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Modification of the measurement of the major variables in mandibular condylar fractures: angulation of sidewards displacement and shortening of the height of the ramus

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Abstract

Our aim was to improve the accuracy of measurement of the angulation and the shortening of the height of the ramus in fractures of the mandibular condyle using modified methods. We analysed spiral computed tomography (CT) of 67 unilateral fractures with the OsiriX v 5.0 (©Pixmeo Sarl) and Mimics 19.0 (©2016 Materialise NV, Belgium) and analysed them with SPSS (version 24.0, IBM® SPSS®). Angulation was measured using both the traditional method and our modified method. The results showed significant difference ($p = 0.000$), and the values measured with the traditional method were lower, which is consistent with geometric analysis. We repositioned the condylar fragment with computer-aided surgical simulation and measured the shortened ramus. We were unable to find a significant difference between these values and those measured with our modified method ($p = 0.053$), so the accuracy of the modified method is acceptable. The measurement of the height of the ramus by our modified method is applicable to patients with unilateral, and those with bilateral, fractures. The accuracy in measurement of the major variables of condylar fractures is acceptable in both theory and practice. On the basis of such accurate measurement, more prospective clinical study is needed to find out the most appropriate treatment for condylar fractures.

Keywords: condylar fracture; angulation displacement; shortening ramus height; modified method

Introduction

Mandibular fractures are the most common facial injury, as the mandible is the most exposed area of the face. The condylar region is the thinnest part, which leads to a high incidence of condylar fractures, and Zachariades et al reported that they account for 17.5%-52% of all mandibular fractures.[1] Missed diagnosis and inappropriate treatment of these fractures may create serious problems such as malocclusion, facial asymmetry, chronic pain in the preauricular region, and disorders of the temporomandibular joint (mainly dysfunction and ankylosis).[2,3] However, their treatment is controversial.

The choice between surgical or non-surgical treatment remains a question for debate.[4] In both studies and clin-

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ical practice, the degree of displacement of the condylar fragment and the shortening of the height of the ramus on the fractured side are important reference indicators. The goals of treatment are reduction of the condylar fragment and restoration of the height of the ramus.[5] For a conservative procedure, such as treatment with an occlusal splint, the thickness of the asymmetrical occlusal splint needs to refer to the shortened height of the fractured side. The botulinum toxin A method aims to dispel the traction of the masseter muscles and, with the aid of the arch bars, rubbers, and occlusal split, to create space to reposition the condylar fragment.[4,6] After treatment, maintenance of the height of the ramus and the presence of residual angulation require long-term observation during follow up, which may affect the patients' occlusion and facial symmetry, particularly in children.[5,7]

In this study we measured the angulation, the difference in height of the fractured and non-fractured ramus, and the shorter height of the ramus of the fractured side with the traditional method and our modified method, respectively. Our objective was to improve the accuracy of these measurements.

Material and methods

All cases included in this study were selected from patients seen between 2012 and 2016, who were diagnosed with condylar fractures, and treated at the Division of Traumatic and Orthognathic Surgery of the Department of Maxillofacial Surgery at the Stomatology Hospital of the Fourth Military Medical University of Xi'an, Shaanxi, China. Inclusion criteria were patients who had unilateral condylar fractures, with computed tomographic (CT) scans of the complete mandible examined in the imaging department of our hospital.

Classification of condylar fractures

We used the classification system described by Neff et al and Loukota et al.[8,9] Fractures were divided into four types depending on the site: condylar head, condylar neck, condylar base, and vertical. The spiral CT images (GE Light Speed Ultra 8 CT Scanner, USA) of the patients were stored in the DICOM format and imported into OsiriX v.5.0 (©Pixmeo Sarl) on OS X 10.11.1 (Mac). We then reconstructed the patients' mandibles, and established what types the fractures were.

Displacement and measurement of angulation

The displacement in angulation was defined as the angle between the two midline axes of the condylar fragment and the stump of the ramus, and only the types of fracture of the condylar neck and base were measured.

In the traditional method we measured the angle directly on coronal CT.[8] To measure the angulation using the modified method, we analysed the geometric location of the condylar fragment and the stump of the ramus and then used the 3-dimensional MPR (multi-planar reconstruction) engine of the OsiriX to display the oblique planes so that the two midline axes of the condylar fragment and the stump of the ramus lay on the same plane. Finally, we measured the angle in this plane. The window showed three views with orthogonal planes, which were locked and could not be unlocked. The position of each view was displayed on the other views as a thin line. We named these the coronal, sagittal, and axis reference lines.

The main steps are as follows (Fig. 1):

We started with the coronal view and corrected the orientation of the sagittal reference line so that it was parallel to

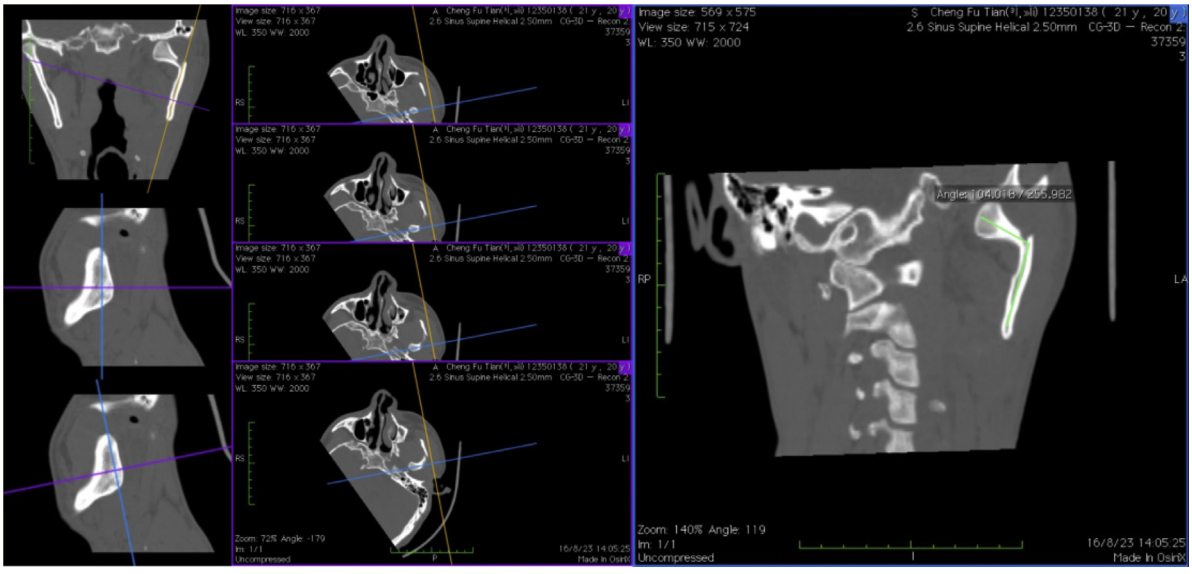

Fig. 1. Steps for the measurement of angulation by the modified method. Purple line = axis reference line. Blue line = coronal reference line. Orange line = sagittal reference line. Green line = the two midline axes.

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