A survey of anatomical items relevant to the practice of rheumatology: pelvis, lower extremity, and gait

Cristina Hernández-Díaz[1], José Alvarez-Nemegyei[2], José Eduardo Navarro-Zarza[3,4], Pablo Villaseñor-Ovies[5,6], Robert A. Kalish[7], Juan J. Canoso[8,9], Angélica Vargas[10], Karla Chiapas-Gasca[11], Joseph J. Biundo[12], Francisco Javier de Toro Santos[13], Dennis McGonagle[14], Simon Carette[15,16], Miguel Ángel Saavedra[17]

[1] *Laboratorio de Ultrasonido Musculoesquelético y Articular, Instituto Nacional de Rehabilitación, México, DF, Mexico*

[2] *Unidad de Investigación, Hospital Regional de Alta Especialidad de la Península de Yucatán, Mérida, Yucatán, Mexico*

[3] *Hospital General de Chilpancingo Raymundo Abarca Alarcón, Chilpancingo, Gro, Mexico*

[4] *Universidad Autónoma de Guerrero, Acapulco, Gro, Mexico*

[5] *Hospital Ángeles de Tijuana, Tijuana, BC, Mexico*

[6] *Universidad Autónoma de Baja California, Mexicali, Mexico*

[7] *Tufts Medical Center, Boston, MA, USA*

[8] *Centro Médico ABC, México, DF, Mexico*

[9] *Tufts Medical School, Boston, MA, USA*

[10] *Departamento de Reumatología, Instituto Nacional de Cardiología Ignacio Chávez, México, DF, Mexico*

[11] *Hospital Adolfo López Mateos, ISSSTE, México, DF, Mexico*

[12] *Tulane Medical Center, New Orleans, LA, USA*

[13] *Servicio de Reumatología, Instituto de Investigación Biomédica de A Coruña (INIBIC), Complejo Hospitalario Universitario A Coruña (CHUAC), Sergas, Universidad La Coruña (UDC), Coruña, Spain*

[14] *UK National Institute for Health Research Leeds Musculoskeletal Biomedical Research Unit, Chapel Allerton Hospital, Leeds Institute of Rheumatic and Musculoskeletal Medicine, University of Leeds, Leeds, UK*

[15] *Division of Rheumatology, Mount Sinai Hospital, University Health Network, Toronto, ON, Canada*

[16] *University of Toronto, Toronto, ON, Canada*

[17] *Hospital de Especialidades Dr. Antonio Fraga Mouret, Centro Médico Nacional La Raza, Instituto Mexicano del Seguro Social, Mexico City, Mexico*

Corresponding autor: MiguelÁngel Saavedra, miansaavsa@gmail.com

Abstract

This study aimed to generate a minimum list of structural and functional anatomical items about the pelvis/hip, knee, ankle/foot, gait, and lower limb innervation, which are most relevant to the practice of rheumatology. To determine their perceived relevance to clinical practice, seven members of the Mexican Clinical Anatomy Task Force compiled an initial list of 470 anatomical items. Ten local and international experts according to a 0-10 Likert scale ranked these items. Of the original list, 101 (21.48%) items were considered relevant (global rate >40). These included 36/137 (26.27%) pelvis and hip items, 25/82 (30.48%) knee items, 22/168 (13.98%) ankle/foot items, 11/68 (16.17%) neurologic items, and 7/15 (46.66%) gait-related items. We propose that these 101 anatomical items of the lower extremity, when added to the 115 anatomic items of the upper extremity and spine we previously reported, may represent an approximation to the minimal anatomical knowledge central to the competent practice of rheumatology. The meager representation of ankle and foot items may reflect a lesser emphasis in these anatomical regions during rheumatologic training. Attention to these and related items during rheumatologic training and beyond may sharpen the rheumatologist's ability in the differential diagnosis of regional pain syndromes as well as strengthen an endangered art: the rheumatologic physical examination.

Keywords: Clinical anatomy; Physical examination; Regional pain syndromes; Rheumatology education.

Introduction

The clinical approach to patients with musculoskeletal regional pain syndromes and systemic rheumatic diseases requires skill in the musculoskeletal physical examination. However, the information gained by inspection, palpation, and motion largely depends on knowledge of what is being seen, felt, or moved. Thus, clinical anatomy is the basic knowledge that underlies an informed and productive musculoskeletal physical examination. In previous studies, we have shown a suboptimal knowledge of clinical anatomy in practicing rheumatologists as well as rheumatology and orthopedic fellows [1, 2]. This perceived deficiency prompted the authors to explore a largely unexplored field: the knowledge of musculoskeletal clinical anatomy that must underlie the practice of rheumatology. The project had two parts. In the first, international experts determined key anatomical concepts and structures of the upper extremity, head, neck, and spine most relevant to the practice of rheumatology [3]. We are now completing the survey by presenting the parallel report on anatomical items of the pelvis, lower extremity, and gait.

Methods

Each member of the Mexican Clinical Anatomy Task Force (GMAC, Spanish acronym) was asked to list the anatomical items of the pelvis, lower extremity, and gait relevant to the practice of rheumatology. The combined list contained 470 items: 137 (29.15%) pelvis and hip items, 82 (17.45%) knee items, 168 (35.74%) ankle and foot items, 68 (14.46%) neurologic items, and 15 gait items (3.20%). This master list was sent to the same GMAC and international experts that participated in the initial study [3], via a one-round, web-supported Delphi survey (SurveyMonkey Inc., Palo Alto, CA, USA). The international experts were from Boston (RAK) and New Orleans (JB), USA; La Coruña (FJTS), Spain; Leeds (DMcG), UK; and Toronto (SC), Canada. As in the previous survey, the senior experts were JJC plus the international experts, and the junior experts CHD, JEN-Z, PV-O, and MAS. The ten participants were asked to rank each of the 470 anatomical items for their potential clinical relevance according to a Likert scale as follows: 1, not important; 2, of dubious importance; 3, somewhat important; 4, important; and 5, very important. Therefore, for each item, added scores could range from a minimum of 10 to a maximum of 50. Items that achieved an added score ≥40 were

considered, as in the previous report, the group of anatomical items most relevant to the practice of rheumatology.

Statistical analysis

The inter-observer agreement for item rating was assessed by two methods: For each expert, a global mean rating was obtained for the 470 items, and these mean ratings were compared using the mean 95% confidence interval approach. Furthermore, the level of overall concordance between all possible pairs of experts was assessed using the intra-class correlation coefficient (ICC). For this correlation analysis, we considered that an ICC of 0 means no correlation; 0 to 0.20, slight correlation; 0.21 to 0.40, acceptable correlation; 0.41 to 0.60, moderate correlation; 0.61 to 0.80, substantial correlation; and 0.81 to 1.0, perfect correlation.

Results

Overall mean scores for the 470 items ranged from 2.27 to 4.38 between the ten participating experts. Expert 1 gave the highest scores and expert 10, the lower scores. The mean scores delivered by experts 4, 5, 6, 7, and 8 showed no statistical difference as assessed by their 95% CI of the mean (Table 1). In the correlation analysis (Table 2), 8/45 (17.7%) of the expert pairs had a substantial concordance; 31/45 (68.8%) had a moderate concordance; and 6/45 (13.3%) had an acceptable concordance. None of the rater pairs showed slight or no concordance.

Item no. 147 (to know that Sigmund Freud published one of the earliest observations of meralgia paresthetica, describing his own case) had the lowest score, and item no. 43 (to be able to palpate the greater trochanter of the femur) had the highest score.

One hundred and one items (21.49%) had a rate ≥40. The grouped rating for the rest of assessed items was 30 to 39, 248 items; 20 to 29, 120 items; and finally, one item reached <20.

Tables 3, 4, 5, 6, and 7 show, arranged by regions, the 101 anatomical items, out of the 470 items initially proposed that reached a relevance score of 40 or more. These included 36 of the 137 (26.28%) pelvis/hip items (Table 3); 25 of the 82 (30.49%) knee items

(Table 4); 22 of the 168 (13.10%) ankle and foot items (Table 5); 11 of the 68 (16.66%) neurologic items (Table 6); and 7 of the 15 (46.67%) gait items (Table 7).

Discussion

In this survey, 101 of the 470 lower extremity and gait items (21.48%) were considered central to the practice of rheumatology. Hip, knee, and gait items reached consensus for more than 25% of the items, contrasting with 13% of the ankle and foot items and 17% of the neurologic items. We found it notable that a lesser percentage of ankle and foot anatomical items were scored as important than the rest of the regions looked at in this study as well as those related to gait and the anatomical items of the upper extremity and spine from our prior study. This difference may relate to the preponderance of ankle and foot pathologies that are considered by referring physicians and patients themselves to fall within the realm of orthopedics or podiatry rather than rheumatology. Alternatively, or also, there may truly be less need to know the exquisite details of a large number of individual anatomical structures that comprise the ankle and foot to diagnose and manage the most common conditions in that region. This discrepancy should be the subject of an in-depth analysis since some of us feel that due to various reasons, ankle and foot receive a meager attention during rheumatologic training and practice. It remains important that rheumatologists know the essential anatomy and clinical syndromes of the foot and ankle; for example, it is a relatively common experience for rheumatologists to diagnose rheumatoid arthritis in someone who has been given a diagnosis of Morton's neuroma or a failed metatarsal arch as the cause of a patient's foot pain. Similarly, patients with spondyloarthritis are often treated initially for a heel spur or plantar fasciopathy. Even in our clinical anatomy seminars, where we strive to be fair to all anatomical regions, it seems natural to start proximally and finish more distally and if time runs short at the end of the session, the ankle and foot receive a more meager share of the allotted time as compared, for instance, with the hand, shoulder, or knee. Regarding the neurologic items, it is understandable that the wide discrepancies noted among the experts would depend on their degree of involvement and interest in diagnosing neurologic conditions and their patterns of patient referral.

The strengths and limitations of our survey methodology were discussed in our previous paper that dealt with the upper extremity and spine [3]. Briefly, one strength includes the individual contribution and then the merging of items by all members of our group. A second strength is the scoring of each item by local and internationally recognized experts. A third strength is the concordance of ratings by all experts. A limitation of this study is that to avoid drastically reducing the number of items, only one round of answers took place. Another limitation is that our results are most applicable to rheumatology and may not be generalizable to other specialties. A similar study in related areas such as general and family medicine, sports medicine, orthopedics and physical medicine, and rehabilitation would be of great interest.

Needless to say, the task we undertook, of reviewing the clinical significance of a full range of musculoskeletal anatomy items, helped by a cadre of leading international authorities, though arduous was quite rewarding. Today, the practice of rheumatology is under ever tighter time and budget constraints, clinical skills are undervalued, and both the medical profession and the public give great credence to technological advances. In our view, enhancing timeless fundamentals may only increase the quality of our evaluations and enhance the public's perception of our profession. Using technology in the face of uncertainty is a virtuous step. Quite different is to use technology when a diagnosis is obvious or easily obtained using well-learned basic skills such as a competent history and an anatomically informed physical examination.

Proficiency with physical examination and ultrasonography are among the core competences for EULAR [4, 5], the Entrustable Professional Activities defined by the Next Accreditation System working group of the ACR [6, 7], the Medical Council of Rheumatology [8] as well as several other organizations that guide the training of rheumatologists.

There would be little argument regarding the inclusion of clinical anatomy as a valuable component of the core curriculum of rheumatology. Knowledge of the anatomy and biology of the musculoskeletal tissues is already considered an essential component. The performance of a competent physical examination of the axial and peripheral joints, periarticular structures, peripheral nerves, and muscles is contingent on anatomical knowledge. Ensuring competency in clinical anatomy in which anatomy and physical diagnosis are combined and applied to actual practice merges what might otherwise

consist of skills that are unable to be tied together and promotes the optimal diagnosis and care of our patients. Furthermore, the optimal use of the history and physical examination is essential to a cost-effective and hypothesis-driven practice of rheumatology. Finally, communication with general and family physicians, radiologists, orthopedic surgeons, and physiatrists would be facilitated by the use of anatomy as a common language.

From the above, we believe the process of reducing over 1000 anatomical items about the upper extremity, head, neck, spine, pelvis, lower extremity, and gait, to the approximately 250 for which consensus was reached, may help define the field of anatomy that is basic for rheumatologic training. Facility with these and related items may impact positively (a) the acquisition of physical examination skills that help most accurately diagnose our patients; (b) the accurate needle placement in joints and soft tissues; (c) in providing the low-power view that perfectly complements the exquisite structural analysis obtained through ultrasonography; and (d) in the development of a common language with related specialties.

References

1. Navarro-Zarza JE, Hernández-Díaz C, Saavedra MA, Alvarez-Nemegyei J, Kalish RA, Canoso JJ, Villaseñor-Ovies P (2014) Preworkshop knowledge of musculoskeletal anatomy of rheumatology fellows and rheumatologists of seven North, Central, and South American countries. Arthritis Care res 66:270–276
2. Saavedra MA, Villaseñor-Ovies P, Harfush LA, Navarro-Zarza JE, Canoso JJ, Cruz-Domínguez P, Vargas A, Hernández-Díaz C, Chiapas-Gasca K, Camacho-Galindo J, Alvarez-Nemegyei J, Kalish RA (2016) Educational impact of a clinical anatomy workshop on 1st-year orthopedic and rheumatology fellows in Mexico City. Clin Rheumatol 35:1299–1306
3. Villaseñor-Ovies P, Navarro-Zarza JE, Saavedra MÁ, Hernández-Díaz C, Canoso JJ, Biundo JJ, Kalish RA, de Toro Santos FJ, McGonagle D, Carette S, Alvarez-Nemegyei J (2016) A survey of anatomical items relevant to the practice of rheumatology: upper extremity, head, neck, spine and general concepts. Clin Rheumatol 35:3025–3030
4. Sivera F, Ramiro S, Cikes N, Cutolo M, Dougados M, Gossec L, Kvien TK, Lundberg IE, Mandl P, Moorthy A, Panchal S, da Silva JA, Bijlsma JW, Working Group on Training in Rheumatology (2016) Rheumatology training experience across Europe: analysis of core competences. Arthritis Res Ther 18(1):300
5. Sivera F, Ramiro S, Cikes N, Dougados M, Gossec L, Kvien TK, Lundberg IE, Mandl P, Moorthy A, Panchal S, da Silva JA, Bijlsma JW, Working Group on Training in Rheumatology across

Europe (2015) Differences and similarities in rheumatology specialty training programs across European countries. Ann Rheum dis 74:1183–1187

6. Brown CR Jr, Criscione-Schreiber L, O'Rourke KS, Fuchs HA, Putterman C, Tan Valeriano-Marcet J, Hsieh E, Zirkle S, Bolster MB (2016) What is a rheumatologist and how do we make one? Arthritis Care res 68:1166–1172
7. Bolster M, Brown C, Criscione-Schreiber LG, Fuchs H, Hsieh E, O'Rourke KS, et al (2015) Core curriculum outline for rheumatology fellowship programs. Am Coll Rheumatol 1–94
8. Pascual-Ramos V, Bernard-Medina GA, Flores-Alvarado DE, Portela-Hernández M, Maldonado-Velázquez MD, Jara-Quezada LJ, Amezcua-Guerra LM, Rubio N, López-Zepeda NE, Álvarez-Hernandez E, Saavedra MÁ, Arce-Salinas CA, Consejo Mexicano de Reumatología (CMR) (2017) The method used to set the pass mark in an objective structured clinical examination defines the performance of candidates for certification as rheumatologists. Reumatol Clin. doi:10.1016/j.reuma.2016.11.007

Table 1 Comparison of the mean score of 470 items, by expert

Expert	Mean	95% CI of the mean
1	4.38	4.30–4.46
2	3.82	3.77–3.87
3	3.76	3.70–3.83
4	3.46	3.37–3.56
5	3.42	3.31.-3.52
6	3.41	3.34–3.48
7	3.26	3.15–3.37
8	3.18	3.09–3.27
9	2.74	2.64–2.83
10	2.27	2.22–2.33

Table 2 Comparison of inter-evaluator agreement by intra-class correlation coefficient

Expert	8	10	1	7	6	2	4	3	9	5
8		0.53	0.60	0.41	0.46	0.59	0.55	0.44	0.58	0.51
10			0.58	0.49	0.40	0.57	0.52	0.41	0.48	0.52
1				0.61	0.45	0.67	0.66	0.56	0.71	0.54
7					0.44	0.52	0.64	0.46	0.62	0.40
6						0.30	0.40	0.34	0.54	0.32
2							0.62	0.54	0.60	0.57
4								0.47	0.66	0.44
3									0.50	0.50
9										0.51
5										

In all instances, the *p* value was <0.0001

Table 3. Pelvis and hip items that reached relevance consensus

No.	Item	Score
1	To be able to palpate the greater trochanter of the femur	49
2	To be able to identify by palpation the anterior superior iliac spine	47
3	To know that the symphysis pubis is frequently involved in spondyloarthritis	46
4	To know the motions of the hip joint: abduction, adduction, flexion, extension, medial-lateral rotations, and circumduction	46
5	To be able to identify by palpation the posterior superior iliac spine	45
6	To know that the greater trochanter pain syndrome is characterized by lateral hip pain and tenderness over the greater trochanter	45
7	To know that in the greater trochanter pain syndrome the pathologic process affects predominantly the tendons of gluteus medius m. and sometimes gluteus minimus m.	45
8	To know that in the weakness of the abductors, the unsupported side falls, as shown by looking at the anterior iliac spine and the gluteal fold (Trendelenburg sign)	45
9	To know that the main hip flexors are the iliacus and psoas major muscles	44
10	To recognize that histologically, the lower third of the sacroiliac joint is synovial	43
11	To distinguish processes that affect one or both sides of the sacroiliac joint	43
12	To know that the main hip extensors are gluteus maximus and the hamstring muscles	43
13	To know that the main hip abductor muscles are gluteus medius and minimus, assisted by tensor fascia lata and gluteus maximus	43
14	To know that the main lateral rotator of the hip is gluteus maximus m.	42
15	To know that the main medial rotators of the hip are tensor fascia lata and the anterior fibers of gluteus medius and minimus muscles	42
16	To be able to identify by palpation the ischium	42
17	To know that bursal involvement is a secondary phenomenon in the greater trochanter pain syndrome	42

18	To know that if a patient is standing on one leg (same side of the trochanteric pain) and within 30 s pain is reproduced, a tendinopathy of gluteus medius and minimus m. should be considered	42
19	To know that the Venus dimple is centered by the posterior superior iliac spine	41
20	To know that the posterior superior iliac spine overlies the middle third of the sacroiliac joint	41
21	To know that femoro-acetabular impingement may lead to hip osteoarthritis	41
22	To be able to identify by palpation the coccyx	41
23	To know that anterior to the hip joint, from medial to lateral, lie in sequence the femoral vein, the femoral artery, and the femoral n.	41
24	To know the relation of the sciatic n. with piriformis m.	41
25	To know that SI joint-induced stress produces somatic pain over the joint and variable referral to the lower limb	40
26	To know that the acetabular labrum stabilizes the hip at the extremes of motion	40
27	To identify by the muscle that attaches to it the anterior inferior iliac spine	40
28	To be able to identify by palpation the body of the pubis	40
29	To know that any of the above (item 23) neurovascular structures may be compressed in iliopsoas bursitis	40
30	To know that the iliopsoas bursa may grow into the pelvis under the iliopsoas fascia	40
31	To know the basis of the maneuvers used to identify piriformis syndrome: resisted external rotation with the extended hip, resisted abduction with the hip flexed 90°, and direct compression on the sciatic n. at the affected site	40
32	To recognize gluteus maximus m. in the patient	40
33	To know the insertion of gluteus medius m.	40
34	To know the actions of gluteus medius m.	40
35	To know that, based on the pathology and pathogenesis, “greater trochanter pain syndrome” is a better designation than “trochanteric bursitis”	40
36	To know that in the greater trochanter pain syndrome, resisted internal rotation of the hip reproduces the pain	40

Table 4. Knee items that reached relevance consensus

No.	Item	Score
1	To know that the patellar reflex depends on the roots L2–4	47
2	To know the suprapatellar bursa or recess	47
3	To know the superficial prepatellar bursa	47
4	To be able to palpate the head of the fibula	47
5	To identify the insertion of the patellar tendon	46
6	To identify the origin of the patellar tendon	44
7	To know the origin of the fibular collateral ligament	43
8	To know that a ruptured medial meniscus features tenderness at the medial joint line and a positive McMurray's test	43
9	To know that most Baker cysts in adults result from a communicating bursa that becomes distended by a knee effusion	43
10	To be able to identify on palpation the fibular collateral ligament	42
11	To identify the infrapatellar fat pad (Hoffa)	42
12	To know the location of the bursa anserina	42
13	To know the origin of the Achilles or calcaneus tendon	42
14	To know the insertion of the fibular collateral ligament	41
15	To know the function of the anterior cruciate ligament	41
16	To know the function of the posterior cruciate ligament	41
17	To know the three muscles whose tendons form pes anserinus	41
18	To know the insertion of sartorius m.	40
19	To know the parapatellar synovial recesses	40
20	To know how to explore the anterior cruciate ligament	40

21	To know how to explore the posterior cruciate ligament	40
22	To know the bursa that gives rise to the Baker cyst	40
23	To know that the bursa that gives rise to the Baker cyst is separate from the knee joint in childhood	40
24	To know that Baker cysts in children, except in chronic idiopathic arthritis, are caused by trauma, are separate from the joint, and slowly regress by modifying sports activities	40
25	To know how to identify by inspection and palpation biceps femoris m.	40

Table 5. Ankle and foot items that reached relevance consensus

No.	Item	Score
1	To know the insertions of the Achilles or calcaneus tendon	48
2	To know to blindly infiltrate or aspirate the tibiotalar joint	48
3	To know that the calcaneus reflex depends on the roots S1–2	47
4	To know the main motion of the tibiotalar joint	46
5	To know the calcaneal origin of the plantar fascia	45
6	To recognize by palpation the tibiotalar joint	45
7	To know the motions of the subtalar joint	45
8	To know where to infiltrate or aspirate blindly the subtalar joint	45
9	To know the action of the Achilles or calcaneus tendon	44
10	To know the location of the retrocalcaneal bursa	44
11	To recognize by inspection and palpation the insertional and the non-insertional Achilles or calcaneus tendon	43
12	To know the bones that meet at the subtalar joint	42
13	To know the location of the subcutaneous calcaneal bursa	41
14	To know the bones that meet at the tibiotalar joint	41
15	To know that the main foot dorsiflexors are tibialis anterior and extensor digitorum longus muscles	41
16	To know that the main foot plantar-flexor is the gastrocnemius-soleus complex assisted by posterior tibialis m.	41
17	To know the actions of the posterior tibialis m.	41
18	To be able to identify by palpation the proximal head of the 5th metatarsal	41
19	To know the tendons and the artery that accompany the tibial n. in the retromalleolar space	40
20	To recognize by palpation the insertional angle of the Achilles or calcaneal tendon	40
21	To know that as a result of the plantar position of the digital nerves, Morton neuromas are close to the plantar surface of the foot	40
22	To identify the tendon of extensor hallucis longus m.	40

Table 6. Neurologic items that reached relevance consensus

No.	Item	Score
1	To know the lower extremity dermatomes	47
2	To know the sensory distribution of the main lower extremity nerves	46
3	To know that the neuropathy of the lateral femorocutaneous n. is known as “meralgia paresthetica”	45
4	To know that the lumbosacral plexus supplies the skin and the muscles of the lower extremity	43
5	To know that the lumbosacral plexus is formed by the ventral rami of the spinal nerves T12–S4	42
6	To know that the sural n., a sensory nerve, is a major nerve for electrophysiologic studies, nerve biopsy, and nerve transplant	42
7	To know the sensory distribution by the sural n.	41
8	To know that the common peroneal n. winds around the neck of the fibula where it can easily be palpated	41
9	To know that the lumbosacral plexus is divided into the lumbar plexus (T12–L4) and the sacral plexus (L5–S4)	40
10	To know that the femorocutaneous n. supplies the skin of the anterolateral thigh	40
11	To know that the sciatic n. divides into the tibial n. (L4–S3) and the common peroneal n. (L4–S2) proximally in the thigh	40

Table 7. Gait items that reached relevance consensus

No.	Item	Score
1	To know that an antalgic gait is any gait that relieves pain	43
2	To know that a high-stepping gait is typical of a foot drop due to muscle paralysis	43
3	To recognize the lower leg swing of a hemiplegic gait	42
4	To know that gait has two phases, the stance phase and the swing phase	41
5	To know that a stamping gait is characteristic of disease of the posterior column of the spinal cord, such as in tabes dorsalis, due to loss of vibration and joint sense	41
6	To recognize the scissors gait (each leg crosses in front of the other) of spastic paraparesis	40
7	To recognize the swaying gait of cerebellar disease	40