MAK HILL Publications Research Journal of Medical Sciences

Research Article
doi: 10.36478/makrjms.2024.10.562.567

Retrospective Study to Compare External and Endoscopic Endonasal Dacryocystorhinostomy for Acquired Nasolacrimal Duct Obstruction

[1]Chhavi Gupta, [2]Parvendra Singh and [3]Manoj Kumar

[1,2]Department of ENT, Graphic Era Institute of Medical Sciences, Dehradun, Uttarakhand, India

[3]Department of Ophthalmology, Graphic Era Institute of Medical Sciences, Dehradun, Uttarakhand, India

ABSTRACT

Nasolacrimal duct obstruction (NLDO) can cause epiphora which is a very common condition with numerous etiologies. Dacryocystorhinostomy (DCR) is the treatment of choice for NLDO. It can be performed through a cutaneous incision, referred to as external DCR (EX-DCR), or via a transnasal approach referred to as endonasal DCR (EN-DCR). The current study aims to assess the functional and anatomic success of the EX-DCR and EN-DCR procedures, along with the operative time, adverse events, success rates and patient satisfaction. This retrospective observational study included 68 patients who had EX-DCR performed by an ophthalmologist and 53 patients whotorhinolaryngologist between 1st July 2019 and 31st December 2023. Data was collected on a number of factors, including age, gender, ocular history, pre- and post-operative eye exams, surgical time, adverse events, follow-up times, patient satisfaction and success. Statistical analysis is carried out with the use of SPSS. A total of 121 patients were included in the study., 53 had undergone EN-DCR surgery and 68 had undergone EX-DCR surgery. Our patient population's demographics were statistically comparable in both groups. With anatomical success of 88.23% in the EX-DCR group and 88.67% in the EN-DCR group and functional success of 76.47% in the EX-DCR group and 77.35% in the EN-DCR group, our results demonstrated a high and comparable success rate of both approaches. We found relatively higher rate of complication in EX-DCR compared to EN-DCR without any serious complications. We discovered that EN-DCR surgery is faster than EX-DCR surgery, which is in line with the literature. In the EN-DCR group, patient satisfaction was likewise noticeably higher. This study suggests that both procedures have a high success rate and are almost equally effective at relieving the symptoms of epiphora. For the treatment of NLDO, EN-DCR is a very appealing procedure due to its shorter recovery time, lack of visible scarring and success rates that are comparable to those of EX-DCR.

OPEN ACCESS

Key Words
Epiphora, nasolacrimal duct, NLDO, EX-DCR, EN-DCR, outcome in DCR

Corresponding Author
Manoj Kumar,
Department of Ophthalmology, Graphic Era Institute of Medical Sciences, Dehradun, Uttarakhand, India
manojophtha@gmail.com

Author Designation
[1]Associate Professor
[2]Assistant Professor
[3]Senior Resident

Received: 15 September 2024
Accepted: 19 October 2024
Published: 24 October 2024

Citation: Chhavi Gupta, Parvendra Singh and Manoj Kumar, 2024. Retrospective Study to Compare External and Endoscopic Endonasal Dacryocystorhinostomy for Acquired Nasolacrimal Duct Obstruction. Res. J. Med. Sci., 18: 562-567, doi: 10.36478/makrjms.2024.10.562.567

INTRODUCTION

Nasolacrimal duct obstruction (NLDO) causes excessive watering of the eyes or epiphora by blocking the flow of tears from the eye to the nose. Epiphora is a very common condition with numerous etiologies[1-3].which can be congenital (like congenital malformations) or acquired (like chronic or acute inflammation, trauma and iatrogenic causes including complications of maxillary sinus surgery, rhino plastic surgery and mid facial fracture repair). The clinical spectrum of epiphora ranges from the infrequent trickle to the persistently bothersome overflow of tears. Dacryocystorhinostomy (DCR), a procedure that allows diversion of the lacrimal drainage is the standard procedure for acquired nasolacrimal duct obstruction (NLDO). It can be carried out by a Transvaal technique known as endonasal DCR (EN-DCR) or by a cutaneous incision known as external DCR (EX-DCR). In both methods, the nasal mucosa and lacrimal sac mucosa are joined above the nasolacrimal duct's mechanical obstruction. Laser endoscopic, non-laser endoscopic, and non-laser non-endoscopic techniques are the three subsets of endonasal techniques that have been employed. An extra option is endocanalicular laser DCR. The external DCR technique was originally described by Adeo Toti[4]. Dupuy-Dutemps and Bourguet[5] then modified it in 1921 by adding suturing of the nasal and lacrimal mucosal flaps to create an epithelium-lined fistula. The intubation with silicone tubes has also been widely used in DCR surgery, since its introduction by Gibbs[6] in 1967. Caldwell[7] first proposed the endonasal approach in 1893and later modified by West[8] and Halle[9].The EN-DCR procedure, in its current form, was introduced by McDonogh[10]. During its early days, EN-DCR failed to gain popularity because the technology wasn't advanced enough to allow for good access to the nasal cavity. However, due to its open approach and improved visualization of anatomic features, EX-DCR was more widely used. Interest in EN-DCR grew after the nasal endoscope[11] was introduced. The reported success rates of both procedures range from 63-97%[12-18]. However, it is difficult to compare the primary surgical success rates of EX-DCR and EN-DCR procedures, though, various studies[15-18] have evaluated the surgical outcome of both the procedures and produced inconsistent findings. The absence of consistent success outcome metrics in the medical literature could be the cause of this, as some authors have defined success as anatomic patency to irrigation while others have concentrated on symptom resolution. Taking into account subjective symptoms may result in a decreased chance of success[18]. In 2001, the Ophthalmic Technology Assessment Committee concluded that it was difficult to make a definite evidence-based determination about the relative efficacies of endonasal and external DCR because of deficiencies in the reported literature[19]. The purpose of the current study is to evaluate the functional and anatomic success as well as operative time, adverse events, success rates and patient satisfaction for EX-DCR and EN-DCR procedures and attempt to fill the gap in the literature.

MATERIAL AND METHODS

This study compares and contrasts EX-DCR and EN-DCR procedures, using a retrospective, non randomized observational design to examine the results. A review of all patients' medical records from 1st July 2019 to 31st December 2023, who had DCR surgery, was done retrospectively. The extracted data was compiled into charts, which were then analyzed. A total of 121 patients (68 for EX-DCR and 53 for EN-DCR) who met the inclusion and exclusion criteria (Table 1) were included in the study. The surgical protocol remained constant during the whole study period. All EX-DCR procedures were performed by one ophthalmologist under local anaesthesia (LA) while all EN-DCR procedures were performed by one otorhinolaryngologist under general anaesthesia (GA). Both surgical procedures were performed under sterile conditions. In EX-DCR, a curvilinear incision is made medially to the angular vein at the level of the medial canthal ligament. The wound is opened for adequate exposure of the anterior lacrimal crest. An osteotomy is created and lacrimal sac opened to form anterior and posterior flaps. A silicon tube is inserted and tied. Then suturing of the anterior flaps of the lacrimal sac and nasal mucosa and trimming of the posterior flaps of the lacrimal sac done. The wound is closed and skin is sutured using 6/0 vicryl sutures. EN-DCR was performed under direct visualisation by endoscope. A surgical incision is made at the lateral nasal wall, anterior superior to the insertion of the middle turbinate. The nasal mucosal flap is elevated off the maxillary bone and lacrimal bone is punched till the lacrimal sac is exposed. Metallic lacrimal probes are passed medially through canaliculi so as to tent the lacrimal sac lumen. Incision is made in anterior wall of lacrimal sac and its walls are marsupialized. All patients were given postoperative prednisone drops to the affected eye four times a day for a month as well as oral cephalosporin. Medication variation was only considered if the patient had a known allergy. Patients are encouraged to wash using nasal rinse or sprays to prevent crust formation. The tubes were kept in situ for a minimum duration of 2 months before removal. Anatomical success is defined as improvement in tearing along with patency to irrigation while Functional success is defined as visualization of fluorescein dye aspiration in the nose by the functional endoscopic dye test. Significance testing was carried out on patient's demographics including age, gender, ocular history, pre-op and post-op eye examination,

Table 1: Inclusion and Exclusion Criteria

Inclusion Criteria	Exclusion Criteria
1.Age >18 years	1.Age <18 years
2.Evidence of obstruction on probing and irrigation	2.Previous DCR to same eye
3.Tear meniscus height >1 mm	3.Any lesion/mass found during surgery
4.Fluorescein dye disappearance test negative	4.If tearing was due to canalicular obstruction or bony deformity or lower eyelid malposition
5.Obstruction on lacrimal scintigraphy	Post-traumatic dacryocystitis
	6.Follow up period <3 months
	7.Bilateral DCR

operative time, adverse events, follow-up time, patient satisfaction and success. We also asked the patient to rate the surgical outcome/ patient satisfaction from 0-10 at 3 month follow up or by telephonic interview. The data so collected was fed into computer using MS Excel or compatible software. The statistical analysis was done using SPSS (Statistical Package for Social Sciences) Version 23.0 statistical Analysis Software.

RESULTS AND DISCUSSIONS

The aim of the present study was to retrospectively compare the clinical outcome of patients with NLDO treated with both EX-DCR and EN-DCR surgery. A total of 121 patients were included in the study (40 males and 71 females), which range from 25-72 years of age with a mean age of 53.10 years. Out of these, 68 patients (mean age =53.68 years) were undergone EX-DCR surgery while 53 patients (mean age=52.38 years) were undergone EN-DCR surgery. The data were collected over a period of 2 years. Both groups were well matched for age, sex and lateralisation of eye which is summarized in (Table 2).

Table 2: Demographic Details

	EX-DCR	EN-DCR
Age Mean (in years)	53.68	52.38
M/F	28/40	22/31
Eye (R/L)	39/29	30/23

In our study anatomical success was achieved by 60 patients (88.23%) in EX-DCR group and 47 patients (88.67%) in EN-DCR group while functional success was achieved by 52 patients (76.47%) in EX-DCR group and 41 patients (77.35%) in EN-DCR group. Our criteria for anatomical success did not include qualified or partial patency, though for documentation purpose partial patency to irrigation is also present in 4 patients of EX-DCR group and 3 patients of EN-DCR group. Comparison of anatomical and functional success is summarized in (Table 3).

Table 3: Comparison of Anatomical and Functional Success

	EX-DCR	EN-DCR
Syringing (Patent/Partial/Non Patent)	60/4/4	47/3/3
Fluorescein in nose during functional endoscopic dye test	52	41

In both procedures, the rate of complications was minimal and they were handled conservatively. Three patients had postoperative hemorrhage in EX-DCR surgery whereas none were noted in the EN-DCR group. Postoperative hemorrhage was either wound hemorrhage or epistaxis. All of these patients were treated conservatively, including nasal spray and/or packing. Hemostasis was achieved with no secondary hemorrhage resulting in surgical intervention. There was one case of cellulitis around the wound in the EX-DCR group whereas no cases of infection were noted in the EN-DCR group. Canalicular obstruction was documented in six cases, with three in each of the surgical groups. There was no documented orbital and subcutaneous emphysema, conjunctival fistula formation, retro bulbar hemorrhage, medial rectus paresis, orbital fat herniating, cerebrospinal fluid leak, orbital tissue damage, canalicular obstruction or nasal mucosal synechiae formation. Complications of both groups are summarized in (Table 4).

Table 4: Complication of DCR surgery

	EX-DCR	EN-DCR
Intra-op hemorrhage	Nil	Nil
Post-op hemorrhage	3	Nil
Orbital and subcutaneous emphysema	Nil	Nil
Retrobulbar hemorrhage	Nil	Nil
Infection	1	Nil
Orbital fat herniation	Nil	Nil
Wound dehiscence	Nil	Nil
Medical rectus paresis	Nil	Nil
Nasal mucosal synechiae formation	Nil	Nil
Any other complication	Nil	Nil

Further analysis of the results revealed that EN-DCR surgery took significant less time to perform than EX-DCR surgery. The average duration of surgery was 42.87 minutes for EX-DCR and 23.58 minutes for EN-DCR. Patient satisfaction was significantly higher in the EN-DCR group, along with expeditious postoperative recovery with less swelling, much more comfort. Comparison are summarised in (table 5).

Table 5: Comparison of EX-DCR and EN-DCR

	EX-DCR	EN-DCR
Mean surgery time (in minutes)	42.87	23.58
Patient satisfaction (out of 10)	8.63	9.11

The follow-up duration was comparable in both groups. Visual acuity and IOP did not change postoperatively. Only one patient in EX-DCR group required revision surgery. The study involved 121 patients in total., 68 of them had undergone EX-DCR surgery and 53 had undergone EN-DCR surgery. The mean age of patients in EX-DCR group is 53.68 years which range from 28-70 years while mean age of patients in EN-DCR group is 52.38 years which range

from 25-72 years hence comparable. The majority of treated patients (58.68%) were female and 41.32% were male. The demographic characteristics of our patient population were similar to those described by others. NLDO is much more common in women than in men and is associated with advanced age. EX-DCR surgery was regarded as the gold standard in treatment for NLDO., due to its low cost, high predictability of success, unimpaired view of the surgical area18 and well-defined landmarks allowing the creation of a wide bony window and the use of mucosal flaps to obtain an epithelialized DCR tract[16,20]. However, the procedure leaves a visible cutaneous scar[21]. Other complications of EX-DCR include bruising, wound infection, punctual eversion, inadvertent incision of periorbita, injury to medial canthal structures, orbital fat herniation, cerebrospinal fluid rhinorrhea and functional interference with the physiological action of the lacrimal pump[16,21,22,23]. Over the last decade, EN-DCR gain popularity over EX-DCR due to some advantages that certain patients might find attractive, such as lack of skin incision and the absence of a visible scar. Furthermore, without a facial and orbicularis incision, EN-DCR leads to reduced risk of surgical manipulation of the medial canthal tendon and physiology of the lacrimal pump mechanism[21,24], hence a more rapid return to normal activities is promoted[18]. EN-DCR has advantages to those with dark skin prone to keloid formation[25], as well as patients with a flat nasal bridge[24]. It also provides equally promising results for long-term success in NLDO with the benefits of minimal invasive surgery. From a surgical standpoint, EN-DCR allows direct observation of intranasal pathology, direct access to the rhinostomy site and also allows assessment of failures. The option of converting an EN-DCR to EX-DCR during surgery is always available for difficult cases[26]. The ability to address nasal or paranasal sinus abnormality at the same time[20], also present in EN-DCR. Potential complications of EN-DCR include damage to the nasal mucosa with scar formation, perirhinostomy granuloma, orbital fat prolapse, transient damage to the medial rectus muscle with diplopia, sump syndrome, recurrence of lacrimal mucocele and adhesions between the ostium and the septum[16,22,23]. Since the introduction of the EN-DCR, the main criticism has been a reduced success rate compared with that of EX-DCR. Comparing wide array of published success rates (ranging from 63-97%[12-18]) is a difficult task because different studies use different criteria. Guidelines[27] published by the Royal College of Ophthalmologists suggest that lack of tearing for 3 months after surgery is a good indicator of successful surgery. According to Moore[22] complications that may result in surgery failure can occur up to 3 months postoperatively, therefore, we consider only those patients who had at least 3 months' follow-up time. Some reports shows longer follow-up may be associated with decreased success[13,14,28,29], although this finding is questioned in other reports[27]. Our findings showed a high and comparable success rate of both approaches, with anatomical success of 88.23% in EX-DCR group and 88.67% in EN-DCR group while functional success was achieved by 76.47% in EX-DCR group and 77.35% in EN-DCR group. There was no statistically significant difference between the two surgical approaches. Hartikainen[15] reported that to improve the success rate of EN-DCR frequent, postoperative follow-up for intranasal cleaning of debris and mucous at the rhinostomy site is required; however, usually only 1 or 2 follow-up visits are necessary in those who undergo EX-DCR. Although EN-DCR may require more postoperative follow-up, we feel that the advantages of the procedure and overall patient satisfaction strongly outweigh this issue.

The discrepancy between anatomical success (patency to irrigation) and functional success (Fluorescein in nose during functional endoscopic dye test or resolution of symptoms) may be due to the lacrimal paradox described by Rose[30,31]. He states that signs and symptoms of drainage disorders can be related to either flow or volume. With appropriate surgery, volume-related backwash from the lacrimal sac can be controlled in most cases. However, flow-related features are mainly caused by restriction or tear conductance from the lateral canthus to the nose. Symptom relief of flow-related symptoms is not achievable in every patient, especially if there is hydraulic resistance of the canaliculi and nasolacrimal duct. Though there are many complications described in literature[16,18,21-24], most of them are extremely rare for both EX-DCR and EN-DCR. We found relatively higher rate of complication in EX-DCR compared to EN-DCR without any serious complications. In our study, we found only three patients with postoperative haemorrhage after EX-DCR surgery, requiring conservative treatment. There was one case of cellulitis around the wound in the EX-DCR group also present. Four patients with EX-DCR and three patients with EN-DCR had failed surgery and undergo revision surgery thereafter. In 2000, Cokkeser[32] reported a lower complication rate and minimal morbidity with EN-DCR versus EX-DCR, our study also confirms this. However, with such a low complication rate, a larger sample size would be necessary to adequately compare complication rates between the 2 approaches. In our study average duration of EX-DCR surgery was 42.87 minutes and EN-DCR surgery was 23.58 minutes. Consistent with the literature[33], we found that EN-DCR surgery is quicker than the EX-DCR surgery. A survey for patient satisfaction was also carried out in our study, which depicts that there is

average score of 8.63 for EX-DCR while 9.11 for EN-DCR. Patient satisfaction was significantly higher in the EN-DCR group and this difference was significant. The latter may be higher due to the shorter surgery time.,s lack of external incision and quicker return to work. Gauba[34] also reach on the same conclusion regarding patient satisfaction.

Limitations of Study: A main pitfall of our study is its retrospective design., due to which there was no standardization of osteotomy size performed in either the EX-DCR or the EN-DCR approach. The follow-up time was also not totally consistent across the study. Another weakness in our study was that bicanalicular silicone stenting of the nasolacrimal drainage system has been used in conjunction with DCR in EX-DCR group of surgical patients, whilst the intubation was not used in EN-DCR procedure patients. Follow up period was also limited to three months in our study. These factors may cause bias.

CONCLUSION

In conclusion, this study suggests that both procedures have a high success rate and are almost equally effective in producing symptomatic relief of epiphora. Due to its shorter duration of surgery, shorter recovery period, lack of visible scarring and success rates that are on par with EX-DCR, EN-DCR is a very attractive procedure for treating NLDO. The lacrimal surgeon's extensive experience with both procedures may have had some bearing on the study's conclusions. A prospective, multi center, large-sample, randomized controlled clinical study may clarify the situation.

REFERENCES

1. Piane R, L. Romano, D. Nuti, F. Romano and D. Passali, 1999. Endonasal dacryocystorhinostomy: a personal experience. Acta otorhinolaryngologica Italica: organo ufficiale della Societa italiana di otorinolaringologia e chirurgia cervico -facciale.255-9.
2. Berlucchi M, D. Tomenzoli, M. Trimarchi, D. Lombardi, G. Battaglia and P. Nicolai, 2001. Dacryocystocele in the adult: etiology, diagnosis and treatment. Acta otorhinolaryngologica Italica: organo ufficiale della SocietÃ italiana di otorinolaringologia e chirurgia cervico-facciale. 100-4.
3. Duggal P, S. Chakravorty, R.K. Azad and C. Mohan, 2006. An epidemiological study on patients undergoing dacryocystorhinostomy. Indian Journal of Otolaryngology and Head and Neck Surgery. 349-51.
4. Toti A. Nuovo metodo conservatore di cura radicale delle suporazioni croniche del sacco lacrimale (dacriocistorinostomia). 385-389.
5. Dupuy-Dutemps L, 1921. Procede plastique de dacryocystorhinostomie et ses resultants. 241-61.
6. Gibbs DC, 1967. New probe for the intubation of lacrimal canaliculi with silicone rubber tubing. The British journal of ophthalmology. 198.
7. Caldwell GW, 1893. Two new operations for obstruction of the nasal duct, with preservation of the canaliculi. Am J Ophthalmol. 189-92.
8. West JM, 1910. A window resection of the nasal duct in cases of stenosis. Transactions of the American Ophthalmological Society. 654.
9. Halle M, 1914. Zur intranasalen operation am tranensack. 256-66.
10. McDonogh M and J.H. Meiring, 1989. Endoscopic transnasal dacryocystorhinostomy. The Journal of Laryngology and Otology. 585-7.
11. Stammberger H, 1986. Endoscopic endonasal surgery-concepts in treatment of recurring rhinosinusitis. Part II. Surgical technique. Otolaryngology-Head and Neck Surgery. 147-56.
12. Tarbet K.J., P.L. Custer., 1995. External dacryocystorhinostomy: surgical success, patient satisfaction and economic cost. Ophthalmology. 1065-70.
13. Durvasula VS and D.J. Gatland, 2004. Endoscopic dacrocystorhinostomy: long-term results and evolution of surgical technique. The Journal of Laryngology and Otology. 628-32.
14. Watters GW, H.B. Whittet, G.A. Shun-Shin and C.A. Milford , 1996. Endoscopic transnasal dacryocystor hinostomy-long-term results. Minimally Invasive Therapy and Allied Technologies. 505-10.
15. Hartikainen J, J. Antila, M. Varpula, P. Puukka, H. Seppä and R. Grénman, 1998. Prospective randomized comparison of endonasal endoscopic dacryocystorhinostomy and external dacryocystorhinostomy. The Laryngoscope. 1861-6.
16. Dolman PJ, 2003. Comparison of external dacryocystorhinostomy with nonlaser endonasal dacryocystorhinostomy. Ophthalmology. 78-84.
17. Simon GJ, J. Joseph, S. Lee, R.M. Schwarcz, J.D. McCann and R.A. Goldberg, 2005. External versus endoscopic dacryocystorhinostomy for acquired nasolacrimal duct obstruction in a tertiary referral center. Ophthalmology. 1463-8.
18. Goldberg RA, 2004. Endonasal dacryocystorhinostomy: is it really less successful. Archives of Ophthalmology. 108-10.
19. Woog JJ, R.H. Kennedy, P.L. Custer, S.A. Kaltreider, D.R. Meyer and J.G. Camara, 2001. Endonasal dacryocystorhinostomy. Ophthalmology. 2369-77.
20. Nussbaumer M, S. Schreiber and M.W. Yung, 2004. Concomitant nasal procedures in endoscopic dacryocystorhinostomy. The Journal of Laryngology and Otology. 267-9.

21. Shun-Shin GA and G. Thurairajan, 1997. External dacryocystorhinostomy-an end of an era. British journal of ophthalmology. 716-7.
22. Moore WM, C.R. Bentley and J.M. Olver, 2002. Functional and anatomic results after two types of endoscopic endonasal dacryocystorhinostomy: surgical and holmium laser. Ophthalmology. 1575-82.
23. Fayet B, E. Racy and M. Assouline, 2004. Complications of standardized endonasal dacryocystorhinostomy with unciformectomy. Ophthalmology. 837-45.
24. Detorakis ET, E.E. Drakonaki, I. Bizakis, E. Papadaki, M.K. Tsilimbaris and I.G. Pallikaris, 2009. MRI evaluation of lacrimal drainage after external and endonasal dacryocystorhinostomy. Ophthalmic Plastic and Reconstructive Surgery. 289-92.
25. Duffy MT, 2000. Advances in lacrimal surgery. Current opinion in ophthalmology. 352-6.
26. Zhou W, M. Zhou, Z. Li and T. Wang, 1996. Endoscopic Intranasal dacryocystorhinostomy in forty-five patients. Chinese medical journal. 747-8.
27. Yung MW and S. Hardman-Lea, 2002. Analysis of the results of surgical endoscopic dacryocystorhinostomy: effect of the level of obstruction. British journal of ophthalmology. 792-4.
28. Delaney YM and R. Khooshabeh, 2002. External dacryocystorhinostomy for the treatment of acquired partial nasolacrimal obstruction in adults. British journal of ophthalmology. 533-5.
29. Mäntynen J, M. Yoshitsugu and M. Rautiainen, 1997. Results of dacryocystorhinostomy in 96 patients. Acta Oto-Laryngologica. 187-9.
30. Guthoff R and J.A. Katowitz, 2007. editors. Oculoplastics and orbit. Springer Science and Business Media.
31. Rose GE, 2004. The lacrimal paradox: toward a greater understanding of success in lacrimal surgery. Ophthalmic Plastic and Reconstructive Surgery. 262-5.
32. Cokkeser Y, C.E. Evereklioglu and H. Er, 2000. Comparative external versus endoscopic dacryocystorhinostomy: results in 115 patients (130 eyes). Otolaryngology-Head and Neck Surgery. 488-91.
33. Walker RA, A. Al-Ghoul and M.R. Conlon, 2011. Comparison of nonlaser nonendo scopic endonasal dacryocystorhinostomy with external dacryocystorhinostomy. Canadian Journal of Ophthalmology. 191-5.
34. Gauba V, 2014. External versus endonasal dacryocystorhinostomy in a specialized lacrimal surgery center. Saudi journal of ophthalmology. 36-9.