Minimally Invasive Temporomandibular Joint Surgery Methods using Surgical Treatment of Hyaluronic Acid in Patients with Various Diseases

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Abstract

The complex approach to the treatment of patients with RD has been elaborated at the department. At the preparatory stage, the doctor rheumatologist assesses the activity of the disease and, in case of necessity, provides the adjustment of therapy in order to get the lowest activity / remission of the main disease for about ≥1 months. Temporomandibular joint (TMJ) involvement occurs in patients with different rheumatic diseases (RDs). Pain, limitation of mouth opening can lead to significant problems. Conservative treatments for TMJ lesions are not always effective. **Objective:** to evaluate the efficiency of minimally invasive surgical interventions (TMJ arthrocentesis and arthroscopy) in patients with RDs. **Patients and methods:** In case of TMJ dysfunction (the mouth opening, closure, chewing, speaking), and lateral and/or protrusion, discomfort, pain, all the degenerative changes detected on MRI need surgical treatment. 80 patients turned to our clinic center. Most of them (n = 70) were diagnosed with RD. Objective examination resulted revealed 93.8% of cases of the limitation in mouth opening and the articulation disorder. 19 patients (28.1%) had masticatory muscle hypertonicity, mostly bilateral (88,9%). In 62.9% of patients participating in the study, the damage to **TMJ** according to the international classification of Wilkes was attributed to stage IV, in 21.9 and 14.9% - to stage III and V, respectively. The clinical and instrumental investigations, patients with stages IV and V according to the Wilkes International

Classification, underwent TMJ arthroscopy and patients with III – TMJ arthrocentesis with arthro lavage. All the patients underwent TMJ magnetic resonance imaging at baseline and 6 months after treatment. After a surgical intervention, a gel containing hyaluronic acid was used as a fluid implant. 14th day and, 1, 6,12 months after the operation, the examination of the disks in the joints showed their normal movement and normal amplitude of the condyles. **Results and discussion**: After surgical treatment, all the groups were noted to have a significant decrease in TMJ pain intensity compared with the baseline level; moreover, the severity of TMJ pain most significantly decreased on day 7 after surgery. Later on, positive changes remained 12 hours after the operation, the patient noted mild periodic pain of the right TMJ while the mouth opening, which was estimated by VAS scale up to 10 mm by the patient. The size of the mouth opening increased up to 35 mm.

Keywords: Hyaluronic Acid, temporomandibular joint, Surgical Treatment

Introduction

The purpose of our research was to evaluate the effectiveness of arthrocentesis and arthroscopy of the TMJ in this category of patients.The topicality of the treatment of the patients with diseases of the temporomandibular joint (**TMJ**) is due to the wide spread of this pathology, the difficulties of early diagnosis of intra-articular lesions, the existence of various approaches to therapy. Over the past 15 years, both conservative and surgical methods for the **TMJ** treating, including the use of minimally invasive interventions, have been developing rapidly in maxillofacial surgery and dentistry (Guarda-Nardini.2012, Fernandez Sanroman.2016). Special interest is the surgical treatment of diseases in patients with rheumatic diseases (**RD**). The therapy in patients of this group requires not only an interdisciplinary approach, but also performing surgical operations during the period of minimal activity or remission of the primary disease. The **TMJ** diseases can occur in patients with various rheumatic disorders, but most often these joints are involved in the pathological process in patients with rheumatoid arthritis (**RA**). Thus, according to different authors, the frequency of lesions of the temporomandibular joint during **RA** widely varies: from 4,7 to 88,0%. Studies have shown correlation between the duration of rheumatoid arthritis and the pathology of the **TMJ**. It was noted that the **TMJ** diseases are more common in patients with more than 5 years of **RD** (Efanova NS. 2016, Tozoglu S. 2011, Manfredini D. 2012).

At the same time, in 20.5% of cases, acute asymmetrical TMJ arthritis, accompanied by severe pain and functional restriction of lower jaw movements, is detected in the debut of RA. According to various studies, in psoriatic arthritis (**PsA**), clinical and structural changes in the **TMJ** occur in

48–80% of cases, and as we know from other sources, in the debut of the disease – in 27,6 % of cases. Involvement of the **TMJ** in the pathological process in ankylosing spondylitis (**AS**) and systemic diseases of connective tissue is not well-studied. The literature data indicate that **AS** is found in 4–35% of cases (Dimitroulis G. 2013, Triantaffilidou K. 2013, Vaquerizo V. 2013). It was found that patients with systemic lupus erythematosus (**SLE**) are much more likely to complain of pain in the **TMJ,** while patients with systemic scleroderma are more likely to experience difficulties and limitations when opening the mouth. According to computer tomography (**CT**) and magnetic resonance imaging (**MRI**), in the vast majority of cases with **RD**, degenerative changes of the **TMJ** corresponding to stage IV – V according to Wilkes international classification, are detected, namely degenerative changes in the bone and cartilage structures of the joint and articular disc with deformity of articular surfaces, the formation of osteophytes, as well as the displacement of the articular disc (Martin-Granizo R. 2014, Karibe H. 2014, Reddy R. 2013).

One part of researchers thinks that performing open surgical interventions on the **TMJ** in patients with **RD** is associated with a greater risk of postoperative complications. Another part of researchers thinks that the use of minimally invasive methods of surgical treatment in this group of patients has great prospects in connection with the minimization of tissue damage during operations. There is no consensus on the use of conservative methods of treatment. Some authors believe that treatment with an occlusion-stabilizing device (**OSD**) and physiotherapy is the only correct approach, whereas, according to others, conservative methods have a number of limitations on the effect on the pathological process and are often inadequate or insufficiently effective (according to various sources, from 8 to 60% of cases) and lead to a relapse of the disease. This study was carried out taking into consideration the insufficient study of the use of minimally invasive surgical interventions in the treatment of **TMJ** in patients with **RD**.

Patients and Methods

A complex approach to treatment of the TMJ in patients in RD was elaborated at the Clinical Center and Department of Maxillofacial, Reconstructive and Plastic surgery of Tbilisi Aramyants Medical-Dental University. At the preparatory stage, a rheumatologist assesses the activity of the disease and, if necessary, corrects the therapy in order to achieve low activity / remission of the main disease within ≥1 months. In the same period, OSD is being prepared, the action of which is aimed at relaxation of the muscles involved in the movement of the lower jaw and centering the position of its condyles. Additionally, physiotherapeutic treatment is applied (magnetic therapy, laser radiation of the red spectral range). In case of

violation of the function of the TMJ (opening, closing of the mouth, chewing, speech), as well as the presence of later and / or protrusion, discomfort, pain, degenerative changes disclosed on MRI, surgical treatment is prescribed (McGain JP. 2011 Srouji S. 2016, Tvrdy P, 2015). In order to minimize intra-operative trauma in patients with RD, arthro lavage and arthroscopy of the TMJ are performed using specialized endoscopic instruments of small diameter (TMJ arthroscopy can be performed on a patient for both diagnostic and therapeutic purposes according to the method R.Martín-Granizo disc fixation for 2011-2013. observed in 87% of cases, stability of fixation and compensatory remodeling of the disc, improvement of tearing of the mouth by 8-9 mm, reduction of pain by 3.5 times in the first 12 months after the intervention. Indications for arthroscopy are the vast majority of internal disorders of the TMJ according to the classification of Wilkes. TMJ arthroscopy is an important procedure for surgical dentistry and maxillofacial surgery, thanks to fewer complications and shortened hospital stay. with ondoscopic arthrocentesis and lavage, aggressive protein compounds that arise as a result of the inflammatory process can be first washed. In cases where there is not enough endoscopic arthrocentesis and lavage and the patient continues to experience pain and trisism, these instruments can be used for surgical manipulation for removal of adhesions and free fragments of dissection of cysts, determination of the contours of the bones of cartilage smoothing, as well as treatment of the synovial membrane. As a result, pain syndrome can be eliminated and joint function restored. Advantages of TMJ arthroscopy include direct visualization and the associated possibility of biopsy, removal of osteoarthritic tissues and performing intraoperative injections. In most cases, a combination of hyaluronic acid preparation and an autologous preparation of blood plasma rich in growth factors (PRGF) is used as an implant of articular fluid. 80 patients with different RD diagnoses (45 with RA, 19 with PsA, 13 with SLE, 3 with AS) were treated using minimally invasive interventions at the Clinical Center and Department of Maxillofacial, Reconstructive and Plastic surgery of Tbilisi Aramyants Medical-Dental University (Ruparelia PB 2014, Srouji S, 2016). Most of them (n=70) were diagnosed with RD at the above medical research centre and the rest were diagnosed by rheumatologists at various medical institutions. All the patients addressed the centre independently due to the complaints of pain in the temporomandibular joint (96.9%) with the intensity of average of 4,9 points by the Visual Analog Scale (VAS) and/or limitation of mouth opening (93.8%), average magnitude of which amounted to 17.8 mm at the standard lower limit of 27 mm. All the patients also had complaints of joint noise. (Manfredini D. 2012, Yanushevich O.O. 2015).

According to the data of objective examination, restriction of mouth opening and articulation disorders were detected in 93.8% of cases. 19

(28.1%) patients had hypertension of the chewing muscles, mainly bilateral (88.9%). More often than lateral and medial wing muscles were drawn. During the palpation of the joints, noise and pain in 100% of cases were reported. In 62.9% of patients participating in the study, the damage to **TMJ** according to the international classification of Wilkes was attributed to stage IV, in 21.9 and 14.9% - to stage III and V, respectively (Fig. 1). Characteristics of the severity of lesions to the temporomandibular joint, depending on the **RD**s, are presented in the Fig 1.

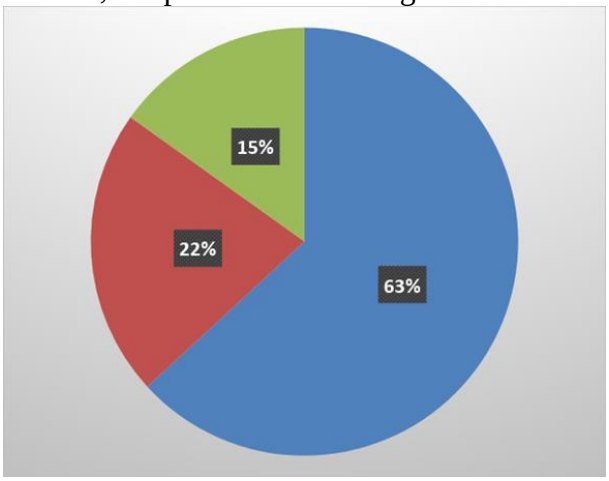


Fig.1 The distribution of patients by stages of lesions to the TMJ (according to Wilkes classification), %

Tab. 1 Characteristics of the severity of lesions to the TMJ according to Wilkes classification

RD	The number of clinical cases	Stage of lesions to the TMJ according to Wilkes classification		
		III	IV	V
RA	45	9	29	7
SLE	13	3	6	4
PsA	19	5	8	6
AS	3	0	3	0

All patients participating in the study underwent MRI of the TMJ initially and 6 months after the treatment. The study was carried out on the device Optima MR 360 Advance with capacity of 1.5 Tesla, the production of General Electric. The interpretation of the results of the MRI of the TMJ was performed in points according to the detected number of pathogens (from 0 to 8 points): change in the form of the joint space, remodeling of pathological condyles, osteophytes, osteosclerosis of the articular head, limitation of the mobility of the condyle, increased volume of intra-articular fluid, degeneration of the articular disc, displacement of the articular disc without reposition, perforation of the articular disc. According to MRI data before treatment,

deformity of the articular discs of various degrees were detected in 100% of patients, in 95.8% - an articular disc displacement was detected without reposition when the mouth was opened, and in 17.9% - a perforation of the articular disc; in most cases (81.9%), the changes were bilateral. After clinical and instrumental examination according to Wilkes international classification, the patients with stage IV and V of TMJ involvement underwent arthroscopic intervention into the TMJ and those with stage III received TMJ arthrocentesis with arthro lavage. The arthroscopic operation included the cavity of the upper joint spots, the resection of pathologically altered tissues, a partial coagulation of the pathological blood vessels and the fibrous scars of the joint using cold plasma ablation. After a surgical intervention, the gel made of hyaluronic acid was used as a fluid implant (Okeson J.P. 2014, Wang XD. 2012) .

Arthrocentesis with arthro lavage was performed under local anesthesia with premedication using two standard injection needles, according to the standard circuit, which were inserted into the superior joint cavities of the TMJ in the posterior and anterior sections for rinsing the cavity with 200 ml of Ringer solution and then administration of hyaluronic acid with PRGF. To register and record the results of the study a specially designed map of clinical examination of patients with diseases of the TMJ was used, including results of clinical, laboratory and instrumental examination methods as well as intensity pain in the temporomandibular joint by **VAS**, parameters of movements of the lower jaw (protrusion, retrusion, laterotrusion, degree of mouth opening) by the magnitude of the excursions of movements and their trajectories, which was filled initially, on the 14th day and 1, 6 and 12 months after surgical treatment. Statistical processing of the results was carried out with using the Statistic software package Statistic 8.0 (StatSoft, USA), including the generally accepted methods of parametric and nonparametric analysis. Differences were considered statistically significant at $p < 0.05$ (Yaremenko AI, 2015).

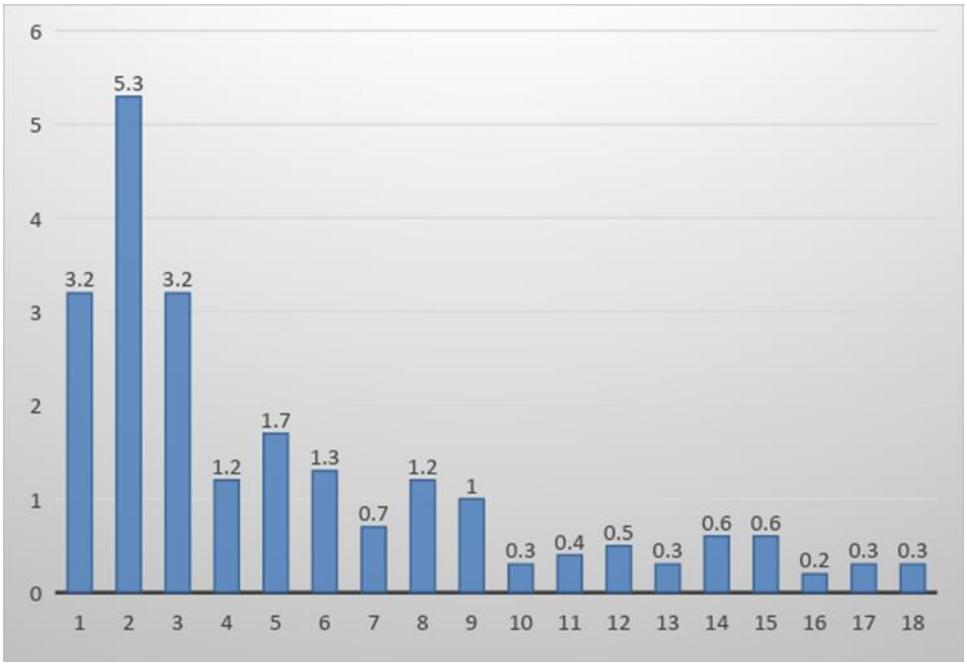
Characteristics of the results

Results

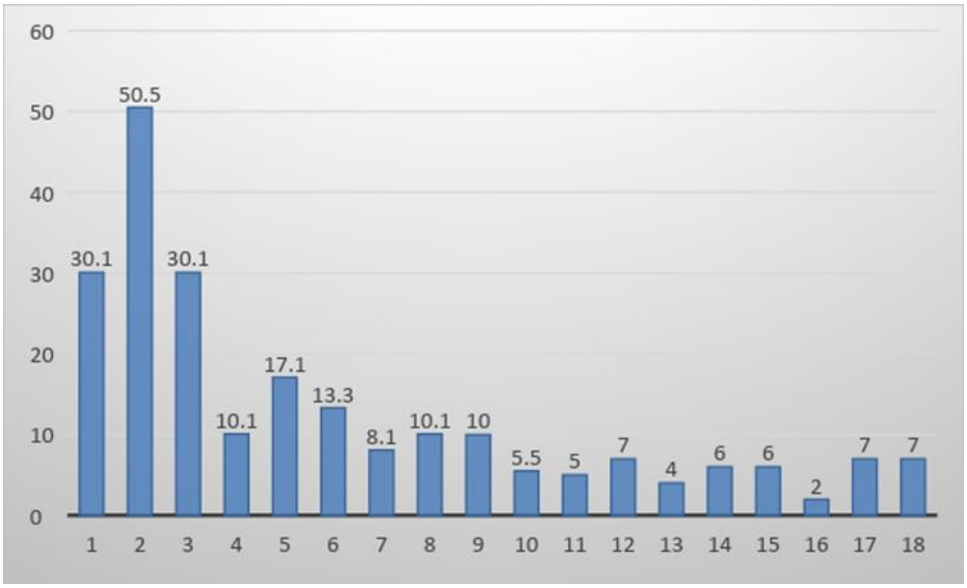
In order to assess the results of surgical treatment, all the patients were divided into three groups:

- group A (n=19) - patients with the severity of the TMJ lesion corresponding to Wilkes stage III
- group B (n = 45) - patients with the severity of the TMJ lesion corresponding to Wilkes stage IV
- group C (n = 16) - patients with the severity of the TMJ lesion corresponding to Wilkes stage V

In all groups after the surgical treatment a significant decrease in the severity of pain in the TMJ compared to baseline level was noted, and it was also noted that the severity of pain was less intensive after 7th day after the surgery. In the future, the positive dynamics remained for the following months what is proved by observations (Fig. 2). Similar data was obtained regarding increasing the degree of mouth opening (Fig. 3). It is necessary to note that the results in group C were worse than in groups A and B. According to the control MRI of TMJ, which was conducted 6 months after the surgical treatment, the best the results were observed in patients of group A, which have been achieved 100% elimination of pathological signs, with the exception of remodeling condyle and reshaping of cavities (Dimitroulis G.2013, Wang XD. 2012). In group B, the number of patients with signs of large osteofits decreased by 58.5%, with limited movements of the condyle - by 95.0%, with degeneration and deformation of the joint disc- by 98.5%, with perforation of articular disc - 2.5 times. Least effective, as it turned out, was the treatment of patients in group C. Patients of this group, in contrast to the patients of groups A and B, in addition to the signs of remodeling condyle and reshaping, signs of deformation and degeneration of the articular disc, osteophytes, foci of osteoresorption and osteosclerosis remained in 100% of cases.



Tab 1.Pain severity relieving dynamics before and after surgery



Tab 2. The dynamics of the degree of mouth opening before and after surgery

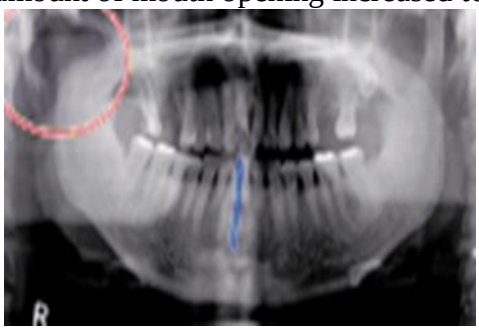
There were no serious complications in the postoperative period. Only 3 patients had developed severe swelling and a soft tissue hyperemia after arthroscopy, which had been eliminated within 8-10 days. Changes in clinical picture and activity in **RD** were not observed (Manfredini D 2010, McCain JP 2011).

We present a clinical case demonstrating effectiveness of a minimally invasive surgical treatment of patients with **RA**. Patient Z, aged 40, addressed the Tbilisi St.Michael Archangel Multiprofile Clinical Hospital, Department of Maxillofacial Surgery with complaints of pain in TMJ area, a crunch-like joint noise and limitation in mouth opening. From the anamnesis it is known that during the last 4 years she has been suffering from **RA**. She has had pain and the TMJ function disorders throughout the year. Since the first symptoms of TMJ function disorders appeared the patient started conservative treatment with a surgeon-dentist at a local policlinic. By the moment the patients addressed the center, she was already receiving methotrexate 15 mg/week, metipred 4 mg/day, non-steroidal anti-inflammatory drugs. Disease activity assessed by index DAS28 (Disease Activity Score), corresponded to a low level - 2.1. At the outpatient stage of treatment, she was treated with the help of **OSD**. The patient noted temporary improvement (Guarda-Nardini, 2012, Karibe H. 2014).

According to MRI data, stage III of the TMJ lesion was detected according to Wilkes classification. In accordance with the diagnosis and the degree of degenerative changes in the temporomandibular joint, it was decided to conduct surgical treatment applying arthrocentesis and arthrolavage of TMJ

in a specialized hospital. At the time of hospitalization, the patient had complaints of pain in the temporomandibular joint with an intensity of 40 mm and a limitation of mouth opening - 19 mm according to **VAS**. An MRI study of the TMJ (Fig. 4, 5) noted the correct position of the condylar processes, displacement of the articular discs without reposition, restriction of the mobility of the condylar processes, their osteosclerosis and deformity. Articular discs were irregular in shape and less active when opening the mouth, located at the top of the slope of the articular tubercle. The bilaminar zone was determined by signal amplification, which indicated the ongoing inflammatory process.

Directly on the operating table the mouth opening up to 41 mm was reached. On the 7th day the pain severity evaluated by the patient according to VAS was as insignificant (20 mm), and the opening of the mouth was 37 mm. On the 14th day, the pain severity was 20 mm according to VAS, the mouth opening was 41 mm. After 1 month, the patient noted a decrease in the intensity of pain to 10 mm according to VAS, the opening of the mouth at the same time was 39 mm. 6 months after the surgery the pain intensity index remained the same, while the opening of the mouth decreased to 34 mm acceptable for the patient. She did not feel difficulties during eating or speech. A control MRI of the TMJ was performed. According to the results of studies of the joints, the normal position of the disks with their full mobility and the normal amplitude of movement of condylar processes were determined. The shape and relief of the articular processes were close to normal, except for the ventral surface of the condylar process on the left, where surface irregularities in the form of small foci were traced (Fig. 6, 7). 12 months after surgery, the patient noted, with the opening of the mouth, periodic minor pain in the area of the right TMJ, which she estimated at 10 mm according to the VAS. The amount of mouth opening increased to 36 mm.



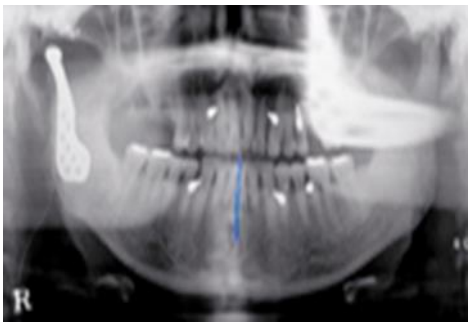


Fig 1. before surgery 6 months after surgery

Fig 2. before surgery 6 months after surgery

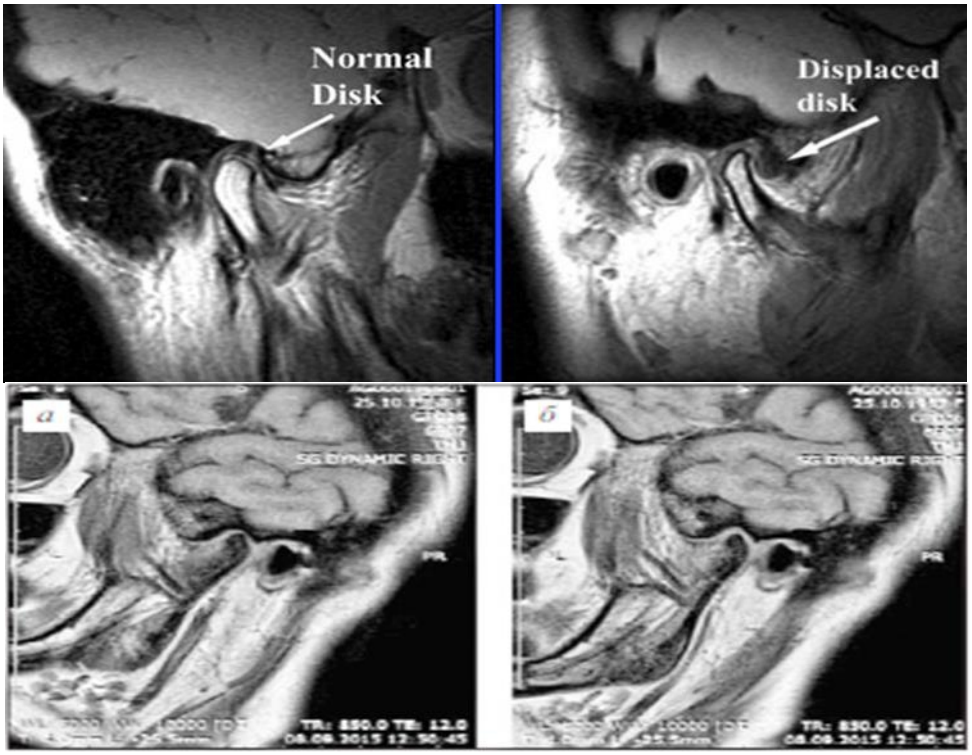


Fig 3. oblique-sagittal section in the position with open (a) and closed mouth (b)

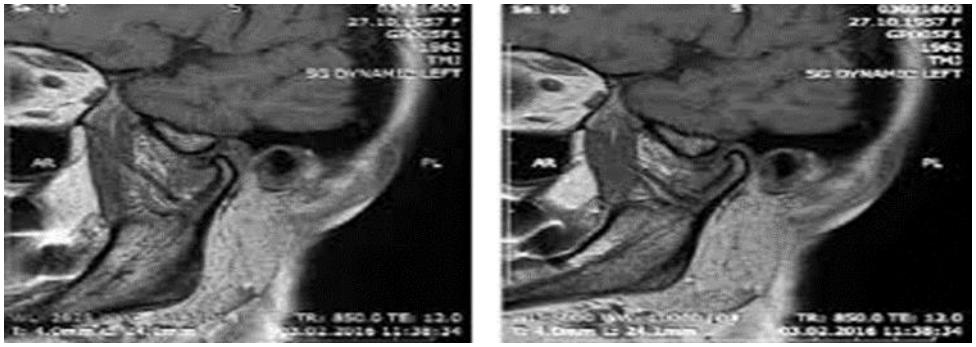


Fig 3. oblique-sagittal section in the position with open (a) and closed mouth (b) 6 months after surgery

Discussion

During the examination of patients, we detected a predominantly severe lesion of the TMJ corresponding to stages IV – V of the disease according to Wilkes classification. In this case, their bilateral lesion was most often noted. All this may indicate that in clinical practice the involvement of TMJ in the systemic inflammatory process is often underestimated both by the patients themselves as well as by the doctors (Martin-Granizo R. 2014, Okeson JP. 2014, Triantaffilidou K. 2013). Apparently, the wavelike course of **RA,** when relapses of the disease are replaced by periods of relative well-being, as well as the use of modern medical methods of treatment contribute to the fact that structural changes are formed gradually and patients decide to visit a dentist and maxillofacial surgeon only when the pain becomes constant and well-pronounced functional limitations appear. So, according to our data, the main reason of the treatment was pain in the TMJ (96.9%) with average intensity 4.9 points according to VAS, which was associated with both the TMJ lesion and, in some cases, the chewing muscles. Limitation of mouth opening and articulation disorders, which were found in 93.8% of cases, as well as complaints of joint noise, became the second most common reason for seeking dental care.

More than 40 years have passed since it was first reported about arthroscopy of the TMJ in the literature. Since then, the development and improvement of methods of surgical treatment of TMJ diseases, the introduction of modern minimally invasive instruments have led to a significant increase in the effectiveness of surgical interventions on these joints. Minimally invasive or closed surgical treatment has such indisputable advantages as low invasiveness, absence or insignificant blood penetration into the joint, the ability to restore joint function quickly in the postoperative period, which makes this method most attractive in the treatment of TMJ lesions in patients with various types of diseases. For example, in a study conducted in Spain, there was an improvement in the evaluation of both

clinical symptoms and MRI changes after TMJ arthroscopy in patients with juvenile idiopathic arthritis (Ruparelia RB. 2014). Complications and recurrences of TMJ arthritis during 12 following months were not detected, and this led to the conclusion that arthroscopy seems to be a promising method for treating TMJ in patients with juvenile idiopathic arthritis resistant to drug therapy. According to the data describing the long-term results of arthroscopy, its effectiveness has also been proven in most cases, both in assessing the symptoms reported by the patient and in relation to the objective signs of a clinical examination of TMJ.

The results of our study coincide with data from previous studies and indicate a high efficiency of minimally invasive surgical methods for the treatment of TMJ in patients with **RD**. A significant change in the intensity of pain according to VAS and the magnitude of the mouth opening on the 14th day with the positive dynamics remaining in other observation periods, a reduction in the number of pathological signs of MRI changes by more than 2 times after treatment compared to the results of MRI before treatment indicate a significant improvement in objective condition of the patients. It should be noted that the best results were observed in patients with less pronounced stages of lesion to the TMJ disease according to Wilkes classification. The low percentage of complications and the absence of exacerbations of the underlying disease in the early and late postoperative periods are also important.

Conclusions

Thus, it can be concluded that:

1) The use of techniques for minimally invasive surgical treatment of TMJ in patients with RD is effective and is associated with a low incidence of postoperative complications and exacerbations of RD;

2) The effectiveness of minimally invasive surgical treatment of TMJ is higher in patients with early and middle stages of lesion to the TMJ according to Wilkes classification;

3) Further research is needed to assess the long-term results of minimally invasive surgical treatment of TMJ in patients with RD.

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