

Indications and Outcome of Mandibular Condylar and Ramus Surgeries

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ABSTRACT

Background: Different surgical procedures are utilized for treatment of various diseases of the posterior mandible depending on the type of disease, site, duration and age of the patient. A thorough knowledge of the anatomical relations of structures and adequate surgical skills are needed to minimize complications. The purpose of this study was to evaluate the indications and outcome of surgical techniques for diseases affecting the condyle and ramus of the mandibles. **Patients and Methods:** Data were retrieved from the case files of patients who had surgeries for diseases involving the ramus/condylar area of the mandible. The diagnosis/indications for surgery, procedure and postoperative outcomes were documented. Outcomes assessed were related to mouth opening, esthetics (appearance of scar and jaw symmetry) and function (occlusion, Jaw movements). Complications such as nerve dysfunction were documented. Paresthesia was tested by simple tactile stimulations. **Results:** There were a total of 27 procedures done either on the condyle or ramus in 23 (100%) patients between May 2006 and October, 2013. 16 procedures were done for tumors in 16 (69.6%) patients, 14 (60.9%) patients had Ameloblastoma, 1 (4.3%) had central neurofibroma and one had keratocystic odontogenic tumor, two procedures for unilateral condylar fractures in 2 (8.6%) patients, five procedures for ankylosis in 3 (13.0%) patients and four procedures were done for dislocation in 2 (8.6%) patients. There was no permanent nerve dysfunction; mouth opening, jaw movements and mastication were remarkably satisfactory. **Conclusion:** Esthetic and functional outcome were quite satisfactory when compared with the preoperative status.

KEYWORDS: Condyle, indications, outcome, ramus, surgeries

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internal carotid artery) are also at risk of damage. Such injuries can reduce quality of life and death can also occur if there is uncontrollable bleeding or airway obstruction.^[3] Diseases of this posterior part of the mandible for which surgical procedures are done include tumors affecting the condyle in isolation or extending to it. Others are disc displacement, degenerative disease, fractures, ankylosis of the temporomandibular joint and contiguous structures, skeletal/congenital disorders and dislocations. Various surgical techniques have been described for treatment of these categories of diseases and a thorough knowledge of the anatomical relations of structures and adequate surgical skills are needed to minimize complications.^[4] There is need to emphasize the precautions and modifications that can minimize such complications. The purpose of this study was to evaluate the indications, esthetic and functional outcome of surgeries on the condyle and ramus of the mandible.

INTRODUCTION

Many complex maxillofacial procedures are carried out on the condyle or ramus of the mandible due to various diseases.^[1] Sufficient care is required to access this posterior part of the mandible to prevent injury and compromise of functions of some vital structures such as parotid gland, auriculo-temporal nerve, facial nerve, hypoglossal nerve, and external carotid artery.^[2] Structures within the bone (inferior alveolar neurovascular bundle) and, others deep to these posterior parts of the mandible (internal maxillary, pterygoid plexus and

PATIENTS AND METHODS

This was a retrospective study that evaluated the outcome of management of patients in which surgeries involving the condyle or ramus of the mandible were done in the oral and maxillofacial department of University of Port Harcourt University Teaching Hospital, Port Harcourt Rivers State from May 2006 to October 2013. Ethical approval was obtained from the ethics and research committee of the hospital. Data obtained from case files and theater records included patient demographics, clinical features of the disease presented, provisional diagnoses made, results of radiologic (Plain X-rays, CT

Scans) investigations and histopathology for tumors. For cases of tumors, patients whose lesions did not extend to the ramus of the mandible on either side were excluded from this study. Techniques by which general anesthesia was achieved were retrieved.

The surgical procedures done, approaches, techniques of surgery, method and device for cutting bone were documented in addition to pre operative and postoperative mouth opening/inter-incisal distances measured with analogue calipers. The esthetic (appearance of scar and jaw symmetry) and functional (jaw movements and occlusion) outcomes of surgery as well as post operative complications (nerve dysfunctions, deaths) were included.

The appearance of the scars was assessed based on the presence of hypertrophic scars or keloid formation. Symmetry of the jaw was assessed by comparing both sides of the jaw when the teeth were in centric occlusion and also by viewing the continuity or a shift in the midline between upper and lower central incisors.

Jaw movement was assessed by the degree mouth opening (upward/downward) and also by asking patient to bite on the upper and lower anterior teeth together (forward), to bring the upper and lower posterior teeth in contact (backward) and to make lateral excursions with teeth on one side in contact. Pain during movement, reduced mobility and lack of contact were noted. The relationships of the upper and lower teeth in normal intercuspal position, cross-bite or scissors-bites were also documented as well as presence of anterior/posterior open bites.

Paresthesia was tested by simple tactile stimulations and features of Frey syndrome were evaluated by asking or examining patients about sweating around the ear during gustation. Facial and hypoglossal motor nerves functions were tested on the muscles of facial expression and tongue. Descriptive analysis of data obtained was undertaken using SPSS version 16.

RESULTS

Overall, 65 major surgical procedures have been done on the mandible in our center with a total of 27 procedures done either on the condyle or ramus in 23 (100%) patients between May 2006 and October, 2013. There were 11 (47.8%) males and 13 (52.2%) females [Table 1]. Age range of patients was 15-78 years, Mean (SD), was 23.3 (16.2) years.

16 procedures were done for tumors in 16 (69.6%) patients, 14 (60.9%) patients had Ameloblastoma, 1 (4.3%) had central neurofibroma and 1 (4.3%) had keratocystic odontogenic tumor. Two procedures for unilateral condylar fractures in 2 (8.6%) patients, five procedures for ankylosis (2 bilateral, true and 1 unilateral, false) in 3 (12.9%) patients and four procedures were done for dislocation (1 bilateral chronic protracted dislocation, [CPD] and 1 bilateral chronic recurrent dislocation [CRD] in 2 (8.6%) patients [Table 2].

Naso-tracheal Intubation was achieved for all cases of resections due to tumors and dislocations and the fractures; tracheostomy was done for cases of ankylosis.

Resections up to the condyle on one side were done in 5 [21.7%] (with disarticulation, 3 [13.0%]; without disarticulation, 2 [8.7%]). Resections up to the ramus on one side were done in 11 (47.8%) cases. Reconstruction was achieved with iliac bone grafts and reconstruction plates 2.4 mm titanium, KLS Martins Inc. Germany or Synthes Inc. Switzerland (Synthes 10/12 mm long screws or KLS Martins 9/11 mm long non-hollow screws; angled 6 holes/straight 20-24 holes) in 15 (65.2%) cases and with twisted 0.6 soft stainless steel wires in 1 (4.3%) patient.

Open reduction and internal fixations (ORIFs) were done for the 2 (8.7%) cases of extracapsular condylar fractures, one with 1.5 mm four holes titanium mini-plate with 10 mm locking screws, Synthes Inc. Switzerland and the second case with 0.5 mm soft stainless steel wires [Table 2].

Table 1: Gender distribution of 23 patients who undertook 27 procedures

Diagnosis	No. of patients (%)			No. of procedures (%)		
	Male	Female	Total	Male	Female	Total
Tumor	7 (30.4)	9 (39.2)	16 (69.6)	7 (25.9)	9 (33.4)	16 (59.3)
Fracture	1 (4.3)	1 (4.3)	2 (8.7)	1 (3.7)	1 (3.7)	2 (7.4)
Ankylosis	2 (8.7)	1 (4.3)	3 (13.0)	4 (14.8)	1 (3.7)	5 (18.5)
Dislocation	1 (4.3)	1 (4.3)	2 (8.7)	2 (7.4)	2 (7.4)	4 (14.8)
Total	11 (47.8)	12 (52.2)	23 (100)	14 (51.8)	13 (48.2)	27 (100)

Table 2: Values of preoperative and post-operative inter-incisal distance and procedures in 23 patients

Diagnosis	Procedure (N)	Preoperative	Postoperative
		inter-incisal distance (mm)	inter-incisal distance (mm)
Tumors	Resection up to the condyle with disarticulation (3)	25-45	35-50
	Resection up to the condyle without disarticulation (2)	28-40	45-50
	Resection up the ramus (9)	23-40	35-55
Fracture of the condyle	ORIF with miniplates (1)	28	45
	ORIF with transosseous wires (1)	25	47
Bony Ankylosis	Bilateral condylectomy/IP (1)	2	44
	Bilateral ramus ostectomy/IP (1)	0	42
Fibrous Ankylosis	Unilateral removal of adhesions and repair of soft tissue (1)	15	45
Chronic protracted dislocation	Bilateral inverted L ostectomy (1)	20	40
Chronic recurrent dislocation	Bilateral High condylectomy (1)	10	38

IP: Interpositional arthroplasty, ORIF: Open reduction and internal fixations

For all the sides in true ankylosis, combined retromandibular and submandibular approaches were utilized to access the ramus and condyle while the false ankylosis which was due to cancrum oris was approached through the soft-tissue cheek defect before it was repaired with local cheek rotation flap.

Interpositional arthroplasty was achieved with inferiorly temporalis myofascial fibers and cut slings of masseter and medial pterygoid muscles respectively. Patients were placed on active jaw exercise as soon as they can commence following surgery for 6-9 months.

In the patient with CPD, the ramus was accessed by submandibular incision on right side and submandibular with retromandibular extension on the left side. The left condyle was accessed with preauricular approach and an extended preauricular approach (inverted hockey stick) was used on the right side for the patient with CRD.

In all categories of patients, there was remarkable improvement in mouth opening. The ranges of values for tumors are reflected in table 2. Mouth opening was improved in the three patients with ankylosis beyond 40mm at 3 months follow-up. Mouth opening improved above 45mm in patients with fractures.

Scars were acceptable in all the patients, except 2 (4.3%) patients with hypertrophic scars. There was acceptable symmetry in the 2 (4.3%) patients with bony ankylosis but there was asymmetry in the third patient due altered bone growth and muscle destruction [Table 3].

Acceptable occlusion (close to normal) was achieved in 12 (52.2%) patients following prosthetic rehabilitation (mild posterior cross bites or edge to edge bites with adequate contact) on the side of the resection which did not compromise mastication. In patients who had ORIF, there was mild deviation and cross bites due to muscle action imbalance in both patients which were corrected with jaw exercise within 2 weeks.

Close to normal occlusion was also achieved in both patients with CPD and CRD. The patient with CPD disengaged the IMF and insisted on complete removal of the hardware in 3 weeks thereby compromising the occlusion leading to anterior cross bite and loss of anterior contact.

There was mild anterior open bite following operations of bilateral ankylosis in one patient which was acceptable (need no

orthognatic surgery for correction). There was moderate open bite and lack of contact in the second patient. Both patients also had reduced mobility in forward/backward and lateral direction. The third patient had no open bite but there was no posterior contact on affected side [Table 4].

All patients with tumors had paresthesia of the lip after resection but variable recovery between 6 and 18 months. There were no cases of inferior alveolar nerve (IAN) paresthesia and facial nerve paresis on both sides in cases of true ankylosis. In the case of CRD, there was facial nerve paresis on the left side in which preauricular incision was done. This persisted for more than 6 weeks; patient was eventually placed on steroids (Tablet Prednisolone 10 mg 8 hourly for 1 week, 5 mg 8 hourly for 1 week, 5 mg 12 hourly for 1 week and 5 mg daily for 1 week), Watson laboratories Inc, USA and neurovitamins (Neurobion 1 tablet 8 hourly for 2 weeks), Merck, Indonesia.

Facial nerve paresis and parotid gland salivary leakage were immediate postoperative complications observed in one case of resection due to tumor, patient was given steroid for paresis and pressure packing, atropine injection into the site for salivary leakage, both resolved within 6 weeks of follow up. There were no pareses of the tongue or features of Frey's syndrome in any of our patients. Among the patients with tumor, there were 2 (8.7%) cases of death due to early post-operative airway obstruction [Table 5].

DISCUSSION

Ankylosis of the temporomandibular joint is defined as restriction or absence of mouth opening due to fusion of the articular components of the joint; glenoid fossa and condyle,^[1] such fusion may extend anteriorly to mandibular notch and the surface of the zygomatic bone, to coronoid process fusing with the base of the skull as well as anterior border of ramus and pterygomaxillary buttress.^[1-6]

A principle of management has to do with the excision or resection of the fused condyle and the articular surface of the glenoid fossa (condylectomy).^[7,8] The gap created can be left without filling with any material (gap arthroplasty).^[9] This can be combined with coronoidectomy to increase interincisal distance beyond 30 mm.^[10] On the other hand, a new joint can be created entirely when it becomes difficult to resect the calcified mass without bridging the base of the skull, or when fusion is beyond the joint.^[11] In such instances, the ramus or angle osteotomies were done.^[11]

Table 3: Esthetic outcome of surgeries in 23 patients

Diagnosis	Jaw Symmetry N (%)			Appearance of scar N (%)		
	Normal	Acceptable	Assymetry	Acceptable	Hypertrophic	Keloid
Tumors	2 (8.7)	8 (34.8)	4 (17.4)	13 (56.5)	1 (4.3)	0 (0)
Fractures	2 (8.7)	0 (0)	0 (0)	2 (8.7)	0 (0)	0 (0)
Ankylosis	0 (0)	2 (8.7)	1 (4.3)	2 (8.7)	1 (4.3)	0 (0)
Dislocations	2 (8.7)	0 (0)	0 (0)	2 (8.7)	0 (0)	0 (0)

Table 4: Functional outcome of surgeries in 23 patients

Diagnosis	Occlusion N (%)			Jaw movements N (%)		
	Normal	Acceptable	Malocclusion	Normal	Hypomobility	Pain
Tumors	0 (0)	12 (52.2)	2 (8.6)	13 (56.5)	0 (0)	1 (4.3)
Fractures	2 (8.6)	0 (0)	0 (0)	2 (8.7)	0 (0)	0 (0)
Ankylosis	0 (0)	2 (8.7)	1 (4.3)	1 (13.0)	2 (8.7)	0 (0)
Dislocations	0 (0)	1 (4.3)	1 (4.3)	2 (8.7)	0 (0)	0 (0)

Table 5: Complications of surgeries in 23 patients

Complications	Tumors	Fractures	Ankylosis	Dislocation
Facial nerve palsy	1 (4.3)	0 (0)	1 (4.3)	1 (4.3)
IAN Paraesthesia	14 (60.9)	0 (0)	0 (0)	0 (0)
Salivary fistula	1 (4.3)	0 (0)	0 (0)	0 (0)
Death	2 (8.7)	0 (0)	0 (0)	0 (0)
Hematoma	3 (13.0)	0 (0)	1 (4.3)	1 (4.3)

IAN: Inferior alveolar nerve

Secondly, following resection of the fused mass, interpositional arthroplasty,^[12-20] using autografts, (chondro-chondral from rib, chondro-osseous grafts from iliac bone, sternoclavicular, metatarsal, metatarsal phalangeal grafts, dermis, temporal superficial fascia or myofascial flap), allografts (lyophilized dura) or alloplast (silicon, Teflon and vitamin graft) is better than gap arthroplasty, although with variable outcomes. Interposition reduces the chances of re-union coupled with prolonged mouth opening jaw exercises.^[16] Costochondral is known to cause hyperplastic growth giving place for sternoclavicular joint grafts.^[14] We used temporal myofascial flap to avoid additional donor site morbidity and this is thicker and more resilient than temporal superficial fascia flap due to added vitality from the muscle but no advantage of stimulating growth.^[12]

Thirdly, consistent jaw exercise has been documented to prevent contact of surface even after resection, it allows decortications, and prevents recurrence of ankylosis.^[1,3,5-10]

Dislocation is the total or partial dislodgement of the condylar head out of the glenoid fossa in any direction but the medial is the most common.^[21] Various procedures for CPD and CRD have been described and this depends on the goal to be achieved. The goals are removal of mechanical obstacles, creation of mechanical barrier to prevent sliding of condyle beyond the articular eminence, muscle action balance and capsular tightening.^[21] The condylar procedures done in this report were aimed at removing obstacles.

Furthermore, principle of surgery for dislocation can focus on leaving the condyle in its new position when there are appreciable mandibular excursions and restore occlusion as in the cases of inverted L ramus osteotomies or to reposition the condyle to its former position and restore both occlusion and excursions.^[22]

In cases where there is fusion in the new site due to bone contacts, chronic inflammation and distorted disc, there will be no movement or movement will be grossly restricted, ≤ 25 mm,

Gotlieb advocated discectomy, condylectomy with or without coronoidectomy.^[23] We did discectomy and high condylectomy without coronoidectomy in our patient with CRD. High condylectomy done on our patient reduces the anterior open bite that usually complicates the low level approach.^[24]

Absolute and relative indications for ORIF have been documented in literature^[25,26] and we felt our patients will benefit from ORIF because of the gross displacements accompanying their extra-capsular fractures and the outcomes in both cases were remarkable.

When tumors involve or extend to the edentulous portion of the mandible, reconstruction becomes more challenging in terms of getting the exact dimensions, shape and contour.^[27,28]

Our morbidity rate of 22% was less than that obtained from other reports.^[1,6,7,20,21] Facial nerve paresis constituted the main complication of this study giving about 13% of morbidity rate. Inflammation rather than direct disruption of the integrity of the nerve was responsible; although electrical nerve stimulator was not available to assist location of the nerve; necessary precautions that minimized injury were knowledge of the anatomical course of the nerve, careful blunt dissection through a wide access, avoidance of use of diathermy close to the nerve, prevention of injury to vessels to prevent hematoma. The length of the incision was not enough to enhance good access in one of our cases of dislocation but the modified preauricular incision used on the right side allowed better visualization of the underlying structures.

Fibrosis and disrupted anatomy from the first surgery in a patient with tumor made plane dissection more difficult in the second surgery leading to injury to the parotid gland and facial nerve. IAN paresthesia was unavoidable in our cases of tumors which constituted about 70%, the lesions were intrabony and large that it becomes difficult to preserve the nerve which was commonly compressed or at times infiltrated by tumor cells. Dermatome invasion occurred to restore innervations within 6-18 months.

Before bone is sectioned, a vital precaution taken to prevent injury to all structures was subperiosteal dissection, this was however difficult when tumors invade overlying soft tissues,^[29] to further protect structures on the medial surface, a wide and flat surface retractor were used, some authors advocate that a thin ledge of bone is first left after removing the outer part and then removed with curved chisel.^[7,19] Subperiosteal dissection

should also be done posterior to the Zygomatic arch to protect temporal and Zygomatic branches of facial nerve.

Approaching the ramus and condyle through the submandibular with retromandibular extension below the area of the parotid gland also help to prevent injury to the structures by allowing direct access to lower and posterior border of the mandible making subperiosteal dissection much easier, however to access the condyle and upper part of the ramus, more masseter muscle fibers have to be detached and the overlying soft-tissue retracted extensively.^[19,20] Detachment of masseter muscle was still preferable than dissecting through the muscle to minimize post-operative swelling and medial pterygoid muscles should also be left intact. For cases of interpositional arthroplasty, the midportion of about two-third the width of the muscular attachments were raised.^[19,20] Preservation of muscles and periosteal attachment as much as possible also helped to reduce open bites and enhance mandibular control in our patients.^[13,21]

We had no paresthesia affecting the regions of distribution of IAN, when surgeries were indicated for ankylosis, dislocation and fractures. Gentle tissue retractions and meticulous sections of bone were done to protect the nerve; this was further prevented when each surgeon worked on either side to minimize fatigue. Again, we modified our method of bone section by first making multiple holes along the lines of cut, and then section was completed by joining the holes still using the drill, the buccal and lingual plates were sectioned individually, where oscillating saws or piezoelectric device are not available, this method is preferable to the continuous bur drilling process which generates more heat and trauma.^[18,20]

Retarded jaw growth, asymmetries and malocclusions that result from long standing ankylosis are difficult to correct in one surgery, a second staged operation in form of conventional vertical body osteotomy or sagittal, split osteotomy are needed to protrude the anterior portion of the mandible, improve on the anterior bite and a sliding genioplasty for the chin retrusion.^[13-17] Distraction osteogenesis has also been found useful.^[10-12]

Horizontal, vertical and oblique ramus ostectomies and pushback of the distal segment of the mandible to also correct the occlusion in dislocation have been described.^[21-23] An inverted L-shaped ramus ostectomy with excision of bone above and behind the mandibular foramen was a modification described in this study; it enhances maximal bone contact which is necessary for stability and healing.^[24,30] The strength of our study lies in the fact that morbidity reduction may not really depend on the number of cases seen but on appropriate techniques and meticulous surgical skills.

In conclusion, we had functional outcome that was satisfactory to a large extent in all our patients, there were no permanent nerve dysfunction, mouth opening, jaw movements and mastication were remarkably improved and esthetic outcome was quite satisfactory when compared with the preoperative status.

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