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Surgical Treatment of Synovial Chondromatosis in the Inferior Compartment of the Temporomandibular Joint With Articular Disc Involvement

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Abstract: The authors report an unusual case of painful synovial chondromatosis originated in the inferior compartment of the temporomandibular joint (TMJ) with articular disc involvement in a 56-year-old woman with complaint of severe pain in the right preauricular region. Magnetic resonance images showed advanced destruction of the right articular disc anteriorly displaced, condylar erosion, and distinct nodules within an extremely expanded inferior joint compartment with large amount of fluid, as well as a large TMJ effusion. A scintigraphy showed elevated bone uptake in the right TMJ, demonstrating intense bone remodeling activity in the region. After a right internal maxillary artery embolization, the patient underwent open surgery. The intraoperative procedures, including articular disc removal, condylar remodeling, and replacement of the articular disc, are described in detail. Synovial chondromatosis of the TMJ is a rare disease, especially when it affects the inferior compartment and the articular disc. Initial diagnosis is challenging and imaging techniques (magnetic resonance imaging and scintigraphy) play an important role in identifying signs, making accurate diagnosis, and offering additional information not available with conventional imaging, such as TMJ inflammation or remodeling. In these patients, open surgery may be considered a definitive treatment, since the postoperative recurrence rate is very low.

Key Words: Magnetic resonance imaging, synovial chondromatosis, temporomandibular joint

Synovial chondromatosis (SC) is a rare pathological condition[1] characterized by a progressive and proliferative disorder of the synovium membrane associated with the formation of free and/or calcified cartilaginous nodules of various sizes, which may cause joint dysfunction and enlargement of the joint capsule. It is considered a metaplastic process that usually affects large joints such as the knee, hip, and elbow,[1–4] but has been rarely reported in the temporomandibular joint (TMJ).[3–5] Nearly all patients of SC in the TMJ occur in the upper compartment of the joint space;[2,6,7] few have affected the inferior or both.[3,8] In rare patients, there may be corrosion of the condyle or the middle cranial fossa floor, or even aggressive destruction of the temporal skull base and/or invasion of intracranial structures.[1,2,7,9]

Clinical symptoms are not specific to the disease.[1] They are similar to a TMJ dysfunction and include pain, swelling, facial asymmetry, crepitation, and difficult mandibular moving.[1,4–6,8,10] Due to the nonspecific symptoms, conventional radiographs, computed tomography (CT), and magnetic resonance imaging (MRI) represent the primary diagnostic modalities for SC. They are important to distinguish this injury from other conditions of the TMJ.[6] Previous studies have reported that CT and MRI are the most useful methods in the diagnosis of SC.[1,5,6] In addition, scintigraphy, technique that demonstrates bone metabolism or remodelling is rarely performed in the diagnosis of SC. However, this examination may play an important role in avoiding misdiagnosing.[11]

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Some authors have reported that SC does not undergo spontaneous resolution.[5] More aggressive excision is required in early stages, when metaplastic synovia is actively proliferating.[12] The most commonly surgical procedures are enucleation, synovectomy, and condylectomy.[1,4,8–10,12]

Therefore, the aim of this paper was to report an uncommon patient of painful SC originated in the inferior compartment of the TMJ, with the involvement of articular disc and synovial membrane, diagnosed by a microscopic examination, MRI and scintigraphy, and treated surgically.

CLINICAL REPORT

A 56-year-old woman presented to the oral medicine clinic complaining of severe spontaneous pain in the right preauricular region, with 2 years of evolution. In addition, the patient reported clicking and crepitus at TMJ bilaterally during mastication. Her medical history was not relevant for any condition. Complete blood count values were within normal limits. There was no mouth opening limitation, oclusal changes, or deviation, but pain increased with function. The patient also reported involuntary clenching.

Panoramic radiography showed osseous outline of the right TMJ with a discrete irregularity on the posterior-superior surface of condyle. Magnetic resonance imaging revealed advanced destruction of the right articular disc that was anteriorly displaced, distinct nodules within extremely expanded inferior joint compartment with large amount of fluid, erosion in the upper surface of the condyle and articular eminence (Fig. 1A). T2-weighted sequence showed a large TMJ effusion, demonstrated by the hyperintense uptake of the synovial fluid expansion posterior to the condyle (Fig. 1B). At this point, differential diagnosis included degenerative osteoarthritis, SC, avascular necrosis, ganglion cyst, synovial cyst, chondrosarcoma, and osteosarcoma. Because of these findings, it was performed the scintigraphy (bone scan) using technetium diphosphonate 99 mTC, which showed elevated bone uptake in the right TMJ, demonstrating intense bone remodeling activity in the region (Fig. 2). The concern about possible malignancy and the possibility of initial exploratory surgery extending beyond the condylar region (for adequate surgical margins) led us to propose a previous right internal maxillary artery embolization (Fig. 3).

Three days after this procedure, the patient underwent open surgery under general anesthesia and endotracheal intubation. The right TMJ was approached through preauricular incision, with blunt and sharp dissection until the temporal fascia was exposed. The fascia was incised at 45-degree angle beginning over the root of the zygomatic arch, exposing the temporal muscle. It was elevated exposing the lateral TMJ capsule, which was incised to approach the interior aspect of the joint. Advanced destruction of the articular disc and a tissue with reddish macroscopic appearance was seen. The articular disc and this tissue were removed and submitted to an intraoperative frozen-section examination, which showed no signs of malignancy. Then, condylar remodeling was performed. To replace the articular disc, a pedicled flap of temporal muscle and fascia was rotated, covering the glenoid cavity. The flap was sutured medially in the medial capsule. The lateral capsule and the other planes were sutured traditionally (Fig. 4A–H). The tissue biopsy specimen of the joint space was submitted to microscopic

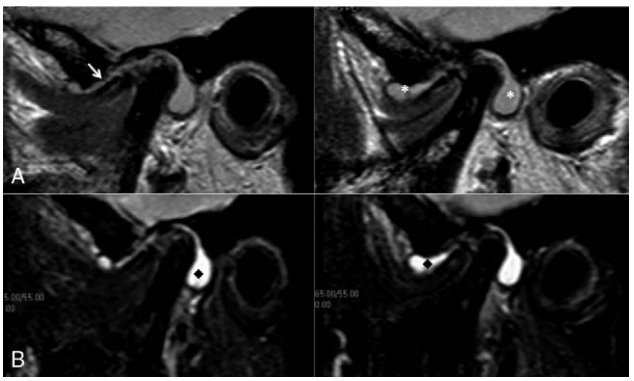

FIGURE 1. Magnetic resonance images of the right temporomandibular joint. *[Sagittal view–closed-mouth position]* (A) T1-weighted sequence showing advanced destruction of the articular disc anteriorly displaced (arrow), erosion in the upper surface of the condyle and articular eminence, and distinct nodules within an extremely expanded inferior joint compartment with large amount of fluid (∗). (B) T2-weighted sequence showing great amount of the fluid inside of the joint (◆).

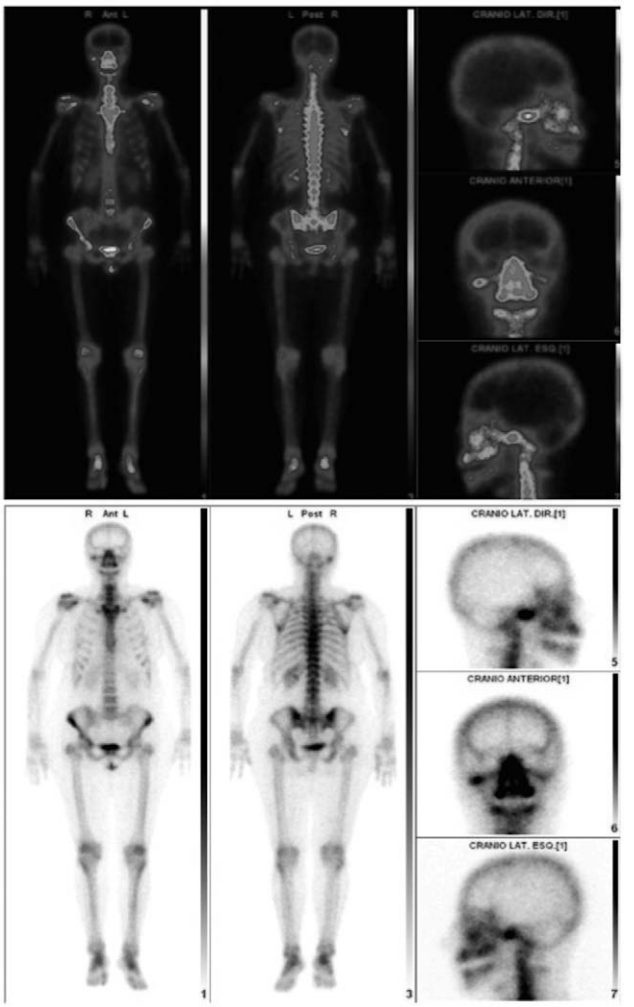

FIGURE 2. Scintigraphy. Elevated bone uptake of technetium-99 m in the right temporomandibular joint.

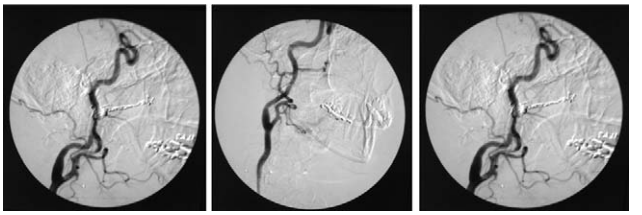

FIGURE 3. Embolization of the right internal maxillary artery.

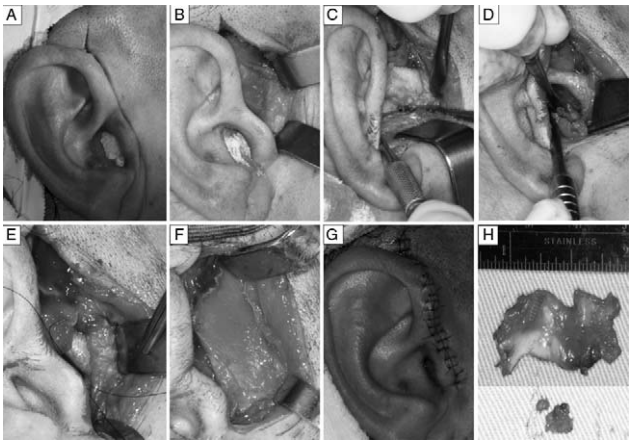

FIGURE 4. Surgical procedure at the right temporomandibular joint. (A) Preauricular incision. (B) Dissection until the superficial temporal fascia, incised over the zygomatic arch. (C) Exposure of the articular capsule. (D) Presence of cartilaginous nodules in both condylar surface and glenoid fossa. (E) Pedicled flap of temporal muscle and fascia was rotated, covering the glenoid cavity. The flap was sutured medially in the medial capsule with 4-0 nylon. (F) Lateral capsule and other planes sutured traditionally. (G) Final aspect f the suture. (H) Remaining articular disc and removed cartilaginous specimen.

examination, which showed reactive changes of the synovial membrane and small zones of chondroid metaplasia. The presence of disorganized and metaplastic noncalcified nodules of hyaline cartilage was also observed, confirming the diagnosis of SC (Fig. 5A–C).

After 9 days, it was performed suture removal, and the patient presented normal mouth opening of 35 mm (Fig. 6A and B) and preserved protrusive and lateroprotrusive movements, with no facial pain and muscles weakness, demonstrating no facial nerve deficit. At 12-month postoperative follow-up, there was excellent healing and a satisfactory mouth opening (Fig. 6C and D).

DISCUSSION

Synovial chondromatosis is a rare benign condition[1] of unknown aetiology and pathogenesis.[1,9] Patients without identifiable etiologic factors are designated primary SC and are more aggressive in their behavior. Secondary SC is developed after trauma or joint disease (inflammatory or no inflammatory arthropathy) and these cases are more common.[2] In our case, it was presented a case of secondary SC, because the patient reported excessive clenching of teeth.

Similarly to our case, previous studies reported that women are most affected[5,7] with an average age of 47.2 years.[7] Although the injury could occur bilaterally,[13] the right TMJ is more affected by SC (right/left side 1.25:1).[5] The predominant symptoms include pain, swelling, limitation in mouth opening, crepitation, and oclusal disorders.[1,4–8,10,14,15] Our patient reported only spontaneous pain in the right preauricular region. Primary diagnosis of SC is extremely difficult[5] due to its rarity and the absence of physical signs and symptoms. In other words, these factors lead to a late diagnosis[1,4,5,7,8,10] or even a misdiagnosis of diseases with similar symptoms, such as temporomandibular dysfunction or arthritis.[7] Some studies reported that the period of occurrence of initial symptoms to confirm the diagnosis of SC is relatively long, varying from 12 to 31 months,[2,3,10,14] agreeing with our case, which was 24 months.

Imaging techniques for the diagnosis of SC include conventional radiographies, CT, and MRI.[1,5–7,10,12–14,16] Due to its high contrast resolution, CT can detect soft tissue swelling, loose calcified bodies, bony changes of the articular surfaces (erosion), and widening of joint spaces,[7,9,12,15] which occurs because of the progressive stretching of the capsule caused by synovial fluid. This finding is an important element in the diagnosis of SC. Magnetic resonance imaging has a significantly improved diagnostic accuracy,[14,16] showing to be superior to other imaging methods in detecting diseases of the TMJ.[2,6,17] Magnetic resonance imaging has the following advantages: absence of radiation to the patient; detection of loose bodies with or without calcification, synovial fluid and extent of dura mater,[8–10,12,14] allowing diagnosis in initial phase of SC; high resolution of soft tissues;[1,6] visualization of articular disc displacement (condition often associated of the SC).[12,17] The present case is interesting because MRI showed distinct nodules within an extremely expanded inferior joint compartment, anterior displacement and destruction of the articular disc, erosion of the condyle's surface, obliteration of the joint space, and abundant fluid within the joint (TMJ effusion).

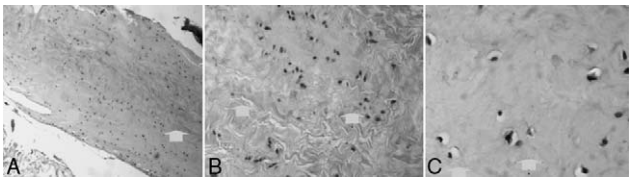

FIGURE 5. Hematoxylin-eosin staining. (A) Chondrometaplasia foci within the synovial tissue (magnification ×40). (B) Noncalcified cartilaginous immature nodules with a hyperplasic lining of synovium-like connective tissue and disorganized arrangement of chondrocytes (magnification ×100). (C) Oval chondrocyte-like cells (magnification ×200).

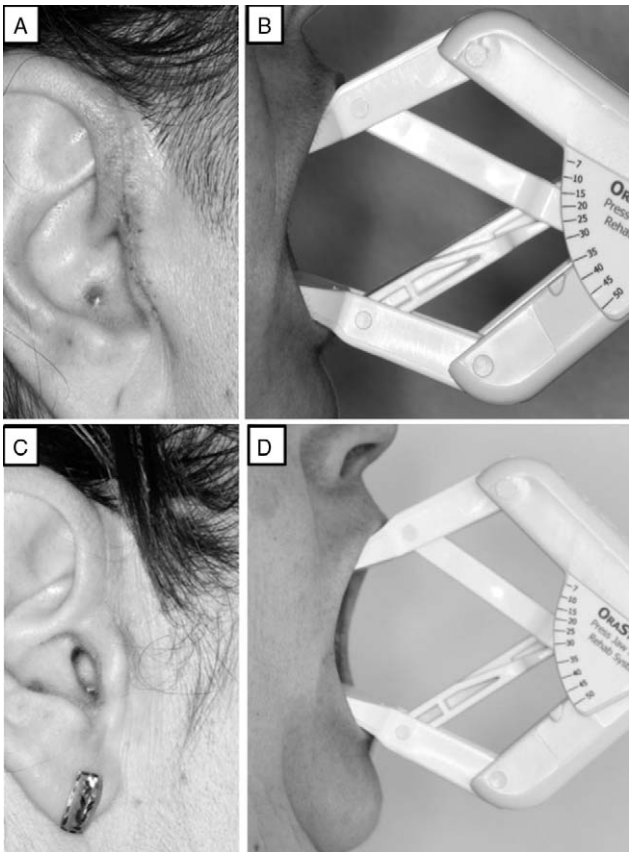

FIGURE 6. (A) Clinical aspect immediately after suture removal. (B) Maximum mouth opening of 35 mm at 9-day postoperative follow-up. (C) Healing at 12-month postoperative follow-up. (D) Increased mouth opening after 12 months.

In routine practice, scintigraphy is usually not performed in the diagnosis of SC. This technique demonstrates bone metabolism and may offer additional information not available with conventional imaging, such as TMJ inflammation or remodeling. In our case, scintigraphy, using technetium diphosphonate 99 mTC, showed active bone remodeling in the right TMJ. The high uptake at the right side in comparison with the left side may be suggestive of great bone remodeling or malignant disease. For this reason, scintigraphy findings must be correlated with CT or MRI to avoid misdiagnosing as malignancy when increased uptake is seen in all phases of 99mTc bone scans, especially in single-joint involvement.[11]

Milgram[18] classified the histological findings of the SC in 3 stages, based on disease activity and development. Stage 1 (early) corresponds to an intrasynovial involvement with active metaplasia only in the synovial membrane and loose cartilaginous bodies are absent. In stage 2 (transitional), there is metaplasia in the synovial membrane and presence of loose bodies containing active chondrocytes that maintain the growth potential; and stage 3 (advanced) shows no sign of metaplasia and presence of multiple loose bodies,[4,5] which can present secondary calcification or ossification. Our patient presented stage 2, because it was observed metaplasia in the synovial membrane and free-floating cartilage nodules without the presence of any calcifications. Furthermore, the stage of the disease should guide the surgical therapy,[12] and early stages (1 and 2) require more aggressive approaches[3,19] because the metaplastic synovium is actively proliferating.[12,19]

When the loose bodies reach the articular disc or other articular structures, their open-surgical removal is required[2,7,16,20] to prevent recurrence.[7] Removal of loose bodies can be performed with procedures such as synovectomy,[21] articular disc excision, eminectomy, and condylectomy. The procedure's choice depends on the location of the injury and the condition of the synovial membrane.[7] Depending on the severity and symptoms, some patients may require discectomy and eminectomy with myofascial reconstruction using the temporal flap.[15] In the reported case, the articular disc was removed due to its advanced destruction, as well as the cartilaginous nodules of the condylar surface and the glenoid fossa. Condylar remodeling was performed. To replace the articular disc, a pedicled flap of temporal muscle and fascia was rotated, covering the glenoid fossa, through suture at the medial temporomandibular capsule. It is known that the reconstruction of the joint capsule with a temporal muscle interposition flap should improve postoperative function.[1]

Recurrence rates of SC are low, when loose bodies and synovium are completely removed.[2,5,10,14,22] The metaplastic process is inactivated and in most patients surgery may be considered a definitive treatment for SC.[5] Moreover, the stage of SC is an important risk factor for recurrence.[3] Primary SC shows a high rate of recurrence[23] because of its more aggressive metaplastic behavior.[2] Due to the lack of initiation factors, secondary SC is usually not invasive, and has less probability of recurrence.[23] In our case of secondary SC, the patient showed no signs or symptoms of recurrence and presented satisfactory mouth opening at 12-month follow-up.

CONCLUSION

Synovial chondromatosis of the TMJ is a rare disease, especially when it affects the inferior compartment and the articular disc. Initial diagnosis is challenging and imaging techniques such as MRI play an important role in identifying signs and making accurate diagnosis. Additionally, the scintigraphy may offer additional information not available with conventional imaging, such as TMJ inflammation or remodeling. In these patients, the open surgery may be considered a definitive treatment, since the postoperative recurrence rate is very low.

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Three-Dimensional Radiological Assessment of Alveolar Bone Volume Preservation Using Bovine Bone Xenograft

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Introduction: Alveolar bone is critical in supporting natural teeth, dental implants as well as a removable and fixed prosthesis. Alveolar bone volume diminishes when its associated natural tooth is lost.

Objective: The aim of this study is to evaluate the effectiveness of bovine bone granules on alveolar bone socket augmentation for ridge preservation following atraumatic tooth extraction.

Materials and Methods: Twenty medically fit patients (12 males and 8 females aged between 18 and 40 years) who needed non-complicated tooth extraction of 1 mandibular premolar tooth were divided randomly and equally into 2 groups. In control group I, the empty extraction socket was left untreated and allowed to heal in a conventional way. In group II, the empty extraction socket wound was filled with lyophilized bovine bone xenograft granules 0.25 to 1 mm of size, 1 mL/vial. A resorbable pericardium membrane was placed to cover the defect. Clinical and 3-dimensional radiological assessments were performed at day 0, 3 months, and 9 months postoperative.

Results: There were no clinical differences in general wound healing between the groups. Comparisons within the groups showed a significant difference of bone resorption of 1.49 mm (95% confidence interval, 0.63−2.35) at 3 months, and further resorption of 1.84 mm ($P \leq 0.05$) at 9 months in the control group. No significant changes of bone resorption were observed in group II during the same time interval. Comparison between groups showed a significant difference of bone resorption at 3 and 9 months (2.40 and 2.88 mm, respectively).

Conclusion: The use of lyophilized demineralized bovine bone granules in socket preservation to fill in the extraction socket seems essential in preserving the alveolar bone dimension as it showed excellent soft and hard tissue healing. This study concludes that the alveolar bone socket exhibited a dynamic process of resorption from the first day of tooth extraction. Evidence shows the possibility of using bovine bone granules routinely in socket volume preservation techniques following tooth extraction.

Key Words: Bone graft, CBCT, extraction socket, ridge preservation

Alveolar bone is critical in supporting natural teeth, dental implants as well as a removable and fixed dental prosthesis. The buccal bundle bone of the alveolar ridge diminishes when its associated natural tooth is lost. Several studies have investigated the morphological alterations that occurred in the alveolar process as a consequence of tooth extraction, both vertically and in the width of the residual bone.[1] The resorption rate depends on time factor since tooth extraction. The contour loss occurs at a more significant rate during the early postextraction period, especially within the first 6 months whereby changes in the buccal alveolar bone plate results in a collapse of the alveolar process, particularly in the maxillary bone.[2]

The alveolar bone is a highly dynamic bone supporting the tooth and its surrounding periodontium. It physiologically resorbs when the tooth is lost. The average of 40% to 60% of original height and width is expected to be lost after tooth extraction, with the greatest loss happening within the first 2 years.[2,3]

A recent systematic review evaluated the dimensional changes in the hard and soft tissues of the alveolar process following tooth extraction. The review concluded that after 3 months of healing, the horizontal resorption of the alveolar bone was 2.2 mm at the crest. After 6 months of healing, the vertical resorption of the alveolar bone was 11% to 22%, whereas the horizontal resorption of the alveolar bone was 29% to 63%.[3]

Ridge resorption proceeds quickly after tooth extraction and significantly reduces the possibility of placing dental implants which then requires the need for bone grafting procedures. Bone grafting in dentistry is still the key to success for bony defects reconstruction when restoring the anatomy and function of the bone. Although bone tissue exhibits a large regeneration potential and may restore its original structure and function completely, bony defects in the jaw may often fail to regenerate to provide adequate functionality. However, in some patients, it may fail to regenerate itself due to various reasons. In order to facilitate and/or promote healing, bone graft materials with known biological activity and predictable tissue responses should be placed into bony defects.[4,5] Over the past 20 years, increasing interest has arisen regarding a concept called "alveolar ridge preservation," which was defined as "any procedure undertaken at the time of or following an extraction

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All procedures performed in our study involving human participants were in accordance with the ethical standards of the institutional and national research committee. Ethical approval was obtained from the Ethical and Research Committee, University of Sharjah and from Human Research Ethics Committee University Sains Malaysia ethical number (No DFCM/18/02/14/027) and (USM/JEPeM/15020045), respectively.

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