

Temporomandibular Joint Synovial Fluid Components Levels: Implications for Arthrocentesis Outcome

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Abstract

Aim: The aim was to evaluate cytological and biochemical findings in the first synovial fluid (SF) aspirate as well in venous blood samples and to estimate the effect of arthrocentesis in the treatment of TMJ disorders.

Patients and Methods: Thirty four patients with TMJ involvement (23 with osteoarthritis and 11 with rheumatoid arthritis, Wilkes' stages III, IV) after noneffective conservative treatment were treated with arthrocentesis using push and pull technique. The first synovial fluid aspirate (SF) was analysed for presence of crystals, rheumatoid factor (RF), PGE₂, glucose level, number of erythrocytes and lymphocytes with cytological investigation. The levels of glucose, RF, CRP, ESR in venous blood were analysed. Preoperative radiographs and the scores pre- and posttreatment (after 6 months) maximal interincisal opening (MIO) for mandibular movement and visual analogue scale (VAS) for pain estimation were performed.

Results: After 6 months MIO improved significantly ($p < 0.001$) and pain according to VAS had substantially decreased ($p = 0.016$). Crystals/granules were found in 6 patients (17.6%). There were not statistical significant differences between SF RF and plasma RF values ($p > 0.05$). Several correlations between the variables were found.

Conclusions: The presence of crystals or chondromatosis granules in the synovial fluid, and presence of high level of PGE₂ indicates a pathological condition of an inflammatory nature. Arthrocentesis with push and pull technique for the treatment of TMJ disorders offer favourable results with regard to increasing jaw motion and improving function.

Keywords: Temporomandibular Joint Disorders; Arthrocentesis; Synovial Fluid

Introduction

The temporomandibular joint (TMJ) involvement may occur in prevalence of malocclusion, dental arch defects e.g. missing of molar teeth [1,2] and in systemic rheumatic diseases [3]. It has been found that 38 - 50% of adults population have signs of TMJ disorders [4,5]. Arthrocentesis is widely used in the treatment of variuos TMJ internal derangements as well as diagnostic purposes [6-8]. It is the simplest form of surgical intervention into the TMJ. Originally arthrocentesis was suggested for the treatment of painful limited mouth opening, closed lock and it is sufficient in many cases to achieve resolution of symptoms and closed lock in the TMJ osteoarthritis and successful longterm follow-up studies have been reporter [9-13].

By filling upper compartment under pressure during arthrocentesis procedure, the adhesions are broken down and lyzed [10,14]. The process during arthrocentesis is referred to as "lysis and lavage" and can give good outcomes in patients with restricted mouth opening, and ohter TMJ disorders [15-17].

The synovial fluid of TMJ osteoarthritis contains higher levels of inflammatory mediators and cytokines, matrix degrading enzymes [18,19]. Arthrocentesis and lavage of the joint removes directly not only most of the degradation products, but inflammatory mediators as well [20,21]. Several inflammatory mediators and cytokines play an important role in the pathogenesis of TMJ osteoarthritis [3,22]. Many cell types are involved in inflammation as macrophages, T-lymphocytes, mast cells, dendritic cells, and neutrophilic leucocytes [19]. Systemic findings (blood analyses) and peripheral i.e. synovial aspirate findings might be expected to influence the treatment effects as a difference in the peripheral expression of biochemical and laboratory findings have been reported [3,16,18]. Arthrocentesis gives a possibility to remove directly not only inflammatory mediators but the degradation products as fibrillations, chondromatosis granules and calcifications as well [23].

The study was designed to evaluate cytological and biochemical findings in the first synovial fluid (SF) aspirate as well in venous blood samples and to estimate the effect of arthrocentesis in the treatment of TMJ disorders.

Patients and Methods

Patients

The patients were referred from the Departments of Maxillofacial Surgery and Internal Medicine at the Tartu University Clinicum. There were 23 (4 men, 19 women, ages varying between 21 - 60 years) patients with diagnoses of TMJ osteoarthritis (Wilkes' stages III, IV;1989) [24]. Four patients had bilateral joint involvement, 19 unilateral and 11 rheumatoid arthritis patients with unilateral involvement of TMJ (11 females, aged 21 - 64 years). Indications for arthrocentesis with push and pull technique [7] were noneffectiveness of NSAID-s, mainly Clotam® (Tolphenamic acid), Arcoxia® (Etoricoxib). Clinical inclusion criteria were pain, reduction of mouth opening with duration of complaints less than one year and radiological changes in the TMJ: The study was approved by the Ethics Committee at the University of Tartu (protocol 94/3, 2007).

Current TMJ pain intensity level was assessed with a 100 mm visual analogue scale (VAS) with endpoints denoted by "no pain" (0 mm) and "worst pain" ever experienced (100 mm). If pain was present the patients were asked to select a field from 1 mm to 100 mm on the VAS scale to estimate their level of pain in the TMJ. The absence of pain is scored as 0. Preoperative data as clinical history, a physical exam and radiographs using orthopantomography (OPTG) and computer tomography (CT) were documented for diagnostic purposes. This included progression time of TMJ dysfunction, the presence of malocclusion, the amplitude of mandibular movement, the presence of joint noises, deviation on maximal mouth opening, and pain on mandibular movements. Clinical data were collected for pain and measurements of maximal interincisal opening (MIO) before and after treatment (Figure 1).



Figure1: TMJ osteoarthritis. Maximal interincisal opening (MIO) is 16 mm before treatment.

All patients were asked to come for reexamination. The scores for preoperative and postoperative MIO and VAS for mandibular function and pain were compared. At the 6 months follow-up, the mean baseline values were recorded.

TMJ arthrocentesis

TMJ anaesthesia was achieved by blocking the auriculotemporal nerve with 2 mL 2% Lidocain (Xylocain, Astra-Zeneca, Sweden). The TMJ was punctured with a 19-G needle inserted into the posterior part of the upper joint compartment in a mouth-open position in order to expand the joint cavity. The needle was connected with the three-way stopcock for infusion therapy (Discofix® B.Braun Melsungen AG, Switzerland) with two syringes in order to perform arthrocentesis using a push and pull technique. Stopcock gives a possibility to open and close the route. The saline solution (NaCl 9 mg/mL) was slowly injected into the posterior part of the upper joint cavity approximately 2 - 3 mL and then aspirated and allocated for laboratory investigations. The washing was repeated 3 - 4 times until the aspirate was clear. The procedure was performed in a single session (Figure 2). No additional substances or drugs were used.



Figure 2: The needle is inserted into posterior part of the upper joint compartment and connected with the three-way stopcock for arthrocentesis.

The first SF aspirate ~2mL was allocated for the following analysis: SF glucose level, SF - rheumatoid factor (RF), presence of crystals/granules, number of erythrocytes and lymphocytes with cytological investigation (% of neutrophils, lymphocytes, granulocytes). PGE₂ level in the first SF aspirate was determined in 11 rheumatoidarthritis patients by radioimmunoassay (RIA) with a commercially available Kit¹²⁵ I-PGE₂ (Du Pont/NEN, Dreieich, Germany).

The washing was repeated 3 - 4 times until the aspirate was clear.

Beforehand venous blood analyses were also performed for erythrocyte sedimentation rate (ESR), plasma RF, plasma-glycose level, thrombocyte count (TPC) and C-reactive protein (CRP).

Statistics

Descriptive statistics was performed to assess the significance with regard to each variable. The significances of differences of clinical parameters (VAS, MIO) before and after treatment was used. A P-value of < 0.05 was considered as statistically significant. Correlations between SF components and blood components levels in the patients before treatment were calculated by Spearman's ranked (rs) correlation coefficient with two tailed significance testing.

Results

Clinical and radiographic findings in patients who underwent arthrocentesis (n = 34) are given in Table 1.

Symptoms	Sum	%Abn	Radiogr. findings	Sum	%Abn
Pain	34	100	Reduced space	18	52.9
Hypomobility	31	91.1	Erosions	28	82.3
Closed lock	6	17.6	Sclerosis	9	26.4
Intermittent lock	5	14.7	Pseudocysts	5	14.7
Calcificates/granules	6	17.6			

Table 1: Clinical and radiographic findings in patients who underwent arthrocentesis (n = 34).

Sum = total number of patients with findings

%Abn = percentage of individuals with abnormal findings

Before treatment crystals or chondromatosis granules (diameter < 3mm) were found in SF aspirate in 6 patients (17.6%). There was no statistical significant difference between SF RF and plasma RF values (p > 0.05). Prostaglandin E₂ level was increased in joint aspirates in rheumatoidarthritis patients with involvement of TMJ (IQR 25 pg/mL) in the first SF aspirate.

The scores for pretreatment and posttreatment MIO and VAS for pain were compared. Assessment of symptoms reported by the patients as well as objective signs noted on clinical examination, confirmed resolution of pain on movement (painless MIO) and increased vertical opening.

There was a significant increase (p < 0.001) in the MIO postoperatively after 6 months and decrease in the VAS after treatment (p = 0.016). The preoperative VAS score for pain ranged from 46 mm to 86 mm with a median of 71 mm. The follow-up VAS scores for pain range was between 2 mm - 29 mm with a median of 18. The preoperative MIO ranged from 25 – 40 mm with a median of 27mm while postoperative MIO ranged from 38 – 49 mm with a median of 41 mm at the follow-up.

Several correlations were found between the data (Table 2). The values of blood sedimentation rate, thrombocyte count and C reactive protein were normal. Arthrocentesis helps also, allowing through washes lavage remove foreign bodies (crystals, calcificates, granulations) and release the adhesions and fibrillations. These findings are confirmed by our previous arthroscopic study [30] (Figure 3).



Figure 3: Posterior recess of the superior compartment of the right TMJ during arthroscopy.

Fibrillations and pronounced adhesions with irregularities of condyle surface.

Chondromatosis granule in a 6 o'clock position and hyperaemia in the posterior capsular wall (Leibur., et al. [30]).

Comparisons	r_s	P - value
VAS before vs VAS after treatment	0.654	< 0.016
Age vs MIO	0.450	= 0.031
Age vs SF	0.418	= 0.041
SF glucose vs number. of SF leucocytes	0.403	= 0.05
Plasma RF vs SF RF	0.793	0.001
SF RF vs number of lymphocytes	0.430	= 0.04

Table 2: Comparisons between variables. Spearman rank correlation coefficients (r_s) are shown with indications for statistical significance.

Discussion

Arthrocentesis is a treatment modality between non-surgical treatment and arthroscopic surgery. It is not an alternative procedure to surgical intervention being highly efficient procedure with low morbidity [10,13,25]. Several authors have found that arthrocentesis could be the best indicated treatment for patients with anterior disc placement [26]. Our study showed that arthrocentesis by push and pull technique restored joint physiology, giving successful results for pain and dysfunction relief in treating patients with TMJ disorders. The relatively rapid improvement after arthrocentesis compared to conservative treatment may be explained by the immediate removal of intra-articular adhesions, pro-inflammatory mediators, cytokines and degeneration products available in the synovial fluid [18,27].

It is claimed that a displaced disc, by itself, is of only limited significance in TMJ closed lock. Total sliding could be easily obtained by irrigation of the upper joint compartment [6]. The arthrocentesis breaks joint adhesences that are responsible for the reduced translatory movement of the condyle and are mainly called into cause to explain the phenomena of the disc anchorage to the fossa or eminence, thus allowing immediate mouth opening [28]. Fibrous adhesions in the upper joint compartment are one of the factors causing limitation of MIO. It is concluded that lavage under sufficient pressure can remove adhesions and widen the joint space [29]. By our data [30] adhesions and fibrillations in the joint space were the most usual pathologic signs and anteriorly displaced disc was found in all TMJ osteoarthritis cases teated arthroscopically. The data in the literature [31] have also shown that the most frequent disc displacement was anterior and a displaced disc was found approximately in one third of asymptomatic patients. We found that arthrocentesis by push and pull method has sufficient pressure to release these bands and thus improving condylar movement. Assessment of symptoms reported by the patients as well as objective signs noted on clinical examination confirmed resolution of pain on movement and increased vertical opening (MIO). These good results were achieved as various factors responsible for the destructive changes in the joint are washed away and healthy synovial fluid production is promoted. This push and pull technique is recommended in case of disorders where radiological findings are minimal (Wilkes’ stages III – IV), allowing full retention of the saline within the joint space and thus lubricating the joint surfaces. Presence of crystals or chondromatosis granules in the joint space of our patients may influence on TMJ movement and apparently presence of crystals in synovial fluid are results of chronic inflammation.. In several papers [32,33] improvement in MIO and decrease in pain level and joint dysfunction on VAS were the criteria used for defining a successful outcome. A positiive correlation between VAS data before and after treatment showed that after treatment the pain disappeared or diminished in the TMJ: Age correlated positively before treatment i.e. the younger the patient the more restrictions in the mouth opening, Positive correlation between age and synovial glucose level showed that the older the patient the higher the values of synovial glucose level. SF glucose level correlated positively with number of SF leucocytes. It means, that glucose in the SF is a favourable factor in the inflammatory process. Thus the advantages of the push and pull technique are as follows: stable access to the joint compartment with limited trauma as the insertion of a single needle should reduce the risks for nervous injuries as well. Several studies have shown that PGE₂ stimulates resorption of bone tissue [34-36]. The presence of higher level of PGE₂ in the synovial fluide aspirate is an important intracellular inflammatory mediator causing destruction of bone structures. Plasma RF before treatment correlated positively with synovial RF i.e. RF values in the blood plasma coincided with synovial fluid aspirate RF values. Synovial RF correlated positively also with lymphocytes. As RF is synthezised by lymphocytes under polyclonal antigens effect, lymphocytes are protecting invasion of foreign antigens.

Conclusions

The presence of crystals or chondromatosis granules in the synovial fluid, and presence of high level of PGE₂ indicates a pathological condition of an inflammatory nature.

Arthrocentesis with push and pull technique for the treatment of TMJ disorders offer favourable results with regard to increasing jaw motion and improving function.

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Conflicts of Interests

The authors declare that they have no conflicts of interest related to this research.

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