

The role of “after washing imaging” in evaluation of tear drainage system by dacryoscintigraphy

Toktam Massoudi, Hamed Shayegani, Ramin Sadeghi
 Nuclear Medicine Research Center, Mashhad University of Medical Sciences, Mashhad, Iran

[Received 6 II 2018; Accepted 4 IV 2018]

Abstract

BACKGROUND: The aim of this study was to evaluate the efficacy of “after washing” imaging in interpretation of dacryoscintigraphy as a functional imaging technique used in evaluation of tearing problems.

MATERIALS AND METHODS: 300 nasolacrimal systems were studied. 100 μCi of technetium-99m sodium pertechnetate as drops of activity (10 μL) were placed into the inferior fornix of each eye. Dynamic images were obtained for 15 minutes in the sitting position. “After washing” phase was done by placing a drop (10 μL) of normal saline in each eye and external ocular massage for an additional 10 minutes. The imaging patterns for each eye in the first dynamic phase and after washing phase were recorded, separately.

RESULTS: First dynamic phase demonstrated a sensitivity of 97.4% and specificity of 22.6%. After washing phase showed a sensitivity of 91.2% and specificity 75.5%. After washing test, the obstruction pattern changed to “patent nasolacrimal duct” or “further progression” of the radiotracer to the nasolacrimal duct in the 25.1% and 24.4% of the nasolacrimal systems, respectively.

CONCLUSIONS: After washing imaging is a useful method in dacryoscintigraphy which can improve the specificity of scan for diagnosis of lacrimal duct obstruction. It can also improve the localization of obstruction level in the lacrimal systems.

KEY words: after washing imaging, tear drainage system, dacryoscintigraphy

Nucl Med Rev 2018; 21, 2: 75–78

Introduction

Tearing is one of the common ophthalmologic problems [1]. Numerous etiologies are known for this symptom and the most common is obstruction at different sites of lacrimal drainage system [2]. Several imaging modalities were introduced to help ophthalmologists evaluating the lacrimal system including facial X-ray, computed tomography (CT), magnetic resonance imaging (MRI), lacrimal ultrasonography (U/S), dacryocystography (DCG) and dacryoscintigraphy (DSG) [3, 4]. Radionuclide dacryoscintigraphy is a functional imaging technique used in evaluation of tearing problems. The normal pattern of lacrimal drainage is filling of the nasolacrimal sac and progression to the nasolacrimal duct and finally to the nasal cavity.

Over the past years, many researchers showed improvement of the sensitivity and specificity of dacryoscintigraphy using various methods [5–7]. The aim of this study was to evaluate the efficacy of “after washing” imaging as an additional phase of imaging in diagnosis of lacrimal apparatus obstructions.

Materials and methods

Three hundred nasolacrimal systems of 150 patients who referred to our nuclear medicine center for dacryoscintigraphy were studied. Demographic information and history of epiphora and its quality for all patients were documented. 100 μCi (3.7 MBq) of technetium-99m sodium pertechnetate as drops of activity (10 μL) were placed into the inferior fornix of each eye with a micropipette. Dynamic images were obtained in anterior views for 15 minutes in the sitting position (64 × 64 matrix, 30 seconds per frame) using a dual-head variable angle Siemens e.cam (Hoffman Estates, IL, U.S.A.) gamma camera equipped with a low-energy high-resolution parallel-hole collimator. Washing test was done using a drop (10 μL) of normal saline in each eye and external ocular massage and imaging was continued for an additional 10 minutes as a second dynamic phase. The imaging patterns for each eye (including normal nasolacrimal systems, sac-duct junction obstruction, obstruction at the proximal and distal portions of the nasolacrimal duct) in the first dynamic phase and after washing phase were interpreted by two experienced nuclear medicine physicians, separately. Sensitivity and specificity of both phases of the study were calculated using 2 × 2 tables of diagnostic accuracy studies.

Correspondence to: Ramin Sadeghi, MD, Nuclear Medicine Research Center, Mashhad University of Medical Sciences, Mashhad, Iran, e-mail: sadeghir@mums.ac.ir; raminsadeghi1355@yahoo.com

Results

Among 150 patients entered the study, 106 patients were female (71.6%) with mean age of 56.60 ± 13.86 years and 44 patients were male (28.4%) with mean age of 62.61 ± 14.22 years and 58.4 ± 14.9 years in all patients. One hundred and ninety-four eyes were symptomatic (Table 1). First dynamic phase demonstrated a sensitivity of 97.4% and specificity of 22.6% (97.4% of the obstructed lacrimal

Table 1. Patient's demographic information

Sex	
Male	44
Female	106
Mean age \pm SD	
Total	58.4 ± 14.9
Male	62.61 ± 14.22
Female	56.60 ± 13.86
Tearing duration	
< 6 months	52
6–12 months	66
> 12 months	76
Symptomatic patients	
Left eye	27
Right eye	17
Bilateral	75
Using topical eye drop (Betamethasone)	
	10
Previous surgery	
Left eye	
Related to lacrimal system	10
Not related to lacrimal system	37
Right eye	
Related to lacrimal system	13
Not related to lacrimal system	35
Previous trauma	
Left eye	12
Right eye	12
Concomitant disease	
Cataract	37
Glaucoma	1
Conjunctivitis	1

systems were detected. On the other hand, only 22.6% of the patent lacrimal systems were normal on dacryoscintigraphy). The after washing phase showed a sensitivity of 91.2% and specificity of 75.5%. 271 lacrimal systems were obstructed in the first dynamic phase, as well as 203 systems in the second dynamic after washing phase. Of total obstructed systems, obstructions at the level sac-duct junction were 68.3% in the first dynamic phase, as well as 46.3% in the after washing phase. Obstructive patterns of scintigraphy were reported in 17.3% and 28.6% at the proximal portion of nasolacrimal duct and 14.4 % and %25.1 at the distal portion of nasolacrimal duct in the first dynamic phase and after washing phase (Table 2). Of 185 lacrimal systems with obstruction at the site of sac-duct junction in 18.4% of cases normal pattern of dacryoscintigraphy were seen. Also, further progression to the proximal and distal sites of lacrimal duct were detected after performing after washing phase in 20.5% and 10.3% of lacrimal systems, respectively. After the washing test, complete improvement of lacrimal drainage was seen in 38.3%, as well as partial improvement in 19.1% of the obstructive systems at the proximal part of nasolacrimal duct. Patent nasolacrimal systems were reported in 41.0% of cases with obstructions at the level of distal portion of nasolacrimal duct after washing phase (Table 3). After the washing test, the obstruction pattern changed to “patent nasolacrimal duct” or “further progression” of the radiotracer to the nasolacrimal duct in the 25.1% and 24.4%, respectively (Figure 1 and Figure 2).

Discussion

Epiphora is a common complaint in the ophthalmologic clinics. Numerous etiologies were known and categorized as follows: nasolacrimal duct obstruction, glaucoma, uveitis, conjunctivitis, corneal abnormalities, lid abnormalities. Since patient's treatment, depends on etiology of tearing, attention to patient's history and physical examination are important and can demonstrate that the etiology is related to lacrimal system, anterior segment of eye or lid abnormalities [8]. Although in the most cases, initial steps of evaluation are adequate for therapeutically decision making, few patients need further assessment.

Over the past years, ophthalmologists have used numerous imaging modalities to evaluate lacrimal system as the most

Table 2. Different patterns of dacryoscintigraphy in the first dynamic phase and after washing phase in all nasolacrimal systems

Pattern of scan	First dynamic phase				After washing phase			
	Patent	Sac-duct junction obstruction	Proximal obstruction	Distal obstruction	Patent	Sac-duct junction obstruction	Proximal obstruction	Distal obstruction
Number of nasolacrimal systems	29	185	47	39	97	94	58	51

Table 3. Analysis of complete and partial improvement of lacrimal drainage in the obstructed lacrimal systems at different levels of obstruction

Type of improvement	Complete improvement	Partial improvement
Level of obstruction	(change to patent pattern after washing test)	(further progression after washing test)
Sac-duct junction	34	7
Proximal portion of duct	18	9
Distal portion of duct	16	-

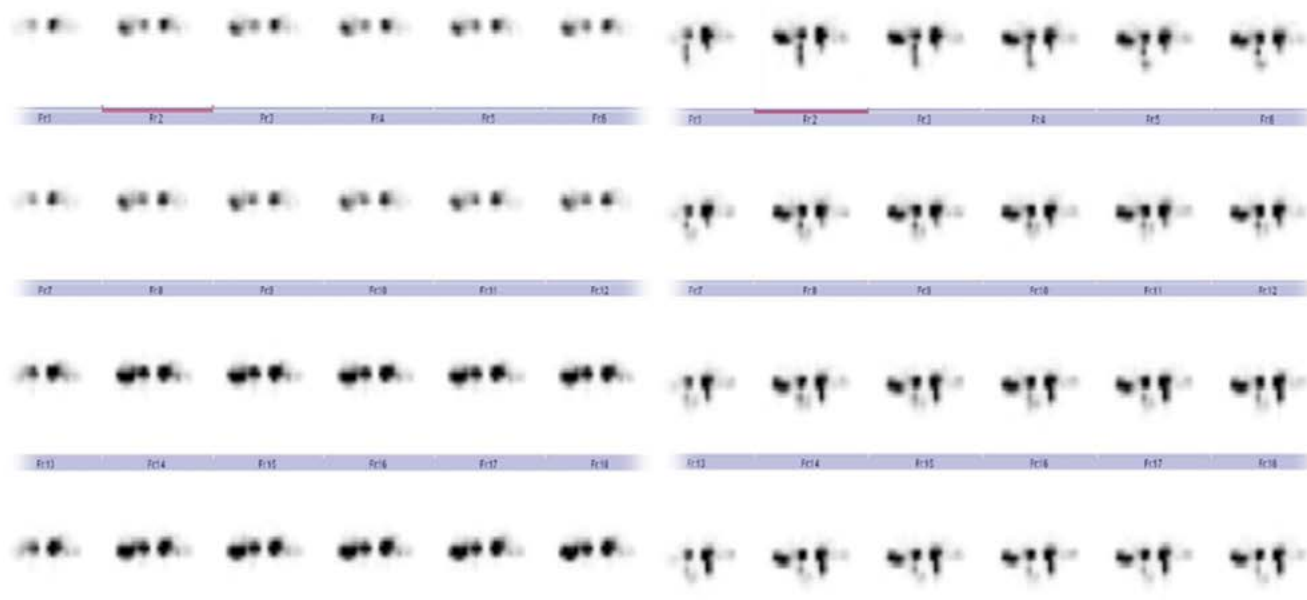


Figure 1. Complete and partial improvement of the level of obstruction after washing imaging. Sac-duct junction obstruction in a 57-year-old woman with left-sided epiphora in the first dynamic phase of nuclear dacryoscintigraphy (left image). Further progression to the distal level of nasolacrimal duct was seen in the left eye and patent pattern of dacryoscintigraphy was detected in the second dynamic after washing phase (right image)

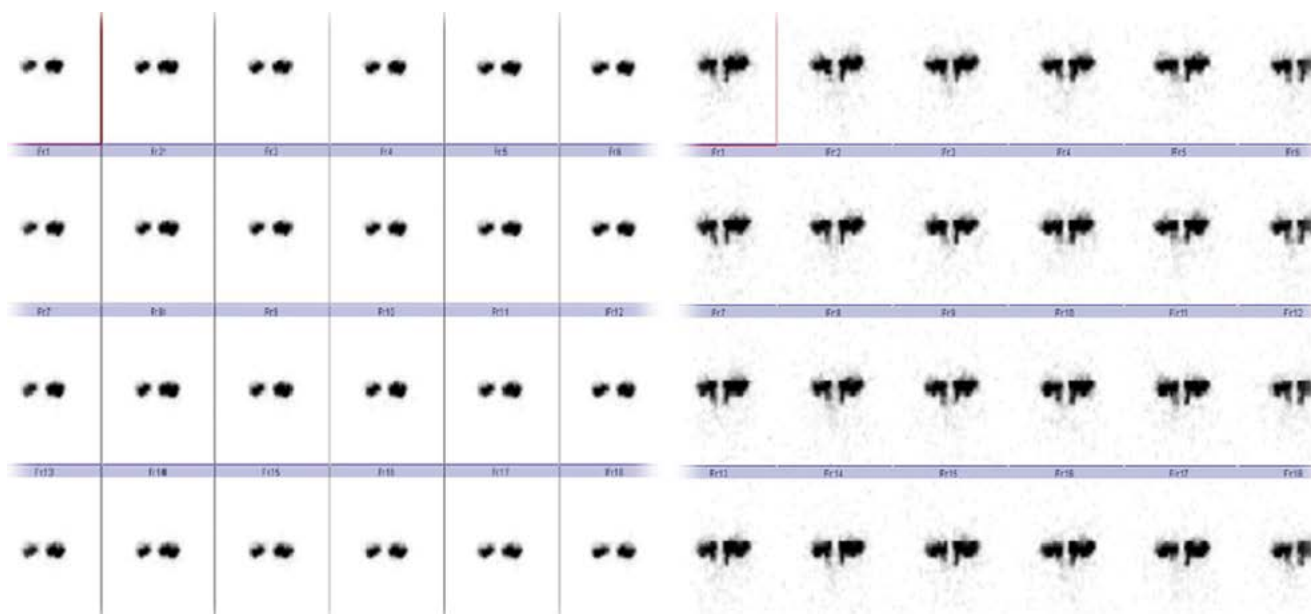


Figure 2. Further progression of tracer after washing test in both eyes. Obstruction at the level of sac-duct junction in a 60-year-old man with history of both side tearing in the first dynamic phase (left image) and obstruction in the distal portion of nasolacrimal duct in the after washing phase in both eyes (right image)

common cause of tearing [3, 4]. Syringing and dacryocystography have been used for this reason and could show abnormal lacrimal ducts, as compare to these techniques, nuclear dacryoscintigraphy is a non-invasive and functional imaging modality for evaluating tear flow drainage under physiologic conditions with higher sensitivity [9, 10].

Although dacryoscintigraphy plays an important role in diagnosis and management of patients, it is also valuable for evaluation of lacrimal system after surgical interventions as shown by Palaniswamy and Subramanyam [7]. Moreover, evaluation of stenosis in the lacrimal drainage system is a possibility that has been provided by nuclear scintigraphy [11]. This technique has some

advantages including safe and simple procedure, high sensitivity, high patient tolerance, low radiation dose to eye lens, however, the spatial resolution of this nuclear method is low and precise anatomical evaluation is not possible. This modality has been performed by instilling radiotracer in the inferior fornix of each eye and imaging of the ocular region with a gamma camera since 1972 and can detect the site of obstruction which help ophthalmologists to choose the best form of therapy [12, 13].

In the current study, we evaluated the added value of instillation of normal saline in the fornices ("after washing" dacryoscintigraphy) for diagnosis of lacrimal duct obstructions. The most common pattern of obstruction was at the site of sac-duct junction in both first dynamic and after washing phases. After the washing test, most changes in the site of obstruction were seen in the obstructed ducts at the proximal and change to the patent pattern in previously obstructed ducts were mostly seen at the distal level. Complete improvement of drainage was demonstrated more than partial improvement of drainage in all sites of obstruction.

Nuclear dacryoscintigraphy was found to have high sensitivity in various studies. The sensitivities of lacrimal scintigraphy for detecting obstruction in the symptomatic patients were reported 81.6% by Jabbour et al., 77% by Rose et al. and 95% by Wearne et al. The sensitivity of 96.3% and specificity of 90.4% were reported by Fard-Esfahani et al. [14–17]. Our study showed high sensitivity (96.3%) and specificity (75.5%) as shown by previous studies mentioned above especially having the "after wash" studies.

Tearing in the patients with normal pattern of lacrimal drainage in the dacryoscintigraphy may be due to other causes not related to nasolacrimal drainage system obstruction that can be resolved by medical therapy.

Although the sensitivity of the dacryoscintigraphy is important, ruling out normal (patent) nasolacrimal systems can be helpful in the prevention of further invasive procedures. On the other hand, detecting the exact site of obstruction may result in modification of surgery and can be of significant value [18].

For increasing the sensitivity and specificity of this imaging modality, few studies were performed. Quantitative dacryoscintigraphy has been performed in number of studies and showed high sensitivity. As shown by Jager et al. quantitative dacryoscintigraphy could increase the specificity of imaging [5]. Further progression of tracer in the lacrimal system after medical treatment with oral pseudoephedrine in one patient was reported by Kim et al. [6]. As shown by Palaniswamy et al. external ocular massage can result in further progression of tracer [7]. To the extent of our knowledge, after washing method as an additional dynamic phase has not been reported in literatures. Our study showed that dacryoscintigraphy had a high sensitivity in both first dynamic and after washing phases for diagnosis of lacrimal system obstruction. However, the specificity of the after washing phase was higher than first dynamic phase with some changes in the localization of obstructions. In conclusion, after washing imaging is a useful method in dacryoscintigraphy, which can improve the specificity of scan for diagnosis of lacrimal duct obstruction. It can also improve the localization of obstruction level in the lacrimal systems.

Acknowledgments

We would like to thank Dr. Emran Askari for his comments on our manuscript.

References

- Jones LT, Jones LT. The lacrimal secretory system and its treatment. *Am J Ophthalmol.* 1966; 62(1): 47–60, doi: [10.1016/0002-9394\(66\)91676-x](https://doi.org/10.1016/0002-9394(66)91676-x), indexed in Pubmed: [5936526](https://pubmed.ncbi.nlm.nih.gov/5936526/).
- Chung YAn, Yoo leR, Oum JS, et al. The clinical value of dacryoscintigraphy in the selection of surgical approach for patients with functional lacrimal duct obstruction. *Ann Nucl Med.* 2005; 19(6): 479–483, doi: [10.1007/bf02985575](https://doi.org/10.1007/bf02985575), indexed in Pubmed: [16248384](https://pubmed.ncbi.nlm.nih.gov/16248384/).
- Nagi KS, Meyer DR. Utilization patterns for diagnostic imaging in the evaluation of epiphora due to lacrimal obstruction: a national survey. *Ophthalmic Plast Reconstr Surg.* 2010; 26(3): 168–171, doi: [10.1097/IOP.0b013e3181b8c747](https://doi.org/10.1097/IOP.0b013e3181b8c747), indexed in Pubmed: [20489540](https://pubmed.ncbi.nlm.nih.gov/20489540/).
- Lefebvre DR, Freitag SK. Update on imaging of the lacrimal drainage system. *Semin Ophthalmol.* 2012; 27(5-6): 175–186, doi: [10.3109/08820538.2012.711413](https://doi.org/10.3109/08820538.2012.711413), indexed in Pubmed: [23163273](https://pubmed.ncbi.nlm.nih.gov/23163273/).
- Jager PL, Mansour K, Vrakink-de Zoete H, et al. Clinical value of dacryoscintigraphy using a simplified analysis. *Graefes Arch Clin Exp Ophthalmol.* 2005; 243(11): 1134–1140, doi: [10.1007/s00417-004-1038-0](https://doi.org/10.1007/s00417-004-1038-0), indexed in Pubmed: [15965670](https://pubmed.ncbi.nlm.nih.gov/15965670/).
- Kim CK, Palestro CJ, Solomon RW, et al. Serial dacryoscintigraphy before and after treatment with pseudoephedrine. *Clin Nucl Med.* 1989; 14(10): 734–735, doi: [10.1097/00003072-198910000-00004](https://doi.org/10.1097/00003072-198910000-00004), indexed in Pubmed: [2553314](https://pubmed.ncbi.nlm.nih.gov/2553314/).
- Palaniswamy SS, Subramanyam P. Dacryoscintigraphy: an effective tool in the evaluation of postoperative epiphora. *Nucl Med Commun.* 2012; 33(3): 262–267, doi: [10.1097/MNM.0b013e32834f6cf7](https://doi.org/10.1097/MNM.0b013e32834f6cf7), indexed in Pubmed: [22186907](https://pubmed.ncbi.nlm.nih.gov/22186907/).
- Approach to the child with persistent tearing. Uptodate Web site. <https://www.uptodate.com/contents/approach-to-the-child-with-persistent-tearing>. Updated Aug 17, 2016 (November 26, 2017).
- Hanna IT, MacEwen CJ, Kennedy N. Lacrimal scintigraphy in the diagnosis of epiphora. *Nucl Med Commun.* 1992; 13(6): 416–420, doi: [10.1097/00006231-199206000-00040](https://doi.org/10.1097/00006231-199206000-00040), indexed in Pubmed: [1407868](https://pubmed.ncbi.nlm.nih.gov/1407868/).
- Peter NM, Pearson AR. Comparison of dacryocystography and lacrimal scintigraphy in the investigation of epiphora in patients with patent but nonfunctioning lacrimal systems. *Ophthalmic Plast Reconstr Surg.* 2009; 25(3): 201–205, doi: [10.1097/IOP.0b013e3181a2ef32](https://doi.org/10.1097/IOP.0b013e3181a2ef32), indexed in Pubmed: [19454931](https://pubmed.ncbi.nlm.nih.gov/19454931/).
- Chavis RM, Welham RA, Maisey MN. Quantitative lacrimal scintillography. *Arch Ophthalmol.* 1978; 96(11): 2066–2068, doi: [10.1001/archophth.1978.03910060454013](https://doi.org/10.1001/archophth.1978.03910060454013), indexed in Pubmed: [718497](https://pubmed.ncbi.nlm.nih.gov/718497/).
- Nixon J, Birchall IW, Virjee J. The role of dacryocystography in the management of patients with epiphora. *Br J Radiol.* 1990; 63(749): 337–339, doi: [10.1259/0007-1285-63-749-337](https://doi.org/10.1259/0007-1285-63-749-337), indexed in Pubmed: [2379059](https://pubmed.ncbi.nlm.nih.gov/2379059/).
- Rossonondo RM, Carlton WH, Trueblood JH, et al. A new method of evaluating lacrimal drainage. *Arch Ophthalmol.* 1972; 88(5): 523–525, doi: [10.1001/archophth.1972.01000030525010](https://doi.org/10.1001/archophth.1972.01000030525010), indexed in Pubmed: [4634791](https://pubmed.ncbi.nlm.nih.gov/4634791/).
- Fard-Esfahani A, Gholamrezanezhad A, Mirpour S, et al. Assessment of the accuracy of lacrimal scintigraphy based on a prospective analysis of patients' symptomatology. *Orbit.* 2008; 27(4): 237–241, doi: [10.1080/01676830802225046](https://doi.org/10.1080/01676830802225046), indexed in Pubmed: [18716960](https://pubmed.ncbi.nlm.nih.gov/18716960/).
- Jabbour J, Van der Wall H, Katelaris L, et al. Quantitative lacrimal scintigraphy in the assessment of epiphora. *Clin Nucl Med.* 2008; 33(8): 535–541, doi: [10.1097/RLU.0b013e31817dea9c](https://doi.org/10.1097/RLU.0b013e31817dea9c), indexed in Pubmed: [18645371](https://pubmed.ncbi.nlm.nih.gov/18645371/).
- Rose JD, Clayton CB. Scintigraphy and contrast radiography for epiphora. *Br J Radiol.* 1985; 58(696): 1183–1186, doi: [10.1259/0007-1285-58-696-1183](https://doi.org/10.1259/0007-1285-58-696-1183), indexed in Pubmed: [3842629](https://pubmed.ncbi.nlm.nih.gov/3842629/).
- Wearne MJ, Pitts J, Frank J, et al. Comparison of dacryocystography and lacrimal scintigraphy in the diagnosis of functional nasolacrimal duct obstruction. *Br J Ophthalmol.* 1999; 83(9): 1032–1035, doi: [10.1136/bjo.83.9.1032](https://doi.org/10.1136/bjo.83.9.1032), indexed in Pubmed: [10460770](https://pubmed.ncbi.nlm.nih.gov/10460770/).
- Denffer Hv, Dressler J, Pabst H. Lacrimal dacryoscintigraphy. *Semin Nucl Med.* ; 1984: Elsevier.