Clinical Chiropractic (2010) xxx, xxx–xxx

ELSEVIER

Clinical Chiropractic

www.elsevier.com/locate/clch

ORIGINAL ARTICLE

Patellofemoral pain syndrome managed by ischemic compression to the trigger points located in the peri-patellar and retro-patellar areas: A randomized clinical trial

Guy Hains DC*, **François Hains DC, FCCS(c), MSc.**

Private Practice, Québec, Canada

Received 5 January 2010; received in revised form 13 April 2010; accepted 20 May 2010

KEYWORDS
Patellofemoral pain syndrome;
Myofascial trigger points;
Ischemic compression;
Chiropractic

Summary

Design: A prospective, randomized controlled trial with cross-over.
Background: Patellofemoral pain syndrome is one of the most common causes of knee pain. Its prevalence is relatively high in adolescents and younger adults. However, very few clinical trials have investigated the different therapeutic approaches commonly used in its clinical management.
Objective: To measure the efficacy of myofascial manual therapy (ischemic compression) directly to the knee for chronic patellofemoral pain syndrome.
Methods: The experimental group ($N = 27$) received 15 sessions of manual ischemic compression applied to peri-patellar and retro-patellar regions. The control group ($N = 11$) received 15 sessions of manual ischemic compression on trigger points over the hip muscles. After 30 days of follow-up, the control group was offered the opportunity to receive the study intervention. Changes in pain intensity were assessed in both groups using a visual analog pain scale and a 5-point scale to monitor the patient's response to the patellar-grinding test. Outcomes were compared between groups using two-way repeated measures ANOVA whereas one-way repeated measures ANOVA were used to test for the main effect of time intervals.
Results: The experimental group showed a significant ($p < 0.05$) reduction in pain that was maintained at 30 days (from 5.97 ± 0.32 to 3.4 ± 0.45) and 6 months (from 5.97 ± 0.32 to 3.5 ± 0.53). Patellar-grinding scores improved only in the experimental group (from 3.4 ± 0.13 to 1.2 ± 0.19).

* Corresponding author at: 2930 Côte Richelieu, Trois-Rivières, Québec, Canada G8Z 3Y8. Tel.: +1 819 375 5600; fax: +1 819 379 4397.
E-mail address: guy.hains@cgocable.ca (G. Hains).

doi:10.1016/j.clch.2010.05.001

Please cite this article in press as: Hains G, Hains F. Patellofemoral pain syndrome managed by ischemic compression to the trigger points located in the peri-patellar and retro-patellar areas: A randomized clinical trial, Clin Chiropractic (2010), doi:10.1016/j.clch.2010.05.001

Conclusion: A treatment regimen with 15 sessions of manual ischemic compression applied to peri-patellar and retro-patellar regions of the knee was found to be effective in short and medium term at reducing symptoms of patellofemoral syndrome for up to 6 months.

Introduction

Patellofemoral pain syndrome (PFPS) is one of the most common causes of knee pain.[1,2] It is the most frequently reported knee complaint diagnosed at orthopedic and physical therapy clinics today.[3] It is more common among women, and frequently affects athletes, dancers, gymnasts and military personal.[4–6] PFPS is also one of the most challenging conditions to clinically manage.[1] PFPS is responsible for 25% of all running injuries for which medical attention is sought.[6,7] Once it has begun, PFPS frequently becomes chronic, resulting in severely limited or completely relinquished physical activity.[8] Some experts stress that the management of PFPS may result in costly, unnecessary, unwarranted and unproven surgical intervention.[9]

Although a consensus of the characteristic signs and symptoms of PFPS does not exist,[1] patients typically report anterior knee pain that is either located in the peri-patella region or moves to a retro-patellar position during active movements involving loading of the patellofemoral joint, notably flexion, squatting and stair ascent or descent.[1,8,10] Other symptoms of PFPS are pain with prolonged sitting while the knees are flexed (cinema or movie sign), resisted knee extension and a positive patellar-grinding test (see below).[6,11] Crepitus frequently occurs concomitantly. While some authors continue to use the term chondromalacia patella (CMP) interchangeably with PFPS, most experts now agree that these are two separate and distinct clinical entities, and that the relationship between the two is poorly documented.[6,8,12]

The patellar-grinding test is generally considered to be the most pathognomic test of PFPS.[5,13] For this test, the patient's leg is extended and the examiner firmly grasps the patella. The examiner then applies a compressive pressure, forcing the patella into the patellofemoral joint space.[6,13,14]

While the pain associated with PFPS is characteristic, the generator of this pain remains largely unknown.[1] Theories about the pain being derived from articular cartilage damage are countered by the knowledge that articular cartilage is aneural, and that symptoms may co-exist with normal cartilage structure.[1] There are six potential major anatomic structural sources of patellofemoral pain: subchondral bone, synovium, retinaculum, skin, muscle and nerve.[4] The infrapatellar fat pad could also be one of the pain generators in PFPS.[1] These structures may in turn be affected by a multitude of other factors, including, but not limited to, systemic illness, various arthritides and inherent structural forces. However, the most common causes of anterior knee pain are overuse, patellofemoral malalignment and trauma.[2,4] Most experts agree that imbalance or misalignment of the extensor mechanism of the knee can lead to overload of the retinaculum and subchondral bone, subsequently activating pain fibers in the bone, synovium or retinaculum.[4] In particular, the vastus medialis oblique (VMO) is posited to be predominately involved in cases of PFPS.[15] In cases of chronic malalignment, the cycle of VMO and vastus lateralis oblique (VLO) dysfunction may be self-perpetuating.[15] Historically, the Q-angle, defined as the angle between the quadriceps muscle and patellar tendon, was given a great deal of significance with respect to the diagnosis and management of PFPS.[16] However, two literature reviews reported that this measurement is of limited value.[17,18]

Predisposing factors of PFPS include acute trauma, overuse, immobilization, excessive weight, genetic predisposition, misalignment of the extensor mechanism, congenital anomalies of the patella, prolonged synovitis, recurrent hemorrhage into a joint, joint infection, and repetitive intra-articular injections of corticosteroids.[8] However, in many cases of PFPS, the onset of symptoms may be insidious and no definite factor is found to be the cause of the clinical symptoms even after radiography and arthroscopy.[8] A thorough and complete history and a physical exam are usually sufficient to diagnose PFPS.[3]

To date, there have been very few clinical trials monitoring the long list of therapeutic approaches employed in the treatment of PFPS, and there is a general paucity of articles comparing the effectiveness of one clinical approach to another.[1] Most of the published studies do not indicate whether conservative measures were performed prior to surgical interventions or, if they were, these measures are often ill defined.[1] Most studies of surgical treatment for patellofemoral disorders are observational case series.[2,19] Until the early 1990s, surgical intervention was a widely practiced treatment for PFPS.

Please cite this article in press as: Hains G, Hains F. Patellofemoral pain syndrome managed by ischemic compression to the trigger points located in the peri-patellar and retro-patellar areas: A randomized clinical trial, Clin Chiropractic (2010), doi:10.1016/j.clch.2010.05.001

Currently, practitioners advocate a trial of conservative management prior to surgery.[2] Conservative treatment generally includes patient education, rest, muscle strengthening, athletic taping, resistance bracing, medication, orthoses, acupuncture, low-level laser, physiotherapy and manual therapies.[1,4,13]

Scientific rationale for the treatment of trigger points in the management of PFPS

Trigger points may be located in muscles, ligaments, tendon and articular capsules.[20] Two trials using patellar mobilizations resulted in significant amelioration on the patellofemoral syndrome.[10,13]

Natural history of PFPS

A questionnaire was completed by 54 patients suffering from patellofemoral pain syndrome at different intervals from 2 to 8 years after the initial diagnosis. Most (98%) reported that they still experienced some pain. However, the pain was diminished in 43% and worsened in 13% of the cases. Most (81.5%) reported that they felt pain about once a week. Knee pain severely restricted sporting activities in 16.7% of patients and half of the patients experienced bilateral knee pain.[9]

The purpose of this preliminary study was to monitor the effects of manual therapy applied to symptomatic patients suffering from chronic PFPS. Specifically, this study sought to measure changes in patients with PFPS receiving manual therapy directed to the knee consisting of ischemic compression and patients receiving sham ischemic compression directed to the hip in reducing symptoms of PFPS.

Methods

Patient recruitment and selection

Approval for this research project was granted by l'Ordre des Chiropraticiens du Québec.

The target number of participants for this study was set at 40 and an announcement was placed in a local newspaper inviting individuals suffering from patellofemoral pain syndrome to contact the first author. The first 38 respondents who met the inclusion criteria were recruited for the study.

Participants were considered eligible for this study if they were between the ages of 18 and 50 years, and had suffered anterior knee pain with activity in one or both knees on a daily basis for at least the previous 3 months. The prospective participants also needed to be positive on the patellar-grinding test. Eligible participants had to agree to receive 15 treatments, 3 times a week. Patients were excluded from this study if they had past knee surgery, a history of fracture of the lower extremity or a history of meniscal or ligamentous injury. Patients diagnosed with osteoarthritis of the knee or presenting clinical signs (enlarged and deformed knee) corresponding to moderate to severe osteoarthritis (OA) of the knee were excluded from the trial. An enlarged and deformed knee would have been the criteria for OA.

Patients who met the eligibility criteria of this study were invited to participate. All patients who agreed to undergo treatment were required to read and sign an informed consent form prior to the commencement of the study. Thirty-eight patients who met the inclusion criteria completed the consent form and participated in the study. Patients

Table 1 Patellar-grinding test scores.

Score	Reaction by patient
0	No reaction
1	Mild reaction; pressure reported to be quite bearable
2	Mild reaction coupled with leg recoil without facial muscle contraction
3	Mild reaction coupled with recoil reflex with medium-strength facial muscle contraction
4	Strong reaction with recoil reflex of leg and pronounced grimacing of facial muscles
5	Extremely strong reaction linked to violent recoil reflex and very pronounced facial muscle grimacing

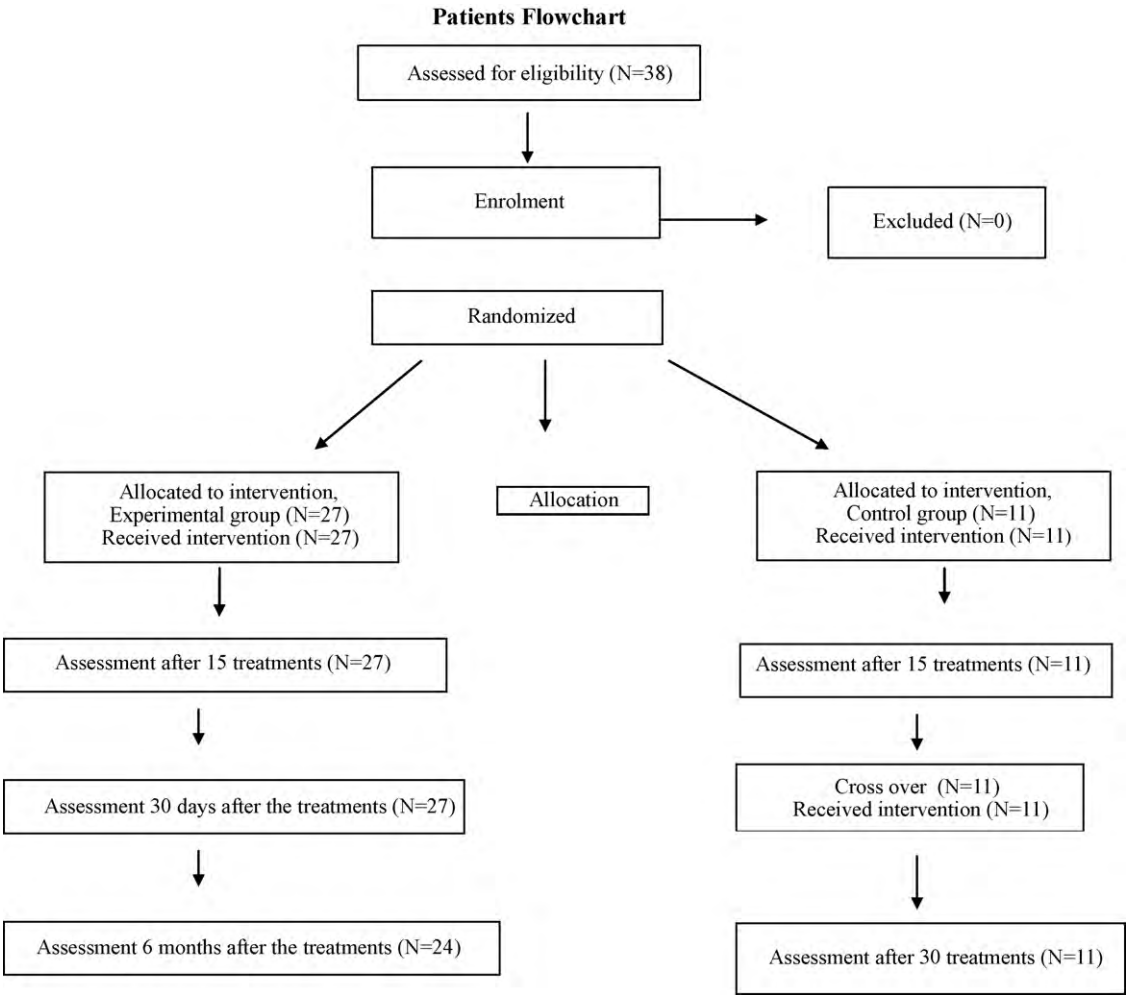
Table 2 Evaluation schedule.

Group	Baseline	After 15 TX	30 days after TX	After 30 TX	6 months later
Active	VAS, PGT	VAS, PGT	VAS		VAS
Control	VAS, PGT	VAS, PGT	VAS		
Cross-over				VAS, PGT	

TX, treatments; VAS, visual analog scale; PGT, patellar-grinding test.

Please cite this article in press as: Hains G, Hains F. Patellofemoral pain syndrome managed by ischemic compression to the trigger points located in the peri-patellar and retro-patellar areas: A randomized clinical trial, Clin Chiropractic (2010), doi:10.1016/j.clch.2010.05.001

were blinded to their group allocation, they did not know if they were in the experimental group or in the control group.



Randomization

Randomized allocation of the participants was managed by an independent research assistant. Upon recruitment, each participant was assigned a random allocation number generated from a 2/3 to 1/3 random number table. Two-thirds were even numbers and 1/3 odd numbers, jumbled together in an opaque envelope. The assistant pulled a number and assigned the patient to either the experimental group or the control group. The 38 patients who met the inclusion requirements received the initial 15 treatments. Twenty-seven in the experimental group and 11 in the control group completed the questionnaires at different intervals (see Table 2).

Outcome measures

Upon entry into the study, baseline measurements were recorded for pain, using the visual analog scale and the patellar-grinding test (PGT). The patellar-grinding test involved passive movement of the patella by the examiner in a superficial to deep direction; that is, the patella was compressed into the patellofemoral joint space. With the patient's leg extended, the examiner assumed a fencer[1] stance and grasped the patella with a reinforced contact, one hand on the other. Pressure was then applied into the joint space. A 6-point grading scale (see Table 1) was used to determine the degree of discomfort to the patient resulting from this test, as described by Meyer et al.[13] In our

Please cite this article in press as: Hains G, Hains F. Patellofemoral pain syndrome managed by ischemic compression to the trigger points located in the peri-patellar and retro-patellar areas: A randomized clinical trial, Clin Chiropractic (2010), doi:10.1016/j.clch.2010.05.001

opinion, the outcome measures of the PGT as described by Meyer were the most specific and practical obtainable.

The patellar-grinding tests (PGTs) were performed by an independent chiropractor, who was blinded with respect to participant treatment allocation. If both knees were painful, the average value was used as the main outcome measures. In addition to the PGT, patients were asked to complete a pain visual analog scale (pain-VAS) at baseline, after the end of treatments. The patients graded their VAS at the current time. The pain-VAS consisted of a 10-cm line with a score of '0' (no pain) at one end and a score of '10' (excruciating pain) at the other end. The pain-VAS has been shown to be a valid and reliable method to record a patient's perception of pain intensity in cases of PFPS.[1] In both groups, pain-VAS scores — were obtained 30 days following the last treatment. At that point in time, patients in the control group were given the opportunity to receive an additional 15 treatments of ischemic compression. After receiving these additional 15 experimental treatments, scores from pain-VAS and the PGT were obtained. Finally, for the experimental group only, pain-VAS was obtained at 6 months following the last treatment (except for 3 patients who could not be reached). The evaluation schedule is presented in Table 2.

Intervention

Participants were invited to stop taking any treatments other than the one given by the author for their PFPS. For this study, patients were randomly assigned to either a treatment group or a control group. The experimental group consisted of 27 patients, 20 women and 7 men, aged 18—42 years (average age 25.3 years). The control group consisted of 11 patients, 8 women and 3 men aged 19—35 years (average age 25 years). Group characteristics are presented in Table 3.

In both instances, treatment was directed to trigger points elicited by palpation by the treating clinician. Trigger points are defined as hyperirritable foci that can be located in muscles, ligaments, tendons, fascia and articular capsules.[20] In the present trial, the authors suspected that the TrPs could also be at the periost. The most pathognominic sign of myofascial pain syndrome is the presence of pressure-sensitive palpable nodules that reproduce the main complaints; they are called trigger points.[22] Recent data indicate that TrPs are treated by 91% of chiropractors.[23] Palpation of the trigger point elicits pain directly over the affected area and often produces a local twitch response.[24] Treatment for patients assigned to either group consisted of a form of manual therapy termed ischemic compression. This approach, also known as acupressure, Nimmo technique or trigger point therapy, is commonly used by chiropractors and other manual therapists and has been used by practitioners for the past 40 years.[25]

Ischemic compression therapy was used in both groups (in different areas). It consisted of the practitioner applying a sustained digital pressure to the areas of elicited pain for between 5 and 15 s. The practitioner began with light firm pressure and gradually increased the pressure used until the patient's maximum pain tolerance was reached. To accommodate patient comfort, when many trigger points were elicited during examination, each point was held for less time than if fewer trigger points were elicited.[26]

The treatment group received ischemic compression therapy to elicited trigger points (if any) in the peri-patellar region (see Fig. 1). Beginning with light pressure, one thumb on the other, compression was applied to hyperirritable foci. Pressure was gradually increased up to the patient's maximum pain tolerance. Using at each visit the patellar-grinding test to locate the hyperirritable foci (if any) located under the patella (retro-patellar trigger points), the author would apply a compressive force on the patella by grasping it using a broad contact (web of the practitioner's hand) and pushing it towards each hyperirritated focus. Since this maneuver could be extremely painful, the practitioner would apply pressure very carefully and within the patient's pain tolerance limits. This modification to ischemic compression was used for retro-patellar pain. It was based on the hypothesis that passive oriented patellar mobilization would function in the same manner as ischemic compression and would result in the elimination of retro-patellar trigger points. This procedure was applied until complete elimination of the trigger points or until the completion of the 15 treatments.

Table 3 Baseline characteristics of the treatment and control groups.

Group	*N*	Gender	Age mean [95% CI]	VAS mean [95% CI]	PGT mean [95% CI]
Experimental	27	7 M; 20 F	25.3 [19.3—31.4]	5.97 [4.6—7.3]	3.4 [2.9—4.0]
Control	11	3 M; 8 F	25 [20.8—28.7]	6.7 [5.6—7.7]	3.7 [3.4—4.1]

PGT, patellar-grinding test; VAS, visual analog scale.

Please cite this article in press as: Hains G, Hains F. Patellofemoral pain syndrome managed by ischemic compression to the trigger points located in the peri-patellar and retro-patellar areas: A randomized clinical trial, Clin Chiropractic (2010), doi:10.1016/j.clch.2010.05.001

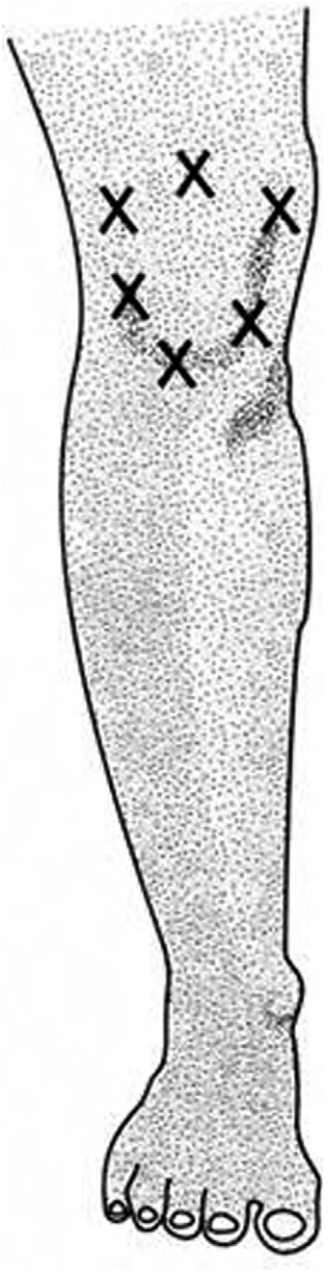


Figure 1 Main peri-patellar trigger points in patellofemoral pain syndrome.

The control treatment consisted of ischemic compression over trigger points located around the hip area (gluteus maximus, medius and minimus) starting with a light pressure and gradually increasing the pressure to the limit of the participant's pain tolerance.

Statistical analysis

Baseline characteristics were compared using *t*-test for independent groups. Results from the 38 patients were analyzed according to the ''intention to treat'' approach. The pain and PGT scores were first submitted to a two-way repeated measures ANOVA (group $\times$ Time intervals). This analysis tested for the main effect treatment (experimental or control), the main effect of Time intervals (baseline evaluation and after 15 treatments) and the interaction. To test for the effects of experimental treatment over the different Time intervals, a one-way repeated measures ANOVA was performed. Whenever a main effect of Time intervals was observed for the experimental group, post hoc comparisons were performed using Tukey tests. For all analyses, statistical significance was set at $p < 0.05$.

Results

No significant side effects were seen during or after treatments.

At baseline there were no statistically significant differences in age, pain scores and patellar-grinding test scores between the two groups (see Table 3).

All 38 participants received the initial 15 treatments and completed the questionnaires as intended except for three who at 6 months were not reachable. For the VAS score, in the experimental group, amelioration after 15 treatments was an average of 60%; 30 days following the last treatment it was 43%, and 6 months later it was 41%. For the control group, after 15 treatments, amelioration was 28%, and 30 days after the treatments it was 13%. For the cross-over group, 15 control plus 15 experimental treatments, improvement was 54% in relation to the baseline (Table 4).

For the PGT score, in the experimental group, amelioration after 15 treatments was an average of 65% (Table 5). For the control group, after 15 treatments amelioration was 9%. For the cross-over group, 15 control plus 15 experimental treatments,

Table 4 Outcome measure for VAS.

Group *N*	Baseline	After 15 TX	30 days after TX	After 30 TX (cross-over)	6 months later
Experimental *N* = 27	5.97 (0.32)	2.4 (0.37)	3.4 (0.45)		3.5 (0.53)
Control *N* = 11	6.7 (0.52)	4.8 (0.62)	5.8 (0.74)	3.1 (0.47)	

N, number of participants; TX, treatments; VAS visual analog score; standard deviation (in parentheses).

Please cite this article in press as: Hains G, Hains F. Patellofemoral pain syndrome managed by ischemic compression to the trigger points located in the peri-patellar and retro-patellar areas: A randomized clinical trial, Clin Chiropractic (2010), doi:10.1016/j.clch.2010.05.001

Table 5 Outcome measure for PGT.

Group *N*	Baseline	After 15 TX	After 30 TX (cross-over)
Experimental 27	3.4 (0.13)	1.2 (0.19)	
Control 11	3.7 (0.20)	3.36 (0.29)	1.4 (0.21)

N, number of participants; PGT, patellar-grinding test; TX, treatments; standard deviation (in parentheses).

amelioration was 62% in relation to the baseline (Table 5).

All patients were treated and assessed as intended, except for 2 patients in the experimental group who could not be reached after 6 months.

The two-way repeated measures ANOVA showed a significant group × Time intervals interaction for patellar-grinding test scores. As illustrated by Fig. 2, the experimental group showed a significant reduction in patellar-grinding test scores (3.44 [95% CI: 3.18—3.70]) before and 1.21 [95% CI: 0.83—1.59] after, compared to the control group (3.71 [95% CI: 3.30—4.12] before and 3.36 [95% CI: 2.76—3.96] after). No significant group × Time intervals interaction was found for pain scores. Finally, pain scores in the experimental group were significantly reduced after 15 treatments, at the 30 days follow-up and at the 6 months follow-up, when compared to the baseline scores. Fig. 3 illustrates the pain scores in the experimental group throughout the trial.

Discussion

Crossley et al.[1] conducted a systematic review of the literature investigating the effectiveness of physical interventions for PFPS. These investigators wrote that, while the plethora of non-operative treatments used in the treatment of PFPS appears to be based on sound theoretical rationale, the evidence for their efficacy is not well established. In general, the authors reported that poor study quality and lack of standardization with respect to the interventions used and outcome measures employed to monitor clinical changes prevented a meta-analysis from being performed, and the inclusion of multiple therapeutic interventions made it difficult to ascertain the treatment effectiveness of any single modality. However, Crossley et al.[1] also concluded that the literature was sufficiently robust for several conclusions to be drawn from it. The authors opined that there was sufficient evidence to report that physiotherapy may be effective in reducing the pain associated with PFPS. There was some evidence to support the use of eccentric exercises over alternative forms of quadriceps strengthening programs. Lastly, it was the opinion of these researchers that there was insufficient evidence to either support or refute the use of patellar taping, acupuncture, low-level laser, chiropractic patellar mobilization or patellofemoral orthoses (braces).

Following the protocols described by McConnell and Amiraka,[27—30] patella taping was reported to result in short-term pain relief among patients with PFPS. The purported aim of patellar taping is to create a mechanical medial shift in the patella, thus centralizing it in the trochlea groove and enhancing patella tracking. It is also theorized that this

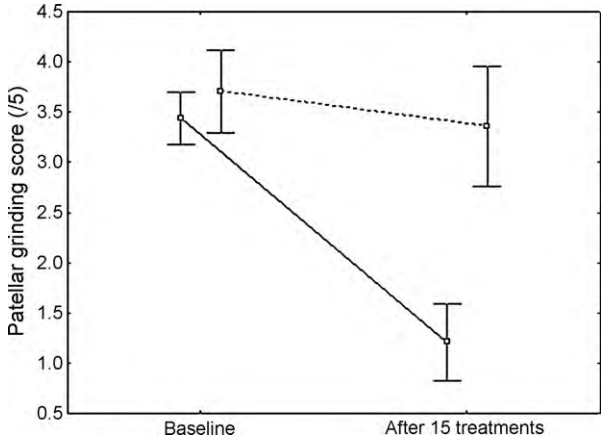


Figure 2 Mean Patellar-grinding scores at baseline and after 15 treatments for both groups. The plain line represents the experimental group and the dotted line the control group.

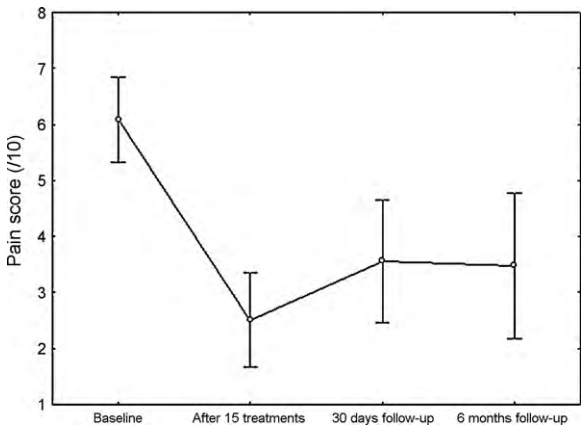


Figure 3 Mean VAS scores throughout the trial for the experimental group.

Please cite this article in press as: Hains G, Hains F. Patellofemoral pain syndrome managed by ischemic compression to the trigger points located in the peri-patellar and retro-patellar areas: A randomized clinical trial, Clin Chiropractic (2010), doi:10.1016/j.clch.2010.05.001

realignment may enhance the activation or timing of the VMO relative to the VLO, and to improve knee flexion loading response during gait. Some support for this theory may be found in a case report of two cases of PFPS associated with vastus lateralis strain.[31]

In the present trial, even though the reaction of the patient to the patellar-grinding test (5 phases) seems very subjective, it was in fact an easily usable and practical outcome measure. After 15 treatments that outcome resulted in a 65% diminution of the pain in the experimental group. This is highly significant when compared with the 9% diminution in the control group and the 62% diminution when that group was crossed over. This outcome compares favourably with the VAS evaluation which gave a 60% reduction of pain in the experimental group when compared to the 28% achieved in the control group and 54% when that group was crossed over.

The results obtained are similar to those obtained by Crossley et al.[30] in their study. Sixty-seven participants completed the trial, 33 in the experimental group and 34 in the placebo group. The treated patients received individual sessions lasting 30—60 min, once a week for 6 weeks. The treatment included patellar taping, retraining of the vastus medialis oblique, gluteal muscle strengthening, and stretching of soft tissue structures. That last stretching of the tissue consisted in the mediolateral (glide and tilt) mobilization of the patella combined with deep friction massage to the lateral soft tissue. The diminution of the pain was on average 60%.

According to the Job Analysis of Chiropractic 2005,[33] lower extremity pains or injury accounts for 8.8% of patients' chief complaints presented in the field. That said, the chiropractic literature offers little in the way of clinical trials investigating the benefits of manual therapies for patient suffering from PFPS. Meyer et al.[13] used a time-series experimental design to determine the effectiveness of chiropractic care during the symptomatic control phase in a patient with bilateral knee pain. In that study, chiropractic care consisted of long axis tibiofemoral adjustments, passive patellofemoral mobilization, and continuous ultrasound therapy. Outcome measures consisted of pain (monitored using a visual analog scale and pain diary), patellar tracking and response to the patellar-grinding test. A reliable 3—4 week time lag was observed between treatment phases and demonstrable changes in the patient's signs and symptoms.

Rowlands and Brantingham[10] reported the results of a prospective randomized, placebo-controlled pilot study investigating the efficacy of patellar mobilization among patients suffering from PFPS. Thirty subjects were randomized into two groups. Group A received patella mobilization and group B received detuned ultrasound. Using both objective (algometry) and subjective (McGill pain questionnaire, Numerical Pain Rating Scale-101 and Patient-Specific Functional Scale) outcome measures, group A demonstrated a better intragroup response than did group B. In addition, there were statistically significant differences with respect to algometric measurements in favour of group A.

The 15 treatments administered in the present trial were based on the author's experience. The ideal endpoint would be upon the complete elimination of the TrPs. This could sometimes take fewer treatments, sometimes more.

Post hoc power analysis

Using the VAS after 15 treatments as a variable for power calculation, a conservative 2 points standard deviation for the ''true mean'' in the general population of patellar pain patient, it was calculated that using two groups ($N = 27$ and $N = 11$) would yield a 0.9039 power value.

To the best of our knowledge, the treatment of PFPS as effected in this trial has not previously been reported.

Limitation of this study

There were several limitations to this study. Some data sets were not obtained, such as patella grinding test scores at 30 day and 6-month follow-up from the patients in the control group. The psychometric properties of the patellar-grinding test are not known. The number of patients in the control group compared to the number of patients in the treatment group was small because the clinicians find it difficult to construct a practice-based study that provides a group with only a placebo treatment. The treatment of the latent trigger points at the hip muscles was not a true placebo treatment. The Cochrane guidance was not followed in this trial; it was not available when the study was done. Lastly, there was only one treating doctor in this study.

In this trial, we also observed that during the treatment stage some patients demonstrated myofascial trigger points at other areas of the knee besides the patellofemoral joint. These additional areas of irritation were not treated during the course of this study and might have contributed to the persistent knee pain of some participants, even after the patellar-grinding test had become negative.

Please cite this article in press as: Hains G, Hains F. Patellofemoral pain syndrome managed by ischemic compression to the trigger points located in the peri-patellar and retro-patellar areas: A randomized clinical trial, Clin Chiropractic (2010), doi:10.1016/j.clch.2010.05.001

Conclusion

The findings from this pilot study suggest that patellofemoral pain syndrome may be successfully managed conservatively by myofascial techniques such as ischemic compression to the knee.

Further controlled studies are required to assess the validity of these findings. Future studies could include a larger patient population of varying ages; more than one treating practitioner, and a no-treatment group. It would be also interesting to monitor any differences among patients with PFPS treated by ischemic compression compared to other therapeutic modalities.

Acknowledgements

The author would like to thank Dr Robin Bélanger D.C. as examiner; Dr. Brian J. Gleberzon D.C. and Dr Anne-Marie Lamy DC for their assistance in preparing this manuscript; and Dr Martin Descarreaux for the statistical analysis.

References

1. Crossley K, Bennell K, Green S, McConnell J. A systematic review of physical interventions for patellofemoral pain syndrome. *Clin J Sport Med* 2001;**11**:103—10.
2. Dixit S, Difiori JP, Burton M, Mines B. Management of patellofemoral pain syndrome. *Am Fam Physician* 2007;**75**:194—202.
3. McmullenW. Roncarati A, Koval P. Static and isokinetic—treatments of chondromalacia patella: a comparative investigation. *J Orthop Sports Phys Ther* 1990;**12**:256—66.
4. Fulkerson JP. Diagnosis and treatment of patients with patellofemoral pain. *Am J Sport Med* 2002;**30**(3):447—56.
5. Dehaven KE, Dolan WA, Mayer PJ. Chondromalacia patella in athletes. *Am J Sport Med* 1979;**7**:5—11.
6. Garrick JG. Anteror knee pain (chondromalacia patella). *Physician Sportsmed* 1989;**17**:75—84.
7. Clement DB, Taunton JE, Smart GW, McNicol KL. A survey of overuse running injuries. *Physician Sportsmed* 1981;**9**:47—58.
8. Kannus P, Natri A, Paakkala T. An outcome study of chronic patellofemoral pain syndrome: seven-year follow-up of patients in a randomized, controlled trial. *J Bone Joint Surg Am* 1999;**81**(3):355—63.
9. Sandow MJ, Goodfellow JW. The natural history of anterior knee pain in adolescents. *J Bone Joint Surg Am* 1985;**67**:36—8.
10. Rowlands BW, Brantingham JW. The efficacy of patella mobilization in patients suffering from patellofemoral pain syndrome. *J Neuromusc Syst* 1999;**7**(4):142—9.
11. Hilyard A. Recent development in the management of patellofemoral pain: the McConnel programme. *Phys Ther* 1990;**76**:559—65.
12. Kelly MA, Insall JN. Historical perspective of chondromalacia patellae. *Orthop Clin N Am* 1992;**23**:517—21.
13. Meyer JJ, Zachman ZJ, Keating JC, Traina AD. Effectiveness of chiropractic management for patellofemoral pain syndrome's symptomatic control phase: a single subject experiment. *J Manipulative Physiol Ther* 1990;**13**(9):539—49.
14. Dryburg DR. Chondromalacia patellae. *J Manipulative Physiol Ther* 1987;**11**(3):214—7.
15. Herringbone L, Payton CJ. Effects of corrective tapping of the patella on patients with patellofemoral pain. *Physiotherapy* 1997;**83**(11):566—72.
16. McGee DJ. *Orthopedic physical assessment*. 3rd ed. Toronto: W.B. Saunders Co.; 1997. p. 506—509.
17. Post WR. Clinical evaluation of patients with patellofemoral disorders (current concepts). *Arthroscopy* 1999;**15**:841—51.
18. Livingston LA. The quadriceps angle: a review of the literature. *J Orthop Sports Phys Ther* 1998;**28**:105—9.
19. LaBotz M. Patellofemoral syndrome, diagnosis pointers and individual treatment. *Physician Sportsmed* 2004;**32**:22—9.
20. Travel JG, Simons DG. *Myofascial pain and dysfunction; the trigger point manual*, 1st ed., vol. 2. Baltimore: Williams and Wilkins; 1992. p. 6.
22. Borg-Stein J. Trigger points and tender points. *Rheum Dis Clin N Am* 1996;**22**:305—23.
23. Christensen MG, Kollasch MW, Ward DA. *Job analysis of chiropractic*. Greeley, CO: National Board of Chiropractic Examiners; 2005. p. 136.
24. Alvarez DG, Rockwell PG. Trigger points: diagnosis and management. *Am Fam Physician* 2002;**65**(4):653—60.
25. Schneider MJ. Tender points/fibromyalgia VS trigger points/myofascial pain syndrome: a need for clarity in terminology and differential diagnosis. *J Manipulative Physiol Ther* 1995;**18**(6):398—406.
26. Hains G. Locating and treating low back pain of myofascial origin by ischemic compression. *J Can Chirop Assoc* 2002;**46**(4):257—64.
27. McConnell J. The management of chondromalacia patella: a long term solution. *Aust J Physiother* 1986;**32**:215—23.
28. McConnell J. A novel approach to pain relief in pre-therapeutic exercise. *J Sci Med Sports* 2000;**3**:325—34.
29. Aminaka N, Gribble PA. A systematic review of the effects of therapeutic taping on patellofemoral pain syndrome athletic training 2005;**40**(**4**):341—51.
30. Aminaka N, Gribble PA. Patellar taping, patellofemoral pain syndrome, lower extremity kinematics, and dynamic postural control. *J Athletic Training* 2008;**43**(1):21—8.
31. LaBore AJ, Weiss DJ. Vastus lateralis strain associated with patellofemoral pain syndrome: a report of 2 cases. *Arch Phys Med Rehabil* 2003;**84**:613—5.
33. Christensen MG, Kollasch MW, Ward DA. Job analysis of chiropractic. A project report. *survey analysis and summary of the practice of chiropractic within the United States*. Greeley, CO: National Board of Chiropractic Examiners; 2005 p. 75.

Please cite this article in press as: Hains G, Hains F. Patellofemoral pain syndrome managed by ischemic compression to the trigger points located in the peri-patellar and retro-patellar areas: A randomized clinical trial, Clin Chiropractic (2010), doi:10.1016/j.clch.2010.05.001