Hand Surgery in Singapore

Tong Pei-Yein[1] Dawn Sinn Yii Chia[2] Usama Farghaly Omar[1] Soumen Das De[3] Renita Sirisena[3] Robert Tze Jin Yap[4] Jacqueline Siau Woon Tan[4] Vaikunthan Rajaratnam[1]

[1]Department of Orthopaedic Surgery, Hand and Reconstructive Microsurgery Service, Khoo Teck Puat Hospital, Singapore
[2]Department of Hand and Reconstructive Microsurgery, Tan Tock Seng Hospital, Singapore
[3]Department of Hand and Reconstructive Microsurgery, National University Health Systems, Singapore
[4]Department of Hand and Reconstructive Microsurgery, Singapore General Hospital, Singapore

Address for correspondence Vaikunthan Rajaratnam, FRCSEd, Department of Orthopaedic Surgery, Hand and Reconstructive Microsurgery Service, Khoo Teck Puat Hospital, Singapore (e-mail: vaikunthan@gmail.com).

J Hand Microsurg:2021;13:10–15

Abstract

Singapore as an island nation is one of three countries in the world that has hand and reconstructive microsurgery (HRM) as an independent specialty. The 52 accredited hand surgeons serving a population of 5.7 million facilitate hassle free access to patients. Hand surgery historically is rooted very much in orthopaedic surgery as in most Asian countries with more than five decades of rapid evolution. Singapore pioneered a structured and systematic training program for HRM and the local surgeons have contributed significantly to the body of knowledge in hand surgery with targeted research and publications with three surgeons being awarded international recognition for their contributions. Singapore continues to contribute significantly to surgical volunteerism regionally through active involvement in the training of regional surgeons through their sustainable volunteer activities and through international fellowships in Singapore hospitals. The future of hand surgery in Singapore will be more competency and multidiscipline based on community-centered approach.

Keywords
- hand surgery
- reconstructive microsurgery
- surgical volunteerism
- Singapore

Introduction

Singapore, an independent island nation of 725.7 sq. km, has a total population of 5.7 million of which 3.5 million are its citizens.[1,2] It is the second most densely populated nation in the world. Singapore has 2.5 doctors per 1,000 population of which 40% are registered specialist with two out of three in the public sector.[3] There is one accredited hand surgeon per 100,000 population—one of the highest in the world. Singapore is a regional leader in the field of hand and reconstructive microsurgery (HRM) in Southeast Asia and one of three countries in the world where hand surgery is an independent specialty.

History of Hand Surgery

In Singapore, hand surgery began as a branch of the Department of Orthopaedics in the country's oldest health care institution, the Singapore General Hospital. Prior to the inception of the Department of Orthopaedics on April 1, 1952, hand conditions were treated by general surgeons and in leprosariums. The early catalyst for the development of hand surgery in Singapore was in response to managing the impact of leprosy and industrialization. Leprosy in the 1950s was managed in leprosariums and the first local orthopaedic surgeon with an interest in this subspecialty was Dr. Yeoh Kean Hong. Following his orthopaedic training, he spent a period

published online
December, 12, 2020

DOI https://doi.org/10.1055/s-0040-1721565
ISSN 0974-3227.

of time with Paul Brand in Vellore in 1961 and returned to Singapore to commence hand surgery reconstruction on leprosy patients (nerve decompression and tendon transfers) under Dr. Donald Gunn (chief of orthopaedic surgery, 1961–1967).[4,5]

With industrialization in the 1960s, the increasing demands of hand injuries resulted in the recruitment of Dr. Pesi B. Chacha by the visionary Dr. V.K. Pillay who was one of the first local Singaporeans to do orthopaedic surgery and head of orthopaedic surgery at Singapore General Hospital (1967–1972), to help develop specialized hand clinics.

Dr. Pesi B. Chacha and Dr. Robert Pho, who joined the department in 1974, were the prime movers of microsurgical reconstructive surgery in Singapore with the first major limb replant in 1975, the first thumb replantation in 1977, the first free fibula in 1979, the first toe transfer in 1980, and the first second toe transfers in 1982.[5]

With increasing workload and a dedicated team of doctors and ancillary staff, the hand surgery unit was formed in Singapore General Hospital in 1985. The pioneering team comprised five permanent staff surgeons. The unit developed into a full department that later matured into a national tertiary center. In 1990, another HRM department was established at the National University Hospital. By 2009, another hand microsurgery unit was formed in Tan Tock Seng Hospital which has to date developed to become a full department.

Historically, Singapore as a former British colony has close links with the Royal Colleges of the United Kingdom, Ireland, and Australasia. The credentialing and accreditation of medical specialist in Singapore falls under the Specialists Accreditation Board of the Ministry of Health. Hand surgery is one of the 35 recognized specialties in Singapore. The initial advanced specialty training was managed by a joint committee on advanced specialty training. The tripartite committee comprises the Academy of Medicine, the Ministry of Health, and the School of Postgraduate Medical Studies. Training in Singapore now has further evolved to include the American style of residency, in which trainees can now enter a 6-year program managed by the now renamed Residency Advisory Committee.[6] In the current Accreditation Council for Graduate Medical Education–based system, the trainees spend 2 years in various surgical and medical specialties early in their training to broaden their perspective and the final 4 years of their residency in hand surgery at the three accredited training centers: Singapore General Hospital, National University Hospital, and Tan Tock Seng Hospital. After completing residency, they are then qualified to sit the exit examination, comprising multiple choice questions, viva, short case discussions, and long case discussions.

The number of national trainees accepted per year on average is 3 with 18 currently in training.

Post exit examinations, hand surgeons in Singapore can undergo clinical fellowships at internationally renowned centers for further subspecialization under the Health Manpower Development Plan sponsored by the Ministry of Health. Through these fellowships, the specialty has been enriched with subspecialization in major areas of hand and reconstructive surgery, congenital conditions, peripheral nerve surgery, wrist trauma and disorders, minimally invasive upper limb surgery, small joint arthroplasty, and complex reconstructive microsurgery. There are 52 registered hand surgeons in Singapore with 32 in public institutions and rest in private practice.

The Singapore Society for Hand Surgery (SSHS) was formed in 1982, upon recognizing the importance of a national body, the society helped accelerate the development and pursuit of hand surgery in Singapore. The first president of the society was Assoc. Prof. Robert Pho.

The society then became a society member of the International Federation of Societies for Surgery of the Hand (IFSSH) in 1986. The SSHS also conducts regular meetings that aim to maintain currency and reinforce networks. In addition, the SSHS conducts an annual Hand Review Course and Annual Scientific Meeting, and several popular examination preparatory courses and cadaveric workshops. Further refinements in the residency training program curriculum, use of technology in training, and investing in hand surgery educators will ensure that Singapore remains a world leader in hand surgical education (►**Fig. 1**).

Pioneers of Hand Surgery

The visionary development of hand surgery and microsurgery was profoundly influenced by dynamic orthopaedic surgeons in the early formative years of hand surgery in Singapore. In particular, Profs. Pesi B. Chacha, Robert Pho, and Lam-Chuan Teoh have been recognized internationally by the "IFSSH Pioneer of Hand Surgery" for their contributions to the specialty.

Prof. Pesi B. Chacha

Prof. Pesi B. Chacha was born in 1938 in Navsari, India. After completing his medical education with distinction and gold medal at Grant Medical College, Mumbai in 1960, he commenced his orthopaedic surgery career in the United Kingdom, doing his orthopaedic residency training at the Western Infirmary Glasgow under Prof. Roland Barnes, and his MCh Orth at the University of Liverpool in 1966. Following his recruitment to Singapore, Chacha became the department head in 1972 and was pivotal in the introduction and development of the field of microsurgery in Singapore. In 1975, he visited renowned microsurgeon Prof. Yoshi Ikuta

Fig. 1 Cadaveric workshops for surgical skill training for local and regional surgeons.

in Hiroshima, Japan and returned with the knowledge and skills. Together with Robert Pho, they purchased the first surgical microscope and microsurgical instruments using generous donations from the philanthropic Lion's Club of Singapore. Chacha was recognized for his efforts in promoting microsurgery and received an award in 1996 for the "Advancement of Reconstructive Microsurgery Surgery in Singapore" by the International Society of Reconstructive Microsurgery.

Chacha as a lifelong learner, obtained his MD from the National University of Singapore in 1972 for his thesis on "Autologous Composite Tissue Tendon Grafts for Division of Both Flexor Tendons in the Digital Theca of the Fingers," the Palmes Academiques, Grade of Knight, French National Award in 1976 from the French government, and the Arris and Gale Memorial Lectureship of the Royal College of Surgeons of England in 1979. He obtained full professorship in 1978 and the visiting professorship from the United Kingdom by the Commonwealth Universities Interchange Scheme in 1979. The Prof. Pesi B. Chacha Lectureship in Spine and Scoliosis Surgery was formed in 2014 as an initiative to recognize and invite international field experts to Singapore.

In 2013, he received the "Pioneer Hand Surgeon" award from the IFSSH. He is recognized for his scientific contributions to hand surgery, and his dedication to training young surgeons in microsurgery both locally and regionally.

Prof. Robert Wan Heng Pho

Prof. Robert Pho Wan Heng was born in 1940 in Papua New Guinea. He obtained his Bachelor of Medicine and Bachelor of Surgery from the University of Sydney in 1966, and obtained his Fellowship of the Royal College of Surgeons of Edinburgh in 1972 and joined the University of Singapore in 1974 and rapidly rose to the rank of full professor in 1984. He was the head of the university, Department of Orthopaedic Surgery at the Singapore General Hospital from 1986 to 1988 and started the first Hand Surgery Unit in Singapore. When the university hospital moved to the campus at National University Hospital, Prof. Pho became the chief of Hand and Reconstructive Microsurgery Department from 1991 to 2000.

Pho has contributed extensively to the growth of hand and reconstructive surgery in Singapore. He and his team performed the first thumb replantation in Singapore in 1977, followed by Singapore's first toe to thumb transplantation thereafter in 1980. He also published the world's first free vascularized fibular transplant for replacement of the distal radius in 1978 and has become a major opinion leader in this field of biological reconstruction.

To date, Pho has more than 130 publications in indexed journals and is well recognized as a world authority in limb reconstruction following oncologic resection.

Pho was also the founding president of the Singapore Society for Surgery of the Hand in 1982, which has led educational activities for hand surgeons in Singapore and regionally.

For his contributions to teaching, research, and clinical service, Pho received numerous awards, such as the Lee Foundation National Healthcare Group Lifetime Achievement Award in 2004, Emeritus Professorship in 2005, and IFSSH Pioneer in Hand Surgery in 2013. The RWH Pho Lectureship, an annual event for invited international renowned doctors, was created in honor of his contributions to the fields of hand surgery and musculoskeletal oncology.

Prof. Lam Chuan Teoh

Prof. Lam Chuan Teoh was tasked by the Singapore Ministry of Health to develop hand surgery as an independent surgical specialty, and he emphasized close collaboration between hand surgeons and therapists. Teoh was born in 1949 in the Perak state of Malaysia. He graduated from the National University of Singapore Faculty of Medicine in 1976, and continued his orthopaedic surgery training at Singapore General Hospital. He obtained FRCS (Glas) and M Med (Surg) in 1981. In 1987, he was awarded the Ministry of Health Human Manpower Development Plan scholarship for his fellowship at the Kleinert Hand Institute in Louisville, United States. After his return, he was appointed the chief of Hand Surgery Department at Singapore General Hospital in 1988.

Teoh was dedicated to the development of hand surgery as a specialty, and to increasing its profile internationally. He was recognized for the successful development of a formal hand surgery specialty training program in 1990 which was accredited by the Singapore Joint Committee in Specialist Training, held position as the chairman of the Specialist Training Committee in Hand Surgery and consequently trained future generations of hand and reconstructive microsurgeons. His dedication to education extended to training of hand therapists, marking an era of close partnership between surgeons and hand therapists.

He was also active in regional training and partnerships, and was a founding member and honorary secretary of the Asia Pacific Federation of Societies for Surgery of the Hand (APFSSH) in 1995, and became its second president in 2000, and also held the post of past president of SSHS. He was a member of the International Hand Study Group of the AO Foundation from 1999 to 2005. To date, he has spoken at more than 280 international courses and conferences and published more than 100 papers and book chapters. He delivered keynote lectures at multiple international conferences including the APFSSH Plenary Lecture, Scandinavian Societies for Surgery of the Hand Moberg Lecture, and Singapore Orthopaedic Association Donald Gunn Lecture.

For his contributions to hand surgery, he was awarded the Lee Foundation National Healthcare Group Lifetime Achievement Award in 2018, and the IFSSH Pioneer in Hand Surgery Award at the 14th IFSSH, 2019.

Current and Innovative Practices

Generally, the practice of hand surgery procedures consists of 60% electives of which 80% of the cases consists of trigger finger release, soft tissue excision, and carpal tunnel release. The majority of emergency cases consists of soft tissue repair, fracture fixation, and soft tissue reconstruction (includes tendon repair/reconstruction/transfer, local/regional flap or skin grafting, and ligamentous repair).[7]

Innovative Pathways for Hand Trauma

Some of the innovations were designed for the delivery of a cost-effective and hassle-free hand surgery service in busy tertiary hospitals.

Semiemergent Day Surgery for Open Hand Injuries

Open hand injuries presenting through the emergency department (ED) are routinely admitted and listed for surgery acutely in our local setting and most of them do not receive surgical treatment within 6 hours of presentation to the ED. This has placed excessive stress in the hospital resources including bed availability. This innovative pathway helps reduce admissions and offload major operative theater caseloads while effectively utilizing day surgery operating theater (DSOT) slots. It also relieved patients of prolonged waiting time for admission and inpatient warding while waiting for emergency operating theater availability. From a financial point of view, this system was conceived to reduce overall treatment cost by removing the aspect of inpatient expenses.

Patients who sustained open hand injuries but without acute neurovascular compromise/compound tissue loss/mangling injury are discharged from the ED after having received first aid treatment by the on-duty hand team, and are scheduled to return to the hospital for surgery on the next available slot in the DSOT. This system is mainly based on prioritizing the patient according to the severity of their injury. This facilitated in hospital bed occupancy management as patients with simple injuries do not require admission. This system has proven its effectiveness specially during the current situation of COVID-19 pandemic.[8]

Hand Hot Clinic

Hand hot clinic has been introduced to provide quick access to specialty service, improve hand emergency care, and reduce burden on the ED. It is intended to provide rapid access to specialized hand care in the ED setting and reduce the admissions of patients with acute hand problems. All the patients are triaged by the ED nurse on arrival, followed by review by the hand team doctor on duty, who will institute initial management and draw up a definitive plan. Simple procedures have been performed in the ED. This allowed for operating room resources to be more appropriately allocated to complex cases. This has overall positive effects on delivery of patient care and on health care cost.

Stroke Hand Clinic

Spasticity in the upper limb has a significant impact on the patient's function requiring multidisciplinary team approach. The lack of a collaborative work process established for adult stroke patients resulted in the design and development of an outpatient multidisciplinary clinical care pathway incorporating treatment algorithm involving the neurologist, hand surgeon, advance practitioner nurse, hand occupational therapist, medical social worker, pharmacist, and dietician. The pathway includes assessment and management of spasticity and identification of surgical candidates for reconstruction and salvage.

Hand Surgery Research

Singapore's contributions to the HRM literature have been and continue to be significant. A cursory review of the literature yielded 426 articles covering a broad and diverse range of topics, including biomechanical studies, epidemiology of common hand conditions, basic science of tendon and nerve regeneration, new techniques for fracture fixation, tendon repair and reconstruction of soft tissue and bone defects, and treatment of complex conditions such as congenital deformities, tumors, and brachial plexus injuries. The limitation to this number includes the failure to capture Singapore surgeon's publication during their training/fellowship/sabbatical outside Singapore.

Finally, several Singapore surgeons have significant contributions to landmark textbooks relating to hand, orthopaedic, and plastic surgery and sit on editorial boards of major journals, such as the *Journal of Hand Surgery* (American volume), *Journal of Hand Surgery* (European volume), *Journal of Hand Surgery* (Asian-Pacific volume), and *Journal of Hand and Microsurgery*.

Surgical Volunteerism

Singaporean hand surgeons have actively been engaged in regional work spanning from relief missions to teaching and training the local surgeons as volunteerism remains the hallmark of a surgeon as a professional.[9] The areas include Bangladesh, Sri Lanka, Cambodia, China, India, Nepal, and Myanmar.[10] Many of the Singapore institutions also run fellowship programs, and have trained fellows from the region, such as Egypt, India, Sri Lanka, Nepal, Malaysia, and Philippines, as well as the United Kingdom, Spain, Italy, and the United States. This has enabled Singapore hand surgeons to forge strong networks with our partners in the region and internationally, a relationship which pays dividends through multicenter research collaborations and conferences. In a recent survey of hand surgeon in Singapore, 55% reported that they have been involved in volunteer work to establish and train surgeons for HRM in other countries. First volunteering experience in the survey was reported in 2009. The targeted countries include: China, Sri Lanka, Bangladesh, Cambodia, India, Myanmar, and Khmer (►**Fig. 2**).

Future of Singapore Hand Surgery

Singapore public health care system has been divided into three major integrated clusters, providing comprehensive health care to the western, central, and eastern parts of Singapore. Each of these clusters has a tertiary HRM unit, which provides the entire range of emergency and elective hand surgery services, including major limb replantation, flap surgery, congenital hand surgery, and peripheral nerve reconstruction. In addition, there are satellite hospitals within each cluster which are equipped to deal with the

Fig. 2 Assoc. Prof. Lam Chuan Teoh teaching in Sri Lanka.

Fig. 3 Some of the current leaders and pioneers of hand surgery in Singapore.

more common elective and semiurgent hand conditions, such as compressive neuropathies, tendinopathies, and fractures with support from the three main HRM units. In parallel to this is a vibrant private sector that includes exclusively hand surgery group practices. It is foreseeable that the next few decades will see the expansion of our work from a "regional" specialty to a "skills-based" specialty, where "hand" surgeons will be called upon to perform intricate procedures in a myriad of anatomical regions. Many surgeons in Singapore are already actively involved in reconstruction of lower limb defects from trauma, functional limb restoration after resection of tumors, and even hepatic artery anastomoses during cadaveric and living-related liver transplantation. Each year, our graduating trainees pursue further specialized training locally and abroad and bring back the most current innovations, skills, and ideas. It is anticipated that hand surgeons will push the boundaries of microsurgery through development and adoption of super microsurgery and robotic microsurgery. We will also see a greater role of hand surgeons in the care of complex issues such as diabetic foot problems, chronic lymphedema, and limb dysfunction after stroke and spinal cord injury.

Hand Surgery in Singapore Survey

In a survey of members of SSHS, 72.7% of the responders aged from 41 to 50 years, while the rest aged older than 60 years. Total 81.8% were male and 18.2% were female. More than 80% are working for public hospitals. Areas of specialties varied between brachial plexus and peripheral nerves, free flaps, congenital hand problems, wrist and arthroscopy, and paralytic upper limb functional reconstruction. Only 9% mentioned that they have patents in hand surgery. More than 70% of the participants mentioned their institutions provide international fellowship. The first, hand surgery fellowship was started in 1980. Numbers of international fellows per year in different institutions ranged from one to four fellows. Nineteen international fellows have been trained so far till 2020 in different fellowship programs within Singapore (►**Fig. 3**).

Participants expected the future of the hand surgery in Singapore to be more recognized by the world and further contribution of hand surgery in more developing countries. They also expected that more innovation and research in hand and microsurgery will grow. Some have expected decrease in incidence of hand injuries with more rise in awareness for safety measures in factories and construction sites.

Conclusion

Hand surgery has gained recognition as a unique specialty crossing orthopaedic surgery, plastic surgery, general surgery, neurosurgery, and microsurgery. The specialty has rapidly developed and is recognized as a highly developed surgical specialty in Singapore.

The hand surgery fraternity in Singapore now faces the challenge of shifting the focus of care to an aging population, from industrial hand trauma that has declined due to advancement in mechanization and successful implementation of workplace safety policies. With collaboration and innovation, as well as support from local and international partners and the Singapore government, the specialty will continue to flourish and value to the local population and regionally.

Conflict of Interest
None declared.

References

1 Singapore. Wikipedia. Available at: https://en.wikipedia.org/w/index.php?title=Singapore&oldid=984583609. Accessed October 21, 2020
2 Population and Population Structure - Latest Database. Available at: http://www.singstat.gov.sg/find-data/search-by-theme/population/population-and-population-structure/latest-data. Accessed October 21, 2020
3 MOH | Health Manpower. Available at: https://www.moh.gov.sg/resources-statistics/singapore-health-facts/health-manpower. Accessed October 21, 2020

4 History - Singapore Society for Hand Surgery. Available at: http://www.sshs.sg/history.html. Accessed October 21, 2020
5 Pho RW, Pereira BP. Hand surgery. Ann Acad Med Singapore 1992;21(2):193–197
6 Teoh LC. Training and certification of hand surgery as an independent specialty. Ann Acad Med Singapore 1995;24(4, Suppl):1–2
7 Sim WP, Ng HJ, Tan S, Bajaj SL, Rajaratnam V. Scope of hand surgery using surgeon administered local/regional anaesthesia. Ann Plast Surg 2019;83(3):278–284
8 Omar UF, Pei Yein T, Rajaratnam V. Managing hand and reconstructive microsurgery service during COVID-19 pandemic: Singapore experience. Postgrad Med J 2020;96(1137):379–383
9 Wicks L, Noor S, Rajaratnam V. Altruism and medicine. BMJ 2011;343:d4537
10 Cheok S, Dong C, Lam WL, Gollogly J, Rajaratnam V. A model for surgical volunteerism: a qualitative study based in Cambodia. Trop Doct 2020;50(1):53–57

