

Report of the BSSH Stack Travelling Fellowship 2017

Peripheral Nerve Injuries: East Meets West

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A) Introduction

Hugh Graham Stack was a pioneering founder of the British Society for Surgery of the Hand. He was instrumental in the formation of the Second Hand Club and in the birth of *The Hand* that later became the Journal of Hand Surgery (British volume). He was the President of our Society in 1973 and became the President of the International Federation of Societies for Surgery of the Hand in 1978. The Stack fellowship was named in recognition of the many contributions he had made to the development of hand surgery in the UK.

I am honoured and grateful to the Society for awarding me the Stack travelling fellowship for the year 2017. The theme of my fellowship was on peripheral nerve injuries (PNI). I visited centres of excellence in the USA and Far East, in order to learn the most advanced techniques of brachial plexus surgeries. The centres were specifically chosen to allow me to study the similarities and differences in the clinical approaches between the West and the East. In addition, I visited other PNI units in the UK in order to gain understanding of the national standards of care for patients with PNI and also to learn from the other experts in the country in their management strategies of PNI. This report is the summary of my experiences and insights gained from the fellowship.

B) United States of America

Barnes-Jewis Hospital, Washington University at St Louis

My first stop was to visit Professor Susan Mackinnon and her team (Amy Moore, Ida Fox and Thomas Tung) at Barnes-Jewis Hospital. She explained to me the importance of basic science research and how they are translated into her surgical practice. Every Monday morning starts with the laboratory meeting where surgeons and scientists report their ongoing research activities and new ideas are generated.

I observed in her clinic and discussed management strategies of a wide variety of PNI. Some notable cases seen in the clinic included gunshot injury to the upper plexus, schwannoma involving C5/6 roots, lower roots brachial plexus injury (BPI) post-nerve transfer (brachialis to anterior interosseous nerve), thoracic outlet syndrome, sciatic nerve palsy following hip arthroplasty, and scapular fracture associated with upper trunk palsy. Scratch-collapse test¹, popularised by Dr Mackinnon, remains controversial among nerve surgeons. I declared myself as an adopter of the test to supplement my overall clinical assessment and shared my experience of using the test in localising entrapment of long thoracic nerve (LTN).²

Having watched many of her surgical videos online (www.passioeducation.com), it was a unique experience observing in person how she expertly performed a double fascicular nerve transfer for elbow flexion and another case of submuscular ulnar transposition. In theatre, I also observed Dr Ida

fox (Figure 1) perform a medial pectoral to axillary nerve transfer³, and observed Dr Amy Moore (Figure 2) reconstruct a high ulnar nerve defect with sural nerve grafting followed by distal AIN transfer⁴ as well as side-to-side (median-to-ulnar) sensory transfer. The team are constantly expanding the application of nerve transfers and Dr Fox very generously shared with me her insights on the assessment, timing and choice of nerve transfers for tetraplegia.⁵



Figure 1 (Ida Fox second from right)



Figure 2 – Author and Amy Moore



Figure 3 – Author with Dr Mackinnon and her husband, Dr Patterson, a renowned Thoracic Surgeon

To conclude my stay in St Louis, Dr Mackinnon very kindly invited me to her house for a dinner with her family (Figure 3) and shared with me many more stories of nerve surgeries.

Mayo Clinic, Rochester

My next stop was to visit Drs Allen Bishop and Alex Shin at Mayo Clinic (Figure 4). They have a unique set-up where every BPI patient is assessed by Drs Bishop, Shin and Spinner in a multi-disciplinary clinic. In the clinic, I saw patients with BPI for acute assessment, long term follow-up of free gracilis transfer, and application of MyoPro exoskeleton device to assist motion. This is suitable for early phase training when there is only M1 or M2 power which could be augmented to M4 or even M5. This could also serve as a potential solution for those with suboptimal elbow recovery.



Figure 4 – Author with Drs Bishop and Shin and their current fellows at the outpatient complex

The teamwork continues into the operating room. I was impressed by the seamless contributions by each of Drs Bishop, Shin and Spinner in a posterior cord

reconstruction with sural nerve grafting and ulnar fascicle to triceps branch nerve transfer. I also saw coverage of a gunshot wound in the hand with a free gracilis transfer.

I have had some experience in using nerve transfer for peroneal palsy after knee trauma^{6,7} and appreciated the opportunity to learn about their observation of fatigability encountered in this group of patients. In a morning departmental meeting, I presented my experience of treating LTN palsy (Figure 5) and had the most stimulating discussion with Dr Bassem Elhassan regarding our differing approach to this condition.

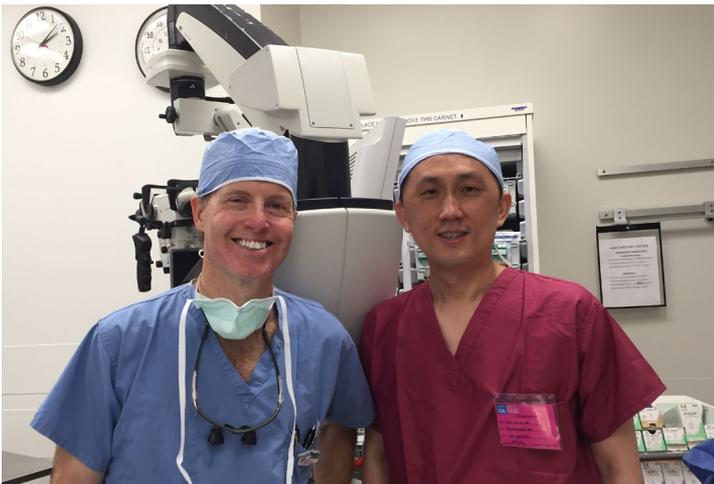


Figure 5 – Author presenting at a meeting at Mayo clinic

Whilst I was at Mayo, I also attended the brachial plexus cadaveric course which allowed me to interact with numerous expert nerve surgeons in a short space of time. Ample time was allocated for case discussion and the friendly environment of the course was particularly conducive for learning.

Hospital for Special Surgery, New York

My last stop in the States was to visit the oldest orthopaedic hospital in the country - Hospital for Special Surgery (HSS) at New York, which was established in 1863. I visited Drs Scott Wolfe and Steve Lee who were incredibly generous with their time and knowledge (Figures 6-7).



Figures 6 & 7 – Author with Dr Scott Wolfe in operating room and author with Dr Steve Lee in outpatient clinic

In the operating room, Dr Wolfe demonstrated superficial radial nerve end-to-side transfer to the median nerve (Figure 8) as a pain relief procedure for a patient who had sustained upper roots BPI.⁸ In the outpatient clinic, we saw a patient with suspected hereditary neuralgic amyotrophy that stimulated an interesting discussion about our approaches to this enigmatic condition. Dr Wolfe has been employing advanced MR neurography to visualise potentially diseased nerves. He shared with me the images that could be produced using their yet-to-publish MRI algorithm. I was blown away by the reconstructed picture where the whole length of LTN could be seen in a single image, akin to a 3D reconstruction.

He also showed me a case of suprascapular nerve palsy where the entrapment could be clearly demonstrated at the suprascapular notch. This facilitated a targeted neurolysis, which was followed by clinical recovery. Spontaneous hourglass nerve constrictions may help to account for some of the non-recovering neuritis cases and we both agree that advances in imaging technology will potentially unravel the mystery.^{9,10}

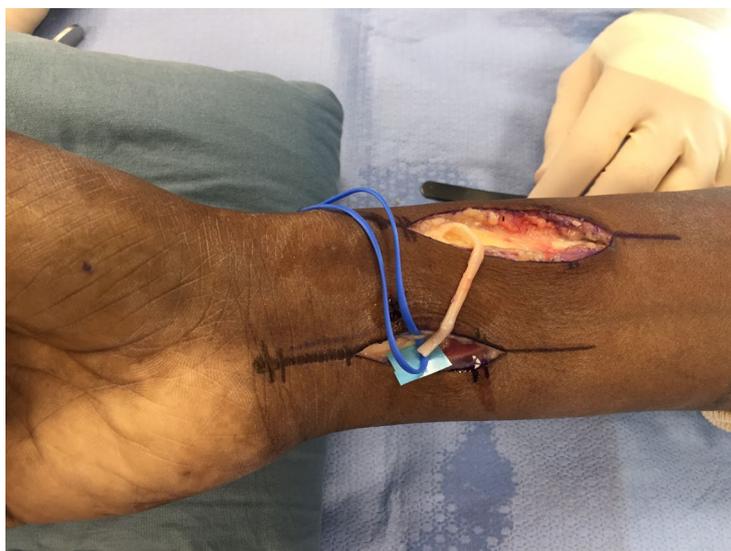


Figure 8 – Superficial radial nerve end-to-side transfer to median nerve for pain relief

Dr Lee and I saw a young male with a devastating open humeral fracture associated with neurovascular injury. The fracture and the brachial artery had been repaired at the referring hospital, but the patient also sustained radial, median and ulnar nerve palsies that required secondary reconstruction. We discussed the role of humeral shortening and the choice of grafts when dealing with massive nerve defects.¹¹

C) The Far East

Huashan Hospital, Shanghai

Huashan Hospital in Shanghai is a Mecca for brachial plexus surgery. There are 8 teams of brachial plexus surgeons in the Department of Hand Surgery, dealing with the enormous workload referred from around the country. I had the fortune to meet Professor Yu-Dong Gu, the grandmaster of brachial plexus surgery in China who is now 81 years old (Figure 9). I read his single-author classic textbook on the treatment of BPI in Chinese and came across the story of the first contralateral C7 (CC7) which he performed in 1986. The patient was a 28-year-old male with pan-plexus injury who also sustained ipsilateral phrenic and spinal accessory nerve palsies and multiple rib fractures. In search of alternative donor nerve, Professor Gu used the healthy CC7. I was particularly intrigued by how he developed the idea. The rationale was in fact well documented in his Chinese textbook but not in the English literature. CC7 nerve transfer was not a discovery by serendipity. Rather, it was prompted by an exceptional case and conceptualised after careful and repeated study of surgical and clinical findings in a large number



Figure 9 – Author with Professor Yu-Dong Gu

of BPI patients. So I co-authored a letter with my colleagues in Shanghai and

shared the story in the European Journal of Hand Surgery,¹² where Professor Gu had first published the clinical outcome¹³ - the story has now come full circle.

My host at Shanghai is Professor Wen-Dong Xu who is also the current President of the Chinese Society for Surgery of the Hand (Figures 10-11). In 2017, their group published the results of a randomised trial of CC7 for spastic arm paralysis in the New England Journal of Medicine.¹⁴ This has challenged our current approach to the treatment of spasticity and heralded a whole new era of central nerve transfer. Professor Xu specifically arranged for me to examine a patient with hemiplegic cerebral palsy before observing the above procedure (Figure 12) in theatre.

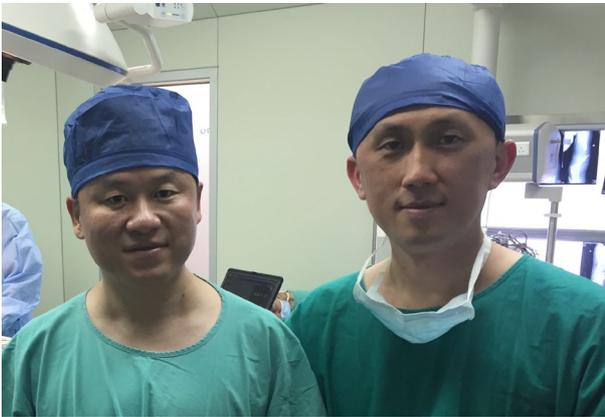


Figure 10 – Author with Professor Wen-Dong

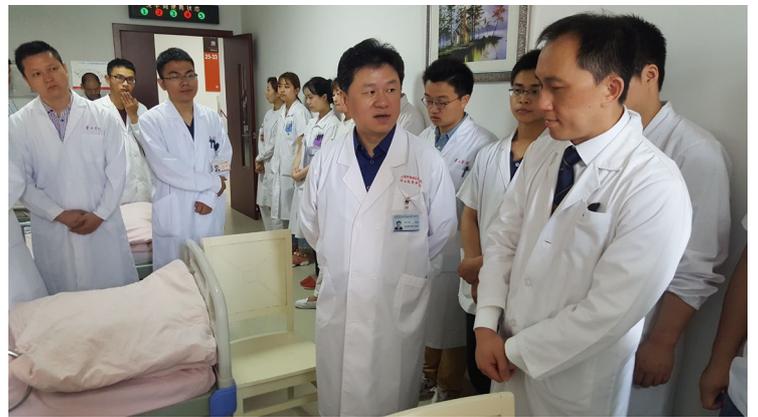


Figure 11 – Author reviewing patients with Prof Xu during a ward round

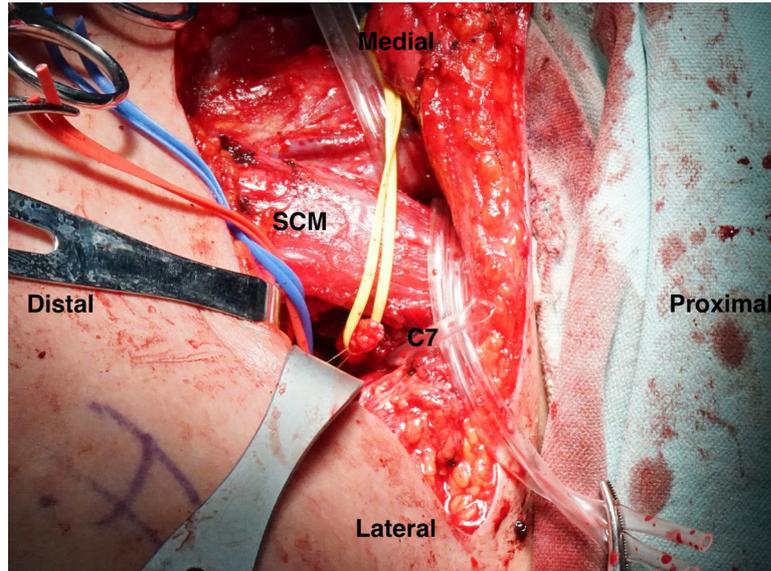


Figure 12 – Collateral C7 transfer for cerebral palsy

Nantong University, Nantong

Before I left Shanghai, I travelled north to visit our Editor-in-Chief, Professor Jin Bo Tang at Nantong University (Figure 13). He shared with me his editorial, research and clinical work. I was particularly impressed by his organisational skills and his attention to details.



Figure 13 – Author with Prof Jin Bo Tang

Jishuitan Hospital, Beijing

I visited Beijing Jishuitan Hospital which is a premier orthopaedic hospital in China. There are some 300 orthopaedic surgeons, including 40 hand surgeons in this 1000-bed hospital. I spent time with Professor Shu-Feng Wang, who runs a very busy brachial plexus and microsurgery practice (Figure 14). On average, he sees about 300 new BPI cases and performs about 500 brachial plexus surgeries a year. The outpatient clinic is packed with patients with total or near-total BPI and I was exposed to a huge amount of clinical signs in a brief period.



Figure 14 – Author with Prof Wang (second from left) and his two talented assistants, Drs Li and Lee

In 2013, their group published the results of CC7 nerve transfer with direct coaptation to the lower trunk in order to restore prehension after traumatic brachial plexus avulsion.¹⁵ Long interposition graft was always felt to be a factor for poor recovery of hand function. In order to avoid the need for graft, Professor Wang developed the technique incorporating extensile mobilisation of the

brachial plexus with or without humeral shortening of the injured arm, and a modified prespinal route of passing donor C7. I had the opportunity to examine a patient with pan-plexus palsy preoperatively and then observe the whole reconstruction in theatre (Figures 15-16).

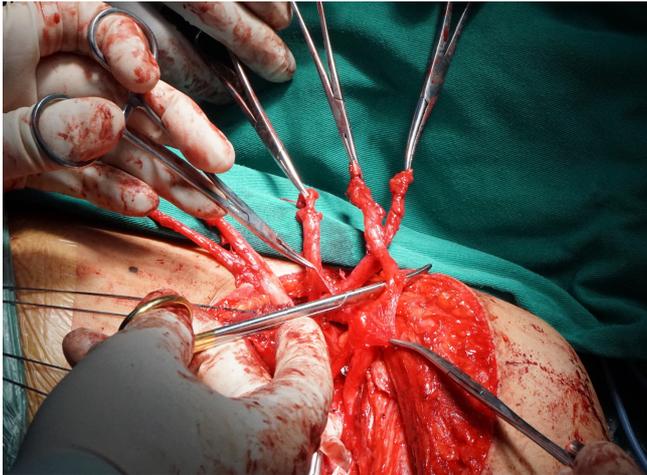


Figure 15 – Full exposure of the brachial plexus

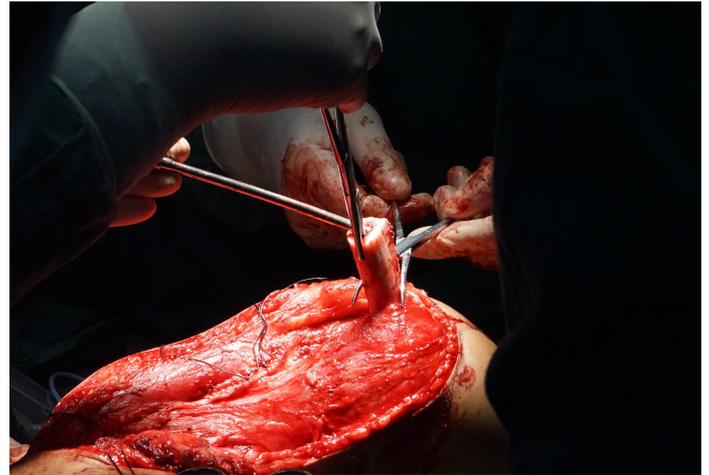


Figure 16 – Humeral shortening osteotomy

The trip to China has truly been an eye-opening experience, both professionally and culturally. At a weekend, I found time to explore the many sights Beijing had to offer and also climbed the Great Wall (Figure 17).

Singapore

As part of my trip to the Far East, I also visited Singapore. Dr Andrew Chin, former President of the nation hand society very kindly organised a lecture tour for the Stack fellow (Figure 18) and I visited the hand units in the three major teaching hospitals in the country, namely National University Hospital, Singapore

General Hospital and Tan Tock Seng Hospital (Figures 19-21). Old friendships were rekindled, and new ones were founded.

Chang-Gung Memorial Hospital, Taiwan

My fellowship year coincided with the renowned brachial plexus live surgery course, convened by Professor David Chuang. This was the second time the course was held in Chang-Gung Memorial Hospital in Taiwan. The course spanned over three days and was filled with key lectures and case discussions. It was a real spectacle with four major brachial plexus reconstructions running simultaneously during each of the first two days of the course (Figure 22). The course was held in November, which was timely for me to consolidate my understanding and to reflect upon what I have learnt over the year.

D) United Kingdom

In order to develop better understanding of the domestic provision of care for patients with PNI, I visited Royal National Orthopaedic Hospital at Stanmore and Leeds General Infirmary. At Stanmore, I spent time with Mr Mike Fox and interacted with Messrs Marco Sinisi, Anthony MacQuillan and Tom Quick. I discussed many cases with Mr Fox and gained understanding of their referral pathways. At Leeds, I spent time with Miss Grainne Bourke. The establishment of Major Trauma Centre and the presence of in-house peripheral nerve expertise in Leeds have facilitated acute assessment and intervention for the poly-traumatised patients with concurrent PNI. The 'all-under-one-roof' level 1 trauma centre is still not available in every major city in the country. We recognise that the provision

of care for those who require multiple disciplines have become ever more challenging and PNI may face the risk of being overlooked in the presence of multiple injuries.

Despite the national publication of the blue book on the “Management of Nerve Injuries” in 2011 and BOA Standard for Trauma on PNI in 2012, delay in recognition and timely referral of PNI remain an issue in the country. Future provision of care for patients with PNI in the UK will rely upon the continuous development of trauma network and closer collaboration between trauma surgeons and peripheral nerve surgeons.

E) Personal Achievements

The travelling has provided a platform for international collaborations. Together with my colleagues in China, we have published two articles related to CC7^{12,16} and we have a Hand Clinic article due for publication in 2019.¹⁷ In the same year, I also co-authored a book chapter on “Nerve Problems around the Shoulder” for a major textbook.¹⁸ In addition, I taught in cadaveric courses in China and delivered multiple lectures. I was subsequently invited back as a keynote speaker in the Chinese Orthopaedic Association congress in 2017 and delivered a lecture titled, “Management of Iatrogenous Nerve Injuries”.

F) Conclusions

Through the Stack travelling fellowship, I have deepened my understanding of the functional and surgical anatomy of the brachial plexus and

peripheral nerves. I have developed insights into the varying approaches of the management of PNI from different centres in the world. PNI can be devastating leading to permanent loss of function and chronic pain. The knowledge and skills gained during this fellowship will undoubtedly help me improve the care for this challenging group of patients. In addition, I have also established important professional networks with other PNI Units in the UK and in the world, which has laid the foundation for future scientific collaborations.

Perhaps, one of the most important lessons that I have learnt relates to *blind spots*. Due to different training systems, cultural barriers, local referral practice, and sub-specialisation, everyone of us, as surgeons, will have blind spots in our knowledge and experience. By the virtue of a blind spot being a blind spot, it is invisible. However, by comparing our visual fields with that of our colleagues in different sub-specialties, and in different countries, we will start to see the margins of our blind spots. It is only after we recognise the limitation in our knowledge and skills, can we then focus our learning and hopefully reduce the size of our blind spots.

Acknowledgement

I would like to acknowledge BSSH for the prestigious award. I am thankful to my colleagues for covering my duties when I was travelling. I am forever indebted to my hosts who have shared with me unreservedly their knowledge and cases, and who have inspired me to emulate their dedication and passion. Last but not least, I am grateful to my beloved wife who provides the unwavering support in my pursuit of surgical excellence.

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