Effect of hyaluronate and splinting alone versus combined treatment (splinting and hyaluronate) on thumb carpometacarpal osteoarthritis

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Abstract

Thumb carpometacarpal osteoarthritis can lead to global hand dysfunctions and its symptoms are pain and inability.

The purpose of this study is to determine the effectiveness of hyaluronate in relieving these symptoms, and to compare it to orthosis and combined treatment (orthosis and hyaluronate).

We enrolled 39 patients, evaluated at the baseline by using numeric rating scale (NRS) for pain, Disability of the Arm, Shoulder and Hand (DASH) and Dreiser Scale for disability degree, and Digital Hydraulic Pinch Gauge for grip strength.

Eligible participants were randomly assigned to one of the three treatments: injection of hyaluronate (group I), combined treatment (hyaluronate and orthosis, Group II) and orthosis (hard-resting splint, Group III).

Patients of Group I and Group II were injected by low molecular weight Hyaluronate once a week for three consecutive weeks. Injections were performed by means of the so-called blind technique.

The data analysis indicated a significant decrease (P<0.01) of pain at week 4, further manifested at week 26 by all groups treated. The same occurred for functional symptoms, and grip strength.

This improvement appears more evident in group I that received HA.

Introduction

The thumb carpometacarpal joint is a biconcave joint between the thumb metacarpal and the trapezium, that allows multiplanar motion.

Trapezio-metacarpal osteoarthritis is a disabling disease characterized by the destruction of normal articular joints.

Usual symptoms are pain, localized at the thumb base, and global hand dysfunctions, including weak pinch and inability to grasp large objects. Patients show a progressive instability and deformity of the articular joint leading to a restriction of their daily activities.

This pathology affects patients from 50 to 70 years of age, especially women (8%-22%) performing manual activities; 10% of all cases of osteoarthritis involve the trapezio-metacarpal joint.1

Important pathogenetic factors are post-traumatic osteoarthritis, instability, malformations, ligamentous laxity, joint hypermobility, subchondral bone microcracks.2

The classification is based on a functional, radiological and clinical evaluation carried out on the basis of some scales, such as Disability of the Arm, Shoulder and Hand scale (DASH), Dreiser Scale, Eaton Glickel scale, and grip strength.

The Dreiser scale is an algofunctional index designed for the evaluation of patients with digital osteoarthritis. The index is based on a questionnaire on 10 daily activities involving the hands. The patient is asked to answer each item using a 4-point verbal scale, from possible without difficulty to impossible. This index was in a few clinical placebo-controlled trials and was found to be sensitive to change.3

The disabilities of the arm, shoulder and hand (DASH) questionnaire is a self-administered region-specific outcome instrument that has been developed as a measure of self-rated upper-extremity disability and symptoms and consists mainly of a 30-item disability/symptom scale.4

The Eaton Glickel scale, developed by Richard Eaton and William Little in 1967 and subsequently modified in 1973, describes four progressive radiographic stages of thumb carpometacarpal arthritis. It is now the most commonly used radiographic classification system for thumb arthritis.5

The initial treatments for trapezio-metacarpal osteo-arthritis are still controversial, and a number of options are available.

The most common conservative treatments for osteo-arthritis are analgesics, orthosis, injection (cortisone, hyaluronate), educational interventions, and physical therapy.

Surgery is indicated when the pathology is severe, however there are numerous complications associated with surgery and for this reason it is advisable to consider conservative options in the first place.6

Intra-articular corticosteroid injections or, alternatively,
hyaluronate are used in order to decrease pain and inflammation and to restore the viscoelasticity of synovial fluids. Some RCTs studied the effect of intra-articular injections, and Meenagh et al. concluded that there is no clinical difference between intra-articular steroid injections and placebo.7

Roux et al. observed 3 groups of patients receiving 1, 2, or 3 hyaluronate injections, and found out that there were no statistically significant differences among the groups regarding pain and function.8

A review published in 2015 highlights that there are only few high-quality studies addressing the conservative treatment of trapezio-metacarpal OA and attributes only some limited effects to orthoses and intra-articular hyaluronate or steroid injections.9

Furthermore, several guidelines recommend the use of orthosis to stabilize the thumb articular complex.10 A randomized trial showed that wearing a splint decreases pain and disability after 12 months, but not after 1 month in patients with osteo-arthritis at the base of the thumb. The use of a splint during daily life activities decreases pain without having effects on functioning, grip strength and pinch strength.11

The aim

The purpose of this study is to determine the effectiveness of hyaluronate in relieving the symptoms of thumb arthritis and to compare it to orthosis and combined treatment, (orthosis and hyaluronate), evaluating pain relief, and functional outcomes among participants.

Materials and Methods

We enrolled 39 patients (Table 1), with painful thumb osteoarthritis referred to our unit. The screening included a questionnaire and hands’ x-rays.

All patients were evaluated at the baseline using: i) NRS scale (number rating scale) for pain intensity; ii) Dreiser and DASH scale for disability degree; iii) Eaton and Glickel scale for radiological evaluation; iv) Digital Hydraulic Pinch Gauge for grip strength. This was evaluated during pulp pinch, latero-terminal and sub-terminal motion.

Inclusion criteria included painful osteoarthritis of thumb, grade II-III of Eaton-Glickel scale. Exclusion criteria were systemic rheumatic disease, bleeding diatheses or anti-coagulation, allergies to steroids, current use of oral or intravenous steroids, active systemic malignancies, hyaluronan injection in CMC joint in the last 6 months, steroid or hyaluronan injection in any other joint in the last 6 months, insulin dependent diabetes mellitus (IDDM), active infection, comorbid hand conditions (such as carpal tunnel syndrome or De Quervain’s tenosynovitis). Patients were asked not to take NSAIDS/COX-2s for pain relief during the study.

Eligible participants have been randomly assigned to one of three treatments: injection of hyaluronate (group I, HA treatment), combined treatment (hyaluronate and orthosis, Group II) or orthosis (Group III). For group I and II, in line with the literature, we used a hard-resting splint for 30 days.

Patients population

Patients Group 1 (HA treatment)

Patients of group 1 (HA treatment), were 15 (Table 2), 3 males and 12 females with a mean age of 65.2 years. The mean value of pain (NRS scale) at the baseline was 6.21, 10.26 according to the Dreiser scale and 34.33 according to the DASH scale. The mean value of grip strength was 7.2

Patients Group II (combined treatment)

The patients of group II (HA treatment and orthosis) were 12 (Table 3), 4 males and 8 females with a mean age of 63.08 years. The mean value of pain (NRS scale) at baseline was 5.75, the Dreiser index 11.8 and the DASH score 27.33. The mean value of grip strength was 8.33.

Patients Group III (orthosis treatment)

Patients of group III (orthosis treatment), were 12 (Table 4), males 3, females 9, mean age 67.41. Mean value of pain at the baseline was 6.5 (NRS scale), Dreiser Index 12.66, and DASH score 33.16. The mean value of grip strength was 7.1.

All patients were observed after 4 weeks and then after 26 weeks. They were evaluated according to NRS, Dreiser index and DASH score and Digital Hydraulic Pinch.

Injection technique

Some studies suggested that injections of hyaluronate (HA) may reduce pain and improve functioning in patients with osteoarthritis.

In our study the patients of Group I and Group II underwent one cycle of 3 weekly i.a. injections of 1 mL (10 mg/mL) of low molecular weight HA using a dorsolateral or infero-lateral approach, after palpating the TMC joint space. The volume of 1 mL of HA was the least painful when injected. The TMC joints were

Table 1. Patients.

| Mean age | 65.23 |
|----------|-------|
| NRS      | 6.1  |
| Dreiser  | 11.25|
| DASH     | 31.82|
| Male     | 10   |
| Female   | 29   |
| Left     | 19   |
| Right    | 20   |
| E.G. II  | 10   |
| E.G. II-III | 7   |
| E.G. III | 22   |

NRS, Numeric Number Scale; DASH, Disability of the Arm Shoulder and Hand; E.G., Eaton Glickel scale.

Table 2. Group 1 - HA treatment.

| No. patients | 15 |
|--------------|----|
| Mean age     | 65.2|
| Males        | 3  |
| Females      | 12 |
| E.G. II scale| 4  |
| E.G. III scale| 11 |
| Right TM OA  | 9  |
| Left TM OA   | 6  |

E.G., Eaton Glickel scale; TM OA, trapezio-metacarpal osteoarthritis.
injected with a 25-gauge needle after skin cleansing with 10% povi-
done iodine.

The joint is very superficial, thus easy to palpate, therefore the
injections were performed through a blind technique by using
anatomic landmarks in order to guide the needle placement.

If the compression of the syringe met resistance, the needle was
not in the joint space and it was repositioned until the HA could be
injected freely.12

**Data analysis**

All analyses were performed using a statistical program. Pain,
functioning, and strength were evaluated at the baseline (T0), at the
4th week (T1), and at the 26th week (Tf). These variables were com-
pared using T-tests.

The primary end-point was changed to DASH score and
Dreiser index at the 26th week. Secondary endpoints included im-
provement of NRS for pain, and grip strength at the 4th week.

Analyses were performed to observe any difference in the im-
provement in pain and functioning among the three groups: hyaluronate, orthosis and combined treatment.

**Results**

**Group 1 - HA injection**

Pain, functioning and strength were evaluated at the baseline
(T0) and also at the 4th week (T1) and at the 26th week (Tf), after HA
injection.

Pain scores and functional tests, expressed by using Numerical
Rating Scale (NRS), Dreiser Index and DASH Score, showed rel-
evant differences 4 weeks after the infiltration (T1) in terms of re-
duction of pain scores (T0 mean value 6.2; T1 mean value 0.93;
P<0.01) and improvement of functioning scores (Dreiser Index: T0
mean value 10.26 - T1 mean value 1.76 - P<0.01; DASH Score: T0
mean value 34.33 - T1 mean value 20.13 - P<0.01). Further im-
provement was observed 26 weeks after treatment (Figure 1).

Similarly, pulp pinch, lateral pinch and sub-terminal pinch
strength, assessed by using a dynamometer (Figure 2), showed im-
provement after 4 and 26 weeks from the date of infiltration, com-
pared with baseline (T0 overall mean value 7.73 Kgp - T1 overall mean
value 13.45 kgp; P<0.01).

Therefore, assessment of the pinch power showed long-term
effects of hyaluronic acid injection in osteoarthritis of the thumb in
carpometacarpal osteoarthritis (CMC OA).

**Group 2 - HA injection and orthosis**

Pain, functioning, hand function and strength were evaluated
at the baseline (T0) and also at the 4th week (T1) and at the 26th
week (Tf), after HA injection, using orthosis to stabilize the thumb’s
articular complex.

A relevant difference was observed between pain scores before
the treatment and after 26 weeks from it. The pain scores are ex-
pressed in mean values (T0 mean value 5.75; T1 mean value 1.25;
P<0.01), with a trend toward pain improvement at an early stage, 4
weeks after the treatment (Figure 3).

Relevant differences were noticed 4 weeks and 26 weeks after
the treatment between Dreiser Index and DASH Scores (Dreiser
Index: T0 mean value 11.8 - T1 mean value 3.08 - P<0.01; DASH
Score: T0 mean value 27.33 - T1 mean value 14.25 - P<0.01).

**Table 3. Group 2 - Combined treatment.**

| No. patients | 12 |
| Mean age     | 63.08 |
| Males        | 4 |
| Females      | 8 |
| G.K. II scale| 4 |
| G.K. III scale| 8 |
| Right TM OA  | 5 |
| Left TM OA   | 7 |

**Table 4. Group 3 - Orthosis treatment.**

| No. patients | 12 |
| Mean age     | 67.41 |
| Males        | 3 |
| Females      | 9 |
| G.K. Scale II| 6 |
| G.K. Scale III| 6 |
| Right TM OA  | 6 |
| Left TM OA   | 6 |

**Figure 1. GROUP I: Pain and function. NRS, Numeric Rating Scale; DASH, Disability of the arm Shoulder and Hand.**

**Figure 2. GROUP I: strength mean value. p.p., pulp pinch strength; l.p., latero-terminal strength; s.t., sub-terminal strength. Overall mean value: T0 7.73 Kgp; T1 13.45 kgp; P<0.01.**
In addition, these results suggested an improvement of pulp pinch strength, measured by means of a dynamometer and expressed as mean value (Figure 4), with regard to significant differences at 4th and 26th weeks compared to the baseline ($T_0$ mean value 8.66 kg - $T_1$ mean value 12.02 kg - $T_f$ mean value 12.83 - P<0.01).

Therefore, patients treated with intra-articular hyaluronate injection and using orthosis to stabilize the thumb articular complex showed a decrease in pain and functional disability and an improvement in hand functioning with an increase of grip strength.

**Group 3 - Orthosis**

Pain, functional disability, hand function and strength were evaluated at the baseline ($T_0$) and at the 4th week ($T_1$) and 26th week ($T_f$) after using orthosis to stabilize the thumb articular complex.

Some differences were noticed between pain scores (NRS: $T_0$ 6.5, $T_f$ 2.58, P<0.01) after 4 weeks and 26 weeks from the use of orthosis (NRS: $T_0$ 6.5, $T_f$ 2.58, P<0.01), as seen in functional tests evaluated after using orthosis at 4 weeks (Dreiser Index: $T_0$ mean value 12.66 - $T_f$ mean value 7.66 - P<0.01; DASH Score: $T_0$ mean value 31.16 - $T_f$ mean value 24.83). However, at the 4th week, the improvement in the functional score was lower than the improvements observed in group 1 and in group 2 (Figures 5-6). Equality could be observed in functional tests at the 4th and 26th week after using the splint.

Pinch strength expressed as overall mean value showed a statistically non-significant increase in value 4 weeks after using orthosis compared to the baseline ($T_0$ mean value 7.38 - $T_1$ mean value 9.61). The analysis of mean values for each type of grip (pulp pinch, lateral pinch and sub-terminal pinch) showed improvement of pulp pinch only four weeks after using orthosis, which remained constant at 26 weeks after using the splint.

**Discussion**

In our study we investigated the effects of HA on the trapezio-metacarpal osteoarthritis, evaluating if splinting in combination with the hyaluronate treatment might be a valid alternative therapy.

This small open label study showed an effective improvement of conservative treatments.

The data analysis indicated a significant decrease (P<0.01) in pain at the 4th week, further shown at the 26th week, in all groups treated. By comparing pain scores at $T_f$ (Figure 7), we observed that this improvement appeared more in group I that was receiving HA. In fact, in this group the pain score at baseline was 6.2 vs 0.3 at 26 weeks.

In group II, the pain score at the baseline was 5.75 vs 1.25 at the 26th week; in group III the pain score at the baseline was 6.5 vs 2.58 at the 26th week.

Function, as measured by the DASH index and the Dreiser score also improved significantly at week 26, especially in group I and II (P<0.01). Likewise, there was an improvement of grip strength, except for group 3, which did not achieve a statistically significant value (Figure 8). Our data in accordance with some stud-
ies prove that HA reduces pain and improves grip strength. A randomized controlled trial of 56 patients showed non-inferiority of HA compared to steroids for pain relief at week 26.

Regarding the use of orthosis, we observed that the splint did not lead to an improvement in functional symptoms. The data analysis showed a decrease in pain, which was lower in III group, and a lower effect in the combined treatment (group II); improvement in functional symptoms, such as grip strength, did not achieve a statistically significant value in group III.

Several guidelines recommend the use of orthosis in osteoarthritis of thumb, but no evidence of efficacy exists. A randomized trial showed that wearing a splint improves pain and disability after 12 months, but not at the first month. Its use during daily life activities results in the reduction of pain, but it is not effective in improving function or grip strength. Usually, a client-centered approach is preferred. Other authors point out that splinting can relieve pain in thumb arthritis and can potentially help patients avoid other treatments, such as drugs and steroid injections.

In line with the literature, we used a hard resting splint for 30 days in group II (combined treatment) and group III (orthosis treatment).

As already observed by other authors, the effect on pain is determined by a reduction of inflammation as a consequence of the use of a hard resting splint. Kortekaas et al. noted a significant positive correlation between pain and ultrasound-assessed inflammation in hand OA.

As regards surgery, the literature highlights that it might be an option. A study of patients undergoing surgery showed that DASH scores improve, but despite this it is effective in relieving pain, many older patients are not eligible for surgery, and HA injections may be an effective low-risk treatment in non-responders to standard medical therapy.

Conclusions

Our analysis showed that hyaluronate is a valid treatment for trapeziometacarpal osteoarthritis. Pain and functional symptoms improved like grip strength assessed at the 4th and 26th week.

Splinting reduces pain, but it does not have any significant effect on grip strength and functional symptoms, if used alone; the association with low molecular weight hyaluronate does not seem to have more effects.

References

1. Haara MM, Heliovaara M, Kroker H, et al. Osteoarthritis in the carpometacarpal joint of the thumb. Prevalence and associations with disability and mortality. J Bone Joint Surg Am 2006;86-A:145-257.
2. Das SK, Farooq A Osteoarthritis. Best Pract Res Clin Rheumatol 2008;22:657-75.
3. Dreiser RL, Maheu E, Guillou GB, et al. Validation of an algofunctional index for osteoarthritis of the hand. Rev Rhum Engl Ed 1995;62:43S-53S.
4. Gummesson C, Atroshi I, Ekdahl C. The disabilities of the arm, shoulder and hand (DASH) outcome questionnaire: longitudinal construct validity and measuring self-rated health change after surgery BMC Musculoskelet Disord 2003;4:11.
5. Eaton RG, Glickel SZ. Trapeziometacarpal osteoarthritis. Staging as a rationale for treatment. Hand Clin 1987;3:455-71.
6. Wajon A, Carr E, Edmunds I, Ada L. Surgery for thumb (trapeziometacarpal joint) osteoarthritis. Cochrane Datab Syst Rev 2009;4.
7. Meenagh GK, Patton J, Kynes C, Wright GD. A randomised controlled trial of intra-articular corticosteroid injection of the carpometacarpal joint of the thumb in osteoarthritis. Ann Rheum Dis 2004;23:116-20.
8. Roux C, Fontas E, Breuil V, et al. Injection of intra-articular sodium hyaluronidate (Sinovial) into the carpometacarpal joint of the thumb (CMC1) in osteoarthritis. A prospective evaluation of efficacy. Joint Bone Spine 2007;74:368-72.
9. Spaans AJ, van Minnen LP, Kon M, et al. Conservative treatment of thumb base osteoarthritis: a systematic review. J Hand Surg Am 2015;40:16-21.
10. Ramon F, Dimet J, Bontron I, et al. Splint for base-of-thumb osteoarthritis: a randomized trial. Ann Intern Med 2009;150:661-9.
11. Gomes Carreira AC, Jones A, Natour J. Assessment of the effectiveness of a functional splint for osteoarthritis of the trapeziometacarpal joint on the dominant hand: a randomized controlled study. J Rehabil Med 2010;42:469-7.
12. Mandl LA, Hotchkiss RN, Adler RS, et al. Can the carpometacarpal joint be injected accurately in the office setting? Implications for therapy. J Rheumatol 2006;33:1137-9.
13. Coaccioli S, Pinoca F, Puxeddu A. Short term efficacy of intra-
articular injection of hyaluronic acid in osteoarthritis of the first carpometacarpal joint in a preliminary open pilot study. Clin Ther 2006;157:321-5.

14. Fuchs S, Monikes R, Wohlmeiner A, Heyse T. Intra-articular hyaluronic acid compared with corticoid injections for the treatment of rhizarthrosis. Osteoarthritis Cartilage 2006;14:82-8.

15. Gomes Carreira AC, Jones A, Natour J. Assessment of the effectiveness of a functional splint for osteoarthritis of the trapeziometacarpal joint on the dominant hand: a randomized controlled study. J Rehabil Med 2010;42:469-74.

16. Sillem H, Backman CL, Miller WC, Li LC. Comparison of two carpometacarpal stabilizing splints for individuals with thumb osteoarthritis. J Hand Ther 2011;24:216-25.

17. [No authors listed]. Summaries for patients. The effects of splinting on thumb arthritis. Ann Intern Med 2009;9:150.

18. Callinan NJ, Mathiowetz K. Soft versus hard resting hand splints in rheumatoid arthritis: pain relief, preference, and compliance. Am J Occup Ther V 1996;50:347-53.

19. Kortekaas MC, Kwok WY, Reijnierse M, et al. Pain in hand osteoarthritis is associated with inflammation: the value of ultrasound. Ann Rheum Dis 2010;69:1367-9.

20. Hartigan BJ, Stern PJ, Kieffhabe TR. Thumb carpometacarpal osteoarthritis: arthrodesis compared with ligament reconstruction and tendon interposition. J Bone Joint Surg Am 2001;83:1470-8.