A systematic review of treatment and outcomes in patients with mandibular coronoid process hyperplasia

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Abstract
Treatment of mandibular coronoid process hyperplasia (MCPH) has been described and explored in the literature. This systematic review aims to provide a comprehensive overview of the surgical and non-surgical treatment options for MCPH in pediatric and adult populations. Three databases were searched for treatment of MCPH patients (MEDLINE, Embase, and Web of Science). Two reviewers selected case reports and case series based on titles and abstracts. Finally, 55 studies reporting a total of 127 cases were included for qualitative synthesis and data extraction. The mean age at symptom onset was 15.6 years, while the mean age at diagnosis was 23.5 years. Of the included cases, 83.7% were male, and the condition was bilateral in more than 81% of the cases. Coronoidectomy was performed in 82.7% of the included cases, while coronoidotomy was performed in 3.9% of the cases. In 85.0% of the surgically treated cases, the approach was intraoral. The mean maximal intraoperative mouth opening was 38.1 mm compared with 16.5 mm at diagnosis. The mean maximal postoperative mouth opening was 35.3 mm, and the mean follow-up period was 16.3 months. Maximum mouth opening was achieved intraoperatively, and non-surgical treatment after surgery aims to reduce the risk of relapse. Additional research with a higher level of evidence is necessary to confirm these findings.

Key words: Trismus, Physical therapy modalities, Hyperplasia, Surgical procedures

I. Introduction
The coronoid process is an anatomical part of the mandible that serves as the attachment for the temporalis muscle, buccinator muscle, and the anterior part of the masseter muscle. In classic anatomy, it is described as a sharp triangular-shaped structure in extension of the anterior border of the mandibular ramus. In reality, this structure shows great morphological variety, including hook-shaped type, triangular type, or rounded type. In the study of Lalitha and Sridevi1, the majority (73.9%) of mandibles had the same type of coronoid process on both sides, while 26.1% of the cases showed different types on the two sides. Allometric variation can be established in mandibular shape in humans, with taller individuals having superoinferiorly taller rami with more anteriorly-oriented and higher coronoid processes and a corresponding deeper sigmoid notch.2

Mandibular coronoid process hyperplasia (MCPH) is an uncommon congenital or developmental condition that is characterized by a macroscopic increase in the size of the coronoid process with a normal histologic structure of the bone. MCPH can exist as a uni- or bilateral condition and causes a slow and progressive reduction of mouth opening. Restricted mouth opening results from impingement of the coronoid process on the medial surface of the zygomatic arch.3-5 Unilateral MCPH can involve facial asymmetry with deviation toward the affected side.6 Langenbeck was the first to report MCPH in 1853, and the first case of restricted mouth opening due to coronoid process enlargement was reported in 1899 by Jacob3. Jacob’s disease refers to the condition where the coronoid process creates a new joint with the zygomatic process.

The pathogenesis of MCPH remains unclear. Several factors might be associated with development of MCPH.6,7 History of facial trauma and, in particular, zygomatic arch trauma is thought to be a contributing factor in some cases.8-11 Hall et
al. hypothesized that MCPH results from a developmental bone defect in neoplastic or cartilaginous growth centers of the coronoid processes, causing continued growth and eventual hyperplasia. Endocrine stimulation also can play a role in the pathogenesis of MCPH. Chung et al. reported that two years of growth hormone therapy for children with short stature led to increase of posterior facial height and growth of the mandible. Only one case was reported on the relationship between growth hormone and growth of the coronoid process of the mandible. However, hypotheses involving increased activity of the temporal muscles have received the most support. Temporomandibular joint (TMJ) disorders with limited mandibular movement due to disc displacement or TMJ ankylosis were considered to be related to MCPH due to compensatory hyperactivity of the temporal muscles. Such findings also were reported in a study by Isberg et al. with experimentally induced mandibular hypomobility in rhesus monkeys. Other findings supporting these theories are the shortened muscle tendon units, including fibrous and hypertrophic masticatory muscle tendons and hypertrophic or hypertonic temporalis muscles, in some syndromes. The most common disorder associated with congenital bilateral MCPH is trismus pseudocamptodactyly syndrome (TPS). Genetic analysis of patients with TPS reveals a defective MYH8 gene, which presumably interferes with myosin activity and, possibly, the binding of myosin to actin. This genetic defect leads to multiple muscle contractures and arthrogryposis. Other syndromes with a common finding of hypotonia can be associated with MCPH. Moebius syndrome is characterized by uni- or bilateral paralysis of the facial mimetic muscles and the lateral rectus muscle of the eye and has been termed “coronoid impingement syndrome” (CIS). CIS is described in literature as an acquired condition after extended craniofacial and orthognathic surgery, where the coronoid process interferes with the zygomatic arch, and contraction of the temporal muscle can prevent the osteotomized mandible from further setback. In addition to progressive mouth opening limitation, patients suspected of MCPH can have a hard end feel and pain in the zygomatic area with maximum mouth opening. However, only a small percentage of these patients actually has symptoms. Pain or crepitation with mouth opening are present in 7% or 8% of patients, respectively. In the neonatal population, limited mouth opening can result in important sequelae, such as feeding difficulties, risk of malnutrition, and a compromised airway with apnea.

If treated conservatively, no improvement of these symptoms can be expected, and further diagnostic modalities are indicated. Before diagnosis of this rare condition, patients might be misdiagnosed with another and more common temporomandibular disorder as listed in the Diagnostic Criteria for Temporomandibular Disorders (DC/TMD) by Schiffman et al. The final diagnosis can be made by a thorough clinical (re)examination, combined with additional imaging. In the literature, panoramic radiograph (orthopantomogram [OPG]), cone-beam computed tomography (CBCT), computed tomography (CT), and bone scintigraphy have been used to diagnose MCPH.

Treatment of MCPH has been described and explored substantially in the literature. Common treatment modalities for patients with MCPH include both surgical and non-surgical procedures. The aim of this study is to perform a systematic review on treatment modalities and outcomes for patients in pediatric and adult populations with MCPH.

II. Methods

1. Protocol design

This protocol was drafted according to the Cochrane Guidelines for review protocols (http://training.cochrane.org/) and was submitted in Prospero, international prospective register of systematic reviews (http://www.crd.york.ac.uk/PROSPERO), registration number CRD42021267132. This systematic review aims to comply with the PRISMA (Preferred Reporting Items for Systematic reviews and Meta-Analyses) statement.
2. Selection of studies

1) Criteria for considering studies for this review (PICOS)
   (1) Types of participants (P)
   Study populations including living infants, adolescents, and adults were considered. No restrictions were made based on race or sex. Studies on animals or study models were excluded.
   (2) Types of interventions (I)
   Studies describing treatment of unilateral or bilateral MCPH were included.
   We did not include treatment of osteochondroma, osteoma, trauma, or oncological treatment of the coronoid process. We also did not include treatment of zygomatic malformation, hypoplasia of the masticatory muscle tendon aponeurosis, and trismus of an unknown cause.
   (3) Types of controls (C)
   The control for treatment of MCPH and its postoperative maximal mouth opening is preoperative maximal mouth opening.
   (4) Types of outcome measures (O)
   The included studies were required to provide outcome measures of postoperative mouth opening, surgical approach, and any alternative or additional treatment.
   (5) Types of studies (S)
   Case reports, case series, cross-sectional observational studies, and cohort observational studies were included. No restrictions were made based on the country or date of publication. Studies in English and French were included. Review articles were excluded.

3. Search methods

According to the inclusion and exclusion criteria, studies were identified in searches in MEDLINE (via the PubMed interface), Embase (via the Embase.com interface), and Web of Science (via the Web of Science interface). The specific search string for each database is displayed in Table 1.

4. Review and selection of studies

Two authors (G.I.L.P. and M.N.) independently screened the titles and abstracts of the obtained search results. References were managed using Covidence software (Covidence systematic review software; Veritas Health Innovation, Melbourne, Australia; https://www.covidence.org/) for study selection and exclusion.

Table 1. Database-specific search strings for MEDLINE, Embase, and Web of Science

| Database        | Database-specific search string                                                                 |
|-----------------|-----------------------------------------------------------------------------------------------|
| MEDLINE         | ((("coronoid"[tiab] OR "coronoid process"[tiab])) AND ("therapy"[tiab] OR "therapeutics"[MeSH Terms] OR "surgery"[tiab] OR "surgical procedures, operative"[MeSH Terms] OR "general surgery"[MeSH Terms] OR "physiotherapy"[tiab] OR "physical therapy modalities"[MeSH Terms] OR "coronoidectomy"[tiab] OR "coronoidotomy"[tiab])) AND ("trismus"[MeSH Terms] OR "coronoid hyperplasia"[tiab] OR "hyperplasia"[MeSH Terms] OR "enlargement"[tiab] OR "elongation"[tiab] OR "limited mouth opening"[tiab]))) |
| Embase          | 'coronoid'/exp OR 'coronoid':ti,ab,kw OR 'coronoid process'/exp OR 'coronoid process':ti,ab,kw OR 'mandible'/exp OR 'mandible':ti,ab,kw AND 'trismus'/exp OR 'trismus':ti,ab,kw OR 'coronoid hyperplasia'/exp OR 'coronoid hyperplasia':ti,ab,kw OR 'hyperplasia'/exp OR 'hyperplasia':ti,ab,kw OR 'elongation'/exp OR 'elongation':ti,ab,kw |
| Web of Science  | TS.=("coronoid" OR "coronoid process") AND TS.=("trismus" OR "coronoid hyperplasia" OR "hyperplasia" OR "elongation" OR "enlargement" OR "limited mouth opening") |

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deduplication, and Zotero software was used for deduplication of search results. After a first selection of articles, the authors considered and compared their selections to achieve consensus. Of the retained abstracts, the full text paper was assessed independently for eligibility. Discrepancies between reviewers were identified and resolved by discussion to reach consensus. The reasons for excluding studies at each step (either title and abstract or full text) are shown as follows.

1) Wrong patient population (P)
2) Wrong intervention (I)
3) Wrong outcome measures (O)
4) Wrong study design (S): review
5) Full text not available
6) Wrong route of administration
7) Wrong language

5. Data extraction and management

Study characteristics and outcome data were extracted by one reviewer (G.I.L.P.). The data extraction table summarizes data on study population characteristics such as age of symptom onset, age of administration, age of diagnosis, diagnostic tools, preoperative maximal mouth opening, treatment, treatment results, and follow-up period.

6. Quality assessment of studies

The quality of the selected articles was assessed by the reviewer using the items and questions in Table 2. The used tool was based on the Quality Assessment Tool for Case Series Studies by NHLBI (National Heart, Lung, and Blood Institute; https://www.nhlbi.nih.gov/health-topics/study-quality-assessment-tools).

7. Statistical analysis for study characteristics

Data were collected using Microsoft Excel 2010 (Microsoft, Redmond, WA, USA) and analyzed using IBM SPSS Statistics for Windows (ver. 26; IBM, Armonk, NY, USA). Descriptive statistics were calculated.

III. Results

1. Selection of studies

The database search rendered 270 records: 23 records in MEDLINE, 156 records in Embase, and 91 records in Web of Science. After deduplication, 179 records were screened based on title and abstract by two reviewers. After achieving consensus regarding selection of articles, 107 full text papers were evaluated independently for eligibility. Finally, 55 studies reporting 127 cases were included for qualitative synthesis and data extraction (Fig. 1).

2. Quality and characteristics of the included studies

1) Quality assessment of the included studies

A quality assessment was performed for each included study. As shown in Table 3, all case reports or case series were verified and assessed for the provided information regarding the study objective. All studies were checked and scored if a case or several cases were fully described or defined with sufficient details to allow the practitioner to make inferences related to their own practice. The description of the treatment of MCPH, the outcome measures, and the follow-up were verified and scored for every case. In general, all studies had a clear objective, although the case definition was not mentioned in 3 studies, and the intervention was not clearly described in 9 studies. Four studies lacked follow-up reports, 10 studies did not describe the cases with sufficient details, and the outcome measures were not sufficiently reported in 11 studies. No studies were excluded due to quality issues. All case reports and case series were included to provide as much information as possible.

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Table 2. Quality assessment tool for case studies

| Question                                                                 | + | ? | – |
|-------------------------------------------------------------------------|---|---|---|
| 1. Was the study question or objective clearly stated?                  |   |   |   |
| 2. Was the study case clearly and fully described, including a case definition? |   |   |   |
| 3. Was the intervention clearly described?                              |   |   |   |
| 4. Was follow-up long enough for outcomes to occur?                     |   |   |   |
| 5. Is the case(s) described with sufficient details to allow other investigators to make inferences related to their own practice? |   |   |   |
| 6. Were the outcome measures clearly defined, valid, and reliable?      |   |   |   |

(+: yes, ?: unclear, -: no)
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2) Study characteristics

Results on case reports and case series are displayed alphabetically in Table 4.1,6,10,14-17,22-25,30-70.

Case populations were considered and described. The age of onset (when the first symptoms were noticed), age at diagnosis, and sex were collected. In addition, the used imaging techniques, maximal mouth opening at diagnosis, possible causes, and the side of coronoid hyperplasia were recorded. The mean and standard deviation age of onset was 15.6±10.3 years, while the mean age at diagnosis was 23.5±14.0 years. In 33.86% of the cases, the age of onset for restricted mouth opening was not clearly specified, while the age at diagnosis was not mentioned in 4 cases. The mean maximal mouth opening at diagnosis was 16.5±7.16 mm. In 10 cases, the maximal mouth opening at diagnosis was not reported. MCPH was bilateral in 81.1% of the cases and unilateral in 18.9% of the cases.

The type of surgical procedure and the surgical approach were recorded, as was maximal intraoperative mouth opening. Coronoidectomy was performed in 82.7% (n=105), coronoidotomy in 3.9% (n=5) and no surgery was performed in 9.4% (n=12) of the cases. In five cases (3.9%), the surgical intervention was not described. In the cases where surgical intervention was executed and reported, surgery was performed by an intraoral approach in 82.7% (n=72), extraoral approach in 9.2% (n=8), and combined intraoral and extraoral approach in 8% (n=7) of the cases. The mean maximal intraoperative mouth opening was 38.1±9.24 mm compared with 16.5±7.16 mm at diagnosis.

The type of postoperative supportive intervention and follow-up period were recorded, and postoperative mouth opening and maximum mouth opening were reported. Postoperative supportive physiotherapy was applied in 91.8% (n=101) of the cases.

In 16 cases (12.5%), the type of postoperative supportive therapy was not described. The Therabite appliance (Thera-Bite Jaw Motion Rehabilitation System; Atos Medical AB, Hörby, Sweden) was used in 23.4% (n=26) of the cases that reported postoperative physiotherapy. Although Therabite was preferred in a substantial amount of cases to maintain and improve the postoperative result, no study could confirm the superiority of one specific type of postoperative physiotherapy. The mean maximal postoperative mouth opening was 35.0±9.6 mm after postoperative supportive therapy. The mean postoperative follow-up period was 16.1 months, with a range between 1.0 and 72.0 months.
IV. Discussion

Progressive limitation of maximal mouth opening is the hallmark of MCPH. Restricted mouth opening, a hard end feel when opening the mouth, pain or slight asymmetry in the zygomatic area, and no improvement of symptoms despite repeated conservative treatment are clinical signs suspicious for MCPH\(^1\). Patients with mouth opening limitation who have no symptoms related to a temporomandibular or masticatory muscle disorder after initial clinical and radiographic exami-
Table 4. Overview of included case reports and case series

| Study                        | Possible cause          | Age of onset (yr) | Age at diagnosis (yr) | Sex | Diagnostic imaging | Mouth opening diagnosis (mm) | Coronoid hyperplasia | Surgical intervention | Surgical approach | Intraoperative mouth opening (mm) | Supportive postoperative intervention | Postoperative mouth opening (mm) | Follop-up (mo) |
|------------------------------|-------------------------|-------------------|-----------------------|-----|--------------------|-------------------------------|----------------------|----------------------|-------------------|-----------------------------------|-------------------------------------|-------------------------------|--------------|
| Acharya et al. (2017)        | NA                      | 13                | 16                    | M   | OPG, MRI, CT       | 15                            | Bilateral             | Coronoidectomy       | Intraoral          | NA                                | Therabite                           | NA                            | 27            |
| Akan and Mehrelieva (2006)   | NA                      | 20                | 24                    | M   | MRI, CT            | 15                            | Bilateral             | Coronoidectomy       | Intraoral          | NA                                | Physiotherapy                       | NA                            | 30            |
| Baraldi et al. (2010)        | Fetal trauma (twin)     | 21                | 21                    | F   | MRI, CT           | 12                            | Right                | Coronoidectomy       | Intraoral          | 30                                | Physiotherapy                       | NA                            | 35            |
| Bayaret et al. (2012)        | Trauma 19 yr            | 21                | 21                    | M   | OPG, CT          | 23                            | Right                | Coronoidectomy       | Extraoral (preauricular)+ intraoral | NA                                | Physiotherapy                       | 38            |
| Bronstein and Osborne (1984)| Trauma 2 yr             | NA                | 20                    | M   | OPG, tomo, fluoro | 20                            | Bilateral             | Coronoidectomy       | Intraoral          | 30                                | Physiotherapy, ultrasound, pulsed galvanis stimulation | NA                            | 39            |
| Colquhoun et al. (2002)      | Trauma 2 yr             | 17                | 23                    | F   | OPG, CT          | 30                            | Unilateral            | Coronoidectomy+ arthroscopy Coronoidectomy   | Intraoral          | 45                                | NA                                | Physiotherapy                       | NA            |
| de la Torre et al. (2001)    | No history              | 12                | 13                    | M   | CT, MRI         | 15                            | Bilateral             | Coronoidectomy       | Intraoral          | 50                                | NA                                | 45              |
| de la Torre et al. (2001)    | No history              | 16                | 16                    | M   | MRI, CT         | 20                            | Bilateral             | Coronoidectomy       | Intraoral          | 35                                | NA                                | 22              |
| Galiè et al. (2010)          | A few months old        | 3                 | 5                     | F   | CT                | 5                             | Bilateral             | Coronoidectomy+ debridement and stretching Coronoidectomy | Intraoral          | 52                                | Physiotherapy                       | 49              |
| Gerbino et al. (1997)        | NA                      | 14                | 15                    | M   | OPG, Water's view, CT | 15 | Unilateral right | Coronoidectomy+ fasciotomy and myotomy | Right coronoidotomy | Intraoral | 46 | Physiotherapy | 41 | 12 |
| de la Torre et al. (2001)    | NA                      | 17                | 19                    | M   | OPG, MRI, CT      | 7                             | Left                 | Coronoidectomy       | Intraoral          | 80                                | Physiotherapy                       | NA                           | NA            |
| de la Torre et al. (2001)    | NA                      | 14                | 16                    | NA  | OPG, CT         | 14                            | Bilateral             | Coronoidectomy       | Intraoral          | 55                                | NA                                | 22              |
| Duffy (1980)                 | NA                      | 15                | 15                    | M   | Unknown          | 13                            | Bilateral             | Coronoidectomy       | Intraoral          | 30                                | Physiotherapy                       | NA                           |
| Fernández Ferro (2008)       | NA                      | NA                | 28                    | M   | Unknown OPG, CT   | 22                            | Bilateral             | Coronoidectomy       | Intraoral          | 22                                | Physiotherapy                       | NA                           |
| Fitzpatrick (1970)           | NA                      | 18                | 27                    | M   | Tomo             | 13                            | Bilateral             | Coronoidectomy       | Intraoral          | 22                                | Physiotherapy                       | NA                           |
| Galiè et al. (2010)          | NA                      | A few months old  | 3                     | F   | CT                | 5                             | Unilateral left       | Coronoidectomy+ fasciotomy and myotomy | Extraoral (coronal) | NA                                | Physiotherapy                       | 30              |
| Gerbino et al. (1997)        | NA                      | 14                | 15                    | M   | OPG, Water's view, CT | 15 | Unilateral right | Coronoidectomy+ fasciotomy and myotomy | Right coronoidotomy | Intraoral | 46 | Physiotherapy | 41 | 12 |
Table 4. Continued

| Study                          | Possible cause       | Age of onset (yr) | Age at diagnosis (yr) | Sex | Diagnostic imaging | Mouth opening diagnosis (mm) | Coronoid hyperplasia | Surgical intervention | Surgical approach | Intraoperative mouth opening (mm) | Supportive postoperative intervention | Postoperative mouth opening (mm) | Follop-up (mo) |
|-------------------------------|----------------------|-------------------|-----------------------|-----|---------------------|-----------------------------|----------------------|----------------------|---------------------|-----------------------------------|----------------------------------|-------------------------------|-----------------|
| Gerbino et al. (1997)          | NA                   | 15                | 32                    | M   | OPG, Water's view, CT | 20                           | Bilateral            | Coronidotomy        | Intraoral            | 42                               | Physiotherapy                     | 38               | 60              |
| Gerbino et al. (1997)          | NA                   | 12                | 14                    | M   | OPG, Water's view, CT | 12                           | Unilateral right      | Right coronidotomy   | Intraoral            | 46                               | Physiotherapy                     | 48               | 60              |
| Gerbino et al. (1997)          | NA                   | 10                | 13                    | M   | OPG, Water's view, CT | 18                           | Bilateral            | Coronidotomy        | Intraoral            | 40                               | Physiotherapy                     | 38               | 15              |
| Gerbino et al. (1997)          | NA                   | 14                | 16                    | M   | OPG, Water's view, CT | 20                           | Bilateral            | Coronidotomy        | Intraoral            | 38                               | Physiotherapy                     | 45               | 60              |
| Ghazizadeh et al. (2017)       | NA                   | Childhood         | 30                    | M   | OPG, CT             | 21                           | Bilateral            | Coronidectomy       | Intraoral            | NA                               | Physiotherapy                     | NA               | 3               |
| Giacomuzzi (1986)              | NA                   | 11                | 19                    | M   | OPG, tomography      | 11                           | Bilateral            | No surgery (refused by patient) | No surgery            | No surgery                      | NA                               | No surgery                      | No surgery       |
| Gibbons et al. (2001)          | NA                   | 16                | 28                    | M   | OPG, CT             | 15                           | Bilateral            | Coronidectomy       | Right extraoral, left intraoral | Intraoral           | No surgery (refused by patient) | 30                | Interdental screw appliance | 40               | NA              |
| Gibbons and Abulhoul (2007)    | NA                   | 16                | 36                    | M   | OPG, CT             | 20                           | Bilateral            | Coronidectomy       | Intraoral            | 30                               | Physiotherapy                     | 38               | 12              |
| Hayter and Robertson (1989)    | NA                   | No history        | 15                    | M   | RX                  | 22                           | Bilateral            | Coronidectomy       | Bicoronal            | NA                               | Physiotherapy                     | NA               | 1               |
| Huang et al. (2020)            | NA                   | When she was young Junior high school | 59 | F | OPG, CT, MRI, CT | 25                           | Bilateral            | Coronidectomy       | NA                  | 41                               | NA                               | 30               | 15              |
| Inoue et al. (2020)            | NA                   | In his 50s         | 14                    | M   | CT                  | 8                            | Bilateral            | Coronidectomy, removal of zygomatic arch exostoses | Intraoral+bicoronal | Intraoral+bicoronal | 40 | Therabite | 45 | 18 |
| Khadembaschi et al. (2020)     | Mucopolysaccharidosis | 12                | 14                    | M   | CT                  | 25                           | Bilateral            | Coronidectomy       | Intraoral            | 43                               | Physiotherapy                     | 35               | 18              |
| Kim et al. (2014)              | NA                   | 13                | 43                    | M   | OPG, MRI, CT       | 25                           | Bilateral            | Coronidectomy       | NA                  | 43                               | Physiotherapy                     | 63               | 15              |
| Kim et al. (2014)              | NA                   | NA                | 21                    | M   | MRI, CT            | 28                           | Right               | Coronidectomy       | NA                  | 35                               | Physiotherapy                     | 65               | 18              |
| Kim et al. (2014)              | NA                   | 15                | 19                    | M   | MRI, CT            | 32                           | Bilateral            | Coronidectomy       | NA                  | 43                               | Physiotherapy                     | 35               | 18              |
| Kraut (1985)                   | NA                   | 18                | 18                    | M   | CT                  | 12                           | Right               | Coronidectomy       | Intraoral            | 43                               | Physiotherapy                     | 43               | 15              |
| Kraut (1985)                   | NA                   | NA                | 38                    | F   | OPG, CT            | 14                           | Bilateral            | Coronidectomy       | Intraoral            | 40                               | Physiotherapy                     | 40               | 2               |
| Kreutz and Sanders (1985)      | NA                   | 17                | 17                    | M   | OPG, CT            | 19                           | Bilateral            | Coronidectomy       | Intraoral            | 40                               | Physiotherapy                     | 40               | 2               |
| Lee and Chung (2012)           | Somatropin           | 12                | 17                    | M   | OPG, CBCT           | 10                           | Bilateral            | Coronidectomy       | Left submandibular, right intraoral | NA                  | NA                               | 53               | NA              |
| Leovic et al. (2006)           | NA                   | 17                | 35                    | M   | CT                  | 15                           | Bilateral            | Coronidectomy       | NA                  | NA                               | Physiotherapy                     | 35               | NA              |
| Study            | Possible cause | Age of onset (yr) | Age at diagnosis (yr) | Sex | Diagnostic imaging | Mouth opening diagnosis (mm) | Coronoid hyperplasia | Surgical intervention | Surgical approach | Intraoperative mouth opening (mm) | Supportive postoperative intervention | Postoperative mouth opening (mm) | Follow-up (mo) |
|------------------|----------------|------------------|----------------------|-----|-------------------|-----------------------------|---------------------|---------------------|-------------------|-------------------------------|-----------------------------------|-----------------------------|----------------|
| Loh et al. (1997) | NA             | 12               | 14                   | M   | RX                | 13                           | Bilateral            | Coronoidectomy      | Intraoral         | 22                            | Physiotherapy                     | NA                          | 37             |
| Loh et al. (1997) | NA             | 18               | 22                   | M   | NA                | 15                           | Bilateral            | Coronoidectomy      | Intraoral         | 25                            | Physiotherapy                     | NA                          | 25             |
| Loh et al. (1997) | NA             | NA               | 25                   | F   | NA                | 16                           | Bilateral            | Coronoidectomy      | Intraoral         | NA                            | NA                                | NA                          | NA             |
| Loh et al. (1997) | NA             | 9                | 9                    | F   | RX                | 22                           | Right               | Coronoidectomy      | Intraoral         | NA                            | NA                                | NA                          | NA             |
| Loh et al. (1997) | NA             | NA               | 25                   | F   | NA                | 18                           | Bilateral            | Coronoidectomy      | Intraoral         | NA                            | NA                                | NA                          | NA             |
| Loh et al. (1997) | NA             | NA               | 33                   | M   | NA                | 33                           | Bilateral            | Coronoidectomy      | Intraoral         | 32                            | Physiotherapy                     | NA                          | NA             |
| Mano et al. (2005) | No history     | 5                | 6                    | M   | OPG, tomo, CT    | 17                           | Bilateral            | Coronoidectomy      | Intraoral         | NA                            | Physiotherapy                     | NA                          | 40             |
| McLoughlin et al. (1995) | NA             | 1                | 7                    | M   | NA                | 12                           | Bilateral            | Coronoidectomy      | Intraoral         | NA                            | Physiotherapy                     | NA                          | 17             |
| McLoughlin et al. (1995) | NA             | 7                | 8                    | F   | NA                | 15                           | Bilateral            | Coronoidectomy      | Intraoral         | NA                            | Physiotherapy                     | NA                          | 39             |
| McLoughlin et al. (1995) | NA             | 12               | 13                   | M   | NA                | 22                           | Bilateral            | No surgery          | No surgery        | NA                            | Physiotherapy                     | NA                          | NA             |
| McLoughlin et al. (1995) | NA             | 8                | 13                   | M   | NA                | 14                           | Bilateral            | Coronoidectomy      | Intraoral         | NA                            | Physiotherapy                     | NA                          | 29             |
| McLoughlin et al. (1995) | NA             | 11               | 13                   | M   | NA                | 17                           | Bilateral            | Coronoidectomy      | Intraoral         | NA                            | Physiotherapy                     | NA                          | 38             |
| McLoughlin et al. (1995) | NA             | 17               | 17                   | M   | NA                | 13                           | Bilateral            | Coronoidectomy      | Intraoral         | NA                            | Physiotherapy                     | NA                          | NA             |
| McLoughlin et al. (1995) | NA             | NA               | 18                   | M   | NA                | 14                           | Bilateral            | Coronoidectomy      | Intraoral         | NA                            | Physiotherapy                     | NA                          | NA             |
| McLoughlin et al. (1995) | NA             | 13               | 18                   | M   | NA                | 19                           | Bilateral            | Coronoidectomy      | Intraoral         | NA                            | Physiotherapy                     | NA                          | 35             |
| McLoughlin et al. (1995) | NA             | 13               | 18                   | M   | NA                | 21                           | Bilateral            | Coronoidectomy      | Intraoral         | NA                            | Physiotherapy                     | NA                          | 33             |
| McLoughlin et al. (1995) | NA             | 14               | 19                   | M   | NA                | 15                           | Bilateral            | Coronoidectomy      | Intraoral         | NA                            | Physiotherapy                     | NA                          | NA             |
| McLoughlin et al. (1995) | NA             | 1                | 21                   | M   | NA                | 10                           | Bilateral            | No surgery          | No surgery        | NA                            | Physiotherapy                     | NA                          | NA             |
| McLoughlin et al. (1995) | NA             | 21               | 25                   | M   | NA                | 26                           | Bilateral            | Coronoidectomy      | Intraoral         | NA                            | Physiotherapy                     | NA                          | NA             |
| McLoughlin et al. (1995) | NA             | 31               | 31                   | M   | NA                | 31                           | Bilateral            | No surgery          | No surgery        | NA                            | Physiotherapy                     | NA                          | NA             |
| McLoughlin et al. (1995) | NA             | 24               | 34                   | M   | NA                | 34                           | Bilateral            | No surgery          | No surgery        | NA                            | Physiotherapy                     | NA                          | 29             |
| McLoughlin et al. (1995) | NA             | 34               | 34                   | M   | NA                | 34                           | Bilateral            | No surgery          | No surgery        | NA                            | Physiotherapy                     | NA                          | 40             |
| McLoughlin et al. (1995) | NA             | 16               | 36                   | M   | NA                | 16                           | Bilateral            | No surgery          | No surgery        | NA                            | Physiotherapy                     | NA                          | NA             |
| McLoughlin et al. (1995) | NA             | 26               | 36                   | M   | NA                | 20                           | Bilateral            | Coronoidectomy      | Intraoral         | NA                            | Physiotherapy                     | NA                          | 30             |
| McLoughlin et al. (1995) | NA             | 20               | 36                   | M   | NA                | 36                           | Bilateral            | No surgery          | No surgery        | NA                            | Physiotherapy                     | NA                          | NA             |
| McLoughlin et al. (1995) | NA             | 34               | 34                   | M   | NA                | 34                           | Bilateral            | No surgery          | No surgery        | NA                            | Physiotherapy                     | NA                          | NA             |
| McLoughlin et al. (1995) | NA             | 23               | 43                   | M   | NA                | 18                           | Bilateral            | Coronoidectomy      | Intraoral         | NA                            | Physiotherapy                     | NA                          | NA             |
| Study                      | Possible cause | Age of onset (yr) | Age at diagnosis (yr) | Sex | Diagnostic imaging | Mouth opening diagnosis (mm) | Coronoid hyperplasia | Surgical intervention | Surgical approach | Intraoperative mouth opening (mm) | Supportive postoperative intervention | Postoperative mouth opening (mm) | Follow-up (mo) |
|---------------------------|----------------|-------------------|----------------------|-----|--------------------|----------------------------|---------------------|----------------------|-------------------|-------------------------------|--------------------------------------|-------------------------------|---------------|
| McLoughlin et al. (1995)  | NA             | 36                | 44                   | M   | NA                 | NA                          | Bilateral            | NA                   | NA                | NA                            | Physiotherapy                        | NA                            | NA            |
| McLoughlin et al. (1995)  | NA             | NA                | 47                   | F   | NA                 | 21                          | Bilateral            | No surgery           | No surgery         | NA                            | Physiotherapy                        | NA                            | NA            |
| McLoughlin et al. (1995)  | NA             | 58                | 78                   | M   | NA                 | 13                          | Bilateral            | Coronoidectomy       | Intraoral          | NA                            | Physiotherapy                        | 29                            | NA            |
| McLoughlin et al. (1995)  | NA             | 2                 | 3                    | M   | NA                 | 13                          | Unilateral           | Coronoidectomy       | Intraoral          | NA                            | Physiotherapy                        | 14                            | NA            |
| McLoughlin et al. (1995)  | NA             | 13                | 15                   | M   | NA                 | 22                          | Unilateral           | Coronoidectomy       | Intraoral          | NA                            | Physiotherapy                        | 40                            | NA            |
| McLoughlin et al. (1995)  | NA             | 14                | 18                   | M   | NA                 | 20                          | Unilateral           | Coronoidectomy       | Intraoral          | NA                            | Physiotherapy                        | 25                            | NA            |
| McLoughlin et al. (1995)  | NA             | 7                 | 19                   | M   | NA                 | 19                          | Unilateral           | Coronoidectomy       | Extraoral          | NA                            | Physiotherapy                        | 24                            | NA            |
| McLoughlin et al. (1995)  | NA             | NA                | 29                   | M   | NA                 | NA                          | Unilateral           | NA                   | NA                | NA                            | Physiotherapy                        | NA                            | NA            |
| McLoughlin et al. (1995)  | NA             | 16                | 31                   | M   | NA                 | 25                          | Unilateral           | Coronoidectomy       | Intraoral          | NA                            | Physiotherapy                        | 38                            | NA            |
| McLoughlin et al. (1995)  | NA             | 20                | 32                   | M   | NA                 | 17                          | Unilateral           | Coronoidectomy       | Intraoral          | NA                            | Physiotherapy                        | 25                            | NA            |
| McLoughlin et al. (1995)  | NA             | 40                | 42                   | F   | NA                 | 18                          | Unilateral           | Coronoidectomy       | Intraoral          | NA                            | Physiotherapy                        | NA                            | NA            |
| Monevska et al. (2016)    | NA             | 11                | 50                   | M   | RX                 | 8                           | Bilateral            | Coronoidectomy       | Intraoral right, extraoral left | Physiotherapy                        | 20                            | 24            |
| Monks (1978)              | Difficult extraction Kabuki syndrome (hypotonia) | Congenital | 0.67 | M | CT | 9 | Bilateral | Coronoidectomy | Intraoral | 22 | Physiotherapy | 24 | 27 |
| Puche et al. (2012)       | Congenital Pena-Shokeir syndrome (hypotonia) | No history | 0.83 | M | CT | 11 | Bilateral | Coronoidectomy | Intraoral | 24 | Physiotherapy | 24 | 25 |
| Ramalho-Ferreira et al. (2011) | No history | 23 | 26 | M | OPG, CT | 19 | Bilateral | Coronoidectomy | Intraoral | 29 | Physiotherapy | 31 | 30 |
| Romano et al. (2017)      | NA             | NA                | 37                   | M   | OPG, MRI, CT       | 16                          | Bilateral            | Coronoidectomy       | Intraoral          | 39                            | Physiotherapy+Therabite               | 39                            | 12            |
| Romano et al. (2017)      | NA             | NA                | 25                   | M   | OPG, MRI, CT       | 20                          | Bilateral            | Coronoidectomy       | Intraoral          | 38                            | Physiotherapy+Therabite               | 40                            | 12            |
| Romano et al. (2017)      | NA             | NA                | 43                   | M   | OPG, MRI, CT       | 13                          | Bilateral            | Coronoidectomy       | Intraoral          | 41                            | Physiotherapy+Therabite               | 39                            | 12            |
| Romano et al. (2017)      | NA             | NA                | 27                   | M   | OPG, MRI, CT       | 19                          | Bilateral            | Coronoidectomy       | Extraoral (preauricular) | Physiotherapy+Therabite               | 47                            | 12            |
| Romano et al. (2017)      | NA             | NA                | 29                   | M   | OPG, MRI, CT       | 13                          | Bilateral            | Coronoidectomy       | Extraoral (preauricular) | Physiotherapy+Therabite               | 38                            | 12            |
| Romano et al. (2017)      | NA             | NA                | 23                   | M   | OPG, MRI, CT       | 17                          | Bilateral            | Coronoidectomy       | Extraoral (preauricular) | Physiotherapy+Therabite               | 39                            | 12            |
| Rowe et al. (1963)        | No history     | 12                | 15                   | M   | RX                | 15                          | Bilateral            | Coronoidectomy       | Intraoral         | NA                            | Mechanical exerciser                 | 35                            | 14            |
| Study                  | Possible cause                  | Age of onset (yr) | Age at diagnosis (yr) | Sex | Diagnostic imaging | Mouth opening diagnosis (mm) | Coronoid hyperplasia | Surgical intervention | Surgical approach | Intraoperative mouth opening (mm) | Supportive postoperative intervention | Postoperative mouth opening (mm) | Follow-up (mo) |
|------------------------|---------------------------------|-------------------|-----------------------|-----|--------------------|------------------------------|----------------------|----------------------|-------------------|-------------------------------|-------------------------------|-----------------------------|---------------|
| Rowe et al. (1963)     | No history                      | 13                | 15                    | M   | RX, CT             | 10                            | Bilateral             | No surgery (refused by patient) | No surgery | No surgery | NA                           | No surgery | 36                          |
| Satoh et al. (2006)    | No history                      | 12                | 13                    | M   | OPG, CBCT          | 27                            | Bilateral             | Coronoidectomy          | Intraoral | 40              | Physiotherapy | 45              | 8                          |
| Schneble et al. (2019)| No history                      | 0                 | 4                     | M   | RX                | 15                            | Bilateral             | Coronoidectomy          | NA               | 25              | None                        | 15              | 60                          |
| Shurman (1975)         | Facial injury, 2 yr prior        | 42                | 44                    | M   | RX                | 22                            | Bilateral             | Coronoidectomy          | NA               | 22              | Physiotherapy | 40-50 | Next few weeks |
| Smyth and Wake (1994)  | No history                      | 8                 | 15                    | M   | RX, CT             | 4                             | Bilateral             | Coronoidectomy          | Intraoral+biocoronal   | 50              | Physiotherapy | 23              |
| Smyth and Wake (1994)  | No history                      | 8                 | 23                    | M   | OPG, CT           | 11                            | Bilateral             | Redo coronoidectomy     | Intraoral+biocoronal   | 40              | Physiotherapy | 50              | 12                          |
| Starch-Jensen and Kjellerup (2017) | No history                     | NA                | 18                    | M   | OPG, CBCT         | 22                            | Bilateral             | Coronoidectomy          | NA               | 22              | Physiotherapy | Therabite (not motivated) | 32              | 3                          |
| Tavassol et al. (2012) | Trauma, age 4 yr                | 11                | 13                    | M   | CT, MRI           | 10                            | Bilateral             | Coronoidectomy          | Intraoral | 48              | NA                           | NA              | Still normal | NA                          |
| Tieghi et al. (2005)   | No history                      | NA                | 17                    | F   | OPG, CT           | 25                            | Bilateral             | Coronoidectomy          | Intraoral | 40              | Bite block, physiotherapy (butterfly jaw exerciser) | 46              | 6                          |
| Totsuka and Fukuda (1991) | No history                     | 14                | 17                    | M   | RX, OPG, CT       | 17                            | Bilateral             | Coronoidectomy          | Intraoral | 45              | Physiotherapy+mechanical extensor | 52              | 10                          |
| Tucker et al. (1984)   | No history                      | 10                | 13                    | M   | RX, CT            | 29                            | Bilateral             | Coronoidectomy          | Intraoral | 48              | Physiotherapy | 44              | 3                          |
| Turk et al. (1999)     | No history                      | 14                | 16                    | M   | OPG, tomo, CT     | 22                            | Unilateral right       | Coronoidectomy          | Intraoral | 40              | Physiotherapy | 44              | 3                          |
| Turk et al. (1999)     | Moebius syndrome, At birth       | 1.5               | M                     | CT  | 8                 | Bilateral             | Coronoidectomy          | Intraoral | NA              | NA                           | NA              | 25                          |
| Utsman et al. (2013)   | Moebius syndrome, At birth       | NA                | NA                    | CT  | 10                | Bilateral             | Coronoidectomy          | Intraoral | 30              | NA                           | NA              | 40                          |
| Wallender et al. (2015)| Prematurity, duplication of chromsome 7P21.1 | 0                 | 0.16                   | M   | CT                | 4                             | Bilateral             | Coronoidectomy          | Intraoral | 25              | Jaw physiotherapy | 25              | 1 wk                        |
| Wenghoefer et al. (2008) | Prehistory, duplication of chromsome 7P21.1 | 2                 | 14                    | M   | RX                | 10                            | Bilateral             | Coronoidectomy          | NA               | NA              | Physiotherapy | Therabite  | 25              | NA                          |
| Wenghoefer et al. (2008) | Prehistory, duplication of chromsome 7P21.1 | 45                | 16                    | M   | NA                | 14                            | Bilateral             | Coronoidectomy          | NA               | NA              | Physiotherapy | Therabite  | 31              | NA                          |
| Wenghoefer et al. (2008) | Prehistory, duplication of chromsome 7P21.1 | NA                | NA                    | F   | NA                | 10                            | Bilateral             | Coronoidectomy          | NA               | NA              | Physiotherapy | Therabite  | 40              | NA                          |
### Table 4. Continued

| Study                        | Possible cause                                    | Age of onset (yr) | Age at diagnosis (yr) | Sex | Diagnostic imaging | Mouth opening diagnosis (mm) | Coronoid hyperplasia | Surgical intervention | Surgical approach | Intraoperative mouth opening (mm) | Supportive postoperative intervention | Postoperative mouth opening (mm) | Follow-up (mo) |
|------------------------------|--------------------------------------------------|-------------------|-----------------------|-----|--------------------|------------------------------|---------------------|---------------------|----------------|-------------------------------|-------------------------------|-------------------------------|----------------|
| Wenghoefer et al. 62 (2008) | NA                                               | NA                | 18                    | M   | NA                 | 16                           | Bilateral           | Coronoidectomy       | NA             | NA                           | Physiotherapy+ Therabite          | >30                           | NA             |
| Wenghoefer et al. 62 (2008) | NA                                               | NA                | 24                    | M   | NA                 | 18                           | Bilateral           | Coronoidectomy       | NA             | NA                           | Physiotherapy+ Therabite          | 40                            | NA             |
| Wenghoefer et al. 62 (2008) | NA                                               | NA                | 5                     | F   | NA                 | 4                            | Bilateral           | Coronoidectomy       | NA             | NA                           | Physiotherapy+ Therabite          | 32                            | NA             |
| Wenghoefer et al. 62 (2008) | CNS disorder, hypertonic muscles                 | NA                | 35                    | M   | NA                 | 5                            | Bilateral           | Coronoidectomy       | NA             | NA                           | Physiotherapy+ Therabite          | NA                            | NA             |
| Wenghoefer et al. 62 (2008) | NA                                               | NA                | 23                    | M   | NA                 | 10                           | Bilateral           | Coronoidectomy       | NA             | NA                           | Physiotherapy+ Therabite          | NA                            | NA             |
| Wenghoefer et al. 62 (2008) | AS                                               | NA                | 38                    | M   | NA                 | 7                            | Right               | Coronoidectomy       | NA             | NA                           | Physiotherapy+ Therabite          | NA                            | NA             |
| Wenghoefer et al. 62 (2008) | NA                                               | NA                | 53                    | F   | NA                 | NA                           | Left                | Coronoidectomy       | NA             | NA                           | Physiotherapy+ Therabite          | >30                           | NA             |
| Wenghoefer et al. 62 (2008) | NA                                               | NA                | 4                     | M   | NA                 | NA                           | Bilateral           | Coronoidectomy       | NA             | NA                           | Physiotherapy+ Therabite          | >30                           | NA             |
| Wenghoefer et al. 62 (2008) | NA                                               | NA                | 14                    | M   | NA                 | 15                           | Bilateral           | Coronoidectomy       | NA             | NA                           | Physiotherapy+ Therabite          | NA                            | NA             |
| Wenghoefer et al. 62 (2008) | CNS disorder, hypertonic muscles                 | NA                | 28                    | M   | NA                 | NA                           | Bilateral           | Coronoidectomy       | NA             | NA                           | Physiotherapy+ Therabite          | >30                           | NA             |
| Wenghoefer et al. 62 (2008) | NA                                               | NA                | 18                    | F   | NA                 | NA                           | Left                | Coronoidectomy       | NA             | NA                           | Physiotherapy+ Therabite          | >30                           | NA             |
| Wenghoefer et al. 62 (2008) | AS                                               | NA                | 52                    | M   | NA                 | 22                           | Left                | NA                  | NA             | NA                           | NA               | NA             | NA             |
| Wenghoefer et al. 62 (2008) | AS                                               | NA                | 56                    | M   | NA                 | 25                           | Bilateral           | NA                  | NA             | NA                           | NA               | NA             | NA             |
| Yamaguchi et al. 60 (1998)  | NA                                               | 17                | 25                    | M   | CT                 | 24                           | Left                | Coronoidectomy       | Intraoral         | NA                           | Physiotherapy              | 43                            | 8               |
| Yoshida et al. 64 (2008)    | Bilateral hypertrophy of masseter muscles        | 28                | 34                    | F   | RX, CT, MRI        | 18                           | Bilateral           | Redo coronoidectomy  | Intraoral         | 44                           | NA               | 38              | 6               |
| Yura et al. 65 (2009)       | No history                                       | 15                | 28                    | M   | OPG, CT            | 30                           | Left                | Coronoidectomy       | Intraoral         | 50                           | Physiotherapy+mouth opening exerciser | 43                            | 15              |
| Zhong et al. 67 (2009)      | No history                                       | 26                | 39                    | F   | OPG, CT            | 8                            | Bilateral           | Coronoidectomy       | Intraoral         | 40                           | Physiotherapy              | 31                            | 9               |

(NA: not available or not correctly reported, M: male, F: female, OPG: orthopantomography, MRE: magnetic resonance imaging, CT: computed tomography, tomo: tomography, fluoro: fluoroscopy, CBCT: cone-beam computed tomography, RX: X-ray, AS: ankylosing spondylitis, CNS: central nerve system)

Griet L. Parmentier et al: A systematic review of treatment and outcomes in patients with mandibular coronoid process hyperplasia. J Korean Assoc Oral Maxillofac Surg 2022
nations should undergo CT for a more accurate diagnosis.

A considerable difference between the age of onset of the first symptoms and the age of diagnosis is noted in the literature. We confirm these findings with a mean difference of 7.92 years in our study. As a rare condition with often painless progressive restricted mouth opening, MCPH is prone to underreporting, misdiagnosis, and delayed diagnosis. In patients with limited mouth opening, temporomandibular disorders typically are considered first.

In 1963, Rowe was the first to classify MCPH as unilateral or bilateral. Izumi et al. classified MCPH into three categories (high, middle, low) by radiologically evaluating the tip of the coronoid process remaining in situ. This technique shows a good outcome, but a limited number of cases have been reported. Coronoidotomy requires less tissue manipulation, reducing the risk of damage to the branches of the facial nerve. The complications are postoperative hematoma formation and postoperative fibrosis. An endoscopically-assisted approach can reduce the complications associated with the intraoral approach.

The intraoral surgical approach is preferred in most cases. It has the advantages of providing sufficient access in most cases without producing an extraoral scar and reduces the risk of damage to the branches of the facial nerve. The complications are postoperative hematoma formation and postoperative fibrosis. An endoscopically-assisted approach can reduce the complications associated with the intraoral approach.

The extraoral coronal approach allows the ability to resect the inferior muscle belly of the temporalis muscle more thoroughly, since aberrant activity of the temporalis muscle can contribute to development of MCPH. It can be difficult to determine the best timing of surgery for MCPH in infants or children. If surgery is performed at an early age, clinical improvement of trismus will be achieved, although postoperative recurrence and dysgnathia are possible. However, most authors agree that, except in patients with very severe limitation of mouth opening, it is best to perform the operation once growth has finished to avoid recurrence, deformity, or restricted mobility of the mandible. Thus, in mild cases, surgical intervention should be delayed until skeletal maturity. Relapse can be induced by persistent underlying causes of coronoid hypertrophy, postoperative fibrosis, or an inadequate physiotherapy program. Change in muscular activity due to detachment of the temporalis muscle and postoperative fibrosis can lead to displacement of the mandible, malocclusion, and an anterior open bite.

After surgical intervention, continuous and active postoperative physiotherapy is key for successful treatment with a long-term result. Obtaining a satisfactory outcome depends largely on proper postoperative rehabilitation. Regular and long-term follow-up is important to assure patient compliance and postoperative physiotherapy. Regrowth of the previously resected coronoid process, hematoma formation, or fibrosis can lead to an unsatisfactory prognosis. It is recommended to start physiotherapy between three days and seven days postoperatively. Active physiotherapy should...
be continued for at least 6 months for satisfactory results. Postoperative cases with limited mouth opening caused by fibrosis secondary to incorrect reorganization of a hematoma at the site of operation and even recurrence in the growth of the coronoid process have been described. Regrowth of a hyperplastic coronoid process can be explained by fibrosis of a postoperative hematoma showing pathological calcification. Poor compliance for postoperative physiotherapy is associated with increased risk of relapse. Compliance for physiotherapy has a bimodal distribution; patients younger than 2 years old and older than 16 years had better postoperative results. Lefavre and Aitchison noted that long-term physiotherapy might be the most important variable in long-term postoperative results and advised postponing intervention in children until optimal cooperation is possible.

Therabite and other appliances have been used to improve limited mouth opening and also to stretch fibrotic tissue around the jaws and prevent further trismus. Importantly, the use of a Therabite in treatment of uni- or bilateral MCPH is only useful as a supportive treatment after surgical intervention, since the responsible mechanical obstruction needs to be removed to obtain acceptable maximal mouth opening. Postoperatively, patients must be educated about the importance of physiotherapy and the use of the Therabite device since postoperative tissue scarring can compromise the obtained maximal mouth opening.

In the literature, the results after coronoidectomy were generally disappointing. However, one must consider the definition of a disappointing result. The DC/TMD protocol considers an unassisted maximal mouth opening of 35 mm or greater or an assisted maximal mouth opening of 40 mm or greater to be a normal interincisal distance. Others considered a mouth opening of 30 mm or greater to be a successful result. However, the postoperative result in studies varies in a range of 30-35 mm and is not consistent to calculate an overall success rate. More important is the clinical result and subjective patient satisfaction and quality of life, which are not always proportionate to the objective findings. Notably, in most studies, it is not mentioned if the reported maximal mouth opening is assisted or unassisted. A more uniform system to report these measures would be helpful to investigate these findings more thoroughly.

In this review, we included only case reports and case studies, which might contribute to reporting bias. Additional research including more cases with a higher level of evidence is necessary to confirm these findings.
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