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Ultrasound guided dry needling and autologous blood injection for patella tendinosis

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ABSTRACT

Objective: To evaluate the efficacy of ultrasound guided dry needling and autologous blood injection for the treatment of patella tendinosis.

Design: Prospective

Setting: Institutional

Patients: Forty seven knees in 44 patients (40 men, 7 women, mean age 34.5 years, age range 17-54 years) with refractory tendinosis underwent sonographic examination of the patella tendon following referral with a clinical diagnosis of patella tendinosis (mean symptom duration 12.9 months).

Interventions: Ultrasound guided dry needling and injection of autologous blood into the site of patella tendinosis was performed on two occasions, 4 weeks apart.

Main Outcome Measurements: Pre and post procedure Victorian Institute of Sport Assessment scores (VISA) were collected to assess patient response to treatment. Follow up ultrasound examination was performed in 21 patients (22 knees).

Results: Therapeutic intervention led to a significant improvement in VISA score when pre and post procedure scores were compared (mean pre-procedure score 39.8; range 8-72; mean post procedure score 74.3; range 29-100; mean follow up 14.8 months, range 6-22 months) and patients were able to return to their sporting interests. Follow up sonographic assessment revealed a reduction in overall tendon thickness and in the size of the area of tendinosis (hypoechoic/anechoic areas within the proximal patella tendon). Furthermore, a reduction was identified in interstitial tears within the tendon substance. Interestingly, neovascularity did not reduce significantly and indeed was more dramatic on follow up in a number of patients.

Conclusions: Dry needling and autologous blood injection under ultrasound guidance shows promise as a treatment for patients with patella tendinosis.

INTRODUCTION

Patella tendinosis or Jumper's knee refers to a clinical syndrome characterised by anterior knee pain and tenderness at the inferior pole of the patella. It is recognised that this represents a phenomenon of myxoid degeneration and tearing of collagen fibres rather than secondary to inflammation[1,2,3]. This condition frequently causes morbidity in sport and may be refractory to treatment. A variety of techniques have been adopted for the treatment of patella tendinosis including physiotherapy[4], sclerosant injection[5], steroid injection[6], extracorporeal shock wave therapy[7] and surgical decompression including resection of the affected tendon and open stimulation techniques[7,8,9].

Autologous blood injection has been evaluated as a treatment for lateral epicondylitis in humans[10,11] and in vitro studies have been performed in rabbit patella tendons[12]. The aim of the current study is to assess the efficacy of ultrasound guided dry needling and injection of autologous blood into the patella tendon as a treatment for proximal patella tendinosis. Following treatment, the patient adopts a standardized physiotherapy protocol to aid rehabilitation prior to commencement of full sporting activity.

MATERIALS AND METHODS

PATIENTS

Forty seven knees in 44 consecutive patients were included in the study that underwent sonographic assessment of the patella tendon and autologous blood injection. Patient informed consent and institutional review board approval was obtained prior to recruitment. There were 40 men and 7 women (mean age 34.5 years, age range 17-54 years) with 22 left and 25 right knees treated. The mean duration of symptoms was 12.9 months (range 1-48 months). 40 patients described sport as a precipitating factor. These included football (17), running (11), tennis (4), rugby (3), boxing (1), triathlon (1), dancing (1), golf (1) and martial arts (1).

Only patients with proximal patella tendinosis were included in the study. Three patients were excluded as ultrasound demonstrated the presence of multiple focal areas of calcification within the proximal tendon as it was felt that this might be an adverse factor in tendon healing. Furthermore, two patients whom had undergone previous surgery for anterior cruciate ligament reconstruction were also excluded. Pre-procedure Victorian Institute of Sport Assessment scores (VISA)[13] were obtained in all patients to allow quantification of the symptoms and to allow follow up and assessment of the efficacy of treatment.

SONOGRAPHIC TECHNIQUE

Sonography of the patella tendon was performed with the patient lying supine on an examination couch. The patient was positioned with the knee partially flexed by placing a pillow behind the knee. When sonography was performed, the patella tendon was therefore under a degree of tension and the wavy configuration that is evident with the knee in full extension is abolished. Patients underwent diagnostic examination and therapeutic intervention at a number of institutions where the senior author practices. Ultrasound machines from two manufacturers were used: Siemens (Acuson) Sequoia (Siemens Medical Solutions, Mountain View, California, USA) with a 15L8W transducer and Toshiba 5500.

SONOGRAPHIC IMAGE INTERPRETATION

The patella tendon was examined in both the transverse and longitudinal planes to confirm the imaging findings. The diagnosis of patella tendinosis was based on the presence of four characteristic sonographic features. These included tendon size, focal alteration in tendon echotexture, interstitial clefts or tears (fibrillar disruption) and neovascularity (Figure 1).

All patients included in the study demonstrated a hypoechoic tendon with loss of the normal fibrillar architecture in the affected tendon segment. A focal increase in proximal patella tendon thickness was also universally apparent. Discreet interstitial tears were present in 31 (66%) patients with no intrasubstance tear identified in the remainder. Neovascularity was present in 39 (83%) patients (23 mild, 13 moderate and 3 severe).

PROCEDURE

Three ml of autologous blood was obtained from the patients' antecubital fossa. Under aseptic technique and sonographic guidance, 3ml of 0.5% bupivicaine was infiltrated along the superficial and deep aspects of the patella tendon at the site of tendinosis. Once the local anaesthetic had been given sufficient time to act, the needle tip was positioned centrally within the site of tendinosis (Figure 2). Following this the tendon was "dry needled", passing the needle repeatedly through the abnormal tendon substance for a one minute period. The local anaesthetic syringe was then removed from the needle and the autologous blood filled syringe was attached, followed by slow injection of the blood. If areas of interstitial tears were evident on sonography, these areas were targeted for injection of the blood. Filling of these clefts can be directly visualized as fluid permeating between the abnormal hypoechoic clefts.

FOLLOW UP AND PHYSIOTHERAPY PROTOCOL

Following the initial treatment, patients were advised to cease the sporting activities that precipitated symptoms but to continue their activities of daily living. If they had been undergoing physiotherapy prior to autologous blood injection this was postponed until the treatment course was completed. A second injection was then scheduled at an interval of four weeks following the initial injection. At this time, a repeat sonographic assessment was performed followed by dry needling and autologous blood injection using the same technique as at the initial visit. After the second injection, the patients were referred for a standardized physiotherapy program specifically designed for the study. At the outset of treatment all patients are advised that the treatment consists of both injection and physiotherapy and they should expect a three month healing period prior to resuming previous levels of sporting activity.

All patients were asked to complete post procedure VISA scores to allow assessment of the efficacy of the treatment. Furthermore, 21 patients (24 knees) were invited back for a repeat ultrasound examination to assess the changes in the patella tendon following treatment.

STATISTICAL ANALYSIS

Comparison was made between the pre- and post-procedure VISA score. Normality of the difference between the pre- and post-procedural VISA scores was assessed using the Kolmogorov-Smirnov test. The data did not show evidence of non-normality and was

analysed using the paired sample t-test. All statistical analysis was performed using SPSS for Windows, version 14.0 (Chicago, Illinois, USA) and *p* values of <0.05 were considered statistically significant.

RESULTS

CLINICAL OUTCOME

The pre-procedural VISA score had a mean (SD) of 39.8 (16.3) and a range of 8-72 that significantly increased to 74.3 (17.5) with a range of 29-100 on post-procedure follow up ($t = 13.770$, $df = 43$, $p<0.001$). The mean follow up period was 14.8 months with a range of 6-22 months. There were 3 treatment failures from the initial 47 patients. These patients failed to achieve symptomatic improvement and at follow up, all 3 had undergone surgical decompression and a follow up VISA score could therefore not be recorded. One of these patients had two autologous blood injections but did not follow the physiotherapy protocol and returned immediately to sporting activity. The further two cases underwent routine injection and physiotherapy as per protocol.

ULTRASOUND OUTCOME

Follow up ultrasound examination was performed using the same technique, knee position and machine as had been performed prior to treatment. The ultrasound features which were used to diagnose patella tendinosis were reassessed for interval change. These included overall tendon thickness, focal alteration in tendon echotexture, interstitial clefts or tears (fibrillar disruption) and neovascularity.

A total of 21 patients (24 knees) returned for ultrasound follow up examination. In 22 cases, a reduction in proximal tendon thickness was observed, with no difference in the remaining 2 cases. Furthermore, the size of the focal alteration in tendon echotexture reduced in 22 cases (Figure 3), with one case remaining unchanged and one case demonstrating an increase in length of the abnormally hypoechoic segment. In only a single case however was the tendon appearance classed as completely normal ie a return to the normal fibrillar pattern of the proximal patella tendon. Two patients demonstrated tiny foci of calcification at the previous site of tendinosis (2mm). Residual interstitial fissures/tears were identified in 3 cases but had resolved in 14 cases. Neovascularity remained in 23 cases. The degree of neovascularity remained unchanged in 9 cases, had lessened in 5 cases and was more florid in 9 cases.

DISCUSSION

Patella tendinosis or Jumper's knee is an extremely common knee disorder with an estimated incidence of between 13 and 20% in athletic populations[14,15,16]. A number of possible intrinsic aetiologies for this condition have been proposed in athletes including abnormal patella tracking[17], limb length discrepancy[14] and lower flexibility of the quadriceps and hamstring muscle groups[18]. While patella tendinosis is frequently diagnosed clinically, imaging in the form of MRI and ultrasound is now well established[6,20,21,22,23]. The sonographic features of tendinosis are well described both in the patella tendon and elsewhere[10,19,21,24]. We used four sonographic features for diagnosis and ultrasound follow up. These included tendon size, focal alteration in tendon echotexture, interstitial clefts or tears (fibrillar disruption) and neovascularity. The degree of neovascularity identified in patients with patella tendinosis is affected by the position

of the knee during sonographic assessment. In the extended position, neovascularity appears more florid and when tension is applied on the tendon in flexion, some of the neovascularity is abolished. For the purposes of the study and to ensure continuity, the knee was examined in a consistent position, with the knee resting on a pillow. This enabled an assessment to be made on follow up sonography of the degree of neovascularity. When the patient returned at four weeks for the second injection, we frequently observed that the hypoechoic focus in the proximal patella tendon had become more echogenic. We postulate that this accumulation of echogenic material relates to the formation of immature scar tissue/granulation tissue though we have no pathological correlation. Furthermore, there were changes in the neovascularity following the autologous blood injection. We anticipated that a decrease in tendon neovascularity would be observed however, this only occurred in nine patients. There were an equal number of patients who showed an increase in vascularity which we cannot explain. This occurred despite resolution in symptoms and a return to sporting activity.

In the current study, we assessed the clinical outcome of patients using the Victorian Institute of Sport Assessment Score (VISA). This assesses symptomatology, simple function and ability to undertake sporting activity, scored out of 100. This has been validated as a clinical method of assessing the severity of patient's symptoms in patellar tendinosis and has been shown to be a reliable and reproducible index[13]. We demonstrated a statistically significant in improvement in symptoms using our technique.

The injection of autologous blood into tendons has been evaluated by studies assessing the in vitro[12] and in vivo[10,11] effects on tendons. Taylor and co-workers assessed the effects of autologous blood injection on the strength of rabbit patella tendons and found a significant increase in injected tendon strength when compared to the contra lateral normal side[12]. Connell and co-workers reported clinical and sonographic improvement in patients treated with autologous blood injection for lateral epicondylitis[10]. In our study, the patella tendon underwent barbotage or "dry needling" prior to autologous blood injection in all cases included in the study. This technique involves the repeated lancing of the area of abnormal tendon. It is performed to stimulate an inflammatory response within the tendon. There is focal disruption of the collagen fibres within the area of tendinosis so the process of dry needling is performed to incite internal haemorrhage. It is then hypothesized that the inflammatory response induces the formation of granulation tissue which strengthens the tendon[11]. Although our study design does not allow comment on the mechanism of action of this technique, a number of workers have postulated possible biologic mechanisms which may contribute. Anitua and co-workers investigated the effects of platelet-rich clots on human tendon cells in culture. They found that autologous preparations rich in growth factors induce cell proliferation and promote synthesis of angiogenic factors during the healing process[25]. Furthermore, it has been hypothesized that basic fibroblast growth factor and transforming growth factor-β may act as humoral mediators in the induction of the healing cascade[26].

We believe that it is essential that this technique should be performed under ultrasound guidance. Fredberg and co-workers found that only one-third of referred athletes with a clinical suspicion of tendonitis were confirmed by ultrasound evaluation[6]. Ultrasound therefore allows confirmation of the diagnosis and provides an imaging baseline under which response can be assessed. It allows the area of tendon abnormality to be precisely located and interstitial tears can be identified and targeted for blood injection. Frequently,

the abnormality can be quite focal and the injectate can be identified permeating through the clefts within the tendon substance. In addition, physiotherapy plays a vital role in the ongoing treatment of patients following the period of rest and series of injections. This comprised of a standardised protocol based on the findings of Purdam and co-workers[27]. Loading of the patella tendon was achieved by decline eccentric dips, with incrementally increasing load over 3-6 months, until the subject had returned to sport. All subjects also received quadriceps, hamstring, and calf stretches. The programme was home based, with regular physiotherapy clinic visits to guide the subjects progression.

There are a number of limitations to this study. We are, in essence evaluating two therapies simultaneously. Autologous blood injection and dry needling is combined with physiotherapy as part of our treatment protocol. We therefore do not know the relative importance of the autologous blood injection and dry needling in therapeutic outcome in the studied group. Previous workers have identified good results with painful eccentric quadriceps training with significant improvement in clinical outcome[4]. However, most of our patients had undergone a course of physiotherapy and the tendinosis had proved refractory to this initial treatment. Secondly, the VISA score provides an objective measure of clinical outcome in patients treated with this technique. We do not however have further objective measurement of tendon healing. The ultrasound findings are descriptive and rather subjective. It would be difficult to justify biopsy of the tendon to provide histological evidence of tendon healing. With this in mind, ultrasound was chosen as the modality to monitor the "healing response" and to observe the sonographic appearances of tendons treated with this new technique. Further research is required with a randomised control trial of autologous blood injection/physiotherapy versus physiotherapy alone.

CONCLUSIONS

Dry needling and injection of autologous blood for patella tendinosis shows promise as an alternative treatment for this chronic condition. It is important to perform this technique under sonographic guidance so the abnormal tendon can be targeted precisely for dry needling and injection of blood. The patient subsequently undergoes a course of physiotherapy following initial treatment prior to resuming sporting activity.

REFERENCES

1. Khan KM, Cook JL, Bonar F, et al. Histopathology of common tendinopathies. Update and implications for clinical management. *Sports Med.* 1999;27(6):393-408
2. Alfredson H. The chronic painful Achilles and patellar tendon: research on basic biology and treatment. *Scand J Med Sci Sports.* 2005;15(4):252-9
3. Sharma P, Maffulli N. Tendon injury and tendinopathy: healing and repair. *J Bone Joint Surg Am.* 2005;87(1):187-202
4. Jonsson P, Alfredson H. Superior results with eccentric compared to concentric quadriceps training in patients with jumper's knee: a prospective randomized study. *Br J Sports Med.* 2005;39(11):847-50
5. Alfredson H, Ohberg L. Neovascularisation in chronic painful patellar tendinosis-promising results after sclerosing neovessels outside the tendon challenge the need for surgery. *Knee Surg Sports Traumatol Arthrosc.* 2005;13(2):74-80

6. Fredberg U, Bolvig L, Pfeiffer-Jensen M, et al. Ultrasonography as a tool for diagnosis, guidance of local steroid injection and, together with pressure algometry, monitoring of the treatment of athletes with chronic jumper's knee and Achilles tendinitis: a randomized, double-blind, placebo-controlled study. *Scand J Rheumatol.* 2004;33(2):94-101
7. Peers KH, Lysens RJ, Brys P, et al. Cross-sectional outcome analysis of athletes with chronic patellar tendinopathy treated surgically and by extracorporeal shock wave therapy. *Clin J Sport Med.* 2003;13(2):79-83
8. Ferretti A, Conteduca F, Camerucci E, et al. Patellar tendinosis: a follow-up study of surgical treatment. *J Bone Joint Surg Am.* 2002;84-A(12):2179-85
9. Shelbourne KD, Henne TD, Gray T. Recalcitrant patellar tendinosis in elite athletes: surgical treatment in conjunction with aggressive postoperative rehabilitation. *Am J Sports Med.* 2006 Feb 13;[Epub ahead of print]
10. Connell DA, Ali KE, Ahmad M, et al. Ultrasound-guided autologous blood injection for tennis elbow. *Skeletal Radiol.* 2006 Jun;35(6):371-7
11. Edwards SG, Calandruccio JH. Autologous blood injections for refractory lateral epicondylitis. *J Hand Surg Am.* 2003;28:272-278
12. Taylor MA, Norman TL, Clovis NB, et al. The response of rabbit tendons after autologous blood injection. *Med Sci Sports Exerc.* 2002;34(1):70-3
13. Visentini PJ, Khan KM, Cook JL, et al. The VISA score: an index of severity of symptoms in patients with jumper's knee (patellar tendinosis). Victorian Institute of Sport Tendon Study Group. *J Sci Med Sport.* 1998;1(1):22-8
14. Kujala UM, Friberg O, Aalto T et al. Lower limb asymmetry and patellofemoral joint incongruence in the aetiology of knee exertion injuries in athletes. *Int J Sports Med.* 1987;8:214-220
15. Kujala UM, Kvist M, Osterman K et al. Factors predisposing army conscripts to knee exertion injuries incurred in a physical training programme. *Clin Orthop.* 1986:210:203-212
16. Jarvinen M. Epidemiology of tendon injuries in sports. *Clin Sports Med.* 1992;11:493-504
17. Allen GM, Tauro PG, Ostlere SJ. Proximal patella tendinosis and abnormalities of patellar tracking. *Skeletal Radiol.* 1999;28(4):220-3
18. Wityrouw E, Bellemans J, Lysens R, et al. Intrinsic risk factors for the development of patellar tendinitis in an athletic population. A two-year prospective study. *Am J Sports Med.* 2001;29(2):190-5
19. Ferretti A, Puddu G, Mariani PP et al. Jumper's knee : An epidemiological study of volleyball players. *Physician Sportsmed.* 1984;12(10):97-103
20. Weinberg EP, Adams MJ, Holledberg GM. Color doppler sonography of patellar tendinosis. *AJR Am J Roentgenol.* 1998;171(3):743-4
21. Terslev L, Qvistgaard E, Torp-Pedersen S, et al. Ultrasound and power Doppler findings in jumper's knee – preliminary observations. *Eur J Ultrasound.* 2001;13(3):183-9
22. Peers KH, Lysens RJ. Patellar tendinopathy in athletes: current diagnostic and therapeutic recommendations. *Sports Med.* 2005;35(1):71-87

23. Khan KM, Bonar F, Desmond PM, et al. Patellar tendinosis (jumper's knee): findings at histopathologic examination, US, and MR imaging. Victorian Institute of Sport Tendon Study Group. *Radiology*. 1996;200(3):821-7
24. Richards PJ, Win T, Jones PW. The distribution of microvascular response in Achilles tendonopathy assessed by colour and power doppler. *Skeletal Radiol.* 2005;34:336-342
25. Anitua E, Andia I, Sanchez M et al Autologous preparations rich in growth factors promote proliferation and induce VEGF and HGF production by human tendon cells in culture.. *J Orthop Res.* 2005;23(2):281-6
26. Iwasaki M, Nakahara H, Nakata K, et al. Regulation of proliferation and osteochondrogenic differentiation of periosteum-derived cells by transforming growth factor-β and basic fibroblast growth factor. *J Bone Joint Surg Am.* 1995;77:543-554
27. Purdam C.R., Johnsson P., Alfredson H., et al. A Pilot Study of the eccentric decline squat in the management of painful chronic patellar tendinopathy. *Br J Sports Med* 2004:38: 395-397

FIGURE LEGENDS

Figure 1. Longitudinal image of the proximal patella tendon. Colour Doppler demonstrates marked neovascularity in the hypoechoic segment of the proximal patella tendon.

Figure 2. Longitudinal image of the proximal patella tendon. The needle (arrow) has been inserted into the hypoechoic area prior to dry needling being performed and autologous blood injection.

Figure 3. Longitudinal image of the proximal patella tendon pre treatment and post treatment at 6 months in the same patient. The post treatment image shows near complete resolution of the hypoechoic segment in the proximal patella tendon. There has been return of the normal echogenic fibrillar pattern in the tendon. There is a tiny residual hypoechoic segment at the insertion.

“Information box”

“What is already known on this topic”

Patella tendinosis is a common problem frequently causes morbidity in sport and may be refractory to treatment. Autologous blood injection has been reported as showing promise in the treatment of tendinosis at other sites including both medial and lateral epicondylitis.

“What this study adds”

This study reports the technique of dry needling and autologous blood injection under sonographic guidance as a therapeutic option for patella tendinosis. The pre and post procedure imaging findings are presented and discussed along with the pre and post procedure VISA score as a measure of clinical outcome.

Statement

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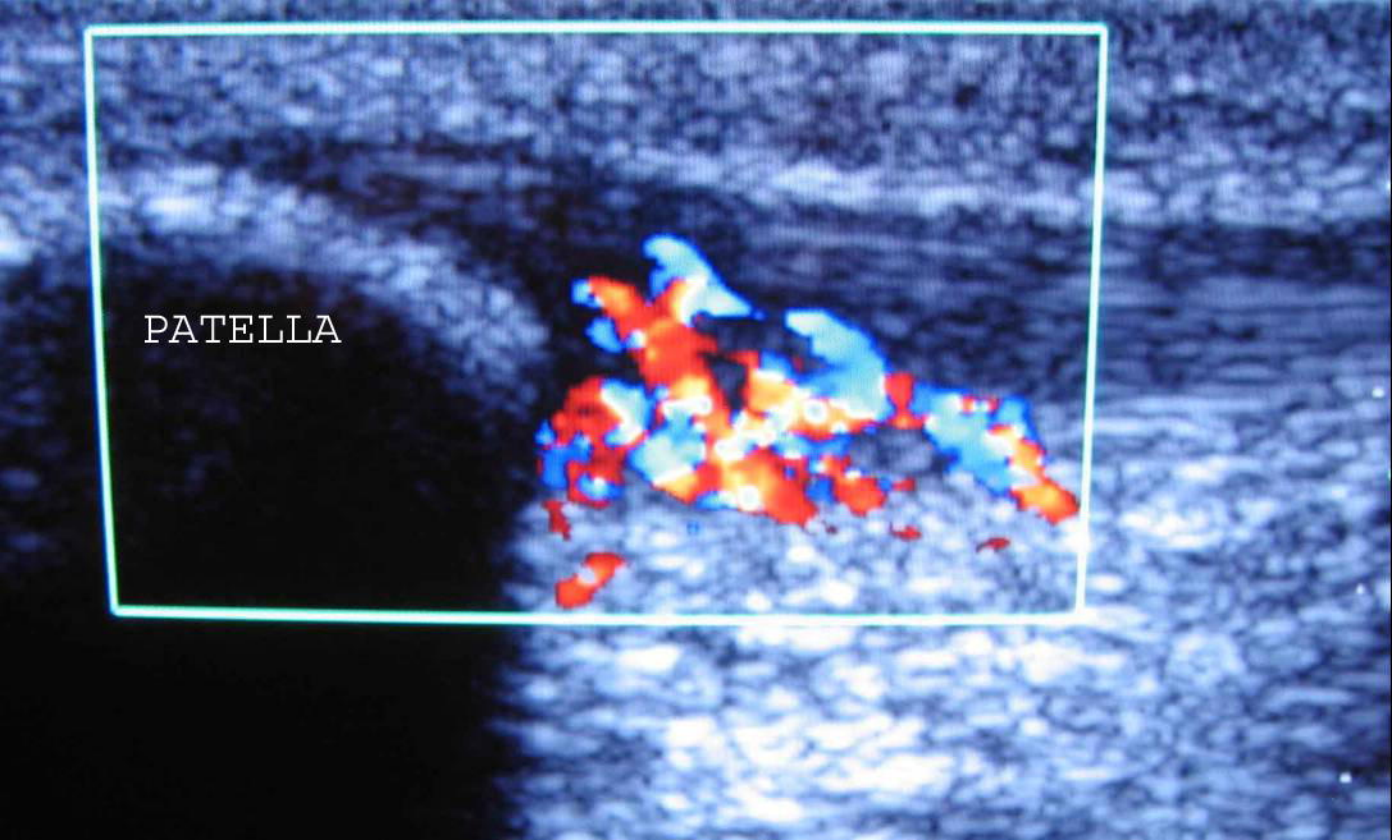
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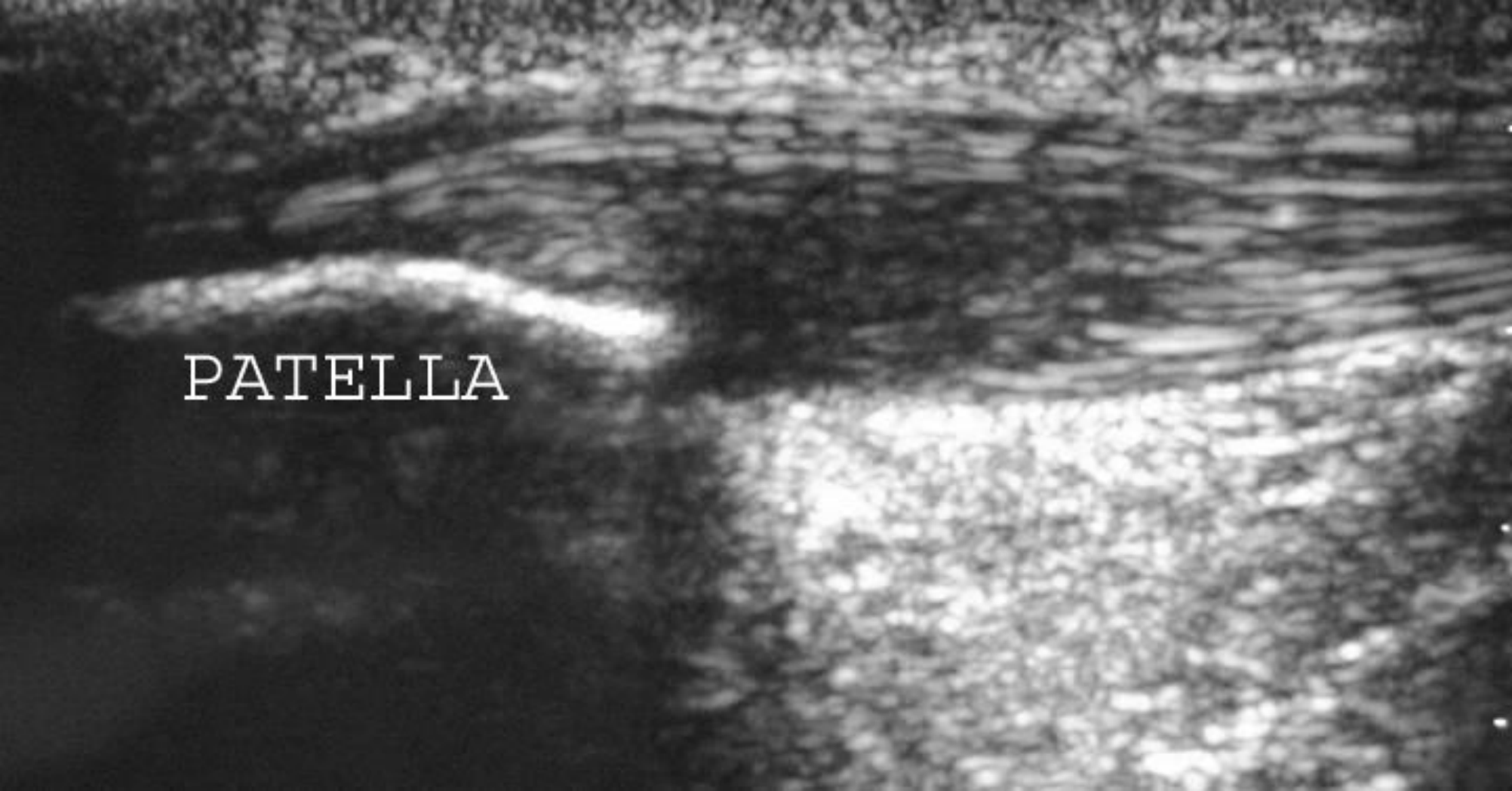
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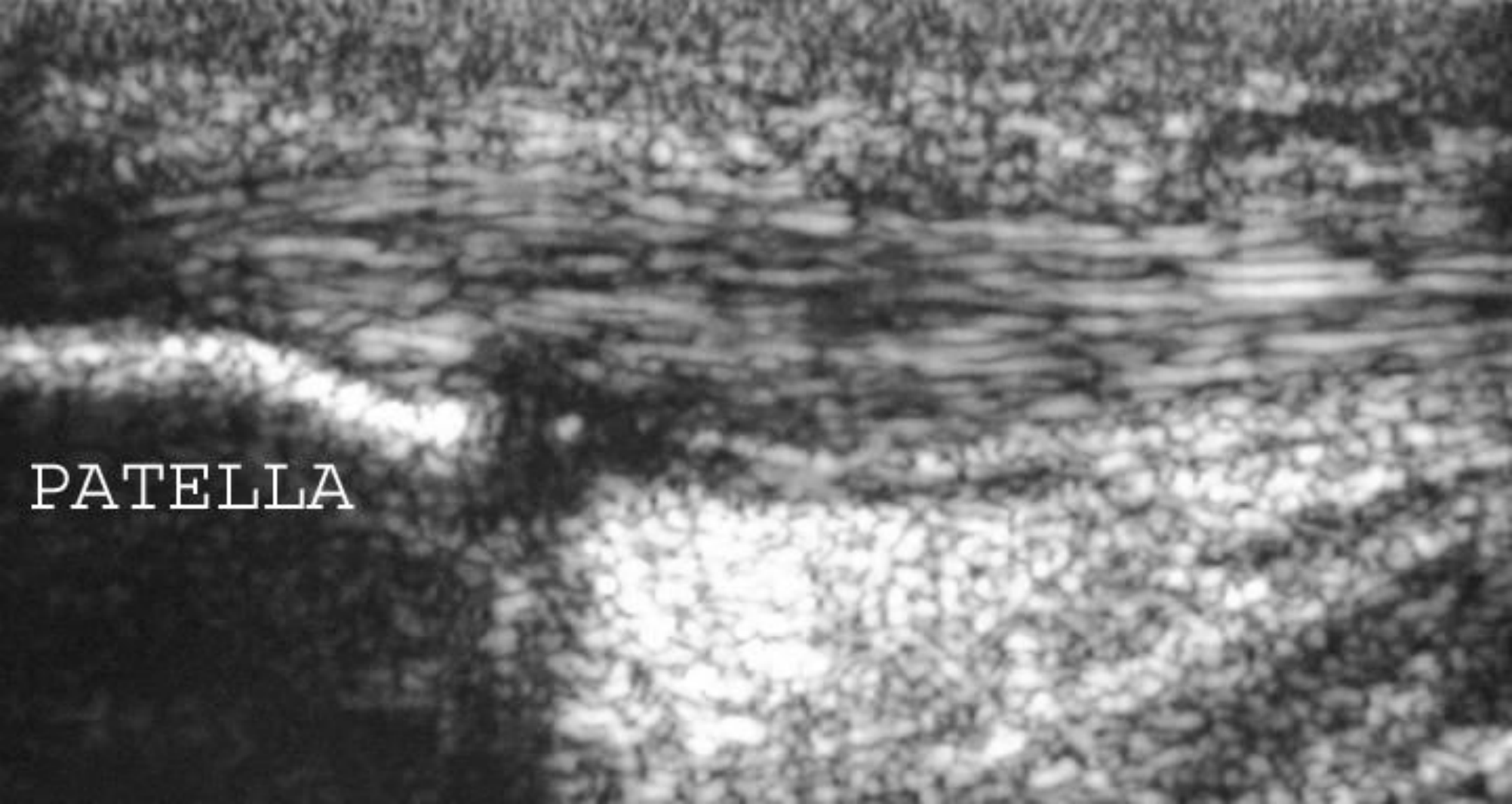
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Notes