In industrialized societies, osteoarthritis (OA) is a leading cause of physical disability, increases in health care usage, and impaired quality of life.1,2,3 TMJ arthritis is a common presentation in orthodontic practice, especially with the increase in adult orthodontic treatment.4 However, arthritis can occur at any age, and it should not be overlooked in infants, children, and adolescents.

It is essential that the orthodontist understand the 2014 evidence base and underlying mechanisms of the disease and its prevalence. Diagnostic criteria are presented, as well as management of associated acute and chronic pain, and associated occlusal changes.

Appliance therapy and sequencing of treatment are critical to treatment success. Medical, physical, and surgical approaches will be discussed for the orthodontic patient.

This article is introductory and is the first in a series. Case histories will be presented in future articles to illuminate the material presented here.

The following are some examples of occlusal changes associated with arthritis. These cases will be presented and detailed in this series of articles.

**Educational aims and objectives**

The aim of this article is to discuss the epidemiology, pathophysiology, diagnosis, and management of TMJ osteoarthritis.

**Expected outcomes**

Orthodontic Practice US subscribers can answer the CE questions on page 45 to earn 2 hours of CE from reading this article. Correctly answering the questions will demonstrate the reader can:

- Realize the underlying mechanisms of the disease and its prevalence.
- Identify some forms of arthritis.
- Define some necessary determinants for diagnosis of TMJ OA.
- Recognize the pathophysiology of TMJ OA.
- Realize forms of diagnosis, and management of TMJ OA.

**Introduction**

Evidence of TMJ arthritis can be seen in skeletal and anthropological studies dating back to Paleolithic specimens.5 TMJ arthritis is a common disorder. There is reduced prevalence of bony changes in prehistoric populations (most probably related to life expectancy), but in examination of modern exhumed remains, the prevalence of TMJ arthritic changes is 22%-32%.6,7 This prevalence is 2:1 (female: male). In orofacial pain practices, prevalences of 30% have been reported.8

Recent CBCT imaging studies confirm this prevalence.9 The prevalence is higher in Angle Class II populations; however, this may be due to resulting occlusal changes from OA.

**Forms of arthritis**

There are over 100 different types of arthritis but most common is osteoarthritis, (OA) related to mechanical stress.10 This is the most common form of arthritis, and we will focus mostly on this in these articles. Other forms of arthritis (rheumatoid, psoriatic, gouty, etc.) are caused by antigen-antibody reaction, metabolic disease, hormonal imbalance, blood breakdown products in joints, genetics, and direct infection of joints. They, however, are present in less than 1% of the population, while OA of all forms presents in the majority of the population.

**Figure 1:** A. Example of healthy TMJ. B. Advanced osteoarthritis. C. Typical intrachondral cyst formation in right TMJ.

**Figure 2:** Examples of occlusal changes associated with condylar changes in patients. A. Psoriatic arthritis (PA). B. Rheumatoid arthritis (RA). C. Idiopathic condylar resorption (ICR). D. Metastatic carcinoma. E. Bilateral osteoarthrosis. F. Osteochondritis dessicans

**Figure 3:** Higher incidence of TMJ OA in Class II

**Figure 4:** The above are common risk factors for all OA. Notice that joint laxity (hypermobility) is listed. Certain genetic disorders (e.g., Ehler-Danlos Type I) with hypermobility may predispose to OA.

**Source:** Arthritis Rheum 2007;56:984-994
Pathophysiology of OA

Milam, et al., proposed a hypothesis for the etiology of TMJ OA relating it to mechanical stress. This stress could come from microtrauma (e.g., bruxism) or macrotrauma, (direct injury). The pressure on joints from excessive forces cause hypoxia in the synovial circulation, and then on release of the pressure, capillary reperfusion occurs, initiating localized joint destruction through direct mechanical damage, release of free radicals, neurogenic inflammation, and eventual destruction of joints by cytokine-mediated release of destructive metalloproteinases (MMPs).

There are 28 known proteases implicated in joint destruction, all of which require zinc as a co-factor, and six have been identified in diseased human TMJs.

Blood in joints from injury can initiate the Fenton reaction, releasing further destructive free radicals.

Although the exact mechanisms of OA have not been elucidated, it is notable that the progression of the disease cannot be changed, (as in rheumatoid arthritis) by blocking the factors identified in joint destruction, although pain may be reduced with short-term use. For example, although cytokine blockers are effective in altering the course of destruction in rheumatoid arthritis (RA), they have no long-term effect in OA.

The most recent hypotheses on the etiology of OA are focused on a hampered repair mechanism in patients with defective DNA, gene polymorphisms, or mutations for certain anabolic factors. It is hypothesized that in asymptomatic patients, mechanical stress does cause physiologic joint changes, but normal repair occurs with no pathology.

In the patient lacking reparative and inhibitory mechanisms, the equilibrium is upset leading to pathology and joint degeneration. It is also known that with aging, the reparative capability of joints decreases.

Disc displacements and arthritis/arthritis

Longitudinal studies with MRI have demonstrated an association between disc displacement with and without reduction and TMJ OA. In cases of disc displacement with reduction, the odds of the patient developing degenerative changes are increased twofold, and in disc displacement without reduction, the risk factors are almost 5 times the normal population. The presence or absence of joint effusions in patients with reducing discs also affects the course of OA. Both imaging and clinical studies estimate that active OA “flare” has a course of 3.6 years before the disease becomes quiescent.

In the past, there were proponents of surgical disc repositioning to prevent further osteoarthritic degeneration. There is no support for this in the literature.

Clinical examination, diagnosis, and management of TMJ OA

Orthodontists should screen patients of all ages for joint changes. Many asymptomatic patients can have evident significant arthritic changes easily seen in panorex or lateral TMJ films in open and closed position. CT or CBCT is the gold standard for diagnosis of bony changes and can detect subtle changes in joint morphology. CT is the most accurate measurement of joint size and joint space.

Disadvantages of CT

- Higher radiation than other studies
- Necessity to take 2 studies to determine open and closed TMJ position
- No visualization of soft tissues (disc position)
- No visualization of joint morphology (joint effusions)
- No visualization of bone marrow inflammation

If there are obvious bony changes on panorex and transcranial radiographs, the value of CT imaging is limited, and if further imaging is necessary, an MRI may provide more information.

![Image](image1.png)

**Figure 1:** Longitudinal studies with MRI have demonstrated an association between disc displacement with and without reduction and TMJ OA.

![Image](image2.png)

**Figure 2:** In the past, there were proponents of surgical disc repositioning to prevent further osteoarthritic degeneration. There is no support for this in the literature.

![Image](image3.png)

**Figure 3:** Orthodontists should screen patients of all ages for joint changes.

![Image](image4.png)

**Figure 4:** Many asymptomatic patients can have evident significant arthritic changes easily seen in panorex or lateral TMJ films in open and closed position.

![Image](image5.png)

**Figure 5:** CT or CBCT is the gold standard for diagnosis of bony changes and can detect subtle changes in joint morphology.

![Image](image6.png)

**Figure 6:** CT is the most accurate measurement of joint size and joint space.

![Image](image7.png)

**Figure 7:** Disadvantages of CT.

![Image](image8.png)

**Figure 8:** Orthodontists should screen patients of all ages for joint changes.

![Image](image9.png)

**Figure 9:** Many asymptomatic patients can have evident significant arthritic changes easily seen in panorex or lateral TMJ films in open and closed position.

![Image](image10.png)

**Figure 10:** CT or CBCT is the gold standard for diagnosis of bony changes and can detect subtle changes in joint morphology.
**Laboratory serology for RA**

A comprehensive rheumatoid panel for use in patients with suspected inflammatory or rheumatoid arthritis is in Figure 11. The orthodontist needs to be familiar with this complete panel. It is strongly recommended that only a rheumatologist order this for your patients, since a general physician is not trained in the complete panel, and an incomplete diagnosis may be made. Rheumatoid serology should be considered with the following patients:

- Patients with bilateral TMJ arthritis
- Patients with a family history of RA or autoimmune disease
- Patients who complain of general malaise and migratory joint and muscle pain
- Patients with bilateral TMJ arthritis who are treatment-planned for extensive occlusal changes.

**Synovial fluid testing**

Aspiration of synovial fluid during arthrocentesis has limited clinical application at this time. It can be helpful in diagnosis of psoriatic and gouty arthritis. It is usually not done as a primary procedure but as an adjunct to arthrocentesis. Evaluation of inflammatory mediators would help to identify acute versus chronic conditions and aid in treatment direction.

**Diagnosis of arthritis is made by necessary determinants**

Normal comprehensive TMD examination and history along with imaging will include necessary determinants for diagnosis of arthritis.

Significant findings in arthritic patients include the following:

- Crepitation 49% detectable prevalence with stethoscopic findings
- Pain focused more in joints than muscles
- Changes in occlusion: posterior prematurities (unilateral or bilateral) anterior open bite, decreased overbite, increased overjet, and midline shift to the affected side
- Increase in lower facial height and retrognathia
- Facial asymmetry to affected joint (unilateral)
- Canted occlusal plane towards the affected joint

*Limited range of motion is not necessarily associated with OA, but arthritic populations (rheumatoid) have an average limitation of 7 mm interincisal opening.

**Management of patients with OA**

In most cases, pain management of patients with TMJ arthritis is straightforward and predictable. In most cases, this involves managing acute flares of a chronic disease. If mechanical stress can be reduced in these patients, flares will be greatly reduced. It may be helpful to coordinate this treatment with an orofacial pain dentist who is more familiar with medical and physical modalities.

**Pain management**

- Rest (behavioral management), soft diet, splint, anti-inflammatories (e.g., Naprosyn 500 mg, EC BID for 2 weeks) Medrol dose pak x1 when severe pain and inflammation. Topicals as indicated — e.g., Voltaren® Gel, compounded topicals. If there is severe muscle pain, a muscle relaxer may be indicated — e.g., cyclobenzaprine 5 mg QHS. Ice for 48-72 hours, and then moist heat.
- PT as indicated — heat, strengthening, maintaining range of motion, ultrasound, TENS. Arthritic patients should be counseled to avoid hard food on a permanent basis in an attempt to further reduce mechanical stress.

**Occlusal management**

It is understood at this point that no specific malocclusion can be linked as a direct cause to TMJ arthritis. However, as has been shown, occlusions are modified by TMJ arthritis, and it is often necessary to initiate occlusal therapy for function, speech, and esthetics in these patients.

Occlusal therapy has little validity in TMJ arthritis patients for pain management. This needs to be emphasized to the patient. Many arthritic patients function well with existing minor occlusal changes, and only conservative treatment is indicated. If the patient has sleep bruxism, continued wear of the stabilization splint at night is recommended. For mild bite changes, for example, anterior open bite, posterior interferences, or simple equilibration may be all that is needed. It is suggested that study casts be mounted prior to any permanent changes. Equilibration will not correct any midline shift or occlusal cants. For more severe malocclusions, prosthodontics, orthodontics, and orthognathic surgery or a combination of these may be indicated.
Occlusal and condylar stability

Prior to any major occlusal therapy, pain must be managed, ROM maximized, and reasonable occlusal stability (condylar stability) established. All patients must be informed that relapse can occur. In any patient who has TMJ arthritis, either gradual or sudden condylar changes can occur over the years, and no guarantees of permanent occlusal stability should be made to the patient. In OA patients, most condylar bony changes occur during the active disease phase (2-4 years). It has been shown in the literature that these joints can be stable up to 30 years assuming no further major insult.20

Gradual occlusal changes may result in occlusal plane changes and compensation, where the teeth remain in contact, but the occlusal plane inclines or cantis up to the affected condyle. They can also result in the return of posterior second molar interferences and anterior open bite, as well as increasing midline shift to the affected side. These changes need to be monitored over time.53,54,55

Protocol to determine condylar and occlusal stability

- Archival set of mounted study models to compare future bite changes
- CBCT (1:1 measurement).
- Serial cephalometric films taken 1 year apart on the same machine. “B” point retrogression should be noted.
- Splint markings followed periodically to assess bite changes. This can assess both bite opening and retrognathia.
- MRI prior to major occlusal changes.
- Serology prior to major occlusal changes.

Optional

Nuclear imaging

It is reasonable with 12-month stability as demonstrated by the previously mentioned protocol to proceed with treatment.

Surgical management

Lysis and lavage or arthroscopic lysis and lavage with dissection of adhesions may be beneficial as a conservative surgical approach to patients with significant remaining pain and/or limited opening with OA. It is certainly more conservative and preferable to either autogenous or alloplastic joints as initial surgical management. Active physical therapy is required postoperatively to maintain opening, or limited opening may reoccur.56,57

It is necessary for orthodontists to understand the prevalence, pathophysiology, diagnosis, and management of arthritic patients of all ages. Simpler cases can be managed by the orthodontist alone. More complex cases will involve an interdisciplinary team, involving an orofacial pain dentist and physicians for further diagnosis and treatment as well as prognosis and timing of orthodontic treatment.

Sodium hyaluronate

Sodium hyaluronate has been investigated in use combined with arthrocentesis with mixed results. There is evidence that it has benefit in patients with disc displacement, but there is no evidence to show any effectiveness in OA patients. The concentration for use in TMJs has not been standardized, and it is not FDA labeled at this time but is approved by insurers. In long-term and short-term use in patients, sodium hyaluronate is equal to steroid in reducing pain, but has fewer side effects (chondromalacia) with repeated steroid injection.58,59,60,61,62,63,64

Alloplastic joint and autogenous joint replacement

TMJ joints have been resected starting in Europe for over 150 years. Various materials including ivory, gold, gutta percha, tantalum were used with limited success. Although autogenous joint replacements have success (rib graft and abdominal or buttocks fat), the most predictable treatment to establish joint stability in arthritic patients is with alloplastic joint replacement. In the case of rheumatoid patients, this may be the only choice. In cases of osteoarthritis, reasonable stability can be established and more conventional and conservative treatment chosen.

In older patients with end-stage arthritis, or in younger patients who have failed other treatment, alloplastic joints may be the only option. Studies have reported most inter-incisal openings after alloplastic surgery in the 30-35 mm range with an average of 33% improvement of opening, but this varies depending on the preoperative opening. The lateral pterygoid muscles are dissected off the joints during surgery; and therefore, there is limited lateral and protrusive movement. New prostheses are in development to correct this.36-41

Figure 14: This demonstrates how splints can be used to follow occlusal changes in a patient with TMJ arthritis. The top maxillary splint was adjusted to maximum intercuspation to a patient’s adapted centric posture (Dawson 1994) (centric relation occlusion cannot exist in an arthritic patient). Notice that the patient has lost contact with the anterior of the splint and is marking heavier on the right posterior indicating mandibular retrogression and morphologic change (ramus shortening) in the right condyle. With permission of Dr. J. McCain

Figure 15: A-P considerations. A lower splint can be measured to follow mandibular retrogression over time by measuring increasing overbite

Figure 16: Total joint replacement. Before and after panorex showing placement of an alloplastic left joint in a patient with limited opening
In patients with alloplastic joint failure, autogenous bone fit over the remaining ramus has had some clinical success.

**Doxycycline and statins**

There have been recent articles advocating the use of doxycycline and statins in preventing the progression of osteoarthritis. Although doxycycline can be of benefit in certain forms of Lyme arthritis, there is no evidence to support its use in OA.

There is no support for statins as anti-inflammatory agents in OA.

**Conclusions**

It is necessary for orthodontists to understand the prevalence, pathophysiology, diagnosis, and management of arthritic patients of all ages. Simpler cases can be managed by the orthodontist alone. More complex cases will involve an interdisciplinary team, involving an orofacial pain dentist and physicians for further diagnosis and treatment as well as prognosis and timing of orthodontic treatment.

The following articles will present specific patient histories to illustrate the information from this article.

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**REFERENCES**


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**CONTINUING EDUCATION**

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