



# Functional and Aesthetic Outcome of Macgregor and Z Plasty (Step Ladder) Approach for Lip Splitting in Oral Squamous Cell Carcinoma

Shavari Shetty<sup>1</sup> · Venkatesh Anehosur<sup>2</sup> ·  
Niranjan Kumar<sup>3</sup>

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## Abstract

**Purpose** The aim of the study is to compare the functional and esthetic results of two lip splitting approaches—McGregor incision and stepladder Z plasty for surgical resection of primary Oral Squamous cell carcinoma (OSCC). **Method** Prospective study involved 24 patients who had modified radical neck dissection for OSCC between 2018 and 2020. Predictor variables were drawn from demographic characteristics (age and gender), primary site, extent of the primary lesion. Patients were divided into two groups randomly with group I McGregor lip splitting incision and group II step ladder Z plasty, with subjective and objective assessment.

**Results** In the overall comparison of the oral incontinence between the two groups, there was no statistically significant results. Z plasty group had better outcome with lesser degree of drooling and good cosmesis. There was no difference between the speech efficiency between the two groups.

Subjective assessment of the appearance of lips and face was better in Z plasty group. Subjective assessment of inversion and eversion was better in McGregor group. Cosmesis was assessed objectively by Stony Brook Scar Evaluation Scale (SBSES). Group 1 had a mean score of 2.92 out of 5 and Group II mean score of 4.08 out of 5. Cosmesis was better in Z plasty group.

**Conclusion** Z plasty was found as a superior option when it comes to cosmesis due to its geometric nature which allows accurate approximation. McGregor offers better functional outcome in terms of lip movement and oral incontinence.

**Keywords** Oral squamous cell carcinoma · Lip splitting · McGregor incision · Stepladder Z plasty · Scar assessment

## Introduction

Oral cancer is one of the three common types of cancers that occurs in India and poses a great public health issue. The differences in prevalence and incidence of various types of oral cancer can be attributed to the regional differences in presence of specific risk factors [1].

The management of oral cancer is often multiple approaches that involved resection of the tumor with negative margin with removal of neck nodes. It is followed by reconstruction and adjuvant treatment with radiotherapy and chemotherapy based on various factors. Of paramount importance of management of primary is to obtain adequate margin of uninvolved tissue surrounding the tumor. Visualization of the tumor may vary from patient to patient and is dependent on the location and size of the tumor. Therefore, it is important to employ every means to obtain adequate surgical access [2].

✉ Venkatesh Anehosur  
venkyrao12@yahoo.co.in

Shavari Shetty  
shavarishetty4@gmail.com

Niranjan Kumar  
drniranjankumar@sdmmedical.org

<sup>1</sup> SDM Craniofacial Unit, SDM College of Dental Sciences and Hospital, A Constituent Unit of Shri Dharmasthala Manjunatheshwara University, Dharwad, Karnataka, India

<sup>2</sup> Department of Oral and Maxillofacial Surgery, SDM Craniofacial Research Centre, SDM College of Dental Sciences & Hospital, A Constituent Unit of Shri, Dharmasthala Manjunatheshwar University, Dharwad, Karnataka 580009, India

<sup>3</sup> Department of Plastic Surgery, A Constituent Unit of Shri, Dharmasthala Manjunatheshwar University, Dharwad, Karnataka 580009, India

To provide wide exposure and clearance for posteriorly located lesions, wherein mandibulotomy or hemi-mandibulectomy procedure is planned, the division of the lower lip is indicated. It greatly enhances the accessibility and visibility for all subsites intraorally, pharyngeal, as well as to the cervical region of the spinal column. It aids in precise tumor resection, mandible alignment, flap in-setting and facilitates overall better results.

Dieffenbach in 1834 was the first to advocate splitting of the lower lip. Roux introduced the division of lower lip and mandible in midline to get adequate access to tumor of the oral cavity and oropharynx in 1836 [2]. Although lower lip splitting is a simple and reliable surgical technique, it has functional and cosmetic disadvantages. Over the past century, the lip splitting incision has undergone variations from being a simple straight vertical division of the lower lip extending to the middle chin, to several modifications to overcome the disadvantages and to improve postoperative appearance and function. The bothersome cosmetic and functional postoperative complications are scar contracture, notching of the lip vermilion and loss of contour of the chin pad, decreased lip sensation, oral incontinence, and decreased mobility of the lip [3].

The commonly used lip splitting incisions are Roux-Trotter incision (straight midline), McGregor incision (straight midline chin-contour), Robson incision (lateral lip splitting), Hayter et al. modification of the McGregor incision (chin contour with chevron) [3] and stepped splitting technique also called as Z plasty [4]. Although incidence-wise Indian subcontinent ranks at the top, there is not many studies done for the comparison of outcomes of these two lips splitting approaches.

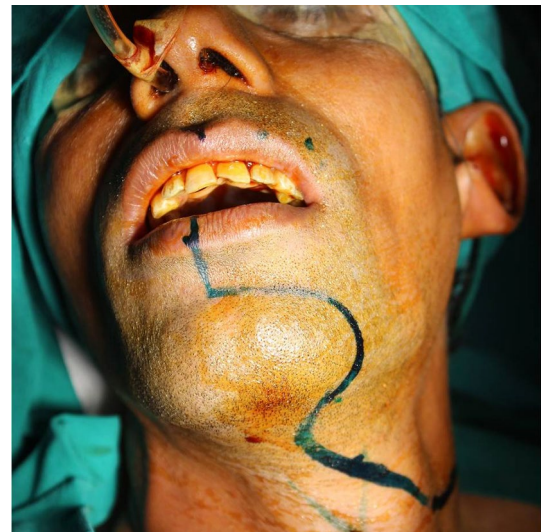
An ideal lip splitting incision should meet the following criteria of not resulting in vermilion notch, should not interrupt with the smooth and round contour of chin pad, should have good functional and esthetic outcomes, should not damage neurovascular structures, and should not cause vertical or circumferential scar contracture [5].

## Material and Methods

Prospective study involved biopsy proven OSCC patients from 2018 to 2020 with Modified radical neck dissection along with resection of primary lesion. Institutional Review Board (IRB) permission was obtained to conduct and publish the study.

Patients in age group between 20 and 60 years, with indication of lip splitting, were included. Patients with previous history of surgery chemoradiation, hypertrophic scar, and resection involving anterior mandible were excluded.

The demographic details were recorded. Twenty-four patients were divided randomly into two groups alternate



**Fig. 1** Marking of Macgregor lip splitting incision



**Fig. 2** Marking of Z plasty (step ladder) lip splitting incision

and first case for allotted to a group by tossing of coin. Group 1 patients underwent McGregor lip splitting incision (Fig. 1), and Group 2 step ladder Z plasty (Fig. 2).

The lip splitting incision was then inferiorly extended with MacFee or Schobringer to carry out Modified Radical Neck Dissection (Figs. 3, 4). Reconstruction of the defect was done using pectoralis major myocutaneous flap, radial forearm flap, anterolateral thigh, fibula free flap, radial forearm flap and skin graft.

Postoperatively, the patients were assessed subjectively and objectively at 15 days, 1 month and 6 months for the following parameters.

1. Oral incontinence:
  - (a) problems with drooling
  - (b) problems with speech



**Fig. 3** Z plasty (step ladder) lip splitting in continuity with neck incision



**Fig. 4** Macgregor incision in continuity with neck incision

2. Appearance of the lip and face
3. Lip movement was assessed by recording the presence of restrictive movement and free mobility with inversion and eversion.
4. Vermilion appearance (presence of notching)
5. Presence of wound dehiscence.
6. Scar assessment by Stony Brook Scar Evaluation Scale (SBSSES)
  - (a) width
  - (b) height: elevated/flat
  - (c) color: darker/lighter than surrounding skin
  - (d) hatch or suture marks: present/absent
  - (e) overall appearance: poor/good

The patients subjectively assessed the below parameters by answering the questionnaire.

1. Oral continence,

2. Degree of satisfaction with the esthetic outcome of the procedure,
3. Degree of satisfaction with the functional outcome—lip movement.

The objective clinical assessment by a single evaluator for the following,

1. Scar assessment using stony Brook scar (SBS) evaluation Scale
2. Presence of vermillion notching
3. Wound dehiscence.

The results obtained from the questionnaire and data derived from the clinical assessment were tabulated and analyzed using Mann–Whitney *U* test.

## Results

Twenty-four (38%) patients had lip splitting approach out of 63 patients. Fifteen (62.5%) were male patients and nine were (37.5%) female patients. Gingiva–buccal complex primary were 12 patients (50%). Other subsites were tongue 8(33%), floor of the mouth 3(12.5%) and retromolar trigone 1(4.1%) (Tables 1, 2).

Oral incontinence assessment showed problems with drooling, though group II patients had better scoring for drooling at 1 month, but it was not statistically significant when compared to group II. At 6 months, all the patients from both the groups fared good for drooling. Problems with speech in both the groups did not show any statistically different results in all the follow-ups. Within the groups, both the techniques have shown improvement in speech between each follow-up (Table 3).

Appearance of face revealed no differences between the groups at 15 days and 1 month intervals. At 6th month, 10 patients out of 12 from group II (Z plasty) showed a good scoring for appearance of face, making it statistically significant (*p* value: 0.0056). (Table 4) Appearance of lips did not show differences between the groups at 15 days and 1 month intervals. At 6th month, 10 patients out of 12 from group II (Z plasty) had good scoring for appearance of lips, making it statistically significant (Figs. 5, 6, 7).

Lip assessment for Inversion showed no significant difference between the groups at 1 month and 6 months. Within the groups, there was significant improvement in inversion between 15 days and 1 month and 15 days and 6 months in both the groups (Table 5). For Lip Eversion, group I showed better results, as compared to z plasty group at 15 days, as well as at 6 months. Overall, group I patients have shown better results for lip function, i.e., movement as compared to group II (Fig. 8). Post-surgical



**Table 1** Details of patients with MacGregor approach

Patient no	Age/Sex	Site	Diagnosis	Treatment done	Reconstruction	Adjunctive RT	Adjunctive CT
1	44/M	Rt. GBS	Well Diff SCC	WE + SEG RES + MRND	FREE FIBULA FLAP	Yes	Yes
2	49/M	Rt. FOM + RMT	Well Diff SCC	WE + HM + MRND	RFFF	Yes	Yes
3	62/F	Rt. Lat. Tongue	Well Diff SCC	WE + HGL + MRND	RFFF	Yes	No
4	60/F	Rt. BM	Well Diff SCC	WE + MARG. MAND + MRND	RFFF	Yes	yes
5	50/M	Lt. BM	Well Diff SCC	WE + MRND + MRND	PMMC	Yes	yes
6	52/M	Lt. BM	Well Diff SCC	WE + MRND	RFFF/ REEXP/PMMC	Yes	No
7	66/M	Lt. Lat Tongue	Well Diff SCC	WE + MRND	RFFF	Yes	No
8	73/M	Lower lip	Well Diff SCC	WE + MRND	PRIMARY CLOSURE	No	No
9	66/M	Rt. lat Tongue	Well Diff SCC	WE + MRND	RFFF	Yes	Yes
10	72/M	Lt. GBS + RMT	Well Diff SCC	WE + HM + MRND	PMMC	Yes	Yes
11	53/M	Rt. Lat Tongue	Well Diff SCC	WE + HMGL + MRND	RFFF	Yes	Yes
12	60/F	Rt. BM	Spindle cell Ca	WE + HM + MRND	PMMC	Yes	Yes

**Table 2** Details of patients with Z plasty (Step ladder) approach

Patient no	Age/Sex	Site	Diagnosis	Treatment done	Reconstruction	Adj RT	Adj CT
1	42/M	Rt. BM + GBS	WELL. DIFF SCC	WE + MRND + SEGMENTAL RESECTION	PMMC	Yes	No
2	38/F	Lt. FOM + ALVEOLUS	CLEAR CELL CARCINOMA	WE + SOHND + SEGMENTAL MAND	FREE FIBULA FLAP	Yes	Yes
3	70/F	Lt. Lat. Tongue	WELL. DIFF SCC	WE + HM GLOSSECTOMY + MRND	RADIAL FOREARM FREE FLAP	Yes	No
4	39/F	Rt. mandible	LANGERHAN HISTOCYTOSIS	WE + SOHND	FREE FIBULA FLAP	Yes	Yes
5	50/M	Lt. FOM + ALVEOLUS	WELL. DIFF SCC	WE + SEGMENTAL MANDIBULECTOMY + MRND	FREE FIBULA FLAP	yes	No
6	59/M	Lt. GBS + RMT	WELL. DIFF SCC	WE + MRND	PMMC	Yes	No
7	45/M	Lt. RMT + GBS	WELL. DIFF SCC	WE + MRND + HM + MAXILLARY ALVEOLECTOMY	ANTEROLATERAL THIGH FLAP	No	No
8	49/M	Rt. BM + GBS	WELL. DIFF SCC	WE + SEGMENTAL MANDIBULECTOMY + MRND	FREE FIBULA FLAP	Yes	Yes
9	67/F	Lt. LAT Tongue	WELL. DIFF SCC	WE + HM GLOSSECTOMY + MRND	RFFF	Yes	No
10	68/M	Lt. LAT Tongue	WELL. DIFF SCC	WE + HM GLOSSECTOMY + MRND	RFFF	Yes	Yes
11	41/M	Lt. LAT. Tongue	WELL. DIFF SCC	WE + SOHND	RFFF	No	No
12	64/F	Rt. GBS	WELL. DIFF SCC	WE + SEGMENTAL MANDIBULECTOMY + MRND	FREE FIBULA FLAP	Yes	No

*M* Male, *F* female, *Rt* right, *Lt* left, *lat* lateral, *BM* buccal mucosa, *GBS* gingivobuccal sulcus, *FOM* floor of mouth, *RMT* retromolar trigone, *diff* differentiated, *SCC* squamous cell carcinoma, *WE* wide excision, *HM* hemimandibulectomy, *SEG RES* segmental resection, *MRND* modified radical neck dissection, *SOHND* supraomohyoid neck dissection, *HMGL* hemiglossectomy, *RFFF* radial forearm free flap, *REEXP* re-exploration, *PMMC* pectoralis major myocutaneous flap, *Adj* adjunctive, *RT* radiotherapy, *CT* chemotherapy

scar at 3rd month follow up, group I had a mean score of 2.92 out of 5 and group II 4.08 out of 5. Hence, group II has better cosmesis of the scar at 6 months (Table 6). Wound dehiscence did not show difference between the groups as no patient reported with wound dehiscence

post-surgery. Vermilion notching is an important esthetic parameter to determine the cosmetic outcome in the surgeries involving lip. One patient from group I (McGregor) presented with vermilion notching and none from group II.

**Table 3** Comparison of two groups (Mc Gregor and Z Plasty) with problems with speech at 15 days, 1 and 6 months time points by Mann–Whitney *U* test

Problems with speech	Mc Gregor	%	Z Plasty	%	Total	%	Z-value	<i>p</i> value
<i>15 days</i>								
Fair	4	33.33	2	16.67	6	25.00	−0.6928	0.4884
Good	8	66.67	10	83.33	18	75.00		
<i>1 month</i>								
Poor	1	8.33	0	0.00	1	4.17	−0.6640	0.5067
Fair	11	91.67	11	91.67	22	91.67		
Good	0	0.00	1	8.33	1	4.17		
<i>6 months</i>								
Fair	8	66.67	11	91.67	19	79.17	−1.0392	0.2987
Good	4	33.33	1	8.33	5	20.83		
Total	12	100.00	12	100.00	24	100.00		
Between 15 days vs 1 month	Wilcoxon matched pairs $Z=2.3664, p=0.0180^*$		Wilcoxon matched pairs $Z=2.6656, p=0.0077^*$					
Between 15 days vs 6 months	Wilcoxon matched pairs $Z=2.5205, p=0.0117^*$		Wilcoxon matched pairs $Z=2.6656, p=0.0077^*$					
Between 1 month vs 6 months	Wilcoxon matched pairs $Z=2.0226, p=0.0431^*$		Wilcoxon matched pairs $Z=2.6656, p=0.0077^*$					

\* $p < 0.05$ **Table 4** Comparison of two groups (Mc Gregor and Z Plasty) with appearance of face at 15 days, 1 month and 6 months time points by Mann–Whitney *U* test

Appearance of face	Mc Gregor	%	Z Plasty	%	Total	%	Z-value	<i>p</i> value
<i>15 days</i>								
Poor	1	8.33	0	0.00	1	4.17	−1.2702	0.2040
Fair	10	83.33	8	66.67	18	75.00		
Good	1	8.33	4	33.33	5	20.83		
<i>1 month</i>								
Fair	11	91.67	6	50.00	17	70.83	−1.7321	0.0833
Good	1	8.33	6	50.00	7	29.17		
<i>6 months</i>								
Fair	10	83.33	2	16.67	12	50.00	−2.7713	0.0056*
Good	2	16.67	10	83.33	12	50.00		
Total	12	100.00	12	100.00	24	100.00		
Between 15 days vs 1 month	Wilcoxon matched pairs $Z=0.0000, p=1.0000$		Wilcoxon matched pairs $Z=0.9129, p=0.3613$					
Between 15 days vs 6 months	Wilcoxon matched pairs $Z=0.0000, p=1.0000$		Wilcoxon matched pairs $Z=2.2014, p=0.0277^*$					
Between 1 month vs 6 months	Wilcoxon matched pairs $Z=0.0000, p=1.0000$		Wilcoxon matched pairs $Z=1.8257, p=0.0679$					

\* $p < 0.05$ 

## Discussion

Lip splitting approach gives better accessibility, visibility and helps in disease free margin resection for primaries situated in the posterior aspect of oral cavity and provides ease in flap in-setting, thus enhancing the oral seal to prevent secondary infection and communication to neck

[6, 7]. While one would think that the surgical involvement of the most esthetic zone of the face such as the lip and mentolabial unit would have irksome outcome, by abiding to the basic surgical principles, these techniques can provide the surgeon best accessibility and allow them to be more aggressive in tumor resection [8].



**Fig. 5** Z plasty (step ladder) incision at 6 months follow up



**Fig. 6** MacGregor incision showing accentuated scar at 6 months follow up



**Fig. 7** Z plasty (step ladder) showing good lip position

In the present study, McGregor has shown better results in oral incontinence as compared to z plasty group.

In the study conducted by Rapidis, though McGregor group presented with some degree of oral incontinence problem, it was worst in lateral lip splitting (Robson) and straight midline (Roux-Trotter) groups. The group with chevron chin contour (modified McGregor) presented with best results with respect to oral incontinence when compared to other groups [3].

The functional outcome after the oral access procedures have not been well documented and addressed in the past surgical literature. Spiro et al. in his study on mandibulotomy approaches to oral and pharyngeal tumors and did not involve in detail the functional outcome of the surgery. He only stated that most of the patients had a 'satisfactory function' and less than seven had persistent issues with swallowing [9].

Stanley advocated that re-attachment of all the muscle layers is essential to maintain the integrity of the oral diaphragm, which is vital for the functions of speech, swallowing and chewing [10].

However, one should note that oral incontinence in patients undergoing such extensive surgery cannot be attributed only to the type of lip splitting incision but it also can be the result of other important factors such as impaired lip mobility caused by loss of facial nerve, loss of sensation

**Table 5** Comparison of two groups (Mc Gregor and Z Plasty) with appearance of lips at 15 days, 1 month and 6 months time points by Mann–Whitney *U* test

Appearance of lips	Mc Gregor	%	Z Plasty	%	Total	%	Z-value	<i>p</i> value
<i>15 days</i>								
Poor	3	25.00	0	0.00	3	12.50	−1.8187	0.0690
Fair	9	75.00	9	75.00	18	75.00		
Good	0	0.00	3	25.00	3	12.50		
<i>1 month</i>								
Poor	2	16.67	0	0.00	2	8.33	−0.8660	0.3865
Fair	8	66.67	9	75.00	17	70.83		
Good	2	16.67	3	25.00	5	20.83		
<i>6 months</i>								
Poor	1	8.33	0	0.00	1	4.17	−2.4826	0.0130*
Fair	8	66.67	2	16.67	10	41.67		
Good	3	25.00	10	83.33	13	54.17		
Total	12	100.00	12	100.00	24	100.00		
Between 15 days vs 1 month	Wilcoxon matched pairs $Z=1.6036, p=0.1088$		Wilcoxon matched pairs $Z=0.0000, p=1.0000$					
Between 15 days vs 6 months	Wilcoxon matched pairs $Z=1.8257, p=0.0679$		Wilcoxon matched pairs $Z=2.3664, p=0.0180^*$					
Between 1 month vs 6 months	Wilcoxon matched pairs $Z=0.0000, p=1.0000$		Wilcoxon matched pairs $Z=2.3664, p=0.0180^*$					

\* $p < 0.05$ 

of the lip caused by removal of inferior alveolar (IA) nerve bundle and also loss of lip support caused by extraction of teeth and underlying bone by mandibulotomy/segmental mandibulectomy/marginal mandibulectomy/ hemi mandibulectomy procedures [3].

Overall, in this study, patients from Z plasty group have given better results for appearance of face and lips.

Rapidis suggested in his study that, to achieve best post-operative cosmetic results, it is mandatory to adhere to basic surgical principles and correct closure of the skin flap is critical [3, 11]. This includes layered suturing of the muscle, subcutaneous and skin, careful approximation of the right

skin points. In case of the areas involving esthetic zones like lip, one should give special attention to alignment of vermillion line which is essential for better cosmetic outcome.

In the study conducted by Rapidis et al., highest number of vermillion notching was seen in straight midline (Roux-Trotter) group and lateral lip splitting (Robson) group. Least vermillion notching incidence is in McGregor and modified McGregor group [3]. Ramon et al. in his study introduced the Z plasty or stepped lip splitting technique. He suggested that the “steps” or right-angled cuts provide accurate repositioning of the skin points [4]. Since Ramon’s stepped technique has more anatomical landmarks, it enhances tissue reapproximation, hence, the incidence of vermillion notching is less [4].

J. P. Hayter, in his technical note, suggested a modified lip splitting technique. He suggested that incorporating a small chevron at the vertical line of McGregor at perioral and vermillion border level can give better wound closure and hence give better esthetic outcome [12].

Christopher Rassekh in his study introduced a modification of the lip splitting technique called as “modified zig zag technique” [5]. He stated that the stepped technique given by Ramon et al. is a reliable technique but consists of small steps, i.e., smaller flaps. If there is ischemic loss of tips presents, it might lead to curvilinear scar of scar puckering. Hence, he advocates the use of slightly larger and more viable flaps for better esthetic results and less postoperative scar contracture.

**Fig. 8** MacGregor incision showing good outcome at 6 months follow up

**Table 6** Comparison of two groups (Mc Gregor and Z Plasty) with scar scores at 15 days, 1 month and 6 month's time points by Mann–Whitney U test

Time points	Mc Gregor			Z Plasty			U-value	Z-value	p value
	Mean	SD	Mean rank	Mean	SD	Mean rank			
15 days	2.17	0.39	8.33	3.00	0.60	16.67	22.00	−2.8868	0.0039*
1 month	2.58	0.51	7.67	3.67	0.49	17.33	14.00	−3.3486	0.0008*
6 months	2.92	0.51	7.71	4.08	0.67	17.29	14.50	−3.3198	0.0009*
Between 15 days vs 1 month	Wilcoxon matched pairs Z=2.0226, <i>p</i> =0.0431*			Wilcoxon matched pairs Z=2.2014, <i>p</i> =0.0277*					
Between 15 days vs 6 months	Wilcoxon matched pairs Z=2.5205, <i>p</i> =0.0117*			Wilcoxon matched pairs Z=2.5205, <i>p</i> =0.0117*					
Between 1 month vs 6 months	Wilcoxon matched pairs Z=1.8257, <i>p</i> =0.0679			Wilcoxon matched pairs Z=2.0226, <i>p</i> =0.0431*					

Hence, from the above studies, we can note that by incorporating chevron pattern, steps or zig zag pattern, we can achieve better repositioning of the flaps and better cosmetic outcome.

In Ramon's stepped technique, the incision extends through the lip and passes through depressor labii inferior muscle 2 mm lateral to the mentalis and reaches the lower border of the mandible lateral to the mentalis muscle. Throughout the incision, it forms small steps cutting through the fibers of depressor labii inferior muscle [4], whereas in McGregor's technique, the incision curvilinearly passes at labiomental sulcus and has lesser involvement of the depressor labii inferior muscle [13, 14]. This may attribute to the better functional results that are seen in group I (McGregor).

In the study conducted by Rapidis, the modified McGregor lip splitting (McGregor with chevron) showed better cosmetic results as compared to the straight midline Roux-Trotter incision (straight midline), McGregor incision (Straight Midline Chin-Contour), Robson incision (Lateral Lip Splitting). Christopher Rassekh stated that “geometric incisions” always produces pleasing and better cosmetic appearance. It has minimal asymmetry and hence gives a good frontal view and a contralateral oblique view [5].

## Conclusion

The Z plasty was found as a superior option when it comes to cosmesis due to its geometric nature which allows accurate approximation. McGregor provided better functional outcome. Hayter et al. modification of the McGregor incision (McGregor with chevron at vermillion) and Rassekh's modified zig zag technique, which is similar to stepped technique but involves larger flaps, have not been well evaluated and need to be studied further. The aim is to constantly evolve and study newer techniques and ultimately provide best results for the patients.

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