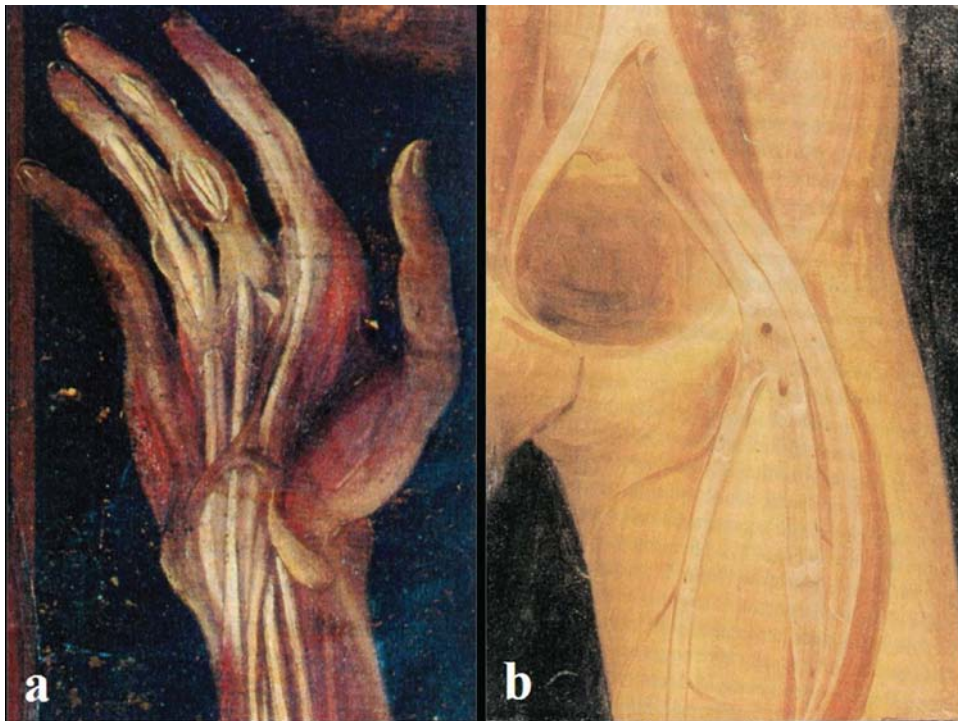


FIGURE 2. a, Girolamo Fabrici d'Acquapendente, *De anatomia musculorum totius corporis*. The palm of the hand. Oil on paper. *Rari* 116.19. b, Girolamo Fabrici d'Acquapendente, *De venarum ostioliis*. Vessels of the pelvis and thigh. Oil on paper. *Rari* 118.6; Venezia, Biblioteca Nazionale Marciana.

invented by Acquapendente (Figure 4). However, looking at the figures of the first editions of the *Operationes chirurgicae* composed by the Paduan anatomist, it does not seem to be so. The “overwhelming” proof that Fabrici did not invent the *Oplomochlion* is that he makes no mention of it in the work itself; at present it is not possible to establish who the inventor is. Fabrici designed numerous surgical instruments for the correction of congenital and acquired skeletal deformities. We believe that it was later the same

artisans who forged Fabrici's surgical instrumentation, thus combining his tools to form this sort of armature that served as an advertisement for the same workshop. The *Oplomochlion* is therefore formed by the union of the surgical instruments designed by Fabrici, but it was not he who assembled them together and formed this sort of armature.

The term *Oplomochlion* derives from *óplon* which means instrument or armature, and from *móchlion* which means a device to reduce dislocations. This machine

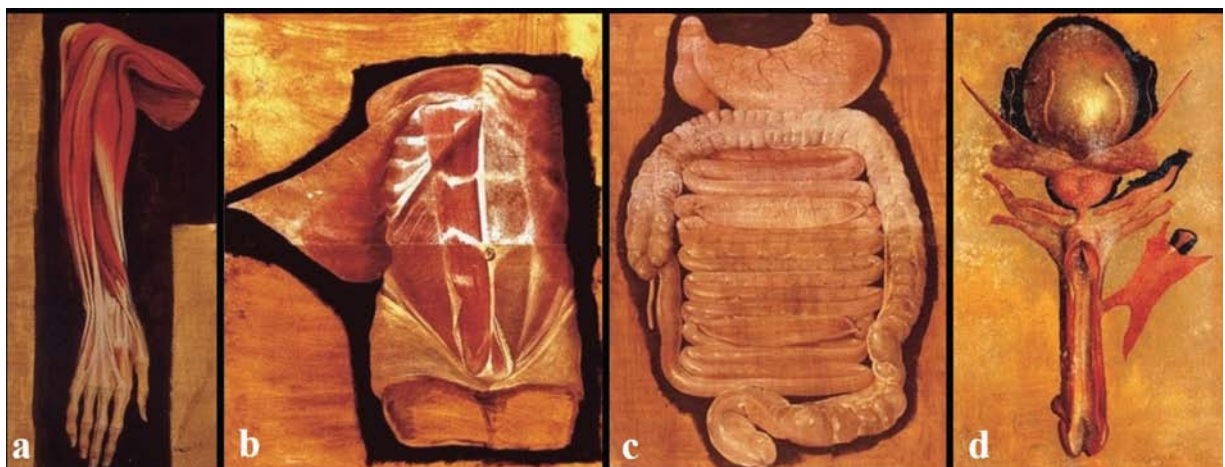


FIGURE 3. Girolamo Fabrici d'Acquapendente, *De anatomia musculorum totius corporis*; a, Muscles of the right forearm, *Rari* 116.16. b, Abdominal muscles and fascia, *Rari* 117, 1-2. c, Large and small intestine, *Rari* 117, 11-12. d, Male genital apparatus. *Rari* 117.23; Venezia, Biblioteca Nazionale Marciana.

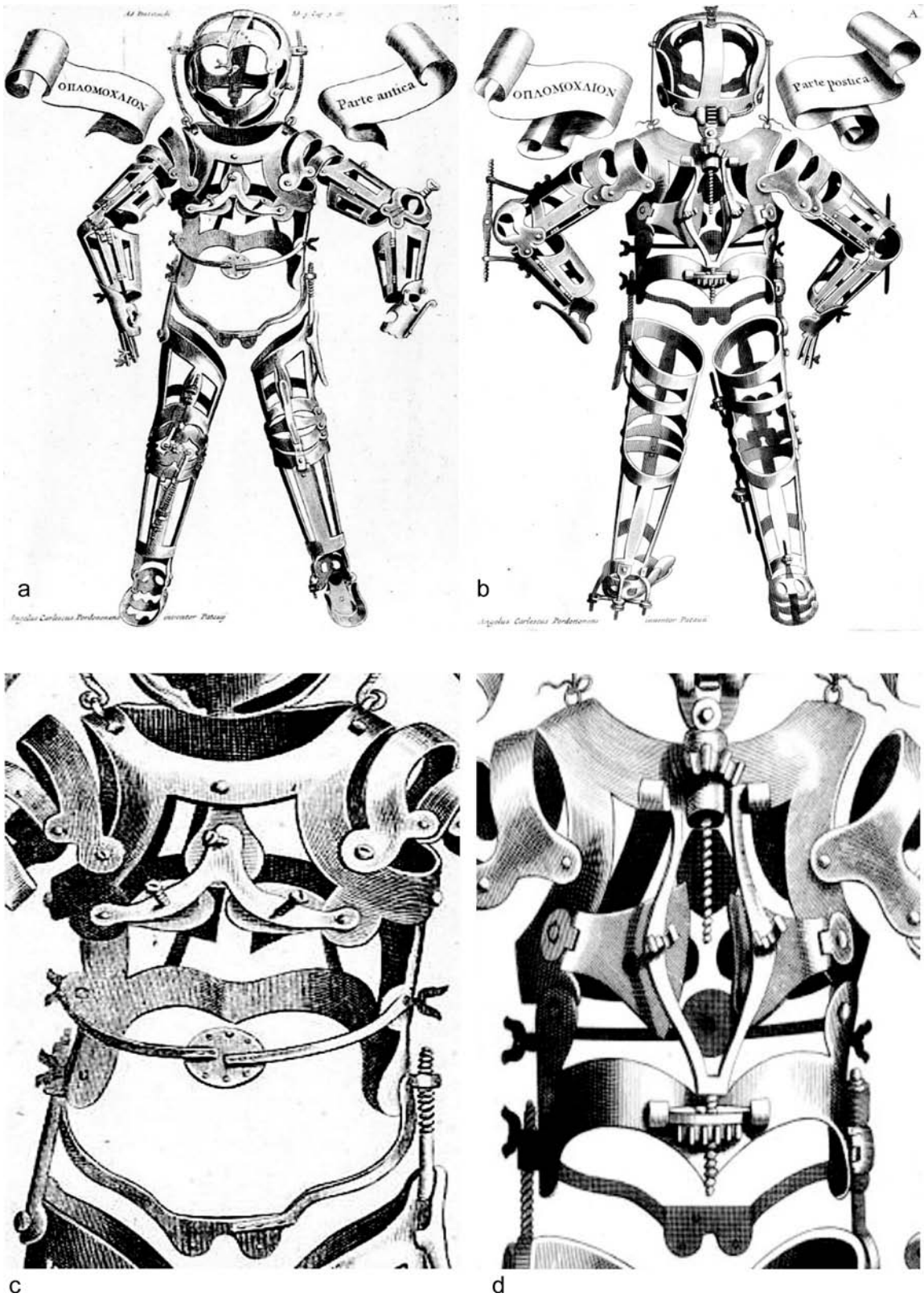


FIGURE 4. a, Anterior view (*pars antica*) to the left and b, posterior view (*pars postica*) to the right of the Oplomochlion. From Fabrici's *Operationes chirurgicae* (1647). c, Front and d, back view of the Oplomochlion corselet. From Fabrici's *Operationes chirurgicae* (1647).

was therefore an apparatus to reduce dislocations (“*quod membris distortis accommodatum*”).¹² There is a passage by Antonio Vallisneri senior that describes well the function of this *orthopedic man*.^{13,14} The *Oplomochlion*, forged in iron, resembles Renaissance armature. Looking at the *Oplomochlion* one immediately notices that it is not specular, but that the right and left halves are different both in the front and the rear. This *orthopedic man* is therefore composed of 4 different parts; their asymmetric anatomy surely indicates a different therapeutic function. It can be assumed that this armature is a “complete catalogue” of all orthopedic orthoses in use at that time; the *Oplomochlion* is composed of a helmet that was probably used to reduce the dislocation of the jaw. This “armed man” is also endowed with a corset, similar to a cuirass of armour, composed of bands of iron and a plate that wrap around the front and sides of the chest, and a posterior concave screw. This armour has 2 rerebraces that both end with a kind of glove and 2 leg braces with 2 metal feet at the ends.

All parts of the *Oplomochlion* are equipped with screws that were used to tighten and move the different parts of this *orthopedic man*. The *Oplomochlion* is therefore the result of the assembly of numerous orthoses for the treatment of various deformities, congenital and acquired, of the spine and limbs, whose applications are described in detail in Acquapendente’s *Operationes chirurgicae* of and which are reported below.

Torticollis

In the chapter “*On the surgery of the cervical spine, or of the neck*” Acquapendente writes about torticollis. He

believed that this was caused by a “catarrh,” which, once it has descended into the neck, attaches to the cervical and thoracic spine causing distortion. In practice, Acquapendente was describing Pott’s disease. The treatment initially envisaged consists of compresses and medicaments to eliminate the catarrh, after which Fabrici used a kind of bust equipped with iron screws that gradually push the cervical column from the opposite side with respect to the anomalous curvature (Figure 4).¹⁵ In this way, the spine was brought back in line, thus correcting the hump, and the gradual pressure avoided the triggering of processes that were painful for the patient.

Dorsal Kyphosis

In the chapter “on Humps,” the deformities of the spine resulting from scoliosis, rickets or tubercular kyphosis are treated. The treatment that Acquapendente proposes is similar to that seen immediately above. Firstly, he uses the same drugs to dissolve the “phlegm”; later, he applies the same corset with a concave screw-shaped iron (Figure 4). The latter pushes the iron plates of the breastplate itself against the ribs and vertebrae, thus exerting pressure in the opposite direction to the pathological curvature.¹⁶ Acquapendente used this orthosis in a famous clinical case, that of Cardinal Carlo de’ Medici, who was suffering from 3 joint pathologies – rheumatoid arthritis, type III Klippel-Feil syndrome and Pott’s disease. In the portrait of the cardinal we note (Figure 5a), in particular, the asymmetry of the face, also confirmed later by computed tomography scan (Figure 5b and c). Acquapendente treated Don Carlo successfully, as evidenced by the letter that Fabrici wrote to the Grand Duchess Cristina

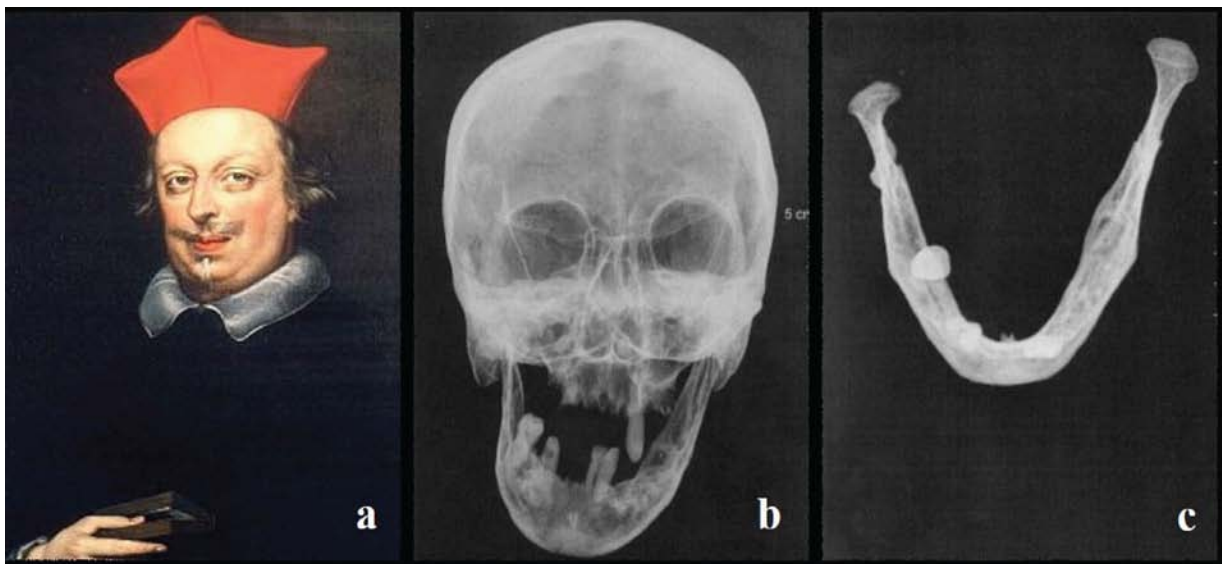


FIGURE 5. a, Portrait of Cardinal Carlo de’ Medici (detail of the face). Justus Sustermans. Galleria Palatina. b, X-ray of the skull in anteroposterior projection with evident asymmetry of the nose and jaw, which appears more developed on the left. c, X-ray of the jaw showing marked hypoplasia of the right hemimandible. From Giuffra V, Vitiello A, Giusiani S, Fornaciari A, Caramella D, Villari N, Fornaciari G: *Rheumatoid arthritis, Klippel-Feil syndrome and Pott’s disease in Cardinal Carlo de’ Medici (1595-1666)*. *Clinical and Experimental Rheumatology* 2009; 27: 596.

di Lorena, the mother of the cardinal.^{17,18} He was the first doctor to have had the idea of correcting scoliosis through a push mechanism and was the first to design a bust for this purpose, which constituted a sort of prototype for modern busts.

Congenital Hip Dislocation

At that time, another very common congenital deformity was the congenital dislocation of the hip. Fabrici was the first doctor in the history of medicine to try to reduce it. He believed that this malformation was caused by an excessive laxity of the ligaments for which the femur “moved easily upward.” Hence, he used the *Oplomochlion* leg brace to correct this congenital malformation on a child, gradually pushing down and holding the femoral head in the acetabulum.¹⁹ The traction, which Fabrici practiced with the *Oplomochlion* leg brace, was the technique later adopted by Pravaz, who was the first to have achieved success in reducing this malformation.²⁰

Spinal Deformities

Acquapendente describes the use of an instrument composed of iron bands when treating children with “saber shin”: this instrument was applied to the leg and pushed the tibia and fibula on the opposite side to the curvature, thereby bringing the skeleton back in axis (Figure 4). In his *Operationes chirurgicae* he also mentions a clinical case of a boy where this instrument had a therapeutic success,¹⁹ being aware that only in childhood are bones still elastic and malleable, unlike those of adults.

Correction of Foot Deformities

Finally, it is likely that the most distal parts of the *Oplomochlion* constituted an apparatus for correcting various deformities of the feet (Figure 4): in particular, for correcting valgus deformity of the hindfoot. Fabrici also encountered and treated another congenital malformation – congenital clubfoot, describing the most frequent form in his *Operationes chirurgicae* – congenital talipes equinovarus. Acquapendente understood that its pathogenesis was due to the defective position that the foot of the fetus assumes in the intrauterine life; he also understood that the distortion of the foot was due to an alteration of the composition and morphology of the ligamentous apparatus. Thanks to these intuitions, Acquapendente was the first physician to invent a treatment for this malformation that actually anticipates Ponseti’s method. Indeed, in the same way as this latter, Fabrici prescribed multiple bandages and, at intervals between these, manual manipulations. He had understood that the bone tissue, together with the tendons and ligaments, is only pliant and malleable in children, less so in adolescents, while in adults it is severely restricted. For this reason, Acquapendente stated that malformations could only be corrected in very young individuals.²¹

Articular Ankylosis

Another clinical problem that Acquapendente treated with his instruments was ankylosis of the joints. He creates a set of grids composed of iron sheets to be applied to the arms, legs and fingers. Using the screws, the physician gradually flexed these grids to push and reposition the bones in their natural place (Figure 4). Here too, before applying these instruments, Fabrici prescribed a hot bath in order to soften the blocked joint, reporting some therapeutic success in the *Operationes chirurgicae*.¹⁹

Fractures

For the treatment of fractures, Acquapendente identified 3 fundamental tools – the surgeon’s hand for the simplest fractures; traction with ropes and bandages for misalignments; and finally, the machines, such as the *Hippocratic bench* and winches for the most displaced ones. For immobilization, Fabrici used the ferule proposed by Hippocrates; these are grids composed of branches of ferula with certain elasticity. Further, Acquapendente was the first doctor to invent an alternative to calloclasia. He also used the *Oplomochlion* leg brace made of iron grids (Figure 4) to realign an incorrectly welded shin fracture. With a gradual pushing movement this instrument allowed the bone stumps to be correctly realigned. This completely innovative therapy can be found today in the use of external fixators. Indeed, Fabrici cited the clinical case of a young man suffering from a misaligned fracture whom he treated with this instrument, and he claimed to have seen the boy himself walking so well as an adult that almost no anomaly was noticed.²²

CONCLUSIONS

The therapeutic success of *Oplomochlion* in the correction of congenital and acquired skeletal malformations is evident. In fact, Fabrici’s innovative orthopedic treatments have proven to be effective and have survived to the present day. Significant in this regard are the orthoses he invented for the correction of scoliosis, fractures welded in a misaligned manner and finally, the method for correcting congenital varus clubfoot. One last test that testifies to the success of Fabrici’s tools is the testimony of Antonio Vallisneri, dating back to 1800, who states that many artisans still went to his museum to see the *Oplomochlion* in order to reproduce it for therapeutic use.¹⁵ If today we can count on many modern methods for the treatment of different musculoskeletal pathologies, we owe that to the numerous solutions proposed by Girolamo Fabrici d’Acquapendente, whose ingenious contribution represents a fundamental phase in the history of Orthopedics.

AUTHORS CONTRIBUTION

C.B., A.B. and E.B.: study concept and design; drafting of the paper; A.B. and M.R.B: data collection and

literature review; S.M. and P.R.: study concept and final approval of the version to be published.

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Submitted August 19, 2019; accepted October 17, 2019.

Funding: The authors received no financial support for the research, authorship and/or publication of this article.

Conflicting Interests: The authors declare no potential conflicts of interest with respect to the research, authorship, and/or publication of this article.

The first two authors (C.B., A.B.) contributed equally to the manuscript.

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