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Cone–beam computed tomographic analysis of maxillary and mandibular changes after high condylectomy combined with orthodontic treatment for active unilateral condylar hyperplasia

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Abstract

Our aim was to evaluate the efficacy of high condylectomy combined with orthodontic treatment for active unilateral condylar hyperplasia in 25 affected patients, by an analysis of the maxillary and mandibular changes on cone–beam computed tomography (CT). High condylectomy was the sole operative treatment. Variables that reflected the canting of the occlusal plane, the height of the maxillary complex, the buccolingual angulation of the maxillary first molar, the height of the ramus, the total length of the mandible, and the deviation of the chin were measured and compared between the two sides and between time intervals: preoperatively (T1) and the end of treatment (T2). The differences between time intervals in the deviation of the chin ($p < 0.001$) and the canting of the occlusal plane ($p < 0.001$) were significant, but there were no significant differences in the height of the ramus ($p = 0.476$) and the total length of the mandible ($p = 0.838$) between the affected and unaffected sides at T2. There were significant differences between time intervals in the buccolingual angulation on the unaffected side and the height of the maxillary complex on the affected side ($p < 0.001$). Facial asymmetry was corrected and the occlusal plane was improved. In conclusion, high condylectomy as the sole operative treatment combined with orthodontic treatment can provide an alternative method for correction of facial asymmetry associated with active unilateral condylar hyperplasia.

Keywords: Condylar hyperplasia; Condylectomy; Cone–beam computed tomography

Introduction

Unilateral condylar hyperplasia is a progressive, non-neoplastic overgrowth of the mandibular condyle, and the main complaint of affected patients is progressive facial asymmetry.[1] The precise aetiology is unknown, though trauma, infection, neoplasia, hormonal influence, genetic factors, abnormal condylar loading, and some abnormality of growth factors are possible causes.[2–4] It most commonly involves patients aged at between 10 and 30 years, and can result in malocclusion and indirectly affect the maxilla (for example, with ipsilateral class III molar and canine relations; cross bite; canting of the maxillary plane; and deviation of the lower dental midline to the contralateral side).[1,2,5] It is diagnosed by a combination of a history of progressive mandibular asymmetry, physical examination (photographs, cast models of dentition, and radiology), and

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bone scintigraphy with 99 m technetium–methylene diphosphonate (^{99m}Tc-MDP).[6,7] Based on bone scintigraphy, it can be divided into active and inactive types. [7, 8] For the active type, high condylectomy is the preferred treatment and is indicated to arrest progression by removing a principal mandibular growth site.[9,10]

The efficacy of high condylectomy for patients with active unilateral condylar hyperplasia has been evaluated using lateral and posteroanterior cephalograms, and panoramic radiographs, but these are limited in their diagnostic capabilities and it is impossible to evaluate facial asymmetry 3-dimensionally because of problems with distortion of images, magnification, and overlapping anatomical structures.[11,12]Nolte et al[13] reported that panoramic radiographs were not suitable for quantitative evaluation, classification, and follow up of affected patients. The advent of cone–beam computed tomography (CT) introduced new ways of scanning images and volumetric reconstruction. Cone–beam CT images were used for accurate and reliable linear measurements of the mandible and dimensions of the temporomandibular joint (TMJ).[14] It is a useful and accurate way to quantify and evaluate mandibular asymmetry in unilateral condylar hyperplasia.[15] If cone–beam CT images are reconstructed into a 3-dimensional image, errors caused by distortion and magnification are reduced.

We know of few studies that have evaluated the efficacy of high condylectomy for active unilateral condylar hyperplasia using cone–beam CT. In this retrospective study, therefore, we analysed bony changes using cone–beam CT in patients with active disease to evaluate the efficacy of high condylectomy combined with orthodontic treatment.

Patients and methods

We retrospectively studied 25 patients (17 female and 8 male, mean (SD) age 23 (6), range 14–38 years) diagnosed with active unilateral condylar hyperplasia between 2012 and 2016. The mean (SD) duration of treatment was 22 (7) months (range 10–33). In 12 the right, and in 13 the left, side of the condyle was affected. All patients had standard clinical and radiographic examinations at the following intervals: preoperatively (T1), seven days postoperatively, and the end of treatment (T2). Clinical examinations were made on all patients for facial symmetry, TMJ function, and occlusions. Serial photographs were taken T1, at seven days postoperatively, and at T2. All patients had a high condylectomy done by two experienced surgeons in the Department of Oral and Maxillofacial Surgery, School & Hospital of Stomatology, Wuhan University. All patients gave their signed informed consent and underwent postoperative orthodontic treatment by two experienced orthodontists.

Cone–beam CT data were obtained from the Department of Oral Radiology, School & Hospital of Stomatology, Wuhan University. The study was approved by the Ethics Committee of the School & Hospital of Stomatology, Wuhan University.

Inclusion criteria were: a diagnosis of active unilateral condylar hyperplasia; high condylectomy as the sole operative treatment and postoperative orthodontic treatment accomplished; and histopathological examination showing increased zones of proliferation and maturation at the condylar head. Exclusion criteria were: condylar osteochondroma; idiopathic condylar resorption; confirmed mandibular fracture; hemimandibular hypertrophy; congenital deformities; endocrine conditions; a history of orthognathic surgery; and any other contraindication to the operation.

Operative technique and postoperative procedures

The operative technique is illustrated briefly as it was described in detail in our previous study.[16] The amount of bone resected was based on the differences in the height of the ramus between the affected and healthy sides, and was usually more than 5 mm. The condylar segment was removed and sent for routine histopathological examination. Intermaxillary elastics were applied immediately postoperatively to guide the jaw into its proper position, and left there for a month. Orthodontic treatment was then given to establish a good and stable occlusion at one month postoperatively. A straight wire appliance 0.046×0.064 cm was applied to the maxillary and mandibular arches. After alignment of the dentition, temporary anchorage devices were implanted into the buccal and palatal interproximal bones of the maxillary molars on the affected side. Meanwhile vertical traction was applied to the canine and posterior teeth on the unaffected side to close the open bite. When the orthodontic treatment had finished the brackets were removed, and retainers applied.

Cone–beam CT and software

Cone–beam CT examinations were made before operation, at seven days postoperatively, and at the end of treatment with a NewTom VG device (QR srl, Verona, Italy). Exposure was set at 110 kV,10 mA, a matrix of 512×512, pixel sizes of 0.3 mm, and slices were 0.3 mm thick. The area from the superior part of the orbit to the mandible was included in the image. Patients were positioned to keep the Frankfurt horizontal (FH) plane parallel to the horizontal plane. During cone–beam CT scanning, patients' jaws were maintained in the intercuspal position. Raw images were exported into DICOM files, which were anonymous and were subsequently imported in Mimics 17.0 software to reconstruct a 3-dimensional hard-tissue model. Linear and angular measurements were made and recorded by two examiners, and the same examiners repeated the same procedure twice at an interval of four weeks.

Landmarks and measurements

Landmarks (Fig. 1) were modified from the 3-dimensional model combined with established reference planes, which included the FH, the midsagittal, and the coronal planes. The