

## Long-term Management of Temporomandibular Joint Degenerative Changes and Osteoarthritis: An Attempt

### Abstract

**Background:** Osteoarthritis is the inflammation of body joints characterized by chronic degeneration of various hard and soft tissues around joint. Stress-bearing joints of body such as knee, hips, spine, fingers, and temporomandibular joint (TMJ) are commonly affected. **Aims and Objectives:** The aims were (1) to study whether constant masticatory mechanical overloading causes osteoarthritis and degenerative changes of TMJ in patients who underwent segmental mandibulectomy with primary repair (without microvascular free flap reconstruction) for malignancies of the mandible, floor of the mouth, and lower gingivobuccal sulcus; (2) to evaluate the effect of nutrition supplements such as glucosamine, chondroitin, and esterified fatty acids in reducing TMJ osteoarthritis and internal derangement; and (3) to assess whether joint flexibility and function improved after using the above medication. **Materials and Methods:** Patients with osteoarthritis and internal derangement of TMJ as well as patients who underwent segmental mandibulectomy followed by postoperative radiotherapy were randomly selected and included in the study. Age group of the patients ranged between 20 and 76 years. **Results:** One hundred and ninety-two patients of segmental mandibulectomy were screened and 79 patients were found to develop osteoarthritis in the longer contralateral mandibular segment (41.14%). This finding was statistically significant in our study ( $P < 0.05$ ). Thirty-six patients of primary TMJ osteoarthritis and internal derangement were also included in the study. The efficacy of oral regimen with glucosamine with chondroitin and esterified (acetylated) fatty acids was found to be effective and satisfactory in controlling the progression of osteoarthritis and degenerative changes in TMJ in patients of both categories. **Conclusion:** Osteoarthritis of TMJ is a degenerative disorder. Age and masticatory load are one of the main contributing factors for its progression. TMJ internal derangement in chronic condition can lead to osteoarthritis. Conservative methods to control its progression will improve joint flexibility and longevity of joint function. Oral regimen of glucosamine with chondroitin and esterified fatty acids has shown satisfactory results in treating TMJ osteoarthritis and internal derangement.

**Keywords:** Esterified fatty acids, glucosamine and chondroitin, internal derangement, osteoarthritis, temporomandibular joint

### Introduction

Temporomandibular disorders are a group of degenerative musculoskeletal conditions associated with the anatomical and functional deformities that affect the temporomandibular joint (TMJ). Osteoarthritis and internal derangement are of special interest among them.

TMJ disorders have to be ruled out from other types of disorders, emphasizing on various factors such as age, gender, mode of onset of pain, duration, aggravating and relieving factors, type of pain, etiological factors such as stress and anxiety, improper chewing habits, masticatory overloading, benign or malignant

neoplasms, jaw cysts, fractures of the jaws due to trauma, inflammatory disorders such as osteoarthritis and rheumatoid arthritis, myofascial pain dysfunction syndrome and internal derangement, orthognathic jaw discrepancies, edentulous maxilla or mandible, and dental arch discrepancies. TMJ internal derangement in advanced stage may be associated with osteoarthritis.<sup>[18]</sup> Other factors of the secondary inflammatory component from the neighboring regions such as otitis, maxillary sinusitis, and tonsillitis must also be ruled out. Systemic factors include rheumatoid arthritis, psoriasis, ankylosing spondylitis, pseudogout, and endocrine disturbance. Presence of specific bacterial organisms such as *Staphylococcus aureus*, *Streptococcus mitis*, *Micobacterium*

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*fermentans*, *Actinobacillus*, and *Chlamydia* spp. in the synovial fluid have been found.<sup>[2]</sup>

TMJ disorders are most commonly seen between ages of 20 and 70 years. The most common are pain dysfunction syndrome, internal derangement, osteoarthritis, and trauma. The American Academy of Orofacial pain classified TMJ osteoarthritis into two categories. Primary is characterized by the absence of any distinct local or systemic factor while secondary is associated with previous traumatic event or disease. Inflammation mainly affects the posterior disc attachment and anterosuperior surface of the condylar head of TMJ with inflammatory mediators in the synovial fluid propagating the degenerative process.<sup>[1,17]</sup>

In osteoarthritis, symptoms such as pain at rest and during maximal mouth opening, and chewing, tenderness to palpation of the joint, clicking and popping sounds on closing and opening the mouth, crepitation, decreased mouth opening due to joint hypomobility, articular disc abnormalities, and stiffness of the joint in early morning are noticed. Among the temporomandibular disorders, internal derangement is the most frequent type of disorder which is characterized by several stages of dysfunction involving the condyle-disc relationship.<sup>[3,4]</sup>

In the management of TMJ pain, various therapeutic and surgical modalities have been in vogue. However, they are applicable depending on the clinical presentation of the patient and proper systematic diagnosis. The temporomandibular pain must be differentially diagnosed by delineating each etiologic factor responsible for it. When the nonsurgical methods do not provide good prognosis often surgical methods such as arthrocentesis, disc repositioning, meniscectomy, eminectomy, disc replacement, and joint reconstruction are applied.

The present study mainly emphasizes on the therapeutic long-term management of the TMJ arthralgia due to osteoarthritis, rheumatoid arthritis, and internal derangement. Usage of glucosamine with chondroitin and esterified fatty acids was found effective and useful in preventing and controlling chronic pain, the progression of inflammatory and degenerative changes in TMJ osteoarthritis, and internal derangement.

## Materials and Methods

A randomized study was conducted between January 14, 2017 and January 15, 2018, on patients who underwent treatment at the Dental unit and Department of Head and Neck Oncology, Regional Cancer Centre, Guwahati, India. An ethical committee clearance was obtained for the study.

Thirty-two patients diagnosed with temporomandibular joint pain due to osteoarthritis or rheumatoid arthritis and early stages of internal derangement (Stage I and II of Wilkie's classification), and those patients who underwent segmental mandibulectomies with primary repair, but

developed osteoarthritis and clicking sound alone (without any microvascular free flap reconstruction) for malignancies of mandible, lower gingivobuccal sulcus, and floor of the mouth were only included in the study. A total of 192 patients who underwent segmental mandibulectomy and postoperative radiotherapy were screened. Patients of segmental mandibulectomy were divided into three categories; (1) anterior, (2) lateral (right or left), and (3) hemimandibulectomy.<sup>[5,6,26]</sup> Patients who were on follow-up since 1–10 years were included in the study. The age of the patients ranged between 20 and 76 years.

Patients with jaw fractures, myofascial dysfunction syndrome, TMJ ankylosis, and patients who underwent mandibular reconstruction with microvascular free flap were excluded.

Diagnostic aids such as orthopantomogram, computed tomography (CT) scan of the oral cavity, previous health records of the patient, and detailed case history were taken into account. All patients were clinically examined thoroughly for TMJ pain and associated factors such as mode of onset, duration, intensity and type, TMJ deviation, and clicking sounds on opening and closing the mouth. For assessment of rheumatoid arthritis, blood tests such as serum erythrocyte sedimentation rate, Rh factor, C-reactive protein, and antinuclear antibodies were advised.

Nonsteroidal anti-inflammatory drugs (NSAIDs) were prescribed to patients of TMJ osteoarthritis and internal derangement as a routine medication for 3–5 days. Alternatively, oral regimen of two nutritional supplements which are, (1) a tablet containing glucosamine 750 mg, collagen 150 mg, and chondroitin sulfate 50 mg along with other ingredients such as Vitamin B12, C, D3, E, folic acid and minerals such as Fe, Mn, Zn, Se, and Cu (twice daily) and (2) a capsule containing cetyl myristoleate-20.5 mg, docosahexaenoic acid-9.5 mg, and eicosapentanoic acid (EPA)-13.5 mg (once daily) was prescribed for 2–3 months duration to patients presenting with initial progressive osteoarthritis, rheumatoid arthritis, and early stages of internal derangement (Stage I and II of Wilkie's classification). Patients with confirmatory findings of rheumatoid arthritis were advised to continue the aforesaid medication and were referred to rheumatologist for further management.

We advocated measures such as patient counseling, consumption of soft semisolid diet, mouth opening exercises, bilateral chewing, intermaxillary fixation with elastics for 6–8 weeks, occlusal splints to control mandibular deviation and improve neuromuscular coordination for patients with TMJ osteoarthritis, and internal derangement not associated without any tumor pathologies.

Fifty-one patients of lateral segmental mandibulectomy and 29 patients of anterior segmental mandibulectomy were reconstructed with bipaddled pectoralis major myocutaneous

flap. In segmental mandibulectomy patients, along with the aforesaid medication, treatment modalities such as guide bar appliance, active mouth opening and jaw stretching exercises with Heister’s mouth opener, and physiotherapy following surgery and postoperative radiotherapy were implemented till adequate mouth opening was achieved. Patients were reviewed and evaluated periodically at an interval of 15 days, 1 month, 3 months, 6 months, and 1 year, respectively. Further, patients were asked to continue the medication depending on recurrence of the symptoms.

**Results**

Out of 14 patients of primary TMJ osteoarthritis, 9 were male and 5 were female, and among patients of rheumatoid arthritis, 2 females and 1 male were present. On clinical presentation, these patients presented with unilateral or bilateral TMJ arthralgia during opening and closing mouth. Joint stiffness and limited mouth opening, deviation of the mandible with pain during opening mouth, and jaw movements were observed in almost all patients. Out of 12 patients of TMJ internal derangement, opening click of TMJ was seen in 7 patients and 5 patients had both opening and reciprocal clicking sounds with reducible articular disc (stage I, II). Internal derangement was associated with osteoarthritis in 7 patients [Tables 1, 3 and Graph 1]. The age group of patients ranged between 20 and 45 years. For radiological assessment, orthopantomograms were advised to confirm the clinical findings. CT scan was advised in selective cases.

One-hundred and ninety-two patients of segmental mandibulectomy were screened and 79 patients (42 male and 37 female) of lateral segmental mandibulectomy were found to develop osteoarthritis in the longer contralateral mandibular segment (41.14%, Figures 1-5). This finding was statistically significant in our study [ $P < 0.05$ , Table 2 and Graph 2]. In these patients, we observed that there was an increased repetitive masticatory overload on the muscles of mastication of longer mandibular segment, which further lead to osteoarthritic changes in the contralateral TMJ of the longer mandibular segment. Patients complained of dull aching pain during mastication

along with limited mouth opening. Anterior displacement of the articular disc on the contralateral longer mandibular segment was seen in 31 patients (62%). Osteoarthritis changes in hemimandibulectomy and anterior segmental mandibulectomy are displayed in Tables 1, 2 and Graph 2. Age group of these patients ranged between 30 and 76 years.

On follow-up, we observed that osteoarthritis and subsequent degenerative changes were observed over 2 years of average period after commencement of

**Table 1: Type of osteoarthritis and number of patients**

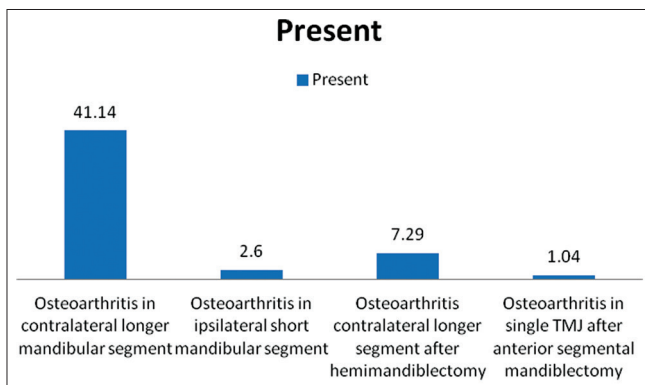
Type of osteoarthritis	Number of patients
Primary TMJ osteoarthritis	14
Rheumatoid arthritis with TMJ involvement	3
Internal derangement	12
Internal derangement with osteoarthritis	7
Lateral segmental mandibulectomy patients with osteoarthritis (secondary) in the contralateral segment of the mandible	79
Osteoarthritis in the ipsilateral mandibular segment	5
Hemimandibulectomies	14
Anterior segmental mandibulectomies	2

TMJ: Temporomandibular joint

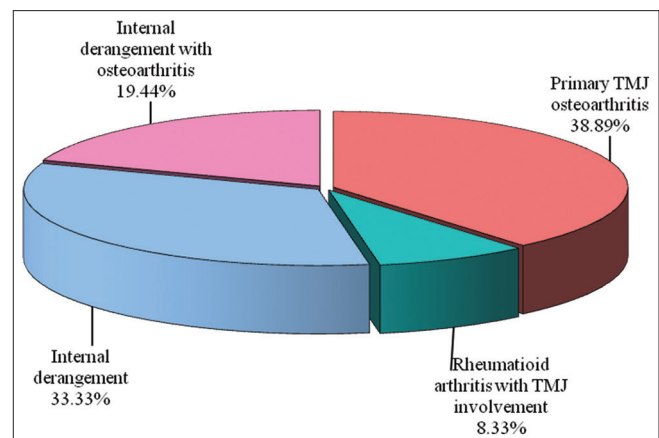
**Table 2: Patients of osteoarthritis after segmental mandibulectomy and postoperative radiotherapy**

	Present (%)	Absent (%)	P
Osteoarthritis in contralateral longer mandibular segment	79 (41.14)	113 (58.85)	0.0001*
Osteoarthritis in ipsilateral short mandibular segment	5 (2.60)	187 (97.40)	0.0001*
Osteoarthritis contralateral longer segment after hemimandibulectomy	14 (7.29)	178 (92.71)	0.0001*
Osteoarthritis in single TMJ after anterior segmental mandibulectomy	2 (1.04)	190 (98.96)	0.0001*

\* $P < 0.05$ . TMJ: Temporomandibular joint



**Graph 1: Patients with temporomandibular joint osteoarthritis and rheumatoid arthritis without any mandibular pathologies or surgical procedures**



**Graph 2: Patients of osteoarthritis after segmental mandibulectomy and postoperative radiotherapy**



segmental mandibulectomy and postoperative radiotherapy. Findings of TMJ on the ipsilateral side were consistent with that of Hamada *et al.*<sup>[7]</sup> However, the osteoarthritis on the ipsilateral side was observed in five cases.

We found that irrespective of the three categories of segmental mandibulectomy patients osteoarthritis and degenerative changes were seen because of mandibular discontinuity and deliberate use of longer (contralateral)

segment for mastication which increased mechanical overload on TMJ.

All patients showed satisfactory improvement on periodic follow-up with the combination therapy of soft diet, mouth opening exercises, and oral regimen of nutritional supplements. Reduction in the intensity of pain and clicking sounds and improvement in joint flexibility and function were noticed approximately after 6–8 weeks. Prosthodontic denture rehabilitation was difficult in lateral segmental mandibulectomy and hemimandibulectomy cases due to mandibular deviation and lack of adequate vestibular depth for retention. Contralateral segment deviation and osteoarthritic changes were seen in 22 patients (43.1%) of lateral segmental mandibulectomy.

**Table 3: Patients with temporomandibular joint osteoarthritis and rheumatoid arthritis without any mandibular pathologies or surgical procedures**

	Number of respondents (%)
Primary TMJ osteoarthritis	14 (38.89)
Rheumatoid arthritis with TMJ involvement	3 (8.33)
Internal derangement	12 (33.33)
Internal derangement with osteoarthritis	7 (19.44)
Total	36 (100.00)

TMJ: Temporomandibular joint

**Discussion**

The great challenge in arthralgia of TMJ is that most often osteoarthritis cannot be diagnosed until it becomes symptomatic at which point structural changes would have already occurred leading to a degenerative disease. Proper approach and diagnosis are essential for detecting the inflammatory degenerative changes in TMJ.

TMJ differs from other joints in the body because a layer of fibrocartilage and not hyaline cartilage covers it. Mandibular condyle is located just beneath the fibrocartilage, making it particularly vulnerable to inflammatory damage. Articular cartilage receives its nutrition from synovial fluid.



Figure 1: Mandibular deviation seen medially with trismus after segmental mandibulectomy and postoperative radiotherapy



Figure 2: Osteoarthritis of the right temporomandibular joint with dislocation of the ipsilateral condylar segment of segmental mandibulectomy



Figure 3: Osteoarthritis of the right temporomandibular joint with condylar head resorption in relation to contralateral mandibular segment



Figure 4: Anterosuperior surface of the condyle prone to osteoarthritis and frictional changes as seen in the right temporomandibular joint



**Figure 5: Anterosuperior surface of the condyle prone to osteoarthritis and frictional changes as seen in the right temporomandibular joint**

Inflammatory changes in the synovial fluid, therefore, influence metabolism of cartilage causing improper lubrication and nutrition. This leads to cartilage and collagen destruction, muscle and ligament weakness, reduction in the extracellular matrix, disc displacement and perforation, joint tightness, increase in the compressive loads on the posterior attachment, maladaptation of the joint, causing increased friction and adhesive wear which leads to osteoarthritis, and joint clicking and internal derangement over a gradual course of time. Thus, a strong rationale exists for therapeutic approaches that target bone resorption and formation, taking into account the complex mechanism of dynamic morphologic transformations that occur in between the joint tissues.<sup>[1,2]</sup>

In a study done by Cevitanes *et al.*, smaller condyles were seen in patients of osteoarthritis with significant bone loss in the superior and lateral articular surfaces. They observed that bone apposition/reparative proliferation in the anterosuperior surface of osteoarthritic condyle were characteristic of osteoarthritis morphology leading to variability in condylar torque.<sup>[1]</sup> High impact and torsional loads on the joint may increase the risk of degeneration of normal joints and individuals who have an abnormal joint anatomy, joint instability, disturbances of joint or muscle innervations, or inadequate muscle strength probably have a greater risk of degenerative joint disease.<sup>[25]</sup>

The development of intra-articular pathologic changes in the TMJ is considered to be closely related to abnormal mechanical loads. It has been reported that mechanical overloading on the TMJ can lead to degradation of the articular cartilage. Israel *et al.* reported that parafunctional masticatory activity, which affects the overloading of TMJ contributes to osteoarthritis associated with fibrous adhesion. Kawai *et al.* stated that mechanical overloading of TMJ induced osteoarthritis like lesions with simultaneous influence on jaw muscle activity, especially at the low activity level.<sup>[11]</sup> Unilateral TMJ osteoarthritis is related to the dentofacial morphology, and it is associated with masticatory muscle imbalance.<sup>[16-24]</sup>

Hamada *et al.* have done a study on 17 patients (11 without condyle group and 6 with condyle group), to examine the intraarticular conditions in unloaded TMJs

(TMJs of the shorter mandibular segment) after segmental mandibulectomy. Deformed discs were observed in 7 of the 11 joints of without condyle group but were not observed in with condyle group, in which there was a normal relationship between the disc and condyle. They observed that in the unloaded TMJs articular degeneration is induced by disturbance of synovial fluid metabolism but that bony conditions are not affected. Furthermore, they stated that the rate of anterior disc displacement was 28.6% in TMJs with the major mandibular fragment and 10% in TMJs with condylar fragment alone. They concluded that the condyle not connected to the mandibular body often dislocates anteriorly out of the glenoid fossa while retaining normal relation with the disc.<sup>[7,15]</sup> It has been suggested that joint effusion reflects an inflammatory reaction in TMJs with internal derangement which may result in osteoarthritis.<sup>[23]</sup>

In our experience with segmental mandibulectomies, we observed that the mandibular drift is common following mandibulectomy especially in more aggressive mandibulectomy techniques involving larger defects. It is characterized by mandible drifting toward the side of the surgical defect. Mandibular drift is caused by loss of mandibular support at either the mandibular symphysis or TMJ. This results in malocclusion and can predispose to osteoarthritis of TMJ. Structural changes in TMJ may as well occur during intraoperative retraction and manipulation of the resectable mandibular segment inferolaterally during the segmental mandibulectomy procedure.

Our study mainly showed interest in knowing the status of the ipsilateral and contralateral TMJs, in patients of segmental mandibulectomies with primary closure alone (without mandibular reconstruction). These type of patients included who underwent segmental mandibulectomy with condyle and without condyle preservation (hemimandibulectomy). We observed that the contralateral TMJ was influenced by masticatory overload on muscles of mastication subsequently leading to degenerative changes and osteoarthritis. Postoperative radiotherapy changes such as fibrosis and trismus in muscles of mastication aggravated TMJ osteoarthritis, especially in the contralateral major mandibular fragment.

Clinically, we observed that intra-oral soft-tissue component at the segmental mandibulectomy site got fibrosed resulting in trismus due to postoperative radiotherapy changes. There was a lack of buccal vestibule as well. Eventually, extramasticatory load impinged on the contralateral mandibular segment, which existed in a position of deviation and malocclusion. Inevitably, the masticatory load in this area increases as the patient uses the contralateral remnant segment more for mastication. We assessed this as a possible cause for osteoarthritis in the contralateral (load bearing) TMJ. The opening click was felt on palpation in the contralateral segment of the mandible in most of the cases.

In severe inflammatory conditions of temporomandibular osteoarthritis and internal derangement NSAIDs, acetaminophen, tramadol, opioid analgesics, injection of corticosteroid, sodium hyaluronate into TM joint, arthrocentesis, arthroscopy surgery, discectomy, eminectomy, and condylectomy were implemented as described in the literature. TMJ osteoarthritis can be successfully treated by conservative nonsurgical techniques even in the advanced stages which forms the first better option. Patients not responding to conservative therapy are further managed with surgical intervention subjective to the clinical presentation of the patient.<sup>[11]</sup>

Use of NSAIDs and opioid analgesics has got a limited role such as in acute pain, which is not advisable frequently, to all patients of TMJ arthralgia, on long-term basis (as in autoimmune diseases like rheumatoid arthritis) since they have side effects such as platelet destruction, bone marrow depression, nephrotoxicity, peptic ulcer, and hepatotoxicity. Injection of corticosteroid into TMJ has got a limited application and studies pertaining to frequency of injecting it, remains debatable as long-term use results in osteoporosis, osteonecrosis myositis, and diabetes.

Nutritional supplements such as glucosamine, chondroitin, and diacerein which were prescribed to patients of osteoarthritis showed varying results in the literature. Although the benefit of glucosamine and chondroitin in the treatment of osteoarthritis is debatable, multiple studies show a positive impact.<sup>[8-14]</sup>

Glucosamine and chondroitin work together to support and protect the collagen and maintain the lubricating properties of fluids around the joints. Esterified fatty acids improve the structure and function of bone by inducing the collagen production, new bone deposition, and prevention of bone resorption and mineralization. They have been vividly used in general body joint pains such as cervical spondylosis, knee and hip joint arthritis (both osteoarthritis and rheumatoid arthritis), and in stiffness of the joint due to arthritis with no adverse effects.<sup>[8,12-14]</sup>

Esterified (Cetylated) fatty acids such as cetyl myristoleate-20.5 mg, docosahexaenoic acid-9.5 mg, and EPA-13.5 mg have been clinically proven to reduce joint pain and inflammation. These enhance cell fluidity and elasticity to act as a cushion for the bones and joints and provide constant lubrication for the joints allowing the cell membranes to stop the inflammatory chemicals. It also helps to stop the chemicals attacking the membrane which makes the joints stiffen, to gain more flexibility. Both the above medication reportedly has no side effects or drug interaction.<sup>[9,10]</sup>

However, in our study, we thoroughly observed that the prescription of glucosamine and chondroitin and capsule containing esterified fatty acids showed positive results and patient satisfaction. We observed that the degeneration of articular cartilage and the resorption of condylar joint

were controlled and progression of osteoarthritis markedly reduced in the patients who presented with initial stages of osteoarthritis and internal derangement of TMJ.

The frictional movements of the joint were reduced which rendered better lubrication of the joint. Thereby, there was a decrease in the intensity of pain which also improved the function, jaw mobility, flexibility of TM joint, and also aided in the prevention and control over the progression of the degenerative disease. Furthermore, we observed that although there was no regeneration of the articular cartilage component, the condylar bone resorption was effectively controlled in the previous resorptive surfaces of the condylar zone which facilitated protection of the remnant bony surface, as we compared the earlier tomograms of the patients at frequent intervals.

## Conclusion

Conservative management is the gold standard in the initial stages of osteoarthritis and internal derangement of TMJ. We found that regimen of glucosamine with chondroitin and esterified fatty acids has shown promising and satisfactory results in reduction in the severity of pain and inflammation of the TMJ, improvement of joint function by restoring joint architecture and kinematics. As the medication has better patient compliance with good performance status, we recommend the application of the above drug regimen to the needful patients. However, further studies in this regard are anticipated in the future in relation to temporomandibular osteoarthritis.

Surgical modalities come into role as the last resort after conservative methods have been applied based on advanced stage of TMJ osteoarthritis and internal derangement. However, reconstruction with microvascular free fibula osteomyocutaneous flap is the only better option to prevent mandibular deviation and TMJ osteoarthritis by thus restoring the proper anatomic contour and function of balancing the masticatory load.

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## Conflicts of interest

There are no conflicts of interest.

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