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If it isn't written down - it is forgotten

Back Pain in the Naval Rotary Wing Community

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While most aviators and aircrew complain that back pain is an occupational hazard, the truth is that it is an overwhelming problem for aviators, and non-aviators alike. It is the fifth most common reason for a visit to a physician in the United States today. It is the second most common cause of work absenteeism. The direct and indirect costs to the consumer have been estimated as high as \$50-100 billion per year. 1 In aviation, it is a problem across all communities, not limited to any particular platform, but by many accounts worse in the rotary wing community 2. Long hours in the cockpit, ineffective seat padding, poor posture, NVG use, and constant vibration all may contribute to strain and fatigue in the lumbar musculature. For those aviators involved in a mishap, the sudden deceleration can create overloading stresses resulting in an acute back injury ultimately predisposing them to chronic pain for the rest of their career. The pain can be a mild intermittent annoyance, or may be so debilitating it affects the safety of flight. It is a problem not only for the aviators, but it also can affect squadron operations as a result of hurried or cancelled flights.

The anatomy of the back is quite complicated. The human body has 24 vertebrae from the base of the skull to the top of the pelvis (seven in the neck, 12 in the thorax, and five in low back region). These segmental vertebrae not only form the central structural element of the back, but also provide flexibility to the neck and torso, as well as protection for the spinal cord, and spinal nerve roots. Between each vertebra is an intervertebral disk, which helps to increase that flexibility as well as absorb shock and vibration as the body moves. The intervertebral disc has a hard fibrous exterior ring (the annulus fibrosus) and a soft gelatinous center (the nucleus pulposus). The spinal cord travels from the brain stem through the spinal column and branches off as nerve roots between each vertebral segment. The nerve roots quickly branch again into the anterior (forward) and posterior (rear) segments. The anterior segments travel to the limbs to provide motor and sensory function. The posterior segments supply the spine itself and the surrounding paraspinal (next to the spine) musculature. It is these posterior spinal nerves that are responsible for the majority of back pain.

Types of Back Pain

Back pain can be classified into three distinct categories (localized, radicular and

referred) and two somewhat overlapping time frames (acute and chronic). Localized pain is confined to the back itself. The source of the problem is in the same general region where the pain is felt. Radicular pain describes symptoms that radiate to the limbs, while the source of the complaint remains in the back (like a ruptured disk). Referred pain radiates to the back from another area and is typically caused by a problem with one of the internal organs (a kidney infection, pancreatitis, or many others).

Most back pain is mechanical in nature. That is to say it is caused by strain and fatigue rather than a specific medical illness. The musculature of the low back is forced to provide both structure and flexibility in the awkward posture associated with flying helicopters. All helicopter aviators are familiar with the term "helo hunch" which refers to the bent forward posture most helicopter pilots assume while flying. In the low back, this posture converts the normal S-shaped spinal curvature of the spine to more of a C-shape. This shortens the deep spinal muscles and stretches the superficial ones. This is an unstable posture and results in excessive fatigue. In addition, this posture forces the front edges of the vertebrae together, and pulls the posterior edges apart putting uneven pressure on the intervertebral disks. In the neck, the pilot is then forced to additionally hyperextend the neck (nose up) in order to see out of the windscreen. Both of these unnatural positions lead to fatigue, overload, and pain.

When vibrational influence is then applied to the back the situation becomes further complicated. Current data is unclear as to the amount of influence helicopter vibrations have on aviator back pain. 3, 4. However, it is known that vibration can lead to microtrauma and damage to the intervertebral disks on a molecular level 5. If the intervertebral disks break down then the back will lose much of its flexibility and may be predisposed to further injury. Injury leads to inflammation, and chronic inflammation can lead to anatomic changes in the shape of the bones themselves. This change in the anatomy can result in chronic low back pain and neurologic compromise. Neurologic involvement may be caused by either bone or bulging disk material pushing against a nerve root or by a condition known as spinal stenosis.

Nerve root compression by a bulging disk is known as a herniated nucleus pulposus (HNP). This leads to pain, numbness, tingling, or weakness shooting down one leg. Spinal stenosis refers to the more serious condition of narrowing of the spinal canal, which can be caused by either soft or hard tissue impingement into the spinal canal itself. The hallmark of this disease is referred to as neurologic claudication, or poorly localized pain, which radiates down one or both legs. It is frequently brought on by walking and relieved by sitting. In extreme cases the patient may develop urinary incontinence.

Many studies have been done to look at the demographics of helicopter aviators who suffer from back pain and the operational impact of their suffering. The prevalence of back pain in an otherwise healthy, young population of aviators has been shown to be as high as 82 to 92 percent 6, 7. Symptoms occurring during flight were reported in 44 to 50 percent of individuals 6, 7, 8. Pain is often a subjective phenomenon and severity is difficult to compare individual to individual. It makes more sense to look at what the overall effect of this pain is on the individual's suffering, and how it affects safety of

flight.

A pilot experiencing a painful distraction while controlling an aircraft could compromise flight safety. Back pain in helicopter aviators has been known to exist for years, and the fact that it is distracting is now thoroughly documented as well. The most common effects of back pain on flight operations are decreased concentration (54 to 66 percent), hurried flight (16 percent), and cancelled flight (seven percent). In addition, up to 12 percent of pilots have reported missing work altogether because of the pain 9.

Supporting the idea that this pain may be more related to posture than vibration is data that suggests that pain varies according to flight regimen. It has been documented in other industrial communities that a chronically forward flexed posture is associated with chronic pain 10. Not surprisingly then, it has also been shown that pilots report back pain 10 to 20 percent more often during instrument flights than during visual forward flight. Further, the non-flying pilot role, with the ability to better adjust position, was associated with the least amount of pain despite that fact that exposure to vibration is equivalent 9. The Israeli Air Force also reports that postural changes required to fly tandem seat aircraft (AH-1S) from the rear seat also induce more frequent, and more intense pain than flying in the front seat 11.

Treatment Options

Back pain in the aviator should always be evaluated by the flight surgeon, or aerospace medical practitioner. A careful interview will be taken in which pain intensity, frequency, timing, and neurologic involvement will be ascertained and documented. If the pain is relatively new in onset without neurologic symptoms or history of significant trauma the physician will often treat the symptoms with non-steroidal anti-inflammatory drugs (NSAIDs) such as ibuprofen, naproxen, or several others. Bed rest may also be prescribed for a duration not greater than 24 hours. The aviator should be able to resume flight duties when asymptomatic, and should not require a waiver. If the pain is persistent for several weeks without relief the physician will often obtain x-rays to rule out underlying medical causes. If neurologic symptoms are present (radicular pain, numbness, or weakness) often the physician will then order more advanced radiologic studies like a CT or MRI scan. If more severe nerve damage is suspected the flight surgeon may even request an Electromyogram (EMG) study to elucidate the extent of the injury.

Ongoing, non-radicular back pain may be treated with occasional NSAIDs, massage therapy, physical therapy, chiropractic manipulation, and if necessary, steroid injections or surgery. If the pain is persistent enough to merit invasive treatment, the flight surgeon will need to take the aviator off flight status to complete treatment and ensure the aviator is safe to fly before returning them to flight status.

The NAMI Whammy

The Naval Aerospace Medical Institute in Pensacola, Fla. provides guidelines that Naval Flight Surgeons are expected to follow in returning ill or injured aviators to flight status.

Regarding low back pain, NAMI's guidelines state, "If symptoms are chronic and/or recurrent, have required hospitalization, and require regular medication beyond occasional FS approved NSAIDs, then the condition is considered disqualifying (CD)."

That means if the pain is not alleviated within 10 days of treatment with NSAIDs, the aviator will require a waiver to remain on flight status.

If the pain is caused by a more serious underlying condition, the requirements are more stringent. If it is determined that the aviator's symptoms are caused by a bulging disk, or other nerve impingement, they will be removed from flight status until they have been asymptomatic for six weeks. Even if they have surgery to remove the bulging disk material, they will not be returned to flight status until they have been asymptomatic for at least six weeks. The further requirement is that they maintain acceptable range of motion and be able to pass a USN or USMC fitness test. If the surgical treatment is more extensive, the grounding may last up to six months for cervical fusions or be permanent for multi-level diskectomies. Obviously this is a brief overview and should not take the place of consulting with the squadron flight surgeon for further clarification.

The Price of Safety

Many authors have recommended ergonomic modification of the cockpit as a method to mitigate aviator back pain. While this is an ideal solution, it is not often economically feasible in operational aircraft models. However, in light of many new airframes being sent to the fleet (AH-1Z, UH-1Y, MV-22) this is a rare opportunity for the flight safety community to look at possible ergonomic changes which can be made to improve aviator posture, reduce the risk of pain, and therefore improve the overall safety of these aircraft. The cost benefit ratio has been nebulous in the past. On the surface, one might say that doing nothing costs nothing. In truth, allowing 80 to 90 percent of helicopter aviators to suffer from back pain does have very real costs. Within the military, the costs are difficult to analyze, so civilian comparisons should be made as a frame of reference.

In 1991, Frymoyer and Cats-Baril reported that in the civilian community, at any given time 15 to 20 percent of people are suffering from back pain. In the military helicopter aviator community, the prevalence is four times that 12. There are direct costs associated with the treatment of back pain including office visits, diagnostic studies, medications, physical therapy, surgical services and inpatient hospitalization. In 1990, the estimate of direct costs in the United States was \$24 billion. There are also indirect costs associated with treating back pain including lost productivity, medical disability payments, and in regard to the aviation community, lost aviators and aircraft. In 1990 the estimated indirect costs to the civilian population were another \$27 billion 12. For an adult population of approximately 200 million people, that amounts to 40 million people suffering from back pain at any given time with an annual cost of about \$1,275 for each sufferer. In 2005 dollars that can reasonably be extrapolated to \$1,500 per person, on the average. The USMC alone has around 3,000 rotary wing aviators and if 80 percent of them suffer with back pain the annual cost is \$3.6 million for Marine assets alone. This does not even take into account back pain in Navy rotary wing aviators or the high cost of replacing an

aviator due to attrition caused by pain, or an aircraft, if fatigue and distraction lead to a mishap.

Prevention

Prevention is the best approach to most aviation related back pain. Obviously, engineering modifications are the preferred, if unlikely choice. Barring that, there are several things that can be done to prevent or decrease the amount of back pain suffered by rotary wing aviators. These include postural modification, strengthening and stretching regimens, and personal equipment modifications.

Good posture reduces the stress applied to the soft tissue surrounding the spine. The hunched flying position not only leads to rapid muscle fatigue as stated above, but also leads to a 180 percent increase in the load applied to the intervertebral disk compared to standing 13. This load is primarily in the anterior portion of the disk forcing the soft nucleus pulposus backward toward the spinal canal and possibly increasing the risk for a herniation and a nerve root impingement. Maintaining the normal "S" curve of the spine would reduce the probability for low back pain 13. There is no known formal training program in place to teach aviators the benefits of good posture while flying.

Some experts have suggested a flight-specific stretching and strengthening regimen for the muscles of the trunk as a way to stabilize the spine, while at the same time increasing flexibility and preventing back pain. The specific exercises are complicated and should be taught by a physical therapist. However, in a general sense it can be said that spending five minutes before and after each flight thoroughly stretching the low back, as well as spending time in the gym slowly and progressively strengthening the abdominals, the hip flexors and back extenders may alleviate some pain.

Personal equipment modifications such as lighter helmets, lighter NVG gear, and seat pads may also improve back pain in these aviators. Some communities already have experimented with lumbar support cushions issued to the aviators. They found that in 90 percent of users, there was some perceived benefit in back pain 7. There are many different commercial products available, several of which have been granted flight clearances in the past by NAVAIR. No data has yet been generated and published by NAVAIR showing whether or not these were efficacious, and no formal issue of lumbar supports or seat pads is done for most rotary wing communities.

Conclusion

Though back pain in rotary wing aviators is a well-known problem, not enough has been done to alleviate it. The problem affects not only individuals, but also squadron operations, combat readiness, and safety of flight. The implications of addressing this problem for our aviators include:

- Decreased time lost from work
- Increased combat readiness

- Decreased attrition rates based on chronic pain and injury
- Decreased health care costs
- Overall improvement in the aviator's health, quality of life and operational effectiveness 13.

Because of the need to maintain high physical standards, the treatment options available to aviators are more limited than those available to the general population, so prevention is of paramount concern. Ideally, cockpits would be redesigned for better ergonomic performance, but this is financially unrealistic. Seat cushion modification to include lumbar support is a high priority need of this community. Alternatively, aftermarket lumbar supports and seat pads issued to individual aviators by their squadron flight equipment shops have been shown in several studies to be an inexpensive way to reduce back pain. A flight-specific training program or "back school" instituted at the group/squadron level involving physical therapists to instruct proper posture and strengthening/stretching exercises may be another low cost way to address this problem. There is no quick and easy way to eliminate a problem that has plagued rotary wing aviators for many years, but with careful attention, sustained focus, and further research, much progress can still be made.

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