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Original Articles/นิพนธ์ต้นฉบับ

Mandible Fracture in Sawanpracharak Hospital

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Abstract

Background: Maxillofacial injury was one of major injuries in Sawanpracharak Hospital. Mandible is dynamic facial bone for chewing and biting which is an important function to be restored. Mandible fracture could be managed by different methods: conservative and symptomatic treatment, closed reduction and intermaxillary fixation, open reduction and internal fixation by interosseous wiring or rigid fixation with plate and screw which was used by many surgeons combination with intermaxillary fixation, then advantage of using it was less value.

Objective: To study epidemiology, surgical technique and cost benefit of alternative internal fixation methods of mandible fracture patients in Sawanpracharak Hospital.

Patients and methods: Retrospective review from medical record of 398 mandible fracture in-patients in Sawanpracharak Hospital during May 2007 - December 2009. 145 patients were managed by the author.

Result: The most common cause of maxillofacial injured patients was road traffic accident and motorcycle was a majority vehicle, males and aged of 10-30 years were majority group, 1,095 (70.4%) patients had combined soft tissue injuries and incidence of mandible fracture was 25.6%. The most common affected region was symphysis: 236 (44.6%). There were 136 (34.2%) cases who had one more contra lateral fracture side. 88 (22.1%) patients had combined facial bone fracture that maxilla was predominate. Internal fixation with interosseous wiring and intermaxillary fixation was the author's preferable technique: 90 (62.1%) cases. The total medical care cost of mandible fracture was 27,947.75 baht per patient and the cost of plates/screws and wire were 4,531.98 and 452 baht per patient respectively. There were 8 (6.7%) cases of wound infection which were responded to antibiotic treatment but one case contributed to chronic osteomyelitis and non-union which was successfully reconstructed by iliac crest bone graft.

Conclusion: The mandible fracture was one of most common maxillofacial injuries and motorcycle accident was a major cause which might be prevented by wearing helmet. It could be effectively treated by interosseous wiring and intermaxillary fixation that the cost was cheaper than plate and screw which should be performed in patients of simple, vertical fracture without suffering from 6 weeks of intermaxillary fixation.

Keywords: maxillofacial injury, fracture mandible, closed reduction, interosseous wiring, intermaxillary fixation, medical care cost.

Background

Maxillofacial injury was one of major injuries and 5th rank of in - patient of department of surgery in Sawanpracharak Hospital[1] which increased in number every year. It may involve soft tissue, facial bone or both parts. Mandible is only dynamic facial bone of lower face which is moved by many mastication muscles for chewing and biting. It is an important function to be restored in maxillofacial injured patients. Mandible fracture could be managed by different methods: conservative and symptomatic treatment for condylar fracture of minimum upset patient[2], closed reduction and intermaxillary fixation (IMF.) for favorable, non displacement or stable with normo-clusion, open reduction and internal fixation (ORIF.) by interosseous wiring (IW.) or plate and screw for non reducible mandible fracture. The class I mandible fracture patients who were treated with interosseous wiring combination with intermaxillary fixation for 4-6 weeks[3] should be advised of mouth care during these period and exercise of opening mouth after removal intermaxillary fixation to gain normal mastication as soon as possible. Rigid fixation with plate and screw which was introduced to take over previous methods[4] was used by many surgeons combination with intermaxillary fixation, then advantage of using it was less value.

Objective

To study epidemiology, surgical technique and cost benefit of alternative internal fixation methods of mandible fracture patients in Sawanpracharak Hospital.

Patients and Methods

Retrospective review from medical record of 398 patients who were diagnosed mandible fracture and admitted in Sawanpracharak Hospital during May 2007 - December 2009 and 145 patients were managed by the author. The patients were grouping by age, sex, fracture sites using classification of location introduced by Dingman and Natvig[5], method of fixation, postoperative result, complications and long term follow up. The medical care cost was calculated and compared between cost of plate / screw to wire per patient. The cause of injuries from Injury Surveillance System (IS)[6] were also studied too.

Patient care process started when patients were diagnosed and admitted, routine basic radiologic study of skull; posteroanterior and lateral views, panoramic view was recommended only for difficult cases. Most of the patients were operated within 2 weeks except for unstable or worsen associated conditions. Prophylactic and postoperative antibiotic drug; Penicillin G. Sodium or Cefazolin was given for all compound fracture of mucosal and skin wound respectively. Operative techniques were described as following protocols; protocol for management of mandible fracture, protocol of fixation technique of placing wire, protocol of fixation technique of placing plate and screw and protocol of intermaxillary fixation technique. After removal arch bar and intermaxillary wires at the end of treatment, all patients were advised to exercise following patient's manual of postoperative and rehabilitation care of intermaxillary immobilization by themselves for early gaining of normal range of opening mouth which was usually in a few weeks.

Protocol for management of mandible fracture

1. Closed reduction and intermaxillary fixation 2 weeks for condylar fracture; unilateral or bilateral.
2. Closed reduction and intermaxillary fixation 4-6 weeks for favorable, non displacement and normoclusion fracture.
3. Closed reduction and monomaxillary fixation 4 weeks for dentoalveolar fracture.
4. Open reduction and rigid internal fixation with plate/screw without intermaxillary fixation for any site of simple and vertical, one or more, opened or closed fracture.
5. Open reduction and internal fixation with

interosseous wiring with intermaxillary fixation 6 weeks for comminuted or oblique fracture.

6. Conservative treatment for coronoidal fracture or mandible fracture with multiple or associated injuries whose conditions were hopeless or patients denied to be operated.

7. Edentulous mandible fracture was conservative treatment, except severe displacement or opened fracture which should be fixed with wiring or plate/screw according to fracture criteria.

8. All carious teeth need to be removed.

Protocol of fixation technique of placing wire.

1. Wire number 22 was placed perpendicularly to fracture line and passing through both outer and inner cortex of mandible except for severe comminuted fracture with multiple fragmentations or oblique fracture where drilled hole could not pass both cortex and additional wiring may be placed to increase rigidity.

2. Wiring loop was preferable due to more stability, however figure of 8 wiring was placed occasionally at marginal border.

3. Location of wiring had to avoid to injury tooth root, tooth bud in child and inferior alveolar nerve.

4. Interosseous wiring loop which passed the same drilled hole of fragmentation of communuted fracture should be crossed link to avoid high tension force which may break fragmented bone into multiple small pieces and caused fixation failure.

Protocol of fixation technique of placing plate and screw.

1. Temporary interosseous wiring loop was placed above or below where plate / screw was planned to be placed at inferior border of mandible, these step was very important to stabilize and precisely approximate fracture sites so plate was adapted and passive contoured to osseous curvature.

2. The 6 holes plate which was accurately adapted and contoured was positioned and fixed with 6 screws bi-cortically: 3 on each fracture lines.

3. The second plate which was also accurately adapted and contoured was placed at superior border along alveolar ridge and fixed with 2 screws of 5 mm. length only outer cortex to prevent tooth root injury.

4. Temporary interosseous wiring loop may be removed after rigid fixation of both plates, however it could be left.

5. Interdental wiring loop was occasionally placed at fracture line.

Protocol of intermaxillary fixation technique.

1. Arch bar should be placed from first molar to first molar of right and left quadrants using techniques which was recommended by R.C. Schultz[7].

2. Arch bar normally consisted of 14 hooks and maxillary arch bar had one more hook longer.

3. Interdental wiring was placed between teeth at fracture line if possible for more stability.

4. Rubber bands were used instead of wire loop to immobilize mandible with maxilla in case non precise occlusion for tracing teeth in proper relation which was recommended by Paul Manson[8].

Result

The total number of mandible fracture patients was 398 (25.6%) from 1,555 maxillofacial injured patients during May 2007 - December 2009 and 145 (36.4%) from 398 cases were managed by the author, 307 (77.1%) were male and 91 (22.9%) were female as Table 1 and aged group majority was 10-30 years old with amount of 206 cases (51.8%) as Table 2.

The major cause of maxillofacial injuries was road traffic accident especially motorcycle with amount of 1,056 (67.9%), 870 (82.4%) cases respectively and 1,095 (70.4%) patients had combined soft tissue injuries as Table 3. The most common affected region was symphysis: 236 (44.6%) which was not too much difference on right and left side and the followed

Table 1 Mandible fracture by sex group during year 2007-2009

Sex	2007	2008	2009	Total (%)
Male	58	132	117	307 (77.1)
Female	18	38	35	91 (22.9)
Total	**76**	**170**	**152**	**398**

Table 2 Mandible fracture by age group (year) during yera 2007-2009

Age (year)	2007	2008	2009	Total (%)
0 - < 10	0	1	3	4 (1.0)
10 - < 20	16	42	37	95 (23.9)
20 - < 30	29	44	38	111 (27.9)
30 - < 40	7	32	32	71 (17.8)
40 - < 50	13	26	15	54 (13.6)
50 - < 60	7	14	16	37 (9.3)
≥ 60	4	11	11	26 (6.5)
Total	**76**	**170**	**152**	**398**

ranks were angle: 139 (26.3%), body: 67 (12.7%), condyle: 57 (10.8%) respectively as Table 4. There were 136 (34.2%) cases who had two or more fracture sites which were normally on contra-lateral side and parasymphysis was a region that usually been found with the second site; 5 from 7 (71.4%) and followed ranks were angle; 85 from 139 (61.2%), condyle 33 from 57 (57.9%), symphysis 101 from 182 (55.5%). Coronoid or ramus fracture were very rare, only one case for each of them. 88 (22.1%) patients had combined one or more facial bone fracture which were maxilla 52 (46.8%), zygoma 38 (34.2%), nose 13 (11.7%), panfacial and frontal bone were less common as Table 5.

Internal fixation with interosseous wiring and intermaxillary fixation was the authors preferable technique: 90 (62.1%) cases compared to my junior young plastic surgeons who preferred rigid internal fixation with plate and screw combined with intermaxillary fixation: 122 cases (48.2%) as Table 7.

The total medical care cost of mandible fracture patients was 11,123,203 baht or 27,947.75 baht per patient but the cost of plates and screws was 1,400,381 baht or 4,531.98 baht per patient compared to the cost of wire was 452 baht per patient as Table 8, 9[6,9].

The complications of 107 (73.8%) patients who were operated by the author: 1 from 17 (5.9%) cases in group of fixation with plate and screw, 7 from 90 (7.8%) cases in group of fixation with interosseous wiring and the total 8 (6.7%) cases got wound infection that most cases were responded to additional high potency antibiotic agents but only one (0.8%) case of the last group contributed to chronic osteomyelitis and non-union which was reconstructed by iliac crest interpositional bone graft and fixation by interosseous wiring and intermaxillary fixation for 8 weeks and finally gained normocclusion. No other serious complications; mal-union, malocclusion or ankylosis were observed in all patients.

Table 3 Causes of maxillofacial injuries during year 2007-2009

Causes	2007	2008	2009	Total (%)
Road traffic accident	140 (65.1)	442 (67.5)	474 (69.2)	1,056 (67.9)
Motorcycle	*107 (76.4)*	*387 (87.6)*	*376 (79.3)*	*870 (82.4)*
Other vehicles	*33 (23.6)*	*55 (12.4)*	*98 (20.7)*	*186 (17.6)*
Fall, hit by hard object	32 (14.9)	102 (15.6)	80 (11.7)	214 (13.8)
Gunshot wound	1 (0.5)	2 (0.3)	7 (1.0)	10 (0.6)
Animal bite	10 (4.7)	11 (1.7)	23 (3.4)	44 (2.8)
Assault	30 (13.9)	92 (14.1)	93 (13.6)	215 (13.8)
Non specific	2(0.9)	6 (0.9)	8 (1.2)	16 (1.0)
Total	**215**	**655**	**685**	**1,555**
Combined soft tissue injury	153	438	504	1,095

Table 4 Distribution of region of fracture

Regions	Rt.	Lt	Number	%	Two or more
Condylar process	34	23	57	10.8	33 (57.9)
Coronoid Process	0	1	1	0.2	0
Ramus	1	0	1	0.2	0
Angle	66	73	139	26.3	85 (61.2)
Body	31	36	67	12.7	29 (43.3)
Parasymphysis	4	3	7	1.3	5 (71.4)
Symphysis	93	89	182	34.4	101 (55.5)
Symphysis menti	-	-	54	10.2	8 (14.8)
Dentoalveolar process	-	-	14	2.7	6 (42.9)
Non specific	-	-	7	1.3	0
Total			**529**	**100**	**267**

Table 5 Combined facial bone fracture

	Number	%
Frontal	3	2.7
Pan facial	5	4.5
Nose	13	11.7
Zygoma	38	34.2
Maxilla	52	46.8
Total	**111**	**100**

Table 6 Distribution of region of fracture sites compares to other studies

	Nakhonsawan	J.W. Pollery[11]	R.O. Dingman[5]
Symphysis	44.6	22	14
Angle	26.3	31	20
Body	12.7	15	21
Condyle	10.8	18	36
Dentoalveolar process	2.7	0	3
Parasymphysis	1.3	7	0
Ramus	0.2	6	3
Coronoid	0.2	1	2
Total	**100.0**	**100**	**99**

Table 7 Methods of Treatment

	The Author (%)	Other 3 Doctors (%)	Total (%)
ORIF. c plate / screw	17 (11.7)	122 (48.2)*	139 (34.9)
ORIF. c IW. / IMF.	90 (62.1)	47 (18.6)	137 (34.4)
CR. / IMF.	13 (9.0)	52 (20.6)	65 (16.3)
No treatment	12 (8.3)	21 (8.3)	33 (8.3)
Refer	8 (5.5)	10 (4.0)	18 (4.5)
Death	5 (3.4)	1 (0.4)	6 (1.5)
Total	**145 (36.4)**	**253 (63.6)**	**398**

*: rigid internal fixation with plate and screw combined with intermaxillary fixation

Table 8 Medical care cost of maxillofacial injuries during year 2007-2009

Year	2007	2008	2009	Total
Total cost (baht)	2,204,366	4,476,321	4,442,516	**11,123,203**
Number of patients	76	170	152	**398**
Cost/patient (baht)	29,004.82	26,331.30	29,227.08	**27,947.75**

Table 9 Material cost during year 2007-2009

Year	2007	2008	2009	Total
Plate/screw cost (baht)	316,251	597,205	486,925	**1,400,381**
Number of patients	60	122	127	**309**
Cost/patient (baht)	5,270.85	4,895.12	3,834.06	**4,531.98**

Discussion

Incidence of mandible fracture was 25.6% of maxillofacial injured patients. The most common cause of injuries was road traffic accident; 1,056 (67.9%) and motorcycle was a majority vehicle; 870 (82.4%). National Board of Road Safety tried to increase helmet wearing which was only 27% (10) to Thai people especially vulnerable aged group (10-30 years). Wearing standard full face helmet with chin protection could save not only skull but also mandible from impact force during accident.

It was not necessary to send the drunken patients for radiological study on the first time because of their non cooperation and causing to useless films which need to be repeated later.

Most common site of mandible fracture in Sawanpracharak Hospital which were symphysis 44.6%, angle 26.3%, body 12.7%, condyle 10.8% respectively was different from the study of J.W. Pollery[11] or R.O. Dingman[5] which were angle 31% and condyle 36% respectively. To explain why different most frequency fracture site was to understand the injury mechanism of road traffic accident of which causing high impact force may hit directly at chin and break symphysis; most prominence of mandible then it did not transmit force to break condyle.

A method of internal fixation with interosseous wiring and intermaxillary fixation cost 10 times cheaper compared to plate and screw but a little higher infection rate and one non union case. These study showed that: it did not need special wire loop at canine which was recommended by R. C. Schultz[7] to prevent slipping or loosening of wire. Intermaxillary fixation was not necessary to be done before operation as recommended by William C. Ardary[12] that it may cause difficult reduction and failure of proper alignment at fracture line but it should be done as final step before endotracheal extubation, except combined facial bone fracture who had to be anterior nasal packed, these patients who were orally intubated should be place arch bars only and intermaxillary wires or rubber bands would be applied later at the day of taking off nasal packing. It was not necessary to perform tracheostomy too. Paul Manson recommended 3-4 weeks of intermaxillary fixation for condylar fracture[13] longer than 7-10 days which was recommended by Barry M. Zide[14] and 2 weeks period of the author's technique for all 24 condylar fracture patients who were successful closed reduction, they could open mouth fully and gain normal excursion within first week after removal arch bars. At the time of finishing immobilization, mandible was assessed of stability by palpation after taking off intermaxillary wires or rubber bands and arch bars still kept in place, if it was questionable bony union it should continue inter-maxillary fixation for a few weeks. Rubber bands did not need to change and could be effectively kept during 6 weeks of immobilization.

The author would like to fix with plate and screw for any patients whose fracture site were simple, vertical and could be precisely approximated of fracture sites and recommendation of placing temporary wiring loop for stabilizing fracture sites before placing plate and screw as key success step. Intra-operative assessment of teeth relation of both jaws at the end of operation every case was very important and necessary to confirm of normoclusion and indicate of successful reduction. The patients could open mouth immediately post operation, however they were advised to eat liquid diet for 6 weeks.

Conclusion

The mandible fracture was one of most common maxillofacial injuries and motorcycle accident was a major cause which might be prevented by wearing helmet. It could be effectively treated by interosseous wiring and intermaxillary fixation that the cost was cheaper than plate and screw which should be performed for patients of simple, vertical fracture without intermaxillary immobilization then they did not

suffer from 6 weeks of intermaxillary fixation. There was one cases of chronic osteomyelitis and non-union which was successfully treated by iliac crest bone graft.

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References

1. 10 อันดับโรคผู้ป่วยในกลุ่มงานศัลยกรรม โรงพยาบาลสวรรค์ประชารักษ์. รายงานประจำปี 2554:60.
2. McGregor IA. Fundamental Techniques of Plastic Surgery and Their Surgical Applications. 8th ed. Edinburgh: Churchill Livingstone; 1989:226.
3. Manson PN. Facial Injuries. In: McCarthy JG, editor. Plastic Surgery. 1st ed. Philadelphia : W.B. Saunders Company; 1990:943.
4. McGregor IA. Fundamental Techniques of Plastic Surgery and Their Surgical Applications. 8th ed. Edinburgh: Churchill Livingstone; 1989:214.
5. Dingman RO, Natvig P. Surgery of Facial Fractures. Philadelphia: W.B. Saunders Company; 1964.
6. Injury Surveillance System in Sawanpracharak Hospital. Annual report; 2007-2009.
7. Schultz RC. Facial Injuries. 3rd ed. Chicago: Year book medical publishers, inc.; 1988:388-91.
8. Manson PN. Facial Injuries. In: McCarthy JG, editor. Plastic Surgery. 1st ed. Philadelphia : W.B. Saunders Company; 1990:925-6.
9. Registry of plate and screw using of maxillofacial injured patient in Sawanpracharak Hospital. Annual report; 2007-2009.
10. Regional report on status of road safety. The South-East Asia Region. World Health Organization; 2009:27.
11. Pollery JW, Flagg JS, Cohen M. Fractures of The Mandible. In: Weinzweig J, editor. Plastic Surgery Secrets. Philadelphia : Hanley & Belfus, Inc.; 1999:165.
12. Ardary WC. Plate and Screw Fixation in the Management of Mandible Fractures. Clin Plast Surg 1989;16: 61-8.
13. Manson PN. Facial Fractures. In: Grabb and Smith's, editor. Plastic Surgery. 4th ed. Boston: Little Brown and Company; 1991:388.
14. Zide BM. The Temporomandibular Joint. In: McCarthy JG, editor. Plastic Surgery. 1st ed. Philadelphia: W.B. Saunders Company; 1990:1475-513.