PROTECTION DEVICE ON THE REPAIR OF RUPTURES OF KNEE EXTENSOR MECHANISM

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ABSTRACT

Objective: To evaluate results obtained using the protection device technique for osteosynthesis or suture of extensor mechanism lesions. Material and Methods: The authors reviewed 18 charts of patients submitted to protection device technique due to traumatic lesion of extensor mechanism that had occurred between the anterior tibial tuberosity and the apical portion of patella. Age ranged from 22 to 69 years, with a mean of 44 years. Male patients prevailed, with 67% of the cases. The most affected spot was, in 83% of the cases, the apical distal third. A protocol was created to collect data, listing the patients and the clinical history from their medical records. Results: The authors observed consolidation of the patella fracture in all 17 patients, and cicatrization of the patellar ligament in one patient. Pain was described in four patients. There were no complications related to the procedure. Conclusion: The protection device showed to be efficient when used in surgical treatment of lesions between the apical patella and the anterior tibial tuberosity, providing active and passive mobility in the early postoperative time.

Keywords – Knee; Patellar ligament; Outcome assessment

INTRODUCTION

The treatment of extensor apparatus injuries varies according to the injured structure, that is, the level affected. Ruptures occur due to injuries and degenerative diseases affecting virtually all ages. Patellar fractures are the most frequent, while injuries of the quadriceps tendon and patellar ligament have a lower incidence.

From a therapeutic standpoint, distal fractures of the patella reaching its apex behave and should be seen as avulsions of the patellar ligament, with surgical treatment if they are diverted, which are more rare than the patellar body fractures¹. Bone or tendon reinsertion is subject to intense muscular traction, especially when early rehabilitation is encouraged, during which excessive traction against the little resistance generated by the repaired structures can lead to a loss of reduction and diastasis of them.

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Devices have been used to protect repair in the literature and in our practical experience, and are used so as not to cause complications that affect the recovery of the knee. The manner in which the device is used can prevent such complications (in cases of injury to the extensor apparatus, the tensile strength can overcome the mechanical tissue strength or the suture or osteosynthesis material used, leading to further fracturing), hence the reason for developing the technique described in this study.

MATERIALS AND METHODS

We evaluated the medical records of 18 adult patients treated at the Department of Orthopedics and Traumatology, Santa Casa de São Paulo, “Fernandinho Simonsen” Pavilion, who suffered traumatic injuries of the extensor apparatus involving the region between the anterior tibial tuberosity (ATT) and the apex of the patella.

After repairing the injury, the following technique with a protective device was used in order to allow for early mobilization of the knee: after the repair of broken structures, a cross-hole is made with a 2-mm drill in the proximal third approximately 1.5 cm from the base of the patella, through the middle of its thickness.

One strand of 1.2-mm thick wire is passed through the hole.

The two ends of the wire crisscross over the patella and are tensioned. Two full twists are made and the system and the two wires are taken together to the ATT. A 3.2-mm cortical screw is introduced in this region in a direction perpendicular or obliquely distal to the proximal ATT, fixing it to the posterior tibial cortex, leaving the neck sticking out (Figure 1).

The knee is flexed to 30° (the patellar ligament begins its tension at 30° of flexion, from 0° to 30° there is physiological laxity with the quadriceps relaxed), a mark is made on the wire at the length where the wires reach the screw, and two additional full twists are made.

The ends are laced around the neck of the screw and the fixation is completed with the final twists; at this time insertion of the screw is completed, so that it does not protrude under the skin (Figures 2 and 3).

Proceed to the closure of the incision, and postoperatively, the patient is asked to initiate flexion-extension assisted by the physiotherapist who starts early passive movement and contractions of the quadriceps for active extension.

A protocol was prepared for collecting patient data obtained from their records relating to their evolution (Appendix 1).
RESULTS

A predominance of males (12=67%) over females (33%=6) was observed in our study. The average age was 44 years, ranging from 22 to 84 years.

Regarding the location of the injury, the distal apical third had been compromised by a single injury in 83% (15 patients) of cases, in 11% (two patients) there was a comminuted fracture of the apical third, and in 6% (one patient) the patellar ligament substance was compromised.

The evaluation of pain after fixation was considered positive when it was present and made a minimum active flexion-extension beyond 90° impossible. According to this criterion, pain was present in 22% of cases (four patients). Regarding extension, only one patient (6%) registered a deficit of –3° (Table 1).

Table 1 – Evolution after application of the protective device.

|                  | TOTAL: 18 patients | YES | %   |
|------------------|--------------------|-----|-----|
| PAIN             | 4                  | 22% |
| FLEXION LOSS     | 0                  | 0%  |
| EXTENSION LOSS   | 1                  | 6%  |
| * RSM            | 6                  | 33% |
| COMPLICATIONS    | 0                  | 0%  |

* RSM – removal of synthesis material

Removal of synthesis material (RSM) was necessary in six patients (33%), and was performed eight months postoperatively, on average. Among these, failure of the synthesis material occurred in 17% (three patients), which did not interfere with the evolution of the final results. We had no complications related to surgical technique.

DISCUSSION

Ruptures of the extensor apparatus result from injuries, and in some cases may be weakened by systemic diseases and use of steroids or fluoroquinolones, affecting virtually all ages, involving the patella, the patellar ligament, quadriceps tendon, and the ATT, as well as surgical treatment, as reported by Mafulli et al.\(^2\), Greis et al.\(^3\), Hardy et al.\(^4\), and Rasul et al.\(^5\).

Several authors, among whom we highlight Magnuson\(^6\), McConnell\(^7\), Muller et al.\(^8\), and Insall et al.\(^9\) showed a marked superiority in their results when applying a protective band anchored in healthy tissue, that is, the intact portion of the patella and the anterior tibial tuberosity (ATT). We stress, however, the study of Enad et al.\(^10\), who compared the functional and clinical results of five patients who underwent early rehabilitation and five patients who underwent late immobilization and rehabilitation, finding no differences after 16 postoperative months; they concluded that a more in-depth study with a longer time of evolution may reveal differences between the two physiatic methods.

This tensioning band can be made using strips of fascia lata, non-absorbable sutures, prosthetic ligaments, and steel wires, with a circular, rectangular, or figure-eight shape fixed in the patella through tunnels in the patella or anchors\(^11,12\). In our clinic, we have successfully used wires passed through in a rectangular or figure-eight shape anchored in a screw that goes through the ATT horizontally.

The technique described uses steel wires because they are resistant to tension, and undergo fatigue failure only after three months, which is the necessary amount of time for the healing of injuries. In the vast majority of cases, no symptoms warrant early removal. In cases with such symptoms, or in athletes, there is the possibility of their removal after the first three months which are essential for definitive healing of both ligament and bone injuries. A disadvantage is its lesser flexibility when compared to non-metallic

\(^{2}\) Rev Bras Ortop. 2009;44(1):57-60
wires. However, Kasten et al.\textsuperscript{(13)} report a comparative study between the two materials, concluding that metallic wires were superior because non-metallic synthetic wires resulted in complications due to tissue reactions and infection.

We agree with Bhargava et al.\textsuperscript{(14)} and Enad et al.\textsuperscript{(15)} when they affirm that protection of the primary repair with cerclage wires and early mobilization provide excellent results in treatment, with the advantage of reducing the risk of arthrofibrosis and its subsequent limitation of movements and loss of joint function.

It is common for patients undergoing this treatment to complain of varying intensities of pain when attempting to flex the knee, hindering progress towards the goal of regaining range of motion quickly while avoiding retractions and adhesions that block flexion compatible with the normal knee, and resulting in unsatisfactory results.

We have found that this pain is caused by the pressure exerted by the wire during movement over the patellar ligament, the retinaculum, the infrapatellar fat pad, the capsule and the synovial membrane, against the femoral condyles, discouraging the patient from continuing physiotherapy.

The protective device technique orients in exactly the same direction as the patellar ligament, without adding pressure to any structure, transferring the tensile strength of the quadriceps directly to the ATT.

Therefore, the device used follows exactly the same direction as the tensile forces acting in a normal knee during movement, justifying its designation as dynamic protection.

We believe that this fact is responsible for the lower number of pain complaints in the patients evaluated in this study, which allowed the recovery of movement to be considered extremely satisfactory.

We note Shelbourne et al.\textsuperscript{(16)}, who uses the same principles through the use of a Dall-Miles cable, a flexible metal device fixed with screws in the center of the patella and an adjustable tension at 60° of flexion, removed between the sixth and eighth weeks. The results they achieved in their 10 patients were similar to ours, arguing that the position of the device, similar to the protective device, allows for an immediate rehabilitation with early restoration of a satisfactory range of motion, allowing for the recovery of the original strength of the quadriceps. This device contains difficulties of use in our context due to its cost, having no advantage over the protective device in reference to our goals.

**CONCLUSION**

The protection device is effective when applied in the surgical treatment of injuries that are located between the apex of the patella and the ATT, propiciating active and passive movement in the immediate postoperative period, with a minimum index of pain complaints.

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**REFERENCES**

1. Enad JG. Patellar tendon ruptures. South Med J. 1999;92(6):563-6.
2. Maffulli N, Wong J. Rupture of the achilles and patellar tendons. Clin Sports Med. 2003;22(4):761-76.
3. Greis PE, Lahav A, Holnstrom MC. Surgical treatment options for patella tendon rupture, part II: chronic. Orthopedics. 2005;28(8):765-9.
4. Hardy JR, Chimitengwende-Gordon M, Bakar I. Rupture of the quadriceps tendon: an association with a patellar spur. J Bone Joint Surg Br. 2005;87(10):1361-63.
5. Rasul AT Jr, Fischer DA. Primary repair of quadriceps tendon ruptures. Results of treatment. Clin Orthop Relat Res. 1993; (289):205-7.
6. Magnuson PB. Fractures. 2nd ed. Philadelphia: JB Lippincott; 1933.
7. McConnell BE. An operation for fractures of the patella using the temporary patellar tendon substitution technic. South Med J. 1971; 64(1):87-9.
8. Muller ME, Allgower M, Schneider R, Willenegger H. Manual of Internal Fixation. 2nd ed. New York: Springer-Verlag; 1979.
9. Insall JN, Windsor RE, Scott WN, Kelly MA, Aglietti P, Cirugia de la Rodilla. 2ª ed. Buenos Aires: Medica Panamericana; 1994.
10. Enad JG, Loomis LL. Patellar tendon repair: postoperative treatment. Arch Phys Med Rehabil. 2000;81(6):786-8.
11. Bushnell BD, Byram IR, Weinhold PS, Creighton RA. The use of suture anchors in repair of the ruptured patellar tendon: a biomechanical study Am J Sports Med. 2006;34(9):1492-9.
12. Levy M, Goldstein J, Rosner M. A method of repair for quadriceps tendon or patellar ligament (tendon) ruptures without cast immobilization. Preliminary report. Clin Orthop Relat Res. 1987; 218(3):297-301.
13. Kasten P, Schewe B, Maurer F, Gosling T, Krettek C, Weise K. Rupture of the patellar tendon: a review of 68 cases and a retrospective study of 29 ruptures comparing two methods of augmentation. Arch Orthop Trauma Surg. 2001;121(10):578-82.
14. Bhargava SP, Hynes MC, Dowell JK. Traumatic patella tendon rupture: early mobilisation following surgical repair. Injury. 2004; 35(1):76-9.
15. Enad JG, Loomis LL. Primary patellar tendon repair and early mobilization: results in an active-duty population. J South Orthop Assoc. 2001;10(1):17-23.
16. Shelbourne KD, Darmelio MP, Klototwyk TE. Patellar tendon rupture repair using Dall-Miles cable. Am J Knee Surg. 2001; 14(1):17-20.