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A MODIFIED SUBMANDIBULAR APPROACH - ASSESSMENT OF OUTCOME

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ABSTRACT

The submandibular approach has been an integral tool in facial surgery since 1934. The technique is indicated in different clinical scenarios. This approach is governed by two key determinants; namely the skin tension lines and the course of the marginal mandibular branch.

Aim of study: this study suggests that moving the incision further into the neck while respecting the course of the facial nerve would help achieving both optimal esthetic outcome as well as less nerve injuries.

Materials and methods: eight patients requiring facial surgery, where the submandibular approach was indicated, were recruited and the modified submandibular incision was applied. The function of the facial nerve was followed up for six months using the Houseman-Brackman test. The esthetic result was assessed by two panels; consultant maxillofacial surgeons, and lay persons mainly concerned with the esthetics. The panel reviewed the cases through a power point presentation. A questionnaire customized to each panel's expertise was then provided.

Results: Surgeons grading intra-class correlation coefficient (ICC) showed that there was an excellent agreement in questions 1, 4, 5 and 7 (ICC=0.672, ICC=0.647, ICC=0.753 and ICC=0.679 respectively). The 5 different maxillofacial surgeons had excellent agreement on that the incision utilized accurately facilitated accessibility, good healing and pleasant esthetic outcome. Regarding lay persons grading, intra-class correlation coefficient (ICC) showed that there was an almost perfect inter-observer agreement on the success of the technique esthetically (ICC=0.826 and 0.838 respectively).

Conclusion: the modified submandibular approach provided better aesthetic results and lower risk of facial nerve injury.

KEYWORDS: Submandibular approach, Risdon incision , Modified submandibular approach.

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INTRODUCTION

The submandibular incision has been a valuable tool in head and neck surgery since the year 1934. It is one of the most useful and commonly used approaches to the mandible specially the body and the angle areas and usually referred to as Risdon approach.[1] This approach/incision is used for many operations in the oral and maxillofacial field like gaining access to mandibular osteotomies, fractures of the angle, body or even the condyles [2],TMJ ankylosis operations, lesions of the submandibular gland and some rare situations like removal of displaced third molar in the submandibular space (Iatrogenic displacement). [3]

Determining the position of the incision has been governed by a group of factors. The direction and position of the skin tension lines has been one of the key determinates of the incision position. The anatomical course of the terminal branches of the facial nerve particularly the marginal mandibular branch (MMB) has been another potent determinant factor. [4]

The course of the facial nerve following its division within the parotid gland is crucial to facial surgery. The facial nerve branches within the parotid gland into two main divisions the termporofacial and cervicofacial divisions.These two major divisions, branch further forming a plexus that undergoes a significant variation in the arborization pattern. The five terminal branches of the nerve (temporal, zygomatic, buccal, mandibular, and cervical) ultimately leave the parotid gland at the anteromedial surface to supply the muscles of facial expression. [5] The MMB of the facial nerve is the nerve in particular risk when performing the submandibular incision. This branch supplies the depressor anguli oris as well as the depressor labii inferioris. These muscles act to pull and close the angle of the mandible. Furthermore, it is responsible for pulling the lip downwards.

Injuries to the MMB nerve are one of the main causes of medicolegal litigation in the field of head and neck surgery. The reported injury to the MMB is from 0 to 20 % during removal of the submandibular branch but the real percent is believed to be higher than this percent. [6] Injury to the MMB during surgery results in cosmetic disfigurement. This spans from paralysis of both depressor anguli oris and the depressor labii inferioris muscles which will in turn cause flattening of the ipsilateral lower lip and its inversion and consequently the patient will not be able to move his lower lip in both the lateral and inferior direction resulting in asymmetry of the lower lip both during smiling and more pronounced during crying. [6]

According to Dingman & Grabb's study in 1962, [7] the course of the MMB below the mandibular inferior border has been the subject of considerable debate with reports of it located at 2 cm below the inferior border of the mandible . A group of authors[5] have casted doubt on the measurements derived from embalmed cadavers . On the other hand, some authors[6] described the change in location as an association with neck extensions performed during facial operative procedures. A Third point of view, is the disturbance in the region of the MMB could be secondary to the trauma or pathology that requires surgical intervention. Furthermore, some authors described more than one branch for this terminal branch of the facial nerve. [8]

The skin tension lines (STLs) described by Langerhans around the mandible follow a transverse orientation. The further from the mandibular border that we advance the more transverse these STLS become. It is only in following these STLS that a facial incision can be concealed, and its scar hidden from the observing individuals. [1]

In this study, we aimed to prove that placing the submandibular incision [9] in a deeper position into the neck will accomplish both better esthetic outcome as well as less nerve injuries.

MATERIALS AND METHODS

The study was conducted in accordance with the Declaration of Helsinki in ethical issues and was approved by the Institutional Ethics Committee. A total of 8 patients were recruited from hospital of the National Bank of Egypt. All the patients required a submandibular approach to operate on the mandible for different lesions. Table (1). All patients were consented to the application of the modified approach and for using the photographs and radiographs as well for educational and publishing reasons. The risks and possible nerve damages were explained before the surgery. All patients were presented with a written informed consent for reviewing and signing by the patient and a family member. Patients included in the study were those with normal facial nerve function undergoing a maxillofacial procedure that requires a submandibular approach.

TABLE (1): Showing patient demographic data and distribution of associated lesions.

Case number	Description	Gender	Age
1	Left Para-keratinized OKC of the mandible	F	25
2	Right Mandibular fibro-Myxoma	M	30
3	Sialoadenectomy of the left submandibular gland	M	45
4	Comminuted mandibular fracture	M	50
5	Comminuted mandibular fracture	M	35
6	Ameloblastoma of the Rt. mandible	M	50
7	Displaced third molar in the submandibular space	F	35
8	Central giant cell granuloma of the RT. mandible	F	30

Surgical Procedure

- The incision was marked at the first neck crease on the side receiving the incision.
- The distance from the inferior mandibular border was confirmed to have exceeded 3cm by direct measurement using a rigid ruler.
- Incision through the skin and subcutaneous layers was performed to expose the underlying fat layers.
- Fat was sharply sectioned at the level of the lower border of the incision. Careful dissection of the overlying skin flaps was performed extending superiorly to ease the retraction that will expose the mandibular border.
- An incision through the deep layer of the cervical facia was performed at the level of the inferior flap.
- Dissection proceeded towards the submandibular gland capsule. This was followed by retraction of the gland which exposes the pterygo-masseteric sling.

-Identification of the MMB and facial vessels was performed at this step and the vessels were only retracted in the case series and never sectioned.

- Sharp incision through the sling exposed the inferior border of the mandible.
- An intraoral incision was advocated in three cases. This was to ease either the administration of hardware or surgical excision the submandibular duct.
- The incision was closed in layers using vicryl suture for the deep layers and a subcuticular running mattress for the skin using 5/0 prolene.

Postoperative Phase and Follow up

All sutures were removed after five days post operatively. The patients were all followed for a period of 6 months to one year. Follow up included a postoperative CT scan at the first follow up visit to assess the surgical procedure outcome. House-Brackmann test was performed to assess facial nerve function on a monthly basis during the follow

up interval. Tables (2, 3). Photographs were taken at one week, six months and one-year intervals. Observation and assessing the patient neck mobility was done throughout the follow up visits. Follow up was performed by a single assessor blinded to the operating team.

TABLE (2): Assessment of motor response of marginal mandibular nerve

• Marginal mandibular branch	• The ability of the patient to smile, grin showing his teeth and moving his lower lip lateral and downwards. • Assess the degree of drooping & asymmetry of the lower lip during function.

TABLE (3): Grades of House-Brackmann test

I.	Grade I	Normal function
II.	Grade II	Mild dysfunction
III.	Grade III	Moderate dysfunction
IV.	Grade IV	Moderately sever dysfunction
V.	Grade V	Sever dysfunction
VI.	Grade VI	Total paralysis

Assessment of Outcome:

The pre-operative, post-operative radiographs along with the photographic images of all patients were compiled into a power point presentation. Each case was assigned a number. All images of the patients were masked at the eye level anonymize the participating individuals. The presentation was shared with a panel of five consultants of oral and maxillofacial surgery OMFS blinded to the operating team. The consultants were selected randomly from oral and maxillofacial surgery units across Egypt. The power point presentation and questionnaire were communicated by email to the surgeons that accepted participating in the study (Supplemental Figure 1). The grading system was explained by direct interview over the phone with the participating surgeons by one of the authors AA blinding the panel to the operating team. Each member of the panel gave a score out of 10, 1 as the worst result while 10 was considered the best result.

A second power point presentation focusing only on the postoperative images of the patients who participated in the study in frontal views as well as worm eye views, was shared with a panel of five lay persons. The Panel of lay persons was selected randomly from dental students. The lay persons were asked to answer a questionnaire focusing on the quality of the scar that the patients had following surgery. (Supplemental Figure 2). Each member of the panel gave a score out of 10 for the aesthetic appearance and outcome. (Supplemental figure 3,4,5,6,7)

Statistical analysis:

Statistical analysis was performed using IBM SPSS Statistics Version 2.1 for Windows. Data was presented as mean and standard deviation (SD). Intra-class correlation coefficient (ICC) with 95% confidence interval (CI) was used to evaluate the inter-observer reliabilities of surgeons and lay persons grading. Based on the study by Landis and Koch (1997), the ICC scale was interpreted as follows: poor (0.0–0.20) to fair (0.21–0.40), moderate (0.41–0.60), excellent (0.61–0.80), and almost perfect (0.81–1). The Mann-Whitney test was advocated for the statistical analysis .

Questionnaire Form

Name: .....

Specialty: .....

Please grade according to your opinion: .....

1: Do you think that the incision facilitated the accuracy of the surgical management of the case?									
1	2	3	4	5	6	7	8	9	10
Least Satisfactory									Most Satisfactory
2: Accuracy of the surgical outcome in relation to the modified incision:									
1	2	3	4	5	6	7	8	9	10
Least Satisfactory									
3: Lower lip abnormalities:									
1	2	3	4	5	6	7	8	9	10
Least Satisfactory									
4: Healing of the surgical site:									
1	2	3	4	5	6	7	8	9	10
Least Satisfactory									
5: Quality of the esthetic healing of the modified incision done:									
1	2	3	4	5	6	7	8	9	10
Least Satisfactory									
6: Grade the overall post-operative outcome:									
1	2	3	4	5	6	7	8	9	10
Least Satisfactory									

Supplemental Figure 1: questionnaire for the panel of the consultant maxillofacial surgeons.

Supplemental Figure 2:questionnaire for the lay persons panel

1- Quality of the esthetic healing of the modified incision done:									
1	2	3	4	5	6	7	8	9	10
Least Satisfactory									Most Satisfactory
2- Grade the overall post-Operative Outcome:									
1	2	3	4	5	6	7	8	9	10
Least Satisfactory									Most Satisfactory

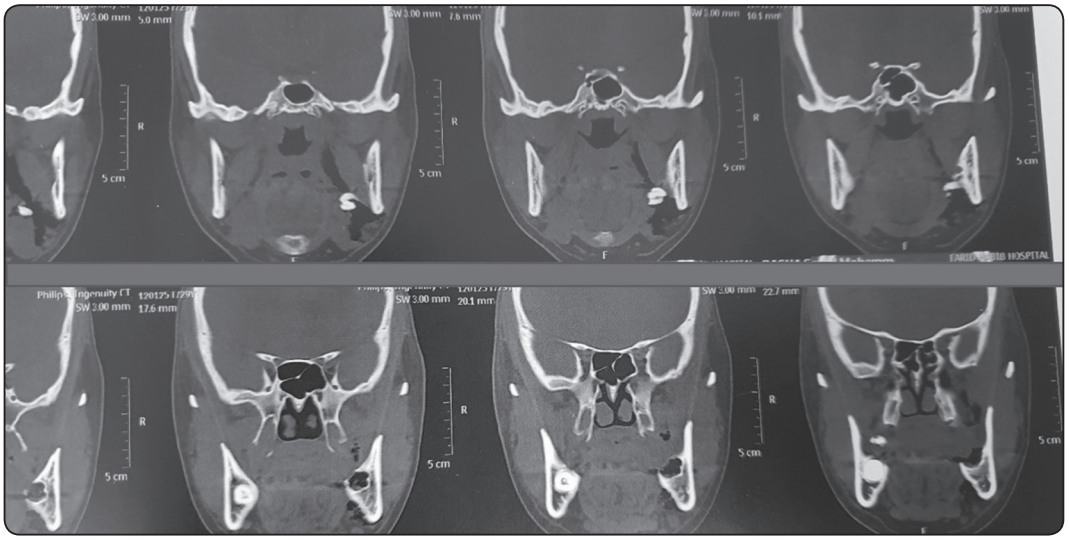

Fig. (3): CT showing displaced third molar.

Fig. (4): OPG showing displaced third molar

Fig. (5) Showing the sutured incision and its site in the neck

Fig. (6) Showing the retrieved displaced third molar

RESULTS

The study included 8 patients (5 males and 3 females) who required submandibular incisions to treat different maxillofacial lesions, our patients age range was from 25 – 50 years (average age was 37.5 years).

During the follow up period, 3 cases showed mild to moderate facial nerve dysfunction. The first case showed grade II mild dysfunction (according to House-Brackman test) in the first week post-operatively that disappeared at the 3 months follow up visit. The second case displayed grade III dysfunction in the left side only which was restored after 3 months. The last showed grade II dysfunction that reverted to normal 6 months after the surgery. Table (4)

Regarding surgeons grading, intra-class correlation coefficient (ICC) showed that there was an excellent agreement in questions 1, 4, 5 and 7 (ICC=0.672, ICC=0.647, ICC=0.753 and ICC=0.679 respectively).Table (5). The 5 different maxillofacial surgeons had excellent agreement on that the incision made, accurately facilitated the surgical management of the case, the site of the operation had a good healing outcome and the quality of the esthetics after healing was pleasing. Table (6), figure (6). Furthermore, they agreed on recommending, practicing and teaching the same technique for other OMFS trainees in the future. On the other hand, the 5 maxillofacial surgeons gave a moderate agreement in questions 2, 3 and 6. These questions were evaluating their opinions regarding

TABLE (4): Results of House-Brackmann system on our cases

	(1-day post-op)	1 Week post-op	3 Months post-op	6 months Post-op	1 Year post-op
Case no.1 Left Para-keratinized OKC of the mandible	Grade II	Grade II	Grade I	Grade I	Grade I
Case no 2 Right Mandibular fibro-Myxoma	Grade I	Grade I	Grade I	Grade I	Grade I
Case no 3 Sialoadenectomy of the left submandibular gland	Grade II	Grade II	Grade I	Grade I	Grade I
Case no 4 Comminuted mandibular fracture	Grade I	Grade I	Grade I	Grade I	Grade I
Case NO. 5 Comminuted mandibular fracture	Grade II	Grade II	Grade II	Grade I	Grade I
Case no 6 Ameloblastoma of the Rt. mandible	Grade I	Grade I	Grade I	Grade I	Grade I
Case NO 7 Displaced third molar in the submandibular space	Grade I	Grade I	Grade I	Grade I	Grade I
Case NO 8 Central giant cell granuloma of the RT. mandible	Grade I	Grade I	Grade I	Grade I	Grade I

the accuracy of the surgical outcome in relation to the modified surgical incision, abnormalities in the lower lip after the surgery and the overall outcome from the modified surgical approach (ICC=0.556, 0.583 and 0.521) respectively. Table (5)

Regarding lay persons grading (Table 7), intra-class correlation coefficient (ICC) showed that there was an almost perfect inter-observer agreement in question 1 and 2 (ICC=0.826 and 0.838 respectively). This agreement indicated that they found the technique esthetically pleasing in terms of scar appearance.

TABLE (5) : Mean±SD of surgeons grading to different questions and inter-observer reliability values.

		Surgeon 1	**Surgeon 2**	**Surgeon 3**	**Surgeon 4**	**Surgeon 5**
Q1	**Mean±SD**	6.5±2.5	9.3±1.7	8.25±2.5	9.3±1.7	9.3±1.7
	ICC	0.672				
Q2	**Mean±SD**	7.1±2.1	9.3±1.7	8.1±1.5	9.3±1.7	9.3±1.7
	ICC	0.556				
Q3	**Mean±SD**	6.0±3.1	9.4±1.7	8.3±2.2	9.3±1.7	9.4±1.7
	ICC	0.583				
Q4	**Mean±SD**	6.6±3.2	9.3±1.7	8.2±1.3	9.3±1.7	9.3±1.7
	ICC	0.647				
Q5	**Mean±SD**	6.3±2.7	8.5±2.4	7.7±1.4	8.5±2.4	8.5±2.4
	ICC	0.753				
Q6	**Mean±SD**	7.7±1.1	8.0±1.9	8.3±2.2	8.0±1.5	7.8±1.2
	ICC	0.521				
Q7	**Mean±SD**	7.5±1.8	8.8±3.2	7.0±2.8	8.8±3.2	8.8±3.2
	ICC	0.679				

TABLE (6): Summary of the questionnaire sent to the oral and maxillofacial surgeons

Question No	ICC	Agreement
1	0.672	Excellent agreement between the surgeons
2	0.556	Moderate agreement between the surgeons
3	0.583	Moderate agreement between the surgeons
4	0.647	Excellent agreement between the surgeons
5	0.753	Excellent agreement between the surgeons
6	0.521	Moderate agreement between the surgeons
7	0.679	Excellent agreement between the surgeons

TABLE (7): Mean±SD of lay persons grading to different questions and inter-observer reliability values.

		Lay 1	Lay 2	Lay 3	Lay 4	Lay 5
Q1	**Mean±SD**	7.8±1.6	7.5±1.6	7.6±1.0	7.3±1.0	8.2±1.0
	ICC	0.826				
Q2	**Mean±SD**	8.5±1.6	7.8±1.5	7.6±0.9	7.3±1.0	8.3±0.9
	ICC	0.838				

DISCUSSION

The facial nerve has 5 main terminal motor branches which supply many areas of the face, one of the terminal branches the MMB is at high risk of injury up to 20% risk of injury during the submandibular incision approach to perform extra-oral surgeries on the neck and mandible.[6]

This branch gives motor supply for the orbicularis-oris muscle, depressor angularis muscle, depressor labii inferioris muscle and the mentalis muscle. Injury to this branch will cause a major problem to the patient which is reflected postoperatively as deficient or even total loss of motor function of the lower lip specially while the patient smiles. MMB of the facial nerve passes just anterior or over the inferior border of the mandible. It then courses downward and forward under the lower lip depressor muscles. It also communicates with the cervical branch via some anastomosing branches. Furthermore, it then supplies the mentalis muscle and the labii inferioris muscle as well.

There is a great debate regarding the position of the anatomical course of MMB. Although some authors suggest that the marginal mandibular rarely passes below the inferior border of the mandible [9]; the finding that increased risk of injury to that particular branch, after the original submandibular incision has been performed, is suggesting the opposite of their claim. Moreover, various reports form cadaveric studies suggest that the MMB may be located as high as 6.9 mm and 6.5 mm above, and as low as 4 mm and 3 mm below the mandibular base on right and left sides respectively.[10] The mean total length of the nerve until the muscular termination point was calculated 33.57 (S.D 3.41) mm on the right and 33.51 (S.D 4.88) mm on the left side.

It has been postulated that the submandibular incision should be placed at a distance greater than the 2cm to avoid injury of the marginal mandibular branch. Though in the conventional approach the incision line is placed in a hidden area; yet the esthetic outcome is dependent on many individual variability such as skin thickness and amount of subcutaneous fat tissue, mandibular plane angle and mandibular body height.This case series supports that placing the incision in a lower position than the original one in a natural neck crease will result in a favorable esthetic outcome while respecting the anatomy of the MMB. The esthetic outcome is established by the ability of the patient to return to his social life. On the other hand, the incision placed further in the neck should not hinder or impede the surgical procedure to be undertaken.

In this study, different maxillofacial applications were selected to thoroughly assess the versatility of the procedure. The questionnaire focused on the ability of the surgical technique to achieve the surgical outcome needed. Furthermore, the opinion of the lay persons would cover the unbiased esthetic assessment of outcome showing no prejudice for or against in an impartial manner.

The selection of each panel was undertaken carefully to avoid bias. The panel of maxillofacial

consultants was selected after an invitation mail was sent out from one of the Authors. The panel was blinded to the operating team and were asked to assess the results through the questionnaire. When the results of the questionnaire were analyzed; there was an excellent agreement among oral and maxillofacial surgery consultants on that the incision made accurately facilitated the accessibility and surgical management of the case, provided good healing outcome, optimal esthetics after healing, that they would recommend, practice and teach the same technique for younger trainees in OMFS specialty in the future. These findings support further advocation of the modified approach. On the other hand, the 5 maxillofacial surgeons gave a moderate agreement in questions 2, 3 and 6. These questions were evaluating their opinions regarding the accuracy of the surgical outcome in relation to the modified surgical incision, abnormalities in the lower lip after the surgery and the overall outcome from the modified surgical approach respectively. Despite this statistical fact, the individual grades for these questions are quite supportive of the result.

CONCLUSION

Placing the submandibular incision within the natural skin crease in a lower position than that employed in the Risdon approach yielded a better aesthetic results and lower risk of facial nerve injury which might be reflected as loss of motor supply for facial muscles supplied by the facial nerve specially those of the lower lip. The authors of this study recommend further research, larger sample size and different applications for surgical intervention of the mandible and neck regions to validate and support that less facial nerve injury can be achieved using this modified technique.

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