IOSR Journal of Dental and Medical Sciences (IOSR-JDMS)
e-ISSN: 2279-0853, p-ISSN: 2279-0861.Volume 23, Issue 6 Ser. 1 (June. 2024), PP 26-32
www.iosrjournals.org

Internal Derangement Of Tmj – A Review

Dr. Ritu Versha [1], Dr. Sachin Sachdeva [2], Dr. Sonika Phogat [3]
(Post Graduate, (Post Graduate, Department Of Oral And Maxillofacial Surgery, P.D.M Dental College And Research Institute, India) [1]
(Professor & Hod, Department Of Oral And Maxillofacial Surgery, P.D.M Dental College And Research Institute, India)[2]
(Senior Lecturer, Department Of Oral And Maxillofacial Surgery, P.D.M Dental College And Research Institute, India)[3]

Abstract
Internal derangements of the temporomandibular joint are conditions in which the articular disc has become displaced from its original position the condylar head. Relevant anatomic structures and their functional relationships are briefly discussed. The displacement of the disc can result in numerous presentations, with the most common being disc displacement with reduction (with or without intermittent locking), and disc displacement without reduction (with or without limited opening). These are described in this article according to the standardized Diagnostic Criteria for Temporomandibular Disorders, as well as the less common posterior disc displacement. Appropriate management usually ranges from patient education and monitoring to splints, physical therapy, and medications. In rare and select cases, surgery may be necessary. However, for the majority of internal derangements, the prognosis is good, particularly with conservative care.

Keywords: *Disc displacement, internal derangement, posterior disc displacement, temporomandibular disorders*

Date of Submission: 24-05-2024 Date of Acceptance: 04-06-2024

I. Introduction

Internal derangement (ID) is a common condition affecting the temporomandibular joint (TMJ) that involves displacement of the articular disc from its normal position between the mandibular condyle and temporal bone[1,2,3,4,5]. It is considered the most frequent cause of TMJ disease and dysfunction.

ID can present in various ways, with the most common forms being[4,5]:

1. Disc displacement with reduction
2. Disc displacement without reduction

Less commonly, posterior disc displacement can occur.[5]

The displacement of the disc can lead to symptoms such as pain, clicking, locking, and headaches[1,4]. Diagnosis is based on clinical history, physical examination findings, and sometimes imaging with MRI[1,4].

Treatment for ID ranges from conservative measures like patient education, soft diet, occlusal splints, and physical therapy to surgical options in refractory cases. However, the prognosis is generally good, especially with early conservative management, as ID is often self-limiting.

This review article will discuss the relevant anatomy, pathogenesis, clinical presentation, diagnosis, and management strategies for internal derangements of the TMJ. Understanding this common condition is important for clinicians managing TMJ disorders.

II. History And Brief Literature Review

Internal derangement of the temporomandibular joint (TMJ) has a rich history dating back to the early 19th century. The term "internal derangement" has been used for over a century in surgical and orthopedic literature to describe disturbances between the articulating components of the TMJ, initially alluding to damage to internal structures and dysfunction associated with changes in joint position[6]. In the 1970s and 1980s, TMJ internal derangement was perceived as a mechanical problem, leading to attempts to reposition or replace the articular disc within the joint[6].

Hey and Davies first described internal derangement in 1814 as a localized mechanical fault interfering with the smooth action of a joint, highlighting the importance of the normal anatomic relationship between the disc and condyle for smooth joint movement. Over the years, our understanding of internal derangement, its causation, and treatments has evolved, allowing for effective nonsurgical and surgical management strategies to be developed[6].

The history of internal derangement of the TMJ includes significant advancements in diagnosis and treatment approaches, from early attempts at repositioning the disc to the development of surgical techniques like arthrocentesis, arthroscopy, and open joint surgery[6]. Understanding the historical context of internal derangement is crucial for appreciating the evolution of management strategies and the current approaches used to address this common TMJ disorder.

Early 1900s

The term "internal derangement" was first used in surgical and orthopedic literature over a century ago to describe disturbances between the articulating components of the TMJ, alluding to damage to internal structures and dysfunction associated with changes in joint position[4]. Alterations in the disc-condyle relationship were suspected as early as 1887 by Sir Astley Cooper[4].

1970s-1980s

In the 1970s and 1980s, TMJ internal derangement was perceived as a mechanical problem, leading to attempts to reposition or replace the articular disc within the joint[4]. In 1979, McCarty and Farrar stressed the relevance of disc displacement as a major disorder of the TMJ[4]. Conservative therapy with mandibular manipulations, oral appliances, and surgical disc repositioning were performed for patients with persistent symptoms[4].

2000

A review by Laskin in 2000 highlighted the distinction between myofascial pain and internal derangement of the TMJ. He emphasized that patients with joint-related symptoms like internal derangement may benefit more from surgical management compared to those with muscle-related symptoms that can be treated non-surgically.[4]

2008

Scrivani et al. published a comprehensive review on temporomandibular disorders in the New England Journal of Medicine in 2008. They discussed the various types of internal derangement, including disc displacement with and without reduction, and the importance of early diagnosis and treatment to prevent progression of the condition.[5]

2010

A review by Mercuri in 2010 provided an in-depth overview of internal derangements of the TMJ. He described the evolution of treatment approaches, from early attempts at disc repositioning to the development of more conservative and surgical management strategies.[3]

2012

Mercuri's chapter in the 2012 edition of Peterson's Principles of Oral and Maxillofacial Surgery further elaborated on the management of internal derangement, including the role of arthrocentesis, arthroscopy, and open joint surgery.[3]

2015

A 2015 review by Klasser highlighted the importance of accurate diagnosis of internal derangement based on clinical history and examination, as well as the use of imaging modalities like MRI to confirm the presence and extent of disc displacement.[2]

2019

In 2019, a review by Bhargava et al. discussed the various treatment modalities for internal derangement, ranging from conservative measures to surgical interventions, and emphasized the need for early intervention to improve outcomes.[4]

2021

A 2021 review by Rani et al. provided a comprehensive overview of the anatomy, clinical manifestations, diagnosis, and management of internal derangement of the TMJ. They highlighted the evolving understanding of this condition and the importance of a multidisciplinary approach to treatment.[1]

These reviews collectively demonstrate the ongoing research and advancements in the understanding and management of internal derangement of the TMJ over the past two decades, with a focus on early diagnosis, conservative treatment, and surgical options for refractory cases.

New Classification System

A recent prospective clinical study aimed to establish a new classification system for TMJ internal derangement based on MRI findings correlated with clinical presentation [8]:

1. Stage 0: Normal MRI study
2. Stage 1A : MRI shows normal condyle-disc-fossa relationship, but with pathologic changes of the lateral pterygoid muscle and/or joint effusion.
3. Stage 1B: MRI shows normal condyle-disc-fossa relationship, but with disc deformity.
4. Stage 2: MRI shows anterior disc displacement with reduction.
5. Stage 3A: MRI shows anterior disc displacement without reduction, with mouth opening ≤ 35 mm.
6. Stage 3B: MRI shows anterior disc displacement without reduction, with mouth opening > 35 mm.
7. Stage 3C: MRI shows anterior disc displacement without reduction, with disc perforation.

This new classification system provides a detailed description of the pathologic changes in the joint based on MRI findings and correlates them with clinical presentation. It aims to guide a specific nonsurgical treatment protocol for each stage.

Previous Classifications

Previous classification systems, such as the one proposed by Wilkes, viewed internal derangement as a progressive disorder from early to late stages. However, the new classification identified patients with disc perforation without disc displacement, which was not accounted for in the Wilkes system.[6]

Other recent classifications have been based solely on MRI scoring without clinical correlation, limiting their clinical applicability.[6]

Based on the search results provided, here is a summary of the Wilkes classification of internal derangement of the temporomandibular joint (TMJ):

The Wilkes classification is a widely used system that categorizes the extent of joint damage in internal derangement of the TMJ. The stages are as follows [6]:

1. Stage I (Early Reducing Disc Displacement):
- Minimal or no pain
- Disc displacement with reduction
- Minimal or no joint sounds

2. **Stage II (Late Reducing Disc Displacement)**:
- Intermittent pain
- Disc displacement with reduction
- Distinct joint sounds (clicking, popping)

3. **Stage III (Non-Reducing Disc Displacement - Acute/Subacute)**:
- Moderate to severe pain
- Disc displacement without reduction
- Limited mouth opening

4. **Stage IV (Non-Reducing Disc Displacement - Chronic)**:
- Moderate to severe pain
- Disc displacement without reduction
- Limited mouth opening
- Degenerative changes in the joint

5. **Stage V (Non-Reducing Disc Displacement - Chronic with Osteoarthrosis)**:
- Severe pain
- Disc displacement without reduction
- Limited mouth opening
- Significant degenerative changes in the joint

The Wilkes classification provides a framework for understanding the progressive nature of internal derangement, from early disc displacement with reduction to advanced stages with chronic disc displacement and osteoarthritic changes[5]. This classification system has been widely used to guide treatment approaches, with more conservative management for earlier stages and more invasive surgical options for later, more severe stages of internal derangement.

Aetiology

Scientists explains that osteoarthritis as an inflammatory process, being most frequent one is the TMJ disorder, characterised by proliferative changes in the synovial and primary degeneration of the cartilage and surrounding tissues.[8,9] It is found that 28% of the adult population have symptoms and clinical signs of temporo mandibular joint disorder.[10,11]The aetiological factors of TMJ disorders as follows: systemic diseases, secondary inflammatory component from the neighbouring regions (otitis, maxillary sinusitis, tonsillitis), trauma (chronical), prevalence of dental arch defects e.g. missing of molar teeth[12] , malocclusion, endocrinological disturbances, odontogenic infections (impacted third molars). Presence of specific bacterial organisms such as *Staph.aureus, Strep. mitis, M. fermentas, Actinobacillus actinomycetemcomitans* in the synovial fluid have been found .[13] Serum antibodies against *Chlamydia species* in patients with mono arthritis of the TMJ have also been reported. [14]

Pathogenesis

Inflammation mainly affects the posterior disc attachment.[8,15] Several inflammatory mediators play an important role in the pathogenesis of TMJ disorders like tumor necrosis factor alpha (TNFalpha), interleukin-1beta (IL-1beta) , prostaglandin E2 (PGE2), leukotriene B4 (LkB4), matrix metalloproteinases (MMPs), serotonin- 5-hydroxytryptamine (5-HT).[10,16] MMPs are the early marker or detector to determine temporo mandibular joint arthritis. [17] Serotonin is the mediator of pain and inflammation is produced in enterochromaffin cells of the gastrointestinal mucosa and absorbed by platelets. It is also produced in the synovial membrane and in the synovial fluid which causes TMJ pain in cases of systemic inflammatory joint diseases .[18,19]

Evaluation And Diagnosis

History and Physical Examination

Complete History taking from the patient , head and neck evaluation, general physical examination and clinical examination are essential .

Laboratory Studies

Laboratory studies are rarely indicated for ID/OA. In other suspected conditions of the TMJ, for example rheumatoid arthritis, the appropriate tests should be ordered.

Imaging

It is necessary to establish the presence or absence of pathology and stage of disease in order to select the appropriate treatment, assist in prognosis, and to assess patient response to therapy. Imaging results will influence treatment strategy.

Radiographs

This can provide the information include plain films, panoramic films, and tomograms (frontal and lateral). The disc and associated soft tissue structures should also be imaged by Magnetic resonance imaging (MRI) [20,21] or arthrography.[22]Other radiological studies may also be indicated.

Computed tomography is very useful to assess bone abnormalities like ankylosis, dysplasia, growth abnormalities, fractures, osseous tumors. [23] 33-D CT is a valuable diagnostic advancement for complex cases needing major reconstructive surgery. A stereo lithography model of a patient's maxillofacial skeleton can be fabricated utilizing 3-D CT technology.[23,24]

Magnetic Resonance is used to assess soft tissues, bone marrow changes, disc position, morphology, mobility, and joint effusion. [25,26] Cine MRI has been used to study the static disc or anchored disc.

Arthrography

MRI has largely replaced by arthrography [23] as the primary imaging study for the pathology of the disc .

Isotope Bone Scan

Radioactive isotope bone scans have a high sensitivity for detecting metabolic activity and inflammation. [27] SPECT is a form of isotope imaging utilizes the computer techniques to improve visualization of the plane of interest.

Non-Invasive Methods

Non-surgical methods such as modification of the diet , occlusal splints, physical therapy, pharmacotherapy, transcutaneous electrical nerve stimulation (TENS) and stress reduction technique followed by surgical methods such as arthroscopy, reconstruction arthroplasty (disk repositioning), meniscectomy, and repair

of perforation of disk.[29,30] When these methods are unsuccessful, they are managed by surgical methods. The surgical treatment is based on change of the morphology and position of the disc, removal of the disc with or without replacement. [31]

Physical Therapy

Physical therapy is used by TMD patients to keep the synovial joint lubricated, and to maintain the jaw motion. One of the exercise for the jaw is to open the mouth to a comfortable fully-open position and then apply a slight additional pressure to open the mouth fully. Another exercise includes stretching the jaw muscles by doing various facial expressions. Avoiding extreme jaw movements, taking medications, applying moist heat or cold packs, eating soft foods are other ways that may keep the disorder from worsen.[5]

Splints

They are plastic mouthpieces that fit over the upper and lower teeth. They prevent the upper and lower teeth from coming together, lessen the effects of clenching or grinding the teeth. Bruxism also causes the TMJ dysfunction due to tooth attrition and subsequent malocclusion; myofascial strain, fatigue or fibrosis of masticatory muscles and capsulitis and adhesions within the TMJ joint space. Splints are effective in reducing the intensity of pain for patients with pain in jaw and masticatory muscles by compensating for or correcting perceived bite defects of the sufferer. The studies on evidence-based medicine for splint therapy, however, have shown equivocal results. The long-term effectiveness of the therapy has been widely debated and remains controversial. [5]

Pharmacotherapy

The pharmacologic agents which are commonly prescribed nonsteroidal anti-inflammatory drugs (NSAIDs) to reduce inflammation. However, research is needed to exploit long term use and to identify whether the advantages in the management of pain and inflammation outweigh the negative side effects. Muscle relaxants also be prescribed for treatment of muscle pain and spasm. However, studies have failed to demonstrate that muscle relaxants are any more effective for pain relief than NSAIDs. To increase their benefit, muscle relaxants combination with NSAIDs are used. [32]

Arthroscopy

Lysis of adhesions and joint lavage are the most performed TMJ arthroscopic surgical procedures to relieve painful hypo mobility. The objective is to eliminate restrictions on the disc and lateral capsule, to wash out micro debris resulting from the breakdown of the articular surfaces, to irrigate the joint by enzymes and prostaglandins and to stimulate the normal lubricating action of the synovial membrane. In addition, the presence of fibrous adhesions in the superior joint space limits normal translatory function of the disc condyle complex. However, the pathogenesis of adhesions remains unclear, suspected that a macro or micro trauma induces haemorrhage; in the presence of limited joint mobility, the blood clot that forms will organize into a fibrous adhesion. Generally, a blunt trocar or blunt probe is utilized in a sweeping fashion between the disc and temporal bone to accomplish lysis of adhesion.[33]

In 1975, Ohnishi described the use of arthroscopy in the TMJ. The physical action of lysis and lavage in the superior joint space, rather than disc repositioning, is believed to be responsible for the success of arthroscopic surgery in earlier studies. [34, 35] This factor led to the use of TMJ arthrocentesis as relatively less invasive alternative to reduce the inflammation in the joint space and to restore the function.[34]

Arthrocentesis

Nitzan described the arthrocentesis ,simplest and minimal invasive form of surgery in the TMJ, aim to release the articular disc and to remove adhesion between the disc surface and the mandibular fossa by means of hydraulic pressure from irrigation of the upper chamber of the TMJ.[36] This is very effective procedure in patients with persistent or chronic closed lock and anchorage in the upper articular space. Lavage of superior joint space with saline exerts its effects through its ability to eliminate joint effusion to reduce the symptoms. It is considered as an intervening treatment modality between nonsurgical treatment and arthroscopic surgery.[37]Being the least invasive and simplest form of surgical interventions into the TMJ, this procedure carries a very low risk and relatively easy to proceed in dental chair office under local anaesthesia alone or in combination with conscious sedation. [38]

Discectomy And Disc Replacement

Discectomy used to regain the mandibular motion and to reduce orofacial pain, and may be followed by disc replacement. It has been shown in 5- and 10-year postoperative follow-ups to increase mandibular motion in patients previously showing no improvement with non invasive management modality. Patient experience with

disc replacement demonstrates the unanswered need for autologous tissue replacements that are capable of function in the complex loading environment of the TMJ, patients experiences continued joint degeneration need a functional, non pathogenic disc replacement. [32]

Joint Reconstruction

Several techniques have been proposed for reconstruction of portions of the joint or the entire joint itself. A hemiarthroplasty may be used to replace the superior articulating joint surface. During reconstruction, joint adhesions are lysed and a Vitallium alloy fossa-eminence prosthesis, manufactured by TMJ Implants, is implanted to replace the temporal component of the joint. Importantly, condylar change often accompanied by degenerative change in the temporal component of articulation. In this case, total joint reconstruction may be necessary. If immune-mediated processes are not present, a costochondral graft permits a comprehensive reconstructive option in which autologous costochondral segments replace the condyle with a biologic graft, as a native tissue, its inherent adaptability and lack of immunogenic potential offer significant advantages over alloplastic materials. Alloplastic alternatives appear to be better suited for the treatment of these patients and those with immune-mediated degenerative processes. The currently available U.S. Food and Drug Administration– approved alloplastic total joint replacement systems include The Christensen Total Joint System (TMJ Implants), the TMJ Concepts System (TMJ Concepts), and the Biomet Micro fixation prosthetic total joint (Biomet Micro fixation). Implant lifetimes are in the range of 10 to 15 years; considering the average age of TMD patients, secondary surgery is often necessary. [32]

Intra Articular Injection of Cortico Steroid

Intra articular injection of cortico steroids alone [40, 41] or after arthrocentesis provides long-term palliative effects on subjective symptoms and clinical signs of TMJ pain. Recently, Sodium Hyaluronate (SH) has been proposed as an alternative therapeutic agent which is high viscous, high molecular substance plays an important role in joint lubrication and protection of the cartilage.[39]

Various studies have demonstrated the use of drugs like Morphine, Fentanyl, Bupivacaine, Corticosteroids and SH for the management of TMJ disorders. Corticosteroids have a potent anti-inflammatory action on synovial tissue and well known to reduce effusion, decrease pain and brings about an increase in range of motion of synovial joints;1 ml of betamethasone is routinely used at the end of lysis and lavage of superior compartment of TMJ.[36 ,42.]

Hyaluronic acid (HA) is a normal product of joint tissues that is continuously released into the synovial fluid, where serves as a lubricant, anti-inflammatory, and pain reliever and also acts as a adjunct. The most common viscous supplementation strategy is a series of either two intra-articular HA injections spaced 7–14 days apart or five injections each 7 days apart.[43]

Several randomized comparisons of intra-articular hyaluronic acid (sodium hyaluronate) and corticosteroid (betamethasone). Intraarticular injection of sodium hyaluronate or corticosteroid (betamethasone) following arthrocentesis has a considerable effect. [45]

Low Level Laser Therapy

AlGaAs 830 nm diode laser in continuous wave mode or He Ne laser 632 nm combined with a diode laser 904 nm in pulsed mode have shown clinical benefits in terms of reduction in pain and clicking. The application of laser beams diminishes pain while simultaneously reducing muscle contraction. When a local effect is desired, laser is effective by stimulating microcirculation and local cell tropism . When a general effect is needed by promoting pain relief for a variety of etiology , including irradiation of trigger points in myofacial pain, acting on tissue repair, reduction of edema and hyperaemia. Similarly, Bertolucci & Grey in 1995 reported significant improvement in articular noise, limitation of oral opening and also in the masticatory function through reduction of muscle contraction and of intra articular inflammation by LLLT. [46]The main effects of laser light used in LLLT on tissue include: Analgesic, Bio stimulating , Anti- inflammatory. Advantages includes aseptic, non-invasive, painless, nonpharmaceutical and reversible therapy, if used properly has no side effects. It has no postoperative discomfort. Disadvantage has been the high cost compared to the conventional therapies and the fast development in the field.[46]

Tissue Engineering Of The Tmj Disc

Early studies exploring tissue engineering of the TMJ disc laid the foundation and demonstrated the potential effort. The disc shows biomechanical properties that may be matched more easily in tissue-engineered constructs in contrast to other musculoskeletal soft tissues. With respect to shear stimulation, shear stress is experienced in vivo by the disc during joint rotation and translation and may be simulated in culture via a rotating wall bioreactor. Another study seem to corroborate the results obtained by Nicodemus et al demonstrating the beneficial application of static over dynamic compressive loading for condylar tissue engineering. Further

investigation is needed to facilitate the potential independent benefits of mechanical stimulation and the interrelated benefits of both mechanical and biochemical stimuli for both disc and condylar cartilage tissue engineering. [32]

III. Conclusion

Internal derangement of the temporomandibular joint (TMJ) is a common condition characterized by alterations in the morphology of the articular disc and associated ligaments, leading to dysfunction and pain in the jaw joint. The condition is typically diagnosed through clinical examination and imaging studies, such as MRI. Treatment options include nonsurgical and surgical interventions, intending to reduce pain, improve joint function, and restore normal anatomy. Early diagnosis and management are crucial to prevent the progression of degenerative joint disease. Non-steroidal anti-inflammatory drugs or muscle relaxants may be prescribed. Physical therapy and stress management may also help manage the condition. If the derangement becomes more severe or refractory to conservative and non–surgical treatment, it may be necessary to surgically repair, reposition, or possibly remove and consider replacing the disc or joint.

References

[1] Rani S, Ramprasad M, Reddy Nv, Krishnanjaneya Ph, Reddy Gv, Sharma R. Internal Derangement Of Temporomandibular Joint-A Review Of Anatomy, Clinical Manifestations, Diagnosis And Management. 2022 Aug 1 [Cited 2023 May 27]. Available From: Https://Www.Researchgate.Net/Publication/374750741_Internal_Derangement_Of_Temporomandibular_Joint-A_Review_Of_Anatomy_Clinical_Manifestations_Diagnosis_And_Management

[2] Klasser Gd. Internal Temporomandibular Joint (Tmj) Derangement. Merck Manuals Professional Edition. 2022 [Cited 2023 May 27]. Available From: Https://Www.Msdmanuals.Com/En-In/Professional/Dental-Disorders/Temporomandibular-Disorders/Internal-Temporomandibular-Joint-Tmj-Derangement

[3] Mercuri Lg. Internal Derangements Of The Temporomandibular Joint. In: Miloro M, Ghali Ge, Larsen P, Waite P, Editors. Peterson's Principles Of Oral And Maxillofacial Surgery. 3rd Ed. London: Bc Decker; 2012. P. 1001-1015.

[4] Bhargava D, Jain L, Deshpande A, Mehra H. Internal Derangement Of Temporomandibular Joint. J Family Med Prim Care. 2021 Oct 20;10(10):3677-3682. Doi: 10.4103/Jfmpc.Jfmpc_1524_20. Pmid: 34804004; Pmcid: Pmc8585524.

[5] Scrivani Sj, Keith Da, Kaban Lb. Temporomandibular Disorders. N Engl J Med. 2008 Dec 18;359(25):2693-705. Doi: 10.1056/Nejmra0802472. Pmid: 19092154.

[6] Oral And Maxillofacial Surgery For Cliniciankrishnamurthy Bonanthaya, Elavenil Panneerselvam, Suva Manuel, Vinay V. Kumar, Anshul Rai.© The Association Of Oral And Maxillofacial Surgeons Of India 2021

[7] Ayman F Hegab [1], Hossam Iabd Al Hameed [2], Khaled Said Karam [2] Classification Of Temporomandibular Joint Internal Derangement Based On Magnetic Resonance Imaging And Clinical Findings Of 435 Patients Contributing To A Nonsurgical Treatment Protocol. Sci Rep. 2021 Oct 22;11(1):20917. Doi: 10.1038/S41598-021-00456-7.

[8] Holmlund, A.B.& Axelsson S , Temporomandibular Arthropathy: Correlation Between Clinical Signs And Symptoms And Arthroscopic Findings, International Journal Of Oral & Maxillofacial Surgery, 25(3), June 1996, 266-271.

[9] Emshoff, R, Clinical Factors Affecting The Outcome Of Arthrocentesis And Hydraulic Distension Of The Temporomandibular Joint, Oral Surgery Oral Medicine Oral Pathology Oral Radiology Endodontics, 100(4),October 2005,409-414.

[10] Voog, Ü,Alstergren, P, Eliasson, S, Leibur, E, Kallikorm, R. & Kopp S, Inflammatory Mediators And Radiographic Changes In Temporomandibular Joints In Patients With Rheumatoid Arthritis, Acta Odontologica Scandinavica, 61(1), January 2003, 57-64.

[11] Voog, Ü, Alstergren, P, Eliasson, S, Leibur, E, Kallikorm, R. & Kopp S, Progression Of Radiographic Changes In The Temporomandibular Joints Of Patients With Rheumatoid Arthritis In Relation To Inflammatory Markers And Mediators In The Blood, Acta Odontologica Scandinavica, 62(1), January 2004.

[12] Tallents, R.H, Macher, D.J, Kyrkanides, S, Katzberg, R.W. & Moss, M.E.,Prevalence Of Missing Posterior Teeth And Intraarticular Temporomandibular Disorders, Journal Of Prosthetic Dentistry, 87(1), January 2002.

[13] Kim, S.J., Park, Y.H., Hong, S.P.,Cho, B.O., Park, J.W.& Kim, S.G. , The Presence Of Bacteria In The Synovial Fluid Of The Temporomandibular Joint And Clinical Significance: Preliminary Study, Journal Of Oral And Maxillofacial Surgery, 61(10) ,October 2003, 1156-1161.

[14] Paegle, D.I., Holmlund, A.B., Östlund, M.R. & Grillner, L. , The Occurence Of Antibodies Against Chlamydia Species In Patients With Monoarthritis And Chronic Closed Lock Of The Temporomandibular Joint, Journal Of Oral And Maxillofacial Surgery, 62(4), April 2004, 435-439.

[15] Leibur Et Al., 2010, Leibur, E., Jagur, O., Müürsepp, P.,Veede, L. & Voog-Oras, Ü, Long-Term Evaluation Of Arthroscopic Surgery

[16] With Lysis And Lavage Of Temporomandibular Disorders, Journal Of Cranio-Maxillo-Facial Surgery, 38(8), December 2010, 615-620.

[17] Alstergren, P., Kopp, S. & Theordosson, E, Synovial Fluid Sampling From Thetemporomandibular Joint: Sample Quality Criteria And

[18] Levels Of Interleukin- 1 Beta And Serotonin, Acta Odontologica Scandinavica,57(1), January 2003, 278-282 .

[19] Kamada, A., Kakudo, K., Arika, T., Okazaki, J., Kano, M.& Sakaki, T., Assay Ofsynovial Mmp-3 In Temporomandibular Joint

[20] Diseases, Journal Of Cranio-Maxillo- Facial Surgery, 28(3),June 2000,247-248.