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EDITORIAL

Tendon appearance at imaging may be altered, but it may not indicate pathology

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Abstract

Both in tendon repair following a tear and in tendinopathy, recovery from pain and restoration of (acceptable) function does not go hand in hand with the appearance of the affected tendon at imaging. The tendon may remain altered for a long while and possibly forever, indicating a possible dissociation between morphology and symptoms. The predictive value of asymptomatic abnormal findings remains limited, and interventions in such instances are inappropriate and not supported by current evidence. Once an initial imaging investigation has depicted the condition of the tendon, additional imaging investigations are unlikely to provide further information or change prognosis in patients in whom abnormalities compatible with a diagnosis of tendinopathy have been identified by either ultrasonography or MRI. Patient education and close clinical monitoring are recommended. This is applicable to the patellar tendon, Achilles tendon, rotator cuff, for both tendon repair and tendinopathy. Given the modest risk of sonographic abnormalities to develop in symptomatic tendinopathy, planning and trying to implement any form of intervention may not be warranted. The current evidence mostly arises from low-quality studies, with heterogeneous risk factors and populations, and caution must be maintained when interpreting the significance of such incidental findings in athletes.

Keywords Tendon · Tendinopathy · Function

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The term tendinopathy is a generic descriptor of the clinical conditions in and around tendons arising from overuse [22]. The terms "tendinosis" and "tendinitis/tendonitis" should only be used after histopathological examination [22]. Symptomatic tendinopathy is disabling, reducing performances and representing a potential reason for temporary or permanent retirement from the sport, and impacts negatively on the quality of life. Frequent sites of tendinopathy in athletes include the Achilles tendon in sports requiring extensive running, the patellar tendon in jumping sports, and the rotator cuff tendons in overhead athletes. There is growing evidence that, both in tendon repair and tendinopathy, recovery from pain and restoration of (acceptable) function does not go hand in hand with an appearance at imaging the tendon remains altered for a long while and possibility forever, indicating the poor association between intratendinous morphology and symptoms. The mechanical properties are altered in tendon repair and tendinopathy as direct results of the tendon damage and reduced activity level [6].

In tendinopathy, ultrasound imaging may show localised thickening, hypoechoic areas, and irregular fiber alignment. Power doppler may depict altered vascularity within and

around the tendons, and sonoelastography may quantify greater alterations in elasticity compared to healthy tendons [25]. In tendon repair, hypoechoic peritendinous areas, greater thickness and width may decrease in the years after surgery or the tendon may remain permanently thickened [9], with adhesions between the tendon and skin [27]. Intratendineous calcifications after Achilles tendon repair are common, and exert no negative impact on the postoperative clinical outcome [3]. In tendon repair, power doppler evidences postoperative increase vascularisation within and around the tendons, which decreases during the healing process until avascular scar formation occurs [4]. A persistent increase or the presence of vascularity may persist at two years postoperatively, but its clinical significance is unclear [3]. At sonoelastography, tendon stiffness pattern progressively increases at 12, 24 and 48 weeks. A stiffer and heterogeneous pattern in the surgically repaired tendon at elastography may be a physiological feature of tendon healing [28].

The impact of the appearance of the tendon on the clinical features after in tendon repair and tendinopathy are debated. It appears, however, that mechanical proprieties may be permanently altered, with dubious influence on clinical features. Morphologic changes have been identified at ultrasound in a large percentage of asymptomatic athletes who do not develop symptoms even at long-term follow-up [7, 8, 12, 14, 17, 21, 24]. Structural changes with tendinopathy features can remain asymptomatic with preserved function. Despite the increasing prevalence with age, most individuals with structural changes of the rotator cuff tendons remain asymptomatic, with full function [23]. The enlargement of an existing tear may predispose to symptom onset [15, 26]. In a three years prospective study, the tendon structure of elite fencers was evaluated to predict the risk of developing symptoms in the Achilles, patellar, or quadriceps tendons [11]. At the last follow-up, patellar tendons diagnosed as abnormal at baseline were more likely to develop symptoms than those normal at baseline, while abnormalities in the Achilles and quadriceps tendons were not predictive for the development of symptoms over the three years of the study [11]. Moreover, 1.45% of tendons diagnosed as normal at baseline evidenced structural abnormalities at three-year follow-up [11].

The relationship between clinical improvements and the normalization of tendon structure in tendinopathy is not clear and is not proven [8]. In a double-blinded trial, 20 athletes with symptomatic proximal patellar tendinopathy were randomly allocated to receive ultrasound-guided intratendinous and peritendinous injections of autologous expanded bone marrow mesenchymal stem cells or leukocyte-poor platelet-rich plasma [21]. Both treatments reported similar efficacy in reducing pain and improving activity levels; however, athletes who received bone marrow mesenchymal stem cells demonstrated greater improvement in tendon structure compared with those who received Lp-PRP [21]. In both groups, pain ameliorated to a similar extent. In a two years prospective sonographic and magnetic resonance study, 45 patients with symptoms in 57 Achilles tendons were diagnosed with tendinopathy [13]. Structural changes identified at sonography were evident in 65% (37 of 57) of symptomatic tendons, and normal morphology in 68% (19 of 28) of asymptomatic tendons [13]. There was no evidence of an association between the sonographic appearance at baseline and clinical outcome, and the use of colour and power Doppler did not improve the diagnostic accuracy [13]. Structural changes were identified at magnetic resonance in 56% (19 of 34) of symptomatic tendons and normal morphology in 94% (15 of 16) of asymptomatic tendons [13]. Recovery from pain and restoration of function does not go hand in hand with the structural morphology of the tendon examined.

There is no evidence in support that physical therapy interventions in patients with structural changes may prevent the progression to symptomatic tendinopathy. Though the documentation of structural changes in asymptomatic athletes may provide some insights, these are unlikely to progress to symptomatic tendinopathy, and prevention programs are missing. Tendons are dynamic structures that interact with the external environment and continually adapt to it. In a long-term sonographic investigation on 70 patients with Achilles tendon rupture, the healthy contralateral tendon was evaluated and compared with a group of individual age- and sex-matched controls [1]. The contralateral tendon demonstrated a statistically significant greater maximum transverse anteroposterior diameter, which may represent a background of subclinical tendinopathy [1]. Therefore, physicians should keep in mind that structural changes at imaging might indicate biomechanics alterations at other sites.

Results of imaging after tendon repair must be examined with caution. Abnormal appearance at imaging does not necessarily imply clinically relevant pathology or poor function. After the repair of a rupture, the tendon increases its width for three to six months [3]. Especially during the first six months, at imaging tendons appear inhomogeneous, with loss of their well-organised fibrillary structure. In the same time frame, hypoechoic areas surrounding the suture threads become visible. Extensive intratendinous calcifications and/or fluid collections are suggestive of a poor prognosis [1]. Hypoechoic peritendinous areas at sonography may persist for several months [16]. Color Doppler imaging evidence decreased vascularization during the first month. Following the first three months after surgery, the intratendinous hypervascularization then regresses until the sixth postoperative month postoperatively [5]. After this period, persistent hypervascularization is likely an indicator of pathological scarring [18]. Peritendinous vascularization does not change considerably postoperatively [5]. Nevertheless, although

these findings have been described as part of the physiological healing process, it is unclear whether abnormalities in this apparently well-ordered process carry any pathological significance, and translate into clinically evident pathology.

The current evidence on elastography following tendon repair is limited. Up to one year after surgery, tendons evidence progressive hardening, but with a relatively heterogeneous pattern [2, 20]. In a large, randomized controlled trial, the efficacy of a prophylactic eccentric training and stretching program on the Achilles and patellar tendons in 209 asymptomatic professional athletes with structural changes was investigated [10]. At 12 months, though structural changes at ultrasonography were reported, the risk of the onset of pain was unvaried [10]. In a randomised controlled trial, the correlation between structural changes at imaging (sonography and MRI) and clinical outcome of 65 patients who underwent open Achilles tendon repair was evaluated [19]. The structural changes at imaging taken into exam were partial defects, thickening, homogeneity, peritendinous reaction, oedema, glide function, evaluating the clinical outcomes, the Achilles tendon total rupture score, strength and endurance. There was no evidence of a statistically significant and clinically relevant association between the structural changes at sonography and MRI with any of the clinical endpoints of interest [19].

The predictive value of asymptomatic findings of the tendon in athletes remains limited. This is applicable to the patellar tendon, Achilles tendon, rotator cuff, for both tendon repair and tendinopathy. Comparative high-quality investigations are required to assess the predictive value of imaging investigations, and to identify possible imaging features related to the development of symptomatic tendinopathy or poor recovery after a rupture. It is also unclear whether additional investigations may provide further information or influence prognosis in symptomatic patients with imaging diagnosis of tendinopathy. Given the modest risk of sonographic abnormalities to develop in symptomatic tendinopathy, intervening in all cases may not be warranted, and interventions are inappropriate and not supported by current evidence. Education and close monitoring are recommended. The current evidence mostly arises from low-quality studies, with heterogeneous risk factors and populations, and caution must be maintained when interpreting the significance of such incidental findings in an athlete.

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Declarations

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