

Secondary Tinnitus as a Symptom of Instability of the Upper Cervical Spine: Operative Management

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Abstract: Tinnitus very often is caused by instability of the craniocervical junction. It very frequently manifests as a high-pitched whistle that disappears after operative correction and stabilization of the articular geometry. Prolapsed intervertebral disks, discoligamentous injury, and even metastases as low as level C3 can cause tinnitus, which also usually disappears after surgery.

Key Words: alar ligament; instability; upper cervical spine

Between January 1996 and January 2000, we operated on the cervical spines of nearly 150 patients per year (on average) at Füssen Hospital, Germany. Statistical evaluation of the large number of patients who received treatment for their cervical spines at our hospital revealed that up to 80% of those with pathological changes in the upper cervical spine (C3 and above) had reported tinnitus as a secondary symptom.

This large number of surgical patients presented with heterogeneous clinical pictures. Mostly, they were patients with degenerative changes in the midcervical spine, but some also presented with prolapsed disks and solitary metastases. However, very many patients presented also with late complications after accidents. These included those with instability of the craniocervical junction due to torn or overstretched ligaments, patients with discoligamentous damage without neurological deficit, and many patients with degenerative discopathies, some with pronounced spinal stenosis.

After becoming aware of the secondary symptom of tinnitus, which some of the patients found very unpleasant, we evaluated the statistics more specifically. Our analysis showed that patients with degenerative changes in the lower cervical spine only rarely reported tinnitus as a secondary symptom, whereas the patient

group with instability at the craniocervical junction had usually reported a unilateral or bilateral high-pitched whistle. In patients with dysfunction at C2-C3 or C3-C4, we also found tinnitus but of a different character. This mostly manifested as splashing or crackling noises.

During surgery on those in the latter patient group, special attention was paid to ensuring complete relief of any nerve structures that may have been involved. At the same time, the region was stabilized, with a very strong emphasis on physiological correction of the craniocervical junction geometry. After operative correction and rehabilitation, the tinnitus disappeared completely and permanently in all but two patients.

In this report, we have deliberately omitted all other symptoms that required surgery of the cervical spine. Later, in describing the patients, we again concentrate on the tinnitus symptom and discuss the other symptoms separately.

PATIENT GROUP

Between January 1996 and January 2000, we operated on a total of 134 patients with secondary tinnitus. Thirteen patients had pathological findings below level C2 but above C5. One patient had a tumor at C2, one had a metastasis at C3, seven patients had disk prolapses at C3-C4, two had instability and angular kyphosis at C3-C4, one patient had a prolapsed C4-C5 disk, and one had instability at C2-C3. The dorsal approach was used for 121 patients undergoing stabilization surgery for in-

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stability at C0-C1-C2. In 98% of these patients, the instability was caused by an accident.

Sixty percent of the patients reported that the injection of 0.5 ml 1% prilocaine hydrochloride (Xylonest) into the C1-C2 joint with a long cannula under an image converter had an effect on their tinnitus. In 8% of these patients, bending the neck would provoke the tinnitus more strongly. In 11 patients, the tinnitus had developed slowly 1 year after the accident. Twenty-one patients reported that they suffered occasional tinnitus but that this was triggered immediately by stress. In four patients, the tinnitus remained unchanged after the operation. Although these patients reported considerable improvement in their degenerative cervical syndrome and cervicooccipital symptoms, the tinnitus had remained unchanged.

During the postoperative phase, 30% of the patients had recurrent tinnitus for a period of up to 4 weeks. This was closely associated with postoperative tension in the neck and shoulder muscles. However, the postoperative tinnitus responded very well to treatment (1) by infiltrating the paravertebral muscles that showed tremendous tension, (2) by chewing gum, which eases and relaxes the neck muscles, and (3) in part by prescribed muscle relaxants.

TECHNIQUE FOR OPERATIVE STABILIZATION OF THE CRANIOCERVICAL JUNCTION

Surgical Procedure

The aim of an operation to correct an unstable cranio-cervical junction with torn or overstretched ligaments after an accident is to stabilize the area. As it has not been possible to date to restore torn alar ligaments to their original condition via a ventral approach or to replace a ruptured transverse ligament, the only access for any stabilization surgery on the cranio-cervical junction is by a dorsal approach.

Patient Positioning for Cervical Surgery

The operation is performed under general anesthesia. The patient is positioned prone with the head slightly flexed and resting on a headrest (Fig. 1). The image converter is integrated and sterile-draped. The incision is made in the midline in the region of the cranio-cervical junction (Fig. 2). After exposure of the spinous processes, the paravertebral muscles are dissected and retracted. Movement at the cranio-cervical junction is observed at operation. Moving the head with the surgical site open allows clear observation of how the indi-

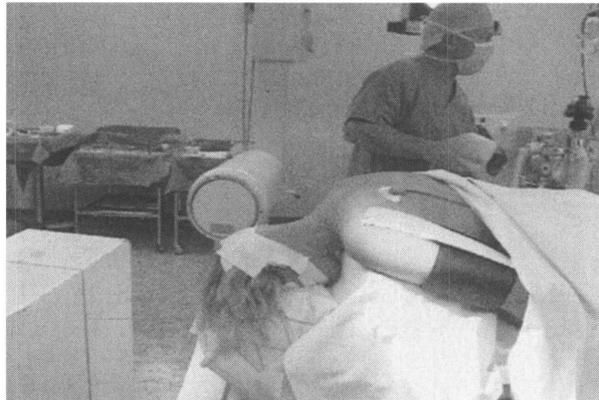


Figure 1. Patient positioning for cervical surgery.

vidual ventral ligaments function and to what extent the movement between individual vertebrae is disharmonious. Furthermore, the region around the articular capsule of C1-C2 can be observed and assessed at operation.

The preoperatively diagnosed instability was confirmed at operation in all cases. However, different instability patterns after accidents were found. Most cases demonstrated combined instability between C0-C1, C1-C2, and C2-C3. Many cases exhibited additional rotation dislocation or subluxation of C1 on C2.

The ideal physiological position of the upper cervical vertebrae is adjusted under the image converter, also taking into account the position of the head relative to the spine. A hole is drilled through the posterior arch of C2 in the direction of the lateral mass of C1 and a screw is set into the hole under temporary compression with titanium screws. This immediately stabilizes C1/C2. Subsequently, a titanium plate is bent to correspond to the angle at the cranio-cervical junction to allow the plate to be screwed to C0, C1, C2, and C3 (Fig. 3). The titanium plate is fixed to the occiput with very short

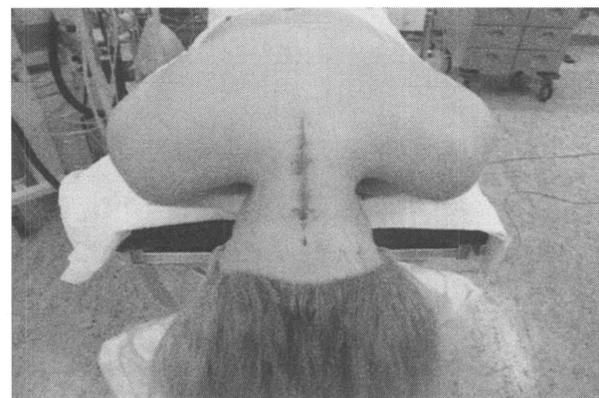


Figure 2. Surgical site via a dorsal approach.



Figure 3. Screwing the plates to C0-C1-C2.

screws after careful drilling into the occipital bone. The transarticular C1-C2 screw, usually 40 mm long, then is tightened. This screw also immobilizes the C1-C2 joint. The plate is screwed also onto the facet joints of C3 in the stabilization complex. By this means, we create a rigid complex incorporating C0-C1-C2 down to and including C3, which prohibits any faulty movements (Fig. 4). After placement of a Redon drain, the cervical musculature is sutured back onto the spinous processes in the midline, which is followed by wound closure in layers and wound dressing.



Figure 4. Postoperative radiograph shows plate screwed into C0-C1-C2 and including C3.

Discussion of the Surgical Method

In the first few years after beginning surgical management of this patient group with unstable craniocervical junctions, we performed fusion with autologous bone at C0-C1-C2 and fixation with titanium wire cerclage. This method had the disadvantage that rotation of the head was not fully obliterated and that, ultimately, incorrect movements could not be ruled out completely. The symptoms did not disappear entirely, and losses of correction at surgery were frequent. Only the introduction of Magerl's transarticular screws, which are screwed through the arch of C2 into the lateral mass of C1, brought considerably better results.

Intraoperative radiography and precise knowledge of the anatomical features of the region are mandatory for this type of fixation because a variable vertebral artery may pass laterally. At the same time, attention must be paid to the C2 nerve root; if the screws pass medially, they create the danger of injuring the dura. A number of patients were operated on using this method. One disadvantage was that the bone grafts placed in this critical region between the occiput and C1-C2 caused major problems. Osteolytic bone changes were very frequent, pseudarthroses were very common, the patients reported recurrent symptoms, and radiographs showed that the correction was lost, with the head generally tending toward dorsiflexion. Only correcting the head position in ventral flexion with fixation brought pronounced improvements in the symptomatology.

Follow-up examinations of a large number of patients who had a relatively high percentage of failures (15) showed this method to be inadequate. The loss of correction of the geometry of the craniocervical junction after surgery caused very many relapse symptoms, even if they were not as severe as before the operation. Thus, since November 1998, we have selected plate fixation (as described) as our standard method (see Fig. 4). The procedure no longer enables any movement at all at the craniocervical junction and furthermore does not permit any loss of the correction achieved in the sense of gradual dorsiflexion of the head. This was the case with slight shrinkage of the bone grafts at the craniocervical junction for fusion without the supporting titanium plates.

This method has been successful also in patients with repeat bone resection and revision surgery but without the possibility of grafting of new bone onto which the plates could be screwed. Long-term observation has not shown any instances of screw or plate loosening in this region.

SUMMARY

Secondary tinnitus may develop owing to altered geometry of the cervical spine, especially the upper seg-

ments. If the tinnitus is caused by morphological changes in the upper cervical vertebrae, it disappears after surgical correction. Tinnitus is a very annoying, tormenting secondary symptom for patients with instability of the upper cervical spine and exacerbates an already compromised patient's state of health, as it accompanies several other pathological changes that generally disappeared after surgery.

In the treatment of tinnitus, this method certainly should be borne in mind, and patients should be asked about any symptoms suggestive of changes in the cervical spine. If a connection exists between the medical history and symptoms of cervical degeneration, cervicocephalic symptoms, and tinnitus, we consider a more exacting functional examination obligatory to rule out tinnitus induced by changes in the cervical spine.