Kaohsiung Journal of Medical Sciences (2012) xx, 1–5

Available online at www.sciencedirect.com
SciVerse ScienceDirect
journal homepage: http://www.kjms-online.com

ORIGINAL ARTICLE

# Incidence and clinical significance of zygomaticomaxillary complex fracture involving the temporomandibular joint with emphasis on trismus

**Chia-Ming Chang [a,d], Edward C. Ko [b,c], Chu-Chiang Kao [a], Pei-Ying Chang [a], Michael Y.C. Chen [a,*]**

[a] *Department of Oral and Maxillofacial Surgery, China Medical University Hospital, Taichung, Taiwan*
[b] *Department of Cartilage and Bone Regeneration (Fujisoft), Graduate School of Medicine, University of Tokyo, Japan*
[c] *Department of Oral and Maxillofacial Surgery, Faculty of Medicine, University of Tokyo, Japan*
[d] *School of Dentistry, China Medical University, Taichung, Taiwan*

Received 27 April 2011; accepted 4 July 2011

**KEYWORDS**
Articular eminence;
Intracapsular bony ankylosis;
Glenoid fossa;
Trismus;
Zygomaticomaxillary complex fracture

**Abstract** Trismus is frequently a sequel of temporomandibular joint (TMJ) involvement in a zygomaticomaxillary complex (ZMC) fracture. Although trismus is commonly observed in patients with ZMC fracture, continuous follow-up examinations of their degree of mouth opening have rarely been documented. The aim of this retrospective study was to determine the incidence and clinical significance of ZMC fracture involving the glenoid fossa or articular eminence of the TMJ with an emphasis on trismus. The medical and computed tomography (CT) imaging data of 28 patients with ZMC fracture treated by oral and maxillofacial surgeons (OMFSs) (OMFS group) and 174 patients with ZMC fracture treated by surgeons other than OMFSs (non-OMFS group) between May 2002 and May 2006 were reviewed. Maximal interincisal opening (MIO) less than 35 mm or three-finger width was considered limited mouth opening and indicative of trismus. Preoperative CT imaging data indicated that about 64% (18/28) and 50% (87/174) of the patients in the OMFS and non-OMFS groups, respectively, had a ZMC fracture involving the TMJ. Among these OMFS patients, 17 (94.40%) patients had limited mouth opening (MIO range, 7–33 mm) preoperatively, which improved markedly postoperatively. Among the non-OMFS patients with such fractures, 42 (48.3%) patients had trismus preoperatively and two retained trismus postoperatively. Lack of proper preoperative CT images, inadequate postoperative follow-up protocol, and/or neglect by patients and medical staff could influence

* Corresponding author. Department of Oral and Maxillofacial Surgery, China Medical University Hospital, 2 Yuh-Der Road, Taichung 40447, Taiwan.
*E-mail address:* mychen@mail.cmuh.org.tw (M.Y.C. Chen).


doi:10.1016/j.kjms.2011.11.016

the outcomes of ZMC fracture involving the TMJ. We make recommendations for reducing the risk of complications subsequent to ZMC fracture involving the TMJ.


## Introduction

The zygomaticomaxillary complex (ZMC), comprising the zygoma and the adjacent parts of the frontal, maxillary, sphenoid, and temporal bones, constitutes the lateral orbit wall and part of the orbital floor. The temporal process of the zygoma and the zygomatic process of the temporal bone form the zygomatic arch, to which are attached the masseter and temporalis fascia. Because of these anatomic features, ZMC fracture can lead to periorbital paresthesia, facial asymmetry, ocular complications, and trismus [1—3].

Approximately 18—83% of the patients with ZMC fracture experience paresthesia over the distribution of the infraorbital nerve. Further, ZMC fracture may cause eyeball complications such as enophthalmos, diplopia, traumatic hyphema, traumatic optic neuropathy, superior orbital fissure syndrome, and retrobulbar hemorrhage. Obvious facial asymmetry is the result of a displaced zygoma, because of its prominent position in the face.

Trismus is mainly attributed to compression of the coronoid process of the mandible (Fig. 1), fibrous or bony adhesion between the zygomatic arch and the coronoid process, and injury of the adjacent masticatory muscles [1,2,4]. It could result directly from the ZMC fracture tearing or impinging on the masseter and temporalis fascia or indirectly from muscle spasms subsequent to zygomatic arch fracture and hematoma formation. If a patient with such compression does not undergo forced mouth opening exercise or surgical reduction, fibrous adhesion may develop between the zygomatic arch and the coronoid process, in a condition known as extracapsular pseudoankylosis [5,6]. In addition, hemorrhage in the TMJ space (hemarthrosis), could result in intracapsular bony ankylosis [4], the incidence of which is much higher than that of TMJ ankylosis resulting from extracapsular injury [4,7].

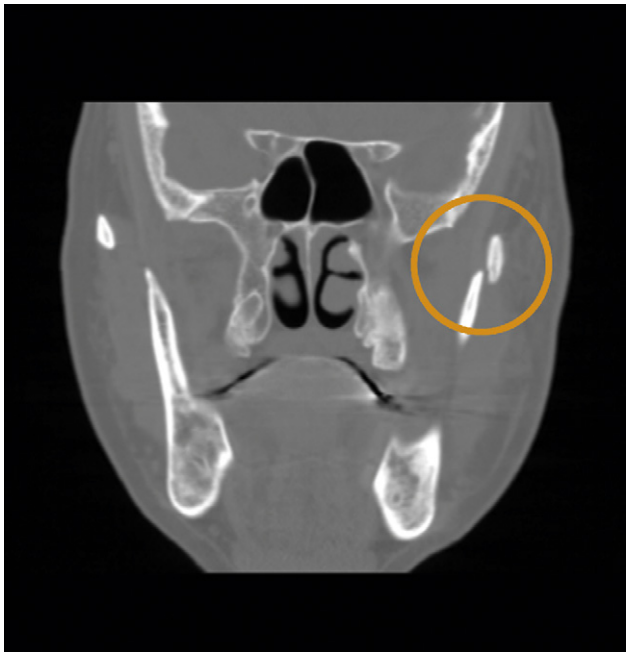

**Figure 1.** Computed tomography (CT) images showing a zygomaticomaxillary complex (ZMC) fracture compressing the coronoid process of the mandible. The encircled area indicates the fracture site.

In our experience, computed tomography (CT) imaging of ZMC fracture cases has revealed fracture lines extending to the glenoid fossa or articular eminence of the TMJ (Figs. 2 and 3). This clinic picture is often accompanied by clinical signs of limited mouth opening, but this finding has not been formally investigated. Furthermore, although trismus is commonly observed in patients with ZMC fracture, long-term follow-up examinations of the degree of mouth opening have rarely been documented. The present retrospective study had two aims: to establish the incidence of TMJ involvement in ZMC fractures, and to define the clinic significance of this condition.

## Patients and methods

We reviewed the medical and preoperative CT imaging (axial and coronal sections, 2 mm/slice or 5 mm/slice) data of patients with facial trauma treated by oral and maxillofacial surgeons (OMFSs) between May 2002 and May 2006 at our institutions; these patients constituted the OMFS group ($n = 28$).

The preoperative maximal interincisal opening (MIO) was defined as the distance between the incisal edges of the maxillary and mandibular incisors at the time of admission. An MIO less than 35 mm, or the width of three fingers, was considered to be limited mouth opening and indicative of trismus. The OMFS group underwent forced mouth opening during postoperative physiotherapy (Fig. 4) and were followed up for at least 2 months to monitor changes in their MIO.

In addition, we reviewed the medical records of patients with facial trauma treated by surgeons other than OMFSs between May 2002 and May 2006. Among 275 patients with ZMC fracture, those patients who underwent CT imaging (axial or coronal sections; 5 mm/slice) preoperatively and were subsequently followed up for at least 2 months by telephonic interviews constituted the non-OMFS group ($n = 174$). These patients did not have a detailed record of MIO.

Further, on the basis of their preoperative CT findings, the patients with ZMC fracture lines extending to the glenoid fossa or articular eminence of the TMJ were classified as the experimental group, and the remaining patients were classified as the control group.

Please cite this article in press as: Chang C-M, et al., Incidence and clinical significance of zygomaticomaxillary complex fracture involving the temporomandibular joint with emphasis on trismus, Kaohsiung Journal of Medical Sciences (2012), doi:10.1016/j.kjms.2011.11.016

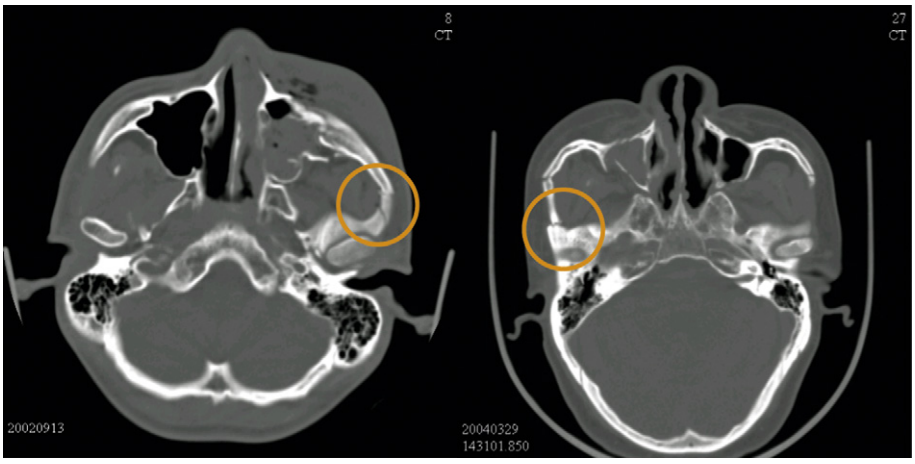


**Figure 2.** CT images showing a ZMC fracture line involving the articular eminence of the temporomandibular joint (TMJ). The encircled areas indicate the fracture site.

The influence of ZMC fracture on trismus was statistically analyzed by *t* test and $\chi^2$ test.

## Results

Table 1 shows the characteristics of the OMFS group. The patients mostly belonged to the 20—29-year-old age group; their mean age ± standard deviation was 32.36 ± 14.69 years (range, 17—58 years), and most of these patients were male. Their follow-up period ranged from 2 months to 21 months (mean period, 8.61 ± 5.94 months).

The experimental OMFS group comprised 18 patients (64.29%); 17 (94.40%) of these patients had limited mouth opening preoperatively. The preoperative MIO of the 18 patients ranged from 7 mm to 33 mm (mean MIO, 23.24 ± 7.68 mm). In this group was one patient whose mouth opening limitation had not resulted from trauma.

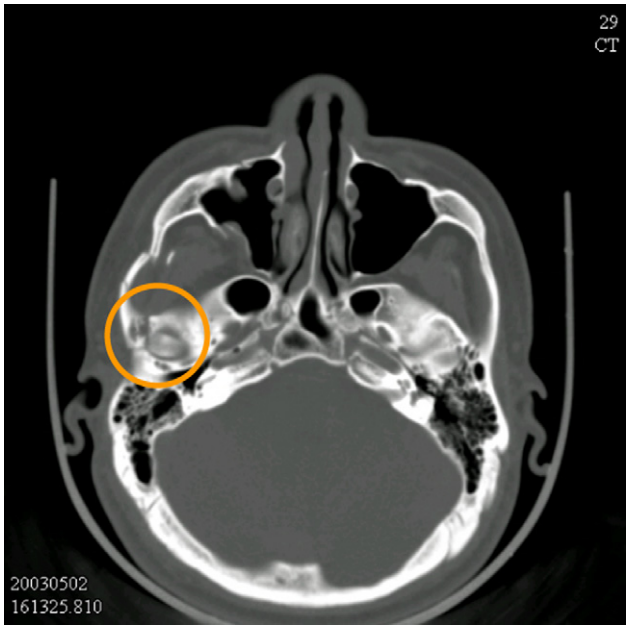


**Figure 3.** CT images showing a ZMC fracture line involving the glenoid fossa of the TMJ. The encircled area indicates the fracture site.

The control OMFS group was comprised of 10 patients, of whom seven had limited mouth opening. The preoperative MIO of these seven patients ranged from 24 mm to 30 mm (31.13 ± 7.24 mm).

The 24 patients with limited mouth opening underwent forced mouth opening physiotherapy postoperatively and were followed up for 8.61 ± 5.94 months. The MIO in the experimental OMFS group increased to 25—53 mm (39.79 ± 6.59 mm), and that in the control OMFS group increased to 37—45 mm (40.57 ± 3.21 mm). Only two patients continued to have limited mouth opening after intervention.

Table 2 shows the characteristics of the non-OMFS group. Again, most of the patients were male and the patients mostly belonged to the 20—29 age group. Their age range was 15—82 years (37.22 ± 15.62 years). Their follow-up period ranged from 2 months to 32 months (13.87 ± 6.74 months). The experimental non-OMFS group included 87 (50%) patients, with a mean follow-up period of 14.00 ± 7.46 months. Forty-two (48.3%) of these patients had limited mouth opening preoperatively and only 26 underwent forced mouth opening physiotherapy to improve the mouth opening. In the control non-OMFS group, 26 patients (29%) had limited mouth opening before surgery.

## Discussion

In this study, approximately 64.9% and 50% of the patients in the OMFS and non-OMFS groups, respectively, had ZMC fracture involving the glenoid fossa or articular eminence, indicating the high incidence of TMJ involvement in such fractures. However, because CT examination of the TMJ area was not performed for all ZMC fracture cases in the non-OMFS group, the incidence of such involvement might be even higher.

We focused on the effect of ZMC fracture extending to the TMJ on trismus. The impact of such fracture on limited

Please cite this article in press as: Chang C-M, et al., Incidence and clinical significance of zygomaticomaxillary complex fracture involving the temporomandibular joint with emphasis on trismus, Kaohsiung Journal of Medical Sciences (2012), doi:10.1016/j.kjms.2011.11.016

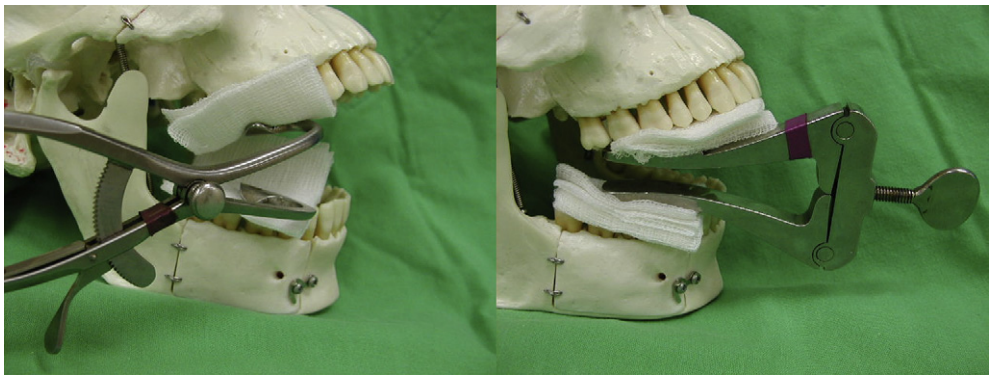

**Figure 4.** Demonstration of forced mouth opening physiotherapy.

mouth opening preoperatively was significant in the non-OMFS group ($p = 0.01$). Although 94.4% and 70.0% of the patients in the experimental and control OMFS groups, respectively, had preoperative limited mouth opening, a significant difference was not detected ($p = 0.08$), possibly because of the small sample size.

Among the OMFS patients, we found a significant difference between the experimental and the control groups ($p = 0.02$) with respect to the degree of mouth opening preoperatively, which is evidence of the impact on trismus of ZMC fracture involving the TMJ. Postoperative forced mouth opening physiotherapy considerably improved the degree of mouth opening, and we found no significant difference within the OMFS group ($p = 0.7024$). However, objective analysis was not possible because of the lack of detailed records on the degree of mouth opening and forced

**Table 1** Mouth opening in patients with ZMC fracture treated by oral and maxillofacial surgeons (OMFSs).

| Parameter | Total ($n = 28$) | Control group ($n = 10$) | Experimental group ($n = 18$) | $p$ |
|---|---|---|---|---|
| Sex | | | | |
| Female | 10 (35.71) | 4 (40.0) | 6 (33.3) | 0.72 |
| Male | 18 (64.29) | 6 (60.0) | 12 (66.7) | |
| Preoperative limited mouth opening | | | | |
| No | 4 (14.29) | 3 (30.0) | 1 (5.6) | 0.08 |
| Yes | 24 (85.71) | 7 (70.0) | 17 (94.4) | |
| Preoperative MIO (mm) | $25.76 \pm 8.29$ | $31.13 \pm 7.24$ | $23.24 \pm 7.68$ | 0.02 |
| Postoperative limited mouth opening | | | | |
| No | 26 (92.86) | 10 (100.0) | 16 (88.9) | 0.27 |
| Yes | 2 (7.14) | 0 (0.0) | 2 (11.1) | |
| Postoperative MIO (mm) | $40.02 \pm 5.75$ | $40.57 \pm 3.21$ | $39.79 \pm 6.59$ | 0.70 |
| Follow-up period (mo) | $8.61 \pm 5.94$ | $7.50 \pm 6.43$ | $9.22 \pm 5.75$ | 0.49 |

Data are represented as $n$ (%) or mean $\pm$ SD. MIO = maximal interincisal opening.

**Table 2** Mouth opening in patients with ZMC fracture treated by surgeons other than OMFSs (non-OMFS group).

| Parameter | Total ($n = 174$) | Control group ($n = 87$) | Experimental group ($n = 87$) | $p$ |
|---|---|---|---|---|
| Sex | | | | |
| Female | 52 (29.89) | 28 (32.2) | 24 (27.6) | 0.51 |
| Male | 122 (70.11) | 59 (67.8) | 63 (72.4) | |
| Preoperative limited mouth opening | | | | |
| No | 106 (60.92) | 61 (70.1) | 45 (51.7) | 0.01 |
| Yes | 68 (39.08) | 26 (29.9) | 42 (48.3) | |
| Postoperative limited mouth opening | | | | |
| No | 169 (97.13) | 84 (96.6) | 85 (97.7) | 0.65 |
| Yes | 5 (2.87) | 3 (3.5) | 2 (2.3) | |
| Follow-up period (mo) | $13.87 \pm 6.74$ | $13.74 \pm 5.98$ | $14.00 \pm 7.46$ | 0.80 |

Data are represented as $n$ (%) or mean $\pm$ SD.

Please cite this article in press as: Chang C-M, et al., Incidence and clinical significance of zygomaticomaxillary complex fracture involving the temporomandibular joint with emphasis on trismus, Kaohsiung Journal of Medical Sciences (2012), doi:10.1016/j.kjms.2011.11.016

mouth opening physiotherapy in the non-OMFS group. Additionally, two patients in the experimental OMFS group continued to have limited mouth opening after treatment as a result of poor cooperation with mouth-opening physiotherapy.

The major difference between the OMFS group and the non-OMFS group was postoperative forced mouth opening physiotherapy. Our protocol of forced mouth opening physiotherapy starts from the second week after the operation, where patients implement the mouth gag, six times per day at home; they are followed-up every week for 2 months.

We suspect that lack of proper preoperative CT imaging, inadequate postoperative follow-up protocol, and/or neglect by patients and medical staff can influence the outcomes of a ZMC fracture involving the TMJ. Considering that a large proportion of patients who experience facial trauma have ZMC fracture [8], we recommend the following steps to reduce the risk of complications of ZMC fracture involving the TMJ: (1) thorough physical examination of the facial skeleton; (2) detailed facial CT imaging, especially of the TMJ area; (3) regular monitoring of mouth opening; and (4) motivation to continue with postoperative physiotherapy. Patients should be informed of the importance of long-term follow-up examinations to prevent intracapsular bony ankylosis.

## References

[1] Bailey JS, Goldwasser MS. Management of zygomatic complex fractures. In: Miloro M, editor. Peterson's principles of oral and maxillofacial surgery. 2nd ed. Ontario, Canada: BD Decker; 2004. p. 445—62.
[2] D'Addario M, Cunningham Jr LL. Management of zygomatic fractures. In: Marciani RD, editor. Oral and maxillofacial surgery. 2nd ed., Vol. II. Philadelphia, PA: Saunders/Elsevier; 2009. p. 182—201.
[3] Gerlock AJ, Sinn DP. Anatomic, clinical, surgical, and radiographic correlation of the zygomatic complex fracture. Am J Roentgenol 1977;128:235—8.
[4] Tanaka H, Westesson P-L, Larheim TA. Juxta-articular ankylosis of the temporomandibular joint as an unusual cause of limitation of mouth opening: case report. J Oral Maxillofac Surg 1998;56:243—6.
[5] Warson RW. Pseudoankylosis of the mandible after a fracture of the zygomaticomaxillary complex: report of case. J Oral Surg 1971;29:223—4.
[6] Lapeyrolerie FM, Itkin AB, Strair HC. Pseudoankylosis from fusion of coronoid process and zygomatic arch. J Oral Surg 1973;31:788—9.
[7] Kellner MJ, Sher M, Stoopack JC. Extracapsular fibrous ankylosis of the mandible after open reduction of a zygomatic arch fracture: report of case. J Oral Surg 1979;37:665—8.
[8] Fonseca RJ, Walker RV, Betts NJ. Oral and maxillofacial trauma. 3rd ed., vol. 1. Philadelphia, PA: Saunders/Elsevier; 2005. 569—642.

Please cite this article in press as: Chang C-M, et al., Incidence and clinical significance of zygomaticomaxillary complex fracture involving the temporomandibular joint with emphasis on trismus, Kaohsiung Journal of Medical Sciences (2012), doi:10.1016/j.kjms.2011.11.016