A Feasibility Study of the Effect of Intra-Articular Corticosteroid Injection on Isokinetic Muscle Strength in Children With Juvenile Idiopathic Arthritis

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This study assessed the magnitude of changes in isokinetic muscle strength in children with juvenile idiopathic arthritis (JIA) before and after treatment with intra-articular corticosteroid injection and assessed the feasibility of a larger study of the same effect. Isokinetic dynamometry was used to measure peak knee extension and flexion torque in 12 children before and after treatment for unilateral knee arthritis. Extensor and flexor strength was reduced on the affected side before treatment (-0.56Nm/kg, \( p = .004 \) and -0.24Nm/kg, \( p = .02 \) respectively). Increases in extensor strength were observed at two weeks \( (p = .01) \) and twelve weeks postinjection \( (p = .03) \). Improvements at 6 weeks approached but did not reach statistical significance \( (p = .17) \). Improvements in flexor strength were not observed until 12 weeks postinjection \( (p = .03) \). Despite significant improvements in extensor strength, low peak knee extensor torque continued to be observed at 12 weeks \( (p = .01) \). Knee extensor and flexor strength is reduced in children with JIA with active arthritis and improves following intra-articular corticosteroid injection. Significant improvements in knee extensor and flexor strength were seen postinjection; however deficits in extensor strength were still evident at three months. Isokinetic dynamometry was safe and well tolerated in our sample of children with JIA with active arthritis.

Juvenile idiopathic arthritis (JIA) is a relatively common and potentially debilitating disease affecting 1 in 1,000 children aged below 16 years (34). Early diagnosis and active therapeutic intervention are essential in minimizing the short
and long term complications of JIA (8). Intra-articular (IA) corticosteroid injection is now established as an integral part of the management of joint inflammation in JIA (13,40,43). The benefits of IA corticosteroid injection in the setting of joint inflammation include reductions in pain and local inflammation, improved range of motion, and decreased long-term sequelae of JIA such as leg length discrepancy (2,46).

Children with JIA have lower levels of physical activity (23,30), lower levels of aerobic and anaerobic exercise capacity (49,50), and higher levels of fatigue (7,44) than healthy peers. Strength and muscle cross-sectional area have also been shown to be decreased in JIA (3,19,22,31–33,54), with the greatest loss seen in muscles adjacent to and acting on inflamed joints (31). The loss of muscle strength in JIA is thought to be due to a combination of local and systemic factors including pain, muscle atrophy due to inactivity, inactivation of muscle due to reflex inhibition, and the effect of cytokines and inflammatory myopathy (14,32,48,51).

The general clinical impression is that both muscle strength and bulk seem to improve after IA corticosteroid injection. Increases in thigh circumference, an indirect measure of muscle cross sectional area, have been reported (2). Although muscle circumference and cross-sectional area show some correlation with muscle strength and function it is not possible to attribute all force changes to these parameters (28). As such, a validated, quantifiable method of assessing muscle strength is warranted to assess changes in strength following IA corticosteroid injection.

In clinical settings quantitative measures of strength are measured in two modes. Measurement of isokinetic strength involves assessment of strength with the joint moving through full range at a constant angular velocity, whereas isometric strength is measured at a fixed angle with sustained contraction against resistance (29). Both isokinetic and isometric strength have been shown to be reliable and valid assessments of muscle strength in children (11), and have both been shown to be reduced in patients with JIA (31–33).

Isokinetic strength is often considered the most clinically relevant single measure of muscle strength as the information it provides on the dynamic capacity of the muscle may be more closely related to functional activities such as walking, hopping or jumping (36,57). Studies in able bodied and disabled athletes have shown a direct correlation between isokinetic strength and performance in specific movement patterns (57). Correlations between isokinetic muscle strength and function have been reported in children with JIA (15). In the only identified published study examining the relationship between isometric strength and function in JIA, no statistically significant correlation between the two was found (54).

The purpose of this study is to test the hypotheses that in children with JIA with active arthritis of their knee: 1) muscle strength is reduced on the affected side compared with the unaffected side; 2) improvements in isokinetic strength are observed following IA corticosteroid injection; and 3) strength testing using isokinetic dynamometry is safe and feasible for use in a larger clinical trial.
Methods

Study Design and Patient Population

This is a single center, prospective, longitudinal cohort study conducted at The Children’s Hospital at Westmead, Sydney, Australia and approved by the Research Ethics Board of this institution. Written informed consent was obtained for each participant before involvement in the trial. The methodology and protocol for isokinetic testing in children with JIA used in this study has been described previously (35).

A consecutive series of children presenting to the rheumatology clinic at The Children’s Hospital at Westmead, aged between 6 and 16 years, with a diagnosis of JIA based on the International League Against Rheumatism (ILAR) criteria (42) and requiring an IA corticosteroid injection of the knee as part of standard therapy between July 2008 and July 2010 were invited to participate in the study. The lower age limit of 6 years was chosen as isokinetic dynamometry has not been validated in children below this age and children younger than 6 years have previously been unable to comply with isokinetic dynamometry, and may be physically too small for the dynamometer (24,55).

The following exclusion criteria were applied: active arthritis or enthesitis affecting other joints of the ipsilateral limb; active arthritis or enthesitis in any joint of the contralateral limb; previous IA corticosteroid injections into any joint in either limb in the preceding 6 months; evidence of significant degenerative changes in the ipsilateral or contralateral limb (based on rheumatologist knowledge of patient and previous x-ray results); previous surgery to ipsilateral or contralateral limb and any other abnormality or disease affecting the ipsilateral or contralateral limb; active sacroiliac disease; participants using a wheelchair; systemic onset juvenile idiopathic arthritis if there were active systemic features in the preceding 6 months; significant cardiac or respiratory disease or an inability to comply with isokinetic dynamometry.

Intra-articular Corticosteroid Injections

All participants had IA corticosteroid injection performed by a pediatric rheumatologist or under close supervision by a pediatric rheumatologist. Participants received sedation with a combination of oral midazolam and inhaled nitrous oxide where required and had topical anesthetic cream applied at the injection site before treatment. Triamcinolone hexacetonide (Sandoz Pharmaceuticals; Australia) was injected into the synovial space under aseptic conditions at a dose of 1 mg/kg to a maximum of 40 mg (2,58).

Clinical Assessments

Participants were assessed before their IA corticosteroid injection and again at 2, 6 and 12 weeks post injection. The baseline assessment was performed up to one week before the IA corticosteroid injection. Further assessments were all made within one week either side of the allocated time point.
Participant age, gender, height (stadiometer), weight (Tanita Body Composition Analyzer TBF-410), self-reported Tanner stage, ILAR subgroup classification of JIA, date of diagnosis, duration of active knee arthritis, previous and current medication use were recorded in all participants at baseline. Documentation of current medication use and active joint count were determined at each visit to monitor disease activity. Primary and secondary outcome measures were assessed at each time point.

**Primary Outcome Measure**

Isokinetic strength of knee extension and flexion was assessed using a computerised isokinetic dynamometer (Cybex Norm with UMAC Software, CSMi Medical Solutions, Stoughton, Minnesota, USA). Isokinetic dynamometry has been shown to be safe to use with children (11), with good inter-session and intra-session reliability (36,37). Strength measurements were made on both the affected and unaffected sides. Measurements of isokinetic strength were made at a velocity of 60 deg/s. This speed is used in pediatric isokinetic strength testing as children are better able to understand movement patterns at this speed (27), and the lower speed reduces the risk of injury (17).

Participants were tested on the affected side followed by the unaffected side. To exclude possible bias of learning effect participants performed five submaximal trials at a velocity of 60 deg/s to familiarize themselves with the equipment before maximal testing. Submaximal trials were performed on both the affected and unaffected side. In reliability studies of isokinetic strength a familiarization period using submaximal trials performed at the same isokinetic test velocity (41), and consisting of between three (6,10) and eight (36) submaximal trials can reduce the effect of learning on the test data (11).

Following the submaximal trials participants performed 5 maximal attempts on the affected side and the single best effort was recorded. This process was then repeated on the unaffected side. A rest period of 1 min between submaximal and maximal trials was given to elicit maximal torque values (17).

Absolute peak torque was adjusted for weight and expressed in Newton meters per kilogram (Nm/kg). The primary outcome measure was then expressed as a ratio of peak knee extensor or flexor torque of the affected limb over the corresponding peak torque of the unaffected limb [Peak Torque Ratio = Peak Torque Affected Limb/ Peak Torque Unaffected Limb]. Expressing the primary outcome measure as a ratio allowed the unaffected limb to be used as a comparator.

**Secondary Outcome Measures**

Thigh circumference was measured at a point two thirds of the distance from the greater trochanter of the femur to the lateral joint line of the knee. Measurement of thigh circumference has been validated as a proxy to detect change in muscle cross-sectional area (25). Joint range of motion at the knee was measured with a goniometer using the standardized landmarks of the greater trochanter proximally, the lateral knee joint line and the lateral malleolus distally.

Pain experienced by participants before, during and after strength testing was assessed to determine the safety and comfort of testing and also to determine if
pain influenced effort and thus strength measurements. A verbally administered numerical rating scale of acute pain was used with participants scoring pain levels between zero and ten. This method of assessment of acute pain has been validated and shows good correlation with visual analog scales of pain (56).

Physical function was assessed using the Child Health Assessment Questionnaire (CHAQ), a validated measurement of function for children with JIA (4,47). The CHAQ consists of questions from 8 functional domains comprising eating, dressing and grooming, walking, arising, hygiene, reach, activities, and grip. A score based on the 8 functional activity domains is formulated between 0 and 3 (where 0 indicates no limitations and 3 severe limitations).

Level of physical activity was assessed using the Habitual Activity Estimation Scale (HAES) a validated and reliable physical activity questionnaire for both healthy children and children with chronic illness including JIA (21,47,53). The HAES estimates duration and intensity of physical activity over a full weekday and a full weekend day over the preceding 2 weeks. Time spent in 4 easily recognizable levels of physical activity intensity (inactive, somewhat inactive, somewhat active, or very active) is reported by respondents. A summary score of total activity (TA) hours was then calculated by adding the time spent per day in the somewhat active and active intensity levels.

Statistical Analysis

Data were normally distributed and paired t tests were used to assess for statistical significance. Analyses were completed using SPSS version 19.0 (SPSS Inc, Chicago, IL).

Results

Fourteen participants fulfilled inclusion criteria and were eligible for enrollment. One participant declined to enroll due to inability to attend regularly for assessments. One participant was initially diagnosed with JIA, but subsequently excluded when a diagnosis of vascular malformation was confirmed. On three occasions enrolled participants were unable to attend for the postinjection visits due to an unrelated illness. One participant was unable to perform the 2 week visit due to pain in the contralateral knee due to an unrelated injury. The mean age of the 12 participants was 12.2 years (SD = 2.4, range = 8.6–16.8 years). Eight participants were female. The mean duration of active knee synovitis at baseline was 4.4 months (range = 0.25–12 months). Eight participants had symptoms for greater than 3 months before injection. Four participants had involvement of their dominant leg. Table 1 shows characteristics of study participants at study inclusion.

Primary Outcome Measure

Peak torque data for strength measurements at all time points are displayed in Table 2 and Table 3. Mean knee extensor torque at baseline was reduced by 36.7% on the side affected by active arthritis when compared with the unaffected side. This reduction reached statistical significance (mean difference = 0.56Nm/kg, SD = 0.54, t=-3.6 p = .004). The mean peak knee flexor torque was reduced by 22.7% on
### Table 1 Patient Characteristics at Commencement of Study

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Mean \((SD)\) 12.2 (2.4) 150.0 (16.1) 41.4 (12.2) 18.0 (23.3) 4.4 (4.0)

JIA = Juvenile Idiopathic Arthritis, ERA = Enthesitis Related Arthritis, Oligo= Oligoarticular JIA, Undiff = Undifferentiated JIA, NSD= Nonsteroidal Anti-inflammatory, SLZ = Salazopyrin, OCS = Oral Corticosteroids, MTX = Methotrexate
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*denotes dominant leg affected, Ratio = peak torque affected knee/peak torque unaffected knee
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*denotes dominant leg affected, Ratio = peak torque affected knee/peak torque unaffected knee
the affected side compared with the unaffected side. This difference also reached statistical significance (mean difference = 0.24Nm/kg, \( t = -2.6, SD = 0.3, p = .02 \)). Comparison of strength testing results on the affected and unaffected side before IA corticosteroid injection and again at 12 weeks post injection are displayed in Figure 1.

Significant improvements in knee extensor strength ratio were observed at two weeks (mean improvement = 0.22, \( SD = 0.2, t = -3.3, p = .01 \)) and twelve weeks (mean improvement = 0.25, \( SD = 0.3, t = -2.4, p = .03 \)) post injection. Improvements at 6 weeks post injection approached but did not reach statistical significance (\( p = .17 \)).

Significant improvements in mean knee flexor strength ratio following IA corticosteroid injection were seen only at 12 weeks (mean= -0.20, \( SD = 0.3, t = -2.5, p = .03 \)). No statistically improvements were seen at 2 or 6 weeks in knee flexor strength ratios. Mean changes in knee extensor and flexor strength ratios over time are displayed in Figure 2 with statistical comparison with baseline displayed in Table 4.

Despite significant improvements in knee extensor strength post injection, peak torque continued to be significantly reduced on the affected side at 12 weeks (mean reduction = 0.20Nm/kg, \( SD = 0.2, t = -3.2, p = .01 \)). There was no differences in knee flexor strength in the affected versus unaffected side at 12 weeks.

**Secondary Outcome Measures**

At baseline there were no differences in thigh circumference between the affected and unaffected sides (mean difference = 0.1cm, \( SD = 1.1, t = -0.1, p = .9 \)). No changes in thigh circumference were seen in the affected limb at 2 weeks (mean = 0.6cm, \( SD = 1.2, t = 1.4, p = .2 \), 6 weeks (mean = 0.2cm, \( SD = 1.1, t = 0.06, p = .9 \), or 12 weeks post injection (mean= -0.7cm, \( SD = 1.5, t = -1.4, p = .2 \)) compared with baseline.

![Figure 1](image_url) — Comparison of mean knee extensor and flexor strength at enrolment and 12 weeks post injection.
Figure 2 — Mean changes in knee extensor and flexor ratios over time.

Table 4 Changes in Knee Extensor and Flexor Ratios Compared With Baseline

<table>
<thead>
<tr>
<th></th>
<th>N</th>
<th>Mean Strength Ratio</th>
<th>SD</th>
<th>Mean Increase and (Percent Increase) in Strength Ratio in comparison with baseline</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Knee Extensors</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Baseline (Preinjection)</td>
<td>12</td>
<td>0.63</td>
<td>0.3</td>
<td>-</td>
</tr>
<tr>
<td>2 wks postinjection</td>
<td>10</td>
<td>0.82</td>
<td>0.2</td>
<td>0.19 (30.1%)*</td>
</tr>
<tr>
<td>6 wks postinjection</td>
<td>11</td>
<td>0.79</td>
<td>0.2</td>
<td>0.16 (25.3%)</td>
</tr>
<tr>
<td>12 wks post injection</td>
<td>11</td>
<td>0.88</td>
<td>0.1</td>
<td>0.25 (39.7%)*</td>
</tr>
<tr>
<td><strong>Knee Flexors</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Baseline (Preinjection)</td>
<td>12</td>
<td>0.77</td>
<td>0.3</td>
<td>-</td>
</tr>
<tr>
<td>2 wks postinjection</td>
<td>10</td>
<td>0.94</td>
<td>0.2</td>
<td>0.17 (22.1%)</td>
</tr>
<tr>
<td>6 wks postinjection</td>
<td>11</td>
<td>0.90</td>
<td>0.2</td>
<td>0.13 (16.9%)</td>
</tr>
<tr>
<td>12 wks post injection</td>
<td>11</td>
<td>0.98</td>
<td>0.1</td>
<td>0.22 (28.6%)*</td>
</tr>
</tbody>
</table>

* Significant at p < 0.05 in comparison with baseline using Paired Samples T-Test
A statistically significant reduction in total joint range of motion between the affected and unaffected sides was observed before injection (mean reduction = 26.7 degrees, \(SD = 26.8\), \(t= -3.4, p = .005\)). Significant improvement in total joint range of motion were seen in the affected limb at 2 weeks post injection (mean increase = 16.3 degrees, \(SD = 14.5\), \(t= -3.7, p = .004\)). Improvements in total joint range of motion were maintained at 6 weeks (mean increase = 16.6, \(SD = 12.3\), \(t= -4.3, p = .005\)) and 12 weeks (mean increase = 18.3, \(SD = 17.0\), \(t= -3.56, p = .005\)) post injection.

The median CHAQ score before injection was 0.42 (range = 0–2.25) with 5 of 14 participants having a CHAQ score corresponding to mild disability (CHAQ <0.13; 12). There was a trend toward reduced CHAQ scores at 2 weeks post injection (median CHAQ score 0.05, range 0–1.875) but this was not statistically significant (mean difference = 0.3, \(SD = 0.5\), \(t = 2.1, p = .06\)). Nonsignificant reductions in CHAQ scores were also observed at 6 weeks (mean reduction = 0.3, \(SD = 0.5\), \(t = 2.0, p = .7\)), and 12 weeks (mean reduction = 0.2, \(SD = 0.6\), \(t = 1.3, p = .2\)) when compared with baseline.

A statistically significant improvement in weekday total activity hours (mean = 9.5 vs. 8.0 hr, \(SD = 2.0\), \(t = -2.5, p = .03\)) but not weekend total activity hours (mean = 7.6 vs. 7.0 hr, \(SD = 2.3\), \(t= -0.9 p = .3\)) was identified between baseline and 2 weeks using the HAES Questionnaire. Levels of weekday and weekend physical activity were increased at 6 and 12 weeks but were not statistically significant.

Although reported pain scores increased in the affected leg during testing for some participants, on each of these occasions the participant was able to complete strength testing and participants reported that their pain returned to pre testing levels at the cessation of testing.

All twelve participants in this study had a single active joint at baseline. None of the participants developed additional active joints during the study period. None of the participants on regular medications had an increase in their medications during the study period. Three of the participants on NSAID’s ceased their medication by six weeks. Two of the twelve participants had a recurrence of synovitis in the affected knee between 3 and 6 months post IA corticosteroid injection thus in both cases was outside of the study period.

**Discussion**

This study was undertaken to determine the feasibility of performing isokinetic strength testing in children with JIA before and after IA corticosteroid injection, to test the hypothesis that strength is reduced as a result of active arthritis in muscles surrounding the affected knee joint, and that improvements in strength would be seen following injection of IA corticosteroid injection.

The result of strength assessments at baseline in this study concur with previous studies indicating that the strength of movements of the knee joint is reduced in active knee arthritis (22). In this study median isokinetic knee extensor strength on the affected side was reduced by 36.7% and median knee flexion strength by 22.7%. The magnitude of the changes observed in extensor strength were found to be both statistically significant and of the order which previous studies of children with active synovitis (31), and individuals with previous injury or disuse considered clinically significant (9,45).
The magnitude of reduction in knee extensor strength at baseline was greater than that observed for knee flexor strength. Other authors have also noted greater reductions in knee extensor than flexor strength in adults with inflammatory and noninflammatory conditions (18,45). The effusion associated with active synovitis of the knee appears to have a greater effect on knee extensor strength than knee flexor strength with even small volumes of effusion resulting in dysfunction of vastus medialis oblique (26). Computerised tomography studies of thigh muscle cross-sectional area after ligamentous knee injury resulting in thigh muscle atrophy from disuse have demonstrated greater muscle loss in quadriceps femoris than in the hamstrings muscle group (45). Children with JIA have also been shown to have significant reductions in muscle bulk adjacent to inflamed joints (31), with reduced muscle cross sectional area, appearing to be related to muscle weakness in the knee extensor muscle (33). The investigators demonstrated that strength was reduced in proportion to mean muscle fiber area which implies that weakness is in part caused by a reduction in muscle fiber area.

In our study eight of twelve participants had involvement of their nondominant leg. This raises the question of the contribution of nondominance to the reduction in strength seen on the affected side. Lower limb dominance has been demonstrated to result in significant strength differences in adults (52). While previously there was no clear consensus as to whether strength differences due to limb dominance existed in pediatric populations (52), recently published normative data of isokinetic strength in children demonstrates a difference in strength due to side dominance of the magnitude of 5–10% (55). The mean baseline reduction of isokinetic extensor strength in our study of 37% is substantially lower than the 5–10% difference quoted in published normative data for children, thus the influence of active knee synovitis is likely to be greater than any potential effect of limb dominance.

Despite significant improvements in knee extensor strength post injection, a statistically significant reduction in mean peak extensor torque of 12.5% was observed on the affected side at 12 weeks. Participants in our study did not undertake any strengthening exercises post injection. The failure of knee extensor strength to improve to be equivalent to strength of the unaffected limb implies that exercise programs following intra-articular corticosteroid injection may be warranted, not only with the aim of improving strength but to improve function and address abnormalities in gait biomechanics that have been noted in children with JIA with inactive inflammation (1,16,39).

Height, weight and limb length are known to influence isokinetic dynamometry measurements of muscle strength. Molnar and Alexander found that age and height alone accounted for more than 50% of the variance in isokinetic strength in normal children aged 7–15 years of age (38). Hormone levels, in particular testosterone have also been shown to have a significant impact on strength. Puberty also exerts a significant influence on strength and the sex difference in peak torque between boys and girls (20). In this study isokinetic strength was assessed over time and compared as a ratio of isokinetic strength of the affected side over isokinetic strength of the unaffected side in an attempt to correct for many of the potential confounding influences that may influence peak torque other than the IA corticosteroid injection.

Some improvement in physical activity levels following IA corticosteroid injection were observed in our study highlighting the potential clinical benefits of
Isokinetic Strength in JIA

IA corticosteroid injection. The degree of impairment in physical functioning of participants in this study was unexpectedly higher than that expected for children with monoarthritis with a median CHAQ score before injection of 0.42, and only 5 of 14 participants having a CHAQ score corresponding to mild disability (CHAQ <0.13; 12). Despite this, a clinically significant reduction of 0.13 or more (12) was seen 2 weeks post injection in seven of the nine patients who reported functional impairment. The mean difference in CHAQ score of 0.30 was also reflective of clinically significant change. Although clinically significant, improvements in physical functioning post injection trended toward, but did not reach statistical significance. Failure to reach statistical significance may be explained by either the small number of participants in this study, or by the fact that the CHAQ is a relatively insensitive tool for assessing short-term changes in function or higher levels of functioning such as the participants of this study (5).

Although pain scores increased during testing in 3 of 12 participants, all participants were able to complete strength testing. Self-reported pain did not appear to impair performance during testing other than in two participants. One participant had significant pain in the unaffected limb at 2 weeks and as such data from that visit were excluded as measurements for the denominator were felt to be significantly affected. One participant reported high levels of pain during testing for both the affected and unaffected limbs and investigators conducting the testing felt that the pain negatively influenced the degree of effort the participant was able to exert in maximal testing. This is reflected in that participant’s results as there was no consistent pattern of affected or unaffected limb being stronger with testing and no identifiable pattern of improvement. Pain levels returned to baseline upon completion of the testing for all participants. No injuries occurred during testing and there were no flares of arthritis in any of the participants during the study period either based on changes in joint count or increases in medication.

Nine of the twelve participants were able to attend all four assessment sessions within the desired time frame. Those that missed a testing session, missed as a result of unrelated illnesses. The high compliance seen in this study suggests that the testing and follow-up schedule is agreeable to participants and their families. Importantly the youngest patient aged only 8 years was able to complete the testing without difficulty.

Of the previous reported studies using isokinetic dynamometry to assess strength in children with JIA the presence of current active arthritis in the joint being tested is only reported in one study (32). In that study 12 of 16 participants had active arthritis and although pain was not formally assessed no adverse outcomes were reported. Thus from the data presented in our study together with past data, isokinetic dynamometry appears to be a safe method with which to quantify muscle strength around the knee in children with JIA even when there is active arthritis present.

Notwithstanding the limitations of a small sample size, this study has demonstrated that the study procedures used are safe and feasible and that statistically significant improvements in knee extensor and flexor strength after IA injection of actively inflamed knee joints occur. The improvements in knee extensor and flexor strength were also considered to be clinically significant being equal to or greater than those expected in patients with clinically significant knee injury or chronic knee pain. The improvements following intra-articular corticosteroid injection
were not universal in all participants nor were they necessarily sustained over the duration of the study.

Based on the results of this study, a larger study would be feasible. Such a study would be of clinical importance as confirmation of persisting deficits in knee extensor strength may indicate the need for specific strengthening exercises or a physiotherapy program following IA corticosteroid injection to address strength deficits.

References


