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Review

A review of techniques of lysis and lavage of the TMJ

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Abstract

We systematically reviewed publications in the English language about techniques of lysis and lavage of the temporomandibular joint (TMJ). We describe these techniques and describe their advantages and disadvantages.

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Keywords: Temporomandibular joint; Arthrocentesis; Lysis and lavage

Introduction

In the 1960s arthrocentesis of large joints, the knee in particular, became a recognised treatment. Physicians went on to develop various techniques of lysis and lavage for other joints, such as the hip, shoulder, tarsus, and wrist.^{1–4} It was then found that the mechanical lysis of adhesions and lavage of the temporomandibular joint (TMJ) was often successful in treating various internal derangements.⁵ Lavage of the upper joint compartment forces the flexible disc apart from the fossa, washes away degraded particles and inflammatory components, and decreases the intra-articular pressure whenever the joint is inflamed. Arthrocentesis has been reported to reduce joint pain, improve function, and reduce clicking. It is most commonly used to treat patients with anterior disc displacement without reduction (closed lock) and disc adhesion. It is also used as a palliative for acute episodes of degenerative or rheumatoid arthritis.^{5–7}

Lysis and lavage of the TMJ were first done using arthroscopy by Ohnishi,⁸ but because it was found that visualisation of the joint is not necessary to accomplish these

objectives, arthrocentesis was developed as a modification of TMJ arthroscopy.^{5,7}

The aim of this paper was to review described techniques of lysis and lavage of the TMJ and to discuss their possible advantages and disadvantages.

Method

We searched MEDLINE for papers in English on the techniques of the lysis and lavage of the TMJ.

Results

There were 8 different methods for the lysis and lavage of the TMJ published in 8 papers, and a modification reported in a book.⁷ According to the times when they were published these were: arthroscopic lysis and lavage,⁸ two-needle arthrocentesis using an irrigation pump,⁹ modified two-needle arthrocentesis,⁷ the double-needle cannula method,¹⁰ single-needle arthrocentesis,¹¹ use of a single Shepard cannula with two ports and two lumens,¹² two-needle arthrocentesis,¹³ single-puncture arthrocentesis,¹⁴ and two-needle arthrocentesis with new anatomical landmarks¹⁵ (Table 1a, Figs. 1 and 2).

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Table 1a
Methods and routes for lysis and lavage of the temporomandibular joint (TMJ).

First author	Lysis and lavage techniques and anatomical landmarks	Suggested advantages
Ohnishi ⁸	Arthroscopy of the TMJ, trocar is inserted to joint space.	Visualisation and examination of the joint space.
Nitzan ⁹	Two-needle arthrocentesis Points of entry are A and B.	Permits massive lavage of the joint, in addition to aspiration and injection.
Laskin ⁷	Modified two-needle arthrocentesis Points of entry are A and D.	It is easier to insert the anterior needle.
Alkan ¹⁰	Use of double-needle cannula method Point of entry is A.	Both irrigation and washout done through the same device. Useful for the joints with strong adhesions or joints with degenerative changes that make the insertion of the second needle into the anterior recess difficult.
Guarda-Nardini ¹¹	Single-needle arthrocentesis Point of entry is A.	Irrigation and washout done through the same needle. Limits the trauma of the intervention, reduces postoperative discomfort and risk of paraesthesia of the facial nerve, reduces the amount of anaesthetic needed, provides the low pressure fluid injection and reduces the risk of hyaluronic acid outflow. Useful in the joints with strong adhesions or joints with degenerative changes that make the insertion of the second needle difficult.
Rehman ¹²	Use of a single Shepard cannula with two lumens Point of entry is A.	Irrigation and washout done through the same device. Useful for joints with strong adhesions or joints with degenerative changes that make the insertion of the second needle into the anterior recess difficult.
Alkan ¹³	Two-needle arthrocentesis Points of entry are A and B.	Irrigation pump from the surgical motor was used. Provides the highest hydraulic pressure and irrigates the upper joint space in 2 min with 300 ml of solution.
Rahal ¹⁴	Single-puncture arthrocentesis Point of entry is A.	Irrigation and washout done through the same device. Useful for the joints with strong adhesions or joints with degenerative changes that make the insertion of the second needle into the anterior recess difficult.
Alkan ¹⁵	Two-needle arthrocentesis Points of entry are A and C.	Outflow was easier, and it may be reasonable, as repeated insertions of a needle are uncomfortable and adversely affect the success of the treatment.

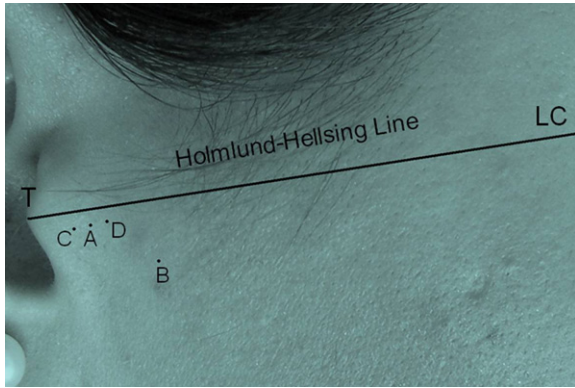


Fig. 1. LC=lateral canthus; T=tragus; A=10 mm from the middle of the tragus and 2 mm below the canthotragal line. B=10 mm further along the canthotragal line and 10 mm below it; C=7 mm anterior from the middle of the tragus and 2 mm inferior along the canthotragal line; and D=2–3 mm in front of point A.

Discussion

Arthroscopy of the TMJ was first introduced by Ohnishi in 1975.⁸ Initially, it involved merely lavage of the joint and the use of a probe to break up adhesions. However, with the introduction of improved instruments, surgeons have been able to do arthroscopic operations for various intra-articular disorders.^{7,16–18}

Arthroscopic lysis and lavage can be used to treat those patients with painful clicking or popping, to release intra-articular adhesions and anteriorly displaced non-reducing discs, and to confirm other diagnostic findings that could warrant surgical intervention.⁷ Approaches for the arthroscopic lysis and lavage of the TMJ are the superior posterolateral, the superior anterolateral, the inferior posterolateral, the inferior anterolateral, and the endaural approach (Fig. 2). However, the superior posterolateral approach is the most common. In this technique, the mandible is distracted downward and forward, producing a triangular depression in front of the tragus. The trocar is inserted into the roof of this depression to outline the inferior aspect of the glenoid fossa. This provides visualisation of the superior joint space.

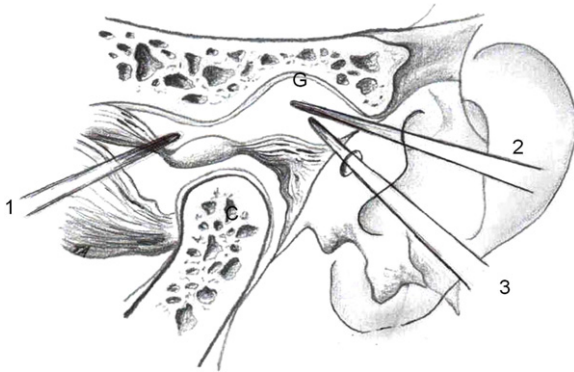


Fig. 2. 1=Superior anterolateral approach; 2=endaural approach; 3=superior posterolateral approach; C=condyle; and G=glenoid fossa.

In the superior anterolateral approach the trocar is directed superiorly, posteriorly, and medially, along the inferior slope of the articular eminence. This approach allows visualisation of the anterosuperior joint compartment.

In the inferior posterolateral approach, the trocar is directed against the lateral posterior surface of the mandibular head. This provides visualisation of the posterior condylar surface and the inferoposterior synovial pouch.

In the inferior anterolateral approach the trocar is inserted at a point anterior to the lateral pole of the condylar head and immediately below the articular tubercle. This technique allows observation of the lower anterior synovial pouch.

The endaural approach is initiated by entering the posterosuperior joint space with a trocar from a point 1 to 1.5 cm medial to the lateral edge of the tragus through the anterior wall of the external auditory meatus. The trocar is directed in an anterosuperior and slightly medial direction toward the posterior slope of the eminence. The posterior superior joint space and medial and lateral paradiscal troughs can be examined with this technique (Table 1b, Fig. 2).^{8,19}

In the past, arthrocentesis was used to treat patients with TMJ closed lock and disc adhesion. Now, it is used for various TMJ problems such as with reducible disc displacement and as palliation for acute episodes of degenerative or rheumatoid arthritis.^{5,17,20} In some seriously injured patients, aspiration of haemarthrosis with gentle lavage may render them more comfortable.⁵

Murakami et al.²¹ first described a technique of TMJ arthrocentesis with pumping irrigation and hydraulic pressure to the upper joint cavity followed by manipulation of the jaw. Nitzan et al.,⁹ then described a technique whereby two needles instead of one were introduced into the upper joint space. This adaptation permitted massive lavage of the joint as well as aspiration and injection.⁹ In this technique the points for the needle's insertion are marked on the skin according to the method suggested by McCain et al. for arthroscopy (posterolateral approach to the upper joint space).^{17,18} A line is drawn from the lateral canthus to the most posterior and central point on the tragus (Holmlund–Helsing Line, Fig. 1).²² The posterior point of entry is located along the canthotragal line 10 mm from the middle of the tragus and 2 mm below the canthotragal line (point A in Fig. 1).⁵ This is the approximate area of the maximum concavity of the glenoid fossa. The distance is about 25 mm from skin to the centre of the joint space.⁵ The anterior point of entry is placed 10 mm further along the canthotragal line and 10 mm below it (point B in Fig. 1). This marking indicates the site of the eminence of the TMJ.

After the points of insertion for the two needles have been marked, local anaesthetic is injected at the planned entrance points. Two 19 gauge needles are inserted in the anterior and posterior recesses of the upper joint space. Through one needle, Ringer's lactate 100–300 ml is injected into the superior joint space. The second needle acts as an outflow portal, which allows lavage of the joint cavity.^{5,9} Shinjo et al.²³ suggested that lactated Ringer's solution is better tolerated than

Table 1b

. Approaches for arthroscopic lysis and lavage of the temporomandibular joint (TMJ).

First author	Arthroscopy of the TMJ		Suggested advantages
	Approach	Technique	
Ohnishi ⁸	Superior posterolateral	The mandible is distracted downwards and forwards to produce a triangular depression in front of the tragus. The trocar is inserted at the roof of this depression, outlining the inferior aspect of the glenoid fossa.	Visualisation of the superior joint space (most commonly used).
	Superior anterolateral	The trocar is directed superiorly, posteriorly, and medially along the inferior slope of the articular eminence.	Visualisation of the anterosuperior joint compartment.
	Inferior posterolateral	The trocar is directed against the lateral posterior surface of the mandibular head.	Visualisation of the posterior condylar surface and inferoposterior synovial pouch.
	Inferior anterolateral	The trocar is inserted at a point anterior to the lateral pole of the condylar head and immediately below the articular tubercle.	Observation of the lower anterior synovial pouch.
	Endaural	Initiated by a trocar entering the posterosuperior joint space from a point 1 to 1.5 cm medial to the lateral edge of the tragus through the anterior wall of the external auditory meatus. The trocar is directed in an anterosuperior and slightly medial direction toward the posterior slope of the eminence.	Posterior superior joint space and medial and lateral paradiscal troughs can be examined.

isotonic saline solution for cells derived from human meniscus tissue. Zardeneta et al.²⁴ recommended a free flow of Ringer's solution 100 ml because denatured haemoglobin and various proteinases were recovered in this fraction, whereas Kaneyama et al.²⁵ suggested that 300–400 ml should be used to wash out bradykinin, interleukin-6, and proteins.

The landmarks at which the needles are placed are in the approximate area of the glenoid fossa; the fossa portal puncture site should be confirmed by palpation. However, anatomical variations should be kept in mind. Some solution should be injected to irrigate and distend the superior joint space. When back pressure in the syringe is felt, mandibular movement will also be felt under pressure if the needle is properly inserted. After the joint has been irrigated, the second needle can be inserted more easily. Proper positioning in the joint is confirmed when injection of the solution results in its exit from the other needle. If the patient's mouth is then closed, pressurised solution will exit from the needle. At the end of lavage, it was proposed that steroids or sodium hyaluronate should be injected to alleviate intracapsular inflammation.⁸ Postoperatively the patient should be given a non-chewing soft diet for a few days. Exercises of range of movement are started immediately and continued for several days. Analgesics are prescribed as necessary for pain.^{5,6,17} Many research studies have shown that lysis and lavage of the upper joint compartment through two needles have good short and long-term results.^{5,9,20,26–29}

Laskin et al.⁷ suggested that because access to the anterior recess is not necessary, as it is when the entire joint must be visualised during arthroscopy, it is easier merely to insert the anterior needle 2–3 mm in front of the posterior needle (point D in Fig. 1). Alkan and Etöz¹⁵ proposed another technique, in which the posterior point of entry was the same as

described earlier for point A.⁵ However, the second needle was inserted 7 mm anterior from the middle of the tragus and 2 mm inferior along the canthotragal line (point C in Fig. 1). This second needle was adjusted parallel and almost 3 mm posterior to the first until bony contact was made. Outflow was easier to achieve when the second needle was inserted behind the first one in the wider part of the upper joint compartment. They suggested that the use of this landmark as the default technique may be reasonable, as repeated insertions of a needle are uncomfortable both for physicians and patients and adversely affect the success of the treatment.¹⁵

Alkan and Kilic¹³ described a modification of the arthrocentesis technique described by Nitzan et al.,⁹ in which an irrigation pump from a surgical and dental implant motor was connected to the second needle, and automatic irrigation under high pressure was initiated. They considered that this modification provided the highest hydraulic pressure and made it possible to irrigate the upper joint space in 2 min with saline solution 300 ml. However, complications may develop in the surrounding tissues as a result of the high pressure if the irrigation pump is connected to the first needle without manual confirmation with the second needle. In addition, if the outlet needle suddenly blocks during the procedure, the surgeon must discontinue the irrigation immediately.¹³

The anti-inflammatory effects of intra-articular corticosteroids on synovial tissues have been well documented.^{7,26} They are useful for alleviating pain, swelling, and dysfunction in patients with inflammatory diseases of the joints such as rheumatoid arthritis and gout, as well as in those with primarily non-inflammatory joint diseases such as osteoarthritis.^{7,30} Local side effects of the intra-articular injection of glucocorticosteroids such as destruction of articular cartilage, infection, and progression of already recognised joint dis-

ease, have been reported.³⁰ However, the cause of these deleterious effects has not been fully explained and adequate controls are lacking. There are many glucocorticoid preparations such as cortisone, hydrocortisone, betamethasone, methylprednisolone acetate, triamcinolone acetonide, and triamcinolone hexacetonide. Methylprednisolone and triamcinolone (40 mg/1 ml) preparations are long-acting and may be preferable.⁷

Brennan and Ilankovan³¹ suggested intra-articular injection of morphine (10 mg in 1 ml) as a long-acting analgesic in patients with continuing pain in the TMJ, and Kunjur et al.³² evaluated the analgesic effects of bupivacaine, fentanyl, morphine, and saline after arthrocentesis. They found that both bupivacaine (1 ml of 0.5% solution) and fentanyl (25 mg in 1 ml) relieved pain for only 8–12 h, saline had no analgesic effect, and morphine (10 mg) was most effective and relieved pain for several days or weeks. Although fentanyl is a more potent analgesic agent than morphine, they thought that it was more rapidly eliminated from the joint capsule because of its high lipid solubility.

Furst et al.³³ reported that bupivacaine alone was a better analgesic than morphine alone or the combination of morphine and bupivacaine. Morphine alone has taken longer to work, with less effect on the pain scores during the 24-h observation period. Bryant et al.³⁴ compared the analgesic effect of intra-articular morphine with that of normal saline and a combination of morphine and its antagonist naloxone after arthroscopy of the TMJ. The pain scores, time to the first request for analgesia, and the analgesic consumption of the patients in the three groups did not differ significantly at any time during the study.³⁴ List et al.³⁵ investigated the analgesic efficacy of a single intra-articular injection of morphine in patients with TMJ arthralgia or osteoarthritis. They found no relation between dose and effect, no significant short-term analgesic effect, and no reduction in the pain score after a week.³⁵ Zuniga et al.³⁶ reported that morphine alone provided only mild, short-acting analgesia.

The local anaesthetic mepivacaine, given alone, was safe and provided the quickest, longest acting, and most effective analgesia.³⁶ Conclusive evidence on the analgesic property of locally applied opioids remains unclear.³⁵ Alpaslan and Alpaslan²⁰ found that arthrocentesis with injection of sodium hyaluronate seemed to be superior to arthrocentesis alone, particularly in patients with closed lock TMJ. This was attributed to the faster and longer effect of the sodium hyaluronate on pain relief.²⁰ In other joints, supplementation with hyaluronan has not shown any obvious benefit over conventional treatment, and its high cost may limit its usefulness.³⁷ Drugs used for intra-articular injection and their therapeutic effects are summarised in Table 2.

The injection of fluid under pressure is a useful way of dealing with the adhesions that are responsible for the reduced translatory movement of the condyle; they are thought to be the main cause of anchorage of the disc to the fossa, or eminence, or both, and their release allows an immediate

improvement in mouth opening.^{6,11} Yura et al.³⁸ reported that low pressure arthrocentesis (6.7 kPa) was unsuccessful in patients with severe adhesions, whereas arthrocentesis under sufficient pressure (40 kPa) released them. They concluded that because irrigation under sufficient pressure can remove adhesions and widen the joint space, the technique might be useful for patients with closed lock and adhesions.

Yura and Totsuka³⁹ found that pathological conditions of the TMJ had no influence on the efficacy of arthrocentesis under adequate pressure, and concluded that it had a wider application than arthrocentesis under low pressure. The superiority of one technique over the other cannot be substantiated, particularly as the two studies were not randomised. In addition, success with arthrocentesis under low pressure has been reported in patients with TMJ closed lock, particularly those with anchored discs where synovitis and adhesions in the joint are the most common pathological signs.^{26,40} However, Dolwick⁶ reported that lysis of adhesions is achieved by intermittent distension of the joint space by momentary blocking of the outflow needle and injection under pressure during lavage using the traditional technique described by Nitzan et al.⁹ It should be kept in mind that the glenoid fossa may be wafer thin¹⁷; pressure should therefore be under control and the surgeon careful enough to avoid any complication.

Guarda-Nardini et al.¹¹ suggested that a single-needle technique should be used for both injection and aspiration of fluid in the posterior recess of the upper joint space (point A in Fig. 1). They reported that this approach has some advantages such as limiting the trauma of the intervention, reducing postoperative discomfort, reducing the risks of postoperative paraesthesia of the facial nerve, reducing the amount of anaesthetic required, providing the low-pressure fluid injection, and reducing the risk of hyaluronic acid flowing out through the second point of injection. They also mentioned that this technique might be more useful in the case of hypomobile joints with strong adhesions or joints with degenerative changes that made the insertion of the second needle difficult.¹¹ The most important disadvantage of this technique is that single-needle lysis and lavage may take more time than the two-needle technique if Ringer's lactate solution 100–300 ml is injected and aspirated.

Rehman and Hall¹² suggested the use of a single Shepard cannula with two ports and two lumens. In this technique both irrigation and washout were made through the same device in the posterior recess of the upper joint space (point A in Fig. 1). They reported that no complications occurred in over 100 procedures.¹² The possible disadvantage of this technique is that low-pressure injection of fluid may not be successful.

Alkan and Baş¹⁰ reported the use of a double-needle cannula, which is similar to the technique of Rehman and Hall.¹² They used a single cannula with two adjacent tubes for irrigation and aspiration, which was placed in the posterior recess of the upper joint space (point A in Fig. 1).¹⁰ The possible

Table 2

Drugs used for intra-articular injection and their therapeutic effects.

Drugs used for intra-articular injection	Therapeutic effect
Corticosteroids ^{7,26} Methylprednisolone (40 mg/1 ml), Triamcinolone (40 mg/1 ml)	Useful for alleviating pain, swelling, any intracapsular inflammation and dysfunction in patients with inflammatory diseases of joints, such as rheumatoid arthritis and gout, as well as in those with primarily non-inflammatory joint diseases, such as osteoarthritis.
Morphine (10 mg in 1 ml) ^{30–35}	Long-acting analgesic (conclusive evidence on the analgesic property of locally applied opioids remains unclear).
Bupivacaine (1 ml of 0.5% solution) ³¹	Pain-relieving effects for only 8–12 h.
Fentanyl (25 mg in 1 ml) ³¹	Pain-relieving effects for only 8–12 h.
Mepivacaine (30 mg) ³⁵	Safe, provided the quickest, longest acting and effective analgesia.
Sodium hyaluronate (1 ml) ²⁰	Gave faster and longer effect pain relief.

disadvantage of this technique is that sufficient pressure may not be achieved during injection of fluid.

Rahal et al.,¹⁴ suggested single-puncture arthrocentesis using a dual-needle device that was similar to those used by Alkan and Baş¹⁰ and Rehman and Hall.¹² They reported that single-puncture arthrocentesis was used in more than 200 cases and they noticed no decrease in the efficiency of the arthrocentesis.¹²

The main advantage of techniques using a single puncture to the fossa portal is that arthrocentesis can be achieved without inserting another outflow needle. It has been suggested that these techniques may be useful for the treatment of patients with hypomobile joints with strong adhesions or joints with degenerative changes that make the insertion of the second needle to the anterior recess difficult.¹¹ However, we know of no evaluation that compares the true benefits of this procedure with the two-needle technique of arthrocentesis.

Infection in the tissues over the site to be punctured (such as an abscess or cellulitis) is generally considered an absolute contraindication to lysis and lavage.⁴¹ Bacteremia, adjacent osteomyelitis, uncontrolled coagulopathy, and malignant tumour are relative contraindications. One prospective trial of 32 patients who were taking warfarin reported no complications after arthrocentesis.⁴¹ If necessary, arthrocentesis can be done in patients with coagulopathy.⁴¹ The value of reversing a coagulopathy with blood components before the procedure is not proved, and clinical judgment should prevail.

Because arthroscopy and arthrocentesis are less invasive and associated with minimal complications, they have recently replaced open operations for patients with dysfunction of the TMJ that failed to respond to conservative treatment.⁵ Yet arthroscopic lysis and lavage have more possible complications than arthrocentesis, which is clinic-based, cost-effective, and minimally invasive. Arthrocentesis has therefore been widely used to treat the internal problems of the TMJ.

Complications after puncture of the TMJ depend on the anatomy of the joint and its relations.⁴² Possible complications of lysis and lavage also depend on the technique used. The complication rate following arthroscopy of the TMJ is given as between 1.8 and 10.3%.^{43–45}

Some of the possible complications are facial nerve injury (0.7–0.6%),^{44–46} fifth nerve deficit (0.1–2.4%),⁴⁴ otic injury (0.5–8.6%),^{44,45} preauricular haematoma, superficial temporal artery aneurysm, arteriovenous fistula, transarticular perforation, intracranial perforation, extradural haematoma, parapharyngeal swelling, and intra-articular problems.^{43–52} Failure to appreciate the anatomical proximity of the cartilaginous meatus and the middle ear cavity has resulted in serious complications. Some of the otological complications are blood clots in the external auditory canal, laceration of the external auditory canal, partial hearing loss, fullness of the ear, vertigo, and perforation of the tympanic membrane with laceration of the external auditory canal.^{43–50} Broken instrumentation was also reported at 0.1%.⁴⁴ The facial nerve is in danger, and it is customary to use the House–Brackmann grading (or its equivalent) when recording this neuropathy.⁵³ Multiple puncture sites and repeated attempts to access a joint increase the risk of damage to the facial nerve. Medial (watch the depth of the arthroscope) and lateral extravasation of irrigant should be reversible.^{45,51,52}

The glenoid fossa is thin, with a range of 0.5 to 1.5 mm.^{17,53} Joints may also be eroded by degenerative arthritis or previous infections. The dura and temporal lobe are located beneath the glenoid fossa. It is possible to perforate this structure at either arthroscopy or arthrocentesis. The surgeon should therefore not go that far. About 25 mm is enough to reach to upper joint space.

The complication rate for TMJ arthrocentesis has not yet been defined, but is considered to be less than that for TMJ arthroscopy.⁴² Temporary facial paresis or paralysis caused by the use of a local anaesthetic, or swelling of the neighbouring tissues caused by perfusion of Ringer's solution may result from arthrocentesis.⁵ However, these effects are transient and disappear within a few hours.⁵ Carol et al.⁴² reported an extradural haematoma and Nitzan⁵ reported preauricular infected swelling after arthrocentesis of the TMJ.

A persistent foramen tympanicum, or foramen of Huschke, is an anatomical variation of the tympanic portion of the temporal bone resulting from a defect in normal ossification during the first 5 years of life. It is present in 6 of 130 ears (4.6%).⁵⁴ Awareness of this may be useful in evaluating

patients. McCain^{45(discussion)} reported that haemotympanum can be seen after postoperative examination of the tympanic membrane in some patients after arthroscopy. While there may be no evidence of laceration of the canal or perforation of the tympanic membrane in these cases, there may be a naturally-occurring conduit in this area that causes a leak of blood, or irrigation fluid, or both, into the middle ear. Follow up examination in such cases showed resolution of the problem with no deficit in hearing.^{45(discussion),54}

In summary, the most important aims of lysis and lavage of the TMJ are to eliminate inflamed synovial fluid, to release the disc, to reduce the pain, and to enable mobilisation of the joint by flushing the upper joint space. To fulfill these aims effectively, more easily, and with fewer complications, different techniques are required. Apart from the technique described by Nitzan et al.,⁹ the modified two-needle technique, single-needle technique, and single-puncture technique with the dual-needle device, may be useful for lysis and lavage of the TMJ to treat joints with fibrosis or advanced arthrosis when the outflow cannot be accomplished well, lavage fails, and the patient is uncomfortable. However, the single-needle technique may take more time. A solution of at least 100 ml should be injected under pressure during the lavage. With knowledge, experience, and skill, and with anatomical variations kept in mind, these techniques will help the surgeon to enter the joint easily and to achieve the procedure successfully and without complications.

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