

Clinical Practice Guideline

Condylar Hyperplasia of the Mandible

Diagnosis and Treatment

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Summary

Background: Condylar hyperplasia of the mandible is characterized by abnormal size and configuration of the condylar process. In Germany, the administrative prevalence of diagnosed and/or treated condylar hyperplasia is 2.4–9.6 cases per 100 000 persons. Misdiagnosis is common and can lead to severe esthetic and functional complications, including facial deformity that can progress into the patient's twenties, as well as dysfunctional speech and mastication.

Methods: We conducted a systematic review of the literature and a structured consensus-finding process with the Delphi method.

Results: The experts recommend timely diagnosis of condylar hyperplasia so that its progression can be prevented by appropriate treatment. The basic diagnostic evaluation consists of history taking, physical examination, and imaging with orthopantomography. If condylar hyperplasia is confirmed, three-dimensional imaging is performed, usually with SPECT. The treatment is mainly surgical: partial condylectomy techniques and orthognathic surgery are the most common methods. If left untreated, the disorder causes

severe dysfunction of mastication as well as disfigurement. Most studies of treatments for condylar hyperplasia have been based on low case numbers and have yielded only level 4 or level 5 evidence.

Conclusion: Condylar hyperplasia is a common, but not widely known problem. Its early diagnosis and treatment can prevent severe jaw asymmetry and further complications such as craniomandibular dysfunction and arthrosis of the temporomandibular joints.

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Condylar hyperplasia of the mandible most commonly affects young adults (1, 2). It involves an as yet unexplained autonomous activation of the condylar growth area in the region of the condylar process.

Since the cause of the excessive growth is still unknown, it is not possible to predict when growth will cease. Left untreated, it leads to progressive facial asymmetry, malocclusion, temporomandibular joint (TMJ) pain, and disturbance of TMJ function when speaking and chewing (3). During the growth phase, asymmetric mandibular growth can be compensated for on the whole by alveolar growth of the maxilla, resulting in greater or lesser degrees of asymmetry. However, if condylar growth has not stopped by the end of puberty, abnormalities of occlusion will develop and require subsequent mandatory treatment. Ultimately, all cases run a self-limiting course, although their timing is not predictable. The untreated course has not yet been scientifically followed-up and published over the long term.

Early diagnosis and treatment are crucial in order to avoid progressive facial deformities and more complex surgery to achieve a good esthetic outcome (4). This is all the more important given that prognostic factors based

on available data to date are still unknown. Late surgery requires greater surgical time and effort and is therefore associated with significantly higher risks. An early operation avoids the problem of asymmetry from developing in the first place and can sometimes even be compensated for spontaneously (this applies to its development during puberty). If craniomandibular dysfunction develops as a result of the asymmetry, then prognosis will worsen; unfortunately, comparative data on this are not available to date.

Early detection forms the basis of patient care and is achieved in a general medical or pediatric setting. The patients are then managed in multidisciplinary centers for TMJ surgery with the involvement of orthodontics/dentistry, oral and maxillofacial surgery, radiology, and physiotherapy.

Data on the prevalence of condylar hyperplasia are sparsely available in the literature and can only be derived indirectly. According to the German Federal Statistics Office and

the Central Research Institute of Ambulatory Health Care in Germany, around 36 800 cases were recorded annually during the period 2019 to 2022 under the ICD code K10.8, which, apart from condylar hyperplasia, also includes patients with condylar hypoplasia, cherubism (an autosomal dominant condition with enlargement of the mandible and maxilla), oral exostoses, and fibrous dysplasia. Since the prevalence of condylar hyperplasia in patients with facial asymmetry (Q67.0, around 7850 each year) is reported in the literature (5, 6) to be 30 to 50%, this is equivalent to a calculated theoretical (*eTable 1*) case number of between 2000 and 4000 patients each year (6, 7).

Based on the coding applied to outpatient and inpatient cases, a rough estimate of 2000 to 8000 patients per 83 000 000 population per year can be made. In summary, therefore, the administrative prevalence of at least diagnostically and/or therapeutically relevant condylar hyperplasia or its sequelae can be estimated at 2.4 to 9.6 cases per 100 000 population. We must assume an unknown number of cases going unreported since, in addition to undiagnosed cases, symptomatic condylar hyperplasia is also subsumed under the ICD codes K07.0 (Major anomalies of jaw size, including hyperplasia and hypoplasia of the jaw), K07.6 (Temporomandibular joint disorders), and Q67.4 (Other congenital deformities of the skull, face, and jaw) (*eTable 1*).

Although recent studies are available on the pathogenesis of condylar hyperplasia, the exact cause leading to the disturbance of condylar growth remains unknown to the present day (7–12). Over the past few years, there has been increasing interest in research in the field of condylar hyperplasia, for example, with regard to diagnostic procedures using low-dose radiation (13). However, there is no consensus in the current literature with regard to classification, diagnosis, and the time and choice of treatment. Furthermore, the limited number of study results are based on publications with a predominantly low level of evidence and therefore carry a high risk of systematic bias (2, 14). This underlines the importance of presenting a standardized literature-based approach to condylar hyperplasia as part of the guideline update.

Methods

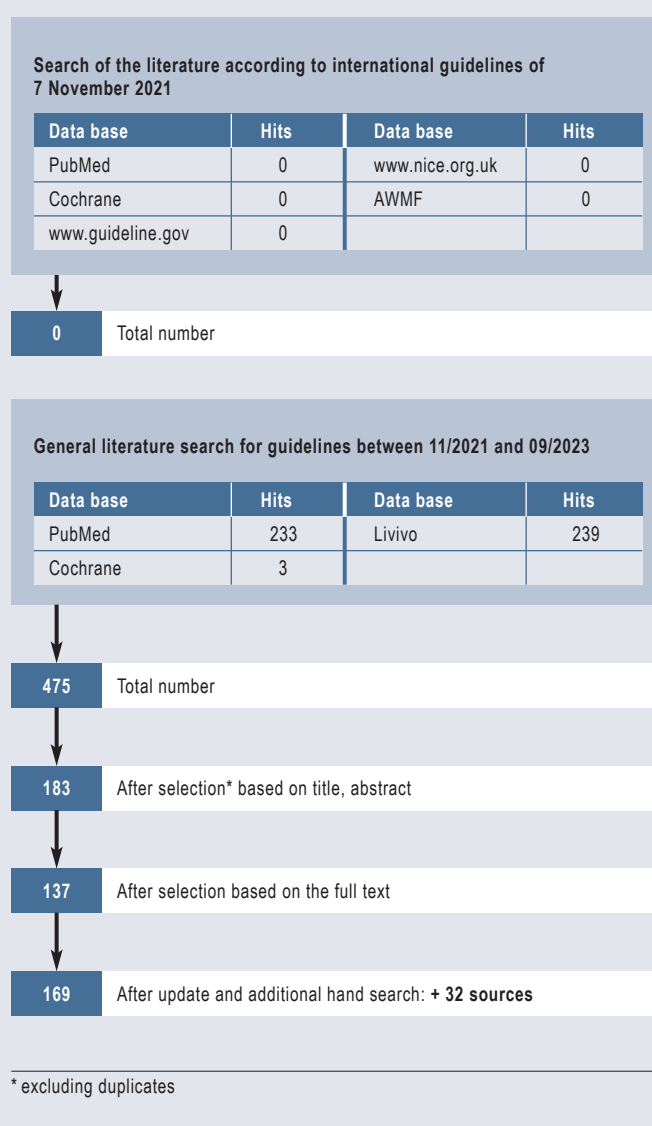
We conducted a systematic search of the literature, including updates, in four international databases for all types of studies on condylar hyperplasia (*eBox 1*). A total of 257 sources were identified (*Figure 1*).

The evaluation of literature evidence was oriented on the Oxford criteria of 2011 (*eTable 2, Figure 3*). The methodological quality up to evidence level 3 was assessed using the SIGN check lists (SIGN, Scottish Intercollegiate Guidelines Network) (*eTable 3*). In order to assess evidence levels 4 and 5, an additional examination of clinical relevance was conducted (*eTable 3*).

- Level of evidence: 1–5
- SIGN check list: ++, +, -
- Clinical relevance: k++, k+, k-

See *eBox 1* for details of consensus building. The levels of recommendation and consensus strengths (*eTable 4*) are classified as follows:

Figure 1



Overview of systematic literature search for the search period 05/2015 to 09/2023; at this time, there were already 88 sources available from the previous guideline.

AWMF, Association of the Scientific Medical Societies; Cochrane, Cochrane Library; Livivo, internet-based search portal of the ZB MED – Information Center for Life Sciences; NICE, National Institute for Health and Care Excellence; PubMed, text-based meta-database offering access to the databases MEDLINE, OLDMEDLINE (before 1966), and PubMed Central; www.guideline.gov, Agency for Healthcare Research and Quality

- Level of recommendation: A: strong recommendation, B: recommendation, C: open recommendation
- Consensus strength: strong consensus (↑↑), consensus (↑)

After approval by the governing boards of the participating professional societies (*eTable 5*), the S3 guideline update was published by the Association of the Scientific Medical Societies (AWMF) on November 10, 2023 with its 28 recommendations and five statements.

The most important results are presented below. Level of recommendation, consensus strength, and level of

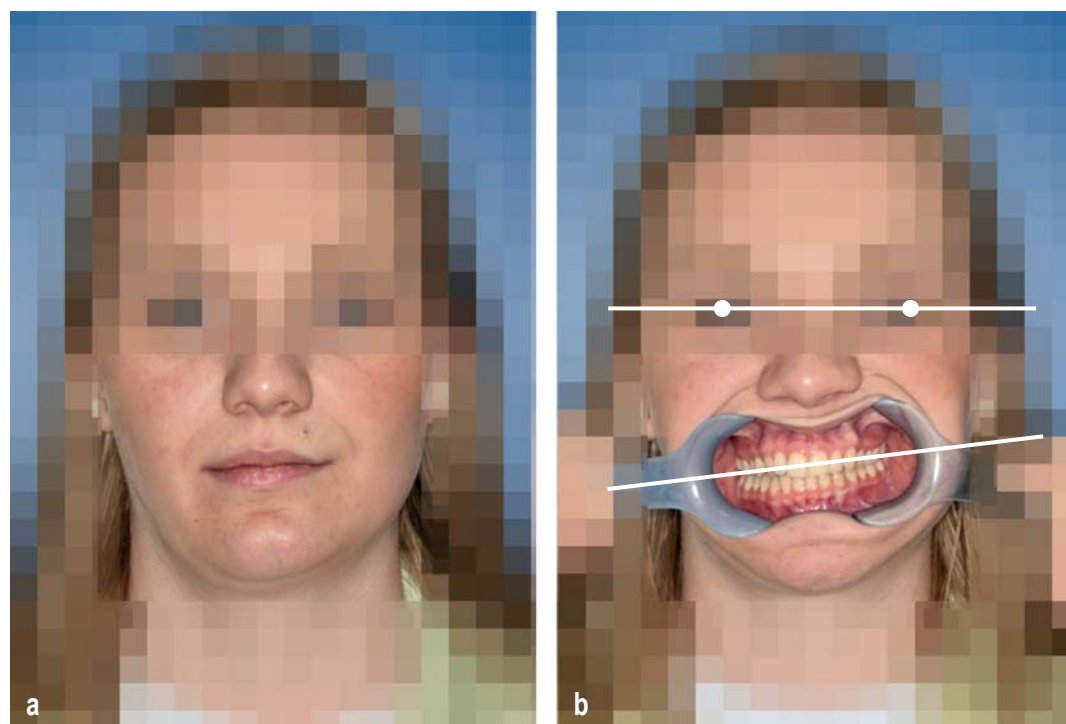


Figure 2: Case example of seemingly only discrete facial asymmetry in a patient with condylar hyperplasia on the right side of the face (a). The extent of the asymmetry becomes clear on intraoral inspection (b) revealing the oblique occlusal plane. The teeth of the right upper jaw are elongated to compensate; note the caudal position of the mandibular basal arch on the right, which will require complex corrective measures.

evidence are stated for the respective recommendations and consensus strength and levels of evidence for the statements.

See the guideline report of the AWMF S3 Guideline “Condylar hypoplasia and hyperplasia” as well as *eBox 1* for further details on methodology.

Clinical presentation and indications for treatment

Condylar hyperplasia of the mandible is characterized by abnormal size and configuration of the condylar process, which develops spontaneously and progressively during puberty or adulthood (usually up to the age of 27 years) and is caused by an autonomic activation of the growth area. Condylar hyperplasia is usually a unilateral (2, 15, 16) and self-limiting (1, 3, 15, 17, 18) process. It presents clinically with (progressive) facial deformity, (progressive) abnormalities of occlusion, functional impairment of TMJ function (speaking, chewing), TMJ noises and pain, and craniomandibular dysfunction (CMD) (1–3, 15). The main reason for treating condylar hyperplasia is facial asymmetry (15, 17) (*Figure 2*). In around one third of cases, however, facial asymmetry goes unnoticed by those affected; primary symptoms are pain and TMJ dysfunction (1, 15, 19), which can also develop in the contralateral joint (14, 15).

Examination for the presence of facial asymmetry should be conducted in patients with symptoms of a TMJ disorder to identify any signs of disorders of condylar growth (A, ↑↑, 4/k+). Depending on the stage in which condylar hyperplasia is diagnosed, therapeutic objectives include either preventing progression of the disorder (20–22) or restoration of normal occlusion and articulation (18), improvement of mandibular mobility (21) and function (22) as well as correction of facial deformities with their associated functional and esthetic impairments (18, 22).

Mandibular hyperplasia, facial syndromes, and benign and malignant neoplasms must be distinguished from condylar hyperplasia in the differential diagnosis (14, 18).

Diagnosis

The diagnosis of condylar hyperplasia should be established early in order to prevent progression of the disorder and to recognize in time its effects on facial growth (B, ↑↑, 4/k++). Apart from the history and clinical examination (inspection, palpation, assessing occlusion), basic diagnostics for suspected condylar hyperplasia should also include imaging studies in the form of an orthopantomogram (OPG, panoramic view of the jaw, *Figure 3*), which can be supplemented by nuclear medicine examinations if required (A, ↑↑, 4/k++). The OPG serves as a screening examination. Three-dimensional imaging using computed tomography (CT) or digital volume tomography (DVT) should be considered for more exact analysis, classification, and clinical monitoring (B, ↑, 4/k++). In Europe, nuclear medicine procedures (usually single-photon emission computed tomography, SPECT)

are the modalities of choice for detecting growth activity in condylar hyperplasia, even though scintigraphy is not yet established internationally as generally recognized diagnostic best practice (2, 23, 24). With this in mind, the German S3 guideline issued a grade B recommendation for SPECT bone scanning to determine the activity level of condylar hyperplasia (B, $\uparrow\uparrow$, 4/k++). A comparison between the two condyles and measurement of an external control (for example, the healthy condyle of a healthy person) are recommended for quantitative evaluation of SPECT scans for unilateral condylar hyperplasia (2, 6, 23, 25). Condylar uptake of at least 55% or a difference of at least 10% between both sides is interpreted as a sign of active unilateral condylar hyperplasia. Values between 5% and 10% are an indication of possible condylar hyperplasia (1, 2, 5, 6, 16, 26–28). The result of the diagnostic assessment determines to a large extent the further course of action, although there is no uniform consensus on this in the international literature. The guideline group recommends that in the first instance monitoring of disease progression be conducted when the SPECT result is borderline (i.e., around the cut-off level, defined as uptake of at least 55% or a difference between the condylar values of at least 10%) and unremarkable clinical findings (B, $\uparrow\uparrow$, 4/k+).

Treatment

Of the 257 identified literature sources, around 200 refer to treatment, of which the majority correspond to the evidence class 4 (*eBox 1*). The choice of therapeutic procedure should therefore be decided on an individual basis. Once diagnosed, the treatment approach for condylar hyperplasia is based on the activity of condylar growth, progression of asymmetries, the degree of facial deformity and malocclusion, age, and other symptoms (2, 14, 26). Conflicting results between scintigraphic examination and clinical progression of asymmetry present a particular problem here.

Conservative treatment methods

Conservative treatment options include both dental prosthetic solutions (29) as well as orthodontic and functional therapeutic measures (for example, occlusal splints) (2, 14, 18). Since no randomized controlled studies dealing with the assessment of conservative approaches for treating condylar hyperplasia are available, the guideline group expresses the open recommendation that conservative measures may be a treatment alternative for inactive condylar hyperplasia, especially for deformities and malocclusions of a lesser degree (0, $\uparrow\uparrow$, 4/k++).

Surgical treatment

Surgical treatment of condylar hyperplasia includes various forms of condylar surgery (high/proportional/low condylectomy) and orthognathic surgery.

There is no exact definition for the term “high condylectomy” for treating condylar hyperplasia. In the literature, this is usually understood to mean resection of the joint surface by 3 to 5 mm or less than 5 mm including the growth region (30, 31). Resection of up to 3 mm is also referred to as “condylar shaving” (30, 31).

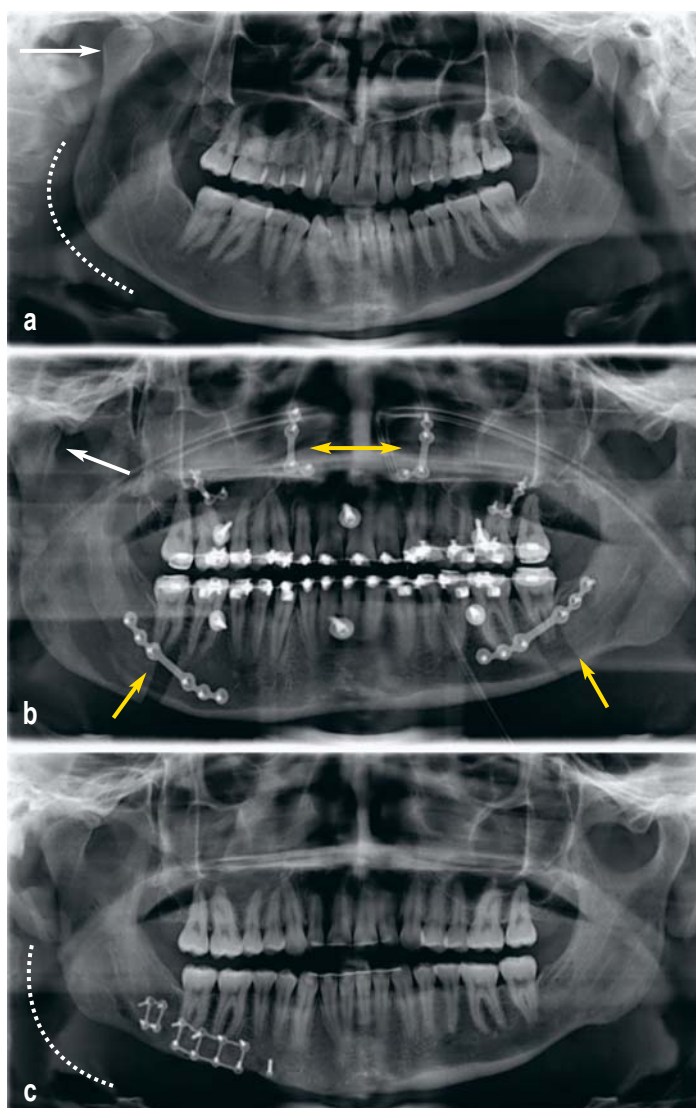


Figure 3: Imaging studies of the patient in Figure 2: A total of four surgical procedures were performed to correct the condition:

- a) Preoperative orthopantomogram showing a hyperplastic condyle (arrow). Note the asymmetry of the mandibular body.
- b) Postoperative orthopantomogram following bimaxillary corrective osteotomy (2nd procedure; yellow arrow) for occlusal plane compensation after high condylectomy had been performed in a previous surgery step (1st procedure; white arrow).
- c) Postoperative orthopantomogram following nerve transfer surgery and resection of an intermediate bone segment (3rd procedure; dotted line); the preoperative asymmetrical basal margin of the mandible is now symmetrical; hardware removal is yet to be performed (4th procedure).

With proportional condylectomy, the degree of resection corresponds to the height difference between the affected and contralateral (“healthy”) condyle, so the height of reduction is determined individually, and it is not a matter of standardized values (27, 32).

There is some controversy concerning the choice of condylectomy procedure. Whereas high condylectomy was for a long time considered the standard procedure for treating active condylar hyperplasia, proportional condylectomy has more recently been increasingly discussed as an alternative, while deep condylectomy is now reserved for individual cases (27). With regard to recurrence prophylaxis, removal of at least 5 mm potentially offers

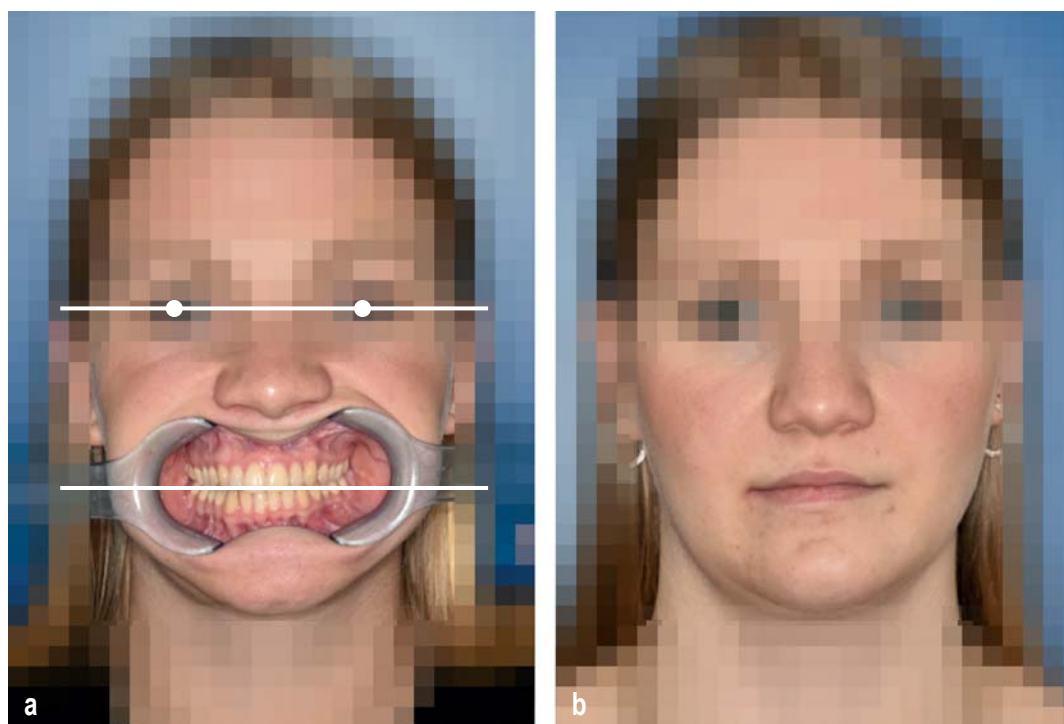


Figure 4: a) corrected occlusal plane after surgery; b) restored bony facial asymmetry after surgery

more reliability than condylar shaving (30). However, a thicker ablation layer may produce postoperative occlusion disorders (26, 27, 30). Some authors, on the other hand, recommend high condylectomy as the procedure of choice due to its lower complication rate, satisfactory esthetic results, and cessation of the condition after surgery (20, 22, 32, 33). Another aspect under discussion is whether proportional condylectomy significantly reduces the need for secondary orthognathic surgery in comparison with high condylectomy (34, 35). Yet, following this line of thought, other authors recommend proportional condylectomy as the optimal therapeutic procedure (35) (Table).

Given the conflicting study results and expert opinions and at the same time small numbers of patients involved in studies, no evidence-based recommendation has so far been offered to help decide between high and proportional condylectomy as the surgical procedure of choice for condylar hyperplasia (↑↑, EC [expert consensus]).

A further point of discussion in the international literature is the question of whether supplementary procedures in the form of articular disc repositioning, possibly together with discopexy, should be regularly performed in addition to condylectomy. Following detailed and controversial discussion within the guideline group, the decision statement was released that an intervention in the form

of routine articular disc repositioning and discopexy for both asymptomatic and symptomatic internal derangement (disc dysfunction) is not usually necessary (↑↑, 1+).

An established surgical procedure as a supplement to condylectomy is orthognathic surgery to correct malocclusion while at the same time improving facial deformities (Figure 4). Both single-stage (18, 20, 22, 33) and two-stage procedures (2, 27, 32) are available for this. So, an orthognathic surgical repositioning operation may be indicated to correct the resulting malocclusion and deformities after high or proportional condylectomy (0, ↑↑, 4/k++). Given the conflicting results and small case figures presented in various studies, no evidence-based recommendation has been provided so far on the optimum time point for orthognathic surgery after condylectomy (↑↑, EC).

Orthognathic surgery is also a treatment option as the sole surgical procedure during the inactive phase (17, 22). See eBox 2 for possible complications arising from surgical treatment.

Operative approach for active condylar hyperplasia

Active condylar hyperplasia is present when the SPECT scan is positive and associated with clinically progressive asymmetry (22, 27). The guideline group recommends high condylectomy with removal of the condylar growth region for patients with active condylar hyperplasia and less marked asymmetry to arrest excessive condylar growth and its associated progressive symptoms (B, ↑↑, 4/k++). On the other hand, the indication for proportional condylectomy should be considered for patients with active condylar hyperplasia and clinically increased condylar growth activity and strongly marked asymmetry (B, ↑↑, 5/k++).

Table

Evidence table of the principal studies on the treatment of mandibular condylar hyperplasia

Reference	Study design	Patient population	Intervention (n = number of patients)	Primary outcome	Key message
(34)	Review article	10 studies on condylectomies (6 retrospective case series, 4 retrospective cohort studies)	168 condylectomies (n = 259) – 65% high, – 35% proportional in 47% with additional orthognathic surgery	Proportional condylectomy: 0.54-fold greater need of orthognathic surgery as compared with high condylectomy	There is low evidence that proportional condylectomy renders secondary orthognathic surgery less likely.
(26)	Retrospective case-control study	Active condylar hyperplasia	High condylectomy, articular disc repositioning, intermaxillary fixation after surgery for one month; followed by orthodontic therapy: – Group A: yes (n = 24) – Group B: no (n = 16)	Follow-up after approx. 13–18 months – Group A: reduction of ipsilateral mandibular ramus height, increase on contralateral side; less asymmetry in comparison with Group B – Group B: not significant	Orthodontic therapy after condylectomy reinforces spontaneous maxillary and condylar remodeling and allows more rapid and stable occlusion with normal position of condyle.
(21)	Retrospective case-control study	Unilateral condylar hyperplasia, surgery comprising condylectomy only, follow-up ≥ 18 months	Condylectomy: – Group A: high (n = 11) – Group B: proportional (n = 38) Both groups: subsequent physiotherapy, orthodontic therapy (≥ 2 months)	After 12 months: number of patients requiring secondary orthognathic surgery: – Group A: 10/11 (91%) – Group B: 6/38 (16%)	There is less need for two-stage orthognathic surgery in patients with proportional condylectomy.
(37)	Case series	Unilateral condylar hyperplasia	Proportional condylectomy (n = 73) – only, 38 patients (52%), – plus orthognathic procedure, 35 patients (48%) – followed by functional rehabilitation, intermaxillary fixation (approx. 2.8 months) – followed by orthodontic therapy for 58% of patients	– orthodontic therapy: improved occlusal function – delayed start of treatment: worse pathological changes Follow-up approx. 35 months (% of patients): – inferior alveolar nerve, temporary weakness: 7%; definitive hypesthesia: 3% – facial nerve: temporary injury: 5% – frontal branch of the facial nerve: definitive injury: 1%	Orthodontic therapy correlated with better occlusion results. Treatment should be provided as early as possible to prevent need for larger resections and to avoid major deformities.
(38)	Retrospective case-control study	Active condylar hyperplasia, follow-up ≥ 2 years	– Group A: orthognathic surgery only (n = 12) – Group B: high condylectomy, articular disc repositioning, and orthognathic surgery (n = 42)	– Group A: recurrence of malocclusion: n = 12 – Group B: larger maximum incisal opening; recurrence of malocclusion: n = 1	– active condylar hyperplasia: high condylectomy plus articular disc repositioning and orthognathic surgery – only orthognathic surgery leads to recurrence of malocclusion.

Alternatively, in cases of (less marked) active condylar hyperplasia, the end of progression may be awaited before undertaking any necessary or desired correction of deformities and malocclusion (0, $\uparrow\uparrow$, 4/k++). With this expectant approach, however, neither the duration of the excessive growth phase nor the ultimate degree of deformity and change in symmetry are predictable. It is therefore possible that the final conditions for correction will be less favorable than after early growth stop.

Due to the poor epidemiological availability of data, no evidence-based recommendation can be given at present for the optimal time point of therapy for condylar hyperplasia. Disease activity must therefore be assessed and treatment determined on an individual basis.

Operative approach for inactive condylar hyperplasia

Abnormal condylar growth is considered to have ceased and condylar hyperplasia to be inactive once the SPECT scan is negative and there is no further progression of

asymmetry. If it is not possible to clearly determine the activity level of condylar hyperplasia using appropriate diagnostic examinations, for example, because of conflicting or borderline clinical and nuclear medical findings, then further follow-up diagnostics should be performed before reaching any indication for surgery (B, $\uparrow\uparrow$, 4/k+).

On the whole, recommendations in the literature for the treatment of inactive condylar hyperplasia are not uniform. The guideline group recommends that with inactive condylar hyperplasia the indication for orthodontic-surgical treatment to correct malocclusion and deformities should be carefully assessed (B, $\uparrow\uparrow$, 4/k++).

Summary and outlook

Condylar hyperplasia is one of the most common causes of facial asymmetry, yet it is often not diagnosed correctly. Early diagnosis and treatment can avoid severe disease

and secondary damage. This guideline update has contributed towards standardizing patient care and avoiding complications based on the best possible evidence.

Despite increased interest in research over recent years, further studies would be desirable, for example, in order to determine the optimum time point for treating condylar hyperplasia or for conducting orthognathic surgery after high condylectomy.

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Conflict of interest statement

NCG is involved in the surgical treatment of patients with condylar hyperplasia.

BK was appointed by the German Society of Neuroradiology (DGNR) and the German Radiology Society (DRG) to prepare the guideline.

AN has received lecture fees and third-party research funding from the Karl Storz company. He is a member of the European Society of Temporomandibular Joint Surgeons, Osteosynthesis Research Group, and the International Bone Research Group. He is involved in the surgical treatment of patients with condylar hyperplasia.

The other authors declare that no conflict of interest exists.

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As with many other professional journals, clinical guidelines in the German Medical Journal *Deutsches Ärzteblatt* are not subject to the peer review process, as S3 guidelines are already texts that have been assessed and discussed by experts (peers) and have a broad consensus.

References

- Wen B, Shen Y, Wang C-Y: Clinical value of $^{99}\text{Tc}^{\text{m}}$ -MDP SPECT bone scintigraphy in the diagnosis of unilateral condylar hyperplasia. *ScientificWorldJournal* 2014; 2014: 256256.
- AlSharif AA, Tarawneh ES, AlKawaleet YI, et al.: Standardization of quantitative single photon emission computed tomography in control individuals and in patients with condylar hyperplasia. *Nucl Med Commun* 2014; 35: 1268–76.
- Verhoeven TJ, Nolte JW, Maal TJJ, Bergé SJ, Becking AG: Unilateral condylar hyperplasia: a 3-dimensional quantification of asymmetry. *PLoS One* 2013; 8: e59391.
- Chouinard AF, Kaban LB, Peacock ZS: Acquired abnormalities of the temporomandibular joint. *Oral Maxillofac Surg Clin North Am* 2018; 30: 83–96.
- Olate S, Almeida A, Alister JP, Navarro P, Netto HD, Moraes M de: Facial asymmetry and condylar hyperplasia: considerations for diagnosis in 27 consecutive patients. *Int J Clin Exp Med* 2013; 6: 937–41.
- Saridin CP, Rajmakers PGHM, Al Shamma S, Tuinzing DB, Becking AG: Comparison of different analytical methods used for analyzing SPECT scans of patients with unilateral condylar hyperactivity. *Int J Oral Maxillofac Surg* 2009; 38: 942–6.
- Amirzargar R, Shirani G, Raisian S, et al.: Distinctive expression of bone metabolism-related genes between PBMCs from condylar hyperplasia, rheumatoid arthritis, and ankylosing spondylitis patients. *Iran J Allergy Asthma Immunol* 2020; 19: 539–44.
- Cao P, Feng Y, Deng M, et al.: MiR-15b is a key regulator of proliferation and apoptosis of chondrocytes from patients with condylar hyperplasia by targeting IGF1, IGF1R and BCL2. *Osteoarthritis Cartilage* 2019; 27: 336–46.
- Doetzer AD, Herai RH, Buzalaf MAR, Trevilatto PC: Proteomic expression profile in human temporomandibular joint dysfunction. *Diagnostics (Basel)* 2021; 11: 601.
- Guo H, Li H, Feng Y, et al.: Cross-talk between synovial fibroblasts and chondrocytes in condylar hyperplasia: an in vitro pilot study. *Oral Surg Oral Med Oral Pathol Oral Radiol* 2021; 131: 558–64.
- Nolte JW, Alders M, Karssemakers LHE, Becking AG, Hennekam RCM: Molecular basis of unilateral condylar hyperplasia? *Int J Oral Maxillofac Surg* 2020; 49: 1397–401.
- Toh AQJ, Becking AG, Leung YY: Mirror-image unilateral condylar hyperplasia in monozygotic twins. *Int J Oral Maxillofac Surg* 2021; 50: 1177–81.
- Lima GM, Diodato S, Costabile E, et al.: Low dose radiation 18F-fluoride PET/CT in the assessment of Unilateral Condylar Hyperplasia of the mandible: preliminary results of a single centre experience. *Eur J Hybrid Imaging* 2018; 2: 7.
- Elbaz J, Wiss A, Raoul G, Leroy X, Hossein-Foucher C, Ferri J: Condylar hyperplasia: correlation between clinical, radiological, scintigraphic, and histologic features. *J Craniofac Surg* 2014; 25: 1085–90.
- Nitzan DW, Katsnelson A, Bermanis I, Brin I, Casap N: The clinical characteristics of condylar hyperplasia: experience with 61 patients. *J Oral Maxillofac Surg* 2008; 66: 312–8.
- Saridin CP, Rajmakers P, Becking AG: Quantitative analysis of planar bone scintigraphy in patients with unilateral condylar hyperplasia. *Oral Surg Oral Med Oral Pathol Oral Radiol Endod* 2007; 104: 259–63.
- Alyamani A, Abuzinada S: Management of patients with condylar hyperplasia: a diverse experience with 18 patients. *Ann Maxillofac Surg* 2012; 2: 17–23.
- Mehrotra D, Dhasmana S, Kamboj M, Gambhir G: Condylar hyperplasia and facial asymmetry: report of five cases. *J Maxillofac Oral Surg* 2011; 10: 50–6.
- Meng Q, Chen G, Long X, Deng M, Cai H, Li J: Histological evaluation of condylar hyperplasia model of rabbit following distraction osteogenesis of the condylar neck. *J Oral Rehabil* 2011; 38: 27–33.
- Abotaleb B, Bi R, Telha W, Zhao W, Li Y, Zhu S: Treatment measures of hemimandibular hyperplasia and associated facial deformities. *J Craniofac Surg* 2021; 49: 126–34.
- Fariña R, Moreno E, Lolas J, Silva F, Martinez B: Three-dimensional skeletal changes after early proportional condylectomy for condylar hyperplasia. *Int J Oral Maxillofac Surg* 2019; 48: 941–51.
- Maniskas SA, Ly CL, Pourtaheri N, Parsaei Y, Steinbacher DM: Concurrent high condylectomy and orthognathic surgery for treatment of patients with unilateral condylar hyperplasia. *J Craniofac Surg* 2020; 31: 2217–21.
- Rushinek H, Tabib R, Fleissig Y, Klein M, Tshori S: Evaluation of three analysis methods for ^{99}Tc MDP SPECT scintigraphy in the diagnosis of unilateral condylar hyperplasia. *Int J Oral Maxillofac Surg* 2016; 45: 1607–13.
- Saridin CP, Rajmakers PGHM, Tuinzing DB, Becking AG: Bone scintigraphy as a diagnostic method in unilateral hyperactivity of the mandibular condyles: a review and meta-analysis of the literature. *Int J Oral Maxillofac Surg* 2011; 40: 11–7.
- Fahey FH, Abramson ZR, Padwa BL, et al.: Use of (99m)Tc-MDP SPECT for assessment of mandibular growth: development of normal values. *Eur J Nucl Med Mol Imaging* 2010; 37: 1002–10.
- El Mozen LA, Meng QG, Li YJ, Long X, Chen GX: Condylar and occlusal changes after high condylectomy and orthodontic treatment for condylar hyperplasia. *J Huazhong Univ Sci Technolog Med Sci* 2015; 35: 265–70.
- Fariña R, Pintor F, Pérez J, Pantoja R, Berner D: Low condylectomy as the sole treatment for active condylar hyperplasia: facial, occlusal and skeletal changes. An observational study. *Int J Oral Maxillofac Surg* 2015; 44: 217–25.
- Fernandes AR, Faria MT, Oliveira A, Barata Coelho P, Pereira JG: Assessment of relative uptake by mandibular condyles in a „normal“ population. *Br J Oral Maxillofac Surg* 2019; 57: 251–4.
- Seto A, Botelho MG, Ho EHT, Jagannathan N: Bilateral condylar hyperplasia—nonsurgical management: a clinical report. *J Contemp Dent Pract* 2018; 19: 463–7.
- Di Blasio C, Di Blasio A, Pedrazzi G, Anghinoni M, Sesenna E: How does the mandible grow after early high condylectomy? *J Craniofac Surg* 2015; 26: 764–71.
- Villanueva-Alcojol L, Monje F, González-García R: Hyperplasia of the mandibular condyle: clinical, histopathologic, and treatment considerations in a series of 36 patients. *J Oral Maxillofac Surg* 2011; 69: 447–55.
- Aerden T, Verstraete L, Politis C: The need for secondary orthognathic surgery after high condylectomy in patients with active unilateral condylar hyperplasia. *Int J Oral Maxillofac Surg* 2022; 51: 206–13.
- Gallagher AL, de Oliveira Ruellas AC, Benavides E, et al.: Mandibular condylar remodeling characteristics after simultaneous condylectomy and orthognathic surgery. *Am J Orthod Dentofacial Orthop* 2021; 160: 705–17.

- 34.Brignardello-Petersen R: Very low-quality evidence suggests that proportional condylectomy results in a lower risk of undergoing additional surgeries than high condylectomy in patients with active condylar hyperplasia. *J Am Dent Assoc* 2019; 150: e168.
- 35.Niño-Sandoval TC, Maia FPA, Vasconcelos BCE: Efficacy of proportional versus high condylectomy in active condylar hyperplasia—a systematic review. *J Craniomaxillofac Surg* 2019; 47: 1222–32.
- 36.Neff A, Riechmann M (Lenkungsgruppe) (2023): DGMKG S3-Leitlinie: Kondylushypo- und -hyperplasie, Update Langversion 1.0, AWMF-Registernummer 007/065. <https://register.awmf.org/de/leitlinien/detail/007-065>.
- 37.Mouallem G, Vernex-Boukerma Z, Longis J, et al.: Efficacy of proportional condylectomy in a treatment protocol for unilateral condylar hyperplasia: a review of 73 cases. *J Craniomaxillofac Surg* 2017; 45: 1083–93.
- 38.Wolford LM, Morales-Ryan CA, Garcia-Morales P, Perez D: Surgical management of mandibular condylar hyperplasia type 1. *Proc (Bayl Univ Med Cent)* 2009; 22: 321–9.
- 39.Al-Moraissi EA, Ellis E, Neff A: Does encountering the facial nerve during surgical management of mandibular condylar process fractures increase the risk of facial nerve weakness? A systematic review and meta-regression analysis. *J Craniomaxillofac Surg* 2018; 46: 1223–31.
- 40.Thiem D, Schneider D, Hammel M, et al.: Complications or rather side effects? Quantification of patient satisfaction and complications after orthognathic surgery-a retrospective, cross-sectional long-term analysis. *Clin Oral Investig* 2021; 25: 3315–27.

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Supplementary material

eTables, eBox:

www.aerzteblatt-international.de/m2024.0210

Supplementary material to accompany the article

Condylar Hyperplasia of the Mandible

Diagnosis and Treatment

by Merle Riechmann, Nils-Claudius Gellrich, Bodo Kress, Christopher Schmidt, Cornelia Schröder, and Andreas Neff

Dtsch Arztebl Int 2024; 121: 816–23. DOI: 10.3238/arztebl.m2024.0210

eTable 1						
Synopsis table of ICD-10 coding for the specific codes “Other specified diseases of jaws” (incl. condylar hyperplasia) (K10.8) and “Facial asymmetry” (Q67.0) and the subsuming codes “Major anomalies of jaw size” (K07.0), “Temporomandibular joint disorders” (K07.6), and “Other congenital deformities of skull, face and jaw” (Q67.4)						
ICD code		2019 Pats. per year	2020 Pats. per year	2021 Pats. per year	2022 Pats. per year	Average
K10.8	inpatient	1720	1429	1521	1504	1544
	outpatient	35 320	33 751	35 406	36 883	35 340
Q67.0	inpatient	138	159	132	116	136
	outpatient	7951	7816	7965	7234	7742
Σ						44 762
K07.0	inpatient	1544	1239	1339	1431	1388
K07.6	inpatient	4331	3343	3073	3147	3474
	outpatient	263 841	253 834	262 307	255 158	258 785
Q67.4	inpatient	1661	1596	1683	1473	1603
	outpatient	75 943	76 418	76 824	69 944	74 782

Source 1: German Federal Statistics Office: data provided on April 23, 2024; Central Research Institute of Ambulatory Health Care in Germany (Zi): data provided on May 20, 2024. Pats., Patients

eTabelle 2: Einteilung der Evidenzniveaus in Anlehnung an die Oxford-Kriterien Stand 2011

LOE	Studientyp
1	Systematische Übersichtsarbeit von randomisiert kontrollierten Studien
2	Randomisierte kontrollierte Studie oder Beobachtungsstudie mit dramatischem Effekt
3	Nicht randomisierte kontrollierte Kohortenstudie
4	Fallserien, Fall-Kontroll-Studien, oder historisch kontrollierte Studien
5	Pathophysiologisch-mechanistische Argumente

eTabelle 3: Bewertung der methodischen Qualität gemäß SIGN-Checklisten bzw. SIGN-analoge Bewertung der klinischen Relevanz für Studien der Evidenzgrade 4 und 5 (kursiv)

++	qualitativ hochwertig, ein Großteil der Kriterien wurden erfüllt (> 75%), kein bis niedriges Risiko für bias
k++	<i>hohe klinische Relevanz, ein Großteil der Kriterien wurden erfüllt (> 75%)</i>
+	qualitativ akzeptabel, die Mehrzahl der Kriterien wurden erfüllt (50 – 75%), mittleres Risiko für bias
k+	<i>akzeptable klinische Relevanz, die Mehrzahl der Kriterien wurden erfüllt (50 – 75%)</i>
-	qualitativ minderwertig, ein Großteil der Kriterien wurden nicht erfüllt (< 50%), erhebliches Risiko für bias
k-	<i>geringe klinische Relevanz, ein Großteil der Kriterien wurden nicht erfüllt (< 50%)</i>
0	Studie wurde verworfen aufgrund erheblicher qualitativer Mängel
k0	<i>Studie klinisch nicht relevant, Studie wurde verworfen</i>

eTabelle 4: Klassifikation der Empfehlungsstärke gemäß AWMF-Regelwerk
 (<https://www.awmf.org/leitlinien/awmf-regelwerk/leitlinien-entwicklung/awmf-regelwerk-03-leitlinienentwicklung/II-entwicklung-strukturierte-konsensfindung.html>)

AWMF-Definition	Zustimmung
Starker Konsens	Zustimmung von >95% der Teilnehmenden
Konsens	Zustimmung von >75-95% der Teilnehmenden
Mehrheitliche Zustimmung	Zustimmung von >50-75% der Teilnehmenden
Keine mehrheitliche Zustimmung	Zustimmung von <50% der Teilnehmenden

Quelle 1: Arbeitsgemeinschaft der Wissenschaftlichen Medizinischen Fachgesellschaften (AWMF)

eTable 5

Participating professional societies and organizations as of 2023

Professional society/organization		Elected representative	Clinic/Practice
German Society for Functional Diagnostics and Therapy	DGFDT	PD Dr. med. dent. M. Oliver Ahlers	CMD Center Hamburg-Eppendorf Falkenried 88 20251 Hamburg
German Society of Orthodontics.	DGKFO	Univ.-Prof. Dr. med. dent. Christopher J. Lux	Department of Orthodontics at Heidelberg University Hospital Im Neuenheimer Feld 400 69120 Heidelberg
German Society for Oral and Maxillofacial Surgery (responsible society)	DGMKG	Univ.-Prof. Dr. med. Dr. med. dent. Prof. h. c. (BNMU [Bogomolets National Medical University], Kyiv) Andreas Neff	Department of Oral and Maxillofacial Surgery University Hospital of Marburg Baldingerstrasse 35043 Marburg
German Society of Neuroradiology.	DGNR	Prof. Dr. med. Bodo Kress	Institute for Neuroradiology Nordwest Hospital Steinbacher Hohl 2–26 69488 Frankfurt
German Society for Prosthetic Dentistry and Biomaterials	DGPro	Univ.-Prof. Dr. med. dent. Peter Ottl	Department for Dental Prosthetics and Materials Science Rostock University Medical Center Strepelstr. 13 18057 Rostock
German Radiology Society	DRG	Prof. Dr. med. Bodo Kress	Institute for Neuroradiology Nordwest Hospital Steinbacher Hohl 2–26 69488 Frankfurt
Society for Pediatric Radiology	GPR	Dr. med. Cornelia Schröder	Radiology with Open MRI Scanner Kiel Exerzierplatz 20a 24103 Kiel
German Society for Skull Base Surgery	GSB	Univ.-Prof. Dr. med. Dr. med. dent. Nils-Claudius Gellrich	Department for Oral and Maxillofacial Surgery Hanover Medical School Carl-Neuberg-Strasse 1 30625 Hanover
German Physiotherapy Association	ZVK	Ima Feurer	Practice for Orthopedic Manual Physiotherapy Singener Str. 36 78315 Radolfzell

Methods

● Systematic review of the literature and literature updates

The latest guideline is based on the hitherto existing S3 guideline on condylar hypoplasia and hyperplasia (as of 06/2016), which in turn represents a comprehensively updated and revised version of the preceding S1 guideline (as of 11/2009) on condylar hypoplasia and hyperplasia. So, when the literature review started, there were already 88 sources available from the predecessor guideline as of 2016. An initial search for existing national and international guidelines on condylar hypoplasia and hyperplasia yielded no hits in the PubMed, Cochrane, AWMF, www.guideline.gov, and www.nice.org.uk databases.

The literature search was conducted using the search terms: “condylar hyperplasia [AND] temporomandibular joint” in the databases PubMed, Embase, Cochrane Library, and Livivo. The guideline group was not in favor of confining the search to certain study types or questions. Use of German or English was an inclusion criterion. This produced 282 hits for the search period May 2015 to November 2021. The sources were updated from the above databases in June 2023 using the same search strategy, this time producing 28 hits. A total of 257 sources from the systematic literature search, together with the updates, were included in the guideline (*Figure 1*). The majority of the literature sources (around 75%) corresponds to level of evidence 4, with the most common study types being case series and case-control studies. Less than 5% of the literature sources correspond to level of evidence 3 and around 20% to level 5.

● Evidence evaluation

The sources were read and graded independently by two experts (MR, CS).

Evaluation of literature evidence was oriented on the Oxford criteria of 2011 (*eTable 2, Figure 3*). Methodological quality was evaluated using the SIGN check lists (*eTable 3*). Since the SIGN checklists for evaluating methodological quality are only available for levels of evidence 1 to 3, an additional assessment of clinical relevance was introduced (*eTable 3*).

● Structured consensus building and grading

The Delphi method formed the methodological basis for structured consensus building. Determination of the grades of recommendation and consensus strength (*eTable 5*) was based on levels of evidence and also took into consideration additional criteria such as clinical experience, feasibility in everyday life, benefit-risk ratio, applicability to the target patient group, and special features pertaining to the German healthcare system.

On completion of a total of three OMF-internal and two interdisciplinary voting meetings and approval by the boards of the participating professional societies (*Table*), the update of the S3 guideline with 28 recommendations and 5 statements was published on November 10, 2023, by the Association of the Scientific Medical Societies (AWMF).

The recommendations contain a direct call for action and are categorized into the three recommendation grades mentioned in the text, taking into account the best available evidence. Expert consensus refers to recommendations or statements that are based on the consensus of the voting members of the guideline group but are not, or can only poorly be, substantiated by the literature. Recommendations with the status of expert consensus are not included in the guideline on condylar hyperplasia.

AWMF, Association of the Scientific Medical Societies; Cochrane, Cochrane Library; Livivo, internet-based search portal of the ZB MED – Information Center for Life Sciences; NICE, National Institute for Health and Care Excellence; PubMed, text-based meta-database offering access to the databases MEDLINE, OLDMEDLINE (before 1966), and PubMed Central; SIGN, Scottish Intercollegiate Guidelines Network; www.guideline.gov, Agency for Healthcare Research and Quality, OMF, oral and maxillofacial

eBox 2

Sick leave and complications associated with surgical treatment for condylar hyperplasia

• Sick leave due to surgical measures for condylar hyperplasia

Based on the experience from everyday clinical practice of a clinic specializing in joint surgery, the length of hospital stay for temporomandibular joint (TMJ) surgery is usually around 5 days, after which physiotherapy is required until physiological range of motion has been achieved (i.e., patient-specific); disorder-related time off-work (incapacity to work) is around one to two weeks.

Duration of hospital stay for corrective surgery is around five days, followed by time to return to work of around two to three weeks. Hardware removal is undertaken around six months after surgery, usually under renewed general endotracheal anesthesia, with a hospital stay lasting around three to four days and further incapacity to work of around one week.

• Complications of treatment for condylar hyperplasia

Apart from the usual complications such as bleeding, infection, and wound healing problems, specific complications associated with surgical treatment primarily include (usually temporary) nerve injury, especially the temporal branch of the facial nerve (22, 27, 39). In general, the risk of temporary facial nerve palsy after TMJ surgery is around 4 to 8% (39). The risk of temporary injury to the inferior alveolar nerve during orthognathic surgery is 29% and that of temporary facial nerve disfunction 3% (40). Rare postoperative complications of orthognathic surgery include recurrence of malocclusion and deformities (recurrence after condylectomy has so far not been reported in the literature) (40), persistence or deterioration of pre-existing myogenic and/or arthrogenic symptoms (39), disturbances of static and dynamic occlusion and joint mobility (articulation) (27).

In addition, with regard to (not reasonably indicated) proportional condylectomy in children and adolescents, minor growth loss in comparison with the contralateral side is basically possible. On the other hand, Farina et al. report that after proportional condylectomy a neo-condyle forms within 12 months to match the ("healthy") contralateral side (21). As regards this statement, however, it should be noted with reservation that it refers to a case series involving 21 patients, but only 12 after dropouts.