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Clinical Paper
TMJ Disorders

High condylectomy versus proportional condylectomy: is secondary orthognathic surgery necessary?

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R. Fariña, S. Olate, A. Raposo, I. Araya, J.P. Alister, F. Uribe: High condylectomy versus proportional condylectomy: is secondary orthognathic surgery necessary?. Int. J. Oral Maxillofac. Surg. 2016; 45: 72–77.

Abstract. The objective of this study was to assess the need for secondary orthognathic surgery in patients undergoing two different condylectomy protocols for active unilateral condylar hyperplasia (UCH). A retrospective cohort study evaluated UCH patients treated by condylectomy. Two groups were established: group 1 comprised those who had undergone a high condylectomy (5 mm removed) and group 2 comprised those who had undergone a proportional condylectomy (removing the difference observed between the measurements of the hyperplastic and the healthy side). Data analysis was done with the Levene test and *t*-test; a *P*-value of <0.05 indicated a statistically significant relationship. Forty-nine patients, with an average age of 19.83 years, were analyzed; 11 were included in group 1 and 38 in group 2. There was no statistical difference between the two groups with regard to age or sex ($P = 0.781$). An average of 5.81 mm was removed in the high condylectomy group, while an average of 9.28 mm was removed in the proportional condylectomy group; this difference was statistically significant ($P = 0.042$). Comparing the two groups, proportional condylectomy reduced the need for secondary orthognathic surgery ($P < 0.001$). The proportional condylectomy can be used as the sole surgical treatment in cases of UCH, thus avoiding the need for secondary orthognathic surgery.

Key words: facial asymmetry; mandibular condyle; condylectomy; low condylectomy; high condylectomy; proportional condylectomy; condylar hyperplasia; hemimandibular elongation; hemimandibular hypertrophy; orthognathic surgery.

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Unilateral condylar hyperplasia (UCH) is a complex pathology that causes serious alterations to facial function and aesthetics. It typically presents as a progressive facial asymmetry with chin deviation towards the contralateral side, a unilateral posterior crossbite, or an open unilateral posterior bite.[1,2] UCH is a well-known disease that often presents in the second or third decade of life and mainly affects women.[3]

It has been noted that the diagnosis of UCH is essentially linked to the clinical progression of the disease. Studies involving radiological series, radiographic analysis, and studies of the face and dental models with a difference of at least 6 months between them have typically been used.[4]

Studies performed using single photon emission computed tomography (SPECT) and positron emission tomography (PET)

have also shown their diagnostic efficacy, although histological studies of the specimens obtained have not always proven a constant relationship between UCH and the results using SPECT.[5,6] To date, a good diagnostic approach to condylar hyperplasia is with anamnesis and clinical and SPECT confirmation.[6]

From reports in the literature it can be observed that the standard treatment for these patients has been a high condylectomy and orthognathic surgery performed at the same time or at a later time, in which the replacement of the articular disc is the treatment choice variable.[7–9]

A high condylectomy in patients with UCH entails the removal of the upper 5 mm of the mandibular condyle to remove the most active part of condyle head growth.[8] Pantoja et al.[10] have stated that when only a condylectomy is performed on the UCH, the post-surgery open bite can be handled with elastic therapy alone, and facial symmetry and occlusal stability can be attained.[10] Brusati et al. reported a series of cases treated with a high condylectomy as the sole procedure, followed by postoperative Delaire functional therapy, in which the normalization of facial and occlusal parameters was achieved.[11] Nevertheless, when this technique is applied alone (high condylectomy), correction of the facial asymmetry is described as not always being adequate, with secondary orthognathic surgery required in some cases to improve facial and dental conditions, especially after puberty, when mandibular growth has ended and compensatory growth has occurred.[11–13]

A previous study published by Fariña et al.[14] showed that in the majority of patients, a low condylectomy (removing the excess condyle such that the rami on the healthy and affected sides are of the same length) as the sole treatment for active condylar hyperplasia was able to resolve the aetiology and allow the facial, occlusal, and skeletal alterations produced by the pathology to be improved, thus avoiding orthognathic surgery.

Given these facts, the goal of the present study was to determine whether a proportional condylectomy reduces the need for the active UCH patient to undergo secondary orthognathic surgery when compared to a high condylectomy.

Materials and methods

Sample design and selection

A retrospective cohort study was designed. Patients with UCH who had undergone condylectomy surgery at the Hospital del Salvador, Maxillofacial Surgery Unit in Santiago, Chile, and at the Oral and Maxillofacial Surgery Department of the Universidad de la Frontera, Temuco, Chile, between 2002 and 2013, were recruited.

All patients with a diagnosis of UCH who had undergone surgery with an exclusive condylectomy technique were included, without distinguishing by gender. These patients had to fulfil all of the following criteria: (1) absence of simultaneous orthognathic surgery; (2) absence of simultaneous complementary cosmetic surgery; (3) at least 18 months of post-condylar surgery follow-up; (4) computed tomography (CT) studies obtained: preoperative and postoperative, within the first month following surgery; and (5) patients who were not breastfeeding or pregnant.

The following subjects were excluded: (1) patients with UCH associated with tumorous growths; (2) patients with an incomplete clinical history; (3) patients with a history of facial or condylar surgery prior to the intervention for UCH; and (4) patients with congenital malformations and anomalies.

Two of the authors (R.F. and S.O.) confirmed the UCH diagnosis based on fulfilment of the following characteristics: (1) the existence of facial asymmetry prompted the initial consultation; (2) there was a history of progressive facial asymmetry with deviation of the chin towards the contralateral side of the affected condyle, with deviation from the midline, a unilateral posterior crossbite, or a unilateral posterior open bite; (3) CT analysis revealed that one condyle was larger than the contralateral condyle without evidence of a bone or articular pathology in the contralateral condyle (healthy condyle); (4) scintigraphy or SPECT showed a difference of at least 10% in isotope between the two temporomandibular joints (TMJs).

The study was conducted with ethics board approval.

Division into groups

All patients underwent a routine morphological CT study. A line was drawn from the uppermost point of the condyle to the mandibular angle (point of intersection of the bisector formed by the edge of the parotid and the basilar edge), and a measurement in millimetres was obtained. The same operator performed this measurement on both sides on two separate occasions.

Subsequently, the vertical difference between the two sides (condylar process and mandibular ramus from the right and left sides) was measured. Using these measurements, two groups were created according to the size of the condylectomy, with confirmation in the postoperative CT, for which the same morphological study was done (Figs 1 and 2). Group 1 comprised patients who had undergone a high condylectomy with the upper 5 mm of the active UCH-affected condyle removed. Group 2 comprised patients who had undergone a proportional condylectomy, in

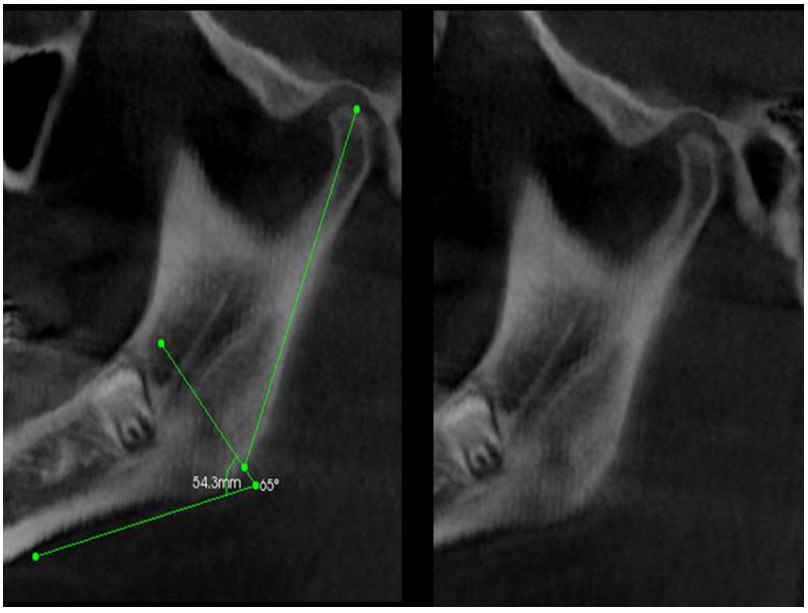

Fig. 1. Measurement of the healthy side in a patient with active unilateral condylar hyperplasia (right side).

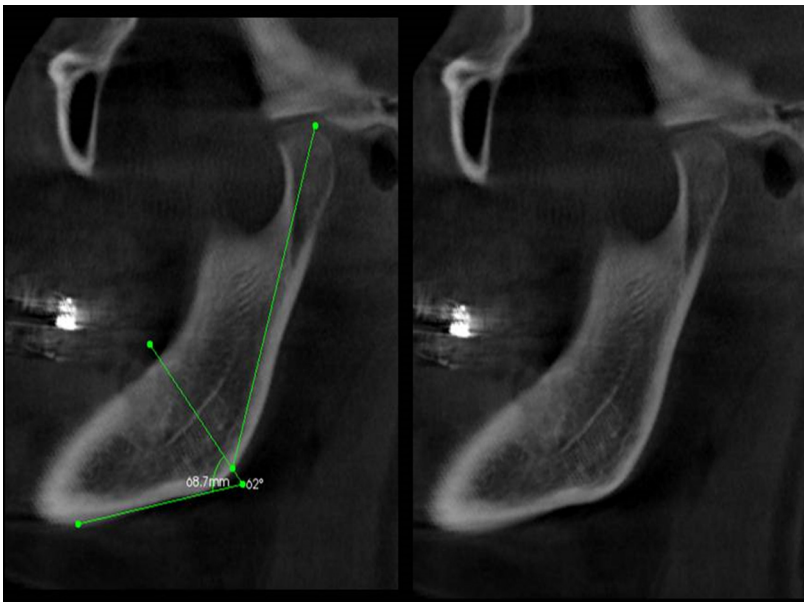

Fig. 2. Measurement of the affected side in a patient with active unilateral condylar hyperplasia (left side).

which as many millimetres were removed as was necessary to make the lengths of the active UCH-affected side and the contralateral side equal (Figs 2–4).

Surgical procedure and follow-up

Using a pre-auricular or endaural access, the head of the condylar process on the affected side was exposed. The osteotomy was performed using fine drill bits mounted on a hand unit or using a piezoelectric system.

None of the operations included disc repositioning; sutures were initially placed to close the articular capsule and subsequently the necessary planes, as far as the cutaneous tissue. The initial control was performed within the first week postoperative and a CT image was obtained during the first month postoperative.

All of the patients underwent a joint phase of orthodontics (devices installed prior to surgery) and physiotherapy. The orthodontic treatment consisted of installing fixed bimaxillary devices, where the elastic therapy was initially oriented to bring the occlusion into dental contact, with consequential reorientation of the mandibular midline towards a centred position with regard to the facial midline. This condition was achieved due to mandibular rotation following the condylectomy. This treatment was continued for at least 2 months. The decision as to whether orthognathic surgery was needed for the patients in each of the two groups was made after 12 months; this was determined according to the presence of the following: crossbite, inverted bite, open anterior or posterior bite, facial profile class II or III, occlusal class II or III, considerable facial asymmetry, or deviation of dental or chin midline by over 3 mm.

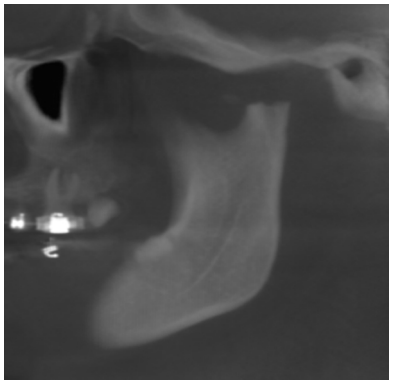

Fig. 3. View of the affected side at 1 month post-condylectomy (patient in group 2).

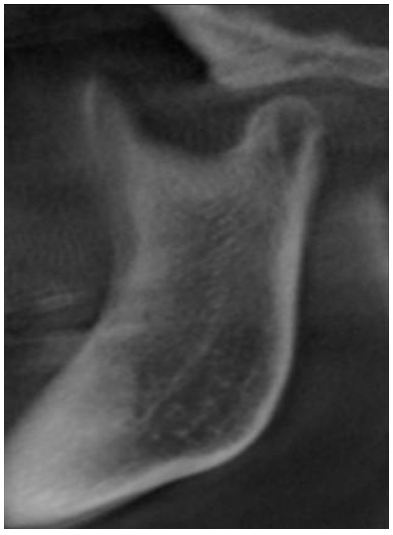

Fig. 4. View of the affected side at 20 months post-condylectomy (patient in group 2).

Data analysis

A descriptive analysis of the sample subjects was undertaken. The Levene test was used to analyze variance, as was the independent sample *t*-test. A *P*-value of < 0.05 was used to establish a statistically significant relationship.

Results

This study included 49 patients with a mean age of 19.7 ± 3.72 years. The majority of patients included were female: 65.3% ($n = 32$) were women and 34.7% ($n = 17$) were men.

Group 1, those who had undergone a high condylectomy, included 11 patients (four male and seven female) with an average age of 19.27 ± 3.65 years. Group 2, those who had undergone a proportional condylectomy, included 38 patients (13 male and 25 female) with an average age of 19.83 ± 3.72 years. There was no statistical difference between the groups with regard to either age or sex of the subjects ($P = 0.781$), nor was there a statistical difference between the groups when the difference in average size between the healthy and hyperplastic sides was compared: group 1, 10.81 ± 1.40 mm; group 2, 9.26 ± 2.56 mm ($P = 0.176$) (Table 1).

For subjects in group 1, 5.81 ± 0.93 mm of the condyle was removed, considering a preoperative difference of 10.81 ± 1.40 mm between the two sides. For subjects who had a proportional condylectomy (group 2), 9.28 ± 2.55 mm was removed, with an initial difference of 9.26 mm ± 2.56 mm. There was a significant difference in the amount of condyle removed between the two groups ($P = 0.042$) (Table 2).

An average difference of 5.11 ± 1.27 mm was maintained between the hyperplastic and non-hyperplastic sides in group 1 subjects. In group 2, this postoperative condition was just 0.52 ± 1.21 mm (Table 2).

Of the 38 patients who underwent proportional condylectomy surgery, just six (15.8%) needed secondary orthognathic correction, which consisted of a bilateral sagittal split osteotomy in four cases and bimaxillary surgery (Le Fort I and bilateral sagittal split osteotomy) in two

Table 1. Patient distribution according to age, gender, and type of condylectomy.

Condylectomy	Number (male/female)	Age, years, mean ± SD	Preoperative difference between condylar process and mandibular ramus (UCH–NHS), mean ± SD
High condylectomy	11 (4/7)	19.27 ± 3.65	10.81 ± 1.40
Proportional condylectomy	38 (13/25)	19.83 ± 3.72	9.26 ± 2.56
Statistical analysis	$P = 0.694$	$P = 0.835$	$P = 0.176$

SD, standard deviation; UCH, unilateral condylar hyperplasia; NHS, non-hyperplastic side.

Table 2. Difference in the tilted maxillary occlusal plane of the affected and healthy sides, amount of condyle removed (millimetres), and need for secondary orthognathic surgery for the two condylectomy groups.

Condylectomy	Number	Preoperative tilted maxillary occlusal plane	Preoperative difference between condylar process and mandibular ramus (UCH–NHS), mean ± SD	Condyle removed, mm, mean ± SD	Postoperative difference between condylar process and mandibular ramus (UCH–NHS), mean ± SD	Secondary orthognathic surgery
High condylectomy	11	4.72°	10.81 ± 1.40	5.81 ± 0.93	5.11 ± 1.27	Yes, $n = 10$ No, $n = 1$
Proportional condylectomy	38	4.75°	9.26 ± 2.56	9.28 ± 2.55	0.52 ± 1.21	Yes, $n = 6$ No, $n = 32$
Statistical analysis		$P = 0.451$	$P = 0.176$	$P = 0.042$	$P = 0.031$	$P \leq 0.001$

SD, standard deviation; UCH, unilateral condylar hyperplasia; NHS, non-hyperplastic side.

(Figs 5–8). Of the 11 cases who underwent high condylectomy surgery, 10 (90.9%) needed orthognathic surgery (six patients underwent triple surgery and five a bilateral sagittal split osteotomy associated with genioplasty). A clinical and statistically significant relationship between having a high condylectomy and the need for secondary orthognathic surgery was revealed ($P < 0.001$). There was no statistical difference between the groups in the tilted maxillary occlusal plane (before condylectomy, $P = 0.451$), which was measured by the angle between the occlusal plane (the straight line that connects the highest points of the distal cuspids of the upper second molar) and the horizontal line at the height of the distal cuspid of the second molar on the affected side, parallel to the frontozygomatic suture, drawn in the frontal view of the cone beam CT (Tables 2 and 3).

Considering the homogeneous variance between the two groups, it is deduced that a proportional condylectomy reduces the need for secondary orthognathic surgery ($P < 0.001$). The relative risk was 0.17 (95% confidence interval 0.08–0.37) for a proportional condylectomy with regard to the need for orthognathic surgery, while the absolute risk was reduced by 0.75 (95% confidence interval 0.55–0.96).

Fig. 5. Photograph of the occlusion before surgery (group 1).

The age of the general sample and of each group did not significantly influence the need for secondary orthognathic surgery ($P = 0.835$). The gender of the patients significantly influenced the decision to perform orthognathic surgery ($P = 0.694$). There was no significant age difference between the patients who needed orthognathic surgery and those who did not ($P = 0.438$).

Discussion

The condylectomy has become established as the preferred technique for treating active condylar hyperplasia.[11,14] Recently Wolford et al.[4] published an update of their condylar hyperplasia classification and placed the high condylectomy together with disc repositioning and orthognathic surgery as the preferred treatment for UCH cases and also for cases of bilateral condylar hyperplasia. In 2002, Wolford et al.,[8] using the same technique, showed its efficacy and stability, presenting close to 5 years of follow-up for the patients who were operated on. Jones and Tier[7] also presented 17 patients, all of whom had a high condylectomy, disc replacement, and orthognathic surgery together.

Villanueva-Alcojol et al.[9] presented 36 patients diagnosed with UCH who were treated with the technique of a high condylectomy without articular disc replacement, of whom just six needed secondary orthognathic surgery. Saridin et al.[15] presented 33 patients who underwent high

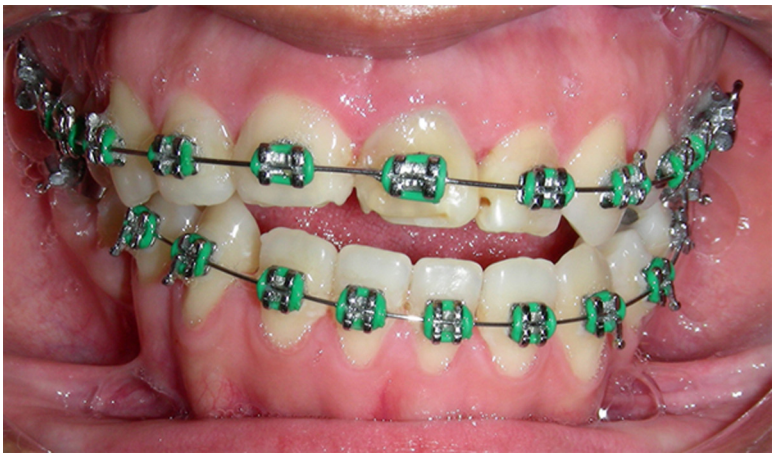

Fig. 6. Photograph of the occlusion at 19 months after condylectomy (group 1).

Fig. 7. Photograph of the occlusion before surgery (group 2).

Fig. 8. Photograph of the occlusion at 20 months after condylectomy (group 2).

condylectomy surgery without disc replacement, although the need for orthognathic surgery in these patients was not addressed.

Despite the scant existing literature analysing mandibular condylectomies, Fariña et al.[14] have shown that a low or proportional condylectomy as the sole treatment in cases of UCH is an aetiological, reasonable, and predictable alternative that allows the procedure to be optimized for dealing with facial asymmetry; the mandible is rotated when the side that has been operated on ascends until it reaches the highest point allowed by ipsilateral dental contact. This contact can be changed with orthodontics, allowing the mandibular rotation to be improved and facial symmetry to be regained.

On this point, the importance of postoperative functional therapy must be stressed, as the bone and occlusal changes achieved are to a large degree due to the mandibular function guided by elastic bands, as noted by Pantoja et al.,[10] Brusati et al.,[11] and Fariña et al.[14]

The high condylectomy has been the routine procedure for the treatment of active UCH. It has been reported that in cases of condylar hyperplasia there is an increase in the number of chondrocytes and with this an increase in the number of cell islands producing connective tissue.[6,17] Thus, when the upper layers of the condyle show themselves to be compromised, a high condylectomy could contribute to limiting anomalous growth of the condylar head.[18] The low condylectomy has been used in cases of osteochondroma[4,19] and in active condylar hyperplasia[14] without complications, proving that a low condylectomy does not restrict the functionality of the articulation and allows posterior facial heights to be equalled (between the hyperplastic and the healthy sides). Thus, a condylectomy that is performed lower than the level traditionally considered to be a high condylectomy would not limit mandibular function or stability, allowing the 'proportional condylectomy' to establish a mandibular function without complications. In fact, prior studies have indicated that the TMJ function in cases of condylectomy performed without disc replacement shows strong performance without restriction of mandibular movements.[9,15]

High condylectomies are highly predictable when linked with orthognathic surgery in the same surgical session.[8] In other studies in which high condylectomies have been performed as the sole treatment, it should be borne in mind that these could have been cases in which the high condylectomy was actually a proportional condylectomy, i.e., that they coincided with the necessary length of mandibular condyle to be removed. In the literature reviewed by this study group, there were no reports of morphological records of the sizes attained by the mandibular ramus and condylar process

Table 3. Distribution according to the need for secondary orthognathic surgery.

Secondary orthognathic surgery	Number (male/female)	Age, years, mean ± SD	Preoperative difference between condylar process and mandibular ramus (UCH–NHS), mean ± SD	Condyle removed, mm, mean ± SD	Postoperative difference between condylar process and mandibular ramus (UCH–NHS), mean ± SD	Type of condylectomy (%)
Yes	16 (6/10)	20.01 ± 2.87	9.93 ± 2.04	6.75 ± 1.79	3.18 ± 2.67	High n = 10/11 (90.9%) Proportional n = 6/38 (15.8%)
No	33 (11/22)	19.75 ± 4.06	8.93 ± 2.71	8.78 ± 2.82	0.12 ± 0.68	High n = 1/11 (9.1%) Proportional n = 32/38 (84.2%)

SD, standard deviation; UCH, unilateral condylar hyperplasia; NHS, non-hyperplastic side.

together, either for the hyperplastic or for the non-hyperplastic sides.

Base skeletal alterations, with or without the existence of mandibular condyle hyperplasia, can require corrective treatment of the facial skeleton in secondary phases. Some researchers have presented orthognathic surgery as the sole treatment in cases of non-active UCH.[20]

The average age of the present study sample of 49 patients was close to 19 years, which would indicate a potentially high capacity for condylar remodelling and adaptation of hard and soft tissue,[21] providing evidence that a proportional condylectomy makes it possible to avoid orthognathic surgery.

In conclusion, based on these results, it is argued that a proportional condylectomy is a rational treatment alternative in cases of active UCH, reducing the need for secondary orthognathic surgery significantly and allowing it to be used as a definitive surgical treatment.

Funding

None.

Competing interests

None.

Ethical approval

This study was approved by the Hospital del Salvador ethics board.

Patient consent

Not required.

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