



Publications 2018

Publishing the results of our work in the peer reviewed literature is essential. In 2018, the following research papers were published as a result of collaborations or primary studies conducted by the Fiona Wood Foundation research team.

With our understanding that every intervention from the time of injury influences the scar worn for life, we approach each clinical problem with a unique set of skills to reduce the suffering from burn injury. All the work is focused on solving a given clinical problem across the spectrum from first aid practices in the community, manipulation of scars at the cellular level, to understanding the barriers to improved function. The key strength of the group is the bringing together of basic science, population health research and clinical research - *Translating Research into Practice (TRIP)*. How this is achieved is indicated briefly for our most recent publications.

1. **Post-injury nervous system morbidity among burn and non-burn trauma patients compared with non-injured people.** Duke JM, Randall SM, Fear MW, Boyd JH, Rea S, Wood FM. Burns 2018; accepted 17 June 2018.

TRIP: The nerves changing after the burn has healed is an area we have been investigating as it impacts for life, the work confirms the intimate relationship between the skin recovery and the nervous system and drives the next steps of work to understand why and how to discover improved treatments.

2. **Analysing longitudinal data.** Duke JM, Randall SM, Fear MW, Boyd JH. Burns 2018.

TRIP: We have contributed significantly to the world's knowledge on the lifelong impact of burn injury by the analysis of data collected overtime. The data linkage capacity in Westerns Australia has made this possible.

3. **Long-term psychiatric morbidity after unintentional burns sustained during childhood.** Duke JM, Randall SM, Vetrichevvel TP, McGarry S, Boyd JH, Rea S, Wood FM. Submitted BMC Burns & Trauma 2018.

TRIP: Understanding the links between burn injury and mental illness is long been an area we have been aware of but now we have measured and caratorised again forming the foundation for the next steps in understanding how and why.

4. **An Australian study of long-term hospital admissions and costs comparing patients with unintentional burns and uninjured people** Randall SM, Wood FM, Rea S, Boyd JH, Duke JM. Submitted Burns 2018.

TRIP: Burn injury care is complex and costly understanding the drivers to costs of care allows us to drive improvement.

5. **Genetic influence on scar outcome after burn injury: genome-wide association study and pathway analysis** Wallace HJ, Cadby G, Melton PE, Wood FM, Crowe MM, Martin LJ, Ward SV and Fear MW Burns 2018.

TRIP: It has long been observed that there are racial differences in the scarring post injury the genetic basis of this remains elusive. However, we have made progress in the understanding of some of the



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key pathways involved in scar development. This knowledge helps direct further work in trying to block or enhance pathway activity to develop drug treatments for scarring.

6. **IFN β inhibits the development of allergen tolerance and is conducive to the development of asthma on subsequent allergen exposure.** Fear VS, Poh WP, Gorman S, Waithman JC, Fear MW. Immunol Cell Biol. Sept 2018.

TRIP: Understanding the immune systems responses is key in understanding healing and the impact on the whole of the patient.

7. **Shear-wave elastography: a new objective method for evaluating scar fibrosis** DeJong H, Abbott S, Zelesco M, Kennedy B, Martin L, Ziman, Wood F. (2018) ScarCon ETRS 2018 Joint Meeting Scar Academy and the European Tissue Repair Society. Wound Repair and Regeneration 2018

TRIP: Measuring scarring reliably remains elusive this is using a tool in a unique way to give insight into the physical properties of a scar.

8. **Macro-mechanobiology of scarring: In Vivo human study of scar stiffness using shear-wave elastography** DeJong H, Abbott S, Zelesco M, Kennedy B, Martin L, Ziman M, Wood F. Australia Fascia Research Congress Abstracts / Journal of Bodywork & Movement Therapies 2018.

TRIP: Measuring scars is key to understanding the changes with our treatments. Scars are a problem due in part to their abnormal stiffness measuring resolution of stiffness is a key component of our understanding.

9. **Predictive Big Data in future burns care** Wood, F, Medicus 2018.

TRIP: Data will be our future to understanding and driving the best treatments at the best time for a given individual.

10. **Monitoring wound healing in minor burns-A novel approach** Kenworthy P, Phillips M, Grisbrook T, Gibson W, Wood F, Edgar D, Burns: journal of the International Society for Burn Injuries, February 2018, Vol.44(1), pp.70-76.

TRIP: Thus, we set out examine if BIS was a valid measure of burn wound healing (closure). BIS measures of tissue resistance were indicators of healing. One unit increase in resistance increased the odds of wound healing by ~6%. We showed BIS is a new (non-invasive) way to monitor the progress of burn wound healing.

11. **Remote Primary Health Care Manual.** Rowe S, Edgar D, Wood F. Chapter 1 – Emergencies and Assessments, Central Australian Rural Practitioners Association (CARPA); Standard Treatment Manual, 7th Edition. Alice Springs, NT.

TRIP: Up to date education is a key aspect of our work ensuring every intervention from the time of injury is considered.



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12. **Coherency image analysis to quantify collagen architecture: implications in scar assessment**, Clemons, T. D., et al. (2018). *RSC Advances* 8(18): 9661-9669.

TRIP: An important histological difference between normal, uninjured dermis and scar tissue such as that found in keloid scars is the pattern in which the collagen is deposited and arranged. In the uninjured dermis, collagen bundle architecture appears randomly, whereas in pathological conditions such as keloid scar tissue, collagen bundles are often found in whorls or in a hypotrophic scar collagen is more densely packed in a parallel row. The novel quantitative approach for analysing collagen orientation is reported.

13. **Applications: Tissue Engineering of Skin. Principles of Regenerative Medicine** (Third Edition). Wood, F. M. (2019). Chapter 73 - Therapeutic A. Atala, R. Lanza, A. G. Mikos and R. Nerem. Boston, Academic Press: 1281-1295

TRIP: There has been great progress in the tissue engineering of skin. It is an exciting area that offers tangible clinical solutions with an enormous potential for further improvement. There are unique requirements related to the body site, patient, pathology, and extent of the skin needing to be replaced, repaired, or regenerated. Innovations include multiple combinations of three-dimensional engineered scaffolds with a functional cell load to produce tissue over time, which is fundamental in the clinical selection of the technique.

14. **Assessing the impact of carbon dioxide laser treatment in burn-related scarring**. *Br J Surg.* 2018; 105:48-51. Douglas H, Lynch J, Murray A, Anton-Harms K, Krop T, Kunath L, van Vreeswick LC, McGarry S, Fear M, Wood F, Rea S, *Wound Repair Regen.* 2018;26(2): A24-A.

TRIP: Laser has been used to try to unscar the scar! The detailed analysis of the technique and how the scar changes is key to working out how best to treat the scar how often how much energy to use.

15. **Case series investigating the cortical silent period after burns using transcranial magnetic stimulation**. Garside T, Wood FM, Vallenge AM. *Burns: journal of the International Society for Burn Injuries.* 2018;44(5):1195-202.

TRIP: The study established transcranial magnetic stimulation (TMS) as a useful and sensitive tool to investigate the brains cortical response to a burn injury. There is a strong suggestion that cortical inhibition is altered following burn injury, and that TMS is a useful and sensitive method for investigating changes in cortical inhibition in burn patients.

16. **Diabetes mellitus after injury in burn and non-burned patients: A population based retrospective cohort study**. Duke JM, Randall SM, Fear MW, Boyd JH, Rea S, Wood FM. *Burns: journal of the International Society for Burn Injuries.* 2018;44(3):566-72.

To compare hospitalisations for diabetes mellitus (DM) after injury experienced by burn patients, non-burn trauma patients and people with no record of injury admission, adjusting for socio-demographic, health and injury factors. Burn and non-burn trauma patients experienced elevated rates of DM admissions after injury compared to the non-injured cohort over the duration of the study. Detailed clinical data are required to help understand the underlying pathogenic pathways triggered by burn and non-burn trauma.



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17. **Ephrin-A2 affects wound healing and scarring in a murine model of excisional injury.** Wijeratne D, Rodger J, Stevenson A, Wallace H, Prele CM, Wood FM, Fear MW, *Burns*. 2018.

TRIP: There is increasing evidence that Ephrin/Eph signalling is important in the skin, involved in hair follicle cycling, epidermal differentiation, cutaneous innervation and skin cancer. However, there is currently limited information on the role of Ephrin/Eph signalling in cutaneous wound healing. The loss of Ephrin-A2 and A5 ligands did not impact on the rate of wound closure or re-innervation after injury. However, changes in the gross morphology of the healed scar and in collagen histology of the scar dermis were observed. Therefore Ephrin-A2 and A5 ligands may play an important role in final scar appearance associated with collagen deposition and structure

18. **Epidemiology of work-related burn injuries presenting to burn centres in Australia and New Zealand.** McInnes JA, Cleland H, Tracy LM, Darton A, Wood FM, Perrett T, Gabbe BJ, *burns journal of the International Society for Burn Injuries*. 2018.

TRIP: Burn injuries to workers can have a devastating impact, however knowledge of the epidemiology of work-related burn injuries in Australia and New Zealand is limited. Almost one in five cases of working-aged people admitted to Australian and New Zealand burns centres was work-related. Through identification of vulnerable groups, this study informs policy and strategies to minimise occupational burn risk.

19. **Grip and Muscle Strength Dynamometry in Acute Burn Injury: Evaluation of an Updated Assessment Protocol.** Gittings PM, Hince DA, Wand BM, Wood FM, Edgar DW. *Journal of burn care & research: official publication of the American Burn Association*. 2018;39(6):939-47.

TRIP: External stabilization is reported to improve reliability of hand-held dynamometry, yet this has not been tested in burns. Hand-held dynamometry is a reliable assessment tool for evaluating within-session muscle strength in the acute and subacute phase of injury in burns up to 40% total burn surface area. External stabilisation of the dynamometer is useful to optimise the accuracy and consistency of these results.

20. **High-intensity Aerobic Exercise Blocks the Facilitation of iTBS-induced Plasticity in the Human Motor Cortex.** Smith AE, Goldsworthy MR, Wood FM, Olds TS, Garside T, Ridding MC. *Neuroscience*. 2018; 373:1-6.

TRIP: Acute exercise studies using transcranial magnetic stimulation (TMS) can provide important insights into the mechanisms underpinning the positive relationship between regular engagement in physical activity and cortical neuroplasticity. Emerging evidence indicates that a single session of aerobic exercise can promote the response to an experimentally induced suppressive neuroplasticity paradigm Further investigation of the factors that influence the relationship between exercise and neuroplasticity is warranted.



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21. **Long-term mental health outcomes after unintentional burns sustained during childhood: a retrospective cohort study.** Duke JM, Randall SM, Vetrichevvel TP, McGarry S, Boyd JH, Rea S, Wood FM, *Burns & trauma.* 2018; 6:32.

TRIP: Ongoing MH support is indicated for paediatric burn patients for a prolonged period after discharge to potentially prevent psychiatric morbidity and associated academic, social and psychological issues.

22. **Loss of Type A neuronal cells in the dorsal root ganglion after a non-severe full-thickness burn injury in a rodent model.** Palanivelu V, Maghami S, Wallace HJ, Wijeratne D, Wood FM, Fear MW. *Burns: journal of the International Society for Burn Injuries.* 2018;44(7):1792-800.

TRIP: Burn scars can be associated with significant loss of cutaneous sensation, and chronic pain. Long-term systemic changes in cutaneous innervation may contribute to these symptoms and dorsal root ganglia have been implicated in the development of chronic neuropathic pain. Therefore, we hypothesized that changes in cutaneous innervation after burn injury may be mediated at the level of the dorsal root ganglia. Investigating whether neuro-protective or neuro-restorative approaches can ameliorate damage to the DRG will be important to improve sensory outcomes for burn patients.

23. **Macro-mechanobiology of scarring: In vivo human study of scar stiffness using shear-wave elastography.** DeJong H, Abbott S, Zelesco M, Kennedy B, Martin L, Ziman M, Wood F, *Journal of Bodywork and Movement Therapies.* 2018;22 (4):853-4.

TRIP: Preliminary evidence from this research suggests that pathological scarring of the skin is associated with altered mechanical properties of subcutaneous tissues. Contraction of underlying muscles can alter the skin/scar stiffness, suggesting that muscle contraction can influence strain within the skin. This information will assist the optimization of treatment delivery including the use of compression, manual, and movement therapies and assist the development of new treatments.

24. **Monitoring wound healing in minor burns-A novel approach.** Kenworthy P, Phillips M, Grisbrook TL, Gibson W, Wood FM, Edgar DW. *Burns: journal of the International Society for Burn Injuries.* 2018;44(1):70-6.

TRIP: Assessment of minor burn wound closure is predominately determined by visual inspection and clinical specialist assessment, which remains largely a subjective analysis and results may vary depending on the clinician's experience. Bioimpedance spectroscopy (BIS) is an instrument that has a demonstrated ability to objectively monitor the wound healing process in various patient populations but has not yet been used in acute burn wounds. The aim of the pilot study was to examine whether the BIS technique is a valid measure of wound healing. BIS is a technique, which has the potential to monitor the progress of wound healing.

25. **An objective measure for the assessment and management of fluid shifts in acute major burns.** Kenworthy P, Phillips M, Grisbrook TL, Gibson W, Wood FM, Edgar DW. *Burns & trauma.* 2018; 6:3.

TRIP: Major burns are life threatening. Replacing fluid lost through the wounds is important to prevent (hypovolaemic) shock. We have shown that bioimpedance spectroscopy (BIS) is a potential method of monitoring fluid shifts after burn. In this study we aimed to establish the utility of whole-body BIS to measure and monitor



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fluid shift in moderate to major burns. BIS is confirmed as a useful clinical tool to monitor fluid volume change in major acute burns.

26. **Perioperative Temperature Management During Burn Care.** Owen K, Litton E, Raby E, Wood F. *Journal of burn care & research: official publication of the American Burn Association.* 2018;39(1):172.

TRIP: Temperature control is known to effect wound healing measuring changes allows strategies to be used to keep the body temperature at the optimum level.

27. **A population-based comparison study of the mental health of patients with intentional and unintentional burns.** Vetrichevvel TP, Randall SM, Wood FM, Rea S, Boyd JH, Duke JM, *Burns & trauma.* 2018; 6:31.

TRIP: Intentional burn patients experienced significantly higher pre- and post-burn mental health morbidity along with significant adverse outcome in comparison with unintentional burns. Early psychological assessment and intervention could help in improving the MH of these patients.

28. **A population-based retrospective cohort study to assess the mental health of patients after a non-intentional burn compared with uninjured people.** Duke JM, Randall SM, Boyd JH, Wood FM, Fear MW, Rea S. *Burns: journal of the International Society for Burn Injuries.* 2018;44(6):1417-26.

TRIP: Patients hospitalised for unintentional burns had significantly higher MH admission rates after discharge than that observed for an uninjured cohort. Ongoing mental health support is clearly indicated for many burns patients for a prolonged period after discharge.

29. **Resistance training for rehabilitation after burn injury: A systematic literature review & meta-analysis.** Gittings PM, Grisbrook TL, Edgar DW, Wood FM, Wand BM, O'Connell NE. *Burns: journal of the International Society for Burn Injuries.* 2018;44(4):731-51.

TRIP: This literature review demonstrated that there were suggestions of improvements in muscle strength and function for patients who undertook resistance training after a burn injury. However, the quality of evidence is poor and further research with robust methodology is needed to confirm the suggested effects from training.

30. **A retrospective cohort study to compare post-injury admissions for infectious diseases in burn patients, non-burn trauma patients and uninjured people.** Duke JM, Randall SM, Boyd JH, Fear MW, Rea S, Wood FM. *Burns & Trauma.* 2018; 6:17.

TRIP: Burns and non-burn trauma patients had higher admission rates for infectious diseases compared with age and gender matched uninjured people. The pattern of annual admission rates for major categories of infectious diseases varied across injury groups. Overall, the burn cohort experienced the highest rates for digestive, lower respiratory and skin and soft tissue infections. These results suggest long-term vulnerability to infectious disease after injury, possibly related to long-term immune dysfunction.



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31. **Two-photon polymerisation 3D printed freeform micro-optics for optical coherence tomography fibre probes.** Li J, Fejes P, Lorensen D, Quirk BC, Noble PB, Kirk RW, Orth A, Wood FM, Gibson BC, Sampson DD, McLaughlin RA *Scientific reports*. 2018;8(1):14789.

TRIP: Miniaturised optical coherence tomography (OCT) fibre-optic probes have enabled high-resolution cross-sectional imaging deep within the body. However, existing OCT fibre-optic probe fabrication methods cannot generate miniaturised freeform optics, which limits our ability to fabricate probes with both complex optical function and dimensions comparable to the optical fibre diameter. Recently, major advances in two-photon direct laser writing have enabled 3D printing of arbitrary three-dimensional micro/nanostructures with a surface roughness acceptable for optical applications. Here, we demonstrate the feasibility of 3D printing of OCT probes.

32. **Up-regulation of alpha1-adrenoceptors in burn and keloid scars.** Drummond PD, Dawson LF, Wood FM, Fear MW. *Burns: journal of the International Society for Burn Injuries*. 2018;44(3):582-8.

TRIP: These findings suggest that increased vascular expression of alpha1-adrenoceptors could alter circulatory dynamics both in burn and keloid scars. In addition, the augmented expression of alpha1-adrenoceptors in keloid tissue may contribute to processes that produce or maintain keloid scars and might be a source of the uncomfortable sensations often associated with these scars.

33. **The validity and reliability of using ultrasound elastography to measure cutaneous stiffness, a systematic review.** DeJong HM, Abbott S, Zelesco M, Kennedy BF, Ziman MR, Wood FM. *International journal of burns and trauma*. 2017;7(7):124-41.

TRIP: Robust evidence supporting the use of ultrasound elastography as a diagnostic tool in cutaneous conditions is low, however, initial indicators support further research to establish the utility of ultrasound elastography in dermatology.

34. **Clinical photography, photogrammetry, and spatial techniques for assisting the assessment and management of burn injuries.** Helmholtz, P., Belton, D., Chow, J., Douglas, H., Wood, F. (2018). *ISPRS Spectrum* 12(2), 7-8.

35. **Maintaining current knowledge for teaching is a core value of the team** ISBI Practice Guidelines for Burn Care, Part 2. ISBI Practice Guidelines Committee. *Burns*. 2018 Nov;44(7):1617-1706. doi: 10.1016/j.burns.2018.09.012. Epub 2018 Oct 19.

Thank you to all the individuals, corporates, Trusts and Foundations that have contributed to the Fiona Wood Foundation in 2018.

Your support directly impacts our ability to continue our research. Anyone's life can change in an instant from burn injury and we strive to continually improve outcomes from burn injury for all.

The Fiona Wood Foundation Board, staff, clinicians and researchers extend to each of you, our heartfelt appreciation of your support. Without you, we would not be able to continue our journey of scarless healing – in mind and body.