

# Atlanto-Axial and Atlanto-Occipital Joints Injection in the Treatment of Headaches and Neck Pain

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## Key Points

- Atlanto-axial joint (AAJ) injection with local anaesthetic is used to make a definitive diagnosis of pain stemming from the AAJ. AAJ injection with local anaesthetic and steroids may be indicated in the management of AAJ pain.
- AAJ with local anaesthetic is usually considered first to predict the response to AAJ radiofrequency lesioning or arthrodesis in intractable cases.
- Atlanto-occipital joint (AOJ) injection is rarely performed.
- Spinal cord injury and syringomyelia are potential serious complications of AAJ and AOJ injections. Vertebral artery injection/injury has been reported with serious morbidity. Inadvertent puncture of the C2 dural sleeve with CSF leak or high spinal spread of the local anaesthetic may occur with AOJ injection.

## Introduction

Cervicogenic headache is referred pain from cervical structures innervated by the upper three cervical spinal nerves. The lateral atlanto-axial joint, which is innervated by the C2 ventral ramus, is a fairly common cause of cervicogenic headache. It may account for 16 % of patients with occipital headache [1]. In human volunteers, distending the lateral atlanto-axial joint (AAJ) with contrast agent produces

occipital pain, and injection of local anaesthetic into the joint relieves the headache [1, 2].

Clinical presentations suggestive of pain originating from the lateral AAJ include occipital or suboccipital pain, focal tenderness over the suboccipital area or over the transverse process of C1, restricted painful rotation of C1 on C2, and pain provocation by passive rotation of C1.

These clinical presentations merely indicate that the lateral AAJ could be a possible source of occipital headache; however, they are not specific and therefore cannot be used alone to establish the diagnosis [3]. These clinical signs have a positive predictive value of only 60 % [1].

The pathology of lateral AAJ pain is usually osteoarthritis or post-traumatic in nature [4, 5]. However, the presence of osteoarthritic changes in imaging studies does not mean that the joint is necessarily painful; also the absence of abnormal findings does not preclude the joint from being painful, and the only means of establishing a definite diagnosis is a diagnostic block with intra-articular injection of local anaesthetic [1].

## Indications

1. AAJ injection with local anaesthetic is used to make a definitive diagnosis of pain stemming from the AAJ.
2. AAJ injection with local anaesthetic and steroids may be indicated in the management of AAJ pain. Intra-articular steroids are effective in short-term pain relief originating from the lateral atlanto-axial joint [6, 7].
3. AAJ injection with local anaesthetic is usually considered first to predict the response to AAJ radiofrequency lesioning or arthrodesis in intractable cases. One report showed favourable long-term outcome after both pulsed and thermal radiofrequency lesioning of the AAJ [8]. In intractable cases, not responsive to more conservative management, arthrodesis of the lateral atlanto-axial joint may be indicated [9].

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## Anatomy of the Atlanto-Axial Joint (AAJ) and Atlanto-Occipital Joint (AOJ)

It is very crucial to be familiar with the anatomy of the AAJ and atlanto-occipital joint (AOJ) in relation to the surrounding vascular and neural structures (Fig. 8.1) to avoid serious complications. The vertebral artery is lateral to the AAJ as it courses through the C2 and C1 foramina. The vertebral artery then curves medially crossing the medial posterior aspect of the AOJ to go through the foramen magnum.

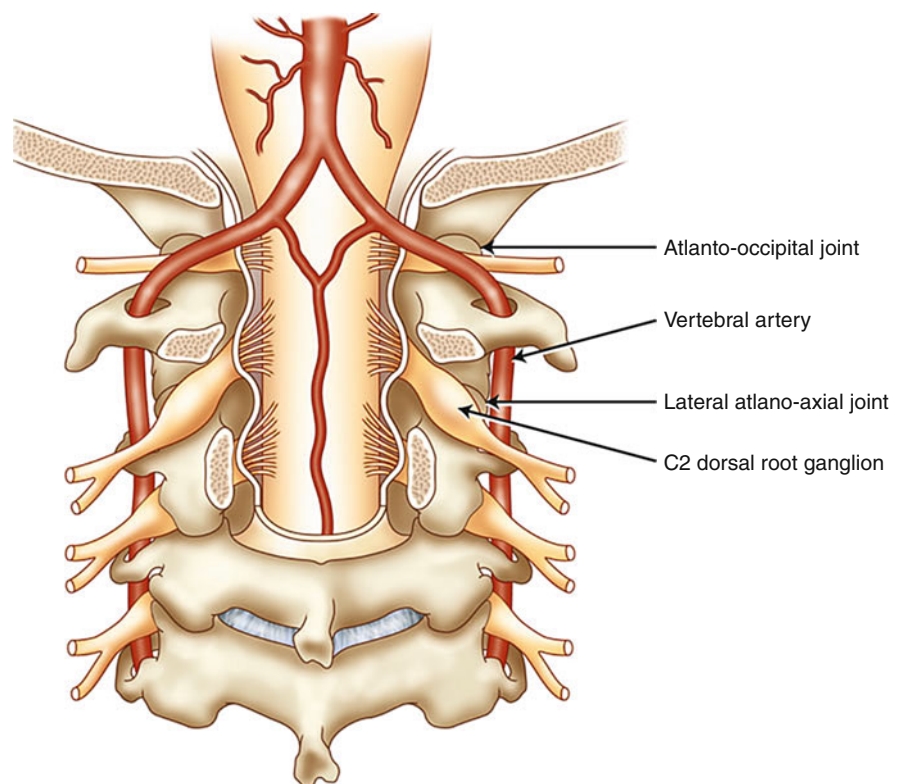
The C2 nerve root, dorsal root ganglion, and its surrounding dural sleeve cross the posterior aspect of the middle of the joint. Therefore, during AAJ injection, the needle should be directed towards the junction of the middle and lateral thirds of the posterior aspect of the joint. This will avoid injury to the C2 nerve root medially or the vertebral artery laterally (Fig. 8.1) [1, 7]. Conversely, the AOJ should be accessed posteriorly from the most superior lateral aspect to avoid injuring the vertebral artery medially.

## Technique of AAJ Injections

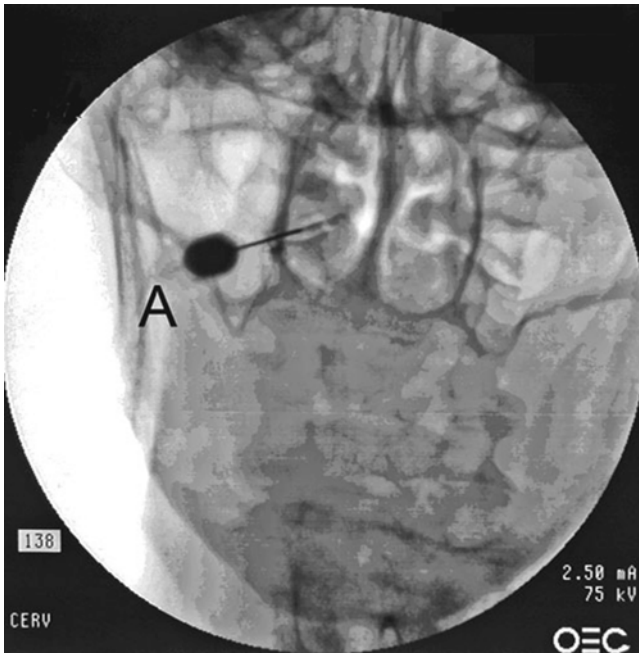
With the patient placed in the prone position and a pillow under the chest to allow for slight neck flexion, the fluoroscopy C-arm is brought to the head of the table in an anteroposterior direction. Under fluoroscopic guidance, the C-arm

is rotated in a cephalad-caudad direction to better visualize the lateral AAJ. The needle insertion site is marked on the skin overlying the lateral thirds of the AAJ. The skin is prepped and draped in the usual sterile fashion, and a skin wheel is raised with local anaesthetic at the insertion site. Then a 22–25-G 3½ inches blunt needle is advanced towards the posterolateral aspect of the inferior margin of the inferior articular process of the atlas (C1). This will avoid contact with the C2 nerve root and dorsal ganglion, which crosses the posterior aspect of the middle of the joint. It is “better” to seek and touch the bone to safely establish the correct depth. At this point, a lateral view is obtained. The needle is withdrawn slightly, directed towards the posterolateral aspect of the lateral atlanto-axial joint, and advanced for couple of millimetres. Usually a distinctive pop is felt signalling entering the joint cavity. Careful attention should be paid to avoid the vertebral artery that lies laterally to the lateral AAJ as it courses through the C1 and C2 foramina. After careful negative aspiration for blood or cerebrospinal fluid, 0.1–0.2 ml of water-soluble nonionic contrast agent is injected to verify intra-articular placement of the tip of the needle.

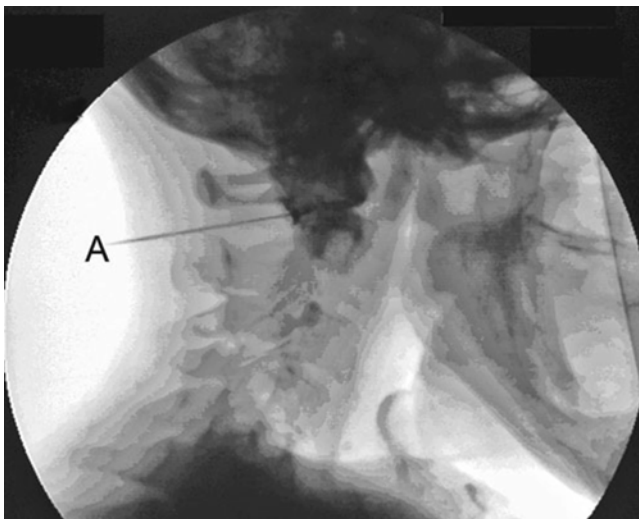
Injection of the contrast agent is done under direct real-time fluoroscopy to check for inadvertent intra-arterial injection which is manifest by rapid clearance of the contrast agent. Anteroposterior and lateral views are obtained to insure that the contrast agent remained confined to the joint cavity without escape to the surrounding structures, especially the epidural space, or posteriorly to the C2



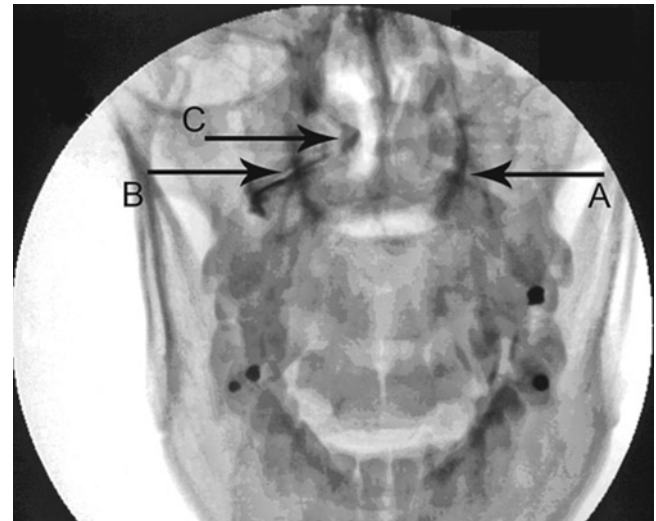
**Fig. 8.1** Illustration showing the relevant anatomy of the atlanto-occipital and atlanto-axial joints



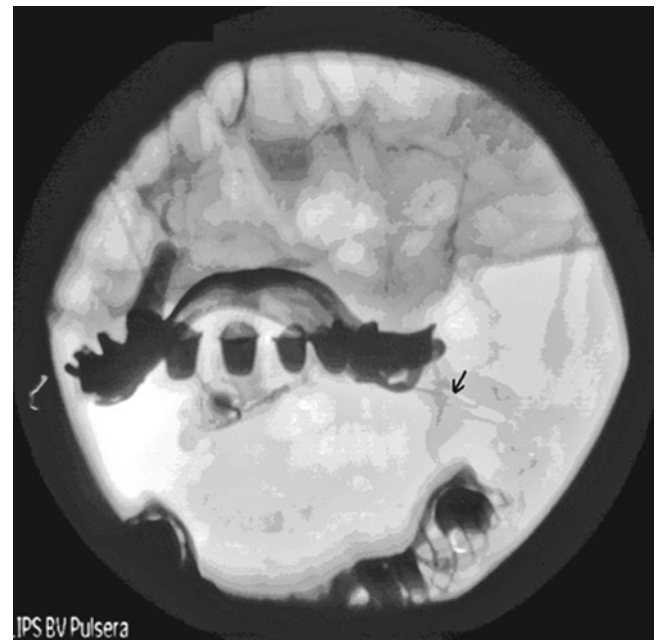
**Fig. 8.2** Lateral atlanto-axial joint (AAJ) injection: AP view showing the needle (A) targeting the lateral third of the joint, and the contrast is contained within the joint space (Reproduced with permission from Ohio Pain and Headache Institute)



**Fig. 8.3** Lateral atlanto-axial joint (AAJ) injection: lateral view showing the needle (A) and the contrast contained within the joint space (Reproduced with permission from Ohio Pain and Headache Institute)



**Fig. 8.4** Lateral atlanto-axial joint (AAJ) injection: A lateral atlanto-axial joint (AAJ). B contrast agent within the AAJ. C contrast spreading to the median atlanto-axial joint (Reproduced with permission from Ohio Pain and Headache Institute)

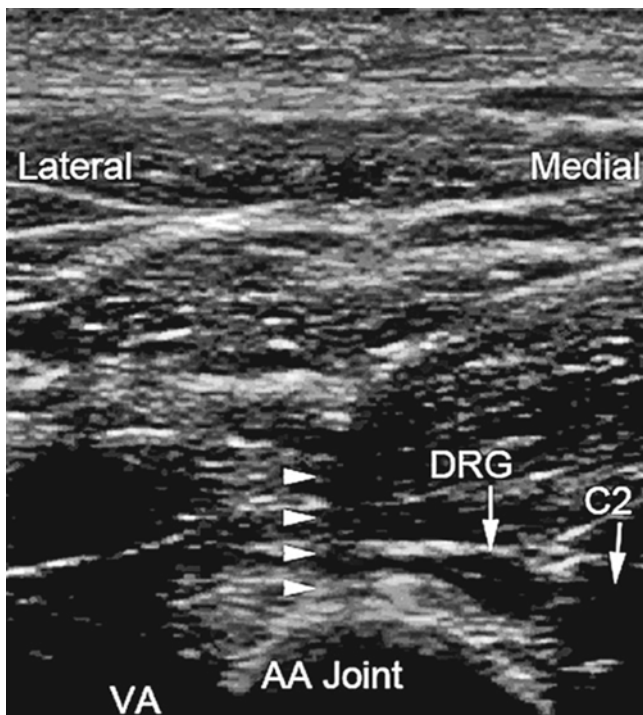


**Fig. 8.5** Lateral atlanto-axial joint (AAJ) injection: Needle inside the left AAJ with the contrast spreading to the right AAJ (arrow) (Reproduced with permission from Ohio Pain and Headache Institute)

ganglion which will adversely affect the specificity of the block (Figs. 8.2 and 8.3). The anteroposterior view usually demonstrates the bilateral concavity of the joint with the contrast material inside the joint space (Fig. 8.2), and sometimes it shows that the lateral AAJ space communicates with that of the median atlanto-axial joint (Fig. 8.4) and the

contralateral AAJ (Fig. 8.5). After careful negative aspiration, 1.0 ml of a mixture of bupivacaine 0.5 % and 10 mg of triamcinolone is injected.

Every effort should be made to make the injection true intra-articular and not periarticular injection. Those procedures are mainly utilized in the diagnosis of pain stemming



**Fig. 8.6** Atlanto-axial joint (AAJ) injection. Short axis sonogram showing the needle targeting the AAJ (*arrowheads*). C2 C2 nerve root, DRG dorsal root ganglion, VA vertebral artery (Reproduced with permission from Ohio Pain and Headache Institute)

from the joints, and periarticular injection is not target specific as the local anaesthetic may contaminate the C2 nerve root which crosses the posterior aspect of the AAJ. Intra-articular injection is more target specific as it selectively anesthetizes the joint [7].

Recently, ultrasound-assisted AAJ injection was reported. With real-time sonography, the vertebral artery can be identified laterally and the C2 dorsal root ganglion medially and accordingly; the needle can be advanced in-between (Fig. 8.6) [10].

## Atlanto-Occipital Joint (AOJ) Injections

### Indications

This procedure is rarely performed for few reasons. Isolated pain stemming from the atlanto-occipital joint (AOJ) is very rare, and usually the patient is presented with localized occipital pain that is aggravated mainly by head nodding. Activity modification and conservative management are usually all what is needed. Also the vertebral artery curves from lateral to medial crossing the posterior aspect of the C1 body which makes it vulnerable to injury while the needle is



**Fig. 8.7** Atlanto-occipital joint (AOJ) injection. AP view (Reproduced with permission from Ohio Pain and Headache Institute)

advanced towards the AOJ, especially with improper positioning of the patient.

### Technique of AOJ Injections

The positioning and approach is similar to that for AAJ injection. The patient needs to flex his head over the neck as much as possible (chin on chest) to open the suboccipital space posteriorly. The atlanto-occipital joint should be accessed posteriorly from the most superior lateral aspect to avoid the vertebral artery (Figs. 8.7 and 8.8).

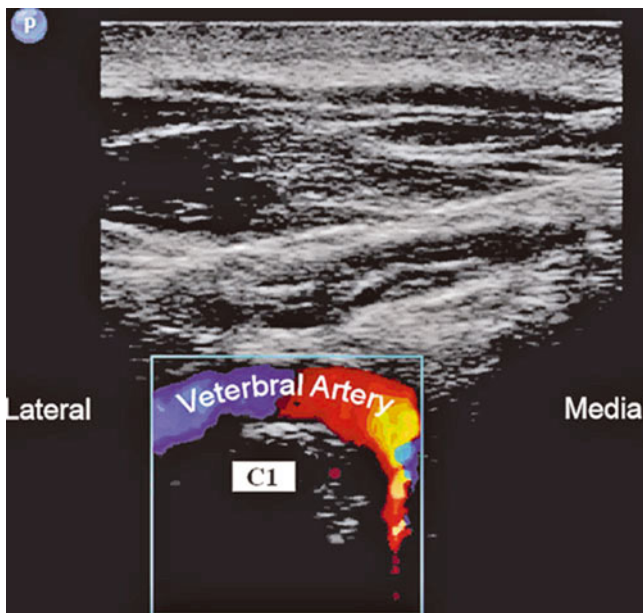
More recently, ultrasound-assisted AOJ injection in conjunction with fluoroscopy was described. With real-time sonography, the vertebral artery is identified as it curves medially behind C1 body and accordingly can be avoided from the needle path, and then the procedure can be continued with fluoroscopy to confirm intra-articular placement of the needle (Fig. 8.9) [10].

### Efficacy of AAJ and AOJ Injections

Narouze and colleagues [7] studied 115 patients with cervicogenic headache. Thirty-two patients had a clinical picture suggestive of atlanto-axial joint pain, and the diagnosis was confirmed in 15 patients with complete abolition of the headache (pain score of zero) after AAJ injection. The prevalence of AAJ pain among patients with cervicogenic headache was



**Fig. 8.8** Atlanto-occipital joint (AOJ) injection. Lateral view (Reproduced with permission from Ohio Pain and Headache Institute)



**Fig. 8.9** Atlanto-occipital joint (AOJ) injection. Sonogram showing the vertebral artery as it curves medially posterior to C1 (Reproduced with permission from Ohio Pain and Headache Institute)

13 % (15/115 patients). At 1, 3, and 6 months after AAJ intra-articular steroid injection, the mean pain scores dropped from a baseline of 6.8 to 1.9, 3.6, and 3.7, respectively. The authors concluded that intra-articular steroid injection is effective in short-term relief of pain originating from the lateral AAJ. There is no data available to demonstrate the efficacy of AOJ intra-articular steroid injections.

## Complications of AAJ and AOJ Injections

1. Spinal cord injury and syringomyelia are potential serious complications if the needle is directed further medially into the spinal canal [11].
2. Vertebral artery injection/injury was reported with serious morbidity. Injection of a contrast agent should be performed under real-time fluoroscopy, preferably with digital subtraction if available, prior to the injection of the local anaesthetic, as negative aspiration is unreliable [12]. Meticulous attention should be paid to avoid intravascular injection as vertebral artery anatomy may be variable. Recently, ultrasound-assisted AAJ and AOJ injections were reported in an effort to add more safety to the procedure as ultrasound can identify the relevant soft tissue structures nearby the joints (e.g. vertebral artery and C2 dorsal root ganglion) (Figs. 8.6 and 8.9) [10].
3. Inadvertent puncture of the C2 dural sleeve with CSF leak or high spinal spread of the local anaesthetic may occur with atlanto-axial joint injection if the needle is directed a few millimetres medially [11].

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