



#### 2.11.1 Applicable Regulations

CASR 67 With regard to the **Skeletal System** the *CASR Part 67* states as follows:

**CASR Part 67 *Table 67.150* criteria for medical standard 1 states:**

- 1.25 Is not suffering from safety-relevant active disease of the bones, joints, muscles or tendons
- 1.26 Is not suffering from safety-relevant functional sequelae of medically significant conditions of the bones, joints, muscles or tendons

**CASR Part 67, *Table 67.155* criteria for medical standard 2 states:**

- 2.24 Is not suffering from safety-relevant active disease of the bones, joints, muscles or tendons
- 2.25 Is not suffering from safety-relevant functional sequelae of medically significant conditions of the bones, joints, muscles or tendons

**CASR Part 67, *Table 67.160* criteria for medical standard 3 states:**

- 3.23 Is not suffering from safety-relevant active disease of the bones, joints, muscles or tendons
- 3.24 Is not suffering from safety-relevant functional sequelae of medically significant conditions of the bones, joints, muscles or tendons

#### 2.11.2 Pain Management

Pain is a complex issue. Severity of reported pain is poorly correlated with the severity of the underlying condition. It is thus very important to identify the underlying condition and prescribe pain relief accordingly. The following discussion should be considered in conjunction with [Chapter 13](#) of this handbook, dealing with certification issues and medication. Each drug group has an annotation, which places it in the category (A-E) as described [Chapter 13](#).

#### ***Non-steroidal Anti-inflammatory Drugs (NSAIDs) (B)***

In general, these medications (NSAIDs) are suitable for aviation duties, but with surveillance of possible adverse effects, particularly of gastric origin. The underlying condition for which they are prescribed needs to be considered in each case.

Cyclo-oxygenase type 2 (COX-2) inhibitors have been found to have an association with coronary disease and strokes in those already predisposed, through an effect on platelet function. It is generally advisable to cease COX-2 inhibitors unless the applicant has a history of peptic ulcer disease. Celebrex continues to be available and Mobic is now usurping the past popularity of Vioxx.

The older non-steroidal anti-inflammatory drugs, such as Ibuprofen, Feldene and Voltaren continue to have a place.

Aspirin is effective as an anti-inflammatory agent, but has a significant risk of GI bleeding.

#### *Paracetamol (A)*

A maximum of four grams a day applies in the case of an adult, due to liver toxicity. It is not an anti-inflammatory agent, functioning in the main, directly on the brain to modify pain response in orthopaedic and rheumatological applications. Where the pain is purely mechanical, rather than inflammatory, Panadol may be the better option.

#### *Disease Modifying Anti-Arthritic Drugs (DMARDs)*

DMARDs have an important role in reducing symptoms from the condition for which they are prescribed. Where the pilot is being managed closely to identify any adverse effect early, and where there has been an adequate trial period—usually 4 weeks after commencing the medication—prior to return to flying or controlling, continued certification is usual. The extent of the functional effect from the underlying condition will be of significance in determining fitness for continued certification.

**Salazopyrin (C).** There are often side effects such as indigestion and hepatotoxic reactions, which largely occur in the first three months. Therefore, the individual should be closely monitored during this initial period of medication.

**Gold (C).** This is out of favour at present. It is toxic to bone marrow and can cause nephrotic syndrome.

**Methotrexate (B).** Toxic effects are revealed early. Full blood count and liver function testing is suggested every six to eight weeks.

**D-Penicillamine (C).** There is a range of side effects such as scleroderma, nephrotic syndrome, myasthenia gravis and marrow toxicity. If an individual is on this treatment without side effects for more than six months, it is likely that they will remain without side effects.

**Luflunamide (C).** In the early period there may be diarrhoea and skin rash. FBE, ESR and LFTs are needed regularly.



**Cyclosporin, cyclophosphamide (C).** Provides serious immune suppression, but with a high risk of side effects. Generally these are only used when the underlying disease is severe and would normally preclude certification anyway.

**Biologic Agents, such as ana kina and anti-tumour necrosis factor preparations (B).** Side effects do not appear to be severe. The high cost at present tends to limit their use to severe disease.

#### **Narcotics (C)**

It should be considered barring treatment using all forms of narcotics for individuals involved in aviation-related duties. In exceptional circumstances, consideration may be given to individuals requiring narcotic analgesia where:

- The condition itself poses no safety risk
- Narcotics have been used for an extended period and it is clear that there is no adverse effect on attention or cognition
- Neuropsychological testing demonstrates that there is no demonstrable decrement in performance
- ATC simulator testing and pilot in-flight testing indicates satisfactory performance
- There is no requirement to use the medication within 12 hours of commencing aviation activities
- There is no evidence of addiction to the analgesic.

Tramadol is gaining considerable popularity. While not an opioid, it does have narcotic effects and may be addictive. It has inconsistent effects and side effects, with neuropsychological side effects and causing serotonin syndrome. Panadeine Forte contains 30mg codeine and is a significant opioid dosage.

Those applicants taking narcotics are, in general, ones who self-select; that is, those experiencing significant side effects from the medication, or with significant problems from the underlying condition. They should not plan to fly. They may feel suitable for duty, but there may well be subtle impairments and self-delusion (ie overconfidence) that the pilot or controller may not identify.

#### **Amitriptyline (C)**

This is often prescribed in low doses of 25 to 50mg at night to augment sleep. It is a soporific and has a long half-life. Some people are highly sensitive and there are a number of cross-reactions. Many people will be 'slow to take off' after taking amitriptyline the night before.



#### **Corticosteroids (B)**

Corticosteroids are a mainstay of treatment in many rheumatological conditions. They can be administered dermally, orally, by eye drops, intra-articularly, injection into the affected soft tissue and intravenously. Local application, even by intra-articular injection, is generally safe. Systemic symptoms are rare. However, occasional sleeplessness and hypomania is observed. There should be no flying or controlling within 24 hours following a corticosteroid injection.

Oral corticosteroids have a large and diverse range of adverse effects. These include mood change, thinning skin, diabetes mellitus, immune suppression and osteoporosis. These are almost invariably time and dose related. A general cut-off for onset of side effects is greater than 10mg per day for more than six months. If more than 10mg per day is being prescribed, bone density assessment should be obtained every two years.

If taking oral medications such as dexamethasone or betamethasone, there should be a more intensive monitoring program, as there is a high incidence of side effects. It is important to understand why the individual has been placed on these medications rather than prednisone or prednisolone.

#### **2.11.3 Functional Assessment**

##### **Range of movement**

Neck range of movement (ROM) is the most important assessment for a DAME. Unless the restriction is severe, 'trick' movements are usually available to compensate for limited neck movement. Provided the pilot can evacuate himself and his passengers safely and rapidly, there is generally no impediment strictly due to ROM limitation.

In reporting to CASA, the ROM should be given in degrees in the three planes of movement, flexion/extension, lateral flexion and rotation.

##### **Operational Assessment**

A specific flight test to evaluate the functional impact of a restriction of movement due to an orthopaedic or rheumatological condition may be required. Each assessment will depend on the pilot, the aircraft type and the normal aviation activity undertaken.

A DAME may recommend directly to the certificate holder/applicant that such an assessment take place, or a recommendation can be forwarded to CASA for aviation medicine section to consider such an assessment. Where the DAME conducts the assessment from a referral, permission should be sought from the pilot for details of the impairment to be included in the referral letter. The letter to the pilot undertaking the assessment should be written in plain English, requesting advice of the functional effects on the certificate holder's ability to carry out aviation duties. These may include cross control in strong crosswinds, or single engine flight in a twin-engine aircraft, the full and free movement of all flight controls, and ability to see unimpeded in all significant areas.

It is often beneficial to talk to the assessing pilot prior to the assessment to clarify the requirements. A Chief Flying Instructor of a registered flying school can perform the assessment, provided that the individual is prepared to conduct such an assessment. Tests directed to be undertaken by CASA aviation medicine section will usually be performed by an approved testing officer (ATO).

Should the pilot refuse permission for release of relevant medical information, there may be a limited capacity to properly assess the individual, and further testing may be required. The pilot should be made aware of the consequences of the refusal and an attempt made to reach agreement on what information can be imparted.

After commencing narcotic or opioid medication, the ATC or pilot should have a test equivalent to their regular test/training regime. For instance, a private pilot will need to bring forward a biannual flight test, and provide a report of that test as part of the assessment for certification.

#### 2.11.4 Specific Conditions

##### *Arthritis*

##### **Rheumatoid arthritis (RA)**

RA often has systemic effects. It tends to be erosive, with the destruction of tissue. Joint deformity in the hand and grip weakness is likely to be the most significant issue for aviation. A normochromic normocytic anaemia of chronic disease is common and needs to be monitored. Sufferers can have a fairly normal life, particularly if the activity of the disease is controlled early. As a generalisation, people with Rheumatoid arthritis tend to function at a higher level than the extent and apparent severity of the disease would indicate. Fitness for aviation duties will be assessed on a case-by-case basis.

There may be ophthalmic effects, such as from the use of Plaquenil or steroids. If there are no signs or symptoms of ophthalmic involvement, there is no requirement for routine ophthalmic assessment beyond those stipulated based on age and Class of certificate.

RA should best be monitored for effective management by a rheumatologist rather than GP. An annual report from the specialist will usually be required as part of ongoing certification. Serial plain X-rays, FBE and ESR can follow disease progression and activity. LFTs are usually required to check for side effects of medication.



#### Osteoarthritis (OA)

There may be **primary osteoarthritis**, without previous trauma to the joint, or **secondary osteoarthritis** where there is a predisposing injury. There is usually no inflammation, but Heberden's and Bouchard's nodes in the hand do have an inflammatory component. The effects can be divided into functional limitations as a result of reduced range of movement and pain. Simple analgesics and physiotherapy are the mainstay of treatment. Unless there is a significant functional impact, sufferers from osteoarthritis will generally have unrestricted certification. Serial plain X-rays and testing for side effects of medication will be required, again on a case-by-case basis.

#### Seronegative polyarthritides

This may be rheumatoid arthritis where there is no rheumatoid factor detectable, or those associated with HLA B27. 8% of the Caucasian population are positive for HLA B27, and some 1% to 8% of these develop a seronegative polyarthritis. The most prominent type is Ankylosing Spondylitis (AS), but there is also Reiter's syndrome, post-salmonella and post-yersinia infection and psoriatic arthritis.

Ankylosing spondylitis presents as a progressive stiffening of the lower back, with pronounced symptoms after extended inactivity, such as sleep. Physiotherapy modalities, exercise and NSAIDs are the most widely used treatment. It affects males to females in the ratio of 8:1. Sitting for a long time, such as in ultra-long haul sectors, may induce stiffness, but it is generally possible to regularly stand and perform stretches.

#### Gout

Gout tends to be poorly treated overall. It can be of sudden onset and disabling. There is increased risk from sitting, when dehydrated and post-surgical. Thus, the aviation environment does have significant risk for a gout attack.

Most attacks are in people who are poorly managed and who are not compliant with medication and diet.

More than three attacks a year, particularly where the serum urate is greater than 0.45, and tophaceous gout, where there is the presence of destructive articular disease demonstrating long-standing poor control, carries unacceptable risk of a further attack. Given that the onset can be sudden, within the length of a flight, and can be incapacitating, careful consideration will be given to making the pilot or controller unfit until adequate control is demonstrated. Control would be shown through uric acid levels, compliance with medication such as allopurinol, and avoidance of alcohol and other dietary modifications.



#### Psoriatic arthritis

This usually presents as mono or oligo arthritis, and affects around 8% of patients with psoriasis. It can be progressive and present similarly to rheumatoid arthritis. It should be considered on a case-by-case basis.

#### *Lupus and Connective Tissue Disorders*

There appears to be a reduction in numbers and severity of these conditions in the last 50 years. Systemic Lupus Erythematosus (SLE) is diagnosed mainly through a positive anti-nuclear factor and elevated anti DNA, but requires at least four criteria. DMARDs hydroxychloroquine and steroids are the mainstay of treatment. Multiple organs may be involved, including reticulo-endothelial with anaemia, and kidneys with proteinuria. When stable, SLE should be reviewed by a rheumatologist three-monthly, with certification usually being limited to 12 months. Annual reports will need to address any systemic involvement.

#### *Polymyalgia Rheumatica*

This generally presents as an acute illness, with equal sex ratio, and rarely under age 60. There is central joint involvement and night stiffness. It is usually well controlled with corticosteroids, of around 15mg of prednisolone per day. Once on treatment, there is a return to normal function within one month, and a gradual reduction in medication with cessation of medication over a period of around two years.

The condition can be relapsing, with the most serious effects being cranial arteritis, which may result in severe headaches and blindness. Visual loss can be sudden. This is rare once on steroids, and if ESR/CRP results are normal, risk is acceptably small.

All certificate holders should be monitored through three-monthly ophthalmology and rheumatology reviews, and three-monthly ESR tests. Certification is usual, provided the condition is controlled, with six- or 12-monthly validity. The relevant reports will be required for re-certification.

#### *Osteoporosis*

This condition is associated with a number of risk factors. These are:

- Chronic ill health
- Cigarette smoking
- Family history
- Systemic steroid use
- Post menopausal women
- Women with non-functioning ovaries.



It is less common in males, but still substantial, especially where testosterone levels drop.

In those with established osteoporosis, bone density estimation should be obtained three-yearly. In the presence of a fracture, bisphosphonates such as fosamax and actonel can assist. Weight-bearing exercise is important for prevention and treatment.

There is little immediate relevance in civilian flying if a fracture does not exist or has not occurred. Any fracture should be treated on its own merits.

#### *Chronic Fatigue Syndrome (CFS) and Fibromyalgia*

This is a diagnosis of exclusion as there is no specific diagnostic test. No pathology has ever been demonstrated to be the cause. It is widely assumed that a psychological disturbance underlies the presentation in most if not all sufferers. Symptoms are diverse, including sleep disturbance, trigger points, and depression. While fatigue is prominent, there is no change in oxygen consumption with exercise; the only detectable change is in terms of perceived effort. Treatment is prolonged and expectant, with anti-depressants widely prescribed. Rest should not be prescribed.

Most CFS patients are not motivated to continue flying while symptomatic. A psychiatric diagnosis should be excluded. While symptomatic, chronic fatigue syndrome is generally incompatible with aviation duties.

#### *Scleroderma*

In its severest form—progressive systemic sclerosis—this condition can have implications on flying. It is generally found in a population in their third and fourth decades and is more common in females. It can progress rapidly, and involve the hand, resulting in contractures, with marked functional limitation. It can be made worse in cold environments such as often encountered in cockpits with poor environmental control. The CREST syndrome (calcinosis, Raynaud's, oesophageal involvement, sclerodactyly and telangiectasia) often involves pulmonary function, with 15% having pulmonary hypertension. It is important to maintain close supervision through rheumatology follow-up at least annually. Refined pulmonary function testing, CT of lungs and echocardiography will be needed where there is any suspicion of pulmonary involvement.

#### *Vasculitis*

Polyarteritis nodosum is the most common form. Vasculature anywhere in the body can be involved, and commonly includes the kidneys. Prognosis is always guarded, and certification will be based on history of extent and severity of disease and effectiveness of medication.



#### *Spinal Injury*

##### **Whiplash**

This condition is something of an enigma, as it tends to be described in only very limited contexts, particularly rear-end motor vehicle accidents. Pathology cannot be demonstrated experimentally. A lateral X-ray should be obtained acutely to exclude instability. A bone scan may be valuable at three weeks to identify bone or connective tissue damage.

Most cases settle very quickly. The principle method of rehabilitation is one of goal setting with steady improvement over several weeks.

Certification should be based on mobility and pain impact. Most cases can be managed by the DAME determining when the certificate holder is fit to return to aviation duties.

##### **Stable fracture of the spine**

There should be an expectation of a return to activities within 12 weeks, with an absolute maximum of 26 weeks. The ability to withstand prolonged sitting will be the main decider.

##### **Non-stable fracture of the spine**

Where there is operative treatment with insertion of a plate, recovery will be in 12 to 26 weeks. With two fracture levels, there is a longer recovery time, but practically all return to full activity.

##### **Posterior ligament rupture**

This is potentially unstable, where two of the three columns in the spine are damaged. Return is based on the treating orthoped advice, but usually should be three months before returning to flying activities.

##### **Spinal fracture with cord lesion**

Nearly all such patients will have fixation with pedicle screws. Recovery is usually based on force of injury. It will be necessary to wait for the assessed maximal recovery, and see how the individual is able to function. Urinary tract obstruction is often the main problem. Modifications to the cockpit, such as a Blackwood Pole for pedal manipulation can potentially still permit some flying.

##### **Paraplegia**

Once stable and functioning satisfactorily utilising a range of mechanical aids, should the individual wish to undertake aviation activities, functional testing will be required. The main issues will be mobility around the cabin, particularly full and free manipulation of flight controls and emergency egress.



#### *Spinal Stenosis*

The diameter of the cord is 11 mm minimum. Where the diameter is less than this, symptoms may occur. Pathology is often found in the lumbar region. There may, however, be smaller sizes found in scans, which have no symptoms. Where the neck is involved, there will usually be a myelopathy. The condition is usually slowly progressive, with nerve root pressure and neurologic claudication. Sitting does not affect the condition significantly, and the result is that pilots are affected very little.

#### *Syringomyelia*

This condition is more common in males, and is mostly an incidental finding. Symptoms, when present, tend to be vague, with difficulty in fine motor control in the hands. There is an asymmetric abdominal reflex. An MRI will show Arnold-Chiari malformation or a syrinx. Where there are symptoms, there is usually drainage of the syrinx, and reassessment. Most will be able to continue flying unrestricted.

#### *Scheuermann's Disease*

This abnormality of bony development is predominantly found in the lower thoracic vertebrae in males. Longitudinal studies have indicated that it has minimal impact in the long-term, and should not affect flying. Occasionally there is significant scoliosis, which requires a brace for about six months.

#### *Spondylosis*

This is an injury to the pars interarticularis. It is not congenital, but is found in 5% of boys by the age of five years. This varies by family history and racial background, and is more common in males. It can occur as a result of overuse in gymnasts and fast bowlers in particular. Rest and attention to technique is the core of treatment.

Spondylolisthesis involves a bilateral lesion with slippage of one vertebral body on the one below. When the slip is at risk of compromising the cord, or there is disability, surgery may be required. There may be some pain or discomfort but generally this does not preclude work.

There is little to suggest that there are any issues for aviation.

#### *Scoliosis*

When scoliosis is less than 30° it is of little consequence. Once at 50-60° at the end of its growth, it is often progressive and requires surgical intervention. There is little impact on function or on flying.



#### *Backache*

Backache, usually lumbar, is very common. Early normalisation of activities is the cornerstone of treatment. Avoidance of twisting is helpful. The few that are not cured within six to 12 weeks should be assessed in a rehabilitation program to seek an underlying problem.

In rotary wing aircraft, the normal posture of forward bending and lateral flexion tends to induce backache. No degeneration is reported from repeated minor stressors. It is usual to not complain of such pain until after retirement from aviation.

#### *Sciatica*

This is leg pain as a result of pressure on nerve roots. Back pain may also be present, but the leg pain is usually much more prominent. Treatment is expectant, with 50% improvement in 12 weeks, 80% in two years and 95% in five years, while surgery (laminectomy) has a 95% success rate. Recurrence is around 1-2% per annum.

It is possible to be fully active with sciatica without the risk of further damage. Thus, return to flying should be based on symptoms and need for medication.

#### *Loss of Limb*

Amputation should be considered on the basis of function. Occasionally, phantom pain or a neuroma in the stump can cause discomfort, but this is rare and can be adequately managed. Should the loss of limb be due to a tumour, the risk of recurrence must be taken into consideration.

Above-knee amputation as opposed to below-knee amputation will have a major impact on functionality. The pilot must be able to demonstrate the ability to fully operate the rudders, or modify the aircraft accordingly. A double above-knee amputee is unlikely to be able to fly an unmodified aircraft due to the inability to generate sufficient force to operate the rudders.

Upper limb prostheses that are most functional are not necessarily the most 'natural' in appearance, often being hooks. The loss of digits makes fine manipulation difficult.

#### *Shoulder Injury*

**Rotator cuff injury.** Most commonly, this is due to supraspinatus tear, and recovery is good. Physiotherapy, with up to three steroid injections can be helpful. Arthroscopic inspection can be useful to identify the pathology more accurately. Ultrasound is not helpful unless the sonographer is very experienced. Time to recover can be from 6 weeks to two years. Once able to move the affected arm through an arc in the functional area, the individual can be returned to flying. Surgical repair is sometimes necessary in the young patient.



**Shoulder instability.** Three episodes of subluxation or dislocation in a single direction should lead to surgical repair. Where there is multidirectional instability with ligamentous laxity, surgical repair is unhelpful, and effort should be directed to conservative treatment of maximal rehabilitation effort. Strength and balance of muscles is needed to overcome the ligamentous injury.

**Frozen shoulder.** Early treatment of frozen shoulder with local and oral corticosteroids has been reported as beneficial. In chronic, established cases the orthopaedic aim is to break down adhesions limiting the range of movement and causing pain. Early intervention with manipulation under anaesthesia and steroid injections usually results in recovery. Once again, ability to move in the functional arc for flying is needed before return to flying should be considered.

#### *Lateral Epicondylitis*

This condition may be encountered in a number of circumstances, usually involving repetitive activities. The core of the treatment is physical therapy with graduated exercises to increase strength and endurance, remediation of the causative activity, and steroid injections into the affected tendon complex are beneficial. Resumption of activity too soon often results in recurrence. Each case should be considered in its merits, based on forearm strength and exacerbating actions.

#### *Carpal Tunnel Syndrome*

Typical CTS symptoms involving the median nerve distribution at the wrist, will often respond to conservative treatment modifying activities combined with steroid injection. Surgery is usually curative. With arthroscopic surgery in experienced hands, the individual can return to work within four weeks, while open surgery recovery requires somewhat longer. Return to flying will be based on an assessment of strength and endurance of the wrist.

#### *Upper Limb Fractures*

The presence of a plaster is a difficult situation to assess. It is best to not attempt to fly while there is an upper limb plaster in place. A better option from the aviation perspective is usually a pin, possibly with a small splint, which will permit continued activity.

Each case needs to be based on functional capability, which should be assessed by the DAME. If there is a desire to fly while there is a plaster in place, or there is doubt about functional capacity, then a functional test, carried out by a CFI or ATO would be appropriate.



#### *Lower Limb Fractures*

Lower limb fractures often take 6 months to heal adequately for normal function. However, many fractures are pinned, or can have an inflatable plaster that is only inflated when putting stress through the bone. Thus, most lower limb fractures will be compatible with continued flying. The DAME should assess likely functional limitations of aviation relevance.

#### *Knee Derangement*

Following an anterior cruciate ligament rupture, there will be a period where the pilot is unfit for flying. Without surgery, this is likely to be around six weeks. With surgery, the expectation would be around three months. Medial collateral ligament tear will have little impact on flying.

#### *Arthrodesis*

Following an arthrodesis, activity is generally near normal. For flying, a hip arthrodesis will be nearly impossible due to the limitation of mobility. Knee arthrodesis is difficult and will require in flight assessment, while ankle arthrodesis should not produce significant difficulties.



# Designated Aviation Medical Examiner's Handbook

## 2. Medical Aspects

### 2.11 Orthopaedics and Rheumatology

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