Bodies of evidence?

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This article examines how anatomy and the world of the anatomical sciences has changed little in 300 years and suggests that what is being taught to medical professionals is outdated, reductionist and missing elements that are regarded as problems for healthcare within an allopathic model. With examples of how human anatomy is missing vital detail relevant to physiotherapy, this article proposes a radical change in the way anatomy is taught and considered by healthcare practitioners from all disciplines.

LEARNING OUTCOMES
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1 To introduce an anatomical paradigm and present a variation on current thinking.
2 To consider how relatively narrow and limiting anatomical thinking influences research methodology and thereby diagnosis and treatment.
3 To propose a broader and more functional and holistic view of traditional anatomy and encourage a more logical and scientific perspective within anatomical teaching.

The paradigm shift

Until the early 1970s, the biggest watch makers in the world were the Swiss (Anon 2020). Famed for their precision, craftsmanship and quality with the mainspring being the heart of the product, the Swiss were comfortable and confident of their place at the top of the horological hierarchy, controlling more than 50% of the world market and employing 1,600 watchmakers.

Just 10 years later the number of watchmakers in Switzerland had dropped to just 600 and the Japanese became the biggest watchmakers in the world. The attitude of the Swiss was simply that there was no alternative to what they had been doing for hundreds of years and that nothing needed to change. This was in spite of all the evidence that was mounting up and knocking at their door. Sometimes it pays to embrace a new order if the old order is to survive.

The world of anatomy is an overwhelmingly academic one. It is not a profession that anyone can simply decide overnight to enter. Where anatomy teaching with cadavers or dissection is concerned, the field becomes even more limited and niche and the opportunities are harder to come by. The practice of human dissection in the UK is confined to medical schools and regulated by the Human Tissue Authority in England and Wales (**www.hta.gov.uk**) and by the Inspector of Anatomy for Scotland in Scotland (**www.gov.scot**). Medical schools teach anatomy to those engaging in medical science degrees, and it is taught following a standard curriculum with specific texts that have changed little in 200 years.

It must be considered that, of late, the teaching of anatomy might be facing something of its own paradigm shift with new methods and technologies that leave cadavers and dissection behind (McLachlan & Patten 2006). Where it has not wavered even slightly is in whether the current content that is disseminated is lacking, flawed or outdated and whether it accurately reflects a new generation of those outside of medical schools, fascinated by the body and human anatomy and eager to take a different perspective of the human form.

Instead, the world of anatomy pushes on with its own version of the mainspring and, like the Swiss watchmakers, considers itself to be complete and therefore untouchable by the future or the outside world. Some medical schools have more recently opened their doors to others in various health professions such as massage and movement therapies, but there is an open resistance from the anatomy world to this, and a declared feeling that the dissection room should be open only to "medical professionals". Anatomical dissection in the UK is overseen by a small cabal who all know each other and it is therefore not hard for those who are deemed unworthy of admittance to be excluded. Even where access is granted, the approach to anatomy is still not adjusted to fit the student, but runs along the same standard anatomical methods that are taught to medical students. It is this attitude that I perceive as a problem.

While there is a wealth of potential donors for the study of anatomy and therefore no shortage of material from which to expand ideas and build new concepts on this subject, many who make the offer are rejected by UK universities for a whole host of reasons.

> "MANUAL THERAPISTS ARE LOSING OUT ON OPPORTUNITIES TO STUDY AND CHART CONNECTIVE TISSUE WHEN ANATOMY DONORS ARE REJECTED BECAUSE THEY ARE DEEMED TO LACK UNIFORMITY"

These can include body size, the number of surgeries the potential donor has undergone, and excessive scar tissue. Such donors are deemed unacceptable because they lack uniformity, and any form that is not represented in the teaching material is deemed to risk throwing a "curve ball" at the student and the teacher alike. Scotland alone rejects almost half of those who offer their bodies for medical study (**www.gov.scot**). The purpose to which donations are used is specific and narrow and, for the manual therapist, turning away any donor who does not accurately represent the anatomy curricular represents an encyclopaedic level of lost opportunity to study and chart areas such as the effects on connective tissue of long-term scarring, and ageing. The loss of this potential to benefit human health is both endless and heartbreaking.

The chicken and egg

The representation of anatomy then becomes the next stage in the problematisation of the human form. The anatomist in a dissection lab does not generally undertake dissection. Prosectors prepare cadavers that have been selected as good candidates for anatomical teaching and prosect according to the specification of the head of department. They cut away the bits that are in the way of what needs to be taught by the anatomists, leaving behind the parts nominated.

This modelling process then creates unrealistic and impossible ideas that get repeated often enough for them to become a truth. An anatomist then becomes a high priest of the half-truth, perpetuating a series of myths that then become the status quo. Taken as anything other than a starting point or an outline, these myths are unhelpful if presented as fact. Simply put, classical anatomy is incomplete at best and potentially harmful at worst

Once no-one questions anything or suggests an alternative view, reality becomes even more extenuated and researchers, taking on the mantle of anatomical actuality, study the individual parts that have been created, imputing meaning on them as separate structures, capable of independent function and with the ability to fail or become injured without reference to other tissues. Diagnoses, treatments, syndromes, therapies, exercises, equipment, workshops and entire approaches then get based around what is essentially a manicured and sculpted model that is missing much of what makes it functional in the first place.

It's worth bearing in mind that this is not the fault of the anatomist. They have been informed by what they are teaching, and teach what they have been informed by. An anatomist therefore knows a huge amount about the human body but, by necessity, needs to know nothing whatsoever of the human condition or humanity itself.

The cadaver contributes nothing except the anatomy in its possession. The behaviours, habits, functions, movements or lifestyles that have formed it are not considered or asked about. A cause of death may be given or availed of, but function in life holds no interest for the anatomist after it.

The act of dissection in anatomical study is rarely undertaken by undergraduate medical students as part of their course. Where it is, the process is proscribed and defined by books such as *Grant's Dissector* which, according to one reviewer is "a vindication of the irreplaceably tried and true method of gaining anatomical knowledge" (Sperber 2006). In other words: "Cut here, tie here, reflect here, study this, do it the same way it's always been done and pass the exam".

Testing acquired anatomical knowledge in the dissection room comes in the form of "stations" where, for instance, the upper limb might be the subject. Upper limbs dissected at various stages with pins in them are arranged around the room and students are required to identify pinned structures with a certain amount of time allocated. An understanding of how these parts might relate to each other is passed by and the cycle is perpetuated.

Science: anatomy's missing link

It is the job of science to adapt and change as new information becomes available, and it ceases to be operative, functional or fit for purpose when it ignores that information or neglects to seek it out. Modern anatomy is a museum piece and its teachers are curators of a history that is no longer fit for purpose and can hardly be recognised as one the basic sciences. If the same anatomy is to be taught over and over again, then the debate on whether cadavers are needed is moot. A simple 3D synthetic model will indeed suffice if texture, context and related anatomical palpation and structural relationships are not to be taught.

> "THE FAILURE TO UNDERSTAND BACK PAIN IS ROOTED IN THE CONSISTENT DENIAL OF STRUCTURAL RELATIONSHIPS IN THE HUMAN FORM"

With anatomy being one of the foundation stones upon which all modern medicine rests, its failures as well as its successes bear considering. Heart surgery, a life-saver in modern times, could not have been achieved without an anatomical foundation.

Back pain, however, presents as a bigger problem in an ageing population and costs society more (Hoy *et al* 2014).The study of anatomy has stood still and its status as a science has diminished (Dyer & Thorndike 2000). The fundamental failure of the basic understanding of back pain is rooted in, and maybe even perpetuated by, the consistent denial of structural relationships in the human form, and by conveniently ignoring of the nuisance that is basic physics.

The human head weighs in the region of 6kg. Standing upright and moving it around on its axis changes the load of this weight through the entire structure of the human form, in turn creating load transfer. Do this on a bicycle, a trained horse or a pair of skis and the direction of travel can be altered. It stands to reason and physics that a head held in a position away from the midline will create a different load through structures underneath it and that these structures will, in turn, require a different contractile input in order for function and balance to be maintained. Such is the simplicity of this model that it forms the basis of how you might teach a five-year-old to ride a bike, yet it has no basis in simple assessment of knee function prior to surgery, and is barely alluded to in many functional assessment or gait analysis protocols.

Crossing over

When considering medicine as a whole, it could be argued that medical specialisation removes the need to consider a more holistic model or wider implications. This, however, creates an unwieldy model, whereby each presenting issue needs specialist consideration, creating a logistical and interminable merry-go-round where opinion and science are often divided and rarely agree.

The anatomists are the servants of medicine rather than the other way around (Orsbon *et al* 2014). It is medicine that tells the anatomist what to teach to fulfil its responsibilities, instead of the anatomist informing medicine of where it is missing knowledge. Medical specialism will determine what it needs from anatomy to make it more successful and create the impetus for curriculum design (Orsbon *et al* 2014).

Extending the circle

Should we be teaching the same anatomy to physiotherapists as we do to undergraduate medical students? The end results of the two learning paths are vastly different, and the need for one to step away from the classical "basics" and develop a more functional approach seems evident. While joint based biomechanical approaches are well established at BSc level education, the principles employed are still rooted in a regional anatomy curriculum that makes little sense and is limiting.

In trying to establish an "elevator pitch" to describe the problem, I use breath as an example that demonstrates the disconnection. The physical act of breathing is a remarkable physiological process and a tool that most physiotherapists will use daily in practice settings. Breathing to move, breathing to soften, breathing to allow for change, increasing blood flow, bringing attention to movement, resistance, stretch, mobilisation, hydrotherapy, as an assessment tool; the list is endless and affected by countless clinical elements (Han *et al* 2016). The descriptive anatomy and the visual power of inflating lungs, their effect on thoracic and abdominal organs and muscular structure and the ability for breath to be transformative, even at the most prosaic level, is a powerful and useful tool.

Learning to breathe, whilst related, is not the same us understanding respiratory physiology (Bintley *et al* 2019). Physiotherapy training and resources rely almost entirely on current anatomical models within basic training, and clinical anatomy resources constructed from standard anatomical teaching models remain important reference tools when moving into outpatient settings (Farrell *et al* 2015).

Bigger is not better

Fat is not a friend to the anatomical dissector and overly large donors will be declined, as fat gets in the way of where a dissector needs to get to and there is a belief that it has little physiological or functional relevance. This is something that is held true for other connective tissues (Pratt 2019).

The fatty layer, the adipose, consists of adipocytes or fat cells held in place by a strong network of collagen fibres. Once we reach adulthood, adipocytes numbers are relatively static, but they expand and contract according to the variable energy changes experienced. The collagen fibres respond accordingly. It is unclear whether they physically grow in terms of fibre length or unwind when under tension but they have the ability to rapidly adapt according to environmental change.

However, these fat-holding fibres are not just a "layer". Instead, they blend in to the underside of the skin and become the fibrous element of the basal layer. When they move inwards towards the muscle, they meld seamlessly into the layer known as epimysium or deep fascia. It is this fatty layer, referred to by a variety of names, such as the panicular layer and the superficial fascia that is changeable and problematic for scarred tissue. It can create restriction and pain that will often be interpreted by patients as being deeper than it is, and it is familiar to the therapist when palpating as it feels lumpy and complex under our hands. Once it is removed, the smooth, striated fascia and muscle is alien to the touch. It is in this area that I believe we experience the phenomena known as muscle knots or trigger points, a principle rarely considered even amongst the trigger point sceptics (**www.PainScience.com**).

The separation and study of layers tends to be selective and, while the principle of cross-sectioning is hardly new, when it comes to considering function more widely, it is rarely employed to explanatory effect.

When considering the thoracolumbar fascia (TLF), there is a wealth of material and studies that examine everything from its histology to its location and where it begins, but the fibres of the superficial fascia are always conspicuous by their absence (Willard *et al* 2012). Yet, as we can see from figure 1, tensional fibres situated in the adipose region, between the skin and the deep fascia, are clearly distributed down and through the next "layer" of the TLF. An interesting "pocket" of tissue connects to the iliac crest and forms strong bonds across it and onto the gluteus medius.

If and how these formations contribute to stability, function or pain remains to be seen. There is, however, no doubt that they must have a functional role to play as they are there and, given the enormity of their presence, the fibrotic nature of their presentation and the strength of their attachment to bony landmarks, they must surely merit the same consideration and understanding as any other structure in the body.

The iliotibial band and swan carving

My friend John Webster, a skilled massage therapist, also dabbles in carving ice with a chain saw. Looking in awe at a carved ice swan, I asked him how he did it. In his sardonic Californian drawl he replied: "You just take a block of ice and cut away everything that doesn't look like a swan."

An iliotibial band (ITB) is made in much the same way. Cut away everything that doesn't look like an ITB and leave the rest. From there we can create any story we like. Syndromes, assessment techniques, foam rollers, research papers (Shamus & Shamus 2015), and weekend workshops. All for something that only exists because of the dissector's scalpel and a book illustration.

FIGURE 1: The upper part of left gluteus maximus. (a) = the remains of loose areolar connective tissue (superficial fascia) lying on top. (b) = the skin of the lower back that has been removed and (c) = the strong fibres that connect superficial fascia through to the underside of the skin can be seen blending into the thoracolumbar fascia and the (hidden) fascia of the gluteus minimus. Some adipose has been scraped away to show the fibres more clearly (© Julian Baker 2020)

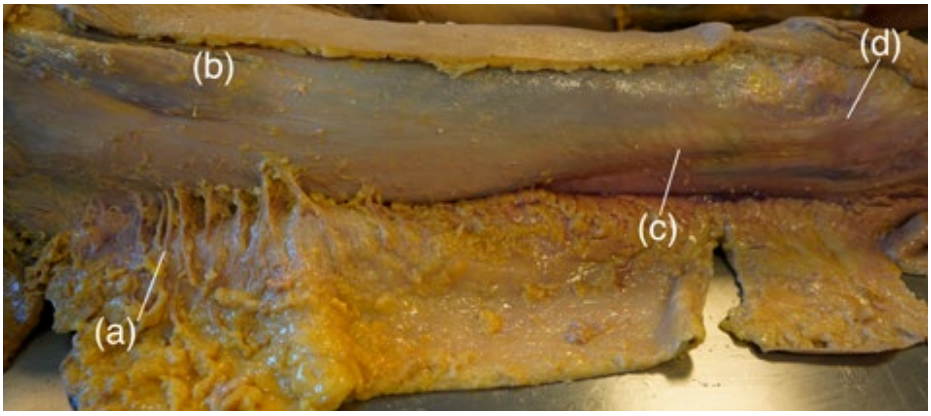

FIGURE 2: A dissection of the left leg showing (a) = collagen fibres of superficial fascia blending to become fibres of the fascia lata. (b) = Vastus lateralis is encased in a bag inside this. The iliotibial band will only be revealed when the leg is trimmed and the ITB fibres left behind. (c) = the guide of where this might happen can be seen in the thickened area. (d) = the ITB fibres diverge at the tibia and continue inferiorly, medially, and posteriorly, forming the external fascia of fibularis longus, the crural and anterior tibial fascia and in most cases, the extended fibres of plantaris, as well as many others (© Julian Baker 2020)

The thickening of the connective tissue through a lateral part of the fascia lata is not in question. However, the illustration and description of the structure, while occasionally referring to the tissue as a whole, consistently fails to consider any role of the crossing and weaving fibrous tissues that give the ITB its integrity (figure 2).

The hamstrings: keep doing what you've always done

Sports injuries tend to be repeat injuries. Even when considering "new injuries" the ability to assess overall function is limited. Localised treatment of specific injuries in regionalised areas is supported by the classical and localised model with little consideration of how any given injury will impact on other systems or functions.

A person who spends five days limping is teaching their functional system a way of behaving that is very quickly going to be part of who they are and how they move. A therapist who is unable to identify this new pattern and address it when treating the patient may unwittingly be prolonging the problem and allowing new ones to emerge.

A good example that combines the repetition of injury with the construct of a poorly represented anatomical structure is the hamstrings. The

"THE DEFINITIONS OF HAMSTRING GROUPINGS ARE SET IN STONE, YET A DIFFERENT DISSECTION APPROACH REVEALS TISSUE CONNECTIONS THAT SIGNIFICANTLY CHANGE HOW WE MIGHT WIDEN OUR VIEW OF THIS STRUCTURE"

definitions of the grouping are set in stone, yet a different dissection approach reveals tissue connections that significantly change how we might widen our view of this structure (figure 3). The implications are staggering and should have contributed to a radical shift in the consideration of the anatomy of the hamstrings and how they are assessed, treated and described (Pérez-Bellmunt *et al* 2015). With only five citations listed in the citation database Scopus (**www.elsevier.com**) in five years, this has yet to create the impact it should.

Conclusion

When we study the body we have to start somewhere. Naming as many parts of the body as a point of reference, and understanding them as a process of function is a reasonable place to start but a terrible place to finish as it fails to translate the human body into the human being. The missing link in our approach to health from a medical perspective is something that we all understand and seem to accept, as if excusing medicine from needing to accept reality. This is demonstrably harmful. The sturdiness of any structure is based on a solid foundation and medical science is no different. If the foundations are missing essential parts, then everything set on top of them becomes unstable.

When you follow the trail to where the fault begins, it is to be found in the perpetuation of an anatomy that omits more than it teaches and an arrogant complacency that ignores the rest. The mainspring remains an integral aspect of a beautiful watch and has not become obsolete. However, we now understand that it is not the only way to power a watch.

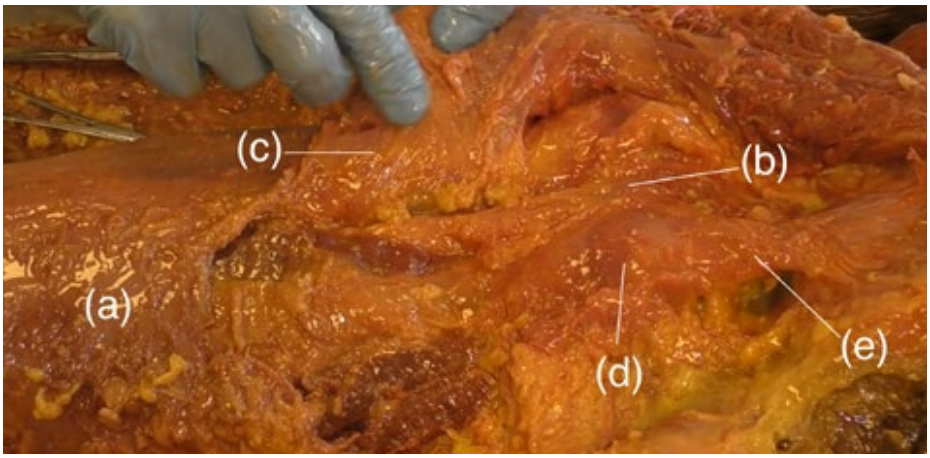

FIGURE 3: Shows a pre-dissected area of the hamstrings. (a) = the fascia lata has been cut on its upper portion and (b) = the path of the sciatic nerve can be clearly seen. (c) = the anterior fascia of gluteus maximus forms a lateral band over head of the (d) hamstring grouping and the (e) ischial tuberosity, demonstrating the potential capacity of the fascia to transfer load and information to from the lower limb

QAP REVIEW

The Paradigms of what is accepted and relevant anatomy knowledge have been set in stone now for some time. This institutionalisation of knowledge has sometimes been to the detriment of knowledge advancement, as new ideas surface they struggle to gain mainstream acknowledgment. In clinical practice, how many diagnostic terms have changed over the years to reflect the advancement of our understanding, sometimes even in conjunction with a new appreciation of how global (dys)functional movements or abnormal loading create these 'pathologies'? This process of recognising the evolution in our learning has enabled our treatments and outcomes to change for the better. For me, this article highlights that 'anatomical truths' can and should be challenged, but only when the counter arguments are underpinned with sound scientific reasoning, inform our clinical decision making and improve our knowledge and patient outcomes.

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About the author

In 1993, Julian was responsible for introducing The Bowen Technique to Europe, and he remains the principle instructor of the College of Bowen Studies, **www.thebowentechnique.com**. He has taught thousands of

students all over the world and, since 2008, has been running dissection classes for manual and movement therapists in the UK and the USA.

From 2007 to 2016, Julian organised and hosted Gil Hedley's dissection classes in the UK and he has taught with, amongst others, Tom Myers and Robert Schleip. He continues to regularly deliver lectures worldwide on anatomical paradigms during which he half-jokingly refers to himself as an Anatomy Anarchist as he challenges conventional ideas on anatomy and questions the myths, language and assumptions that surround manual therapy.

Julian is a member of the Anatomical Society, the Institute of Anatomical Sciences, the Fascia Research Society, and is an "expert" member of the Federation of Holistic Therapists. He has been on the board of the British Fascia Symposium since its inception.

During 2020, Julian ran a six-day live-stream dissection class that examined his approaches and, since April 2020, has created a series of over 20 webinars all of which can be found at **www.functionalanatomy.com**

Acknowledgement

The images in this article have been taken from dissections that are typical of what will be found in every cadaver, and are only possible to include thanks to the generosity of the donors and their families to whom we are constantly indebted.

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Further resources

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