To Repair, Reconstruct, Replace & Reduce
Upper Limb Injuries Amongst Other Orthopaedic Problems

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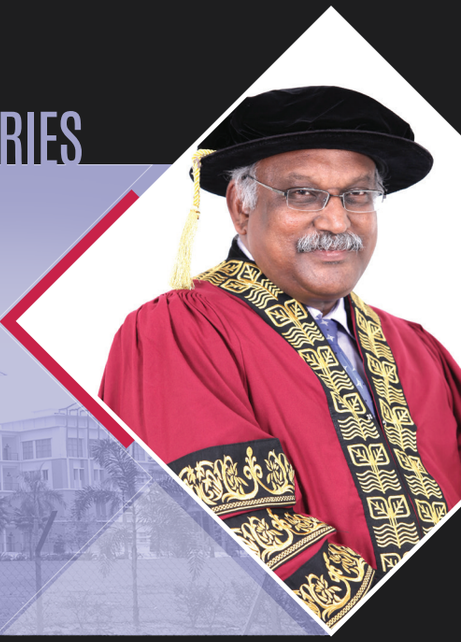

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ABSTRACT

Injuries of the limbs are very common from many different causes, and can be devastating to the patient as it may lead to a range of functional deficits which unless managed properly, can result in death or loss of the limb. Injuries to the limb can be treated by skilful neglect or by performing various surgical procedures, ranging from simple debridement to complex reconstructive procedures or replacement of the defective part. Challenges in treating limb injuries include limited availability of operating theatre time for general anaesthesia, but for hand injuries this can sometimes be overcome by using local anaesthesia. Although there are problems with the use of local anaesthesia, there are ways to resolve these problems. The injured limb is often swollen, obscuring landmarks which locate the site of surgical incision. Sometimes direct repair of the injured part may not be possible, and the use of parts harvested from the patient may be required. It is important to know if the length of the harvested parts is adequate, and this can be estimated using a mathematical formula. The outcome of the treatment also has to be assessed to determine if the patient has improved following treatment.

While injury can be caused by accidents, it can also be the result of improper use of a daily object, improper posture, and repetitive use of office equipment. Although rare, injuries can also be inflicted by the patient for various reasons. These self-inflicted injuries can mimic other pathological conditions, and could lead to a wrong diagnosis if not recognized. Injuries can also result in ganglion cyst, a benign condition which can occur in rare locations such as the proximal interphalangeal joint. Besides that, injuries from plant thorns and cat bites can result in fungal infections whereas squamous cell carcinoma of the nailbed is believed to be related

to preceding trauma. Injuries that occur at the office are usually musculoskeletal disorders and can be prevented by proper measures. Exercises can help prevent and treat musculoskeletal disorders.

Joints that cannot be repaired need to be replaced using joint prosthesis and the commonly used joint prosthesis are for the knee and hip. The use of different materials and configurations can affect the rate of wear and tear as well as loosening of the prosthesis. Meanwhile, understanding of the forces acting on the femoral femur bone is essential in developing a good prosthesis for the hip, whereas finite element analysis is used to study the stress acting on the bone.

While the treatment of injuries is important, the prevention of injuries should be given just as much attention and importance. Injuries caused by motor vehicle accidents can be prevented by understanding the injury mechanism and by developing preventive strategies. This may be aided by the use of computer simulation using finite element models and crash test dummies which can help in understanding the mechanism of injury and designing better safety devices. Hence the study of limb injuries and musculoskeletal disorders is diverse in its requirements for solutions that range from treatment as well as prevention.

INTRODUCTION

The Orthopaedic surgeon is often faced with various challenges especially when dealing with injuries to the limbs. The problems associated with injuries are loss of limb and loss of function. When the thumb is lost as a result of an injury, 40% of the hand function is lost. Injuries to the limb can occur due to various causes, including industrial accidents, farming accidents, home accidents, motor vehicle accidents, sports injuries and assault occurring during criminal activity. Many structures can get injured, and bones, blood vessels, nerve, tendons and muscles are usually damaged. The damaged structures need to be repaired; for example, a fracture needs to be reduced and its alignment needs to be maintained by either a Plaster of Paris cast, an external fixator or an internal implant. Blood vessels need to be anastomosed, nerves coapted, and tendon and muscles must be sutured. Sometimes the injured structures cannot be repaired and hence need to be reconstructed, usually with locally available tissues. If these are lacking, then the structures must be obtained from cadaveric tissues. A good example is the use of available tendons for tendon grafting and tendon transfer. Other examples include the use of the sural nerve as a cable graft. Also, part of a functioning nerve can be transferred to a non-functioning nerve while bone loss can be restored by lengthening the bone. Severe injuries of the joint can lead to early osteoarthritis and loss of mobility. Joints such as the hip and knee can be replaced. The articular surfaces of these joints are replaced by two metal surfaces with a polyethylene insert in between. Treatment of these injuries are not straightforward and are often plagued with many problems which need to be solved by research. Many of these injuries especially industrial injuries and motor vehicle injuries can be prevented by properly adhering to the safety rules and regulations. There is a need for further improvement in the

design of safety mechanisms for industrial machinery and farming equipment. New safety devices for motor vehicles should be also be designed to minimize injury resulting from motor vehicle accidents.

CAUSES OF UPPER LIMB INJURIES AND MUSCULOSKELETAL DISORDERS

Work Related Hand Injuries

One of the commonest injuries seen at Hospital Serdang is work related hand injuries. The incidence of work related hand injury is 47.3% (Al Husuny et al, 2012). The disability and diminished productivity as a result of Work-Related Hand Injuries (WRHIs) will have an impact on the socioeconomic status of the worker, worker's immediate family and related companies, as well as the surrounding community. We investigated the prevalence of Work-Related Hand Injuries (WRHIs) and factors associated with it over a six month period in 2010 at a tertiary government hospital. Data was collected using a pre-tested validated questionnaire and subjects included those who had work related hand injuries and above 18 years of age. Data was analysed using SPSS version 18. The incidence of WRHI among the study subjects was 24.9%, of which 47.3% of them had severe injuries involving the hand. The mean age of the respondents was 30.36 (± 9.54SD) years. Most of the injuries (82.5%) occurred between Mondays to Fridays. Majority of the hand injuries (70.1%) were due to injuries caused by machines and 48.6% of the hand injuries occurred when the hand was trapped in the moving part of the machine. Majority (62.1%) of the workers had injuries to the fingers while the remaining 32.4% had open fractures. Based on bivariate analysis there was significant association between severity of WRHIs and locations

of injury, mechanisms of injury, sources of injury and sectors of industry ($p < 0.05$). Meanwhile logistic regression analysis showed that WRHIs was significantly associated with source of injury and sector of industry. Injuries to the hand that occurred while operating on a mechanical machine was 26 times more likely to be severe compared to those occurring from other sources like sharp tools, heavy doors, and wet floors. Metal-machinery industry workers were eight times more likely to report severe WRHIs than workers from other sectors of industry like wood-furniture, construction, food preparing, service and automotive.

WRHIs can be very severe and may result in loss of limb. Severed limbs can be reattached using microsurgical techniques, however multiple factors play a role in determining whether this can be successfully carried out. For example, if the machine is very sharp, the limb is cut with minimal tissue loss and therefore is likely to be suitable for reattachment; whereas in a chain saw injury the zone of injury is wider and therefore reattachment may be less successful. The fingers may be totally crushed especially when crushed by a printing press machine and severely crushed injuries may end up with amputation. The use of mechanical machines should only be done by well- trained workers and adequate duration of training should be given before allowing the workers to use the machines. There is a need for special protective mechanisms to be set up to prevent injuries to those working in metal-machinery industry.

Figure 1 Patient with work related injury to the hand
(From personal collection)

Oil Palm Harvesting Related Injury

The oil palm industry is an important income generator in Malaysia and injury to the limb can also occur while harvesting oil palm fruits. The weight of the fresh fruit can range from a few hundred grams to 20 kg, the weight being dependent on the age of the palm tree. A 20 year old tree can produce fruits weighing as much as 15 kg and above. The weight of the palm oil fruit and the height of the tree can contribute to the mechanism of injury. Older palm oil fruit trees are higher, and therefore bearing in mind the weight of the palm oil fruit, the higher the tree the more the force created by the falling fruit. A falling palm oil fruit can cause brachial plexus injuries as the forces acting on the shoulder can be so great that it may cause avulsion of the roots of the brachial plexus. This injury is more prone to occur while harvesting the palm oil fruit from an older tree because it is much taller compared to the younger ones. Palm oil trees can grow up to a height of 18 feet, and palm oil plantation workers should be made aware of this and the risks associated with it. Tools specially designed should be used to harvest

the palm oil fruit from older trees (which are much taller) to avoid brachial plexus injuries. Brachial plexus injuries caused by falling palm oil fruit while harvesting palm oil fruit can be easily prevented.

Figure 2 Worker harvesting palm oil fruit

Figure 3 The palm oil fruit
(*Source:* **Arumugam** M & Tamrin, 2014)

We treated a 20-year-old man who had injured his left brachial plexus while he was harvesting fresh fruit bunch (FFB)(Arumugam & Tamrin, 2014). The palm tree was only 5.5-meter-high indicating the age of the tree to be between four to five years old and the approximate weight of the FFB was between 10 to 20kg (Figure 2). The harvester used his existing tool to harvest the fruit and as he had to stand right below the fruit to harvest it, the FFB which was cut fell on his left shoulder (Figure 3). Immediately after that he experienced reduced sensation of the left upper limb and inability to move his left upper limb. There was no head injury. Referral to a specialist was done about 6 weeks after the injury The MRI findings were reported as traumatic avulsion of C5-T1 nerve roots. He had sustained a pan global brachial plexus injury. He could not flex his elbow and his left upper limb was wasted (Figure 4.). Neurotization of nerve to biceps was done using the sural nerve as a graft. The suprascapular nerve was also neurotised using the spinal accessory nerve. Approximately one year four months after the procedure, he recovered his ability to flex his elbow to 90 degrees and the muscle power of the biceps was Grade 3 (Figure 5). The shoulder was not subluxed and the sulcus sign was negative. There was no recovery in the other muscles however.

Figure 4 The patient with wasting of the left upper limb muscles
(*Source:* Arumugam M & Tamrin, 2014)

Figure 5 Showing the patient flexing his left elbow following surgery
(*Source:* Arumugam M & Tamrin, 2014)

Brachial plexus injury can be treated by various procedures. The success rates however depend on various factors. New harvesting tools should be designed to avoid brachial plexus injury occurring during harvesting of palm oil fruits.

Another common injury is the palm oil thorn injury. It is rather nasty and can cause chronic pain and swelling if not removed. The thorn is usually not detectable on X-ray but can be detected using ultrasound (Figure 7). Early removal and debridement of the wound will result in relief of pain and swelling (Figure 8). The inflammatory reaction has been attributed to the toxin in the palm oil thorn and occasionally steroids may be required to reduce the inflammation. More work needs to be done in this area to develop an antitoxin for the toxin found in the palm oil thorn. It will certainly help to reduce the severe inflammatory response seen after being pricked by the palm oil thorn. This will enhance the healing process and minimise the functional loss seen after injury caused by palm oil thorn.

Figure 6 The swelling over the PIP joint of the right middle finger
(From personal collection)

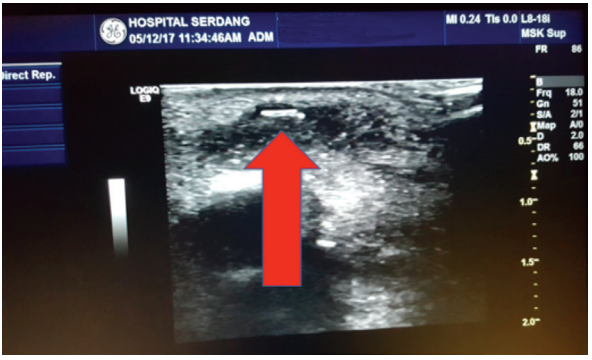


Figure 7 The ultrasound image of the palm oil thorn (red arrow)
(From personal collection)

Oil palm thorn injuries can easily be avoided using appropriate protective gear. Proper gloves with thick material should be used, and although the use of gloves may be cumbersome, it protects against the sharp oil palm thorns. Early treatment will prevent complications such as infection, pyogenic flexor tenosynovitis and stiffness of the joint.

Figure 8 The surgical debridement and removal of a palm oil thorn
(From personal collection)

Motor Vehicle Accidents

Motor vehicle accidents can result in serious injuries like brachial plexus injuries whereby the function can be restored by surgery. We studied the outcome of the Oberlin procedure in patients with C5-C6 brachial plexus injury treated at the Hand & Microsurgery Department, Selayang Hospital between 2000 and 2004 (Arumugam & Pathmanathan, 2005). These patients sustained injury to the brachial plexus as a result of motor vehicle accidents. They were not able to flex their elbow. We performed the Oberlin procedure on these patients. The nerve fascicle from the ulnar nerve was transferred to the nerve to biceps which is a branch of the musculocutaneous nerve. This transfer can only be done if the ulnar nerve is functioning well. The transfer of the fascicle from the ulnar does not cause any functional deficit; most of the patients had good and useful recovery of elbow function. Transferring part of the ulnar nerve fascicle to the nerve to biceps (Oberlin procedure) is useful in restoring elbow flexion. In our study too, we found that elbow flexion can be restored in patients with upper trunk brachial plexus lesions using the Oberlin procedure. However patient selection is important to ensure a satisfactory outcome.

Figure 9 The incision over the inner aspect of the arm
(From personal collection)

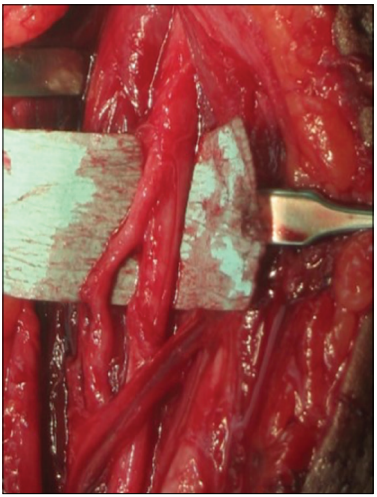


Figure 10 The nerve to biceps branching out from the musculocutaneous nerve
(From personal collection)

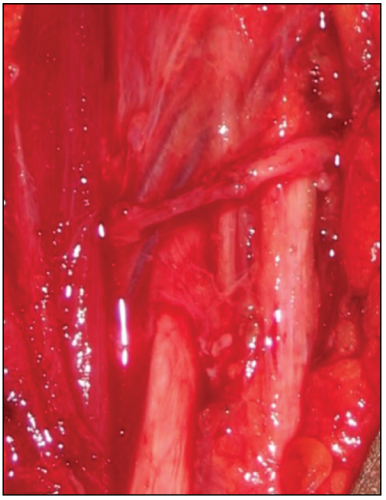


Figure 11 Neurotization of nerve to biceps using a fascicle from ulnar nerve
(From personal collection)

There will be no functional deficit in the muscles supplied by the ulnar nerve. However there may be some temporary numbness in the areas supplied by ulnar nerve which will recover. The neurotization is done using fine sutures with or without fibrin glue. Usually recovery of biceps muscle function can be as early as 2 months.

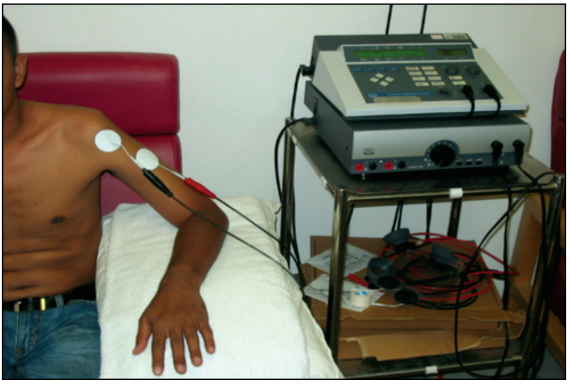


Figure 12 Patient undergoing muscle stimulation therapy

Figure 13 Patient is able to flex the elbow up to 90 degrees with 5kg weights
(From personal collection)

Motor vehicle accidents can result in serious wrist injuries (Husin,P et al., 2012). One of the most dreaded injuries to the wrist is dislocation of the radiocarpal joint, which can be easily missed by an untrained person. Awareness of this type of injury is very important however, ~~as~~ it can be difficult to treat, especially if delayed. This is because the reduction of the dislocated radiocarpal joint can be difficult when there is overgrowth of fibrous tissue. Hence early diagnosis and reduction of the dislocated joint is one of the factors responsible for a good outcome.

For the patient with the dislocated radiocarpal joint (as shown in Figure 14 and 15), we treated the injury by open reduction and reconstruction of the radiocarpal ligaments and dorsal intercarpal ligaments using anchor sutures.

Figure 14 Lateral view of the wrist joint with dorsal dislocation of the carpal bone
(from Husin, P et al., 2012)

Figure 15 AP views of the wrist with dislocation of the radiocarpal joint
(from Husin, et al., 2012)

Home Accidents

Occasionally, we do see injuries because of home accidents resulting in dislocation of multiple joints (Rashdeen et al., 2005). We reported an unusual case where both the metacarpophalangeal and carpometacarpal joints of the thumb in an eight year- old child were simultaneously dislocated. It is very rare to get dislocation of two joints simultaneously especially in a child. She presented to the Emergency department with a painful thumb after her sibling accidentally stepped on her hand. Closed reduction was unsuccessful. We were however able to reduce the joint by doing an open reduction through a dorsal incision. The metacarpal head was found to have pierced through the anterior capsule and prevented the reduction of the metacarpophalangeal joint. We concluded that dorsal dislocation of the metacarpophalangeal joint in a child can be treated by open reduction via dorsal approach.

Compression of the Lateral Cutaneous Nerve

Injury to the nerves can also occur in a subtle manner. Carrying a heavy hand bag or shopping bag can indirectly cause injury to the lateral cutaneous nerve of the forearm (LCNF) by compression.

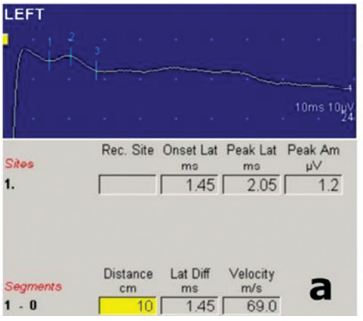
Figure 16a Area of sensory deficit (dorsum)

Figure 16b Area of sensory deficit (volar)

(Figures above from Arumugam, et al., 2013b)

We encountered a patient who had sensory deficits along the forearm typical of LCNF compression or injury. A 50-year-old Indian housewife presented with discomfort involving the left forearm for 6 months (Manohar et al., 2013b). She did not have any preceding trauma neither was there any invasive procedure that was carried out that coincided with or preceded the symptoms onset. She was not involved in any sporting activity that required the use of her elbow. On clinical examination, there was sensory deficit along the anterolateral border of the forearm (Figures 16a and b). She did not have any tenderness or weakness, and had full range of motion. The rest of the neurological and joint examinations were normal, and there was no evidence of cervical spine problem. A nerve conduction study (NCS) was performed and it showed a decreased sensory nerve action potential (SNAP) of the LCNF (left 1.2 μV, right 3.3 μV) (Figure 16a & b). Needle electromyography

(EMG) was normal. A diagnosis of sensory neuropathy of the left LCNF was made based on these findings. She was referred to the physiotherapist and she recovered unremarkably within six weeks. She was absolutely pain free with complete resolution of her symptoms. Entrapment of cutaneous nerves should be considered in cases of patients with abnormal pain in the upper extremity especially when there is no history of trauma to the affected limb. The use of NCS is very useful to diagnose such conditions.



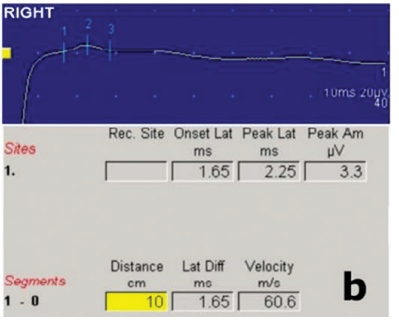


Figure 17a NCS Left LCNF **Figure 17b** NCS Right LCNF

(Figures above from Arumugam et al., 2013b)

The lateral cutaneous nerve of the forearm (LCNF) is also known as the lateral antebrachial cutaneous nerve. It is a sensory nerve which innervates the anterolateral aspect of the forearm. It is the terminal branch of the musculocutaneous nerve and traverses the anterior compartment of the arm anterolaterally between the biceps and brachialis. It exits the arm 2 to 5 cm proximal to the elbow flexion crease lateral to the biceps tendon by piercing the brachial fascia, it is at this point that the LCNF gets entrapped. The nerve then runs volar to the cephalic vein, as it travels down the forearm to the wrist along its radial border. At the wrist, the nerve lies volar

to the radial artery and then runs distally towards the ball of the thumb. Majority of the cases of neuropathy involving the LCNF are usually non-traumatic in origin. The neuropathy can be caused by irritation of the nerve from repetitive vigorous activity around the elbow where the nerve is fixed by the fascia and compressed by the biceps tendon at its lateral edge. Iatrogenic injury of this nerve can also occur during venipuncture of the cephalic vein. The needle or cannula may cause injury to this nerve because of the proximity of this nerve with the cephalic vein. Diagnosis of this condition may be difficult. Since this is nerve is purely sensory and there is no motor deficit it may be under recognized.

Self-inflicted Injuries

Injury can sometimes be deliberately caused by the patient for various reasons, and these can range from workman's compensation to psychiatric disorder (Manohar & Azhar, 2012b).

Figure 18 Area of affected lesion

Figure 19 Gas shadow in the forearm

(Figure 18 and 19 from Arumugam & Azhar, 2012)

A 17-year-old girl was admitted to the Orthopaedic ward with a history of recurrent ulcers and soft tissue swelling involving her right upper extremity. According to her, the ulcers and swellings were located over the right forearm and hand and appeared every fortnightly and resolved within in a week. There was no involvement of the arm however. There was no history of associated systemic symptoms. She had only minimal pain limited to these lesions. Upon clinical examination there was a swelling and a small ulcer on the dorsum of her right hand. On palpation, crepitation could be felt over the affected lesion (Figure 18). Laboratory investigations were presented as all normal. X-ray results revealed gas shadow in the forearm (Figure 19). In view of these findings, a course of antibiotics was prescribed to the patient and she was asked to come for follow up a week later. During the follow up visit, the swelling around the lesion had subsided, and there was no concrete evidence to support a diagnosis of gas gangrene. The location and pattern of the lesions highly suggested that it was caused by needle-pricks. A thorough evaluation showed no connection between the affected limb with the digestive and respiratory systems, taking into consideration all these findings, suspicions were raised regarding the factitious nature of the emphysema. According to the patient's mother, the patient had difficulty attending school and had arguments with the family. As the patients' mother was a nurse and her father was diabetic, syringes were easily accessible at her home. The right upper extremity was affected, and this could be easily reached as the patient was left handed. We also observed that the patient appeared to be depressed, so she was referred to a psychiatrist for further evaluation. A diagnosis of factitious dermatitis was made. Self-infliction should be suspected when the patient presents with unexplained recurrent subcutaneous emphysema. Punctuate marks should be looked for. The exact cause of factitious disorder is unknown. It may

occur due to a combination of psychological factors and stressful surroundings. Voluntary control of the affected person's behavior is possible. The full sequence of their factitious illness is schemed by the patient. As in obsessive-compulsive disorder, patients may accept the behavior but cannot control it. A significant etiologic role is rejection and childhood deprivation, and the personality of these individuals shows a vulnerability to life events. Although the actual prevalence of this condition is not known, the diagnosis of factitious disorder should be carefully considered when a thorough investigation fails to explain the patient's symptoms. It is important to recognize this disorder to prevent the person from deceiving medical personal and claiming compensation for their condition. They should not be scolded or told off, but instead gradually counselled. There is no role for any surgical intervention as this will be unnecessary and will not cure this condition. This diagnosis is made after careful exclusion of other conditions to avoid complications that may arise from an incorrect diagnosis. Careful evaluation by an experienced psychiatrist is extremely important and is essential before considering the diagnosis of factitious dermatitis.

Office Workers

Poor posture, use of incompatible office furniture and overuse of computer can lead to musculoskeletal discomfort. The prevalence rate of musculoskeletal discomforts based on severity levels among office workers were studied (Shariat et al., 2016a). The main aim of this study was to determine the prevalence rate of musculoskeletal discomforts based on the severity among office workers. This study included office workers with ages between 20 to 50 years who had at least a year's experience of working with a computer. A form of structured questionnaire, known as the Cornell questionnaire was used. The findings of the study showed that 69.7% of the subjects

suffered from at least one of the following symptoms: severe pain in the neck, shoulder or lower back respectively. For neck-related aches, 15% had low pain, whereas 51% had mild pain and 33.9% had severe pain. For low back pain 19.3% had low pain, while 50.7% suffered mild pain and 30% had severe pain. For shoulder 34.9% had severe pain, 45.4% mild pain and 19.7% low severity pain. We concluded that, the subjects are more vulnerable to body aches in the neck, shoulders and lower back compared to body aches in the arms, knees, upper back, forearms, wrists, hands, hips and thigh.

In another study, a systematic review of the literature was done to identify musculoskeletal disorders and how they correlated with physical activity among office workers. Literature databases (Science Direct, PubMed and Scopus) between 2003 and 2014 were searched for the key words 'office worker', 'musculoskeletal disorders', 'neck pain', 'shoulder pain', 'lower back pain', 'physical activity' as well as 'health and field studies' (Shariat et al., 2016b). From the review we concluded that musculoskeletal disorders are a serious problem among office workers, and mainly due to lack of physical activity as well as sedentary lifestyle. To prevent and decrease musculoskeletal pain and discomfort among office workers regular physical activity may help. Most commonly reported musculoskeletal disorders were pain affecting the lumbar spine, neck and shoulder. These disorders affect approximately 80% of the general population at any one point of their life. There are many hypotheses explaining the underlying mechanisms behind office work-related musculoskeletal disorders. Prior research has shown that office workers who do not get up from their desks, and sit for long durations at their workplace show cognitive impairment. Apart from this, they also suffer from disturbed sleep. The office workers may also develop various other conditions such as musculoskeletal disorders, physiological disturbances, psychological problems and medical problems.

Treatment of Musculoskeletal Disorders Among Office Workers

Pain in the neck, shoulder and lower back can be caused by extended periods of sitting and inactivity. A series of stretching and resistance exercises for the upper body and lower body is recommended (Shariat et al., 2016f,g) which do not require the use of any special equipment. The focuses of these exercises are on the lower back, neck, and shoulder areas and the duration of the exercises is short and follow the guidelines of the American College of Sports Medicine.

We published a proposed package of office exercise training to reduce and prevent occurrence of musculoskeletal disorders (Shariat et al., 2016c). The main objective of these office exercises is to decrease the soreness, pain, and degree of discomfort by increasing the flexibility and strength of trunk muscles.

DIFFICULTIES ENCOUNTERED IN TREATING UPPER LIMB INJURIES AND ITS SOLUTIONS

Pain Caused by the Tourniquet Cuff

Operation theatre time under general anaesthesia is often an issue for orthopaedic cases as other cases are given more priority for example intra-abdominal injury and Caesarian sections. One of the options is to do the case under local anesthesia, especially for hand injury cases. As the structures in the hand are minute and require delicate repair, a bloodless field is required. A tourniquet is used to create a bloodless field, but the duration has to be for less than two hours to prevent any ischaemic injury to the limb. Under general anaesthesia, patients do not feel any discomfort during surgery. However when local anaesthesia with tourniquet is used, it causes discomfort to the patient and the degree of tolerance decreases progressively as

the inflation time increases within the two hour limit. We managed to design a dual cuff tourniquet system to reduce the discomfort (Arumugam et al., 2010a). The effect of the 2 alternating cuffs being inflated and deflated enabled the tourniquet cuff to be tolerated longer within the 2-hour limit period.

Figure 20 The double cuff tourniquet being tested in the lab

New Unit of Measurement for Pressure in Newer Tourniquet Machines

The use of tourniquet machines has its own problems. Newer machines are designed using kPa as the unit of measurement of pressure as compared to mmHg for the older machines. This can cause confusion among the users. To familiarize the users with the new system a formula to convert mmHg to kPa was used (Arumugam, 2009).

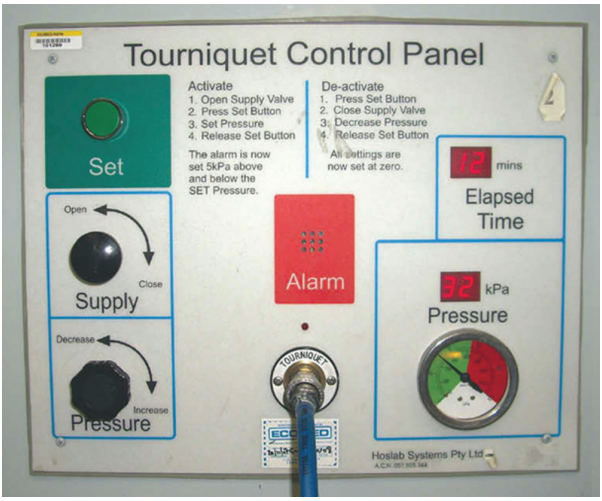


Figure 21 The wall mounted tourniquet machine using kPa as the unit of measurement
(From Arumugam, 2006c)

Conversion of mmHg to kPa:
1 atm = 760 mmHg = 101.325 kPa;
1 mmHg = 101.325/760 = 0.133 kPa;
1 kPa = 760/101.325 = 7.5 mmHg;
atm = atmosphere;
kPa = kilo Pascal;
mmHg = millimetres of mercury.
Example of conversion:
e.g. 200 mmHg = 200 x 0.133 = 26.6 kPa.

Tourniquet Paralysis

The tourniquet is a device used to create a bloodless surgical field, enabling visualization of the anatomical structures during surgical procedures. It is especially useful in the field of hand

and microsurgery, plastic surgery and orthopaedic surgery. If the tourniquet is not properly used it can lead to tourniquet paralysis. To increase awareness among especially paramedical staff, I published an article to highlight the issues with use of tourniquet (Arumugam, 2011). Tourniquet paralysis occurs as a result of pressure on the nerve exerted by the tourniquet cuff, which can manifest ranging from paraesthesia to paralysis. Certain group of patients are more prone to this problem especially obese patients, older patients, patients with hypertension and patients with atherosclerosis. Prevention of tourniquet paralysis is important by following a few essential steps which include checking the pneumatic tourniquet device, the tourniquet inflation pressure, general skin condition, peripheral pulses and the duration it was applied for. A tourniquet cannot be used on the limb of a renal patient with an arterio-venous fistula present for dialysis and extreme care has to be taken if used on sickle cell anaemia patients, to prevent a sickling crisis. The correct tourniquet cuff size should be used, and the tourniquet machine should be calibrated regularly. The tourniquet should not be inflated for more than two hours at any one time; after two hours it should be deflated and used again only after a 20 minute interval to prevent ischaemic injury.

Locating the Flexor Carpi Radialis (FCR) Tendon in Swollen Wrists

Very often the injured hand is swollen. In the case of distal radius fracture, the FCR tendon is a land mark to be used as a guide to make the incision when performing open reduction and internal fixation. In a swollen hand however, it is difficult to identify the location of the FCR, and an easy anatomical landmark to it is the Mano's line (Arumugam, 2012e).

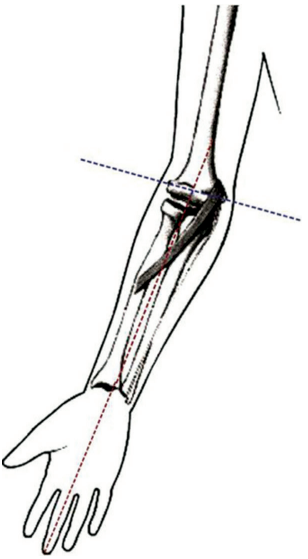


Figure 22 The diagrammatic representation of the line drawn to identify the FCR tendon
(Figure from Arumugam, 2012e).

A line between the lateral and medial epicondyle is drawn. A perpendicular line is then drawn from the midaxial line of the middle finger, with the wrist in neutral position to bisect the first transverse line. In the distal forearm along this line and just proximal to the wrist crease, the FCR tendon can be identified. An incision too medial may injure the palmar cutaneous branch of the median nerve while an incision too lateral may injure the superficial sensory branch of the radial nerve.

Figure 23 The cadaveric dissection to confirm the location of Mano's line
(Figure from Arumugam, 2012e)

Figure 24 The swollen wrist of a patient with a distal radius fracture. The interrupted line shows the midaxial line of the middle finger.
(Figure from Arumugam, 2012b)

Figure 25 The flexor carpi radialis tendon located along the line in the distal part of the wound and diverges ulnarly as we go proximally
(Figure from Arumugam, 2012b).

Estimation of Length of Palmaris Longus for Reconstructive Procedures

In the injured hand the tendons are injured beyond repair. The palmaris longus is often used as a spare part. Palmaris longus is tendon of choice in reconstructive, plastic and cosmetic surgeries. Thus, a suitable length is required, and it would be more convenient if the length of the tendon of the palmaris longus could be estimated before harvesting. We carried out a study to determine the relationship between the length and width of the palmaris longus tendon and the length of forearm and hand, the relationship between the length and the width of the palmaris longus tendon and wrist width and wrist circumference, as well as to identify a technique to estimate the length of the tendinous part of palmaris longus before harvesting it (Manohar & Rampal, 2013). A standardized proforma was used to collect the data of each of the 31 cadaveric

upper limbs. The data was analysed using SPSS software version 17. It is important to note that p value less than 0.05 is considered statistically significant in this study. Out of the 31 upper limbs, palmaris longus tendon was absent in 3 (9.68%). Meanwhile, the mean length and width of the palmaris longus tendon was found to be 16.20 cm and 0.48 cm, respectively. The mean length of the forearm and hand was 26.6 cm and 21.2 cm, respectively. The mean width of the wrist and wrist circumference was 8.2 cm and 14.82 cm, respectively. These indicate a significant and moderate relationship between the length of palmaris longus tendon and the length of forearm ($r = 0.49$, $r\,2 = 0.24$, $p < 0.01$). In addition, there was also a significant relationship between the length of palmaris longus tendon and the length of hand ($r = 0.56$, $p < 0.01$). The length of the available palmaris longus is important as it will enable the surgeon to estimate the amount required. We described a novel method to estimate the length of the palmaris longus tendon by measuring the length of the hand. We can thus estimate the length of the palmaris longus based on the length of hand, as follows: 'y' = 0.55 + 0.73 'x' whereby 'y' is the length of the palmaris longus and 'x' is the length of the hand. For example, if length of hand is 21.3 cm, then the length of palmaris longus tendon = 0.554+ (21.3 × 0.734) = 0.554 + 15.6 cm = 16.19 cm. Thus, if we measure the length of hand and it is 21.3 cm, the approximate length of palmaris longus tendon is 16.2 cm (Manohar & Rampal ,2013).

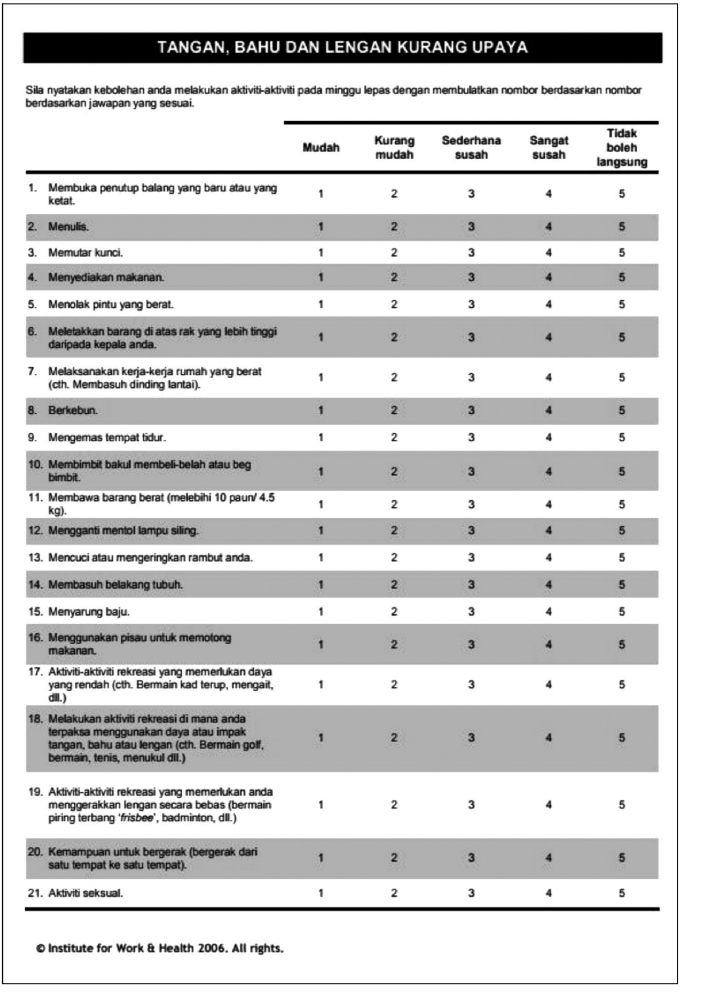
Lack of Instruments in Bahasa Melayu to Evaluate Upper Extremity Disability and Symptoms

DASH

DASH (Disability Arm Shoulder Hand) is an instrument which is self-administered by the patient. The DASH score is the scale for disability/symptom and its shorter version is known as QuickDASH.

It was developed to evaluate upper extremity disability and symptoms by considering the upper extremity as one functional unit. The main portion of the DASH contains a 30-item disability/ symptom scale assessing the patient's health status. The first section is about the degree of difficulty in performing different physical activities in the arm, shoulder, or hand. The next section probes into the various symptoms such as pain, tingling, weakness and stiffness. The patient responds to each item and evaluates the severity of injury. Another additional section is on the effects of these injuries in relation to patient's social activities, work, sleep, and self-image. The patient responds to 5 options for each to each item using the Likert-like scale. Responses are rated between 0 (no difficulty) to 5 (unable). The overall scores for all items ranged from 0 (no disability) to 100 (most severe disability). To assess the outcome of treatment for local patients, the DASH score was translated into Bahasa Melayu. To measure internal consistency reliability, Cronbach's alpha was used. For homogeneity the inter-rater reliability was then carried out. Validation of the questionnaire was done by administering it to 30 patients admitted to the Orthopaedic ward in Serdang Hospital. They commented about various aspects which included language, the ability to understand and the overall format of the Malay version of the DASH (MVDASH). Cronbach's alpha for the overall MVDASH was 0.99, and 0.98 for the physical components. For the symptom and social components were 0.94 and 0.95 respectively. Intra-class correlation coefficient (ICC) was 0.943. The MVDASH had very high internal consistency and Inter-rater reliability. The face validity indicates that the respondents had a good understanding of the questionnaire with regards to language and the overall format. It is now being used as an assessment tool in the clinics (Amir et al., 2011). Translating the DASH score into Bahasa Melayu was a collaboration between UPM and the Institute

for Work & Health, Toronto, Ontario, Canada. With the availability of the MVDASH, it is now easier to evaluate our patients because the questionnaire is in Bahasa Melayu and can be understood by majority of the patients seen in the clinic.



TANGAN, BAHU DAN LENGAN KURANG UPAYA

Sila nyatakan kebolehan anda melakukan aktiviti-aktiviti pada minggu lepas dengan membulatkan nombor berdasarkan nombor berdasarkan jawapan yang sesuai.

	Mudah	Kurang mudah	Sederhana susah	Sangat susah	Tidak boleh langsung
1. Membuka penutup balang yang baru atau yang ketat.	1	2	3	4	5
2. Menulis.	1	2	3	4	5
3. Memutar kunci.	1	2	3	4	5
4. Menyediakan makanan.	1	2	3	4	5
5. Menolak pintu yang berat.	1	2	3	4	5
6. Meletakkan barang di atas rak yang lebih tinggi daripada kepala anda.	1	2	3	4	5
7. Melaksanakan kerja-kerja rumah yang berat (cth. Membasuh dinding lantai).	1	2	3	4	5
8. Berkebun.	1	2	3	4	5
9. Mengemas tempat tidur.	1	2	3	4	5
10. Membimbit bakul membeli-belah atau beg bimbit.	1	2	3	4	5
11. Membawa barang berat (melebihi 10 paun/ 4.5 kg).	1	2	3	4	5
12. Mengganti mentol lampu siling.	1	2	3	4	5
13. Mencuci atau mengeringkan rambut anda.	1	2	3	4	5
14. Membasuh belakang tubuh.	1	2	3	4	5
15. Menyarung baju.	1	2	3	4	5
16. Menggunakan pisau untuk memotong makanan.	1	2	3	4	5
17. Aktiviti-aktiviti rekreasi yang memerlukan daya yang rendah (cth. Bermain kad terup, mengait, dll.)	1	2	3	4	5
18. Melakukan aktiviti rekreasi di mana anda terpaksa menggunakan daya atau impak tangan, bahu atau lengan (cth. Bermain golf, bermain, tenis, menukul dll.)	1	2	3	4	5
19. Aktiviti-aktiviti rekreasi yang memerlukan anda menggerakkan lengan secara bebas (bermain piring terbang '*frisbee*', badminton, dll.)	1	2	3	4	5
20. Kemampuan untuk bergerak (bergerak dari satu tempat ke satu tempat).	1	2	3	4	5
21. Aktiviti seksual.	1	2	3	4	5

Figure 26 The Malay version of the DASH score (Amir et al., 2011)

Lack of Instruments in Bahasa Melayu to Assess the Severity of Musculoskeletal Discomfort

To assess the level of musculoskeletal discomfort among office workers related to their ergonomic situation, the Cornell Musculoskeletal Discomfort Questionnaire (CMDQ) was developed. We translated the Cornell Musculoskeletal Discomfort Questionnaire into Bahasa Melayu and validated it for reliability (Shariat et al., 2016d). The objective of our study was to analyze the validity and dependability of the Malay translation of the Cornell Musculoskeletal Discomfort Questionnaire (Ardalan et al., 2016d). In order to evaluate the accuracy of the original findings, the questionnaire was self-administered two times, with an interval of two weeks with a retest. The number of participants was 115. The range of Cronbach Alpha coefficient showed a considerable consistency of the items for each sub-scale (Cronbach's a>0.95). The range of Kappa coefficients was between (ICC=0.690–0.949, p<0.001), (ICC=0.801–0.979, p<0.001) and (ICC=0.778–0.944, p<0.001) for frequency, severity and interference scales. We concluded that for the evaluation of musculoskeletal discomfort among the office workers the Malay-language version of the CMDQ (CMDQ-M) is reliable and has a high validity.

Accuracy of Different Instruments used to Measure the Severity of Musculoskeletal Disorders in Office Workers

We studied the comparative reliability of different instruments used to measure the severity of musculoskeletal disorders (Shariat et al., 2016e). The aim of our study was to determine the reliability of the Cornell questionnaire, goniometer and Borg questionnaire, all commonly used instruments to assess the severity of musculoskeletal disorders in office workers. 120 healthy office workers, body mass:

87.1 ± 10.3 (kg), age: 27 ± 5.1 (years), height: 1.78 ± 0.16 (m), (mean ± SD), who had at least one year of experience in office working, were chosen randomly. To measure the range of motion in the neck, hip, knee and shoulder area a plastic goniometer (30" height) was used three times, with a period of one hour between measurements to evaluate the test-retest accuracy. To measure the severity of musculoskeletal disorders the Cornell questionnaire was used and to measure perceived exertion the Borg scale was used. The questionnaires were filled out twice with an interval of 2 weeks between measurements. The Inter-class Correlation Co-efficient (ICC) indicated that all instrument sub-scales showed high levels of repeatability. The ICC coefficient was (0.805–0.954, $p<0.001$) for the Borg scale, (0.785–0.978, $p<0.001$) for the goniometer and (0.883–0.975, $p < 0.001$) for the Cornell questionnaire. We concluded that for the evaluation of the severity of musculoskeletal disorders in office workers the Cornell questionnaire, goniometer and Borg questionnaire all exhibit high reliability.

Aseptic Loosening of Femoral Components of the Total Knee Prosthesis

Many badly injured knees will end up with osteoarthritis of the knee. The treatment for severe knee osteoarthritis is total knee replacement (TKR). One of the complications is aseptic loosening of the prosthesis, which is loosening not due to infection but due to wear and tear, the prosthesis causing stress shielding of the bone, and the development of soft tissue at the edge of bone and implant due to comparative motion of prosthesis. It is one of the main reasons for the revision of a TKR. The femoral component is frequently affected. One of the areas to consider is the development of new materials to solve the problem of aseptic loosening. Apart from issues with the material, problems with the design also has

a role to play in causing loosening of the implant. Material and design deficiencies are important in aseptic loosening of TKR. The components of knee implant are required to have some significant material properties in order to prevent aseptic loosening and failure. The femoral component of TKR requires properties such as high strength, low elastic modulus similar to that of bone, good ductility, high corrosion and wear resistance and biological compatibility with osseointegration. Advances in different combinations of materials for bearing surfaces in order to minimize the wear debris, introduction of low modulus materials to reduce the stress shielding effect, and efforts to generate bioactive and/or porous surfaces to enhance the implant fixation are ways to improve the limitations of current materials. The existing metals, ceramics and polymers currently in use are unable to effectively prevent aseptic loosening, and there is a need for developing new biomaterials, alternative combinations of biomaterials, and biomaterials with multi-functional properties. Such materials should simultaneously minimize the wear debris, relative micromotion and stress shielding effects (Bahraminasab, et al., 2012). The application of a new biomaterial and associated engineering design aspects of the femoral component of a TKR can help reduce aseptic loosening (Bahraminasab et al., 2013a, b). The suggested new biomaterial is the functionally graded material (FGM). FGM is made by selectively altering the composition or structure of a material, permitting components to be made with variable properties. This will enable non-uniform properties to be integrated into mechanical components and allow numerous functions to be performed without difficulty by single components. The existing femoral components are composed of a solitary material, usually Co–Cr alloys, with a coating layer, which basically provide uniformity in composition and structure. In an FGBM component, the configuration and structure are changed from a high wear resistant ceramic such as alumina at the bottom of the

component and to a low modulus material with good bonding at the top of the component, by increasing the concentration of metal (e.g. Ti) and porosity, at the top of the component.

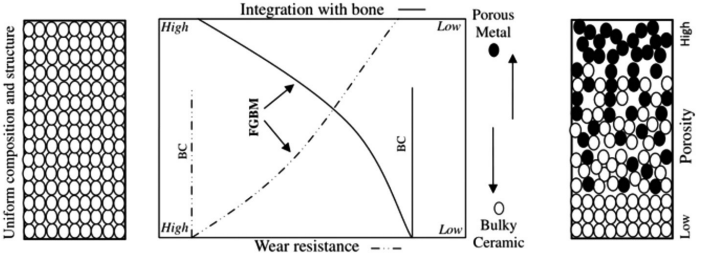


Figure 27 Properties of functionally graded biomaterials (Bahraminasab et al., 2013b)

The ensuing material retains the characteristics of a prosthetic femur without any abrupt changes caused by the creation of a separate boundary (Marjan et al., 2014b). The likely advantages of applying functionally graded biomaterials (FGBMs) in prosthetic femur are brought about by reducing the important causes of failure including wear, micro-motion and stress-shielding effect. In designing a knee prosthesis, the type of implant bearing is a crucial factor as it can affect aseptic loosening of the femoral component. The use of a stem is desirable to condylar pegs because it is not as invasive and affords guides for prosthesis insertion (Bahraminasab, et al., 2014a).

Stress Shielding Effect of Femoral Components of the Total Knee Prosthesis on the Femoral Bone

We did a finite element study on the effects of shape memory alloy on the stress distribution and contact pressure in total knee replacement (Bahraminasab et al., 2011). As a phase towards

developing a biomaterial for femoral component of total knee replacement, we aimed to introduce NiTi shape memory alloy as a hopeful material for orthopedic implant and to assess the effect of different material properties on contact behavior of the joint and stress distribution of the femoral bone using finite element analysis. Two separate analyses using finite element analysis were performed. Under static loading conditions one analysis was done with rigid bones and the other analysis with deformable femur, at 0 degree of flexion angle. The analysis revealed no difference between the countless materials with regards to the peak contact pressure but considerable variance with regards to the Von Mises stresses. The findings from the study also showed that stress values for the NiTi implant were closer to the natural femur when compared with other metals. We conclude that finite element analysis showed that the stress shielding effect on the femoral bone can be reduced by using NiTi shape memory alloy.

Aseptic Loosening of Femoral Components of the Total Hip Prosthesis

We did a finite elemental analysis of the outer and inner surfaces of the proximal half of an intact femur (Shuibi et al., 2012). To study the behavior of the femur bone when it is subjected to external loads, finite element (FE) simulation is useful. We wanted to verify FE simulation with experimental work using surface strain at the outer surface of the femur by using von Mises strain and then using the verified model, to evaluate the strain for its inner surface. For the purpose of analysis, a standardized femur obtained from the bone repository situated in the Biomechanics European Laboratory (BEL) was used as a baseline for finite element modeling. The material model used for the study was assumed to be isotropic and linearly elastic. The abductor load and a head load were the two

external loads applied. For the outer surface strain there was good agreement between the experimental and simulation results, which indicated that the model developed was acceptable in terms of geometry, boundary conditions, and loading. For the inner surface strain simulation results for strain at the outer femoral surface were very close to the experimental results. We conclude that the values of stress and strain in the anterior, posterior, medial, and lateral positions of the femur showed that strain distribution is not uniform across the section of the femur, suggesting the occurrence of circumferential bending. This information about von Mises strain of the femur especially on the inner surface is important when designing total hip replacements (THRs). Implants may fail due to bone resorption (Shuibi et al., 2013a,b). Bone is a living tissue which is continuously being formed. Its structure and its growth are dependent partly upon the applied mechanical load. After an implant is inserted, the load equilibrium is disturbed, leading to bone resorption and the stress shielding phenomena. Hip prosthesis failure can occur due to aseptic loosening which is one of the leading causes. We wanted to find out the effect of bone resorption on the stress values to obtain a thorough understanding of the behavior of the stress adaptive bone-remodeling. The bone material used for the analysis was assumed to be isotropic and linearly elastic, and the external loads applied comprised of a femoral head load and an abductor load. To evaluate the changes in the bone's density and modulus, a finite element computer was developed. Several values such as stress for bone, cement mantle in medial, and lateral positions of Total Hip Replacement (THR) were documented. We noted that as bone resorbs, both mass density and Young's modulus also reduces, thus decreasing the strength of the bone. The convergence value for density depends not only on the initial value, but also on how the load is applied. The final

density value depends on the loading path. As the bone resorbs, the maximum primary stress for bone, cement mantle (PMMA), and implant, increases with time. The loosening is a result of the high concentrated compressive stress. Patients who have had total hip replacement done should try to minimize and avoid repetitively performing the following activities such as abduction, standing on a single leg and climbing up and down the stairs. These activities can lead to failure of the implant. The sliding of bone-cement-implant interface is also another mechanism causing failure. This type of failure can be reduced by advising patients to minimize activities that involve hip adduction and activities that require patient to stand on one leg. We conclude that reducing the maximum shear stress may possibly increase THR life and reduce implant failure.

COMPLICATIONS THAT MAY ARISE FROM UPPER LIMB INJURIES

Ganglion Cyst of the Proximal Phalangeal Joint

Trauma has been postulated to cause ganglion cyst, which can give rise to pain in the finger (Arumugam, 2006). We reported a case of ganglion cyst of the proximal interphalangeal joint of the right middle finger. A forty-three-year-old Malay lady presented to the Orthopaedic clinic with a one-month history of pain and swelling over the dorsal aspect of the proximal interphalangeal joint (PIPJ) of the right middle finger following a trivial injury to her finger. The swelling had progressively increased in size after the injury and she was unable to fully flex the finger , however extension of the finger was unaffected. An X-ray did not reveal any abnormalities and she was diagnosed to have ligament strain. She was treated conservatively with analgesics, but as her problem persisted, she continued to seek other medical opinions before presenting to

the Hand Clinic a year later with the same complaint. There was minimal swelling over the proximal interphalangeal joint, and on palpation of this area, there was tenderness over the ulna aspect of the right middle finger. She was unable to flex the effected finger fully. There was no weakness of the fingers nor was there any loss of sensation. Radiographic findings were unremarkable. Pre-operatively a diagnosis of glomus tumour of the right middle finger was made. The differential diagnoses considered were ligament sprain, proximal interphalangeal joint (PIPJ) ganglion cyst and thrombosis of the palmar digital vein.

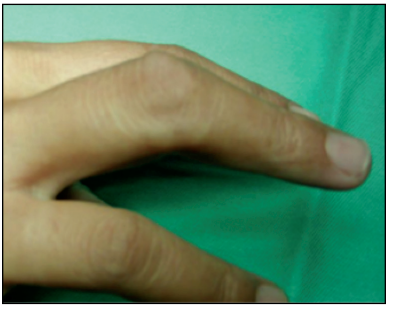


Figure 28a Swelling over PIP joint

Figure 28b Ganglion cyst in the PIP joint

(Figures 28a and 28b from Arumugam, 2006)

Excision biopsy was carried out on the right middle finger. An incision was made along the medial side of the right PIPJ of the right middle finger. A mass measuring 0.1 cm X 0.3 cm which was bluish black in color was found adherent to the surface of the bone. The mass was removed completely, haemostasis was secured and the wound was closed using Ethilon 6/0 sutures. Post operatively, the patient was treated with a one-week course of antibiotics (Cloxacillin 500 mg QID) and analgesics as needed.

Histopathological examination of the excision biopsy revealed the lesion to be a ganglion cyst. Ganglions are basically benign conditions, that are commonly found in the wrist. They can be located either on the dorsal or volar aspect. In most cases, periodic follow up and observation is acceptable. Indications for more aggressive treatment include pain, interference with activity, nerve compression and imminent ulceration.

Fungal Infection

Cat bite or thorn prick injuries of the hand can give rise to fungal infection (Arumugam & Nizlan, 2008). A 60-year-old man presented with a 3-month history of a non-healing ulcer located over the tip of his right thumb. The patient was not a known diabetic and had no other significant illness. The ulcer initially was only a small blister over the tip of the thumb which later ruptured and spread proximally to cover the entire pulp area of the thumb.

Figure 29 Ulceration at the tip of the thumb
(From Arumugam & Nizlan, 2008).

There was no history of fever, weight loss, or loss of appetite. He was a pensioner, an avid gardener and had cats as pets. The patient was initially treated by a private orthopedic surgeon for the non-healing ulcer of the right thumb and underwent numerous debridements which were unsuccessful in ameliorating the ulcer. The patient came to get our opinion approximately 3 months after the onset of the initial lesion on the thumb. Apart from the non-healing ulcer numerous painless erythematous nodules also had developed on his right forearm and one on the right thigh. Taking the patient's age into consideration and the chronicity and appearance of the ulcer, an initial working diagnosis of basal cell carcinoma of the thumb was made, and the patient was admitted for further confirmatory tests and treatment. A few differential diagnoses which were considered at the time of admission were atypical bacterial infection, tuberculous ulceration, and fungal infection. The basic blood investigations did not give any clue as to what condition the patient was having.

Figure 30 Painless erythematous nodules in the forearm
(From Arumugam & Nizlan, 2008)

The wound swab culture from the ulcer on the right thumb did not grow any organism and a course of intravenous antibiotics did not heal the ulcer. An open biopsy of one of the nodules in the forearm was performed and this revealed acute and chronic inflammatory changes without any granuloma formation. Mantoux test and melioidosis serology were both negative. A second biopsy was performed to rule out fungal infection. The specimen was sent to the Institute for Medical Research (IMR). Culture of the biopsy specimen by IMR, using Sabouraud's dextrose agar and potato carrot medium grew dark brown plaques which microscopically appeared to be branching hyphae. The culture was reported from IMR as *Sporothrix schenckii.*

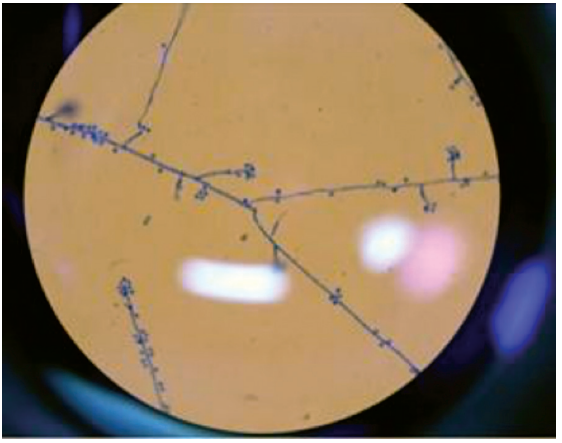


Figure 31 Branching hyphae of the fungus
(From Arumugam & Nizlan, 2008)

After the diagnosis of lymphocutaneous sporotrichosis infection of the right upper limb was made, the patient was treated with itraconazole 200 mg twice daily. One month after starting

the antifungal treatment, the ulcer began to dry up; at 3 months, all other lesions including the one on the right thigh, had healed leaving multiple hyperpigmented scars along the lymphocutaneous distribution in the upper limb.

Therefore, fungi could be a cause of infection resulting in a chronic non-healing ulcer. In this patient, the infection could possibly have been caused by a thorn prick or cat bite, although the patient did not recall such an incident. However, it is still a possibility, as it may have been brushed off as something minor.

Subungual Squamous Cell Carcinoma

Subungual squamous cell carcinoma in a thumb

Subungual squamous cell carcinoma can occur after trauma to the digit. Squamous cell carcinoma arising from the nail bed is not common. This condition can be easily misdiagnosed, especially if there is preceding trauma. We reported a case of a 70 year-old man who presented with pain and swelling of the right thumb after accidentally hitting it with a hammer (Arumugam, 2007). He was initially treated by a general practitioner. The subungual haematoma was drained and analgesics were prescribed for pain.

Approximately six months after the initial trauma he presented with a non-healing wound with an ulcerating growth measuring 2.5x2.1 cm at the tip of the right thumb. Upon closer examination the nail plate was noted to be raised. The differential diagnosis was pyogenic granuloma. Biopsy from the tumour showed an ulcerated moderately differentiated squamous cell carcinoma arranged in sheets and large clumps.

Figure 32 Subungual carcinoma of the thumb
(From Arumugam, 2007).

With the findings mentioned the patient was diagnosed to be having moderately differentiated squamous cell carcinoma of the subungual region of the right thumb. Radiographs of the right thumb showed that the distal phalanx and part of the proximal phalanx was also affected. The patient did not have any distant metastasis. A disarticulation of the metacarpophalangeal joint of the thumb was performed with the patient's consent. The wound on the right thumb healed well without any complications. Patient was not keen for further surgery to reconstruct the thumb.

Velpeau in 1850 was the first person to describe squamous cell carcinoma of the nailbed. The actual incidence is not known. The age group that appears to be commonly affected is in the 5th decade. The age of the youngest patient reported to have squamous cell carcinoma of the nail bed was 25 years old. Although the actual cause is not known, a few possible causes have been proposed such as chronic infections, radiation exposure, human papillomavirus (HPV) infection, burns scar, chronic exposure to sun and chronic dermatitis. Squamous cell carcinoma arising from the nailbed

in a patient with psoriasis has been reported. An association between squamous cell carcinoma and HPV exists. Genital-digital transmission is one of the possible suggested mechanism of transmission. This is further supported by the fact that no HPV DNA was detected using polymerase chain reaction (PCR) in patients with subungual squamous cell carcinoma of the toe. However, we did not perform PCR on the sample obtained from our patient. In our patient, he did have preceding trauma however there was no past history of viral warts. Crush injury, fishbone penetration and paper staple puncture have been reported before as the cause of trauma preceding subungual squamous cell carcinoma. Our patient had accidentally injured his right thumb with a hammer. The exact mechanism in which squamous cell carcinoma occurs after trauma is unknown, however this observation could just be a coincidental finding, pain bringing attention to an area of the digit and also bleeding of the tumor after the injury. There are various different ways in which squamous cell carcinoma of the nail bed can present. The lesion can resemble chronic paronychia, verruca vulgaris, a pyogenic granuloma, an ulcerative lesion or appear as a small swelling. The involvement of axillary lymph nodes and distant metastasis does not commonly occur because the tumor grows at a slow rate and is of low grade in nature. The bone is usually involved in advanced stages of the disease. Diagnosis is very often delayed as this condition is not common. Preceding trauma in our patient brought the attention to the tumor. Most of the reported cases of squamous cell carcinoma involve the thumb. Other digits like the index finger and middle finger can also be involved.

There are many differential diagnosis and these include delayed healing of a traumatic wound, chronic nail biting, paronychia and fungal infections. Other differential diagnoses include pyogenic granuloma, verruca vulgaris, verrucous carcinoma,

subungual metastasis, acral amelanotic melanoma, and subungual keratoacanthoma. Pyogenic granuloma is quite common, and it is usually presents as a small red, oozing and bleeding growth that looks like raw meat. There is often preceding trauma and it grows rapidly over a period of a few weeks to an average size of half an inch. Verruca vulgaris presents as multiple raised hyperkeratotic lesions and can appear on the palmar or dorsal aspect of the fingers. Verrucous carcinoma is rare, and usually occurs in 6th decade, the clinical presentation of verrucous carcinoma is a slow growing, fungating, recalcitrant and exophytic mass. The clinical presentation of subungual metastasis is variable, it may present as an erythematous swelling of the digit or it may appear as a violaceous nodule which may cause distortion of either the nail plate or the surrounding soft tissue which may be mistaken for an acute infection. Acral amelanotic melanoma presents as a small bluish lesion in the subungual area. The skin around the nail is edematous and is usually slightly tender. Subungual keratoacanthoma is a rapidly growing tumour which presents as a rapidly growing painful mass. X rays show a lytic cup shaped erosion of the distal phalanx. Healing occurs rapidly. A plain X ray therefore is useful to determine if there is bone involvement. A biopsy often clinches the diagnosis.

There are various modalities to treat squamous cell carcinoma of the nailbed. The choice depends on the extent of the tumor. In the early stages of the disease Moh's micrographic surgery can be used to limit tissue loss. For lesions without any bone involvement wide local excision with no less than 4mm of normal tissue from the margins of the tumor should be done together with reconstruction of the remaining digit. Reconstruction can be done with full thickness skin graft or local flaps. Numerous local flaps have been described, these include dorsal V-Y flap, a Brunelli flap and a lateral pulp flap. The treatment of choice for lesions with involvement of the bone is

amputation. The level of amputation depends on the extent of bone involvement. Radiation therapy is recommended for the salvage of those cases of subungual squamous cell carcinoma that cannot be resected. Squamous cell carcinoma of the nail bed is not a common condition. One has to be aware about the disease and a have high index of suspicion in order to make an early diagnosis. Lesions of the nail not responding to the initial treatment should be biopsied.

REDUCING INJURIES THROUGH RESEARCH

Injuries caused by motor vehicle acidents can be reduced and prevented by using finite element modelling which can be usecd to predict the injury pattern. We wanted to develop a finite element model (FEM) head for 1 -year old anthropometric testing device (ATD) for use in occupant safety analysis (Nursherida et al., 2015b). In this study, a biofidelic finite element models (FEM) of 1-year-old head with fontanel was developed to investigate child head dynamic response under drop impact conditions. FEM computer simulation is often used to substitute human experimental head injury studies and it is useful in predicting car accident injuries, enhancing understanding of injury mechanism and developing prevention strategies(Rafukka et al., 2016a).. The advantages of FEM over physical dummies include lesser cost and repeatability. There was good correlation in terms of accelerations (G) between experiment and simulation for forehead impact. This type of testing is especially useful for assessment of motor vehicle crashworthiness. We managed to develop a FEM of a 1-year-old head which was validated against experimental data in terms of acceleration. Finite element modelling of a 3-year-old Nigerian child neck is useful for neck injury prediction (Rafukka et al., 2016d). The child's neck determines the head kinematic response on impact. This greatly influences the severity of head injury especially in a motor vehicle

crash. For evaluating head-neck associated injuries we wanted to develop a biofidelic neck model using correct anthropometric measurements for a child. For this purpose, a 6-year-old hybrid III (HIII) child dummy neck finite element (FE) model was scaled down to a 3-year-old (3YO) Nigerian child anthropometry and inertial properties. Using pendulum flexion and extension tests the head-neck assembly was validated. The new neck model showed similar response with three-year-old child dummy neck developed by Mizuno et al. in-flexion test. The neck model developed was useful in predicting neck injury in a 3-year-old Nigerian child. The development and validation of a one-year old child neck numerical model dummy (Nursherida et al., 2015a). and newborn head numerical model dummy (Nursherida et al., 2016) is useful for studies related to impact simulations Human experimental head injury studies can be substituted using finite element models. These models are very useful for analysis of automotive collision. Apart from this it is useful for understanding the injury mechanism and to develop prevention strategies. The benefit of using FEM in crash test dummies has advantages over physical dummies as the cost is less and they can be used repeatedly. There aren't enough paediatric FEM due to insufficient material property data for children. Models representing twelve-month-old (12MO) child dummies are lacking. The cost of treating a child with head injury is high. Head injury is the leading cause of death and disability for children around the world below the age of 18. The study of pediatric head injury is greatly hampered by the lack of data obtained from pediatric post mortem human specimens (PMHS). To substitute PMHS testing, anthropometric test devices (ATDs) and finite element models (FEMs) can be used. Lack of data for the design and validation of these models prompted us to develop and validate a 12MO finite element dummy head model and simulated results in comparison

with the child cadaver experimental data under drop condition tests. The head assembly was validated using frontal/forehead set-up of head drop tests. The simulation of a frontal head drop test was done and compared with the experimental cadaver data. The certification procedure is the test with drop height of 130 mm. We were able to develop a finite element model of the 12-month-old head which was validated against experimental data in terms of head acceleration. We wanted to compare the anthropometric dimensions of 3-year-old Nigerian children with crash dummies in order to determine whether they corresponded with child dummies used in crashworthiness assessment of vehicles and child restraint system (CRS) used by this population (Raffuka et al., 2016c).

We compared anthropometric data collected in United States by Snyder and anthropometric data measured from three-year-old Nigerian children. Anthropometric survey was performed on 30 Nigerian children aged 2.5 to 3.5 years old. 23 standard measurements were recorded from each child including the weight, height and circumferences etc. Numerous percentiles mean, and standard deviation values were collected and comparison with international database was done.

Further comparison was also carried out with the dimensions of crash dummies: Hybrid III three-year-old (HIII 3YO) dummies are based on US child anthropometry and Q3s dummies are based on combined US, Europe and Japanese anthropometry data. The validity of these crash dummies for safety evaluation of cars and CRS used for Nigerian children were checked and confirmed. As observed, the dimensions of a three-year-old Nigerian child appeared to be about 25% lower than US data reported by Snyder. Significant difference was also found between the dimensions of a three-year-old Nigerian child and crash dummies especially for weight and stature. We found that the currently available crash

dummies were not valid for 3-year-old children. This study provides the external dimensions of 3-year-old Nigerian child that could be used for crash dummies and CRS design. We also wanted to improve the biofidelity of the original hybrid III 6-year-old dummy head for frontal impact and extend its application to right and left parietal locations (Rafukka et al., 2016b). Modification of head skin material properties was done, and the head response was validated using the scaled 9 year-old (YO) child cadaver reported in the literature. Validation for the modified head model was then done for two drop heights for frontal, right, and left parietal impact locations. Peak resultant acceleration of the modified head model appeared to have good correlation with scaled 9YO child cadaver head response for frontal impact on dropping from 302 mm height and fair correlation with 12.3% difference for 151 mm drop height. Right parietal peak resultant acceleration values correlate well with scaled 9YO head experimental data for 153 mm drop height, while fair correlation with 16.4% difference was noticed for 302 mm drop height. Left parietal, however, showed low biofidelity for the two drop heights as the difference in head acceleration response was within 30%. We concluded that to estimate injuries in vehicle crash for head in the parietal impact locations the modified head model could be used. These parameters could not be measured by the current hybrid III dummy head model.

CONCLUSION

Treating limbs injuries is not easy. The role of the surgeon is to repair, reconstruct, replace and reduce injuries to the limbs. There are many causes of limb injuries including work-related injuries, home accidents, motor vehicle accidents, crime related injuries and self-inflicted injuries. Even office workers have musculoskeletal disorders and injuries. All these conditions can be treated but have

their own challenges, and further research into finding appropriate solutions to the various challenges is required. Various complications can arise because of limb injuries as elaborated earlier, and they need to be recognized and treated accordingly. Most important of all, many of these injuries can be prevented with proper safety devices and mechanisms. The Orthopaedic surgeon not only has a role in treating patients who have limb injuries but also should play a very big role in research directed at the prevention of these injuries.

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BIOGRAPHY

Manohar Arumugam was born in Ipoh, Perak on 30th October 1964. He pursued his medical degree from Kasturba Medical College, Mangalore, India. He started his career as a house officer in August 1991 at University Hospital, Kuala Lumpur. He subsequently obtained his Master of Surgery in Orthopaedics from University of Malaya in 1998. After his gazettement at Hospital Kuala Lumpur, he did his subspeciality training in Hand & Microsurgery under the supervision of Dato Dr.V. Pathmanathan at Hospital Kuala Lumpur and later at Selayang Hospital. During his AO fellowship in 2002 he did a 3 month observership at the Royal Orthopaedic Hospital, Birmingham and Pulvertaft Hand Centre in Derby. In June 2005, he joined Universiti Putra Malaysia (UPM) as an Associate Professor in the Department of Orthopaedic Surgery, serving as an Orthopaedic surgeon in Hospital Kuala Lumpur and Hospital Serdang. He then did his fellowship training at the Royal Northshore Hospital, Sydney, under the guidance of Professor Michael Tonkin and completed his Fellowship in Hand & Microsurgery there in 2007.

He provided Hand and Microsurgery services at Hospital Serdang by running two clinics a week and an operating list weekly. In 2010 he was appointed as the Head of the Hand & Microsurgery unit. In April 2014 he was appointed as a full Professor in the field of Orthopaedic Surgery. He is currently the Head of Department of Orthopaedic Surgery at Universiti Putra Malaysia (UPM).

He is actively involved in teaching undergraduate students and uses innovative methods to make teaching more fun. Prior to the existence of the Master of Surgery in Orthopaedics program in Universiti Putra Malaysia, he supervised four PhD and four Masters students from various other departments and faculties. Currently he is focusing on supervising Masters of Orthopaedic Surgery trainees. In the past, he has been the Principle Investigator for various

projects and received three Research University Grants (RUGS) from UPM. He has also been a co-investigator on other grants with other researchers from UPM's Faculty of Medicine and Health Sciences and Faculty of Engineering. Prof Manohar's research focus area includes hand surgery, road traffic accidents, musculoskeletal disorders in office workers, biomaterials for prosthesis, and knee osteoarthritis. He has collaborated with other faculties in UPM especially the Engineering faculty to conduct his research. He and his colleagues at the Faculty of Engineering have copyrighted a software for microprocessor system to control multi compartment pneumatic tourniquets. Apart from local institutions, he has also collaborated with international institutions such as the Royal North Shore Hospital in Sydney and the Institute for Work & Health, Toronto, Canada. He has numerous publications in peer-reviewed journals and conference proceedings, and has also written book chapters.

Active in research, he was appointed as a Research Associate for the Institute of Advance Technology (ITMA). He is also a member of the University Research Grant Application Evaluation Committee. He has been appointed as a reviewer for various journals including Malaysian Journal of Medicine & Health Science, Medical Journal of Malaya, Journal of Hand and Microsurgery, Nigerian Journal of Clinical Practice, Malaysian Family Physician and Clinical Case Reports. He is also an appointed member of the Editorial Board for Malaysian Journal of Medicine & Health Science since 2015.
Professor Dr. Manohar Arumugam has 26 years of clinical experience and 12 years of experience as an academic. He is also committed to his various administrative duties within the Department, the Faculty, the University, Hospital Serdang and other professional bodies such as the Malaysian Society for Surgery of the Hand. He is also a member of various committees including the

working committee for Hospital Pengajar UPM (HPUPM). With his vast experience in academics, he was appointed as committee member for the National Orthopaedic Curriculum Committee in 2016. He is also a member of the Conjoint Board of Orthopaedics and an examiner for the Part 2 Conjoint Board Orthopaedics Exam, and has been an External Examiner for Manipal Melaka Medical College. The Ministry of Health's Hand Subspeciality Fellowship Training has also appointed Professor Manohar as an examiner for the Part I and II Hand Subspeciality examinations. He is currently involved in the training of Orthopaedic surgeons who are in the Ministry of Health Hand Subspeciality training program at Hospital Serdang.

He is an active member of the Malaysian Society for Surgery of the Hand and was the past president (2015-2017). He is also active in the Malaysian Orthopaedic Association. In 2012 he was awarded the Asean Orthopaedic Association Senior Travelling Fellowship. He is currently the Head of the Hand Special Interest Group of the Malaysian Orthopaedic Association. Apart from National bodies he is also an International member of the American Society for Surgery of the Hand, and the International Bone Research Association.

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I would also like to express my humble gratitude to my highly respected consultant teachers and mentors whose guidance has made me what I am today: the late Prof. Dr. Sengupta, my supervisor and teacher during my days as a Master of Orthopaedic Surgery trainee; Dato' Dr.V. Pathmanathan, my mentor during my Hand Surgery training after gazettement as an Orthopaedic surgeon; and Prof. Dr. Michael Tonkin my mentor during my fellowship training in Hand & Microsurgery at the Royal Northshore Hospital, Sydney.

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My heartfelt appreciation for the love, encouragement and support from my dear wife Assoc. Prof. Dr. Rina Karunakaran and the love and endurance of my only daughter, Divya. I am also grateful to my father Mr. Arumugam, my loving mum Madam Lalitha Manohari and my two younger brothers for their love, guidance and support.

I also would like to take this opportunity to thank Assoc. Prof Nizlan Mohd, Dr. Hezery Harun, and his team for helping me to oversee the arrangements for the Inaugeral Lecture. Last but not least I would like to thank the CoSComm for making the arrangements for the Inaugural Lecture and UPM press for publishing the inaugural book. Thank you.

LIST OF INAUGURAL LECTURES

1. Prof. Dr. Sulaiman M. Yassin
   The Challenge to Communication Research in Extension
   22 July 1989

2. Prof. Ir. Abang Abdullah Abang Ali
   Indigenous Materials and Technology for Low Cost Housing
   30 August 1990

3. Prof. Dr. Abdul Rahman Abdul Razak
   Plant Parasitic Nematodes, Lesser Known Pests of Agricultural Crops
   30 January 1993

4. Prof. Dr. Mohamed Suleiman
   Numerical Solution of Ordinary Differential Equations: A Historical Perspective
   11 December 1993

5. Prof. Dr. Mohd. Ariff Hussein
   Changing Roles of Agricultural Economics
   5 March 1994

6. Prof. Dr. Mohd. Ismail Ahmad
   Marketing Management: Prospects and Challenges for Agriculture
   6 April 1994

7. Prof. Dr. Mohamed Mahyuddin Mohd. Dahan
   The Changing Demand for Livestock Products
   20 April 1994

8. Prof. Dr. Ruth Kiew
   Plant Taxonomy, Biodiversity and Conservation
   11 May 1994

9. Prof. Ir. Dr. Mohd. Zohadie Bardaie
   Engineering Technological Developments Propelling Agriculture into the 21st Century
   28 May 1994

10. Prof. Dr. Shamshuddin Jusop
    Rock, Mineral and Soil
    18 June 1994

11. Prof. Dr. Abdul Salam Abdullah
    Natural Toxicants Affecting Animal Health and Production
    29 June 1994

12. Prof. Dr. Mohd. Yusof Hussein
    Pest Control: A Challenge in Applied Ecology
    9 July 1994

13. Prof. Dr. Kapt. Mohd. Ibrahim Haji Mohamed
    Managing Challenges in Fisheries Development through Science and Technology
    23 July 1994

14. Prof. Dr. Hj. Amat Juhari Moain
    Sejarah Keagungan Bahasa Melayu
    6 August 1994

15. Prof. Dr. Law Ah Theem
    Oil Pollution in the Malaysian Seas
    24 September 1994

16. Prof. Dr. Md. Nordin Hj. Lajis
    Fine Chemicals from Biological Resources: The Wealth from Nature
    21 January 1995

17. Prof. Dr. Sheikh Omar Abdul Rahman
    Health, Disease and Death in Creatures Great and Small
    25 February 1995

18. Prof. Dr. Mohamed Shariff Mohamed Din
Fish Health: An Odyssey through the Asia - Pacific Region
25 March 1995

19. Prof. Dr. Tengku Azmi Tengku Ibrahim
Chromosome Distribution and Production Performance of Water Buffaloes
6 May 1995

20. Prof. Dr. Abdul Hamid Mahmood
Bahasa Melayu sebagai Bahasa Ilmu-Cabaran dan Harapan
10 June 1995

21. Prof. Dr. Rahim Md. Sail
Extension Education for Industrialising Malaysia: Trends, Priorities and Emerging Issues
22 July 1995

22. Prof. Dr. Nik Muhammad Nik Abd. Majid
The Diminishing Tropical Rain Forest: Causes, Symptoms and Cure
19 August 1995

23. Prof. Dr. Ang Kok Jee
The Evolution of an Environmentally Friendly Hatchery Technology for Udang Galah, the King of Freshwater Prawns and a Glimpse into the Future of Aquaculture in the 21st Century
14 October 1995

24. Prof. Dr. Sharifuddin Haji Abdul Hamid
Management of Highly Weathered Acid Soils for Sustainable Crop Production
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25. Prof. Dr. Yu Swee Yean
Fish Processing and Preservation: Recent Advances and Future Directions
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Pesticide Usage: Concern and Options
10 February 1996

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Microbial Fermentation and Utilization of Agricultural Bioresources and Wastes in Malaysia
2 March 1996

28. Prof. Dr. Wan Sulaiman Wan Harun
Soil Physics: From Glass Beads to Precision Agriculture
16 March 1996

29. Prof. Dr. Abdul Aziz Abdul Rahman
Sustained Growth and Sustainable Development: Is there a Trade-Off 1 or Malaysia
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