



# Congenital orthopaedic limp deformities in Corpus Hippocraticum

Maria-Triantafyllia Revelou<sup>1</sup> · Anna Eleftheriou<sup>1</sup> · Georgia Fezoulidi<sup>1</sup> · Panayiotis Hatzikyriakou<sup>1</sup> · Vasileios Raoulis<sup>1</sup> · Gregory Tsoucalas<sup>1</sup> 

Received: 16 May 2018 / Accepted: 5 February 2019 / Published online: 15 February 2019  
© SICOT aisbl 2019

## Abstract

During the fifth century BC in ancient Greece during the eve of orthopaedics, the Hippocratic School of Medicine diagnosed a series of congenital limb deformities. Congenital dislocation of the arm, elbow, wrist, hip, knee, tarsotibial joint, apex leg, as well as talipes valgus (clubfoot), congenital clavicle fractures, and thumb malfunction were all discussed by Hippocrates and his followers. Ancient Greek medico-philosophers, fond of a “perfect” human body, proposed an immediate non-interventional approach, while archaic orthotics and specialized footwear were suggested. The Hippocratic methodology was once more re-emerged in the sixteenth century by Ambroise Paré and in the nineteenth century by Wilhelm Roser, becoming since then the main principle for the confrontation of congenital deformities. Various surgeons until nowadays are still being influenced by the Hippocratic doctrine.

**Keywords** Hippocrates · Corpus Hippocraticum · Ancient Greece · Orthopaedics · Congenital limb deformities · Orthotics · Clubfoot · Ambroise Paré · Wilhelm Roser

## Introduction

In ancient Greece, the “*taxis*” (Greek: *τάξις*, everything in order) of the human body was considered a priori a necessity for a perfect birth [1]. Ancient Greeks attributed huge significance in body’s harmony, both male’s and female’s, believing in natural perfection, in body’s balanced homeostasis and in the absolute *Hygeia* (Greek: *Υγεία*, was the goddess of health), weening that any disfigurement had to be directly corrected [2]. The Hippocratic School of Medicine tried to dissociate the connection between disease and divine. During that era, it was strongly believed that any form of disability or deformation served as a metaphor of the gods punishment. Thus, the affected person was either punished or simply cursed [2, 3]. Hippocrates (ca 460–370 BC) (Fig. 1 and his followers understood that it was possible for infants to be born with skeletal deformities of the limbs, which were

possibly been caused by an endometrial injury of the fetus or by its position in the restricted area of the uterus during the embryological life [4]. Thus, for the first time, a scientific approach tried to overshadow superstition. In its purest meaning, “orthopaedic” meant for ancient Greek medico-philosophers someone to have a harmonic pace with no disfiguration at all, derived from the ancient Greek verb “orthopoedo” (Greek: *ορθοπο(ε)δω*). Another term having the same grammatical root, firstly used by the Hippocratic School of Medicine, was the “*orthon-paedion*.” “Corpus Hippocraticum” introduced the term “*paedion*” (Greek: *παιδίων*) which meant a specific anatomic area. In the work “On Generation” (Greek: *Περί Γονήης*, Littré VII, page 484, paragraph 10), the disfiguration of a “*paedion*” was considered as an imbalance of the body’s harmony. The “*orthon paedion*” (*ortho-paedion*, combination of two words), the “normal anatomy of an area”, was a necessity in ancient Greek medico-philosophy. Any orthopedic birth defect should have been confronted accordingly to the suggested treatment. Scientific orthopaedics were born during the Classical era in the Hellenic peninsula and high priority was given towards the treatment of the newborns [2].

Concerning congenital orthopaedic limb deformities of the newborns, in “Corpus Hippocraticum” (ca 5th-third century

✉ Gregory Tsoucalas

<sup>1</sup> History of Medicine, Anatomy Department, School of Medicine, Democritus University of Thrace, Alexandroupolis, Greece



**Fig. 1** Hippocrates and comparative anatomy. Hippocrates studies and compares the skulls of man and a bull, sixteenth century woodcut, artist unknown

BC) was noted, “... regarding the infant whom we have diagnosed with skeletal deformities of the limbs, I have the opinion that it becomes disabled after a fracture suffered, either because the mother was injured in the region where the embryo was developing or because it fell down or it suffered another violent fracture. If the fetus suffers an injury, the deformity appears in the corresponding spot where the injury occurred” while a second mechanism was described due to a “restricted-tight” uterus, “... infants may also manifest deformities of the limbs as follows, when in the uterus the region where the injury occurred is restricted, the body, as it has to necessarily move [develop] in such a space, undergoes deformities in that region” [5, 6].

Our study aims to gather all fragments from in “Corpus Hippocraticum” (Éditions Littré & Édition Pourmaropoulos-Kaisaros) concerning congenital deformities of the limbs in order to unveil Hippocratic views and treatment suggestions.

### Limb congenital malformations

A series of limbs deformities-malformations were discussed in “Corpus Hippocraticum,” divided into upper and lower limb malformations. For the congenital dislocation of the arm, Hippocrates and his followers noted that the arm was dismantled downwards. Concerning its relative dislocation, they documented the following two views. Firstly, “the bone closest to the lesion remained shorter. It is what happens to the “galiagones” (Greek: γαλιάγκωνες = those who have short limbs like a cat). The forearm shortens a little, the hand even less, and the shoulder bones don’t shorten at all”. Secondly,

“In the future, the patient will be able to handle his hand with great force, but he will not be able to lift the arm up to his ear, when his elbow is tense”. They believed it is due either to a dislocation which may occur during pregnancy, or to a traumatic incident occurring during childbirth, while physicians should immediately intervene to correct the lesion. It was highly recommended a reduction combined with physiotherapy for the correct muscular development of the arm, the forearm, and the hand [7–9].

For the congenital dislocation of the elbow, the bones of the forearm could have been dislocated either forward (point: unable to stretch the forearm) or backwards (point: unable to bend the forearm), a view which was later supported by Paul of Aegina (625–690 AD) too. The realignment of the bone for the reduction of the dislocation was the same, whether it was forwards or backwards. Thus, a violent tension was used by the physicians of the era, consisting of a simple procedure. First, the physician should put a ball of tape wrapped tightly on the elbow, stretching afterwards the hand, bending it abruptly around the ball. In the case when the reduction effort was a failure, the following consequences appeared “... in the congenital dislocations, the bones underlying the injury remain shorter, the shortening is greater in the forearm bones that are closer to the injury, followed by the bones of the wrist and finally by the fingers... As for the muscles, they are condemned to atrophy” [8].

In the case of the congenital dislocation of the wrist, Hippocrates and his pupils formulated the following opinion, “... in the congenital dislocation of the wrist, the hand stays shorter, while soft tissues (Greek: σάρκες) become atrophic, especially to the opposite side of the dislocation”. For the congenital dislocations of the fingers of the hand, they observed that the bones under the lesion were shorter and muscle atrophy was also observed [7].

The existence of congenital dislocation of the hip was also known in the Hippocratic era. In the book “On Articulations” (Greek: Περί Ἀρθρῶν), it was repeatedly mentioned. The Hippocratic school reported, “... when the dislocation occurs from birth, the disability is very serious. As for young children suffering from this injury, most of them are unable to stand up, but they pull their healthy part, finding support on earth with the hand of the strong healthy side. If, however, newborns with such bone dislocation are properly trained, they stand upright on their healthy leg, holding a crutch under the armpit of their healthy side. Some of them use a crutch under both armpits”. The importance of early diagnosis and treatment was emphasized, “... these disabled children can walk. Some of them walk like grown-ups who suffer from dislocation without realignment of the bone, whereas others while walking press the entire foot down, but they unavoidably drop because one leg is shorter. It is possible to achieve this result (i.e., to walk) if children are taught with care and precision to take appropriate postures before they even acquire this ability.

The younger are the sufferers with this disability, the greater the supervision should be, as if they are not looked after in their youth, the entire leg becomes atrophic and thus inactive". Bilateral dislocation was also observed, "... in some people, either from birth or because of an illness, both two thighs are dislocated outward". The custom of the legendary tribe of Amazons was mentioned, "... some testify that the Amazons used to dislocate either the knees or the thighs of the young boys from an early age, in order for them to hobble and thus prevent men from scheming against women" [8].

For the dislocation of the knee, "... things are analogous to what we previously said... the knee is dislocated... backwards... The backwards dislocation may also be reduced with modest extent... If a reduction does not occur and the dislocation is backward, the disabled cannot bend the knee (he cannot bend it almost in any other case of dislocation) and the front of the thigh and the leg become atrophic" [7].

For the congenital dislocation of tarsotibial joint, the Hippocratics gave the follow description, "... the leg is dislocated with the ankles or not... Reduction as in the dislocation of the wrist... Congenital or acquired dislocations follow an analogous way" [7, 8].

According to the Hippocratic School, talipes valgus (Greek: βλατισποδιά, clubfoot), like most deformities should be carefully addressed, "... most cases of congenital clubfoot are remediable, unless the declination be very great ... The best plan then is to treat such cases at as early a period as possible, before the deficiency of the bones of the foot is very great, and before there is any great wasting of the flesh of the leg. There is more than one variety of clubfoot, the most of them being not complete dislocations, but impairments connected with the habitual maintenance of the limb in a certain position ... In a word, as if molding a wax model, you must bring to their natural position the parts which were abnormally displaced and contracted together, so rectifying them with your hands, and with the bandaging in like manner, as to bring them into their position, not by force but gently ... This, then, is the mode of cure, and it neither requires cutting, burning, nor any other complex means, for such cases yield sooner to treatment than one would believe. However, they are to be fairly mastered only by time, and not until the body has grown up in the natural shape". Thus, a forceful permanent stabilization could correct talipes valgus. Galen (ca 129–210 AD) adopted and proposed the same treatment eons later [8].

Congenital dislocation of the apex leg could be remedied using, as nowadays, various special designed shoes, "... concerning small congenital dislocations, some may be reduced, especially the deformed leg. There are many types of deformation. As for the treatment, after molding the wax and the resin, we place them conveniently around the foot,

adding plentiful bandages, wrapping up the foot, while a lead wrapper could also be placed. Moreover, appropriate footwear may be used" [7].

Clavicle fractures were common among newborns and relatively innocent, and as Hippocrates rightly described, healing was taking place in a short period of time and suggested that the formation of the bone callus was not of a concern, as clavicle would return soon to its original form, "... the clavicle fracture, if done in the middle, is easier to heal than if it is eccentric... However, the part of the fracture is deformed, and this deformation, very uncomfortable at first for those who endure it, becomes less remarkable over time. The clavicle's bone broken part are quickly bond, as well as all the other spongy bones, as the healing spreads within a short time period to the bones of this kind" [8]. Galen added that a special type of bandage was in use since the time of Hippocrates [9].

In "Corpus Hippocraticum," another unspecified deformity was also described, "... nature has set the fingers' arrangement wisely, by separating them from one another and the thumb is in contradiction with the index. An example of a deformity that restricts the movement is when, by nature or by development, the thumb is retained near the other fingers" [10].

## Discussion

Hippocrates worked at length on the abovementioned congenital deformities of the limbs and as a result has suggested different aetiologies and treatments. As it has already been mentioned, his belief was that deformities occur during the intra-uterine life if the mother falls or suffers any form of injury upon her abdominal area [5, 6]. Although orthopaedics did not existed as a separate specialty in Greek antiquity, a sizable part of the "Hippocratic Collection" of Medical Treatises was dedicated to it. The term was not clearly mentioned. However, the term "paedion" had been variously referenced by the Hippocratics. It was maybe because the ancient Greek was a too rich, vivid, and descriptive language avoiding to compose a compound word, or simply it was unnecessary for the philosophers of the era to give a name to what it was an obvious concept, the ideal correct placement of the body parts in space, thus orthopaedics [4].

During the eighteenth and the nineteenth centuries, many opinions on the cause of these congenital dislocations were expressed, and they generally vary, but they can easily be classified in the three following divisions: physiological, pathological, and mechanical doctrines. French anatomist Gilbert Breschet (1784–1845), French anatomist and

orthopaedic Jacques Mathieu Delpech (1777–1832), and Italian surgeon Giovanni Battista Palletta (1748–1832) are supporters of the first opinion, as the first two attribute the deformities to the arrested development of the apparatus of the joint caused by a condition of the cerebrospinal axis, and the third believes that they are the result of a defective gene [11]. In the second category, we have French physician Charles-Emmanuel Sédillot (1804–1883), who talks about the softening and relaxation of the ligaments, as well as Parise and Malgaigne who believe that hydrarthrosis (water in the joints) is the reason of the deformities [11, 12]. Finally, the third opinion is supported by the French barber surgeon Ambroise Paré (ca 1510–1590) who agrees with Hippocrates on the causes of the congenital dislocations but he also blames the contractions of the womb, the violence of the accoucheur, and the position of the fetus. Moreover, French anatomist François Chaussier (1746–1828) refers to muscular contractions and intra-uterine convulsion as the causes of congenital dislocation of the humerus and femur, and Guerin has applies this denomination to most deformations [11].

Talipes valgus is a deformity that affects one in 1000 births representing nowadays one of the most common congenital orthopaedic anomalies. There are many forms of this disease; most of them are curable but still there is no available treatment for all of its forms, especially when the declination is great. There are also unresolved issues such as the possible recurrence of the disease [13]. Hippocrates was the first to describe a treatment and his principles are today as valid as they were 2500 years ago. He has stated that club-foot can, in most cases, be overcome without “cutting or burning, or any other complex mode of treatment”, while a supportive immobilization aid or specialized shoes could be placed for the correction of this deformity [8]. Further studies on the disease were performed after the Dark Ages, during the Renaissance, producing though no novel approach. From manipulation in antiquity to splint and plaster and the non invasive Hippocratic method, various surgical treatments were tested during the nineteenth and twentieth centuries; however, talipes valgus’ pathology still continues to challenge the paediatric orthopaedic surgeon as it has a notorious tendency to relapse. Moreover, more than 90% of the cases (especially calcaneovalgus type) responds to conservative treatment based on the ancient Greek thought [13]. Since the era of Galen who has illustrated the views of Hippocrates, noting that he had not offered any additional information [9], eons passed for novelties to be introduced. During the nineteenth century, English physician and accoucheur Philip M. Lyons in 1834 has combined the views of Hippocrates and others like Irish anatomist and surgeon

Abraham Colles (1773–1843) and French anatomist and zoologist Isidore Geoffroy Saint-Hilaire (1805–1861) to form his theory that clubfoot, apart from congenital malformation (damage inside the uterus, or embryological deformity), could have been caused by an active or passive irregularity in the muscles and ligaments which are connected with the foot, proposing immobilization and specialized footwear (Fig. 2), as treatment [14], exactly as Ambroise Paré did [15].

Concerning hip displacement, which occurs more often on the left side rather than the right, Hippocrates believed that this is due to a malposition in the uterus as he had stated that, “those persons, then, are most maimed who have experienced the dislocation in uterus”. P.M. Dunn agreed with Hippocrates and also added that this phenomenon is related with the fact that the fetus tends to lie with its back on the left side of the uterus twice as often as it does on the right [16]. However, recent evidence has brought down his theory, as 40% of the fetuses lie on the left side and 35% on the right, so there is no great difference. There were other scientists who expressed their beliefs on the origin of the hip displacement, like American surgeon John Murray Carnochan (1817–1887), who said that muscular spasmodic retraction can cause the dislocation, or French anatomist and surgeon Guillaume Dupuytren (1777–1835) who had blamed a defect in the depth or completeness of the acetabulum, both separating their opinion from the Hippocratic views [11, 17]. More than 2000 years have passed since Hippocrates referred to hip displacement and suggested that treatment is possible if started early. In 1879, German surgeon Wilhelm Roser (1817–1888) proposed a preventive approach by describing an early diagnosis and an acute reduction by abduction, embracing once more the Hippocratic doctrine [18].

To acute intervene for the correction of a congenital deformity in a newborn may rise nowadays a series of dilemmas, as usually a complex in the connection between the new mother and the fetus is present, due to their interest being often in conflict [19]. The ancient Greek Hippocratic School of Medicine with its contributions in congenital deformities revolutionized the practice of medicine, proposing an immediate and rigorous clinical evaluation, diagnosis, and intervention. Since the fifth century BC, a series of interventions such as the on sight reduction of any congenital dislocation and various simple orthopedic orthotics designed to correct talipes valgus combined with specialized footwear with the aim of obtaining a proper correction of the deformity set the main principles for the future [20]. Despite the fact of the incorrect belief of the Hippocratics that dislocations were curable if treatment was applied in early stages, the whole preventive approach was reintroduced and proposed again during the eighteenth to the

**Fig. 2** Specialized footwear for the clubfoot, end of the nineteenth century, Malson Mathieu, Paris, and Lyon, France

424 Maison MATHIEU. — Paris et Lyon.

---

**Appareils pour le traitement des pieds-bots.**

40275. Attelle en bois, du Dr de Saint-Germain ..... 10 »  
 40276. Appareil à plaquette métal, pour pied-bot opéré..... 12 »  
 40277. Gouttière métallique articulée..... 15 »  
 Ces appareils se placent directement après la ténotomie.

**Mesures à prendre :**

Le pied dessiné à plat sur une feuille de papier. | La hauteur du talon jusqu'au genou.



40280.



40281.



40282.

40280. Appareil du Dr Kirmisson avec deux articulations à boules : une pour corriger l'équinisme et le varus, la seconde pour corriger l'enroulement de l'avant-pied, modèle Mathieu..... 55 à 65 »  
 40281. Appareil à boule de Nélaton, modèle Mathieu..... 45 à 55 »  
 40282. Appareil à traction élastique, du Dr Th. Anger..... 40 à 50 »

Ces appareils se composent : d'une molletière et d'une chaussette en cuir moulé fixées à une semelle en acier s'articulant en genouillère à la tige postérieure fixée à la molletière. Avec les appareils de Nélaton et du Dr Kirmisson, on peut placer le pied à l'aide de la main dans la position voulue : les articulations se fixent alors au moyen de deux petites vis à marteau que l'on serre solidement avec une clef.



40284.

40284. Botte moulée de Mathieu pour maintenir le pied après l'opération et terminer la guérison. 25 à 40 »

L'appareil se compose d'une attelle métallique rivée sur une molletière et une chaussette en cuir moulé. Une bride en cuir s'agrafant sur l'attelle maintient le pied au fond de la chaussette moulée.

40285. Appareil avec deux articulations à boules et coulisse verticale. 55 à 65 »

**Mesures à prendre pour les appareils précédents.**

Le moulage du pied et de la jambe (si possible).  
 Longueur du genou à la cheville.  
 — de la cheville au sol.  
 Circonférence au-dessous du genou.  
 — du mollet.  
 — à la cheville.  
 — au bout de pied.  
 — au cou-de-pied en passant par le talon.



40285.

Donner une bottine, ou le tracé du pied dessiné à plat sur une feuille de papier. Indiquer le côté malade.

nineteenth centuries. Methodology as well as the treatment measures still inspiring modern orthopaedics [18].

### Conclusion

The Hippocratic School raised a craft based on superstition to a noble professional art that relied on thorough clinical observation, continuous practice, and personal experience. Although ancient Greek medico-philosophers could not comprehend entirely the human pathology and physiology, they had succeeded through their ingenious philosophy to interpret human's body evolution. Thus, congenital limb

deformities which were studied by the Hellenic medicine in ancient Greece since the fifth century BC presented no exception. The Hippocratic doctrine in the eve of orthopaedics proposed an acute non-invasive intervention for their correction. Simple reduction methods had been proposed by the Hippocratics in the treatise "Moclique", archaic orthotics and footwear were manufactured and endured time being used in daily medical practice since the nineteenth century when they came once more in vogue.

### Compliance with ethical standards

**Conflict of interest** The authors declare that they have no conflict of interest.

**Publisher's note** Springer Nature remains neutral with regard to jurisdictional claims in published maps and institutional affiliations.

## References

- Mikroulis G, Laios K, Tsoucalas G, Karamanou M, Aristotle AG (2014) (384–322 BC) on siamese twins. *Arch Balkan Med Union* 49(3):339–340
- Tsoucalas G, Sgantzios M (2017) Paul of Aegina (ca 625–690 AD), and his orthopaedic surgical reconstruction of the preternatural fingers. *Int Orthop* 41:211–216
- King H (2004) *Health in antiquity*. Routledge, London, p 181
- Tsoukalas J (2004) *Paediatrics from Homer until nowadays*. Science Press, Thessaloniki & Skopelos
- Hippocrates (1967) *Hippocratic Collection [Ἱπποκράτης Ἀπαντα τὰ Ἔργα, Περὶ Γονῆς]* (ed. Pournaropoulos G, Kaisaros E, translation and comments). Martinos, Athens
- Hippocrate (1851). *De la Génération [Περὶ Γονῆς]* (ed. É. Littré), vol. 7. Baillière, Paris, p 484
- Hippocrate (1844). *Mochlique [Μοχλικός]* (ed. É. Littré), vol. 4. Baillière, Paris, par 5. par 18, par 26, par 31
- Hippocrate (1844). *Des Articulations [Περὶ Ἀρθρῶν]* (ed. É. Littré), vol. 4. Baillière, Paris, par 12, par 14, par 19, par 21, par 52–55, par 62, par 87
- Galenus (1821–1833) *Claudii Galeni Opera Omnia [Ἱπποκράτους το περὶ Ἀρθρῶν Βιβλίον και Γαληνοῦ εἰς αὐτό, Ὑπομνήματα τέσσαρα]*, vol 13a. C. Cnobloch, Leipzig, pp 394–396, 404–410, 417–419, 478, 607–608, 813, 822
- Hippocrate (1841) *De l'Officine du Médecin [Κατ' Ἱητροῖον]* (ed. É. Littré), vol. 3. Baillière, Paris, par 4
- Hamilton FH (1860) *A practical treatise on fractures and dislocations*. Norman Publishing, San Francisco
- Billman F (2012) A pioneer in medicine and surgery: Charles Sédillot (1804–1883). *Int J Surg* 10(9):542–546
- Hernigou P (2017) History of clubfoot treatment; part III (twentieth century): back to the future. *Int Orthop* 41(11):2407–2414
- Lyons PM (1834) On clubfoot. *Lond Med Gaz* 15(1):541–546
- Petkovic M, Petkovic L, Dobanovacki D, Pajic M, Matic A (2012) Historical review of congenital foot deformity treatment. *Med Pregl* 65(1–2):73–78
- Dunn PM (1993) Hippocrates (460–c 356 BC) and the founding of perinatal medicine. *Arch Dis Child* 69:540–541
- Wilkinson JA (1985) Congenital displacement of the hip joint. Springer-Verlag, Berlin & New York, p 54
- Price CT, Ramo BA (2012) Prevention of hip dysplasia in children and adults. *Orthop Clin North Am* 43(3):269–279
- Pinter A (1996) Hippocrates or Taigetos—ethical dilemmas in neonatal surgery. *Orv Hetil* 137(3):115–119
- Sanzarello I, Nanni M, Faldini C (2017) The clubfoot over the centuries. *J Pediatr Orthop* 26(2):143–151