ACP Student Research Grant Reports

ACP Student Research Fund – Tom Calderbank

Hello my name is Tom, a 5th year medical student, from the University of Leicester. Following a generous contribution of £2,100 from the ACP’s Student Research Fund, I spent the 2015/16 academic year completing a research project amounting to an intercalated BSc in the East Midlands Forensic Pathology Unit.

“So you’ve watched a lot of CSI then?”, was the reaction of my friends and family when I told them I was going to take a year from my medicine degree to research knives and stab wounds. I will admit that the majority of my experience in forensics before this year came from the (significantly more) glamorous crime fiction world; however, this year-long journey in research has instilled an interest not just in pathology, but in research as a future career.

Rewind to December 2014, to the release of the fresh batch of project catalogues for the following intercalation year. I found myself reading briefs on the minutiae of cell cytology and microbiology, seemingly locked in a competition to have the longest acronym for different proteins. As a visual learner, I found this too abstract; I enjoy being able to see something in ‘real life’. Eventually, something caught my eye ‘The application of micro-Computed Tomography (microCT) in the differentiation between serrated and non-serrated blades in stab wounds in skin’. Now this sounded interesting, and compared to the other projects the brief didn’t outline what results were to be expected; this research would genuinely find something new. Also, in all honesty, it just sounded really cool. This report will provide a testimony of my journey through this work, glitz and glamour not guaranteed.

What I did

This project aimed to answer two different study questions:

1) Can microCT and other imaging techniques view tool marks in porcine skin?
2) Using the ‘best’ method found above, what is the incidence of serrated blade tool mark production in skin, and is there any inter-observer agreement in their identification?

The first question took the majority of the experimental time from October to February. A relatively straightforward routine that involved producing stab wounds in porcine skin with a coarsely serrated knife using a drop tower (who knew stabbing pork was such a good stress reliever!), preparing it in different ways and then imaging. It wasn’t until the third time in the same week that the butcher asked me what I was doing with so much pork.

The four imaging techniques used were photography, stereomicroscopy, scanning electron microscopy (SEM) and microCT. The variables considered in the pilot experiments included: tissue preservation, partially/fully opening the wound tract, and scanning parameters (SEM and microCT). The aim of this was simply to find the easiest and most effective method for observing these tool marks. Stereomicroscopy emerged as the best method out of the four, as it did not require any tissue preservation, was easy to carry out and the images obtained were straightforward to interpret. The picture below is a composite made up of photography, stereomicroscopy, SEM and microCT images.

Inter-observer agreement was tested by showing three medical students randomised stereomicroscopy images...
of stab wounds produced by three different knives, a coarsely serrated blade, a finely serrated blade and a non-
serrated blade (more stress relief?). Following a short
introduction to interpretation of images, the individuals
were asked to identify whether a regular tool mark
pattern was present, and which knife they thought the
sample was produced by. Statistical tests to assess inter-
observer agreement were carried out using SPSS and the
open source programming language, R.

Tool marks were identified in 89% of samples produced
by a serrated blade, with good agreement. Flat blade
samples did not exhibit the same tool marks, and no
agreement was found. The correct type of serrated blade
was identified >50% of the time, whereas flat bladed
samples were correctly identified only in 32% of cases.

These results reinforce the idea that serrated blades
produce a distinct tool mark pattern in skin, different
to that of non-serrated blades. The knife identification
results indicate that it may be possible to predict the tool
mark pattern of a suspected blade, based on whether
it has serrations and their arrangement on the blade.
Further work would use statistical methods to compare
stereomicroscopy with other imaging techniques, e.g.
micro-Computed Tomography.

What I have learnt

Literature reviews are great for brainstorming
The initial part of my review highlighted that serrated
blade tool marks had been seen in skin, and this had
also been demonstrated using microCT. This was
disheartening, as it was difficult to see what my research
would bring to the field. Sometime later, I found another
tool mark analysis paper in cartilage that focused upon
statistical validation of practical methods, something
that I noticed hadn't yet been done with porcine skin, or the
new non-invasive imaging methods.

Whilst the methods between my work and the other
statistical work differed greatly, I would not have
considered this idea before reading that paper. At the start,
I thought of the literature review as being a necessary part
of research that would just contribute to the writing of the
introduction of my work. In fact, they are an important
source of ideas and inspiration!

Ability to adapt is key
From the start, the predominant focus of this work was
on microCT (due to its promise in the previous literature)
and how it would help in this area of tool mark analysis.
In the pilot experiments to assess scanning parameters
and tissue preparations, other imaging techniques were
used initially as a comparison to microCT, which I
assumed would produce the best results. What I didn’t
expect, however, was that the simpler techniques proved
extremely effective, but why was there a paper on
microCT, and no research that used a simple photograph?

About halfway through the year, before moving onto
statistical validation, the project title changed to remove
the focus upon microCT. Whilst microCT was effective
in tool mark analysis, if this was eventually to be used as
a forensic method, then a more straightforward practical
method would be favourable. The lesson I took from this
was that it is possible that the design of a study could
change slightly from what you set out to do, depending
on how the results turn out.

Conferences are the real reason why people do academia
In May, I had an abstract accepted for oral presentation
at the International Society of Forensic Radiology and
Imaging congress in Amsterdam. Before going on this trip,
I had an idea that academia is relatively thankless work,
until I saw the buffet lunches and unlimited coffee that was
on offer at this conference! Believe it or not, this wasn’t
the part of the trip that sold me into a career in academia:
the opportunity to present my work to people who had
dedicated careers to this area of work was extremely
rewarding. It was fascinating to hear the insights of people
whose papers I had read not a week before, and whose
work I had based a lot of my project on.

Student research tips
1) Don’t dismiss a literature review as a tedious,
   inevitable process.
2) Don’t be disheartened if something doesn’t go to plan.
3) Take your work to conferences, it makes it seem so
   worthwhile. (Also, better than any student food you’ll
   eat.)
4) Have something completely different to do that will
take your mind from the research. I played rugby
throughout the year, and this allowed me to return to
my work with a fresh mind.

So, alongside the new exciting stabbing facts, I hope
this report has provided an insight into the intercalated
medical research BSc, it was an exciting year and some
of the lessons I learnt will be useful in the clinical years
of the MBChB. It wouldn’t have been possible without
the support of the Association of Clinical Pathologists, or
my supervisors Professor Guy Rutty and Professor Sarah
Hainsworth. For now, I am still waiting for a phone call
for that guest spot on CSI …