

# TREATMENT OF QUADRICEPS TENDON RUPTURE IN HEMODIALYSIS PATIENTS: A 2020 UPDATE

## TRATAMENTO DA RUPTURA DO TENDÃO DO QUADRÍCEPS EM HEMODIALISADOS: UMA ATUALIZAÇÃO EM 2020

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### ABSTRACT

Quadriceps tendon tears are uncommon injuries often associated with chronic diseases, including end-stage renal disease (ESRD). The role of secondary hyperparathyroidism as a predisposing factor for tendon tears in this group of patients is well documented, and the weakening of the tendon-bone junction is part of this context. The treatment of choice for quadriceps tendon ruptures in patients with ESRD is surgery, which should be performed as soon as possible. There are several surgical techniques to be used, but the lack of comparative studies does not allow us to conclude which one is the best option. More recent publications have preferred the association of techniques, with emphasis on the use of autologous tendon grafts as a reinforcement tool, which is the author's procedure of choice. Recent studies reported the use of biological agents to stimulate healing and allografts, but the information seems preliminary to be routinely recommended. **Level of evidence II; Observation of therapeutic studies.**

**Keywords:** Quadriceps muscle. Hemodialysis. Hyperparathyroidism.

### RESUMO

As rupturas do tendão do quadríceps são lesões incomuns, frequentemente associadas a doenças crônicas, incluindo a doença renal em estágio de falência funcional. O papel do hiperparatireoidismo secundário como fator predisponente para rupturas tendíneas nesse grupo de pacientes está bem documentado, e o enfraquecimento da junção tendão-osso faz parte desse contexto. O tratamento de escolha para rupturas do tendão do quadríceps em pacientes com falência renal é a cirurgia, e deve ser realizado o mais rápido possível. Existem várias técnicas cirúrgicas a serem utilizadas, mas a falta de estudos comparativos não nos permite concluir qual é a melhor opção. Publicações mais recentes têm preferido a associação de técnicas, com destaque para o uso de enxerto tendíneo autólogo como ferramenta de reforço, procedimento de escolha do autor. Estudos recentes relatam o uso de agentes biológicos para estimular a cicatrização e aloenxertos, mas as informações parecem preliminares para serem rotineiramente recomendadas. **Nível de Evidência II; Observação de estudos terapêuticos.**

**Descritores:** Músculo quadríceps. Hemodiálise. Hiperparatireoidismo.

**Citation:** Malta LMA, Santos AASMD, Malta MC, Machado LM, Lugon JR. Treatment of quadriceps tendon rupture in hemodialysis patients: a 2020 update. *Acta Ortop Bras.* [online]. 2022;30(1)Esp.: Page 1 of 4. Available from URL: <http://www.scielo.br/aob>.

### INTRODUCTION

The rupture of a quadriceps tendon is considered an uncommon injury, predominating in middle-aged males.<sup>1,2,3</sup> However, an increased incidence of this condition especially in younger patients is associated with the presence of comorbidities such as diabetes mellitus, gout, rheumatoid arthritis and end-stage renal disease (ESRD), among others.<sup>4-7</sup> Of note, in the presence of associated diseases, quadriceps ruptures can occur with low-intensity trauma as the underlying condition weakens the tendon and facilitates its rupture (6,8). Also, there are several reports in the literature of bilateral ruptures of the quadriceps tendon in patients with associated diseases, particularly ESRD.<sup>2,5,7-10</sup>

Once occurred, the quadriceps rupture imposes a strong negative impact on the individual's gait capacity, commonly manifesting with pain at the injury site and the inability to actively extend the knee.<sup>1,11-13</sup> Considering the poor healing capacity of the tendon, especially when there is a retraction of the stump and previous changes in its structure, the appropriate treatment is early surgical repair, and the literature broadly supports this approach.<sup>9,14,15</sup> However, different approaches are described for this purpose without a clear definition as to which one is the most adequate.<sup>14-16</sup> This article aims to present a literature review on the surgical treatment of quadriceps ruptures in patients with ESRD, pointing out the options for operative techniques and highlighting those most frequently used in the last decade.

All authors declare no potential conflict of interest related to this article.

The study was conducted at Hospital Universitário Antonio Pedro, Faculty of Medicine at the Universidade Federal Fluminense, Rio de Janeiro, RJ, Brazil.

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Article received on 11/17/2020, approved in 03/04/2021.



## END-STAGE RENAL DISEASE

End-stage renal disease (ESRD) is a prevalent condition worldwide, being a significant cause of morbidity and mortality in the population. Its incidence has grown in recent years, generating a severe impact on public health policies, especially in developing countries.<sup>17</sup>

The United States Renal Data System (USRDS) publishes annual epidemiological data on kidney disease in that country, guiding researchers from the most diverse areas and facilitating the implementation of public policies by the government agencies. In 2017, 124,500 new cases of ESRD were reported totaling 746,557 prevalent cases at the end of the year (growth of 2.6% compared to 2016). The leading listed causes of ESRD were diabetes mellitus, hypertension, glomerulonephritis, and polycystic kidney disease. Currently, the overall mortality rate for patients with ESRD in the United States is 134/1000 patient/year, with 165/1000 patients/year for dialysis and 29/1000 patients/year for transplant.<sup>18</sup>

## PATHOPHYSIOLOGY OF TENDON RUPTURE

A rupture of the quadriceps tendon results from an indirect force, when a vigorous contraction of the anterior thigh muscles is exerted on the flexed knee with the foot resting on the ground (eccentric contraction).<sup>11,14</sup> The following functional disability is evident as a consequence of local inflammatory response, the formation of a tendon gap (Figure 1) and deficit in the active knee extension. The vast majority of quadriceps tendon ruptures occur in men with a mean age of 60 years, and, also previously mentioned, there is a frequent association between ruptures of this tendon and the presence of comorbidities.<sup>11,14,16</sup>

Several chronic diseases are capable of producing long-term changes in the tendon structure, resulting in its weakening and predisposing it to rupture.<sup>6,8,11</sup> In this scenario, forces that do not exceed the physiological demands can cause discontinuity in the midsubstance of the tendon or avulsions at the enthesis (spontaneous ruptures).<sup>2,5,7,19</sup> Among the possible mechanisms of intrinsic tendon injury, we can mention altered proteoglycan metabolism, hypovascularization, decreased collagen production, the formation of intrasubstantial calcifications and chronic inflammation.<sup>8,11</sup> However, in patients with ESRD, the leading risk factor for rupture is secondary hyperparathyroidism.<sup>5,9,19</sup>

## HYPERPARATHYROIDISM AND TENDON RUPTURE

The first article reporting a ruptured quadriceps tendon in a patient with hyperparathyroidism secondary to chronic kidney disease was published in the early 1960s,<sup>20</sup> and since then numerous studies have

reassured this association.<sup>5,9,19,21-25</sup> The increase in parathormone levels results in the stimulation of osteoclastic activity, which promotes bone resorption in order to balance serum calcium. Since resorption occurs diffusely in the skeleton, the areas of tendon insertion are not spared, resulting in weakness of the tendon-bone junction. Accordingly, most of the quadriceps tendon ruptures in patients with ESRD are located at this point.<sup>26,27</sup> In addition, some studies suggest that tendon rupture is more frequent in patients with a long period of hemodialysis treatment, probably due to chronic biochemical changes that culminate in degenerative injuries to the tendon and its insertion.<sup>21,24</sup>

## SURGICAL TECHNIQUES

### Direct repair

In ruptures of the quadriceps tendon that occur above its insertion, it is possible to perform a direct repair by approaching and suturing the tendon stumps. The first report of simultaneous bilateral rupture of the quadriceps tendon was published in 1949, when the authors described the treatment of an obese 67-year-old patient who underwent simple sutures of both injuries.<sup>28</sup> They used silk interrupted sutures to perform the tenorrhaphy, taking advantage of the 2 cm stump that remained attached to the patella, obtaining a satisfactory final result. Currently, the simple suture technique does not find a reliable support in the literature. A 2017 systematic review involving a total of 44 patients showed that this procedure was adopted in only 22% of them.<sup>16</sup> Other authors consider that previous tendon degeneration, especially in patients with ESRD, requires additional procedures to strengthen the suture. The strengthening can be done with local tenoplasty following the techniques of Scuderi and Codivilla,<sup>6,14</sup> sometimes associated with the use of cerclage wire around the patella.<sup>6</sup>

### Transosseous repair

Since the first report of a quadriceps tendon rupture associated with hyperparathyroidism and chronic kidney disease by Preston and Adicoff in 1962,<sup>20</sup> the transosseous suture technique has been the most used treatment for the disorder.<sup>1,14,16</sup> As the majority of quadriceps injuries in this group of individuals occur at the tendon insertion, there is no distal stump for the direct suture to be safely performed (Figure 2).<sup>13</sup> The preferred procedure to circumvent this difficulty has been to reinsert the tendon at the upper pole of the patella.<sup>7,10,29</sup> In the transosseous suture technique, resistant non-absorbable sutures are initially braided in the proximal stump of the tendon. This step can be completed according to the surgeon's preference, but the Krackow type of suture has been the most used procedure.<sup>4,7,30</sup> Longitudinal drill holes are made in the patella, allowing the suture ends to be passed distally and tied with the



Figure 1. Palpable gap above superior pole of patella.



Figure 2. Intraoperative aspect of rupture.

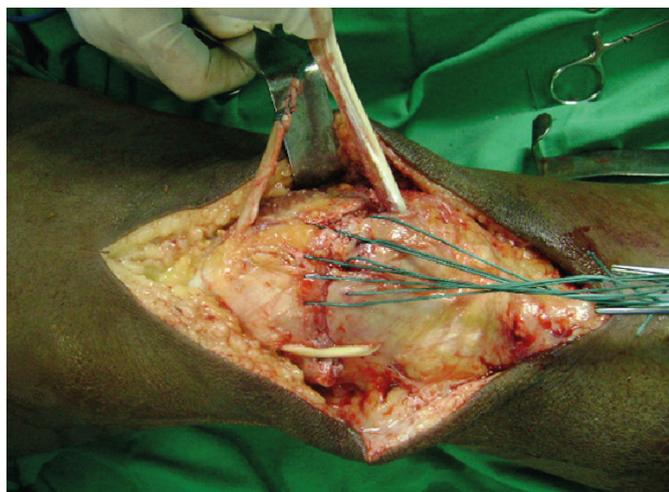
necessary tension to bring the stump closer to its insertion point.<sup>13</sup> To promote healing of the tendon-bone junction, old ruptures or that associated with tissue degeneration may require additional reinforcement as previously described for the direct repair technique.<sup>1</sup>

### Suture anchor repair

In 2002, Richards and Barber published a technical note regarding two cases of ruptured quadriceps tendons treated with suture anchors in the patella. It was the first report of this technique in the English literature, and the authors argue that the higher resistance of the suture would allow a more aggressive rehabilitation program.<sup>31</sup> In the suture anchor technique, small threaded devices are implanted in the upper pole of the patella. Resistant non-absorbable suture wires attached to these devices are tied to the proximal stump of the tendon and tensioned, approaching it in a way similar to that described for the transosseous suture technique.<sup>19,30</sup> The suture anchor repair is not the procedure most frequently used, but the number of published studies regarding this technique has grown substantially in the last decade.<sup>19,30,32</sup> Although there are no comparative clinical studies,<sup>14</sup> the advantages attributed to anchor repair are the shorter operative time, easier access to the implant site, preservation of the patella and higher mechanical resistance.<sup>31</sup> Despite this, a biomechanical study concluded that the transosseous suture is more resistant and cheaper than the suture anchor repair.<sup>32</sup>

### Autologous tendon reinforcement

Recent studies have shown concern in obtaining more resistant repairs when treating quadriceps tendon ruptures, especially when there are signs of tendon degeneration.<sup>13,33</sup> This situation is particularly frequent in patients with ESRD, and the eventual delay in rupture diagnosis can create additional difficulty for satisfactory results when more straightforward techniques are used.<sup>9,15</sup> To address this common problem, several authors have advocated the use of autologous tendon grafts to reinforce the suture.<sup>9,13,15,33</sup> After the initial repair employing one of the above-mentioned techniques, the graft is transfixated through the extensor apparatus, at points above and below the lesion. The graft is then sutured to the transfixing points, creating a protective wrap that prevents excessive tension at the repair site.<sup>13,15</sup> Most studies indicate the use of semitendinosus tendon graft for this purpose.<sup>13,15,33</sup> In 2014, we published our own experience on a series of patients with ESRD and quadriceps tendon rupture. Of the 11 operated knees, six were treated with transosseous repair associated with autologous semitendinosus reinforcement,<sup>13</sup> which is our preferred technique (Figures 3 and 4).



**Figure 3.** Transosseous suture and autologous semitendinosus graft augmentation.



**Figure 4.** Final construction.

However, it is noteworthy that there are other graft possibilities. Alternatives such as the gracilis muscle tendon, fascia lata or the combination of different tendons have also been described.<sup>1,9</sup>

### Special situations

In cases of multiple recurrences of rupture or chronic ruptures with significant retraction of the tendon stump, some salvage procedures have been proposed.<sup>12,34</sup> In 2015, Rehman et al. reported the case of a 61-year-old patient who had suffered the third rupture of the right quadriceps tendon.<sup>34</sup> His comorbidities were arterial hypertension and glaucoma; both controlled with medication. In the surgical procedure, the tendon was elongated and repaired with the Codivilla's technique, and reinforced with grafts from the semitendinosus and gracilis. On the upper surface of the repair, they added a fragment of Prolene mesh fixed with sutures and bathed the site with platelet-rich plasma. Describing a satisfactory result after one year, the authors drew attention to the possible utility of platelet-rich plasma. Its properties to stimulate the release of growth factors and recruit repair cells can play an essential role in the healing of soft tissues.

More recently, Lamberti et al. reported the case of a 51-year-old patient with ESRD and chronic rupture of the left quadriceps tendon.<sup>12</sup> The patient had been on a hemodialysis program for eight years, and her rupture had evolved for 16 months. Due to the substantial retraction and poor quality of the tendon, they opted for reconstruction using an entire extensor mechanism allograft. In the surgery, the original patella was removed, and the graft's anterior tibial tuberosity was fixed to the proximal third of the tibia with a screw and cerclage. The quadriceps and patellar tendons of the graft were tensioned and sutured to the respective remnants, with the knee in full extension. After a 4-year follow-up and assisted rehabilitation, the patient was able to achieve a satisfactory function. As advantages of the allograft, the authors mentioned the creation of a framework for fibrous invasion and the preservation of donor sites of autologous grafts. However, they remembered that the possibility of immune reaction and disease transmission are still disadvantages of this method.

### CONCLUSIONS

Patients with quadriceps tendon tears are best treated with surgery, including the ESRD ones. There are several techniques to be used, but which is the best one is still a matter of controversy. Recent publications have reported a preference for the combination of techniques, with a particular enthusiasm on the use of autologous tendon grafts, which is the author's choice. Biological agents and structural allografts are also mentioned as options, but new studies should confirm their routine application.

**AUTHORS' CONTRIBUTION:** Each author contributed individually and significantly to the development of this article. LMAM: writing and substantial contribution to the creation of the work; AASMDs and MCM: substantial contribution in the conception of the work. Final approval of the version of the manuscript to be published; LMM: writing and acquisition of data for work; JRL: Substantial contribution in the conception of the work. Critical review of its intellectual content. Final approval of the version of the manuscript to be published.

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