Comparison of different approaches to the reduction of anterior temporomandibular joint dislocation: a randomized clinical trial


Abstract. This randomized clinical trial was designed to compare three different reduction methods for anterior temporomandibular joint (TMJ) dislocation. The three methods evaluated were the conventional method, wrist pivot method, and extraoral method. The study sample comprised 90 consecutive patients suffering from anterior dislocation of the TMJ, who were allocated randomly to one of the three groups. This study found success rates of 86.7% for the conventional method, 96.7% for the wrist pivot method, and 66.7% for the extraoral method. The extraoral method was more difficult for the physician and the patient than the other two methods. For the patients, the wrist pivot method was easier than the other methods. For the doctors, the extraoral method was significantly more difficult than the other methods. In conclusion, due to the absence of a biting risk with the extraoral method and the lack of a significant difference in success between this method and the conventional method, the extraoral method could be considered the appropriate first-line treatment where there is a risk of the patient biting the surgeon’s hand. Given the overall benefits of the wrist pivot method, this method could be considered the first-line and gold standard treatment modality in other cases.

Key words: temporomandibular joint; temporomandibular joint dislocation; temporomandibular joint reduction.

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Temporomandibular joint (TMJ) dislocation can occur in any direction, but the most common is acute anterior dislocation. This usually occurs spontaneously and may be caused by yawning, laughing, seizures, or intraoral procedures such as tooth extractions. Several methods have been proposed for jaw reduction. With the conventional method, which is now used widely, the physician stands in front of the patient and puts his/her thumbs on the patient’s lower molars and other fingers on the mandibular body and angle. The physician then applies continuous force in the lower and...
posterior direction. However, due to masseter muscle spasm and the patient pulling their head backwards throughout the reduction procedure, this method of reduction may be difficult for the physician. There is also a risk of biting and the transmission of infectious diseases such as hepatitis and HIV with this procedure. Because of these disadvantages, researchers continue to look for alternative methods.

One such alternative is the wrist pivot method, which was introduced in recent years. With this method, the doctor puts his/her thumbs in the submental area of the patient and places the other fingers over the lower molars. The doctor then makes an ulnar deviation and small flexion of the wrist. To date, there is no evidence-based data on the advantages and disadvantages of this method.

Several extraoral methods to eliminate the risk of biting have been proposed to date. Among these, the method of Chen et al. is of note, although its efficacy has been shown to be less than that of the conventional method in some studies. With this method, the doctor puts his/her thumb on the dislocated coronoid process and places the other fingers of that hand behind the mastoid process. On the opposite side, the thumb of the other hand is put on the malar eminence and the other fingers on the mandibular angle area. The coronoid is then pushed back on the dislocated side by the thumb.

The present study was performed to systematically assess these methods of TMJ reduction so that the most appropriate method can be chosen for each patient. A clinical trial design was used for this study.

Materials and methods

Study design and patients

This was a randomized clinical trial study (Iranian Registry of Clinical Trials number IRCT201304249039N2). The study was conducted at a tertiary referral centre for otorhinolaryngology in the city of Tehran. The purpose of the study was to perform a comprehensive assessment of the different TMJ reduction methods in patients with acute anterior dislocation of the mandible. After obtaining informed consent, the patients were allocated to one of three groups by simple randomization. Their jaw reduction was then done by one of the three different methods. Based on a sample size calculation, 30 cases were assigned to each group. The power of the study was assumed to be 80%. Patients were recruited over a 2-year period (2012–2014).

The inclusion criterion was the presence of anterior mandibular dislocation, and the exclusion criteria were posterior dislocation, dislocation associated with fracture, and traumatic dislocation. There was no patient loss during enrolment, allocation, or analysis.

After admission and diagnosis of the pathology, the patient was assigned to group A, B, or C by simple randomization. They were given an opaque envelope by a nurse, in which the group type was written. Patients in group A were approached using the conventional method, those in group B with the extraoral method, and those in group C with the wrist pivot method (Figs. 1 and 2).

In all groups, the reduction was done by two otorhinolaryngology residents who had been trained in all reduction methods and had passed the required learning curve before starting the study. Following the reduction procedure and when the patient’s condition was stable, a questionnaire that had been designed for the study was used to gather the necessary information from the patient and physician; the information was recorded on special forms that were given to the patient and to his/her physician.

If the jaw reduction procedure was proving unsuccessful after 2 min, the method was considered to have failed, and another method was selected for reduction by the physician. To prevent patient crossover among the groups, the information from the second reduction was not included in the analysis.

The patient outcomes were evaluated as follows: (1) the success rate of the reduction was calculated for each group; (2) the degree of difficulty of the reduction for the surgeon was scored from 1 to 10 on a verbal numeric scale (VNS), with 1 being very easy and 10 being very difficult; and (3) the degree of difficulty of the reduction for the patient was scored from 1 to 10 on a VNS, with 1 being very easy and 10 being very difficult.

Various parameters for statistical analysis were recorded using the questionnaire,
including patient age, patient sex, unilateral or bilateral dislocation, recurrent or primary dislocation, time delay before seeing the doctor, the need for a muscle relaxant, the duration of the reduction in seconds, the success or failure of the reduction, the degree of difficulty for the surgeon and for the patient (on a VNS), and any history of seizures, dementia, or an infectious viral disease in the patient.

**Conventional method**

Dentures or any other foreign material must be taken out of the mouth. If a muscle relaxant is needed, patient monitoring, an intravenous line, and oxygenation should be established. The physician must wear gloves and protect their thumbs by wrapping gauze or placing a plastic splint around them.

The physician stands in front of the patient and puts his/her thumbs on the patient’s lower molars. The patient must sit on a chair so that his/her mandibular level is not above the doctor’s elbow; this will allow the physician to apply the most effective force. The physician’s other fingers are placed on the mandibular body and angle. The physician then applies continuous force in the lower and posterior direction. When the masseter muscle is relaxed, the mandible moves downwards and backwards. At the same time, additional force can be applied upwards on the mentum with the third and fourth fingers. This will help mandibular rotation. With this movement, the mandible moves more towards the back and downwards, the condyle slips into the glenoid fossa, and thus the reduction is achieved. For bilateral dislocation, both sides can be reduced at the same time; however, it is easier to first reduce one side and then the other (Fig. 1A).

**Extraoral method**

With this method, the doctor puts his/her thumb on the dislocated coronoid process and places the other fingers of that hand behind the mastoid process. On the opposite side, the other thumb is placed on the malar eminence and the other fingers on the mandibular angle area. For the reduction, the fingers against the angle of the mandible apply force towards the front, and the coronoid is pushed back on the other side by the thumb. The fingers behind the mastoid also apply extra force. Thus, the mandible turns and the condyle is reduced (Fig. 2).

**Wrist pivot method**

The patient sits in front of the doctor. The doctor puts his/her thumbs in the submental area of the patient and places the other fingers over the lower molars. The doctor then makes an ulnar deviation and small flexion of the wrist. Thus, the patient’s mandible rotates and the condyle goes downwards and backwards, entering the glenoid fossa. In this way, both sides should be reduced at the same time. This is unlike the conventional and extraoral methods, in which each side can be reduced individually or together (Fig. 1B).

**Statistical analysis**

Data obtained using the questionnaires were analyzed using IBM SPSS Statistics version 21.0 software (IBM Corp., Armonk, NY, USA), through analysis of variance (ANOVA), t-test, and Fisher’s exact test. Significance was set at a P-value of less than 0.01.

**Results**

The total sample comprised 90 patients; 42 (46.7%) were male and 48 (53.3%) were female. The patients ranged in age from 15 to 90 years, with an average age of 47.46 ± 21 years. The average delay before arrival at the hospital was 3 ± 4 h (range 10 min to 29 h). The dislocation was a recurrence for 66 patients (73.3%); there was no previous history of dislocation for the other 24 patients (26.7%). Table 1 shows the comparison of these variables between the study groups. The percentages of recurrent cases and of bilateral dislocations did not differ significantly between

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**Fig. 2.** Jaw reduction by extraoral method: the thumb is placed on the anteriorly displaced coronoid and the other fingers behind the mastoid process (A), while simultaneously placing the opposite thumb against the malar eminence and the other fingers behind the angle of the jaw (B).
the three groups ($P = 0.32$ and $P = 0.73$, respectively).

**Outcome results**

Using ANOVA and post hoc tests (Bonferroni), it was found that there was a significant difference between the three methods in terms of difficulty for the doctors ($P = 0.00$). For the doctors, the extraoral method was significantly more difficult than both the conventional ($P = 0.003$) and wrist pivot ($P = 0.000$) methods (Bonferroni test). However, there was no significant difference in difficulty between the conventional and wrist pivot methods ($P = 0.36$).

There was a significant difference between the three methods in terms of difficulty for the patients ($P = 0.00$). According to the patients, the wrist pivot method was easier than the other methods ($P = 0.007$ vs. conventional method and $P = 0.000$ vs. extraoral method). The average difficulty reported by the patients (VNS) for the conventional method was lower than that for the extraoral method (4.8 compared to 5.6), but this difference was not statistically significant ($P = 0.64$).

Comparing the duration of the reduction between the three groups, the $P$-value was 0.01 ($P < 0.01$ considered significant). With regard to the duration of the reduction, there was a significant difference only between the extraoral and wrist pivot methods ($P = 0.007$); the average duration of the reduction was 28.1 s for the extraoral method and 11.65 s for the wrist pivot method. No significant difference was seen for the other comparisons.

The comparisons of the study parameters are shown in Tables 2–4.

**Success rate**

The difference between the success rates of the three methods was not significant ($P = 0.08$). The difference in success rate between the extraoral and conventional methods was not significant ($P = 0.06$). There was no significant difference in success rate between the conventional and wrist pivot methods ($P = 0.16$). The wrist pivot method was significantly more successful than the extraoral method ($P = 0.003$).

Only with the extraoral method was the success rate greater for one-sided dislocation than for bilateral dislocation (100% success rate for unilateral dislocation and 54.5% for bilateral dislocation, $P = 0.02$). There was no significant difference between the three methods with regard to the success of reduction for primary or recurrent dislocation. Of note, no muscle relaxant was required for any patient in any of the groups.

**Table 1. Comparison of the distribution of the variables age, sex, laterality, recurrent disease, and duration of the dislocation in each of the three study groups. There was no statistically significant difference between the groups for these variables.**

<table>
<thead>
<tr>
<th>Variable</th>
<th>Conventional (n = 30)</th>
<th>Extraoral (n = 30)</th>
<th>Wrist pivot method (n = 30)</th>
<th>P-value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Age, years, mean (min–max)</td>
<td>47.1 (15–87)</td>
<td>47.9 (18–90)</td>
<td>47.4 (18–85)</td>
<td>0.99</td>
</tr>
<tr>
<td>Sex, male/female</td>
<td>16/14</td>
<td>12/18</td>
<td>14/16</td>
<td>0.62</td>
</tr>
<tr>
<td>Laterality, bilateral/unilateral</td>
<td>19/11</td>
<td>22/8</td>
<td>22/8</td>
<td>0.73</td>
</tr>
<tr>
<td>Recurrent disease, yes/no</td>
<td>20/10</td>
<td>21/9</td>
<td>25/5</td>
<td>0.32</td>
</tr>
<tr>
<td>Duration of dislocation before visit, hours, mean (min–max)</td>
<td>3.6 (0.2–29)</td>
<td>2.8 (0.5–21)</td>
<td>2.7 (0.5–15)</td>
<td>0.65</td>
</tr>
</tbody>
</table>

**Table 2. Comparison of the conventional and extraoral methods regarding difficulty for the doctor and the patient and the duration of the reduction procedure.**

<table>
<thead>
<tr>
<th>Difficulty</th>
<th>Conventional (n = 30)</th>
<th>Extraoral (n = 30)</th>
<th>P-value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Difficulty for physician</td>
<td>3.9 ± 3.08 (1–10)</td>
<td>6.4 ± 3.1 (1–10)</td>
<td>0.003</td>
</tr>
<tr>
<td>VNS 1–10, mean (min–max)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Difficulty for patient</td>
<td>4.8 ± 2.54 (1–10)</td>
<td>5.6 ± 2.73 (1–10)</td>
<td>0.64</td>
</tr>
<tr>
<td>VNS 1–10, mean (min–max)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Duration of reduction, seconds, mean (min–max)</td>
<td>17.38 ± 16.05 (3–60)</td>
<td>28.1 ± 26.67 (2–110)</td>
<td>0.14</td>
</tr>
</tbody>
</table>

VNS, verbal numeric scale.

**Table 3. Comparison of the conventional and wrist pivot methods regarding difficulty for the doctor and the patient and the duration of the reduction procedure.**

<table>
<thead>
<tr>
<th>Difficulty</th>
<th>Conventional (n = 30)</th>
<th>Wrist pivot method (n = 30)</th>
<th>P-value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Difficulty for physician</td>
<td>3.9 ± 3.08 (1–10)</td>
<td>2.7 ± 2.02 (1–10)</td>
<td>0.36</td>
</tr>
<tr>
<td>VNS 1–10, mean (min–max)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Difficulty for patient</td>
<td>4.8 ± 2.54 (1–10)</td>
<td>2.8 ± 1.94 (1–8)</td>
<td>0.007</td>
</tr>
<tr>
<td>VNS 1–10, mean (min–max)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Duration of reduction, seconds, mean (min–max)</td>
<td>17.38 ± 16.05 (3–60)</td>
<td>11.65 ± 11.12 (2–60)</td>
<td>0.73</td>
</tr>
</tbody>
</table>

VNS, verbal numeric scale.

**Table 4. Comparison of the wrist pivot and extraoral methods regarding difficulty for the doctor and the patient and the duration of the reduction procedure.**

<table>
<thead>
<tr>
<th>Difficulty</th>
<th>Wrist pivot method (n = 30)</th>
<th>Extraoral (n = 30)</th>
<th>P-value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Difficulty for physician</td>
<td>2.7 ± 2.02 (1–10)</td>
<td>6.4 ± 3.1 (1–10)</td>
<td>0.000</td>
</tr>
<tr>
<td>VNS 1–10, mean (min–max)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Difficulty for patient</td>
<td>2.8 ± 1.94 (1–8)</td>
<td>5.6 ± 2.73 (1–10)</td>
<td>0.000</td>
</tr>
<tr>
<td>VNS 1–10, mean (min–max)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Duration of reduction, seconds, mean (min–max)</td>
<td>11.65 ± 11.12 (2–60)</td>
<td>28.1 ± 26.67 (2–110)</td>
<td>0.007</td>
</tr>
</tbody>
</table>

VNS, verbal numeric scale.

**Table 5. Comparisons of the success rates of the three reduction methods.**

<table>
<thead>
<tr>
<th>Success rate, 95% CI</th>
<th>Conventional vs. Extraoral</th>
<th>P-value</th>
</tr>
</thead>
<tbody>
<tr>
<td>86.7%</td>
<td>vs. extraoral</td>
<td>0.06</td>
</tr>
<tr>
<td>66.7%</td>
<td>vs. conventional</td>
<td>0.06</td>
</tr>
<tr>
<td>96.7%</td>
<td>vs. wrist pivot method</td>
<td>0.003</td>
</tr>
<tr>
<td></td>
<td>vs. extraoral</td>
<td>0.003</td>
</tr>
</tbody>
</table>

CI, confidence interval.
The comparisons of success rates for the three different methods are summarized in Table 5.

Discussion

There is a paucity of information regarding the different approaches to the reduction of TMJ dislocation in the literature. Although TMJ dislocation is a rare entity, many affected patients are referred to the ENT and maxillofacial emergency centers for this condition. Dentists in their own offices as well as in dental clinics sometimes encounter this problem during oral procedures.

Physicians at the study hospital, a tertiary referral otolorhinolaryngology hospital in the city of Tehran, are faced with this situation in the emergency department. The routine procedure used in this centre, and in most other centres, has been termed the ‘conventional method’. This method is relatively easy for doctors and the success rate is acceptable. The main disadvantage in the use of this method is the doctor’s hands being inside the patient’s mouth and the risk of biting and subsequent transmission of diseases such as HIV, hepatitis, and syphilis. Therefore, a technique that is suitable for the patient and the doctor, and that does not require the doctor’s hands to be in the patient’s mouth, is needed. Different methods to achieve this goal have been reported.

In a previous study, Ardehali et al. referred to the risk of mandibular condyle fracture with the extraoral method. Although in theory this is a possibility due to the reduction forces being perpendicular to the anterior tubercle of the glenoid fossa, this complication was not seen in any of the 30 patients in the present study who were managed with this method.

When only the conventional method was used for the reduction of TMJ dislocation in the emergency room of the study centre, diazepam injections were frequently required after failed initial attempts. However, during this research project, in which another method was used in the case of a failed attempt, no diazepam was required for any of the 90 patients.

In the study by Ardehali et al., the success rate was reported to be 55.2% for the extraoral method and 86.2% for the conventional method. In the present study, the success rate was 66.7% for the extraoral method and 86.7% for the conventional method. The success rates of the conventional method in the present study and that performed by Ardehali et al. are almost identical. However, the success rate for the extraoral procedure was higher in the present study than in the previous study. As the sample size was almost the same in both studies, and considering the researchers’ personal experience, it appears that the success rate depends on the experience and skills of the physician in charge of performing the procedure.

Chen et al. stated that the extraoral method is technically so simple that, to an extent, the procedure could be taught to a patient’s companion so that a patient’s dislocated jaw could be reduced at home in the case of re-dislocation of the joint. However, the results of the present study showed the extraoral method to be technically the most difficult one, requiring practice and the skills of the operator.

The difficulty of the method from the patient’s perspective was assessed using a verbal numeric scale. Although this scale may not be very accurate, the present researchers have not identified a better scale to assess the level of pain and discomfort.

Extraoral method

The extraoral method was much more difficult for the patients and physicians than the other methods. The time required for the reduction and the failure rate of this procedure were greater than those for the wrist pivot method, although there was no significant difference between the extraoral method and conventional method in regard to these.

This method was more difficult for the patient, which may be due to the direct pressure placed on the bone (not on the teeth). Although the extraoral method solves the issue of the doctor’s hands being in the patient’s mouth, it appears that this technique is more difficult for the doctors as well.

As mentioned previously, the extraoral procedure was significantly more successful in unilateral cases than in bilateral cases.

In general, taking into consideration the issues discussed above and the lack of a significant difference in success rate when compared to the conventional method, the extraoral method may be regarded as an appropriate first-line treatment protocol, especially in unilateral dislocations, in cases where there is a high risk from biting (seizures, HIV, etc.) or there are communication problems, such as in patients with dementia.

Wrist pivot method

From the doctors’ perspective, the wrist pivot method was easier than the extraoral procedure, although there was no statistically significant difference between this method and the conventional method. The patients found this method to be easier than the other two methods. Less time was required to perform the reduction and the failure rate of this method was lower when compared to the extraoral method, although these differences were not found for the same comparisons with the conventional method.

There was no relationship between the success of this method and recurrent dislocation or unilateral/bilateral dislocation.

Thus, it appears that the wrist pivot method, apart from the risk of biting, is preferable to the other methods. Compared with the conventional method, its only major advantage is that it is easier for the patient. The wrist pivot method could, therefore, be a good alternative to the other methods. The authors suggest that this method should be used as the first-line treatment for the reduction of TMJ dislocation.

Conventional method

The conventional method was easier for the doctors in comparison with the extraoral method, although there was no difference in success rate or time taken to perform the reduction. In comparison with wrist pivot method, the only difference was that the patients found this method to be more difficult.

In the patients studied, no relationship was observed between the success rate and latency (time between the occurrence of dislocation and the reduction procedure) or being recurrent, but there was a relationship between the success rate and unilateral/bilateral (100% in unilateral dislocation for extraoral method and 76% in bilateral dislocation).

An algorithm was developed using the results of this study and is given in Fig. 3. This algorithm is recommended for the approach to patients with anterior TMJ dislocation; however, it requires validation in further studies.

When approaching a patient with TMJ dislocation, the risk of biting and disease transmission should be considered. In high-risk patients, such as those with mental retardation, dementia, a history of seizures, or a history of intravenous drug use, the extraoral method is preferred. In other patients, the physician should consider the type of dislocation. In this study, the extraoral method was successful in all unilateral cases; thus for unilateral cases, the extraoral method is advised. In bilateral cases, it is recommended that the wrist
pivot method be tried first. It appears that the wrist pivot method is a good alternative to the conventional method for the reduction of anterior dislocation of the TMJ. This method, due to patient comfort and the good success rate, can be considered the first-line therapy in patients who are able to cooperate and from whom the risk of transmission of viral diseases is low. In the situation of a biting risk and unilateral dislocation, the researchers recommend the use of the extraoral TMJ reduction method as the first-line procedure.

**Ethical approval**

Ethical approval was obtained from the Otorhinolaryngology Research Committee.

**Patient consent**

All patients provided consent before participation in the study. Permission was obtained to publish the photographs.

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**Competing interests**

No conflict of interest.