

APPLICATION OF THE CHAMPY TECHNIQUE ASSOCIATING WITH TENSION WIRE LOOP IN SURGICAL TREATMENT OF MANDIBULAR ANGLE FRACTURE

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Abstract

Objective: 1. Describe the clinical and radiological characteristics of patients with mandibular angle fractures (MAF); 2. Evaluate the results of treatment of the Champy technique associating with tension wire loop and the standard Champy technique in the surgical treatment of MAF. **Methods:** Controlled randomized clinical trial study on 98 patients of MAF were examined and treated at the department of maxillo-facial surgery of National Institute of Odonto-Stomatology and Vietnam-Cuba Hospital in Ha Noi, from January 2008 to August 2012. **Results:** MAF often coordinates with other mandibular fractures (66.3%) that the majority located in the chin area (87.5%), by traumatic force impacting on opposite mandibular body with MAF (80.6%), majority of MAF is open fractures (90.8%), unfavorable fractures (98.0%) and displaced fractures (74.5%); MAF often occurs in the left side (60.2%) and has mostly wisdom tooth in the fracture line (96.9%). The common symptoms of MAF include limited mouth opening, malocclusion, throbbing pain and bleeding torn gums in wisdom tooth. In the diagnosis of MAF, the diagnostic value of CT scan is 100%; of panoramic X-ray 92.9%, of facial X-ray 96.9% and coordinating the panoramic and facial X-ray 100%. Survey on cone beam CT to measure the bone anatomical dimensions of mandibular angle region from which giving the recommended screw length and estimating the position of osteosynthesis. Evaluation at discharge, 3 and 6 months after surgery), the treatment success rates of the group II were 87.8%; 90.7% and 92.7% (in succession) and that of group I were 61.2%; 61.4% and 62.9%. **Conclusion:** Early and late postoperative results showing that the Champy technique associating the tension wire loop (group II) is better the standard Champy technique (group I) statistically significant with $p < 0.05$.

Key words: Mandibular angle fracture, standard Champy technique, Champy technique associating the tension wire loop.

1. BACKGROUND

Maxillofacial trauma is the common emergency on daily life; in the facial fracture caused by trauma, the Mandibular Fracture (MF) accounts for high percentage (60 – 64%) and prone to mandibular angle fractures (MAF) (23 – 42% of MF) [3]. The MAF has the highest rate of postoperative complications in the MF, can be up to 32%. In the world, at present in the surgical treatment of MAF, there are many methods, but most surgeons tend to select the method in oral surgery and less soft tissue trauma. Since 1975, Champy M et al. based on previous studies of Michelet FX (1973) gave “Champy technique” in

osteosynthesis of MAF, since then this method has popularized very quickly around the world. Research by David M.Saito (2008), 50 - 80% of the surgeon applies standard Champy technique in treating MAF [4]. This technique has many advantages, but it has some limitations in the application process such as difficult reduction of fracture ends, intermaxillary fixation (IMF) after surgery for at least 2 weeks and often have fracture gaps in mandibular inferior border after surgery [6]. To overcome this limitation, Robert C.Wang (2007) provide Champy technique associating with tension wire loop tension wire loop has both reduction of fracture ends and fixation of

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angle fracture at the mandibular border; therefore againsting fracture gaps in mandibular inferior border after surgery [9]. In Vietnam, since 2005 the standard Champy technique has been applied in several central hospitals, but so far the author has not seen any research on Champy technique associating with tension wire loop. Therefore, to contribute to improving the quality of treatment for patients with MAF and simultaneously overcoming some of the limitations of standard Champy technique, we carried out this theme with two objectives:

1. Describe the clinical and radiological characteristics of patients with MAF.
2. Evaluate the results of treatment of the Champy technique associating with tension wire loop and the standard Champy technique in the surgical treatment of mandibular angle fractures.

2. SUBJECTS AND METHODS

2.1. Research Subjects: This study was performed on maxillofacial injured patients with MAF that were examined and treated surgically at the National Hospital of Odonto-Stomatology and Vietnam – Cuba Hospital in Ha Noi from 01/2008 to 08/2012.

2.1.1. Inclusion criteria: Patients with the isolated, simple, total MAF or that associated with other fracture of mandible. Patients accepted with

osteosynthesis surgical treatment using either the Champy's standard technique or the Champy's technique associated with tension wire loop. If the MAF patient has another associated fracture of mandible, this associated fractures have to use the rigid fixation. Patients were treated surgically within 7 days after injury, followed during treatment and follow-up examination after discharge.

2.1.2. Exclusion criteria: MAF with comminuted fractures or complex fractures. MAF were not caused by maxillo-facial injury. MAF associated with maxillary fracture influencing the occlusion. MAF in context of multiple trauma or associated with cranial traumatism causing difficulties in the treatment and evaluation. Patients do not cooperate with their doctors in treatment and research [9].

2.2. Research methods: the controlled randomized clinical trial study; the sample size is calculated to sample size formulas for interventional study of WHO. The minimum sample size of two groups is 72 patients. However, in reality we have performed on 98 patients. Using the simple randomized sample. Randomly chosen patients in either of two groups: **Group I** (control group): surgical treated patients with the Champy's standard technique. **Group II** (interventional group): surgical treated patients with the Champy's technique associating tension wire loop.

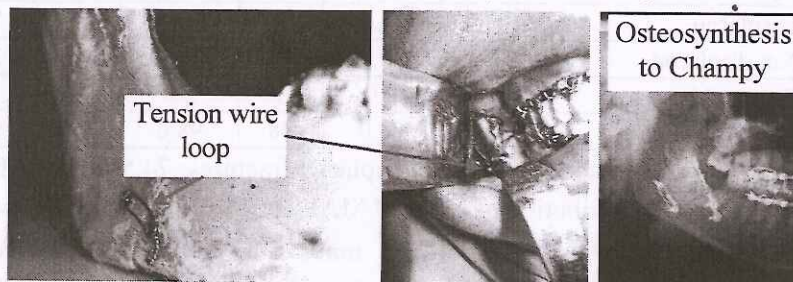


Figure 1. Osteosynthesis of MAF according to Champy technique associating the tension wire loop. These patients were treated and followed-up after surgery, evaluated at discharge (Table 1), 3 and 6 months after surgery (Table 2)

2.3. Data processing methods: Using SPSS 17.0 statistical software

Table 1. Evaluation criteria at discharge of Rudolf Seemann [10]

Evaluation criteria		Good	Medium	Bad
anatomy	- Contour of the bone	< 1 mm	1 - 2 mm	> 2 mm
	- Fractured gap size	< 1 mm	1 - 2 mm	> 2 mm
Function	- Occlusion	Correct	Correct	False
	- Number of the teeth contact region	3 region	2 region	1 region
Aesthetic	- Facial balance	Yes	No	Deformed
	- Wound status	Good	Accepted	Repaired
Postoperative complication (before discharge)		No	Yes, recovered	Yes, not recovered

Table 2. Evaluation criteria at 3 and 6 months after surgery of Rudolf Seemann [10]

Evaluation criteria		Good	Medium	Bad
Anatomy	- Contour of the bone - Fractured gap size	< 1 mm < 1 mm	1 - 2 mm 1 - 2 mm	> 2 mm > 2 mm
Function	- Chewing - Sense in fixation area - Maximum open mouth - Occlusal status, contact teeth at central occlusion	Good Good > 4 cm Correct, contact 80- 100%	Accepted Stimulated 2 – 4 cm Correct, contact 51 – 79%	Difficult Painful < 2 cm False, contact ≤ 50%
Aesthetic	- Facial balance - Scar	Yes Good	No Accepted	Deformed Repaired

3. RESULTS

Males: 79.6%; females: 20.4%; ratio male/female = 4/1. Common ages 19 to 39 : 83.7%. Mean age 23.95 ± 6.83 years. Causes of injury include traffic accidents: 68.4%; assaults: 16.3%; working accidents: 3.1%; fall: 11.2% and sport accidents: 1.0%. Distribution of MAF patients to age, sex, cause of injury in the two groups did not differ with $p > 0.05$.

3.1. The clinical and radiological characteristics of two groups

MAF associated with another MF accounted

for 66.3%; simple MAF (1 or 2 side of mandibular angle) accounted for 33.7%. Simple MAF: one side 90,9% (30/33); two side 9.1% (3/33); associated MAF: condyle 6.1% (4/65), body 18.5% (12/65) and chin area 75.4% (49/65). Position of impacted force caused the MAF includes chin area: 9.2%; body opposite to fractured angle: 80.6%; body on the same side to fractured angle: 3.1% and the angle on the same side: 7.1%. No difference about associated fractures, impacted force position between 2 groups with $p > 0.05$.

Table 3. Distribution of types of MAF in the two groups

Mandibular angle fractures	Group I		Group II		Total		P	
	n	%	n	%	n	%		
Properties	Closed	3	6.1	6	12.2	9	9.2	>0.05
	Opened	46	93.9	43	87.8	89	90.8	
Types	Displaced	37	75.5	36	73.5	73	74.5	>0.05
	Not displaced	12	24.5	13	26.5	25	25.5	
Direction	Favourable	1	2.0	1	2.0	2	2.0	>0.05
	Unfavourable	48	98.0	48	98.0	96	98.0	

Comment: MAF with open fractures: 90.8%; displaced fractures: 74.5% and unfavorable direction: 98.0%. No differences in the distribution of types of MAF between the two groups with $P > 0.05$.

96.9% (95/98) patients with mandibular wisdom teeth in the MAF and in of which 96.8% (92/95) to removing the wisdom teeth before osteosynthesis. The main symptom of MAF included throbbing pain (97.7%); limited open mouth (95.9%); pain swelling (92.9%);

malocclusion (90.8%); bleeding torn gum in wisdom teeth area (84.7%). MAF correct diagnostic value of panoramic film is 96.7%; anterior-posterior face film: 96.8%; oblique mandibular film: 77.8%; combination of these two films: 100%; CT scan: 100%.

Table 4. Bone thickness of angle region (n = 20; Cone Beam CT)

Angle bone thickness	Dimensions	Mean ± SD (mm)	Minimum (mm)	Maximum (mm)
Cheek monocortical thickness, at 5mm position from inferior border		2.81 ± 0.55	2.08	4.03
Cheek monocortical thickness, at the external oblique line		3.58 ± 0.96	2.15	5.46
Bicortical thickness of angle, at 5 mm position from angle apex		6.63 ± 0.96	4.82	8.99
Bicortical thickness at facial arterial notch, 5 mm from inferior border		9.54 ± 1.35	6.55	12.71

Comment: Monocortical screws recommended at inferior border is 5 mm, along the external oblique line is 6mm. Bicortical screws recommended at the angle is 8mm, at facial arterial notch is 10 - 12mm.

Table 5. Position of mandibular canal and mandible height at angle

Position of mandibular Canal, mandible height at angle	Dimensions	Mean ± SD (mm)	Minimum (mm)	Maximum (mm)
	Distance from mandibular canal to inferior border (at the second molar)		8.07 ± 0.89	5.46
Distance from mandibular canal to external surface of mandible (at the second molar)		6.75 ± 1.11	5.01	8.61
Distance from alveolar crest of wisdom tooth to mandible angle apex		30.65 ± 2.44	24.94	34.46
Distance from alveolar crest of wisdom tooth to inferior border		22.65 ± 2.31	18.63	27.92

Comment: To ensure the safety of mandibular canal when using bicortical screws at the inferior border, position of screw fixation < 7 mm from the inferior border. Based on mandible angle height (30.65 mm) surgeon can estimate osteosynthesis position.

The IMF time (in weeks) after osteosynthesis of 2 groups: 1.81 ± 0.83 That of group I: 2.57 ± 0.42 and II: 1.05 ± 0.11. The period of postoperative IMF of group II was shorter than group I significantly with p < 0.05.

3.2. Evaluation of postoperative results of MAF osteosynthesis

3.2.1. Evaluation of results at discharge (5 - 7 days after surgery)

- Bone border for the two groups was good: 61.2%; medium: 32.7% and bad: 6.1%. In these groups, the good level of group II (83.7%) was higher than that of group I (38.8%) significantly with p < 0.05. The gap of fractures for 2 groups was good: 72.4%; medium: 19.4% and bad: 8.2%. In these groups, good level of group II (98.0%) was

higher than that of group I (46.9%) with p < 0.05.

- Occlusal status for 2 groups was good: 83.7%; medium: 16.3% and bad: 0.0%. In these groups, good level of group II (95.9%) was higher than that of group I (71.4%) with p < 0.05. Aesthetic results for 2 groups was good: 92.9%; medium: 7.1%. In which, good of group II (93.9%) and I (91.8%) was same with p > 0.05.

- Total results (anatomic, function, aesthetic, complication) when patients discharged in group I: good 61.2% (30/49), medium 32.7% (16/49) and bad 6.1%; in group II: good 87.8% (43/49), medium 10.2% (5/49) and bad 2.0%. The good total results in group II (87.8%) was higher than that in group I (61.2%) significantly with p < 0.05 ($\chi^2 = 9.08$; p = 0.011).

3.2.2. Evaluation of postoperative results at 3 and 6 months period

Table 6. Postoperative complications of MAF osteosynthesis

Postoperative time	Complications	Group I		Group II	
		n	%	n	%
Before discharge	Wound-healing disturbance	2	4.1	1	2.0
	Wound infection	3	6.1	1	2.0
3 and 6 months	Fracture of plates or screws	0	0.0	0	0.0
	Severe nerve trauma	0	0.0	0	0.0
	Pseudarthrosis	0	0.0	0	0.0
	Malocclusion	1	2.0	0	0.0
Total (n = 49)		6	12.2	2	4.1
Rate of the total complication (n = 98)		8.2 (8/98)			
Comparison between two groups		$\chi^2 = 2.18$; p = 0.14			

Comment: At all 3 time of evaluation after surgery, postoperative complications occurred between two groups were no differences with p > 0.05 (p = 0.14).

Table 7. Total result at 3 (n = 87) and 6 months (n = 76) after surgery

Postoper-ative time	Total results	Group I		Group II		Total		comparison in 2 groups
		n	%	n	%	n	%	
3 months	Good	27	61.4	39	90.7	66	75.9	$\chi^2 = 10.22$ P = 0.0013
	Medium	14	31.8	4	9.3	18	20.7	
	Bad	3	6.8	0	0.0	3	3.4	
6 months	Good	22	62.9	38	92.7	60	78.9	$\chi^2 = 10.11$ P = 0.0015
	Medium	10	28.6	3	7.3	13	17.2	
	Bad	3	8.6	0	0.0	3	3.9	
Comparison in 3 and 6 months		$\chi^2 = 0.22; p = 0.639$						

Comment: Evaluation at all 3 and 6 months after surgery showed that good total results of group II was higher than that of group I with P < 0.05.

- Evaluation at 3 months, good results of anatomical fractures of group II was 90.7% and that of group I was 54.5%. At 6 months, that of group II was 92.7% and that of group I was 60.0%.

- Evaluation at 3 months, the good results of the maximum open mouth of group II was 95.3% and that of group I was 77.3%. At 6 months, that of group II was 97.6% and that of group I was 77.1%.

- Evaluation at 3 months, the good result of occlusion of the group II was 95.3% and that of group I was 68.2%. At 6 months, that of group II was 97.6% and that of group I was 68.6%.

- Good total results (treatment success rate) of group I at discharge, 3 and 6 months after surgery: 61.2%, 61.4% and 62.9%; that of group II: 87.8%, 90.7% and 92.7%. The treatment success rate of group II at all 3 evaluated time after surgery were higher than that of group I significantly with p < 0.05 (P values respectively: 0.011; 0.0013 and 0.0015).

4. DISCUSSION

4.1. The clinical and radiological characteristics of two groups and supporting technical details in the MAF surgical treatment

- Gender in MAF: the majority of male 79.6%. Maybe the men often drink beer and like the high speed in traffic. Common age group in MAF is the adulthood (19 - 39 years), mean age 23.95±6.83 years. This age group participate in social activities, productive labor, in traffic and fighting; so this age commonly see at the general trauma and in particular MAF. Comparison with Mark H. Moore: male 92.0%, Jason Potter: male 80.4% [5], Kay-Uwe Feller: male 82.7% not significant with

p > 0.05 [7]. The common injury causes of MAF include traffic accidents (68.4%) and assaults (16.3%), of which the most common cause depend on each country and region in the world. Comparison with Paza AO: traffic accidents 39.1% and assaults 42.6% [1]; Albert J.Fox 16.2% and 69.1% with p < 0.05 [2].

- The majority of MAF associated with another line of MF: 66.3% (65/98), while simple MAF: 33.7%; In these associated fractures, the chin area fracture is the most common with 75.4%. Comparison with Albert J. Fox: associated MAF 75% and chin area fracture 64.5% [2], Anil P. Punjabi 32.6%; Manoj Kumar Jain 46.2% with p > 0.05. Maybe trauma force impacts very strong on mandible (traffic accidents and fighting) that cause the mandibular fracture in multiple locations at the same time. Trauma force impacted to the mandibular body is easy to cause the MAF on the same side with location of injury force (80.6%, indirect fractures). Therefore, when examining patients with maxillo-facial trauma having a traumatic force impacted on the mandibular body, we need to check the MAF opposite to impacted force positions. The majority of MAF was open (90.8%), unfavorable 98.0% and displaced (74.5%). So, the most MAF has need of surgical treatment (displaced and unfavorable fracture is easy to the secondary displacement); treated the sooner the better, if the management was late, the risk of infection was raised (due to open fractures). The most MAF has the wisdom teeth in the fracture (96.9%) and 96.8% of that have removed this wisdom tooth before osteosynthesis. Comparison with Alsushi Kasamatu: wisdom

teeth in the fracture 90.6%, Barry C.,: 97.5%. According to Jeevan Ramakrishnan et al, teeth in fractured line is the main obstacle for the process of bone healing because of causing infections of fractured line; through the periodontal ligament of wisdom tooth the fracture line were opened into the oral environment. The results of clinical symptoms of MAF in this study are similar in the study of Jose E. Barrera; Edward W Chang. It shows that when examining the maxillo-facial trauma patients suspected of MAF we should examine carefully to find out the following symptoms: angle pain swelling, limited mouth opening, malocclusion, bleeding torn gum at wisdom tooth and throbbing pain.

- According to results of this study, patients with clinical diagnosis of MAF need to associate the panorama film with the straight facial film (because the correct diagnosis value is 100%). The special cases have to take CT Scan. This is consistent with the conclusions of the Madhu K. Nair, associating the panorama film with straight facial film will increase the correct diagnostic value of MAF [8]. From the angle bone anatomical characteristics, while using the 2.0 mm miniplates for Champy's principles osteosynthesis (along external oblique line), length of monocortical screws should be about 6 mm; even so using them along the inferior border for the tension wire loop, length of that should be about 5 mm. If using bicortical screws must placed <7 mm from inferior border.

4.2. Evaluation of postoperative results of MAF osteosynthesis

4.2.1. Evaluation of results at discharge (5 - 7 days after surgery)

- The good results (at the discharge) for the anatomy of angle fractures (including contour and gaps between the ends of fracture bones), for the clinical occlusion of group II were higher than that of group I significantly with $p < 0.05$. It show that Champy technique associating with the tension wire loop helps to reduce the occlusion and ends of fractured bone better than Champy's standard technique.

- Evaluation at the discharge, the good total results for two groups was 74.5%; in which the good level of the group II (87.8%) was higher than that

of group I (61.2%) significantly with $p < 0.05$. The good total results at discharge (not remove the IMF) reflect completely on the results of bone reduction and fixation of the osteosynthesis method, because the patient don't chew at this time.

4.2.2. Evaluation of postoperative results at 3 and 6 months period

- Evaluating the fractured anatomy on X-ray at 3 and 6 months after surgery shows that the good results of the group II was higher than that of group I significantly with $p < 0.05$. Evaluation at 3 and 6 months after surgery shows that the good results of the maximum open mouth (> 4 cm) of group II was higher than that of group I significantly with $p < 0.05$; and that of occlusion of group II was also higher than that of group I with $p < 0.05$. The good total result (or treatment success rate) of the Champy technique associating with the tension wire loop (group II) is always higher than that of group I at 3 and 6 months with $p < 0.05$.

- However, evaluation at 3 and 6 months after surgery shows that the aesthetic results and postoperative complications of two groups did not differ statistically with $p > 0.05$.

5. CONCLUSION

5.1. Conclusion for clinical and radiological characteristics of subjects

- MAF often coordinates with other mandibular fractures (66.3%), majority of associated fractures located in the chin region (87.5%). Most MAF due to traumatic force impacting on opposite mandibular body (80.6%). The majority of MAF is open (90.8%), unfavorable (98.0%) and displaced (74.5%) fractures. MAF often occurs in the left side (60.2%) and has mostly wisdom tooth in the fracture line (96.9%). The common symptoms include limited mouth opening, malocclusion, throbbing pain and bleeding torn gums in wisdom tooth. X-rays often used in the diagnosis of MAF were panoramic (92.9%) and straight facial films (96.9%). Correct diagnostic value of the panoramic film associating with straight facial film was 100%; that of CT Scan was 100%. Survey on cone beam CT to measure the thickness of monocortical and bicortical bone of angle region, the distance from mandibular canal to exterior surface of mandible

from which making the recommended screw length in osteosynthesis of angle region.

Results of clinical and radiological, general characteristics between two groups did not differ (similarities) with $p > 0.05$.

5.2. Postoperative results of MAF by Champy's standard technique (group I) and the Champy technique associating with the tension wire loop (group II)

Evaluation at all three time after surgery, the treatment success rate (good total results) of group II (respectively 87.8%, 90.7% and 92.7%) were higher than that of group I (61.2%, 61.4%

and 62.9%) significantly with $p < 0.05$. Early and late postoperative results show that the Champy technique associating with tension wire loop (group II) was better than the Champy's standard technique (group I) significantly with $p < 0.05$. Thanks for tension wire loop helping the accurate and easy reduction of MAF during surgery (reducing the surgery time), the additional fixation of MAF at inferior border after surgery, against separation of the MAF bone ends at the inferior border object, reducing the intermaxillary fixation time after surgery, and helping the stabilization of postoperative results.

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