High volume image guided injections in chronic Achilles tendinopathy

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Abstract

Purpose. To determine the effectiveness of high volume image guided injections (HVIGI) for chronic Achilles tendinopathy.

Methods. We included in the study 30 consecutive patients (mean age 37.2 years, range 24 – 58 years) with Achilles tendinopathy for a mean of 35.8 months (range 2 – 276 months) who had failed to improve after a three-month programme of eccentric loading of the gastro-soleus complex. Patients were injected with 10 ml of 0.5% Bupivacaine Hydrochloride, 25 mg Hydrocortisone acetate, and up to 40 ml of injectable normal saline. A study-specific questionnaire and the Victorian Institute of Sport Assessment – Achilles tendon (VISA-A) were retrospectively administered to assess short- and long-term pain and functional improvement.

Results. Some 21 patients (70%) responded. Patients reported significant short-term improvement at 4 weeks of both pain (mean change 50 mm, [SD 28, p < 0.0001], from a mean of 76 mm [SD 18.2], to a mean of 25 mm [SD 23.3]), and function scores (mean change 51 mm, [SD 31.2, p < 0.0001], from a mean of 78 mm [SD 20.8], to a mean of 27 mm [SD 28.4]). Patients also reported significant long-term improvement in symptoms using the VISA-A questionnaire (mean change 31.2 points, [SD ¼ 28, p < 0.0001], from a mean of 44.8 points [SD 17.7], to a mean of 76.2 points [SD 24.6]) at a mean of 30.3 weeks from the injection.

Conclusions. HVIGI significantly reduces pain and improves function in patients with resistant Achilles tendinopathy in the short- and long-term.

Keywords: Achilles tendinopathy, image guided injection, neovascularization, eccentric loading

Introduction

Achilles tendinopathy is a common overuse injury with an incidence of 14.5% in army recruits, and a lifetime risk of 52% in former elite male distance runners [1,2]. Up to 29% of Achilles tendinopathy patients may require surgery for Achilles tendinopathy, of which up to 31% do not participate in sport or vigorous physical activity [3,4]. Achilles tendinopathy has a multi-factorial aetiology [2,5], with training errors reported in up to 60 – 80% of such patients [6].

The aetiology of pain in tendinopathy is widely debated, with recent evidence that neo-vascularization and neo-innervation may be responsible [7 – 10]. Neo-vascularization is only present in patients with tendinopathy, and the area in which patients perceive most pain correlates with the area where most neo-vascularization occurs on power Doppler ultrasound scan (US) [10].

In Achilles tendinopathy, there is evidence of neural in-growth in conjunction with neo-vascularization, and a pilot study injecting a sclerosing agent, Polidocanol into and around the neo-vessels [8,11] significantly reduced pain in eight of 10 patients. A similar study of patellar tendinopathy, which has a similar histological picture to Achilles tendinopathy, gave equally encouraging results [12,13].
Injections of sclerosing substances close to the tendon seem to be remarkably safe. As Polidocanol is not on sale in our country, we hypothesized that a high volume image guided Achilles tendon injection (HVIGI) of normal saline would decrease the amount of pain perceived by Achilles tendinopathy patients, whilst at the same time improving daily functional ankle and Achilles movements.

Methods

Ethics
Consultation with the Local Ethics Committee determined that ethics approval was not required. The London Independent Hospital Board granted consent for the study. Data was managed with strict confidentiality. The data were coded prior to analysis, and consent was implied if patients returned the postal questionnaire.

Sample size
No formal pre-intervention power calculation was performed. However, a post hoc power calculation was performed once results were obtained.

Subjects
All patients who received HVIGI between 2004 and 2006 for the management of Achilles tendinopathy were identified from the computerized radiology records at LIH.

Inclusion and exclusion criteria
Patients were included in the study if they were aged 18–65 and had been diagnosed with Achilles tendinopathy for at least three months before receiving HVIGI. They had to have undergone a programme of eccentric rehabilitation according to published guidelines [14]. Patients were excluded from the study if they had undergone Achilles tendon surgery, had concurrent musculoskeletal ankle problems, or had suffered a complete or partial tear of their Achilles tendon.

Data collection method
A total of 30 patients, (26 males and four females, mean age 37.2 years, range 24 – 58), satisfying the above criteria were identified. In February 2006, these patients were sent a study-specific questionnaire and two VISA-A questionnaires. The study questionnaire was designed to assess pain and function before and two weeks after HVIGI, and to obtain details of symptom history, treatment and sporting participation. The VISA-A questionnaires were used to assess the long-term outcome for the effectiveness of HVIGI. Patients were asked to complete the first VISA-A questionnaire recalling the symptoms immediately prior to HVIGI, and the second for the symptoms on the day they returned the questionnaires (see Appendix).

Injection procedure
Patients were positioned supine on a couch with their hip externally rotated, the knees flexed to 45° and the ankle plantigrade. Both Achilles tendons were scanned by a board certified musculo-skeletal radiologist (OC) using an US scanner (Sonoline Elegra; Siemens, Erlangen, Germany) equipped with a 13 MHZ probe in both the longitudinal and transverse planes throughout their length. The Achilles tendon was assessed for any thickening, degeneration, hypo-echogenic areas and presence of any other surrounding soft tissue abnormality. The thickness of the tendon was recorded in mm [15]. Power Doppler was used to ascertain the presence of intra-tendinous neo-vascularization (Figure 1a, 1b). The same board certified musculo-skeletal radiologist (OC) scanned and injected every patient.

Verbal consent was obtained from each patient after having been given a detailed explanation of the procedure and possible outcome.

Using an aseptic technique and assisted by a nurse, a 21 gauge needle attached to a 30 cm connecting tube was inserted under real-time ultrasound guidance between the anterior aspect of the Achilles tendon and Kager’s fat pad. A mixture of 10 ml 0.5% Bupivacaine hydrochloride and 25 mg of Hydrocortisone acetate was injected, followed by 4–10 ml of injectable normal saline. The position of the needle and flow of fluid was monitored continuously by US during this phase, and the needle moved gently across the anterior aspect of the tendon.

After HVIGI, the Achilles tendon was scanned again with power Doppler to assess whether any neo-vascularization remained (Figure 1c, 1d). Patients were allowed to walk on the injected leg immediately, but were advised strictly to refrain from high impact activity, such as running or jumping, for 72 h. They were also given information regarding possible steroid flare and risk of infection. After 72 h, they were instructed to restart heavy eccentric loading under the guidance of a chartered physiotherapist. Patients returned to their referring clinicians two weeks post injection for advice about further physiotherapy and returning to sport.
Statistics

Descriptive statistics is given. Kolmogorov-Smirnov tests determined that the interval data from 100 mm VAS, and VISA-A questionnaires was normally distributed. Student’s t-tests were therefore used to compare pain and function scores pre- and post-injection. All data were analysed with SPSS (Statistical Package for Social Scientists®, version 12.0.1, SPSS® Inc USA).

Results

Subjects

Thirty patients satisfying the above inclusion and exclusion criteria were identified. Two questionnaires were returned stating that the patients had moved from their given addresses. No follow-up address could be found for these patients, limiting the number of possible replies to 28 (male, female 26:4 mean age 37.20, range 24–58). Some 21 of 30 patients (70%) responded to the questionnaire.

Subjects typically were athletically active to a high standard, in their third or fourth decade, had significant long-term symptoms, had abnormal findings on US examination, and had reduced sporting ability (Table I). Eight subjects competed professionally or at county level, while the remaining subjects were recreational or club participants with a mean sporting participation of 9.3 h per week. The mean duration of symptoms prior to injection was 35.8 months (range 3–276 months), with a mean sporting limitation of 29.1 months (range 0–276 months). At the time of injection, all patients had thickening of the Achilles tendon (mean 7.8 mm, range 5.4–15.0 mm), disordered intra-tendinous collagen structure, and evidence of neo-vascularization.

Twenty of the 21 patients who responded complied with the recommended two-week eccentric loading program post HVIGI. The one patient who did not perform any eccentric loading exercises still rated the success of HVIGI as 60%, and was able to return to sport at their previous level.

The procedure was effective in returning patients to sport. Nineteen of 21 patients returned to sport; 10 at their pre injury level, and nine at a reduced level. One patient was unable to return to sport, and perceived no improvement due to HVIGI treatment. No complications were reported as a result of the HVIGI. No patient experienced a rupture or tear of the Achilles tendon at follow-up, and no patient progressed to surgery.
Follow-up results

Short-term

In asymptomatic patients, the VAS should score 0 mm [16]. At its highest, the VAS will score 100 mm for strong severe pain or dysfunction. In the short term (two weeks post-HVIGI), the VAS pain scores showed a mean change of 50 mm (SD 28), from a mean of 76 mm (SD 18.2), to a mean of 25 mm (SD 23.3) (Figure 2). Using the same pre-HVIGI VAS, patients demonstrated a mid-term (mean 30.3 weeks) mean improvement of 47 mm (SD 39.2), with a mean VAS pain score of 28 mm (SD 32.1) at follow-up. The VAS function scores showed a mean functional gain of 51 mm (SD 31.3) 2 weeks post-HVIGI. Pre-HVIGI, the mean score was 78 mm (SD 20.8). Post-HVIGI, the mean score was 27 mm (SD 28.4). All the VAS pain and function changes were statistically significant ($p < 0.001$). (Figure 2).

Long-term

A VISA-A score of 100 points represents a normal asymptomatic Achilles [17]. Scores become progressively lower with worsening tendinopathy symptoms.

Table I. Patient data and questionnaire feedback regarding activity levels and treatment.

<table>
<thead>
<tr>
<th>Sex</th>
<th>Age when injected (years)</th>
<th>Hours of sport per week pre-injury</th>
<th>Sport level pre-injury</th>
<th>Returned to sport?</th>
<th>Percentage improvement due to injection</th>
<th>Length of sporting limitation (months)</th>
<th>Length of symptoms (months)</th>
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<td>5–10</td>
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<td>10</td>
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<tr>
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<td>16–20</td>
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<td>100</td>
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<td>8</td>
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<td>Club</td>
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<td>60</td>
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<td>Yes - Same level</td>
<td>100</td>
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</tbody>
</table>

Figure 2. Mean retrospective VISA-A and VAS Pain and Function scores pre- and post- HVIGI. VISA-A follow-up was performed long-term.
The mean VISA-A score pre-HVIGI was 44.8 points (SD 17.7), and post-HVIGI was 76.2 points (SD 24.6) (Figure 3). This mean change of 31.5 points (SD 28) ($p < 0.001$) occurred over a mean follow-up period of 30.3 weeks (SD 20.4). Using a two-sample equal variance power calculator, a sample size of 21 and the long-term VISA-A results, the power of the present study was calculated as 0.91.

**Discussion**

Patients were advised to commence eccentric loading post-HVIGI [18]. With decreased pain, patients would be able to stress their tendons in a more physiological fashion, with the final aim to improve the tendon’s collagen structure, so that the tendon would have been better able to deal with the stresses placed upon it [19–22].

The VISA-A questionnaire is a validated and reliable index for assessing Achilles tendinopathy [17]. VAS scores are validated and reliable measures of pain, and allowed direct comparison of treatment results with other studies [16].

US is cost effective, and accurately confirms clinical diagnoses of Achilles tendinopathy. It also enables precise guidance of the injections, ensuring that the desired area is injected [23]. Power Doppler is more sensitive than colour Doppler in imaging intratendinous neo-vascularization [24].

Neo-vascularization is often present in patients with tendinopathy [9,10], and is accompanied by nerve in-growth. Our hypothesized rationale behind the management modality we describe was that the high volume injection would produce local mechanical effects causing neo-vessels to stretch, break or occlude. By occluding and possibly breaking these neo-vessels, the accompanying nerve supply would also be damaged either by trauma or ischemia, therefore decreasing the pain in patients with resistant Achilles tendinopathy. We only assess neo-vascularty immediately following the injection, and we assumed that those patients who experienced a significant improvement in symptoms had a reduction in neo-vascularization. This is a weakness of the study. However, the disappearance of neo-vascularization immediately post-injection would confirm this hypothesis [25].

Other studies have divided results into VAS scores for patients who responded to treatment and those who did not [11,12,21,22]. To obtain a more complete picture, we have grouped all VAS scores regardless of treatment response. The mean VISA-A change in our patients was 31.5 points ($p < 0.001$). We believe that this change is clinically relevant, as 19 of the 21 patients returned to a higher level of sport, reflecting the promising nature of HVIGI as a management modality for resistant Achilles tendinopathy. The slope of the pre-HVIGI trend line in Figure 3 highlights the wide range of patient symptoms prior to the injection. On the other hand, the much flatter post-HVIGI trend line suggests that most patients had improved to a similar level at follow-up.

Therefore, patients with low VISA-A scores, and hence more severe symptoms, had the same chance of recovery as those patients with an initially high VISA-A score. The VAS pain results reflect closely those from similar studies examining the effects of sclerosing agents on neo-vascularization and pain [11,12]. One such study by Ohberg et al. returned a mean improvement in VAS pain of 52.7 mm at follow-up. Our results are fractionally lower at 50 mm. However, Ohberg et al.’s patients received up to four injections, whereas our patients had only one injection: repeating the injections may yield better results. It remains to be ascertained whether a difference of 2 mm on the VAS pain scale is clinically and functionally relevant. Changes in VAS pain are again promising when comparing HVIGI to studies evaluating eccentric loading. Using eccentric loading, Fahlstrom et al. found a mean pain VAS improvement of 55.6 mm at 6 weeks follow-up in patients who responded to treatment [21]. We found a similar decline in patients’ pain (50 mm), but only

![Figure 3. VISA-A score of each patient before and after HVIGI treatment. Lines of best fit highlight the trends for the VISA-A scores.](image-url)
at two-week follow-up, and including patients who did not improve. However, our results are in a smaller number of patients, and an eccentric loading program was used post-HVIGI. Eccentric loading is presently regarded as the cornerstone of Achilles tendinopathy management, and should remain so at present, although we acknowledge that it may not be as effective as previously reported [14]. All of our patients were athletes (Table I), and all but two returned to their sport. However, a greater number of professionals and elite athletes returned to their pre-injury level of sport compared to athletes at a lesser level of participation. We recently reported that, following surgery for Achilles tendinopathy, athletes have a greater chance of an uncomplicated and quicker recovery compared to non-athletes [26]. The reason is undoubtedly multifactorial, but professional and elite athletes likely receive more structured rehabilitation, and are more motivated to return to their previous sporting level.

The mean difference of 0.76 months between the duration of symptoms and length of sporting limitation was not unexpected. At ultrasound, areas of tendinopathy can be evident for some time before pain occurs, and start to impair lower limb function [27]. During this ‘window’, patients are often able to exercise through pain, possibly causing more tendon damage.

We are fully aware of the limitations of the present study. For example, as ours is the only centre offering this procedure, and as HVIGI is not offered within the NHS, only patients attending the independent sector received this treatment. This therefore limited patients’ numbers, and the size of our study. Also, it biases the type of patients who were offered HVIGI.

Postal questionnaires have a notoriously low response rate. At a 70% return rate, we are aware that an incomplete picture may have been shown. Efforts were made to limit this factor by a follow-up call to patients four weeks after questionnaires were sent out. Every five years, the population of London changes by up to one third [28]. This may have impacted on our results, as two patients had moved and could not be traced for follow-up. Finally, this is a retrospective study which required some patients to remember the pain and function limitation for their Achilles tendinopathy as far back as 79 weeks. This may have induced recall bias, possibly making some of the feedback inaccurate.

Further studies examining the mechanism of pain reduction and functional return following HVIGI are required. A prospective study with follow-up estimates of the amount of neo-vascularization would more accurately evaluate the potential of this modality as an alternative to surgery. Also, neo-vascularization in the Achilles tendon could be assessed, and measured in a prospective fashion [29]. We stress that this is to be considered a preliminary study, and the good results obtained using HVIGI should not be overplayed until further research with larger sample sizes has been conducted.

Conclusion

In conclusion, this preliminary study indicates that HVIGI significantly reduce pain and improve short and long-term function in patients with chronic Achilles tendinopathy, regardless of their level of symptoms. HVIGI is safe and relatively inexpensive, with the potential to offer an alternative management option before surgery, aiding a quicker return to sport.

Acknowledgements

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References


Appendix

Achilles Tendinopathy Questionnaire

Thank-you for filling out this questionnaire about the effects of the steroid injection that you received on . . . . . . for your Achilles tendon problems. Please answer all of the questions as this will help us to evaluate the effectiveness of the treatment and possibly improve it for future patients.

Please make any comments that you feel relevant regarding the Achilles injection that you received:

Please fill in the following question using the provided scales. An example is provided below. Use this approach for all following questions of this nature.

Please make any comments that you feel relevant regarding the Achilles injection that you received:

Please fill in the following question using the provided scales. An example is provided below. Use this approach for all following questions of this nature.

0% = NO improvement due to injection  100% = Maximum improvement due to injection

Example Question: How much improvement in Achilles/ankle pain would you associate with your injection?

Answer: 0____________________________ | ___________________________ 100

Section one: Your symptoms and your sport

1. On average, how many hours per week of sport did you do before this Achilles injury?

   Please tick the appropriate box

   Less than 5 hours □  5 – 10 hours □
   11 – 15 hours □  16 – 20 hours □
   More than 20 hours □
2. Before this Achilles injury, what level of sport did you participate at?

Please tick the appropriate box
- Professional ☐
- Semi-Professional ☐
- County ☐
- Local Club ☐
- Recreational ☐
- Other ☐

3. How long had your Achilles tendon been giving you problems before the injection on ........?

Years ☐
Months ☐

4. Before your injection, for how long had you had to limit your participation in sport?

Years ☐
Months ☐

5. Have you returned to sport since the injection?

Please tick the appropriate box

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<tr>
<th>Yes, at the same level</th>
<th>Yes, at a reduced level</th>
</tr>
</thead>
<tbody>
<tr>
<td>No, have not been able to return to sport</td>
<td>No, have not yet tried</td>
</tr>
</tbody>
</table>

6. How would you describe the overall recovery of your Achilles/ankle problem?

Please tick the appropriate box
- Back to normal and stayed better ☐
- Got better then recurred ☐
- Slightly better but not back to normal ☐
- Never improved ☐
- Other (Please specify) __________________________

7. What percentage of the total improvement in your symptoms do you attribute to the injection?

| 0% | 100% |

---

Section two: Previous medical management

8. How many clinicians had you seen with this problem prior to the injection?

Put a number in the box next to each professional group.

- Doctor ☐
- Physiotherapist ☐
- Surgeon ☐
- Osteopath ☐
- Masseur ☐
- Other (Please specify) __________________________

9. Prior to your injection, what other treatments had you tried/received?

Please tick all the appropriate boxes

- Orthotics ☐
- Physiotherapy ☐
- Strapping ☐
- Surgery ☐
- Massage ☐
- Other injection ☐
- Medication (Please specify) __________________________

10. Have you done specific eccentric re-training guided by a physiotherapist?

This would include slow heel lowering off the edge of a step and similar exercises for about six weeks.

Yes ☐
No ☐
11. Which of the following investigations have you received for your Achilles problem?

*Please tick all the appropriate boxes*

- Blood Tests
- X-ray
- CT Scan
- MRI Scan
- Ultrasound Scan
- Arthroscopy
- Other (Please specify) _______________________________________________

**Section three: Pain**

12. Which 3 activities gave you the most **pain** in your Achilles/ankle prior to your injection?

<table>
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</table>

Please use the scale below to rate the **pain** on doing each these activities **2 weeks before** and **2 weeks after** the injection.

**Activity 1**

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<th></th>
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<td></td>
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<td></td>
<td></td>
<td>10 Strong severe pain</td>
</tr>
</tbody>
</table>

**Activity 2**

<table>
<thead>
<tr>
<th>2 weeks before the injection</th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>No pain</td>
<td>0</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>10 Strong severe pain</td>
</tr>
<tr>
<td>2 weeks after the injection</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>No pain</td>
<td>0</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>10 Strong severe pain</td>
</tr>
</tbody>
</table>
Activity 3

2 weeks before the injection

| No pain | 0 | 10 | Strong severe pain |

2 weeks after the injection

| No pain | 0 | 10 | Strong severe pain |

13. What would you rate the pain score as being in your Achilles/ankle in the last two weeks?

| No pain | 0 | 10 | Strong severe pain |

Section four: Function

14. Which 3 activities did you find it most difficult or impossible to do because of the symptoms (e.g. weakness, loss of balance, pain etc) in your Achilles/ankle prior to your injection?

Activity 1

Activity 2

Activity 3

Activity (1)

2 weeks before the injection

| Normal function | 0 | 10 | Impossible |

2 weeks after the injection

| Normal function | 0 | 10 | Impossible |
Finally, please add any comments about:

**Section 5: Comments**

Thank you for filling in this questionnaire. This will help us improve our treatment for patients with Achilles tendon problems.