BACK PAIN, AND PAIN REFERRED FROM THE BACK

Nothing defines human frailty more dramatically than acute back pain. Almost all of us will have an attack. Few experiences are so humiliating as the sudden transition from fit competence to pain-centered helplessness, with total dependence on others for food and care.

How Common are Low Back Syndromes?

Ten to thirty percent of adult populations have back pain at any point in time. Pain sufficient to impair ability to work affects about 8% of the population. No group is immune. Young and fit athletes are at risk, but so are many in sedentary occupations, such as secretaries or bus drivers.

Where does the pain come from?

Overwhelmingly, the damage is concentrated in the two lower lumbar segments (Figure 1). *Other animals show neither this prevalence nor distribution.*

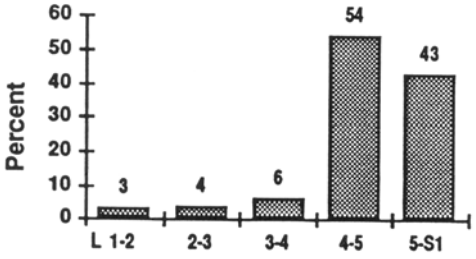

Figure one. Concentration of damage in the two lower lumbar segments, L4-5, L5-S1 (Schutz and Watson, 1987).

Evolution of the Human Spine

We walk erect. Our ancestors assumed the upright posture 2 to 4 million years ago, before the evolution of the modern brain, or hand. Indeed, the upright posture allowed the development of the special skills of our arms and hands, which in turn required evolution of our brain for integration and control. This freedom, and these skills, were obtained at the cost of locking our low back, hips and knees at the limit of the range of travel. Locked joints are subject to much greater crushing forces than those that are free to move. It has been well argued that all of the joints that are vulnerable to wear and tear changes, osteoarthritis, are under-engineered in humans.

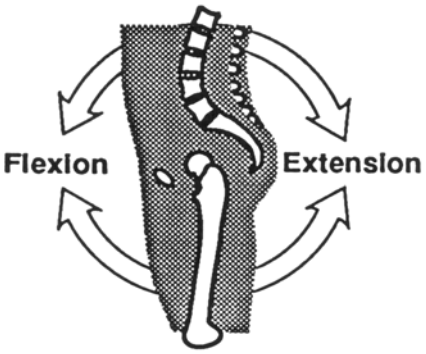

Figure 2. Bending forward is flexion, and standing erect or bending backward is extension.

The strong position for the back is the position of an athlete, with knees, hips, and back partly flexed; this is the posture assumed by most skaters, runners, skiers, and boxers. Weight-lifters and dancers load their back in extension, and are at special risk for major back problems.

Figures 2 and 3 shows the angles in the low back when we stand erect. The problem is not just that we are curved, but that the two lower levels may be *locked* at the limit of their range of travel. The force through a locked joint rises dramatically.

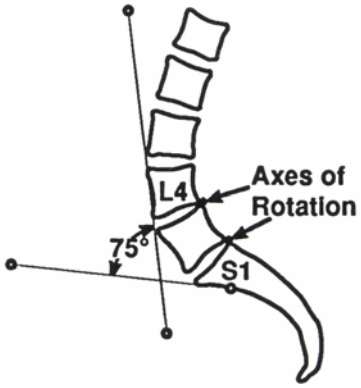

Figure 3. Hyperextended low back in humans. In chimpanzees, the angle between L4 and S1 is close to zero. When extension reaches the limit of its range, crushing forces are great, and greatest at the axis of rotation.

The Mechanics of a *Locked* Joint

With your right hand, hold the middle finger of your left hand firmly. If the finger is in mid-range, slightly bent forward, you can load the joint at the base of the finger with all your force and produce no pain. Next move the finger into extension, and back further, until ligaments tighten and the joint is locked. It begins to hurt. It will hurt with relatively little pressure, *even if that pressure is directed away from the joint!*

The pain is produced by the crushing action of tight ligaments on bone, and is concentrated at the axis of rotation, which in turn is determined by the site of attachment of the tight ligaments. This is what happens in the low back when you sag into the sway-backed position.

The Results of Injury

The structures in the low back that are targeted by these forces are shown in more detail in Figure 4. Most obviously at risk are the two levels between the 4th lumbar and 1st sacral vertebrae. Between the vertebrae are the discs, which consist of a central watery gel, held in place by a surrounding ring ligament. The discs act as flexible cushions to permit movement, and to distribute forces uniformly from one vertebra to another. If the ring ligament tears, the gel can escape and press on the nerve to the leg - a herniated or ruptured disc. This can cause dramatic pain and disability, but resolves with nonoperative treatment surprisingly often. Evidence of nerve root pressure is present in only about 2% of patients with acute or chronic back pain. All the structures involved have a good blood supply (except the disc center), and heal well if given a chance.

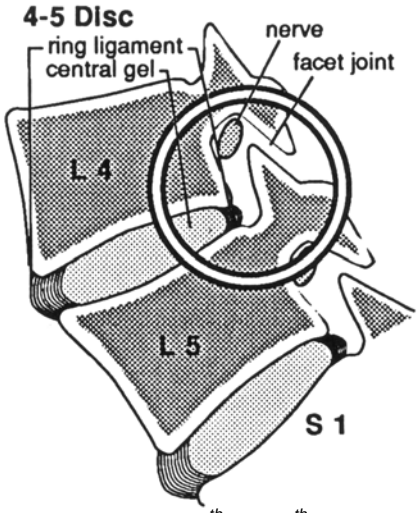

Figure 4. Enlarged view of the 4th and 5th lumbar vertebrae. The circle is centered on the axis of rotation of the fully extended joint, and on the structures targeted by crushing forces: bone, ring ligament, facet joints, and the nerve itself.

With recurrent injury, the spacing and cushioning function of the disc may be lost, so that the joint becomes unstable, free to slip back and forth. Studies have shown that damage to all of these components is common, and it is difficult to identify the exact source of the pain in any one episode.

Referred Pain

You won't feel any of this directly, because you are unaware of these structures. Your brain is not able to feel the bones and ligaments deep in your back. You feel the pain, but the brain gives misleading information about its nature and site of origin. If you have a sliver in your finger or a sore on your tongue, you know exactly what is going on because these are richly represented in your brain; they are part of your "body image". But deep parts of your body are not similarly represented in the brain.

So the pain must be referred, that is, misinterpreted as arising in other structures that share the same nerve supply. The errors can be quite great, so that pain arising in the back is commonly felt in the buttock, thigh, knee, calf, or foot. If there is a continuous band of pain extending from low back all the way to a toe, it is easy to guess that all these separate sensations are linked. But there may be separate islands of pain in any of the regions, sometimes with little current discomfort in the low back itself.

Pain Equivalents

The discomfort may have a different quality in the various regions to which it is referred. It may feel like aching, burning, a feeling of swelling, numbness or tingling. This is all the same pain, arising in the same deep structures of the back, and travelling to the same regions of the brain. The quality is more characteristic of the area to which it is referred than of the original cause. These different qualities have the same diagnostic meaning as pain, so we call them ***pain equivalents***. The feeling of **swelling** need not mean that an arthritis is present in the knee. Similarly, the feeling of **numbness** does not necessarily mean that nerves have been damaged. All this may vary from day to day so that it is easy to think that 3 or 4 separate things may be wrong.

Referred Tenderness

If there is pressure on a nerve, there are characteristic signs that can be recognised by any physician. But nerve pressure is not present in the majority of patients. How can a firm diagnosis be made, given the confusing variety of symptom locations and qualities? In referred pain syndromes characteristic sites of tenderness develop, which have features that make them valuable for diagnosis, and assessment of relative severity. They lie deep, are constant in location, often in areas which have no symptoms, and are generally unknown to the patient.

It is difficult to measure pain with words or gestures, free from possible exaggeration. However, quantitative tender point assessment permits objective assessment of the relative severity of pain for scientific or legal purposes. Tender points have this property because they are unknown to the patient. Typically, the tenderness at these sites is much greater than the tenderness of an inflamed arthritic joint. Control points have been identified, often within areas of symptoms, which remain nontender in most patients with pain syndromes. This permits an examination that contrasts the lack of tenderness at control sites with the tenderness at the predicted sites, a valuable check on possible psychological exaggeration. The naivety of the patient with regard to tender and control points is almost total, and is so valuable that I am almost reluctant to divulge my trade secrets!

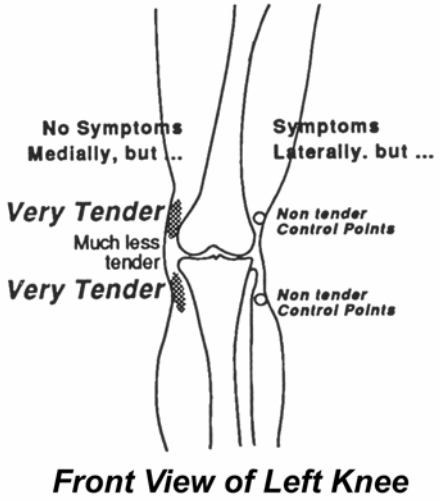

Figure 5. Patterns of tender and control sites about the left knee in a patient with referred pain from the back. Arthritis of the knee gives very different patterns.

But consider, for example, the region of the knee (Figure 5). Pain is felt near the outer knee, but this region remains non tender and offers excellent control points. The inner knee is usually not symptomatic, but marked tenderness is characteristically found there, with a complex inner anatomy. There is tenderness in the fatpad 2 inches above the joint line, and 2 inches below the joint line, with much less tenderness at the level of the joint itself.

Abdominal Muscles

We have identified the two lower discs as the site of attack of most mechanical problems in the low back, and locked extension as reason for this special vulnerability. Why are some more vulnerable than others? There are a number of factors, but the most common and most reversible is abdominal muscle weakness. No examination of a patient with back or leg pain is complete without an assessment of abdominal muscle strength (Figure 6). If abdominal muscles are weak, you are doomed to sag into

locked lumbar hyperextension. If you have weak abdominal muscles, you must first test them, then rebuild and maintain them, and then learn to use them.

Safe, Tough Situps

For safety, make sure that your back is well flexed, with knees, hips, trunk, and neck all well bent, and feet held (Figure 6). The work must be done with lower abdominal muscles, not upper abdominal or leg muscles. Begin with a pelvic tilt, pressing the small of your back to the floor to make sure the vulnerable low back is curled before the real load is applied. Then put your chin to your chest, and curl up, keeping your tummy sucked in tight! Maintain this curved lower spinal posture while easing back down. Done with this technique, the exercise will be tough, but not cause pain. Patients in severe pain, with osteoporosis, or with nerve root pressure may need special exercises.

Figure 6. Purple-faced, suck-in situp.

To build strength, the effort must be really tough, and easy exercises, like pelvic tilts, are not tough enough. The key muscles are in the lower abdomen, which must be sucked in so tight your face goes purple! For safety, you have shortened the lower half of the body by bending your hips and knees, so your feet must be held, or they will come up, rather than your head. The force required to hold your feet down is a good measure of the toughness and effectiveness of the exercise.

Power Walking

Once you have strong abdominal muscles, you must learn to use them. There is a tremendous cultural prejudice in favour of the erect posture; aristocrats stand upright, and only peasants stand with a bent, but strong back. We teach **power walking** with tummy tight and knees bent, shoulders rounded and head forward, but you must overcome the ghostly voice of your parents telling you to "stand up straight!"

Other causes of lumbar hyperextension may be identified, such as flexed hips, due either to joint disease or to tight surrounding ligaments. A pelvic tilt, due to unequal leg length or spinal problems, may be a correctable factor.

Acute Back Pain

Acute back pain is a strange kind of medical emergency in many ways. Most episodes follow injury or strain, but often there is a delay of hours or days between the event and the pain. You may not get immediate warning that your spine is being incorrectly used, and so continue with a dangerous activity too long. The earlier appropriate treatment is started, the faster the recovery. Having learned this, you may be too apprehensive about using your back, and become weak and more vulnerable.

Is there nerve root pressure? This is the most important medical question at the onset. If not, most patients should stay away from hospitals. Struggling through traffic, on and off stretchers and X-ray tables is the last thing you need. **Three days of lying flat in bed** (with bathroom privileges) will alleviate most attacks. This means *flat*, on your back with a pillow or two under your knees, or on your side with a pillow between your knees, but definitely not sitting (this increases disc pressure), or even propped up.

How can we tell if there is nerve root pressure? If the pain is confined to the back or buttocks, important nerve root pressure is unlikely. If it goes below the knee, and especially if there is new numbness or weakness, then professional assessment is needed. One of the most important signs is restriction of straight leg raising. You have to be totally relaxed during the performance of this test, so you can't do it yourself safely and meaningfully. We can teach you modifications of this test, which can be useful if you get minor flares of pain during the recovery period.

If you have pressure on a nerve, then close medical supervision is necessary. The escaped disc material is 90% water, and usually shrinks over a period of days or weeks, so that invasive treatments may not be needed. If needed, newer techniques may offer rapid relief and early recovery. However, the invasive therapies involve removal of the gel still present in the center of the disc, not just the portion that has escaped. Noninvasive therapy allows a return to a more normal anatomy.

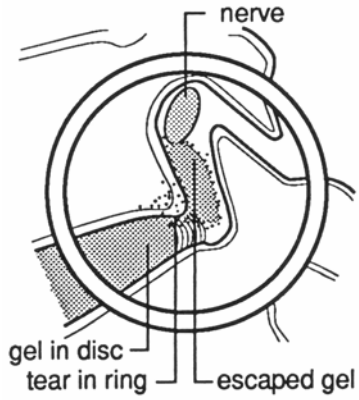

Figure 7. Herniated disc. Detailed view of structures shown in Figure four. The ring ligament has torn, and gel from the center of the disc has escaped to press on the nerve root. There is also an inflammatory reaction, which initially makes the swelling and pain worse, but helps healing.

If disc material escaped, there may be two separate problems. The first may be pressure on a nerve, but with luck this will resolve within a few weeks. Further damage without warning symptoms is unlikely.

The second problem is the tear in the ring ligament that allowed the disc material to escape. This also will heal, unless you prevent healing by loading your back too soon, forcing more disc material out, and preventing solid repair. You can't tell from symptoms whether the injured ligament has yet healed. We know from knee and ankle ligament tears that it may take 6 months for solid healing to occur. After a major back event you should delay activities likely to stress your back for a similar length of time, even if you feel well and guilty.

Having said this, it is safe and important to gently resume your situp exercises as soon as the acute pain and signs of nerve pressure have eased. If your trunk, hips, and knees are well-flexed, and your tummy muscles sucked in

really tight, you can do this safely. You must stay well flexed throughout the exercise. Some people find it difficult to learn how to do this and need careful coaching to ensure a safe technique. A moment of triumph occurs when the first situp is done, and done without pain. You know then that despite your recent injury, your back is capable of sustaining a load so long as your position is safe, and muscles firm. You will not be forced to give up work and leisure activities important to you and your health. From that point, you are in control.

Secondary Prevention

Your treatment program has got you up and moving, but still with some symptoms. How can you minimize these, and the risk of another attack? You have learned from doing your situps that your back can take a load without pain, so long as it is in a safe position. If not, go back to step one.

How you stand, sit, walk, lift, and sleep are all important. We have discussed how you should stand and walk - something like a teen-age gorilla, with your tummy tucked in. Many develop the habit of splinting the back by locking the lower spine in extension. For a moment this may feel more secure. In the long run this posture is self-defeating, and encourages rapid loss of abdominal muscle strength.

It may be very helpful for you to wear an abdominal support. This would not only reinforce the postural effects of your abdominal muscles, but also gives you something to grunt against. When you lift, it is normal to grunt. This increases the pressure in your abdominal cavity, so that you float your upper body over this pressure system, passing the load to your pelvic floor, not the spine. The effect is dependent on the weakest part of the system - your lower abdominal muscles. You are making them strong again, but they may tire. The support needs to be delivered to the lower abdominal wall, from the umbilicus to the hair-line.

Sitting involves a very different set of problems. When you sit you don't need your abdominal muscles, and they relax. With supporting muscles inactive, the vertebrae are free to slip backward or forward, particularly if there has been previous injury. Support to your lower back can be very important. You lean back into the support or chair back, which should wrap around the whole of the lower back, and give focused support at and just below the belt line. Support under the thighs, feet, and elbows add to comfort. No position is perfect, and it is helpful if you can adjust your position from time to time. Better yet, get up and move around.

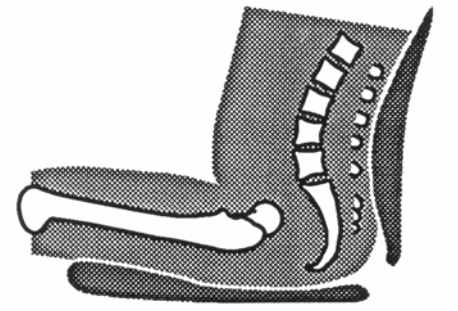

Figure 8. Anatomically shaped support for the back should deliver focused, wrap-around support at the belt line. Good seats should support the lower thighs, and be adjustable for angle and height.

Lifting, especially lifting and turning, must be done with care. Even bending forward to wash can be painful. Hips and knees bent and tummy tight is the beginning of the answer. Keep loads close to your body, and for a time avoid lifts over your head. Get down on your knees in the garden. When standing, work at counter height, or switch to a high stool. Some exercises in standard programs for the hips and knees may hurt the back. **Do no exercises with your knees straight!**

Chronic pain syndromes

When pain persists, locked lumbar hyperextension and abdominal muscle weakness are often underlying and correctable factors. The emphasis will be on tough, safe situps, and using the flexed posture while walking, working, or standing. Use abdominal supports without guilt. Other factors that may increase sensitivity to pain are poor sleep and low fitness. Medication and physical measures can give welcome if short-term benefit, but the long term goal is a return to a high level of general fitness through exercise.

This program must be carefully structured. Exercise with weak abdominal muscles may make things worse. If you are out of shape, a fitness program has to be found that is *gently* progressive, forgiving but determined, with long term goals. It is best if it is also fun. It should make you puff, sweat, and laugh.

Beyond Coping

There are many ways of coping. If you have an incurable disease, you may cope by accepting this fact, look for pleasure in what today offers, and adjust your activities and expectations to your limitations. But this is not the appropriate coping style for curable disease. Doing exercises and fitness activities despite aching, stiffness, and exhaustion requires a much more aggressive style of coping. Many set their priorities in terms of family, job, house or garden, with themselves last. This may mean that there is no energy or time left for their own needs, and a reordering of priorities may be appropriate. If you can return to a high level of fitness, others will be better served. Despite today's burden of pain, stiffness and fatigue, there is a realistic expectation of improvement. Budget limited resources of energy and time to get better, even if other high priority items may for a time have to be set aside. All the reasons why you don't have time and energy for your wellness activities are the reasons why you must make these choices. These have to be your decisions; you are responsible, and you are in control.

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