

Original Article

# Cutaneous scar visibility after external dacryocystorhinostomy: A comparison of curvilinear and W shaped incision



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## Abstract

**Purpose:** The major drawback of an external dacryocystorhinostomy (ExDCR) is visible skin scar leading to poor patient satisfaction. In this study we have analyzed the skin scarring objectively after Curvilinear incision (CLI) and W shaped incision (WSI).

**Methods:** This is prospective trial done at Department of Ophthalmology at tertiary level hospital. All the patients with primary acquired nasolacrimal duct obstruction were included in the study. Patients were assigned to group A (CLI) or Group B (WSI). Cosmetic outcome was assessed by scar visibility at 1st, 3rd and 6th month postoperatively by two ophthalmologists separately, who were unaware of incision type.

**Results:** We studied 64 patients with median age 59.0 years (IQR [Interquartile range]: 50.0–66.8 years). Scar visibility was significantly ( $p = 0.001$ ) more in WSI group at all follow-ups. None of the patients of CLI group showed visible scar at six months whereas ten patients (31.3%) of WSI group still had minimal scar ( $p < 0.001$ ). Older patients had significantly less scar than younger patients. The time taken to perform ExDCR was significantly more with WSI (41.0 min, IQR: 40.0–44.0 min) than for CLI (33.0 min., IQR: 31.3–35.0 min);  $p < 0.05$ . Overall complication rates were similar in both the groups ( $p > 0.05$ ) but extension of skin incision was more common in WSI group.

**Conclusions:** We found that CLI is more aesthetic, simpler, requiring less operative time and less incision related complications when compared with WSI.

**Keywords:** Dacryocystitis, Epiphora, Lacrimal, Lacrimation, Nasolacrimal duct

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## Introduction

External dacryocystorhinostomy (ExDCR) is preferred surgery for nasolacrimal duct obstruction (NLDO) and has high success rate >90%. In fact, ExDCR is regarded as the gold standard in terms of surgical success.<sup>1–3</sup>

The major drawback of an ExDCR is visible skin scar. Scarring occurs in 9 to 33% of patients undergoing ExDCR surgery.<sup>4–6</sup> Therefore, patient satisfaction is often not

proportionate to surgical success.<sup>7,8</sup> The scarring can be minimized by the site of incision, meticulous surgical technique, bloodless surgical field, and skin flap. A recent study suggests that, in addition to the above-mentioned factors, the shape of the incision also has a significant impact on scar visibility.<sup>9</sup> Many types of surgical incisions like curvilinear tear trough,<sup>10,11</sup> sub-ciliary lower eyelid,<sup>12–14</sup> W-shaped nasal,<sup>9,15</sup> and trans-conjunctival subcaruncular<sup>16,17</sup> have evolved in an attempt to reduce the scar visibility. A recent study com-

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pared linear and W-shaped incision (WSI) and found that WSI is cosmetically better.<sup>9,15</sup> In this study authors commented that it would have been more clinically meaningful to compare CLI instead of a linear incision. They mention this fact as a "major limitation" of their study.<sup>15</sup> There is only one study comparing WSI and CLI in ExDCR till date.<sup>18</sup> Hence we undertook this study to analyze the skin scarring objectively after WSI and CLI.

## Methods

This is a prospective trial conducted in the Department of Ophthalmology at a tertiary care hospital of South India which was approved by the institutional review board. The study was conducted in accordance with the Declaration of Helsinki. All patients diagnosed with primary acquired nasolacrimal duct obstruction (PANDO) were included in the study. We excluded the patients with secondary acquired nasolacrimal duct obstruction, canalicular obstruction, common canalicular obstruction, skin fistula, any skin disorder that could affect the wound healing, and a previous tendency of keloid formation. Cases of intranasal pathology like synechia and deviated nasal septum were also excluded. The diagnosis of PANDO was established by syringing and probing. The consent for ExDCR was obtained after explaining the details to the patients about different kinds of incisions and surgical approaches. Patients were alternately assigned to group A (CLI) or Group B (WSI).

## Surgical technique

All surgeries were done under local anesthesia by a single oculoplastic surgeon (BW). Tissue was infiltrated with a local anesthetic which consisted of an equal mixture of 2% lignocaine and 0.5% bupivacaine, with 1:100,000 adrenaline. Six milliliters of the same were injected over the lacrimal crest, two milliliters in the infratrochlear region and two milliliters in the infraorbital region. The nasal packing was done with a gauze soaked in 4% lignocaine and 1:100,000 adrenaline. In group A 12 mm CLI was given in tear trough along the direction of orbicularis muscle (Fig. 1A). The WSI was given

12 mm in vertical length, forming three consecutive equilateral triangles with 4 mm side length, with two triangle tip points and one base showing the medial canthus, forming a "W" shape (Fig. 1B). After the creation of skin flaps, the surgical procedure was identical in both the groups. Subcutaneous dissection was done on both sides of the incision. At the level of the anterior lacrimal crest, the orbicularis fibers were gently separated to expose the periosteum over the anterior lacrimal crest. The skin and muscle were retracted and medial palpebral ligament was identified and cut. The periosteum was vertically incised, anterior to the lacrimal crest and elevated from the lacrimal fossa using Freer's elevator and the sac was reflected laterally. A bony ostium 15 mm × 15 mm was made with Kerrison's punch. The largest possible single U-shaped flap of the nasal mucosa and lacrimal mucosa was made. The posterior remnant of the nasal mucosa and lacrimal sac were also completely excised. The anterior flap of the sac was sutured to the anterior flap of the nasal mucosa with three interrupted 6-0 vicryl sutures to prevent sagging under tension. The orbicularis muscle and skin were closed with three interrupted 6-0 vicryl sutures in both the groups. In WSI sutures were placed at the tip of V at three places. In case there was an extension of the incision, it required one extra suture. Surgical time was noted in each case from putting first incision to last suture in minutes. Syringing was done to ensure patency. Postoperatively, tablet ciprofloxacin 500 mg and serratiopeptidase (10 mg), and diclofenac (50 mg) tablet were given twice daily for five to seven days to all patients. Nasal decongestant oxymetazoline (0.5 mg/ml) was administered as one drop four times daily on the side of surgery for one week. Ciprofloxacin ointment 0.3% was given for application over the wound twice a day for seven days. Ciprofloxacin (0.03 mg/10 ml) and dexamethasone (0.01 mg/10 ml) eye-drops were instilled four times daily for the first week post-operatively on the side of surgery, which was tapered and stopped over one month. The nasal pack was removed and syringing was done for all patients on the 1st postoperative day. All patients were discharged on the second postoperative day.

The patients were examined on postoperative day 1, day 10, after one month, 3 months and 6 months. Functional outcome was evaluated by symptomatic relief from epiphora



Fig. 1. Location of Curvilinear(A) and W incision (B).

and syringing at each examination. Sutures were removed on the first follow up on the tenth day.

Cosmetic outcome was assessed by scar visibility at the first, third and sixth month postoperatively by two ophthalmologists (AH and SN) independently. They were unaware of the incision types and the side of surgery. The assessment was done by direct visualization under the same light conditions and in the same room from a 100 cm distance. First, the examiners were told to predict the side (right or left) of surgery by looking for a scar. If examiners were unable to tell the side of surgery it was taken as no scar grade 1. If they could recognize the side by scar they were asked to grade the scar. Minimally visible scar tissue was assessed as grade 2, moderately visible scar tissue as grade 3, and easily visible scar tissue as grade 4.

### Statistical analysis

Sample size calculated for this study was 64 (32 in WSI group and 32 in CLI group) by Non-Parametric Wilcoxon Mann Whitney *U* – Test using *n.master2.0* software. We assumed the probability of score of one group being larger by 0.5 times the score of another group is 0.7, type I error of 5%, power of 80%, two-sided and an equal number in each group. Statistical Package for the Social Sciences version 19.0 software was used for the statistical analysis. Scarring was measured by the scale previously described by Devoto. This scale describes four grades of severity scoring and hence was considered ordinal variable. Since we encountered many null values in our results we were unable to apply planned tests like Wilcoxon and Kruskal Wallis test. Scarring and other categorical variables were presented by number and percentages and compared using the Chi-square test. Other continuous variables like age and duration of surgery were presented as median (with IQR [Interquartile range]) because of non-compliance of normality. They were compared using Mann Whitney *U* test. A *p*-value < 0.05 was accepted as being statistically significant.

### Results

We studied 64 patients belonging to south Indian ethnicity with median age 59.0 years (IQR: 50.0–66.8 years). Thirty-seven (57.8%) patients were females. The study included 29 (45.3%) patients under 55 years and 35 (54.7%) patients over 55 years. Thirty-four (53%) patients underwent right-sided surgery. None of our patients had bilateral surgery. All our cases had patent syringing and none had epiphora 6 months postoperatively. The baseline characteristics for WSI and CLI are given in Table 1.

Scar was visible in all the patients in both the groups at the end of the first month and both the surgeons could identify the correct side of surgery in all the patients. The staging of the patient by both surgeons was concordant in all the patients at all three observation points (kappa value = 1). We also observed that all the patients showed improvement between the first and third month but there was no change in scar between the third and sixth month. At the third and sixth month postoperatively both observers were not able to recognize the side of surgery in 90% of the cases (Table 2).

The scar visibility was significantly lesser in the CLI group at the sixth month (Fig. 2). The details are shown in Table 3.

We also found that older patients (those over 55 years of age) had significantly less scarring than younger patients (Table 4).

We encountered complications in nine cases. Complications consisted of bleeding in three cases, an extension of skin incision in four, torn nasal mucosa in one and torn sac flap in one. Overall complication rates were similar in both the groups (*p* > 0.05) but all four cases of wound extension belonged to WSI group.

The time taken to perform ExDCR was significantly more with WSI (41.0 min, IQR: 40.0–44.0 min) than for CLI (33.0 min, IQR: 31.3–35.0 min); *p* < 0.05.

### Discussion

We found that CLI incision is cosmetically better than WSI incision (*p* < 0.05). The surgical time taken to perform ExDCR with CLI incision was significantly lesser than WSI incision. All patients showed scarring at one month which improved by the third month. The cosmetic results were much better in older patients.

Our study demonstrates that CLI has a better cosmetic outcome than WSI. The proportion of our patients having scarring at the last follow up was significantly lesser in the CLI group (CLI vs WSI, 34.4% vs 0%). There are few studies which have studied scarring after WSI and CLI (Table 5). The study by Dirim et al. which compared CLI and WSI concluded that there was no statistically significant difference between the frequency of scarring between two groups (40% in CLI vs 50% in WSI).<sup>18</sup> There is no other previous study that has compared WSI with CLI. However, we found two studies by Eckini et al. which have compared cosmetic results of WSI with the linear incision. Eckini et al. themselves describe the comparison of linear incision instead of CLI as one of the limitations of their study. Assessment scores of the ophthalmologist were significantly lower for the “W incision” than for the vertical incision in this study ( $1.57 \pm 0.68$  vs  $2.13 \pm 0.95$ ). They found scarring in 49% of WSI group and

**Table 1.** Baseline characteristics of participants by W-shaped Incision (WSI) group and Curvilinear incision (CLI) group.

	WSI(n = 32)	CLI(n = 32)	Total(n = 64)
Age in years (Median; IQR <sup>a</sup> )	56.5, 35.8–65.8	60.0, 53.5–69.3	59.0, 50.0–66.6
Sex			
Male	15(46.9%)	12(37.5%)	27(42.2%)
Female	17(53.1%)	20(62.5%)	37(57.8%)
Side of surgery			
Right	19(59.4%)	15(46.9%)	34(53.1%)
Left	13(40.6%)	17(53.1%)	30(46.9%)

<sup>a</sup> IQR: Interquartile range.

**Table 2.** Distribution of scarring at first, third and sixth month by groups.

	No scarring		Minimal scarring		Moderate scarring	
	WSI	CLI	WSI	CLI	WSI	CLI
First month	0	0	21(65.6%)	32(100%)	11 (34.4%)	0
Third month	21(65.6%)	32(100%)	11 (34.4%)	0	0	0
Sixth month	21(65.6%)	32(100%)	11 (34.4%)	0	0	0

WSI = W shaped Incision; CLI = Curvilinear Incision.

**Fig. 2.** Scar Grade 6 month after external dacryocystorhinostomy with Curvilinear incision(A, B) and W shaped incision(C, D).**Table 3.** Comparison of scarring at sixth month by groups.

Scarring at sixth month	Type of incision		p-value
	WSI (n = 32)	CLI (n = 32)	
Absent	21 (65.6%)	32 (100.0%)	0.0003
Present	11 (34.4%)	0	

Chi-square: 13.283, df: 1.

**Table 4.** Scarring in Old vs Young for W shaped Incision (WSI) group.

Scarring at sixth month	Age category		p-value
	≤55 years (n = 15)	>55 years (n = 17)	
Absent	4 (26.7%)	17 (100.0%)	0.00005
Present	11 (73.3%)	0	

Chi-square: 16.03, df: 1.

69% of vertical incision group patients. Eckini et al. got similar results in his 16 cases series where he performed bilateral ExDCR with one side WSI and another side linear nasal incision.<sup>9,15</sup> Hence both the studies which examined scarring after WSI showed scarring in about 50% of patients (Table 5).<sup>9,18</sup>

In another study by Davis BW concluded that scarring after CLI during ExDCR is minimally visible to surgeons and nearly

invisible to patients but this study did not have a comparative arm.<sup>9</sup> Seventy-five percent of their patients had scarring and 3.7% had severe scarring. The last follow up of this study was at three months. The lower frequency of scarring in both the groups in present study reinforces the point that scarring after surgery depends on a multitude of factors like anesthesia, incision site, incision shape, wound closure and skin flap approach.<sup>11</sup> One other factor that has been repeatedly highlighted as an important determinant for scarring is the direction of the incision line.<sup>19</sup> Borges AF et al also recommended that the incision should be performed parallel to the tensile strength lines and emphasized the importance of obtaining relaxed tensile strength lines at the skin incision.<sup>20</sup> When the final tensile strength of the long line of the incision (relaxed skin tension line) is minimized, scar formation is optimized.<sup>5,19</sup> Ekinci et al. considered the WSI as a modified form of Z-plasty, and their study shows that it is effective in reducing incisional scarring by relaxing skin tension in patients undergoing ExDCR compared to the linear incision.<sup>9,15</sup> Similarly, CLI is also performed along tensile strength lines and hence low incidence of scarring.<sup>10</sup>

We followed our patients for a maximum of six months. We found no change in scarring score between 3rd and 6th month, though both differed from the 1st month. Thus maximum scar maturation was achieved in the first three months,

Table 5. Previous studies with WSI and CLI.

Study	Incision studied	Last follow up in months	Scarring at last follow up (%)				Scarring grade for CLI				Patients having scarring at last follow-up (%)	
			Scarring grade for WSI				Scarring grade for CLI				WSI	CLI
			1*	2#	3@	4\$	1*	2#	3@	4\$		
Ekinci M <sup>14</sup> 2013	WSI vs L	6	51.3	43.2	2.7	2.7	-	-	-	-	48.6	-
Ekinci M <sup>15</sup> 2014	WSI vs L	6	-	-	-	-	-	-	-	-	-	-
Dirim B <sup>18</sup> 2015	WSI vs CLI	18	50	36	5.3	7.9	60	16	10	14	50	40
Davies BW <sup>9</sup> 2015	CLI	3	-	-	-	-	25.5	53.7	17.1	3.7	-	74.5
Our study	WSI vs CLI	6	65.6	34.4	0	0	100	0	0	0	0	34.4

WSI = W shaped Incision; CLI = Curvilinear Incision; L = Linear Incision.

1\* = Not visible scar; 2# = Minimally visible scar; 3@ = Moderately visible scar; 4\$ = Easily visible scar.

especially in CLI group. We cannot give similar comment about WSI as 34.4% of the patients still had minimal scarring at the end of the sixth month and their scar might have completely healed later. Akaishi PM et al studied cases with sub-ciliary incision and they also found no difference between 3rd and 6th month scar scores.<sup>12</sup> Bond et al concluded that post-surgical scar maturation occurs as a series of defined macroscopic and microscopic stages over the course of one year.<sup>21</sup>

We also studied the impact of aging on scarring. We found that the subjects older than 55 years showed significantly lesser scarring than the younger subjects (Table 4). Bond et al. also found that the rate of scar maturation varied within the study group. The older subjects (>55 years) displaying accelerated maturation, whereas a prolonged high turnover state and a retarded rate of maturation were observed in younger subjects.<sup>21</sup> Similar results were obtained by Sharma et al and Caesar RH et al. In their studies, the average age of patients was higher for the patients with invisible scars and lower for those with the scars.<sup>4,22</sup>

There are differences in the visibility of cutaneous scar among different races. The pigmented races, to which Indians also belong, are known to have a poorer scarring. Hence our results cannot be generalized to other patient populations, especially the fair skinned people. All of our patients were Indian and most of them were dark-skinned.<sup>14,23</sup>

We used 6-0 vicryl suture for the suturing of mucosal flaps as well as skin for all of our cases. Other surgeons used 6-0 nylon, 6-0 silk, 6-0 prolene. Waly MA et al found that the use of prolene 6-0 sutures for skin closure gives better cosmetic results with only 15% patients having cosmetically significant scars.<sup>23</sup> Braided sutures (like the vicryl) usually incite a greater inflammatory response.<sup>24</sup> But we did not find any inflammation due to sutures in any of our case. We did not use prolene in any of our cases and believe that this aspect should be analyzed in a comparative study.

Surgical time was significantly higher for WSI (median: 41.0 min, IQR: 40.0-44.0 min) incision compared to CLI (median: 33.0 min, IQR: 31.3-35.0 min). Although Eckini M et al mention "Suturing time during WS incision wound closure results in a longer operation time" but to our surprise, none of the studies so far involving WSI or CLI have studied the duration of surgical procedures.<sup>15</sup> Surgical time taken depends upon many operative variables like the technical difficulty of the procedure, excessive bleeding, and whether intubation was done or not. None of our patients underwent nasolacrimal duct intubation. Intraoperative bleeding occurred in two of the patients, one belonging to each group. Even in them, the surgical times was comparable (WSI: 50 vs CLI: 45 min). Therefore, we conclude that the significantly higher time required for surgery in WSI group was probably due to the technical difficulty of WSI.

Overall, the complication rates were similar in both the groups but all four patients that showed the extension of skin incision belonged to WSI group. Rest of the complications were similar in both the groups.

One of the limitations of our study was a short follow up for 6 months, as previous studies show that scar maturation can go up to one year.<sup>21</sup> All of our CLI group patients had fully improved by the end of the third month but we cannot comment on the long term scarring status of WSI patients who had persistent scarring at the end of six months follow up. We also could have included other parameters like

patients' subjective scoring for scar, width, height, pigmentation, color, and suture marks for scar assessment.<sup>25</sup>

## Conclusions

We conclude that the frequency of scarring is much less with CLI than WSI. CLI also reduces the time required for the surgical procedure and has a lesser chance of wound extension.

## Conflicts of interest

The authors report no conflict of interest. The authors alone are responsible for the content and writing of the paper.

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