



Atlantoaxial Instability (AAI) in Dogs

Quick take

Atlantoaxial instability (AAI) is a neck (cervical) spinal condition where the **first two neck vertebrae** — **atlas (C1)** and **axis (C2)** — become unstable or misaligned.

This instability allows the **dens (odontoid process) of C2 to press on the spinal cord**, causing **neck pain, weakness, or paralysis**.

It's most common in **toy and small breeds** (Yorkshire Terriers, Chihuahuas, Pomeranians, Toy Poodles) and usually results from a **congenital (born-with) defect** in bone or ligament structure. It can also occur after trauma in any breed.

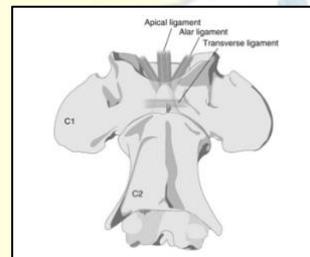
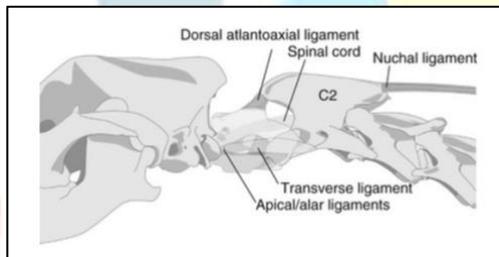
Surgery is the best option for most dogs with neurologic deficits.

Medical management may be possible for mild or high-risk cases but carries a greater chance of relapse.

1) What's going on inside?

The anatomy

The **atlas (C1)** supports the skull and pivots around the **dens**, a peg-like projection on the **axis (C2)**. They're held together by strong ligaments (especially the **transverse ligament**) and shaped for stability.

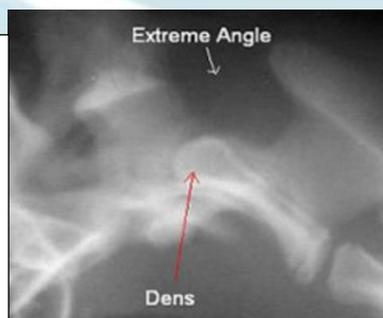


The problem

If the dens is **malformed, absent, or fractured**, or if ligaments are **weak or torn**, C1 and C2 shift abnormally.

Even small movements can cause **compression or bruising of the spinal cord** right under the brainstem — a very delicate area.

Increase in the angle between the 1st and 2nd vertebrae, with bending in the canal leading to compression of the spinal cord. The dens is absent, with a rounded off edge on the cranial aspect where the dens is normally projecting.



Note the angulation between the first and second vertebrae. A dens is absent in this dog.



Causes

- **Congenital malformation** (most common in toy breeds)
- **Trauma** (falls, rough handling)
- **Developmental bone weakness**
- **Ligament laxity** (often hereditary)

What this does

- Spinal cord compression → **pain, ataxia, paralysis**
- **Chronic instability** → inflammation, scar tissue, and permanent cord injury
- Sometimes sudden worsening after years of mild signs

2) What owners notice

- Sudden or intermittent **neck pain**
- Crying, shaking, reluctance to move neck or jump
- **Wobbly or weak** gait in all four limbs
- “Head held low” or “stiff neck”
- Collapse or paralysis after minor trauma
- In severe cases: breathing difficulty, even sudden death from spinal cord compression

Signs can come on **suddenly** or **wax and wane**.

3) Diagnosis

Steps

- **Neurologic exam:** identifies pain/reflex changes high in the neck
- **X-rays (with extreme caution!):** may show abnormal C1–C2 spacing



A left lateral radiograph of a dog with dorsal displacement of the second cervical vertebra (C2) vertebra. Minimal flexion of the head was necessary to demonstrate the subluxation in this patient.

- **CT or MRI: essential for surgical planning** - confirms spinal cord compression and bone malformation
- **Fluoroscopy (motion X-rays)** may be used to assess instability

Sedation or anaesthesia is needed — these dogs must be **handled very gently** to prevent worsening compression during imaging.



Please note the abnormal indentation of the vertebral canal at the level of the atlantoaxial junction

4) Treatment options

A) Conservative (medical) management

Used for:

- Mild cases (pain but walking)
- Very young puppies (<8 months) where bones too small for implants
- High anesthetic risk cases
- Owners declining surgery

Components:

- Rigid neck splint or brace for 6–8 weeks
- Strict cage rest
- Pain control (NSAIDs ± gabapentin)
- Muscle relaxants if needed
- No rough play or jumping — lifelong caution



Some dogs improve short-term

Many relapse or worsen; success rates only ~20–40% long-term

One single mistake, jump, rough play with another dog can cause relapse.

B) Surgical stabilization (the gold standard)

Goal: Permanently **realign and stabilize the C1–C2 junction** to stop motion and **relieve spinal cord pressure**.

1. Approaches

Type	Description	Notes
Ventral fixation (most common.. the one we use)	Approach from the underside of the neck. Uses pins, screws, wires, plates or cement	Best long-term results Can take advantage of 3D guides when patient stable enough to wait (>10 days)
Dorsal fixation	Approach from the top of neck with wires or sutures; less stable in very small dogs	Less frequently used



2. **Decompression** (removal of dens/odontectomy or scar tissue) may be performed if spinal cord compression is severe, or if the dens grew abnormally towards the vertebral canal.
3. **Bone fusion:** over time (6–12 weeks), bone grows around the implants, permanently stabilizing the joint.

5) Prognosis and outcomes

Presentation	Prognosis after surgery
Mild signs, ambulatory (able to walk)	Excellent (80–95%) regain normal life
Moderate paresis	Good (70–85%) improvement
Non-ambulatory but deep pain present	Fair (60–70%) improvement likely
No deep pain or severe cord damage	Guarded (<50%)

Most dogs improve within **weeks to months**; some require rehab and lifelong precautions.

Cats: rare but similar; surgical results also generally positive when treated early.

6) Complications and realistic rates

Complication	Approx.rate	Comments
Implant loosening or migration	10-20 %	Particularly in very small dogs, poor technique or transarticular implants
Infection	5-10%	Usually managed with antibiotics. Explantation can be needed in refractory patients (removal of cement/implants)
Persistent neurologic deficit	10-30%	Depends on preoperative severity of signs
Respiratory arrest during surgery	2-5%	Due to compression of the brainstem
Recurrence of instability	5-15%	Rare if fusion solidifies
Death during/after surgery	5% (2-10%)	Depends on severity of preoperative injury and surgical technique

Modern ventral fixation techniques have greatly reduced risk and improved outcomes.

3D guides: remain challenging to apply in practice due to the **long delay in modelisation and shipping**. They facilitate the placement of implants for surgeons who are not experienced with free-hand drilling.



7) Recovery & aftercare

Hospital

- Stay: 2–5 days
- Pain control, IV fluids, careful neck support
- May require ventilatory monitoring in severe cases

Home care

- Strict rest for 6–8 weeks minimum
- No neck flexion/extension or rough play
- Soft harness (never neck collars!)
- Pain and anti-inflammatory medications
- Rechecks with X-rays or CT to confirm fusion progress
- Gradual rehabilitation therapy after 6–8 weeks

Many dogs start improving **within 2–4 weeks**, with **full recovery over 3–6 months**.

8) Long-term management & lifestyle

- Avoid jumping, falls, and rough play permanently
- Use **ramps and harnesses** for lifting and walks
- Regular weight management
- Annual rechecks or earlier if new neck pain appears
- Some dogs retain mild stiffness — most adapt beautifully

Once fused, the joint is **permanently stable** and recurrence is rare.

9) Questions to ask your surgeon

- What type of instability or malformation does my dog have (dens absent, fractured, or ligamentous)?
- Which fixation technique do you recommend and why?
- What are the expected success and complication rates in your hands?
- What are the signs of implant failure I should watch for?
- Will my dog need rehabilitation therapy afterward?
- What's the long-term outlook for activity and comfort?

10) Trusted veterinary references (English)

- ACVS (American College of Veterinary Surgeons) — Atlantoaxial Instability in Dogs
- VCA Hospitals: Atlantoaxial Luxation Overview
- Brisson, B.A. (2010). Vet Clin North Am Small Anim Pract — review of congenital cervical diseases
- Thomas et al., 2014, J Small Anim Pract: surgical outcomes in toy breeds
- Slocum & Devine, 1986; Fossum, 2020: ventral fixation techniques
- Jeffery & Smith, 2012: prognosis and post-op outcomes for AAI

Bottom line

Atlantoaxial instability is a potentially **life-threatening** neck disorder seen mainly in **toy breeds**.

Mild cases may respond to **strict rest and bracing**, but **surgery offers the best chance** for long-term stability and comfort.

Modern **surgical stabilization yields success rates of 80–90%** in walking dogs.

Careful post-op management and lifelong activity modification help ensure a safe, happy, pain-free life.