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MISCELLANEOUS

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Treatment of patients with arthrosis of the temporomandibular joint by infiltration of sodium hyaluronate: a preliminary study

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Abstract Patients with degenerative disease of the temporomandibular joint (TMJ) who did not respond to conservative medical therapy (splint therapy, selected grinding or physiotherapy) can be treated by arthrocentesis, which is associated with intra-articular injections of sodium hyaluronate (Hyalgan). In this study, we treated ten dysfunctional patients with degenerative joint disease (DJD) who had been diagnosed clinically and had had the diagnosis confirmed by MRI. All subjects presented impaired mouth opening, joint pain at rest and on movement and impaired masticatory efficiency. We performed one cycle of five infiltrations with joint arthrocentesis and the injection of sodium hyaluronate at weekly intervals. The following parameters were assessed before and after infiltration and at follow-up after 6 months: mouth opening (with a mean of between 36.5 mm and 41.9 mm); sideways movements (to the right 4.9 mm to 8.9 mm and to the left 4.7 mm to 9.2 mm); pain at rest (VAS=1.8 to 0.5) and on movement (VAS=7.8 to 1.1); masticatory efficiency (VAS=5.7 to 8.6); subjective judgement of the functional TMJ limitation level (from 2.8 to 0.8); judgement of efficacy (from 2.4 to 3.2); judgement of tolerability to the therapy (from 2.0 to 3.1). The therapeutic benefits observed can be attributed both to joint arthrocentesis and to the characteristics of sodium hyaluronate itself. All the parameters considered revealed a statistically significant positive variation that persisted over time ($P<0.05$). The results obtained by this minimally invasive, fast and easy technique proved to be valid and lasting. This infiltration technique using sodium hyaluronate looks very promising for patients affected by symptomatic DJD who do not respond to conservative medical therapy, reflecting similarly encouraging findings in the orthopaedic treatment of degenerative knee pathology.

Keywords Temporomandibular joint · Degenerative joint disease · Arthrocentesis · Sodium hyaluronate · Arthrosis

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Introduction

Sodium hyaluronate, a glycosaminoglycan produced and released by specialised synovial cells, is present in particularly high concentrations in the joint cartilage and synovial fluid. In normal conditions, this substance plays an important role in maintaining intra-articular homeostasis: it favours the elasticity and viscosity of the synovial fluid, providing a cushion against any shocks; it has a lubricating, anti-inflammatory and pain-relieving action and enables the tissue repair processes to be activated in the cartilage with a normalising action on the synthesis of endogenous acid by the synovial cells [1].

In the presence of osteoarthrosis, the concentration and molecular weight of sodium hyaluronate in the synovial fluid are diminished as a consequence of the dilution, fragmentation and production of acid molecules with a lower weight than normal, thus compromising the conditions of homeostasis [2]. In order to overcome this problem, a treatment has been devised whereby the pathological fluid is removed from the joint and exogenous sodium hyaluronate is infiltrated, thus bringing the concentration and molecular weight of the synovial fluid back to normal. This kind of treatment is called viscosupplementation [3] and has already been used for many years to treat degenerative knee pathology [4, 5, 6].

Sodium hyaluronate injection has also been proposed for the treatment of TMJ symptomatic degenerative disease that has failed to respond to conservative medical

and physical therapies. This minimally invasive therapeutic approach using arthrocentesis and infiltration aims to restore the protective function of the synovial fluid, normalising the concentration and molecular weight of the sodium hyaluronate [7].

Materials and methods

In this study, ten patients suffering from DJD (nine women and one man, age range: 39–68 years, mean age: 49.3 years) underwent one cycle of five infiltrations [8, 9] of sodium hyaluronate (Hyalgan from Fidia S.p.A.) into one or both of the TMJ, with a total of 15 joints being infiltrated according to the protocol in use for the treatment of degenerative knee pathology [10, 11, 12, 13].

Before being treated with infiltration, all of the patients involved in this study had undergone splint therapy, physiotherapy or selected grinding without success. All persons gave their informed consent prior to being treated. The treatment with Hyalgan was always preceded by arthrocentesis of the upper joint cavity with Ringer-lactate solution.

The patients presented degenerative disease with pain, crepitus in the joint and impaired mouth opening and masticatory efficiency. The examinations performed were a panoramic radiograph and a MRI of the TMJ with the mouth both opened and closed on the sagittal and coronal planes.

Before proceeding with the infiltration, various parameters were assessed, such as the maximal mouth opening, the sideways movements of the jaw, the presence of pain at rest and when chewing food (assessed by VAS), masticatory efficiency and the functional limitation level during usual jaw movements [8, 11, 14, 15].

The technique used to perform arthrocentesis of the TMJ (Fig. 1) employs the same reference points as are used in arthroscopic examination [16]. The skin surface is disinfected with povidone iodine. Local anaesthesia is then achieved with mepivacaine 2% (Carbocaine). The anaesthetic is first injected into the joint cavity, relaxing this virtual space. Subsequently, the needle is withdrawn gently to the skin surface, thus anaesthetising the soft tissues over the joint, too. Two 19 G needles are then placed to make entry and exit points for the liquid to be injected that will wash out the entire joint. The arthrocentesis (with 50 cc of Ringer lactate) eliminates the catabolytes present in the synovial fluid [13].

This procedure may often prove difficult if the inner part of the joint shows debris. However, the pressurising effect exercised by the injection of fluid into the joint is useful in weakening and breaking up any such debris that may be present. Once arthrocentesis is complete, 1 cc of Hyalgan is injected into the joint, and the two needles are removed.

During treatment, the mouth opening is monitored before and after each infiltration. Assessments are then made of the presence or absence of pain when chewing food and at rest and of the patient's masticatory efficiency before each infiltration. Even the functional limitation level of the joint is assessed after each administration. The patient's judgement about the efficacy of the therapy and the tolerability of the infiltration procedure itself are also recorded. In the follow-up period, the patients are again assessed on the basis of all the chosen parameters at 1, 3 and 6 months after the last of the five infiltrations. During the whole period of the five infiltrations, patients followed a physiotherapy program of guided mouth opening that went on for 4 weeks after the last injection.

Fig. 1 Technique applied

Results

After the cycle of infiltrations it was possible to note that spontaneous opening of the mouth had improved in each of the patients who had been treated by a minimum of 1 mm to a maximum of 9 mm, with a mean increase of 4.9 mm, passing from an initial mean value of 36.5 mm to 41.4 mm at the end of treatment. At 1 month, opening remained at a mean value of 42.7 mm, and at 3 months, it was 42.5. At 6months, the mean value reached 41.9 mm, slightly lower than the mean values at 1 and 3 months, but still higher than the initial mean values. The maximal mean opening value was achieved 1 month after therapy, and at 6 months, the mean value was still higher than the value obtained at the end of treatment (see Fig. 2). Statistical analysis (ANOVA) confirmed that over the course of time the cycle of infiltrations favours an improvement in mouth opening (P=0.001, P<0.05).

Sideways movements of the jaw to the left and right were assessed in terms of time, the side affected by the disorder (left, right or bilateral TMJ) and the direction of movement. At baseline, the right side gave a mean value of 4.9 mm, while mean movement to the left was 4.7 mm.

At the end of the therapy, movement to the right had increased on average by 4.4 mm, reaching a mean value of 9.3 mm, while the left side had increased by 4.1 mm, reaching a mean value of 8.8 mm. After 1 month, this increase had slightly decreased (P=0.000000, P<0.05).

At 3 months, sideways movement had further decreased to a mean value of 8.6 mm on both sides, increasing again after 6 months to a mean value of sideways movement to the right of 8.9 mm and to the left of 9.2 mm. Variations at follow-up showed a range of less than ±1 mm, demonstrating substantial stability in the results obtained.

Pain at rest was present before treatment in five patients and was assessed as a mean VAS value of 1.8. After the treatment, the mean value had decreased to VAS=0.8. After 1 month, the mean value was VAS=0.2. After 3 months, the mean VAS value was 0.1. At 6 months, it had slightly increased to 0.5. The statistical significance was equal to P=0.0169 (P<0.05).

Pain on movement was present in all the patients, with a mean value of VAS=7.8. Symptomatology improved after treatment in all cases, with a mean value of VAS=1.6.

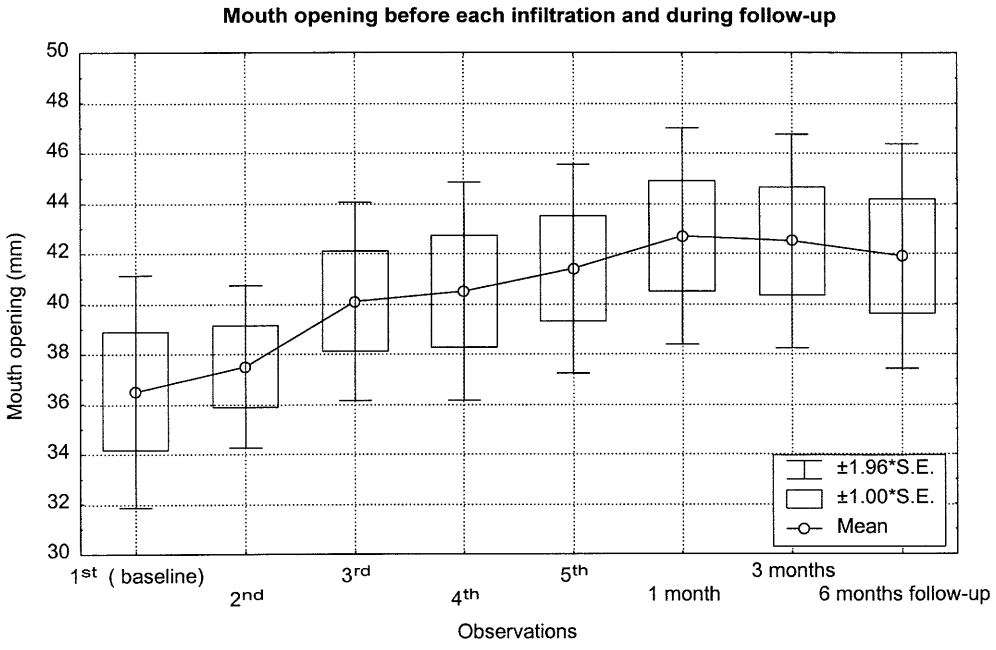

Fig. 2 The opening of the mouth improves after each single injection, and there is substantial preservation of time during the following 6 months

At 1 month, it had improved to a mean value of VAS=1.2. After 3 months, a mean value of VAS=0.8 had been reached. The next control at 6 months showed an absence of pain in seven patients out of the ten who had received treatment, with a mean value of VAS=1.1 (see Fig. 3). ANOVA showed the presence of statistical significance in the data obtained (P=0.00000, P<0.05).

The patients' masticatory efficiency was assessed before treatment and gave a mean value of VAS=5.7, which meant they had considerable difficulty in eating hard, solid food. At the end of therapy, this parameter had notably improved, rating a mean value of VAS=7.9. At 1 month, the mean VAS value was 8.2. After 3 months the patients' masticatory efficiency had reached a mean value of VAS=8.7, and at 6 months it had slightly decreased to a mean value of VAS=8.6 (see Fig. 4). ANOVA showed the presence of statistical significance in the data obtained with P=0.00000 (P<0.05).

The efficacy judgement of the therapy expressed by the patient was measured numerically (0=poor, 1=slight, 2=moderate, 3=good and 4=excellent) after each infiltration. After the first infiltration, the mean efficacy value was 2.4. The mean values increased progressively in the course of the following sessions. After the fifth infiltration, the mean value was 3.3, and it remained constant at 1 and 3 months, after which time it decreased slightly,

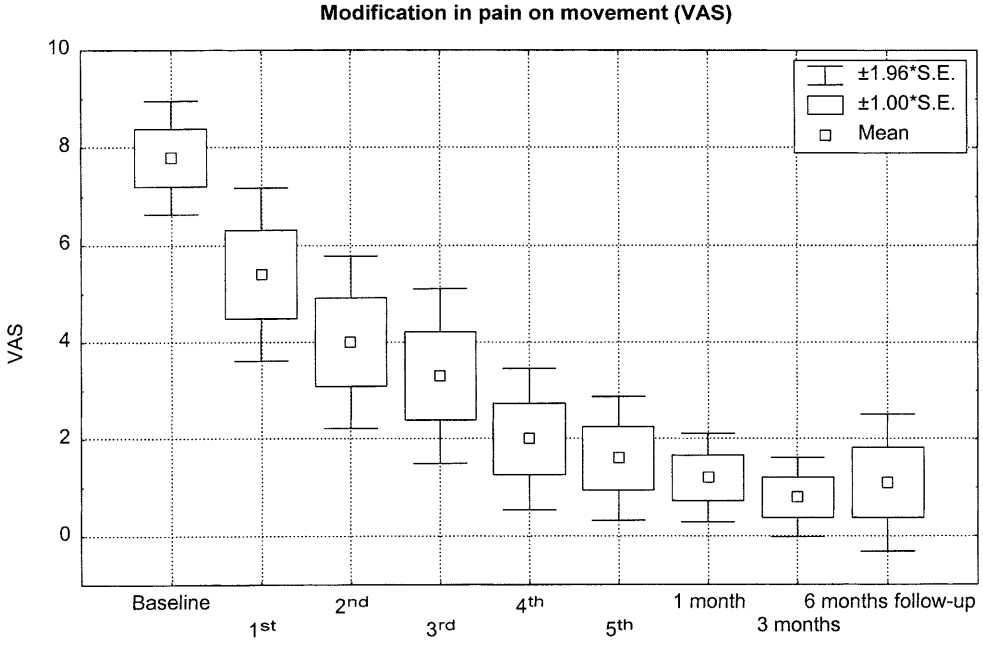

Fig. 3 Decrease in pain on movement during the treatment with five sodium hyaluronate infiltrations and the situation at the 6-months follow-up

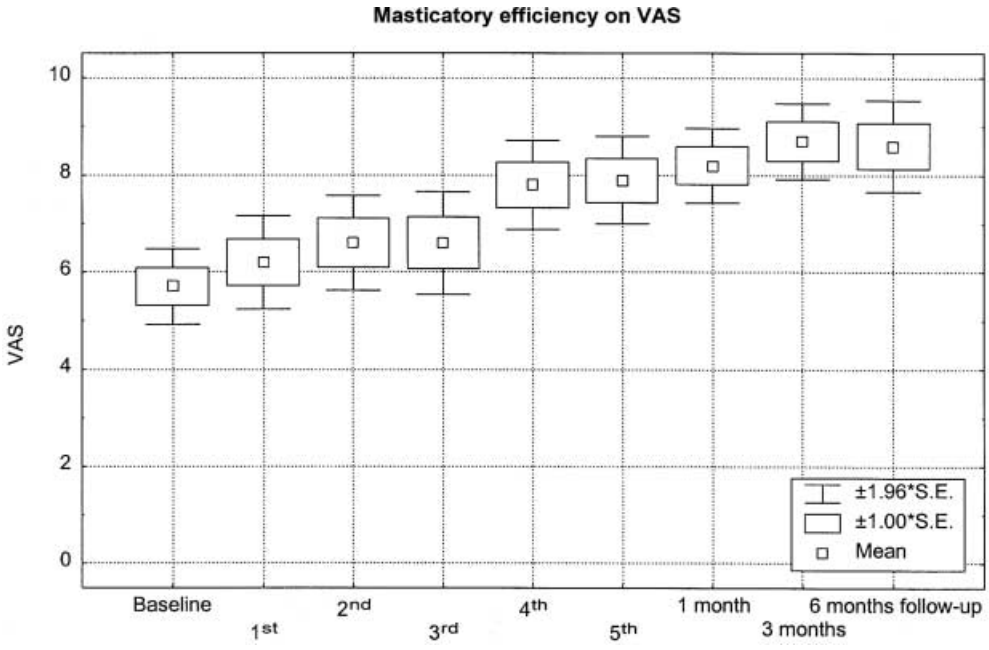

Fig. 4 Improving in masticatory efficiency, and its substantial preservation at the 6 months follow-up

reaching a mean of 3.2 at 6 months after treatment, with a statistical significance of P=0.00004 (P<0.05).

The patients' tolerability judgement of the actual method of administration was then assessed (0=poor, 1=slight, 2=moderate, 3=good and 4=excellent). At the first session, tolerability rated a mean value of 2.0. The mean value had increased by the fifth infiltration to 3.1, indicating a decidedly positive pattern, which proved to be statistically significant with P=0.00526 (P<0.05).

The functional TMJ limitation level was assessed at baseline (score 0=absent, score 1=slight, score 2= moderate, score 3=intense and score 4=severe), and it rated a mean score of 2.8. After therapy it had reached a mean value of 1.3. At 1 and 3 months, the patients presented a mean value of 1.1, which reached a minimum at 6 months with a mean value of 0.8. In the case of this parameter, too, statistical analysis showed the presence of significance with P=0.00000 (P<0.05).

Discussion

The use of sodium hyaluronate was first described by Rydell and Balazs [18] and by Helfet [15] in the treatment of patients suffering from osteoarthrosis. Many studies conducted from the 1970s onward on osteoarthrosis of the knee [2, 10, 11, 12, 13] demonstrated that sodium hyaluronate helps to alleviate pain, improve functionality and reduce joint crepitus. This substance opens up a new therapeutic approach, and the authors recommend the use of cycles of five infiltrations [10, 19] to be given at weekly intervals. This approach is preferable to the use of NSAIDs and cortisone drugs, which are not without undesirable side effects.

In 1985 [20] and in 1987 [21], Kopp et al. likened the short- and long-term effects of the intra-articular injection of sodium hyaluronate to that achieved with corticosteroids (betamethasone). Both the drugs used reduced painful symptomatology and improved the clinical signs without revealing any statistically significant differences in therapeutic effect. The authors concluded that both drugs were useful and had a significant long-term effect in cases of chronic DJD, but they proposed using sodium hyaluronate as the better alternative because of its lesser risk of side effects. In 1991, the same authors, Kopp et al. [22], observed the short-term effects of injections of sodium hyaluronate, glucocorticoids and saline solution in patients presenting TMJ rheumatoid arthritis. In all cases, they observed a significantly positive effect in the patients treated with sodium hyaluronate or with glucocorticoids. Subsequently, in 1993, Bertolami et al. [23] used sodium hyaluronate to treat some intracapsular disorders (degenerative disease, reducing and non-reducing disc displacement), and they observed that the use of sodium hyaluronate significantly improved the clinical signs and symptoms when compared to saline solution, which had been used on other patients.

Fader et al. [22] proposed pressurised infusions of sodium hyaluronate into the TMJ (pumping technique) to treat cases of persistent and symptomatic closed-lock, demonstrating a short-term benefit with regard to symptomatology and function.

Sato et al. [8] proposed its use in cases of non-reducing displacement of the disc as an alternative therapeutic treatment, obtaining an overall improvement in clinical signs and symptoms despite the fact that the displacement remained uncorrected.

In a 1997 study, Hirota [25] showed that the injection of sodium hyaluronate in patients presenting joint dysfunction reduced the quantity of catabolytes present in the synovial fluid (metabolites of arachidonic acid and cytokines) and improved painful symptomatology and mouth opening.

The main indications for the use of this substance therefore proved to be traumatic and degenerative joint pathologies. Intra-articular administration in degenerative disease normalises the viscoelasticity of the synovial fluid and activates the tissue repair processes in the cartilage [2].

The results of our study show the efficacy of treatment administered as a cycle of five intra-articular infiltrations of Hyalgan. A single injection can be more useful to solve a dislocation of the disc than to treat a degenerative pathology. An improvement was observed in the range of mouth opening and sideways movements, a decrease in painful symptomatology at rest and during movement, an increase in masticatory efficiency, a progressive decrease in functional limitation and an increase in the parameters of efficacy and tolerability of the treatment. The increase in mouth opening is undoubtedly due to a mechanical effect of the liquid injected into the joint. This liquid determines an increase in the hydraulic pressure with consequent expansion of the intra-articular space, an effect which probably also causes the removal of any debris that may be present. This pressurising effect is associated with: (1) the elimination of pain by the infiltration of the local anaesthetic that is activated at the time of treatment; (2) the use of Ringer-lactate lavage solution, which removes the intra-articular catabolytes and (3) sodium hyaluronate, with its analgesic, anti-inflammatory and lubricating properties. Therefore, the improvement in symptomatology and function is linked at first with the pressurising effect and the removal of catabolytes, and it is subsequently maintained by the action of sodium hyaluronate and by the patient's regular physiotherapy exercises after treatment.

As regards painful symptomatology at rest, it should be noted that five of the patients were asymptomatic at the beginning of treatment and remained so after the cycle of infiltrations, indicating that this technique is not damaging to the joint, is a reliable method and, provided it is performed correctly, does not cause any iatrogenic damage to the joint, either traumatic or infective.

Statistical analysis (ANOVA) of the results confirmed their validity, giving statistically significant *P*-values for all parameters.

Conclusions

The results of our study demonstrated that arthrocentesis with the infiltration of sodium hyaluronate is a valid method of treating TMJ degenerative disease. In particular, a decrease in pain and an improvement in functionality of the jaw were observed. Function improved well initially and then slowly and progressively declined, indicating the need to repeat the cycle of treatment with sodium hyaluronate over time.

Although infiltration is a slightly invasive method of administration, it proved to be absolutely reliable if correctly performed, and was not the source of any iatrogenic damage in our patients, even though there are case reports in the literature that warn of the possible risks linked with this surgical practice [26, 27].

It has been demonstrated that the TMJ behaves in a similar way to the other joints that orthopaedic specialists commonly treat with sodium hyaluronate, especially in terms of symptomatology and long-term functionality.

Patients tolerate intra-articular infiltrations well, even though in some cases they may experience numbing of the facial nerve for the first few hours, this effect being linked with the use of Carbocaine.

This method of infiltrating sodium hyaluronate to treat DJD has been widely used in orthopaedic practice for some time, and it is to be hoped that it will gain ground in maxillo-facial surgery as a possible alternative to treat sufferers who have not responded to conservative medical therapies.

References

1. Marshall KW (1997) The current status of Hylan therapy for the treatment of osteoarthritis. Today's Therapeutic Trends 15: 99–108
2. Marshall KW (2000) Intra-articular hyaluronan therapy. Current Opinion in Rheumatology 12: 468–474
3. Balazs EA, Denlinger JL (1993) Viscosupplementation: a new concept in treatment of osteoarthritis. J Rheumatol 20 [Suppl 39]: 3–9
4. Weiss C, Balasz EA, St Onge R, Denlinger JL (1981) Clinical studies of the intra-articular injections of Helon (sodium hyaluronate) in the treatment of osteoarthritis of human knees. Semin Arthritis Rheum 11: 143–144
5. Namiki O, Toyoshima H, Morisaki N (1982) Therapeutic effect of intra-articular injection of high molecular weight hyaluronic acid on osteoarthritis of the knee. Int J Clin Pharmacol Ther Toxicol 20: 501–507
6. Peyron JG (1993) Intra-articular hyaluronan injections in the treatment of osteoarthritis: state-of-the-art review. J Rheumatol 20 [Suppl 39]:10–15
7. Yustin D, Kryshtalskyj B, Galea A (1995) Use of Hylan G-F 20 for viscosupplementation of the temporomandibular joint for the management of osteoarthritis: a case report. J Orofacial Pain 9: 375–379
8. Sato S, Ohta M, Ohki H, Kawamura H, Motegi K (1997) Effect of lavage with injection of sodium hyaluronate for patients with nonreducing disc displacement of the temporomandibular joint. Oral Surg 84: 241–244
9. Sato S, Sakamoto M, Kawamura H, Motegi K (1999) Disc position and morphology in patients with non reducing disc displacement treated by injection of sodium hyaluronate. Int J Oral Maxillofac Surg 28: 253–257
10. Dougados M, Nguyen M, Listrat V, Amor B (1993) High molecular weight sodium hyaluronate (hyalectin) in osteoarthritis of the knee: a 1 year placebo controlled trial. Osteoarthritis Cartilage 1: 97–103
11. Huskisson EC, Donnelly S (1999) Hyaluronic acid in the treatment of osteoartritis of the knee. Rheumatology 38: 602–607
12. Altman RD, Moskowitz R (1998) Intra-articular sodium hyaluronate (Hyalgan) in the treatment of patients with osteoarthritis of the knee: a randomized clinical trial. J Rheumatol 25: 2203–2212
13. Frizziero L, Govoni E, Bacchini P (1998) Intra-articular hyaluronic acid in the treatment of osteoartritis of the knee: clinical and morphological study. Clin Exp Rheumatol 16: 441–449

14. Bellamy N, Kirwan J, Boers M, Brooks P, Strand V, Tugwell P, Altman R, Brandt K, Dougados M, Lequesne M (1997) Recommendations for a core set of outcome measures for future phase III clinical trials in knee, hip, and hand osteoarthritis. Consensus development at OMERACT III. J Rheumatol 24: 799–802
15. Helfet AJ (1974) Management of osteoarthritis of the knee joint. In: Disorders of the knee. Lippincott, Philadelphia, pp 175–194
16. Holmlund A, Hellsing G (1985) Arthroscopy of the TMJ. An autopsy study. Int J Oral Surg 14: 169–175
17. Dimitroulis G, Dolwick MF, Martinez A (1995) Temporomandibular joint arthrocentesis and lavage for the treatment of closed lock: a follow-up study. Br J Oral Maxillofac Surg 33: 23–27
18. Rydell N, Balazs EA (1971) Effect of intra-articular injection of hyaluronic acid on the clinical symptoms of osteoarthritis and on granulation tissue formation. Clin Orthop 80: 25–32
19. Maheu E (1995) HA in knee osteoarthritis: a review of clinical trials with Hyalgan. Eur J Rheumatol Inflamm 15: 17–24
20. Kopp S, Carlsson G, Haraldson T, Wenneberg B (1985) The short-term effect of intra-articular injections of sodium hyaluronate and corticosteroid on temporomandibular joint pain and disfunction. J Oral Maxillofac Surg 43: 429–435
21. Kopp S, Carlsson G, Haraldson T, Wenneberg B (1987) Long-term effect of intrarticular injections of sodium hyaluronate and corticosteroid on temporomandibular arthritis. J Oral Maxillofac Surg 45: 929–935
22. Kopp S, Akerman S, Nilner M (1991) Short-term effects of intrarticular sodium hyaluronate, glucocorticoid, and saline injections on rheumatoid arthritis of the temporomandibular joint. J Craniomandib Disorders 5: 231–238
23. Bertolami CN, Gay T, Clark GT, Rendel J, Shetty V, Liu C (1993) Use of sodium hyaluronate in treating temporomandibular joint disorders: a randomized, double-blind, placebo controlled clinical trial. J Oral Maxillofac Surg 51: 232–242
24. Fader KW, Grummons DC, Maijer R, Christensen LV (1993) Pressurized infusion of sodium hyaluronate for closed-lock of the temporomandibular joint. Part I. A case study. J Craniomand Prac 11: 68–72
25. Hirota W (1998) Intra-articular injection of hyaluronic acid reduces total amounts of leukotriene C4, 6-keto-prostaglandin F1 alpha, prostaglandin F2 alpha and interleukin-1 beta in sinovial fluid of patients with internal derangement in disorders of temporomandibular joint. Br J Oral Maxillofac Surg 36: 35–38
26. Iida K, Kurita K, Tange K, Yoshida K (1998) Necrosis of the articular tubercle after repeated injections of sodium hyaluronate in the temporomandibular joint. A case report. Int J Oral Maxillofac Surg 27: 278–279
27. Carrol TA, Smith K, Jakubowski J (2000) Extradural haematoma following temporomandibular joint arthrocentesis and lavage. Brit J Neurosurg 14: 152–154