Are you listening?

Dr. Andrew Varadi, BSc, DC

Dr. Andrew Varadi, BSc, DC

No investigation is complete without using all of the practitioner's senses. Listening to biomechanical tissues at work is no different than auscultation of heart or lungs. As Chiropractors, our stethoscopes offer a world of practical and clinical applications that relate directly to the subluxations and fixations that form the basis of our philosophy.

Introduction

Many providers listen for the presence of crepitus or grind, but few delve deeper. Sonic cartilage topography and synovial friction assays at the clinical level are innovative and thus hard to reference. The technique was derived over a 20-year period and is traced in a series of articles in the Canadian Chiropractor beginning 1999. The term, 'Joint Sound Diagnostics (JSD)' refers to the sensitive tracking and monitoring of post-traumatic and early degenerative joint conditions at the clinical level. Concurrent similarly related studies are also in the works.[1,2]

The basics

JSD is not static cartilage thickness or histological composition imaging.[3,4] The water skier is more concerned with the surface of the lake rather than depth or consistency.[5,6] Cartilage surface is a dynamic reflection of a host of physiological variables and is an essential component of physical and radiological exams for a more comprehensive assessment. Mechanical forces can destroy a vulnerable surface, which is not in the right position (subluxation) or moving smoothly (fixation).[7]

Comparison investigations

Joints are investigated primarily by visual imaging, despite joints giving motion and needing motion for assessment.[8,9] Cinema radiography was a gallant effort, but there are things that can only be heard. Much of the current biochemical, radiological and histological research is promising but not yet directly clinically applicable for the early Osteoarthritis that strikes most of us, should we live long enough. Powerful micro processing has also advanced model simulations.[10] Computerization hopes to cross the threshold of prevention.[11] Despite the intense behind the scenes research, publicly visible preventative care methods and education with respect to OA are pale in comparison to osteoporosis.

The potential

Audio monitoring may hear what pictures cannot yet see. Advanced imaging systems remain handicapped by lack

of mobility and weight bearing, unable to capture the moment of irritation.[12] They cannot monitor in short time frames for change or rates of change.[13] Every diagnostic tool has its place, and safe applicable ones like this are hard to come by. The strength of JSD lies not in what has happened, but in what is happening now, and how to modify, limit or avoid specific activities capable of propagating further damage. It monitors cartilage strain at the clinical diagnostic level rather than after the fact laboratory level.[14] This is a key step towards prediction and prevention.

The common approach

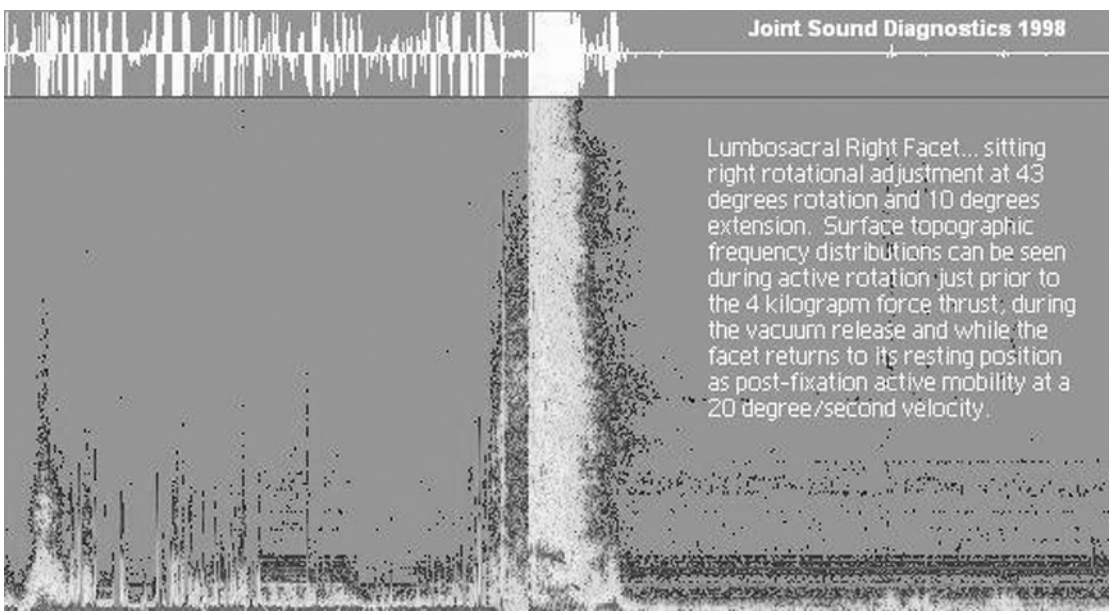
Screening early damage is as important as for cholesterol, hypertension, hyperglycemia and so on. Cartilage is that thin layer between activity and the physical and economic disability it can ultimately inflict. Unfortunately, both patients and doctors alike ignore joints unless they hurt. Then, the common approach is pain relief or muscle relaxation, removing the only two defenses a joint has from mitigating further damage, allowing the patient to return to doing what caused it in the first place. The line-ups for fusions and joint replacements are long. By the time OA is seen in films, it is too late to prevent, as with cancer. It is progressive and treatment is often limited to pain. JSD has potential to help patients help themselves and offers practitioners, therapists and trainers a way to provide safer exercises and rehabilitation programs.

The practitioner

I worry when we run pain clinics offering acupuncture, massage, Orthotics[15] or laser that others also use, rather than our own analytical approach. It fades the recognition of who we are and makes us more vulnerable. We have the potential for so much more. While pain relief is beneficial, it allows OA to progress silently. Our philosophy is as important as the treatment we do and new methodology must stem from within our own profession, not borrowed. There is so much more to learn in our own field, nevertheless that of others.

The questions

JSD research poses many questions, as do imaging investigations such as dual-detector spiral CT arthrography, 3D dual-echo steady state (DESS) MR imaging or high frequency ultrasound. However, JSD offers some answers specific to what we do. The intent here is simply to spark your interest. Have you ever heard an adjustment, not a "crack", but the process up close (diagram 1)? How long before the vacuum reappears and you can adjust again? Does the adjustment result in reduced friction? Does it lessen crepitus? Does it have potential to reduce the risk of OA? Does correcting a subluxation result in quieter and smoother function? Can we reduce the shear or force of adjustments to make them safer? Can you demonstrate it with engineering principles acceptable to the scientific community?



JSD helps redefine subluxation and fixation further and complements motion palpation, kinesiology and radiological for a more comprehensive assessment. It's strength also lies in the ability to monitor both healing and deterioration in real-time.[16] This is important to determine whether a joint is truly healing or just adapting to damage. The pain subsides either way, so it is not an accurate indicator of a joint's condition. Degeneration appears at the moment healing is replaced with adaptation.

Far reaching applications

Doesn't all this want to make you dust off your old stethoscope? And it gets more interesting. Synovial fluid, like blood, has properties like viscosity, volume and can be infiltrated by effusion or blood, ready for the investigator's probe.[17] It tells a story. Is direct sampling the only mode of monitoring? Is radiology and lab analysis the only way to detect systemic joint involvement or early onset Gout, Rheumatic Arthritis or Crohn's? Do joint sounds correlate to fever, infection, pharmaceutical usage and menopause? I am not saying we should go deeper into this, but it does provide food for thought and evidence that we are not simply linear thinkers.

The education

Analysis is unlike auscultation of heart or lung, which move automatically. Joints must be made to function with controlled load, direction and force variables to listen to them. Thus, unlike an ECG, Ultrasound or x-ray, it cannot be merely given to a technician to perform. Therefore, the physics, pathology, technique and interpretation would be best if taught within the core college curriculum. Introducing this cartilage topography research tool to bright young minds increases our chances of competing in the fast paced world of Osteoarthritic investigations.[18]

Conclusion

Listening to joints in motion needs to be an integral part of our examination and treatment plan. JSD is in the infancy stages, an undiscovered country. Even in its simplest form of cartilage topography, early friction detection and the precise movements that create it, there is benefit both at the research and clinical levels. We are at the leading edge of joint maintenance, and perhaps of earlier Osteoarthritis detection. Are you listening?

References

1 Nagata Y. Joint-sounds in gonoarthrosis – clinical application of phonoarthrography for the knees. J UOEH 1988; 10(1):47–58.
2 Bassiouni M, Bassiouni H, el-Feki M. Sensitivity versus specificity of phonoarthrography as an indicator for cartilage degeneration. Clin Rheum 1995; 14(2):135–142.
3 Ateshian GA, Soslowsky LJ. Quantitative anatomy of diarthrodial joint articular layers. In:Basic Orthopaedic Biomechanics, Mow VC, Hayes WC (eds), 1997, Raven Press, New York, 2nd ed.
4 Ateshian GA, Soslowsky L. Mow VC. Quantitation of articular surface topography and cartilage thickness in knee joints using stereophotogrammetry. J Biomech 1991; 24:761–776.
5 Wang H, Ateshian GA. The normal stress effect and equilibrium friction coefficient of articular cartilage under steady frictional shear. J Biomech 1997; 30:771–776.
6 Soslowsky LJ, Ateshian GA, Mow VC. Stereophotogrammetric Determination of Joint Anatomy and Contact Areas., 1990, In: Biomechanics of Diarthrodial Joints, Mow VC, Ratcliffe A, Woo S, (eds.), Springer-Verlag, New York, 2:243–268.
7 Mow VC, Ateshian GA. Friction, Lubrication, and Wear of Diarthrodial Joints. In:Basic Orthopaedic Biomechanics, 1997, Mow VC, Hayes WC, (eds), Raven Press, New York, 2nd ed.
8 Cohen ZA, McCarthy DM, Kwak, SD, Legrand P, Fogarasi F, Ciaccio EJ, Ateshian GA. Knee cartilage topography, thickness, and contact areas from MRI: In vitro calibration and in vivo measurements. Osteoarthritis and Cartilage1999; 7:95–109.
9 Hohe J, Ateshian GA, Reiser M, Englmeier K-H, Eckstein F. Surface size, curvature analysis, and assessment of knee joint incongruity with MR imaging in vivo. Magnetic Resonance in Medicine 2002; 47:554–561.
10 Flatow EL, Ateshian GA, Soslowsky LJ, Pawluk RJ, Grelsamer RP, Mow VC, Bigliani LU. Computer simulation of glenohumeral and patellofemoral subluxation: estimating pathological articular contact. Clin Orthop Rel Res 1994; 306:28–33.
11 Kwak SD, Blankevoort L, Ateshian GA. A mathematical formulation for 3D quasi-static multibody models of diarthrodial joints. Computer Methods in Biomechanics and Biomedical Engineering, 2000; 3:41–64.
12 Soltz MA, Ateshian GA. Experimental verification and theoretical prediction of cartilage interstitial fluid pressurization at an impermeable contact interface in confined compression. J Biomech 1998; 31:927–934.
13 Rivers PA, Mow VC, Pawluk RJ, Strauch RJ, Rosenwasser M., Ateshian GA. Osteoarthritic changes in biochemical composition of thumb carpometacarpal joint cartilage and its correlation with biomechanical properties. J Hand Surg 2000; 25A:889–898.

14 Wang C, Deng, J-M, Ateshian GA, Hung CT. An automated approach for direct measurement of two-dimensional strain distributions within articular cartilage under unconfined compression. J Biomech Engineering 2002; 124:557–567.
15 Varadi A. Post-traumatic rehab. Canadian Chiropractor 2003; (8):2:18–22.
16 Mow VC, Bachrach NM, Ateshian GA. The effects of a subchondral bone perforation on the load support mechanism within articular cartilage. Wear 1994; 175:167–175.
17 Ateshian GA, Soltz MA, Mauck RL, Basalo IM, Hung CT, Lai WM. The role of osmotic pressure and tension-compression nonlinearity in the frictional response of articular cartilage. Transport in Porous Media 2003; 50: 5–33.
18 Xu L, Strauch RJ, Ateshian GA, Pawluk RJ, Mow VC, Rosenwasser MP. Topography of the osteoarthritic carpometacarpal joint and its variations with gender, age, site, and osteoarthritic stage. J Hand Surg 1998; 23A: 454–464.