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Intra operative complications of sagittal split ramus osteotomy

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Abstract

Introduction: Sagittal split osteotomy of the mandible is frequently used to correct dentofacial deformities. Many complications are associated with this surgical procedure. Hence the objective of this study was to evaluate intraoperative complications associated with surgical advancement of the mandible by sagittal split ramus osteotomy (SSRO) and to analyze whether occurrence of complications was associated with concomitant third molar extraction on the operating side or not.

Material and Methods: A total of 22 patients comprised the sample for this study. 42 had bilateral sagittal osteotomy procedure performed. On 19 sides, third molar extraction was done simultaneously during the surgical procedure. Chi sqaure test was applied to see the association between timing of extraction and intra-operative complications. The p value was found to be 0.023 which was statistically significant.

Results: The results showed that the mean age of patients was 23.10±3.46 years. In 11 (50%) patients single jaw osteotomy was performed while 11 patients (50%) had double jaw osteotomy. 36 out of 42 sides (85.7%) had no major complications. A total of 3 sides (7.1%) had bad splits; bad split of lingual cortical (distal) segment, of buccal cortical (proximal) segment sparing lower border, split extending to posterior border. The IAN was visibly injured during surgery in 3 (7.2%) sides, of which 1 side (2.4%) represented total transaction of the nerve which was primarily repaired and in 2 sides (4.8%), nerve was entrapped between osteotomized segments but was freed successfully. Intra-operative complications were more on the right side as compared to left side.

Conclusions: It was concluded that although SSRO is overall a safe and predictable procedure, meticulous attention must be paid to prevent troublesome complications and wherever possible, mandibular third molars should be removed at least 6-9 months before the operative procedure.

Keywords: Lower mandibular third molar (wisdom tooth); sagittal split ramus osteotomy (SSRO); inferior alveolar nerve (IAN); temporomandibular joint (TMJ)

Introduction

Sagittal split osteotomy of the mandible is frequently used to correct dentofacial deformities.[1] After its introduction by Trauner and Obwegeser,[2] sagittal-split ramus osteotomy (SSRO) has been modified by several surgeons to develop better surgical technique and outcomes.[3-6]

The benefits of SSRO include better masticatory function,[7] reduced temporomandibular joint pain[8] and improved facial aesthetics.[9,]The surgical procedure consists of osteotomy of the mandible, in which the angle area is exposed by intraoral incision and split in a near sagittal plane on both sides. The distal segments are then slid relative to the proximal segments and fixed with screws or plates. The osteotomy in SSRO is performed in close proximity to the inferior alveolar nerve (IAN) and thus IAN damage often results.[10]

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Although the SSRO is a common and safe procedure, several complications have been reported including nerve injury, excessive bleeding, unfavourable (bad) splits, temporomandibular joint (TMJ) problems and psychological problems.[11-13] The incidence of bad splits from these studies varied between 0.21% and 22.72%.[14] The buccal plate of the proximal segment and the posterior aspect of the distal segment were the most affected areas. The dental literature recognizes that performing sagittal ramus osteotomy when impacted third molars are present significantly increases the risk of unfavorable fractures of both the proximal and distal segments.[15]

The occurrence of bad splits cannot always be avoided. Considering the common bone healing process and internal architecture, unfavorable fractures can result in poor bone healing including delayed union, mal-union and/or fibrous union. It is thought to lead to post-operative instability after orthognathic surgery.[16] Nerve injury with resultant neurosensory disturbance is considered to be the main complications of SSRO.[17] IAN injury during surgery largely results from manipulation of the nerve or structures surrounding the nerve or from direct injury to the nerve during the operation.[18] IAN damage can consist of complete or partial transection, extension, compression, crushing, or ischemia. The incidence of nerve damage apparent at operation during BSSO has been reported to vary from 1.3% to 18%.[19] Transient paraesthesia has been, however reported to be as much as 85 %.

The aim of the present study was to evaluate intraoperative complications associated with surgical advancement of the mandible by sagittal split ramus osteotomy (SSRO) and to analyze whether occurrence of complications was associated with concomitant third molar extractions.

Materials & Methods

This study consisted of patients who required mandibular advancement or setback in the sagittal plane. They underwent sagittal split ramus osteotomy (SSRO) at the affiliated hospitals of the Department of Maxillofacial Surgery, Margalla Institute of Health Sciences, Rawalpindi, in the period between January 2010 and December 2014. All patients received pre and post-operative orthodontic treatment carried out by local practicing orthodontic specialists or postgraduate students under supervision, except for one case who was managed as a case of 'Surgery-first, accelerated orthodontics' approach. The dental and skeletal movements were planned by institution team of surgeons and orthodontists.

Information was collected from the medical records at the Department of Oral & Maxillofacial Surgery. None of the patients had a record of neurosensory disturbance in the inferior alveolar nerve (IAN) prior to surgery. The patients received standard regimens with prophylactic antibiotics and dexamethasone. Surgical procedure involved adequate elevation and reflection of buccal mucoperiosteal flap under general anesthesia. The patients were operated according to a modified Obwegeser bilateral sagittal split osteotomy. This consisted of the posterior extent of split, intended to finish before the posterior aspect of ramus just behind the lingula in the mylohyoid groove and anterior extension to the distal aspect of the mandibular first molar with lower border splitting, except in one case in which the lower split was intended to be on the lingual aspect of the body. After completion of the split, the distal segment was repositioned in the planned position. Flap was repositioned and sutured. All of the osteotomies were performed and/or supervised by the same surgeon. Before fixation, the mandibular and maxillary dental arches were held together with power chain or dental wires. The bony

segments were fixed using one upper border mini-plate with at least two screws on each side at each osteotomy site in the majority of the patients, except in one case which received two plates on each side. Following fixation, the wiring was released; the occlusion and the position of the condyles were checked. The intra-operative complications assessed in the study were; excessive bleeding (rupture of vessel), unfavourable (bad) split, Injury to the inferior alveolar nerve (IAN)including both nerve entrapment between osteotomized segments but freed successfully; partial transaction and complete nerve transection with primary repair during procedure.

All the data from record was entered into computer using SPSS version 19 and analysis of all variables was done to determine frequency and percentages. Mean ± SD was calculated for age. Chi-square test was applied for categorical variables like intraoperative complications and timing of third molar extraction etc.

Results

Among 22 study patients, there were 12 males and 10 females with the mean age of 23.10±3.46 years. Age range in this study was 18-30 years. In 11 (50%) patients had single jaw osteotomy while 11 patients (50%) had double jaw osteotomy. Genioplasty was done in only one patient (4.54%) as concomitant procedure (Table I, II) All patients had sagittal split osteotomy done bilaterally, except for two patients who had L-shaped osteotomy done on the other side.

In 36 out of 42 sides (85.7%), there were no major complications. A total of 3 sides (7.1%) had bad splits; bad split of lingual cortical (distal) segment, of buccal cortical (proximal) segment sparing lower border, bad split extending to posterior border. (Table III)

A small number of patients had inferior alveolar nerve injury during the operation (Table III). The IAN was visibly injured during surgery in 3 (7.2%) sides, of which 1 side (2.4%) represented total transection of the nerve which was primarily repaired and in 2 sides (4.8%) nerve was entrapped between osteotomized segments but was freed successfully. Intraoperative complications were more on right side as compared to left side. The relationship of operating side and intraoperative complication has been shown in Figure 1.

Wisdom tooth extraction was noted for both sides (Table IV). In 19 sides of total 42 (45.2%) including 10 right sides and 9 left sides, third molar extraction was done simultaneously during procedure. In 9 sides (21.4%) including 5 right sides and 4 left sides, third molars were extracted more than 6 months prior to surgery. Chi-square test was applied to see the association between the timing of extraction and intraoperative complication, with a significant p-value (Table V). No intraoperative cardiovascular, allergic or other severe complications were seen in these patients. Excessive bleeding was recorded in only one patient with no visualization of major vessel, which was controlled by taking protracted local measures including pressure packing, use of absorbable gelatin sponge and oxidized regenerated cellulose.

Table I: Frequency of gender, single/double jaw osteotomy and genioplasty

		frequency	percent%
Gender	Male	12	54.5
	Female	10	45.45
Single jaw osteotomy	Yes	11	50
	No	11	50
Double jaw osteotomy	Yes	11	50
	No	11	50
Genioplasty	Yes	1	4.54
	No	21	95.4

Table II: Mean a of age of patients

	N	Minimum	Maximum	Mean	Std. Deviation
Age	22	18	30	23.10	3.463

Table III: Frequency of intra-operative complications

Intraoperative complications	Frequency	Percent
None	36	85.7
IAN nerve transection with primary repair	1	2.4
Nerve entrapment but freed successfully	2	4.8
Bad split	3	7.1
Total	42	100.0

Table IV: Cross tabulation between side of osteotomy (left/ right side) with timings of wisdom extraction (left / right side)

	timing of wisdom extraction (left / right side)					Total
side of osteotomy	3rd molar extraction done simultaneously	recent 3rd molar extraction < 6 months	3rd molar extraction > 6 months	3rd molar absent	3rd molar present but not extracted	
left side	9	1	4	2	5	21
right side	10	1	5	2	3	21
Total	19 (45.2%)	2 (4.8%)	9 (21.4%)	4 (9.5%)	8 (19%)	42 (100%)

Table V: Intra-operative complication with timing of wisdom extraction

	timing of wisdom extraction					Total
intraoperative complication	3rd molar extraction done simultaneously	recent 3rd molar extraction < 6 months	3rd molar extraction > 6 months	3rd molar absent	3rd molar present but not extracted	
None	16	1	8	4	7	36
IAN NERVE TRANSECTION WITH PRIMARY REPAIR	0	1	0	0	0	1
NERVE ENTRAPEMENT BUT FREEED SUCCESFULLY	1	0	1	0	0	2
BAD SPLIT	2	0	0	**0**	1	3
Total	19	2	9	4	8	42

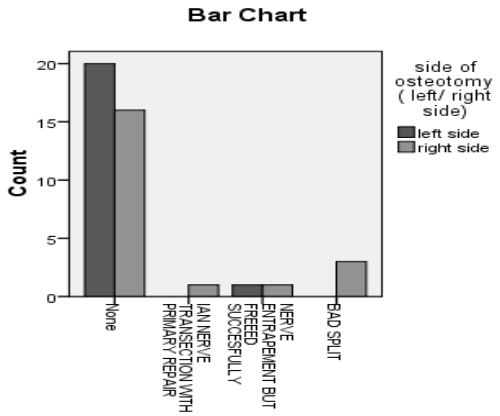

Figure 1: intraoperative complication and side of osteotomy

Discussion

Today the most common orthognathic procedure for correction of mandibular deformities is considered to be the sagittal split ramus osteotomy (SSRO). As an elective procedure, the morbidity must be as low as possible. Permanent injury to the inferior alveolar nerve is one of the main complications, with a reported incidence between 5% and 30%.[20] According to a literature study by Ylikontiola et al. the nerve injury incidence was reported at 40 %.[21] Westermark et al. reported an incidence of 33% with visible nerve injury.[22] In comparison, the incidence of inferior alveolar nerve damage recorded in this study is low (7.2% of the sides) with 2 (4. 8% of the sides) nerves only entrapped between segments and only one site (2.4%) underwent a complete transection which was repaired primarily.

Nerve injury with resultant neurosensory disturbance can occur during operation. The IAN as can be injured by medial protecting retractors, while sawing of the bone, splitting with chisels, as result of entrapment between osteotomized segments, advancing the distal fragment or as a result of direct injury or compression by rigid fixation.[23,24]

The SSRO is an extremely technical and sensitive procedure and vigilant attention can

probably prevent many complications like nerve injury and unfavorable splits. According to Bell, Proffit and White the incidence of nerve injury with sagittal split osteotomy cannot be minimized greatly by good surgical technique, but the severity of the damage can be minimized.[11] Many authors have found that surgical skill considerably influence the incidence of postoperative neurosensory disturbance.[25,26] In one case, where complete cutting of the lower border was intended to keep the split on the lingual side, the nerve got severed and was noticed soon thereafter. After gently freeing the nerve, a primary nerve repair was undertaken using 7-0 polypropylene sutures using micro instruments.

Some of the rare intraoperative complications are intraoperative haemorrhage, aspetic necrosis and facial nerve palsy.[27]

In this study troublesome bleeding was encountered in one patient. This was controlled by local measures including pressure packing and use of pro-coagulants. A reserve blood replacement was used to replenish blood loss although this was compounded by a concomitant maxillary osteotomy. We routinely manage orthognathic surgery procedures in hypotensive anesthesia in addition to an elevated head position, primarily to reduce blood loss in maxilla but it also tends to help in mandibular surgery. Previous studies also indicate that severe intraoperative bleeding is very rare.[12,28]

Incidence of bad (unfavourable) splits range between 0.21% and 22.72%.[14] Bad splits usually involve the lingual part of the distal segment. Martis found an incidence of 1.93% of such fractures[12] and Panula, Finne and Oikarinen reported an incidence of 2%.[29] Bothur and Bloomqvist reported difficult splits in 8.8 % of the sides and bad splits of 1.3 %.[28] In this study, bad split occurred in 7.1% of the sides. There was no bad split in the sides in which third molar was extracted more than 6 months before surgery with a significant p-value.

In one patient, where a concomitant removal of horizontally impacted mandibular third molar was planned, a lingual bone bad split was encountered when the tooth was sectioned at the cervical margin and attempt was made to complete the split by rotating the Coupland elevator. The fractured segment was fixed using bicortical screws in addition to the mini plate fixation. In another patient, the buccal segment bad split was encountered after it was found that the lower border was not split completely. After an initial difficulty at initiating the split, the buccal segment got fractured. The segment was fixed using a long 8 hole mini plate incorporating the buccal segment. (Figure 2)

In the patient who had had an extended split to the posterior border of the ramus, it was due to a little excessive malleting of the osteotomes. (Figure 3) This is not classically counted as a bad split, since this was indeed the split line prescribed by Obwegeser in his original study but nevertheless was not intended. The case required a setback of mandible and the tooth containing segment was seen to extend beyond the confines of the condyle containing segment posteriorly. At 3 weeks postoperatively, a unilateral relapse was noted which was then managed with cross elastics and orthodontics.

Intuitively, the presence of a third molar in operating side would seem to raise the chances of an unfavorable split when attempting a SSRO. Some authors recommend that impacted third molars removed at the beginning of orthodontic treatment or at least 6 months before SSRO as the available sites for rigid fixation are diminished when impacted teeth are present.[30,31,32] However some studies have found no significant difference in the incidence of bad splits or other complications between 2 groups of patients who had third molars removed at the time of SSRO and

those who were without third molars when SSRO was carried out.[33,34,35,36]

Bad splits cannot be always avoided but can be prevented to a great deal through a meticulous surgical technique. Removal of third molar 6 to 9 month before surgery will allow for ossification of the extraction sites and bad splits can be prevented.[30] Prevention is also focused on adequate osteotomy design, eliminating sharp angle where abnormal stress occurs on bony segments, completion of adequate cuts into the retrolingular depression and through the inferior border and careful separation of the segments.

If a fracture occurs, the fractured segments should be incorporated into the fixation scheme if possible.

Malpositioning of the mandibular condyle post surgery is also a relatively common intraoperative complication in SSRO, but the effects are only known later from clinical relapse or cross sectioning imaging only later.

Conclusions

Severe complications were rather rare in this study of 42 cases of SSROs. With a low frequency of complications it is difficult to reveal significant associations and larger samples might be needed to recognize relationships between complications and variables such as third molar extraction timing etc.

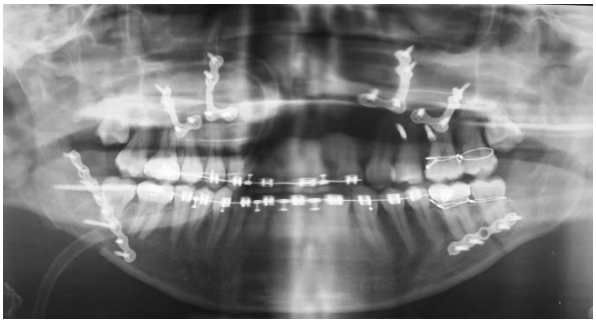

Figure 2: Unfavorably split right sided buccal segment has been incorporated in the fixation for the right SSRO using an 8 hole mini-plate.

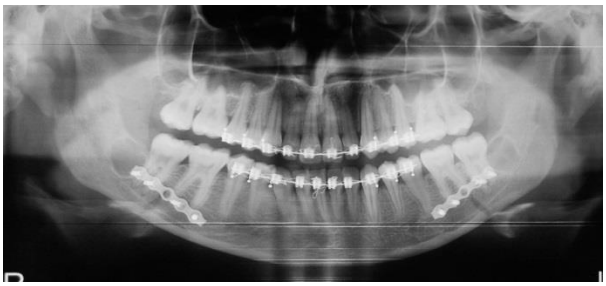

Figure 3: Right sided SSRO split has extended onto the posterior border of the ramus.

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