



## Clinical and imaginological characterization of synovial chondromatosis in the temporomandibular joint: A systematic review

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### Abstract

**Introduction:** Synovial Chondromatosis (SC) is a metaplastic rheumatologic condition that manifests itself in the Temporomandibular Joints (TMJs). This causes common symptoms related to Temporomandibular Disorders (TMD). Differential diagnosis is obtained through clinical and imaging evaluation.

**Objective:** To clarify, through a systematic review, the manifestations that characterize, differentiate and relate SC in the TMJ from the point of view of clinical and imaging diagnosis.

**Material and methods:** The PubMed database and the keywords were used: Synovial Chondromatosis, Clinical Diagnosis, Imaging Tests, TMD Patient, Healthy Patients, Signs and Symptoms. Inclusion criteria were: five years, English language, title covering the keywords and clinical and original research in humans, literature reviews and case reports. As exclusion criteria: cases that did not deal with SC in the ATM, articles that do not match the objective of the work. The characteristic SC, differences and relationships between TMD and SC were the main variables analyzed.

**Results:** Initially, 335 articles were found, after application of filters, inclusion criteria and evaluation of abstracts, nine were selected. Five relevant publications were added. The signs and symptoms common to the alterations: localized joint pain, edema, limitation of mouth opening and joint noises. Magnetic resonance images, computed tomography and TMJ radiographs were fundamental for the differential diagnosis and indicated the presence of intraarticular fibrocartilaginous bodies in the SC.

**Conclusion:** It is necessary to interpret the imaging tests in order to establish the differential diagnosis between TMD and SC.

**Keywords:** Synovial Chondromatosis; Radiodiagnosis; Ear-jaw articulation; Imaging Examination; Clinical Diagnosis; Signs and symptoms

### 1. Introduction

Temporomandibular dysfunction (TMD) can be considered as a compilation of clinical alterations that affect the masticatory muscles, the Temporomandibular Joint (TMJ) and adjacent structures<sup>[1]</sup>, this condition presents signs and symptoms that resemble a disorder known as Synovial Chondromatosis.

Synovial chondromatosis (SC) or osteochondromatosis is defined as a disease caused by loose bodies produced by metaplastic foci of mesenchymal origin, which undergo secondary calcification, forming new cartilage in the synovial membranes of joints, tendon sheaths or bursa<sup>[2]</sup>.

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Its main clinical features involve pre-auricular pain, swelling in the affected region, limited mouth opening, crackles and deviations in mouth opening, clinical signs that are similar to those found in TMD<sup>[3-5]</sup>. Chen et al., (2012), establishes a classification, which uses clinical-radiological parameters to classify SC in the lower region of the TMJ, which has a more updated specification, which uses clinical-radiological parameters to classify SC in this inferior region. of the ATM. Stage 1 includes several perceived loose bodies with expansion of the lower compartment without bone erosion. Stage 2 shows calcified nodules attached to the enlarged condyle, due to erosion and articular disc in the normal pattern. Finally, in stage 3, the condyle undergoes destruction caused by erosion by pressure or by direct mass invasion and involvement of the lower surface of the disc<sup>[6]</sup>.

This condition, frequently observed in larger joints such as the knee, elbow, shoulder and hip, affects mostly males. When it occurs in the TMJ, there is a prevalence in females. Previously considered a rare condition, nowadays an increase in cases can be observed, due to the evolution of imaging tests such as three-dimensional exams or direct visualization, which allowed a more accurate diagnosis<sup>[7]</sup>.

Imaging tests are of great relevance for confirming diagnoses in the dental field. And when it comes to the identification of SC, orthopantomography (OPT), magnetic resonance imaging (MRI), computed tomography (CT) and arthroscopy are commonly used<sup>[8-10]</sup>. Through them, it is possible to distinguish the difference between a patient without and with morphological alterations in the TMJ. In its normal appearance, the condyle can be represented by a rounded bony projection with an oval superior surface and the condylar process is lined by a thin and continuous cortical bone<sup>[9]</sup>. In the condition of CS, it presents with loose or attached cartilaginous bodies or nodules of variable sizes, which cause an uneven increase in the joint capsule <sup>[10]</sup>.

Through research carried out, it is possible to observe the scarcity of studies that verify, through clinical and imaging exams, the identification of SC and its relationship with TMD. Therefore, the present study aims to characterize the clinical and imaging manifestations of synovial chondromatosis in the Temporomandibular Joint from the point of view of clinical and image diagnosis.

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## 2. Material and methods

For the elaboration of the present work, the following guiding question was used: "What are the specific signs and symptoms observed by clinical and imaging exams of patients who present pain and masticatory functional alterations caused by synovial chondromatosis of the TMJ?". Therefore, the PICO search strategy (Patient, Intervention, Comparison, Outcome) was used to plan the research.

P (problem): people with synovial chondromatosis in the TMJ, of unilateral or bilateral manifestation, without age and sex restrictions. Studies in humans with a diagnosis of chondromatosis at any stage of the disease were included, as well as studies without surgical intervention or histopathological diagnosis, provided they presented a symptomatic diagnosis of the disease, ruling out other diagnostic possibilities.

I (intervention): clinical diagnosis by standardized and validated tests, in addition to imaging tests by radiography, tomography or magnetic resonance imaging of the temporomandibular joint.

C (control): TMD patients not affected by synovial chondromatosis, as well as healthy patients.

O (outcome): signs and symptoms in the masticatory muscles and temporomandibular joint such as: masticatory myalgia, temporomandibular arthralgia, noises, locking, deviations and deflections of the TMJ, signs of osteoarthritis/osteoarthrosis, joint disc displacements with and without reduction, limitation of movements excursive and mouth opening.

In its preparation, studies originally published in English from 2017 to 2022 and open access were evaluated, with reference to the MEDLINE (National Library of Medicine) database. Relevant conceptual publications, outside this period, on the topic were added to the introduction and discussion items as a conceptual and dissertation basis for the research.

Thus, the following keywords were used: Synovial Chondromatosis, Clinical Diagnosis, Imaging Tests, TMD Patient, Healthy Patients, Signs and Symptoms. First, to obtain synonyms for the keywords, the Decs platforms (Descriptors in Health Sciences) and later the MeSh (Medical Subject Headings) were consulted. The exclusion and inclusion criteria are shown in table 1.

**Table 1** Inclusion criteria, exclusion criteria and main variables analyzed

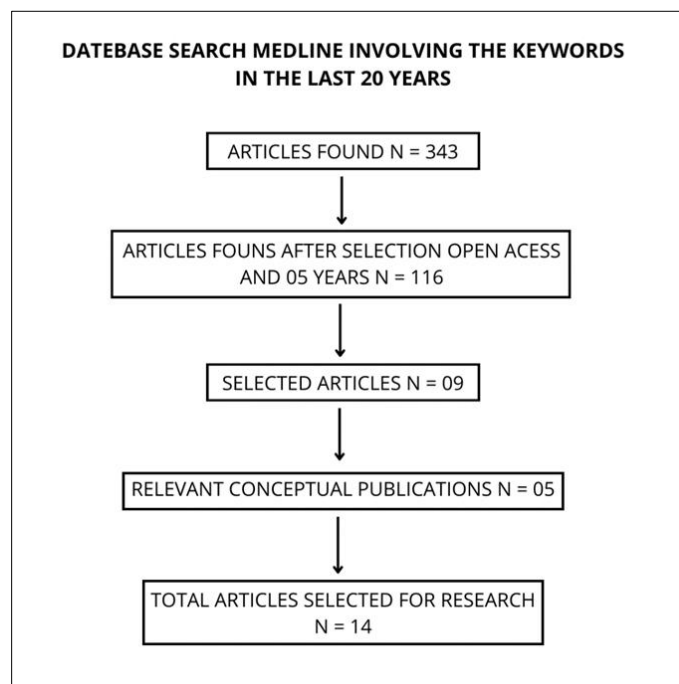
Inclusion criteria	Exclusion Criteria
Articles from the last 05 years	Cases that were not CS at ATM
Published in English	Articles whose title does not match the purpose of the work
That include the selected keywords in the title	Abstracts that do not address the purpose of the study
Human clinical research, original human research, literature reviews, case reports.	Studies with laboratory sample
Main variables analyzed	
Features between TMD and synovial chondromatosis	
image exams	
Clinical manifestations	

### 3. Results

In the database search, 343 articles were found on the MedLine platform. After applying the open access filter, 116 works were evaluated and all had a minimum period of publication of five years. After evaluating abstracts and titles, nine articles were selected, and five studies were added for presenting scientific relevance to the research (Figure 1).

Of the 14 articles studied, three (20%) studies evaluated only the Magnetic Resonance Imaging (MRI), one (6.66%) evaluated Cone Beam Computed Tomography (CBCT), one (6.66%) evaluated CT, four (26.6%) studies evaluated MRI and CT, one (6.66%) evaluated Orthopantomogram (OPT) and CBCT, four (26.6%) evaluated the three imaging techniques, six (42.85%) deal with arthroscopy.

In addition, in the 14 selected articles, the main signs and symptoms found, through physical examination, TMJ auscultation and mandibular kinematics examination; were: localized pain, swelling, limited mouth opening and joint noises.



**Figure 1** Flowchart of the study selection process

**Table 1** Summary of studies in chronological order and their main results for Synovial Chondromatosis

Quotes	Sample (n)	clinical diagnosis	Imaging Exams	imaging visualization
Meng J et al. (2010) <sup>16</sup>	20 patients with histopathological confirmation of synovial chondromatosis, 12 women and 8 men.	Pain, limited mouth opening, edema in the pre-auricular region and crackles. 5 patients with a history of swelling in the affected joint and 3 with headaches. Physical examination showed mandibular deviation (14/20), sensitivity (11/20) and open bite (3/20).	Conventional Radiography, CT, MRI and Arthroscopy	Conventional radiography: widening of the joint space and bone changes such as sclerosis, flattening, hyperplasia or erosion.
Wang P, et al. (2012) <sup>7</sup>	22 patients, 15 women and 7 men with a mean age of 43.5 years.	Destruction of the glenoid fossa, erosion of the condyle, joint effusion, metaplastic synovium containing loose and adherent cartilage nodules.	MRI nad CT	CT: bony abnormalities of the condyle and glenoid fossa, extension to neighboring regions, and loose bodies.
Sink J, et al. (2014) <sup>10</sup>	Male, 82 years old.	There was no palpable mass or pain on palpation. Mandibular range of motion was within normal limits.	MRI and Arthroscopy	MRI: joint effusion, hypointense free bodies, synovial enlargement, and dumbbell-shaped or ring-shaped mass with heterogeneous signal intensities.
Sozzi D, et al. (2016) <sup>3</sup>	Female, 68 years old.	Right pre-auricular edema, pain aggravated by palpation and chewing, mouth opening limitation of 20mm with deviation to the right.	MRI	Arthroscopy: diagnosis and treatment for the primary phase of CS.
Liu X, et al. (2016) <sup>5</sup>	10 patients, 2 men and 8 women. Mean age of 45.4 years.	Limitation of mouth opening, crackling, pain, edema and swelling. The problems affected the left side in 8 cases and the right side in 2.	MRI and CT.	Calcified loose bodies, bone changes on the joint surfaces and in the glenoid fossa, enlargement of the TMJ joint spaces and bone erosions on the condyle. Arthroscopy: diagnostic method.
Paparo F, et al. (2016) <sup>14</sup>	Female, 36 years old.	Limited mouth opening and edema of the right preauricular region, without signs of facial nerve paralysis and paresthesia or hypoacusis and long-lasting TMD.	CBCT and Arthroscopy	MRI: increased joint space and mucosal lesion involving the TMJ with extension to the glenoid fossa.
Brabyn PJ, et al. (2018) <sup>17</sup>	6 patients, 5 women and 1 man. Average age of 42 years.	Involvement of the left side of the TMJ, bruxism, pre-auricular pain, limitation of mouth opening. Edema in 2 patients and mild to moderate pain.	MRI and CT	CT: partial erosion of the glenoid fossa, without dural involvement, calcified bodies present in the upper TMJ and increased joint space.
Vellone V, et al. (2018) <sup>19</sup>	Female, 64 years old.	Right temporomandibular pain, limitation of mandibular movements and swelling in the right preauricular region.	CT, MRI, OPT and Arthroscopy	MRI and CT: 13 mm oval mass in communication with the temporomandibular cavity.

Benslama, et al. (2019) <sup>12</sup>	12 patients, 4 men and 8 women with a mean age of 50.5 years.	Joint pain (10 cases), movement restriction (6 cases) and edema (4 cases).	OPT, CT e MRI	CT: irregularity in the shape of the right condyle, without focal bone lesions.
Liu X, et al. (2019) <sup>15</sup>	1415 patients, 426 male and 989 female. Mean age 43 ± 6.53 years.	A preoperative evaluation was performed including maximum interincisal opening, occlusal relationship and sensitivity to palpation. Intervention by arthroscopy provided direct	MRI and CT	MRI: hypointense free bodies and hyperintense joint fluid on T2-weighted sequence, large amount of synovial fluid with capsular expansion even without ossification/calcification of cartilaginous bodies.
Lee LM, et al. (2019) <sup>20</sup>	16 patients, 2 men and 14 women aged between 19 and 49 years (mean age 32.68 years)	Pain, continuous crackling and limited mild mouth opening. 4 patients suffered from closed mouth opening (25%). 8 patients suffered from crepitus (50%). 10 patients suffered from pre-auricular pain (62.5%)	OPT, CT and MRI	CT: ossification lesions around the condyle. MRI: free bodies within the superior joint compartment. Arthroscopy: Location and direct visualization during surgery, total removal of all loose bodies.
Nath P, et al. (2020) <sup>13</sup>	Male, 38 years old.	Pain in the right ear and preauricular tenderness, tenderness and edema in the TMJ region, with a mouth opening of 38 mm, there was deviation to the right and a click in the right TMJ.	MRI and Arthroscopy.	OPT: calcified loose bodies around the right condyle and increased joint space with erosive changes. CBCT: opacities on the medial, anterior, posterior and superior surface of the condyle. CT: distinct nodules within a joint compartment, enlargement of the TMJ space, calcifications, bone erosion on the adjacent articular eminence and glenoid fossa.
Houston KR, et al. (2020) <sup>18</sup>	Female, 68 years old.	Left atrial edema. Reduced mouth opening.	CT	Hazy density in the intra-articular portion of the left TMJ. Bone erosion of the glenoid fossa and expansion of the area. Intra-articular mass with calcified loose bodies.
Destruhaut F, et al. (2021) <sup>4</sup>	Female, 21 years old	Persistent and intense pain in the left TMJ, with an increase during mastication and/or muscle fatigue, associated with joint noises. Oral limitation (31mm) and deviation to the left.	CTCB, OPT and Arthroscopy	OPT: did not contribute to the visualization of lesions on the left condyle. No impingement, enlargement or lysis of the condylar joint was found. A radiolucent image was visible in front of the condyle. TCCB: highlighted calcified bodies. Arthroscopy: method of treatment.

#### 4. Discussion

CS is a proliferative disorder, which derives from a benign metaplastic process and results in the formation of cartilaginous or osteocartilaginous nodules - found in the peduncular form or as a loose body - in the synovial membrane of the temporomandibular joint<sup>[11,21]</sup>. Despite presenting very well characterized images in their exams, it is an uncommon disease in the TMJ and there are not many studies that clearly point out its etiology<sup>[23]</sup>. Thus, Ivask et al (2015) <sup>[23]</sup> recognized the development of two forms of the disease. One of them can be through primary injuries and the other after trauma or some pathological process.

Research indicates the coexistence of CS with other types of diseases, such as TMJ osteoarthritis and condylar hyperplasia. In this sense, it is necessary to carry out a good differential diagnosis, since its signs and symptoms are nonspecific and the TMJ is one of the least affected joints<sup>[13,16]</sup>.

Predominantly in our study, in relation to gender, TMJ involvement is more frequent in women than in men, with a ratio of 1.5:1. However, the basic literature does not substantiate the reason for the higher incidence in females compared to males. Furthermore, it is seen that the main age group affected by the disease is 18 to 75 years old, with the average age of onset of cases being 46 years old in both<sup>[21,24]</sup>. In general, joint TMD conditions are more common in females, in the age group close to that of CS, which could be a relationship with the predisposition to develop CS<sup>[26,27]</sup>. When analyzing the signs and symptoms related to SC, it is possible to observe a similarity with those present in TMD, which justifies the need to carry out the differential diagnosis, among them, the following stand out: uni or bilateral preauricular edema; pain aggravated by factors such as chewing or palpation; reduced mouth opening; deviation in mouth opening; muscle fatigue; joint noises and crepitus<sup>[3-5,16,20]</sup>, therefore, in order to perform the differential diagnosis, it is necessary to use image tests.

A recent study demonstrates the relationship between Temporomandibular Disorders (TMD) and quality of life, aiming to verify the improvement or worsening of their conditions. There are several etiological factors that modify this situation, the psychological aspect being the main one. This, in turn, can worsen the situation so that the considerable reduction of pain does not mean the improvement of functional aspects, thus impairing the patient's quality of life<sup>[11]</sup>.

CS is a condition that normally involves larger joints, but it can also affect smaller ones, such as the temporomandibular joint, yet in both there are similarities in clinical and radiographic aspects. Therefore, the use and precision of the best diagnostic method to identify this condition is of such importance, in order to - in the future - indicate the most appropriate type of treatment, conservative for TMD and, many times, surgical for CS<sup>[25]</sup>.

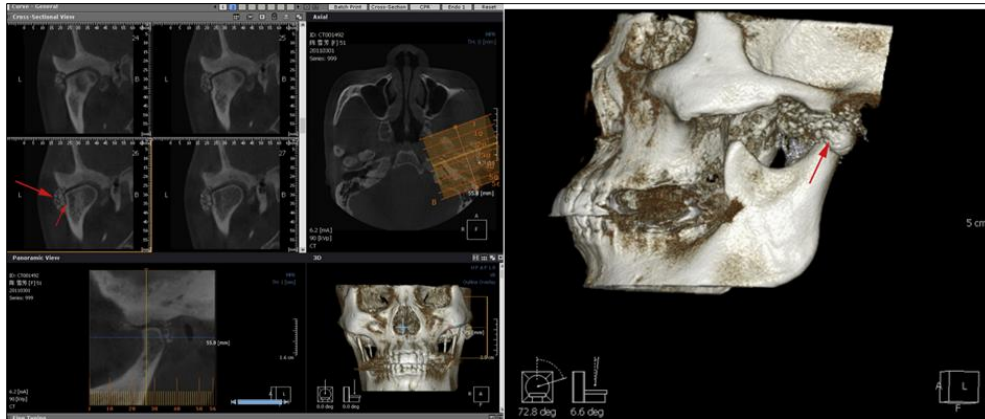


Fonte: Liu (2019).

**Figure 2** Magnetic Resonance Imaging showing Synovial Chondromatosis of the TMJ. In figure A: arrows indicating hypointense free bodies surrounded by hyperintense joint fluid. In figure B: arrow indicating isolated chondrified loose bodies detected during arthroscopic surgery

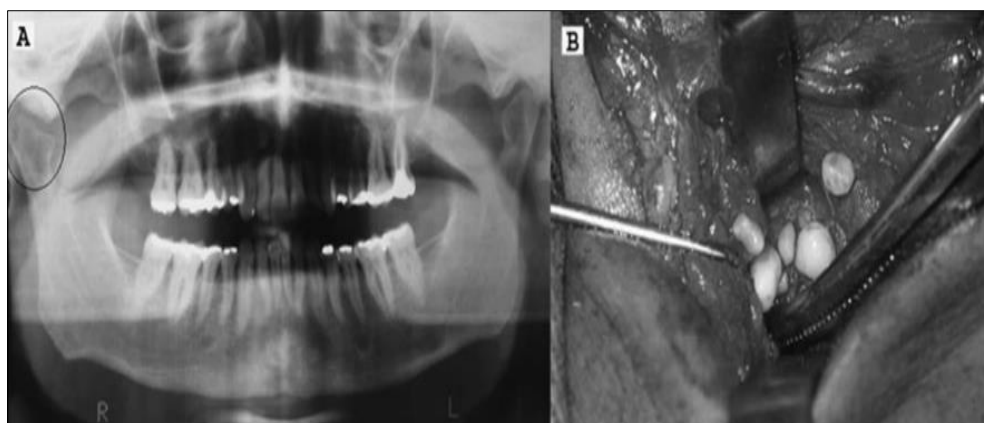
TMJ CS is constantly diagnosed late or erroneously, this is due to the difficulty in distinguishing it from other diseases with similar characteristics. In an attempt to make the diagnosis more assertive, imaging tests such as MRI, CT and OPT are used<sup>[16]</sup>.

On MRI, CS of the TMJ is indicated by the presence of cartilaginous nodules with signs of low and isointensity in the joint space, which may present small or localized rounded shapes, with different degrees of calcification, similar to a “ring”<sup>[7]</sup> On CT, multiple loose bodies of moderate to increased density can be identified, delimited and located, with expansion of the intra-articular space and bone changes, such as erosions of the mandibular fossa, joint tubercle and head of the mandible<sup>[3]</sup>. Both techniques, CT and CBCT, were not identified as having greater or lesser accuracy for the diagnosis of CS by the authors. However, some pointed to CBCT as advantageous due to the lower radiation dose and to be used more specifically for dental diagnosis.



**Figure 3** In Figure A: Cone Beam Computed Tomography in coronal plane showing erosive bone alterations of the condyle joint surfaces and loose bodies in the left TMJ. In figure B: Three-dimensional reconstruction of the CBCT showing a large number of high-density, space-occupying lesions on the lateral aspect of the left condyle

Orthopantomography shows calcification of several loose bodies around the mandibular condyle, increased joint space with signs of erosion in the condyle head, but with less accuracy. Although this technique can show enlargement of the joint space, nodules that are not calcified/ossified may not be verified<sup>[13]</sup>. Therefore, CS is often diagnosed in this exam as an imaging finding.



Fonte: Bonatti (2008)

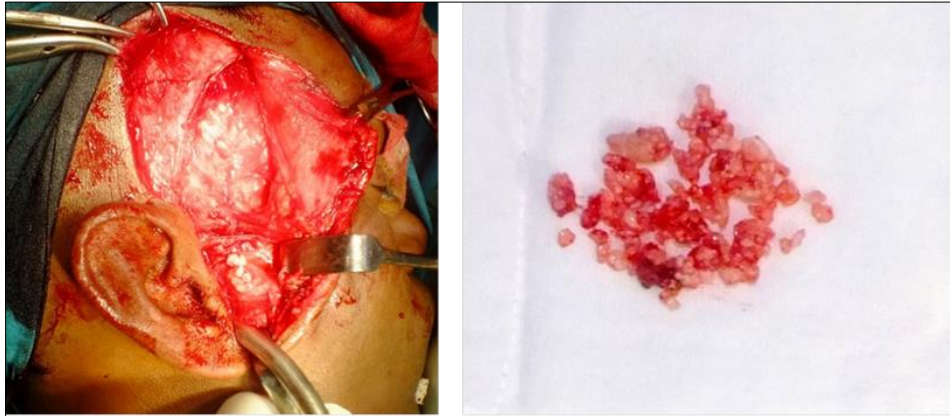
**Figure 4** Orthopantomography showing changes in the right TMJ (A); Surgical removal of the CS (B)

The choice of imaging method rests with the professional, because from this, the best treatment plan can be developed.

Arthroscopy is also mentioned as a minimally invasive procedure, which has been well indicated as a diagnosis and surgical treatment for removing the fragments in cases of SC (Figure 2 B). In general, the surgical technique consists of accessing the region through an arthroscope, which makes it possible to visualize and locate directly, trans-surgically, the calcified bodies, which are removed during lavage with Ringer's solution (arthrocentesis), by means of puncture cannulas, which achieve a better view of the field. However, according to the intraoperative findings, there are different types of procedures that can be performed, ranging from washing the structure to removing loose bodies<sup>[17]</sup>. However, the visualization of the corpuscles and the surgical therapy depend on the previous imaging diagnosis, performed by

the other imaging tests mentioned. In this context, arthroscopy was not presented here as an initial diagnostic test, but rather effectively associated with the intervention.

For the treatment of CS with extra-articular extension and in cases of recurrence, arthrotomy and removal of cartilaginous nodules are usually performed. Surgery involves a preauricular approach followed by synovectomy and resection of the lesion. In some cases, condylectomy may also be necessary<sup>[4,5,13,17]</sup>.



Fonte: Nath (2020).

**Figure 5** Figure A: Synovial chondromatosis exposed in surgery. Figure B: Fragments of the lesion after TMJ removal

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## 5. Conclusion

SC presents signs and symptoms similar to those of temporomandibular disorders, to highlight: the symptoms being persistent pain, joint noises and the signs: limitation of mouth opening and edema.

CS is observed in imaging exams due to the production of loose/cartilaginous bodies, which less frequently affects the temporomandibular joint.

The main tests for finding CS are CT and MRI. The latter has the advantage of demonstrating bodies with a lower degree of calcification, while CT favors a more precise delimitation and localization of calcified fibrocartilaginous bodies.

Thus, it is essential to use the most accurate imaging tests, such as CT and MRI - together with clinical investigation - to perform the initial and differential diagnosis with other TMJ joint dysfunctions and the elaboration of the most appropriate treatment plan for the patient.

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## Compliance with ethical standards

### *Disclosure of conflict of interest*

No conflict of interest.

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