



University of Dundee

Designing a Scientific Poster

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1. Introduction

Poster presentations are a means of communication commonly used at scientific conferences and meetings. The main purpose of your poster is to present an outline of your research in a way that's quickly and easily understood by the viewing audience. It should stimulate debate and foster an exchange of ideas and opinions between its readers and the presenter. Making a scientific poster is relatively easy to do but making an *effective* scientific poster is more challenging, so hopefully, after reading this learning material you'll be able to produce your own research poster.

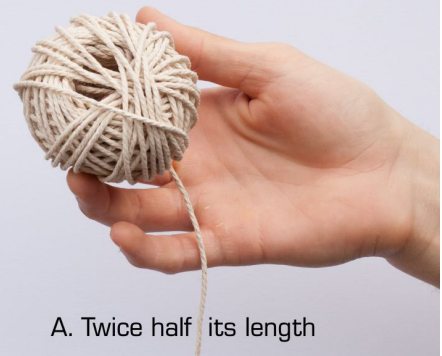
One of the most difficult problems to overcome when designing a scientific poster is knowing what exactly to include and what to leave out. This can seem like a daunting first hurdle, especially if you've never attempted a poster before. Be aware that it's impossible to condense all your research into a single sheet of paper so avoid trying to achieve this. Your poster should summarise your research or highlight an overview or snapshot of a particular aspect of your study.

Therefore, I reckon a good starting point for any scientific poster is to use your **Abstract**. You should already have written this by the time you come to prepare your poster. An Abstract is limited to a specific number of words and graphical elements and is, therefore, an ideal foundation point for constructing your poster. So, basically, your poster is a visual abstract.

The first question people often ask me about posters is "*What size should the text be?*" I'm afraid that's like asking "*How long is a piece of string?*" in that it all depends on how much text you need to include in your poster to convey your message properly. The more text you wish to appear, the smaller the font needs to be and vice versa, but we'll cover this in greater detail later.

Most of the skills and techniques needed to develop and design an effective scientific poster differ greatly from those required to author an 80-page thesis, write a research paper for inclusion in a scientific journal or when delivering an oral presentation in front of an audience. However, all these skills essentially come down to a need to optimise how you convey information and communicate with those who wish to access your research work. The following sections will hopefully guide you through the process of designing a scientific poster and make the process a bit easier, and with any luck make it an enjoyable and fun aspect of your study.

Q. How long is a piece of string?



A. Twice half its length

2. Purpose of a Scientific Poster

The basic purpose of any poster is to sell something to an audience. This may be in the form of the latest cinematic release, a music gig, a food chain, or a specific brand of running shoe. The topic you're attempting to 'sell' to the wider academic audience in this instance just happens to be your research study.

Poster sessions allow the opportunity for conference delegates to wander through display areas reading posters of interest, and to discuss the work presented with other viewers and the presenters of the work if they're in attendance. It can be an effective way of obtaining feedback from your peers on a work in progress that you may not have fully developed into a Paper. Remember that a conference delegate could be more interested in the finger buffet

and coffee that's available on break-out sessions and may only have a few seconds to decide which posters to stop and investigate further. When there could be as many as 100+ posters at a conference, the need to quickly attract attention to your poster is vital.

Your poster should provide a brief overview of your research that is both quickly and easily understood. It should foster an exchange of ideas between yourself, the presenter, and your audience. Another important purpose of any poster is to initiate discussion about your area of research and to expose it to the wider scientific community. Concentrate on the most important, interesting and astounding finding(s) from your research project.

3. Conference Organiser's Instructions

Once you've been successful in having your poster accepted at a conference the first step is to obtain submission guidelines from the conference organisers. It's important that you read these instructions very carefully. This may seem a glaringly obvious statement but it's surprising how vital details can be overlooked. Instructions are normally made available on the conference website or emailed to you and these can range from a few simple guidelines to a full list of criteria you, as the presenter, must adhere to. These will normally be as follows:

- Conference dates
- Poster submission deadline
- Poster ID number
- Poster set-up times
- Viewing times
- Poster dimensions and orientation
- Floor plan of the presentation area

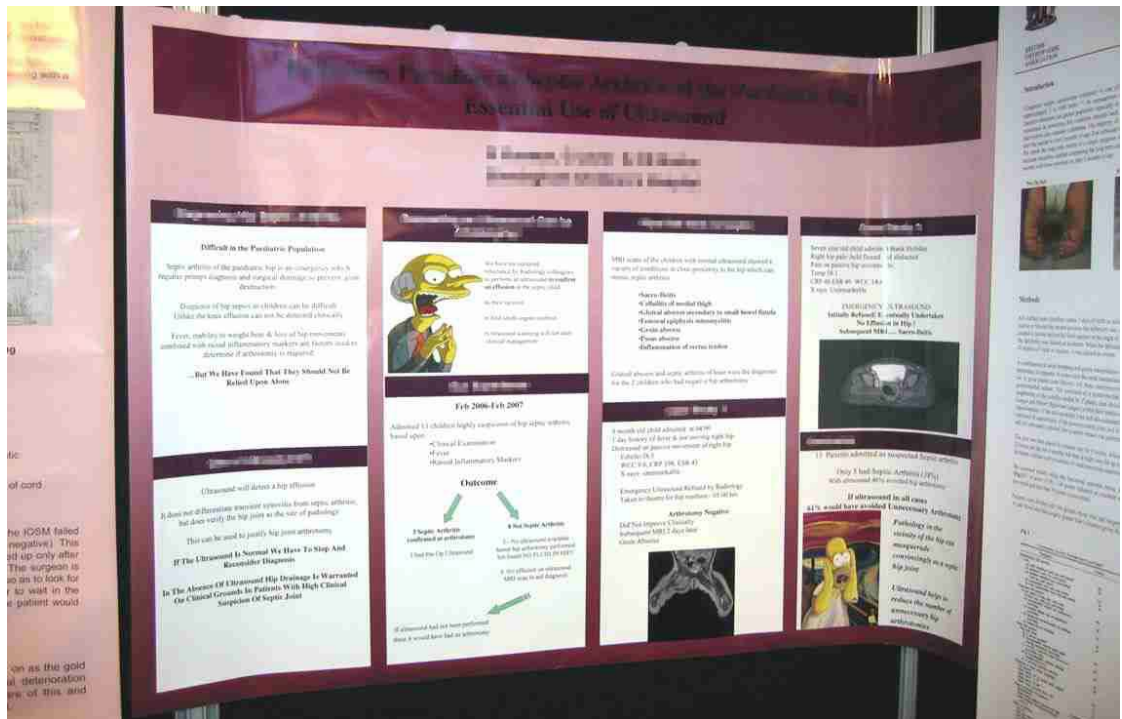


A typical conference poster session.

Some organisers may ask you to use a specially supplied poster template. If this is the case, you *must* ensure that you follow the template exactly as deviating from the design may make your poster invalid for acceptance and display.

Picture the scenario if you will. The organiser's instructions state that you need to produce an A1 size (595 x 841mm) portrait poster and you turn up to present your work with a beautifully designed and printed A0 size (1189 x 841mm) landscape poster! Best case scenario; your poster may still be accepted but it will look ridiculous in the allotted presentation space. Worst case scenario; your poster is rejected as you've not followed the instructions properly and your research doesn't get displayed at all. All your efforts, invested time and production costs have gone to waste.

Don't worry about any production costs for your poster as this does not apply.



Oops! Who didn't follow the instructions properly then? This poster is clearly encroaching onto other display boards as it's been printed landscape instead of portrait orientation as per the conference guidelines. While we're at it, why go to the trouble of making your title almost illegible by using a dark font on a dark background? I'm also sure the Simpsons Empire haven't permitted the use of their copyrighted characters. We'll discuss image copyright later. Bear in mind that all content should serve a purpose and enhance the quality of the poster. Purely decorative elements should be avoided as they detract focus and attention from the content that does matter.

Increasingly posters are required to be portrait orientation and A0 size (A Zero), although this is not set in stone. However, posters are not always displayed in a traditional printed format and increasingly may be required to be in the form of an ePoster. The Covid pandemic has necessitated and compounded this need. Don't get worried, all this means is that the poster you've already designed will be displayed in electronic format on large screens at the conference site along with other ePosters. Just as in printed posters, you'll be asked to email or upload your ePoster to the conference website before a specific date.

Conferences and meetings sometimes offer Awards for the best poster on display which is normally judged by a delegation of experts within the subject field. This will most likely be in the form of a certificate but can also be a monetary prize so it's always worthwhile spending as much time and effort as you possibly can to get your poster as good as it can be. Once you've submitted your poster, you'll normally be allocated a poster ID number which corresponds to a position on the exhibition floor plan where you'll display your poster. Ensure you use only the allocated display space with your associated poster number.

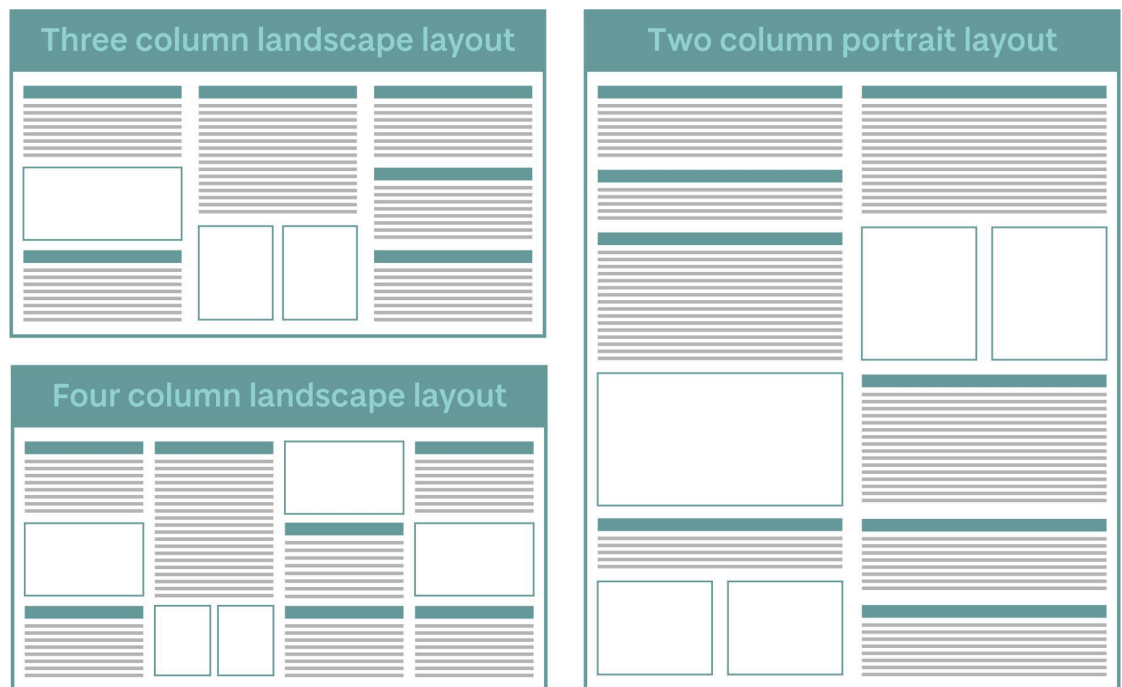
Well done for getting your research accepted at a conference, you're now ready to design your poster!

3.1 Your Instructions

We have a few simple instructions that we'd like you to follow:

- Your poster should be A3-size (420 x 297mm) - not widescreen. Or the dimensions of the templates you're supplied with. Don't worry too much about actual dimensions, as long as the ratio is correct = A4, A3, A2, A1, A0.

- For your poster, there's no right or wrong orientation so you're free to choose either Portrait or Landscape style. Choose whichever orientation you prefer and one you feel best suits your text and layout.



These tried and tested examples are the most commonly used poster layouts. Rarely would you use a three-column structure in a portrait poster or a two-column structure in a landscape poster.

- The University of Dundee logo must appear somewhere on your poster. The most obvious position is at either side of your poster title. Please ensure the correct logo, pictured right, is used. The logo file is an emf file which stands for Enhanced Windows Meta File. I doubt you'll have image software that can view it, so you must open the software you're using and insert the file that way, e.g. open **PowerPoint**, go to the top banner and select **Insert**, then choose **Picture** and select the **emf file** from where you've saved it. Any other logos associated with your research such as TAAG or NHS Tayside, will be provided for you on request. See correct usage of the University logo: <https://www.dundee.ac.uk/brand/design-guidelines/logo-shield/>
- We'll supply you with four poster templates. The first two are basic "Dummies' Guides" that if you fill in all the 'gaps' you'll have an adequate if somewhat bland looking poster. I'd suggest removing the blue lines from the text boxes as these are only there to highlight the column structure. We're looking for you to add your artistic flair and design input so please feel free to use any template you like and play about with colours and fonts. The other two are official University templates that you can also use if you wish and can be downloaded here: <https://www.dundee.ac.uk/brand/toolkit/templates/>. This doesn't mean you're obliged to use any of the supplied templates but you're free to express yourself and design your own from scratch if you wish.
- You only need to supply an electronic copy of your poster, and we'll print it for display and marking purposes. Posters should be emailed to me, [Ian Christie](#), and your course administrator. Please ensure that your Supervisor(s) have had the opportunity to read over your poster and give feedback before you submit; they're names do appear on the poster as co-authors after all.



**University
of Dundee**

Thesis Title to go here

Your name and Supervisor(s) name to appear here
Place of study, Course title and Year of course to appear here



<p>INTRODUCTION This is a very simple one-page, three-column, landscape design that will allow you to quickly and easily produce a basic scientific poster for your course submission.</p> <p>AIMS AND OBJECTIVES You will need to type, or copy and paste, your main text into these text boxes. You will also need to insert any images and graphic elements such as illustrations, tables and graphical data, into the poster. Ensure that any graphical elements are relevant to your study and not just added to 'fill a gap'.</p> <p>METHODS AND MATERIALS Only once you are satisfied that you have all the relevant elements inserted and spaced out properly can you then add colours, change text properties, insert bulleted lists and add design elements to ensure your poster is more attractive. The 'Methods and Materials' section is ideal for using photographs to illustrate how your research was carried out.</p>	<p>RESULTS Please note that the University logo must appear somewhere on your poster. The IMAR logo must only appear if your project is associated with the Institute of Motion Analysis and Research. If your project is a collaboration with another institute, say NHS Tayside or St Andrews University, then their respective logos should also appear on the poster. The 'Results' section will normally contain your graphs and tabular data.</p>	<p>DISCUSSION Section Titles can be in a larger and different font from the main text. The three text boxes (columns) have been given a coloured border purely so you can see the bounding area; this can be removed once the design is near completion.</p> <p>CONCLUSIONS Try to keep your poster as clear and concise as possible. Font size is dictated by the amount of text you wish to appear on the poster; this can be a tricky balance to strike. All graphic elements should be clearly labelled and referred to in main text.</p> <p>REFERENCES AND ACKNOWLEDGEMENTS You must reference any works in full that you cite in the main text of your poster. You should also acknowledge any person(s) who has helped with any part of your research but does not warrant being termed a co-author. Note that you can use a substantially smaller font for this section to create additional space if required.</p> <p>Please see Ian Christie if you require any help with your poster.</p>
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Our bland but perfectly acceptable (landscape) poster template, which you can edit and graphically enhance in any way you see fit. Remember to remove the blue text box border.



Poster title 82pt Calibri (60pt min), 12pt space after

Name 1, Name 2, etc. in Calibri 36pt Office, Address line 1, Address line 2, Town/city, Postcode in Calibri 36pt

<p>Introduction</p> <p>Body text: Calibri 32pt minimum. Avoid drop shadows, outlines and other text effects.</p> <p>Layout: This 3-column layout is a starting point only. It can be adapted to 4 columns or to be read across, instead of down, the page.</p> <p>For horizontal layouts, either make text boxes the full width of the poster or ensure they are of equal height (see below).</p> <p>To aid text legibility on wide panels, use no more characters per line than you would use on a portrait format A4 page. Text spanning the entire width of a poster will be difficult to follow – use more than one column if needed.</p> <div style="display: flex; justify-content: space-around;"> <div style="text-align: center;"> <p>Vertical 3-column scheme:</p> </div> <div style="text-align: center;"> <p>Horizontal layout:</p> </div> </div>	<p>Section 1</p> <p>Body text: Calibri 32pt minimum. Avoid drop shadows, outlines and other text effects.</p> <p>Colours: Block colours available from the University of Dundee colour palette can be used as solid backgrounds for sections.</p> <p>Please refer to the brand guidelines for more details on brand colours: https://www.dundee.ac.uk/brand</p>	<p>Section 3</p> <p>Body text: Calibri 32pt minimum. Avoid drop shadows, outlines and other text effects.</p> <div style="text-align: center;"> <p><small>Caption: emerge caption, Calibri, 20pt</small></p> </div>	<p>Discussion or conclusions</p> <p>Body text: Calibri 32pt minimum. Avoid drop shadows, outlines and other text effects.</p> <table border="1" style="width: 100%; border-collapse: collapse; font-size: 8pt;"> <tr><td>Row title</td><td>xx</td><td>xx</td><td>xx</td><td>xx</td><td>xx</td></tr> <tr><td>Row title</td><td>xx</td><td>xx</td><td>xx</td><td>xx</td><td>xx</td></tr> <tr><td>Row title</td><td>xx</td><td>xx</td><td>xx</td><td>xx</td><td>xx</td></tr> <tr><td>Row title</td><td>xx</td><td>xx</td><td>xx</td><td>xx</td><td>xx</td></tr> <tr><td>Row title</td><td>xx</td><td>xx</td><td>xx</td><td>xx</td><td>xx</td></tr> <tr><td>Row title</td><td>xx</td><td>xx</td><td>xx</td><td>xx</td><td>xx</td></tr> </table> <table border="1" style="width: 100%; border-collapse: collapse; font-size: 8pt;"> <tr><th>Column title</th><th>Column title</th><th>Column title</th><th>Column title</th><th>Column title</th><th>Column title</th></tr> <tr><td>xx</td><td>xx</td><td>xx</td><td>xx</td><td>xx</td><td>xx</td></tr> <tr><td>xx</td><td>xx</td><td>xx</td><td>xx</td><td>xx</td><td>xx</td></tr> <tr><td>xx</td><td>xx</td><td>xx</td><td>xx</td><td>xx</td><td>xx</td></tr> <tr><td>xx</td><td>xx</td><td>xx</td><td>xx</td><td>xx</td><td>xx</td></tr> <tr><td>xx</td><td>xx</td><td>xx</td><td>xx</td><td>xx</td><td>xx</td></tr> </table>	Row title	xx	xx	xx	xx	xx	Row title	xx	xx	xx	xx	xx	Row title	xx	xx	xx	xx	xx	Row title	xx	xx	xx	xx	xx	Row title	xx	xx	xx	xx	xx	Row title	xx	xx	xx	xx	xx	Column title	Column title	Column title	Column title	Column title	Column title	xx	xx	xx	xx	xx	xx	xx	xx	xx	xx	xx	xx	xx	xx	xx	xx	xx	xx	xx	xx	xx	xx	xx	xx	xx	xx	xx	xx	xx	xx
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The official University poster template (also landscape format) with University Brand colours. Templates and other University Brand elements, and how to implement them, can be found here:

<https://www.dundee.ac.uk/brand/>

I'd like to take a second to mention writing style here. A lot of academic works are overly wordy in their approach, using incredibly long words, unintelligible jargon, and over-complicated sentences. I'd suggest writing your poster in short, clear sentences, which are far easier to read and understand, and can make your point quicker and more forcibly. The use of bulleted lists where appropriate instead of long passages of structured sentences is also a good method of reducing the amount of text you use.

This may shock you, but I'd suggest you use no more than 300-400 words in your poster. Try and make every sentence as concise as possible. This is not a vocabulary exercise, so no flowery, descriptive language, please. If people are ignoring your poster, it's likely overly wordy and they find the prospect of spending several minutes reading your introduction daunting. Less but accurate content is definitely more where posters are concerned.

Another reminder here is for you to please standardise elements within your poster. It wouldn't be the first time I've seen figures referred to as 'Fig. 1' 'Figure 1' and 'figure 1' all in the same poster! Similarly, standardise words such as 'pre-operative' 'pre operative' and 'preoperative'. Also, refer to your participants in the same way throughout the poster and not as 'volunteers', 'participants' and 'patients' on the same poster. These general rules should also be applied to your Thesis Dissertation.

4. Which Software?

There's an abundance of software currently available for design projects such as posters but the vast majority of these can be expensive as well as having steep and time-consuming learning curves. There can be no denying the power and capabilities of such industry-standard software as [QuarkXPress](#), [Adobe Illustrator](#), [CorelDraw](#), [Adobe InDesign](#) and [Spark](#) but mostly these are aimed at professional designers, which in most cases, we're not. If you're already familiar with such a software package this would be the software of choice to use, but if this is your first attempt at a poster, we encourage you to use **Microsoft PowerPoint**.

Some professional sources will specifically tell you to avoid using Microsoft PowerPoint to design a scientific poster ... but why? PowerPoint is not a program typically designed for or used for publication layout or graphics but on the plus side, you'll probably already have it installed on your PC or laptop and be familiar with its functions. Ultimately, it's not the design software that determines the success of a poster but rather the planning and creativity of the individual using that software.

You can achieve satisfactory results quickly and easily using PowerPoint by utilising the in-built templates and effects functions and by having some straightforward design input. There's also no need to spend your valuable research time learning the intricacies of unfamiliar software that you may use only once or twice a year. You're not a professional designer who requires exact colour-matching or switching between RGB and CMYK values so therefore it's best to use something that we know how to work, which works quickly and gives excellent results. Your research study time is precious, so, PowerPoint it is!

5. Preparing Your Scientific Poster

As with any type of presentation, it's important to spend some time planning the structure before considering details of the content. Then decide or determine:

- What is the purpose of your poster; what message do you want to convey?
- Who is your audience; at what level should your poster be pitched?
- Major sections to include; objectives, introduction, methods etc.

- Fill in the details; decide exactly what needs to be included. Your supervisor’s advice here is invaluable.
- Edit - review - spell check - edit again; will invariably mean reducing text, not adding more.

It’s best to allow yourself at least one week to plan and produce your poster, anything less may prove stressful, and the rushed result may not do you or your research the justice it deserves. Remember I mentioned earlier that I feel a good starting point for your poster is to use your **Abstract** and expand and adapt its content.

Throughout the planning process ask yourself if you have answered the following questions.

- What was done?
- How was it done?
- Why is it important?
- What is your take-home message?

It’s worthwhile looking at sources on the Web or around the University Campuses at other posters from various disciplines. This will give you an initial feel for style, design, level of detail and methods of construction. Be wary, however, just because it’s on the Internet or pinned to a wall doesn’t mean it’s any good!

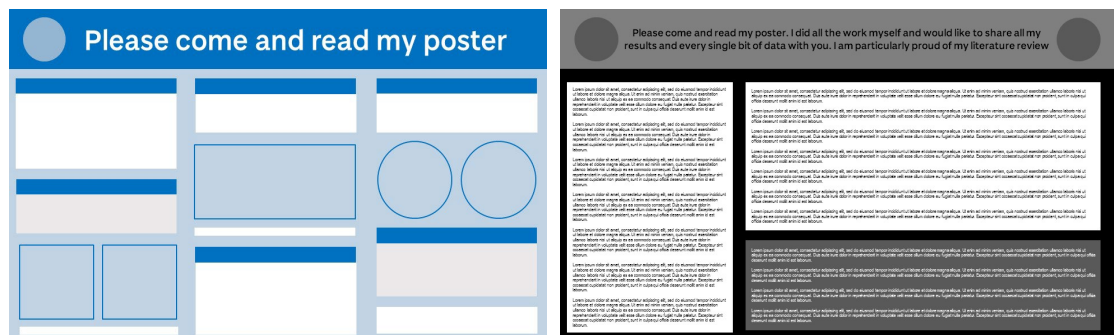
Therefore, try to critique any posters you see = what’s good about it, what would you do to improve it, is there too much text, too little text, do the images add to the understanding etc. I’ve supplied some instances of good and not so good posters at the end of these materials so please check them.

6. Poster Content

Typically, a poster will be 841 x 1189mm which is termed A0 size (A Zero). As the text and figures need to be large enough to be read from a distance of at least one metre this means you’ll have a limited amount of space available for main content. As mentioned previously, always ensure you’ve read the instructions issued by the conference organisers relating to poster presentations before you embark on producing your poster as this can save you valuable time and resources.

Picture the scene. You’re attending a poster session and upon entering the exhibition space you’re faced with over fifty posters. You’ve a 15-minute period in-between oral presentations so which poster do you gravitate towards? Most likely the poster that attracts your attention quickest I’d reckon. Therefore, making an instant impression is vital.

Look at the two posters below, which one would attract your attention?



I’m guessing and hoping you chose the left-hand poster(?)

Also remember that all these posters are competing for attention, and your audience will probably only spend a few minutes looking at one poster before moving onto the next. Therefore, it's vital that your message is clear and can be gleaned from your poster quickly and easily. Merely pinning up an enlarged scientific paper written for a journal is not acceptable.

The best approach is one of simplicity by presenting only the most important aspects of what you've accomplished with your research. Then if a reader has further interest in your topic, they can discuss things in greater detail with you or by contacting you at a later date. I reiterate that it's vital that you ask your Supervisor's advice on how best to approach your poster and what should appear in it.

6.1 Sections to Include

The following format for structuring research has evolved over many years and is now followed virtually without exception. It's called the **IMRaD** structure (**I**ntroduction, **M**aterials, **R**esults and **D**iscussion) and most, but by no means all, posters will follow this format of headings.

TITLE BLOCK: This will be the largest font size used in your poster as it's the first means of attracting attention. Make this text as large as you possibly can without it interfering with other elements within your poster, and without looking ridiculously large. Directly underneath the title, you should state the author names (you as lead investigator should appear first) and the institute or place where the study took place. It's also useful to include the title of the course you're studying and the year(s) of study. Academic works normally use the surname followed by their initials when referring to authors, e.g., Blogs J, Christie IS, Drew TS. The list of authors should only include your Supervisor(s) and people who contributed *substantially* to the research work. Individuals that helped you but don't merit author status are more appropriately included in a list of **Acknowledgements** at the end of your poster.

The following criteria can be used to help you decide who to include as your co-authors:

- Could they present and defend the work at a conference?
- Did they actively contribute to the design and execution of experimental work?
- Will they accept intellectual responsibility for the reported results?
- Did they contribute significantly to the novel aspects of the work?



An example of a poster title header incorporating a graphical element and institution logos.

INTRODUCTION: Get your audience immediately interested by explaining the background of your subject but be concise and only include the most relevant details. Avoid writing a literature review but if you must, only use the most relevant references ... but not too many. Your introduction should also include the **Aims** and **Objectives** of your research. Sometimes these two terms can get confused and are just itemised in the same bulleted list. Ensure you differentiate between the two; the Aims are what you hope to achieve from your research and the Objectives are the steps you'll use to achieve these aims.

METHODS AND MATERIALS: This section should outline the techniques used to carry out your experimental work, equipment used, participant demographics and data collection techniques. This lends itself to a bulleted list format and is an ideal place to show photographs and diagrams of any equipment used and participants involved, particularly if the research is of a

dynamic nature, such as gait and motion analysis or sports. Explain your statistical analysis methods and the software used to analyse your results; I would suspect in most cases this would be SPSS. Try to keep this section as short as you can. Any images, diagrams, or other figures that you use should be produced to an impeccable standard. We will go into this in greater detail later.

RESULTS: You'll probably need to summarise your results or concentrate on just a few most important examples. Present your results graphically and use tabular data where appropriate. You may find that you have hundreds of graphs and tables in your thesis and associated Appendices, so you must concentrate on your main findings and only explain and display the most pertinent results.

DISCUSSION: State why your findings are important and the relevance of your results with previously published research studies. Mention if your findings apply to clinical practice or any other areas such as rehabilitation, prehabilitation or injury prevention. State any limitations with your study as this also highlights that you've thought critically about the research.

CONCLUSION and Future Recommendations: This should state your main findings and whether your aims have been attained. This is arguably the most important piece of text in the entire poster so try to make it stand out from the rest of the text. You can do this by using a slightly larger or bolder font, or by using a different background/text colour than the rest of the presentation. A bulleted list is an effective way of presenting your conclusions as it can be quickly assimilated. State any recommendations and your thoughts regarding any future research of your study. Ask yourself WHY your research is important and answer this question by explaining why your audience and peers should be bothered about your findings.

REFERENCES and Acknowledgements: Reference any citations used throughout the main text of your poster. The most commonly used reference style is the Standard Harvard system but ensure you use the organiser's preferred citation method and remember there's no need to reference all citations used in your entire research but only those you've cited within the poster itself. Your study may have been funded by a charity or an external funding body, if so, it's usual and proper to acknowledge this. Please note that any images that are not your own personal copyright (e.g., images downloaded from the Internet or scanned from books or publications) should also be referenced appropriately. Finally, acknowledge any individuals who have helped and contributed in any way to your poster but do not satisfy the criteria for co-authorship but please try to avoid an 'Oscars acceptance speech' style list of names.

CONTACT DETAILS: It's a good idea to supply some contact details so readers can correspond at a later date. Normally an email address or a website URL will suffice but increasingly QR codes (see right) are being used that can be scanned on smartphones to link to a website or a file of particular interest. This will give the reader further content, perhaps more tabular data, and images or even videos for a better understanding of your research. It's not enough just to plonk a QR Code on your poster, however. You need to explain why the viewer should scan it by stating what the code will link to. Would you scan any old QR Code without the knowledge that where you're being taken is relevant and safe to do so! Some people find it's best never to give out your personal mobile number so in such instances use an email address as a contact.

Unless specifically not allowed by a conference organiser, a much smaller font size should be used for References, Acknowledgements and Contact Information. Some presenters make the mistake of using the same font size as the main body of text and obviously, these sections are not as 'important' visually as the main research content.

7. Design Elements

An effective poster should convey its message mainly by graphical means. Short statements should link, and lead the viewer, from one figure to the next in a seamless and easy to follow fashion. Large sections of text should be avoided where possible. Remember to try and *show* rather than *write* what you have done.

Some research topics don't lend themselves to displaying great photographs and images, so if for example, you're conducting an audit on existing data, there are ways and means to make your graphs and tables stand out and look more interesting.

It's usually best to use vertical text ordering as this makes it easier for several people to read your poster at one time. They tend to get in each other's way if a horizontal-ordering pattern is used. Whichever ordering sequence you choose make sure the reader can easily see which section leads onto the next. You can do this by numbering each section or by connecting them with arrows but if you've planned a simple column structure your text should flow effortlessly without the need for additional navigational elements. Remember that effective design logically guides the reader through the presentation, reading from left to right and from top to bottom, in most cultures.

7.1 Fonts

Choosing a legible font (typeface) for your text is vital to the success of your poster. It does, after all, need to be legible. Remember to make all the text on your poster large enough to be read from approximately one to three metres.

Essentially there are two types of fonts, **Serif**, and **Sans Serif**. Serif fonts have extra strokes or decorative flourishes at the ends of the letters, whereas sans-serif fonts end sharply with no added embellishments.

TIMES NEW ROMAN = Serif

ARIAL = Sans Serif

Serif fonts are commonly used in newspapers and books as they are believed to increase readability. It's a general rule of thumb to have Headings in a sans serif font, with the main body of text using a serif font. Which to use is subjective and depends on personal preference and the particular project and its requirements. Why not try for yourself when you've drafted your poster and see which way you find more readable and pleasing on the eye.

Always restrict the number of fonts used. One of the biggest mistakes in bad poster presentations is to use too many different styles of font. This creates an amateurish, unorganised and sometimes chaotic appearance. With today's software, it can be tempting to use numerous stylish and quirky fonts ... please resist this temptation! Remember this is an academic piece of work and not a cartoon strip.

Stick to one or maybe two fonts. Remember that *italic* and **bold** can be used with a single font to subtly change the appearance and importance of what is being said. Alternatively adding **colour** to text can enhance **specific** elements that you may wish to highlight.

Another reason for keeping fonts simple is the process of 'font substitution'. This is when you send your poster to get printed by an external source. The printing company you use may not have 'QuirkyFontSansSerif.ttf' on their system and their software will substitute this font with one it thinks matches best. Font substitution can lead to all manner of formatting errors possibly making your poster a jumbled mess.

7.2 Font Alignment

You may have heard the term ‘font alignment’ being used? This describes how text is placed upon the page relative to its bounding margins. There are four commonly used alignment options:

- Left aligned
- Right aligned
- Centred
- Justified

This is an example of **Left Aligned** text. The quick brown fox jumps over the lazy dog. The quick brown fox jumps over the lazy dog.

This is an example of **Right Aligned** text. The quick brown fox jumps over the lazy dog. The quick brown fox jumps over the lazy dog.

This is an example of **Centred** text. The quick brown fox jumps over the lazy dog. The quick brown fox jumps over the lazy dog.

This is an example of **Justified** text. The quick brown fox jumps over the lazy dog. The quick brown fox jumps over the lazy dog.

Which alignment technique you use will depend on what text it’s applied to. Main textual content should be either left aligned or justified and even then, it depends on how long the lines of text are, i.e., how many words are on each line. Rarely would the main text be right aligned and very rarely, if ever, would it be centred.

Say for example you have a two-column structure to your poster. If you justify the text, the software automatically spaces out each word to make it reach from one margin to the next. This can make the words look spaced apart with large gaps between words. Not only can it look odd but it’s more difficult to read.

This is an example of **Left Aligned** text. The quick brown fox jumps over the lazy dog. The quick brown fox jumps over the lazy dog.

This is an example of **Justified** text. The quick brown fox jumps over the lazy dog. The quick brown fox jumps over the lazy dog.

You can see that the left-hand box, which has text aligned left, is more legible and pleasing on the eye than the justified text in the right-hand box.

If you didn’t already know “The quick brown fox jumps over the lazy dog” is a *pangram* , which is a sentence that contains every letter of the English alphabet.

7.3 Sentence Case

Format all your main text in what is termed ‘sentence case’ as it’s so much easier to read than being capitalised. Read the two paragraphs of text below as an example.

VERY FEW STUDIES HAVE BEEN CONDUCTED ON THE KINETIC ASPECTS OF GAIT ANALYSIS TO DATE. KINETIC PARAMETER SUCH AS POWER, WHEN USED AS A TOOL TO MEASURE THE LEVEL OF LIMITATIONS IN CEREBRAL PALSY (CP) CHILDREN, OFFERS BETTER SCIENTIFIC EXPLANATIONS OF THEIR IRREGULAR GAIT.

Very few studies have been conducted on the kinetic aspects of gait analysis to date. Kinetic parameter such as Power, when used as a tool to measure the level of limitations in Cerebral Palsy (CP) children, offers better scientific explanations of their irregular gait.

I think you'll agree that the second paragraph is far easier to read. Using all capitals is normally fine for Headings and very short strings of text such as short figure captions.

8. Graphical Elements

Graphical elements are vitally important in poster design, as the success of your poster will be determined by their clarity. Graphics, including photographs, tables, graphs, and illustrations, should be the backbone of your poster. To use an orthopaedic analogy, the main text should be the 'ribs' linking each 'vertebral' image!

All graphics should be clear and self-explanatory with labels and text added for clearer understanding. Ask yourself if the graphic is relevant and not just there to fill a gap in your text. All your graphic elements should be clearly captioned and referred to in the main text of your poster. A general rule of thumb is to aim to have an equal number of graphics to text blocks which will help balance your poster. This is not always practical or achievable, but it's a good point to aim for. Also, if you have a series of graphs or images, try making them all the exact same dimensions and have them evenly distributed and aligned.

It's normal practice to have sequentially numbered Captions describing each graphical element. Any tables should have the Table Caption above the table whilst all other images should have the caption below.



I'd suggest you watch Dr Andrew J. Murphy's series of tutorials about using images in your research. These are excellent learning resources and can be found in your course resources on the University's Blackboard My Dundee platform.

8.1 Photographs

Yes, it's okay for you to take your own photographs and yes, it's okay to use your mobile to take them! Camera phones these days are so sophisticated and easy to use it'd be silly not to utilise them. There are a few simple rules to follow, however. If you're taking and using your own photos make time to compose the scene well. Ensure that the photo is clear, well lit, uncluttered and shows *only* what you intend to show.

When staging your photograph ask yourself what's important, focussing especially on what's in the background of the shot. Leave plenty of space around your central image - remember you can crop an image but can never add to it once taken. Also, ensure that date and time feature are set to OFF as this can sometimes obscure an essential element of the photo whilst at the same time dating the work.

I'd also suggest taking as many photographs as you can, especially if you're taking shots of participants, patients or volunteers during experimentation. There's nothing worse when writing up your thesis than thinking you should've taken a photograph a particular way or from a different view and angle.

When taking photographs of volunteers and patients please ensure they've given written consent that any images they appear in can be used in future presentations or publications. If consent has not been granted you *must* ensure that all features and identifying factors are obscured. This is best achieved by blurring or pixelating the features on the original photograph.

If you're taking photographs of different subjects on different days, it's a good idea to set your phone/camera onto a tripod and keep the tripod in the same position for each subject. This adds uniformity to all your photographs and gives a more professional result. Using a tripod also stabilises any inherent shakiness which may cause blurriness.



Where do we start?! These two images somehow found their way into dissertations.

If I remember rightly, the left-hand figure intended to show an example of 'claw-toe' but look at the background! It's like a game of "How many superfluous items can you spot?"

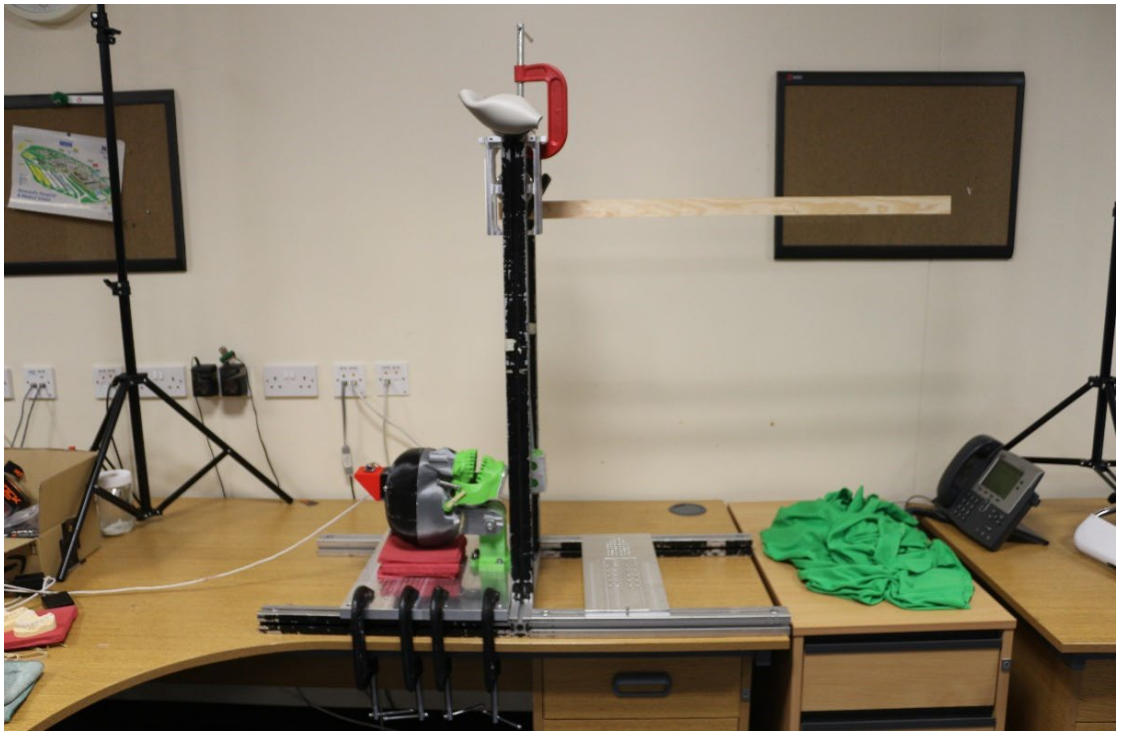
- 1) Coat-hanger
- 2) Lab coat
- 3) Walking stick
- 4) Doorstop
- 5) Red chair
- 6) Filing cabinets
- 7) Even a person!

Placing the foot in front of a white wall or any self-coloured background would have improved this photograph instantly.

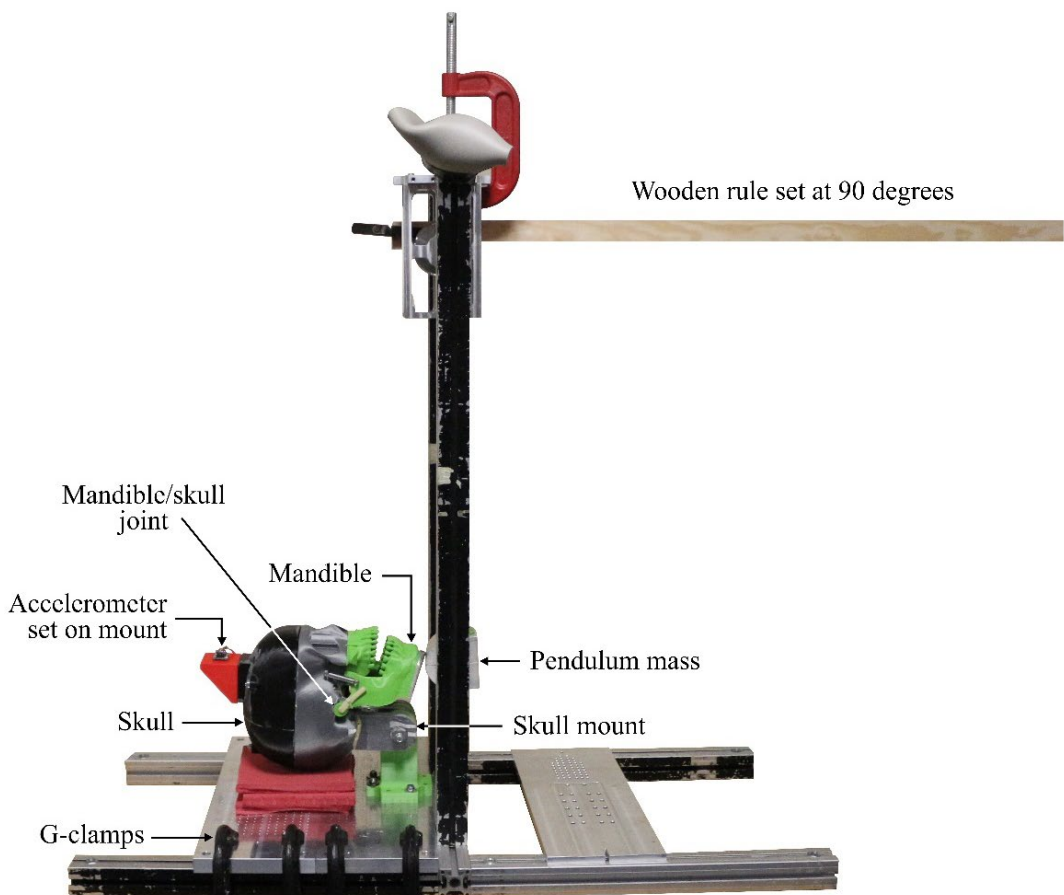
The right-hand figure looks as though Dr Arnold, unsuccessfully disguised with a black box over his eyes, is standing in his kitchen preparing to go barefoot hiking! The only crucial elements in this photo are the subject, the rucksack, the footplate and the scales, everything else is unnecessary and confuses the viewer and the point you are trying to convey.

These two examples could be easily improved by removing the backgrounds and adding labels and text, explaining what each element is. Remember to make any labels or added text large enough to be read from a distance.

The following diagrams show an original photograph that was taken for a research project on the forces impacting upon different sporting mouthguards. By masking the background and adding a few labels it becomes much clearer and more academically sound.



Original photograph of experimentation rig.



Final diagram with background clutter masked and removed. Labels added for clearer understanding.

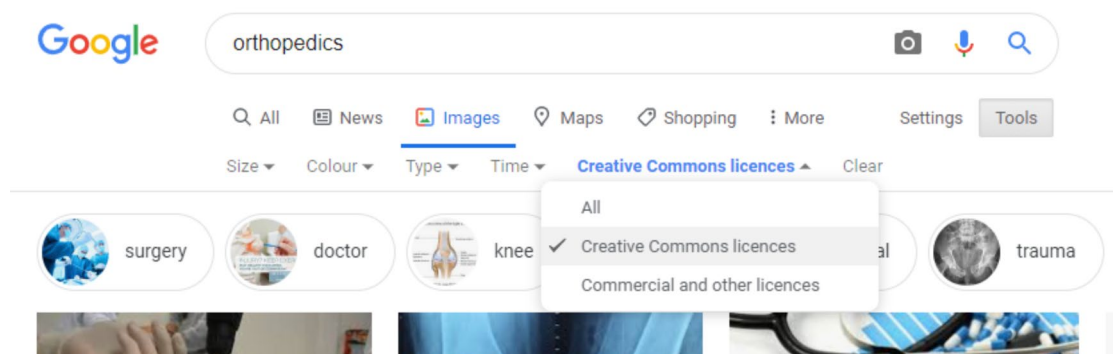
8.2 Web Images

As we all know, web images are free to download and use. **WRONG!** You must treat any images you use from the internet, in the same manner, you would a written citation. Simply adding the term 'adapted from' in your figure caption does not give you the right to use any image you find. Someone has created the image and therefore it must be attributed properly. This normally takes the form of the original image source and not from the Search Engine (e.g., Google) you used to find it (see example below).

Marshall, J. (2000). Hemiarthroplasty. [Online image]. Available at: www.surgeonsrus.org.uk/images/hemiarthroplasty_image.jpg (Accessed 22 October 2022).

It is important that you state an access date as the internet is a constantly evolving beast and the image you cite may not be at the same URL in the future. Web images can be confusing and take several different forms, the most common of which are listed below.

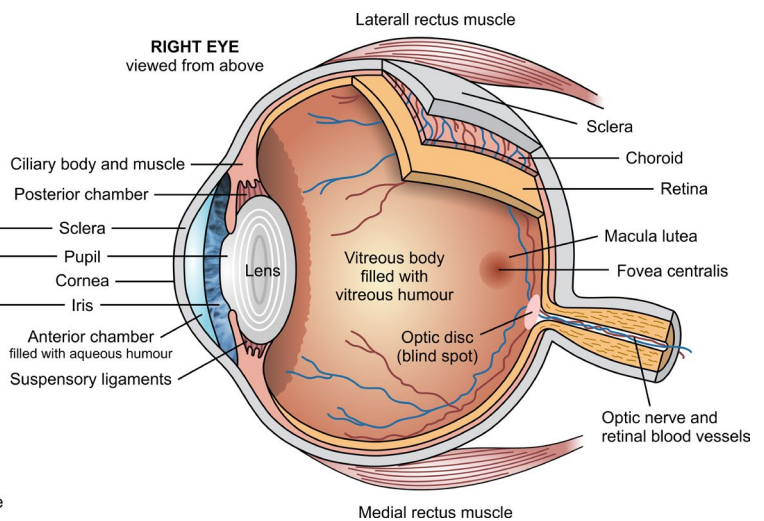
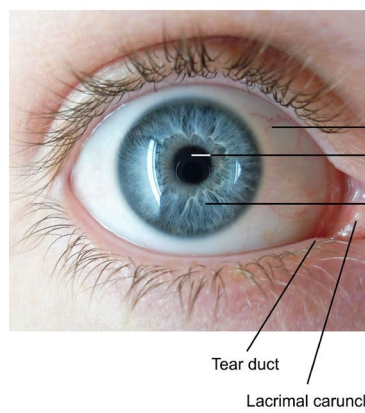
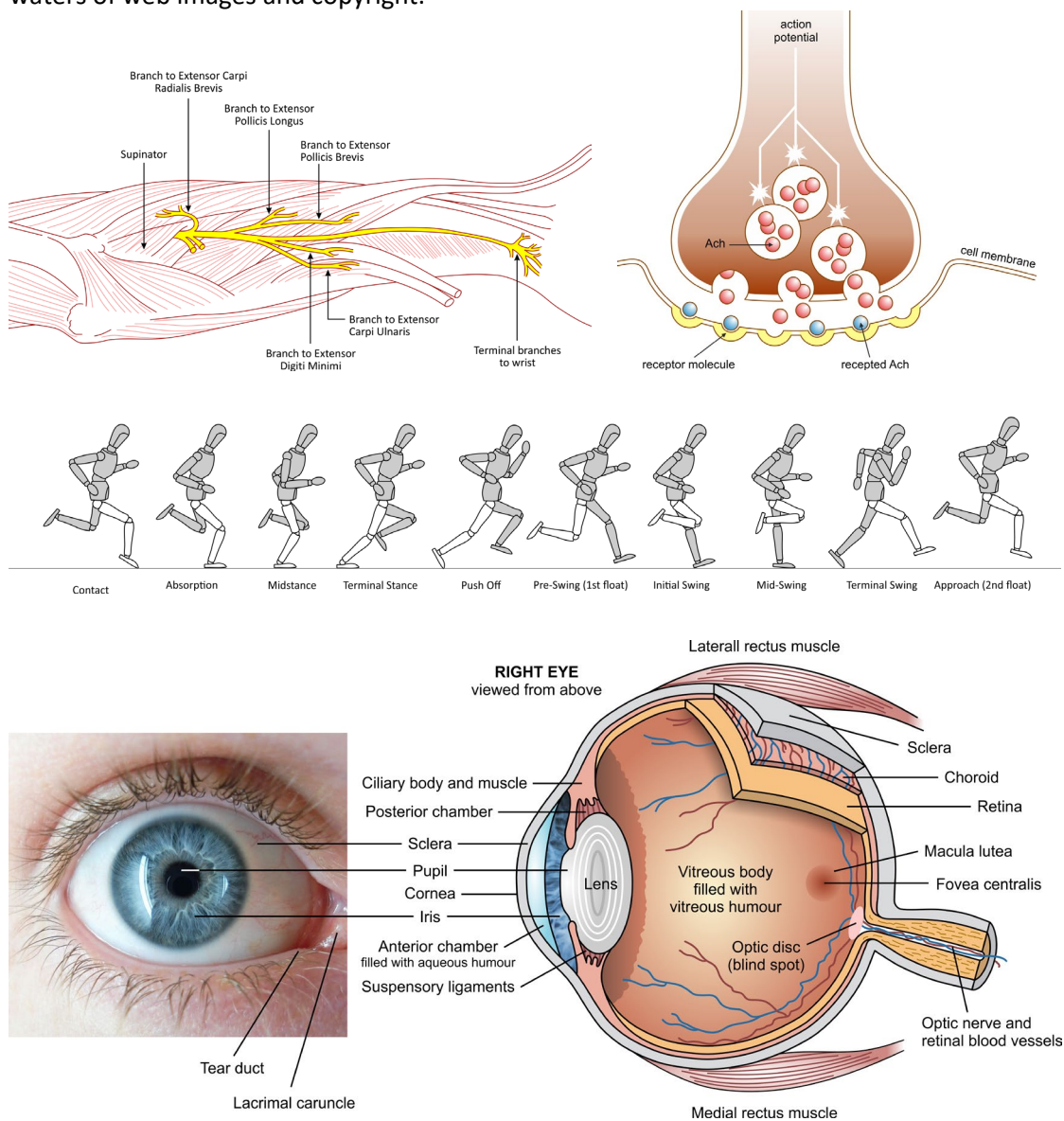
- **Royalty-Free Images.** Be cautious of the term 'free' here. This can be very misleading because a royalty-free image means that even though you're not required to pay every time you use it, you're still required to make an initial purchase of the rights to use the image.
- **Public Domain Images.** You're free to use public domain images without any restriction as the copyright has either expired, the image never had copyright in the first place, or the owner has agreed that the image can be used. May still require a citation.
- **Creative Commons (CC) Images.** CC is a public copyright license where the original creator of the image has agreed to allow others to use and adapt the original free from any charges. You can find such images on websites such as Wikimedia Commons and Flickr Commons, but ensure you check whether any creative commons and public domain images you use require an attribution or a URL to the original image source. See search criteria using Google images below.



- **Clipart.** I'm sure you wouldn't, but *never* use Clipart in any academic work and always avoid downloading watermarked images. The watermarks are there for a reason, namely that the image is under copyright and is not free to use.



I suspect any images you'll need will be specific to your particular area of research, so I suggest it's best to take your own photographs or ask a member of staff to take them for you. I can also produce any bespoke illustrations or diagrams for you. Depending on workload, these normally take less than a week to produce and you don't need to worry about the murky waters of web images and copyright.



Some examples of bespoke diagrams produced by Ian Christie for previous student research projects.

There are many useful image databases you can access via the [Library and Learning Centre \(LLC\)](#). The University also has a license agreement to use software called [Primal Pictures Anatomy TV](#) which is a great anatomical image repository. To access the images, go to the Anatomy TV website and choose the **UK Shibboleth** login option (green button). Then select the option for the University of Dundee and enter your @dundee.ac.uk credentials.

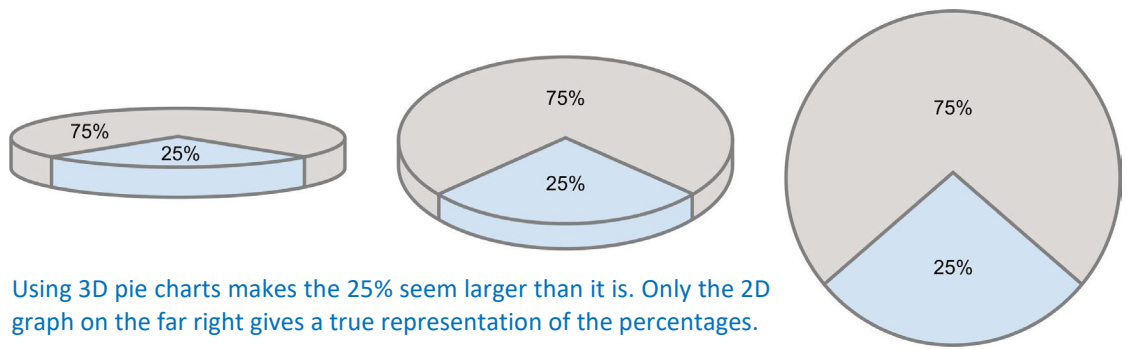
8.3 Graphs and Tables

Almost every scientific poster will require some graphical and/or tabular data to be included so your readers can better understand your Results. Software such as SPSS and Microsoft Excel are commonly used but they can produce different looking graphs so be sure to use the correct style of graph for what you are attempting to show. Refer again to **Dr Andrew J. Murphy's** excellent resources on the University Blackboard VLE.

You may have produced several, if not hundreds, of graphs for your thesis but unfortunately, I'd suggest leaving most of them out. Not that they're not all vitally important to your research but you'll need to carefully select only the very essential graphical data for your poster. One or two excellent graphs are better than seven or eight overcomplicated ones that are difficult to understand.

In my experience, it's best to remove any unnecessary borders, lines, backgrounds, and any unnecessary labels and markers from graphs. If it's not needed, get rid! Simplify your graphs and tables as much as possible by removing all non-essential information and ensure that the text axes and legends are large enough to be legible from one metre. Use flat styles and solid colours and highlight any important values in your data. Be consistent with the style of graphs and the colour scheme used as this shows attention to detail and reduces any chances of confusion as to why assorted colours have been used.

Avoid applying dark backgrounds to graphs as this makes reading them more difficult. I'd suggest not displaying two-dimensional data in 3-D graphs. Three-dimensional shaded graphs look impressive but not for sound academic work as they can create optical illusions which complicate the true difference of bar heights and make pie-chart data look confusing.



Using 3D pie charts makes the 25% seem larger than it is. Only the 2D graph on the far right gives a true representation of the percentages.

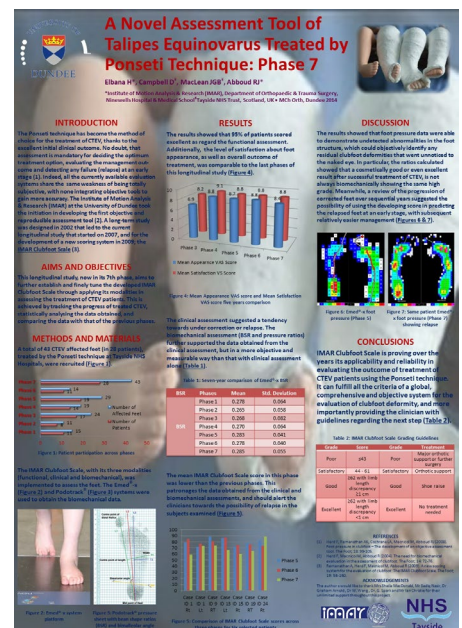
8.4 Backgrounds

Keep your background non-distracting. I'd recommend that you use a white or another light-coloured background for your poster. You should avoid photos, busy patterns, or distracting colours as these will shift the focus away from your poster content. If you simply must use a darker colour, ensure your text is white (or at least lighter) to maintain legibility.

Generally speaking, using a photograph as a background image for your poster rarely looks good and at worst is disrupting to the viewer (more about the poster pictured on the right in Section 15).

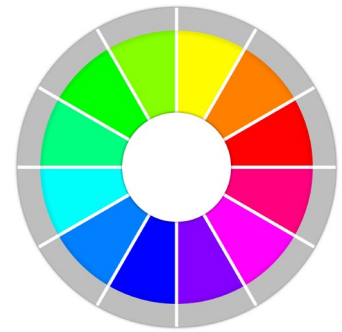
It's an especially difficult graphical effect to create successfully as the image tends to overpower the text and make the poster difficult to read. If you try to get around this by making the photograph transparent or 'bleached out', it's then difficult to make out what the photograph is of, again confusing the point of including it.

Using an image as a background also renders it impossible to have any white space on your poster (see Section 8.6). It's best to leave the background white, grey, or use a light colour from your preferred colour palette.



8.5 Colour Palette

Colour can liven up your poster and make it more visually appealing but please be selective of the colour combinations you choose. I'd advise you to use only 2-3 different colours and it's best to avoid bright clashing colours which are opposites on the colour wheel (see on right) such as blue-orange, green-red, and purple-yellow. Some colour combinations are difficult to read and should be avoided. You'll notice from the examples below that choosing the correct colours is vitally important to the legibility of your poster.



Blue text on a red background appears blurred

White text on a black background eventually strains the eyes

Yellow text on a white background is hard to see and difficult to read

Red text on a green background makes you feel a bit queasy



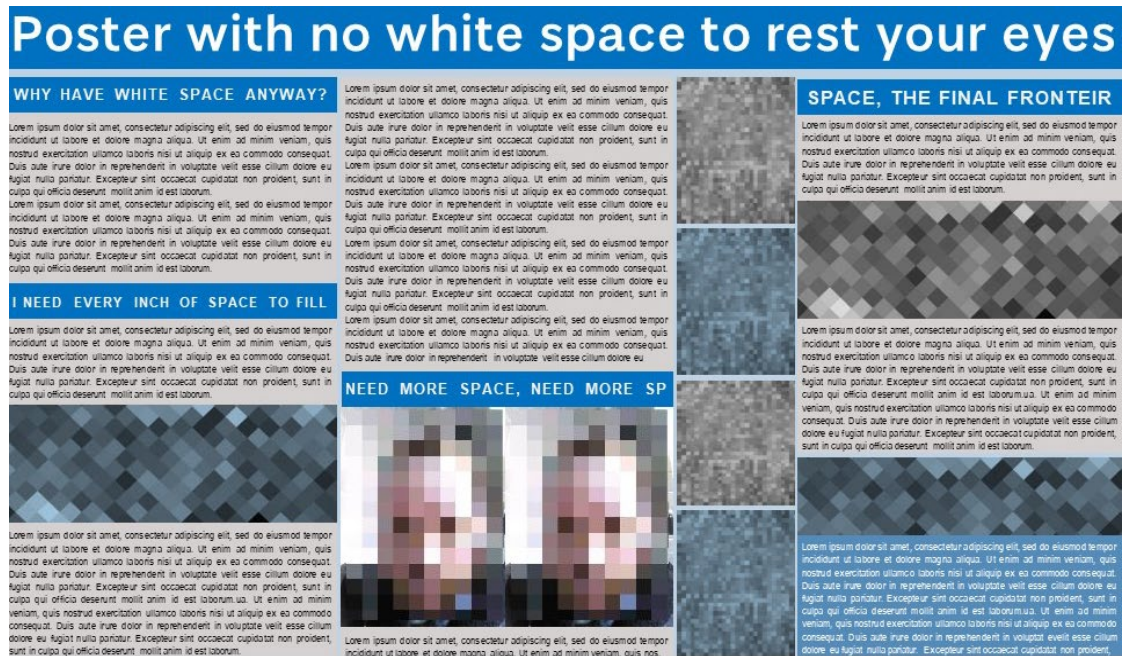
Ouch! True, this poster attracts attention but nobody's going to hang around long to read what may well be amazing academic content but could bring on a migraine.

Please be aware that people who suffer from colour vision deficiency (colour blindness) may not see the same colours you choose, which can be an issue when designing your poster. A few things to bear in mind include not relying solely on colour to convey a message, keeping your colour palette limited to two or three colours, using texture and patterns to show contrast, carefully selecting any contrasting colours and shades, and avoiding using bad colour combinations. Please see further information here:

<https://www.getfeedback.com/resources/ux/how-to-design-for-color-blindness/>

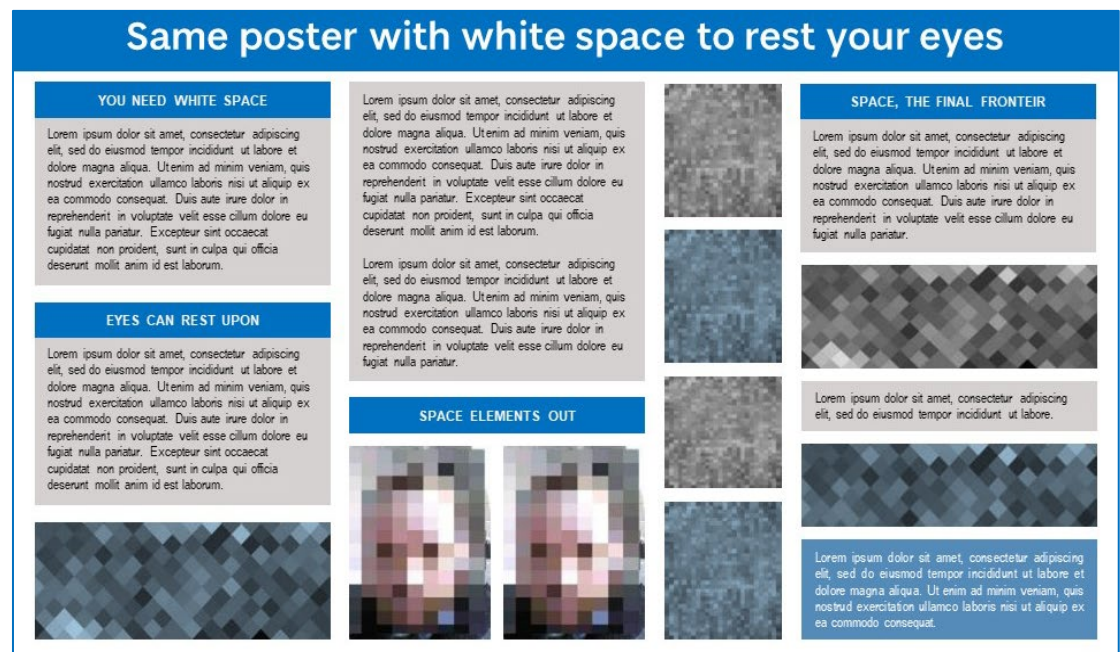
8.6 White Space

White space, sometimes referred to as ‘negative’ space, is not *negative* at all. A cramped and overcrowded poster is difficult to read so white space is your friend. I tend to think of white space as another graphic element, albeit an invisible one, that separates content and gives structure to your poster. Ensure you leave white space around each unique element (text block, table, image) and always leave an equal-sized border of white space around the poster edges.



An example of a poster with no white, or negative, space. Not hugely appealing, is it?

It's best not to try and fill every available space with text and graphics as the eye needs a place to rest while the brain processes the information it's received before going onto the next item on your poster. This may surprise you, but I'd suggest that 10-20% of your poster should, in fact, be blank. Look upon each element of the poster as a picture that needs a surrounding frame to separate each element.



The same poster with added white space, gives the viewer places to rest their eyes whilst reading. The text has been edited so only essential information appears. The poster is now in digestible chunks.

9. Common Pitfalls of Poster Design

Leaving it to the last minute. Posters take longer to produce than you may at first imagine, so please ensure you set aside as much time as you possibly can to concentrate on its construction.

Overcrowding content. It's a common mistake to try and fill every millimetre of available space but trying to cram as much information into the poster as you can just makes it look amateurish and chaotic.

Using too small a font size. It's an easy option to reduce the font size to fit more textual content into your poster. The secret is to use the minimum amount of text you can. Be mindful that your audience will be viewing your poster from at least one meter away so all the text must be legible from that distance. The reason why it's difficult recognising when a poster has too much text is that nearly every poster you'll see has too much text! The common option is to try and emulate any posters that you've seen, but that invariably repeats the same mistake everyone else makes.

Using a quirky font. Remember that this is a piece of academic work and should not use quirky or unusual fonts. Legibility and simplicity are the keys to successful poster design.

Using too many different colours. The last time I looked there were 16 million different colours available on my Microsoft Windows system but using two or three is key to the overall look of your poster. Using too many colours is distracting, confusing and unprofessional.

Spelling, grammar and punctuation error's. Always use the spelling facility in Powerpoint. Any misspelt words will be underlined in red making them easy to spot. I'd suggest asking your supervisor to give any piece of work the once over and why not get a couple of your fellow students to check for errors. [Grammarly](#) is a free app with a paid-for premium option. The free downloadable version will highlight the most common spelling and grammatical errors and suggest suitable alternatives.

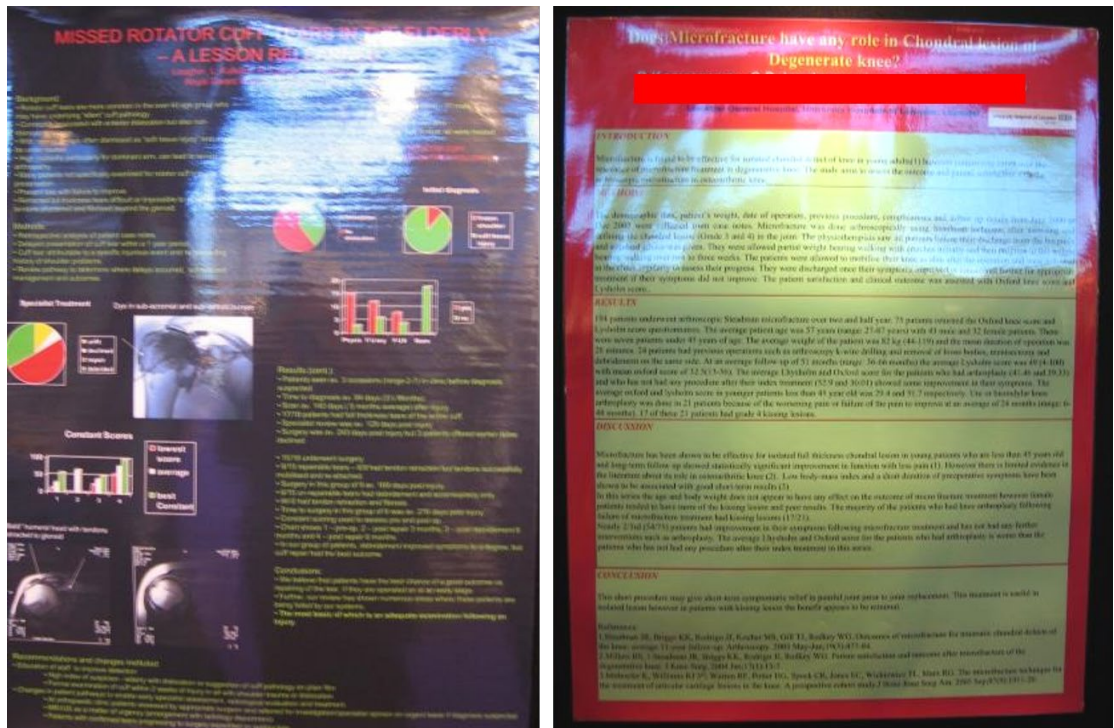
10. Getting it Printed

The good news is that you don't need to get your poster printed! It'll be printed for you for at no cost and in large format, which you can keep once the poster has been displayed and marked. However, now you are more familiar with the process you'll require some information on how to go about getting any of your future research posters printed.

Most print companies prefer your poster in PDF format. Portable Document Format (PDF) is a file format that presents documents, including text formatting and images, in a manner independent of the software, hardware or operating system used to produce the document. This ensures that colours are a correct match, and your fonts are embedded into the file so that what is displayed on screen is exactly what you'll get printed out. Perhaps you remember the old acronym WYSIWYG? More than likely you're far too young, but it means What You See Is What You Get. But I digress ...

Zoom into your images as much as possible to check they are sharp and not pixelated. Remember a printshop worker will only print your poster. Even if they see an error or things look strange, it's not their job to point out any mistakes, so please ensure everything is the way you want it in the PDF file before emailing it. Ensure you leave enough time to get the poster reprinted just in case it has any errors when it's returned to you. I find it best to use a local printing company and not an online service. That way you can interact with the people printing your poster and you don't need to pay extra for postage.

There are lots of options open to you regarding paper thickness and paper coating (gloss, matt, silk etc.). I'd suggest you get your poster printed on as good quality matt paper as you can afford. Using gloss paper can cause glare and reflections from any overhead lighting, making the poster difficult to read. There's even the option to get your poster printed on fabric that can be folded for easy storage and transportation to and from conferences.



Glare caused by the combination of printing on glossy paper and overhead lighting. See what I mean about using far too much text? The right-hand poster is basically a page of a textbook printed on large paper. Would a poster without any graphical elements attract you to read it?

11. Handy 10-point Checklist

Each year we award a Presentation Skills Award, which is given to the student who has best presented their research, orally, by PowerPoint, and visually via a scientific research poster. I've listed below a handy checklist of items you should try and adhere to. Here's a little secret - these are the criteria we use to mark and judge the posters.

- 1) Is your title descriptive of the poster content?
- 2) Is it clear who carried out the research and where and when it was carried out?
- 3) Is the poster eye-catching and visually stimulating?
- 4) Is the project pursued self-explanatory within a few minutes?
- 5) Is the poster easy to read?
- 6) Is there a good balance of text to graphics?
- 7) Has any design initiative been shown?
- 8) Has the IMRaD structure been followed?
- 9) Is there consistency between elements?
- 10) Are all graphical elements clearly numbered, labelled, and referred to in the main text?

If you can answer 'yes' to all of these questions, then I reckon you've designed a pretty decent scientific poster.

12. Some Final Thoughts

At least a couple of days before you get your poster printed ask a few friends or colleagues to read through it carefully. This will give you time to make any final adjustments and corrections if anything is unclear or confusing. It will also ensure any spelling or grammatical errors that have slipped past you and your computer's spelling and grammar checker are picked up. Remember any mistakes that remain will be up there for everyone to see.

Don't waste your time perfecting your layout as you work on your poster. Do this at the end, after you have added all your information. It'll save you a great deal of time and frustration continually adjusting line spacing and getting every element aligned and fitting. It'll also let you adjust the font sizes before you tweak everything to perfection.

Always, without exception, ask your co-authors (Supervisors) to read the poster for feedback. Their names are associated with the research, so it is paramount they are happy with the work you are presenting.

Consider taking some more detailed information about your work with you, possibly in the form of a handout or A4 copies of your poster. You can pass this on to anyone interested that would like more detail than you can display within your poster.

Remember at the very beginning I mentioned that your poster should initiate discussion between the viewer and presenter? Seems ages ago now but it's true, so you'll need to be able to present and answer questions about your poster. It's a good idea spending some time practising running through your poster, so you're prepared for any discussion.

13. Summary


- Keep your poster simple and think **BIG**
- Show rather than write (a picture is worth a thousand words)
- Use no more than two typefaces
- Use colour but choose it carefully (and tastefully)
- Guide your audience through the poster
- Edit - review - spell-check - edit again
- Your poster should be eye-catching, informative and attractive
- Supply handouts or use QR code
- There are NO universal rules so enjoy ... this is meant to be fun!

14. Good Examples

The following posters are examples of some pretty decent efforts from past students here at UDOTS. I'm not saying they're perfect, but they've tried to keep things simple, well-structured and balanced whilst using strong images. I'm not judging academic content here, only the way the poster looks.


You'll notice that some examples use the old University of Dundee logo. The latest logo, as seen on the first poster, is the one that you should use.

Feel free to critique each poster by writing a list of what's good about them and think of what elements you'd like to appear in your poster. I'll give my feedback on each poster in Section 16.



Can Photo Generated 3D Models Used To Assess Shoe Fit

Veeragandham Koteswara Prasad, Tim Drew,
Department of Orthopaedic & Trauma surgery, TORT Centre, Ninewells Hospital, Dundee | MCh Orth 2016-17



University of Dundee

INTRODUCTION

Ill fitted shoes can result in various painful conditions over a period. Studies have shown the majority of individuals wear incorrectly sized footwear.

Current technology for shoe designing and precision fitting uses 3D scanning technology and needs high investment and skilled operators to function, rendering its application to individual screening unrealistic.

Our study is based on the assessment of shoe fit via 3D foot models with using inexpensive readily available technology i.e. the smartphone.

AIMS AND OBJECTIVES

The study aims at assessing correct shoe fit by using free or relatively cheap 3D photo modelling techniques and software.

METHODS AND MATERIALS

20 volunteers participated and their foot and shoe images were captured and further processed in CAD software to generate 3D models and were assembled and assessed, shown in Figures 1, 2, 4 and 5.

RESULTS

The histogram showing difference in inventor findings foot length to Shoe length with mean difference of 2.51 millimetres and standard deviation of 1.226 millimetres. The p value is .000 indicating significant difference. As shown in Figure 2. The histogram showing inventor differences in Fore shoe width to Forefoot width with mean of 07 millimetres and standard deviation of .54millimetre as shown in Figure 3.

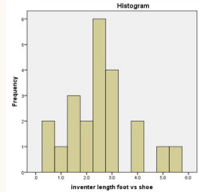
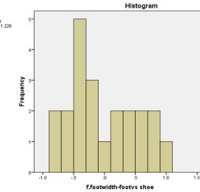



Figure 2: Histogram showing length variations. Figure 3: Histogram showing width variations.

DISCUSSION

The present study showed reasonable evidence that most individuals were wearing shoes longer than the actual foot length, also that in the majority of individuals foot width was wider than the shoe width. A tight forefoot shoe width means detrimentally affects normal gait.

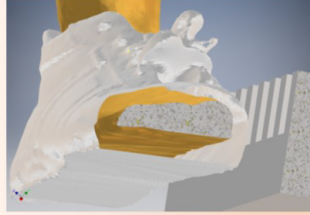



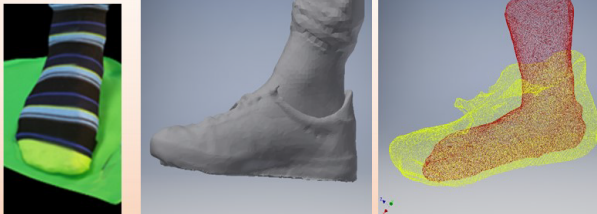
Figure 5: Sectioned images of the assembled models

CONCLUSION

The 3D shoe and foot models enabled a much more detailed and sophisticated assessment of shoe fit than is currently available at high street shoe shops.

With further development this method could help many people to assess correct shoe fit and hence a correct fitting shoe. This could give individuals the power to choose the best fitting shoe available which could prevent many foot related problems occurring due to ill-fitting footwear.

REFERENCES: Gonnetilleke, R. S. & Luximon, A., 1999. Foot flare and foot axis. Hum Factors, 41(4), pp. 596-607.
ACKNOWLEDGEMENTS: I sincerely thank my guide Dr Tim Drew and Professor Rami Abboud and Ian Christie for helping me to complete my work.

Poster A.



The design, development and evaluation of a prototype Total Talar Prosthesis

Calvin Rupert Mathias, Tim Drew
Department of Orthopaedic & Trauma Surgery, TORT Centre,
Ninewells Hospital & Medical School, University of Dundee, Scotland, UK | MCh (Orth) Dundee, 2014-2015



INTRODUCTION

Avascular necrosis (AVN) is a dreaded complication of talar fractures. In traditionally, end stage AVNs treated by ankle arthrodesis or talarctomy which causes significant gait disturbance and surrounding subtalar and talonavicular early osteoarthritis. A total talar prosthesis may provide a suitable alternative to improve the range of ankle movement, thus ensuring a better quality of life.

AIMS AND OBJECTIVES

- To develop a prototype modular implant system that recreates ankle joint kinematics and can accommodate a wide range of anatomical variation.

METHODS AND MATERIALS

The design process included several steps:

- Initial 3D sketching for discussion and selection of the most promising concept.
- 3D CAD models of the implant were generated and simulated within 3D bone models (Figure 1)
- Physical models were 3D printed in ABS plastic (Figures 2-4)
- Implantation procedure was simulated in sawbone and cadaver (Figures 5 and 6).

DISCUSSION

- End-stage ankle arthritis causes physical disability, and diminished quality of life that is at least as severe as in patients with end-stage hip arthritis.
- The current accepted "gold standard" treatment for ankle and subtalar arthritis is arthrodesis.
- The fused ankle contributes to a shift in the ground reaction force, gait disturbance and abnormal ankle biomechanics.
- The resultant accelerated rate of hindfoot and midfoot arthritis causes pain, limp and increased requirement of walking aids in patients.
- Total ankle replacement (TAR) restores joint kinematics but the present TAR designs replace only the talar dome and are contraindicated in talar AVN.
- The main concept behind the final design was to maintain ankle movement and allow proper load transmission between the foot and the rest of the lower limb.
- The previous limited designs of talar body implants were mainly custom-made, that were fixed into the remaining talar head and neck and had limitations and failures related to sizing and implant loosening.
- A modular design can be inserted with ease into a wide variety of patient profiles without need for customization.
- Further mechanical testing and finite element analysis needs to be done on metal prototypes prior to clinical use.

CONCLUSIONS

- The study has presented the concept of a modular three-component talar prosthesis incorporating subtalar and talonavicular joint fixation as a innovative treatment of talar AVN and talar extrusions.
- Encouraging results were seen in the sawbone simulation and cadaveric experiments demonstrated the practicality of implantation.
- This study demonstrates that a modular total talar replacement is possible in a clinical setting, provided mechanical simulation and experimental analysis are performed and required enhancements are made in the prosthesis design.




Figure 4: Total talar prosthesis prototype



Figure 5: Sawbone implantation



Figure 6: Cadaveric implantation



RESULTS

- Ankle ROM - 50° (5° dorsiflexion and 45° plantar flexion).
- Subtalar movement - 25° inversion and 5° eversion.

REFERENCES


- OSBERG, M., HULTMARK, C.L., LINDQVIST, J. & PORTINELLI, W. 2006. Long-term results following ankle arthrodesis for pain secondary to rheumatoid arthritis. *Journal of Bone and Joint Surgery*, 88B, pp. 215-219.
- GLASSBROOK, M., DANES, L.C., VOYAKIS, A., ROSE, C., REYER, M., WYLLIE, A.J., LLOYD-JONES, A. & PERRIN, H. 2008. Comparison of the functional quality of life between patients with and without end-stage hip arthritis. *The Journal of Bone and Joint Surgery*, 90B, pp. 628-632.

Poster B



A NOVEL ANCHOR FOR FIXATION OF NECK OF FEMUR FRACTURES

Mohamad Alqubali, Dr Tim Drew | MCh (Orth) Course 2014-2015
Department of Orthopaedic and Trauma Surgery, TORT Centre, Ninewells Hospital and Medical School, Dundee, UK



INTRODUCTION

Hip fracture (neck of femur fracture) is the most common reason for admission to an orthopaedic trauma ward

- It is more common in the elderly caused by relatively minor trauma
- In younger patients are usually caused by a high-energy impact
- It affects the base of the femoral neck, which may disrupt the blood supply to the femoral head, leading to avascular necrosis
- Managed by reduction and internal fixation with screws in younger fit patients, or by replacement of the femoral head with an arthroplasty in older less fit patients

AIMS AND OBJECTIVES

- The aim of the study was to test a prototype implant (HE-Bolt) designed for the treatment of neck of femur fractures
- Device was compared against Cannulated Cancellous Screws (CC Screw)
- Test and evaluate, torque, and the axial load needed to cause failure of both implants on surrogate bones

METHODS AND MATERIALS

- Physical and CAD implant of a functional and testable prototype HE-Bolt was produced (Figures 1 & 2)
- The HE-Bolt is a hollow expandable device designed to be capable of reducing a fracture by means of two collapsing and expandable mechanism
- Sawbone femurs were cut to simulate neck of femur fractures. These were then reduced using CC screw and the prototype device (HE-Bolt)
- Both constructs were tested for torsional resistance using a torque wrench, and an axial compression resistance tests on a Universal Testing Machine (UTM)

RESULTS

- Torsional angular displacement of 5°. The torque to achieve this degree of displacement was recorded (Table 1)
- Axial compression test results were similar in both load failure, three CC Screw suffer than HE-Bolt (Table 2)
- The actual failure was due to the surrogate bone breaking at the sub-tricharteric area in all experimental tests (Figures 3 and 4)

Table 1: Torsional and degree of rotation of both implants

Implant	Torsional forces	Degree of rotation
HE-Bolt (I)	2.5 Nm	5°
HE-Bolt (II)	2.4 Nm	5°
HE-Bolt (III)	2.4 Nm	5°
HE-Bolt (IV)	1.8 Nm	5°
CC Screw (I)	3.0 Nm	5°
CC Screw (II)	2.6 Nm	5°
CC Screw (III)	2.8 Nm	5°

Table 2: Axial loading and stiffness results of both implants

Implant	Force applied on implant (Newtons)	Stiffness	Mean Force/deg
HE-Bolt	32.4 kN	350N/mm	171.5N/mm
HE-Bolt	5.0 kN	65 N/mm	
CC Screw	7.50 kN	200N/mm	166.2N/mm
CC Screw	9.7 kN	333N/mm	

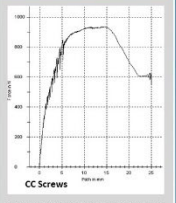


Figure 4: Graph of axial load three CC Screws

CONCLUSIONS

- Explored a concept of providing a better fixation method for femoral neck fractures (Figure 5).
- CC Screws stiffer than the HE-Bolt due to the difference in implant grade materials
- This study provided evidence that this novel method of fixation, the (HE-Bolt) has some potential to improve fixation, and should be further developed







Figure 5: HE-Bolt in Surrogate bone

REFERENCES AND ACKNOWLEDGEMENTS

The management of hip fracture (British Orthopaedic Association) <http://www.bonf.org.uk>
 BIANCHI, M., TOINETTI, L., P., HANCOCK, S. & TAYLOR, P. 2009. Out-rev internal fixation for femoral neck fractures. *Younger patients doing the best?* *Journal of Orthopaedic Trauma*, 23, 463-467



Poster C

THE ERGONOMIC EFFECTS OF OPERATING TABLE HEIGHT



University of Dundee

Dr Mohammad Riaz, Dr Tim Drew

Institute of Motion Analysis and Research, Department of Orthopaedic and Trauma Surgery, University of Dundee, MCh (Orth) 2019

BACKGROUND

There is a very high prevalence of musculoskeletal complaints in surgeons and theatre ergonomics appear to play an important contributory role¹. The aim of this study was to investigate the ergonomic effects of the operating table height on the surgeon.

OBJECTIVES

- At three different operating table heights:
1. Measure the neck angles of the volunteer.
 2. Measure the procedure duration.
 3. Measure the peak torque.
 4. Obtain subjective assessment of comfort.

METHODS

Volunteers were required to perform a brief orthopaedic procedure on an operating table adjusted to three different heights (xiphisternum, elbow, and anterior superior iliac spine). Neck angles were measured using Vicon[®] high speed motion capture system. Peak torque was measured with a special digital torque screwdriver. Time taken to complete the task was recorded. On completion, volunteers rated each height for degree of comfort. See Fig. 1.



Fig. 1 Photo of apparatus

RESULTS

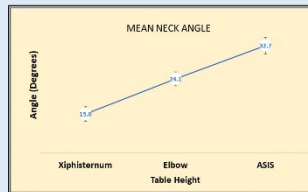


Fig. 2 Mean neck angles with 95% CI

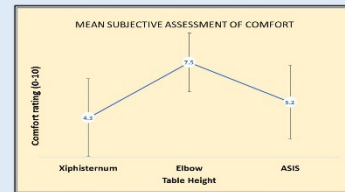


Fig. 4 Mean subjective assessment of comfort with standard deviation

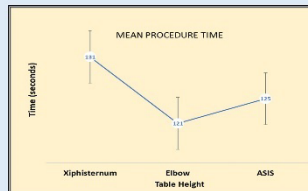


Fig. 3 Mean procedure time with 95% CI

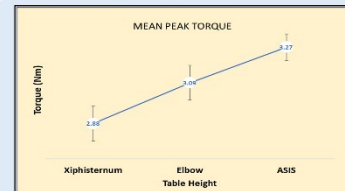


Fig. 5 Mean peak torque with 95% CI

CONCLUSIONS

1. Elbow level is the most ergonomic height for an operating table.
2. At this height, the procedure time is lowest and the comfort rating highest.
3. This height also provides an acceptable compromise for neck angles and peak torque.
4. Operating table height has a significant impact on surgeon performance and this must be explored further with studies conducted in an operating theatre while performing live surgery.

ACKNOWLEDGEMENTS AND REFERENCES: Many thanks to the IMAR staff for their support and expertise particularly Prof Abdoal, Dr G. Arnold, Mr S. Nisar and Mr J. Christie.
1. Ronstrom, C., Hallbeck, S., Lundberg, B., & Christner, K. L. (2017). *Surgical Ergonomics, Surgeons as Educators*. Tobias S. Kohler (Editor). ISBN: 9783319447293, 387-417.



SCAN QR CODE WITH MOBILE DEVICE FOR COMPLETE PAPER



Poster D



a comparative study between

Blades and Studs in football boots



James L. Nutt BMSc Degree 2009 Institute of Motion Analysis and Research, TORT Centre, Ninewells Hospital and Medical School

INTRODUCTION

The incidence of non-contact injuries in football is high. A significant proportion of the blame is aimed at the footwear worn. Bladed design boots have attracted criticism, with many high profile sports teams banning them amid fears of causing knee injury.

No previous study has provided conclusive evidence that bladed stud design causes greater risk of knee injury.

AIM

This study aimed to bio-mechanically compare a bladed boot design with a more conventional studded boot design to assess their potential for causing non-contact injury to the knee.

METHODS

Thirty-one competitive football and rugby players were recruited. A standard running and side-stepping manoeuvre was performed along 18 meters of FIFA[®] approved synthetic turf (Figure 2).

A TMSI Mobi[®] sEMG device was used to measure peak muscle activity in four lower limb muscles (Figure 3) these muscles are closely related to the stability of the anterior cruciate ligament:

- Vastus Medialis
- Vastus Lateralis
- Rectus Femoris
- Semi Tendinosis

A Vicon[®] motion analysis system was used to track the participants and monitor stance phase during the sidestep manoeuvre (Figure 4). The Percentage Difference in peak average sEMG values were compared between the two boot types, and used to test for any significant difference.



Figure 1: The bladed and studded football boots

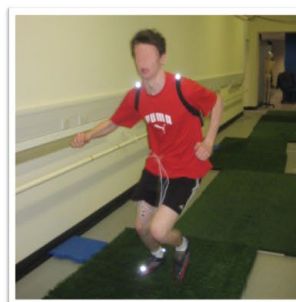


Figure 2: A subject running

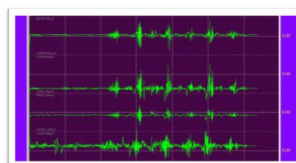


Figure 3: A graphical display of sEMG data from the four muscle groups studied

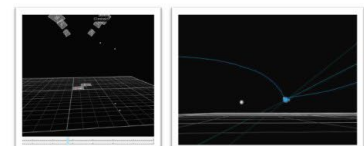


Figure 4: Vicon[®] display of participant through sports laboratory and close up view of initial contact of boot

RESULTS

The results from all four muscle groups studied, showed no significant difference in peak average sEMG muscle activity when performing sidestepping manoeuvres in bladed boots compared with studded boots (p<0.05).

CONCLUSION

This study shows that with relation to muscle activity, there is evidence to disprove beliefs that bladed boots are more responsible for causing non contact lower limb injury than their studded counterparts.

Neither boot could be concluded to be significantly more dangerous than the other.

RECOMMENDATIONS


- Further study with an 8 or 16 lead sEMG device.
- Data analysis during different non-contact running manoeuvres.

Poster E

15. Not So Good Examples!

The following posters were also produced in UDOTS and each presenter's anonymity has been protected! I seem to remember that most of these posters were last-minute submissions and were therefore not seen by co-authors or myself. Disclaimer complete!

Again, feel free to critique each poster by writing a list of what's bad about them and how to avoid these mistakes appearing in your poster. Remember that critiquing includes positives as well as negatives. Again, you can check to see if you agree with my thoughts on page 30.



Analysis of the Methodology of the Knee Society Score

(University of Dundee, Dundee, Scotland, UK) 2001
TORT Centre, Ninewells Hospital

Scoring systems- Should be Valid (measure what is intended to measure) & Reliable (consistency or repeatability of a measure)

Knee Society Score(KSS)::Dual Scoring System with Positive & Deductive Elements
Total Knee Score (TKS): Pain, ROM, AP Stab, ML Stab; **Flex Contr, Ext Lag, TF Align**
Total Function Score (TFS): Walking Distance, Stairs; **Walking Aids.**

III. Reliability Analysis:

To measure the Internal Consistency of the Score.
Parameters: 1.Cronbach's Alpha (measure of the correlation between the variables of the score). Minimum Value of 0.5 desired.
2. Pearson's Correlation (correlation coefficient between the individual variable and the total score). Acceptable Value- 0.2

1932 Preoperative Scores used and all 5 Components of the score analysed.

Component	Cronbach's Alpha	Cronbach's Alpha if parameter removed	Pearson's correlation
Total Knee Score			
All Qns	-0.05*		
Pain		-0.16*	0.07*
ROM		0.09*	-0.16*
AP Stab		-0.09*	0.08*
ML Stab		-0.02*	-0.03*
Flex Contr		-0.06*	-0.002*
Ext Lag		-0.04*	-0.03*
TF Align		-0.06*	-0.007*
Positive Elements of TKS			
All Qns	0.11*		
Pain		0.11*	0.04*
ROM		0.09*	0.05*
AP Stab		0.03*	0.15*
ML Stab		0.13	0.02*
Deductive Elements of TKS			
All Qns	0.19*		
Flex Contr		0.01*	0.17*
Ext Lag		0.09*	0.15*
TF Align		0.43*	0.04*
Total Function Score			
All Qns	0.08*		
Walk Dist		-0.72*	0.23
Stairs		-0.50	0.20
Walk aids		0.53	-0.32
Positive Elements of TFS			
All Qns	0.53		
Walk Dist		NA	0.37
Stairs		NA	0.37

Introduction: KSS
1. Not tested for Validity & Reliability.
2. Tested for Inter-observer & Intra-observer Reliability.
3. Justification for Dual Rating established.

Materials & Methods:
KSS scores of patients undergoing TKA analysed using 3 analysis functions of SPSS statistical analysis software (version 10).

I. Factor Analysis:
To identify minimum factors that can be used to represent relationships among set of many interrelated variables
685 TKS of KSS scores analysed
Procedure:
3 factor model considered (Eigen value more than 1 & Total Variance of 55%).
Factor matrix obtained (Orthogonal Relationship, not interpretable).
Rotation phase (Varimax) to achieve simple and interpretable matrix.

Rotated Matrix (Highest Absolute Values)

	Factors (Components)		
	1	2	3
Pain	.366	.473	8.140E-02
ROM	.844	-8.538E-02	-4.021E-02
AP Stab	-.175	.385	.674
ML Stab	.105	-.188	.766
Flex Contr	-.795	-.146	-2.818E-03
Ext Lag	-1.932E-02	-.615	.287
TF Align	-1.879E-02	.586	.136
Factors	"Arc of Movement"	"Patient Satisfaction"	"Stability"

II. Discriminant Analysis:
To determine the predictability of the score in identifying failures at an early stage.
To determine variables which could predict failure.
685 postoperative scores taken for analysis but only 646 considered
636 belonged to non-revised group(0.00) and 10 to revised group (1.00)

Variables	Original	Stepwise (Log Likelihood)	Wald	Sig.
Constant	685	636		
Walk Dist	76.1491	1.130000	7.310	.0000
Stairs	21.1220	1.230000	2.770	.0002
Walk Aids	2.2122	1.030000	.222	.6312
Ext Lag	1.72001	1.230000	1.000	.3177
Flex Contr	00.01191	0.130000	.292	.5800
TF Align	.22127	.230000	.222	.6312
AP Stab	.22222	1.030000	.222	.6312
ML Stab	1.03000	1.030000	1.00000	.3022
ROM	1.27110	1.030000	1.0000	.3071
Pain	.272422	1.130000	.222	.6312
AP Stab	20.1022	2.030000	.222	.6312
ML Stab	1.27242	0.230000	.222	.6312
Ext Lag	1.27242	0.230000	.222	.6312
Flex Contr	1.27242	0.230000	.222	.6312
TF Align	1.27242	0.230000	.222	.6312

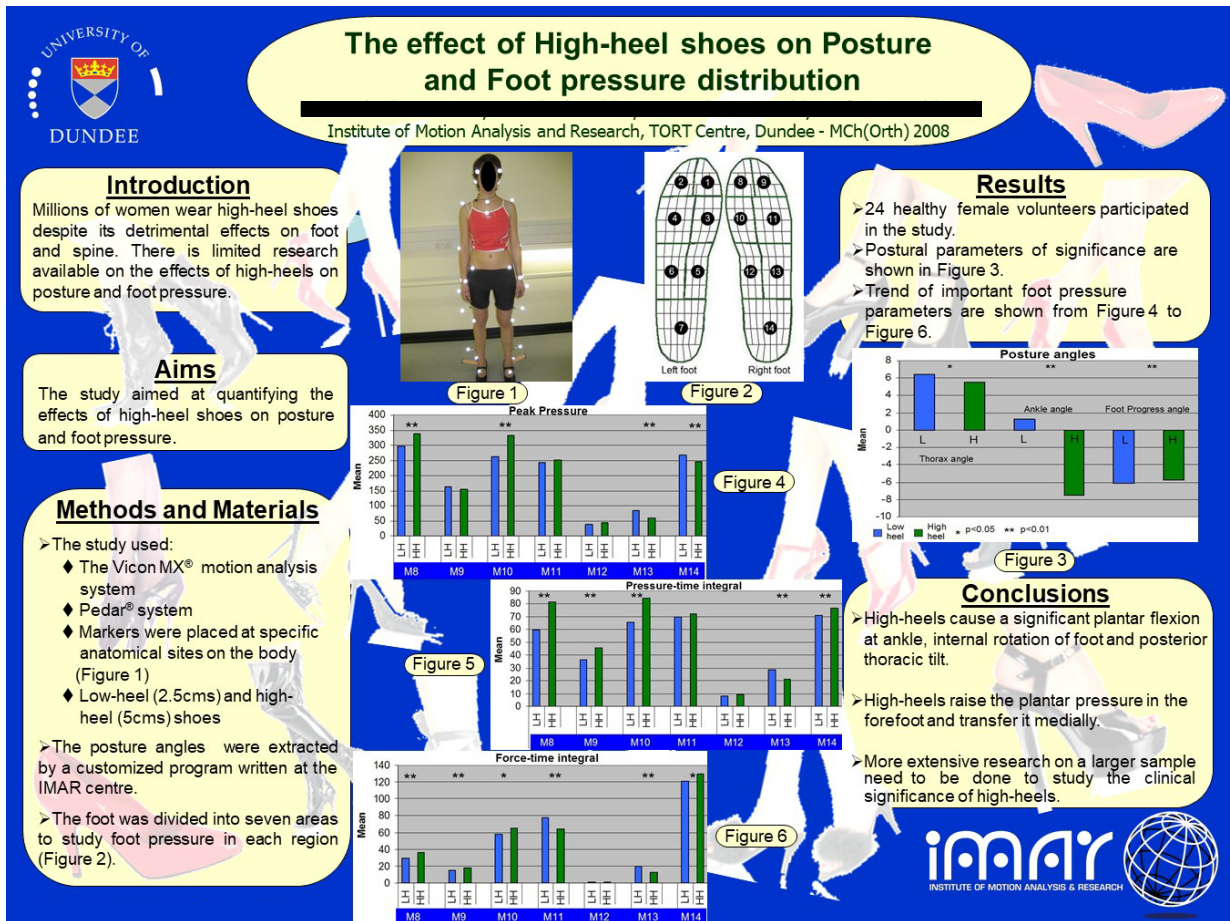
Predictors of failure
Classification Results

	Actual	Membership	
Original Count	00	100	
	636	10	636
Percentage (%)	100	4	6
	22	17	39
Ungrouped	00	984	1.6
	100	400	600
Ungrouped	564	436	1000

Overall Prediction rate of 98.7%
Score good in predicting results but caution should be exercised in predicting failures.

Conclusion:
I. TKS of the KSS can be interpreted in a more meaningful way by adopting a three-factor model, the factors being arc of movement, patient satisfaction, and stability.
II. Variables pain, walking distance, use of walking aids and the total knee score can be established as the predictors of the result following total knee arthroplasty.
III. TKS & TFS not reliable when added up, but somewhat reliable when considered individually. Thus, results should mention all variables. Positive elements of TFS reliable. Score is good in predicting success of the surgery but caution should be exercised while predicting the failures.

Poster F



Poster J

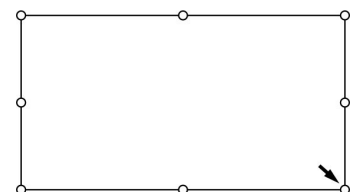
16. Thoughts on Poster Examples (Critique)

I'd like to start by saying that you should never judge a book by its cover. That's sometimes not true but you get my sentiment! What I really mean here is that just because a scientific research poster looks dreadful, it doesn't necessarily mean that the same applies to the research itself. I respect anybody who has spent months, perhaps years, conducting their research and making many sacrifices along the way. So, it's therefore vital that you should disseminate your study, whether in the form of a dissertation, an oral presentation, a published paper, or in this case a poster, to the best of your abilities.

I hope you're sitting comfortably as this may take some time!

Poster F: Designing a poster about an audit-based research topic can be difficult to make visually appealing. The key here is to keep it simple, show only the most important findings graphically and remember to use plenty of the 'white space' we talked about earlier. There are a few things wrong with this poster but here are some important thoughts:

- 1) The University shield logo has been 'squashed' horizontally which instantly gives an amateurish feel to the poster. The aspect ratio of any logos and indeed images should not be altered when resizing. Resize by dragging the corner handles of the image and not the mid-point resizing handles. Alternatively, change the dimensions in the sizing box.



- 2) The light blue Title and especially the Authors text could be more legible by darkening the font colour. The use of the white text behind the Title (did you even notice this?) is rendered illegible and should just have been another line of text below the Authors.

- 3) Attention to detail is vital in producing any sound academic work and I'd like to highlight some inconsistencies before we go any further. In the first text block, there's no space before the first hyphen, but then a space after the hyphen and the end of the sentence has changed from Times Roman to Arial font. As I read this it made me wonder if there was any significance to the end of the sentence by changing the font; is the author trying to highlight something important? In this case, no, the author just hasn't noticed the font has changed.

In the second text block, which is a different grey colour to the first text box for some reason, a double colon is used as well as the normal single colon. The first line of text is in a larger font than the last two, which also have some bold text. Did you wonder why a few of the words were in red? I did but found no clear reason for this. So, you see what I mean about the consistency of elements making the poster easier to understand and not putting doubt in the viewer's mind.

Another point worth noting is the use of abbreviations in the second text box.

ROM, AP Stab, ML Stab; Flex Contr, Ext Lag, TF Align

Hmmm! Would your viewer necessarily know what this all means? Well, they would, if the poster followed the 'Abbreviation Rule' which uses the full term in the first instance with the abbreviation in brackets, then subsequently uses the abbreviation, e.g. Anteroposterior Stability (AP Stab).

- 4) Some of the text and data within the tables are cropped off which may instantly make the viewer give-up trying to decipher the results and move onto another poster immediately. Has the person who designed this poster not noticed the units can't be read!? It gives the impression that the researcher couldn't be bothered to correct this or worse, doesn't really care about their work ... so why should their audience?
- 5) The Conclusions, which are arguably the most important element of the poster, look like a Footnote to the document.
- 6) By following some simple rules such as paying attention to detail, aligning elements, using more white space, removing text and punctuation inconsistencies, adding some colour and having clear headings for each section, this would have been a perfectly acceptable audit poster. The researcher may well have done an incredible research study, but they haven't given their research poster the proper attention it deserves.

Poster G: As we already discussed, what seems a long time ago now, first impressions are vital in attracting an audience. My first impression of this poster is that the Title topic sounds fascinating but visually it's rather DAUNTING! Do I really want to strain my eyes reading all that small text on those green and purple backgrounds? The poster has all the correct sections but has far too much text. I'd advise the author to cut down on the amount of textual content, make the font larger and choose a less clashing colour scheme. It would benefit greatly by having more space between all the elements, giving it a less cluttered appearance.

Poster H: This author has taken the "Dummies' Guide" template we provide and literally filled in the blanks and nothing more. Whilst this is okay it makes for a boring and rather uninspiring poster.

The research title is 'Knee Bracing within Skiing' which appears to me to be a dynamic and exciting bit of research, but the poster simply doesn't reflect this in any shape or form. Strangely, there are no images at all! Firstly, I'd like to see an image of the knee anatomy, possibly showing an ACL injury, then a photograph of what a knee brace looks like, specifically the two braces studied. Or show a subject wearing the brace and highlight the placement of the EMG sensors.

You may think, where can I fit another two graphic elements into this poster? Well, there are little tricks we can use to make more space. This could be easily achieved by reducing the font size by as little as 1pt, reducing the inter-line and paragraph spacing ever so slightly, and by making the References and Acknowledgements a much smaller font size. On the plus side, the author *has* supplied an email address for further correspondence.

Poster I: In Section 8.4, I mentioned that using a photograph as a background image for your poster rarely looks good and at worst is disrupting to the viewer. Well. Here's the proof! To compound matters some parts of the image used are a bluish colour and the author has chosen a blue font making large parts of the text almost invisible never mind illegible. I also stated earlier that using red text on a blue background was best avoided but here the poster title is exactly that combination.

Again, there is far too much text and because of this, the font size has been made too small in order to fit all the content in. I'd go as far as to say that this is a visual assault and one that does the conducted research no good whatsoever. However, with just a single mouse-click, this could be corrected to some degree.

A Novel Assessment Tool of Talipes Equinovarus Treated by Ponseti Technique: Phase 7
 Elbana H*, Campbell D*, Maclean JGB*, Abboud RJ*
 *Institute of Motion Analysis & Research (IMAR), Department of Orthopaedic & Trauma Surgery, Ninewells Hospital & Medical School, Tayside NHS Trust, Scotland, UK • MCh Orth, Dundee 2024

INTRODUCTION
 The Ponseti technique has become the method of choice for the treatment of CTEV, thanks to the excellent initial clinical outcome. No doubt, that assessment is mandatory for deciding the optimum treatment option, evaluating the management outcome and detecting any failures (relapse) at an early stage (1). Indeed, all the currently available evaluation systems share the same weakness of being totally subjective, with none integrating objective tools to gain more accuracy. The Institute of Motion Analysis & Research (IMAR) at the University of Dundee took the initiative in developing the first objective and reproducible assessment tool (2). A long-term study was designed in 2002 that led to the current longitudinal study that started on 2007, and for the development of a new scoring system in 2009, the IMAR Clubfoot Scale (3).

RESULTS
 The results showed that 95% of patients scored excellent as regard the functional assessment. Additionally, the level of satisfaction about foot appearance, as well as overall outcome of treatment, was comparable to the last phases of this longitudinal study (Figure 4).

DISCUSSION
 The results showed that foot pressure data were able to demonstrate undetected abnormalities in the foot structure, which could objectively identify any residual clubfoot deformities that were unnoticed to the naked eye. In particular, the ratios calculated showed that a cosmetically good or even excellent result after successful treatment of CTEV, is not always biomechanically showing the same high grade. Meanwhile, a review of the progression of corrected feet over sequential years suggested the possibility of using the developing score in predicting the relapsed feet at an early stage, with subsequent relatively easier management (Figures 5 & 7).

AIMS AND OBJECTIVES
 This longitudinal study now in its 7th phase, aims to further establish and finely tune the developed IMAR Clubfoot Scale through applying its modalities in assessing the treatment of CTEV patients. This is achieved by tracking the progress of treated CTEV, statistically analysing the data obtained and comparing the data with that of the previous phases.

METHODS AND MATERIALS
 A total of 43 CTEV affected feet (in 28 patients), treated by the Ponseti technique at Tayside NHS Hospitals, were recruited (Figure 1).

CONCLUSIONS
 IMAR Clubfoot Scale is proving over the years its applicability and reliability in evaluating the outcome of treatment of CTEV patients using the Ponseti technique. It can fulfil all the criteria of a global, comprehensive and objective system for the evaluation of clubfoot deformity, and more importantly providing the clinician with guidelines regarding the next step (Table 2).

REFERENCES
 (1) Hariri F, Ramcharan A, Chittenden A, Maclean JGB, Abboud RJ (2020). Foot pressure in children – The assessment of talipes equinovarus. *Foot* 97: 105002.
 (2) Hariri F, Maclean JGB, Abboud RJ (2024). The need for biomechanical evaluation of the management of clubfoot. *Foot* 125: 105512.
 (3) Ramcharan A, Hariri F, Maclean JGB, Abboud RJ (2020). An evolving scoring system for the management of clubfoot. *The IMAR Clubfoot Scale*. *Foot* 97: 105003.

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Figure 1: Seven-year comparison of Emmed® a BSR

Phase	Mean	Std. Deviation
Phase 1	0.278	0.054
Phase 2	0.263	0.058
Phase 3	0.268	0.062
Phase 4	0.270	0.064
Phase 5	0.283	0.041
Phase 6	0.273	0.040
Phase 7	0.285	0.035

Figure 2: IMAR Clubfoot Scale grading guidelines

Grade	Score	Grade	Recommendation
Poor	44-61	Poor	Microsurgical support or further surgery
Satisfactory	62-65	Satisfactory	Orthotic support
Good	66-70	Good	Shoe raise
Excellent	71-75	Excellent	No treatment needed

Figure 3: Comparison of IMAR Clubfoot Scale scores across three phases for six selected patients

Case	Case	Case	Case	Case	Case	Case
1	2	3	4	5	6	7
10	11	12	13	14	15	16

A Novel Assessment Tool of Talipes Equinovarus Treated by Ponseti Technique: Phase 7
 Elbana H*, Campbell D*, Maclean JGB*, Abboud RJ*
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I've made only one change to demonstrate why, unless you're a graphic designer, you should never use a background image - I've deleted it! Which poster would you rather read? Or should I rephrase that when that poster can you actually read?

Poster J: My initial thought is that whilst this isn't a great looking poster it would make a great jigsaw puzzle! Initial appearances can be misleading sometimes as the use of high-heel shoe Clipart all over the place is the main obstacle to this being, not the worst poster ever. The amount of text seems ideal and the use of bullet points reinforces this. Aligning all elements properly would add a better balance overall. The Figures are all captioned and numbered and referred to in the main text body, which helps pinpoint an image instantly when reading the poster. However, Figure 3 is out of sequence visually.

17. Conclusion

Well, thanks for bearing with me on this, but that's about it from me. I can almost hear the sighs of relief! Hopefully, I've given you enough tips and ideas so you can now go and design a scientific poster highlighting your amazing research. There's a multitude of helpful resources on producing posters on the web so go and explore, and if there's anything you want to discuss please don't hesitate to come and see me if possible (office next to Dr Tim Drew), call me on Microsoft Teams or drop me an email. I'm really looking forward to seeing your efforts.

18. Further Reading List

- 1) Dr Andrew J. Murphy's series of tutorials about using images in your research: <https://my.dundee.ac.uk/ultra/institution-page>
- 2) Fundamentals of Data Visualization, Claus O. Wilke: <https://serialmentor.com/dataviz/>
- 3) Useful website on poster design with tutorials: <https://www.makesigns.com/tutorials/>
- 4) The University of Dundee brand of design elements: <https://www.dundee.ac.uk/brand/>
- 5) Video, image and sound resources at the University of Dundee Library and Learning Centre: <https://libguides.dundee.ac.uk/az.php?t=8371>
- 6) Online QR Code generator: <https://www.qrcode-monkey.com/>
- 7) Anatomical image repository: <https://www.anatomy.tv/>

19. References

- 1) The cover image is a collage of posters produced at UDOTS over the last 20 years.
- 2) Any images that are not my own personal copyright are licensed under the Creative Commons Share-Alike 3.0 & 4.0 license.
- 3) The colour-wheel image is freely available at www.publicdomainpictures.net