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Rajantie, H.

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Postoperative temporomandibular dysfunction in patients with fractures of the zygomatic complex: a prospective follow-up study

H. Rajantie^{a,*}, J. Snäll^a, H. Thorén^{b,c}

^a Department of Oral and Maxillofacial Diseases, University of Helsinki and Helsinki University Hospital, Helsinki, Finland

^b Department of Oral and Maxillofacial Surgery, Institute of Dentistry, University of Turku, Turku, Finland

^c Department of Oral and Maxillofacial Diseases, Turku University Hospital, Turku, Finland

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Abstract

The aim of this prospective follow-up study was to clarify the incidence and characteristics of dysfunction of the temporomandibular joint (TMJ) in patients treated surgically for fractures of the zygomatic complex. Patients were evaluated on presentation and six months after injury to assess the function of the masticatory system using the Helkimo index, which incorporates two complementary subindices: the subjective symptomatic (anamnestic) index (A_i) and the objective clinical dysfunction index (D_i). Forty-five patients (12 women and 33 men, mean (range) age 44 (21–83) years) completed the study. Six patients developed subjective symptoms of dysfunction of the TMJ during follow-up, in four of whom they were severe. Clinical findings were noted in 38 patients but without significant association with subjective symptoms.

Dysfunction of the TMJ is common six months after surgical treatment of a fracture of the zygomatic complex, and patients with such fractures should be evaluated for temporomandibular dysfunction during follow-up and referred for treatment when necessary.

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Keywords: zygomatic fracture; temporomandibular dysfunction; midfacial fracture

Introduction

A fracture of the zygomatic complex is common in adult patients with midfacial trauma.^{1–3} The zygomatic bone is located in the vicinity of the cranial portion of the mandible, and a fracture of the zygomatic complex therefore brings it into close contact with the temporomandibular joint (TMJ) meaning that dysfunction of the TMJ may develop secondary to maxillofacial trauma.^{4–6}

Dysfunction reflects formation of a haematoma, contusion, muscular strain, or disruption of the joint. Fractures

of the zygomatic complex are particularly likely to cause reduced mouth opening as a result of interference by the dislocated zygomatic bone of the masticatory muscles or the mandibular coronoid process. Zygomaticocoronoid ankyloses, or Jacob's disease, is a rare condition in which bony or fibrous union develops between the coronoid process and the zygomatic arch, and results in restriction of movements of the jaw.⁷ Trauma to the head and neck has been reported to upset the integrated behaviour of the jaw and neck, which underlines the functional coupling of the jaw and the head-neck motor system.⁸

Surgical treatment of fractures of the zygomatic complex is indicated when there are aesthetic or functional disturbances. Despite successful reduction and osteosynthesis, temporary or more long-lasting dysfunction of the TMJ

* Corresponding author at: Department of Oral and Maxillofacial Diseases, Helsinki University Hospital, FI-00029 HUS, Finland.

E-mail address: hanna.rajantie@icloud.com (H. Rajantie).

may develop in some patients. The aim of this study was to clarify the incidence and characteristics of such dysfunction in patients treated surgically for fractures of the zygomatic complex.

Patients and methods

Inclusion and exclusion criteria

The patients were drawn from a larger group of patients who had had facial fractures treated surgically, and who had been recruited for a clinical follow-up study. One group comprised those who had a fracture of the zygomatic complex, who were to have surgical reduction (with or without fixation with titanium miniplates) through local approaches (intraoral, eye-lid, or eyebrow), and who were followed up for six months. Patients with infected fractures, or any other facial fracture that required surgical treatment, were excluded. We also excluded patients with a history of symptoms of temporomandibular dysfunction.

Evaluation of function of the TMJ

Function of the masticatory system was evaluated six months postoperatively with a questionnaire, a supplementary interview, and a clinical examination of the masticatory system. The Helkimo subjective (anamnestic) (A_i) and clinical (D_i) indices were used to identify the occurrence and severity of dysfunction.⁹ The subjective symptoms (A_i) were recorded at the first visit and six months after the operation using a questionnaire and an interview, and were therefore calculated solely on the patients' reports.

Because the patients presented with trauma it was not possible to record the clinical findings (D_i) preoperatively, so they were recorded only six months after the injury. One of the authors (JS) made the clinical examination and only clinically demonstrable findings were recorded and included in the index.

Patients were divided into three groups according to the severity of their subjective symptoms of dysfunction, as follows: symptom free (A_i0); mild symptoms (A_iI), and severe symptoms (A_iII). Patients who were classified as "symptom-free" reported no symptoms of the masticatory system. Patients with mild symptoms reported one or more of the following: sounds in the TMJ, feeling of fatigue in the jaws, or feeling of stiffness in the jaws on awakening or on movements of the lower jaw. Patients with severe symptoms reported one or more of the following: difficulties in opening the mouth wide, locking, luxations, pain on movement of the mandible, or pain in the region of the TMJ or the masticatory musculature.

Patients were divided into four groups according to the severity of the objective clinical findings: no findings of dysfunction (D_i0); mild dysfunction (D_iI); moderate dysfunction

Table 1A
Clinical Index D_i .

A	Impaired range of movement, mobility index*:	
	Normal range of movement	0
	Slightly impaired mobility	1
	Severely impaired mobility	5
B	Impaired function of the TMJ:	
	Smooth movement without sounds or deviations on opening and closing of the mouth	0
	Sounds in one or both joints, or deviations ≥ 2 mm, or both.	1
	Locking, or luxations, or both of the TMJ	5
C	Muscular pain:	
	No tenderness on palpation	0
	Tenderness on palpation in 1-3 sites	1
	Tenderness on palpation in 4 or more sites	5
D	Pain in the temporomandibular joint:	
	No tenderness on palpation	0
	Tenderness on palpation laterally	1
	Tenderness on palpation posteriorly	5
E	Pain on movement of the mandible:	
	No pain on movement	0
	Pain in 1 movement	1
	Pain in 2 or more movements	5
F	Sum A+B+C+D+E dysfunction score	0-25
G	Dysfunction group 0-5	0-5
H	Clinical index D_i according to the code	D_i I-III

* For more details, see Helkimo.⁹ TMJ=temporomandibular joint.

Table 1B
Details of the code.

No. of points	Dysfunction group	Findings	Code
0	0	No symptoms	D_i0
1-4	1	Mild	D_iI
5-9	2	Moderate	D_iII
10-14	3	Severe	D_iIII
15-19	4	Severe	D_iIII
20-25	5	Severe	D_iIII

(D_iII); and severe dysfunction (D_iIII). Tables 1A and 1B show the criteria for D_i0 - D_iIII in more detail.

Analysis of data

The primary outcome variables were A_i and D_i . Predictive variables were age, sex, cause of injury (assault, fall, traffic, and sport), delay in treatment (days), associated fracture of the mandibular coronoid process, and the surgical technique used to reduce the fracture. The technique of reduction was defined as: transoral, transbuccal hook, temporal (Gillies' method), or combined technique (any combination of the above).

Statistical analysis

The significance of differences and of the associations between the presence of A_i and D_i six months postoperatively and sex, age, cause of injury, associated fracture of the coronoid process, delay in treatment, and reduction tech-

Table 2
Descriptive statistics of 45 patients with surgically-treated fractures of the zygomatic complex.

Variable	No.
Sex:	
Male	33
Female	12
Mean (range) age (years):	44 (21-83)
Cause of injury:	
Assault	15
Fall	14
Traffic	12
Sport	4
Fracture of the coronoid process	4
Mean (range) delay in treatment (days)	5.2 (0-15)
Reduction technique:	
Transoral	17
Transbuccal hook	16
Combination of 2 techniques	9
Temporal (Gillies' method)	3

Table 3
Subjective symptoms (A_i) and objective clinical findings (D_i) of dysfunction in 45 patients six months after operation on the fracture of the zygomatic complex.

Index	Description	No. of patients
Subjective (anamnesic) index (A _i):		
A _i 0	No symptoms	39
A _i I-A _i II	Symptoms present	6
A _i I	Mild symptoms	2
A _i II	Severe symptoms	4
Clinical index (D _i):		
D _i 0	No clinical findings	7
D _i I-D _i III	Clinical findings present	38
D _i I	Mild clinical findings	31
D _i II	Moderate clinical findings	7
D _i III	Severe clinical findings	0

nique were evaluated with the chi squared, Fisher's exact, and Mann-Whitney U, tests.

Results

A total of 79 patients with fractures of the zygomatic complex fulfilled the inclusion criteria. Of these, 27 were excluded because of failure to attend for the six-month follow-up visit, six because they had a history of symptoms of dysfunction of the TMJ, and one because of missing data; 45 patients were therefore included in the analysis.

Table 2 shows descriptive statistics of the 45 patients. Table 3 shows the Helkimo subjective (anamnesic) (A_i) and clinical (D_i) indices in the 45 patients six months postoperatively. Six patients had subjective symptoms and 38 had clinical findings of temporomandibular dysfunction. Symptoms were severe in four patients whereas no patient had "severe" dysfunction. Clinical findings of dysfunction were usually mild.

Table 4 shows the association between symptoms (A_i) of dysfunction and clinical findings (D_i). Impaired range of

Table 4
Association between symptoms of dysfunction of the temporomandibular joint (A_i) and clinical findings (D_i) six months postoperatively. No patient had pain on movement.

Clinical findings	All patients with clinical findings (n=38)	Patients with symptoms of dysfunction of the TMJ (n=6)
Impaired range of movement:	25	4
Moderate	20	4
Severe	5	0
Impaired function:	24	5
Moderate	23	4
Severe	1	1
Muscular pain:	9	3
Moderate	8	3
Severe	1	0
Pain in the TMJ:	2	0
Moderate	2	0
Severe	0	0

TMJ=temporomandibular joint.

movement (n=25) and impaired function of the TMJ (n=24) were the most common clinical findings. All six patients who had symptoms of dysfunction also had clinical findings of dysfunction. However, most patients (32/38) with clinical findings of dysfunction had no symptoms of temporomandibular dysfunction.

We found no significant correlation between predictor variables and A_i/D_i (Tables 5 and 6).

Discussion

Our aim was to clarify the incidence and characteristics of dysfunction of the TMJ in patients who had been treated surgically for a fracture of the zygomatic complex.

Six patients out of a total of 45 developed symptoms of dysfunction of the TMJ during the study period. Four patients had severe symptoms six months after operation, with clinical signs in 38. The most common clinical findings were reduced range of movements of the jaw and impaired function. We found no correlation between predictive variables and symptoms or clinical findings of dysfunction.

Our observation that 38 of the 45 patients who had their fractures of the zygomatic complex treated surgically had clinical signs of dysfunction six months postoperatively differs notably from that of Ribeiro et al⁵ who followed up five patients with fractures of the zygomatic complex that had been treated with fixation at the zygomaticomaxillary buttress by an intraoral approach. The patients were examined over nine follow-up appointments and evaluated with respect to bite force, mandibular mobility, and electromyography of the masticatory muscles, which showed that maximum mouth opening returned to normal during the first month postoperatively, and normal bite force and electromyographic activity were achieved after the second month. Those are excellent results.

Table 5

Association between subjective symptoms (A_i), clinical findings (D_i), sex, cause of injury, fracture of coronoid process, and surgical technique.

Predictor	A_i I- A_i II (symptoms present)	A_i 0 (no symptoms)	D_i I- D_i III (clinical findings present)	D_i 0 (no clinical findings)
Sex:				
Male (n=33)	6	27	26	7
Female (n=12)	0	12	12	0
Cause of injury:				
Assault (n=15)	4	11	14	1
Fall (n=14)	0	14	13	1
Traffic (n=12)	1	11	9	3
Sport (n=4)	1	3	2	2
Fractured coronoid process	1	3	3	1
Reduction technique:				
Transoral (n=17)	1	16	16	1
Transbuccal hook (n=16)	4	12	14	2
Combination of 2 techniques (n=9)	0	9	5	4
Temporal (Gillies method n=3)	1	2	3	0

Table 6

Association between subjective symptoms (A_i), clinical findings (D_i), age, and delay in treatment.

Predictor	A_i I- A_i II (symptoms present)	A_i 0 (no symptoms)	D_i I- D_i III (clinical findings)	D_i 0 (no clinical findings)
Mean (range) age (years)	43 (33-52)	44 (21-83)	45 (21-83)	41 (23-59)
Median (IQR) delay in treatment (days):	3 (2-5)	12	4 (2-7)	5 (4-7)
Range	0-6	2-15	0-15	1-9

The reasons for the appreciable discrepancy between our results and those of Ribeiro et al⁵ are that patients were examined differently, and outcome variables were defined differently. Other likely reasons are differences in the characteristics of patients such as mechanisms of injury and type of fracture. Four of the five patients in their study⁵ had minimally-displaced fractures, and all fractures were treated with intraoral plating. Our patients, by contrast, required different treatment methods depending on the type and degree of dislocation of the fracture. The mechanism of trauma, severity of the fracture, and several other clinical factors may have influenced the outcome of the function of the masticatory system. Unfortunately, we had few patients, and we could find no significant difference between outcome and mechanisms of trauma or any other predictive variable.

Dysfunction of the TMJ can be assumed to be less common after fractures of the zygomatic complex than after mandibular fractures. Al-Hashmi et al evaluated temporomandibular function in 59 patients 7-36 months after treatment of mandibular fractures.¹⁰ They compared patients who had been treated in two separate units (South Australia (n=36) and Oman (n=23)), and found clinical signs of dysfunction in 17 and 14 patients, respectively. Surprisingly, the rates were clearly lower than those found here. Facial traumatologists are surely aware of the risk of dysfunction, particularly after fractures of the mandibular condyle. Our results highlight the importance of its evaluation after fractures of the zygomatic complex as well.

The finding that dysfunction of the TMJ is common after these fractures is important, but it should also be noted that severe dysfunction was relatively rare in our patients

and subjective symptoms, which are stronger predictors of the need for treatment than symptom-free clinical findings, were far less common than clinical findings of dysfunction. Severe subjective symptoms developed in four patients. However, none of them had severe clinical findings of temporomandibular dysfunction. The symptoms are known to vary widely over time, and so more follow-up studies in the future could yield useful information.

A total of 79 patients met the inclusion criteria, and 52 completed the six-month follow-up. Of these, seven patients were excluded for other reasons. A low response level is common among injured patients, which reflects the nature of these patients who often have little regard for personal health and safety.^{10,11} Among patients who were invited to attend, it is more likely that those with problems would participate so the rate of problems in the group examined is likely to be an overestimate.

We used the Helkimo index because of its simplicity.⁹ However, it has not been completely validated and does not offer a diagnostic classification of temporomandibular disorders. The new Research Diagnostic Criteria for Temporomandibular Disorders include new research findings but, for this index to be suitable for research purposes, it should be used for an extended period of time to allow research workers to organise directly-comparable, good-quality studies.¹² Another limitation of the Helkimo index is that it does not differentiate between muscle-related and joint-related conditions, and some symptoms that are now considered harmless, such as joint sounds, are included in the index.¹³ The subjective (anamnesic) index (A_i) also does not describe the frequency or intensity of the symptoms, nor does it measure

the interference of the symptoms with the patient's quality of life.

Conclusions

Patients' subjective symptoms of temporomandibular dysfunction are common for six months after surgical treatment of a fracture of the zygomatic complex, so these patients should be evaluated during their follow-up and referred for treatment of the dysfunction as necessary.

Conflict of interest

We have no conflicts of interest.

Ethics statement/confirmation of patients' permission

The Ethics Committee of the Department of Surgery and the Internal Review Board of the Division of Musculoskeletal Surgery, Helsinki University Hospital, approved the study protocol (Dno 33/E6/06). The study was registered at Helsinki University Hospital, Finland under identification number HUS2325. All participants signed written informed consent. The study followed the principles of the Declaration of Helsinki.

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