ORIGINAL ARTICLE

Comparison of functional outcome after open and closed reduction of mandibular subcondylar fracture

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Abstract

Objective: To compare open reduction with internal fixation of mandibular subcondylar fracture with closed reduction in terms of adequate mouth opening.

Method: The randomised clinical trial was conducted from March 2014 to February 2015 at the Oral and Maxillofacial Surgery Department, King Edward Medical University and Allied Hospitals, Lahore, Pakistan, and comprised patients who presented with unilateral subcondylar fractures. The patients were randomly divided into 2 groups. Group-A patients were treated with closed reduction and immobilisation and were discharged the same day, while Group-B patients were treated by open reduction with internal fixation and retained in ward for 1 day. Both were recalled for periodic follow-ups, and were compared in terms of achieving adequate mouth opening. Data was analysed using SPSS 20.

Results: Of the 70 patients, 35(50%) were in each of the two groups. The mean age in Group-A was 28.88±11.86 years compared to 28.22±10.80 years in Group-B ($p>0.05$). Mean mouth opening in the two groups were consistently positive, and significant at the last two follow-ups($p<0.001$).

Conclusion: The difference in results of both treatment modalities was significant, indicating that open reduction and internal fixation should be the preferred treatment.

Keywords: Mandibular sub-condylar fracture, Open reduction, Closed reduction, Internal fixation, Mouth opening.
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Introduction

Mandibular fractures are frequently seen in road traffic accidents (RTAs), sports injuries and interpersonal violence, with the most common sites of fracture being parasymphysis and mandibular subcondyle. Mandibular subcondylar fractures (MCFs) account for 25-35% of the total mandibular fractures.[1] The mode, vector and site of impact influence the fracture diversity. MCF hinders various joint movements and hampers optimal mouth opening.[2] These fractures need to be treated to avoid severe functional disabilities, including restricted mouth opening, malocclusion, compromised lateral excursion of the condyle and deviation on mouth opening. Hence, treatment needs to be methodised for effective management of MCFs in terms of adequate mouth opening and patient satisfaction. Two methods have been established to treat MCFs: open reduction and internal fixation (ORIF) and closed reduction with external fixation (CREF).[3] A study suggested appropriate classification to provide fracture insight and treatment commencement.[4]

Various authors have devised classifications to describe MCFs to facilitate management decisions. Some discussed anatomical line of fractures, angles of displacement and dislocations, while others suggested displacement and dislocations at high and low level with reference to articulation fossa.[5,6]

Studies have supported surgical reduction owing to less morbidity, minimum or no wound infections, optimal occlusion, no damage to nerve or deviance of jaw on opening mouth can be corrected.[6-8] Others have supported both treatments as effective.[9,10] Still others favoured closed reduction over open surgical modality.[11-13]

Numerous studies and two consensus meetings were unable to conclusively recommend either of the treatment options.[14] One study provided maxillomandibular fixation (MMF) after ORIF for a shorter period of time to provide occlusal stability and to avoid muscle dystrophy.[15] Another study worked on both conservative and surgical methods but was not satisfied with either modality.[7,16] A recent study conducted in Pakistan also addressed the question and reported open reduction techniques to have better functional outcomes.[17]

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The current study was planned to compare the functional outcome of indirect fixation and immobilisation and ORIF of subcondylar fractures at different follow-up periods.

Patients and Methods

The randomised clinical trial (RCT) was conducted from March 2014 to February 2015 at the Oral and Maxillofacial Surgery Department, King Edward Medical University and Allied Hospitals, Lahore, Pakistan, and comprised patients who presented with unilateral subcondylar fractures. After approval from the institutional review board, the sample size was calculated using 90% power of study, 5% level of significance and expected mouth opening at 6 months 56% in closed reduction and MMF and 90% in ORIF.[2] The World health Organisation (WHO) calculator was used for the purpose.[18] To account for dropouts, 4 extra patients were included in each group. The RCT was registered at clinicaltrials.gov with identifier NCT03494309.

The sample was from among male and female patients aged 16-50 years with displaced MCFs irrespective of multiple mandibular fractures. Fractures below the condylar neck and above the angle of mandible with the fracture line extending from sigmoid notch till posterior border of ramus posterior and inferior limit taken as lingula were labeled as MCFs. Patients having bilateral MCFs with mid-facial fractures, insufficient bilateral dentition, medically unfit for surgery, with old healed mandibular fractures and history of previous mandibular surgery for the same indication were excluded. After taking written informed consent, the patients were randomly divided into two groups using the lottery method. Group A patients were treated by closed reduction and MMF, while group B patients were treated surgically using ORIF.

Detailed history was taken, examination was done and confounders were controlled by strictly following the exclusion criteria. Initial evaluation included mouth opening measured clinically in millimeters (mm). Mouth opening was categorised as adequate at $\geq$35mm and inadequate at <35 mm. X-ray face posterioanterior (PA) view and orthopantomograph (OPG) were done to assess the fracture. Biochemical and haematological investigations and X-ray chest were carried out as part of anaesthetic workup.

In group A patients, MCFs were reduced by hand manipulation bringing teeth in occlusion and using teeth facets as guide. Once maximum intercuspation, i.e., centric occlusion, was achieved passively, the arch bar was secured with wires on upper and lower arches. Occlusion was rechecked and class 2 elastics were provided in direction which would proximate and immobilise fracture segments, while engaging elastics on upper arch bar hook, passing through lower arch bar peg and then upper arch bar hook again from the opposite side towards the fractured side to keep the fractured fragments compressed, maintaining teeth in centric occlusion. Any sharp projection of wire or arch bar was checked and patient was instructed about oral hygiene and liquid diet. Patients were recalled after four weeks to disengage the hardware and first assessment was recorded. Instructions were given for active physiotherapy after the removal of the arch bar and elastics, and patients were intimated of next visits as per the study plan.

Group B patients were treated surgically by exposing fracture sites under general anaesthesia (GA). After mouth disinfection, incisions were given in accordance with fracture line and choice of surgeon. For MCFs the approach was extra-oral which comprised retro-mandibular incision, preauricular incision or submandibular incision, and for other mandibular fractures, intra-oral vestibular incisions were given. Once all fractured segments were exposed, they were reduced keeping centric occlusion and bone alignment in vision, fixation of fractured fragments was done in proximate position, with plates and screws. At least two screws were applied on either side of the fracture line, and incision lines were sutured. The skin sutures were removed on the third day and steri-strips were applied for another week to avoid suture scars. The intra-oral sutures were removed on the 5th day and strict oral hygiene and soft diet plan was given to patients for 6 weeks. After surgery, ORIF patients were observed in the ward for 24 hours before being discharged.

In both groups, 3 follow-up visits were planned at 1st, 3rd and 6th months. At each visit, adequate/inadequate mouth opening was recorded. Patients having maximum intercuspation, reporting satisfaction in chewing, and having clinically adequate mouth opening and closing were categorised as adequate mouth opening, while patients not having either of the three were labelled as having inadequate mouth opening.

Data was analysed using SPSS 20. Quantitative variables, like age, and mouth opening, was expressed as mean $\pm$ standard deviation (SD), while qualitative variables, like gender and adequacy of mouth opening, were presented as frequencies and percentages. Chi-square test was used to analyse qualitative data. For quantitative data, the two groups were compared using t-test at each patient contact. Mixed model analysis of variance (ANOVA) was applied to determine between-subjects and within-subject effects. The model was designed to incorporate repeated measures of mouth opening and treatment

groups. P<0.05 was considered significant.

Results

Of the 70 patients, 35(50%) were in each of the two groups. The mean age in group A was 28.88±11.86 years compared to 28.22±10.80 years in group B (p>0.05). The minimum age of patients in both groups was 16 years, while the maximum age in groups A and B were 48 and 55 years respectively. Both groups had 28(80%) males and 7(20%) females (Table-1).

Table-1: Baseline characteristics.

S. No.	Parameter	Group A	Group B	p-value
1	Age (years)	28.89±11.87	28.33±10.8	0.809
2	Gender M	28(80%)	28(80%)	0.759
	F	7(20%)	7(80%)	
3	Pre-operative mouth opening (mm)	11.77±3.53	11.74±4.31	0.976
4	Pre-operative adequacy of month opening	0%	0%	-

At 1st month post-treatment, mouth opening improved but was not adequate in both groups (p>0.05). At 3 and 6 months, the difference in mouth opening was significantly adequate in both groups (p<0.05) (Table-2; Figure).

Discussion

There has been a rising trend of MCFs in recent years in close conjunction with the urban drift of the population worldwide. The common modes of MCFs are drug abuse, domestic violence and unsafe motor-vehicle driving practices.[19,20] Young males represent the most frequently

Table-2: Inter-group comparison of mouth opening.

S. No.	Follow up time	Adequacy of Mouth Opening (%)			Mouth Opening (mm)		
		Group A n (%)	Group B n (%)	p-value	Group A (mm)	Group B (mm)	p-value
1.	Pre-Operative	0	0	-	11.77±3.53	11.74±4.31	<0.001
2.	1month	0	0	-	21.34±2.33	28.09±1.25	
3.	3months	2(5.7%)	33(94%)	<0.001	31.09±2.43	36.86±1.68	
4.	6months	12(34.4%)	35(100%)	<0.001	33.89±1.18	41.49±1.87	

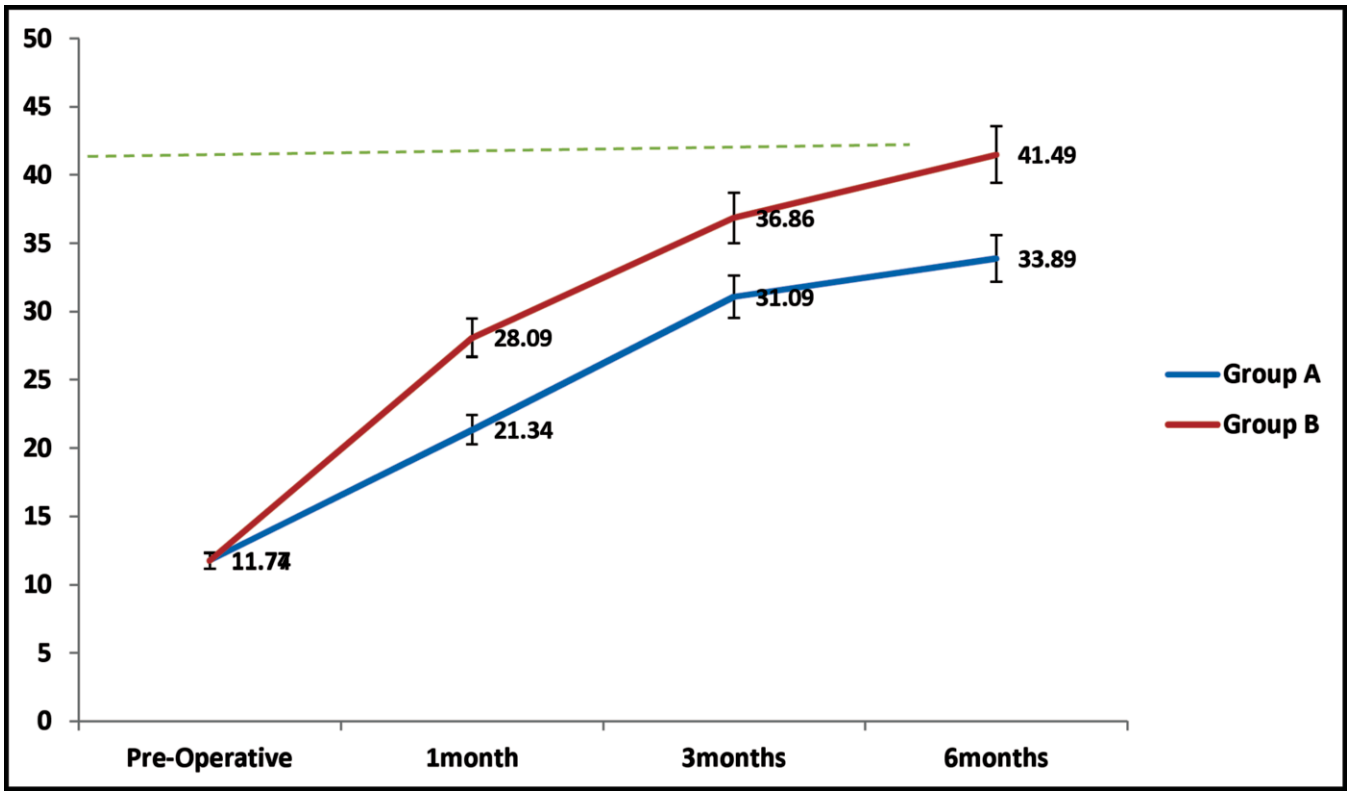

Figure: Mouth opening in treatment groups at pre-operative and follow-up.

afflicted segment of society. Despite its urgent need, no agreement has been reached in the two consensual meetings regarding the optimal treatment of MCFs.[14] The current study comprised MCF patients with ages ranging 16-55 years. Previous studies have also reported that young patients suffer from MCFs with higher frequency.[19,20]

The male-to-female (M:F) ratio in the present study was 4:1 with 80% patients being males, which is in line with other studies.[19,20] All the instigating factors leading to MCFs, including violence, assault, drug abuse, RTAs and sports injuries, are more common among young males, and this largely explain the high incidence of MCF in this segment.[21]

In the current study, ORIF turned out to be the better and more effective mode of treatment in terms of adequate mouth opening. This is also in line with earlier studies.[6,9] Haug et al. studied patients from different races and reported no difference in functional outcomes, including range of motion (ROM), sensory and motor functions, on the basis of gender, race, age or cause.[22] The only parameter that differed between the two groups was chronic pain after MMF. However, the study had a small sample with 10 patients in each group, and they hailed from different races.[22] Leiser et al. reported mouth opening to be similar in the two study groups,[3] but it was a retrospective study on Caucasian patients.[3]

Various meta-analyses favour ORIF.[8] A 2015 review also showed better results for ORIF, but stated that different study protocols, lack of information on classification, follow-up time, and inclusion criteria made it difficult to compare different studies, suggesting that further prospective, randomised studies should examine these issues.[23]

In the current study, 65.6% patients in the MMF group did not achieve adequate mouth opening at 6 months post-intervention, while all the ORIF patients achieved adequate mouth opening. Mal-union with reduced vertical ramal height is one of the factors leading to limited mouth opening, while non-union, haematoma formation and infection have been the other reasons.[7] In ORIF, the fractures were reduced under vision, thereby eliminating the possibility of mal-union and, hence, non-union. In MMF, the use of non-rigid fixative wires allowed excessive movements, resulting in delayed healing and mal-union / non-union. This, in turn, led to functional impairment in terms of restricted mouth opening.

The current study has some limitations. The pre-traumatic pictures or X-rays were not available. The outcome was based on surgeons' observation as well as patients' satisfaction. Patients' compliance for physiotherapy, dietary modifications and orodental hygiene was uncertain. The surgical approach in ORIF patients was not standardised and was at the surgeon's discretion. Blinding could not be done as both the patient and the doctor were aware of treatment provision due to obvious differences between surgical and closed reduction. Also, the study was done at a single centre and represents a small segment of the population. Further prospective RCTs should be conducted to broaden the evidence base. Though ORIF was found to be superior in the current study, the treatment option is not without risks. Expertise and facilities have a major role in the success of treatment. There are potential complications of ORIF, including damage to the facial nerve, visible scars and even failed surgery. Patients who undergo CREF are at the risk of having to undergo second surgery and anaesthesia in case of treatment failure.

Conclusion

The difference in results of treatment modalities in terms of mouth opening was statistically significant. ORIF should be the preferred treatment. However, further RCTs with uniform protocols are needed to provide confirmation of the findings.

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Conflict of Interest: None.

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