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Delta And Lambda Plate For Open Reduction And Internal Fixation Of Mandibular Subcondylar Fracture: A Comparative Study

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INTRODUCTION

Facial injuries attributed to various factors are more common in the modern era.The temporomandibular joint is certainly not exempt from injury related to these factors. The condylar process forms an important component of temperomandibular joint and integrity of the condylar process takes part in proper occlusion and facial appearance. The anatomic complexity of this region makes diagnosis and treatment particularly challenging. In addition to its role in the processes of speech, mastication, swallowing, and facial expression makes proper management of these injuries paramount[1].Neck of condyle is a constricted part just below the head and is a site of attachments for many muscles and ligaments.In terms of strength, the condylar neck constitutes the weakest region of the entire mandible and is therefore the most susceptible to fracture as a result of indirect forces, where the forces of impact are transmitted along the mandible from distant sites such as the angle, body or symphysis to the condylar[4] neck.The main potential anatomic problems in temporomandibular joint surgery are the facial nerve and the terminal branches of the external carotid artery.Ideally, the selected approach should accomplish maximize exposure for the specific procedure, avoid damage to the branches of the facial nerve, avoid damage to major vessels,avoid damage to the parotid gland, maximize use of natural skin creases for cosmetic wound closure. Common causes of most mandibular trauma include motor vehicle accidents,interpersonal violence,falls and sports-related injuries.The term condylar fractures can be applied to the fractures of the condylar process which occurs between the sigmoid notch, including articular surface of condyle.Condylar fracture accounts for 25-35% of all mandibular fractures and deserves a special consideration apart from rest of the mandible due to their anatomical differences and healing potential.Several clinicians have developed classification schemes to describe condylar process fractures.Spiessl and Schroll,[6] published one of the first classifications of condylar process fractures based on displacement and dislocation, Lindhal [7]proposed another classification, based

on the level of fracture, relationship of condyle to ramus and to glenoid fossa. The method of fixing condylar fracture is either by open reduction or by closed reduction, which has always evoked controversies[8].But many agree that treatment must include restoration of functional occlusion, acceptable appearance of face and normal working of jaws. As improved material for fixation has been introduced and surgical techniques have been refined, a shift has occurred with acceptance and even reliance of rigid internal fixation by both surgeon and patient.The final choice[10] of treatment for each individual take into account a number of factors including position of condyle, location of fracture, duration of fracture, age of the patient, presence or absence of other associated injuries, presence of other systemic conditions, history of previous injury, cosmetic impact of surgery and desire of the patient. Producing good results with open reduction depends on correct application of technique. The principle behind open reduction and internal fixationwith miniplate osteosynthesis is *"functionally stable osteosynthesis*" as proposed by champy[11,12] et al.Champy determined ideal line of osteosynthesis in the region of mandibular body but no such lines were proposed in the region of condyle because of limited data. Mayer et al[13] attempted to fill the void to determine ideal line of osteosynthesis in the region of condyle. Multiple approaches have been proposed and used in order to visualize and reduce condylar fractures which include the intra-oral,coronal, preauricular,facelift(Rhytidectomy),post-auricular,endural,endoscopic,retromandibular[14,15] submandibular and often in combination. Potential damage to facial nerve and its branches with some approaches[16] and possibility of post-operative scar have drastically affected the choice of surgical approach. Retromandibular[17] approach deserves special attention as it is ideally suited to the technique of miniplate osteosynthesis in the area of difficult access. This approach seems to give the benefits of the direct access, good cosmesis and adequate exposure for manipulation and reduction of the fracture and for placement of fixation. The single plate[20] fixation technique does not provide sufficient strength to withstand the strains occurring in subcondylar fractures Ideally two miniplates[21] should be applied in the posterior and anterior border of the condylar neck in a triangular fashion with one plate below the sigmoid notch and another plate along the posterior border of the ramus. Hence, it was concluded that the use of two correctly positioned plates for the stabilization of subcondylar fractures is currently the best solution in order to provide stable osteosynthesis in subcondylar fractures, but an experimental study showed that 2 miniplate osteosynthesis[22] with forces directed in lateral and anteroposterior direction is most stable .In contrast newer plate like *delta*[23] plate and *lambda* plates[24] owing to its design withstand better forces directed medio- lateral and antero-posterior directions thus thought to be providing three dimensional stability.This demanded for introduction of newer osteosynthesis system that provided three dimensional stability with other added advantage

MATERIALS AND METHODS

Patients diagnosed clinically and radiographically with definitive mandibular sub-condylar fracture, requiring open reduction and rigid internal fixation who reported to Department of Oral and Maxillofacial Surgery, A.J. Institute of Dental Sciences Mangalore were included in the study.Ethical clearance was obtained from institutional ethical clearance committee prior to study.Written informed consent were obtained from each patient.18 Patients were equally divided into two groups of 09 each using simple random sampling. Group 1 included 09 patients, fracture fragments were stabilized using titanium *Delta* plate***(Fig.1).***Group 2 included 09 patients, fracture fragments were stabilized using titanium*Lambda* plate***(Fig.2).***

Inclusion Criteria: Patients between 18-60 years of age ,displaced subcondylar fracture requiring open reduction and rigid internal fixation,fracture duration less than 2weeks

Exclusion Criteria:Communited condylar fracture /dicapatular fractures, presence of any pathology in the vicinity of fracture site, previous history of trauma in condyle on same side or contra

lateral side, congenital anomalies associated with mandible, medically compromised patients who are not fit to undergo surgery under general anesthesia. All surgical procedures were performed under general anaesthesia after a complete hemogram study, investigations by radiographs and CT scan, obtaining medicine fitness and after pre- anaesthetic evaluation (PAC) for the intended procedures. All operative procedures were
carried out by a single surgeon.

Preoperative assessment : Clinical assessment includes:
Occlusion evaluation for derangement, Maximum interincisal distance, Mandibular deviation on mouth opening Radiological assessment includes:
Orthopantamograph (OPG) evaluation for Overriding of fracture fragments ,Level of condylar fracture ,Shortening of ramus ,Presence of any pathology/ other associated fracture in mandible
Computed tomography (CT) scans evaluation for {coronal view}:Direction of Displacement of condyle ,Associated fractures ,Level of fracture

Intraoperative Assessment: Time taken (in minutes) from after achieving anatomical reduction till fixation of either of the plate noted using stop clock.Ease of miniplates adaptation (Surgeon's Evaluation),Stability of fracture fragments by carrying out all the functional mandibular movements.

Postoperative Assessment:
Clinical evaluation: (1month, 3 months and 6 months) Occlusion evaluation, Maximum interincisal distance. Mandibular deviation on mouth opening, Functional deficit, if any.

➢ Radiographic evaluation using Orthopantamograph (OPG):

➢ At 1 week post-operatively:

To assess proper anatomical reduction of the fracture fragments, plate adaptation, plate fracture or loosening of screws observed.

➢ At 1month and 3months post-operatively for : Bony consolidation,Degree of secondary displa cement, Plate infection, Plate fracture,Loosening of the screws

Surgical procedure:
Patient made to lie down in a supine position, painted and draped under aseptic conditions.The surgerywas performed under deliberate hypotensive general anaesthesia with nasotracheal intubation. Throat pack placed and intraoral asepsis achieved using chlorhexidine. All the fractures were addressed byRetromandibular approach (Hind's Incision) for fixing both *Delta* and lambda plates. Markings for the retromandibular approach done using marker pen***(Fig.3).*** Local infiltration of Lignocaine with adrenaline (1:2, 00,000) along the incision line is administered. Approach: Skin incision 2 cm long, parallel to the posterior border of the mandible, commencing 0.5cm below the earlobe. Incision will be placed using a No.15 BP blade only for skin. Dissection: After that deep dissection will be done using diathermy with blunt dissection in parotid gland using small curved haemostat. The parotid capsule will be incised and the gland will be blunt dissected in an anteromedial direction. A haemostat is repeatedly inserted and spread open – parallel to the anticipated direction of the facial nerve branches.Pterygomassetric sling was identified and dissected. Masseter muscle was stripped from lateral surface of mandible upwards to visualize fractured condyle. When the bone surface is reached, the periosteum is elevated and the fracture is identified and reduced. To facilitate fracture reduction, the distal stump is mobilised caudally by applying intraoral pressure to the last mandibular molars with a finger.Fracture was reduced anatomically under direct vision, start time in minutes using stop watch is noted down, followed by fixation carried out using, ***Delta* plate** as per the specification base is oriented towards the angle of the mandible. At the top of the plate is an arm with 2 longitudinally arranged holes, two more holes form the 2 corners of the base of the plate. Fixation is completed using 8mm screw***(Fig 4)*** ***Lambda plate*** osteosynthesis system depending upon the manufacturer's specification, long arm positioned along the posterior border of the mandible with the oblique extension under the

sigmoid notch and two screws in the Condylar fragment and the remaining two distributed along the ramus.The anterior arm is adapted to follow the sigmoid notch and fixation done using 8mm screw***.(Fig 5)***.Immediately after fixation of all the screws in either of the plates, clock is stopped time (in minutes) is recorded.Functional mandibular movements were carried out to check for stability.Deliberate hypotensive anaesthesia was discontinued and wound was checked for bleeding vessels. Haemostasis achieved .Surgical site irrigated using Betadine and Gentamycin. Watertight closure of parotid capsule was achieved during closure. Layered closure with resorbable sutures (3-0 vicryl) and skin closure for retromandibular approach, suturing was done subcutaneously using 4-0 nylon. Throat pack removed .Pressure dressing using Dynaplast done over the incision site. Patient extubated and shifted to post-op ward uneventfully. Postoperatively IV antibiotics continued for 5days and IV fliuds stopped on first post- operative day.6th day post-operatively IV medications are stopped and oral medications prescribed. Suture removal done on 7th postoperative day. Patients discharged on 7th post-operative day.Advised: Soft diet, Mouth opening exercise.

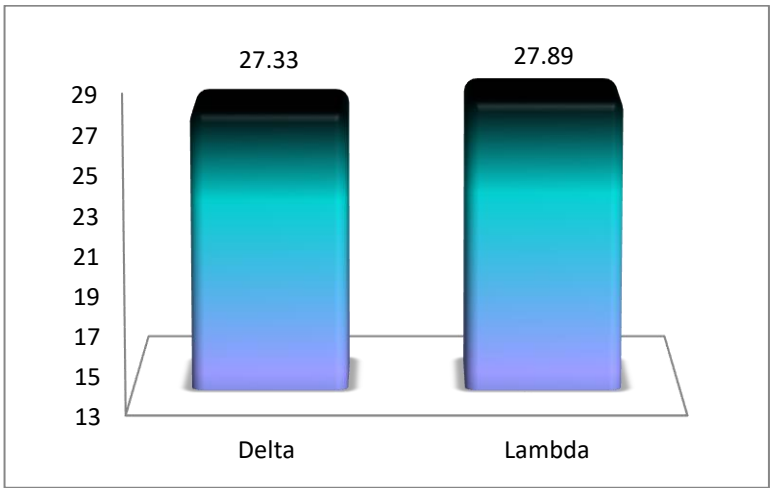
RESULTS

The present study was carried out on 18 patients to evaluate the efficacy of specially designed titanium delta and lambda plate in the management of mandibular subcondylar fracture.18 patients (09 patients each) were randomly allotted to group1 (delta plate) and group 2 (lambda plate) respectively. Age group included in this study was in the range of 18- 60 years. The peak incidence in terms of age emerge in the both group was 27.33 years in Group 1{Delta plate} (SD 3.162) and Group 2{Lambda plate} 27.89years (SD3.919) respectively. No significant difference was observed in terms of age of the two groups. ***(Table1,Graph1***)Left side of condyle was most commonly involved in fracture than right side. Out of 18 patients we observed total of 11(61.11%) fractures on left condyle, while 9(50%) patients had of the fractures on the right condyle in both the group.Unilateral distribution of condylar fracture was observed more commonly than bilateral distribution in both the group. Out of 3(16.7%) patients presenting with bilateral subcondylar fracture,2 (22.2%) were in group1(Delta plate) and 1(11.1%) in group2(lambda plate), and of 15 (83.3%) unilateral subcondylar fractures 7 (77.8%) were included in group 1(delta plate) and 8(88.9%) in group 2(Lambda plate) making it total of 21 fractures. All the patients were managed by ORIF of subcondyle using either titanium DELTA plate (9/9) or LAMBDA plate (9/9) plates viaretromandibular approach.Operating time for treatment of one condyle range from 25-30 minutes. To assess the surgical ease the time taken (in min) after anatomic reduction till the fixation of subcondyle. Based on this time scale time taken was significantly higher in the group2 (lambda) as majority of the lambda operations are >25 minutes and is statistically significant with p value of 0.009 ***(Table 2, Graph 2***)Mouth opening of all operated case range from 30-40 mm .Among 18 patients more than 40mm (88.9%) mouth opening was achievedwhich was 7(77.8%) in group1 (Delta Group) and 9(100%) in group 2 (lambda plate).2 patients in group 1(Delta Group) mouth opening achieved was between 30-39mm.There was significant improvement in mouth opening in either of the group post-operatively. ***(Table 3, Graph 3)*** Most patients in this study has a satisfactory occlusion postoperatively 17(94.4%) in which 1 patient in group 2 (Lambda plate) had slight derangement in occlusion which improved on postoperative IMF for 2weeks. ***(Table 4, Graph 4)***Persisting deviation on mouth opening were clinically observed post-operatively and recorded. In this study post-operative deviation were persisting in only 2(11.1%) patients one each in both the group***(Table 5, Graph 5)***.Postoperative radiographic assessment were done using orthopantamograph (OPG) Accurate reduction was achieved in 7(77.8%) patients in group 1(delta plate) and 8(88.9%) patients in group 2(lambda plate) and. Slight displacement was observed in 22.2%(2/9) patients in group1(delta plate). Good anatomical reduction in group 2 (lambda plate) was attributed to its design and adaptability. ***(Table 6, Graph 6)***Looking at the complications as a result of the treatment, in this study, none of the cases were reported with plate fracture, loosening of the screw or infected implant requiring implant removal. All though sialocele was

observed in 5(27.8%) patients, which is attributed to the approach, it was resolved after 2 weeks post-operatively, facial nerve parasthesia observed in all patients in either of the group which was only transient in nature. ***(Table 7 Graph 7)***

Table 1: Mean age in a sample population

	GROUP	N	Mean	Std. Deviation	t	df	Sig. (2-tailed)
AGE	Delta	9	27.33	3.162	-0.331	16	0.745
	Lambda	9	27.89	3.919			



Graph 1: Mean age in a sample population Mean age in group1 was 27.33 years and in group 2 was 27.89 among the age group of 18-60 years included in this study.

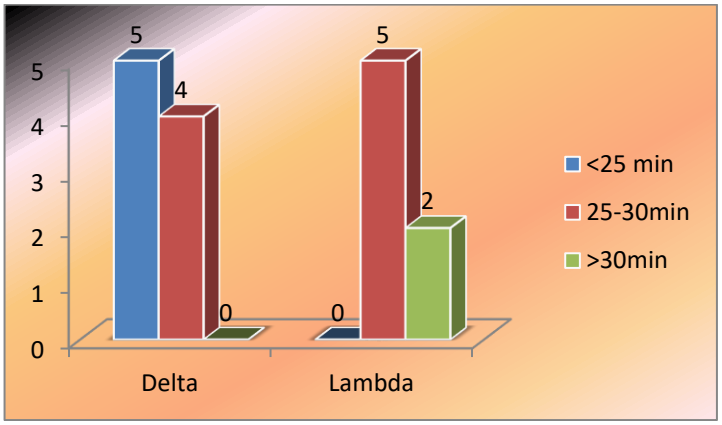
Table 2: Ease of plate fixation It is the time taken after anatomical reduction of fracture fragments till the fixation of the plate.

Crosstab

			GROUP		Total
			Delta	Lambda	
TIME TAKEN	<25 min	Count	5	0	5
		% within GROUP	55.6%	0.0%	27.8%
	25-30 min	Count	4	5	9
		% within GROUP	44.4%	55.6%	50.0%
	>30 min	Count	0	4	4
		% within GROUP	0.0%	44.4%	22.2%
Total		Count	9	9	18
		% within GROUP	100.0%	100.0%	100.0%

Chi-Square Tests

	Value	P value (sig if <0.05)
Pearson Chi-Square	9.111	.009
N of Valid Cases	18	

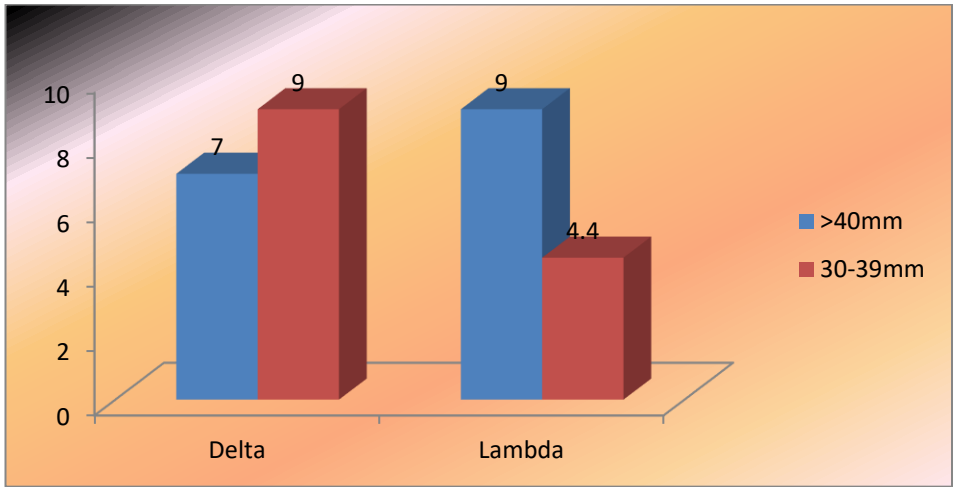


Graph 2 Ease of plate fixation time taken for fixation of lambda plate was more as compared to delta plate, which was statistically significant

Table 3: Post-operative mouth opening assessment

Crosstab					
			GROUP		Total
			Delta	Lambda	
MOUTH OPENING POST-OP	>40 mm	Count	7	9	16
		% within GROUP	77.8%	100.0%	88.9%
	30-39 mm	Count	2	0	2
		% within GROUP	22.2%	0.0%	11.1%
Total		Count	9	9	18
		% within GROUP	100.0%	100.0%	100.0%

Chi-Square Tests		
	Value	P value (sig if <0.05)
Pearson Chi-Square	2.250	.471
N of Valid Cases	18	
b. Computed only for a 2x2 table		

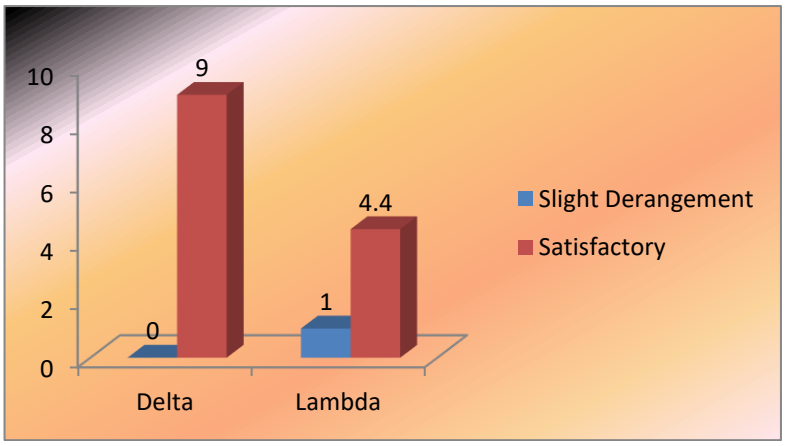


Graph 3: Post-operative mouth-opening assessment Post-operatively mouth-opening was measured among both the group, it was observed that mouth 6 opening was satisfactory in both the group (>40mm)

Table 4:0cclusion assessment (post-operatively)

Crosstab					
			GROUP		Total
			Delta	Lambd a	
OCCLUSION POST- OP	SLIGHT DERANGEMENT	Count	0	1	1
		% within GROUP	0.0%	11.1%	5.6%
	SATISFACTORY	Count	9	8	17
		% within GROUP	100.0%	88.9%	94.4%
Total		Count	9	9	18
		% within	100.0%	100.0%	100.0%

Chi-Square Tests		
	Value	P value (sig if <0.05)
Pearson Chi-Square	1.059	1.000
N of Valid Cases	18	
b. Computed only for a 2x2 table		

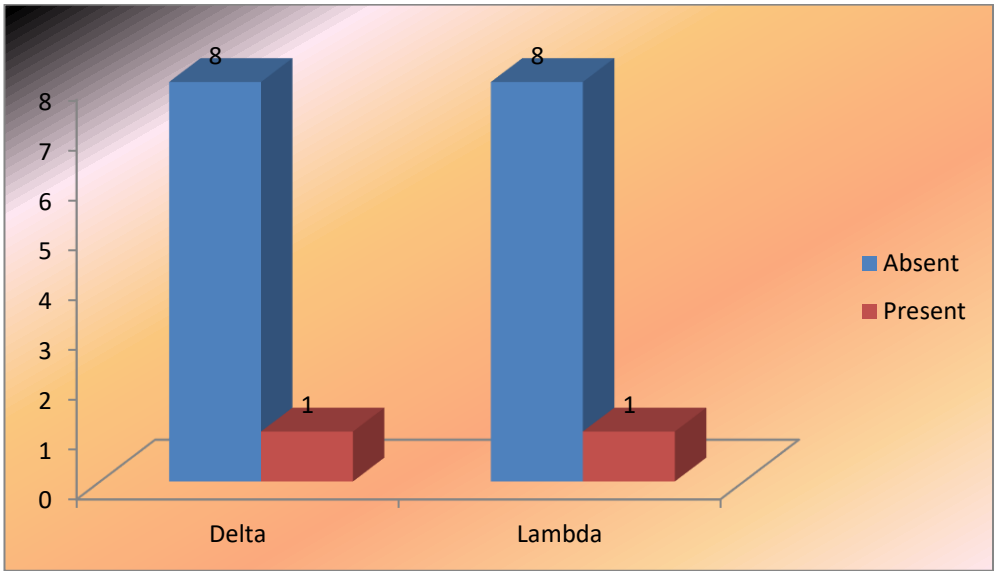


Graph 4: Occlusion assessment (post-operatively) Satisfactory occlusion achieved in both the group post-operatively, 88.9% in lambda group and 100% in delta group.

Table 5: Deviation on mouth opening (post-operative)

Crosstab					
			GROUP		Total
			Delta	Lambda	
Deviation postop	absent	Count	8	8	16
		% within GROUP	88.9%	88.9%	88.9%
	present	Count	1	1	2
		% within GROUP	11.1%	11.1%	11.1%
Total		Count	9	9	18
		% within GROUP	100.0%	100.0%	100.0%

Chi-Square Tests		
	Value	P value (sig if <0.05)
Pearson Chi-Square	.000	1.000
N of Valid Cases	18	
b. Computed only for a 2x2 table		

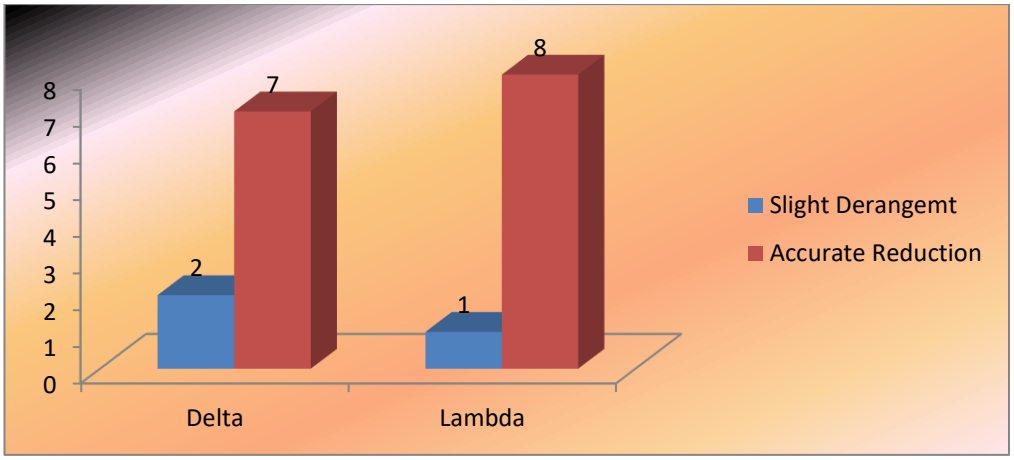


Graph 5: Deviation on mouth opening (post-operative) Only 2 patients in lambda group had a deviation on mouth opening, attributed to presence of 631 bilateral fracture

Table 6: Radiographic evaluation (post-operative)

Crosstab					
			GROUP		Total
			Delta	Lambd a	
RADIOGRAPHIC EVALUATION post-op	SLIGHT DISPLACEMENT	Count	2	1	3
		% within GROUP	22.2%	11.1%	16.7%
	ACCURATE REDUCTION	Count	7	8	15
		% within GROUP	77.8%	88.9%	83.3%
Total		Count	9	9	18
		% within GROUP	100.0%	100.0%	100.0%

Chi-Square Tests		
	Value	P value (sig if <0.05)
Pearson Chi-Square	.400	1.000
N of Valid Cases	18	
b. Computed only for a 2x2 table		

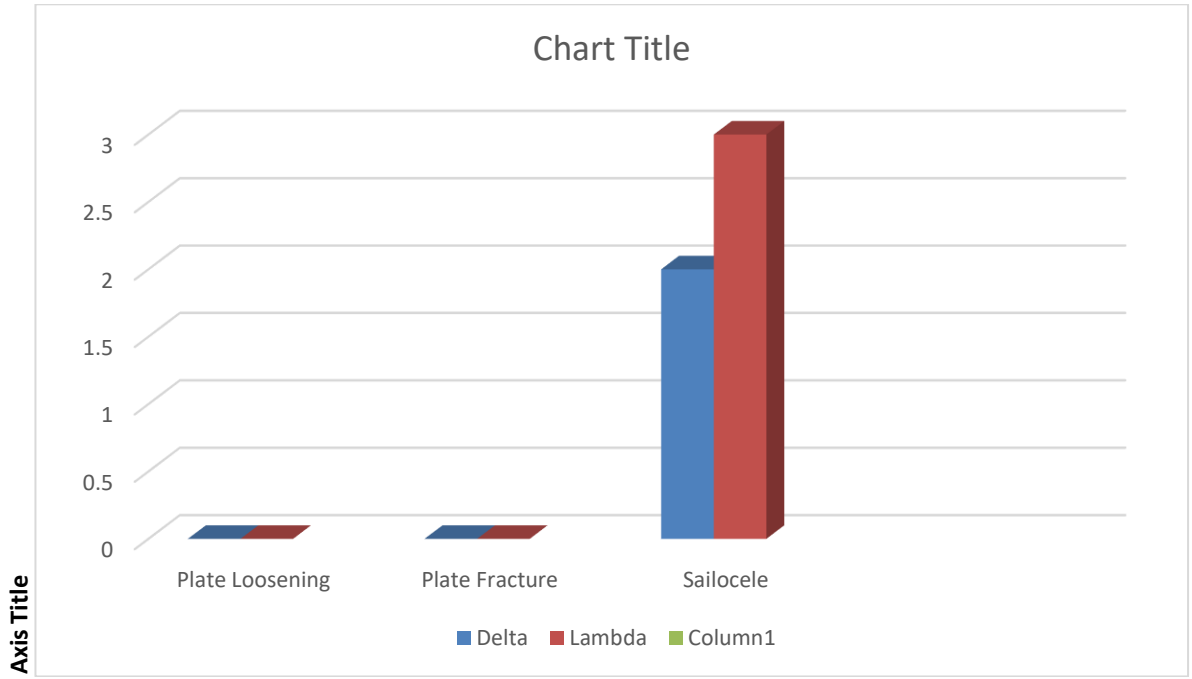


Graph 6: Radiographic evaluation (post-operative) Accurate reduction achieved radiographically in 7 (77.8%)

patients in group1 and 8 (88.9%) in group2 respectively

Table 7: Complications

Crosstab					
			GROUP		***Total***
			Delta	Lambda	
Plate loosening	Absent	Count	9	9	18
		% within GROUP	100.0%	100.0%	100.0%
Plate fracture		% within GROUP	100.0%	100.0%	100.0%
Sialocele	Absent	Count	7	6	13
		% within GROUP	77.8%	55.6%	66.7%
	present	Count	2	3	5
		% within GROUP	22.2%	33.3%	27.8%



	Delta	Lambda
Plate Loosening	0	0
Plate fracture	0	0
Sailocele	2	3

Graph7: Complications

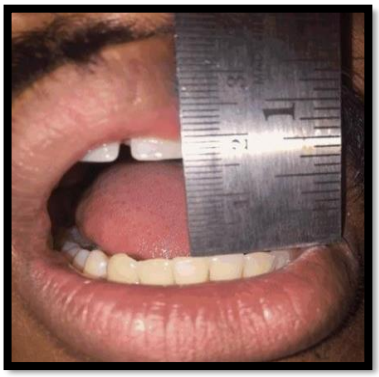
CASE PRESENTATION -1

(Fig.4)

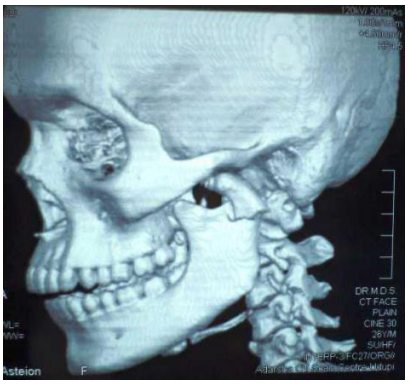
PREOPERATIVE

PRE-OP OCCLUSION

FRONTAL VIEW



PRE-OP MOUTH OPENING



CT SCAN

INTRA-OPERATIVE

POST-OPERATIVE

POST OP RADIOGRAPH -OPG

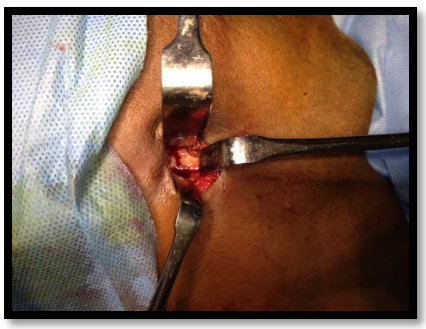
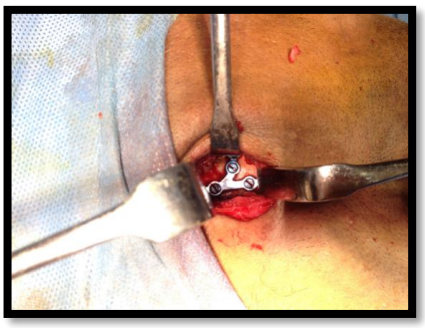
CASE PRESENTATION- 2
(Fig 5)

PRE-OPERATIVE



CT SCAN

INTRA-OPERATIVE


POST-OPERATIVE

DISCUSSION

The mandible is U shaped bone that articulates with temporal bone by means of articular surface of condyle and the only mobile bone of the face which plays an important role in masticatory function. Due to its close relationship with Temperomandibular Joint (TMJ) any insult to temperomandibular joint region has its own long term effects and some of the sequel may be in the form of disturbance in occlusion, deviation of mandible, internal derangement, ankylosis with inability to move a jaw. Therefore proper assessment and appropriate treatment plan has to be given a prime importance. There has been two different theories regarding the biomechanical consideration of mandibular condyle on subjecting it to mechanical strain .Some believe mandible works on third order lever principle while few others believe that it works on simple centering device. It was the work of Mayer et al who carried out a study to know the bio-functionality of internal fixation device on condyle region and action of muscles on mandible. Photoelastic[9] stress analysis study proved that it is the tensile strain which arises along the anterior border of ramus and neck of condyle, while compressive strain arises along posterior border of ramus of mandible. In terms of strength, the condylar neck constitutes the weakest region of the entire mandible and is therefore the most susceptible to fracture as a result of indirect forces, where the forces of impact are transmitted along the mandible from distant sites such as the angle, body or symphysis to the condylar neck[2,19] Among the mandibular fractures it is the condylar fracture which accounts for around 25-30% of

all fractures[20-22].The treatment of condylar and subcondylar fracture(Lindhal) still remains one of the most controversial topics of oral and maxillofacial surgery[23].The choice of fixing the condylar fracture can follow two routes open reduction or by closed reduction[24] These therapeutic approaches is guided by various parameters such as age of the patient, position of fracture in relation to capsule (intracapsular/extracapsular),level of fracture and severity of condylar dislocation [25] Irrespective of mode of treatment it is the perfect and possible restoration of the function, articular mobility and dental occlusion which has to be achieved. So final therapeutic decision depends on careful considerations of treatment objectives, potential risk involved and sound clinical judgments[26].The major principle in all fracture treatment is prefect reduction, but generally it cannot be maintained post-operatively without suitable fixing materials. So once the decision has been taken to address the fractured condyle by open reduction, an osteosynthesis material has to be selected to restore the pre-existing anatomic relationships and acceptable function. The placement of a single 4- or 6-hole straight miniplate vertically on the posterior border of the condylar neck remains the most commonly used technique worldwide[27-29] Biomechanical studies to support this concept has been very few and many other authors have reported failure rate with this technique (up to 35%)which includes plate fractures, screw loosening and structural instability[30-32]. Meyer et al in his experimental studies proved that this technique did not provide sufficient strength to withstand the physiological strains occurring in this region during function[33].Therefore to address this issue more and more authors advocated the use of 2 miniplates in combination, the first being placed in the axis of the condylar neck as usual, the second being placed obliquely under the mandibular notch and reported significantly better results with this technique[16,31,34-36].Due to smaller condylar fragment and technical difficulty encountered during fixation of two plates made it impossible to use. To address the space constraints and limited accessibility to fractured condyle advanced osteosynthesis materials were developed which could satisfy both stability and ease of surgery. This lead to introduction of delta, lambda, a-plate, trapezoidal plates.The advantages of these newer osteosynthesis plates were their ability to provide 3-dimensional stability which can be attributed to its mechanical junctions of plates arm.Specially designedtitanium DELTA and LAMBDA condylar plate is shaped for adaptation in the anatomically constricted region of condylar neck. The DELTA[18] plate, the base is oriented towards the angle of the mandible. At the top of the plate is an arm with two longitudinally arranged holes; two more holes form the 2 corners of the base of the plate. A finite-element [37]analysis study done to evaluate the plate design shows the distribution of tensile strains in the plate, particularly at the anterior border, when masticatory forces are applied condylar plate is placed with one arm parallel to the condylar axis and second arm parallel to the mandibular notch. Hence, this plate meets the criteria of 2 single miniplates with reduced hardware. This plate also provides dynamic osteosynthesis of functionally stable osteosynthesis. On the other hand the Lambda plate replicates two-plate technique with simplified application ,Lambda shape and 6-hole design address a large fracture zone its linear hole arrangement facilitates fixation of higher subcondylar fractures. Its design guides proper placement adjacent to posterior border and sigmoid notch. For placement, the straight 5-hole segment should be nearly parallel to the posterior border and aligned with the condylar-head. Our study aimed to evaluate and compare the effectiveness of DELTA and LAMBDA plates in the management of open reduction and internal fixation of subcondylar fractures using retromandibular approach. 18 patients clinically and radiologically diagnosed with mandibular subcondylar fractures were equally divided into two groups.

09 patients were included in Group 1 –Delta plate and other 9 patients in Group 2- Lambda plate respectively using simple random sampling and were evaluated for various parameters intra-operatively and postoperatively.The *causes* of maxillofacial fractures have changed over past three decades and they continue to do so. The main causes worldwide are:road traffic accidents (RTA), assaults, falls, sports-related injuries and civilian warfare. In our study it was road traffic accidents (100%). which was a cause of injury .Our findings were in accordance with the previous studies[38-40].The male predominance is a relatively consistent finding in most studies. In Indian scenario males being engaged in outdoor activities compared to female, also male vehicle drivers[41]out number female drivers and in rural areas females being confined to household activities, which explains

lesser incidence in female counterpart [42].*Gender distribution* in our study showed a clear predominance of males (100%) which is consistent with the literature of other studies. But recent literature also shows a trend towards a more equal male-to-female ratio[43].This trend can be attributed to a changing workforce and the fact that increasing numbers of women are working outdoors in more high- risk occupations, thus becoming more exposed to RTAs and other causes of maxillofacial fracture. In terms of *age* groups, facial fractures occur most frequently in people of third decade which is in concurrence with the other studies[44-45].The most likely reason for could be they are more socially interactive than other age groups. In our case series the mean age of examined patients at the time of surgery, was 27.61 years with a wide range from 18 to 60 years, which was consistent with findings of other studies [46,47].The *classifications* for the fractured mandibular condyle are determined by the radiographic and computed tomography findings of the injury and have great variability. However, consensus has been reached regarding the anatomic sites of the trauma, which include fractures inside the temporomandibular joint capsule, fractures of the condylar neck, and fractures at the level of or below the sigmoid notch.Lindhal classified condylar fractures as those of the condylar head, condyle neck and subcondylar. The present study used the classification proposed by Lindahl[4].Most condylar fractures are based on clinical findings ,but therapeutic decisions are based on preliminary *imaging* assessments. Panoramic radiography(OPG)[48] and computed tomography (CT) are two successive and complimentary imaging modalities. With panoramic radiographs fractures at condylar neck and base of condyle can be easily visualized in addition to this it also shows approximate direction of displacement but cannot indicate exact angle of displacement.Therefore panoramic radiographs can be useful for confirming clinical suspicion and for identifying contra lateral mandibular fracture. Computed tomography [16] (CT) is regarded as the gold standard for the radiographic evaluation of fractures of the mandibular condyle process. CT (coronal view) shows displacement, override, condyle head dislocation and the angle of condylar fractures. Inclusion of 3D CT reconstructions greatly facilitates the surgeon's understanding of the fracture morphology, simplify the overall visual option and assist surgical treatment planning. In our study all the patients were pre-operatively subjected to orthopantamogram (OPG) and CT scan (coronal view) to visualize the fracture pattern and to establish proper treatment plan. Multiple approaches that have been proposed for the visualization and the reduction of the condylar fractures including intra-oral, preauricular, post-auricular, coronal, rhytidectomy, retromandibular, Submandibular, endural, endoscopic and sometimes in combination.[49,50]All these studies conducted to evaluate various approaches aimed at reducing complications such as injury to facial nerve ,and unacceptable facial scar. In our case series, retromandibular approach was employed to address the fractured condyle. This approach has become popular because it provides good access, allows direct visualization of fracture site, posterior border of ramus thus making it minimally invasive[26] approach for subcondylar fractures. None of the patients in both the groups in our study had any major intraoperative bleed, which can be attributed to the fact that retromandibular vein being retracted within the flap and internal maxillary artery was never encountered. Another complication associated with the retromandibular approach is Sialocele[51] In our study 2 patients developed sialocele, which resolved after a week. There were no reports of permanent facial nerve damage or Frey's syndrome in any of our cases during the follow-up period, which was in accordance with other studies.[52-53]Many studies have proved that load sharing miniplates provide better stability for fixation of condylar fracture of mandible as it tends to neutralize both tensile and compressive force acting on a condyle by masticatory[54,55]system. Delta and lambda plate used in this study can be considered as a load sharing plates that can be employed in treatment of mandibular subcondylar fractures. Various biomechanical studies have shown the promising results of both titanium delta and lambda plates its ability to withstand heavy masticatory load. All this could be attributed to its design, stiffness; ability to provide 3dimensional stability, less working area, its biocompatibity also it is designed to follow functional osteosynthesis. The mean time taken for the surgical procedure, from incision to skin closure was approximately 50 min (minimum 30, maximum 85). Increased operating time is usually attributed to difficult fracture repair as a result to medial override fractures, medial subluxation of

the condylar head, or lack of occlusal[16]contact.In our study in order to evaluate ease of fixation, we made a slight variation in measuring the length of surgical procedure for both delta and lambda plate, and time taken in our study was time taken from the end of anatomical reduction till miniplate fixation. It was found that Lambda plate fixation took more time (more than 30min) as compared to delta miniplate, which could be attributed to its design. Restoring the pretraumatic *occlusal relationship* is one of the most important goals of treatment of condylar fracture. After the management of condylar fractures, discrepancy in occlusion is considered to be the most obvious problem for patients and also for the examiner.Ellis et al indicated that posttraumatic dysfunction complaints following condylar fractures might be mainly attributed to malocclusion [27].In the literature, criteria used for occlusion assessment, is closely related with a patient's dental condition, additional fractures in the maxillofacial region, dislocated bilateral condyle fractures, inadequate treatment, or inadequate adaptation of fractured fragments.[56]In our study, criteria used to asses dental occlusion was based on observation "satisfactory" or "slight derangement" and based on these observations during follow-up, satisfactory occlusion was observed in 94.4% (17/18) and 1 patient in group 2 (Lambda plate) had slight derangement in occlusion which improved on postoperative IMF for 2weeks and was attributed to unoperated condylar head fracture on the opposite side.The results found in our study are in agreement with results reported in the literature.[57]Many factors can affect *mouth opening*, which involve the period of postsurgical IMF, severity of displacement before management, surgery of the fracture side, and patient cooperation during rehabilitation.In the present series all the patients were followed up for 6months and mouth opening using measuring scale was measured during follow-up. Post-operatively mouth-opening more than 40mm was achieved in 16/18 (88.9%) – 7 patients (77.8%) in group1 , and 9 patients (100%) in group2 respectively .2 patients in group1 had a mouth opening between 30-35mm.Our findings were in accordance with study of *Dijkstra* who reported that most patients with MMO > 35 mm can chew and speak without difficulty thereby restoring functional harmony.At 1week,1month and 3months post-operatively all the patients were subjected to OPG to visualize and compare the accuracy of fracture reduction, degree of secondary displacement, resorption or erosion of the condylar head, process of bony ossification, and checking for morphological alteration of the osteosynthesis material. Radiographically post-operative scores of 1- representing "slight displacement" and 2- accurate reduction respectively were formulated. Based on these scores we found accurate position in 15 cases (83.3%), while slight displacement was observed in 3/18(16.7%) of the cases. Despite all therapeutic efforts for treatment of condylar fracture a variety of short- and long-term complications can be seen with treatment of these fractures. These risks include pain, edema, bleeding, infection, healing failure, nonunion, malocclusion and malunion many authors have found failure rate of around [57] 35 % which was attributed to insufficient strength of an osteosynthesis device to withstand adequate load resulting in complications like plate fracture, loosening of screws and secondary displacement. Inadequate stability of the fracture due to lack of bone contact between the fragments, combined with functional loads of the miniplates during bone healing, involve a certain risk for bending or fractures of the plates .In our study there was no reports of plate fractures. Inadequate osteosynthesis results in loosening of the screws which has been reported in various studies .In our study there were no reports of any screw loosening in both the groups.The use of perioperative and postoperative antibiotics in the treatment of mandible fractures, especially in the dentate portion is well established to reduce the risk of infection[58] .In our case study there was no incidence of post-operative infection which could be due to antibiotic prophylaxis for all our patients until discharged, and then oral antibiotics were continued for 3 to 5 subsequent postoperative days.

CONCLUSION

In recent times, the attitude towards treatment of condylar fractures has changed from an exclusively conservative approach to open reduction in selected cases. As operative treatment becomes more standardized, the indications have widened. Successful treatment of condylar process

fractures depends on the biologic character and adaptive capability of the masticatory system and to achieve these goals different osteosynthesis techniques has evolved which brought about wide range of options in the treatment of subcondylar fracture.

After evaluating various parameters, following conclusions can be drawn from the study:

- Open reduction and internal fixation of subcondylar fractures described gives good results.
- Osteosynthesis system employed in this study was titanium delta and lambda plate which yield better results in terms of rapid restoration of masticatory function and normal morphology.
- Both delta and lambda plate allows a functionally stable osteosynthesis in the subcondylar region of the mandible and this type of osteosynthesis can resist physiologic strains in the injured temporomandibular joint.
- Clinical and radiographic evaluation confirm the effectiveness of the operative technique
- As far as ease of adaptation and fixation is concerned it was the Delta plate which proved to be less time consuming intra-operatively for adaptation and fixation as compared to Lambda plate.
- There were minimal or no complications associated with the osteosynthesis system.

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