

## Fistula Symptom

Toru SEKITANI and Shoichi HONJO

*Department of Otolaryngology, Yamaguchi  
University School of Medicine*

(Received February 24, 1975)

Lucae (1881)<sup>1)</sup> was the first to describe the fistula symptom as an important sign of circumscribed labyrinthitis, which was followed by the famous animal work of Ewald (1892)<sup>2)</sup> who opened fistula on the semicircular canals near the ampullae in pigeons, using his pneumatic hammer. Ewald compressed and then aspirated the fistula, producing an ampullopetal and ampullofugal flow of endolymphatic fluid. In this work he proved that the direction of the nystagmus elicited depends upon the direction of the endolymphatic stream.

About thirty years later Nylen (1923)<sup>3)</sup> and Lorente de No (1927)<sup>4)</sup> observed eye-movements synchronous with the respiration in animals with labyrinthine fistula. Lorente de No ascribed these eye-movements to perilymph movements and supposed that fistula symptom produce some displacement of the membranous labyrinth and of the endolymph. Nylen proved that the fistula symptom could be produced after elimination of the otolith membranes by centrifugation of the animals and the fistula symptom was a reaction elicited in the semicircular canals.

Since then clinical and experimental studies of fistula symptom are abundantly documented in the literature.

As to the localization of fistula in the labyrinth, clinically we find out most often in the lateral semicircular canal, occasionally in the oval or round window and rarely in the anterior or posterior canal. Ritter (1970)<sup>5)</sup> studied 50 cases with definite labyrinthine fistula identified by surgery and numbered 48 in the lateral semicircular canal (4 combined with anterior canal fistula), 1 in the oval window and 1 in the promontory.

It is generally agreed by otologists that in order to present fistula symptom some pathological changes should be existed in the bony labyrinth because this symptom does not occur in normal subjects. The most common condition involving fistula symptom is, as above mentioned, a fistula of the wall of the bony labyrinth. The fistula of the bony labyrinth in circumscribed labyrinthitis creates conditions similar to those Ewald produced in animals. According to the law of Ewald the direction of the

nystagmus depends on the direction of the endolymphatic flow. For the horizontal semicircular canals, the ampullopetal flow is the effective stimulus, thus eliciting a nystagmus towards the same direction, while an ampullofugal flow produces a nystagmus towards the opposite direction. In other words, compression causes a nystagmus towards the compression side, while aspiration leads to a nystagmus towards the opposite side. For the vertical semicircular canals the ampullofugal flow is much more effective than ampullopetal one, so that the ampullofugal flow produces a nystagmus towards the same side.

From the clinical point of view, it is true that many cases with fistula on the bony labyrinth do not follow the theoretical law of Ewald. If the nystagmus follows the Ewald's law, the reaction is called typical positive reaction; on the other hand if the nystagmus is of opposite nature, it is called paradoxical positive reaction. In clinical experiences we are able to find out numerous combinations between these two reactions. For example, the compression may be produce typical reaction while the aspiration elicits inverted reaction, or vice versa. Reports in the literature concerning the rate of typical and paradoxical reactions differ to a great extent. According to Nylen the direction of the induced nystagmus depends on the underlying pathology of the fistula. If there exists a normal perilymphatic fluid between the defect in the bony wall and the membranous labyrinth, the fistula reaction will be typical, while if there is a direct contact between the bony defect in the bony wall and the membranous labyrinth, a paradoxical fistula reaction occurs.

We come now to review our present study of fistula symptom, made possible through the courtesy of our colleagues in the Dept. of Otolaryngology, Yamaguchi University Hospital for last few years.

All 26 cases dealt with in our present study were divided into three main groups in accordance with appearance of fistula symptom and existence of fistula in the labyrinth.

- Group 1. Eleven cases with fistula symptoms existing fistula in the labyrinth.
- Group 2. Five cases without fistula symptom existing fistula.
- Group 3. Ten cases with fistula symptom without fistula.

Our subjects consisted of 17 males and 9 females. Their ages ranged from 63 to 19 (average 43) years. All subjects were carried out otoscopic examination, hearing tests and vestibular function tests such as equilibrium, spontaneous or positional nystagmus, caloric, rotatory and fistula tests.

In order to perform on fistula tests, the external auditory meatus of the subjects was tightly closed with the tip Politzer bag. The bag was provided with a fistula opening. Every connection was checked for tightness so that air cannot escape. Compression and aspiration were instituted and eye movements (nystagmus) of the subjects were observed using Frenzel's leuchtbrille and recorded by electronystagmography. For the purpose confirming whether eye movements (nystagmus) were present or not, and if present, direction of the nystagmus, the tests procedures were repeated at least a few times.

#### DIRECTION OF NYSTAGMUS INDUCED BY FISTULA TEST

Table 1 shows direction of nystagmus induced by fistula tests in eleven cases which presented a positive fistula symptom and existed the fistula on the bony labyrinth identified by surgery (Group 1). In this group we found out a typical positive reaction in two cases, a paradoxical positive reaction in only one case and in seven of these 11 cases direction of the nystagmus was irregular (See in Table 1). In the majority of cases (10 cases) the fistula localized in the lateral semicircular canal, except only one case in the oval window.

Table 2 shows direction of nystagmus induced by fistula tests in ten cases presenting a positive fistula reaction without any fistula on the bony labyrinth. In this group we found out no typical and paradoxical positive reaction, but in all 10 cases irregular type of positive reactions as to direction of nystagmus.

It is of importance to keep in mind that the group of cases presenting positive fistula reaction without fistula on the bony labyrinth contained on typical or paradoxical reaction, although the group of cases with fistula on the bony labyrinth included both reactions.

**Table 1.** Direction of Nystagmus in Fistula Symptom  
Group 1.

Type	Compression	Aspiration	Number
I	Same side	Opposite side	2
II	Same -	Negative	2
III	Opposite -	Same -	1
IV	Opposite -	Opposite -	3
V	Opposite -	Negative	3
Total			11

**Table 2.** Direction of Nystagmus in Fistula Symptom Group 3.

Type	Compression	Aspiration	Number
IV	Opposite side	Opposite side	4
V	Opposite -	Negative	6
Total			10

### SYMPTOMS AND VESTIBULAR RESPONSES

Onsets of vertigo were complained of in all 11 cases of Group 1, in four of 5 cases of Group 2 and in four of 10 cases of Group 3. Clinically it seems to be important that in Group 3 no onset of vertigo occurred in 60 per cent of cases, notwithstanding presenting fistula symptoms. On the other hand, the great majority of cases in Groups 1 and 2 suffered from onsets of vertigo. In the great majority of patients in this study vertigo or feeling of off-balance came on when walking or standing. This trouble was aggravated by all kinds of head movements or by compression and aspiration on the external ear canal with finger. In the severe cases onsets of vertigo occurred when turning over in bed and accompanied, but not always, by nausea or vomiting. In the majority of cases onset of vertigo was brief and temporary in duration, lasting a few seconds to several minutes. However, in a few cases (3 of Group 1) it was longer, lasting several days.

Tinnitus occurred in five cases on the affected side without any relation to the fistula on the bony labyrinth, because this trouble was present long years before the onset of vertigo.

Hearing losses were profound in five ears showing deafness, severe in twelve ears presenting a 60 to 70 dB combined sensorineural and conductive in nature, and moderate in nine ears showing a 20 to 25 dB loss characterized by a flat audiometric pattern.

Table 3 shows vestibular responses in cases of each three Groups. In 11 cases of Group 1 we found out equilibrium disturbances in 8, spontaneous or positional nystagmus in 3 and disturbed caloric responses in 7 (cp 5, dp 2). In 5 cases of Group 2 we found out equilibrium disturbances in 4, spontaneous or positional nystagmus in 2, and disturbed caloric responses in 2 (cp 2). In 10 cases of Group 3 we found out equilibrium disturbances in 3, spontaneous or positional nystagmus in 1 and disturbed caloric responses in 2 (cp 2).

From the above mentioned data we are able to consider that in the majority of cases in Group 1 and 2, which identified the fistula on the bony labyrinth, vestibular responses were disturbed, on the other hand in cases of Group 3 without the fistula, the majority cases showed normal vestibular responses. In 15 cases with disturbed equilibrium we found out that subject's body fell or swayed towards the opposite side in 10 and towards the affected side in 5. In 6 cases with spontaneous or positional nystagmus, spontaneous nystagmus were horizontal in all cases and their directions were towards the opposite side in 4 and the affected side in 2, and four cases presented direction-fixed positional nystagmus.

**Table 3.** Vestibular Responses

Groups	Equilibrium		Spontaneous & positional nystagmus		Caloric response
1 (11 cases)	Disturbed	8	Present	3	Disturbed 7 (cp 5, dp 2)
	Normal	3	Absent	8	Normal 4
2 (5 cases)	Disturbed	4	Present	2	Disturbed 2 (cp 2)
	Normal	1	Absent	3	Normal 3
3 (10 cases)	Disturbed	3	Present	1	Disturbed 2 (cp 2)
	Normal	7	Absent	9	Normal 8

## TREATMENT

All 26 cases in our present study were performed on middle ear surgery such as tympanoplasty III and IV. A ablation of the membranous labyrinth was done in five cases in which cochlear and vestibular responses showed so called dead labyrinth before operation. At surgery, granulation tissues and cholesteatomous mass surrounding the fistula were removed and a piece of vein graft taken from V. saphena magna was covered on the fistula.

In the great majority of cases clinical courses were uneventful, particularly vertigo or off-balance sensation was complained for a few days after surgery and then subsided. In three cases spontaneous nystagmus still continued for one to two months after surgery with vertigo.

## DISCUSSION

We come, finally, to discuss mechanism of the fistula symptom occurring cases with fistula on the bony labyrinth. In discussing the physiological condition of fistula reaction, it is agreed, beyond any doubt, by otologists that the direction of the nystagmus in the fistula symptoms follows the Ewald's law. From clinical point of view, however, it is true that the direction of nystagmus in the fistula symptoms does not always accord with this law. This fact is a matter of course, because there are many differences between the physiological experiment and the various pathological reactions observed in patients in our clinical experiences. As shown in this study, in the case with a fistula on the bony wall of the lateral semicircular canal, if the fistula is closed by granulation tissues or cholesteatomatous masses, the fistula symptom does not occur, notwithstanding presence of the fistula. According to Fischer (1956)<sup>6)</sup> there is a case in which granulation tissue (a pendunculated polypus) forms a solid bridge between the labyrinth and the external auditory meatus. In this case when the patient touches his tragus slightly, as in washing his face, he may produce the fistula reaction, accompanying with vertigo and falling. In cases with fistula symptoms the underlying pathology in the bony labyrinth or peri and endolymph varies so greatly that no regularity of the direction of the nystagmus induced by fistula tests is found. As above mentioned before, there are various explanations why the induced nystagmus is sometimes directed to one side, sometimes to the other. However, this is our opinion as to observation of the fistula symptoms that the examiners have only to consider the reaction is present or not; For example, if eye movement occurs by fistula tests the reaction is called positive; on the other hand if eyes remain quiet, negative, and no other conclusions should be drawn.

From theoretical point of view, the term fistula symptom can be used when the symptom (reaction) is a result of the mechanical stimuli of compression or aspiration, which produce respectively to increase or decrease of endolymphatic pressure. From this standpoint the fistula symptom is divided into three types: 1. true fistula symptom; 2. vasomotor fistula symptom; and 3. pseudo fistula symptom. Regarding the true fistula symptom we have already reviewed in this paper in detail.

The vascular fistula symptom was first described by Barany (1906)<sup>7)</sup> and thoroughly studied by Mygind (1918). Mygind observed undulating eye movements synchronizing with the rhythm of the pulse. Also he reported the influence of the blood circulation upon the nystagmus. For instance,

by pressure on the carotid artery on the affected ear side, he produced the slow phase of the nystagmus to the affected side, while on cessation of the pressure the eye movements were reversed.

With regard to pseudo fistula symptom presenting a positive reaction without a fistula on the bony labyrinth, there are various theories to explain the phenomenon. Alexander and Lassalle (1908)<sup>8)</sup> stated that the cause of pseudo fistula reaction is a decreasing threshold for mechanical stimuli. In our experiences it is well known that in cases of inner ear lues with normal ear drum the pseudo fistula symptom is present. This symptom seems to be caused by luetic inflammation of the eight nerve, which leads to increased conductivity for mechanical stimuli.

### SUMMARY

The studies of fistula symptom were carried out in 26 cases, containing three groups: 11 cases with symptom existing fistula; 5 cases without symptom existing fistula; and 10 cases with symptom without fistula (pseudo fistula symptom). The direction of nystagmus induced by tests, symptoms and vestibular responses in each group were reviewed, and mechanism of fistula symptom was discussed.

### REFERENCES

- 1) Lucae, A: Ueber optischen schwindel bei druckerhoehung im ohr. *Arch. Ohren-, Nasen-u. Kehlkoph.*, 17 : 237, 1881.
- 2) Ewald, J. R.: *Physiologische untersuchungen*. Wiesbaden: Laupp, 1892.
- 3) Nylen, C. O.: A clinical study of the labyrinthine fistula symptoms. *Acta oto-laryng. Supl. III.* 1923.
- 4) Lorent de No, R.: Untersuchungen ueber die anatomie und die physiologie des ohrlabyrinthes und des nervus octavus. *Monatschrift Ohrenh.*, 61 : 1300, 1927.
- 5) Ritter, F. N.: Chronic suppurative otitis media and the pathologic labyrinthine fistula. *Laryngoscope*, 80 : 1025, 1970.
- 6) Fischer, J. J.: *The labyrinth*. Grune & Stratton, 1956.
- 7) Barany, R.: Untersuchungen ueber die vom vestibula-apparat des ohres reflektorisch ausgelost. *Mnatschr. Ohrenh.*, 40 : 229, 1906.
- 8) Alexander, G and Lassalle, J. J.: Zur klinik des labyrinthhaeren nystagmus. *Wien klin. Rundschau*, 22 : 1, 1908.