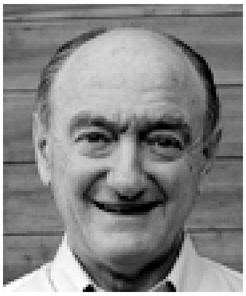
Editorial

Clinical Anatomy: An Unmet Agenda in Rheumatology Training



Without the art, there can be no data for the science. Without the science, there can be no reason for the art.
— Alvan Feinstein, *Clinical Judgement*

A working knowledge of anatomy is vitally important to an informed practice of medicine. However, there is both ample data and anecdotal observation to support that a substantial proportion of medical students and internal medicine residents have not received an adequate training in clinical anatomy and in the musculoskeletal examination at the time of completion of their training[1,2]. The reasons for this are diverse, yet not surprising, given data such as those found by LaCombe, who reported that the percentage of clinical teaching that occurs at the bedside dropped from 75% in the early 1960s to 16% by 1978 and most likely remains at a similarly low number[3]. This deficit in training is unfortunate, given the high frequency of patients who present for evaluation of musculoskeletal symptoms in the population at large[4]. In this exciting era of rapid technological advances in understanding disease pathogenesis and in therapeutics, we believe it remains critically important that we consistently provide these fundamental skills to our students.

What is clinical anatomy? Most basically defined, it is the application of the knowledge of human anatomy to the diagnosis and care of the patient[5]. It is also the conception of the human body not as a mere volume to be seen, felt, and moved, but also to be known and understood. Clinical anatomy, as we can teach ourselves daily in our offices, is learned by looking at the body's contours and always questioning what is bringing them to appear as they do in front of us[6].

There are several reasons that clinical anatomy is so essential to the rheumatologist:

(1) Most importantly and obviously, the vast majority of conditions diagnosed and managed by rheumatologists involve components of the musculoskeletal system including joints, bursae, muscles, tendons, entheses, and bones. The ability to accurately identify the anatomic component affected in a given patient engenders a more insightful understanding of symptoms and physical findings and facilitates diagnosis and nosologic classification.

(2) A background and confidence in clinical anatomy is key to the recognition and treatment of regional pain syndromes. A substantial portion of a rheumatologist's time (about 30%) is spent in the care of patients with these conditions[7]. Indeed, the diagnosis of regional pain syndromes is a true exercise in clinical anatomy[8-10].

(3) The boundary between rheumatology and other subspecialties in which the musculoskeletal system is central such as orthopedics, rehabilitative medicine, neurology, and geriatrics is a fuzzy one; consequently, patients may be directed one way or another according to the whims of their beliefs or the beliefs and habits of their primary care physician, and they often go the "wrong" way first. As a result, it becomes critical for the rheumatologist to be familiar with problems that are not primarily "rheumatologic" in nature such as scaphoid fractures, shoulder instability, meniscal or ligamentous tears, the symptoms and signs of failed arthroplasty, limb ischemia, and entrapment neuropathies, lest patients be wrongly treated. In addition it is often necessary that patients with rheumatic diseases receive care that is coordinated between specialists from more than one of these fields, such as the patient with rheumatoid arthritis who requires joint replacement or tendon repair and then must successfully rehabilitate from surgery.

(4) One more reason to know clinical anatomy is to maintain confidence as we compare our musculoskeletal knowledge with that of our fortunate colleagues who possess an ultrasound machine[11,12] or to that which can be obtained by increasingly sophisticated but expensive magnetic resonance imaging (MRI) technology. We would submit that this gap can be narrowed by knowledge of clinical anatomy, leading to more cost-effective care of the patient and leaving to the ultrasonographist and MRI radiologist that which is legimately beyond the possibility of the most skillful examination. Further, an improved knowledge of anatomy would facilitate communication between the ordering rheumatologist and the radiologist.

Without a common standard of training in clinical anatomy in rheumatology fellowship training programs, we believe that the competence in this important skill set among graduating fellows is highly variable. Rheumatologists have been defined as internists who know how to examine joints. We would want to extend this view and define rheumatologists as internists who know how to examine the musculoskeletal system, the vascular system, and the peripheral nervous system. We owe to our fellows the adequate training that will allow them the confidence and satisfaction of knowing that they possess this expertise. Undoubtedly, most established rheumatologists, the authors included, would benefit from consistent review and new learning from informed examination and anatomic study.

How can a program best teach its fellows clinical anatomy? Among medical school educators an ongoing controversy continues over whether anatomy should be taught in the dissecting room or on a computer screen[13-15]. The old-fashioned way was based on heavy textbooks (they have become lighter and lighter) and the dissection of rigid cadavers. Currently, virtual imaging based on models, computerized tomography, and MRI scanning has helped immensely our understanding of structure and gross function, and has been adapted by some, including a number of medical schools, to teach clinical anatomy. While we acknowledge the merits of each of these methods, we favor, in agreement with McLachlan, *et al*[16], the teaching of anatomy using live models and the daily examination of patients, and propose that this method may ideally be used in combination with either dissection or computer simulation. Examples exist of medical school curricula that have attempted to incorporate clinical anatomy into the teaching of musculoskeletal diseases and examination[17], and we encourage more rheumatology fellowship programs to consider implementing this type of approach in their training. A successful program could be extended and used for continuing education purposes for primary care practitioners.

We have taught clinical anatomy in workshops that use a series of hypothetical clinical vignettes as a jump-off point for the examination of living models. In these sessions, attendees gather around the model and observe a region-based examination in which the surface anatomy and dynamic palpation is demonstrated by the workshop leader while selected anatomical drawings are projected to correlate the surface and internal anatomy. We have successfully utilized this model of teaching clinical anatomy in workshops at the 2005 and 2006 American College of Rheumatology national meetings as well as in numerous sessions with medical students, residents, and rheumatology fellows.

Dynamic palpation is central to this method and is done by placing the exploring hand proximally on a limb and asking the model to move the distal part in order to identify the muscles that bring about the requested motion — a kind of palpatory electromyogram. An easy and fun application of this method can be demonstrated on yourself while you perform everyday activities. Next time you are out for an evening stroll or when you walk your dog, review the anatomy of gait: grasp your own thigh with the free hand, first on the front, then on the side, and finally in the back, as all those muscles that we generically lump together as "thigh muscles" come alive. You can learn when and how each muscle acts during ambulation. When you place the hand on the side of the pelvis between the greater trochanter and the iliac crest you will feel the lesser glutei in action. Since the gluteus medius and minimus tighten as we bear weight on that leg, they must be the muscles that keep our pelvis straight as we walk and allow the swing leg to not hit the ground as it passes the other leg in the swing phase of gait. Are the lesser glutei alone in this function, or is there some structure that not so passively lends a hand? Lower your hand to the greater trochanter and below and you get the answer: indeed, there is a strong band that gets tight in mid-stance and helps support the weight of the pelvis, the iliotibial band[8]. When done in conjunction with flipping through the dusted off anatomy atlas, the learning from this type of exercise — that is available to all — can be immense and gratifying.

A sampling of human anatomy in everyday practice. Having found the anatomy books we will next explore a sampling of surface anatomy that we may observe on the patients we see every day in practice, and match this to the anatomy under the surface. We will start at the hand: dorsally, in the extended hand the extensor tendons show in the back of the hand over the carpus and metacarpals but not over the digits. How does this happen? The extensor tendon just proximal to the metacarpophalangeal (MCP) joint divides into 3 bands, one being its direct continuation, plus medial and lateral saggital (shroud) bands. The latter, which encircle the metacarpal head, fuse with the palmar plate and thus prevent dorsal bowstringing of the extensor tendon. However, the most interesting part is that both the direct and the saggital fibers of the extensor tendon incorporate into a triangular structure referred to as the extensor expansion, of which the saggital fibers form its proximal edge. This structure is pulled on the sides by the lumbricals and interossei and incorporates the link ligament of Landsmeer that helps stabilize the extensor mechanism[18]. Understanding these amazing anatomical arrangements, plus the anatomy of the flexor tendon sheaths and related pulleys that retain the flexor tendons close to bone and prevent bowstringing, plus the thenar and hypothenar muscles' anatomy and function, opens the door to comprehending finger function in the normal hand and in diseases such as rheumatoid arthritis, where distortion of these structures contributes to the formation of well known deformities such as ulnar deviation and subluxation as well as volar subluxation of the MCP joints[19].

We will move next to the wrist. From the volar side, where does that transverse carpal ligament insert that binds the carpal tunnel anteriorly? If you knew that there are 4 bony eminences into which this ligament inserts, and knew how to recognize by palpation these eminences, the scaphoid tubercule and the crest of the trapezium on the radial side, and the pisiform (this is easy enough) and the hook of the hamate (we challenge you to find this) on the ulnar side, then you would be all set, except that you now need to know where the median nerve lies, so that when you perform a carpal tunnel injection the needle will not elicit an unwanted jerk during the procedure. If you now ask the patient to sharply palmarflex the wrist, 3 tendons tense up. These are, from ulnar side to radial side of the volar aspect of the wrist, the flexor carpi ulnaris, palmaris longus (in the 90% of people who have it), and flexor carpi radialis. The median nerve most commonly lies between the latter 2. This is why the needle should be inserted just to the ulnar side of the palmaris longus, and in those missing this tendon, ulnar to the midpoint between the radial and ulnar boundaries of the wrist.

Moving to the lower extremity, with the patient face down, can you understand that if the knee is now flexed 90 degrees and the leg is dropped sideways the piriformis muscle, which is an external rotator of the hip, is now being stretched and has an opportunity to cause sciatica in that patient with the elusive piriformis syndrome? Do you know that in the same position, hip extension may bring acute anterior thigh pain in someone with femoral neuropathy or L2-L3 radiculopathy?

In the knee region, are you familiar with the pathophysiology of the Baker's cyst? Have the patient lie face down and ask her, having the leg straight in extension, to flex the knee while you gently resist by pressing down on the heel. Watch the muscles in action — medially, in the popliteal fossa a sharp tendon stands out, the semitendinosus, but don't miss the fleshy semimembranosus that contours it, as this is the real medial boundary of the cyst. And lateral to the cyst is the medial head of the gastrocnemius. Now let the knee flex about 40 degrees and the cyst's tension will suddenly drop as the bordering muscles separate; the pathophysiology of Baker's cysts and Foucher's sign (the softening of the cyst in flexion) has now been understood[9]!

To cite another example, not to leave the foot out of this exercise (and if you are seriously interested in the spondyloarthropathies) — with the patient still face down, follow the contour of the Achilles tendon and determine how, after narrowing just above the calcaneus, it suddenly widens, which suggests that in addition to inserting in the calcaneal tuberosity, it embraces the heel and incorporates some of its fibers into the plantar fascia. And, by the way, just above the calcaneal insertion, can you palpate some fluctuance in the insertional angle, disclosing the retrocalcaneal bursal proliferation or effusion that so frequently accompanies Achilles enthesopathy, lending support to the enthesis organ concept[10]?

Referred pain. Aspiring rheumatologists should also be familiar with referred pain patterns. Jonas H. Kellgren, a foremost English rheumatologist, published groundbreaking papers in *Clinical Science* in 1938 and 1939 describing where pain is felt when a structure at or deep to the aponeurotic fascia is stimulated with an irritating solution. Pain from fascia is sharply localized and felt a few centimeters distal to the needle; muscle pain is felt diffusely over a considerable area that can be quite distant from the needle, while the sharply localized tendon pain is intermediate in radiation[20,21]. The same is true of deep joints, as shoulder pain is felt in the deltoid area and hip pain is experienced in the anteromedial thigh and even the knee. The referred pain concept was extended to the cervical spine[22], the facet joint[23], and the sacroiliac joint[24], among other structures. The complexities involved in deep pain radiation may be exemplified by buttock pain, which experimentally may be caused by stimulation of the multifidus in the mid-lumbar region and gluteus medius[20], the interspinous ligaments L5, S1, S2[21], the lumbar facet joints[23], and the sacroiliac joint[24]. We feel it is incumbent on rheumatology trainees to become familiar with these issues, as pain in a given location should make them consider all of its possible sources, some of them remote.

We submit that if we rheumatologists master clinical anatomy — an opportunity that is open to us all — we stand individually and as a group to benefit in many ways. Examining our patients with an anatomist's eye will make our practices not only more efficient and productive, but also more interesting and enjoyable[25]. Further, if most of us can incorporate knowledge of clinical anatomy into our everyday practices we will be quicker to make diagnoses in the office and will rely less on expensive imaging techniques when a diagnosis can be made without them, thus making our practice more time- and cost-effective. At the same time we will be able to define and validate that for which ultrasound and other musculoskeletal imaging techniques are truly indicated. It will place ultrasound-enabled rheumatologists into an even greater standing, as they will be called for help in situations that are beyond the limits of the competent examination. We will also have greater insight into that which our colleagues in orthopedics and neurosurgery can accomplish to benefit a patient when what we can do without a scalpel has been exhausted. We will have a better ability to more efficiently triage cases to the physiatrist or physical therapist when their skills may further benefit a patient. Last but not least, an enhanced knowledge of clinical anatomy will make us legitimate contenders to that shared territory where rheumatology, orthopedic surgery, neurology, and physical medicine converge, the regional pain syndromes, where we prematurely planted our flag without having first prepared ourselves to participate in its conquest.

We would aspire that rheumatology training programs dedicate the time and resources to train their fellows in clinical anatomy. We encourage programs to integrate the use of living models with the use of the recently available Internet and simulation models or, if preferred, the old-fashioned anatomy textbook or cadaver prosection. Live models may be selected from a panel of volunteer or paid patients, but if properly done may just as well be the learners themselves who can examine each other. We would hope that faculty with skills and interest in teaching physical diagnosis can be inspired to participate and be recognized and hopefully compensated as well for their involvement. In this exciting time of tremendous advances in rheumatology, we feel it remains essential for the proper diagnosis and treatment of patients that trainees possess expertise in clinical anatomy and be knowledgeable enough in this area to be able to perpetuate it in the future to their own students. Further, as stated by Feinstein once again[26], "without art there can be no data for science." Perhaps just as importantly the art of medicine, which for the rheumatologist should include a confident ability and instinct in clinical anatomy, is a key ingredient to that which keeps the practice of clinical medicine satisfying throughout a career.

ACKNOWLEDGMENT

Dedicated to Professor Michael Benjamin, a foremost anatomist who continues to bridge the intricacies of musculoskeletal anatomy and rheumatology.

ROBERT A. KALISH, MD,
Assistant Professor of Medicine,
Division of Rheumatology,
Tufts–New England Medical Center,
Tufts University School of Medicine,
750 Washington Street, NEMC Box 599,
Boston, Massachusetts 02111, USA;
JUAN J. CANOSO, MD,
Adjunct Professor of Medicine,
Tufts University School of Medicine,
ABC Medical Center,
Mexico City, Mexico

Dr. Kalish receives grant support from the American College of Rheumatology: Clinician Scholar Educator Award, 2004-2007.

Address reprint requests to Dr. Kalish. E-mail: rkalish@tufts-nemc.org

REFERENCES

1. Freedman KB, Bernstein J. Educational deficiencies in musculoskeletal medicine. J Bone Joint Surg Am 2002;84A:604-8.
2. Clawson DK, Jackson DW, Ostergaard DJ. It's past time to reform the musculoskeletal curriculum. Acad Med 2001;76:709-10.
3. LaCombe MA. On bedside teaching. Ann Intern Med 1997;126:217-20.
4. Rasker JJ. Rheumatology in general practice. Br J Rheumatol 1996;34:494-7.
5. Boon JM, Meiring JH, Richards PA. Clinical anatomy as the basis for clinical examination: Development and evaluation of an introduction to clinical examination in a problem-oriented medical curriculum. Clin Anat 2002;15:45-50.
6. Lockhart RD. Living anatomy. 6th ed. London: Faber and Faber; 1963.
7. Vanhoof J, Declerck K, Geusens P. Prevalence of rheumatic diseases in a rheumatological outpatient practice. Ann Rheum Dis 2002;61:453-5.
8. Fairclough J, Hayashi K, Toumi H, et al. The functional anatomy of the iliotibial band during flexion and extension of the knee: implications for understanding iliotibial band syndrome. J Anat 2006;208:309-16.
9. Canoso JJ, Goldsmith MR, Gerzof SG, Wohlgethan JR. Foucher's sign of the Baker's cyst. Ann Rheum Dis 1987;46:228-32.
10. Benjamin M, Moriggl B, Brenner E, Emery P, McGonagle D, Redman S. The "enthesis organ" concept: why enthesopathies may not present as focal insertional disorders. Arthritis Rheum 2004;50:3306-13.
11. Kane D, Balint PV, Sturrock R, Grassi W. Musculoskeletal ultrasound — a state of the art review in rheumatology. Part 1: Current controversies and issues in the development of musculoskeletal ultrasound in rheumatology. Rheumatology Oxford 2004;43:823-8.
12. Kane D, Grassi W, Sturrock R, Balint PV. Musculoskeletal ultrasound — a state of the art review in rheumatology. Part 2: Clinical indications for musculoskeletal ultrasound in rheumatology. Rheumatology Oxford 2004;43:829-38.
13. Shaffer K. Becoming a physician: Teaching anatomy in the digital world. N Engl J Med 2004;351:1279-81.
14. Winkelmann A, Güldner FH. Cadavers as teachers: the dissecting room experience in Thailand. BMJ 2004;329:1455-7.
15. Spitzer VM, Scherzinger AL. Virtual anatomy: An anatomist's playground. Clin Anat 2006;19:192-203.
16. McLachlan JC, Bligh J, Bradley P, Searle J. Teaching anatomy without cadavers. Med Edu 2004;38:418-24.
17. Saleh K, Messner R, Axtell S, Harris I, Mahowald ML. Development and evaluation of an integrated musculoskeletal disease course for medical students. J Bone Joint Surg Am 2004;86A:1653-8.
18. Landsmeer JMF. The coordination of finger-joint motions. J Bone Joint Surg Am 1963;45A:1654-62.
19. Wise KS. The anatomy of the metacarpo-phalangeal joints, with observations of the aetiology of ulnar drift. J Bone Joint Surg Br 1975;57B:485-90.
20. Kellgren JH. Observations on referred pain arising from muscle. Clin Sci 1938;3:175-90.
21. Kellgren JH. On the distribution of pain arising from deep somatic structures with charts of segmental pain areas. Clin Sci 1939; 4:35-46.
22. Smythe HA. The C6-7 syndrome. Clinical features and treatment response. J Rheumatol 1994;21:1520-6.
23. Mooney V, Robertson J. The facet syndrome. Clin Orthop 1976;115:149-56.
24. Fortin JD, Aprill CN, Ponthieux B, Pier J. Sacroiliac joint: pain referral maps upon applying a new injection/arthrography technique. Part II: Clinical evaluation. Spine 1994;19:1483-9.
25. Woolf AD. History and physical examination. Best Pract Res Clin Rheum 2003;17:381-402.
26. Feinstein A. Clinical judgement. Baltimore: Williams and Wilkins; 1967.