HISTORY OF HAND SURGERY

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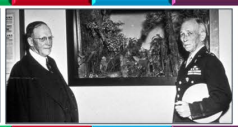
The history of hand surgery is a tale of recognition of the hand as an entirely separate organ and increasing appreciation of its importance in separating humans from the rest of the living world. Indeed, injuries and other conditions of the hand have been described since antiquity. Hippocrates [460 – 356 BC] wrote on the reduction of hand and wrist fractures, but was unable to clearly differentiate between nerve and tendon.[1,2] This error was perpetuated by Galen [131 – 201], one amongst his many spectacular anatomical follies, who went on to advise against suture of these 'nerves'.[2] Ibn Sina [980 – 1036], Avicenna in the West, is usually credited for being the first to systematically repair tendons.[1] Andreas Vesalius [1513 – 1564] placed anatomy on a strong scientific foundation by careful human dissection, ushering in an era of advancement in all of Medicine. His illustrious contemporary Ambroise Pare [1509 – 1590] reported on hand infections and described hand contracture release, along with a variety of upper limb prostheses and splints.[1] Pare is rightly the first among the 'Giants of Hand Surgery' recognized by the IFSSH.[3]

158 AD	11TH CENTURY	1579	1768	1831	1833	1874	1885	1887	1896	1900	1908	1913	1926
Galen, recognized "the hand serves the principal human needs as well as higher mental functions"& proposed treatment for traumatized tendons and nerves	**Avicenna**, the first to systemically repair tendons	**Ambroise Pare**, first among the 'Giants of Hand Surgery' recognized by the IFSSH	**William Smellie**, recorded the first case of Obstetric brachial plexus palsy	**Dupuytren-** a meteor in the world of science, operated upon the palmar contracture	**Sir Charles Bell**, wrote "in the human hand that we have the consummation of all perfection as an instrument"	**Duchenne**, established the term *paralysie obstetricale*. In 1879, ERB localized the lesion site in these paralysis	**Klumpke**, described lower root brachial plexus lesions and oculopapillary signs associated with them	**Guermon prez**, introduced the concept of transposition pollicization and published, 'Hand Surgery' the world's first treatise on hand surgery	**Sir Robert Jones**, published the first ever clinical radiograph of hand	**Carl Nicoladoni**, first ever pedicled toe to thumb transfer in a 5 years child	**Sir Robert Jones**, described his set of tendon transfers for radial nerve palsy	**Howard K Tuttle**, first to describe nerve transfer-terminal branch of C4 root to upper trunk	**Sterling Bunnell**, the father who considered it *"only a field of special interest"* suffered a hip fracture, developed non-union, resorting to surgeries done seated








1944	1945	1962	1963	1964	1965	1966	1968	1969	1973	1985	1994	1999	2000
Sterling Bunnell meets General Kirk- embryogenesis of specialty of Hand Surgery	**Birth Of ASSH**	**Malt& Mckhann-** performed the first arm replantation	**Chen Zhongwei** performed the firsthand replantation	**Roberto Gilbert Elizalde-** first technically successful hand transplantation, which got rejected in 21 days	**Komatsu& Tamai** performed the first thumb replantation	**Birth Of IFSSH**	**Birth Of BSSH**, with **Guy Pulvertaft** as the first president	**John Cobbett-** first clinical great toe transfer	**Birth Of ISSH & Hanno Millesi** pioneered the use of free nerve grafts in peripheral nerve injuries	**Narakas** proposed a grading system to classify and determine the prognosis of brachial plexus injuries	**Christophe Oberlin** revolutionized the utility of nerve transfer in brachial plexus surgery	**Warren Breidenbach** performed thefirst ever clinical hand transplant with long term success	**Jean Michel Dubernard-** performed the first double hand transplant

An era of detailed study of hand anatomy followed. Petrus Camper [1722 – 1789] was an early influential teacher, after whom the flexor superficialis decussation is named. Sir Astley Cooper [1768 – 1841] described components of the palmar fascia, as well as its contracture about a decade before Baron Guillame Dupuytren [1777 – 1835].[4] Nevertheless, Dupuytren produced such a detailed description of the pathoanatomy, surgery and care afterwards that the condition came to be named after him. This was also helped by his giant stature in European surgery, given his contributions to almost every field of surgery imaginable. From his description of a post-mortem dissection of a diseased hand: "… *When the skin was removed from the palmar surface of the hand and fingers, the folds which I have before noticed, disappeared altogether. It was evident then that the folded arrangement of the skin during life depended on some other affection… The dissection was continued by exposing the palmar fascia, and I was astonished to perceive that this fascia was tense, retracted, and shortened. From its lower portion were given off kinds of chords, which passed to the diseased finger… I cut through the prolongations extending from the fascia to the fingers; the state of contraction immediately ceased, and the slightest effort was sufficient to bring them to complete extension; …*"[5] While he may now be remembered for the hand condition named after him, this description was but a miniscule constituent of his massive tome of work. Dupuytren's career illustrates how hand surgery was then far

from a separate specialty, being an incidental constituent of the wider gamut of the ever-advancing art of the surgeons.

The 19th century then witnessed a great explosion in our understanding of the physiology of the body, which had its bearing on the surgeons' respect towards hand function. Ernst Weber [1795 – 1878], an influential German physician widely considered to be the founder of experimental psychology, performed rigorous studies on the physiology of sensation. He described a "just noticeable difference" for all senses, which was the minimum difference in stimulus magnitude needed for the subjects to notice a difference. Applied to touch sensation, this is a precursor of the modern two-point discrimination measurement.[6] In France, Duchenne de Bologne [1806 – 1875] began the earliest studies on the working of muscles by electrical stimulation.[7] His student Jean – Martin Charcot [1825 – 1893] systematized neurology with careful correlation of clinical signs with lesions and is regarded as the founder of modern neurology. Both Duchenne and Charcot worked extensively at the Saltpetriere Hospital in Paris, an erstwhile gunpowder factory and later hospice for the lowest of French society, redeeming it to the forefront of European medicine by the turn of the 20th century. Meanwhile, across the Channel, Darwin and his successors lead a scientific upheaval of yet unseen proportions. More pertinent to a history of hand surgery, however, would be the work of Sir Charles Bell [1774 – 1842], a Scottish surgeon, anatomist and artist. Apart from describing the cause of the eponymous facial nerve palsy, he is generally credited for the discovery of the difference between the motor and sensory roots of the spinal cord. In

1833, he published *The Hand: Its Mechanism and Vital Endowments as Evincing Design* as part of the Bridgewater Treatises, funded by an endowment from the will of the Eighth Earl of Bridgewater.[8] This Treatise possibly qualifies for the first scientific work of importance to specifically discuss the anatomy and function of the hand and upper limb. In a series of superbly illustrated sections, Bell discusses the comparative upper limb anatomy of fishes to humans. He managed to correlate the different forms of the upper limb to the different functional requirement of each major animal group, contributing this as a proof for thoughtful design by a Creator. Darwin was still aboard the *HMS Beagle* in 1833 and the publication of his Theory two and a half decades in the future. By 1871, in *The Descent of Man,* Darwin offered the ligament of Struthers as a proof of the common origin of man with other animals.[9]

The field of surgery was propelled forward in the second half of the 19th century by the increasing adoption of antiseptic techniques and anaesthesia, while a regular supply of injuries was ensured by a series of wars. Silas Weir Mitchell [1829 – 1914] drew upon his experiences from the American Civil War to describe 'causalgia' with nerve injuries, now familiar to us as CRPS.[10] He was also the first to name the 'phantom limb' sensation of amputees. Across the Atlantic, Pierre Charles Huguier [1804 – 1873] described a metacarpal phalangisation technique in 1874.[11] Guermonprez, in 1887, described pollicization of an intact finger ray based on studies in monkeys.[12] He went on to publish a textbook titled *Hand Surgery*, possibly the first ever in the specialty. A truly remarkable surgeon of this era was Carl Nicoladoni [1847 – 1902] of Austria.

Modern specialists would be overawed by the breadth of his work, but Nicoladoni's original ideas were far beyond his time. He performed the first ever tendon transfer in the form of a peroneal transfer for Achilles tendon reconstruction.[13] In 1891, he performed salvage of a degloved thumb with a thoracic pedicled flap. He later described an osteoplastic thumb reconstruction using a tibial bone graft under such a flap. Nicoladoni welcomed the new century with the first ever toe – to – thumb transfer, reported in 1900 in a 5-year old child. His technique in his own words (translated): "… *With a large dorsal four-cornered flap, the metatarsophalangeal link of the second toe should be exposed and opened after cutting through the dorsal tendons. To the thoroughly prepared thumb stump wound, the tendon of the flexor thumb is first united with the volar tendons of the toe and then the I phalanx stump of the thumb with the base of the proximal phalanx of the toe using a catgut bone suture. Then the dorsal tendons are brought together, and finally the large dorsal flap is combined with the dorsum of the thumb stump so that a wide joint of the same is secured to the dorsal stump. …*"[14] Nicoladoni also described nerve decompression surgeries for the axillary, radial and ulnar nerves.

The First World War provided the impetus for the recognition of Orthopaedics as a separate specialty in Britain, owing largely to the efforts of Sir Robert Jones [1857- 1933]. He described his set of tendon transfers for radial nerve palsy during and just after the war.[15] Interestingly, Jones retrieved a bullet from the hand of a 12-year old boy using then recently described X rays, needing an exposure time of 2

hours. The case was reported in the *Lancet* in 1896.[16] The hand radiograph, complete with the bullet in the 3rd CMC joint, became the first ever published clinical radiograph. Leo Mayer [1884 – 1972], performed experiments in to tendon repair and adhesions beginning in Europe. He was an early American pioneer in tendon surgery, especially in tendon transfers of the upper and lower limbs. Another American contemporary surgeon's "special interest" in hand surgery would eventually lead to its official birth as a separate specialty. In Europe, Marc Iselin [1898 – 1983] stressed the importance of surgery of the hand as early as 1928. Claude Verdan [1909 – 2006] established a clinic in Lausanne, Switzerland focusing on the emergency and continued management of hand injuries in 1946,[1] apart from contributing foundational work in the field of digital flexor tendon repair.

In 1943, at the height of the Second World War, Franklin Delano Roosevelt was called upon to appoint the next Army Surgeon General. The Army Chief preferred General Eisenhower's doctor, as did other top officers. FDR, paraplegic from poliomyelitis that he suffered at the age of 39, decided that his wounded troops needed rehabilitation most. Given his own personal experience with Orthopaedics, FDR appointed the first, and till date only, Orthopaedic surgeon to the post – General Norman Kirk. During a hospital inspection in 1944, General Kirk was reminded of an old friend: "… *I was shocked to see many 'crippled hand' cases. It appeared that not enough was being done for them. Immediately I thought of* ***Sterling Bunnell*** *as the man to head a 'crippled hand' service for the Medical Corps of the Army. ….*"[17]

Asa Sterling Bunnell, then 62 years of age and having just finished his *magnum opus* textbook *Surgery of the Hand*,[18] closed shop in San Francisco and flung himself in to a fury of travel across the United States to set up ten Hand Surgery centres. As early as 1918, Bunnell had published his work on finger flexor tendon repair, but then considered this "only a field of special interest".[1] However, in 1926, Bunnell was the pilot of a small aircraft that crashed near the coast of California. His passenger was killed and he himself suffered a hip fracture, that was fixed by none less than Marius Smith – Petersen with his newly designed triflanged nail. The fracture did not unite and Bunnell was forced to give up aviation for the more sedate pastime of duck hunting, where he met the later Surgeon General Kirk. Bunnell also began to prefer to operate sitting, leading him to focus more on Hand Surgery. By the time General Kirk's letter came to him, Bunnell had amassed great experience in the management of a wide variety of hand problems. The American Society for Surgery of the Hand was founded in 1945, mostly by Bunnell's trainees.

Across the Atlantic, at the small port of Grimsby, Guy Pulvertaft [1907 – 1986] was accumulating sizable experience in hand injuries by treating local fishermen, when the Second World War broke out. Suddenly flooded with injured airmen, Pulvertaft proved to be up to the task with diligent effort. Post 1950 Pulvertaft authored multiple papers on flexor repair and grafting, and stressed on immediate mobilization post repair. This was in opposition to Bunnell's teaching, who visited Pulvertaft and graciously accepted that his own results were less good than

Pulvertaft's.[19] In 1968, the British Society for Surgery of the Hand was born with Pulvertaft as its first President. No less a figure than Sir Reginald Watson – Jones, a close friend and sailing associate of Pulvertaft, expressed his concerns over setting up a specialty society in a prompt telegram [reproduced with the telegraphist's spelling errors]: " *YOU MUST THINK LONG CAREFULLY AND BROADLY BEFORE SUPPORTING SOCIETY FOR SURGERY OF THE HAND… WHICH WOULD MEAN ALSO SOCIETY FOR SURGERY OF SPINE WITH NEURO SURGEONS SOCIETY FOR SURGERY OF PELVIS WITH EUROLOGICAL SURGEONS SOCIETY FOR SURGERY OF STERNUM WITH THYMUS SURGEONS AND SO AD ABSURDAM…*"[19]

In spite of these initial misgivings, Hand Surgery spread across the world. The Japanese Society for Surgery of the Hand was established in 1957, inspired by a letter from Bunnell and a film on "Tendon repair" brought to Japan by Harry Miller of Pennsylvania, USA. The International Federation of the Societies for Surgery of the Hand was formed in 1966 with eight member-societies, currently having societies from 57 nations. The Indian Society for Surgery of the Hand [ISSH] was formed in 1973 with Guy Pulvertaft as Chief Guest, who also help set up societies in Bangladesh, Ethiopia and Kuwait. The first president of Indian Society for Surgery of the Hand was Dr. A Sengupta from Calcutta with Dr. B B Joshi from Mumbai as his Vice President.

The second half of the 20th century saw the advent and subsequent wide adoption of microsurgical techniques, expanding the horizons of hand surgery. Malt and Mckhann performed the first replantation of an arm in 1962 in Boston,[20] realizing a long-cherished dream of surgeons. Harold Kleinert [1921 – 2013] successfully revascularized a thumb after a near total amputation in 1963 and had to supply angiographic proof of the functioning anastomosis for incredulous editors.[21] The first replantation of an amputated thumb was performed by Komatsu and Tamai in 1965.[22] Chen Zhongwei [1929 – 2004] replanted a hand in 1963 at the Shanghai Sixth People's Hospital, but this was unknown in the West.[23] The American Replantation Mission to China in 1973 was further surprised to learn that a second toe transfer had been performed by T.Y Young in 1965[24] and a combined 2nd and 3rd toe transfer in the same year by Chen.[25] While the entirely original American microsurgeon Harry Buncke [1922 – 2008], had successfully performed a toe transfer in monkeys by 1966,[23] the first clinical great toe transfer was completed by John Cobbett [1930 – 2016] in 1969.[26] Free tissue transfers then followed in profusion, being too numerous to be enumerated serially.

Nerve surgeries, especially those pertaining to the brachial plexus, developed parallel to the developments in the field of microsurgery with great benefits from the microsurgical techniques. In 1764, William Smellie, an English obstetrician, wrote, "the prolonged compression was responsible for a paralysis of both arms which lasted for several days and disappeared after frictions" in his *Treatise of Midwifery*.[27] This has been considered as the first description of obstetric palsy. More convincing

descriptions were reported by Jaquemier in 1846 and Danyau in 1851 which attributed these injuries to the prolonged and difficult labour, and the use of assisting devices.[28,29] Duchenne in 1874 described four cases of obstetric paralysis which represent the first elucidation of upper brachial plexus palsy. However, he advised electrical stimulation as the treatment for these injuries.[30] Erb in 1877, localized the lesion site of upper brachial plexus paralysis based on anatomical and electrodiagnostic studies. Later, in 1885 Augusta Dejerine Klumpke reported on lower plexus paralysis and the oculo-papillary signs associated with them.[31] The mediocre results of non-microsurgical repair of these injuries hindered the progress in this field. With introduction of the microsurgical techniques, the results of nerve repair proved better and hence the new developments in this field took off after a hibernation of almost a century. Hanno Millesi in 1973 reported his landmark work on interposition sural nerve graft to bridge the gaps found after peripheral nerve injuries.[32] Though, Tuttle in 1913, was the first to describe nerve transfer in brachial plexus injuries, where he transferred the terminal branch of C4 root to the upper trunk, the progress in this field was slow and limited till the vast experience of Narakas (1985) in adult plexus injuries and Gilbert in birth brachial plexus injuries were published.[33,34] However, the invention of the 'partial nerve transfer technique' by Dr Christophe Oberlin, reported in 1994, could be considered as an important landmark in the field of brachial plexus surgery.[35] He introduced a revolutionizing concept in which a fascicle could be taken from a functional nerve in the vicinity of the paralyzed muscle and

transferred to the nonfunctional nerve supplying the paralyzed muscle in close proximity to its target muscle without having any functional deficit in the donor nerve. Since, the nerve coaptation was done very close to the target muscle it, an earlier recovery of the muscle, was made possible which was a dream in a patient with higher level plexus injury especially, the avulsion injury. This concept lend way to a myriad of nerve transfers for different nerve palsies and have brightened the prospects for the management of nerve injuries.

The future of Hand Surgery, no doubt, will involve further refinements in technique coupled to better understanding hand function. While hand surgeons have been busy coping up with an explosion of procedures in their field, biologists have attributed greater importance to the hand than earlier. The evolution of the upper limb has been studied in greater detail, with modern theories holding hand use responsible for the cognitive development of the human species. In the coming years, greater synthesis of widely separate fields of knowledge would likely converge in to a 'science of the hand', of which surgery would be but a practical necessity.

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